OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

19353
(1 of 7)

FINAL REPORT

Project DP/SYR/86/011 Contract No 85/

F I N A L   R E P O R T

Contract No 89/44
UNIDO Project No DP/SYR/86/011
Leningrad Institute of Precision Mechanics and Optics

TABLE OF CONTENTS

LIST OF ANNEXES

SYNOPSIS

Final Report is devoted to the LITMO execution of the UNIDO contract 39/44 from May 1989 to June 1991. This Report covers basic steps, findings and results of the LITMO activities under the Contract. Final Report contains the following sections:

1. Elaboration and delivery to Project Area of the complete Technical Documentation of two models of microscope prototypes.

2. Project Area Services of the LITMO Personnel in the field of optical design and optomechanical fabrication of optical instruments.

3. Training services for the SSRC staff in the field of microscope optical design and optomechanical manufacture at LITMO.

4. Terminal Section which includes main results and conclusions of the complete work under Contract.

This Report comprises a title page, a table of contents and thirty three (33) pages of text and six (6) annexes.

INTRODUCTION

UNIDO Contract 89/44 is carried out by LITMO as contracting services of the Project DP/SYR/86/011 concerning the establishment of the Centre for Optical Technology Development at SSRC (Damascus,Syria).

The aim of this Contract is to contribute to the establishment and development of the above Centre in Syria.

In carrying out the work under Contract LITMO uses the following statement of work: UNIDO Contract No89/44; Terms of Reference dated June 1988 and Proposal dated December 1988 and April 1989, which LITMO submitted to UNIDO.

Through the implementation of this Contract it is intended to solve the following problems:

1. To elaborate Technical Documentation and complete Know-how package of two modern versions of microscope prototypes for further manufacture at SSRC.

2. To provide technical assistance, expertise and consultations on the process technology based on machines and equipment available at the Project during the erection phase of the Contract.

3. To provide expert services at the Project Area which should be concentrated around design and manufacturing of elaborated microscope models.

4. To provide the training services and upgrading facilities for the SSRC staff in the field of microscope optical design and optomechanical manufacture.

For proper realization of the above Contract problems the development of the Contract is carried out by LITMO in the following basic directions:

- working out Technical Documentation and Know-how package for the two microscope prototypes named BIOMEM - S,L;
- fellowship training for the SSRC staff in various field of microscope optical design and optomechanical fabrication at LITMO;
- expert services at the Project Area by LITMO specialists concerning optical and optomechanical manufacture.

BODY

1.00 Elaboration and delivery to Project Area of Complete Technical Documentation of two models of microscope prototypes.

In accordance with the Protocol (Damascus, 16.10.89) the work out and delivery to SSRC Technical Documentation of the microscope prototypes is carried out by LITMO at the following three steps:

1. Preliminary Technical Documentation PDC-20.11.89
2. Detailed DEsign Documentation PDC-15.04.90
3. Know-how package of the two versions of microscope prototypes PDC-20.11.90.

Total number of microscope prototypes should be - 20 units.

1.01. Preliminary Technical Documentation.

At this step LITMO worked out Preliminary Documentation containing schemes of high quality microscope optical systems, basic features, basic drawings of contemporary modular microscope designs, which formed the basis for the further work under Contract.

In particular, LITMO designed new high quality Achromatic series objectives for microscopes BIOMEM - S.L such as 4 x 0.1, 10 x 0.25, 40x 0.65, 100 x 1.25 (class CF - Chromatic Free) with new values of technical parameters.

Designed eyepieces - 10x has a large distance of exit pupil and high image quality.

Upon the request from the SSRC an additional simple set of three objectives and two eyepieces was designed by LITMO.

In accordance with SSRC request the documentation required carries an appendix giving the rationale and basic of arriving at the final designs, prescription of tolerances, design optimization and quality assessment criterions adopted. (See Annex 1, Draft Final Report).

During the expert services at Damascus (27.01. - 7.02.90) LITMO and SSRC specialists evaluated and compared image quality, tolerances and data for designed optical systems. At these expert services LITMO experts handed over to SSRC completed optical design data sheets of all elements of BIOMEM- S,L microscopes and drawings of principle microscope components.

Detailed technical discussions were arranged by LITMO specialists for SSRC personnel to study documentation and recommendations concerning the delivery of Documentation.

At this step SSRC and LITMO specialists found the following advantages and features of the microscope design developed and taken as the basis for future production:

1. High-quality optical image provided by LITMO design achromatic series objectives and wide-field eyepiece - 10x for elaborated models of microscopes. These objectives have a very small image curvature with lateral chromatism being fully corrected, and spherochromatic and secondary chromatic aberration approximating zero. All objectives and the eyepiece contain only ordinary types of optical glass without using special glasses or crystals.

2. The illuminating system is in line with the best models available; it is capable to provide uniform illumination of transparent microobjectives in bright field of transmitted light. This system has a simple design and permits continuous observation from low to high magnifications with comfortable operation. The light source uses 6V - 20W long life bulb, considerably simplifying time-consuming bulbreplacement.

3. The high eyepoint design, drive control knobs and indication facilities are in agreement with ergonomic standards and engineering physiology providing comfort for long period of observation.

4. Sturdiness of the microscope design and its individual mechanical components allows reliable long-time observation.

5. Microscope design is adopted to manufacture and final assembly and adjustment.

6. The modular design concept underlying the available BIOMEM models permits to further develop certain other models of microscopes: polarising, phase-contrast ones, etc.

1.02. Detailed Design Documentation.

At this step LITMO elaborated Detailed Design Documentation for the microscope prototypes. This Documentation contains:

detailed drawings for the objectives, eyepiece and condenser; features; constituent modules; complete drawings of the different assemblies; optical and mechanical designs of the component parts and total system; information about materials and standard parts, optical tooling drawings for the microscope optics, microscope description prototypes as follows:

No	Item		Sheets
1	000.010	BIOMEM -C,L	18
2	10.000	Monoeyepiece	11
3	30.000	Coordinate stage	43
4	40.000	Stage	90
5	50.000	Condenser A=0.9	30
6	60.000	Condenser A=0.3	13
7	70.000	Nosepiece	15
8	80.000	Nosepiece	8
9	90.000	Illumination	21
10	100.000	Stand	4
11	110.000	Stand	2
12	120.000	Basis with collector	54
13	130.000	Basis	4
14	140.000	Stand of stage	31
15	150.000	Focusing mechanism for microscope Biomem -L	58
16	160.000	Focusing mechanism for microscope Biomem -C	10
17	170.000	Block of power supply	68
18	190.000	Set of accessory units	22
19	200.000	Objective 4 x 0.1	22
20	210.000	Objective 10 x 0.25	31
21	220.000	Objective 40 x 0.65	41

22	230.000	Eyepiece 10 x	18
23	240.000	Microscope separable mirror	11
25	-	Optical tooling for objectives,condenser	
26	-	Information about materials	
27		Fasteners	
28	-	Information about cements	

(See Annexes 2,3.4,5,6, Draft Final Report).

During the conference of SSRC and LITMO specialists (Leningrad, 13.06.90) this Documentation was discussed in details and approved by SSRC specialists.

The following salient point of Detailed Design Documentation were noted:

1. Documentation is fulfilled in accordance with the ISO specifications.

2. This Documentation is suitable for the microscope optical and mechanical fabrication on the machines and equipment available at the SSRC.

3. There are no die-cast, plastic or presses parts in the microscope designed construction according to the methodology of microscope prototypes fabrication.

4. During the fabrication some modifications or corrections of the microscope parts may be possible to suit SSRC workshop facilities, if necessary.

Based on Documentation LITMO suggested to the Project Area to procure the following balancing equipment required for further effective utilisation of the Know-how package:

Laser centering unit, model M1;

High speed polishing machine PM1;

Precision Lathe @Shoubline.

One copy of Detailed Design Documentation was handed to SSRC representatives for delivery to Damascus (Leningrad, 13.06.90).

1.03. Know-how package of the two versions of microscope prototypes.

At the third step of Know-how package LITMO developed complete optical, opto-mechanical and mechanical Know-how package for microscope manufacture adopted for individual parts, surface finishing, assembly, final testing, performance evaluation.

The optical Know-how package contains:

1. Optical tool drawings for the fabrication set of objectives.
2. Test plates drawings for all optical elements, standard control and working test plates in pairs.
3. Technological process to manufacture objectives, eyepiece, condenser and illumination system.
4. Technological process to manufacture prism and mirrors.
5. Technological process of lens cementing and coating.
   (See Annex 1 Final Report)

Mechanical Know-how package contains:

1. Manufacturing technology of all mechanical parts and workpieces of microscope prototypes.
2. Technological process of assembly of focusing mechanism, stages, nosepiece, stands, condensers, bases with collector.
   (See Annex 2.1,2.2 Final Report)

Opto-mechanical Know-how package contains:

1. Route charts of technological process of fixing and centring objective lenses in mounts for each lens separately.
2. Route charts of technological process of assembly and adjusting objectives, eyepiece, condenser.
3. Adjusting tables for objectives 40 x 0.65, 100 x 1.25.
4. Detailed technical documentation of additional equipment for micro-optics, centring and adjusting is as follows: centring chucks (two types); autocollimation tube ("CA"); testing device with autocollimation tube; inspection microscope for checking objectives parfocal distance and centring.

5. Drawings of tools and accessories for microobjectives assembly such as set of holders for centring chuck, mounting jig, thread bushing, wrenches.
(See Annexes 3.4.1,4.2 Final Report).

Technical Documentation for final testing and performance evaluation of microobjectives, eyepiece and BIOMEM -S,L prototypes contains:

- technical requirements, testing regulations, test methods, list of equipment for microscope testing required for microscope performance evaluation.

(See Annex 3 Final Report).

During the expert services (28.10. - 7.11.90,Damascus) LITMO and SSRC specialists studied and discussed in details the complete Know-how package elaborated and delivered by LITMO to SSRC. One copy of Know-how package was handed to SSRC to study and prepare assembly and adjusting opto-mechanical parts of microscopes.

For an advanced and effective utilization of the opto-mechanical Know-how package LITMO experts pointed out the necessity of the establishment at SSRC an opto-mechanical assembly and adjustment workshop.

SSRC personnel expresses their satisfaction with the developed Know-how package containing full process microscope technology.

The following advantages of the developed Know-how package were noted:

1. Advanced method of fixing objective lenses in mounts by cementing using hermetic cement;

2. New effective process of centring lenses in mounts based on autocollimation which provides high precision independent centring and efficiency requiring no special workers qualification.

3. High quality, reliability and efficiency of the objective assembly and adjustment are achieved through the use of adjusting tables and detailed typical microobjective instruction.

4. A simple and reliable method of final testing and performance evaluation of BIOMEM-S.L prototypes using additional LITMO design equipment is developed and recommended for SSRC.

5. The Know-how packages features a detailed and clear shape presentation of documentation covering the assembly and manufacturing technology of all parts and units of the microscope prototypes.

Thus, as it follows from the above, LITMO elaborated and submitted to SSRC the complete Technical Documentation and Know-how package of the two modern versions of BIOMEM-S.L prototypes conceptually suitable for the SSRC workshop facilities and ready to be used in fabrication of the two versions of microscope prototypes.

2.00. Expert services programme realization

2.01. Expert services programme aim and its co-ordination

Expert services in the Project Area according to Contract No 89/44 and Terms of Reference must provide Project fulfilment, namely the establishment of the Centre for Optical Technology Development in Syria and technical assistance to microscope prototype fabrication in this Centre.

Total volume of the expert services according to Contract is ten (10) man-months, in particular:

Team Leader	- 2 m/m
Expert in Optical Thin Film Technology	- 2 m/m
Expert in Optomechanical Design	- 2 m/m
Expert in Optical Tooling	- 2 m/m
Expert in Precision Optics Fabrication	- 1 m/m
Expert in Graticulation	- 1 m/m

During Expert services the schedule was changed according to concrete critical points of the contract fulfilment.

2.02. The first step of the expert services

The first step of the Expert services was made in October, 1990, during LITMO representatives (Team Leader Prof. V.Veiko and Team Deputy Leader Dr. G.Kotov) visit to SSRC between 10 - 17.10.89. (See Annex 7, Protocol, Damascus 16.10.89).

During their visit prof. V.Veiko and Dr. G.Kotov carried out a preliminary expertise of SSRC optical workshop equipment, materials, abrasives, etc.

This expertise showed that SSRC Centre of Optical Technology facilities are generally sufficient enough to start microscope optical parts fabrication.

LITMO experts were apprised of the Project activities by way of visit to the optic technology wing, test laboratories and other ancillary facilities available at SSRC. Technical discussions were also arranged with concerned faculty members in different section for detailed elaboration of individual available equipment. LITMO team expressed satisfaction and appreciation of the basic facilities set up already at [illegible] within the ambit of present Unido executed UNDP project and remarked that this can serve as excellent resource base for establishing intense technical co-operation between [illegible] and LITMO.

Upon further enhanced interaction in different department, Dr. G.Kotov, collected technical specifications of expendable and non-expendable equipment available at the project. Details are given in Annex [illegible], Protocol, [illegible], 18.[illegible], Draft Final Report).

The volume of the first step of the Expert services was 0.5 man months.

2.03. The second step of Expert services

The next step of expert services was agreed upon during the technical conference of the [illegible] and LITMO representatives in Leningrad, between 06.12. - [illegible].12.89 (See Annex [illegible], Protocol, Leningrad 15.12.89, Draft Final Report).

It was decided that the second step of Expert services would be a joint mission of prof. Rodionov, prof.Putilin and prof. Schekhonin to Project Area for 12 days starting approximately on 26.01.90.

The visit shall be planned only upon completion of optical design data sheets of all elements incorporation in the construction of BIOMEM-L,S, and the same shall become the basis for discussion in the Project Area. In accordance with their own expertise, prof. Rodionov shall carry out in depth discussions and render advise in the area of optical system design, optimization and evaluation; prof.Putilin in optics production technology; prof. Schekhonin in assembly and testing; and all three experts jointly in mechanical design and fabrication.

The joint mission of Profs. Rodionov,Putilin,Schekhonin to [illegible] was held between 27.01. - 07.02.90.

LITMO experts provided expertise delivery of Technical

Documentation of the two models of microscopes BIOMEM-S,L in the Project area. The experts studied in details the facilities of the optical workshop, test laboratory, mechanical workshop available at SSRC. Experts handed over to SSRC completed optical design data sheets of all elements incorporated in construction of BIOMEM-S,L microscopes. Technical discussions, consultations were arranged by LITMO experts for SSRC specialists, for preparing recommendations concerning delivery of Technical Documentation including optical system design, assembly and testing, optics production technology and mechanical design and fabrication. Fellowship training, expert services components were discussed also.

A detailed technical report was submitted by LITMO experts containing the finding of experts mission and recommendations for future work in the project area (see Annex 7, Protocol,Damascus ,27.01. - 07.02.90, Draft Final Report).

The Expertise showed a necessity of additional joint activities to provide the production of the BIOMEM-S,L microscope prototypes.

The main results of expertise, discussion and recommendations were the following:

1. SSRC facilities in equipment and specialists are enough in common for the beginning of optical and mechanical fabrication of parts of prototype microscope BIOMEM-S,L.

2. It is necessary to provide the optical workshop with air-conditioning, with air temperature constant with accuracy + 1.5 inside range 20-25' for any time of day and any season.

3. It is necessary to establish special separate workshop for lens mounting and centring, micro-optics assembly, adjusting and centring, provided with the need equipment.

4. For realizing of the prototype of microscope BIOMEM-S,L production, it is necessary to provide project area with additional equipment:

- MI laser lens cementing and centring machine (are ordered);
- LOH smoothing and polishing machine (is ordered);
- small Schaublin lathe (must be ordered);

- measuring instrument for lens thickness and air separation measurement, including micrometers, microindicators, deptimeters, sets of end gauge (must be purchased);
- centring floating chuck and special microscope for lens mounting and centring (design documentation developed by LITMO);
- standard biological or research microscope for objectives adjusting and testing (must be purchased);
- objective centring ring (design documentation developed by LITMO, making in SSRC);
- punch for gasket ring fabrication (making in SSRC);
- star-test slide (making in SSRC);
- aperture measuring target (designed by LITMO, making in SSRC),
- slide for objective centring and parfocal distance checking (must be purchased or made);
- small low magnification microscope, inserting in biological microscope tube (must be purchased);
- magnification glass 4-6 x (must be purchased);
- object-micrometer slide (must be purchased).

5. LITMO elaborated the design documentation and Know-how package oriented to methods lens mounting and centring, objective assembly and adjusting, accepted as a result of discussion and described above.

6. It is the problem of front lens fabrication for 100x objective and equipment for objective centring and parfocal adjusting. This problems will be solved by LITMO during Know-how documentation elaboration.

The volume of these Expert services was 1.5 m/m. So the total volume of expert services with regard to the first step ones amounted 6 m/m. During the expert's mission the future programme of Expert services was also discussed and co-ordinated. (See Annex 7, Protocol, Damascus, 17.02.1990, Draft Final Report).

Considering the need to produce a great number of test plates during a short time, the small experience of the project staff in this field, and the good experience in optical tooling and mechanical fabrication, for all of that, it was decided to increase the duration of expert services in micro-optics and test plates fabrication. This period becomes 4 m/m instead of 2 m/m such as for the period of fine mechanical fabrication decrease for one m/m and the activity of optical tooling fabrication (1 m/m) will be services in micro-optics fabrication may begin only after providing constant air temperature (+ 1.5) in the optical workshop.

Volume of another expert services may be changed according to the concrete circumstances.

More exact Experts' services schedule was agreed upon during SCRC representatives visits to LITMO 13.06.90 and 27.09.90 as follows:

- microoptics fabrication

  V. MASHEHIN

  A. IVANUSHIN

  A. TOPOROV

from approx. 27.10.90 during 40 days each (4 m/m);

- in mechanical fabrication

  B. BUKIN

from approx. 20.01.91 during 30 days (1m/m);

- in optical assembly, testing, coating

  S. Rodionov

  E. PUTILIN

  A. SHECKONIN

from approx. 10.03.91 during 30 days (3m/m);(see Annex 7,Protocols,Leningrad,13.06.90 and 27.09.90, Draft Final Report).

2.04. <u>The third step of the Expert services</u>

The third step of the Expert services began on 28.10.90 when LITMO representatives arrived at SCRC:

Prof. S.Rodionov, Optical Designer,

Prof. E.Putilin, Thin Film, Optics fabrication,

Prof. A.Shekhonin, Optical testing and Construction,

Prof. G.Kotov,

Mr. A.Ivanіouchіne. Expert.Prisms, Mirrors and micro-optics fabrication,

Mr.V.Machekhine. Expert, Test plate, Micro-optics and Optical tools Fabrication,

Mr. A.Toporov, Expert, Lens Centring and Cementing.

According to expert services schedule in Project area three experts:Mr.Ivanioushin, Mr.V.Machekine, Mr. A.Toporov had started their mission at SSRC optical workshop in 28.10.90 in the field of micro-optics and test plate fabrication. The period of Expert services was 40 days (4m/m).

LITMO specialists have suggested the following for the advance of the Project and effective utilization of Know-how packages:

1. At this stage of the Project execution, it is necessary to establish in SSRC an opto-mechanical assembly and adjusting workshop.

At present SSRC facilities are enough in common for the optical and mechanical fabrication of parts of prototype microscope BIOMEM-S,L. But there is a shortage in equipment required for fixing and centring lenses in mounts, assembly and adjusting micro-objectives.

The shortage in the above mentioned equipment makes any further advance of the Project impossible (as it is mentioned also in the Technical Report of the Joint experts' LITMO mission between 26.01. - 29.02.90).

The attached Annex includes list of equipment required for the establishment of opto-mechanical workshop.

2. It is necessary to provide the protection and checking against dust for optical workshop laboratory for micro-optics smoothing, polishing, cementing and coating.

At this stage cleanliness of air in these laboratories is required floors, ceiling and walls in the optical workshop are not provided with any dust protection factor.

It is necessary to make a good entrance tambour to smoothing, polishing and coating laboratories to provide the water cleaning twice a day for walls, floors and equipment in the laboratories.

Because of the fact that local water is very hard and it leads to form bad films on optic surfaces, therefore. it is necessary to use only distilled water during the process of smoothing, polishing and washing micro-optics.

In the future it is necessary to remove laboratories precision optics (smoothing, polishing, coating, cementing, checking) to another place with good anti-dust conditions. The best method of the dust protection is tiling the walls and floors with ceramic.

Ceiling must be tainted as well.

For good temperature stability, it is preferable to make in this laboratories double walls, windows and doors.

3. The experts draw the attention of SSRC administration to the fact, that optical fabrication is a dangerous trade because on its bad results on the health: Dioxide (polishing material), plumb oxide (in glass dust), vapours of solvents. For the neutralization of harmful effects of such elements it is necessary to provide workers of optical workshop by milk and juice (0.5 L every day per person).

Experts carried out an analysis of SSRC optical equipment, auxiliary materials and test facilities, examination of technological process of fine optics manufacture at SSRC and gave important recommendations to this process.
During Expert services LITMO experts supervised SSRC personnel work in optics fabrication and fulfilled necessary training of SSRC workers.

A detailed report was prepared by the experts after Experts services were over (See Annex 7, Draft Final Report).

2.05. <u>The fourth step of the Expert services</u>

According to Experts' services schedule Dr. Bukin, LITMO expert in the field of fine mechanics fabrication departed from Leningrad to Damascus on 25.01.91. Duration of Dr. Bukin's expertise at SSRC was one m/m.

The main aims of Dr. Bukin's expertise were:

- to assist in the arrangement of a very important site of production and sharpening of metal cutting tools at SSRC, especially for fine finishing;

- to train the SSRC personnel in manufacture and fine training of lens mounts;

- to train the SSRC personnel in manufacture and assembly of sophisticated and critical microscope units (nosepiece, focusing mechanisms, etc.).

The main result's of expert services were the following:

- technological processes used in the workshop conform to the conditions of single production;

- LITMO technological processes of manufacturing different types mechanical parts of microscope prototypes can be successfully realized in the workshop of SSRC, because all conditions were very favourable:

- high quality of equipment (SHAUBLINE-125 and FM-4M);

- many types of cutting tools;

- many types of measuring tools for checking inside and outside dimensions;

- high qualification of workers.

Experts' recommendations.

It is necessary:

- to have an attachment for grinding cutting tools with special device for adjusting different cutting angles;

- to illuminate the working zone of the tool grinding machine;

- to make a special device for thread chasers;

- to have an instrument for measuring the roughness and wave of surfaces;

- to have a grave milling machine for working scales, figures and letters on the parts of the microscope;

- to install 0.001 mm accuracy indicators at two co-ordinates, when workpieces of the microobjective are being finish turned.

Detailed technical report was submitted by Dr.Sukin containing the findings of expert mission and recommendations for the future work in the Project Area (See Final Report, Annex 1A).

2.06. The final step of the Expert services

According to Expert's services schedule a joint mission of Prof.Rodionov, Prof.Putilane, Prof.Schelhonin and Prof.Bukin was held in the Project Area between 28.04 - 28.05.1991.

The aim of the expert services was to provide the final stage of microscope prototypes fabrication, assembly, adjusting and testing according to Technical Documentation, Know-How package and Expert recommendations.

Because of the limited facilities of the SSRC workshop, it was decided that only 40 x 0.65 microobjective, eyepiece-10x, condenser-0,9 and microscope with coarse and fine focusing mechanism, nosepiece without illuminating system should be fabricated, assembled and adjusted during the experts' visit. These parts of microscope prototypes are the most complicated for fabrication and assembly.

Expert services was held in the following directions:

- Micro-optics fabrication such as lens cementing and checking, lens centring and coating;
- Mechanical fabrication of microscope parts such as focusing mechanism, co-ordinatal stage, nosepiece;
- Opto-mechanical assembly and adjusting of lenses in mounts of microobjective, eyepiece and condenser;
- Assembly, adjusting and testing of microobjective;
- Assembly, adjusting and testing of microscope.

Duration of the experts' services was 30 days (1 month).

The main results of expert services were the following:

- Technical Documentation and Know-How package of the two modern versions of microscope prototypes after correction and testing during expert services are fully ready to be used in microscope prototypes fabrication.
- Manufactured parts of microscope prototypes such as microobjective 40x0.65, eyepiece 10x, condenser 0.9, focusing mechanism, co-ordinate stage, nosepiece confirmed high quality of technical Documentation and Know How package. Testing of microscope parts showed that these features meet contemporary world level of the microscope design of the class concerned.

- As a result of fellowship training and expert services, SSRC staff is ready to produce microscope prototypes adopted for SSRC optical and mechanical facilities independently based on appreciable qualification of the SSRC personnel.

Experts' recommendations:

It is necessary:

- to pay more attention to fabrication of front lens, negative lenses (No.2 and No.4 for microobjective 40x0.65), particularly to centring, thicknesses and surface forms;

- to pay more attention to surface quality of lenses because at present there are many scratches on optical surfaces;

- to provide the optical and assembly workshop with higher temperature stability and cleanliness;

- to establish working sites for checking lens thicknesses, surface quality, lens diameters.

Detailed technical report of the joint LITMO experts' mission of Prof. S. Rodionov, Prof. E. Putiline, Prof. A. Shekchonin, Prof. B. Bukin is submitted (See Final Report, Annex 2A).

Expert services at the project area was finalized in accordance with contract terms as follows:

- Joint expert mission of Proff. S. Rodionov, E. Putiline, A. Schekchonin from 27.02 to 9.03.1990 - 2m/m.

- Expert mission in microoptics and test plate fabrication Mr. A. Ivaniouchine, Mr. V. Machekine, Mr. A. Toporov from 26.10 to 9.12.1990 - 4m/m.

- Expert mission in fine mechanics fabrication.
  Prof. B. Bukin from 26.01 - 4.03;
  27.04 - 27.05.1991 - 2m/m.

- Expert mission in optical coating, optical assembly, optical testing.
  Proff. S. Rodionov, E. Putiline, A. Schekchonin from
  28.04 to 28.05.1991 - 3m/m.

Total experts' services were 11 m/m instead of 10m/m under Contract.

3.00. FELLOWSHIP TRAINING PROGRAMME REALIZATION

3.01. Content and volume of training

1. Fellowship training programme at first was made up in the TERM OF REFERENCE, for 15 man months and devoted to optics (cause 3.6) technology and related disciplines.

During the first technical conference of the LITMO and SSRC representations (Damascus, 16.10.89) it was agreed that 6 fellows for 2.5 months each could receive group training at LITMO under present contract, followed by 3.5 m/m individual training in separate relevant fields of study.

Time duration of training could be January to June or April - September 1990. During the second technical conference of the LITMO and SSRC representatives (Leningrad, 15.12.89) it was decided that group training of 5 candidates for 3 months each should commence from 15.02.90, group training should be followed by individual training for 2.5 months each in microscope optics fabrication (including front lens and cementing) for 2 candidates, optical testing and assembly for other 2 candidates, optical design for 1 trainee. Individual training in the field of Fine mechanics fabrication should also commence from 15.04.90 for the period for 2.5 months . It was agreed that courses of study had to lay emphasis on practical training (70%) with minimum theoretical education (30%) as considered necessary for understanding basic fundamentals. Extra money payable to LITMO for individual training should be decided by UNIDO, keeping into consideration provision under BL 31- 00 and other financial obligations.

Some changes in the training programme were made and agreed upon during LITMO experts' visit to Project Area between 26.01. - 09.02.90. (Protocol, Damascus 07.02.90). Considering the training given to the fellows in the Project Area and real need of the project LITMO experts and Project director agreed to reconsider training programme and to organize the training items as follows:

- group training for 5 candidates for one month (15.02 to 15.03.1990);
- individual training for the above candidates for four months (15.03. to 15.07.1990) in the field of micro-optics production technology (2 persons), optical testing (2 persons), optical design (1 person);
- individual training for one candidate for 2.5 months in the field of Fine mechanical fabrication.

The above training programme consists of 27.5 m/m, 15m/m is being offered by LITMO under the contract 89/44, while for remaining 12.5 m/m . LITMO offered a special financial condition for UNIDO.

This condition was agreed between UNIDO and LITMO in AMENDMENT to CONTRACT No 89/44 on April 1990 (See Annex 7, Draft Final Report).

During LITMO experts visit to SSRC (26.01. - 02.02.90) candidates for trainings were considered:

Miss H.SHAMS AL-DEEN and Mr. A. AL-ABDULLAH - in the field of micro-optics production technology. Miss N.RAJAB and Mr. N.KRENBEH - in the field of optical testing and assembly. Mr. M. SWIDAN - in the field of fine mechanics fabrication.

3.02 Group training

Fine candidates: Mr. I. SHALESH, Miss.H.SHAMS AL-DEEN, Mr. A. AL-ABDULLAH, Miss H. RAJAB, Mr.N. KRENBEH arrived in Leningrad, LITMO and began group training on 05.03.90. Training was carried out during one month.

Training programme was discussed and adjusted by LITMO and SSRC representatives before the beginning of the training process. (protocol. Leningrad 15.12.89). Group training was devoted to the basic optical technology concerned by the Project.

The course of study includes theoretical education and practical training.

Theoretical education was devoted to:

- study optical and physical-mechanical properties of optical glasses and materials;
- study the standardized indexes of glass quality;
- study the grinding and polishing of spherical and plane optical surfaces;
- study optical instruments and machineries;
- study the methods of assembly and disassembly the blocks in the appliances;
- study the calculation of size and selection kind of lenses and plate workpieces;

- main methods of optical testing such elements as surface shape errors, prism resolution, residual stress and so on.

Practical training was concerned with:

- technological operations such as sawing of glass, grinding, smoothing, polishing different types of optical surfaces;
- cementing of lenses;
- centring of lenses;
- testing optical elements in workshops.

Each person has made practically about 25 lenses all stages from the beginning to the finish.

Group training was carried out by LITMO specialists using optical workshop facilities.

After completion of the Group training, LITMO teachers provided the tests for assessment of Syrian specialists knowledge in this field.

Group training Report of SSRC personnel members was submitted to LITMO, UNIDO and SSRC (See Annex 7, Draft Final Report).

3.03. <u>The individual training (first stage)</u>

The first stage of the individual training covered the period from April 1990 to July 1990, totally 2.5 months in the field of

- optical design for one person (I. SHALESH);

- optical fabrication technology for two persons;
  (H.SHAMS AL-DEEN and AHMAD AL-ABDULLAH);
- optical testing and assembly for two persons
  (N.RAJAB and N.KEENBEH).

LITMO laboratories and Optical college facilities were used to individual training. LITMO computers were used for study computer aided optical design.

During 10 days the fellows have studied in detail all operation of micro-optics fabrication and checking, assembly and adjusting at the world-known Leningrad Optical-Mechanical Company "LOMO", the main microscope producer.

Eleven leading LITMO professors took part in the fellowship training.

Short-term evening course in Russian language was arranged for all trainees.

The Fellow who had training in the field of optical design received basic theoretical and practical knowledge and necessary practices in the modern methods of optical design and optical system quality evaluation.

The most important theoretical and practical knowledge obtained at LITMO includes:

- basic principles of modern optical system;
- modern conception of basic functional elements of optical systems;
- modern conception about beams limitation, generalized pupil co-ordinates, generalized apertures, generalized equations for optical systems characteristics;
- basic modern concentration of aberration of optical systems;
- basic elements of modern aberration theory;
- important elements of modern optical image theory;
- basic principle of modern optical systems construction;
- basic principle of optical system of microscope;
- modern methods and techniques of analysis of optical system in computer design ;
- basic principle, methods and technique of automatic optimization of optical system, practice in optimization and

optical design by using LITMO optical design and optimization computer programme "OPAL".

All methods and techniques studied during training should be applied at SSRC for solving various problem connected with design, evaluation and fabrication microoptics at SSRC.

The fellows, who had individual training in the field of microoptic production technology received theoretical and practical knowledge and skill in fabrication of microscope test planes, lenses and prisms such as:

- methods, technique and know-how to fabricate test plates which are the basic testing instrument in microoptics fabrication;
- all stages of the prism fabrication;
- methods and know-how of microobjective front lens fabrication.

All studied methods and techniques, acquired knowledge and practices are very useful for the arrangement of micro-optics fabrication at SSRC. Necessary theoretical knowledges, numerous know-how packages along with good practice will allow to solve many problems at SSRC optical workshop dealing with micro-optics for microscope prototype fabrication and personnel training.

The individual training for the fellows in the field of optical testing and assembly is aimed at better understanding and deeper insight into optical testing, assembly and adjusting of microscope. The most specific benefits of individual training are as follows:

- knowledge of basic elements of geometrical optics;
- knowledge of the modern theory and principles of optical image formation, including main characteristics of optical systems and optical image structure;
- knowledge of the theory and practical methods of optical instrument adjustment;
- better understanding and appreciation of the optical testing methods for different types of optical elements;
- knowledge and practical investigation of the microscope.

Methods and techniques, knowledge and practices studied during the training are very useful in application for assembly, adjustment and testing of optical instruments. Upon return to SSRC the Fellows are able to solve different problems related to the assembly, adjustment and testing of elaborated microscope prototypes under Contract.

After Individual training the Fellows prepared their reports (See Annex 7, Draft Final Report).

The first stage of Individual training was over on 20.07.90.

The Total volume of the first stage of training (including group training) amounted 22.5 man/months (5 persons, 4.5 months each, from 5.03.90 to 20.07.90). The sixth candidate, Mr. Swidan, did not arrive at LITMO during the first stage of training. According to Protocol (Damascus, 07.02.1990) the volume of training must be 27.5 m.m.

Thus, the second stage of Individual training must be 5 m/m and include 2.5 months of Individual training for Mr. Swidan in the field of Fine mechanics fabrication.

3.04. <u>The Individual training (final stage).</u>

The Final stage of Individual training was co-ordinated during the visit of SSRC representatives Dr. MRAYATI, Dr. H. ABOV ALNOUR, Dr. SH. MEKDAD and Mrs. M. KALLAS to LITMO on 27.09.90. (Protocol, Leningrad, 27.09.90, see Annex 7).

It was agreed that final stage of Individual training must include:

- training in the field of Fine mechanics fabrication Mr. SWIDAN from approximately 10.11.90 for the period of 2.5 months and Mr. D. ABBASI from approximately 15.12.90 for the period of 5 weeks;
- training in the field of micro-optics fabrication for A. OBEID from 15.12.90 for the period of 5 weeks.

Mr. M. SWIDAN arrived at LITMO and began his training on 18.11.90. Training duration was 2.5 months till [illegible].

The core curriculum proved to be extremely helpful and the equipment used contributed to better understanding and deeper insight into Fine mechanics fabrication for [illegible] prototypes. The more specific benefits of individual training are given below:

a) study of technical documentation and know-how package of the following microscope units: mounts, lens holder of micro-objectives, springs, washers, axles, gears and worms;

b) practice in positioning of mechanical workpieces in machines and study of influential factors of the workpiece production precision. It was found compulsory to machine mechanical workpieces in one setting without removal in order to provide high precision;

c) Practical knowledge in the fabrication of one of the most critical parts of the microscope, namely the nosepiece, including such operations as its mounting, boring, thread cutting and in-operation testing;

d) experience in sharpening of cutters, diamond cutters to remove thin layers (0,01 mm) from lens mounts;

e) experience in application of additional devices for the production of sophisticate parts and higher precision;

f) In the course of the training the Fellow manufactured the following critical parts of the microscope: nosepiece, microscrew of fine focusing mechanism, lens mounts.

All methods and techniques studied during the training should be applied at SSRC for solving various problems connected with fine mechanics fabrication microscope prototypes.

Firstly , the Fellow is able understand and using the LITMO know how documentation for fine mechanics fabrication and assembling according to UNIDO project DP/SYR/86/011.

Secondly, he can solve various problems in mechanical fabrication, such as making different types cutters, positioning of sophisticated microscope parts, cutting and testing objective thread etc.

Mr. D.ABBASI arrived at LITMO and started his training on 18.12.90. Training duration was 5 weeks till 22.01.91.

Features of individual training were as follows:

a) Manufacture of individual training precision axles including calculations of in-machining cutting forces, deformations and maximum thickness of metallic layer removed;

b) design and calculation of tools for machining shafts and hole for focusing mechanism;

c) development of production and assembly process for critical and sophisticated units of microscopes such as nosepiece, micro-focusing mechanisms, iris diaphragm, micro-objectives.

d) practical knowledge of methods to position and test a nosepiece, to bore holes, cut the thread, face the end.

e) experience in cutting and testing the objective thread.

f) production technology of workpieces and assembly of iris diaphragm.

During the training Mr. D.ABBASI had a visit to Leningrad Optical-Mechanical company "LOMO" and studied in details microscope mechanical parts fabrication for mass production and microscope assembly process.

Reports on individual trainings of Mr.M.SWIDAN and Mr.D.ABBASI are enclosed (see Annex 7, Draft Final Report).

As to individual training of Mr. A.OBEID, it was agreed between LITMO and SCRC representatives during LITMO experts' mission to SCRC on 27.10.90 - 09.11.90 that it was impossible for Mr.A.OBEID to be absent at SCRC at that time critical for the Project fulfilment (micro-optics fabrication).

In addition it is necessary to take into account that Mr.OBEID is the head of the Optical workshop at SCRC.

Mr.OBEID arrived to LITMO for individual training in micro-optics - [illegible].05.1991. Duration of his training is 5 weeks.

The total volume of the Fellowship training provided by LITMO will be 22.5 m/m in accordance with Contract terms.

TERMINAL SECTION

The main problems posed in the Contract have been successfully solved and the results obtained can be summarized as follows:

A. Detailed Technical Documentation and Know-how Package necessary and sufficient for the production of the two models of microscope prototypes BIOMEM-S,L were developed in full agreement with Contract Terms.

The microscope Technical Documentation developed completely meets contemporary world level of the microscope design of the class concerned. This design features a high-quality image, modular concept, ease of operation, fabricability,etc. In addition, it is conceptually adopted for SSRC optical and mechanical facilities.

The Technical Documentation and Know-how Package were handed over to SSRC by LITMO and studied in details by SSRC personnel. LITMO specialists made necessary comments and refinements in the Documentation as a result of joint technical conference and discussions.

B. Expert services at Project Area were fully completed (11 m/m instead of 10 m/m under Contract).

The Expert services resulted in better understanding of SSRC machines and equipment, necessary purchase of balancing equipment, arrangement of additional workshops at SSRC . LITMO specialists made recommendations and consultations to SSRC staff as to the improvement of the work under Project. LITMO experts supervised the final stages of the fabrication, assembly, adjusting of microscope prototypes as the most critical and important steps in the fulfilment of the contract.

C. Group and individual training of SSRC personnel by LITMO in the field of optical design; microoptics fabrication; optical testing, assembly and adjusting, fine mechanics fabrication was finalized in accordance with the contract. Twelve leading LITMO professors participated in the training. As a result of the intense and effective training the Fellows acquired necessary knowledge and practice indispensable for the realization of Project aimed at the establishment of the Centre for Optical Technology Development and microscope prototype production.

Training and subsequent work confirmed an appreciable qualification of the Fellows and the SSRC staff.

D. The efficiency of the contract completing was confirmed by the fabrication of a high class microscope prototype using LITMO Technical Documentation and Know-How Package by trained SSRC Fellows and specialists under the LITMO experts supervision.

It should be stated that the main aim of the Contract to contribute to the establishment of the Centre for Optical Technology Development at SSRC has been conceptually solved, i.e. the SSRC workshop has been equipped with modern machines and plants, and provided with highly qualified specialists in optics. Therefore the SSRC workshop is capable to solve different complicated problems in optical instrument production.

Recommendations

Thus, the first step in the establishment of the Centre for Optical Technology Development at SSRC has been made and at present it is essential to make further efforts in the achievements gained, primarily to organize the following scientific groups:

- optical instruments designers
- optical systems designers
- technologists in optical mechanics, assembly and adjustment of optical instruments.

These groups must carry out independent work in design, technology and know-how for new optical developments.

LITMO CONTRACT EXECUTIVES

Prof. S. Rodionov

Prof. E. Putilin

Prof. A. Shekhonin

Prof. B. Bukin

Dr. G. Kotov

Annex - 1

TECHNICAL REPORT OF THE LITMO EXPERT'S MISSION OF DR. BOUKIN IN PROJECT AREA (DAMASCUS) BETWEEN 26.01 - 5.03.91

[illegible]

1. Reasons for expert

[illegible]

2. Analysis of equipment, tool and measuring instruments

[illegible]

3. Examination of technological processes of fine mechanics parts manufacture at SSRC

4. Recommendations on refinement of fine mechanics fabrication

milling machine using an indicator after moving the table of the machine.

5. SSRC staff work performed under the supervision of the expert

[illegible] prototype of the [illegible] Annex [illegible]. The special arrangement for [illegible] was designed and made for [illegible]. All [illegible] units were made with necessary accuracy and [illegible] the drawing specified.

Conclusion

[illegible] finalize my report with the [illegible] SSRC personnel [illegible] the different and important process of developing the prototype of [illegible] microscope. [illegible] from personal [illegible] with hard working, [illegible] thoughtful [illegible] thankful for the constant help in work [illegible] visit.

[illegible]

[illegible] representative
[illegible]

[illegible]
[illegible]

Annex 1

List of the know-how documentation of the elaborate prototype

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Annex 2

No	Name of parts with number	January, 1991						February, 1991																				March, 1991		
		26	27	28	29	30	31	2	3	4	5	6	9	10	11	12	13	16	17	18	19	20	23	24	25	26	27	2	3	4
1	Prepare at work	XXXXXXXXXXX																												
2	Holder 70.008					XXXXXX																								
3	Revolver 70.073								XXXXXXXXXXXXXXXXXXXXXXXXX																					
4	Spring 70.012								XXXXX																					
5	Stand 80.001										XXXXX																			
6	Attachment for boring												XXXXXXXXXXXXXXXXXXXX																	
7	Nosepiece 70.001																				XXXXXXXX									
8	Microscrew 150.001												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX																	
9	Case 150.021																		XXXXXXXXXXXXXX											
10	Spur gear 150.022																	XXXXX												
11	Spur gear 150.021															XXXXX														
12	Worm 150.027														XXXXXXXX															
13	Holder 150.012																	XXXXXXXXXXXXXXXXXXXXXXXXXX												
14	Bearing 150.021																		XX											
15	Bushing 150.028																				XXXXXXXX									
16	Bearing 150.014																			XX										
17	Nut 150.002																								XX					
18	Case 220.014																								XXXXX					
19	Holder 220.012																								XX					

No	Name of parts with number	January, 1991						February, 1991																				March, 1991		
		26	27	28	29	30	31	2	3	4	5	6	9	10	11	12	13	16	17	18	19	20	23	24	25	26	27	2	3	4
20	Holder 220.008																									XXXXX				
21	Holder 220.009																										XXXX			
22	Holder 220.011																										XXXX			
23	Holder 220.012																												XXX	

Annex -2A

Technical report of the joint experts' LIIMO mission of Prof. S. Rodionov, Prof. L. Putiline, Prof. A. Sheckonin and Dr. Boukin to project area (Damascus, Syria between 29.04 - 28.05.1991).

1. Introduction

Within the framework of UNIDO contract no. 89/44 related to the project DP/SYR/86/011, according to protocols technical conferences of representatives of SSRC and LIIMO at Leningrad 15.12.1989, 13.06.1990 and 27.09.1990 expert services in project area was held by joint mission of Prof. Rodionov, Prof. Putiline, Prof. Sheckonin and Prof. Boukin.

Prof. S. Rodionov is the expert in the field of micro-optic testing and adjusting, optical design. Prof. L. Putiline is the expert in the field of thin film optical coating and optical elements fabrication. Prof. A. Shechonine is the expert in the field of micro-optic assembly and adjusting. Prof. B. Boukin is the expert in the field of fine mechanics fabrication and assembly.

The aim of expert's service was to provide the final stage of microscope prototypes fabrication, assembly, adjusting and testing according to technical documentation, know-how package and expert recommendations.

Because of the limited facilities of the SSRC workshop, it was decided that only 40X micro-objective and microscope with coarse and fine focusing mechanism, nosepiece without illuminating system must be fabricated , assemblied and adjusted during expert's visit. These parts of microscope are the most complicated for fabrication and assembly.

Duration of expert's service was 30 days (4 M/M).

2. Final stage of microscope optical element fabrication

By the beginning of expert services the following optical elements were fabricated:

- Almost all needed test plates,
- All lenses for 40X micro-objective,
- Two lenses for 10X eyepiece,
- Prism.

During expert's visit lens checking, cementing and coating processes were organized and SSRC personnel was studied.

2.1. Centring and cementing equipment installation

According to experts' recommendations LOH laser centring and cementing machine M1 was purchased by the project. Experts have carried out the installation, adjusting and testing of this machine.

Machine vacuum system was corrected and required vacuum was achieved.

Lens centring checking process was tested and as a result experts concluded that this machine may be used for checking of all lenses except front lens. SSRC specialists were studied for making of lens centring check using M1 machine. For lens centring using this machine experts recommended to fabricate special massive brass chucks, providing accuracy and convinient of cementing process. Chucks drawings were developed by experts and chucks were fabricated and adopted.

2.2. Lens checking

Checking is the critical step on final stage of optical elements fabrication. Working places for micro-optics checking were organized according to experts' recommendations, SSRC personnel was instructed and trained to fulfill needed checking operations.

A. Lenses centring checking

For this operation LOH laser cementing and centring machine has recommended to use vacuum attachment and tefal chuck of this machine. As a result of expetrise this machine suitable for centring checking all microscope lens (single lens and cemented doublet) except front lens 40X and 100X micro-objective.
The main steps at the lens centring checking are:

- Chuck and prism choice and installation;
- Optical vacuum value and speed of rotation choice;
- Laser adjusting and focusing;
- Optimal amplification setting and determination (calibration); diameter's quality estimation during lens rotation using the oscilloscope;
- Centring value calculation using two kinds of formulae, one for single lenses another for cemented doublets.

For singlet angle of optical wedge is calculated and for doublet angle of light beam deviation, according to drawings.

All units of 40X micro-objective's lenses except front lens were checked by SSRC personnel under expert's supervision and as results all lenses except 220002 and 220004 are in tolerance. Lenses 220002 and 220004 have great decentring (more than two times greater than tolerance) and must be fabricated all over again.

B. Lenses diameter checking

For lenses diamater checking was used micrometer (accuracy 10 micrometers). All lenses are in tolerances.

C. Lenses thickness checking.

For lenses thickness checking was developed and fabricated special device using micrometer and dial Indicator. This device provides checking of all lenses thickness positive as soon as negative with accuracy 1 micrometer. To adjusting device for concrete lens measurement use set of slide gage. All lenses for 40X micro-objective were measured. The most problem to provide required thickness was for front lens (220001) and lens 220002, 220003, 220004.

D. Lenses surfaces form checking

Lenses surfaces form was tested by test-plates by observation Newton's rings. For all lenses surfaces form was good, except lenses 220004 and front lens.

2.3. <u>Lenses cementing:</u>

For lences cementing was used LOH laser cementing and centring machine M1 and special brass chucks.

After testing several kinds of cements such as cyanoacrylate, Canadian balsam LOMO and Canadian balsam "Duktil" experts suggested as the best Canadian balsam "Duktil".

Cyanoacrylate cement very strong but may cause a tension in lens and too fast no time to adjusting.

Method of using "Duktil" balsam was elaborated and tested. The method consists of the following steps:

- Heating balsam in boiling water;
- Cleaning negative and positive lences;
- Cleaning the special brass chuck;

- Inserting the negative lens in the chuck and heating on a heat plate;
- Putting one drop of balsam to negative lens then putting positive lens;
- Screwing chuck on spindel M1 machine and centring positive lens until hot .

This method is adjustable and easy to training.

2.1. Optical coating:

Programme of expert service on the field of optical thin film coating was to provide fabrication of three layer anti-reflection coating on the microscope optical elements according to the drawing.

The main points of this programme are:

- Working out of the aluminium oxide and magnesium fluoride deposition conditions (determination of substrate temperature for monolite layers deposition);

- Determination of substrate temperature providing minimum of zirconium dioxide layer porosity;

- Calculation of the optical constants for the magnezium fluoride, zirconium dioxide, aluminium oxide layers;

- Fabrication of one-layer and three-layers anti-reflection coatings using a.m. substances.

- Development of recommendations concerning layers thicknise checking during deposition;

- Development of the calculation alhorithm for determination of optical constants and layer's thicknesses a.m. substances;

- Development of the fabrication methods for the anti-reflection coating on microscope's optical elements.

3. Assembly and adjusting of the lenses in mounts and the micro-objectives

This stage of the work is the most critical point of the all opto-mechanical parts of the contract and consists of the following steps.

3.1. Organization of the special optical mechanical workshop for micro-obtics assembly and testing

According to expert's recommendations, optical mechanical assembly and adjusting workshop was organized in a seperated room. In this workshop were established the following working places:

- Working places for lens in mount adjusting and cutting with small exact lathe Shoubline - 102, special centring chucks and autocollimation tube;

- Working table for lens in mount cementing with special rotational device;

- Working table for lens in mount checking, with two dial indicator on nozzel, templets for the checking lens in mount and micrometer;

- Working table for micro-objective assembly and adjucting with special checking microscope, tools and attachments.

3.2. Shoubline - 102 lathe installation and adjusting:

The small precision Shoubline-102 lathe was purchased specially for lens in mount centring and cutting.

During experts' services Shoubline-102 lathe installation and adjusting were fulfiled as following:

- Longitudinal and transverse carriers movements were adjucted to provide accuracy about 5 micrometer or distance 100 mm;

- Adaptors for centring chuck and autocollimation tube were developed and fabricated;

- Adaptors for two dial indicator which provide accuracy reading of carriers movements 5 micrometers were developed and fabricated.

3.3. Fixing lensesin mounts

According to technical documentation and know-how, package lenses are fixed in mount by cementing. The first task was the choice of cement. After testing of many kind of cement "ALTECO-ACL" cyanoacrylate adhesive type EL by ALPATECHNO company (Japan) was found the most suitable and available. This cement provide strong and fast fixing, is easy to use.

For lens in mount cementing special rotated device was used. SSRC personnel was trained to make this operation for all micro-objective 10X lenses.

3.4. Centring and cutting lenses in mounts

For this operation, small precision Shoubline-102 lathe with special attachment was used. The main steps of this operation are as follows:

- Special adaptor screw into the centring chuck;
- Lens in mount screw on adaptor;
- Find the autocollimation image from the first surface of lens and adjust it by the first screws of the centring chuck to toleranted radius of rotation;
- Do the same for the second surface of lens and the second screws of chuck;
- Check radius of rotation for the third surface;
- Cut the base diameter and faces of the mount "as clear";
- Screw off lens in mount and check the diameter by micrometer,distances from lens to faces by dial indicator,calculate required cutted values;
- Screw lens on the adaptor, repeat the adjusting and then cut diameter and faces.

As result of experiments, this process is very easy to realization by non-skiilled personnel and provide very high accuracy.

SSRC personnel was trained in this operation and made two sets of lenses in mounts of good quality.

3.5. Technological process of assembling, adjusting and testing micro-objectives:

This process includes the following operation: making up a set of objective units; washing mechanical pieces; clean the lenses in mounts; setting a pole from the assemblies and put them in mount; adjusting obective for compensate aberration, checking parfocal distance and centring.

For objective assembly and adjusting it is necessary to have the following tools and devices: support for assembly, special wrenches, inspection microscope with telescopic tube and illuminator, standard objective for comparison of objective under tested, objective startest, mounting jig.

Know-how package contains full process of micro-objective assembly and adjusting. High quality, reliability and efficiency of this process is achieved through the use of adjusting tables and detailed typical micro-objective instruction.

During the objective adjusting such abrrations as coma, spherical aberration and astigmatism must be corrected. Eliminating the coma is provided by moving the objective component in transverse direction using mounting jig. Spherical aberration is compensated by selection required distance rings based on adjusting table. Astigmatism is eliminated by rotation of objective components. During the assmbly it is necessary to provide the required objective parfocal distance of (45+0,015) mm in size. It is achived by using of distance rings or cutting the holder end objective, centring is provided by rotating the holder with objective lenses.

In order to test the quality of objectives quality control is performed. The testing of micro-objectives is fulfilled according to the technical requirements included in the know-how package. Objective test features are as follow: numerical aperture, magnification, image quality, parfocal dictance and centring.

3.6. Testing of manufactured micro-objective 40X0,65:

Based on technical Documentation and know-how package SSRC personnel with LITMO experts fabricated, assembled and tested micro-objective prototype 40X0,65.

This achromatic objective has original and complicated design and provides high-quality optical image (class CF - Chromatic Free). New design micro-objective 40XC,65 CF was manufactured at first time.

Testing of manufactured objective is performed in accordance with technical requirements covering objectives for microscopes BIOMEM-S,L.

SSRC staff took part in testing of objective under LITMO experts suporvision.

Micro-objective must meet the following characteristics.

A) Image quality is evaluated by diffraction image of a point given by the objective.

   Star-test specimen was used as point object. Diffraction image of a point must be present as a bright core with a concentric ring about it. For objective 40X0,65 a discontinuity up to 0.3 of the ring circumference length is allowed. Assembled micro-objective without additional adjusting had a small aberrations (coma, spherical aberration and astigmatism).

   After adjusting the micro-objective aberrations became negligable, small values. Objective image quality is calculated by comparison of the image given by standard objective, Soviet objective high-quality (plan-objective) and German objective.

   This comparison showed that image-quality of manufactured objective not worse than other micro-objectives.

   Because of optical components and mechanical parts not coating the image contract of tested objective was low.

   Testing confirmed the high stability and non-sensitivity objective design to manufacturing errors and efficiency of the process of centring lenses in mounts which provides high precision centring nad requiring no special workers qualification.

B) Magnification of the objective was 40X when to microscope mechanical length of the tube was set to 160 mm.

C) Numerical aperture of objective was 0.65.

D) Parfocal distance of objective must be (45 + 0.015)mm. Some correction of this objective feature was made by cutting the support end of the holder.

E) Objective decentring should not exceed +15 mm in the object plane.

Results of objective testing confirmed high-quality of optical design, technical documentation and know-how package, appreciable qualification of the SSRC staff. Followship training and subsequent work confirmed the ability of SSRC staff for assembly and adjusting of all microscope objectives independence.

4. Fine mechanics fabrication

Expert service in the field fine mechanics fabrication was in the two direction: final stage of microscope prototype parts fabrication and microscope prototype assembly.

4.1. Final steps of microscope prototype parts fabrication:

In accordance to technical documentation and know-how package under the expertc' cupervision , the main parts of microscope prototype were fabricated as follows:

- Focusing mechanisms of Biomem L,S microscope prototype;

- All mechanical pieces of microscope eyepiece;
- All parts of monocyepiece;
- All parts of condenser A-0.3;
- Parts of co-ordinate stage.

During process of fabrication, necessary corrections on technical documantation and know-how package were made by experts and SSRC mechanical workshop personnel was trained and have studied corrected know-how.

4.2. Assembly of the microscope prototype

The main problem was assembly of the focusing mechanism for microscope Biomem L,S containing coarse and fine focusing.

The situation was very critical because of the absence of necessary equipment namely grinding machine for vee-way slides and grinding machine for screw.

For this reason grinding was changed by lapping. Special laps were fabricated and necessary correction in the know-how package were made, personnel was trained.

The following parts of focusing mechanism were lapped:

- Screw and nut for fine focusing;
- cylindrical heads of bolts;
- Worm and shaft;
- Balls slides.

Then focusing mechanism was assemblied, adjusted and tested. All steps of this process were recorded and studied by mechanical workshop personnel.

Testing of the focusing mechanism showed it's performance of high quality and better than toleranced:

- Coarse focusing movement range - 41mm;
- Fine focusing movement range - 5mm;
- Fine focusing mechanism scale - 2 micrometers on 1 division;
- Fine focusing mechanism minimum movement - 0.25 micrometer;
- The last movement - 2 division;
- nonrectilinearyty of the movement - less than 10 micrometers.

Trial assembly of all microscope was also made to check goodness of microscope parts fabrication and know-how verification. Because of the shortage of time, all parts of microscope were noncoated.
Results of final assembly proved the quality of parts fabrication.

5. Conclusion:

The main results of expertise discussion and recommendations are the following:

5.1. Technical documentation and know-how package of two modern versions of microscope prototype after correction and testing during expert services are fully ready to be used in microscope prototype fabrication.

5.2. Manufactured parts of microscope prototype such as micro-objective 40X0.65, focusing mechanism, co-ordinated stage nosepiece confirmed high quality technical documentation and know-how package appreciable qualificvation af the SSRC personnel.

5.3. As a result of followship training and expert services, SSRC staff ready to produce mycroscope prototypes independently.

5.4. Experts' recommondations:

a) It is necessary to pay more attention for fabrication of front lens, and negative lenses (No.2 and No.4 for micro-objective [illegible] particularly for centring, thicknesses and surface forms;

b) Pay more attention for surface quality of lenses because at present there are many scratches on optical surfaces;

c) It is necessary to provide the optical and assembly workshop with more stronger temperature stability and cleanliness;

d) It is necessary to establish the working places for checking lens thicknesses, surface quality, lens diameters.

LITMO EXPERTS

Prof. Rodionov

Prof. Putilin

Prof. Sheckonine

Prof. Bokine

SSRC REPRESENTATIVE

Dr. F. Mousselly

Annex - 3A

PROTOCOL

Technical conference of the experts of Leningrad Institute of Precision Mechanics and Optics (Leningrad, USSR) and Scientific Studies and Research Center (SSRC) National Project Staff (Damascus, Syria) 26.05.1991.

Within the framework of UNIDO Contract no. 89/44 relating to the project DP/SYR/86/011, expert service and technical conference of LITMO experts and specialists of SSRC were held at Damascus between 27.04 - 28.05, 1991.
The following representatives of the above mentioned sides took part in the expert service and conference.

From LITMO

Prof. S. Rodionov , Optical Design, Testing and adjusting micro-optics.
Prof. L. Putiline , Thin Film , Optics Fabrication.
Prof. A. Shekhonine, Optical Testing and Assembly.
Prof. B. Boukine, Fine Mechanics Fabrication and Assembly.

From SSRC

Dr. F. Mousselly, Project National Director.
Dr. N. Bizri, Head, optical Design
Eng. K. Maya, Head, Thin Film.
Eng. A. Obeid, Head, Optical Workshop.
Eng. D. Abbasi, Head, Mechanical System Design.

1. According to Protocol (Damascus, 07.11.1990), SSRC requested LITMO to finalize the elaboration of the know-how package for micro-optics, mechanical fabrication, assembly, adjusting and testing of microscope prototypes which has been handed to SSRC.
   LITMO and SSRC specialists studied and discussed in details the technical documentation and made necessary comments and refinements according to SSRC facilities and ready to be used in fabrication of microscope prototypes.

2. According to LIIMO expert recommendations for the advance of the project and utilization of the know-how package SSRC staff made the following:

   a) Purchased such additional equipment as:
      - Precision lathe "Shoubline - 102".
      - Laser cementing and centring machine - M1.
      - High speed polishing machine PM1.
      - Set of mechanical tools and accessories.

   b) Arrangement of opto-mechanical wokrkshop for fixing and centring lenses in mounts, assembly and adjusting micro-objectives and microscope.

   c) Fabricated different types of chucks for lens cementing, centring lenses in mounts, templets etc....

   Part of equipment required for the opto-mechanical workshop was delivered by LIIMO experts.

3. Expert services were concentrated around realization of technical documentation and know-how package for manufacturing of microscope prototypes in the following directions:

   - Micro-optics fabrication such as lens cementing and checking , lens centring and coating ;

   - Mechanical fabrication of complicated parts of microscope such as focusing mechanism, co-ordinatal stage , nosepiece;

   - Opto-mechanical assembly and adjusting of lenses in mounts of micro-objectives and eyepiece;

   - Assembly, adjusting and testing of micro-objectives and microscope.

   A detailed technical report was submitted by LIIMO experts containing the findings of their mission (see Annex).

Expert Services at project area were finalized in accordance with contract terms as follows:

- Joint expert mission of prof. S. Rodionov, E. Potiline, A. Sheckonine from 27.01 to 9.02.1990 2m/m.

- Expert in micro-optics and test plate fabrication Mr. A. Ivaniouchine, Mr. V. Machekine, Mr. A. Toporov from 28.10 to 9.12.1990 4m/m.

- Expert in fine mechanical fabrication, Prof. Boukine from 26.01 to 4.03 ,27.04 - 27.05.1991 2m/m.

- Expert in optical coating, optical assembly, optical testing, Prof. S. Rodionov, E. Potiline, A. Sheckonine from 29.04 to 28.05.1991 3m/m.

Total volume expert services was 11m/m instead of 10m/m on contract.

4. Final stage of individual training for SSRC project staff was provided by LITMO as follows:

   - MR. M. Swedan in fine machanics fabrication from 13.11.90 - 22.01.91 (2.5m/m).

   - Mr. D. Abbasi in fine mechanics fabrication from 15.12.90 - 22.01.91 (1m/m)

   Total volume of training was 26.3m/m.
   Mr. Obeid will arrive to LITMO for individual training in micro-optics fabrication from 28.05 - 1.07.91 (5 weeks).

5. The conclusion of the complete work under Contract is summerized as follows:

   a) Detailed technical documentation and know-how package necessary and sufficient for the fabrication of the two modern models of microscope prototypes were developed by LITMO in full agreement with Contract terms.

   b) The expert services resulted in better understanding of project machines, necessary purchase of balancing equipment and arrangement of additional workshops at SSRC. LITMO specialists made recommendations and consultations to SSRC staff for the improvement of the activities under project.

c) Fellowship training of the SSRC personnel by LIIMO in various field of microscope design and opto-mechanical fabrication was finalized. As a result the fellows acquired necessary knowledge and practice indispensable for realization of project. Training and subsequent work confirmed an appriciable qualification of the fellows and SSRC staff.

d) The main aim of contract as to contribute to the establishment of the Center for optical technology development at SSRC was conceptually solved. SSRC personnel expressed satisfaction and appreciation of LIIMO activities under Contract.

From LIIMO	From SSRC
S. Rodionov.	F. Mousselly.
L. Peutiline	
A. Sheckonine.	

(2 of 7)

FINAL REPORT

Project DP/SYR/85/011 Contract No 83/4

Annex 1

Leningrad Institute of Precision Mechanics and Optics

F I N A L   R E P O R T

(project DP/SYR/86/011)
contract No 89/44

Annex 1

Route charts Technological Process of Manufacture of the Microscope Optical Parts (lenses, prism)

Leningrad
1991

PROOF GLASSES

Proof glasses are used for testing radius value of optical surfaces by interferometric method.

The types of producted proof glasses must be as follows:

SPG - standard proof glasses for testing the working surfaces of control proof glasses;

CPG - control proof glasses for testing the working surfaces of working proof glasses;

WPG - working proof glasses for testing the optical surface radius value of optical details;

SPG are machined in paires consisting of convex and concave glasses of the same radius.

CPG and WPG of all the radii are made of the single sign only.

CPG radii correspond to the curvature of the detail under test.

WPG radii are of the opposit sign to the detail's surface curvature.

Proof glasses are made of such types of glasses as FK-8 with quality parametre as follows :

bubbles - not worse than B2
vienes - not worse than P2
double refraction - not worse than P

Accuracy of proof - glass - making must correspond to the following tabel :

Radius of the working surface of proof glasses, mm	*Maximum possible deviation, nomber of Newton rings*	
	general N	*local N*
From 0.5 to 37.5	**0.2**	**0.1**
More 37.5 to 5000	**0.1**	**0.07**
More 5000	**0.05**	**0.05**

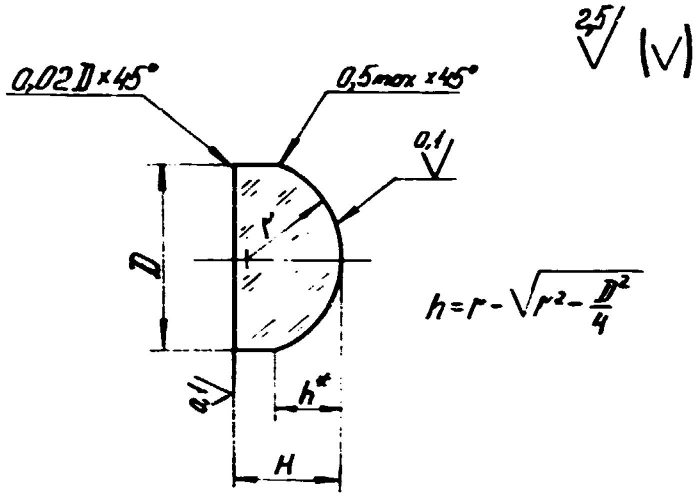
MAXIMUM DEVIATION FOR SPG *TABLE*

<table>
<tr><th rowspan="2">Nominal value, mm</th><th colspan="3">Maximum deviation ,% from nominal radius value, for accuracy classes</th></tr>
<tr><th>1 class</th><th>2 class</th><th>3 class</th></tr>
<tr><td>From 0.5 to 0.75 included</td><td>0.05</td><td>0.15</td><td>0.3</td></tr>
<tr><td>From 0.75 to 2.0 included</td><td rowspan="2">0.05</td><td rowspan="2">0.08</td><td>0.2</td></tr>
<tr><td>More 2.0 to 5.0 included</td><td>0.3</td></tr>
<tr><td>More 5.0 to 10.0 included</td><td>0.04</td><td>0.06</td><td>0.15</td></tr>
<tr><td>More 10.0 to 12.0 included</td><td rowspan="6"></td><td rowspan="2">0.05</td><td>0.1</td></tr>
<tr><td>More 12.0 to 15.0 included</td><td>0.08</td></tr>
<tr><td>More 15.0 to 22.0 included</td><td rowspan="3">0.04</td><td>0.06</td></tr>
<tr><td>More 22.0 to 32.0 included</td><td rowspan="2">0.05</td></tr>
<tr><td>More 32.0 to 37.5 included</td></tr>
<tr><td>More 37.5 to 250.0 included</td><td>0.03</td><td>0.1</td></tr>
<tr><td>More 250.0 to 1000.0 included</td><td>0.02</td><td>0.05</td><td>0.15</td></tr>
<tr><td>More 1000.0</td><td>$\frac{0.02}{1000.0}$</td><td>$\frac{0.05}{1000.0}$</td><td>$\frac{0.15}{1000.0}$</td></tr>
</table>

NOTES

1. *CPG must have accuracy class of the SPG , with whose surface their working surface is compared.*
2. *WPG must have accuracy class of the CPG , with whose surface their working surface is compared.*

r from 0,5 to 37,5



* The dimension for information.

Fig. 1

r more than 37,5

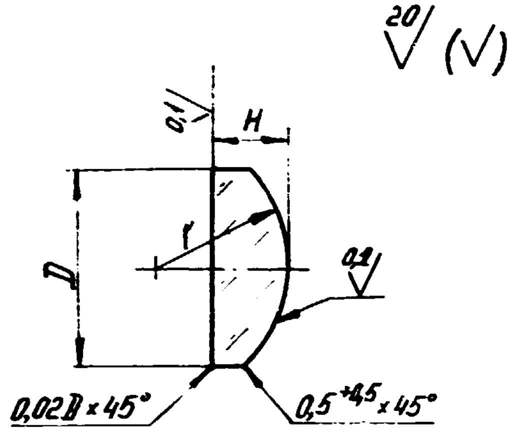
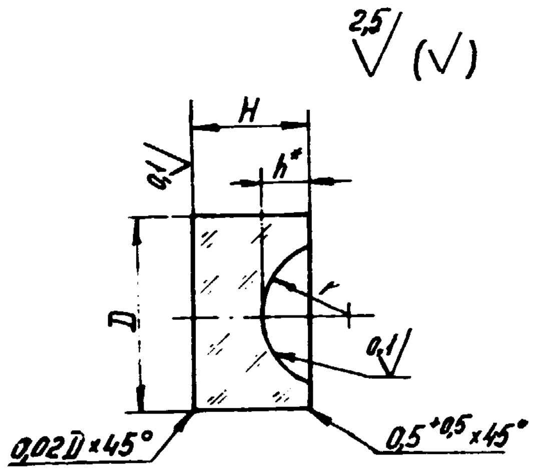


Fig. 2

r from 0,5 to 37,5



* The dimension for information.

Fig. 3

r more than 37,5

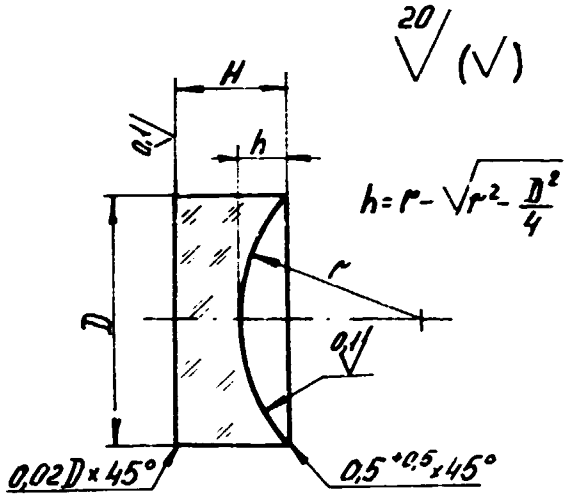


Fig. 4

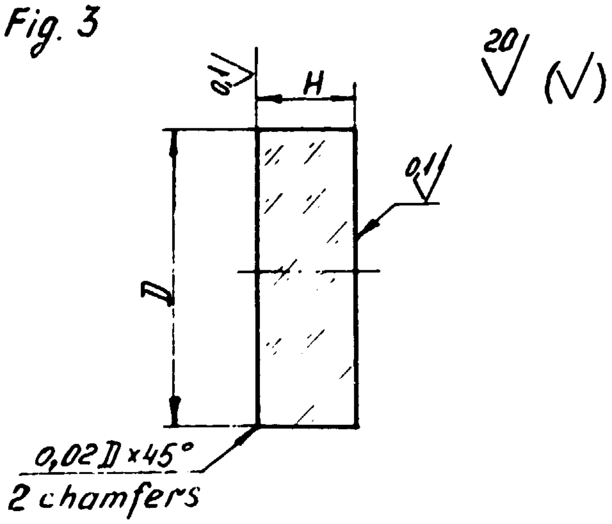


Fig. 5

Table N°

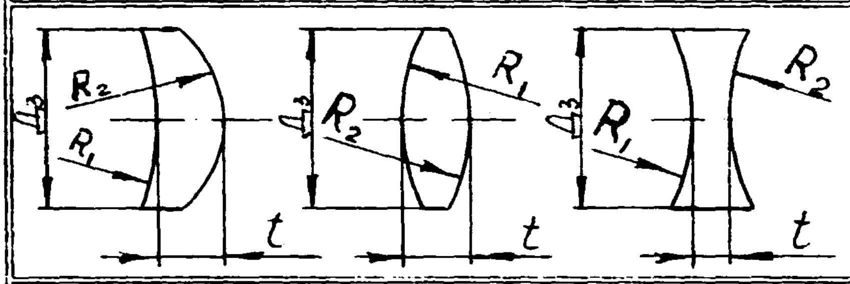
№	Detail's parametrs		Parametrs of the working proof glass (WPG)				
	N	A_3 mm	Surface sign*	Radius, mm	Φ, mm	H, mm	N of drawing
1	2	3	4	5	6	7	8
I	200.00I	9,5	+ –	4,I30 5,998	8 II	6 I2	I 3
2	200.002	I0,5	– –	48,3I0 II,56I	I2 I2	I0 I0	4 3
3	200.003	I0,5	+ –	I0,7I5 22,I80	I2 I2	I0 I0	I 3
4	2I0.00I	7,0	 –	∞ 9,204	 9	 7	5 3
5	2I0.002	7,5	+ –	20,090 I0,209	9 9	7 7	I 3
6	2I0.003	9,5	– +	28,840 I0,520	II II	I0 I0	3 I
7	2I0.004	9,5	– –	I0,520 I2,794	II II	I0 I0	3 3
8	2I0.005	I3,0	– +	24,320 75,340	I5 I5	I0 I0	3 2
9	220.00I	5,7	 –	∞ 2,729	 7	 7	5 3
I0	220.002	7,5	– +	20,840 5,9I6	9 9	7 8	3 I
II	220.003	7,5	– –	5,9I6 5,572	9 9	9 9	3 3
I2	220.004	9,0	– +	I6,444 6,9I8	I0 I0	7 7	3 I
I3	220.005	9,0	– –	6,9I8 I2,050	I0 I0	7 7	3 3
I4	220.006	I0,5	– –	79,8 8,79	I2 I2	I0 I2	4 3
I5	220.007	I0,5	+ +	8,79 55,85	I2 I2	8 I0	I 2
I6	230.00I	I,9	 –	∞ 0,787	 4	 4	5 3
I7	230.002	5,4	 –	∞ 2,754	 7	 7	5 3
I8	230.003	7,5	+ +	70,96 3,98I	9 7	7 5	2 I
I9	230.004	6,5	– –	3,98I 5,I76	8 8	8 8	3 3
20	230.005	8,5	– +	22,860 4,656	I0 9	7 8	3 I
2I	230.006	8,0	– –	4,656 8,954	9 9	9 7	3 3
22	230.007	I0,0	+ –	349,900 7,762	I2 I2	I0 I2	2 3
23	230.008	I0,0	+ +	7,762 I24,450	I2 I2	8 I0	I 2

Table N (continued)

I	2	3	4	5	6	7	8
24	240.00I	25,0	+ -	59,980 I3,740	28 28	I5 20	2 3
25	240.002	27,5	+ -	I3,740 4I,780	26 30	I5 I5	I 4
26	240.003	28,0	- -	78,890 46,240	30 30	I5 I5	4 4
27	240.004	28,0	- +	28,250 80,I70	30 30	I5 I5	3 2
28	50.00I	24,0	- -	I8,408 27,730	25 25	I5 I5	3 3
29	50.002	24,0	+ -	I3,900 I8,750	25 25	20 I5	I 3
30	50.003	I3,5	- +	6,3I0 7,I45	I5 I4	I2 8	3 I
3I	I20.II5	24,5	+ -	23,440 I3,305	25 25	20 20	I 3
32	I20,II6	28,5	- -	∞ 27,800	32 32	I5 I5	4 3
33	I20.II7	28,5	- -	28,9I0 42,760	32 32	I5 I5	3 4
34	I20.II8	28,5	+ -	3I,700 26I,800	32 32	I5 I5	I 4
35	I20.2II	28,5	- -	66,220 60,8I0	32 32	I5 I5	4 4

* *Sign „+" is for the convex working surface of the WPG*
Sign „-" is for the concave working surface of the WPG

TECHNOLOGICAL PROCESS CART N 1



N	CONTENTS OF OPERATIONS
1.	Stick the slabs to a blocking tool
2.	Reduce to thickness t1=
3.	Remove the slabs and stick again
4.	Reduce to thickness t2=
5.	Knock off the slabs
6.	Clean up the slabs
7.	Stick the sheet glass to the slabs
8.	Trepan holes in slabs to make blanks
9.	Break off blanks
10.	Clean the blanks
11.	Stick the blanks into a stack with the length L=
12.	Reduce the stack to diameter Д3
13.	Dismantle the stack
14.	Clean the blanks
15.	Reduce R1 to thickness t3=
16.	Reduce R2 to thickness t4=
17.	Bevel the technological chamfers f1 and f2
18.	Clean the blanks

TESTING

1. Lens centre thickness t4= mm.
2. Radii : R1= ; R2= mm.
3. Chamfer sizes f1= ; f2= mm.

	EQUIPMENT
1.	Grinding machine
2.	Drilling machine
3.	Rounding machine
4.	Curve - generator
5.	Pedal grinding machine

	TOOLS FOR MACHINING
1.	Plane blocking tool
2.	Diamond drills
3.	Diamond wheel type ...
4.	Diamond wheel
5.	Cup-type chamfering tool

	ATTENDING MATERIALS
1.	Microgrit WCA
2.	Blocking wax
3.	Slabs of sheet glass
4.	Glass-cooling fluid
5.	Sponge

	JIGS AND TOOLS
1.	Plane holder Ø=
2.	Collet chucks Ø=
3.	Electric hotplate

	MEASURING EQUIPMENT
1.	Gauge
2.	Micrometer
3.	Spherometer

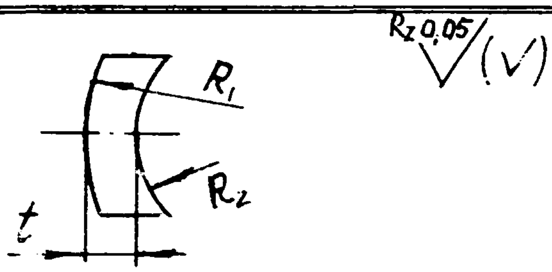
Table N1

Lens N°	NN of operations of mechanical working of Blank's according to technological cart N1										Notes
	2	4	8	II		I2	I5		I6		
	t_1 mm	t_2 mm	Φ mm	L, mm	M pieces	A_3, mm	R_1	t_3 mm	R_2, mm	t_4, mm	
I	2	3	4	5	6	7	8	9	I0	II	I2
200.00I	7,I0	6,70	I0,5	70	I0	9,5	3,94	4,5	6,I8	4,30	R_1 on Φ 7mm
200.002	3,20	2,70	II,5	82	30	I0,5	II,75	2,5	48,50	2,30	
200.003	3,00	2,60	II,5	80	30	I0,5	I0,50	2,4	I9,80	2,20	
2I0.00I	4,50	4,00	8,0	6I	I5	7,0	9,43	3,7	-	3,70	
2I0.002	3,50	3,I0	8,5	63	20	7,5	I9,90	2,5	I0,40	2,30	
2I0.003	3,90	3,40	I0,5	70	20	9,5	I0,33	2,0	29,05	I,80	
2I0.004	5,50	5,00	I0,5	76	I5	9,5	I0,7I	4,8	I2,98	4,60	
2I0.005	3,00	2,60	I4,0	36	30	I3,0	75,I5	2,I	24,5I	I,90	
220.00I	3,50	3,00	6,2	62	20	5,7	2,92	2,8	-	2,80	
220.002	5,85	5,35	8,5	82	I5	7,5	5,72	3,7	2I,00	3,45	
220.003	4,50	4,00	8,5	62	I5	7,5	5,76	3,7	6,I0	3,50	
220.004	4,50	4,I0	I0,0	84	20	9,0	6,70	2,2	I6,63	2,00	
220.005	4,70	4,20	I0,0	86	20	9,0	7,I0	4,0	I2,24	3,80	
220.006	5.50	5,00	II,5	I02	20	I0.5	8,79	4,7	79,8	4,40	
220.007	5,60	5,35	II,5	89	I5	I0,5	8,79	3,5	55,85	3,I0	
230.00I	2,00	I,50	2,0	-	-	I,9	0,97	I,25	-	I,25	
230.002	2,20	I.70	6,4	52	30	5,4	2,94	I,45	-	I,45	
230.003	5,00	4,60	8,5	7I	I5	7,5	3,79	I,7	70,77	I,40	

Table N1 (continued)

I	2	3	4	5	6	7	8	9	I0	II	I2
230.004	4,2	3,70	7,5	55	I5	6,5	4,I7	3,5	5,36	3,3	
230.005	5,5	5,I0	9.5	77	I5	8,5	4,46	2,I	23,05	I,9	
230.006	4,8	4,30	9,0	88	20	8,0	4,84	4,0	9,I4	3,8	
230.007	3,7	3,20	II,0	98	30	I0,0	7,95	2,95	350,20	2,7	
230,008	4,I	3,65	II,0	93	25	I0,0	7,57	I,60	I24,20	I,3	
240.00I	I2,8	I2,30	26,0	I25	I0	25,0	I3,95	I2,I0	59,78	I0,5	
240.002	I6,7	I6,2	28,5	82	5	27,5	I3,55	2,30	42,00	2,I	
240.003	6,2	5,70	29,0	II6	20	28,0	46,45	5,50	79,I0	5,3	
240.004	I0,5	I0,I0	29,0	I02	I0	28,0	28,44	9,85	79,95	8,4	
50.00I	8,2	7,70	25,0	II7	I5	24,0	I8,60	7,50	27,92	7,3	
50.002	I3,0	I2,40	25,0	I25	I0	24,0	I3,62	8,70	I8,94	8,5	
50.003	I2,2	II,70	I4,5	II8	I0	I3,5	6,50	II,50	6,95	I0,3	R_2 on ϕ 7mm
I20.II5	9,6	9,I0	25,5	92	I0	24,5	I3,50	8,85	23.20	5,2	
I20.II6	8,0	7,50	29,5	II0	I5	28,5	28,00	7,30	-	7,3	
I20.II7	8,0	7,50	29,5	II0	I5	28,5	29,I2	7,30	43,00	7,I	
I20.II8	8,5	8,00	29,5	I22	I5	28,5	3I,50	4,50	262,00	4,3	R_1 on ϕ 24 mm
I20.2II	II,2	I0,70	29,5	I09	I0	28,5	6I,I0	I0,50	66,50	I0,3	

TECHNOLOGICAL PROCOCESS CART N2



N	CONTENTS OF OPERATIONS
1.	Stick pitch pellets on surface R1= mm (M pieces)
2.	Block the blanks on radius R2= mm (M pieces)
3.	Grind surface R2= mm, followind the sequence of steps:
4.	Clean the block
5.	Polish surface R2= mm.
6.	Lacquer clean and dry surfaces of well-set details
7.	Dismantle the block
8.	Clean the blanks
9.	Stick pitch pellets on surface R2= mm (M pieces)
10.	Block the blanks on radius R1= mm (M pieces)
11.	Grind surface R1= mm, followind the sequence of steps:
12.	Polish surface R1= mm.
13	Lacquer clean and dry surfaces of well-set details
14.	Dismantle the block and clean the blanks

TESTING

1.	Lens centre thickness	t=	mm
2.	Surface form precision	N1= N2=	;
3.	Polished surface cleanness	P1= P2=	;

	EQUIPMENT
1.	Grinding and polishing machine
2.	Pedal machine
	TOOLS FOR MACHINING
1.	Mushroom-type grinder
2.	Cup-grinder N
3.	Mushroom-type polisher N
4.	Cup-type polisher N
5.	Plane grinder
6.	Plane polisher
	ATTENDING MATERIALS
1.	Grinding abrasives
2.	Polishing powder
3.	Sticking pitch
4.	Polishing pitch
5.	Protecting lacquer
6.	Sponge
	ADJUSTMENT
1.	Mushroom-type holder N
2.	Cup-type holder N
3.	Plane holder
	MEASURING EQUIPMENT
1.	Thickness-measure gauge
2.	Proof plate, magnifying 6^x

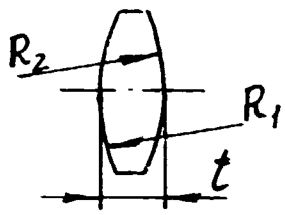
Table N2

Lens N	NN of technological operations according to technological process cart N										Remarks
	I		2		3 | 4 | 5	9		I0		II | I2 | I3	
	R_1 mm	M pieces	R_2 mm	M pieces	R_2 mm	R_2 mm	M pieces	R_1 mm	M pieces	R_1 mm	
200.00I	5,998	I	4,I3	I	4,I3	4,I3	I	5,998	I	5,998	
200.003	22.I8	3	I0,7I5	3	I0,7I5	I0,7I5	I5	22,I8	I5	22.I8	
2I0.002	I0,209	I5	20,09	I5	20,09	20.09	7	I0.209	7	I0.209	
2I0.003	28.84	3	I0.52	3	I0,52	I0,52	I5	28.84	I5	28.84	
2I0.005	24,32	I5	75.34	I5	75.34	75,34	7	24,32	7	24.32	
220.002	20,84	3	5,9I6	3	5,9I6	5,9I6	I5	20.84	I5	20.84	
220.004	I6.444	I	6.9I8	I	6,9I8	6.9I8	7	I6,444	7	I6,444	
230.005	22.86	I	4.656	I	4,656	4,656	I5	22.86	I5	22.86	
230.007	349.9	I	7.762	I	7,762	7,762	I5	349,9	I5	349,9	
240.00I	59.98	I	I3,74	I	I3,74	I3,74	I5	59,98	I5	59,98	
240.002	4I.78	I	I3,74	I	I3,74	I3,74	7	4I,78	7	4I,78	
240.004	80,I7	3	28.25	3	28,25	28,25	I5	80,I7	I5	80,I7	
50.002	I8.75	I	I3,9	I	I3,9	I3,9	3	I8,75	3	I8,75	
50.003	6.3I	I	7,I45	I	7,I45	7,I45	I	6,3I	I	6,3I	
I20.II5	I3.305	3	23,44	3	23,44	23,44	I	I3,305	I	I3,305	
I20.II8	26I,8	3	3I,7	3	3I,7	3I,7	I5	26I,8	I5	26I.8	

Table N 2a

Lens N	t	Tested parameters					
		N		Δ N		Surf. qual	
						P_I	P_2
		A	B	A	B	A	B
200.00I	4 ± 0,03	3	3	0,3	0,3	0,02	0,I
200.003	I,9 ± 0,I	3	3	0,3	0,3	0,I	
2I0.002	2 ± 0,I	3	3	0,25	0,25	0,02	
2I0.003	I,5 ± 0,I	3	3	0,3	0,3	0,I	
2I0.005	I,6 ± 0,I	3	3	0,3	0,3	0,I	
220.002	3,I ± 0,02	3	3	0,3	0,3	0,02	
220.004	I,6 ± 0,I	3	3	0,3	0,3	0,I	
230.005	I,5 ± 0,I	3	3	0,25	0,25	0,02	
230.007	2,4 ± 0,I	3	3	0,25	0,25	0,02	
240.00I	I0 ± 0,2	5	5	0,3	0,3	0,006	0,02
240.004	I,8 ± 0,2	5	5	0,3	0,3	0,02	
50.002	I0 ± 0,05	3	3	0,3	0,3	0,I	
50.003	8,2 ± 0,05	3	3	0,3	0,3	0,I	0,02
I20.II5	4,86 ± 0,I	5	5	0,5	0,5	0,006	0,02
I20.II8	4 ± 0,I	5	5	0,5	0,5	0,02	

TECHNOLOGICAL PROCOCESS CART N3



$Rz\,0{,}05/\,(\surd)$

$R_1 < R_2$

N	CONTENTS OF OPERATIONS
1.	Stick pitch pellets on surface R1= mm (M pieces)
2.	Block the blanks on radius R2= mm (M pieces)
3.	Grind surface R2= mm followind the sequence of steps:
.	Clean the block
5.	Polish surface R2= mm.
6.	Lacquer clean and dry surfaces of well-set details
7.	Dismantle the block
8.	Clean the blanks
9.	Stick pitch pellets on surface R2= mm (M pieces)
10.	Block the blanks on radius R1= mm (M pieces)
11.	Grind surface R1= mm,followind the sequence of steps:
12.	Polish surface R1= mm.
13	Lacquer clean and dry surfaces of well-set details
14.	Dismantle the block and clean the blanks

TESTING

1.	Lens centre thickness	t=	mm
2.	Surface form precision	N1=	;
		N2=	
3.	Polished surface cleanness	P1=	;
		P2=	

	EQUIPMENT
1.	Grinding and polishing machine
2.	Pedal machine

	TOOLS FOR MACHINING
1.	Mushroom-type grinder
2.	Cup-grinder N
3.	Mushroom-type polisher N
4.	Cup-type polisher N
5.	Plane grinder
6.	Plane polisher

	ATTENDING MATERIALS
1.	Grinding abrasives
2.	Polishing powder
3.	Sticking pitch
4.	Polishing pitch
5	Protecting lacquer
6.	Sponge

	ADJUSTMENT
1.	Mushroom-type holder N
2.	Cup-type holder N
3.	Plane holder

	MEASURING EQUIPMENT
1.	Thickness-measure gauge
2.	Proof plate, magnifying 6ˣ

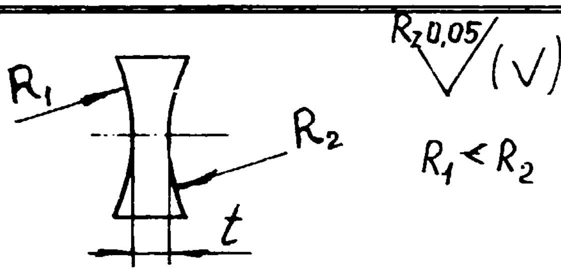
Table N3

Lens N	NN technological operations according to technological process cart N										Remarks
	I		2		3 | 4 | 5	9		I0		II | I2 | I3	
	R1 mm	M pieces	R2 mm	M pieces	R2 mm	R2 mm	M pieces	R1 mm	M pieces	R1 mm	
200.002	II.56I	I5	48.3I	I5	48,3I	48.3I	6	II.56I	6	II.56I	
2I0.00I	9.204	37	∞	37	∞	∞	7	9.204	7	9.204	
2I0.004	I0.52	7	I2.794	7	I2.794	I2,794	3	I0.52	3	I0.52	
220.00I	∞	I	2.729	I	2.729	2,729	37	∞	37	∞	
220.003	5.572	3	5.9I6	3	5,9I6	5,9I6	I	5.572	I	5,572	
220.005	6.9I8	7	I2.05	7	I2.05	I2,05	I	6,9I8	I	6,9I8	
220.006	8,79	I	79,8	7	79,8	79,8	7	8,79	I	8,79	
230.00I	∞	I	0,787	I	0,787	0,787	40	∞	40	∞	
230.002	∞	I	2.754	I	2,754	2,754	37	∞	37	∞	
230.004	3,98I	3	5.I76	3	5,I76	5,I76	I	3.98I	I	3,98I	
230.006	4.656	6	8,954	6	8.954	8,954	I	4.656	I	4,656	
240.003	46,24	I5	78,89	I5	78,89	78,89	7	46,24	7	46,24	
50.00I	I8.408	6	27,73	6	27,73	27,73	I	I8,408	I	I8,408	
I20.II6	27.8	I5	∞	I5	∞	∞	3	27,8	3	27,8	
I20.II7	28.9I	7	42,76	7	42,76	42.76	3	28,9I	3	28.9I	
I20.2II	60,3[illegible]	[illegible]	66,22	I5	66,22	66,22	I5	60,8I	I5	60,8I	

Table N 3a

<table>
<tr><th rowspan="3">Lens N</th><th colspan="7">Tested parameters</th></tr>
<tr><th rowspan="2">t</th><th colspan="2">N</th><th colspan="2">ΔN</th><th colspan="2">Surf. qual</th></tr>
<tr><th>A</th><th>B</th><th>A</th><th>B</th><th>P_I
A</th><th>P_2
B</th></tr>
<tr><td>200.002</td><td>2 ± 0,I</td><td>3</td><td>3</td><td>0,3</td><td>0,3</td><td colspan="2">0,I</td></tr>
<tr><td>2I0.00I</td><td>3,36 ± 0,I</td><td>3</td><td>3</td><td>0,3</td><td>0,3</td><td colspan="2">0,02</td></tr>
<tr><td>2I0.004</td><td>4,3 ± 0,I</td><td>3</td><td>3</td><td>0,3</td><td>0,3</td><td colspan="2">0,I</td></tr>
<tr><td>220.00I</td><td>2,49 ± 0,0I</td><td>3</td><td>3</td><td>0,3</td><td>0,3</td><td colspan="2">0,02</td></tr>
<tr><td>220.003</td><td>3,I7 ± 0,02</td><td>3</td><td>3</td><td>0,25</td><td>0,25</td><td>0,02</td><td>0,I</td></tr>
<tr><td>220.005</td><td>3,4 ± 0,I</td><td>3</td><td>3</td><td>0,3</td><td>0,3</td><td colspan="2">0,I</td></tr>
<tr><td>220.006</td><td>4 ± 0,I</td><td>3</td><td>3</td><td>0,3</td><td>0,3</td><td colspan="2">0,I</td></tr>
<tr><td>230.00I</td><td>0,92 ± 0,0I</td><td>3</td><td>3</td><td>0,3</td><td>0,3</td><td colspan="2">0,006</td></tr>
<tr><td>230.002</td><td>I,I4 ± 0,0I</td><td>3</td><td>3</td><td>0,25</td><td>0,25</td><td colspan="2">0,02</td></tr>
<tr><td>230.004</td><td>3 ± 0,02</td><td>3</td><td>3</td><td>0,25</td><td>0,25</td><td colspan="2">0,02</td></tr>
<tr><td>230.006</td><td>3,5 ± 0,I</td><td>3</td><td>3</td><td>0,25</td><td>0,25</td><td colspan="2">0,02</td></tr>
<tr><td>240.003</td><td>5 ± 0,2</td><td>5</td><td>5</td><td>0,3</td><td>0,3</td><td colspan="2">0,02</td></tr>
<tr><td>50.00I</td><td>7 ± 0,05</td><td>3</td><td>3</td><td>0,3</td><td>0,3</td><td colspan="2">0,I</td></tr>
<tr><td>I20.II6</td><td>7 ± 0,I</td><td>5</td><td>5</td><td>0,5</td><td>0,5</td><td colspan="2">0,02</td></tr>
<tr><td>I20.II7</td><td>6,8 ± 0,I</td><td>5</td><td>5</td><td>0,5</td><td>0,5</td><td colspan="2">0,02</td></tr>
<tr><td>I20.2II</td><td>I0 ± 0,I</td><td>5</td><td>5</td><td>0,5</td><td>0,5</td><td colspan="2">0,02</td></tr>
</table>

TECHNOLOGICAL PROCOCESS CART N4



N	CONTENTS OF OPERATIONS
1.	Stick pitch pellets on surface R1= mm (M pieces)
2.	Block the blanks on radius R2= mm (M pieces)
3.	Grind surface R2= mm, followind the sequence of steps:
.	Clean the block
5.	Polish surface R2= mm.
6.	Lacquer clean and dry surfaces of well-set details
7.	Dismantle the block
8.	Clean the blanks
9.	Stick pitch pellets on surface R2= mm (M pieces)
10.	Block the blanks on radius R1= mm (M pieces)
11.	Grind surface R1= mm, followind the sequence of steps:
12.	Polish surface R1= mm.
1	Lacquer clean and dry surfaces of well-set details
14.	Dismantle the block and clean the blanks

	TESTING	
1.	Lens centre thickness	t= mm
2.	Surface form precision	N1= ; N2=
3.	Polished surface cleanness	P1= ; P2=

	EQUIPMENT
1.	Grinding and polishing machine
2.	Pedal machine

	TOOLS FOR MACHINING
1.	Mushroom-type grinder
2.	Cup-grinder N
3.	Mushroom-type polisher N
4.	Cup-type polisher N
5.	Plane grinder
6.	Plane polisher

	ATTENDING MATERIALS
1.	Grinding abrasives
2.	Polishing powder
3.	Sticking pitch
4.	Polishing pitch
5.	Protecting lacquer
6.	Sponge

	ADJUSTMENT
1.	Mushroom-type holder N
2.	Cup-type holder N
3.	Plane holder

	MEASURING EQUIPMENT
1.	Thickness-measure gauge
2.	Proof plate, magnifying 6ˣ

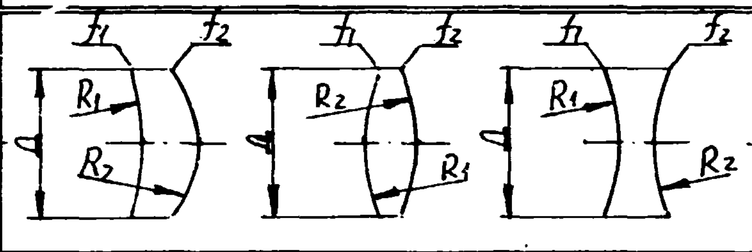
Table N4

Lens N	NN technological operations according to technological process cart N										Remarks
	I		2		3 | 4 | 5	9		I0		II | I2 | I3	
	R_1 mm	M pieces	R_2 mm	M pieces	R_2 mm	R_2 mm	M pieces	R_1 mm	M pieces	R_1 mm	
220.007	8,79	I	55,85	1	55,85	55,85	1	8,79	I	8,79	
230.003	3.98I	I5	70.96	I5	70.96	70,96	I	3.98I	I	3.98I	
230 008	7.762	I5	I24.45	I5	I24.45	I24.45	I	7.762	I	7.762	

Table N 4a

Lens N	t	Tested parameters					
		N		ΔN		Surf. qual	
						P I	P2
		A	B	A	B	A	B
220.007	2,7 ± 0,I	3	3	0,3	0,3	0	,I
230.003	I,09 ± 0,02	3	3	0,3	0,3	0	,02
230.008	0,9 ± 0,I	3	3	0,25	0,25	0	,02

TECHNOLOGICAL PROCESS CART N5



N	CONTENTS OF OPERATION
1.	Stick the lens to the chuck
2.	Reduce the lens to diam. Д= mm
3.	Remove lens from chuck
4.	Chamfer on ƒR1= mm.
5.	Chamfer on ƒR2= mm.
6.	Clean the lens

	TESTING
1.	Lens diameter D, mm
2.	Decentring tolerance C, mm
3.	Polished surface cleanness P
4.	Chamfer size f1, mm f2, mm
5.	Lens focus distance f′, mm

	EQUIPMENT
1.	Optical centring machine
2.	Pedal machine

	TOOLS FOR MACHINING
1.	Diamond wheel type APP
2.	Cup-type chamfering tool
3.	REMARKS: chamfering tools must be marked according to the radius of curvature

	ATTENDING MATERIALS
1.	El. corundum powder
2.	Benzene , spirit
3.	Cotton cloth

	MEASURING INSTRUMENT
1.	Gauge
2.	Magnifying glass

Table N5

N of a Lens	Parameters of details under test				
	Д мм	C мм	$f_{R_1} \times \alpha^{\circ}$	$f_{R_2} \times \alpha^{\circ}$	f' mm
200.00I	8,2e9	0,0I	0.6x45°	$0.I^{+0.I}$x30°	-9I.39
200.002	9e9	0,02	$0.I^{+0,I}$x45°	$0,3^{+0.2}$x30°	I5.36
200.003	9e9	0,02	$0.3^{+0,2}$x60°	$0.I^{+0.I}$x45°	-29,83
2I0.00I	5,5e9	0,05	$0.I^{+0.I}$x45°	$0.I^{+0.2}$x45°	I8.32
2I0.002	6e9	0.05	$0,2^{+0,2}$x45°	$0,I^{+0.I}$x45°	39,79
2I0.003	8dI0	0,0I	$0,I^{+0.I}$x60°	$0,3^{+0.2}$x45°	22 96
2I0.004	8e9	0.03	$0,I^{+0,I}$x30°	$0.I^{+0,I}$x30°	I2,57
2I0.005	II.5e9	0,05	$0,2^{+0,2}$x45°	$0,4^{+0.2}$x45°	72,68
220.00I	4.2e9	0,02	$0.I^{+0,I}$x45°	$0.I^{+0,2}$x30°	4,33
220.002	6e9	0,0I	$0,I^{+0.I}$x60°	$0,I^{+0,2}$x45°	-I2,I3
220.003	6dI0	0.02	$0,I^{+0,I}$x30°	$0,I^{+0,I}$x30°	8,45
220.004	7,5e9	0,0I	$0.I^{+0,I}$x60°	$0,3^{+0.2}$x45°	-I7,2I
220.005	7,5dI0	0,03	$0,I^{+0,I}$x30°	$0,I^{+0,I}$x[illegible]°	[illegible],55
220.006	9dI0	0,04	$0,I^{+0,I}$x45°	$0,I^{+0,I}$x30°	I2,79
220.007	9e9	0,02	$0,I^{+0.I}$x60°	$0.3^{+0.2}$x45°	-I2,I2
230.00I	is not centered				I.52
230.002	4e9	0.02	$0,I^{+0,I}$x30°	$0.I^{+0,I}$x30°	4,I6
230.003	6.2e9	0.0I	0.6x45°	$0.I^{+0,I}$x90°	-5.724
230.004	6.2dI0	0,03	$0,I^{+0,I}$x30°	$0.I^{+0.I}$x30°	4,88
230.005	7,2e9	0,0I	$0,I^{+0,2}$x60°	$0.3^{+0.2}$x45°	-8.II
230.006	7.2dI0	0,02	$0.I^{+0,2}$x30°	$0,I^{+0.2}$x45°	6,83
230.007	8.5dI0	0.05	$0.I^{+0,I}$x45°	$0.I^{+0.I}$x60°	I2.63
230.008	8.5e9	0.02	$0.I^{+0,2}$x30°	$0.3^{+0.2}$x45°	-II.84
240.00I	23h9	0.03	$0.3^{+0,3}$x45°	-	26,77
240.002	26e9	0.02	$0,3^{+0,3}$x45°	$0,3^{+0.3}$x30°	-28,I8
240.003	26e9	0,2	$0,3^{+0,3}$x45°	$0,3^{+0,3}$x45°	48,I2
240.004	26e9	0,2	$3.4^{+0,2}$x45°	$0,3^{+0,3}$x30°	66.93
50.00I	22,5h9	0,0I	0.2max x30°	0,2max x30°	I9,29
50.002	22,5h9	0.0I	$0,2^{+0.2}$x45°	$0,2^{+0,2}$x30°	-403,3I
50.003	I2,5h9	0,0I	tc diameter 6hI2x30	-	I8,7I
I20.II5	23e9	0.02	$0,3^{+0,3}$x60°	-	42,67
I20.II6	27e9	0,I	$0,3^{+0,3}$x45°	$0,3^{+0,3}$x30°	45,56
I20.II7	27e9	0,02	$0,3^{+0,3}$x30°	$0,3^{+0,3}$x30°	29,32
I20.II8	27e9	0.02	-	$0,3^{+0,3}$x45°	-48,5I
I20.2II	27e9	0,02	$0,3^{+0.3}$x45°	$0,3^{+0,3}$x45°	53,55

TECHNOLOGICAL PROCESS CART N 6

EQVIPMENT

1. Work place for cementing

N CONTENTS OF OPERATION

1. Prepare optical balsam in testtube
2. Wash the dropper with ethyl spirt.clean with degreased napkin.brush off the dust with a squirrel brush and put into the test-tube
3. Clean the lenses. brush off the dust with a squirrel brush and lay out in pairs
4. Heat the details up to $t=(80-120)^{\circ}C$
5. Heat balsam up to $t=(120-130)^{\circ}C$
6. Take off the upper lens and put a drop of cementing substance with the dropper on the lower lens
7. Put the upper lens on the lower one . lap them together with acor till the surplus of balsam and the air bubbles come out
8. Take off the surplus of cement at the edges with napkin
9. Put the cemented details on a special table with horisontal surface checked by a level
10. Centre the details in centring device.
   Put the centered details on the levelchecked horisontal surface.
   Clean the details finally

ATTENDANT MATERIALS

1. Optical cement canadian balsam
2. Acetone , spirt , ether

JIGS AND TOOLS

1. Setting for cementing
2. Magnifying glass 10^{x}
3. Cork
4. Dropper
5. Squirrel brush
6. Cotton napkin
7. Cotton wool
8. Test-tube
9. Support
10. Bamboo stick

TESTING

1. Centring precision
2. Surface cleanness
3. Cement layer quality

MEASURING INSTRUMENT

1. Centring device

Table 6

ASS.	C	Lens
2I0.0I0	0,0I	2I0.00I 2I0.002
220.0I0	0,0I	220.002 220.003
220.020	0,0I	220.004 220.005
220.030	0,04	220.006 220.007
230.0I0	0,0I	230.003 230.004
230.020	0,0I	230.005 230.006
230.030	0,02	230.007 230.008
240.0I0	0,I	240.00I 240.002

TECHNOLOGICAL PROCESS CART	N 7
	EQVIPMENT
	1. Vacuum machine 2. Spectrophotometer 3. Machine forcleanning detail 4. Electrolytic bath
N CONTENTS OF OPERATION	ATTENDANT MATERIALS
1. Preliminary pump out vacuum camera to $P = (10^{-5} - 10^{-6})$ mm Hg 2. Clean the details with spirit (spirit rectified) using cotton-wool tampon or degreased lawn napkin. Instead of rectified spirit spirit - ether mixture may be used. Details less than Ø5mm size are cleanned by rinsing out in spirit and distilled water 3. Fill camera with air 4. Fill evaporators with film-forming matters 5. Put the details into a holder 6. Pump out vacuum camera to $p=(10^{-5}-10^{-6})$mm Hg 7. Fill te camera with working gas (air, N_2 , Ar) to $p=10^{-2}$ mm Hg 8. Clean the details in subnormal discharge (schedule is chosen according to instructions on vacuum machine exploitation) 9. Deliver the layers of Cr, Al Film thickness of Cr $t \simeq 300$ A Evaporation of Cr must be stopped at achieving transmission -20% Sedimentation velocity of Cr(2-5), of Al-1000 Å/S . Evaporation of Al must be stopped at achieving transmission $\simeq 0.1\%$ 10. Keep the details in vacuum $p<10^{-6}$ mm Hg for 2-3 hours 11. Fill camera with air 12. Take the details out of the holder	1. Film-forming matters 2. Spirit C_2H_5OH rectified 3. Spirit-ether mixture 4. Cotton wool 5. Lawn napkins 6. Squirrel brush **JIGS AND TOOLS** 1. Holders for fastening details on the receiving surface 2. Plane-parallel plates Ø40mm, wedge angle<Ø.5 (for control in transmitted light) 3. Wedge-shaped plates Ø40mm, wedge angle>5° (for control in reflected light)
TING 1. Place of spectral curve o flectance (tested on special device in the interval of λ = (400 - .0) Mm)	

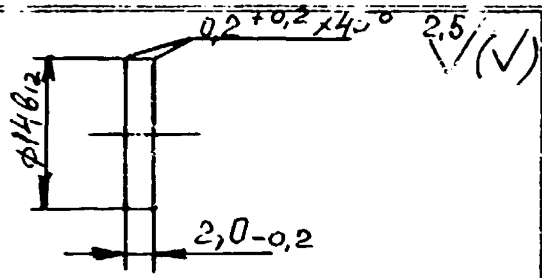
NOTES:

1. After 10-15 cycles of evaporation vacuum camera must be cleaned.
2. Before filling evaporator with Al anneal the spiral at t-(2000-2500) C during 20-30 minutes.
3. Lay Cr substance on tungsten wire (0.8-1.0),mm in electrolytic bath.

Electrolytic composition : Cr_2O_3 - 40 g
H_2SO - 0.4 ml
H_2O - 160 ml

Electrolysis schedule : voltage 8 V
current de .15-0.20) A/cm^2
electrolysi 24 hours

TECHNOLOGICAL PROCESS CART №3



N	CONTENTS OF OPERATIONS
1.	Stick the slabs to a blocking tool
2.	Reduce to thickness $t = 2,2_{-0,1}$ mm
3.	Restick the slabs by repulling
4.	Reduce to thickness $t = 2,0_{-0,2}$ mm
5.	Knock off the slabs
6.	Clean up the slabs
7.	Stick the sheet glass to the slabs
8.	Trepan holes in slabs to make up blanks $\phi 16_{-0,5}$ mm
9.	Break off blanks
10.	Clean the blanks
11.	Stick the blanks into a stack with the length L= 50 mm, (Mpieces)
12.	Reduce the stack to diameter $\phi = 14\, B_{12}$ mm
13.	Dismantle the stack
14.	Clean the blanks
15.	Bevel the technological chamfers
16.	Clean the blanks

TESTING

1.	Thickness	$t = 2,0_{-0,2}$	mm.
2.	Diameter	$\phi = 14\, B_{12}$	mm.
3.	Wedge Shape	$\theta = 15'$	
4.	Chamfer size	$0,2^{+0,2} \times 45°$	

EQUIPMENT

1. Grinding machine
2. Drilling machine
3. Rounding machine
4. Pedal grinding machine

TOOLS FOR MACHINING

1. Plane blocking tool mm
2. Diamond drills
3. Diamond wheel type ...
4. Cup-type chamfering tool

ATTENDING MATERIALS

1. El.corundum abrasives of grind size
2. Blocking wax
3. Slabs of sheet glass
4. Glass-cooling fluid
5. Sponge

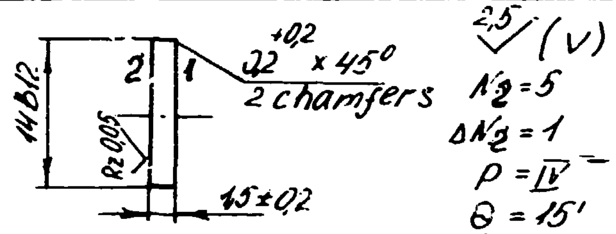
JIGS AND TOOLS

1. Plane holder Ø=
2. Electric hotplate

MEASURING EQUIPMENT

1. Sliding callipers
2. Micrometer

TECHNOLOGICAL PROCESS CART N9



N	CONTENTS OF OPERATION
1.	Make a block (M pieces)
2.	Grind surface 1, following the sequence of steps, to the thickness t1= 1,8-0,1 mm
3.	Dismantle the block
4.	Clean the blanks
5.	Block the blanks for machining surface 2
6.	Grind surface 2, following the sequence of steps, to the thickness t2= 1,5±0,2 mm
7.	Polish surface2
8.	Lacquer clean and dry surfaces of well-set details
9.	Dismantle the block
10.	Clean the blanks
11.	Bevel the technological chamfers
12.	Clean the blanks

TESTING

1. Thickness 1,5±0,2 mm
2. Wedge shape Θ=15'
3. Surface form precision N=5; ΔN=1
4. Polished surface cleanness P=IV
5. Chamfer size

	EQUIPMENT
1.	Grinding and polishing machine
2.	Pedal grinding and polishing machine

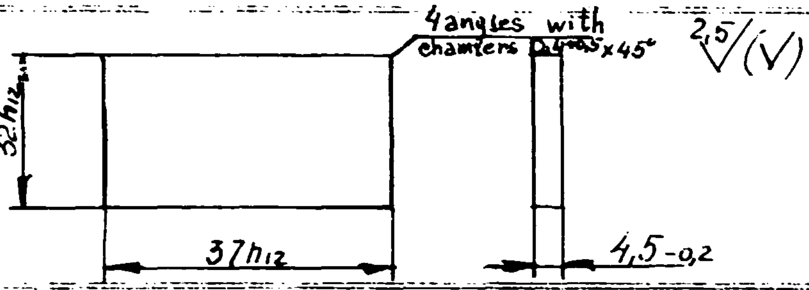
	TOOLS FOR MACHINING
1.	Plane grinding tool ϕ= 90 mm
2.	Plane polishing tool ϕ=90 mm
3.	Cur-type chamfering tool

	ATTENDANT MATERIALS
1.	El. corundum abrasives of grind size
2.	Polishing power
3.	Blocking wax
4.	Protecting lacquer
5.	Polishing pitch
6.	Benzene, acetone, spirit

	JIGS AND TOOLS
1.	Plane holder ϕ = 80 mm
2.	Electric hotplate

	MEASURING INSTRUMENT
1.	Micrometer
2.	Proof plate R= ∞

TECHNOLOGICAL PROCOCESS CART N 10



N	CONTENTS OF OPERATIONS
1	Stick the blanks to a plane slab with their clean surfaces
2.	Reduce to thickness $t = 4{,}7_{-0{,}1}$ mm
3.	Restick the blanks by a block to machine the second surface
4.	Reduce to thickness $t = 4{,}5_{-0{,}2}$ mm
5.	Dismantle the block
6.	Clean the blanks
7.	Stick the blanks into a stack
8.	Saw the stack into ... pieces of the size 33 x 38 mm
9.	Grind the surface of sawind holding sides sizes $32h_{12} \times 37h_{12}$ mm
10.	Bevel the chamfers $0.4^{+0{,}5} \times 45$ at the angles.
11.	Dismantle the stack
12.	Clean the blanks

TESTING

1. Thickness $4{,}5_{-0{,}2}$ mm
2. Sizes of the sides $32h_{12} \times 37h_{12}$ mm
3. Wedge-shape 0,05 mm.

EQUIPMENT

1. Grinding and polishing machine
2. Pedal grinding machine
3. Sawing machine

TOOLS FOR MACHINING

1. Plane grinder
2. Dimond sawing wheel

ATTENDING MATERIALS

1. El.corundum grinding abrasives of grind size
2. Blocking wax
3. Glass-cooling fluid
4. Cleaning liquid

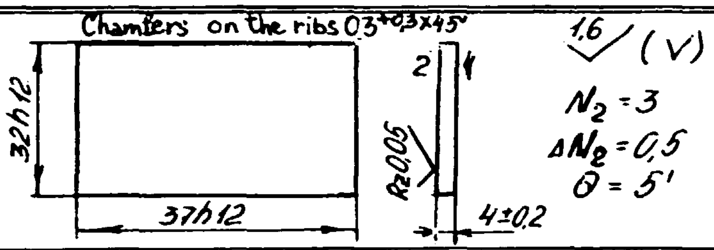
ADJUSTMENT

1. Plane holder

MEASURING EQUIPMENT

1. Sliding callipers

TECHNOLOGICAL PROCESS CART № 11



N	CONTENTS OF OPERATION
1.	Make a block (M pieces)
2.	Grind surface 1, following the sequence of steps, to the thickness $t = 4,3_{-0,1}$ mm
3.	Dismantle the block
4.	Clean the blanks
5.	Block the blanks for machining surface 2
6.	Grind surface 2, following the sequence of steps, to the thickness $t = 4,0^{+0,2}$ mm
7.	Polish surface2
8.	Lacquer clean and dry surfaces of well-set details
9.	Dismantle the block
10.	Clean the blanks
11.	Bevel the technological chamfers
12.	Clean the blanks

TESTING

1. Thickness $4,0 \pm 0,2$ mm
2. Wedge shape $\theta = 5'$
3. Surface form precision N=5; ΔN=1
4. Polished surface cleanness P=IV
5. Chamfer size $0,3^{+0,3} \times 45^{\circ}$

	EQUIPMENT
1.	Grinding and polishing machine
2.	Pedal grinding and polishing machine

	TOOLS FOR MACHINING
1.	Plane grinding tool ∅= mm
2.	Plane polishing tool ∅= mm

	ATTENDANT MATERIALS
1.	El. corundum abrasives of grind size
2.	Polishing powder
3.	blocking wax
4.	Protecting lacquer
5.	Polishing pitch
6.	Benzene, acetone, spirit

	JIGS AND TOOLS
1.	Plane holder ∅= mm
2.	Electric hotplate

	MEASURING INSTRUMENT
1.	Micrometer
2.	Proof plate R=∞

TECHNOLOGICAL PROCESS CART

N 12

EQVIPMENT

1. Vacuum machine
2. Spectrophotometer
3. Machine forclean ning details
4. Ultrasonic bath

N	CONTENTS OF OPERATION
1.	Preliminary pump out vacuum camera to P - (10^{-5} - 10^{-6}) mm Hg
2.	Clean the details with spirit (spirit rectified) using cotton-wool tampon or degreased lawn napkin.
3.	Fill camera with air
4.	Fill evaprators with film-forming matters
5.	Put the details into a holder
6.	Pump out vacuum camera to p=(10^{-5}-10^{-6})mm Hg
7.	Fill the camera with working gas (air, N_2 , Ar) to p-10^{-2} mm Hg
8.	Clean the details in subnormal discharge (schedule is chosen according to instructions on vacuum machine exploitation)
9.	Heat the details to t = $(250\text{-}300)^{\circ}$ C
10.	Deliver the layers of Al_2O_3,HfO_2,MgF_2, controling by photometer on λ =550 mm; sedimentation velocity (5 - 10) Å/S
11.	Cool the details in vacuum p<10^{-6} to t = (40 - 50)$^{\circ}$C
12.	Fill camera with air
13.	Take the details out of the holder

ATTENDANT MATERIALS

1. Film-forming matters
2. Spirit C_2H_5OH rectified
3. Spirit-ether mixture
4. Cotton wool
5. Lawn napkins
6. Squirrel brush

JIGS AND TOOLS

1. Holders for fastening details on the receiving surface
2. Plane-parallel plates 40mm, wedge angle<0.5' (for control in transmitted light)
3. Wedge-shaped plates 40mm, wedge angle>5° (for control in reflected light)

TESTING

1. Place of spectral curve of reflectance(tested on special device in the interval of λ = (400 - 740) Mμ)

N O T E S :

1. Before making nonreflecting films on the details , test evapration of λ/4 of the layers of Al_2O_3, HfO_2, MgF_2 must be carried on using plane detail is of 40mm. These details must be placed at different distances from the axis of revolution of the detail holders R1=60 , 100 , 140 , 200 mm not less than 3 details in a row. After evaporation, spectral transmission (reflection) curve measurements are carried out for. details placed at different distances from the axis of revolution. Deviation value of the place of λextrem must be not more , than (5 - 10)% . The value of refractive index must be found using Textrem (or Rextrem).
2. After 10 15 cycles of evaporation vacuum camera must be cleaned or screening foil used to protect the equipment must be changed.
3. Concrete types of equipment and schedules of work are chosen by the experts.
4. Details less than 4mm size are cleaned by rinsing out in spirit and distilled water.

MACKING OF PRISM БУ-60

N	CONTENTS OF OPERATIONS
1.	Starting workpieces of the size 87 X 54 X 25 mm (3 pieces) grind from two sides to thickness 21h14. Difference of thickness at the edges not more than 0,01 mm. Surface roughness $\overset{2.5}{\nabla}$ Equipment: Tools: plane grinder $\varnothing$ = (110-125) mm. Abrasives: el. corundum of grind sizes from 100 to 25 µm.
2.	Stick 3 slabs into a stack with their plane sizes. Sticking substance: shellac.
3.	Grind the block to gabarit sizes 85 X 52. Deviation linear measures 0,1 mm. Angles between the surfaces $90^\circ \pm 1'$. Equipment: Tools: plane grinder $\varnothing$ = (110-125) mm. Abrasives: el. corundum of grind sizes from 100 to 10 µm (included). Measuring equipment: sliding callipers, angle-measuring gauge.
4.	Clean the block of slabs with running water.
5.	Cut the block of slabs into 4 stacks of the sizes 41,5 X 25 X 63 mm. Equipment: Tools: Glass-cooling fluid: glycerine 20%, water 80%.
6.	Make a block of 2 stacks to machine the surface of cutting of the size 63 X 41,5. Adjustment for blocking: plane holder $\varnothing$ = (90-95) mm. Sticking substance: paraffin for sticking. Equipment: termostate (electr. heated hotplate).
7.	Grind the block surface of the total square (63 X 41,5) X 2 to thickness 23,5 $\pm$ 0,1 mm. Difference of thickness at the edges of the block not more than 0,01 mm. Equipment: Tools: plane grinder $\varnothing$ = (80-85) mm. Grinding abrasives: el. corundum of grind size from 40 to 10 µm (included). Measuring equipment: micrometer (0-25 mm)
8.	Clean the block of slabs with running water.
9.	Polish the block. Surface form precision and cleanness over the diameter 40 mm = N=1,0; ΔN=0,5; P=III. Equipment: Tools: plane grinder $\varnothing$ = 80-85 mm. Polishing powder: microgrif CeO Measuring equipment: proof plate R= ∞, diameter 45 mm.

1	2
10.	Clean the block. Cover clean dry surfaces with protective varnish
11.	Restick the block by repulling. Adjustment for blocking: plane holder $\emptyset$ = (90-95) mm. Substance for blocking: blocking pitch. Equipment: termostate (electr. hotplate).
12.	Grind the second side of the block of the total square (63 X 41,5) X 2 to the thickness 23 ± 0,01 mm. Difference of thickness at the edges of the block not more than 0,01 mm. Equipment: Tools: plane grinder $\emptyset$ = (80-85) mm. Grinding abrasives: el. corundum of grind size from 40 to 10 μm (included). Measuring equipment: micrometer (0-25 mm)
13.	Clean the block with running water.
14.	Polish the block. Surface form precision over the diameter 40 mm - N=1,0; Δ N=0,5. Equipment: Tools: plane grinder $\emptyset$ = (80-85) mm. Polishing powder: microgrit CeO Measuring equipment: proof-plate R= ∞ , diameter 45 mm.
15.	Clean the block. Cover clean and dry surfaces with protective varnish
16.	Dismantle the block. Clean the blanks. Equipment: termostate (el.hotplate) Cleanning liquid: mixture of acetone-benzene (aceton-spirit).
17.	Repeat the operations 6...16 to machine the urface of sawing of the rest two stacks.
18.	Make a block of 4 stacks to grind the surface of cutting of the sizes 63 X 23 mm. Adjustment for blocking: plane holder $\emptyset$ = (100-105) mm. Sticking substance: sticking paraffin. Equipment: termostate (el.hotplate).
19.	Grind the block surface of the total square (63 X 23) X 4 to the thickness 40 ± 0,1 mm. Difference of thickness at the edges of the block not more than 0,01 mm. Equipment: Tools: plane grinder $\emptyset$ = 80-85 mm. Grinding abrasives: el. corundum of grind size from 40 to 10 μm (included). Measuring equipment: micrometer (25-50 mm)
20.	Clean the block with running water.

1	2
21.	Polish the block.Surface form precision and cleanness over the diameter 40 mm - N=1,0;ΔN=0,5; P=III. Equipment: Tools: plane polisher $\emptyset$ = (80-85) mm. Polishing powder: polirit Measuring equipment: proof-plate R= ∞ , diameter 45 mm.
22.	Clean the block. Cover clean and dry surfaces with protective varnish
23.	Restick the block by repulling. Adjustment for blocking: plane holder $\emptyset$ = (100-105) mm. Substance for blocking: blocking pitch. Equipment: termostate (el.hotplate).
24.	Grind the second block surface of the total square (63 X 23) X 4 to the thickness 40 ± 0,1 mm. Difference of thickness at the edges of the block not more than 0,01 mm. Equipment: Tools: plane polisher $\emptyset$ = (80-85) mm. Grinding abrasives: el. corundum of grind size from 40 to 10 μm (included). Measuring equipment: micrometer (25-50 mm)
25.	Clean the block with running water.
26.	Polish the block. Surface form precision and cleanness N=1,0; ΔN=0,5; P=III. Cover clean and dry surfaces with protective varnish Equipment: Tools: plane polisher $\emptyset$ = (80-85) mm. Polishing powder: microgrit CeO Measuring equipment: proof-plate R= ∞ , diameter 45 mm.
27.	Dismantle the block, clean the stacks.
28.	Make two chamfers not more than 2 mm wide at the diagonal of each stack (4 pieces) at the opposit sides. Equipment: Tools: plane grinder. Abrasive: el.corundum of the grind size 20 μm.
29.	Place one stack into the jig 10100 , fasten it and saw in the diagonal direction. Machine by two settings. Equipment: sawing machine Tools: diamond cutting wheel Adjustment: special adjustment -jig 10100 Cooling fluid: glycerine 20% , water 80%
30.	Repeat operation N29 with the rest of the stacks (3 pieces)

1	2
31.	Block 4 halfs of the stacks up to the adjustment. Adjustment: special adjustment -jig 10200 Blocking substance: blocking paraffin. Equipment: termostate (el. hotplate)
32.	Grind the gypotenuse sides of the blanks in the block. Difference of thickness at the edges of the block not more than 0.01 mm Make the side of the small cathetus of the prism 21h14. Eqipment: Tools: plane grinder ϕ=(120-130) mm Abrasive: el. corundum of the grind size from 40to 10 µm (included) Measuring eqipment: sliding callipers
33.	Polish the gypotenuse side of the blanks in the block. Surface form precision and cleanness over the diameter 40 mm-N=1.0 ΔN=0.5; P=III. Polishing powder: microgrit CeO Tools: plane polisher (on pitch) ϕ=(120-130) mm Cover clean and dry surfaces with protective varnish
34.	Dismantle the block to single blanks of prisms and clean them Equipment: termostate (el. hotplate) Cleaning liquid: spirit
35.	Repeat operation N31...34 with the rest 4 halfs of the stacks
36.	Chamfer sharp ribs of all the prisms to the size 0.2 mm Equipment: Tools: plane grinder ϕ=(70-100) mm Abrasive: el. corundum of the grind size 10 µm
37.	Place 8 prisms into the jig 10300 (4 prisms into each slot) to chamfer the ribs making the angle 30° Adjustment: special adjustment-jig 10300. Blocking substance: blocking paraffin. Equipment: termostate(el. hotplate)
38.	Chamfer the ribs making the angle 30° Chamfer size and chamfer place must correspond to the drawing Equipment: Tools: plane grinder ϕ=(120-150) mm Abrasive: el. corundum of the grind size 28... 10 µm
39.	Dismantle the block and clean the prisms Equipment: termostate Cleaning liquid: mixture of acetone-benzene(acetone-spirit)
40.	Make a block of the same prisms to chamfer the ribs making the angle 30° from the second side Adjustment: special adjustment - jig 10300 Blocking substance: blocking paraffin. Equipment: termostate(el. hotplate)

1	2
41.	Repeat the operations 38, 39
42.	Repeat the operations 38, 39, 40 with the rest 16 prisms
43.	Block 6 prisms into the jig 10300 (6 prisms into each slot) to chamfer the ribs making the angle 60° Adjustment: special adjustment - jig 10300 Blocking substance: blocking paraffin. Equipment: termostate(el. hotplate)
44.	Chamfer the ribs making the angle 60° Chamfer size and chamfer place must correspond to the drawing Equipment: Tools: plane grinder ϕ=(120-150) mm Abrasive: el. corundum of the grind size 28... 10 μm
45.	Dismantle the block and clean the prisms Equipment: termostate(el. hotplate) Cleaning liquid: mixture of acetone-benzene(acetone-spirit)
46.	Make a block of the same prisms to chamfer the ribs making the angle 60° from the second side Adjustment: special adjustment -jig 10300 Blocking substance: blocking paraffin. Equipment: termostate(el. hotplate)
47.	Repeat the operations 44 and 45
48.	Repeat the operations 43, 44, 45 with the rest of the prisms
49.	Take off the film of protective varnish from the surface of the prisms Cleaning liquid: acetone, spirit

Pos.	Designation	Name	Quant.
		Documentation	
	10.100 ASS	Assembly drawing	
		Details	
1	10.101	Base	1
2	10.102	Set Square	1
3	10.103	Set Square	1
4	10.104	Set Square	1
5	10.105	Serew	1
6	10.106	Gasket	1
		Prop details	
7		Serew M4×10	5

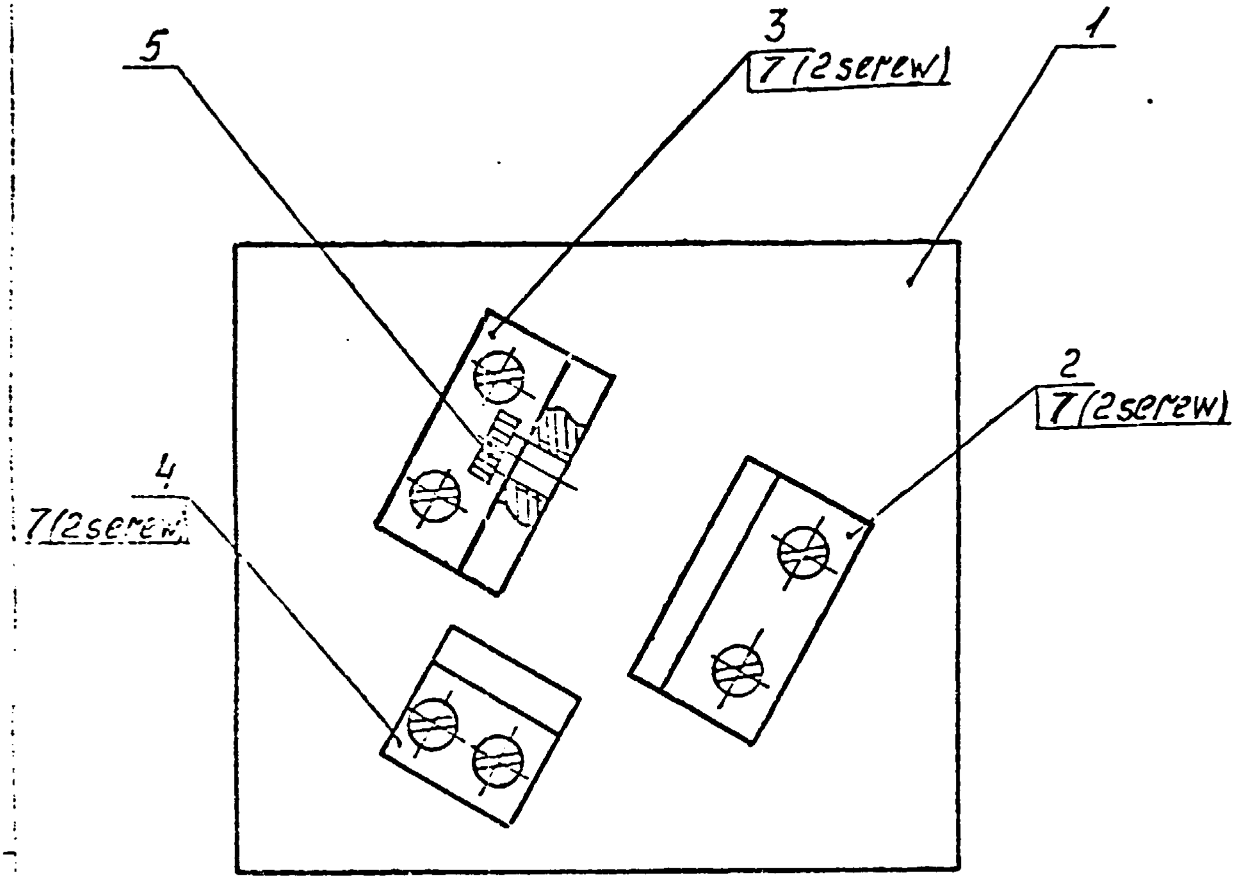
10.100. Assembly drawing

Know-how package

Optical tool for microscope BIOMEM-S.L.

Project DP/SYR/85/011
Contract N 83/44

LITMO



Gasket (pos. 6) is placed bettwen the set square and the detail.

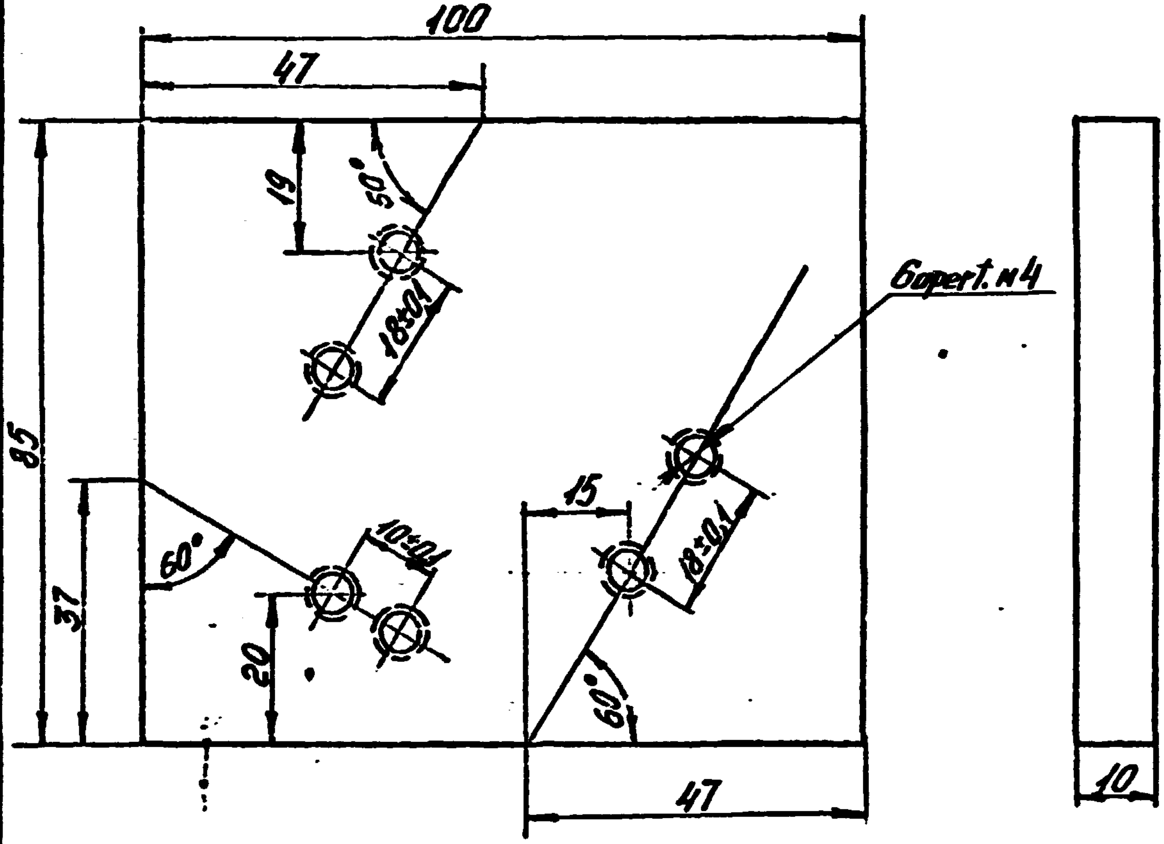
10.100 ASS Assembly drawing

Know - now package

Optical tool for microscope BIOMEM-S.L

Project D.?/SYR/86/011
Contract N 89/44

LITMO



1. $H14;\ h14;\ \pm\frac{IT14}{2}$.

2. Take off the sharp edges.

Material: Aluminium Alloy F31
Quant: 1

10.101 Base

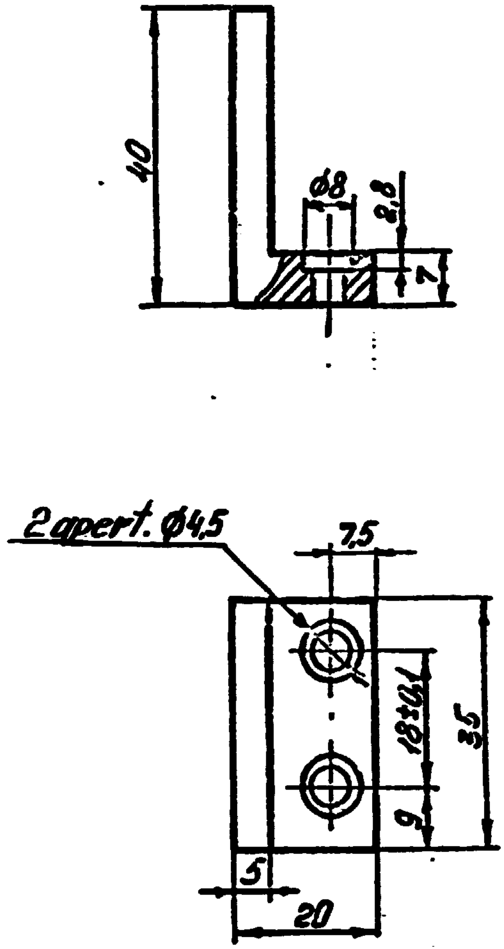
Know-how package

Optical tool for microscope BIOMEM-S,L

Scale 1:1

Project DP/SYR/86/011
Contract N89/44

LITMO



1. $H14;\ h14;\ \pm\frac{IT14}{2}$

2. Take off the sharp edges.

Material: Aluminium Alloy F31
Quant: 1

Set Square
10.102

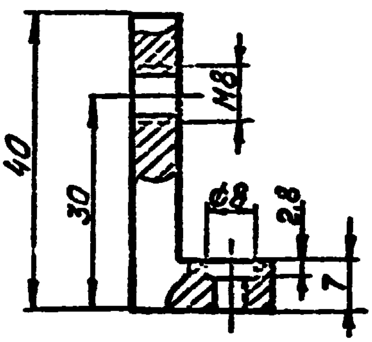
Know-how package

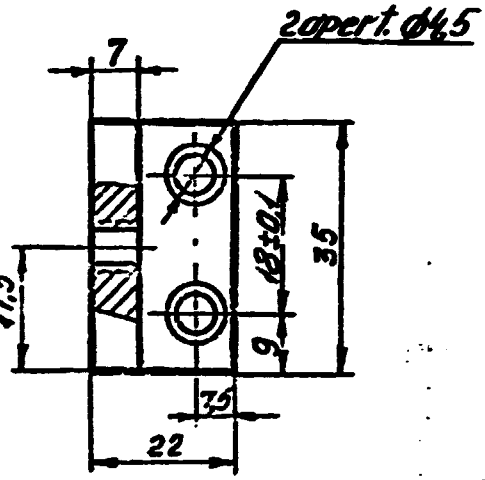
Optical tool
for microscope
BIOMEM-S,L

Scale
1:1

Project DP/SYR/86/011
Contract N 89/44

LITMO





1. H14; h14; $\pm\frac{IT14}{2}$

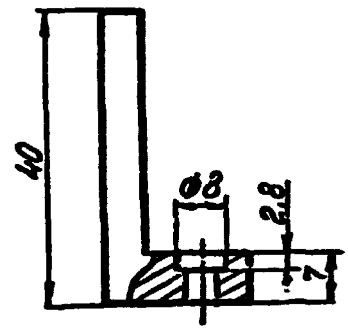
2. Take off the sharp edges.

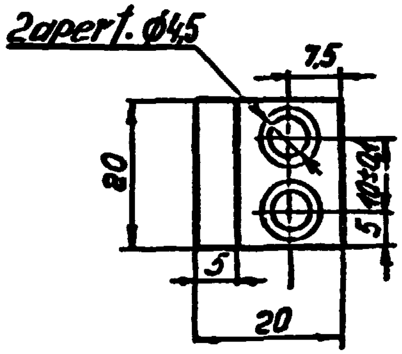
Material: Aluminium Allou F31
Quant: 1

Set Square
10.103

Know-how package	
Optical tool for microscope BIOMEM-S,L	Scale 1:1
Project DP/SYR/86/011 Contract N 89/44	LITMO

$\sqrt[3.2]{}$





1. H14; h14; $\pm\frac{IT14}{2}$

2. Take off the sharp edges.

Material: Aluminium Alloy F31
Quant: 1

Set Square
10.104

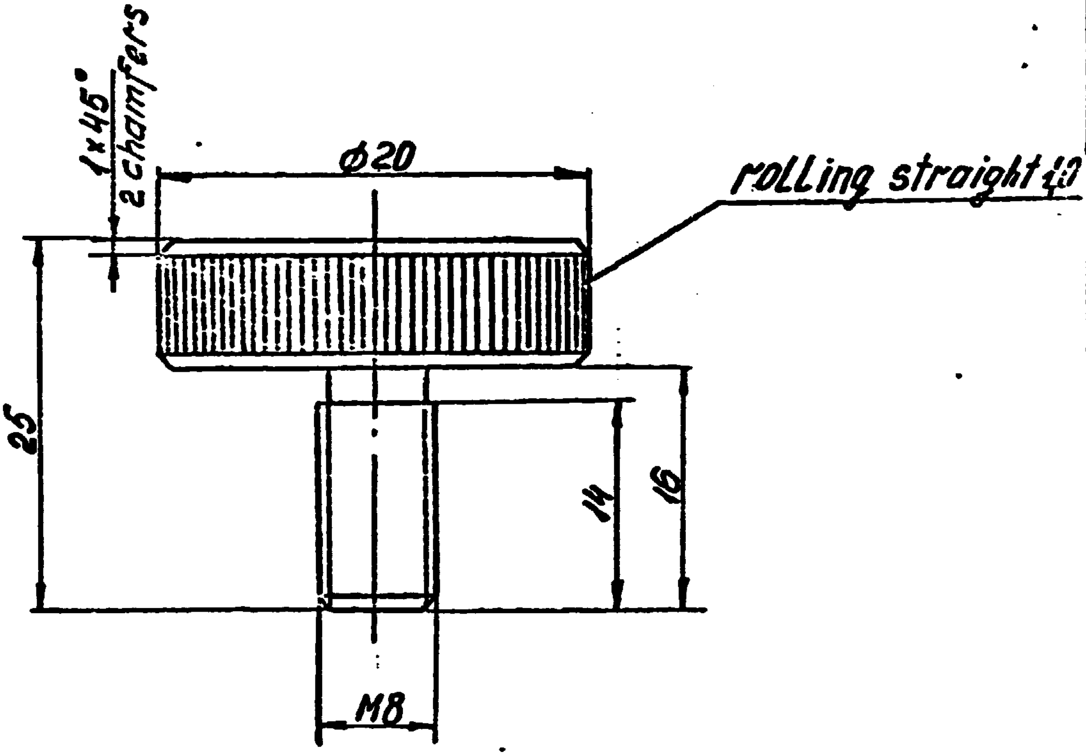
Know-how package

Optical tool for microscope BIOMEM-S,L

Scale 1:1

Project DP/SYR/86/011
Contract N89/44

LITMO



1. H14; h14; $\pm\frac{IT14}{2}$

Material: Brass
Quant: 1

Serew
10.105

Know-how package

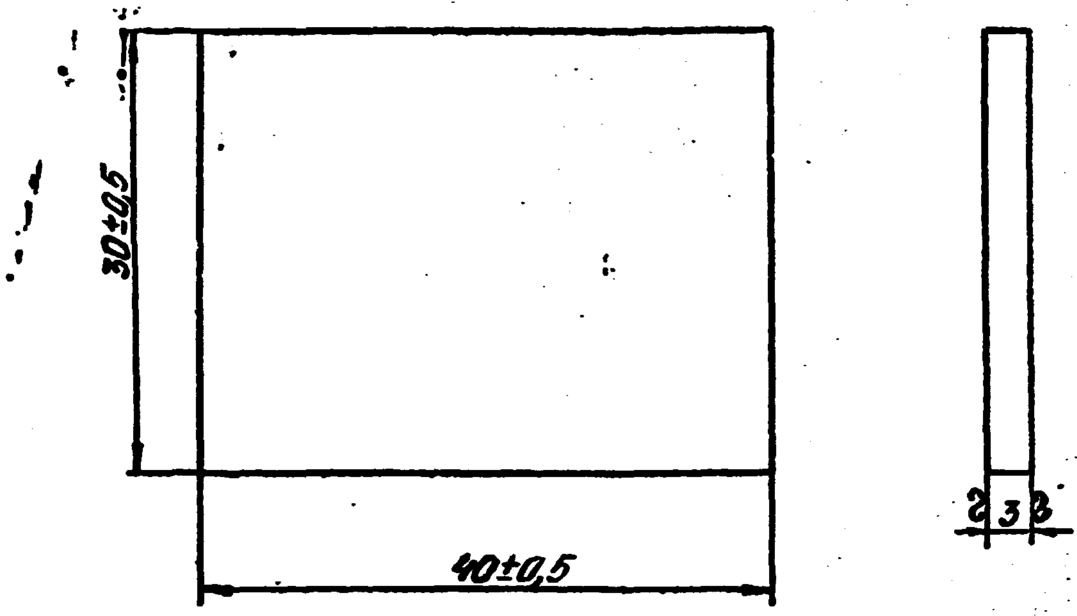
Optical tool for microscope BIOMEM-S,L

Scale 2:1

Project DP/SYR/86/011
Contract N89/44

LITMO

3,2



Material : Tekstolit

Quant : 1

10.106 Gasket

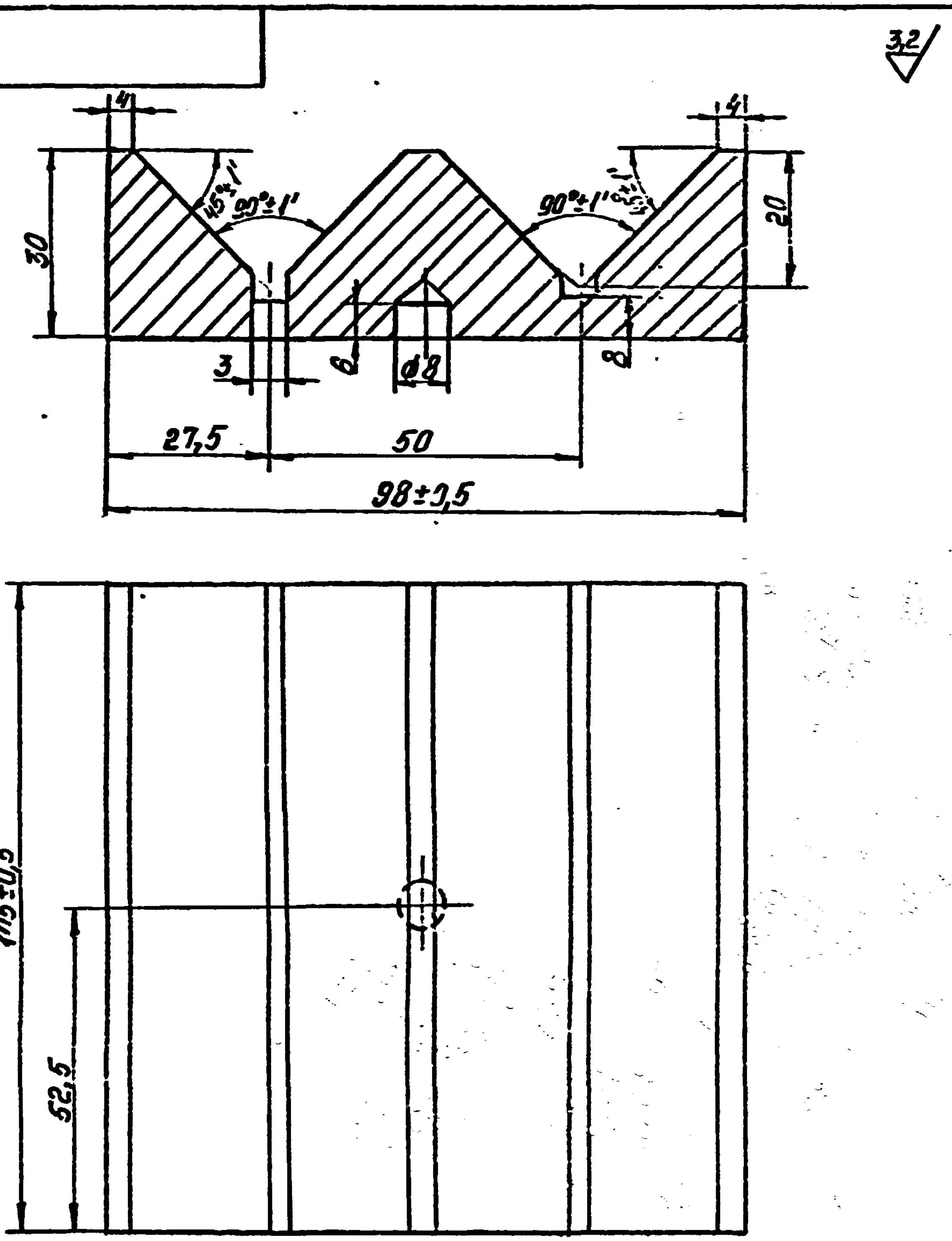
Know - how package

Optical tool for microscope BIOMEM-S,L

Scale 2:1

Project DP/SYR/86/011
Contract N89/44

LITMO



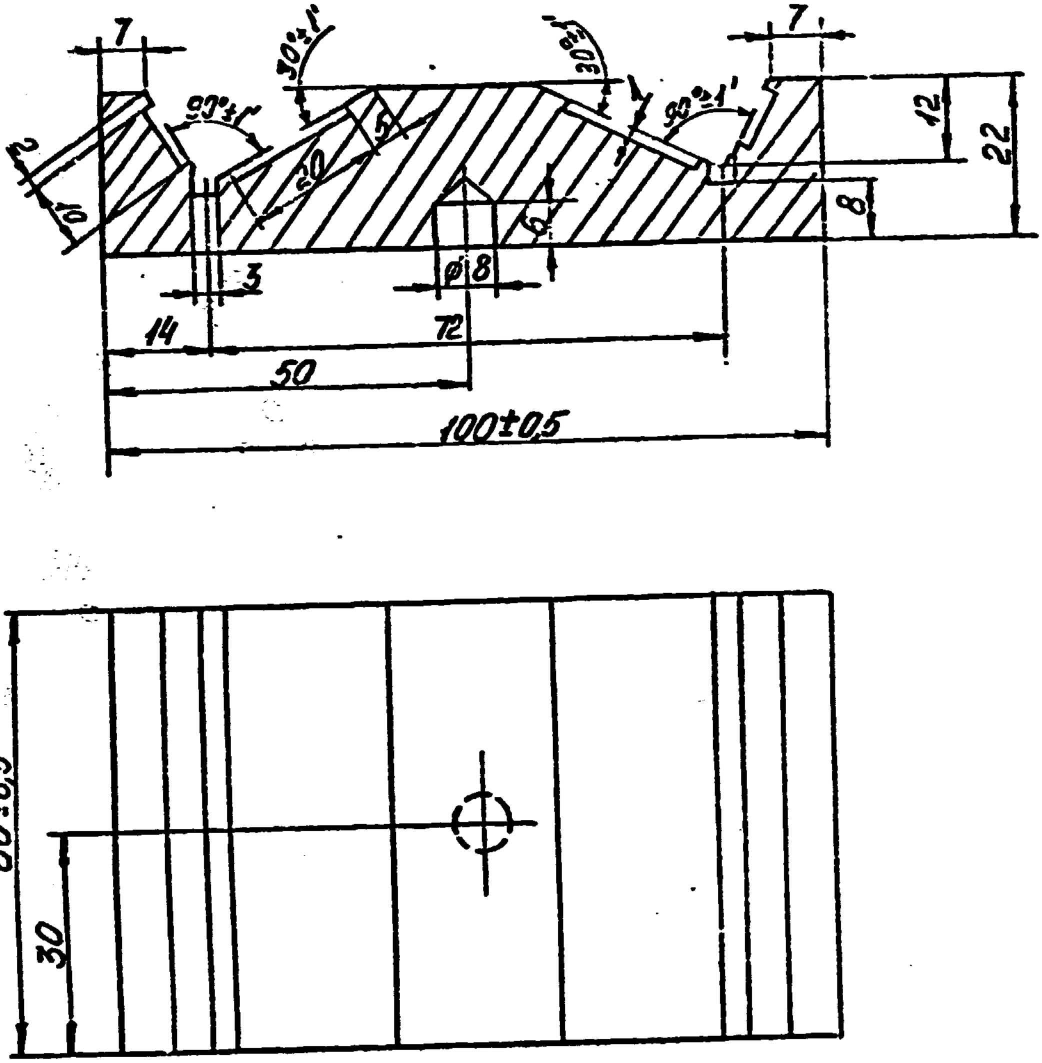
1. H14; h14; $\frac{IT14}{2}$.
2. Take of the sharp edges.

Material: Aluminium Alloy F31

Quant: 1

10.300

Know-how package		
Optical tool for microscope BIOMEM-S,L	Scale 1:1	1
Project DP/SYR/86/011 Contract N89/44	LITMO	



1. H14; h14; $\frac{IT14}{2}$.

2. Take of the sharp edges.

Material: Aluminium Alloy F31

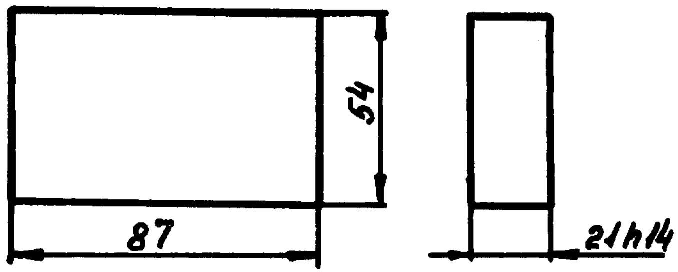
Quant: 1

10.200

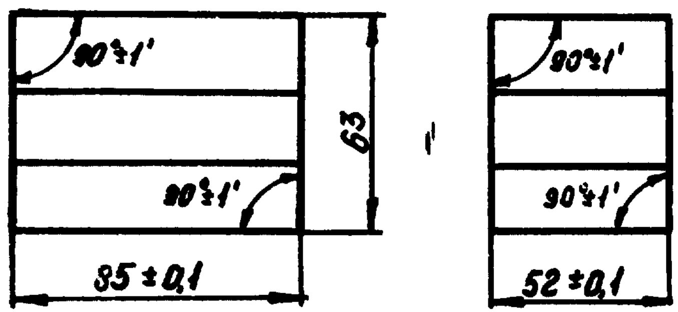
Know - how package		
Optical tool for microscope BIOMEM-S,L		Scale 1:1
Project III/SYR/S3/011 Contract N83/44	LITMO	1

Operational drafts

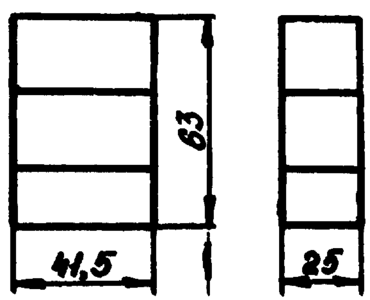
Operation N1



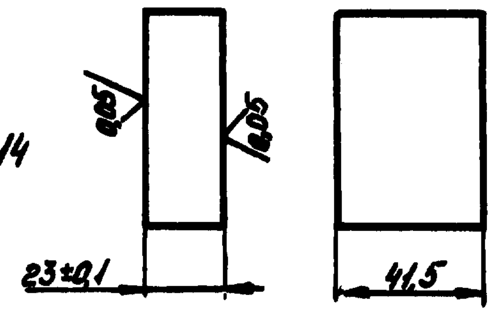
Operation N3



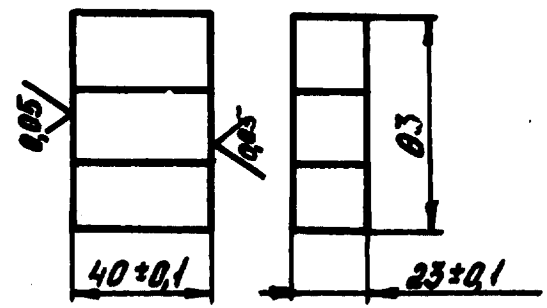
Operation N5



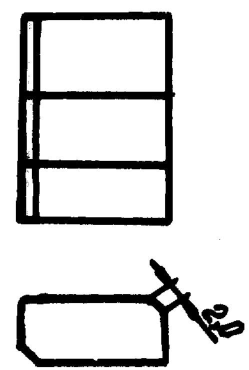
Operation N7-N14



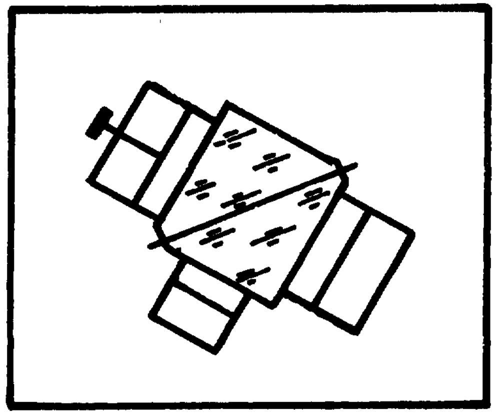
Operation N19-N26



Operation N28



Operation N29

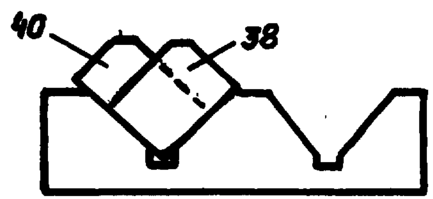


Jig 10.100

Operation N32

Jig 10.200

Operation N38,40



Jig 10.300

19353
(3 of 7)

FINAL REPORT

Project DP/SYR/86/011 Contract No 89/44

Annex 2.1

Leningrad Institute of Precision Mechanics and Optics

F I N A L   R E P O R T

(project DP/SYR/86/011)
contract No 89/44

Annex 2.1

Route charts Technological Process of Manufacture of the Microscope Mechanical Parts

Leningrad
1991

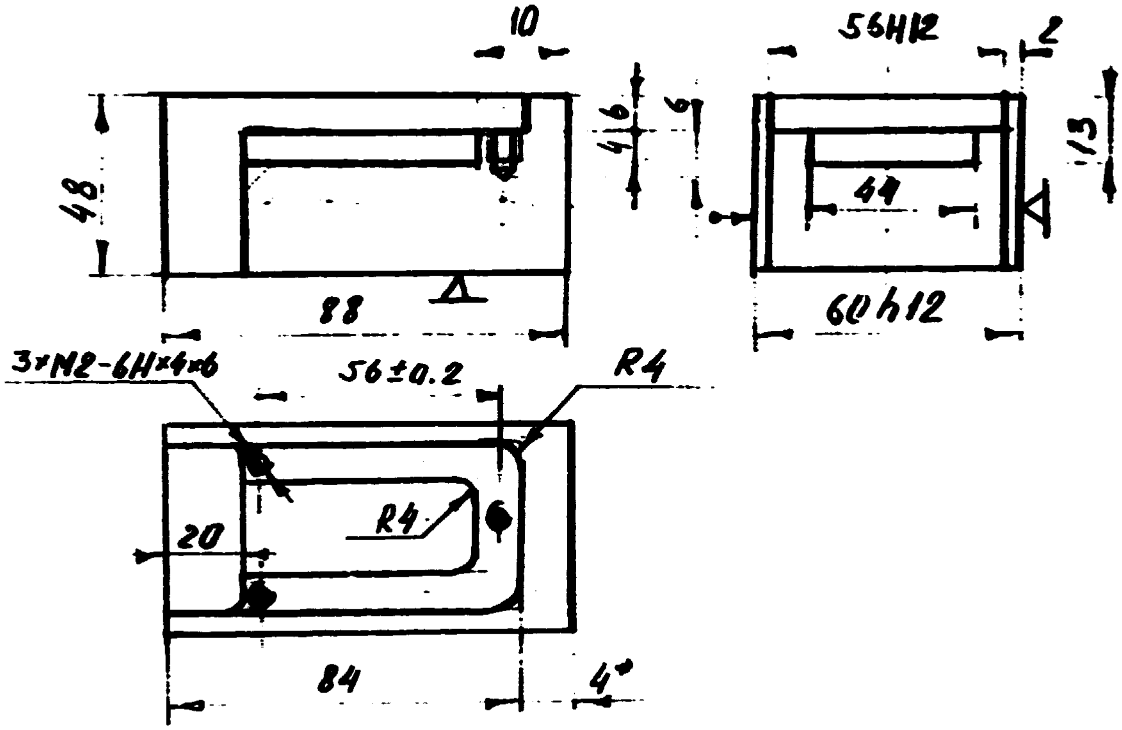
OPERATION DRAFT	NUMBER OF PIECES	OPERATION	
		BLANK	
SEE SHEET 2	10.001	PROFILE	DIMENSIONS
		ROUND ALUMINIUM ALLOY	88*60*12*43

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	MILLING MACHINE VICE		
002	CENTRE THREE HOLES BY MARKING OUT		CENTRE DRILL	
003	DRILL 3 HOLES ø 1.5 TO THE 12 mm DEPTH		DRILL ø 12H11	
004	MILL GROOVE 56H12 * 84 TO THE DEPTH 6 mm		MILL ø 8 mm	SLIDING CALLIPERS
005	MILL GROOVE 44H14 * 78 TO THE DEPTH 7 mm		MILL ø 8 mm	SLIDING CALLIPERS
006	MILL GROOVE 56H12 * 20 TO THE BODY SIZE		MILL ø 8 mm	SLIDING CALLIPERS
007	CUT SCREW IN 3 HOLES TO THE 4 mm DEPTH		TAP M 2	
008	DULL SHARP EDGES		FILE	

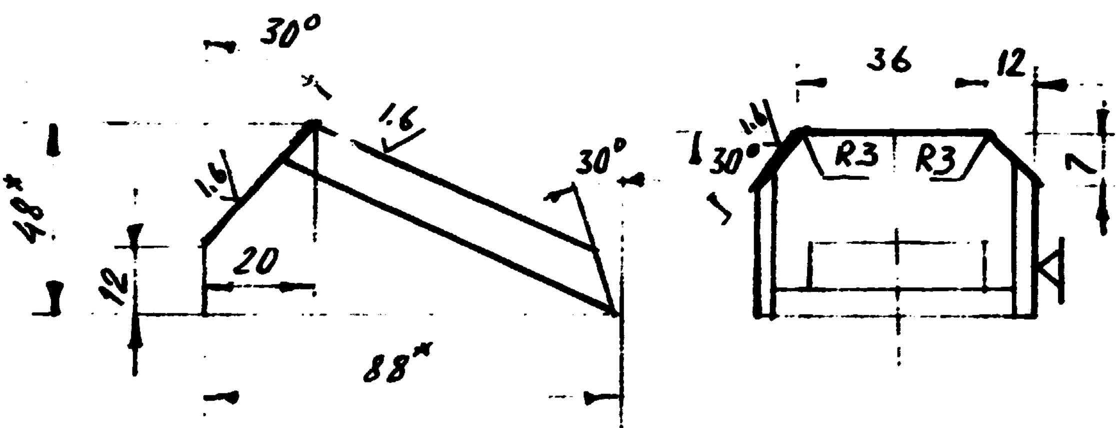
SHEET 1	NAME OF SHEETS

Operation 1

3.2√

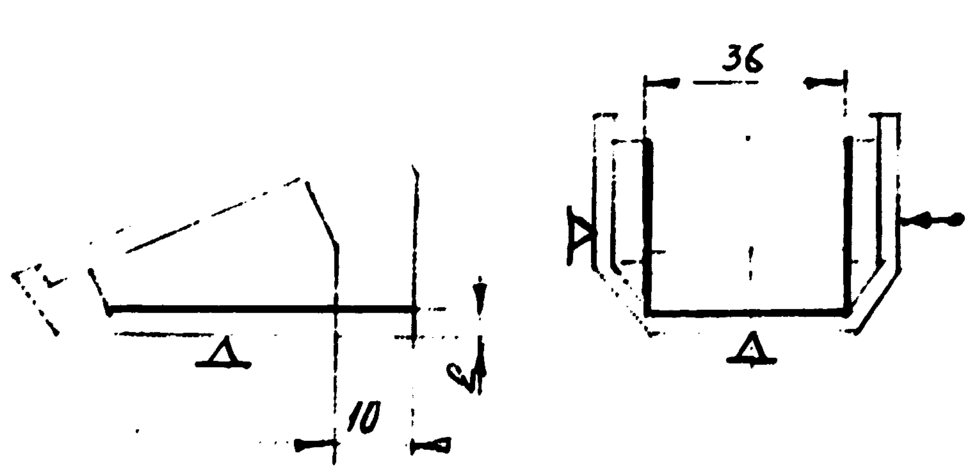


Operation 2



Operation 3

3.2√



[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]			
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]		[illegible]	
	[illegible]			[illegible]
[illegible]	[illegible]		[illegible]	
[illegible]	[illegible]		[illegible]	
	[illegible]			
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]		[illegible]	[illegible]
	[illegible]			
[illegible]	[illegible]		[illegible]	

[illegible]	[illegible]

OPERATION 1	

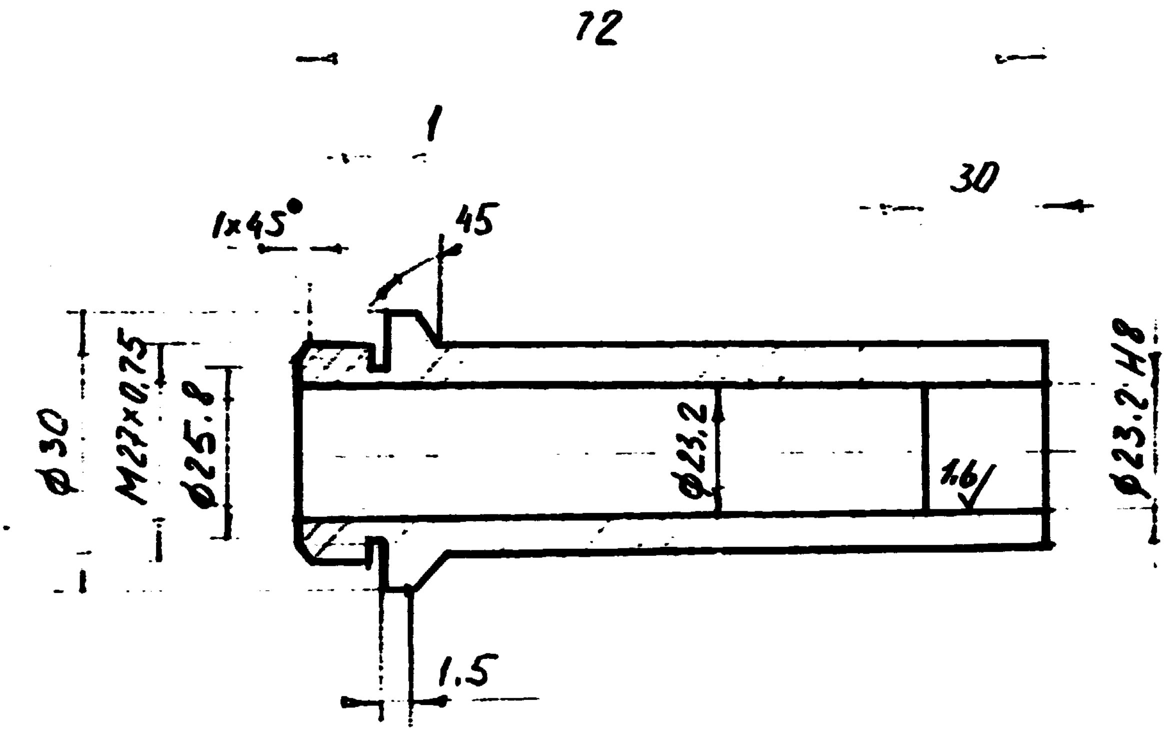
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	10.002		
		PROFILE	DIMENSIONS
		ALUMINIUM ALLOY	ø 30 x 80

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 125 3-JAWS CHUCK		
002	CUT FACE		TOOLHOLDER	
003	CENTRE		CENTRING DRILL ø 2	
004	DRILL HOLE ø 15mm TO THE 80 mm DEPTH		DRILL ø 15H9	SLIDING CALLIPERS
005	DRILL HOLE ø 18 mm TO THE 80 mm DEPTH		DRILL ø 18h9	
006	DRILL HOLE ø 20 mm		DRILL ø 20h9	
007	BORING HOLE ø 23 H14, 1=60		BORING CUTTER	
008	BORING HOLE ø 23.2H8 TO THE DEPTH 30 mm		BORING CUTTER	INDICATOR
009	TURN ø 25h11 TO THE 67mm LENGHT WITH CUT FACE		TOOLHOLDER	SLIDING CALLIPERS

Operation 1

10.002

3.2 (√)



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
010	TURN GROOVE ø 25.8 * 1.6,		GROOV CUTTER	
	MAINTAINING THE SIZE 71 mm WITH CUT FACE			
011	TURN ø 27 6g TO THE 10 mm LENGHT		FORM CUTTER	
012	CUT SCREW M27 * 0.75		SCREW CUTTER	
013	DULL SHARP EDGES		FILE, SCRAPER	
014	CUTT OFF WITH CUT CHAMFER		FORM CUTTER	
	1 * 45°, MAINTAINING THE SIZE 76h12 mm			
	OPERATION 2			
	COATING : ANODIC OXIDATION			
	BLACK. THE SURFACE B - GREY			
	ENAMEL SHAGREEN			

SHEET 3	NAME OF SHEETS 3

		OPERATION I	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	10.003		
		PROFILE	DIMENSIONS
		ROUND ALUMINIUM ALLOY	84h12 x 56h12 x 46h14

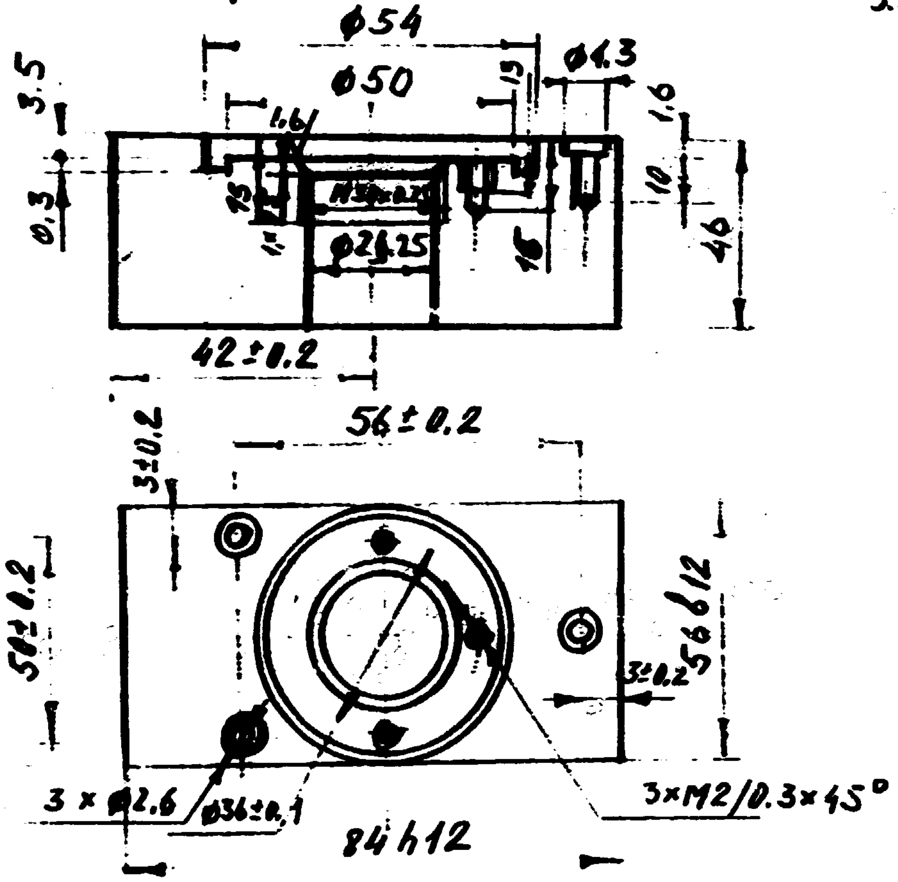
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	MILLING MASHINE VICE, ANGLE TABLE		
002	CENTRE BY MARKING OUT 7 HOLES, MAINTAINING THE SIZES SPECIFIED		CENTRING DRILL o 2 mm	
003	DRILL 3 HOLES o 1.5mm TO THE 13 mm DEPTH		DRILL o 1.5 mm	
004	DRILL 3 HOLES o 2.6 mm TO THE 12mm DEPTH		DRILL o 2.6 mm	
005	COUNTER-BORE 3 HOLES, MAINTAINING THE SIZES o 4.3 mm AND 1.6 mm		COUNTER BORE o 4.3 mm	
006	DRILL o 10 mm TO THE BODY SIZE		DRILL o 10 mm	SLIDING CALLIPERS
007	DRILL o 15 mm TO THE BODY SIZE		DRILL o 15 mm	
008	DRILL o 18 mm TO THE BODY SIZE		DRILL o 18 mm	SLIDING CALLIPERS
009	BORE HOLE o 29.25H6 FOR THE NEXT PASSES		BORING CUTTER	SLIDING CALLIPERS

SHEET 1	NAME OF SHEETS 4

Operation 1

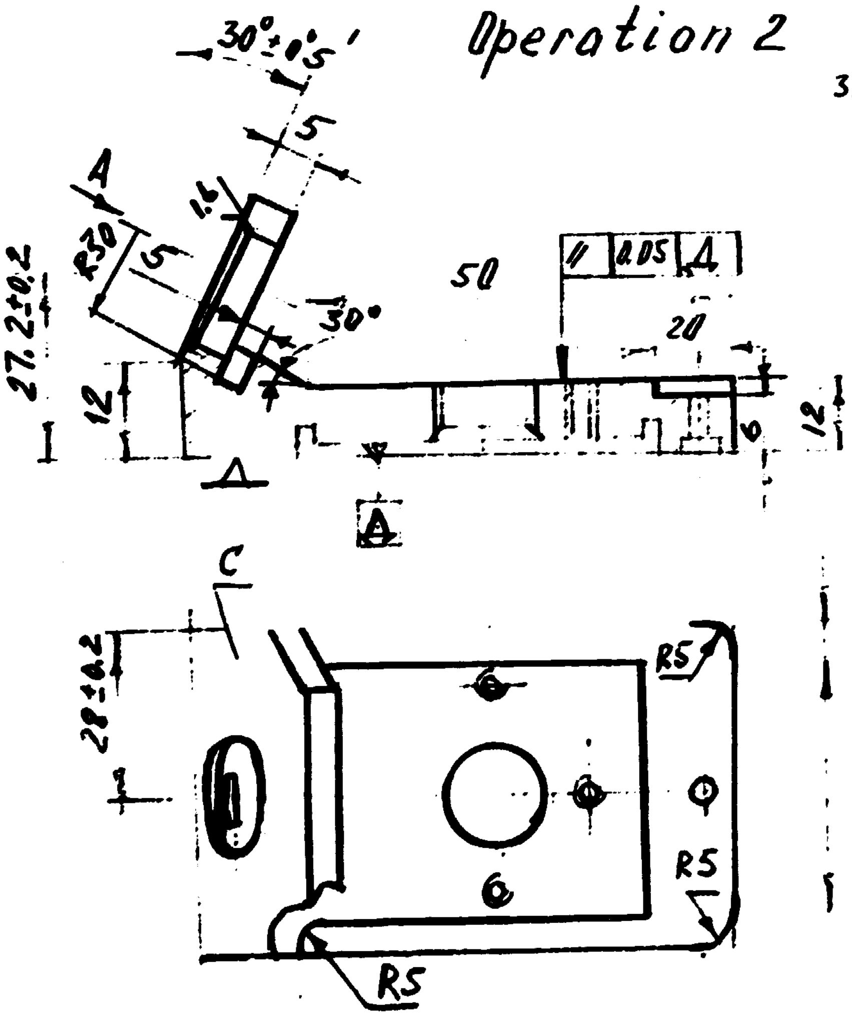
10.003

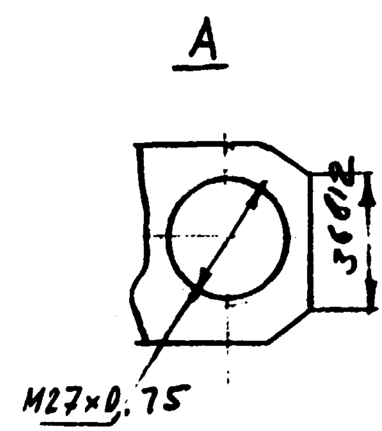
3.2√



Operation 2

3.2√(√)





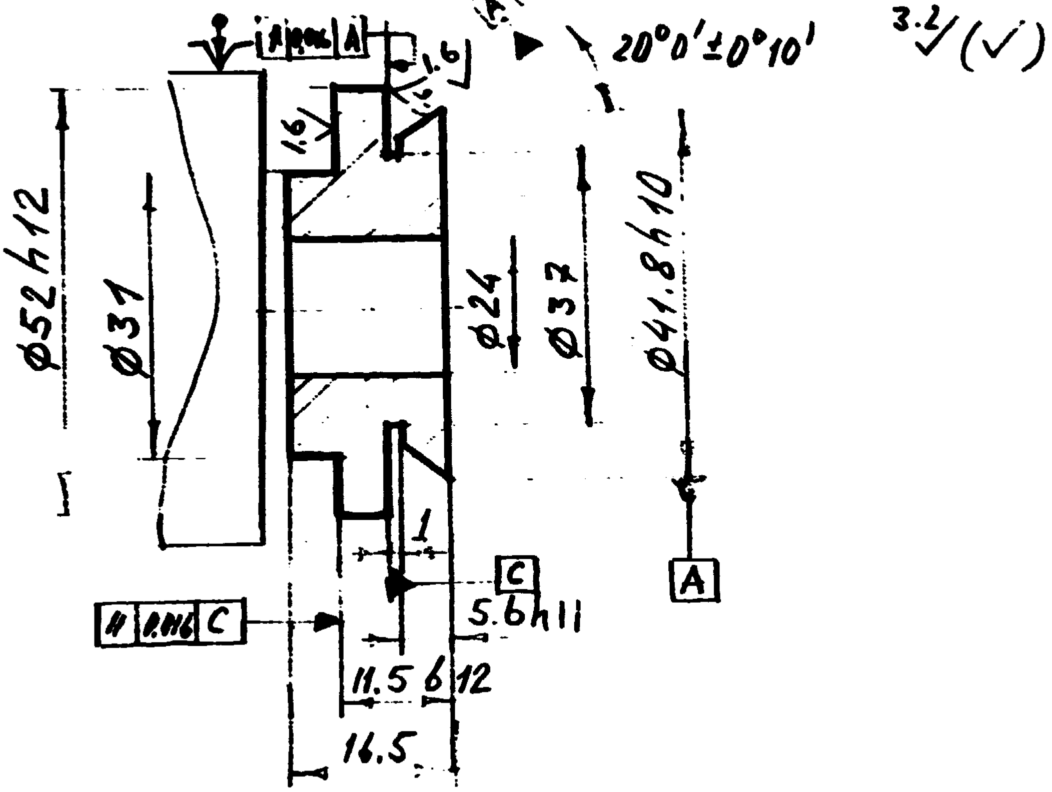
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
010	MILL GROOVE ø 54H14 TO THE 3.5 mm DEPTH		END MILL	SLIDING CALLIPERS
011	TURN GROOVE ø 50 mm TO THE 0.3 mm DEPTH		FLYING CUTTER	DEPTHMETER
012	CUT CHAMFER 1 x 45°		COUNTERSINK < 90°	
013	CUT SCREW M30 x 0.75		TAP M27 x 0.75	
014	DULL SHARP EDGES		FILE, SCRAPER	
	OPERATION 2			
001	MOUNT WORKPIECE WITH RECETTING 76h12 mm	VICE		
002	MILL PLATE, MAINTAINING THE SIZES 50 mm, 12 mm		MILL ø 50 mm	SLIDING CALLIPERS
003	MILL GROOVE, MAINTAINING THE SIZES 6.5mm, 43mm, 67mm AND 6mm			
004	MILL PLATE, MAINTAINING ANGLE		MILL ø 60 mm	SLIDING CALLIPERS
	30°±0°5' AND SIZE 12 mm			
			SHEET 3	NAME OF SHEETS 3

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
008	TURN ø 41.8H10 TO THE SIZE		TOOLHOLDER	SLIDING CALLIPERS
	5.5H11			
009	TURN ø 52h12 TO THE SIZE 14.5 mm		TOOLHOLDER	
007	DRILL HOLE ø 10 mm		DRILL ø 10 mm	SLIDING CALLIPERS
008	DRILL HOLE ø 18H12 mm		DRILL ø 18H9	SLIDING CALLIPERS
009	BORE HOLE 26.25H6 TO THE NEXT PASSES		BORING CUTTER	
010	CUT CHAMFER 1 * 45°		COUNTERSINK ∢ 90°	
011	CUT SCREW M30 * 0.75 - 6H		TAP M30 * 0.75	
012	FILE R5 (BRENCH-WORKING OPERATION)		FILE	
013	DULL SHARP EDGES		FILE, SCRAPER	
	OPERATION 3			
	COATING : ANODIC OXIDATION			
	THE SURFACE C - GREY ENAMEL SHAGREEN			

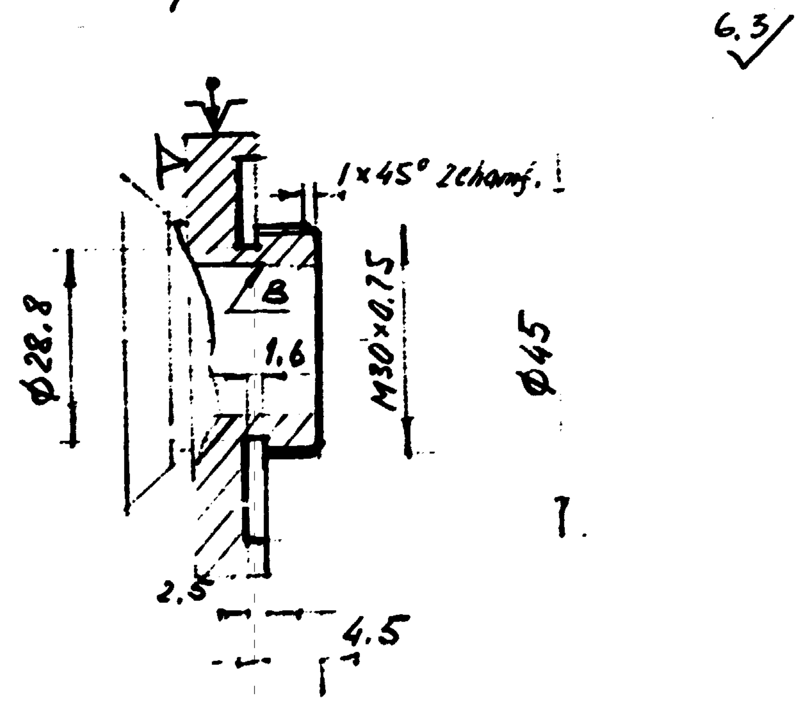
			OPERATION 1	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
SEE SHEET 2		10.004		
			PROFILE	DIMENSIONS
			ROUND BAR BRASS	ø 55 x 20
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 125 3-JAWS CHUCK		
002	FACE		TOOLHOLDER	
003	CENTRE		CENTRING DRILL ø 2 mm	
004	DRILL HOLE ø 10H9 TO THE		DRILL ø 10	SLIDING CALLIPERS
	20 mm DEPTH			DEPTHMETER
005	DRILL HOLE ø 15H9 TO THE		DRILL ø 15	SLIDING CALLIPERS
	20 mm DEPTH			
006	DRILL HOLE ø 20H9 TO THE		DRILL ø 20	SLIDING CALLIPERS
	20 mm DEPTH			
007	BORING HOLE ø 24H14 mm TO THE		BORING CUTTER	SLIDING CALLIPERS
	20 mm DEPTH			
			SHEET 1	NAME OF SHEETS 3

Operation 1

10.004



Operation 2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
008	TURN ø 41.8H10 TO THE SIZE		TOOLHOLDER	SLIDING CALLIPERS
	5.5H11			
009	TURN ø 52h12 TO THE SIZE 14.5 mm		TOOLHOLDER	
010	TURN GROOVE WITH CUT FACE , MAINTAINING THE SIZES		FORMCUTTER	SLIDING CALLIPERS
	ø 37h14, 1 AND 5.6H11			
011	TURN CONER, MAINTAINING ANGEL 20°0' ± 0°10'		CUTTER	ANGLEMETER
012	TURN GROOVE ø 31 ± 8, MAINTAINING		GROOVE CUTTER	SLIDING CALLIPERS
	THE SIZE 11.5b12			
013	DULL SHARP EDGES			
014	CUT OFF WORKPIECE, MAINTAINING		PARTING OFF	
	THE SIZE 17 mm		CUTTER	
	OPERATION 2			
001	MOUNT WORKPIECE			
002	FACE, MAINTAINING THE SIZE 4.5h14		TOOLHOLDER	SLIDING CALLIPERS

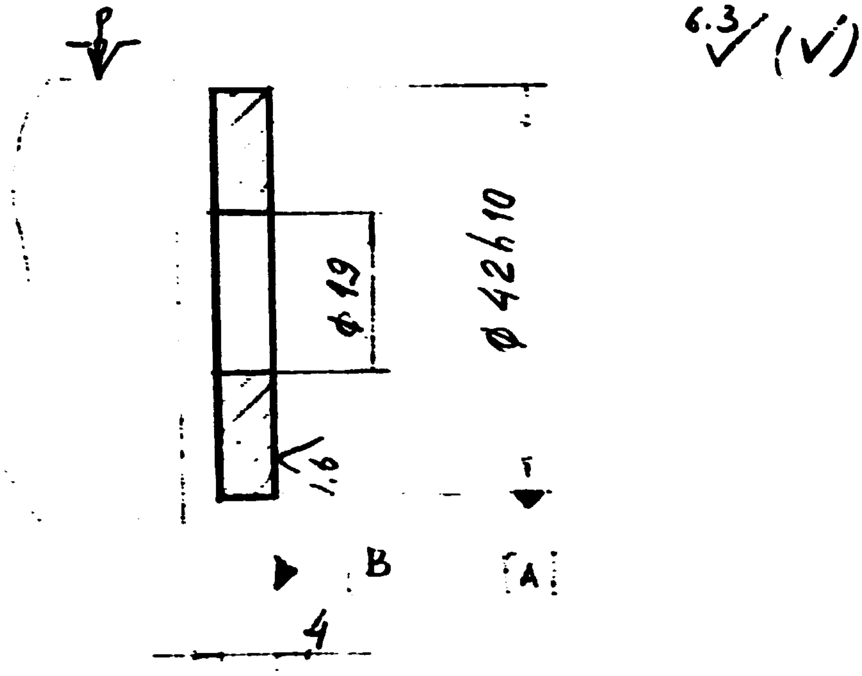
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
003	TURN ø 45 TO THE 2.5 mm DEPTH		FORM CUTTER	SLIDING CALLIPERS
004	TURN INSIDE GROOVE		FORM CUTTER	SLIDING CALLIPERS
	ø 28.8 x 1.6 mm			
005	TURN ø 30 6g		BORING CUTTER	MICROMETER
006	TURN CHAMFER 1 x 45°		CHAMFER TOOL	
007	TURN SCREW M30 x 0.75		SCREW CUTTER	
008	DULL SHARP EDGES			
	OPERATION 3			
001	OUTSIDE SURFACE Cu / Cr6			
	THE SURFACE B - ENAMEL			

SHEET 4	NAME OF SHEETS 4

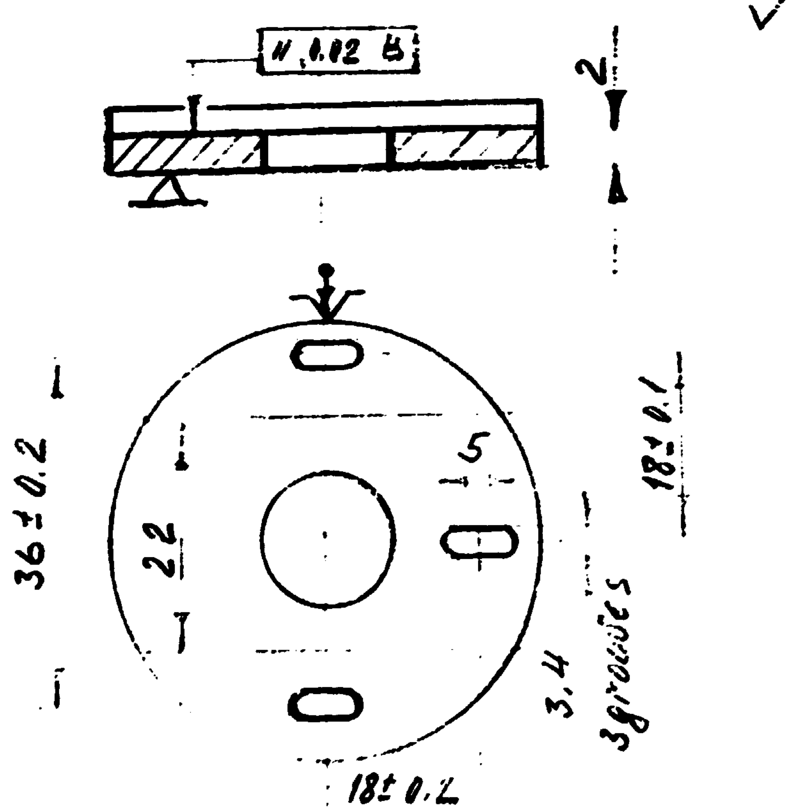
				OPERATION 1	
	OPERATION DRAFT	NUMBER OF PIECES	BLANK		
		10.006			
			PROFILE	DIMENSIONS	
			ROUND ALUMINIUM ALLOY	o 45 * 10	
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS	
001	MOUNT THE BLANK	SHAUBLIN - 125 3-JAWS CHUCK			
002	CUT BUT END		TOOLHOLDER		
003	CENTRE		CENTRING DRILL		
004	DRILL o 19h14 TO THE BODY SIZE		DRILL o 19	SLIDING	
005	TURN o 42h10		TOOLHOLDER	CALLIPERS	
006	CUT OFF WITH FACING MAINTAINING		PARTING OF TOOL		
	THE SIZE 4h14				
007	DULL SHARP EDGES		FILE		
	OPERATION 2				
001	MOUNT WORKPIECE		MILLING MACHINE ANGLE TABLE		
			SHEET 4	NAME OF SHEETS 3	

Operation 1

10.006



Operation 2

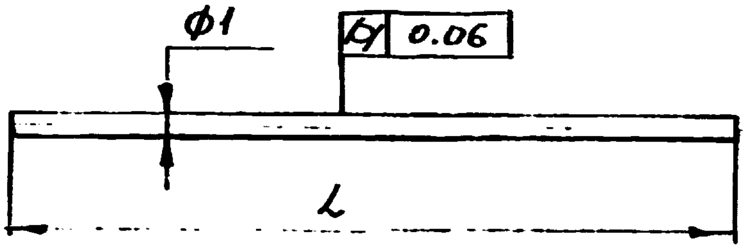


N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
002	MILL GROOVE MAINTAINING		MILLING END	
	THE SIZES 22H14 AND 2h14			
003	DRILL THREE HOLES ø 3.4 mm TO THE BODY SIZE, MAINTAINING THE			
	SIZES: 18±0.1 AND 36±0.2			
004	MILL THREE GROOVES TO THE		MILL END	
	BODY SIZE, MAINTAINING		ø 3.4	
	THE SIZE 5 mm			
	OPERATION 3			
	COATING : ANODIC OXIDATION			
	BLACK			

SHEET 3	NAME OF SHEETS 3

			OPERATION	
	OPERATION CHART	NUMBER OF PIECES	[illegible]	
	SEE SHEET [illegible]	[illegible]		
			PROFILE	DIMENSIONS
			[illegible]	[illegible]
[illegible]	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
[illegible]	CUT OF WIRE TO DIMENSION [illegible]	METAL CUTTING BENCH	WIRE CUTTER	SLIDING CALIPERS
[illegible]	FILE END OF PIECE		FILE	
[illegible]	BLUNT SHARP EDGES			
[illegible]	MAKE BURR			
			SHEET [illegible]	NAME OF SHEET [illegible]

30.001
30.002

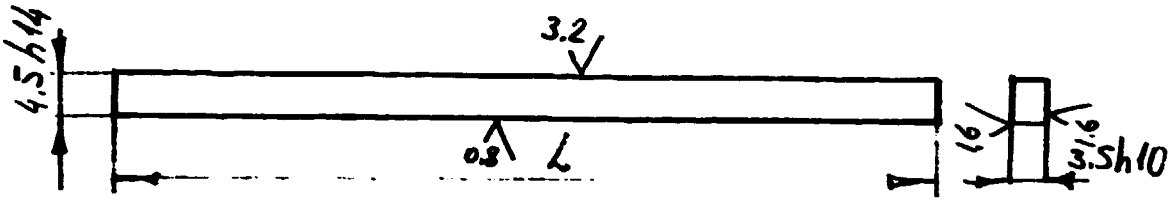


L	Number of piece
110h14	30.001
154h14	30.001-01

		[illegible]	
OPERATION SHEET	NUMBER OF PIECES	[illegible]	
	[illegible]	PROFILE	DIMENSIONS
		[illegible]	[illegible]
NO. JOB STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
[illegible] MOUNT THE BLANK	MILLING MACHINE, VISE		
[illegible] MILLING SURFACE [illegible]		[illegible]	SLIDING CALLIPERS
[illegible] MILLING SURFACE [illegible]			
[illegible]			
[illegible] MILL END SURFACE			
[illegible]			
[illegible]			
		[illegible]	[illegible]

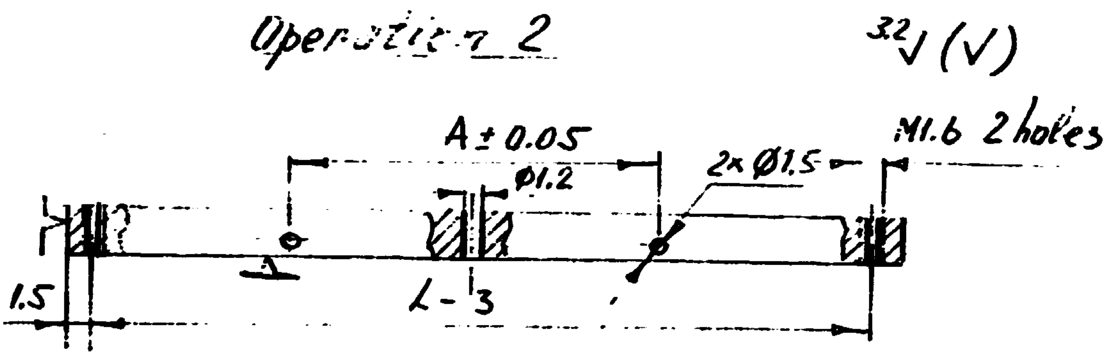
30.002
30.003

Operation 1



Number of pieces	L	A
3.0.002	116h11	50±0.05
30.003	160h11	70±0.05

Operation 2



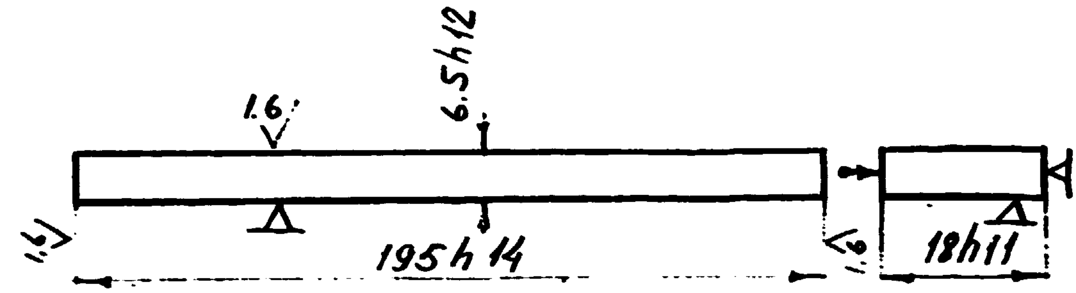
			OPERATION 3	
	OPERATION SHEET	NUMBER OF PIECES	PLAN	
		[illegible]		
			PROFILE	DIMENSIONS
No	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MARKING OUT AXES LINE OF OPENING			
002	DRILL OPENING ⌀0,8MM		DRILL ⌀0,8	
003	DRILL OPENING ⌀0,6?? MM...			
004	DRILL THE OPENING ⌀0,5MM		DRILL ⌀0,5	
005	SCREW HOLE THE OPENING		TAP M0,8	
006	BLUNT SHARP EDGES			
	REMOVE FAT COATING CHEMICAL OXIDATION			
			SHEET N	NAME OF SHEETS

			OPERATION	
	OPERATION DRAFT	NUMBER OF PIECES	SKETCH	
	SEE SHEET 2	[illegible]		
			PROFILE	DIMENSIONS
			[illegible]	
No	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	TERMAL TREATMENT [illegible]			
002	MOUNT THE BLANK	MILLING MACHINE, VICE		INDICATOR CLOCK
003	MILLING PIECES BY FOUR SIDES,BEARING DIMENSION [illegible]		MILLING CUTTER	SLIDING CALLIPERS
004	TERMAL TREATMENT [illegible]			
005	MILLING THE SURFACE,BEARING DIMEN- SION [illegible],AND [illegible]	MILLING MACHINE, VICE	MILLING CUTTER	SLIDING CALLIPERS
006	BLUNT SHARP EDGES		SCRAPER,FILE	
			SHEET 1	NUMBER OF SHEETS

30.004

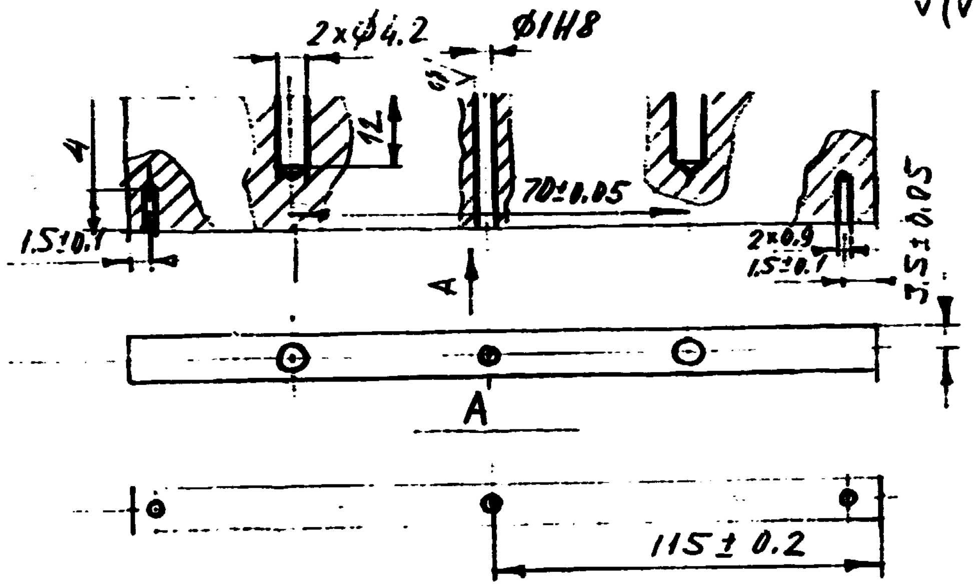
Operation N1

3.2√(√)



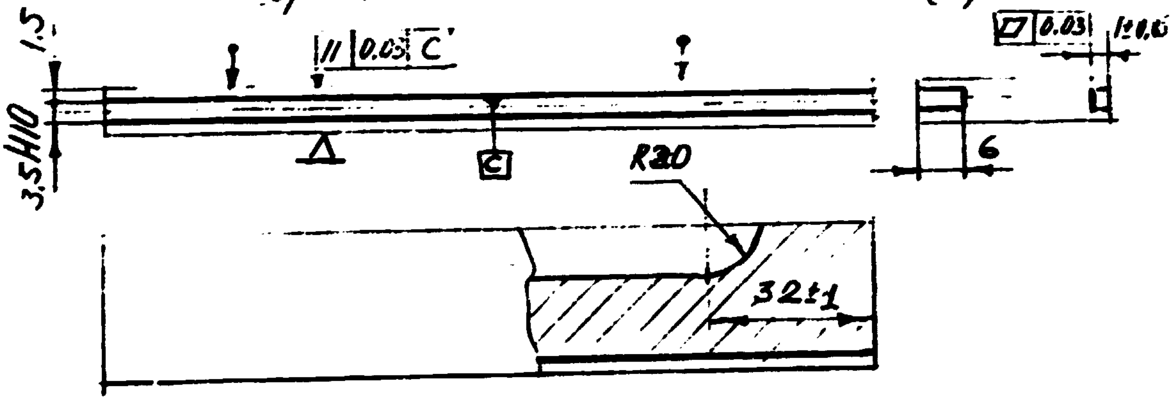
Operation N2

3.2√(√)



Operation 3

1.6√(√)



			OPERATION 2	
OPERATION DRAFT		NUMBER OF PIECES	JIG	
SEE SHEET [illegible]		ONE	SEE SHEET ONE	
			PROFILE	DIMENSIONS
No	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MARKING OUT [illegible] OPENING [illegible] AND TWO [illegible]	MARKING PEDESTAL	MARKING POINT	MICROSCOPE
002	MOUNT THE BLANK	JIG, COORDINATE [illegible] TABLE		INDICATOR 0.001mm
003	CENTER DRILL [illegible], AND TWO OPENING [illegible], BEARING DIMENSION [illegible] AND [illegible]		CENTER DRILL [illegible]	MICROSCOPE
	TABLE [illegible]			
004	DRILL OPENING [illegible]		DRILL [illegible]	
005	DRILL TWO OPENING [illegible] IN DEPTH 12 mm		DRILL [illegible]	
006	RETURN JOB [illegible]			
007	CENTER DRILL TWO OPENING [illegible]		CENTER DRILL [illegible]	
008	DRILL TWO OPENING [illegible] IN [illegible] DEPTH			
			SHEET 2	NAME OF [illegible]

OPERATION CHART	NUMBER OF PIECES	BLANK	
		OPERATION [illegible]	
SEE SHEET [illegible]	[illegible]	SEE SHEET	
		PROFILE	DIMENSIONS

N°	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT THE BLANK	MILLING MACHINE		INDICATOR [illegible]
0002	MILLING PROFILE [illegible] DIMENSION [illegible]		GROOVE MILLING CUTTER TYPE [illegible]	SLIDING CALIPERS [illegible]
0003	MILLING GROOVE [illegible] DIMENSION [illegible] AND [illegible] FOR THE NEXT		GROOVE MILLING CUTTER TYPE [illegible]	SLIDING CALIPERS [illegible]
	PASSAGES [illegible]			
0004	BLUNT SHARP EDGES			

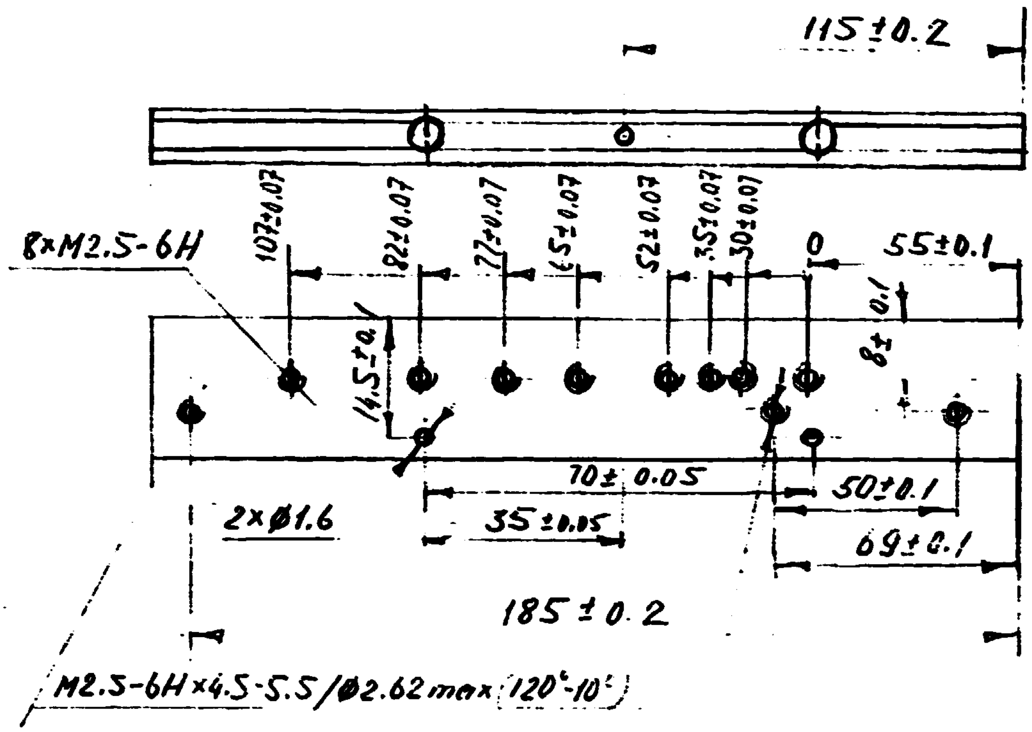
SHEET [illegible] | NUMBER OF SHEETS [illegible]

OPERATION CHART	NUMBER OF PIECES	PART
SEE SHEET 2	[illegible]	SEE SHEET [illegible]
		PROFILE DIMENSIONS

NO	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	[illegible]	[illegible]	[illegible]	[illegible]
002	[illegible]	DRILL MACHINE [illegible]		
		TABLE [illegible]		
003	[illegible]		[illegible]	[illegible]
004	[illegible]		[illegible]	[illegible]
005	[illegible]		[illegible]	[illegible]
006	[illegible]		[illegible]	[illegible]
007	[illegible]		[illegible]	

SHEET 2 [illegible]

Operation 4



2×M2-6H×4.5-5.5/Ø2.1max (120°-10°)

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	
[illegible]	[illegible]		[illegible]	
[illegible]	[illegible]		[illegible]	
	[illegible] [illegible]			

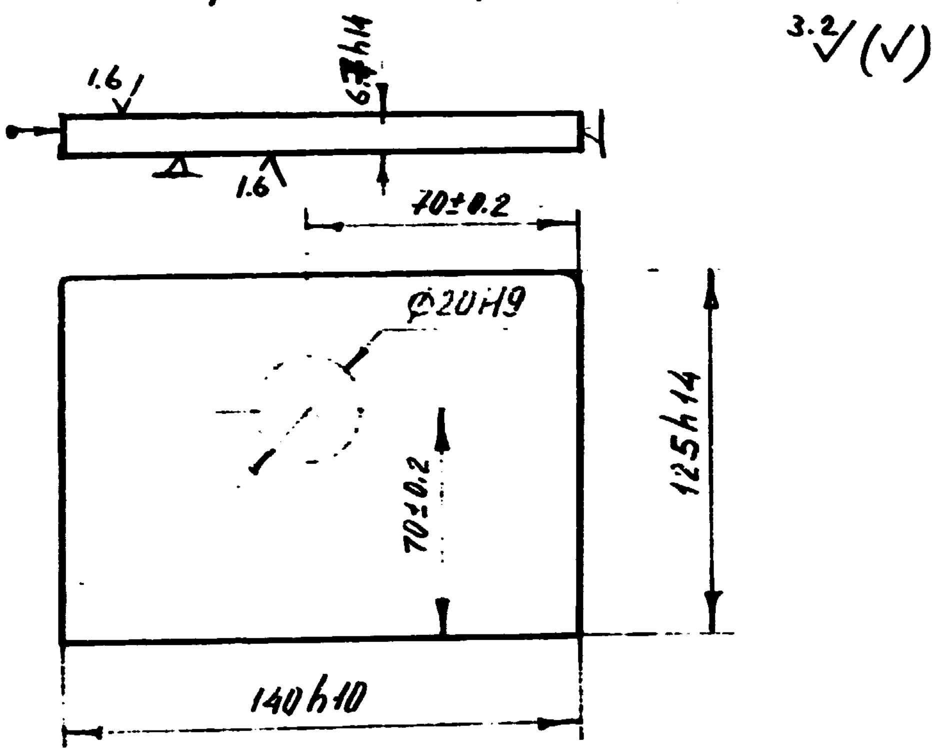
[illegible] [illegible]

		OPERATION [illegible]
OPERATION CHART	TYPES OF [illegible]	[illegible]
SEE SHEET 2	[illegible]	PROFILE DIMENSIONS

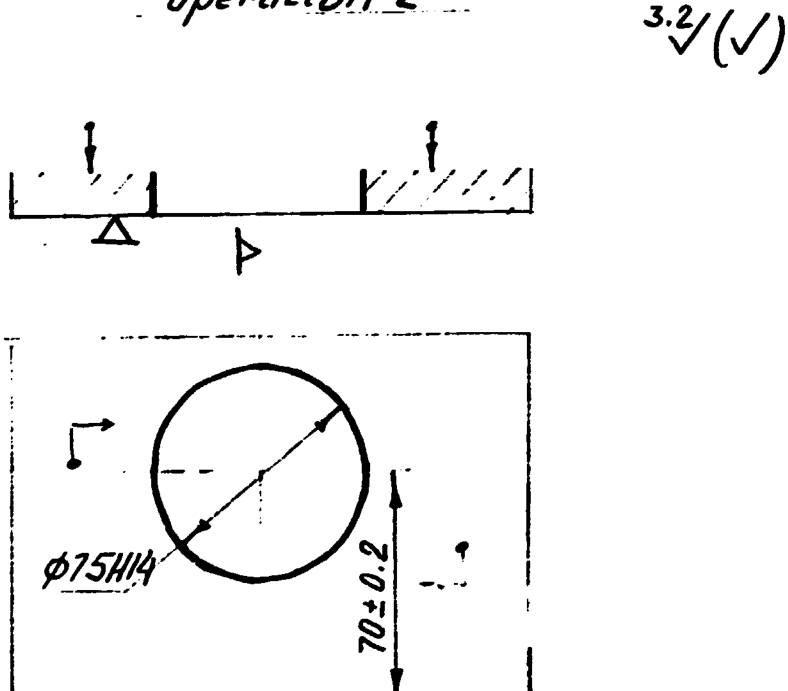
No.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT THE BLANK	MILLING MACHINE, VICE		
0002	MILLING SURFACE ON DIMENSION [illegible]		[illegible] CUTTER	SLIDING CALLIPER
0003	[illegible]			
0004	MILLING SURFACE ON DIMENSION [illegible]			
0005	BLUNT SHARP EDGES		SCRAPER, FILE	
0006	MARK [illegible] CENTER OF DRILLING [illegible] AND [illegible]			
0007	DRILL [illegible]		DRILL [illegible]	

SHEET [illegible] NO OF SHEETS [illegible]

Operation 1.



Operation 2



	[illegible]

[illegible]	NUMBER OF [illegible]	[illegible]
SEE SHEET 1	[illegible]	SEE SHEET [illegible]

NO.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	MILLING MACHINE [illegible]		
002	MILL [illegible]	[illegible]	END MILLING CUTTER	SLIDING CALLIPERS
003	BLUNT SHARP EDGES			

SHEET 2	NUMBER OF SHEETS 2

[illegible]

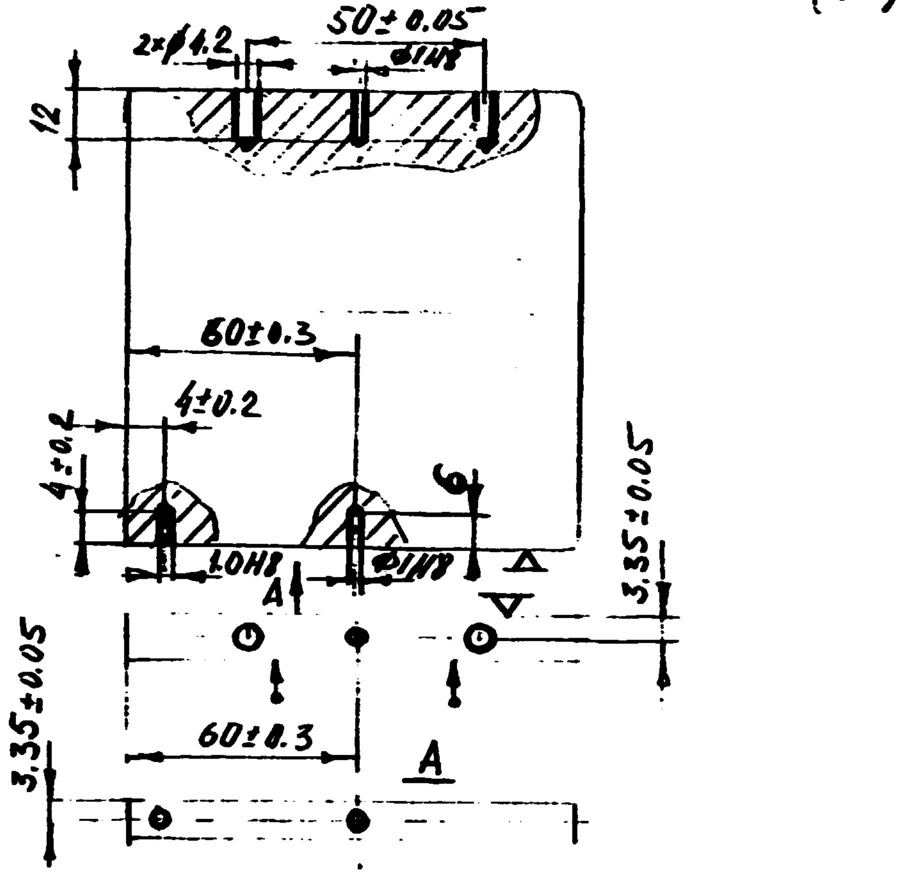
[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]

	[illegible]
	[illegible] [illegible]

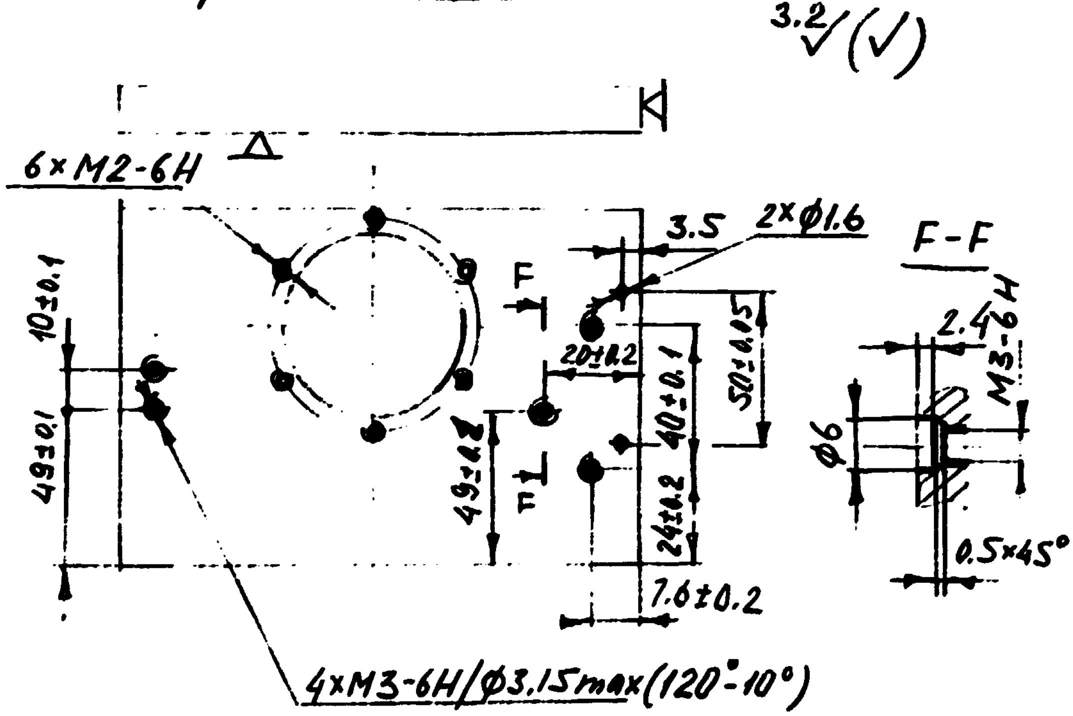
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]			
[illegible]	[illegible]			

[illegible]

Operation 3



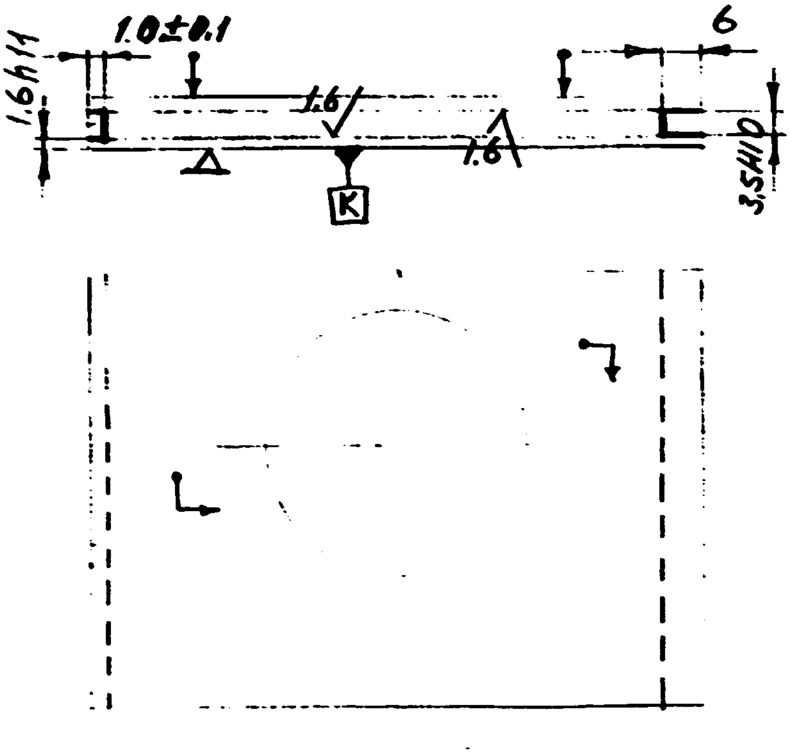
Operation 4



			OPERATION -	
OPERATION CHART		NUMBER OF PIECES	PLAN	
		SAME	SEE SHEET 2	
			PROFILE	DIMENSIONS
NO.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT THE PLAN	DRILL MACHINE [illegible] TABLE [illegible] ROTATABLE TABLE		
0002	DRILL [illegible] OPENING		DRILL [illegible]	
0003	CUT CHAMFERS [illegible]		DRILL [illegible]	
0004	DRILL [illegible] OPENING		DRILL [illegible]	
0005	CUT CHAMFERS [illegible]		DRILL [illegible]	
0006	DRILL TWO OPENINGS [illegible] [illegible]		DRILL [illegible]	
0007	DRILL [illegible] [illegible]		DRILL [illegible]	
0008 0009	[illegible] [illegible]		[illegible] [illegible]	
			SHEET 1	NAME OF SHEET 1

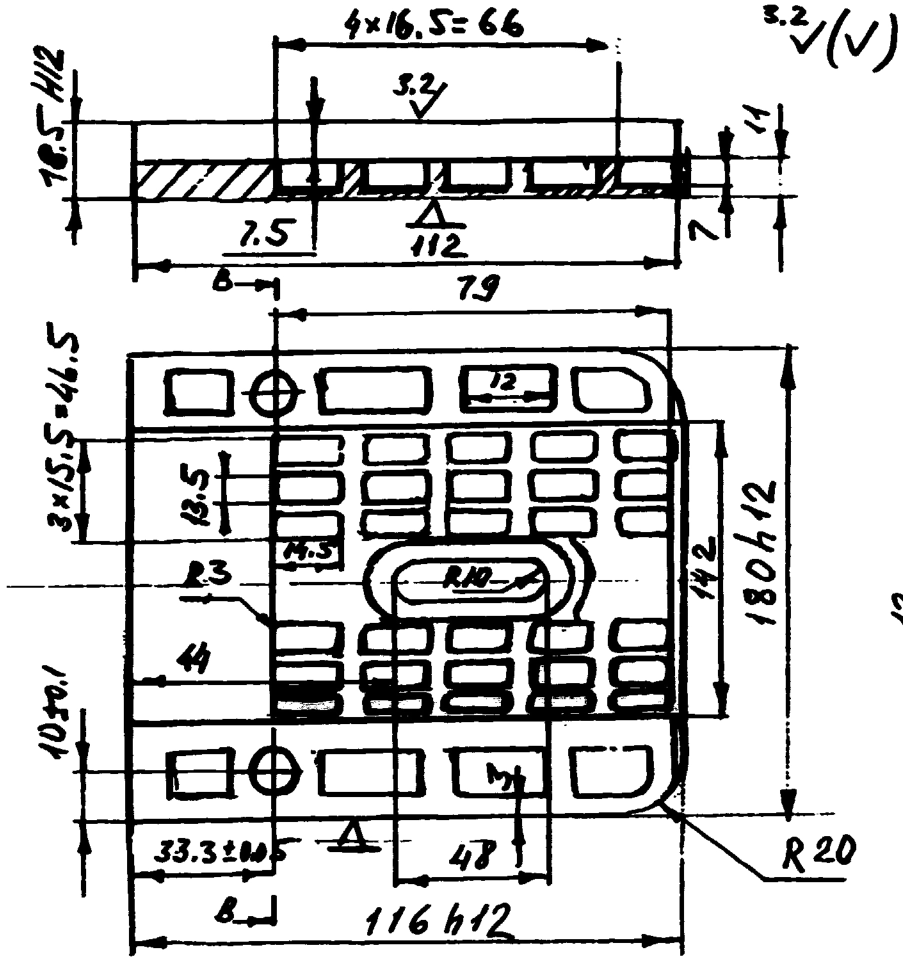
			OPERATION	
OPERATION DRAFT		NUMBER OF PIECES	PLAN	
SEE SHEET 2		[illegible]	SEE SHEET 2	
			PROFILE	DIMENSIONS
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	MILLING MACHINE		INDICATOR GAUGE
002	MILLING GROOVE [illegible] DEPTH [illegible] IN DIMENSION [illegible]		GROOVE MILLING CUTTER [illegible]	DEPTHMETER SLIDING CALIPERS
003	MILLING GROOVE [illegible] DEPTH [illegible] IN DIMENSION [illegible] FOR THE THREE [illegible]			
	GAGES [illegible]			
004	BLUNT SHARP EDGES ON END OF SURFACE AND OPENING		[illegible] DRILL	
005	SCREW HOLE		TAP [illegible]	
	[illegible] COATING ANODIC OXIDATION BLACK			
			SHEET [illegible]	NUMBER OF SHEETS [illegible]

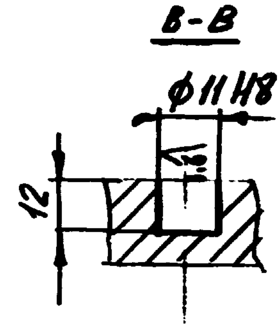
Operation 5



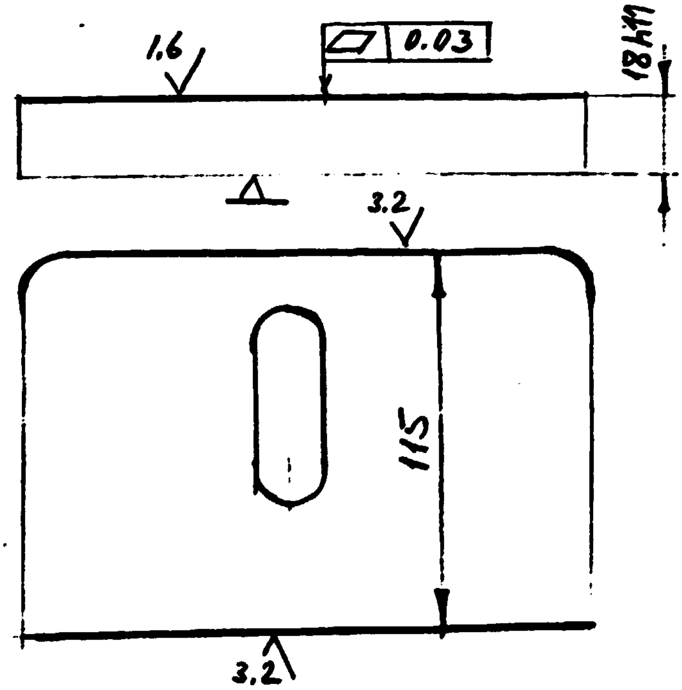
			PREPARED :	
OPERATION CHART		NUMBER OF PIECES	BLANK	
SEE SHEET 2		[illegible]	PROFILE DIMENSIONS	
			ROLL	COMPANY
NO.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	MILLING MACHINE PEDESTAL [illegible]		
002	MILL SURFACE BEARING DIMENSION [illegible]		MILLING CUTTER [illegible]	SLIDING CALIPERS
003	MILL [illegible]		MILLING CUTTER	
004	MILL [illegible]			
005	MILL [illegible]			SLIDING CALIPERS
006	MILL [illegible]		FORM MILLING	SLIDING CALIPERS [illegible]
007	MILL CENTRAL [illegible]			
008	DRILL TWO [illegible]		DRILL [illegible]	
			SHEET 1	NUMBER OF SHEETS

Operation 1





Operation 2



[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]			
	[illegible]			
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]		[illegible]	
[illegible]	[illegible]			
	[illegible]			

[illegible] [illegible]

NO.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	[illegible]	MILLING MACHINE [illegible]		[illegible]
002	[illegible]		[illegible] CUTTER [illegible]	SLIDING CALIPERS
	[illegible]			
	[illegible]		[illegible] CUTTER	SLIDING CALIPERS

		OPERATION N 3	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	[illegible]		
		PROFILE	DIMENSIONS

N	ACT. STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	MILLING MACHINE [illegible]		INDICATOR [illegible]
002	MILLING SURFACE IN DIMENSION [illegible]		MILLING CUTTER TOOLHOLDER	SLIDING CALLIPERS
	[illegible] TWO			
	MILLING [illegible] TO THE SIDES TO [illegible]		MILLING CUTTER	SLIDING CALLIPERS

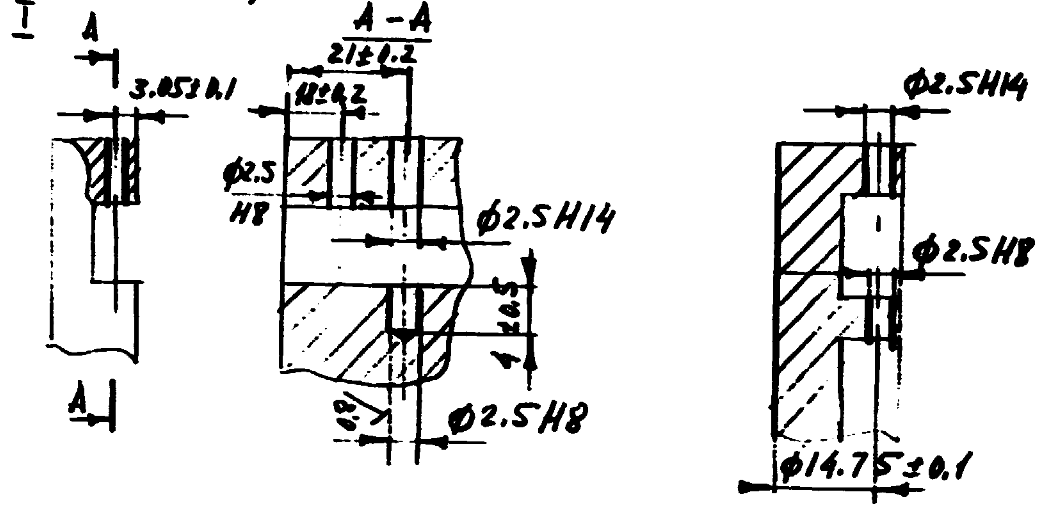
SHEET [illegible]	NUMB. OF SHEETS [illegible]

		OPERATION [illegible]
OPERATION SHEET	NUMBER OF PIECES	PLAN
	[illegible]	SEE SHEET [illegible]
		PROFILE DIMENSIONS
		[illegible]

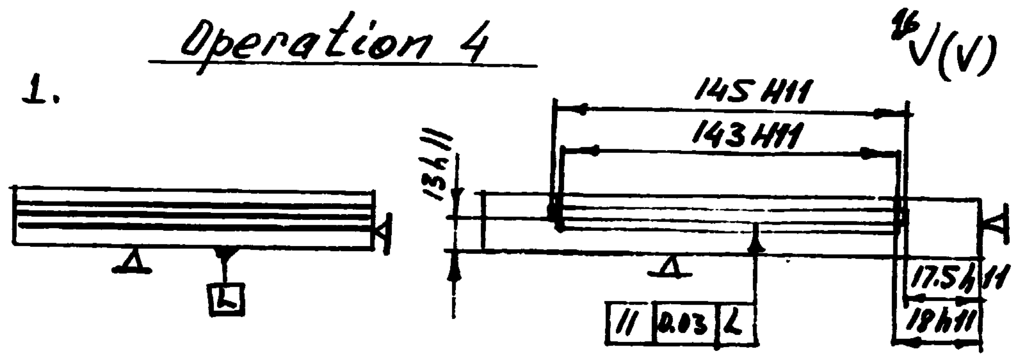
No.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT BLANK	DRILL MACHINE [illegible] [illegible]		
002	DRILL [illegible]		DRILL [illegible]	
003	[illegible]		[illegible]	
004	DRILL [illegible]		DRILL [illegible]	
005	TURN WORKPIECE			
006	DRILL [illegible]		DRILL [illegible]	
007	[illegible]		[illegible]	
008	DRILL [illegible]			

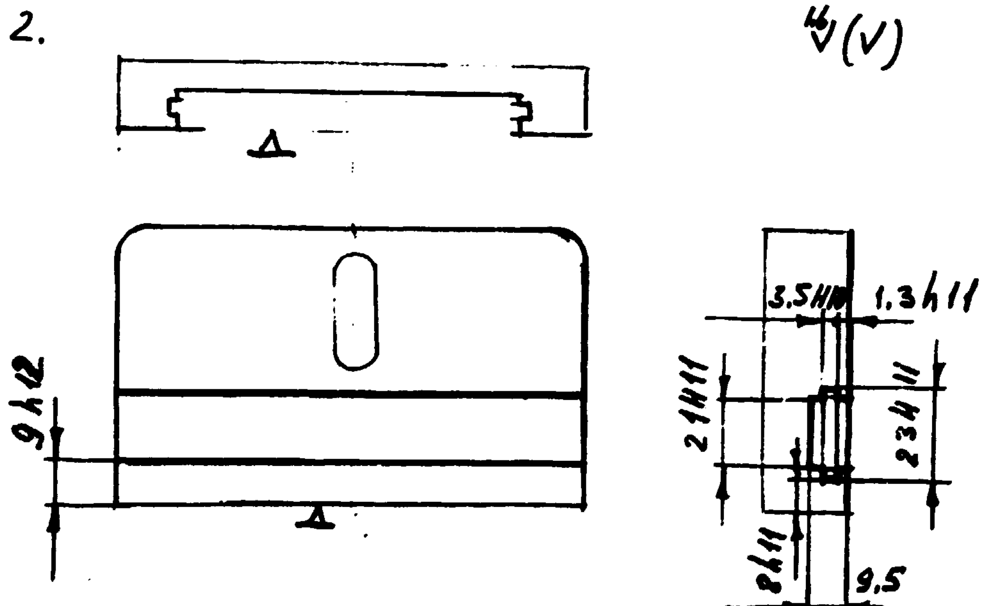
SHEET [illegible] [illegible]

Operation 3



Operation 4





No.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
[illegible]	MILLING [illegible]		MILL [illegible]	
[illegible]	TURN BLANK			
[illegible]	DRILL OPENING [illegible], BEARING [illegible] AND [illegible]		DRILL [illegible]	
[illegible]	[illegible] DRILL OPENING [illegible]		REAMER [illegible]	
[illegible]	[illegible] DRILL [illegible]		DRILL [illegible]	
[illegible]	TURN THE BLANK			
[illegible]	DRILL TAP OPENING [illegible] IN DIMENSION [illegible]		DRILL [illegible]	
	BEARING DIMENSION [illegible]			
[illegible]	CUT [illegible] THREAD		TAP [illegible]	

SHEET [illegible] [illegible] OF SHEETS [illegible]

		OPERATION [illegible]	
OPERATION SHEET	NUMBER OF PIECES	PLAN	
SEE SHEET [illegible]	[illegible]	SEE SHEET [illegible]	
		PROFILE	DIMENSIONS

No.	SUB STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT BLANK	MILLING MACHINE, VICE		INDICATOR [illegible]
0002	MILLING GROOVE, BEARING DIMENSION [illegible] AND [illegible]		END MILLING CUTTER	SLIDING CALLIPERS
0003	MILLING GROOVE [illegible], BEARING DIMENSION [illegible], [illegible] AND [illegible]		FORMING MILLING CUTTER [illegible]	SLIDING CALLIPERS DEPTHMETER
	TAP PASSAGES			
0004	MOUNT THE BLANK	VICE		INDICATOR [illegible]
0005	MILLING GROOVE, BEARING DIMENSION [illegible]		END MILLING CUTTER	SLIDING CALLIPERS
0006	MILLING GROOVE [illegible], BEARING DIMENSION [illegible] AND [illegible]		FORMING MILLING CUTTER [illegible]	SLIDING CALLIPERS DEPTHMETER
0007	CUT SHARP EDGES		SCRAPER	
			SHEET [illegible]	NUMBER OF SHEETS [illegible]

[illegible]

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		
[illegible]			
[illegible]			
[illegible]			
[illegible]			
[illegible]			

[illegible] [illegible]

		OPERATION [illegible]
OPERATION DRAFT	NUMBER OF PIECES	PLAN
[illegible]	[illegible]	
		PROFILE / DIMENSIONS
		[illegible] / [illegible]

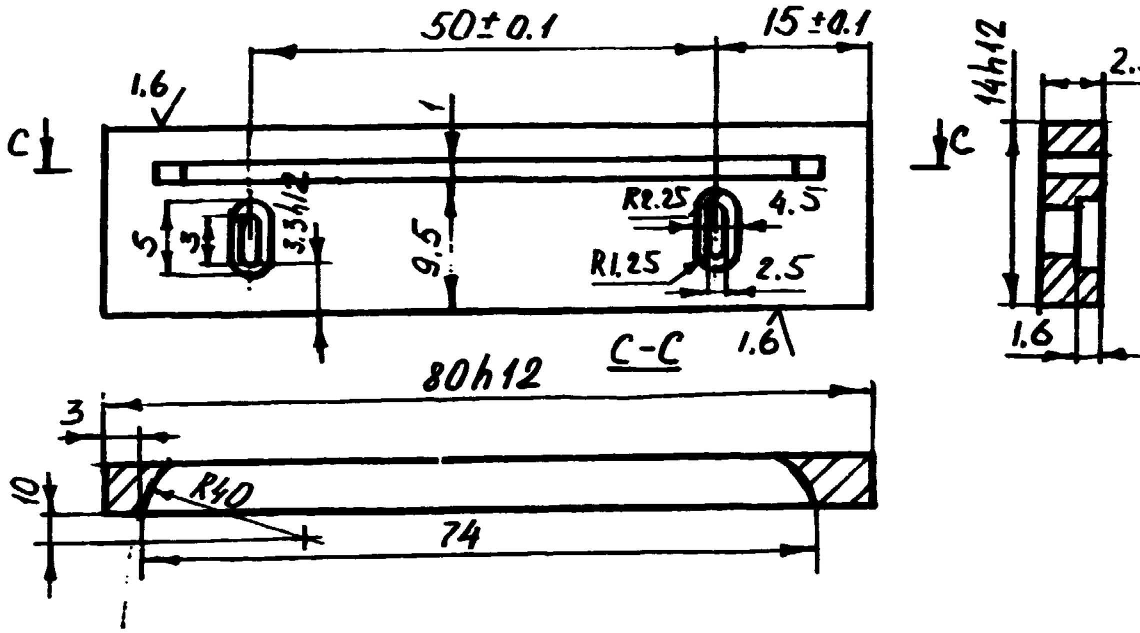
No	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
[illegible]	MARKING OUT AXES LINE	MARKING PEDESTAL	MARKING POINT	MICROSCOPE
[illegible]	DRILL CENTER [illegible] OPENING		CENTRING DRILL [illegible]	
[illegible]	DRILL CENTER [illegible]			
[illegible]	DRILL OPENING [illegible]			
[illegible]	DRILL [illegible]			
[illegible]	BLUNT SHARP EDGES			

SHEET [illegible]	[illegible]

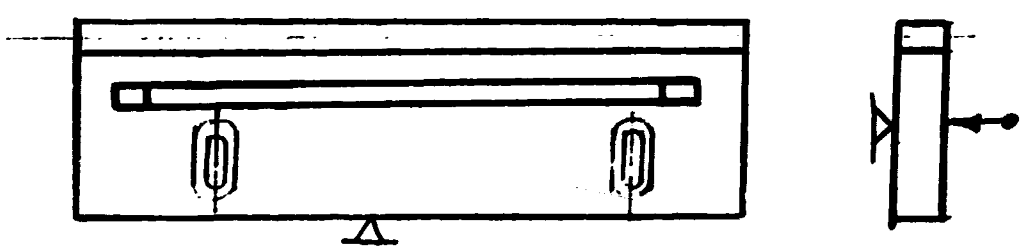
			OPERATION No [illegible]	
	OPERATION SHEET	NUMBER OF PIECES [illegible]	[illegible]	
		[illegible]		
			PROFILE	DIMENSIONS
No	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE WORKPIECE [illegible]	MILLING MACHINE		
002	MILL FLANGE [illegible]	[illegible]	END MILL	
003	MILL THE GROOVE [illegible]		DISC MILLING CUTTER [illegible]	
004	[illegible] FOR DRILLING TWO HOLES [illegible] TO THE FOLLOWING [illegible]			
	COORDINATES [illegible]			
005	DRILL TWO HOLES [illegible]		DRILL [illegible]	
006	MILL THE [illegible]			
007	MILL THE [illegible]		[illegible] MILLING CUTTER [illegible]	
			SHEET [illegible]	[illegible] OF SHEETS [illegible]

Operation 1

3.2 √(√)



Operation 2



$m = 0.4$ right

$z = 60$

$g - F$

$h = 0.94$

$\beta = 18°$

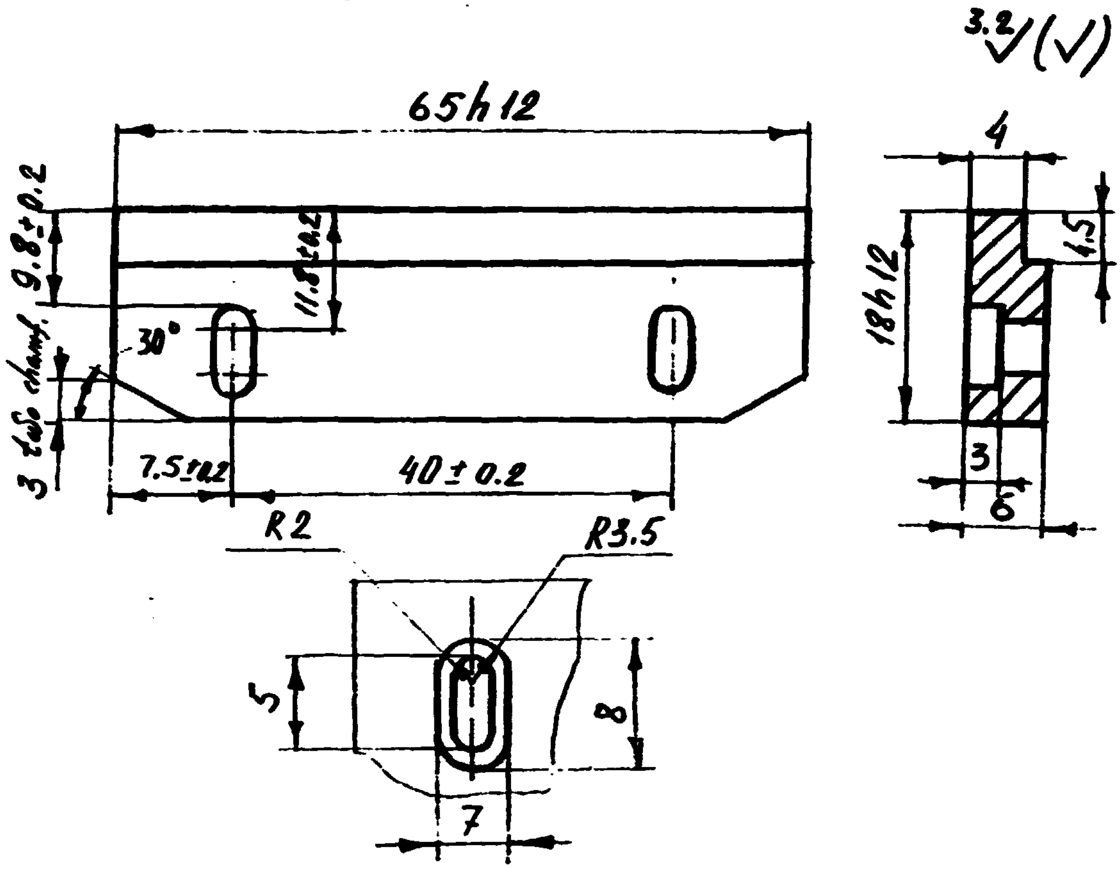
		[illegible]	
[illegible]	[illegible]	[illegible]	
	[illegible]		
		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	
[illegible]		[illegible]	
[illegible]			
[illegible]			
[illegible]		[illegible]	
[illegible]			
[illegible]		[illegible]	
		[illegible]	[illegible]

		OPERATION N 2	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	[illegible]		
		PROFILE	DIMENSIONS

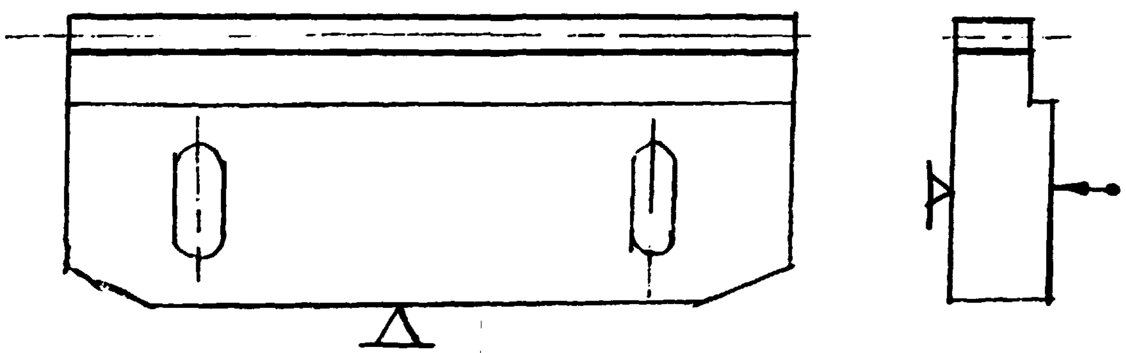
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE WORKPIECE	MILLING MACHINE		
002	MILL THE SEPARATE PROFILE			
	[illegible]			
	OPERATION 3			
	CHEMICAL OXIDATION			

SHEET 2 NUMBER OF SHEETS 3

Operation 1

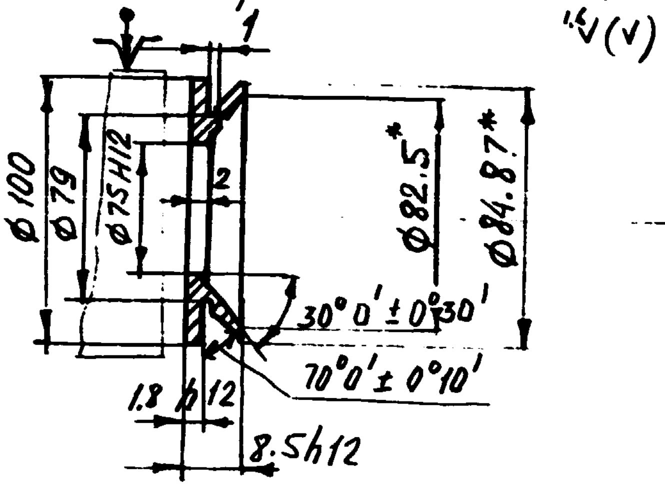


Operation 2

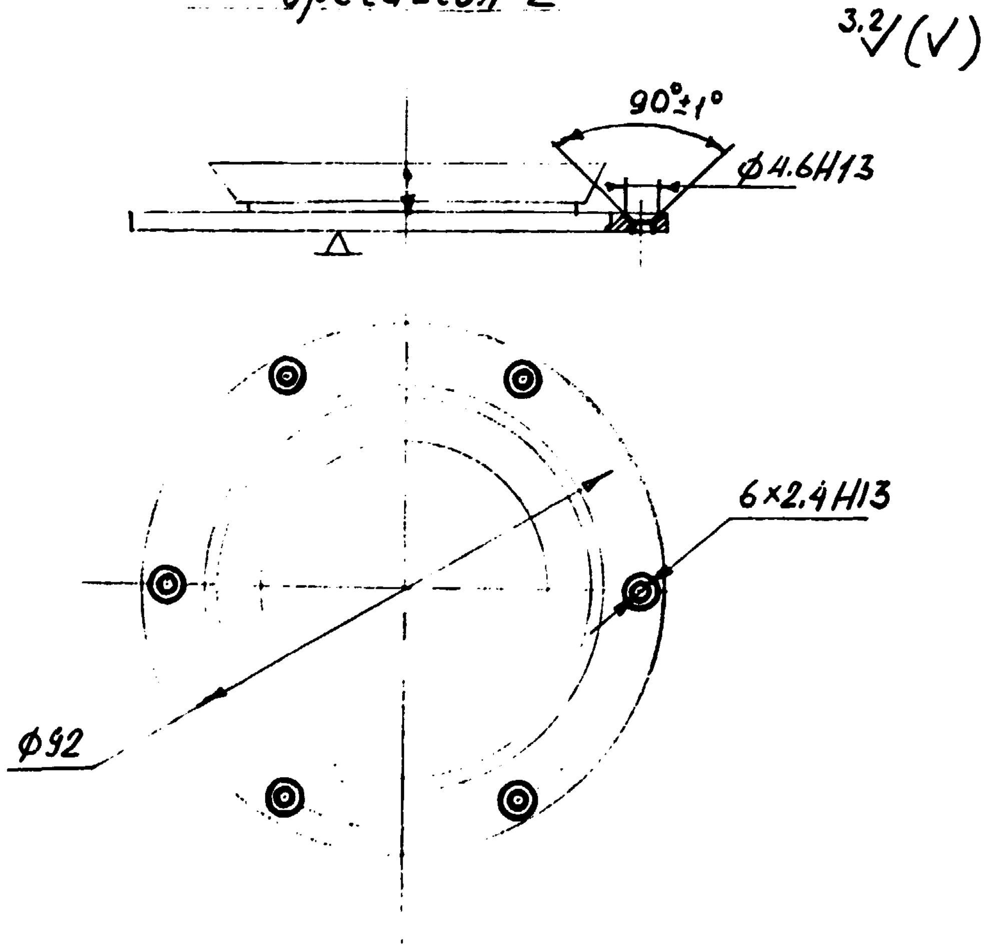


m=0.5
z=33
9-F
h=1.125
right.

Operation 1

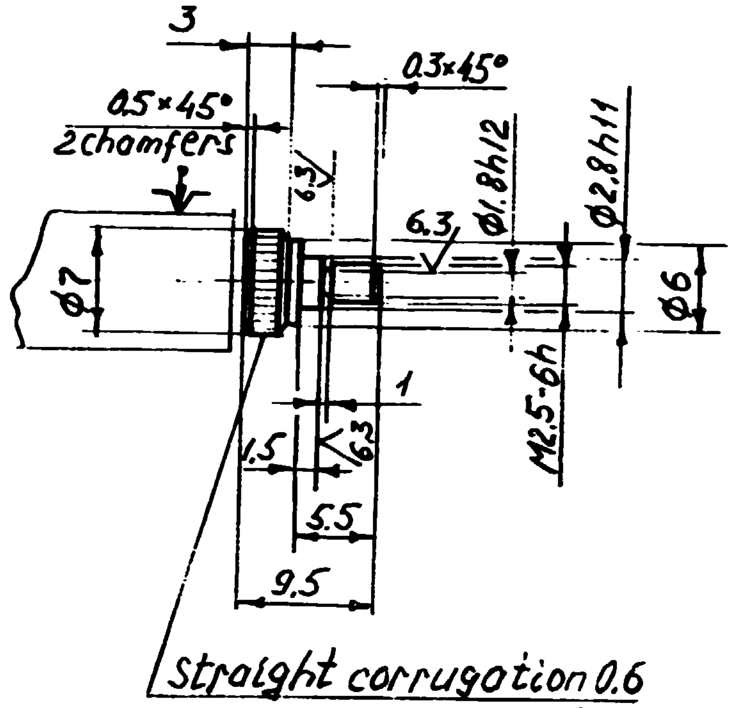


Operation 2



[illegible]

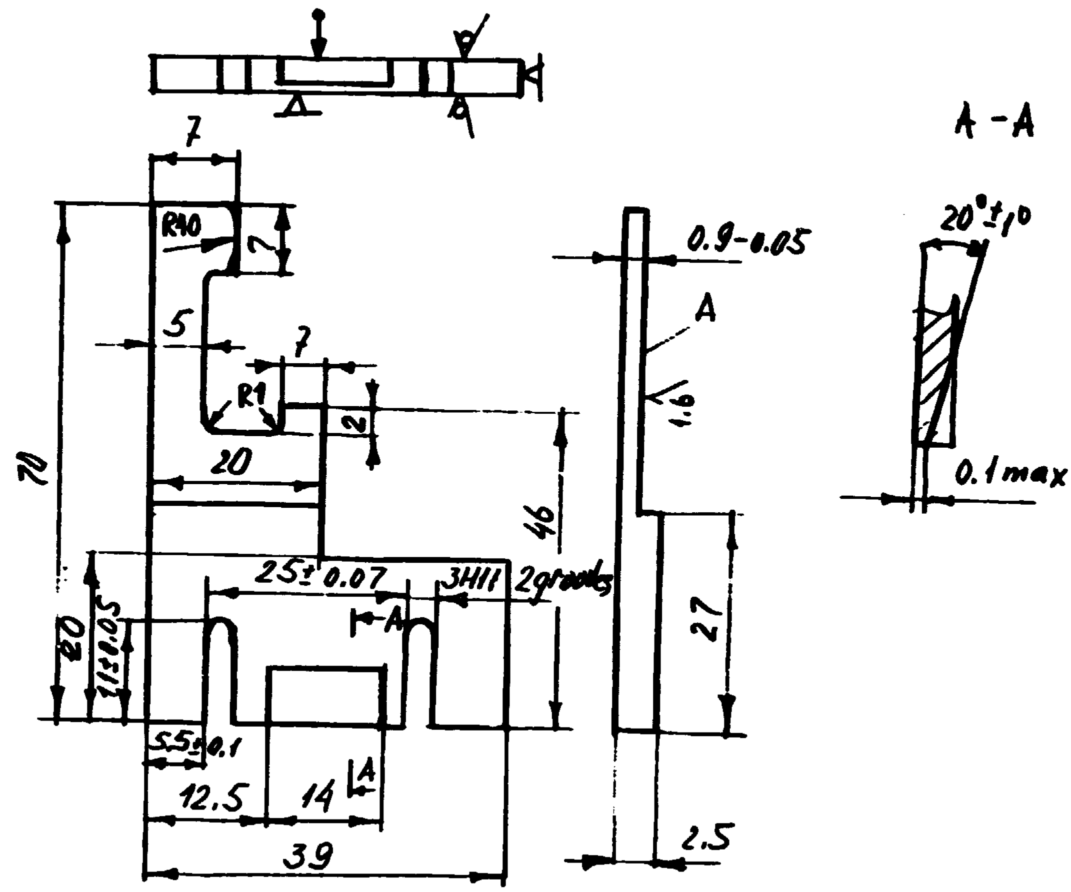
operation 1



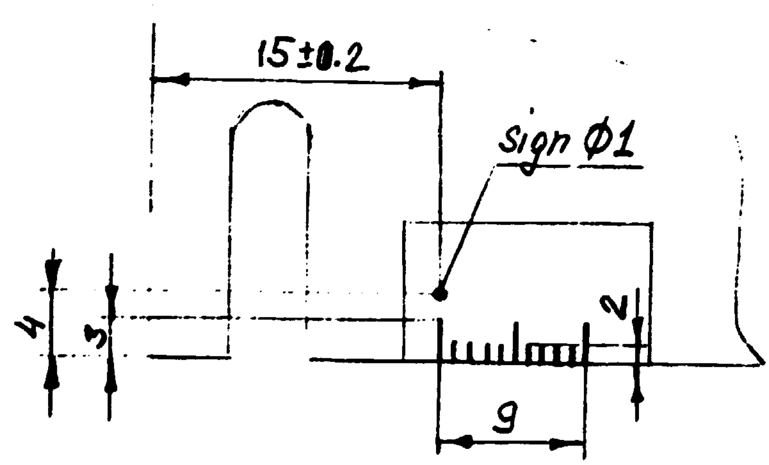
3
0.3×45°
0.5×45°
2 chamfers
6.3
6.3
Ø1.8h12
Ø2.8h11
Ø7
Ø6
1
1.5
6.3
M2.5-6h
5.5
9.5
Straight corrugation 0.6

[illegible]

Operation 1



Operation 2



OPERATION [illegible]

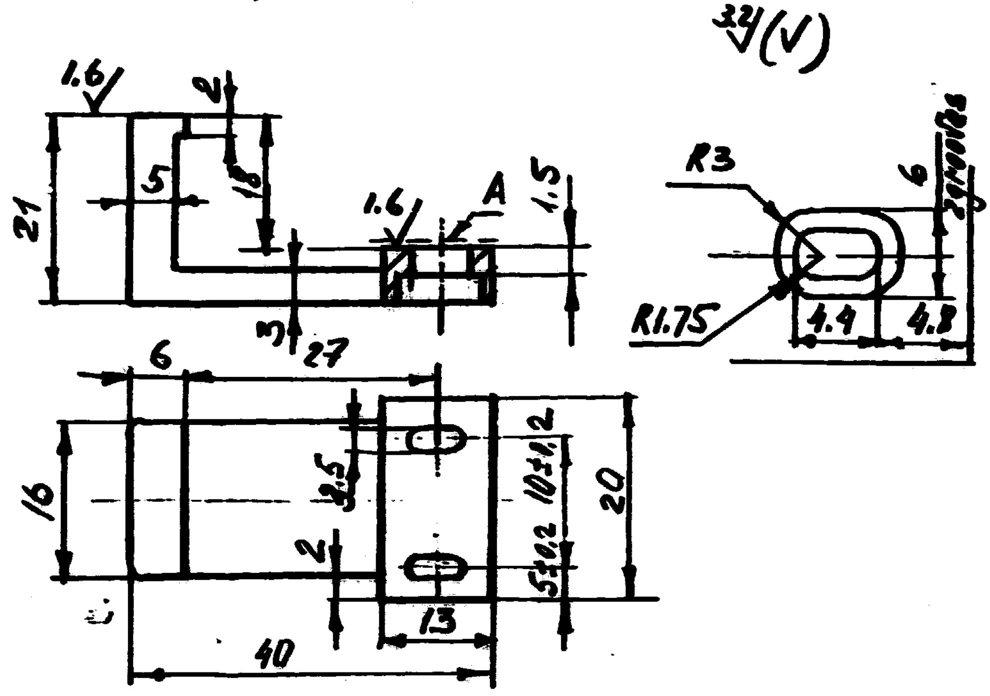
OPERATION CHART	NUMBER OF PIECES	PLAN
SEE SHEET [illegible]	[illegible]	

PROFILE DIMENSIONS

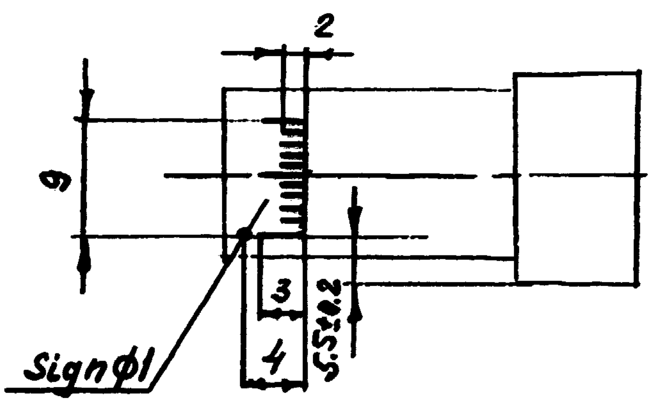
No	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE PLAN	[illegible]		
[illegible]	MILL [illegible] [illegible] [illegible]			
	SPECIFIED			
	OPERATION [illegible]			
	[illegible]			

SHEET [illegible] [illegible]

			OPERATION No. [illegible]	
OPERATION SHEET		NUMBER OF PIECES	PLAN	
		[illegible]		
			PROFILE	DIMENSIONS
			[illegible]	[illegible]
No.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK WITH [illegible]	MILLING MACHINE [illegible]		
002	CONTOUR MILL MAINTAINING SIZES SPECIFIED		END MILLING CUTTER	SLIDING CALLIPERS
003	DRILL HOLE [illegible] MAINTAINING [illegible]		DRILL [illegible]	
004	MILL [illegible]		MILL [illegible]	
	[illegible]			
005	MILL [illegible]			
	MAINTAINING [illegible]		MILL [illegible]	
006	[illegible]			
007	FILE [illegible] MILL CUTTER		FILE	
			SHEET [illegible]	NUMBER OF SHEETS [illegible]


1.6
2
5
18
21
1.6
A
1.5
3
27
6
16
2.5
10±0.2
20
2
5±0.2
13
40
R3
6
R1.75
4.4
4.8

Operation 2


2
9
3
4
5.5±0.2
Signϕ1

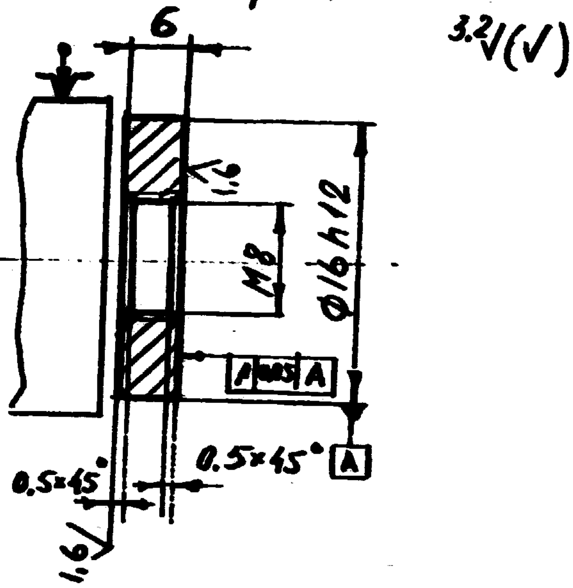
		OPERATION N 2	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	10,016	SEE SHEET 2	
		PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	ENGRAVE MILLING MACHINE		
002	MILL LINES MAINTAINING SIZES			
	SPECIFIED			
	OPERATION 3			
	COATING: ANODIC OXIDATION BLACK,			
	EXCEPT SURFACE A - BLACK ENAMEL			

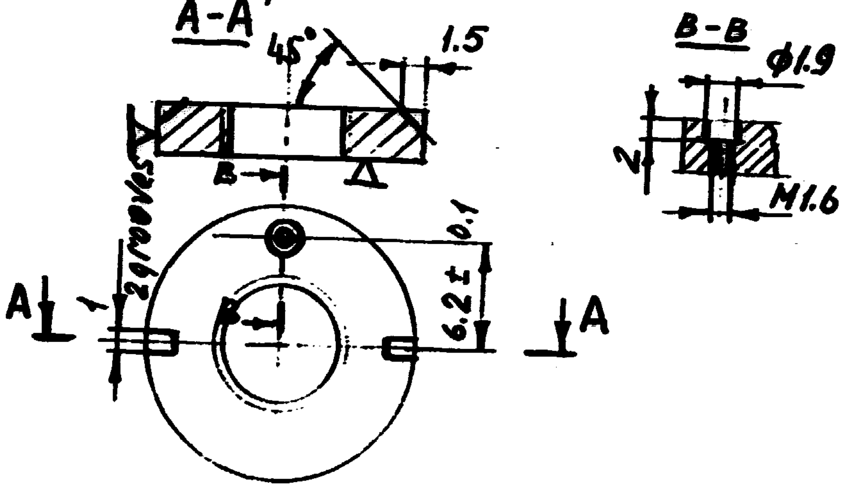
SHEET 1	NAME OF SHEETS 3

				OPERATION N 1	
OPERATION DRAFT		NUMBER OF PIECES	BLANK		
SEE SHEET 2		[illegible]	PROFILE	DIMENSIONS	
			ROUND BRASS	⌀ [illegible] x [illegible]	
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS	
001	MOUNT THE BLANK	CHAUBLIN - 135 3-JAWS CHUCK			
002	TURN ⌀ [illegible] TO THE LENGHT 10 mm		TOOLHOLDER	SLIDING CALLIPERS	
003	FACE		TOOLHOLDER		
004	CENTER		CENTRING DRILL		
005	DRILL HOLE FOR THE THREAD M5 TO THE DEPTH		DRILL ⌀ [illegible] mm		
	OF 10 mm				
006	TURN CHAMFER 0,5 x 45°		CHAMFER TOOL		
007	DULL SHARP EDGES		FILE		
008	CUT THREAD M5		TAP		
009	CUT OFF MAINTAINING THE SIZE [illegible]		PARTING OFF TOOL		
			SHEET 1	NUMB. OF SHEETS 4	

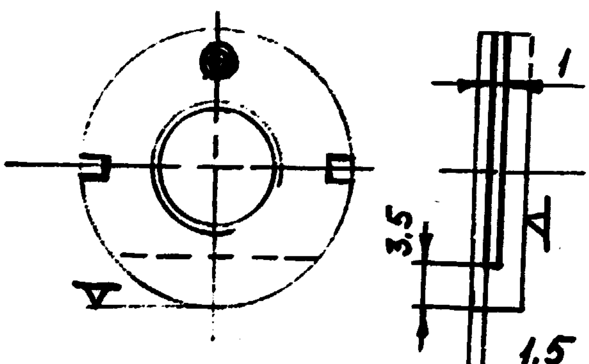
Operation 1



Operation 2



Operation 3



		OPERATION N 3
OPERATION DRAFT	NUMBER OF PIECES	BLANK
SEE SHEET 3	30,013	SEE SHEET 2

PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	MILLING MACHINE		
002	MILL 2 CORNER GROOVES TO THE SIZE 1 mm		MILL DISK 1 mm * 50	
003	CENTRE MAINTAINING THE SIZE 5.2±0.1 mm		CENTRING DRILL	
004	DRILL HOLE ⌀ 1.4 mm TO THE BODY SIZE		DRILL ⌀ 1.4H11	
005	COUNTER BORE ⌀1.9 TO THE 2 mm depth		COUNTER BORE ⌀ 1.9H14	
006	CUT THREAD M1.6		TAP M1.6	
007	DULL SHARP EDGES		FILE	

SHEET 3	NAME OF SHEETS 4

	OPERATION N 3

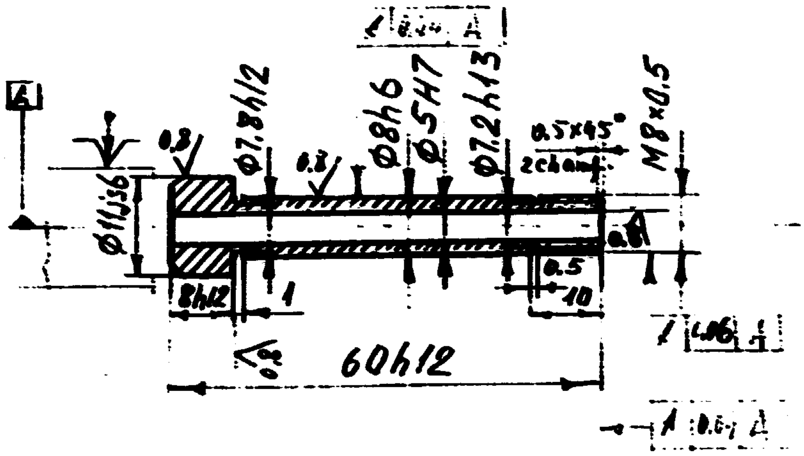
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	20.012		
		PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	MILLING MACHINE VICE		
002	MILL GROOVE 1 mm, MAINTAINING THE SIZES			
	3,5 mm AND 1.5 mm			
003	DULL SHARP EDGES			
	OPERATION -			
	COATING:			
	CHEMICAL OXIDATION			

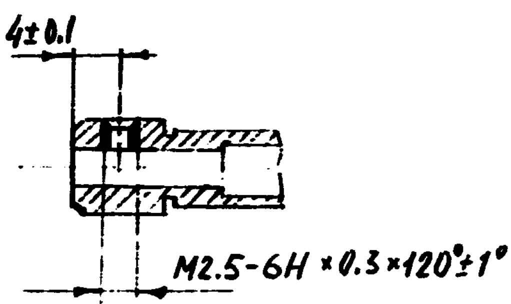
SHEET 4	NUMBER OF SHEETS 4

			OPERATION N 1	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
SEE SHEET [illegible]		[illegible]		
			PROFILE	DIMENSIONS
			ROUND BRASS	⌀ 13 * 80
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	[illegible] - 125 3-JAWS CHUCK		
002	TURN FACE		TOOLHOLDER	
003	TURN ⌀ [illegible] TO THE LENGHT		TOOLHOLDER	
	OF 65 mm			
004	TURN ⌀ [illegible] TO THE LENGHT		TOOLHOLDER	
	OF 52 mm			
005	TURN GROOVE ⌀ 7,5mm * 1 mm		GROOVE CUTTER	
006	TURN GROOVE ⌀ 7,8 mm * 4,5 mm		GROOVE CUTTER	
007	TURN CHAMFER 0,5 * 45°		CHAMFER TOOL	
008	CENTRE		CENTRING DRILL	
			SHEET .	NAME OF SHEETS -

Operation 1



Operation 2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	DRILL HOLE ⌀ 4 mm TO THE DEPTH OF 70 mm FOR THE NEXT		DRILL ⌀ 4 mm	
	PASSAGES			
010	BORING HOLE ⌀ 4,8[illegible] mm TO THE DEPTH OF 70 mm		BORING CUTTER	
011	REAM HOLES ⌀ 4,9[illegible] mm		REAMER ⌀ 4,[illegible]	
012	SCREW M[illegible] x 0,5		SCREW CUTTER	
013	CUT OFF PIECES MAINTAINING THE SIZE [illegible] WITH TURN		PARTING OFF CUTTING	
	CHAMFER 0,5 x 45°			

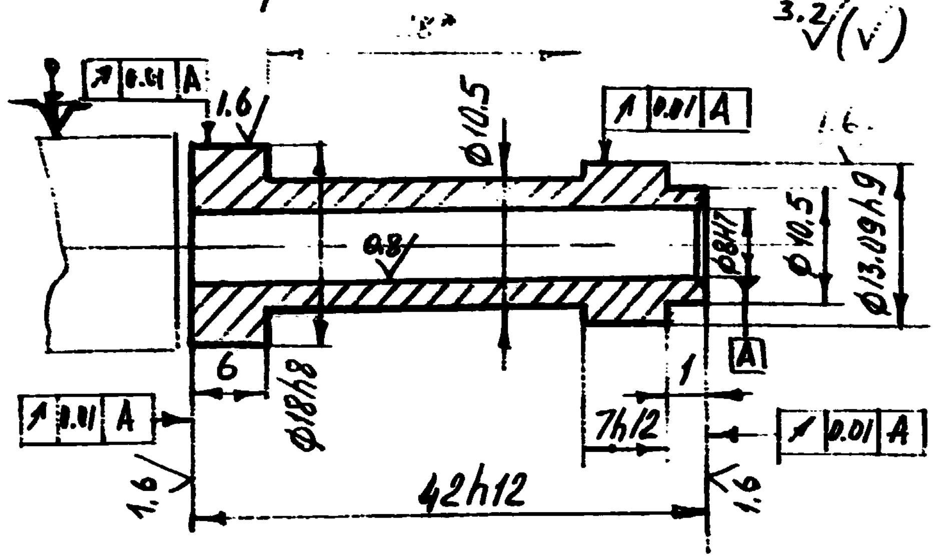
SHEET [illegible] | NUMS OF SHEETS 4

				OPERATION N 2	
	OPERATION CHART	NUMBER OF PIECES	BLANK		
	SEE SHEET 2 (OP. 2)	30.019	SEE SHEET 2 (OP. 1)		
			PROFILE	DIMENSIONS	
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS	
001	MOUNT THE BLANK	MILLING MACHINE PRISM			
002	? CENTRE		CENTRING DRILL		
003	DRILL HOLE ⌀ 2,5H9 MAINTAINING THE SIZE 4±0,1 [illegible]		DRILL ⌀ 2,5H[illegible]		
004	COUNTERSINK 0,3 x 120°±1°		COUNTERSINK		
005	THREAD SCREW M2,5-6H		TAP		
006	REAM ⌀ 3H7		REAMER ⌀ 3H7		
	OPERATION 3				
	COATING : CHEMICAL OXIDATION BLACK				

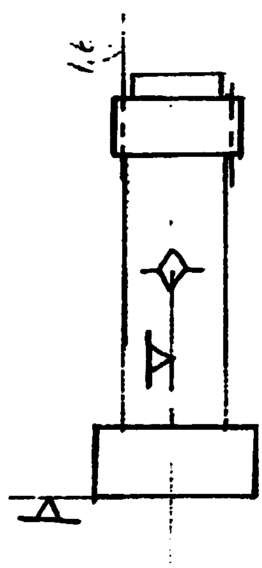
SHEET 3 | NAME OF SHEETS 3

			OPERATION No 1	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
SEE SHEET 2		20.000	PROFILE	DIMENSIONS
			ROUND ALUMINIUM ALLOY	⌀ 20 x 100
No	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 102 3-JAWS CHUCK		
002	FACE		TOOLHOLDER	
003	CENTRE		CENTRING DRILL	
004	DRILL HOLE ⌀ [illegible] TO THE LENGTH 55 mm		DRILL ⌀ [illegible]	
005	TURN ⌀ 10,5, MAINTAINING THE SIZE 1 mm		TOOLHOLDER	SLIDING CALLIPERS
006	TURN ⌀ 17,5 (SPECIAL) MAINTAINING		GROOVE CUTTER	SLIDING CALLIPERS
	THE SIZES 7±0,2, 25±0			
007	TURN ⌀ 16h8 TO THE LENGTH 8 mm		TOOLHOLDER	MICROMETER
008	TURN ⌀ 13,3h9 TO THE LENGTH			
	7h12 mm			
			SHEET 1	[illegible]

Operation 1



Operation 2



$m = 0.5$

$z = 23$

$\beta = 18°$

left

8 - F

$h = 1.125$

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	BORING HOLE ø7, ø7.5, ø7.95		BORING CUTTER	INDICATOR
	FOR THE THREE PASSAGES			
010	TURN CHAMFER 0.5 x 45°		CHAMFER TOOL	
011	REAM ø 8H7		REAMER	
012	CUT OFF TO THE SIZE 42±12 mm			
013	DULL SHARP EDGES		SCRAPER	

SHEET 3	NAME OF SHEETS -

		OPERATION N 2	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 3 (OP. 2)	30,021	SEE SHEET 3 (OP. 1)	
		PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	MILLING GEAR MACHINE		
002	MILL GEAR RING FOLLOWS			
	PARAMETERS :			
	$m=0.5$, $z=33$, $\beta=15°$ LEFT, 8-7, $h=1.125$ m			
	OPERATION 3			
	COATING: ANODIC OXIDATION BLACK.			

SHEET 2	NAME OF SHEETS 3

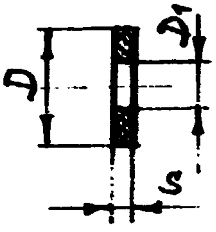
		OPERATION N 1
OPERATION DRAFT	NUMBER OF PIECES	BLANK
SEE SHEET 2	30.033 30.034	

PROFILE	DIMENSIONS
ROUND	⌀ D × L

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SCHAUBLIN - 135 3-JAWS CHUCK		
002	FACE		TOOLHOLDER	
003	CENTRE		CENTRING DRILL	
004	DRILL HOLE ⌀ D1		TOOLHOLDER	
005	TURN ⌀ D H14			
006	CUT OFF, MAINTAINING A SIZE		PARTING OFF TOOL	

SHEET 1	NAME OF [illegible]

Operations 1



Number of piece	D	D_1	S
30.023	10h14	6H14	0.5
30.024	12h14	8.5H14	0.5

		OPERATION N 1	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	30.000	PROFILE	DIMENSIONS
		ROUND STEEL	⌀ 3 x L

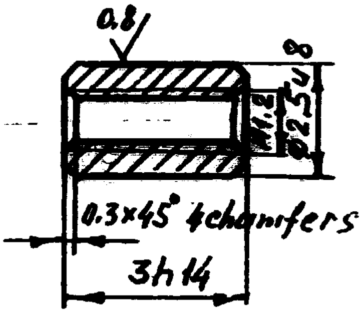
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SCHAUBLIN - 102 TYPE COLLET ⌀ 3 mm		
002	FACE		TOOLHOLDER	
003	CENTRE		CENTRING DRILL	
004	DRILL HOLE ⌀ 1 H9 mm		DRILL ⌀ 1 mm	
005	TURN CHAMFERS 0.2 x 45°		CHAMFER TOOL	
006	TURN ⌀ 2.5h8 TO THE LENGHT 5 mm		TOOLHOLDER	MICROMETER
007	THREAD SCREW M1.2		TAP M1.2	
008	CUT OFF, MAINTAINING THE SIZE 3±[illegible] mm		PARTING OFF CUTTER	SLIDING CALLIPERS
009	DULL SHARP EDGES			

SHEET 1	NUMB OF SHEETS 2

30.028

Operation 1

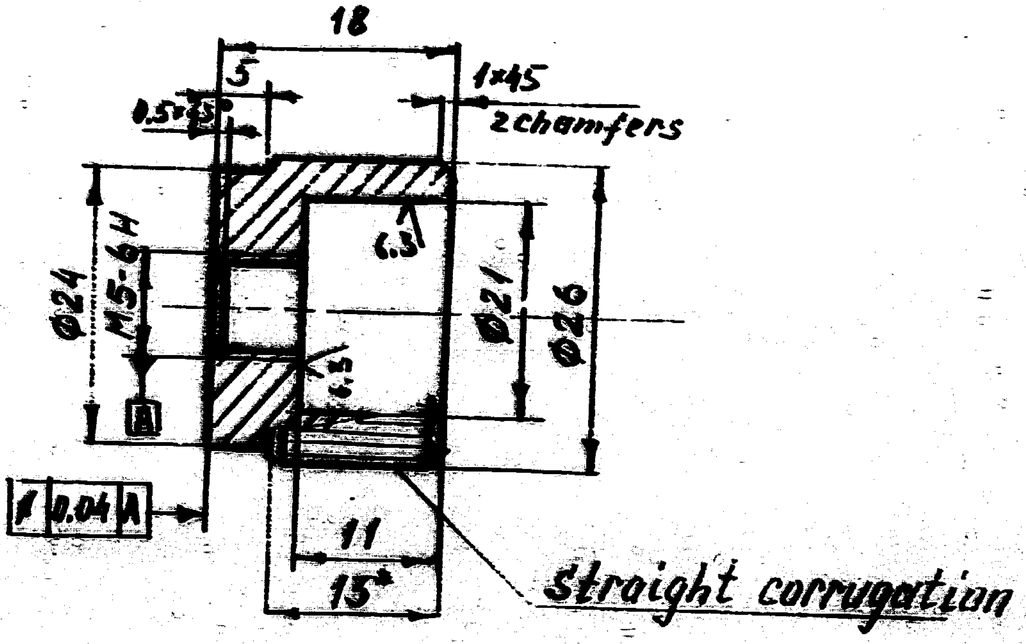
$^{3.2}\sqrt{}(\sqrt{})$



3.1

			OPERATION N 1	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
		30.029		
			PROFILE	DIMENSIONS
			ROUND BRASS	ø28 x 50
No	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 125 3-JAWS CHUCK		
002	FACE			
003	TURN ø 26h14 TO THE 25 mm LENGHT		TOOLHOLDER	SLIDING CALLIPERS
004	TURN CHAMFER 1 x 45°		CHAMFER TOOL	
005	ROLL CORRUGATION t=0.8 l=15 mm		KNURLING	
006	TURN ø 24 MAINTAINING THE SIZES		FORM CUTTER	SLIDING CALLIPERS
	15 mm WITH CHAMFER 1 x 45°			
007	CENTRE		CENTRING DRILL	
			SHEET 1	NAME OF SHEETS 4

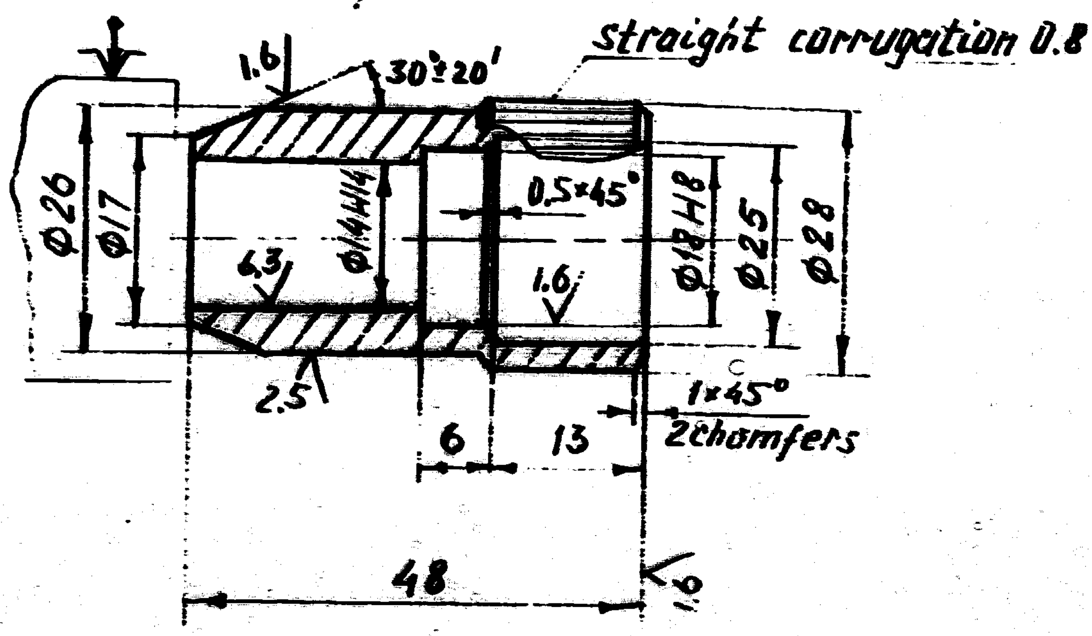
Operation 1


18
5
0.5×45°
1×45
2chamfers
6.3
6.3
Ø24
M5-6H
A
Ø21
Ø26
0.04 A
11
15*
straight corrugation

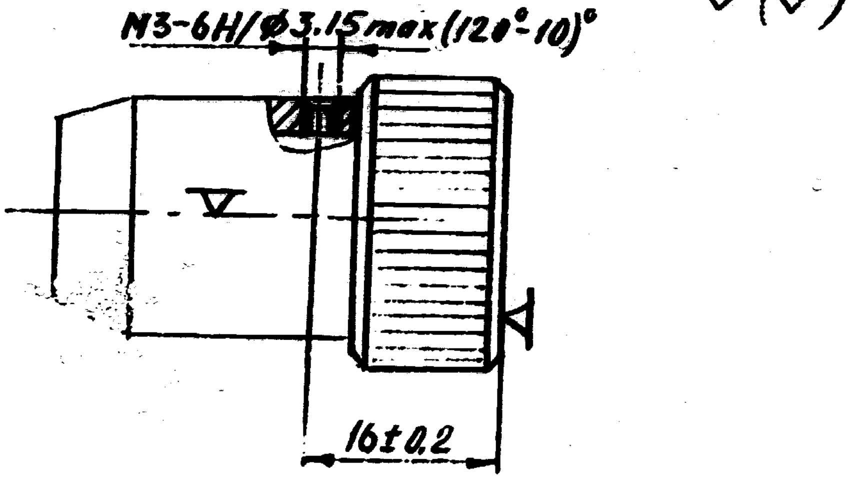
№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
008	DRILL HOLE ø 18 mm TO THE LENGHT 25 mm		DRILL ø 4.3H9	
009	DRILL HOLE ø 18 mm TO THE LENGHT 11 mm		DRILL ø 18H10	
010	BORING HOLE ø 21 mm WITH		BORING CUTTER	
	CUT BOTTOM TO THE LENGHT 11 mm			
012	CUT OFF, MAINTAINING THE SIZE 18 mm		TAP M5	
	OPERATION 2			
	COATING : CHIMICAL OXIDATION OUTSIDE SURFACE TO COAT BY BLACK			
	ENAMEL EXCEPT THE SURFACE B			

SHEET 3	NAME OF SHEETS 4

Operation 1



Operation 2



		OPERATION N 1	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE: SHEET 2	30.031	PROFILE	DIMENSIONS
		ROUND ALUMINIUM ALLOY	ø30 mm

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 125 3-JAWS CHUCK		
002	FACE		TOOLHOLDER	
003	CENTRE		CENTRING DRILL	
004	DRILL HOLE ø 14H14		DRILL ø 14 mm	
005	TURN ø 28h14 mm		TOOLHOLDER	SLIDING CALLIPERS
006	TURN ø 26h14 mm MAINTAINING THE SIZES 13 mm, 50 mm AND		TOOLHOLDER	SLIDING CALLIPERS
	2 CHAMFERS 1 x 45°			
007	BORING HOLE ø 18H8 TO THE LENGTH 13 mm		BORING TOOL	SLIDING CALLIPERS

SHEET 1	NAME OF SHEETS 4

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
008	TURN ø 25H14 TO THE DEPTH 13 mm			
009	TURN CHAMFER 0.5 x 45° 11 mm			
010	TURN CONER (20°±20' MAINTAINING		FORM CUTTER	
	ø 17 mm			
011	CUT OF WORKPIECE TO		PARTING OF CUTTER	
	THE SIZE 48 mm			

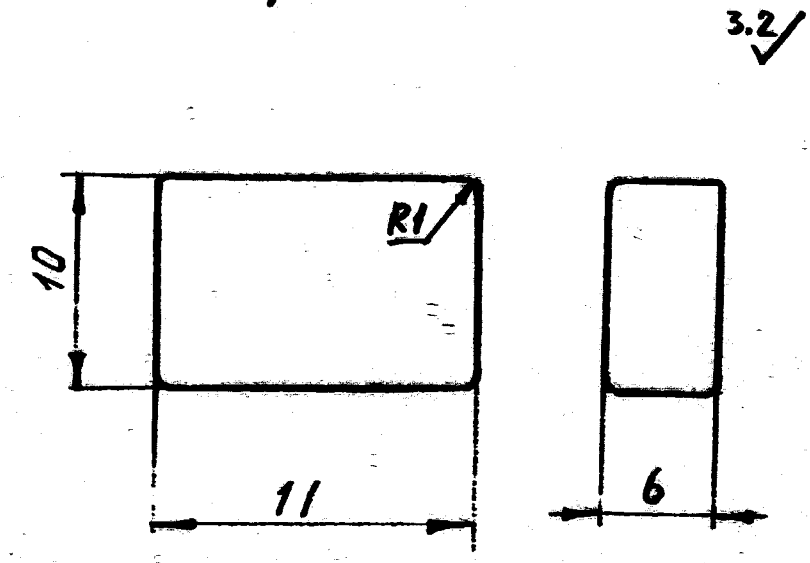
			OPERATION	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
			PROFILE	DIMENSIONS
№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT WORKPIECE	MILLING MACHINE PRISM		
002	CENTRE		CENTRING DRILL	
003	DRILL HOLE ø 2,5MM, MAINTAINING			SLIDING CALLIPERS
	16 ± 0.2			
004	THREAD SCREW M3		TAP M3	
	OPERATION 3			
	ANODIC OXIDATION BLACK OUTSIDE SURFACE TO COAT BY			
	BLACK ENAMEL			

SHEET 3	NAME OF SHEETS 3

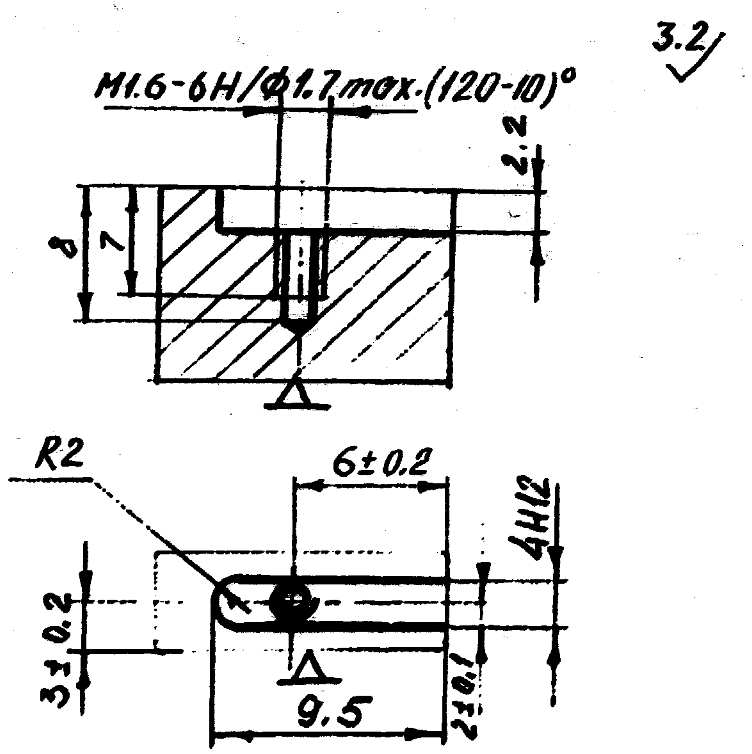
		OPERATION № 1	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2 (OP. 1)	30.032	PROFILE	DIMENSIONS
		SHEET BRASS	6 x 13 x 12

№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK (WITH RESETTING)	MILLING MACHINE VICE		
002	CONTOUR MILL MAINTAINING SIZES SPECIFIED		MILL END	SLIDING CALLIPERS
003	FILL R1 BY CONTOUR		FILE	
	OPERATION 2			
001	MOUNT WORKPIECE			
002	CENTRE MAINTAINING 3±0.2 AND 6 ± 0.2			
002	DRILL HOLE ø 1H7 TO THE DEPTH 8 mm		DRILL ø 1 mm	
004	MILL GROOVE 4H12 TO THE		MILL END	SLIDING CALLIPERS
	DEPTH 2.2 mm, MAINTAINING		ø 4 mm	
	THE SIZE 7.5 mm			
			SHEET 1	NUMBER OF SHEETS 2

Operation 1



Operation 2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
005	COUNTERSINK ø 1.7 / 120-10)°		COUNTERSINK (120°	
006	THREAD SCREW M1.6 TO THE 7 mm DEPTH			
007	DULL SHARP EDGES		FILE	
	OPERATION 2			
	COATING : MAT-FINISH Cu /Cr			

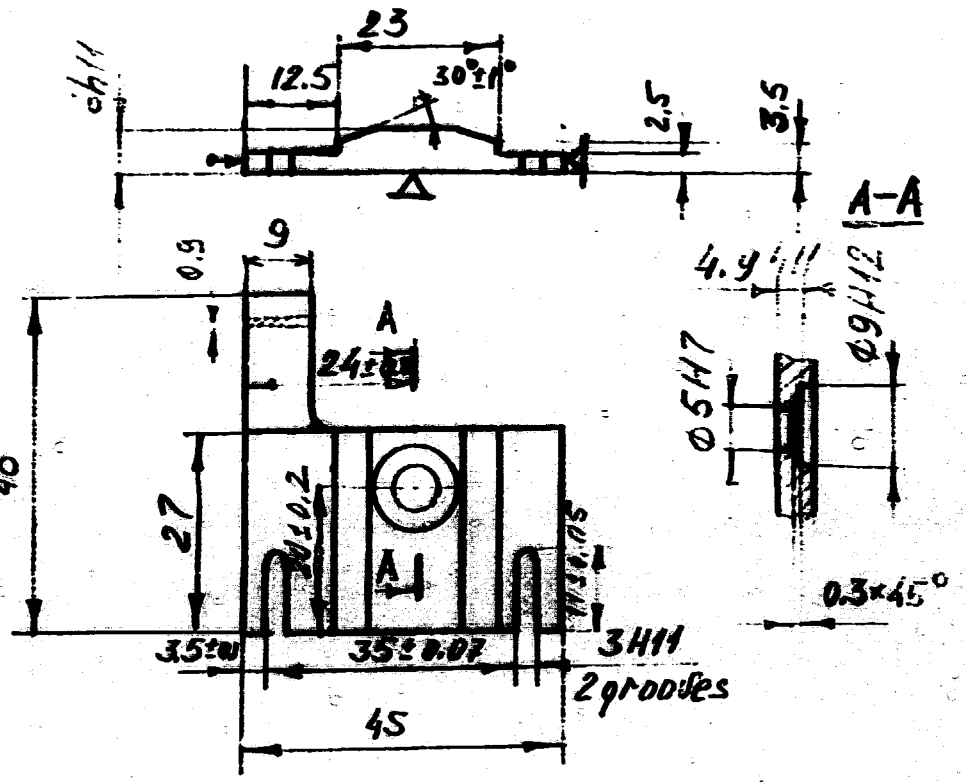
SHEET [illegible]	NAME OF SHEETS 4

		OPERATION [illegible]	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 3	30.036	PROFILE	DIMENSIONS
		SHEET BRASS	5 x 46 x 55

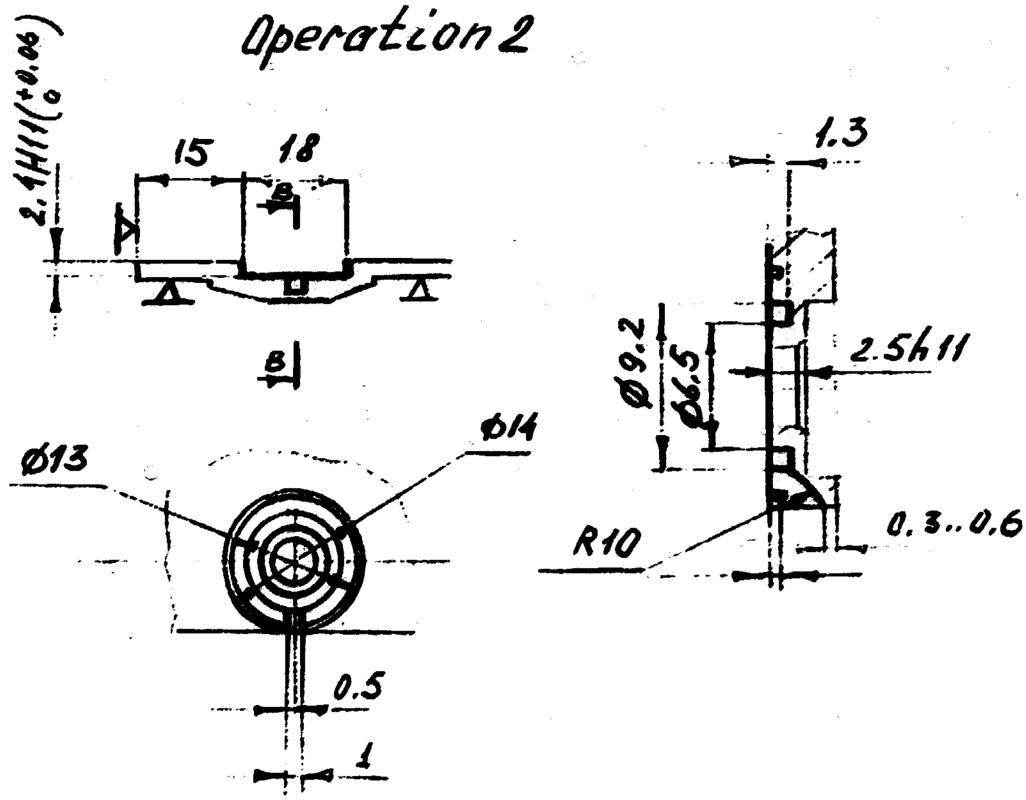
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE BLANK	MILLING MACHINE VICE		
002	CONTOUR MILLING, MAINTAINING SIZES SPECIFIED		MILL END Ø 10 mm	SLIDING CALLIPERS
003	MILL SURFACE MAINTAINING THE SIZES 27h14, 0.9 mm AND 9 mm			
004	TURN TWO GROOVES 3H11,MAINTAINING TO THE SIZES : 3.5±0.1, 55±0.07		MILL END Ø 3 mm	SLIDING CALLIPERS
	AND 11±0.05			
005	CENTRE HOLE MAINTAINING TO THE SIZE 20±0.2 AND 24±0.2		CENTRING DRILL	
006	DRILL HOLE Ø 4.5H7 TO THE BODY SIZE		DRILL Ø 4.5H7	

SHEET 1	NAME OF SHEETS 3

Operation 1



Operation 2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
007	COUNTERBORE ⌀ 9H12, MAINTAINING		COUNTERBORE ⌀ 9H12	
	THE SIZE 4.9h11			
008	COUNTERSINK 0.3 x 45° REAME ⌀ 5H7		COUNTERSINK < 90°	
009	DULL SHARP EDGES		REAMER ⌀ 5H7	
	OPERATION 2			
001	MOUNT WORKPIECE	MILLING MACHINE		
002	MILL GROOVE, MAINTAINING THE		MILL ⌀ 10 mm END	
	SIZES 2.4H11, 15h14, 18H14			
003	TURN GROOVE ⌀ 6.5 AND ⌀ 9.2 mm			
	TO THE DEPTH 1.3 mm			
	OPERATION 3			
	COATING : MAT FINISH Fe / Cr6 EXCEPT THE SURFACE C AND E			

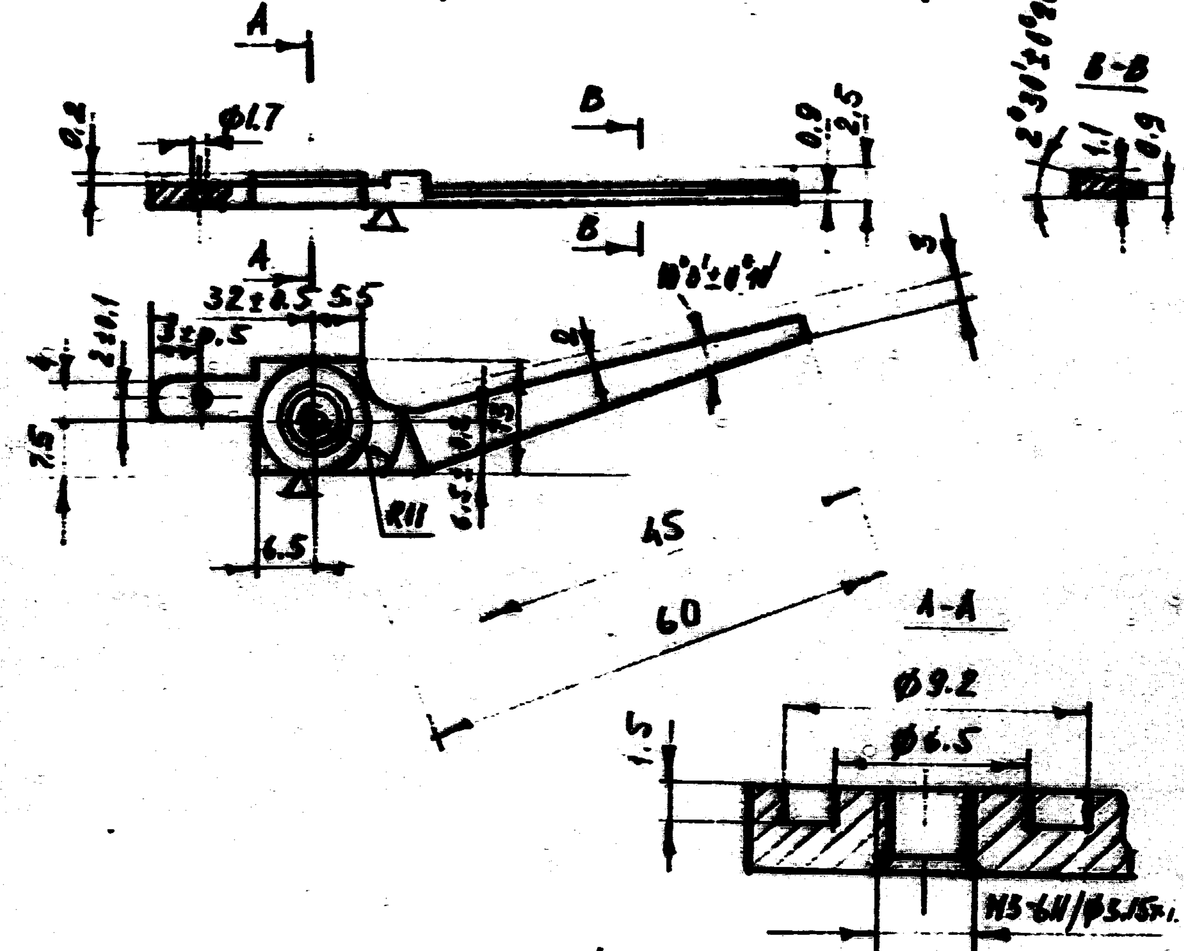
SHEET 3	NAME OF SHEETS 3

OPERATION DRAFT	NUMBER OF PIECES	OPERATION N 1	
		BLANK	
SEE SHEET 2	30.035	PROFILE	DIMENSIONS
		SHEET BRASS	2.5 x 95 x 25

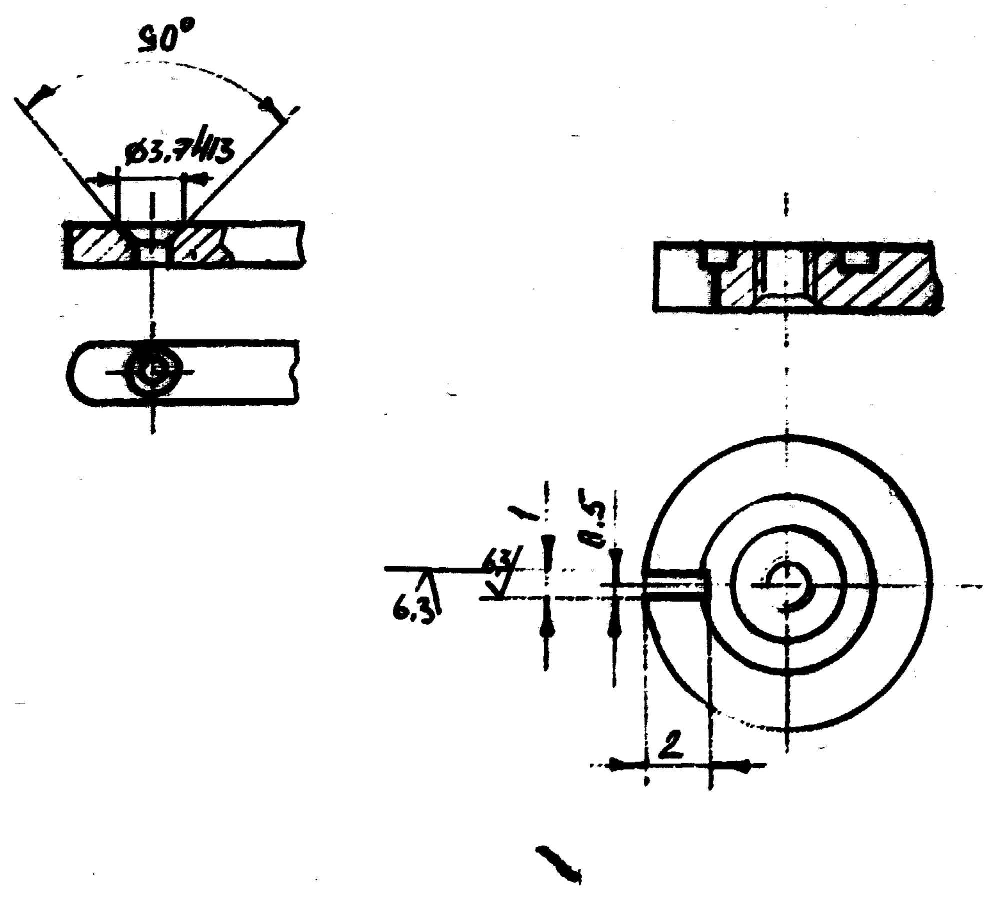
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE BLANK	MILLING MACHINE		
002	DRILL HOLE ø 2.5 FOR SCREW M3		DRILL ø 2.5 mm	
003	COUNTOUR MILLING MAINTAINING SIZES SPECIFIED WITH RESETTING -	ANGLE TABLE	END MILL ø 4.5 mm	SLIDING CALLIPERS
004	MILL SURFACE, MAINTAINING THE SIZES 0.2 AND R1		END MILL ø 4.5 mm	
005	MILL CORNER, MAINTAINING THE SIZES			ANGLEMETRE
	∢ 2°30'± 0°20', 0.9 AND 1.1 mm			SLIDING CALLIPERS
006	DRILL HOLE ø 1.7 mm MAINTAINING THE SIZES 3±0.5 AND 2±0.1		DRILL ø 1.7 mm	
			SHEET 1	NAME OF SHEETS 3

30.03.5
1.6y

Operation 1



Operation 2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 2			
001	MOUNT AND REMOVE WORKPIECE			
002	COUNTERSINK MAINTAINING ∠ 90°		COUNTERSINK ∠ 90°	
	ø 3.7H13			
003	MILL GROOVE MAINTAINING THE SIZES 0.5 mm, 1 mm AND 2 mm			
	OPERATION 3			
	COATING : MAT FINISH Fe / C-5			
			SHEET 1	NAME OF SHEETS 2

ASSEMBLY PROCESS OF THE UNIT 30.010 "DRIVE"

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
1.	COMPLETE ASSEMBLY UNIT 30.010 WITH THE FOLLOWING ELEMENTS : PARTS : RING 30.018 REF. N1 SLEEVE 30.019 REF. N2 SPUR GEAR 30.021 REF. N3 SPUR GEAR 30.022 REF. N4 WASHER 30.023 REF. N5 WASHER 30.024 REF. N6 KNOB 30.029 REF. N7 KNOB 30.031 REF. N8 STANDART UNITS REF. N11 - SCREW M3-6g -1 REF. N12 - SCREW M1.6-6g-1 REF. N13 - NUT M5-6H -1 REF. N14 - WASHER -1 REF. N15 - WASHER -1			
2.	WASHING			
2.1	WASH THE PARTS IN BENZIN AND DRY THEM FOR 15 MIN AT 20°C	ASSEMBLY STAGE	BENZIN TANK , BRASH	
2.2	BRING THE PART REF. N2, 30.019 INTO THE HOLE OF THE PART REF. N3. CHEEK FOR THE EVENNESS OF REF.N2 PART ROTATION : UF THE PART IS ROTATING NONUNIFORMLY OR WITH DIFFICULTY ABRASIVE PAST MUST BE APPLIED.			
2.3	WASH THE PARTS IN BENZIN AND REMOVE THE ABRASIVE. (HOLD THE PARTS IN BOILING WATER FOR 30 min TO COMPLETELY REMOVE THE ABRASIVE)			

ASSEMBLY PROCESS OF THE UNIT 30.010 "DRIVE" (2)

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
2.4	LUBRICATE THE SURFACE OF PART REF.N2 WITH OIL T-2			IN ORDER TO IMPROV FRICTION PROPERTIE ENBRICATION WITH MOLIBDENUM DISUL IS USED
2.5	ASSEMBLE PARTS REF.N2 AND REF.N3, MOUNT WASHER REF.N5, AND SCREW PART REF.N1 30.018 ADJUST RING REF.N1 TO BE CERTAIN THERE NO AXIAL PLAY IS NO AXIAL PLAY WHEN PART REF.N2 IS EVENLY RO-TATING.			
2.6	SECURE POSITION OF REF.N1 WITH SCREW M1.6 REF. N12		SCREW DRIVER	
2.7	INCORPORATE 30.022 REF.N4 INTO THE ASSEMBLED COMPLE-TE SET. CHECK SMOOTH AND EASY RO-TATION. FIT-IN, IF NECESSARY			ABRASIVE PASTE , 2-3mkm GRAIN SIZE.
2.8	WASH CAREFULLY PARTS IN BENZIN. DRY THEM.			COTTON CLOTH
2.9	LUBRICATE PART REF.N4 (SEE ITEM 2.5) MOUNT REF.N4 , TWO WASHERS REF.N6,WASHER REF.N15, SCREW-ON PART REF.N 7 30.029. CONTROL TO HAVE MINIMUM AXIAL PLAY IN A SMOOTH AND EASY ROTA-TION OF PART REF.N4			
2.10	SECURE PART REF.N7 WITH NUT REF.N13 AND WASHER REF.N14			
2.11	INSERT THE ASSEMBLED GEAR SET INTO HOLE OF PART REF.N8 TIGHTENITS SCREWS M3-6g REF.N11		SCREW DRIVER	

ASSEMBLY PROCESS OF THE UNIT 30.020 GUIDE WITH BUSHES

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
1.	COMPLETE THE ASSEMBLY UNIT 30.020 WITH THE FOLLOWING PARTS : GUIDE REF.N1 30.006-1 PIECE BUSH REF.N2 30.028-4 PIECES			
2.	WASHING			
2.1	WASH THE PARTS IN BENZIN AND DRY FOR 15 min AT t=20°C			
2.2	EMBED 4 THREADED BUSHES REF. N2 30.028 INTO HOLES OF PART N1 30.006	BENCH	SCREW PRESS	CHECH ALIGNMENT [illegible] THE BUSH THE F[illegible] TE SURFACE

HOLD - DOWN 30.030 ASSEMBLY

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
1.	COMPLETE ASSEMBLY UNIT 30.010 WITH THE FOLLOWING PARTS : HANDLE 30.032 REF.N1 - 1 PIECE SHAFT 30.033 REF.N3 - 1 PIECE HOLDER 30.034 REF.N5 - 1 PIECE LEVER 30.035 REF.N7 - 1 PIECE SPRING 30.036 REF.N9 - 1 PIECE SCREW 30.032 REF.N12 - 1 PIECE			
2.	WASHING WASH THE PARTS IN BENZIN AND DRY FOR 15 min AT t=20°C	ASSEMBLY CTAGE	TANK FOR BENZIN	
2.1	PUT CPRING 30.036 REF.N9 INTO GROOVE o9.2 OF PART 30.034 REF.N5 SO THAT THE BENT SPRING COIL COULD GET INTO A 1 mm WIDE GROOVE.			
2.2	BRING LEVER 30.035 REF.N7 INTO COINCIDENCE WITH HOLE o5.7H7 AND THE FREE BENT SPRING COIL INTO COINCIDENCE WITH THE LEVER GROOVE FIXING IN WITH SHAFT 30.033 REF.N3 AXIAL TRAVEL SHOULD NOT EXCEED 0.1 mm WHEN THE SHAFT IS COMPLETELY TIGHTENED AND THE LEVER LOAD IS 5N.		BENCH	THREAD OF SHAFT REF.N3 MUST BE LUBRICATED WITH GLUE CEMENT

GENERAL ASSEMBLY " COORDINATE (2)

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
2.3	MOUNT PART 30.032 REF.N1 ON THE LEVER REF.N7 AND SECURE IT WITH SCREWS M6-g REF. N12		SCREW DRIVER	

GENERAL ASSEMBLY " COORDINATAL STAGE " N 30.000

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
1.	COMPLETE ASSEMBLY UNIT 30.000 WITH THE FOLLOWING UNITS AND PARTS : 30.010 "DRIVE" REF.N1 30.020 "GUIDE WITH BUSHES" REF. N2 30.030 "HOLD-DOWN" REF.N3 PARTS : GUIDE - 30.001 - 8 PIECES REF. N19 GUIDE - 30.001-01 - 8 PIECES REF. N19 GUIDE - 30.002 - 1 PIECE REF. N11 GUIDE - 30.003 - 1 PIECE REF. N12 GUIDE - 30.004 - 1 PIECE REF. N13 GUIDE - 30.005 - 1 PIECE REF. N14 SEPARATOR - 30.007 - 2 PIECES REF.N16 SEPARATOR - 30.008 - 2 PIECES REF.N17 RACK - 30.009 - 1 PIECE REF.N19 RACK - 30.011 - 1 PIECE REF.N20 FLANGE - 30.012 - 1 PIECE REF.N22 SCREW - 30.013 - 4 PIECES REF.N24 SPRING - 30.014 - 4 PIECES REF.N25 HOLDER - 30.015 - 1 PIECE REF.N26 STAND - 30.016 - 1 PIECE REF.N27 STANDART UNITS : SCREW A, M1.2-6g REF.N31 2 PIECES SCREWS : SCREW A, M1.6-6g REF.N33 - 4 PIECES SCREW A, M2 -6g REF.N34 - 1 PIECE SCREW B, M2.5-6g REF.N35 - 1 PIECE SCREW B, M2.5-6g REF.N36 - 1 PIECE SCREW B, M3 -6g REF.N37 - 4 PIECES SCREW A, M2 -6g REF.N39 - 6 PIECES SCREW A, M2 -6g REF.N40 - 6 PIECES BALL 2.5 REF.N41 - 40 PIECES SCREW A, M3 -6g REF.N43 - 1 PIECE PIN 148 * 6 REF. N46 - 2 PIECES PIN 148 * 12 REF. N47 - 2 PIECES			

GENERAL ASSEMBLY " COORDINATAL STAGE " N 30.000 (3)

-N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
4.1	WASHING			
2.1	WASH THE PARTS IN BENZIN AND DRY THEM FOR 15min AT t=20°C			
3.	ASSEMBLING PUT 4 PARTS 30.001 REF.N9 INTO THE ASSEMBLY CASE 30.010 REF.N2 SECURING THEM WITH SCREWS REF.N39 N1.2.			
3.1	EMBED 2 PINS REF.N47 AND REF.N46 INTO THE HOLE IN PART 30.005 REF.N14 AND MOUNT TWO SPRINGS 30.014 REF.N25. SET PART 30.002 REF.N11 ON THE PINS AND COMPRESS THE SPRINGS SECURING THE PART 30.002 WITH TWO PINS ø1.6mm			
3.2	MOUNT TWO GUIDES 30.001 REF.N9 SECURING THEM WITH TWO SCREWS REF.N33			
3.3	MOUNT TWO GUIDES 30.001 REF.N9 ON THE OPPOSITE SIDE OF PART 30.005 REF.N14 SECURING THEM WITH SCREWS REF.N39.			
3.4	CHARGE BALLS REF.N41 INTO SEPARATORS 30.007 REF.N16. PUT SEPARATORS WITH BALLS ON THE PINS FROM THE OPPOSITE SIDES OF THE ASSEMBLY IN ITEM 3.3. BRING THE ASSEMBLY WITH SEPARATORS INTO GROOVES OFASSEMBLY REF.N2 30.020 FROM THE OPPOSITE SIDE WITH SCREWS REF.N39. TIGHTEN TWO SCREWS REF.N31		SCREW DRIVER	
3.5	REMOVE TECHNOLOGICAL PINS RELEASING SPRINGS. THE GUIDES MUST TRAVEL SMOOTHLY WITHONT JERKS.			
4.	ASSEMBLY OF THE SECOND COORDINATE TRAVEL GUIDES.			

GENERAL ASSEMBLY " COORDINATAL STAGE " N 30.000 (3)

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
4.1	PUT 4 PARTS 30.001-01 REF.N10 INTO THE GROOVES OF THE ASSEMBLY CASE 30.020 REF.N2 SECURING THEM WITH SCREW WITH REF.N 39 (N1.2).			
4.2	EMBED 2 PINS REF.N46 AND REF.N47 INTO THE HOLE IN PART 30.004 REF.N13 AND MOUNT TWO SPRINGS 30.014 REF.N25. SET PART 30.003 REF.N12 ON THE PINS AND COMPRESS THE SPRINGS, SECURING THE PART 30.003 REF.N12 WITH TWO PINS ø1.6.			
4.3	MOUNT TWO GUIDES 30.001-01 REF.N10 SECURING THEM WITH TWO SCREWS REF.N33		SCREW DRIVER	
4.4	MOUNT TWO GUIDES 30.001-01 REF.N10 ON THE OPPOSITE SIDE OF THE PART 30.004 REF.N13, SECURING THEM WITH SCREWS REF.N39.			
4.5	CHARGE BALLS REF.N41 INTO SEPARATORS 30.008 REF.N17 PUT SEPARATORS WITH BALLS ON THE PINS FROM THE OPPOSITE SIDES OF THE ASSEMBLY IN ITEM 4.4. BRING THE ASSEMBLY WITH SEPARATORS INTO GROOVE OF ASSEMBLY REF.N2 30.002 FROM THE OPPOSITE SIDE WITH SCREW REF.N39. FROM THE OPPOSITE SIDE WITH SCREWS			
4.6	TIGHTEN SCREW REF.N35 REMOVE TECHNOLOGICAL PINS RELIASING SPRINGS. THE GUIDES MUST TRAVEL SMOOTHLY WITHOUT JERKS.			
5.	ASSEMBLY DRIVE WITH RACKS			
5.1	MOUNT AASEBLY 30.010 REF.N1 INTO THE HOLE CASE, SECURING DRIVE WITH SCREW			

GENERAL ASSEMBLY " COORDINATAL STAGE " N 30.000 (4)

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
	REF.N36. MOUNT RACK 30.011 REF.N20, SECURING HER WITH SCREW REF.N37 PRILIMINARY. THE TRAVEL MUST BE SMOOTHLY. SECURING SCREWS REF.37 FINISH.			
5.2	MOVE GUIDE SECOND COORDINATE OF TRAVEL IN THE EXTREM POSITION. RACK 30.009 REF.N19 SECURING WITH SCREWS REF.N34 PRELIMINARY. ADJUSTING CLEARANCE BETWEEN SPUR GEAR AND RACK, SECURING THE SCREWS FINISH .		SCREW DRIVER	
6.	MOUNT PART 30.012 REF.N22, SECURING HER WITH 6 SCREWS REF.N40. THE PART 30.016 REF.N27 SECURING WITH TWO SCREWS REF.N37.			
7.	MOUNT THE PART 30.015 REF.N26, SECURING HER WITH TWO SCREWS 30.013 REF.N24.			
8.	MOUNT ASSEMBLY 30.030 REF.N30 , SECURING HER WITH TWO SCREWS 30.013 REF.N24 .			

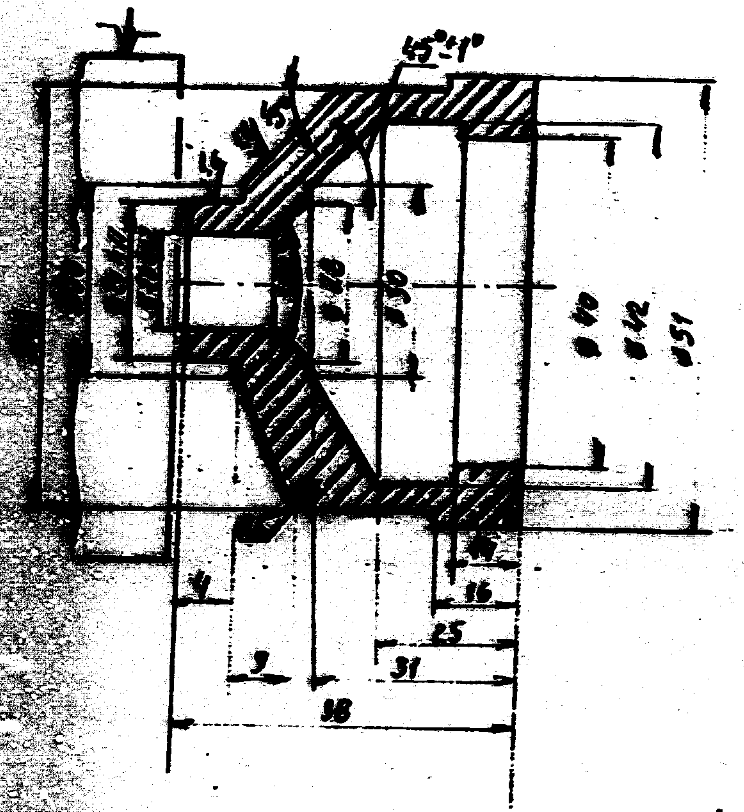
OPERATION DRAFT	NUMBER OF PIECES	OPERATION	
		BLANK	
SEE SHEET (2, 3)	50.005	PROFILE	DIMENSIONS
		ROUND BAR BRASS	ø 52 * 50

№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 125 3-JAWS CHUCK		
002	CUT THE END		TOOLHOLDER	
003	CENTRE		CENTRING DRILL	
004	DRILL HOLE ø 15 mm TO THE DEPTH 45 mm		DRILL ø 15 mm	SLIDING CALLIPERS
005	BORE HOLE ø 20 H12 TO THE DEPTH 45 mm		BORING CUTTER	SLIDING CALLIPERS
006	BORE HOLE ø 30 H12 TO THE LENGHT 31h14 WITH CUT END		BORING CUTTER	SLIDING CALLIPERS
007	BORE HOLE ø 40 H14 TO THE LENGHT 25 mm		BORING CUTTER	SLIDING CALLIPERS
008	TURN GROOVE ø 42 H14 , MAINTAINING TO THE SIZES 25 AND 14 mm		FORMING CUTTER	DEPTHMETER MICROMETER

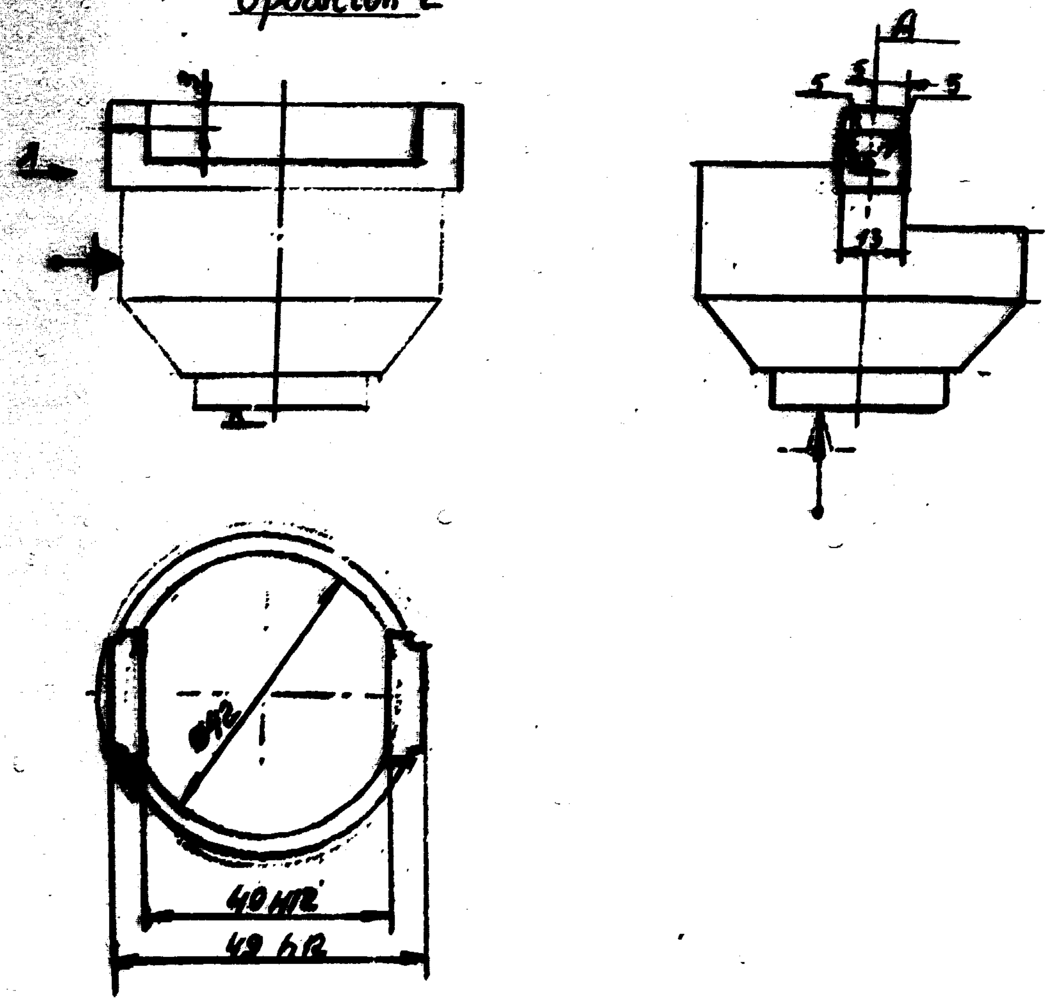
SHEET 1	NAME OF SHEETS 6

Operation 1

50.005
32



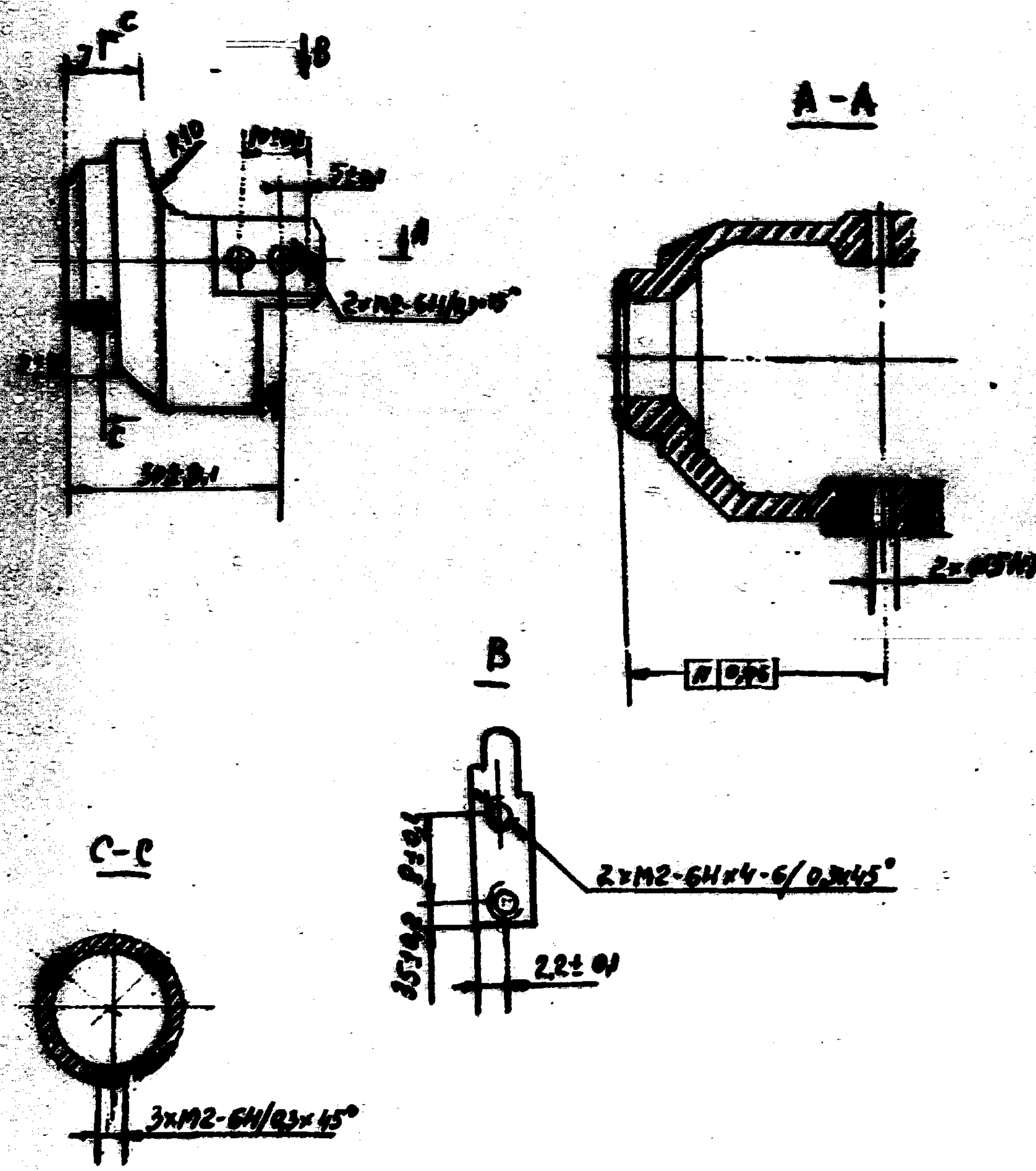
Operation 2



50.005

6.3

Operation 3



№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	TURN CONE < 120° ± 1°		FORM CUTTER	
010	TURN CONE < 45° ± 1°		FORM CUTTER	
011	TURN ⌀ 51 mm TO THE 45 mm LENGTH		TOOLHOLDER	SLIDING CALLIPERS
012	TURN ⌀ 48h14 , MAINTAINING TO THE SIZE 14 mm AND 45 mm		FORM CUTTER	
013	TURN GROOVE ON THE LEFT SIDE OF WORKPIECE, MAINTAINING TO THE		FORM CUTTER	SLIDING CALLIPERS
	SIZES 34 mm , ⌀ 24h11 AND 7 mm			
014	TURN CONE < 45°		TOOLHOLDER	ANGLEMETER
015	FILE R 5		FILE	
016	DULL SHARP EDGES		FILE	
017	CUT OFF WORKPIECE , MAINTAINING THE SIZE 38 mm			SLIDING CALLIPERS
	OPERATION 2	MILLING MACHINE DIVIDING AT-		
001	MOUNT AND REMOVE THE BLANK	TACHMENT		
002	MILL GROOVE, MAINTAINING THE SIZES 4.5h12, 40h12 TO THE		MILL END ⌀ 10 mm	SLIDING CALLIPERS
	14.5 mm DEPTH			
			SHEET 4	NAME OF SHEETS 6

№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
003	MILL TWO SHOULDER, MAINTAINING THE SIZES 48h12, 4.5h12, 3 mm,		MILL END ø 10 mm	
	13 AND 5 mm			
004	FILE R5		FILE	
	OPERATION 3			
001	MOUNT AND REMOVE THE WORKPIECE	MILLING MACHINE DIVIDING ATTACHMENT		
002	MILL R10 mm , MAINTAINING THE SIZES 7 mm			
003	CENTRE AT MARKING OUT THE HOLE ø 5H7, TWO HOLES M2, MAINTAINING		CENTRING DRILL	
	THE SIZES 30±0.1, 5±0.1, 10±0.1 AND TWO HOLES			
	M2, MAINTAINING THE SIZES 3.5±0.1, 8±0.1 AND 2.2±0.1			
004	DRILL HOLE ø 4.9h9 FOR REAMER		DRILL ø 4.9	
005	REAMER HOLE ø 5H7		REAMER ø 5H7	
006	DRILL 2 HOLES ø 1.7 mm TO THE BODY SIZE		DRILL ø 1.7h9	
007	DRILL 2 HOLES ø 1.7 mm TO THE 6 mm DEPTH		DRILL ø 1.7h9	
008	CUT THREAD IN TWO HOLES TO THE BODY SIZE M 2		TAP M 2	
			SHEET 5	NO. OF SHEETS 6

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	CUT THREAD IN THE HOLES TO THE 4 mm DEPTH		TAP M 3	
010	CENTRE AT MARKING OUT		CENTRING DRILL	
	THREE HOLES M2, MAINTAINING THE SIZE 2 ±0.1			
011	DRILL 3 HOLES TO THE BODY SIZE		DRILL ⌀ 1,7 mm	
012	COUNTERSINK 3 HOLES 0.3 x 45°		COUNTERSINK ∠ 90°	
013	CUT THREAD IN 3 HOLES M 2 TO THE BODY SIZE		TAP M 2	
014	DULL SHARP EDGES		FILE, SCRAPER	
	OPERATION 4			
	COATING : CHEMICAL OXIDATION			
	OUTSIDE SURFACE - BLACK ENAMEL, EXEPT THE SURFACE B			

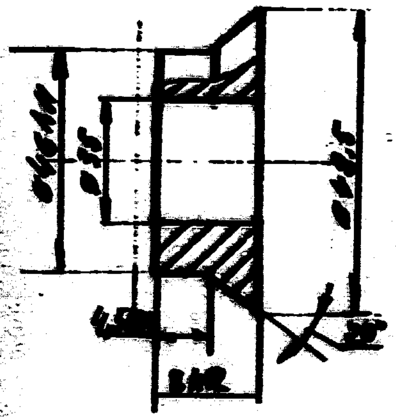
SHEET 6	NAME OF SHEETS 6

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	50.000		
		PROFILE	DIMENSIONS
		ROUND BAR BRASS	ø 50 × 20

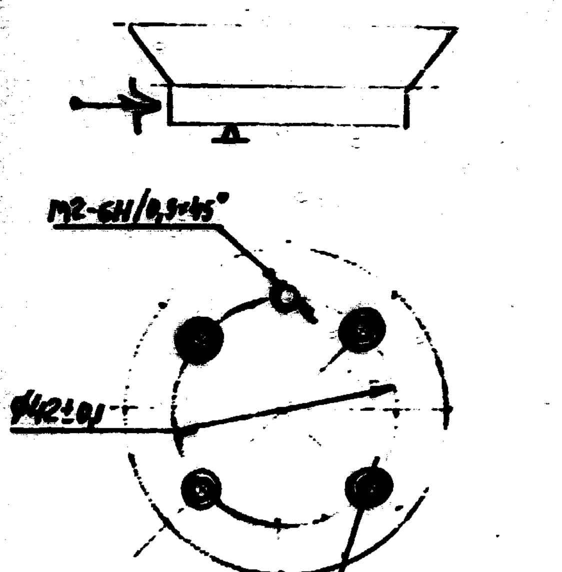
№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE BLANK	SHAUBLIN - 1215 3-JAWS CHUCK		
002	CUT THE END		TOOLHOLDER	
003	CENTRE		CENTRING DRILL	
004	DRILL HOLE AND BORING HOLE ø 35H14 TO THE		DRILL ø 20 mm BORING CUTTER	SLIDING CALLIPERS
	14 mm DEPTH			
005	TURN ø 48.5 mm			
006	TURN CONER < 20° AND ø 46h11 , MAINTAINING THE		FACING TOOL	SLIDING CALLIPERS
	SIZE 3.5H11			
007	CUT OFF WORKPIECE , MAINTAINING THE SIZE 8h 12		PARTING OFF CUTTER	

SHEET 1	NAME OF SHEETS 3

Operation 1



Operation 2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 3	MILLING MACHINE		
001	MOUNT AND REMOVE THE BLANK	DIVIDING ATTACHMENT		
002	CENTRE FOUR HOLES AT MAKING OUT MAINTAINING THE		CENTRE DRILL	
	SIZE ⌀ 42 ± 0.1			
003	CENTRE HOLE M2		CENTRE DRILL	
004	DRILL FOUR HOLES ⌀ 2.4H12 TO THE BODY SIZE		DRILL ⌀ 2.4H12	
005	COUNTER BORE FOUR HOLES ⌀ 4.3 mm TO THE 1.6 mm		COUNTERSINK ⌀ 4.3 mm	
	DEPTH			
006	DRILL HOLE ⌀ 1.7 mm TO THE BODY SIZE		DRILL ⌀ 1.7 mm	
007	CUT THREAD M2 TO THE BODY SIZE BODY SIZE		TAP M 2	
	OPERATION 3			
	COATING : CHEMICAL OXIDATION			

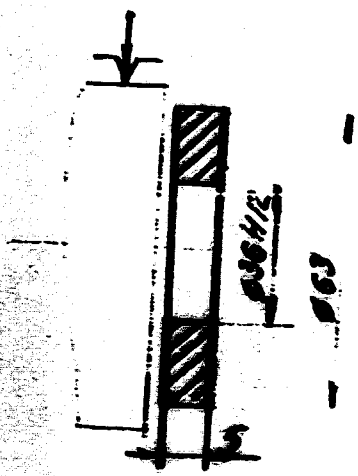
SHEET 3	NAME OF SHEETS 3

			OPERATION	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
SEE SHEET 2		50.012	PROFILE	DIMENSIONS
			ROUND SHEET STEEL	ø 5*22*15
№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK WITH RESETTING	MILLING MACHINE		
002	MILL THE END		TOOLHOLDER	
003	CENTRE		CENTRING DRILL	
004	DRILL HOLE ø 10H14 TO THE 10 mm DEPTH		DRILL ø 10 mm	SLIDING CALLIPERS
005	DRILL HOLE 20 mm TO THE 10 mm DEPTH		DRILL ø 20 mm	SLIDING CALLIPERS
006	BORE HOLE ø 36H12 mm		BORING CUTTER	
007	TURN ø 63h14 TO THE 10 mm LENGTH MAINTAINING THE		TOOLHOLDER	
008	DULL SHARP EDGES		FILE	
			SHEET 1	NAME OF SHEETS 4

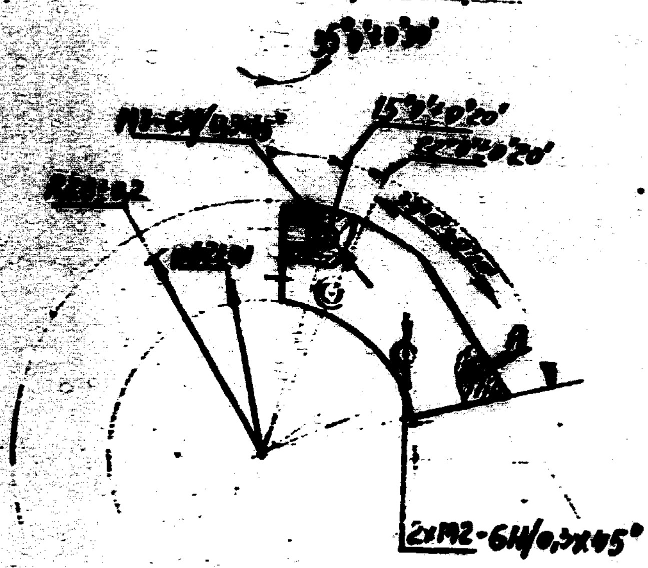
50.011

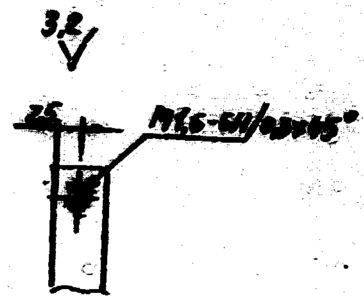
3,2

Operation 1

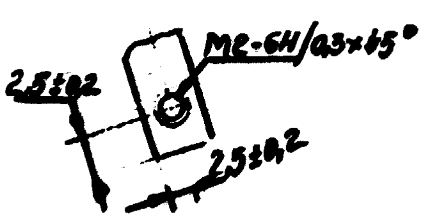


Operation 2





A



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	CUT OFF WORKPIECE, MAINTAINING		PARTING OFF CUTTER	
	THE SIZE 6 mm			
010	RESETT WORKPIECE			
011	CUT END MAINTAINING		TOOLHOLDER	SLIDING CALLIPERS
	THE SIZE 5h14 mm			
	OPERATION 2			
001	MOUNT AND REMOVE THE	MILLING MACHINE		
	WORKPIECE	DIVIDING ATTACHMENT		
002	CENTRE THE HOLE AT MAKING OUT, MAINTAINING THE SIZE R2? ± 0.2		CENTRING DRILL	
	AND ANGLE 15°0' ± 0°20'			
003	CENTRE THE 3 HOLES AT MAKING OUT, MAINTAINING THE SIZES		CENTRING DRILL	
	⌀ 42 ± 0.1, ANGLE 22°30' ± 0°30', 65°0' ± 0°20'			
004	DRILL HOLE ⌀ 2.5 TO THE BODY SIZE		DRILL ⌀ 2.5	
005	DRILL TWO HOLES ⌀ 1.7 mm TO THE BODY SIZE		DRILL ⌀ 1.7 mm	
			SHEET 3	NAME OF SHEETS 4

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
006	COUNTERSINK THREE HOLES 0.3 x 45°		COUNTERSINK (90°	
007	MILL PLATE, MAINTAINING ANGLE 30°0' ±0°30' AND THE SIZE			
	30 ± 0.3 mm			
008	CUT OFF THE WORKPIECE, MAINTAINING THE ANGLE 45°0' ± 30'			
	AND 1 mm			
009	FILE R2 (BENCH WORKING)		FILE	
010	DULL SHARP EDGES		FILE	
011	DRILL HOLE 1.3 mm WITH COUNTERSINK 0.3 x 45°, MAINTAINING THE		DRILL 1.3 mm COUNTERSINK	
	SIZE 2.5 ± 0.2			
012	CUT THREAD M 1.6		TAP M 1.6	
	AND ANGLE 45°0' ± 0°30'			
013	DRILL HOLE ⌀ 1.7 mm TO THE 6 mm DEPTH, MAINTAINING THE SIZE		DRILL 1.7 COUNTERSINK	
	2.5 ± 0.2 mm			
014	CUT THREAD M 2 TO THE 4 mm DEPTH		TAP M 2	
	OPERATION 2 CHEMICAL OXIDATION [illegible]			

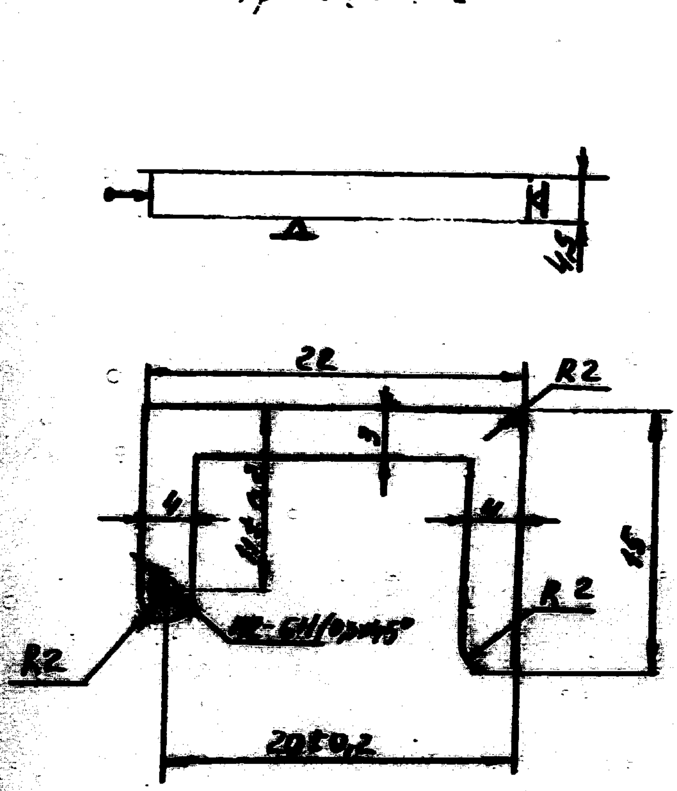
OPERATION

OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	50.012	PROFILE	DIMENSIONS
		ROUND SHEET STEEL	ø 5*22*15

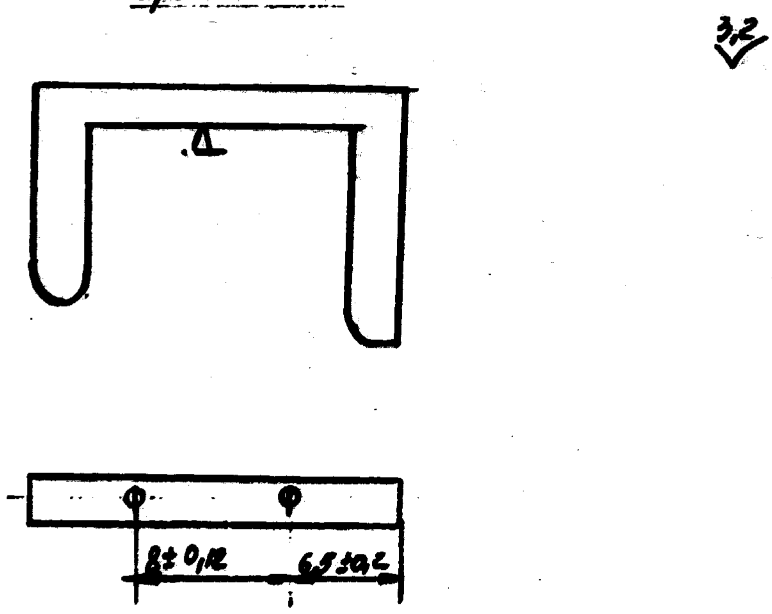
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK WITH RESETTING	MILLING MACHINE		
002	MILL TWO OUTSIDE SURFACES MAINTAINING THE SIZE 4.5 mm	VICE	END MILL ø 20 mm	SLIDING CALLIPERS
003	MILL INSIDE PLATES, MAINTAINING THE SIZES 4 mm, 3 mm AND		END MILL ø 10 mm	
	13 mm (11 ±0.3 + R2)			
004	DRILL HOLE ø 1.7, WITH COUNTERSINK 0.3 x 45° , MAINTAINING THE SIZE		DRILL ø 1 COUNTERSINK	
	11 ± 0.2 TO THE BODY SIZE		< 90°	
005	CUT THREAD M 2		TAP M 2	
006	FILE R 2 (BRENCH - WORKING)		FILE	
			SHEET 1	NAME OF SHEETS 3

Operation 1

50.012



Operation 2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 2			
001	MOUNT THE WORKPIECE	MILLING MACHINE VICE		
002	CENTRE TWO HOLES		CENTRING DRILL	
003	DRILL TWO HOLES ⌀ 2.4 TO THE		DRILL ⌀ 2.4	
	BODY SIZES 6.5 ± 0.2 AND 8 ± 0.12			
	OPERATION 3			
	COATING : CHEMICAL OXIDATION			
	EXCEPT THE SURFACE A			
			SHEET 3	NAME OF SHEETS 3

		OPERATION
OPERATION DRAFT	NUMBER OF PIECES	BLANK
SEE SHEET 2	50.013	

PROFILE	DIMENSIONS
ALUMINIUM ALLOY SEET	10 * 32 * 12

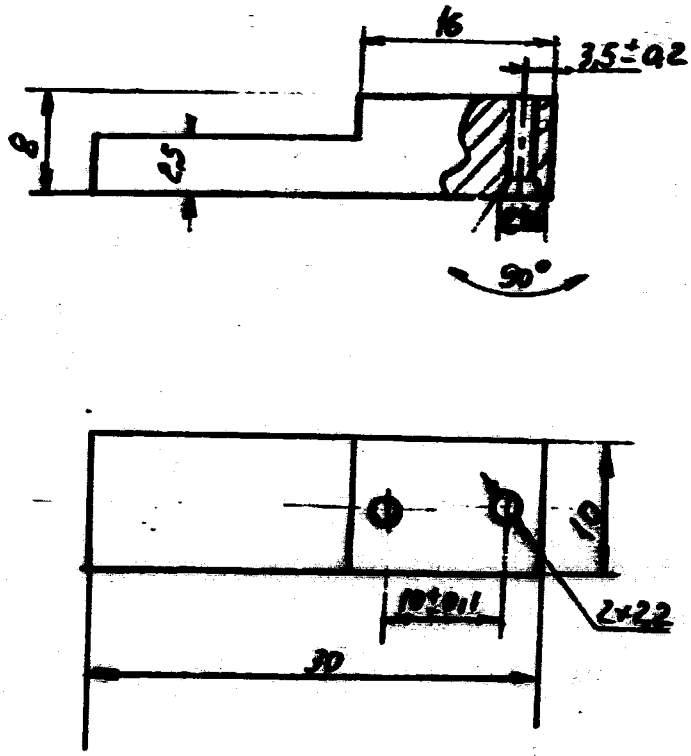
N.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE BLANK	MILLING MACHINE VICE		
002	CONTUR MILL, MAINTAINING THE		END MILL CUTTER Ø 10 mm	SLIDING CALLIPERS
	SIZES 8 * 10 * 30 (R 1.6)			
003	MILL SHOULDER, MAINTAINING THE SIZES 2.5 mm AND 5 mm		END MILL CUTTER Ø 5 mm	SLIDING CALLIPERS
004	DRILL TWO HOLES Ø 2.2 mm , MAINTAINING THE SIZES 3.5 ± 0.2,		DRILL Ø 2.2 mm	
	10 ± 0.1 mm			
005	RETURN WORKPIECE			
006	COUNTERSINK TWO HOLES, MAINTAINING THE SIZES Ø 4.6 mm AND ∠ 90°		COUNTERSINK	

SHEET 1	NAME OF SHEETS 2

50.013

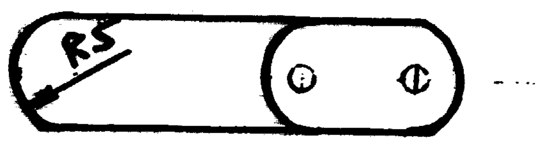
Operation 1

3,2



Operation 2

3,2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 2			
	BRENCH - WORKING			
	FILE [illegible]		FILE	
	OPERATION 3			
	ANODIC OXIDATION BLACK			
	ENAMEL EXEPT THE			
	SURFACE A AND THE HOLES			
			SHEET [illegible]	NAME OF SHEETS [illegible]

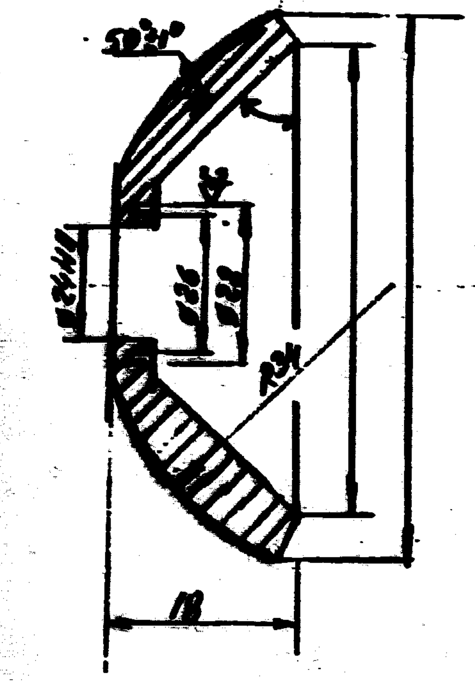
		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET [illegible]	50.000		
		PROFILE	DIMENSIONS
		ALUMINIUM ALLOY ROUND BAR	⌀ 65 × [illegible]

№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE BLANK	SHAUBLIN - 125 3-JAWS CHUCK		
002	CUT END		TOOLHOLDER	
003	CENTRE		CENTRING DRILL	
004	DRILL HOLE ⌀ 10 mm TO THE LENGTH 25 mm		DRILL ⌀ 10 mm	SLIDING CALLIPERS
005	DRILL HOLE 20 mm TO THE LENGTH 25 mm		DRILL ⌀ 20 mm	SLIDING CALLIPERS
006	BORE HOLE ⌀ [illegible]		BORING CUTTER	SLIDING CALLIPERS
007	BORE HOLE ⌀ [illegible] TO THE DEPTH [illegible] mm		BORING CUTTER	SLIDING CALLIPERS
008	TURN CONE [illegible], MAINTAINING THE SIZE FROM ⌀ 55 TO ⌀ [illegible] mm		BORING CUTTER	SLIDING CALLIPERS
			SHEET 1	NAME OF SHEETS 4

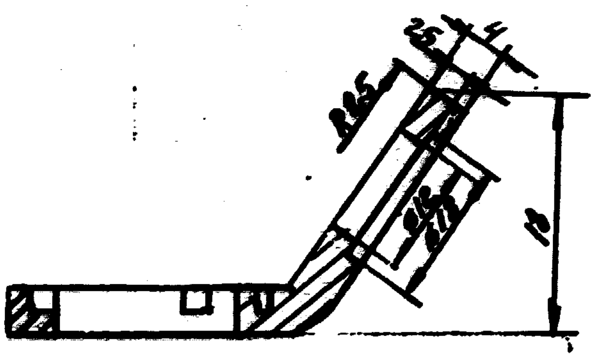
50.021

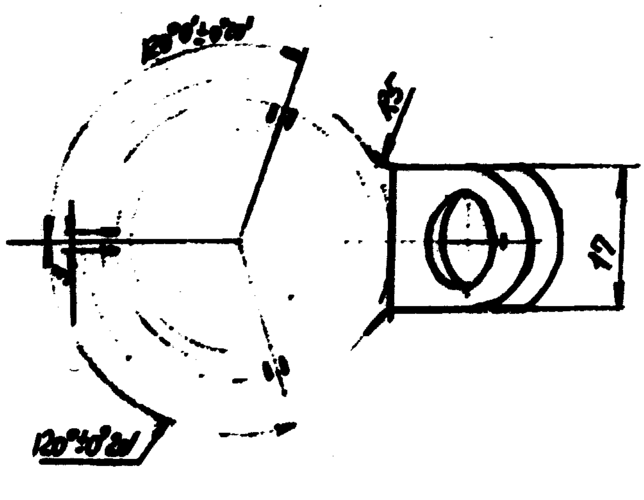
3.2

Operation 1



Operation 2





N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	TURN GROOVE ⌀ 26 AND ⌀ 28 mm TO THE DEPTH 5H14		GROOVE CUTTER	
010	TURN SPHERE R36,		PAINTING CUTTER	
	MAINTAINING ⌀ 55			
011	CUT END UNDER ANGLE 40°		TOOLHOLDER	
012	DULL SHARP EDGES		FILE	
013	CUT OFF WORKPIECE , MAINTAINING		PARTING OFF	
	THE SIZE 18h14		CUTTER	
	OPERATION 2			
001	MOUNT AND REMOVE THE BLANK	MACHINE ANGLE STAGE		
002	MILL CONTOUR, MAITAINING THE SIZE : R15 , R5 AND		MILL END ⌀ 10 mm	
	17 mm			
003	MILL 3 GROOVES 5H14 TO		MILL END ⌀ 3 mm	
	THE 2 mm DEPTH			
004	RESETT THE WORKPIECE			

SHEET 3 | NAME OF SHEETS 4

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
005	MILL INSIDE AND OUTSIDE PLATE, MAINTAINING ANGLE 90° AND THE		MILL END CUTTER ⌀ 30	
	SIZE 4 mm			
006	CENTRE AT MARKING OUT THE AXIS OF HOLE ⌀ 12		CENTRING DRILL	
007	DRILL ⌀ 10 mm TO THE BODY SIZE		DRILL ⌀ 10	
008	COUNTER BORE THE HOLE ⌀ 12H12		COUNTER BORE ⌀ 12	
009	COUNTER BORE THE HOLE ⌀ 14H12		COUNTER BORE ⌀ 14	
	OPERATION 3			
	BENCH - WORKING			
	FILE R 5.5 mm		FILE	
	OPERATION 4			
	COATING : ANODIC OXIDATION BLACK			

SHEET 4	NAME OF SHEETS -

OPERATION

OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	50.025	PROFILE	DIMENSIONS
		ALUMINIUM ALLOY ROUND BAR	ø 60 * 50

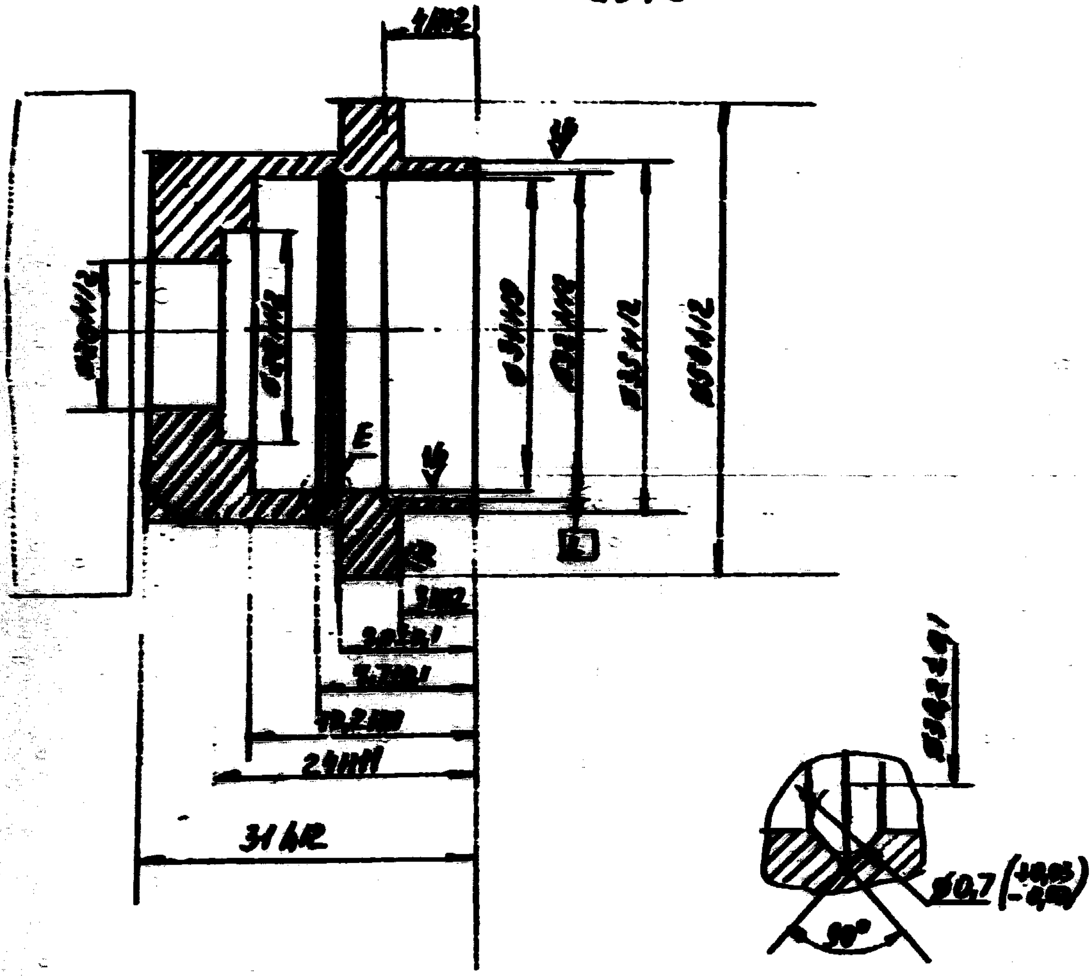
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 125 3-JAWS CHUCK		
002	CUT END		TOOLHOLDER	
003	CENTRE		CENTRING DRILL ø 3	
004	DRILL HOLE ø 10H12 FOR THE NEXT PASSES TO THE DEPTH 35 mm		DRILL ø 10 mm	SLIDING CALLIPERS
005	BORE HOLE ø 12H12 TO THE DEPTH 35 mm		BORING CUTTER	SLIDING CALLIPERS
006	BORE HOLE ø 29H12 TO THE 24H11 DEPTH WITH FACE		BORING CUTTER	SLIDING CALLIPERS
007	BORE HOLE ø 31H9 TO THE DEPTH 19.2H11		BORING CUTTER	SLIDING CALLIPERS
008	BORE HOLE 32H12 TO THE 4H13 DEPTH		BORING CUTTER	SLIDING CALLIPERS
			SHEET 1	NAME OF SHEETS 6

Operation 1

50.022

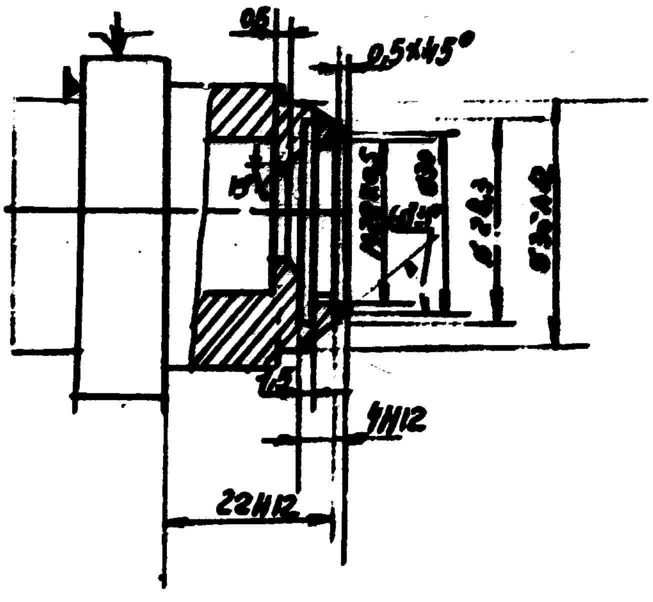
$\overset{3.2}{\nabla}$(v)

Push 1



Push 2

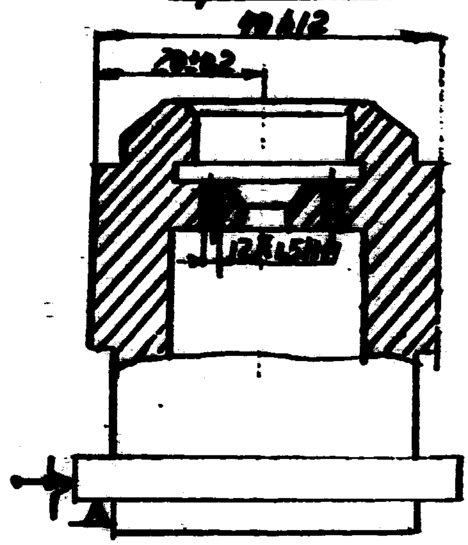
$\overset{3.2}{\nabla}$(v)

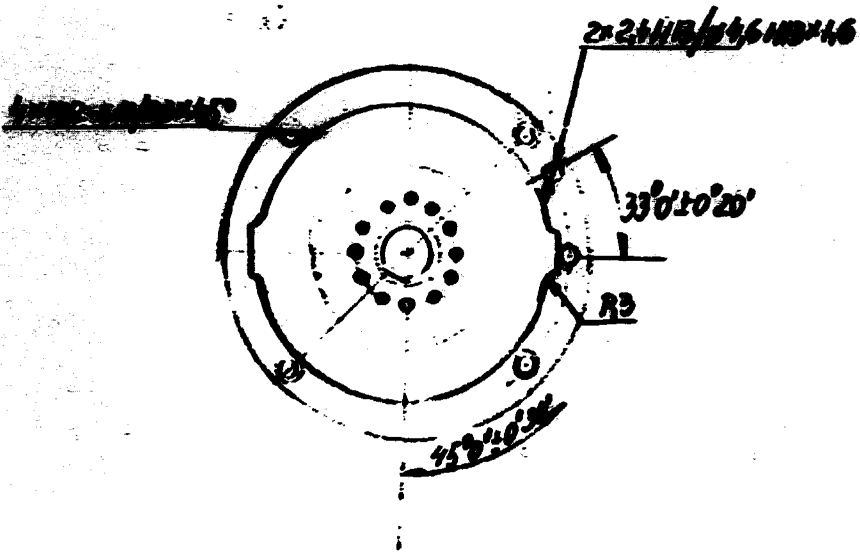


N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	TURN GROOVE, MAINTAINING THE SIZES 5.7 ±0.1, ∠ 90° AND		FORM CUTTER	SLIDING CALLIPERS
	⌀ 30.2 ± 0.1			
010	TURN ⌀ 53h12 TO THE 35 mm LENGTH		TOOLHOLDER	SLIDING CALLIPERS
011	TURN ⌀ 35h12 TO THE 3h12 LENGTH		TOOLHOLDER	SLIDING CALLIPERS
012	TURN ⌀ 42h14, MAINTAINING THE		TOOLHOLDER	SLIDING CALLIPERS
	SIZES 3 ± 0.1 AND 35 mm WITH CUT END			
013	DULL SHARP EDGES		FILE	SLIDING
014	CUT OFF, MAINTAINING THE SIZE 31h12		PARTING OFF TOOL	CALLIPERS
	OPERATION 2			
001	MOUNT AND REMOVE WORKPIECE			
002	CUT END MAINTAINING THE SIZE 22h12		TOOLHOLDER	
003	TURN HOLE ⌀ 27.5 H9 TO THE 4h12 DEPTH		BORING CUTTER	SLIDING CALLIPERS
004	TURN GROOVE ⌀ 28.3h14 × 1.5 WITH CUT END 4h12		GROOVE CUTTER	
			SHEET 4	NAME OF SHEETS 5

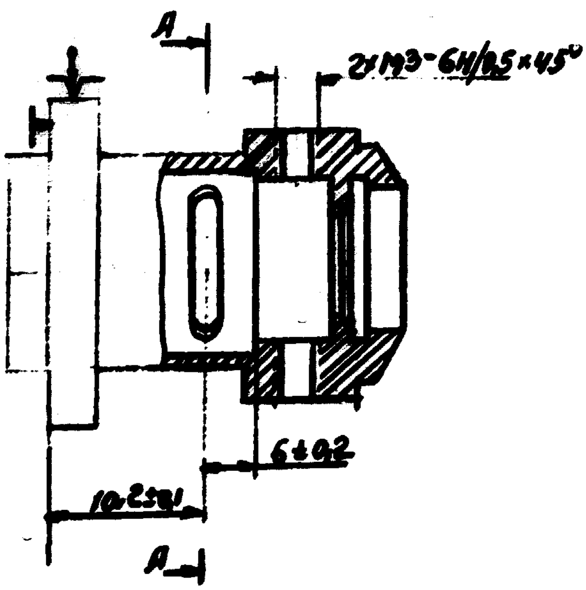
2

Operation 2

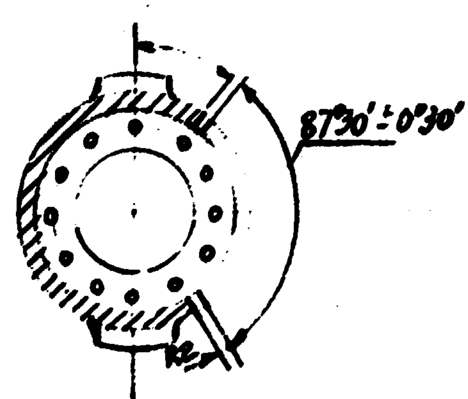




Operation 3



A-A



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
005	TURN CONE 15°, MAINTAINING THE SIZE 1.5		FORMING CUTTER	
006	TURN CHAMFER 0.5 x 45°		CHAMFER TOOL	
007	CUT THREAD M25 x 0.5		SCREW CUTTER	
008	TURN ⌀ 36h12 TO THE 3 mm LENGTH		TOOLHOLDER	SLIDING CALLIPERS
009	TURN CONE ∠ 60° ± 1°, MAINTAINING ⌀ 30		TOOLHOLDER	
010	TURN GROOVE ⌀ 36h12, MAINTAINING THE SIZE 10h12		GROOVE CUTTER	SLIDING CALLIPERS
011	DULL SHARP EDGES		FILE	
	OPERATION 2			
001	MOUNT AND REMOVE WORKPIECE	MILLING MACHINE		
		DIVIDING ATTACHMENT		
002	MILL TWO SHOULDER, MAINTAINING 10h12		END MILL CUTTER	SLIDING CALLIPERS
003	MILL TWO PLATE MAINTAINING THE SIZES 20 ± 0.2 AND		END MILL CUTTER	SLIDING CALLIPERS
	40h12			
004	DRILL TWO HOLES ⌀ 8.4H12, MAINTAINING ANGLE 30°0' ± 0°30'		DRILL ⌀ 8.4	

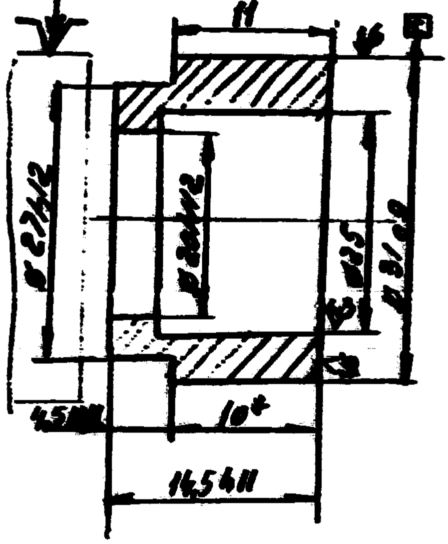
SHEET 5	NAME OF UNITS 6

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
005	DRILL FOUR HOLES FOR SCREW ▼		DRILL ⌀ 1.7	
006	COUNTERSINK FOUR HOLES 0.3 x 45°		COUNTERSINK ∠ 90°	
007	CUT THREAD M2 (FOUR HOLES)		TAP M 2	
008	DRILL 12 HOLES ⌀ 1.5H11 TO THE BODY SIZE		DRILL ⌀ 1.5	
009	RESETT WORKPIECE			
	OPERATION 3		COUNTER BORE ⌀ 4.6	
001	MOUNT AND REMOVE WORKPIECE	MILLING MACHINE		
002	DRILL TWO HOLES ⌀ 2.5 [illegible]	DIVIDING ATTACHMENT		
003	COUNTERSIK HOLES 0.5 x 45°		COUNTERSINK ∠ 90°	
004	CUT THREAD IN TWO HOLES M 3		TAP M 3	
005	MILL GROOVE, MAINTAINING THE SIZES 10.2±0.1, 61°30'± 0°30', 37°30'±30'		END MILL ⌀ 4	
	OPERATION 4			
	CHEMICAL PASSIVATING, THE SURFACE X - BLACK ENAMEL			
			SHEET 6	NAME OF SHEETS 6

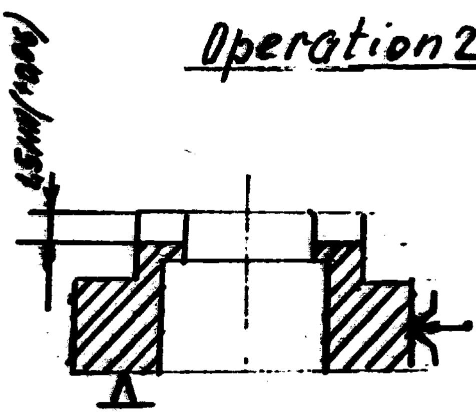
			OPERATION	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
SEE SHEET 2		50.000	PROFILE	DIMENSIONS
			ALUMINIUM ALLOY ROUND BAR	ø 32 x 25
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 125 3-CAMS CHUCK		
002	CUT END		TOOLHOLDER	
003	CENTRE		CENTRING DRILL	
004	DRILL HOLE ø 10H14 FOR THE 20 mm DEPTH		DRILL ø 10 mm	
005	BORE HOLE ø 20H12 TO THE DEPTH 20 mm		BORING CUTTER	SLIDING CALLIPERS
006	BORE HOLE ø 25H14 TO THE 11 mm DEPTH		BORING CUTTER	SLIDING CALLIPERS
007	TURN ø 31e9 TO THE 20 mm DEPTH		TOOLHOLDER	SLIDING CALLIPERS
008	TURN GROOVE ø 27b12 , MAINTAINING THE SIZE 10h11		GROOVE CUTTER	SLIDING CALLIPERS
			SHEET 1	NAME OF SHEETS

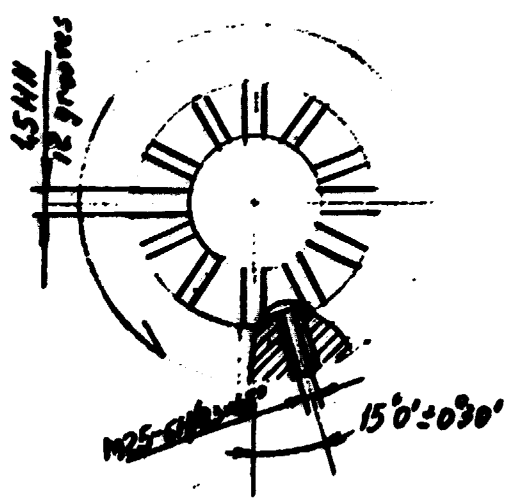
Operation 1

3,2 V (v)



Operation 2





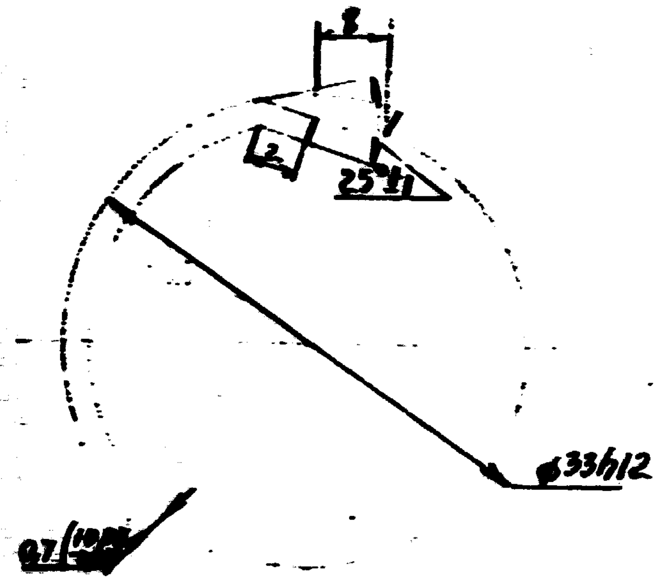
№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	CUT OFF WORKPIECE WITH CUT END IN THE SIZE 14.5h11		PARTING OFF CUTTER	SLIDING CALLIPERS
	OPERATION 2			
001	MOUNT THE WORKPIECE	MILLING MACHINE		
002	MILL 12 GROOVES 1.5H11 TO THE 1.5H11 DEPTH	DIVIDING ATTACHMENT	DISK MILL 1.5	MICROSCOPE
003	DRILL HOLE ⌀ 2.2H9 AT		DRILL ⌀ 2.2	
	MARKING OUT, MAINTAINING ∠ 15°0'±0°30' AND 6±0.2 TO THE BODY SIZE			
004	COUNTERSINK 0.3 × 45°		COUNTERSINK	
005	CUT THREAD M 2.5 TO THE BODY SIZE		TAP M 2.5	
			SHEET 2	NAME OF SHEETS

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	59.024		
		PROFILE	DIMENSIONS
		WIRE 11 - 0.7	ø 0.7

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	COIL SPRING ø 33%12			
002	CUT ONE COIL			
003	CUT WIRE 8 mm FROM EXTREM END COIL			
004	PRESS END OF COIL MAINTAINING THE SIZE 2 mm AND ANGLE 25°21'			
005	FILE EXTREM END OF COIL		FILE	

SHEET 1	NAME OF SHEETS 2

Operation 1

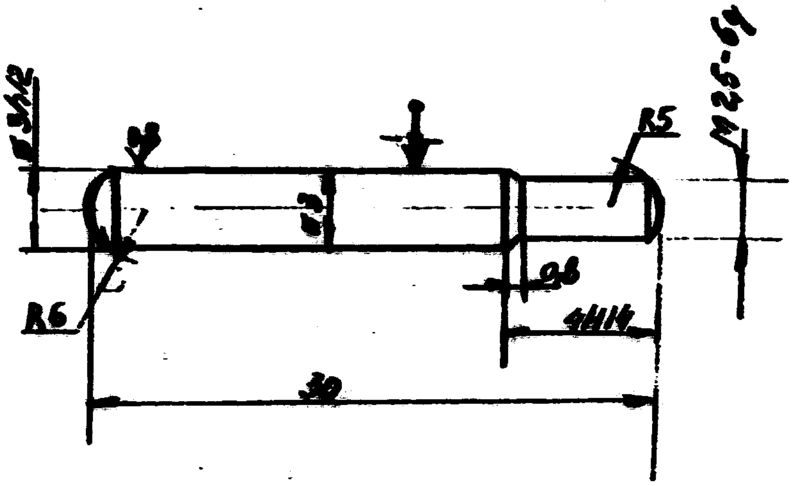


			OPERATION	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
SEE SHEET 2		50.000	PROFILE	DIMENSIONS
			ROUND BAR STEEL	⌀ 5 x 50
№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK WITH RESETTING	SCHAUBLIN - 125 TYPE COLLET		
002	TURN ⌀ 3h12 TO THE 30 mm LENGTH		TOOLHOLDER	
003	TURN ⌀ 2,5h9 mm TO THE LENGTH 4H14		TOOLHOLDER	-
004	TURN SPHERE R 5		FILE	
005	CUT THREAD M 2.5 TO THE 3.5 mm LENGTH		SCREW CUTTER M 2.5	
006	CUT OFF THE WORKPIECE TO THE 30 mm LENGTH		PARTING OFF CUTTER	
007	TURN SPHERE R 6		FILE	
	OPERATION 2			
	COATING Fe / Ni ? Cr			

SHEET 1 NUMBER OF SHEETS 2

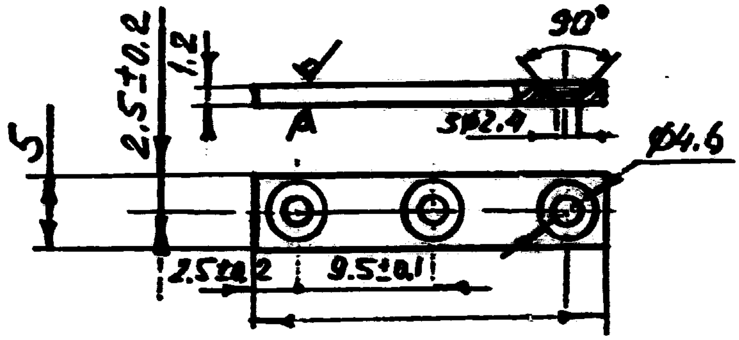
50.025

3,2 (√)



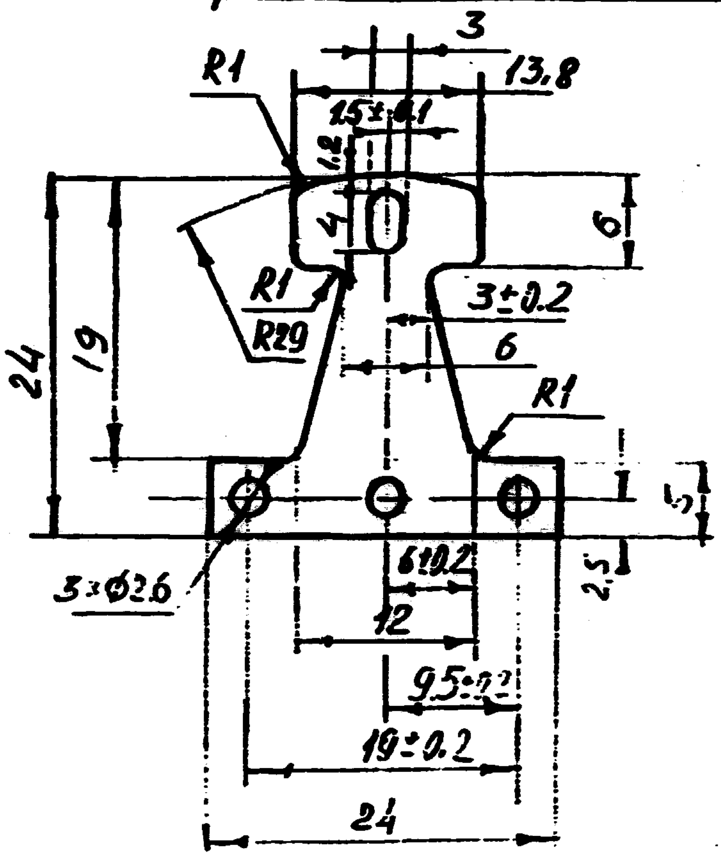
			OPERATION NO	
	OPERATION DRAFT	SHEET OF TOOLS	BLANK	
		TOOL	PROFILE	DIMENSIONS
			STRIP [illegible] STEEL	DETAILS
No	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE BLANK	MILLING MACHINE VICE		
002	CONTOUR MILL MAINTAINING THE SIDES [illegible]		MILL ⌀ 5mm	
003	CENTRE 3 HOLES MAINTAINING THE SIZE [illegible]		CENTRE DRILL	
004	DRILL 3 HOLE ⌀ 3.4mm TO [illegible]		DRILL ⌀ 3.4 mm	
005	COUNTERSINK [illegible], MAINTAINING ⌀ [illegible]		COUNTERSINK	
006	DULL SHARP EDGES [illegible]		FILE	
			SHEET 1	NUMBER OF SHEET [illegible]

Operation N 1   70.001

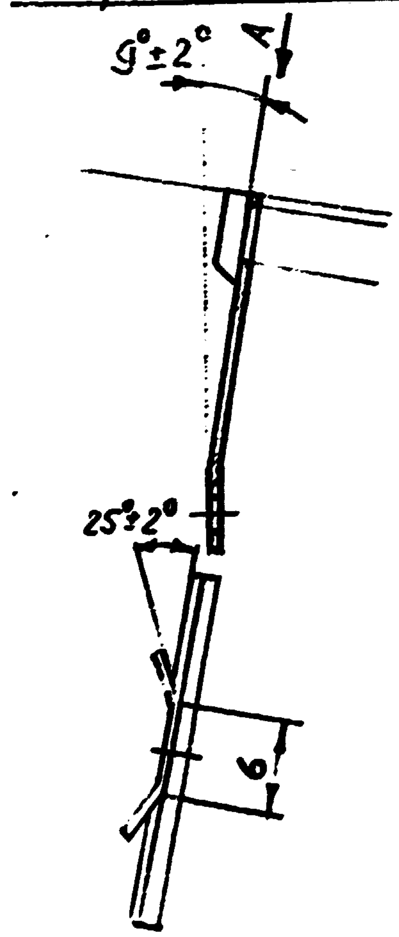


			OPERATION N 1	
	OPERATION DRAFT	NUMBER OF PIECES	BLANK	
		TIME TOTAL		
			PROFILE	DIMENSIONS
			[illegible] STEEL STRIP 1.5mm	
N	WORK STEP	EQUIPMENT	TOOL	MEASURING TOOL
	BENCH-WORKING			
001	CONTOUR CUT WORKPIECE MAINTAINING SIZES SPECIFIED		CUTTER	SLIDING CALLIPERS
002	MARKING-OUT THE CENTER OF HOLES			
003	CENTRE		CENTRE DRILL	
004	DRILL 3 HOLES ø 2.5mm	MILLING MACHINE	DRILL ø 2.5mm	
005	DRILL HOLE ø 3mm		DRILL ø 3mm	
006	MILL SLOT, MAINTAINING THE SIZES 1.5, AND 3mm			MILL ø 3mm
	OPERATION 2 THERMAL TREATMENT			
001 002	HEATING UP TO 800°C, EXPOSE 15 MIN COOLING DOWN IN OIL TO 25°C			
			SHEET 1	NUMBER OF SHEET 2

Operation N1 70.002



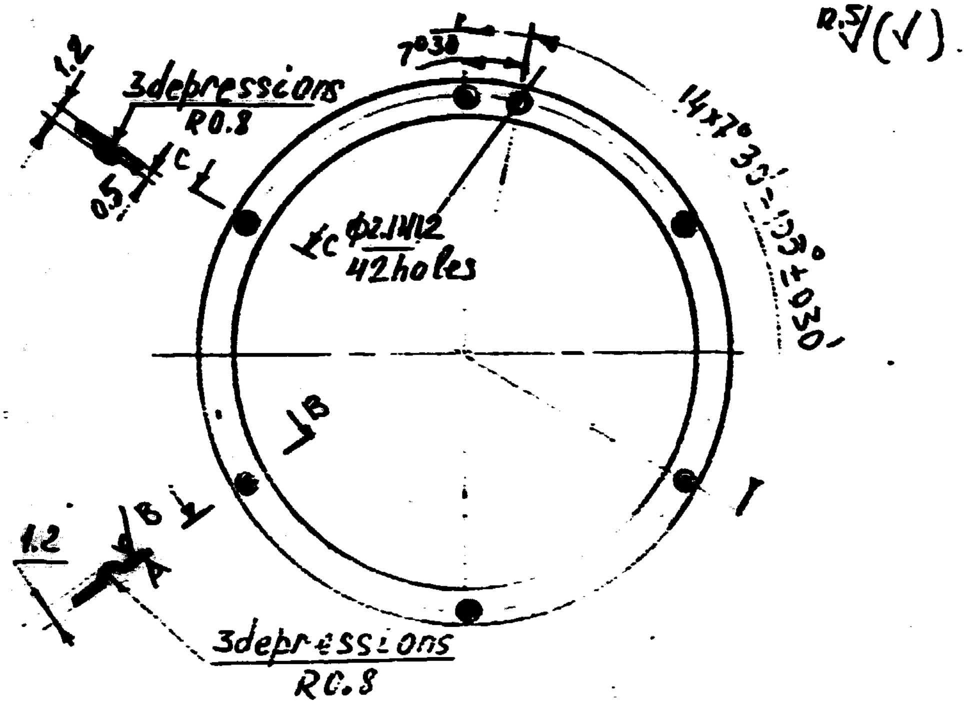
Operation N2



OPERATION N 1

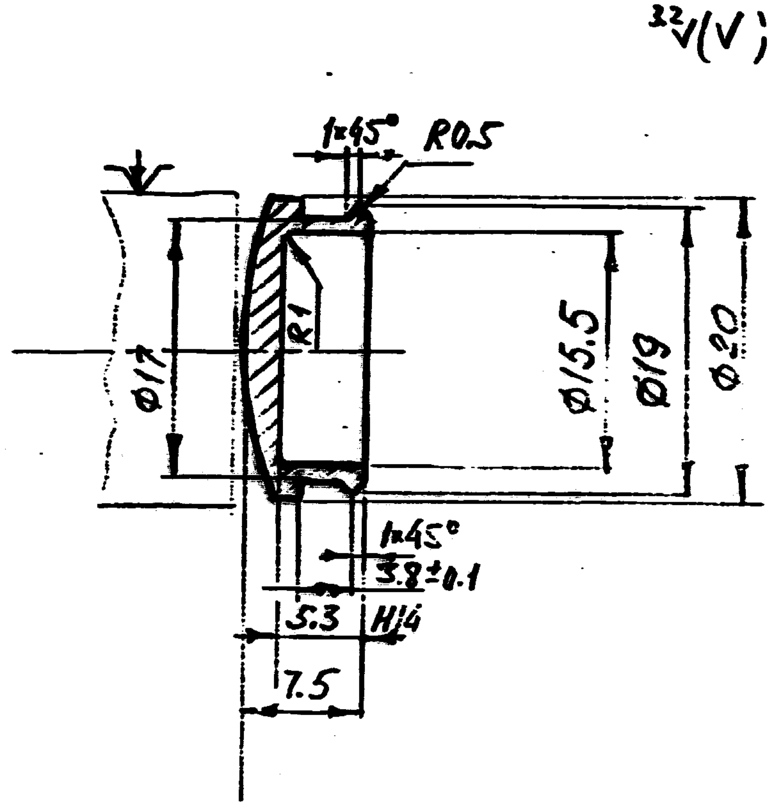
OPERATION CHART		NUMBER OF PIECES	BLANK	
		TIME		
			PROFILE	DIMENSIONS
			STRIP OR SHEET	TEXTE
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT BLANK	SHAPING MACHINE AT-TACHMENT AND STEEL PIN		
002	CUT PINS D [illegible]		BORING CUTTER	
	OPERATION 2	MILLING MACHINE		
001	MOUNT WORKPIECE	THE STEEL PIN WITH PERFORATION		
002	DRILL 40 HOLES D [illegible]		DRILL D [illegible]	
003	PRESS A DEPRESSION			
004	DULL SHARP EDGES		FILE	
			SHEET 1	NUMBER OF SHEET

Operation 2 N 70003

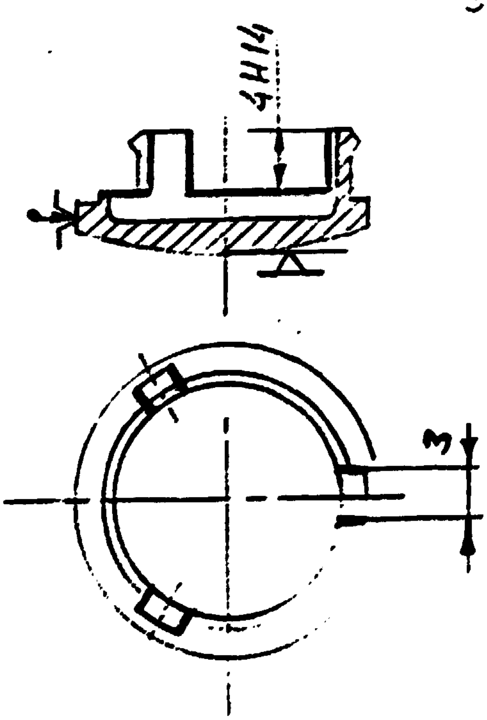


			OPERATION No 1	
OPERATION DRAFT		NUMBER OF PIECES	PLAN	
		TIME	PROFILE	DIMENSIONS
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT BLANK	[illegible] 3-JAW CONCENTRIC CHUCK		
002	TURN BUTT END		TOOL-HOLDER	
003	TURN ⌀ 30mm IN 15mm LONG	[illegible]	TOOL-[illegible]	SLIDING CALLIPERS
004	TURN ⌀ 15mm IN [illegible] LONG			
005	TURN CHAMFER 1x45°		CHAMFER TOOL	
006	TURN GROOVE ⌀ 17x2.5mm WITH CHAMFER 1x45° AND R=0.5mm		CHAMFER TOOL	
007	TURN HOLE ⌀ 12.5mm IN 5.5[illegible] DEPTH WITH R1			
			SHEET 1	NUMBER OF SHEETS [illegible]

Operation 1 N 70.004



Operation 2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0008	CUTT OFF IN THE SIZE WITH SHAPE [illegible]		FORM CUTTER [illegible]	
0009	DULL BLUNT EDGES		SCRAPER	
0010	REMOVE AND MOUNT PIECE			
0011	FILE AND LAPPING SHAPE		FILE	

SHEET 2 — NUMBER OF SHEET 4

		OPERATION N [illegible]
OPERATION DRAFT	NUMBER OF PIECES	BLANK
	[illegible]	
		PROFILE / DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT BLANK	MILLING MACHINE DIVIDING ATTACHMENT		
0002	MILL THREE SLIDES IN SIZE [illegible] AND LONG AXIS		MILL [illegible]	
0003	DULL SHARP EDGES		FILE	

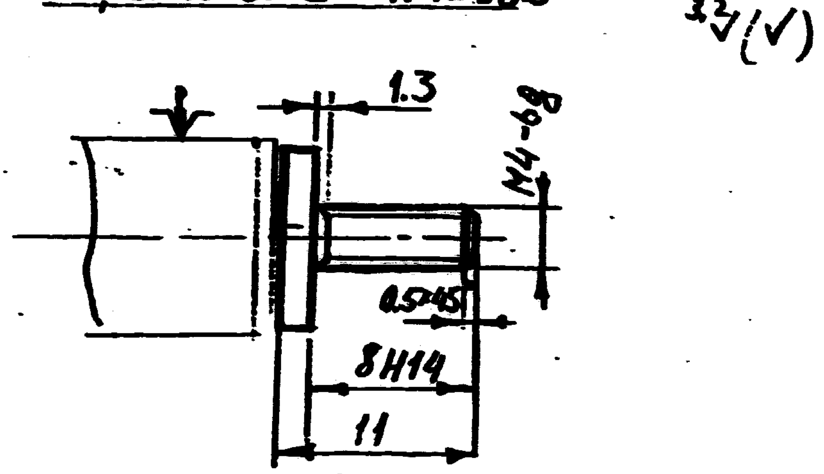
SHEET [illegible]	NUMBER OF SHEETS [illegible]

		OPERATION N 1
OPERATION DRAFT	NUMBER OF PIECES	BLANK
	TIME	PROFILE / DIMENSIONS
		STEEL BAR ROUND / 18x80

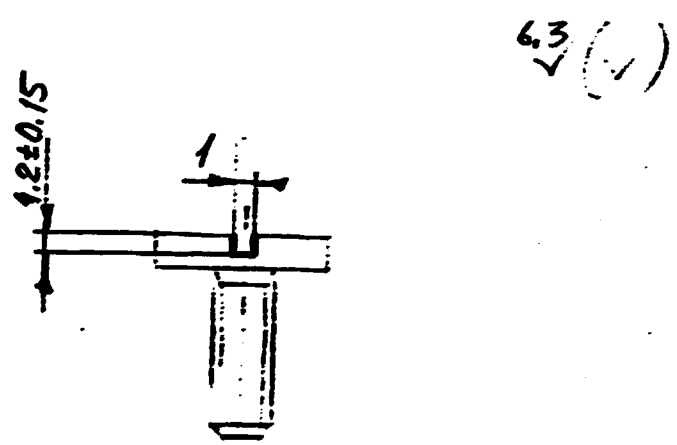
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT BLANK	[illegible] 3-JAW CONCENTRIC CHUCK		
002	TURN BUTT END		TOOL-HOLDER	
003	TURN ⌀ 11.5mm ON 15mm LONG			SLIDING CALLIPERS
004	TURN ⌀ 4mm IN SIZE 8h14 WITH BUTT END AND CHAMFER 0.5x45°			SLIDING CALLIPERS
005	THREAD SCREW M4-6g		CUTTER	
006	CUT OFF PIECE IN SIZE 10h14			

SHEET 1 | NUMBER OF SHEET 1

Operation 1 N 70005



Operation 2



OPERATION N [illegible]

OPERATION CHART	NUMBER OF PIECES	BLANK	
	PIECES	SEE SHEET [illegible]	
		PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT BLANK	VICE		
0002	FRENCH FILE THE GROOVE [illegible]MM			
0003	SHARP BLUNT EDGES		FILE	
	OPERATION [illegible]			
	CONSOLIDATION/COATING CHEMICAL OXIDATION			

SHEET [illegible] | NUMBER OF SHEET [illegible]

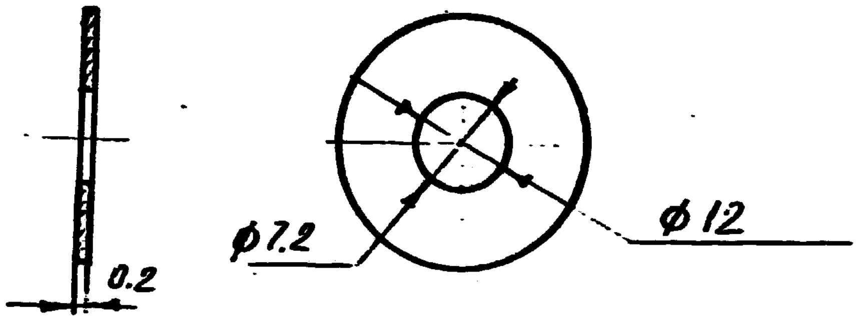
OPERATION N 1

OPERATION CHART	NUMBER OF PIECES	BLANK	
	[illegible]		
		PROFILE	DIMENSIONS
		RIBBON STEEL [illegible]	

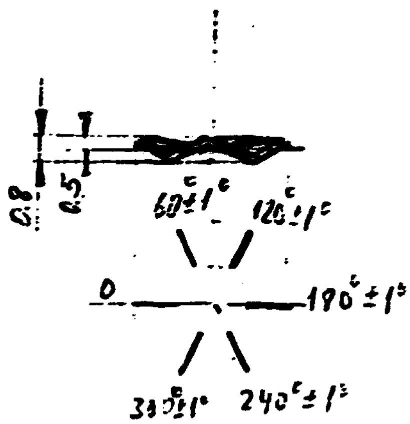
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	CUT RING [illegible]	[illegible]-125 PRESS		
0002	PRESS [illegible]			
	OPERATION 2			
	THERMAL TREATMENT HARDEN [illegible]			
	OPERATION 3			
	LUBRIFICATION CHEMICAL OXIDATION			

SHEET 1	NUMBER OF SHEET [illegible]

Operation 1 N 70.006



Operation 2 N 70.005



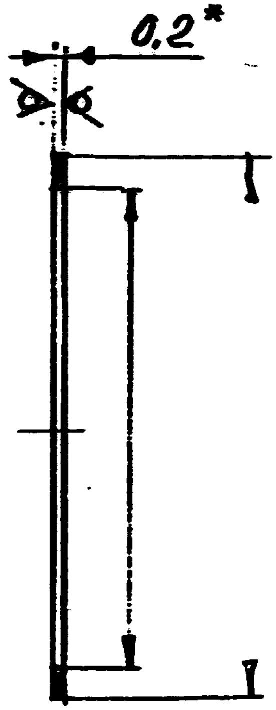
	OPERATION N 1

OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	TOTAL		
		PROFILE	DIMENSIONS
		STRIP STEEL 0.8	

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	CUT RING D [illegible]	[illegible]-125 [illegible] CENTER	PARTING TOOL	SLIDING CALLIPERS

SHEET 1	NUMBER OF SHEETS

Operation N 1 N 70007



	OPERATION N 1

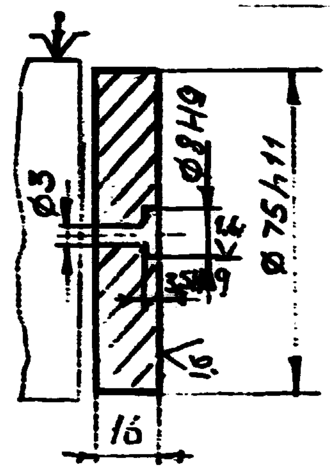
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	[illegible]		
		PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT BLANK	SHAUBLIN-125 3-JAWS CONCENTRIC CHUCK		
002	FACE		TOOL-HOLDER	
003	TURN ø 75-h11 TO THE SIZE 20mm		TOOL-HOLDER	SLIDING CALLIPERS
004	TURN ø [illegible]h12 TO THE SIZE 12.5h11		TOOL-HOLDER	
005	TURN ø [illegible], MAINTAINING SIZE 9.5h11		TOOL-HOLDER	SLIDING CALLIPERS
006	TURN FACE MAINTAINING SIZE 16h12 AND 0.5mm			
007	TURN GROOVE 45° IN 0.5mm DEPTH			
008	TURN GROOVE ø 11 TO THE SIZE 0.5mm			

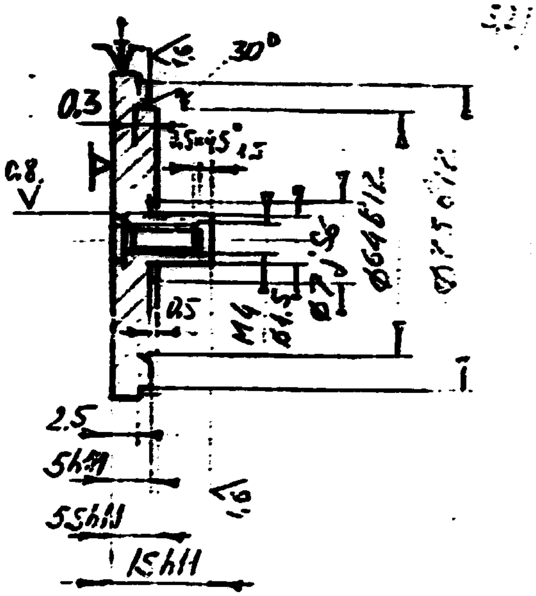
SHEET 1	NUMBER OF SHEET [illegible]

Operation 1 N 70.008

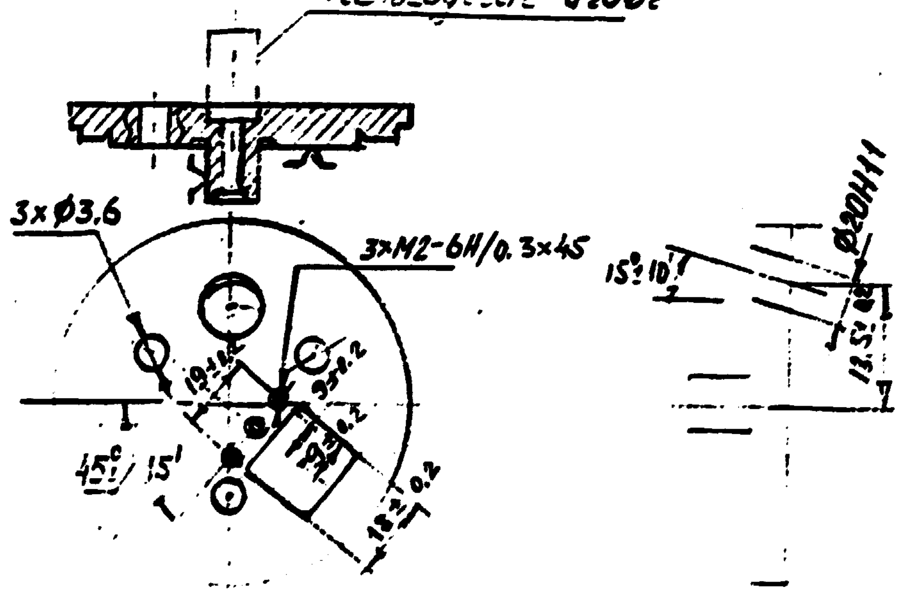
Push 1



Push 2



Operation 2



S.NO	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	CENTER		CENTER DRILL [illegible]	
010	DRILL HOLE FOR THE THREAD M4 TO BODY SIZE		DRILL [illegible]	
011	BORING HOLE [illegible] TO THE DEPTH [illegible]		BORING CUTTER	
012	TURN CHAMFERS [illegible]		CHAMFERING TOOL	
013	DULL SHARP EDGES		SCRAPER	
014	CUT THE THREAD M4 [illegible]		TAP	
015	CUT OFF WORKPIECE TO THE SIZE [illegible]		PARTING OFF TOOLS	
016	RESET WORKPIECE	COLLET TYPE [illegible]		
017	FACE, MAINTAINING THE SIZE [illegible]		FACING TOOL	
018	BORING HOLE [illegible] TO THE DEPTH [illegible]		BORING CUTTER	
019	TURN CHAMFER [illegible]		CHAMFER TOOL	
020	DULL SHARP EDGES		SCRAPER	

[illegible]	[illegible]

	OPERATION № [illegible]

OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	[illegible]	PROFILE	DIMENSIONS

№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT BLANK	MILLING MACHINE DIVIDING ATTACH-MENT COLLET TYP		MICROINDICATOR (0.001)
002	CENTRE 3 HOLES MAINTAINING ⌀ 33±0.1		CENTRING DRILL	
003	CENTRE 3 HOLES MAINTAINING THE SIZE [illegible]			
004	DRILL 3 HOLES FOR THREAD M5-6H		DRILL ⌀ [illegible]	
005	MILL SLOT [illegible], MAINTAINING THE SIZE [illegible] AND 3mm		MILL ⌀ 3mm	SLIDING CALLIPERS
006	DRILL 3 HOLES ⌀ [illegible]			
007	CENTRE HOLE MAINTAINING THE SIZE [illegible] BY ANGLE [illegible]	[illegible]	CENTRE DRILL	INDICATOR
008	DRILL ⌀ 10mm		DRILL ⌀ 10mm	

SHEET 4	NUMBER OF SHEET 5

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0009	DRILL ⌀ [illegible]		DRILL ⌀ [illegible]	
0010	BORING ⌀ 30H11		COUNTERBORE	
0011	CUT THREAD M8 TO BODY SIDE		TAP M8	
0012	RESET WORKPIECE			
0013	COUNTERBORE 2 HOLES [illegible] TO THE BLANK SIDE		COUNTERBORING ⌀ [illegible]	
	OPERATION 3			
0001	DELUBRICATION/CHEMICAL OXIDATION			

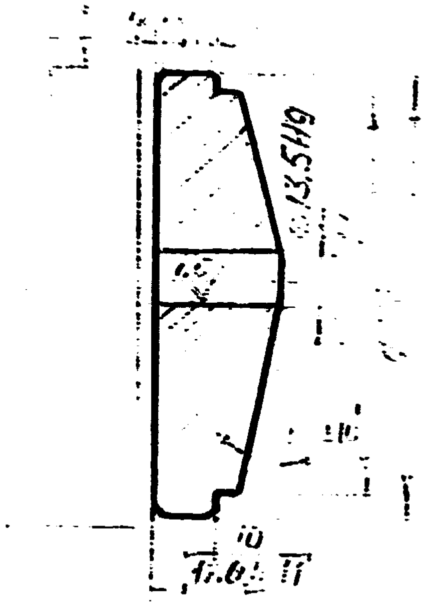
SHEET [illegible]	NUMBER OF SHEETS [illegible]

		OPERATION N 1	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	70009		
		PROFILE	DIMENSIONS
		ROUND BAR BRASS	o 180*50

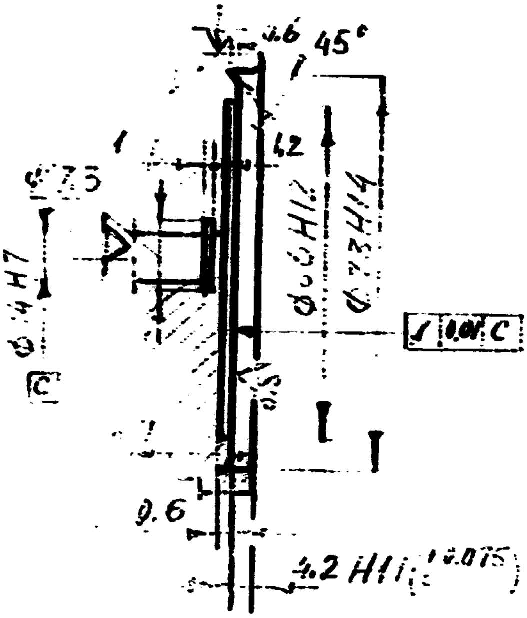
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT BLANK	SHAUBLIN-125 3-JAWS CONCENTRIC CHUCK		
002	FACE		TOOLHOLDER	
003	CENTRE		CENTRE DRILL	
004	DRILL HOLE o 12.0mm		DRILL o 12mm	SLIDING CALLIPERS
005	TURN o73h11 TO THE SIZE OF 10mm		TOOLHOLDER	SLIDING CALLIPERS
006	TURN o78h11 TO THE SIZE OF 25mm		TOOLHOLDER	SLIDING CALLIPERS
007	TURN TWO CHAMFERS 1*45°		CHAMFERS TOOL	
008	CUT OFF TO THE SIZE 18mm			SLIDING CALLIPERS
			SHEET 1	NUMBER OF SHEET 5

Operation 1

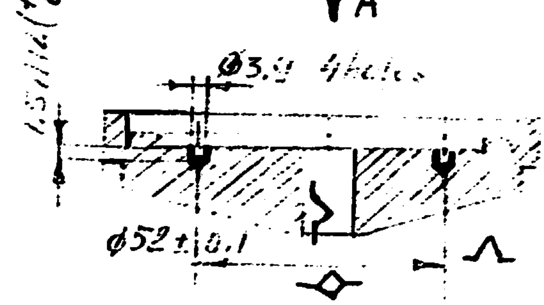
Push 1



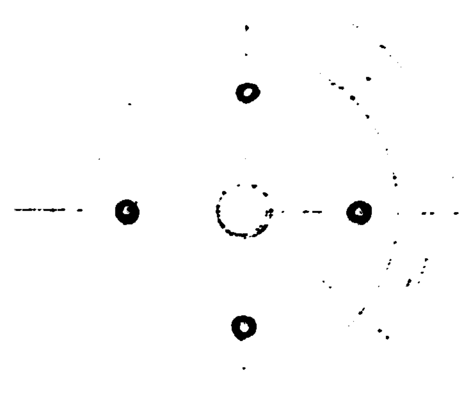
Push 2

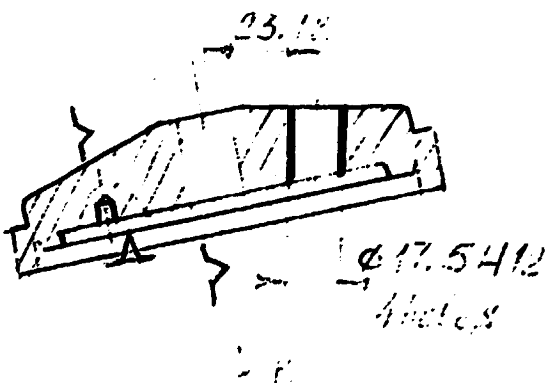


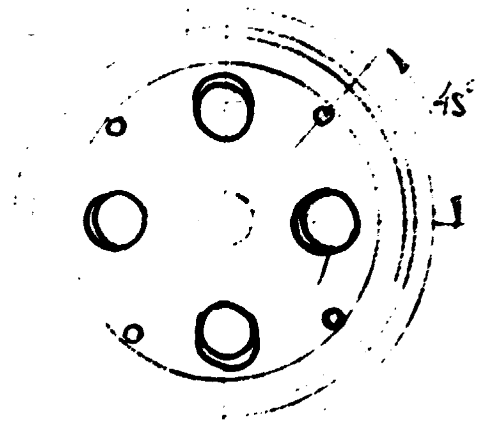
Operation 2



A

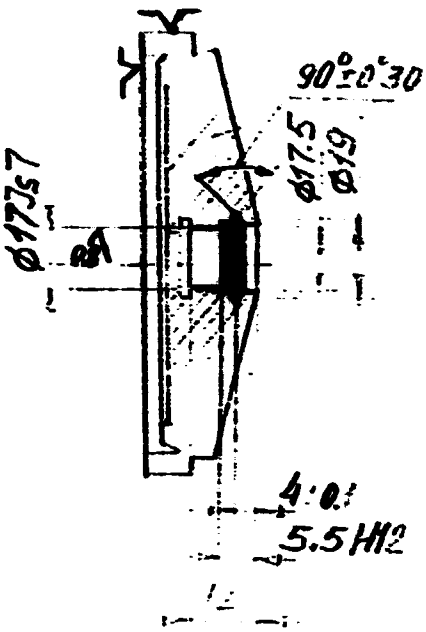




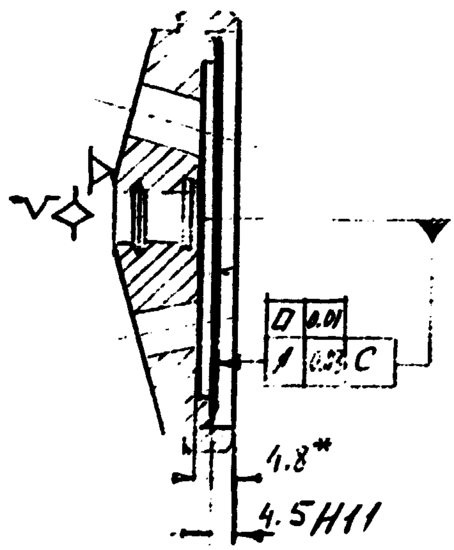


Operation 3

Push 1

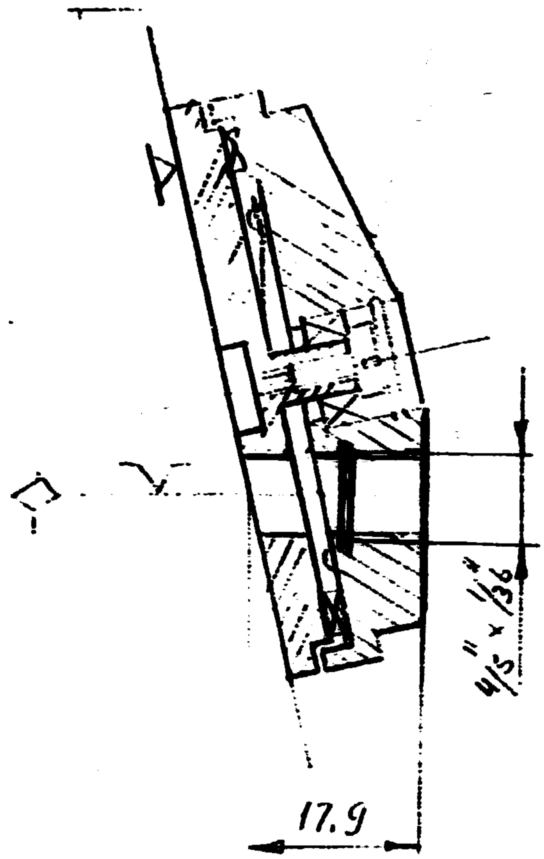


Push 2



* For information

Operation 5



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	RESETE WORKPIECE			
010	TURN ø 73H14 TO THE DEPTH 4.2H11 WITH BOTTOM CUTTING		BORING TOOL	SLIDING CALLIPERS
011	TURN ø 66H12 WITH BOTTOM CUTTING TO THE DEPTH 0.9mm		BORING TOOL	SLIDING CALLIPERS
012	BORE A HOLE ø 14H7		BORING TOOL	SLIDING CALLIPERS
013	TURN GROOVE ø 17.3 MAINTAINING SIZES 1 AND 1.2mm		BORING CUTTER FOR RECESSING	
014	TURN GROOVE TO THE DEPTH 0.6mm MAINTAINING ANGLE 45°		FORM CUTTER	
015	DULL SHARP EDGES		SCRAPER	
			SHEET 3	NUMBER OF SHEET 5

		OPERATION N 2	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	70009	PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT WORKPIECE	MILLING MACHINE ARBOR WITH NUT		
002	DRILL 4 HOLES o3.9mm TO THE SIZE OF 1.5H12	DIVIDING ATTACH-MTNT	CENTRIC DRILL o 1.5mm	MICROMETR (0.001)
003	REMOVE WORKPIECE			
004	DRILL HOLE IN THE PLATE OF BASIC SURFASE		CENTRE DRILL o 1.5mm	
005	RESETT WORKPIECE	TECHNOLOGICAL PIN o 3.9mm		
006	ROTATE DIVIDING ATTACHMENT TO THE 15°±0°10′			
007	CENTRE		CENTRE DRILL o 1.5mm	MICROMETER
008	DRILL o 17.5H12 FOR THE THREE PAS-SAGES IN FOUR HOLE	DRILL o 10mm DRILL o 17.5H12	SLIDING CALLIPERS	

SHEET 4	NUMBER OF SHEET 5

OPERATION N 3

OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	70009	SEE SHEET 2	
		PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT BLANK	SHAUBLIN-125 3-JAWS CONCENTRIC CHUCK		
002	TURN HOLE o 17mm TO THE SIZE 12.0mm		BORING CUTTER	DEPTHMETER
003	TURN HOLE o 17.5mm TO THE SIZE 5.5H12		BORING CUTTER	SLIDING CALLIPERS
004	TURN GROOVE 90° TO THE SIZE o 19 AND 4±0.1		FORM CUTTER	
005	RESETT WORKPIECE			
006	TURN FACE MAINTAINING THE SIZE 4.5H11	ARBOR WITH NUT	FACING TOOL	MICROMETR
007	ROLER CORRUGATION		KNURLING	
	OPERATION 3			
001	CHEMICAL OXIDATION			

SHEET 5	NUMBER OF SHEET 5

OPERATION DRAFT	NUMBER OF UNIT	

		PROFILE	DINENSIONS

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVIS,TOOL	MEASURING TOOLS
1	MAKING AP A SET			
001	MAKE UP A SET OF ASSEMBLING UNITS AND PIECES OF THE NOSEPIESE			
	ASSEMBLES : 70010,70020 PIECES:			
	CLEAT 70001 SPRING 70002			
	70002-02 SEPARATOR 70003			
	CAP 70004 SCREW 70005			
	WASHER - 70006-2 SPACER - 70007-2			
	HOLDER - 70008 REVOLVER- 70009			

SHEET 1	NUMBER OF SHEET

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	STANDART UNITS SCREW M2-6g -3			
	BALL -4 BEARING 17#785 -1			
	BALL 2-40 -42			
002	WASHING			
	WASH MECHANICAL PIECES WITH BENZIN AND DRY THEN DURING 15min T=20°C		TANK	
3	FITTING SPRING WITH THE HOLGER			
001	MOUNT SPRING 70002 REF.2 WITH CLEAT 70001 REF.1 ON THE HOLDER			
	70008 REF.3 SCREW 3 SCREWS IN HOLDER MAINTAINING			
	THE SIZE 9.5±0.2		SCREW DRIVER	SLIDING CALLIPERS
4	PRESS BALL IN HOLE OF REVOLVER			
001	MOUNT THE BALLES o 4mm IN HOLES OF REVOLVER,MAINTAINING THE SIZE 1.7mm	PRESS PIEDISTAL		SLIDING CALLIPERS
002	CHASE BALLS IN HOLES		CHASING	

SHEET 2	NUMBER OF SHEET

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
003	MOUNT BEARING IN HOLE OF REVOLVER	SCREW PRESS		
004	APPLEY A GROPE OF OIL ON THE BEARING		HAIR-BRUSH	
5	ASSEMBLING NOSEPIESE			
001	MOUNT ON THE HOLDER 70010 SPACER 70007 REF.8			
002	FITTING SEPARATOR 70003 REF.4.IN HO-LES OF SEPARATOR MOUNT 42 BALL 0 2MM			
003	APPLAY A THE GREASE		HAIR-BRUSH	
004	PUT SPACER			
	FILL ON THE HOLDER SHARFT REVOLVER 70020			
	MOUNT TWO WASHER 70006 AND SCREW IN HOLES SCREW 70005			

SHEET 3	NUMBER OF SHEET

			OPERATION N 1		
OPERATION DRAFT		NUMBER OF PIECES	BLANK		
		70000 (70009)	UNIT NOSEPIES 70000		
			PROFILE		DIMENSIONS
N	WORK STEP	EQUIPMENT	TOOLS		MEASURING TOOLS
001	MOUNT UNIT	SHAUBLIN-125 BO-RING ATTACHMENT SCREW CAP			
002	BORING HOLE o 20.27H9		BORING TOOL		
003	ROTATE REVOLVER TO 45° THE NEXT POSITION				
			SHEET 1		NUMBER OF SHEET 2

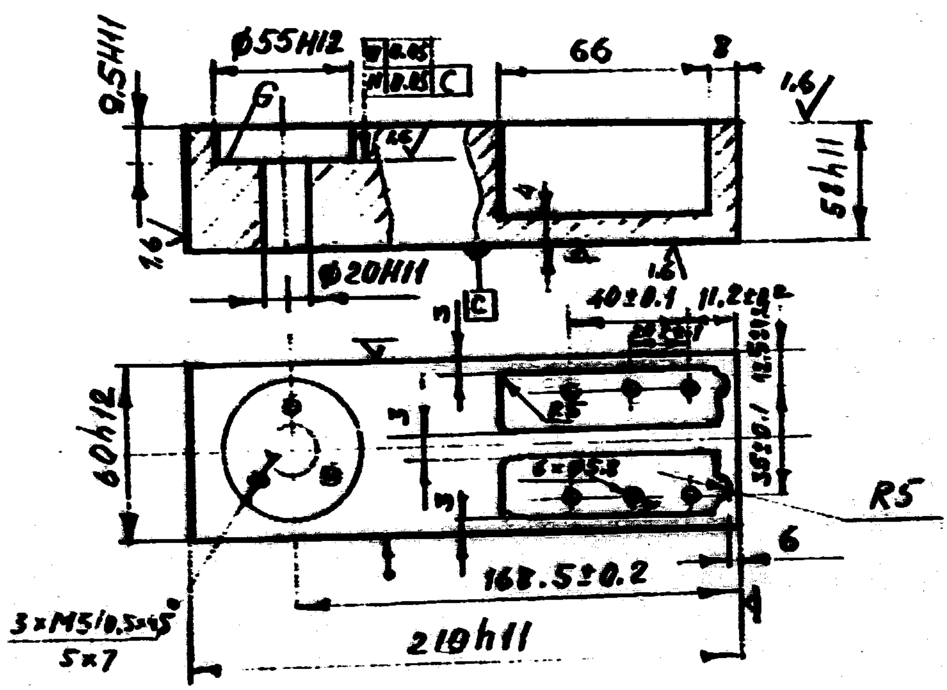
		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	20.001		
		PROFILE	DIMENSIONS
		ROUND ALUMINIUM ALLOY	Ø16h11*50h12 [illegible]

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	MILLING MACHINE, VICE		
002	CENTRE BY MAKING OUT		CENTRE DRILL Ø [illegible] mm	
	4 HOLE (Ø2H11 AND Ø2.5H9), MAINTAINING THE SIZES OF SPECIFIED			SLIDING CALIPERS
003	DRILL 3 HOLES Ø2.5 mm TO THE 16.5 mm DEPTH		DRILL Ø2.5 mm	
004	DRILL HOLE Ø[illegible] mm TO THE [illegible] SIZE		DRILL Ø[illegible] mm	
005	CENTRE BY MAKING OUT TWO HOLES Ø10 mm FOR MILLING GROOVES.		CENTRE DRILL	
	MAINTAINING THE SIZES 12.5±0.1, 35±0.1 AND [illegible] mm			
006	DRILL 2 HOLES Ø10 mm TO THE 50 mm DEPTH.		DRILL Ø[illegible] mm	
007	DRILL [illegible] mm TO THE [illegible] SIZES			

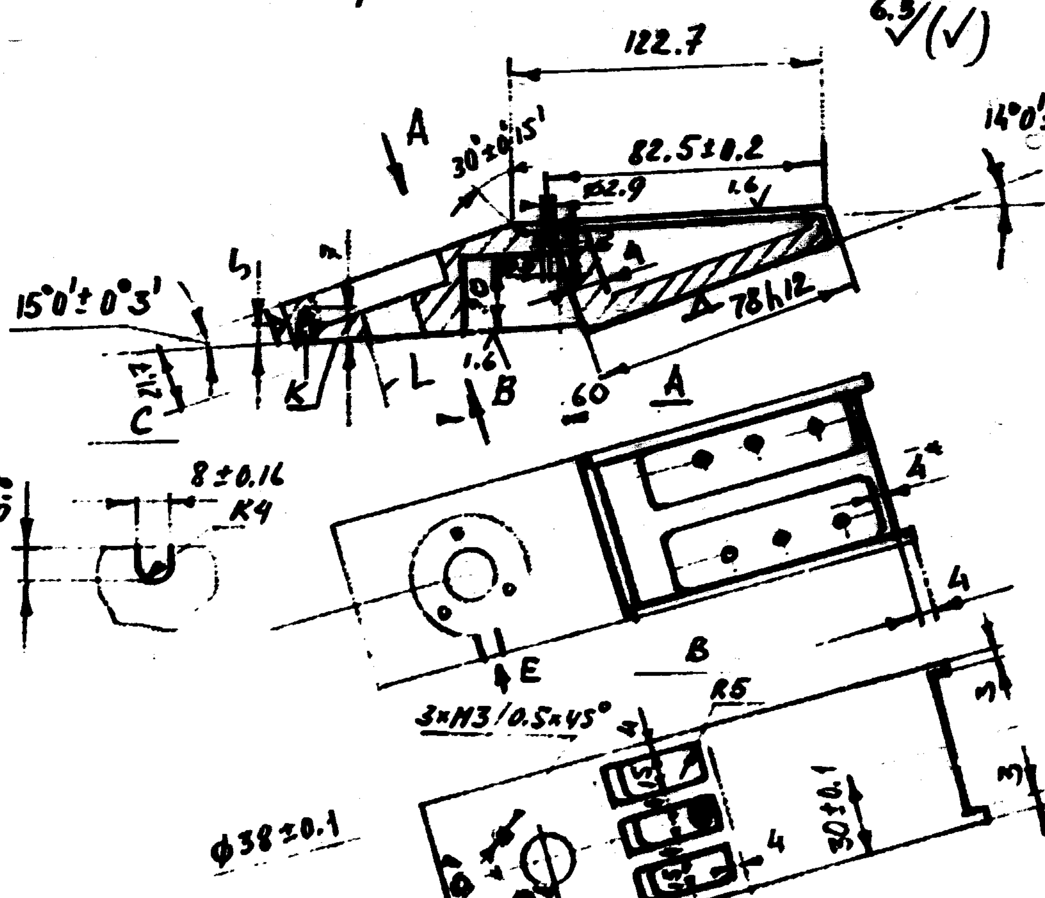
4d?

80.001

Operation 1



Operation2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
003	MILL THREE GROOVES AFTER DRILLING FOR MILL, MAINTAINING THE SIZES		MILL ⌀10 mm	SLIDING CALLIPERS
	4, 5, 60 TO THE DEPTH 20 mm			
004	CENTRE BY MARKING OUT 3 HOLES, MAINTAINING THE SIZES 18.5±0.1,		CENTRE DRILL	
	⌀ 38±0.1			
005	CENTRE BY MARKING OUT HOLE ⌀2.9 mm,		CENTRE DRILL ⌀ 90°	
012	CUT SCREW M3 IN 3 HOLES TO THE 5 mm DEPTH		TAP M3	
013	REMOUNT WORK-PIECE			
014	CENTRE BY MARKING OUT 6 HOLES MAINTAINING THE SIZES 11.3±0.2,		CENTRE DRILL ⌀ 2 mm	
	20±0.1, 40±0.1 AND 35±0.1			
015	DRILL 6 HOLES TO THE BODY SIZES ⌀ 5.8 mm		DRILL ⌀ 5.8 mm	
016	DULL SHARP EDGES		FILE, SCRAPER	
	OPERATION 2 : SEE SHEET 2 OPERATION 2 :			
001	MOUNT BLANK WITH RESETTING	MILLING MACHINE		
002	MILL FLAT MAINTAINING ANGLE [illegible] AND SIZE 21.7 mm		END MILL	[illegible]

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
003	MILL GROOVE, MAINTAINING THE		END MILL ø8mm	
	SIZES 5.6, [illegible]0.16EPT[illegible] [illegible] mm			
004	CENTRE BY MAKING OUT 3 HOLES, MAINTAINING THE SIZES 18.5±0.1,		CENTRE DRILL	
	ø 30±0.1			
005	CENTRE BY MAKING OUT HOLE ø2.9 mm, MAINTAINING THE SIZES 30±0.1 AND		CENTRE DRILL	
	52.5±0.2			
006	DRILL 3 HOLES ø2.5H9 TO THE 7mm DEPTH		DRILL ø2.5H7	
007	DRILL HOLE ø 2.9H14 TO THE		DRILL ø2.9H14	
	BODY SIDE			
008	COUNTER-BORE HOLE ø2.9H14, MAINTAINING THE SIZES ø 5 AND 2 mm		COUNTER-BORE ø 5 mm	
009	COUNTER-SINK 3 HOLES, MAINTAINING THE SIZES [illegible]		COUNTER-SINK 90°	
010	RESET WORKPIECE			
011	MILL PLATE, MAINTAINING ANGLE [illegible]	MILLING MACHINE	END MILL	
012	MILL GROOVE AS SPECIFIED, MAINTAINING THE SIZES 4 AND 3 mm		END MILL	

№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
013	MILL GROOVE,MAINTAINING THE		END MILL ⌀8mm	
	SIZES 5.5, 8±0.16 AND R4			
014	FILE R2 ALONG THE CONTOUR MAINTAINING THE SIZES 18.5±0.1,		FILE	
015	MILL COVER 30°±0°15',MAINTAINING THE SIZE 122.7 mm			
	OPERATION 3			
001	ANODIC OXIDATION BLACK			
002	OUTSIDE SURFACES ENAMEL GREY SHAGREEN EXCEPT THE SURFACES C,D,A			
	THE SURFACE L - BLACK ENAMEL			
	BODY SIZE			
006	COUNTER-BORE HOLE ⌀2.9H14,MAINTAINING THE SIZES ⌀ 5 AND 2 mm		COUNTER-BORE ⌀ 5 mm	
007	COUNTER-SINK 3 HOLES,MAINTAINING THE SIZES 0.5×45°		COUNTER-SINK [illegible]	
010	ACCEPT WORK PIECE			
011	MILL PLATE,MAINTAINING ANGLE 14°0'±0°10'	MILLING MACHINE	END MILL	
012	MILL GROOVE AS SPECIFIED,MAINTAINING THE SIZES 4 AND 2 mm		END MILL	

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	20.001		
		PROFILE	DIMENSIONS
		ROUND ALUMINIUM ALLOY	121h14±58h12± 58h12

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	ROUGH BLANK WITH RESETTING	MILLING MACHINE, VICE		
0002	MILL 2 PLATES MAINTAINING THE SIZES < 14°0'±0°20', 31, 6 mm,		MILL END ø20 mm c 2 mm	SLIDING CALLIPERS
	11.5 mm,			ANGLEMETER
	6 mm			
0003	MILL SURFACE F, MAITAINING		FLY CUTTER	
	THE SIZES 11x14 AND 15 mm			
0004	DULL SHARP EDGES		FILE, SCRAPER	

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 2 (SHEET 2 OPERATION 2)			
001	MOUNT WORKPIECE WITH RESETTING	MILLING MACHINE, VICE		
002	DRILL TWO HOLES FOR MILL ø 10 mm TO THE LENGHT 5 mm		DRILL ø 10 mm	SLIDING CALLIPERS
003	MILL GROOVE MAINTAINING THE SIZE 6.5mm, 5.5mm, 20mm x 45mm		END MILLING CUTTER ø 10 mm	SLIDING CALLIPERS DEPTHMETER
	TO THE 6 mm DEPTH			
004	MILL GROOVE, MAINTAINING THE SIZES 15x45 mm TO THE 8 mm		END MILLING CUTTER ø 10 mm	
	DEPTH			
005	MILL GROOVE 15mmx45mm,			
	MAINTAINING SIZE 6mm TO THE 8 mm DEPTH		END MILLING CUTTER	SLIDING CALLIPERS
006	CENTRE FOR DRILLING THE HOLE, MAINTAINING THE SIZES 32.5±0.2,		CENTRE DRILL ø 2 mm	
	28±0.2 AND 34±0.2			
007	DRILL ø2.2mm TO THE 7 mm DEPTH OPERATION 2)		DRILL ø 2.2 mm	
008	COUNTERSINK 0.3 x 45°		COUNTERSINK [illegible]	
009	THREAD [illegible] M2.5 TO THE DEPTH 5 mm		TAP M 2.5	
010	MILL CORNER [illegible] 5 mm		END MILLING CUTTER	

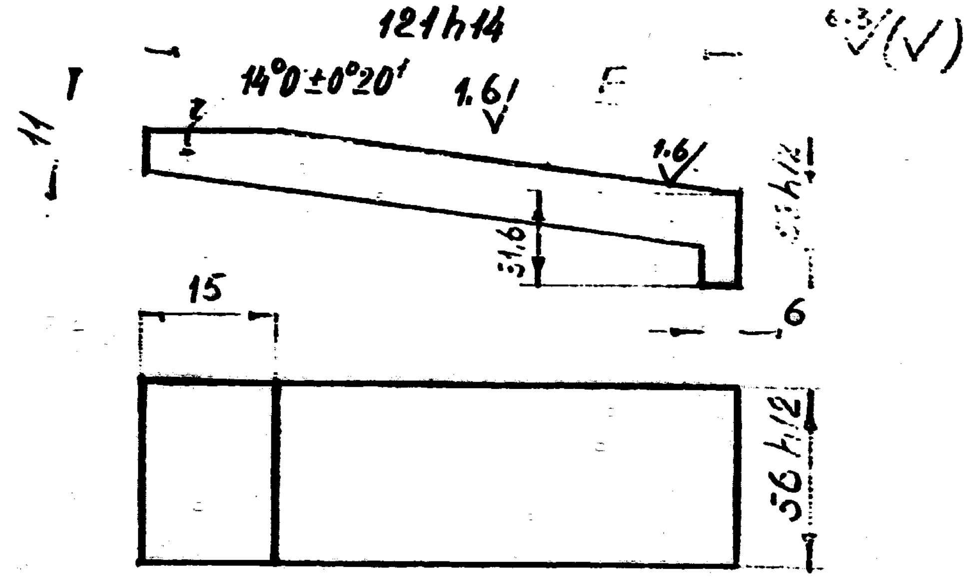
SHEET 3 NAME OF SHEETS 4

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 3 (SHEET 2 OPERATION 3)	MILLING MACHINE, VICE		
001	MOUNT WORKPIECE WITH RESETTING			
002	MILL TWO GROOVES 3 * 1.5 mm BY COUNTER,MAINTAINING 92		END MILLING CUTTER ø 4 mm	SLIDING CALLIPERS
003	MILL TWO CHAMFERS (60°±1°		END MILL	
	MAINTAINING THE SIZE 1 mm		CUTTER ø 20 mm	
	OPERATION 4 BENCH-WORKING			
001	COUNTER FILE,MAINTAINING		FILE	
	DIMENSIONS OF R			
	SPECIFIED			
	OPERATION 5			
	COATING - ANODIC OXIDATION BLACK			
	THE SURFACE P-ENAMEL BLACK			

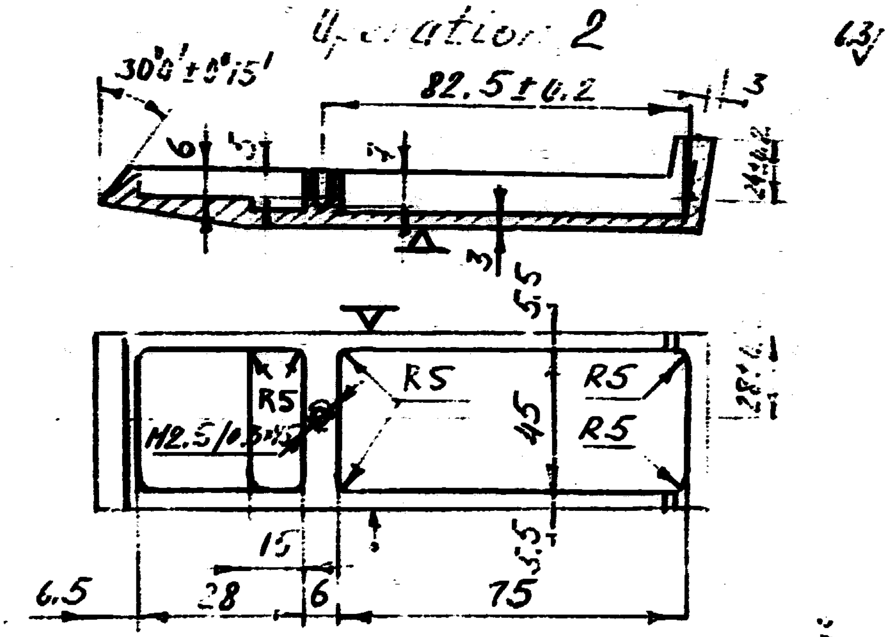
SHEET 4 NAME OF SHEETS 4

80.0G2

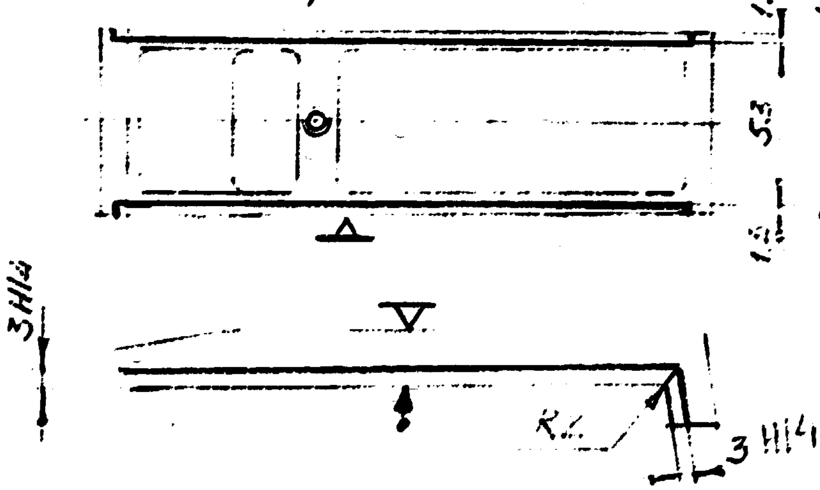
Operation 1

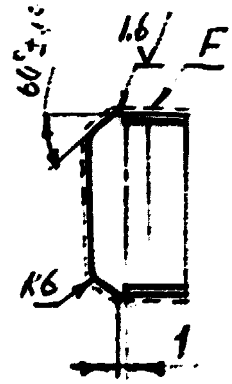


Operation 2



Operation 3



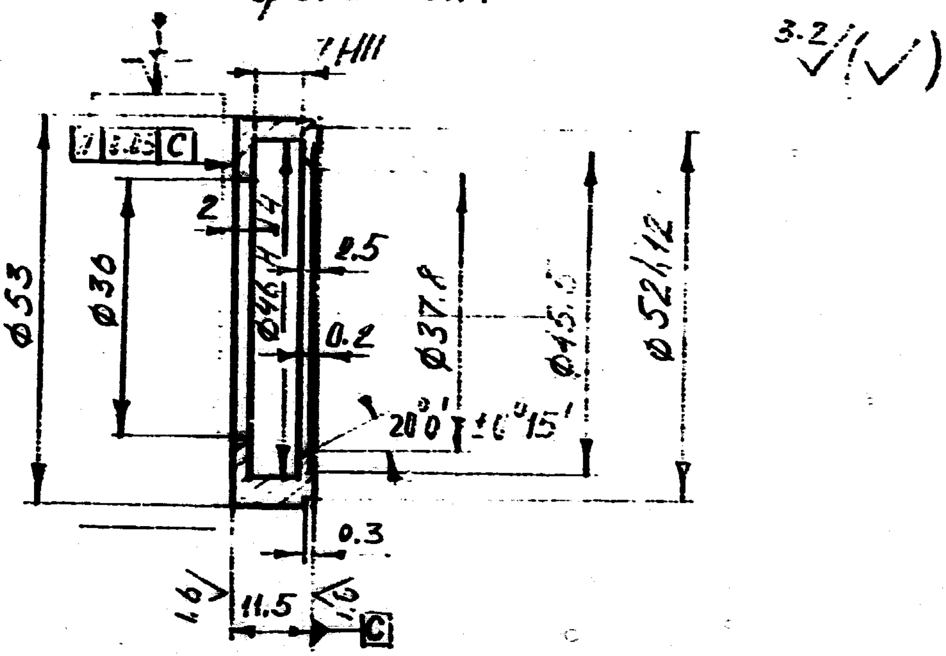


		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	30.000	PROFILE	DIMENSIONS
		ROUND BAR ALUMINIUM ALLOY	⌀ 55 × 20

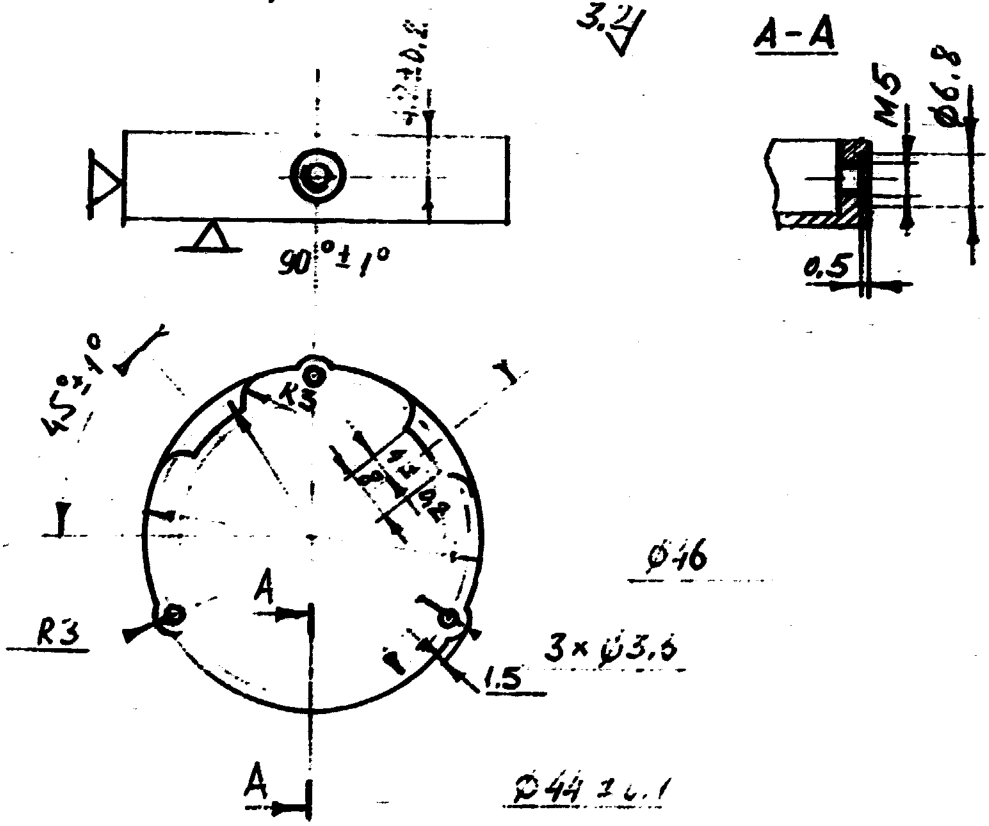
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN-125 3-JAW CHUCK		
002	CUT OUT END		TOOLHOLDER	
003	CENTRE		CENTRING DRILL ⌀ 2 mm	
004	DRILL HOLE ⌀ 15 mm TO THE 15 mm DEPTH		DRILL ⌀ 15 mm	
005	DRILL HOLE ⌀ 20 mm TO THE 15 mm DEPTH		DRILL ⌀ 15 mm	
006	BORE HOLE FOR THE ANY PASSES ⌀30 mm TO THE 15 mm DEPTH		BORING CUTTER	SLIDING CALLIPERS
007	BORE HOLE ⌀ 37.5H11 TO THE 9.5h11 mm DEPTH		BORING CUTTER	SLIDING CALLIPERS
008	TURN ⌀ 55h14		TOOLHOLDER	SLIDING CALLIPERS
009	TURN GROOVE ⌀ 52h12 × 6.3 mm SIDES		CUTTER TOOL	

SHEET 1 | NAME OF SHEETS 4

Operation 1



Operation 2



№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
1010	TURN GROOVE ⌀ 45.5 ± 0.2 mm			
1011	TURN INSIDE GROOVE ⌀ 46h14,		GROOVE CUTTER	MICROMETER 0.01
	MAINTAINING THE SIZES 2.5 AND 7h11 mm WITH CUT BUTT END			SLIDING CALLIPERS
1012	TURN CORNER 20°0'±30' ✗		BORING CUTTER	
1013	DULL SHARP EDGES		FILE, SCRAPER	
1014	CUT OFF, WITH CUT BUTT END,		PARTING OFF TOOL	SLIDING CALLIPERS
	MAINTAINING THE SIZE 11.5h11 mm			
	OPERATION 2 (SEE SHEET 2 OPERATION 2)	MILLING MACHINE DIVIDING		
2001	MOUNT WORKPIECE	ATTACHMENT		
2002	MILL TWO SHOULDERS, MAINTAINING THE DIMENSIONS		MILLING END CUTTER ⌀ 6 mm	SLIDING CALLIPERS
	SPECIFIED: (45°±1°, (90°±1°,			
	⌀ 46h14, 4±0.2 AND 6 mm			
2003	MILL THREE GROOVES 10 mm, MAINTAINING THE SIZE 1.5 mm		MILLING END CUTTER ⌀ 4 mm	SLIDING CALLIPERS
2004	CENTRE THREE HOLES MAINTAINING ⌀ 44±0.1		CENTRING DRILL	

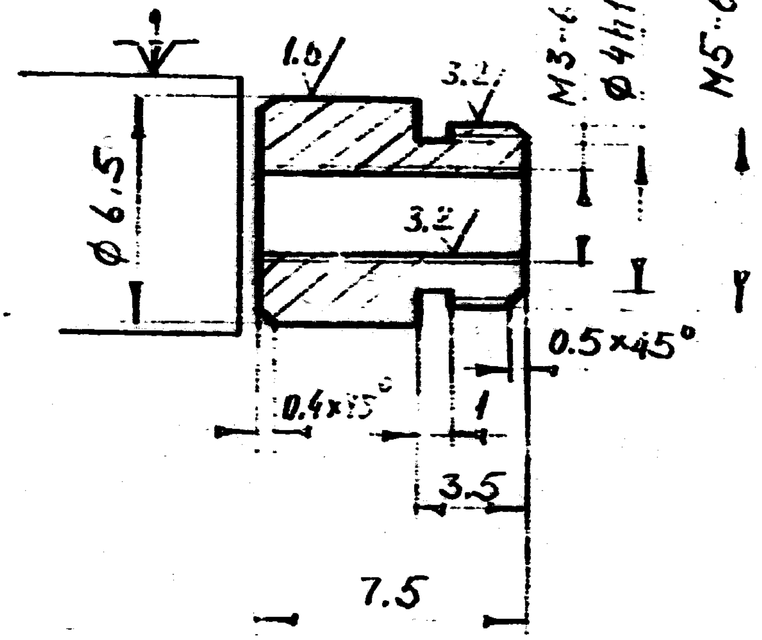
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0005	DRILL THREE HOLES ø 3.6 mm TO THE BODY SIZE		DRILL ø 3.6 mm	
0006	RESET WORKPIECE			
0007	MARKING OUT THE AXIS OF HOLE M5, MAINTAINING THE SIZES SPECIFIED			
0008	CENTRE		CENTRE DRILL	
0009	DRILL HOLE ø 4.2 mm TO BODY SIZE		DRILL ø 4.2 mm	
0010	COUNTER-BORE ø 6.8H14 TO THE 0.5 mm DEPTH		COUNTER-BORE ø 6.8 mm	
0011	DULL SHARP EDGES			
	OPERATION 3			
	COATING: ANODIC OXIDATION BLACK			
	THE SURFACE 6 - GREY ENAMEL [illegible]			

			OPERATION	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
SEE SHEET 2		80.004		
			PROFILE	DIMENSIONS
			ROUND BAR BRASS	ø 8 * 20
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHPUBLIA-125 3-JAWS CHUCK		
002	CUTT BUTT END		TOOLHOLDER	
003	TURN ø 6.5h14 TO THE LENGHT		TOOLHOLDER	SLIDING CALLIPERS
	10 mm			
004	TURN ø 5 mm TO THE LENGHT 3.5mm 15 mm DEPTH			SLIDING CALLIPERS
005	TURN CHAMFER 0.5 * 45°		CHAMFER TOOL	
006	TURN GROOVE ø 4 * 1 mm		GROOVE CUTTER	
007	CENTRE		CENTRING DRILL ø 2 mm	
008	DRILL HOLE ø 2.5h11 TO THE 10 mm LENGHT		DRILL ø 2.5h11	
009	THREAD SCREW M5-6g LENGHT		SCREW CUTTER	
			SHEET 1	NR. OF SHEETS 5

80.004

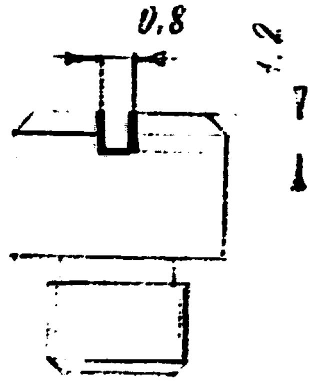
Operation 1

6.3/(✓)



Operation 2

6.3/

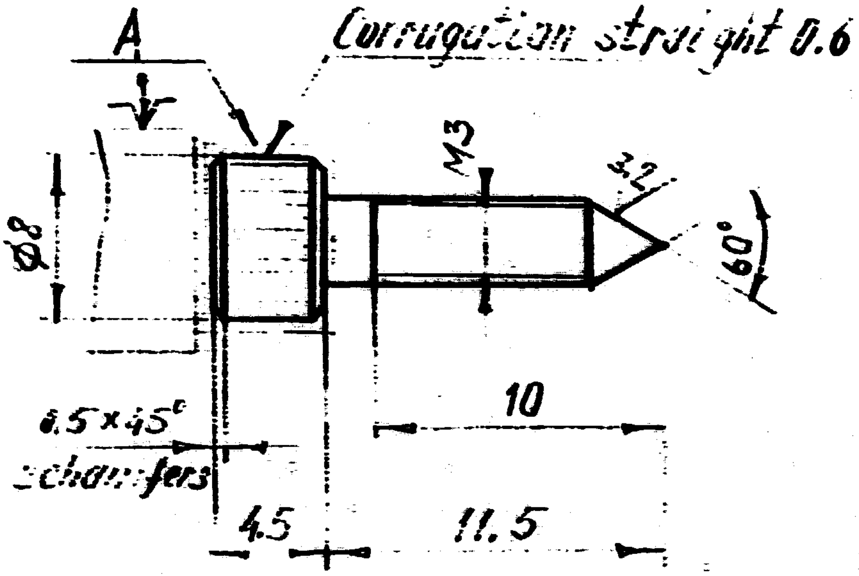


N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0010	THREAD SCREW M3-6		TAP M3	
0011	CUT OFF, MAINTAINING THE SIZE		PARTING OFF CUTTER	SLIDING CALLIPERS
	7.5 mm WITH CUT CHAMFER 0.4 x 45°		CHAMFER CUTTER	
	OPERATION 2			
	BENCH WORKING			
0001	FILE GROOVE 0.8 x 1.2 mm		FILE	
0002	DULL SHARP EDGES		FILE, SCRAPER	
	OPERATION 3			
	COATING: Cd / Cr 6			

			OPERATION	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
SEE SHEET 2		00.005	PROFILE	DIMENSIONS
			ROUND BAR STEEL A12	⌀ 8 x 20
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN-125 3-JAWS CONCENTRIC CHUCK		
002	CUTT BUTT END		TOOLHOLDER	
003	TURN CONER ∠ 60°		TOOLHOLDER	ANGLEMETER
004	TURN ⌀ 3h9, MAINTAINING THE		TOOLHOLDER	
	SIZE 11.5 mm			
005	TURN GROOVE ⌀ 5 x 2 mm,		GROOVE CUTTER	
	MAINTAINING THE SIZES 16 mm			
	AND 4.5 mm		⌀ 2 mm	
006	TURN TWO CHAMFERS 0.5 x 45°		CHAMFER TOOL	
			SHEET 1	NAME OF SHEETS 3

80.005

Operation 1



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
007	[illegible] CORRUGATION STRAIGHT [illegible]		KNURLING	
008	THREAD CUTTING M[illegible], MAINTAINING		TAP M[illegible]	SLIDING CALLIPERS
	THE SIZE 10 mm			
009	CUT OFF, MAINTAINING THE		PARTING TOOL	SLIDING CALLIPERS
	SIZE 15 mm			
	OPERATION [illegible]			
	COATING CHEMICAL OXIDATION			
	THE SURFACE A - Fe / [illegible]			
	COATING: [illegible]			

TECHNOLOGICAL PROCESS OF ASSEMBLING THE NOSEPIECE

ON STAND N.80.000

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
1.	COMPLETE ASSEMBLY UNIT 80.000 WITH			
	UNITS AND PARTS			
	UNITS : N. 70.000			
	NOSEPIECE REF.N 1			
	PARTS :			
	STAND REF.N3 80.001 - 1			
	COVER REF.N4 80.002 - 1			
	HOLDER REF.N5 80.003 - 1			
	BUSHING REF.N6 80.004 - 1			
	SCREW REF.N7 80.005 - 1			
	STANDARTS UNITS :			
	SCREW M 2.5 - 1			
	SCREW M 3 - 6			
2.	WASHING	BENCH		
	WASH PIECES IN BENZIN AND DRY	TANK		
	THEM DURING 15 min AT T=20°C			
3.	ASSEMBLING			
	SECURE WORKPIECE 80.001 REF.N3 ON			
	THE STAGE			
	MOUNT ASSEMBLY N.70.000 REF.N1 SE-	SCREW		
	CURE IT PRELIMINARY SCREWS M3	DRIVER		
	REF.N10			
3.1	SET MOUNT 80.003 REF.N5 INTO THE			
	HOLE OF THE STAND 80.001 REF.N3			
	SECURE IT PRELIMINARY WITH THREE			
	SCREWS M3 REF.N10			
3.2	MOUNT OF SPECIAL CENTRING BUSHING			
	TO ø 37.8H11 ON THE SUPPORT END			
	OF HOLDER 80.003			
	SCREW IN A SPECIAL CENTRING BU-	THREADED		
	SHING INTO A THREADED HOLE	CENTRING		
	4/5" x 1/36" AND ON THE SUPPORT	BUSHING		
	END B OF THE NOSEPIECE SOCKET	(4/5"x1/36"		

TECHNOLOGICAL PROCESS OF ASSEMBLING THE NOSEPIECE

ON STAND X.00.000 (2)

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
	ALIGN AXES OF SPECIAL CENTRING BUSHINGS (37.8H11 AND 4/5" 8 1/36") ON SCREWS REF.N10 USING A CYLINDRICAL HOLDER AND TIGHTEN THE SCREWS.	SCREW DRIVER		
3.3	PUT THE AUTOCOLLIMATION TUBE ON THE SURFACE OF THE SUPPORT HOLDER 00.003 REF.N5 VIA AN ADAPTER BUSHING	AUTOCOLLIMATION TUBE ADAPTER BUSHING		
	PRESS A PLANE-PARALLEL MIRROR PLATE TO THE SURFACE OF THE SUPPORT END B UNDER THE OBJECTIVE OF THE NOSEPIECE	PLANE - PARALLEL MIRROR PLATE		
3.4	DEVIATION OF THE AUTOCOLLIMATION GLARE FROM THE CENTRE OF THE EYEPIECE CROSSHAIRS OF THE AUTOCOLLIMATION TUBE SHOULD NOT EXCEED 8'			

OPERATION

OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	150.311		
		PROFILE	DIMENSIONS
		ROUND BAR BRASS	⌀ 2 × 50

№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 125 TYPE COLLET		
002	CUT END	-	TOOLHOLDER	
003	TURN ⌀ 0.8h12 TO THE LENGTH 0.3h12		CUTTER TOOL	SLIDING CALLIPERS
004	TURN ⌀ 1.5h11 TO THE LENGTH 2h12		CUTTER TOOL	SLIDING CALLIPERS
005	CENTRE ⌀ 0.3 mm × 60 °		CENTRING DRILL	
006	TURN ANGLE GROOVE 0.1 mm DEPTH		FORM CUTTER	MICROSCOPE
007	CUT OF WORKPIECE WITH CHAMFERING MAINTAINING THE SIZE			
	THE SIZE 1.2h12 AND 0.2 × 45°		—	

SHEET 1	NAME OF SHEETS 2

OPERATION		
OPERATION DRAFT	NUMBER OF PIECES	BLANK
SEE SHEET 2	120,312	

PROFILE	DIMENSIONS
STEEL SHEET	0.1 mm

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 1			
001	PRESS RING ø 28 x ø 20	STAMP		
002	CUT TWO HOLES ø 0.8H12 0.8H12			
	OPERATION 2			
001	CUT PART OF RING ([illegible])			
	OPERATION 3			
001	GRIND [illegible] 2	GRINDING MACHINE		

SHEET 1	NAME OF SHEETS 2

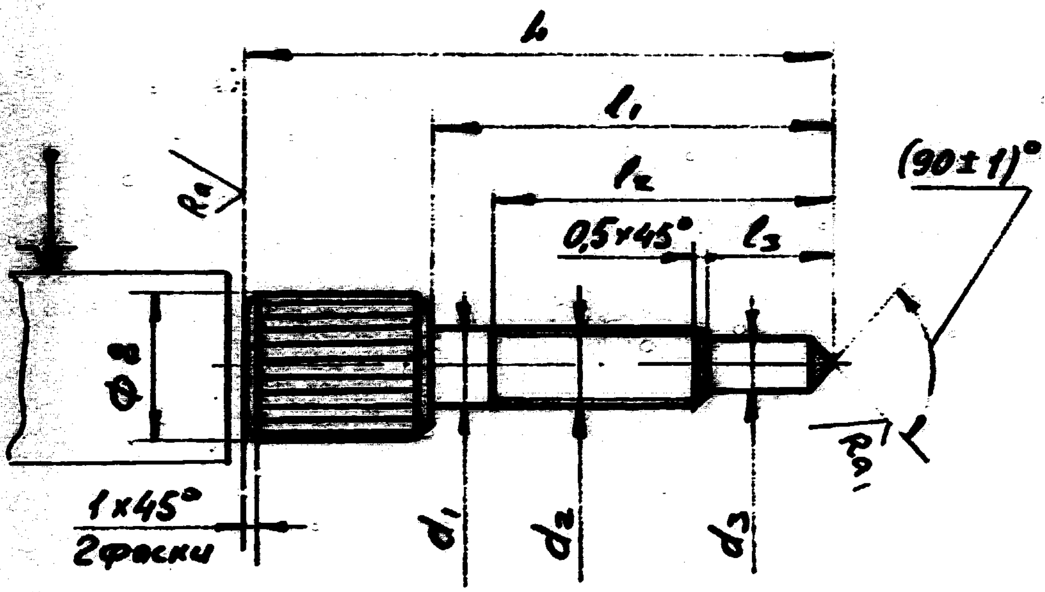
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 4			
0.01	MOUNT A PIN IN HOLE OF			
	GAB			
0.02	PRESS THE GAB			
0.03	REPEAT 0.01 AND 0.02 FOR			
	THE SECOND HOLE. THE			
	PINS MUST BE DIRECTION			
	IN OTHER SIDE OF GAB			

SHEET 2	NAME OF SHEETS 2

				OPERATION	
OPERATION BRAFT		NUMBER OF PIECES	BLANK		
SEE SHEET 2		140.002 140.003 140.015			
			PROFILE	DIMENSIONS	
			ROUND BAR STEEL	o 10 * 200	
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS	
001	MOUNT THE BLANK	SHAUBLIN - 1215 TYPE COLLET			
002	CUT THE END		TOOLHOLDER	SLIDING CALLIPERS	
003	TURN o 8 TO THE LENGHT OF L+2 mm		TOOLHOLDER	SLIDING CALLIPERS	
004	TURN o d1 TO THE LENGHT OF l1				
005	TURN o d3 TO THE LENGHT OF		CHAMFER TOOL	SLIDING CALLIPERS	
	l3 WITH CHAMFERING 0.5 * 45°				
006	TERN THE CONE < 90° ± 1°		TOOLHOLDER		
007	CUT THE THREAD d2 TO THE LENGHT		SCREW CUTTER		
	OF l2				
008	TURN THE CHAMFER 1 * 45°		CHAMFER TOOL		
			SHEET 1	NAME OF SHEETS 4	

$\sqrt{^{3,2}}\,(\checkmark)$

Операция I



Обозн.	L	l_1	l_2	l_3	d_1	d_2	d_3	R_a	R_{a_1}
140.002	32	20	17	0	Ф4	М4-6g	0	3,2	3,2
140.003	32	20	17	0	Ф3	М3-6g	0	3,2	3,2
140.015	37	25	25	10	Ф5	М8×0,5-6g	4	1,6	1,6

140.002
140.003
140.015

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	TURN A 1.5 mm FLUTE		GROOVE CUTTER	
	ALONG THE LENGHT L WITH CHAMFERING 1 x 45°			
010	ROLL - ON		KNURLING	
011	CUT - OFF THE WORKPIECE TO THE		PARTING OFF	SLIDING
	SIZE L		CUTTER	CALLIPERS

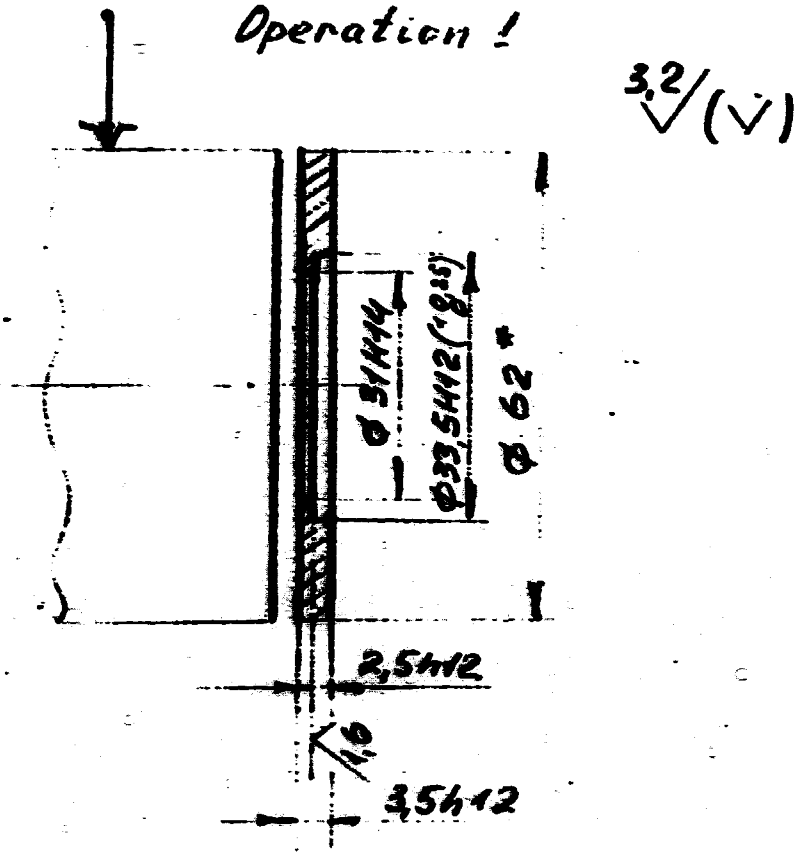
SHEET 3	NAME OF SHEETS 4

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 2			
	BRENCH - WORKING			
001	DULL SHARP EDGES		FILE	
002	FOR 140.015			
	GRIND CONE SURFACE TO 1.6			
	GRIND THE TOP END TO 1.6	GRINDING MACHINE		
	OPERATION 3			
	ELECTROPLATING			
	COATING TO THE TECHNICAL			
	REQUIREMENTS IN THE DRAWING			

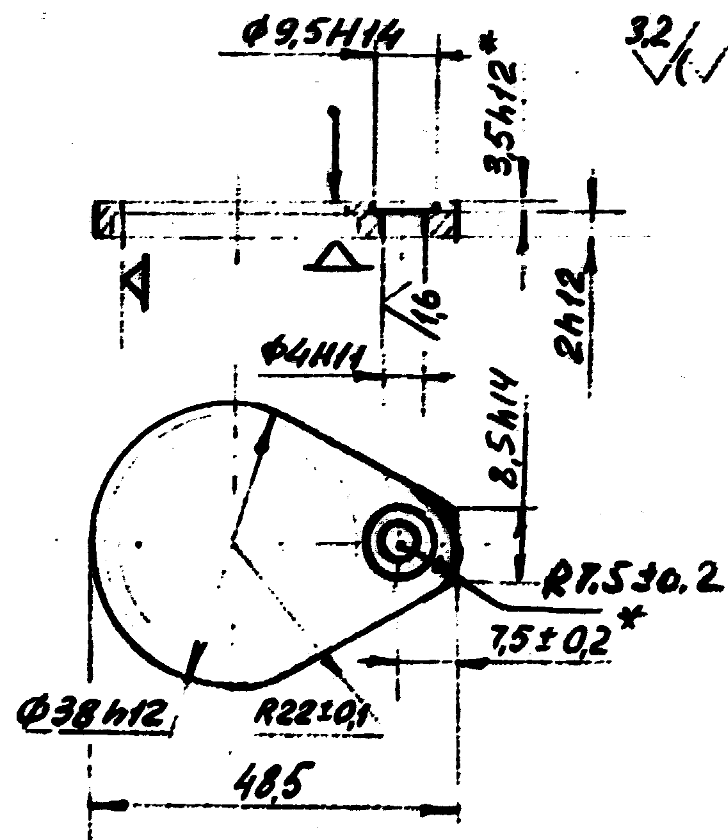
SHEET 3	NAME OF SHEETS 3

			OPERATION	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
SEE SHEET 2		140.005		
			PROFILE	DIMENSIONS
			ROUND BAR ALUMINIUM ALLOY	ø 65 * 50
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 1215 3-JAWS CHUCK		
002	CUT THE END		TOOLHOLDER	
003	CENTRE		CENTRING DRILL	
004	DRILL FOR THE NEXT PASSES AND BORE THE HOLE ø31H14		DRILL BORING CUTTER	SLIDING CALLIPERS
005	BORE HOLE ø33.5H12		BORING CUTTER	SLIDING
	WITH CUT BOTTOM TO THE SIZE 2.5h12			CALLIPERS
006	CUT - OFF WORKPIECE TO THE SIZE 3.5h12		PARTING OFF TOOL	SLIDING CALLIPERS
	OPERATION 2 (SEE SHEET 2)	MILLING MACHINE		
001	MOUNT AND REMOVE THE WORKPIECE	ANGLE TABLE		
002	MILL BY MARKING OUT , MAINTAINING		END MILL	SLIDING CALLIPERS
	TO THE SIZES ø38h12, 48.5, 8.5h14			
			SHEET 1	NAME OF SHEETS 3

Operation 1



Operation 2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
003	CENTRE BY MARKING OUT THE HOLE ø 4H11		CENTRE DRILL	
004	DRILL HOLE ø4H11 TO THE BODY SIZE			
005	DRILL THE HOLE ø9.5H14, MAINTAI - NING THE SIZE 2h12		COUNTER BORE ø 9.5	SLIDING CALLIPERS
	OPERATION 3. BRENCH-WORKING			
	FILE FOR COUNTOR TWO CHAMFERS 0.5 x 45° AND R7.5 ± 0.2			
	OPERATION 4			
	COATING CHIMICAL PASSIVATION			
	BLACK ENAMEL SHAGREEN			

SHEET 3	NAME OF SHEETS 3

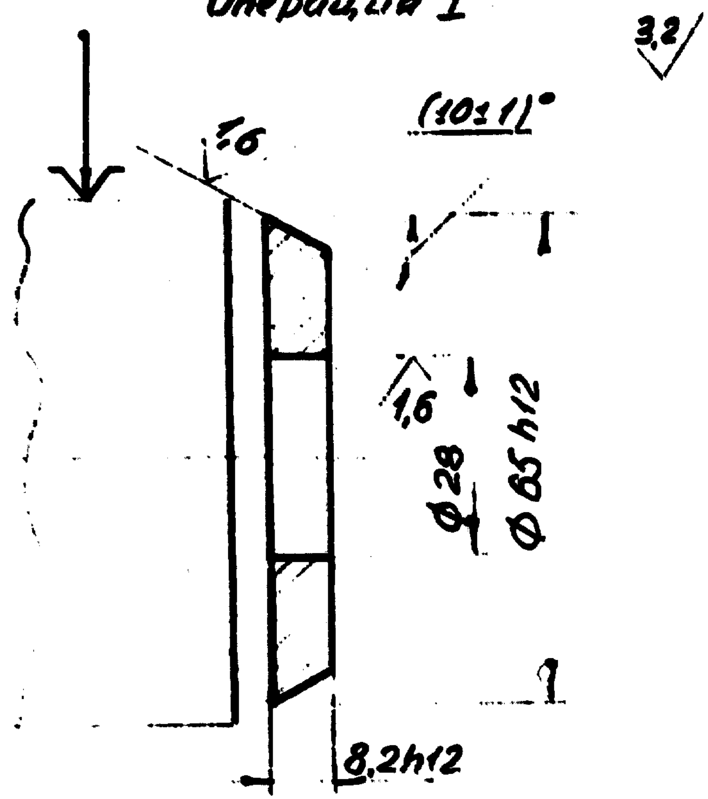
	OPERATION

OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	140.006	PROFILE	DIMENSIONS
		ROUND BAR STEEL 50	⌀ 70 x 200

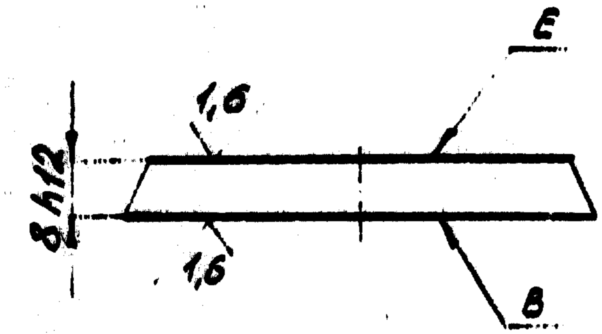
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SAMBOLIN - 1215 3-JAWS CHUCK		
002	CUT THE END		TOOLHOLDER	
003	TURN ⌀ 65h12 TO THE LENGHT OF 11 mm		TOOLHOLDER	
004	TURN CONICAL SURFACES AN ANGLE (10 ± 1)°		TOOLHOLDER	ANGLEMETER
005	CENTRE		CENTRING DRILL	
006	DRILL AND BORE A HOLE FOR ⌀ 28 TO THE DEPTH OF 10 mm		DRILL BORING CUTTER	SLIDING CALLIPERS
007	BORE A HOLE ⌀ 28 TO THE DEPTH OF AT LEAST 8.2 + 0.2		BORING CUTTER	SLIDING CALLIPERS
008	CUT - OFF THE WORKPIECE TO THE SIZE OF 8.2h12 WITH ON ALLOWANCE		TOOLHOLDER	SLIDING CALLIPERS
	FOR GRINDING END SURFACES			

SHEET 1	NAME OF SHEETS 4

Операция I



Операция II

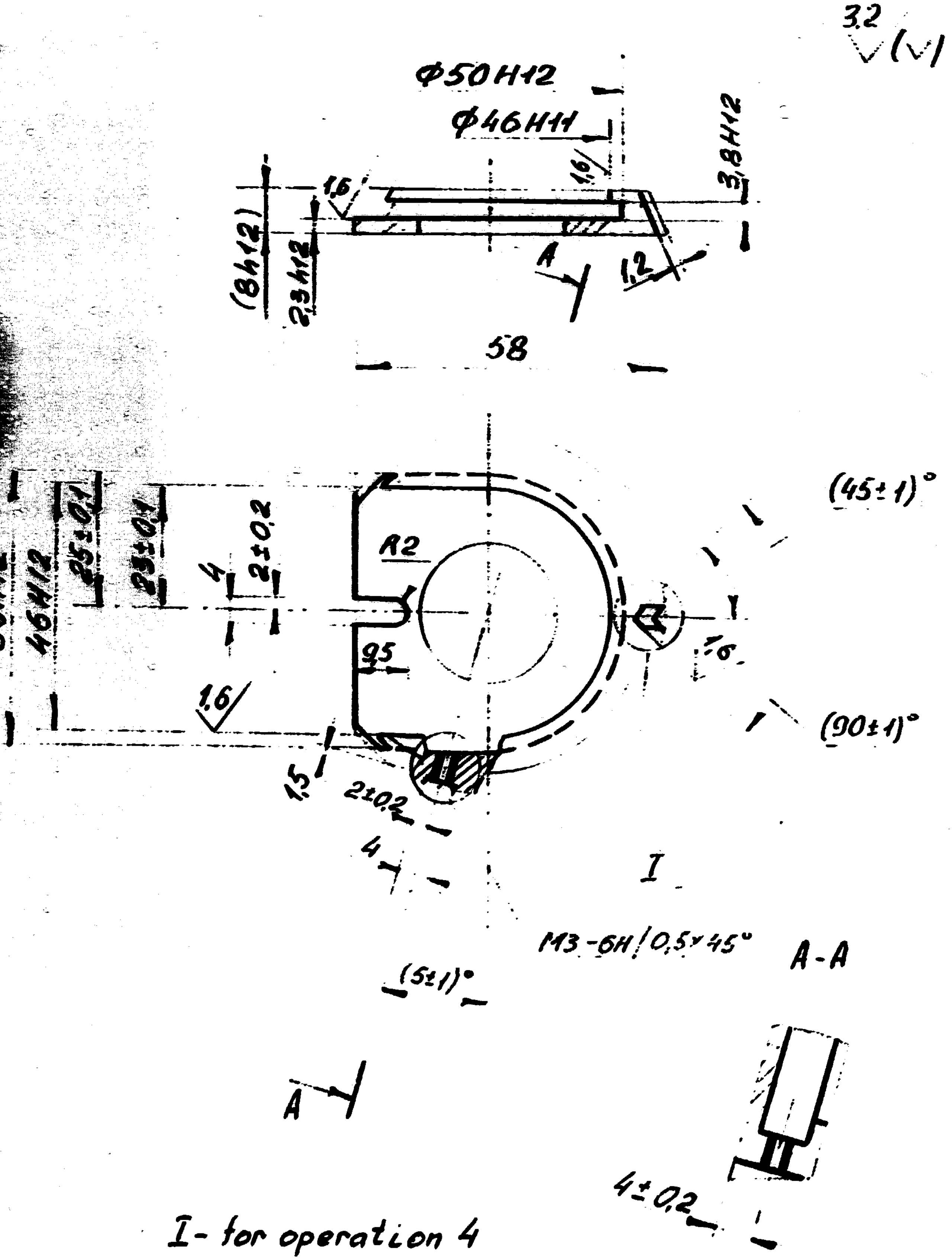


140.006

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 2	GRINDING MACHINE, MAGNE-		
001	MOUNT AND REMOVE THE WORKPIECE WITH RESETTING	TIC STAGE		
002	GRIND THE WORKPIECE WITH RESETTING TO THE SIZE OF 8h12			
	002.1 - SETTING SURFACE B AS THE BASE			
	002.1 - SETTING SURFACE E AS THE BASE			
	OPERATION 3			
	MILLING	MILLING MACHINE		
001	MOUNT AND REMOVE THE WORKPIECE	MAGNETIC STAGE		
002	MILL PRELIMINARY AND FINALLY GROOVE 46H12, MAINTAINING			SLIDING CALLIPERS
	SIZE 2.3h12			
003	MILL GROOVE 50h12, MAINTAINING SIZES 3.8H12 AND 2.3 h12			SLIDING CALLIPERS
004	MILL GROOVE 4 TO THE DEPTH OF 9.5 mm		END MILL ø 4 mm	
	OPERATION 4			
001	MOUNT AND REMOVE THE WORKPIECE	MILLING MACHINE	FACING MILL	

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
002	MILL THE GROOVE AT THE ANGLE ((90° ± 1)° TO THE DEPTH			
	OF 1.2 TO BODY SIZE			
003	MILL FLAT 4 TO THE DEPTH OF 1.5 TO BODY SIZE		END MILL ø 4 mm	DEPTHMETER SLIDING
004	DRILL A HOLE TO THE MARKING OUT FOR THE THREAD M3-6H TO BODY SIZE		DRILL ø 2.5	CALLIPERS
005	REAM THE HOLE 0.5 x 45° THE BASE		COUNTERSINK (90°	
006	CUT THE THREAD M3-6H TO BODY SIZE		TAP M3	
	OPERATION 5			
	ELECTROPLATING			
	COATING TO TECHNICAL REQUIREMENTS IN THE DRAWING			
	Fe / Ni15Cr			
			SHEET 3	NAME OF SHEETS 4

Operations 3,4



I- for operation 4

140.006

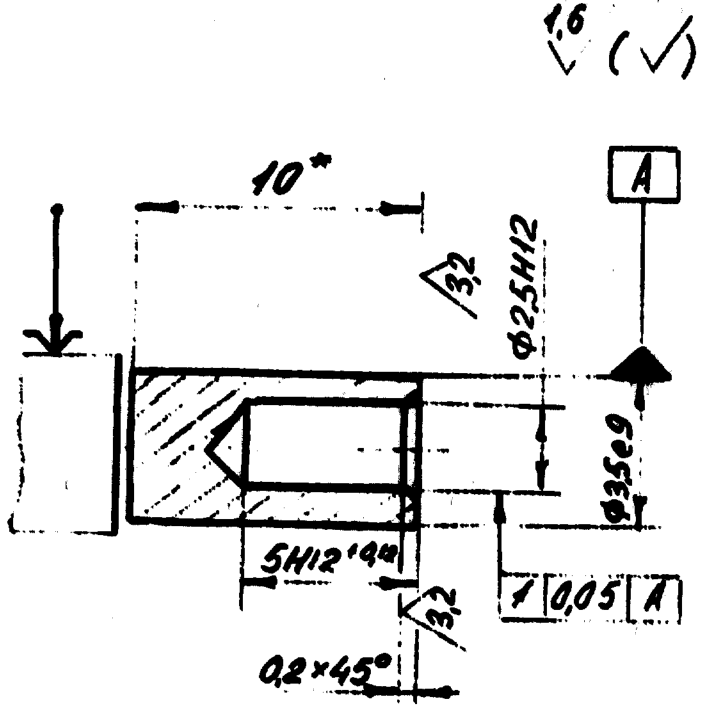
OPERATION DRAFT	NUMBER OF PIECES	OPERATION BLANK	
SEE SHEET 2	140.007	PROFILE	DIMENSIONS
		ROUND BAR STEEL A75	ø 5 # 50

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 1215 3-JAWS CHUCK		
002	CUT THE END		TOOLHOLDER	
003	TURN ø 3.5e9 TO THE LENGHT OF 11 mm		TOOLHOLDER	CLIDING CALLIPERS
004	CENTRE		CENTRING DRILL	
005	DRILL ø 2,5H12 TO THE DEPTH 5H12		DRILL ø 2.5	
006	REAM HOLE 0.2 # 45° OF AT LEAST 8.2 + 0.2		COUNTERSINK < 90°	
007	CUT - OFF THE WORKPIECE TO THE SIZE OF 10 mm		PARTING OFF CUTTER	SLIDING CALLIPERS
	OPERATION 2			
001	MOUNT THE WORKPIECE			

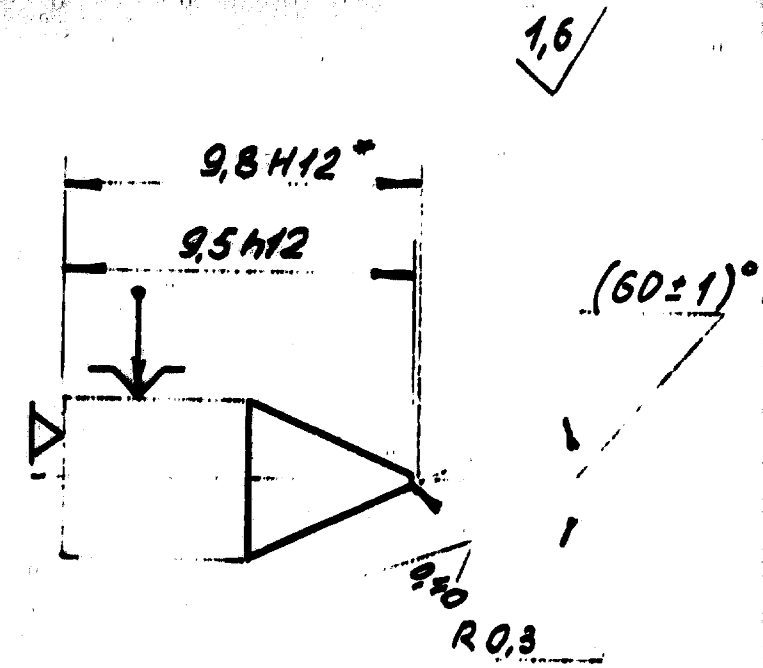
SHEET 1	NAME OF SHEETS 3

140.007

Operation 1



Operation 2 and 4



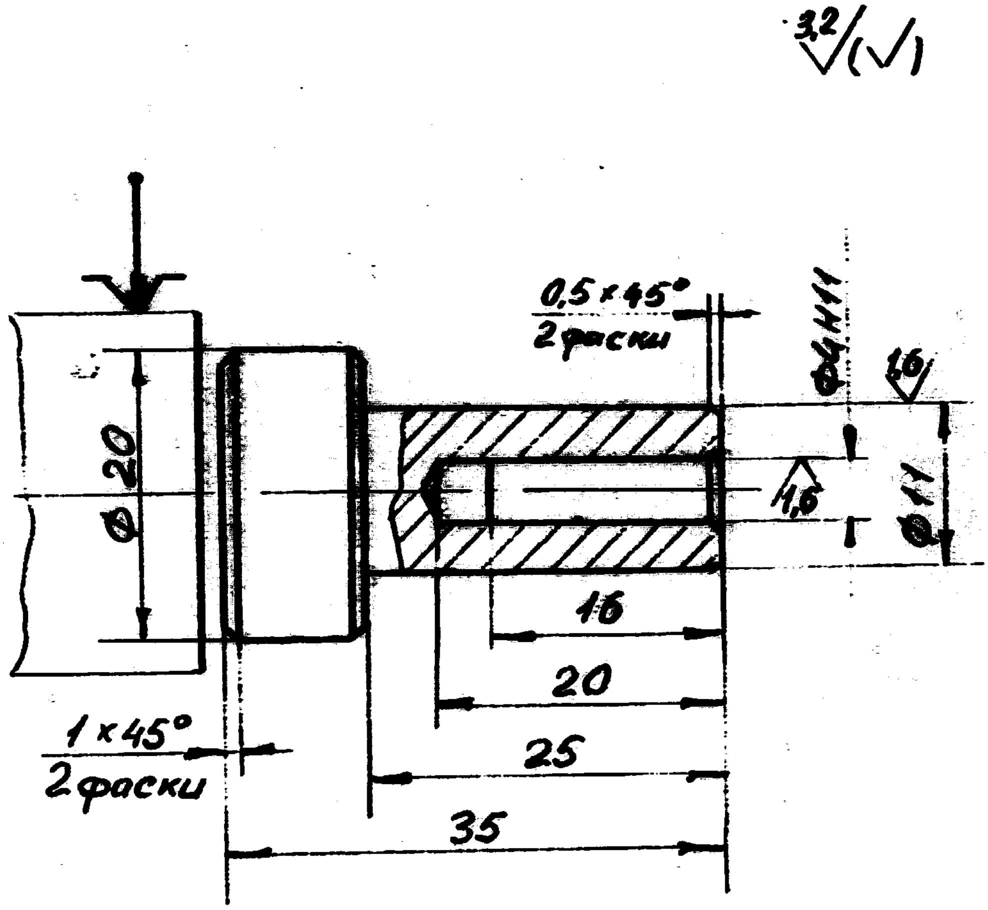
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
002	TURN CONICAL SURFACE (< 60 ± 1)°		TOOLHOLDER	
	MAINTAINING THE SIZE 9.8 h12			
	OPERATION 3			
	TERMAL THREATMENT			
	HARDEN (HEAT TO THE 860°)			
	COATING DOWN TO THE 20°C IN WATER HRC 61-63			
	OPERATION 4			
001	MOUNT AND REMOVE THE BLANCK	GRINDING MACHINE		
002	GRINDING THE CONICAL SURFACE			
003	AND R 0.3 , MAINTAINING THE SIZE 9.5h12			
	OPERATION 5			
	COATING : CHIMICAL OXIDATION IMPREGNATION BY OIL			

SHEET 3	NAME OF SHEETS 3

OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	140.000	PROFILE	DIMENSIONS
		ALUMINIUM ALLOY ROUND BAR	ø 25 x 50

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 1215 3-JAWS CHUCK		
002	CUT THE END		TOOLHOLDER	
003	TURN ø 20 TO THE LENGHT OF 37 mm		TOOLHOLDER	SLIDING CALLIPERS
004	TURN ø 11 WITH CUTTING SHOULDER		TOOLHOLDER	SLIDING CALLIPERS
	TO THE SIZE OF 25 mm			
005	TURN TWO CHAMFERS 1 x 45° AND 0.5 x 45°		CHAMFER TOOL	
006	CENTRE		CENTRING DRILL	
007	DRILL FOR REAMING ø 4H11 TO THE DEPTH OF 20 mm		DRILL ø3.9 mm	
008	BORE (REAM) THE CHAMFER 0.5 x 45°		COUNTERSINK < 90°	
			SHEET 1	NAME OF SHEETS 3

Операция I



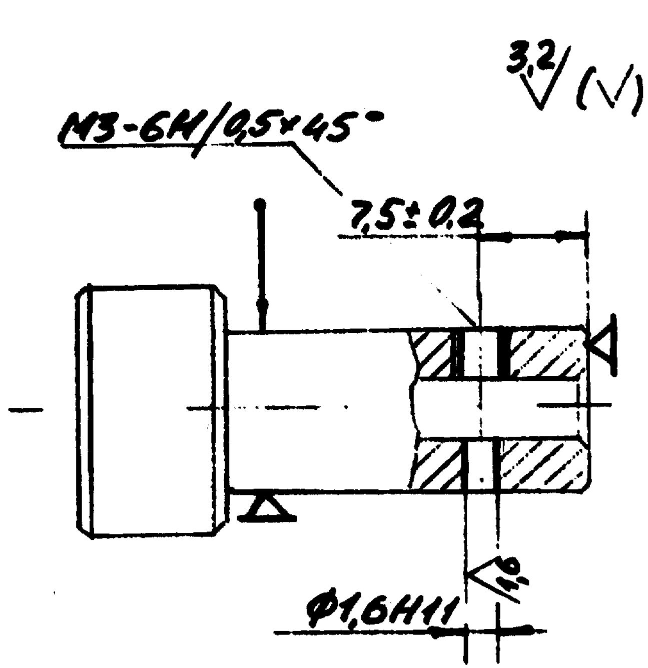
140.008

№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	REAM THE HOLE ⌀ 14H11 TO THE DEPTH OF 16 mm		REAMER ⌀ 4H11	
010	TURN A 2 mm FLUTE WITH CHAMFE-RING 1 x 45°		PARTING OFF CUTTER	
011	CUT - OFF THE WORKPIECE TO THE		PARTING OFF	
	SIZE OF 35 mm		CUTTER	
	OPERATION 2			
001	MOUNT AND REMOVE THE WORKPIECE	MILLING MACHINE (TACK PRISM)		
002	CENTER FOR DRILLING MAINTAINING		CENTER DRILL	
	THE SIZE OF 7.5 ± 0.2			
003	DRILL A HOLE FOR REAMING ⌀1.6H11		DRILL ⌀ 1.5 mm	
004	DRILL A HOLE FOR THREADING M3-6g		DRILL ⌀ 2.5 mm	
005	REAM A HOLE ⌀ 1.6H11		REAMER ⌀ 1.6H11	
006	CUT A THREAD M3-6HNING THE SIZE		TAP M3	
007	CALIBRATE WITH A REAMER THE AXIAL HOLE ⌀ 4H11		REAMER ⌀ 4H11	

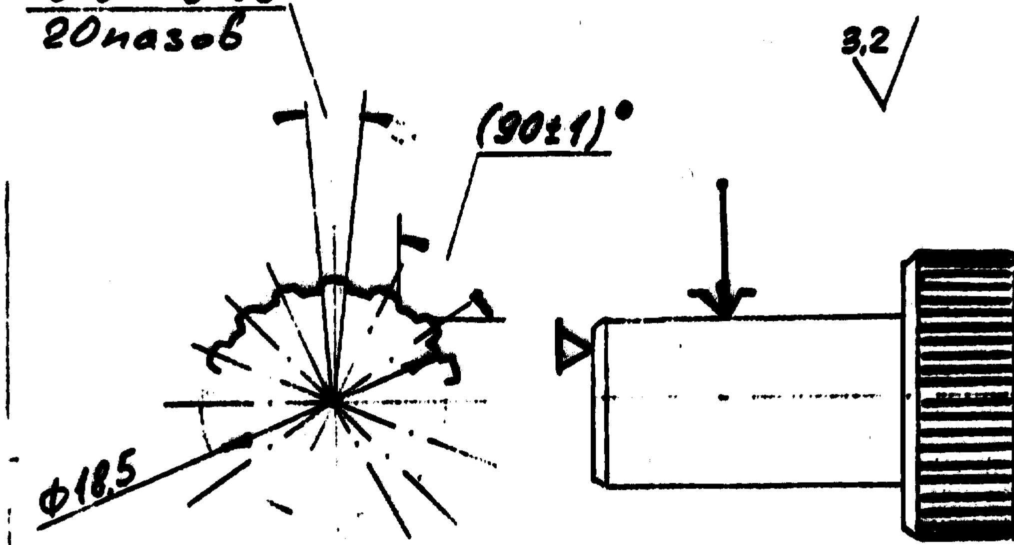
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 3			
001	MOUNT AND REMOVE THE WORKPIECE	MILLING MACHINE		
002	MILL 20 GROOVES TO BODY SIZE	DIVIDING ATTACHMENT	FACING MILL CUTTER	
	OPERATION 3			
	COATING : ANODIC OXIDATON BLACK			
	THE OUT SIDE SURFACE ENAMEL			

SHEET 3	NAME OF SHEETS 3

Операция II



Операция III

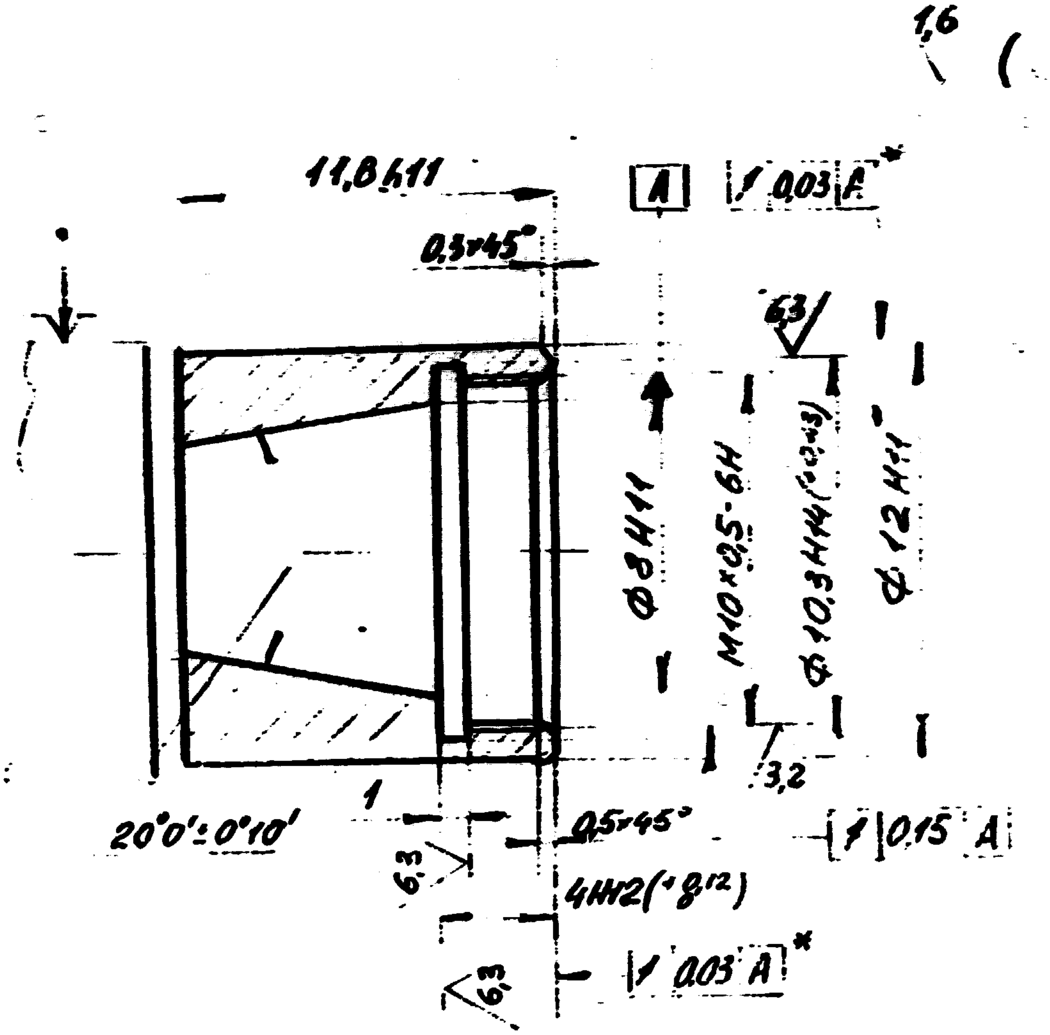


140.008

OPERATION DRAFT	NUMBER OF PIECES	OPERATION	
		BLANK	
SEE SHEET 2	140.009		
		PROFILE	DIMENSIONS

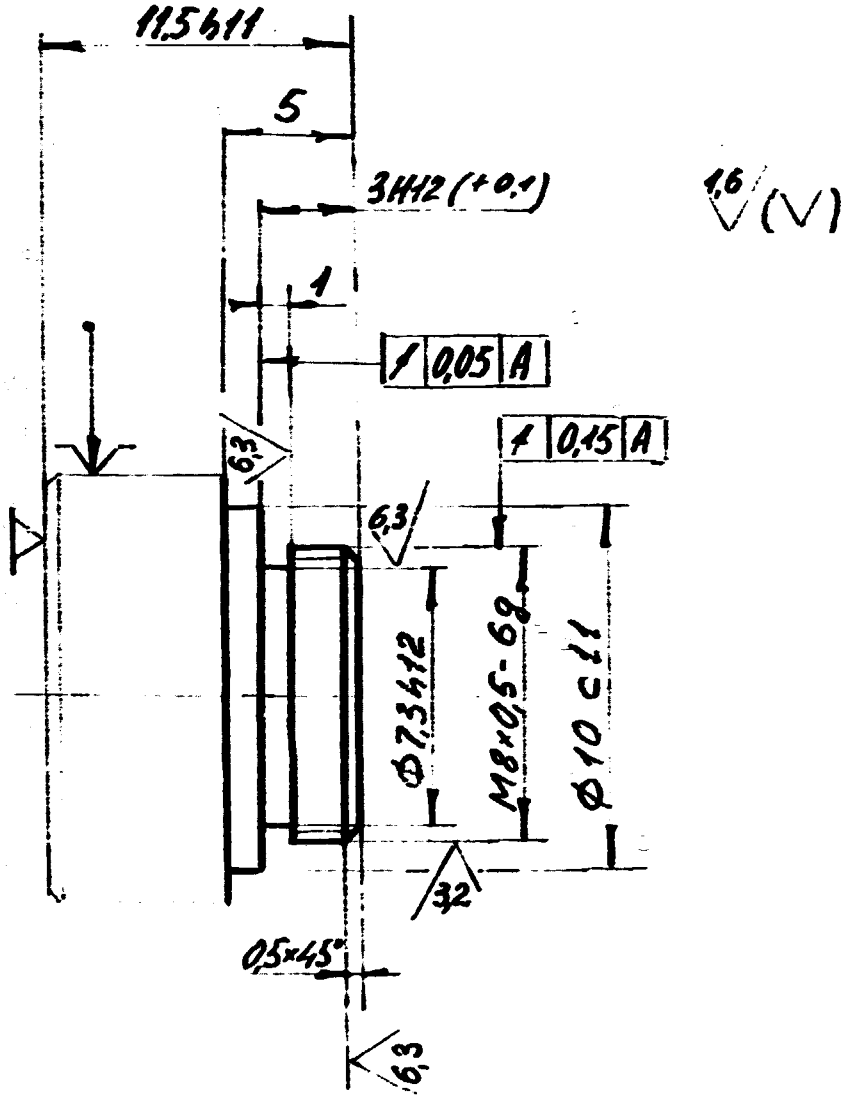
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 1215 3-JAWS CHUCK		
002	CUT THE END		TOOLHOLDER	
003	CENTRE		CENTRING DRILL	
004	DRILL A HOLE o 6.5 TO THE DEPTH OF 14 mm		DRILL o 6.6 mm	
005	BORE o 8H11 TO THE DEPTH OF 4.2 WITH BOTTOM UNDERCUTTING		BORING CUTTER	SLIDING CALLIPERS
006	CUT THE END TO THE SIZE OF 4H12 (+ 0.12)		CUTTER	DEPTHMETER
007	BORE A CONE (20°0' ± 10' TO THE DEPTH OF AT LEAST 12 mm			
008	BORE A GROOVE 1 TO o 10.3H14, MAINTAINING THE SIZE 4H12		BORING CUTTER	SLIDING CALLIPERS
009	BORE THE HOLE FOR THE THREAD M10 x 0.5 - 6H		BORING CUTTER	SLIDING CALLIPERS
			SHEET 1	NAME OF SHEETS 3

Операция I


1,6
11,8 h11
0,3×45°
A
0,03 A *
6,3
Ф8H11
M10×0,5-6H
Ф10,3H14(+0,43)
Ф12H11
3,2
1
20°0'±0°10'
0,5×45°
0,15 A
6,3
4H12(+0,12)
0,03 A *
6,3

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
010	BORE THE CHAMFER 0.3 x 45°			
011	CUT THE THREAD M10 x 0.5		SCREW CUTTER	
012	TURN ø 12h11 (TECHNOLOGIST)		TOOLHOLDER	
	TO THE LENGTH AT LEAST 11.8h11			
013	TURN THE CHAMFER 0.5 x 45°		CHAMFER TOOL	
014	CUT OFF THE WORKPIECE TO THE SIZE OF 11.8h11		PARTING OFF CUTTER	
	OPERATION 2	SHAUBLIN - 125 TYPE COLLET		
001	MOUNT AND REMOVE THE WORKPIECE			
002	CUT THE END THE SIZE		TOOLHOLDER	SLIDING CALLIPERS
	OF 11.5h11			
003	TURN ø 10C11 TO THE LENGTH OF 5		TOOLHOLDER	SLIDING CALLIPERS
004	TURN FOR THE THREAD M8 x 0.5 - 6g		TOOLHOLDER	SLIDING CALLIPERS
	TO THE LENGTH OF 3.1 mm			
005	TURN THE GROOVE 1 TO ø 7.3h12 , MAINTAINING THE SIZE OF 3H12		GROOVE CUTTER	

Операция II



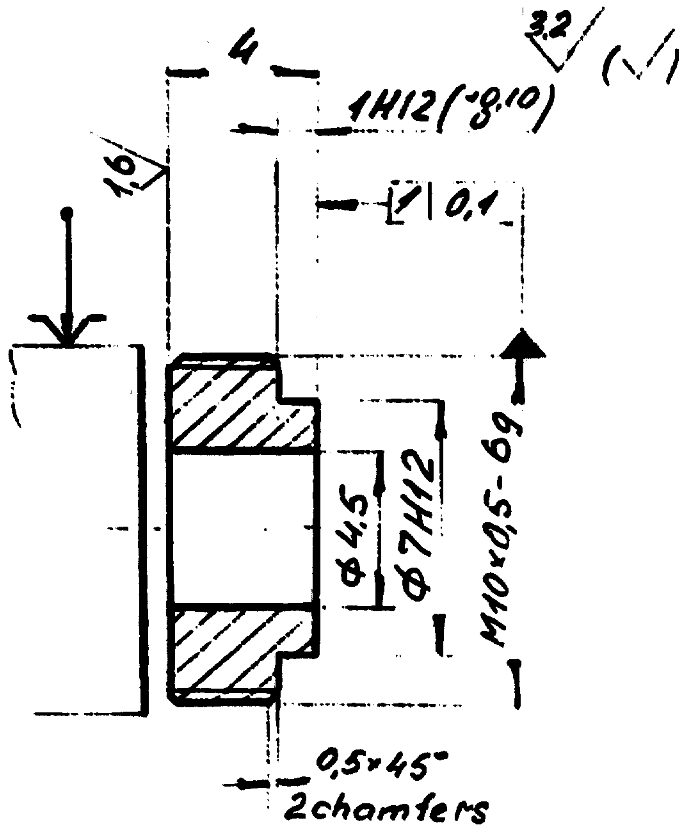
140 009

№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
006	TURN THE CHAMFER 0.5 x 45°		CHAMFER TOOL	
007	CUT THE THREAD M8 x 0.5 - 6g		SCREW CUTTER	
	OPERATION 3			
	COATING Cu / Ni 6 Cr MAT			
	FINISH			
			SHEET 3	NAME OF SHEETS 3

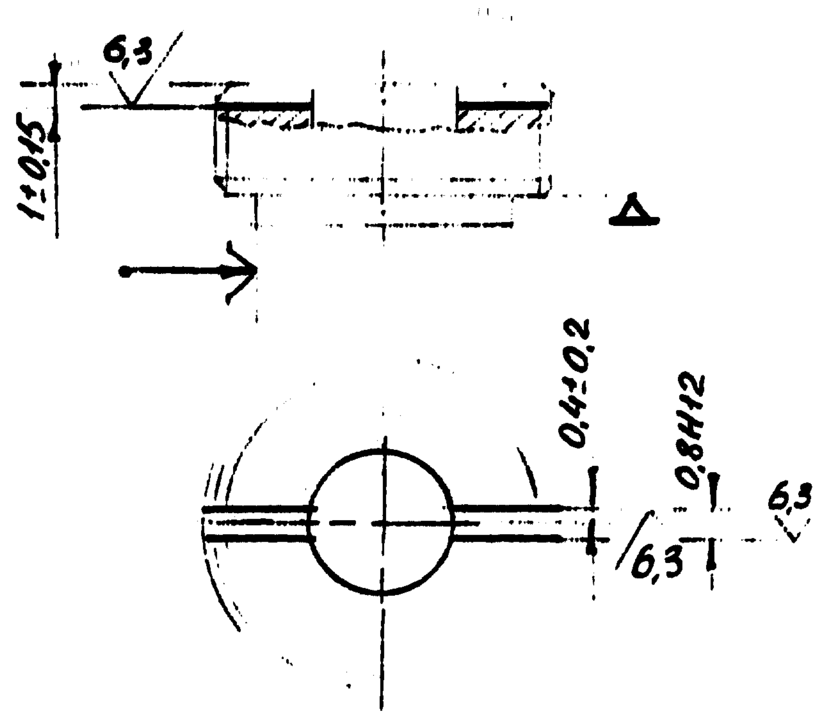
		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	140.011	PROFILE	DIMENSIONS
		ROUND BAR BRASS	ø 12 x 20

№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 1215 3-JAWS CHUCK		
002	CUT THE END		TOOLHOLDER	
003	TURN FOR CUTTING THE THREAD		TOOLHOLDER	SLIDING CALLIPERS
	ø 10h9 TO THE LENGTH OF 12 mm			
004	TURN ø 7H12 TO THE LENGTH OF 1H12		TOOLHOLDER	SLIDING CALLIPERS
005	TURN THE CHAMFER 0.5 x 45°		CHAMFER TOOL	
006	TURN 2 WITH CHAMFERING 0.5 x 45° TO ø 8 MAINTAINING THE SIZE 4		PARTING OFF CUTTER	SLIDUNG CALLIPERS
007	CUT THE THREAD M10 x 0.5 - 6g		SCREW CUTTER	
			SHEET 1	NAME OF SHEETS 3

Operation 1



Operation 2



№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
008	CENTRE		CENTRING DRILL	
009	DRILL HOLE ⌀ 4.5 TO THE DEPTH OF 4.5 mm		DRILL ⌀ 4.5 mm	
010	CUT - OFF THE WORKPIECE TO THE SIZE OF 4 mm		PARTING OFF CUTTER	
	OPERATION 2			
001	MOUNT AND REMOVE THE			
	WORKPIECE			
002	MILL GROOVE 0.8H12 1 ± 0.15 IN			
	DEPTH TO BODY SIZE			
	OPERATION 3			
	COATING Cu / Ni6Cr MAT FINISH			

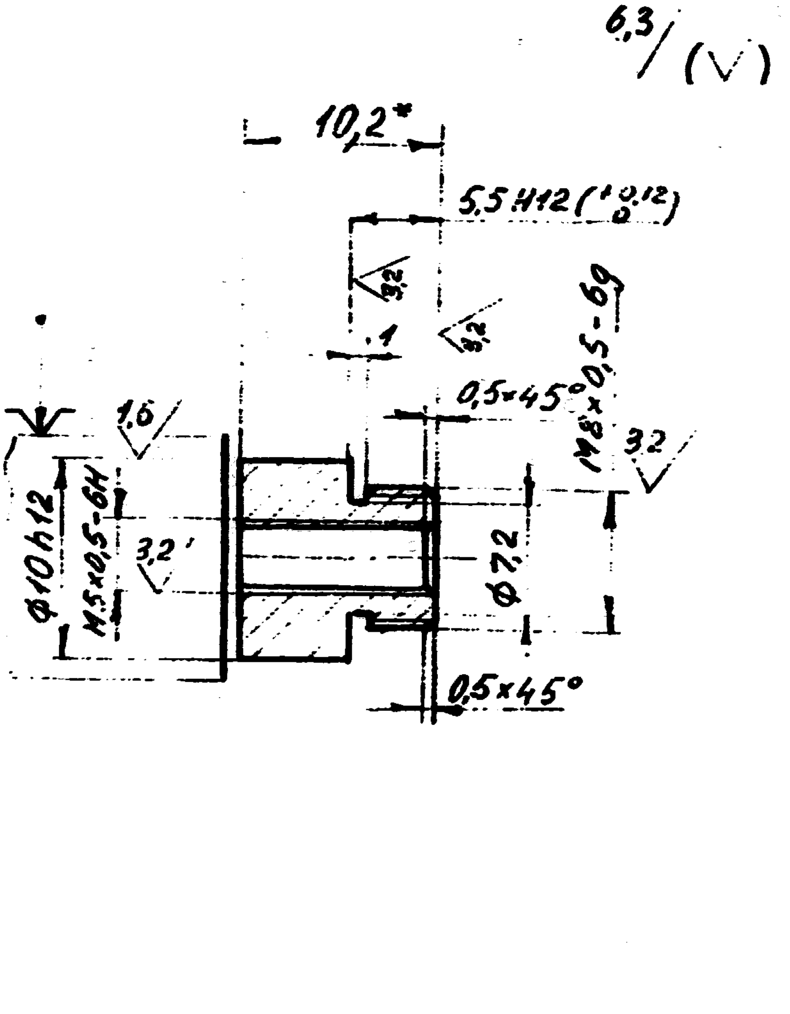
SHEET 3	NAME OF SHEETS 3

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	140.012		
		PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 1215 3-JAWS CHUCK		
002	CUT THE END		TOOLHOLDER	
003	TURN ø 10h12 TO THE LENGTH OF 12 mm		TOOLHOLDER	SLIDING CALLIPERS
004	TURN FOR THE THREAD M8 x 0.5-6g TO THE LENGTH OF 5.7 mm		TOOLHOLDER	SLIDING CALLIPERS
005	TURN GROOVE 1 TO ø 7.2 mm		GROOVE CUTTER	
006	CUT THE END TO THE SIZE OF 5.5H12		PARTING OFF CUTTER	DEPTHMETER
007	TURN THE CHAMFER 0.5 x 45°		CHAMFER TOOL	

SHEET 1	NAME OF SHEETS 3

Операция I

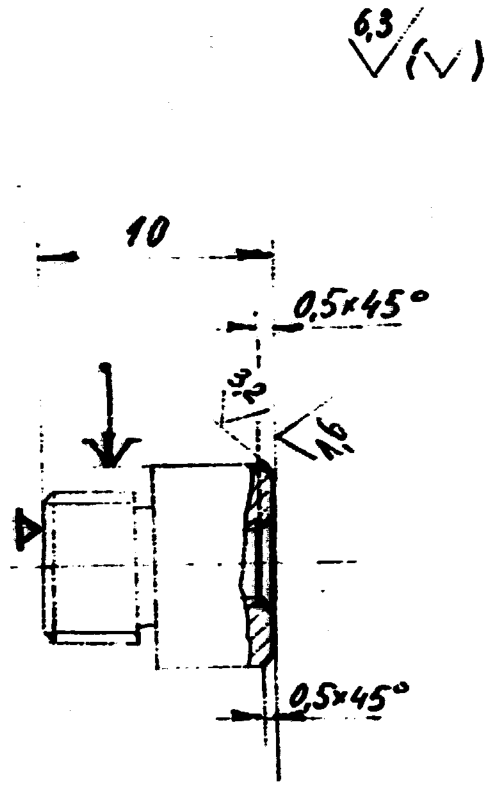


140 612

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
008	CUT THE THREAD M5 x 0.5 - 6H TO THE DEPTH OF 15 mm		SCREW TOOL	
009	CENTRE		CENTRING DRILL	
010	DRILL FOR THE THREAD M5 x 0.5 TO THE DEPTH OF 15 mm		DRILL ø 4.2	
011	BORE THE CHAMFER 0.5 x 45°		CHAMFER TOOL	
012	CUT THE THREAD M5 x 0.5 - 6H TO THE DEPTH OF AT LEAST 10.2 mm		TAP M5	
013	CUTT OFF THE WORKPIECE TO THE SIZE OF 10.2 mm		PARTING OFF TOOL	SLIDING CALLIPERS
	OPERATION 2			
001	MOUNT AND REMOVE THE WORKPIECE	TYPE COLLET		
002	CUT THE END TO THE SIZE OF 10mm		TOOLHOLDER	
003	BORE THE CHAMFER 0.5 x 45°		CHAMFER TOOL	

SHEET 3	NAME OF SHEETS 3

Операция II



146.412

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
004	TURN THE CHAMFER 0.5 x 45°		CHAMFER TOOL	
	OPERATION 3 (1 VERSION)			
001	MOUNT AND REMOVE THE WORKPIECE		HOLDER	
002	MILL A SLOT 0.8H12 TO THE DEPTH OF 1 ± 0.15 TO BODY SIZE		DISK MILL	
	OPERATION 3 (2 VERSION)			
	BENCH - WORKING			
001	MOUNT AND REMOVE THE WORKPIECE	MACHINE VICE		
002	FILE THE GROOVE		FILE	
	OPERATION 4			
	COATING Cu / Cr6 MAT FINISH			

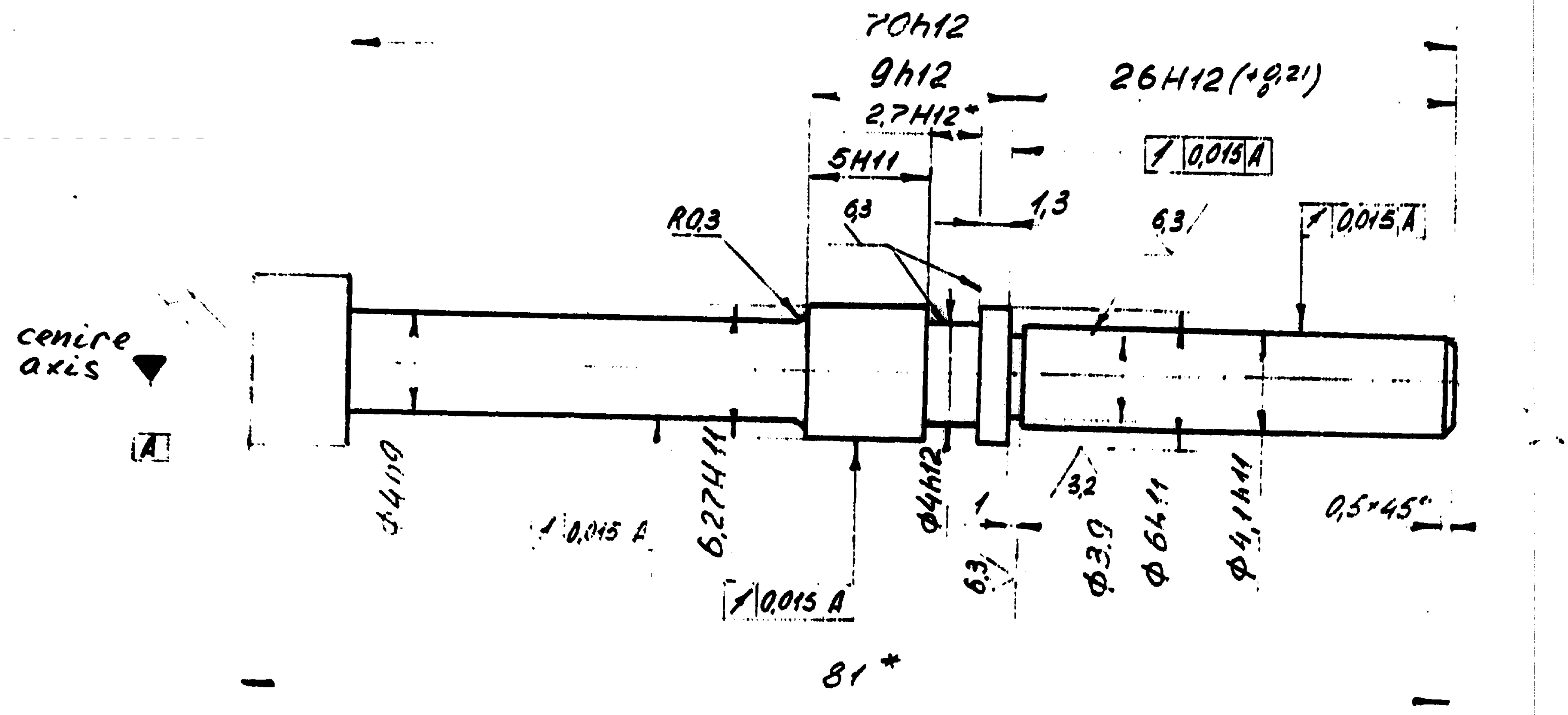
		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	140.013		
		PROFILE	DIMENSIONS
		ROUND BAR STEEL A12	ø 8 x 81

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 1215 3-JAWS CHUCK		
002	CUT THE END		TOOLHOLDER	
003	CENTRE 12 mm		CENTRING DRILL	
004	CUT OFF THE BLANK SIZE OF 81 mm		PARTING OFF CUTTER	SLIDING CALLIPERS
005	RESET WORKPIECE			
006	CUT THE END		TOOLHOLDER	
007	CENTRE		CENTRING DRILL	

SHEET 1	NAME OF SHEETS 7

Operation 2

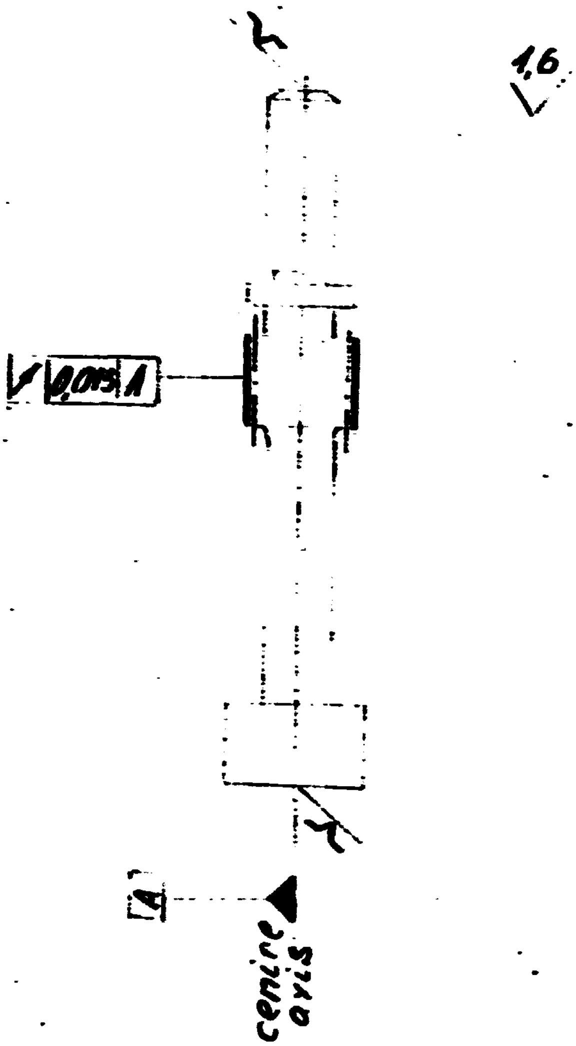
140.013



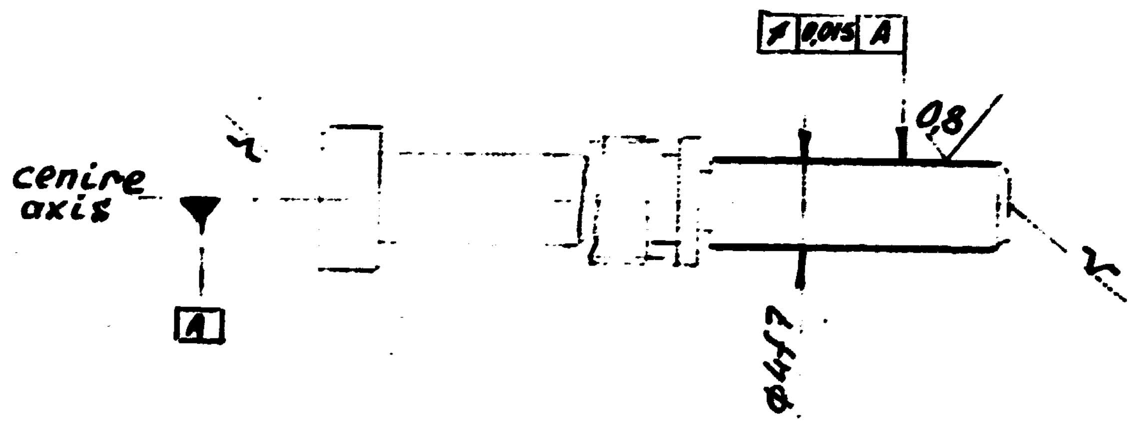
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 2 (SEE SHEET 2)			
001	MOUNT AND REMOVE THE BLANK	SHAUBLIN - 125 MALE CENTRES,		
		TRAVELLING STEADY, DRIVING DOG		
002	TURN ø 4.1H11 TO THE LENGTH 26H12		TOOLHOLDER	SLIDING CALLIPERS
003	TURN GROOVE ø 3.9, MAINTAINING TO THE SIZE 2.6H12		GROOVE CUTTER	
004	TURN ø 6.27H11 TO THE LENGTH		TOOLHOLDER	SLIDING CALLIPERS
	9h12			
005	TURN GROOVE 2.7H12 ø 4H12, MAINTAINING THE SIZE 5H11		GROOVE CUTTER	
006	TURN ø 6H11 TO THE BODY SIZE		TOOLHOLDER	SLIDING CALLIPERS
007	TURN ø 4h9 AT TECHNOLOGICAL SHOULD TO THE LENGTH 70 mm		TOOLHOLDER	SLIDING CALLIPERS MICROMETER
	OPERATION 3	MILLING MACHINE		
001	MOUNT AND REMOVE WORKPIECE	MALE CENTERS, DRIVING DOG		

SHEET 5	NAME OF SHEETS 7

Operation 3



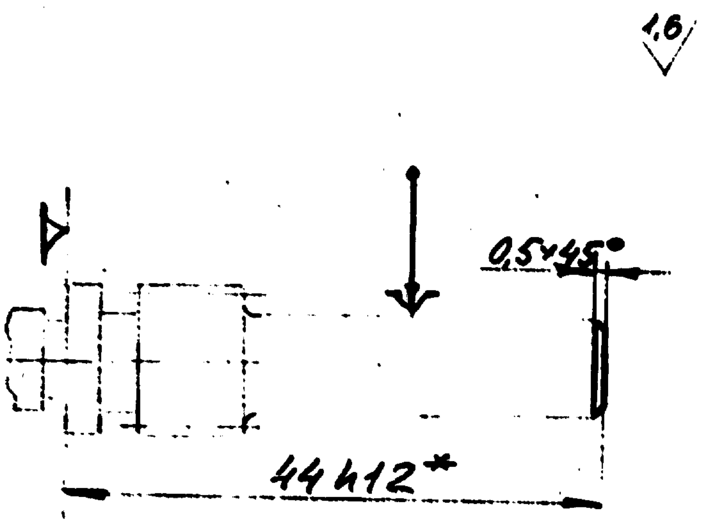
Operation 4



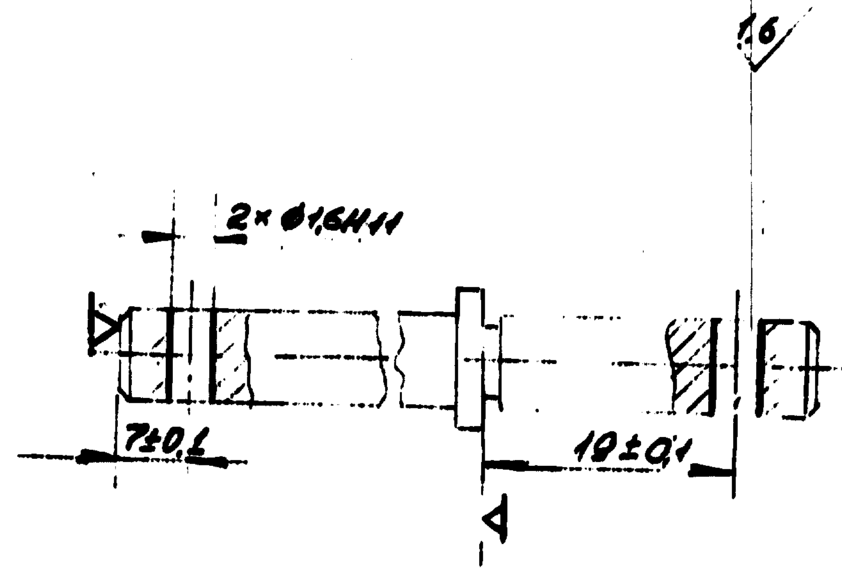
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
002	MILL SPUR GEAR m=0.4 z=12 α=18° 10-F d =5.05		MODULE MILL CUTTER	
	OPERATION 4			
001	TERMAL THREATMENT			
	HEATING TO THE 180° t=6 hours			
	OPERATION 5 (SEE SHEET 3)			
001	MOUNT AND REMOVE WORKPIECE	GRINDING MACHINE		MICROMETER
002	GRIND ⌀ 4f7	MALE CENTRES		
	OPERATION 6 (SEE SHEET 4)			
001	MOUNT AND REMOVE WORKPIECE	SHAUBLIN - 125		
002	CYT OF THE RIGHT END OF WORKPIECE TO THE SIZE 70h12	TYPE COLLET	PARTING OFF CUTTER	SLIDING CALLIPERS
003	TURN CHAMFER 0.5 x 45°			

SHEET 6	NAME OF SHEETS 7

Operation 6



Operation 7

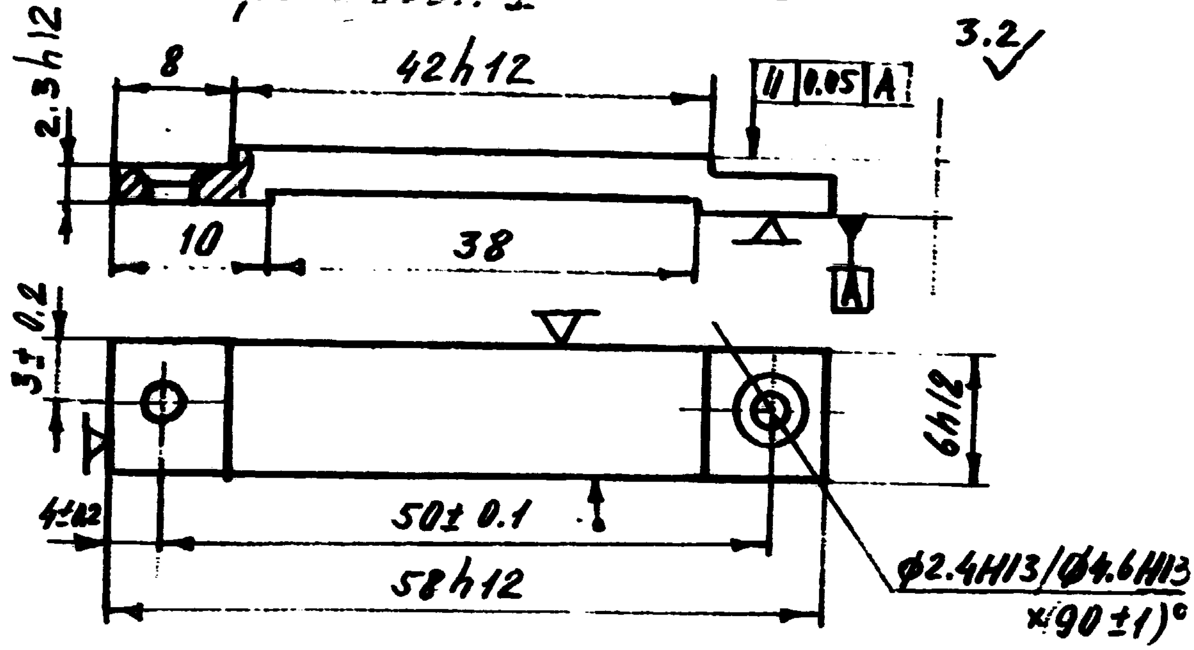


N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 7 (SEE SHEET 4)	MILLING MACHINE		
001	MOUNT AND REMOVE WIRKPIECE	PRISM		
002	DRILL 2 HOLES BY MARKING OUT WITH CENTRE ø 1.6H11 TO THE BODY SIZE		DRILL ø 1.6	
003	DULL SHARP EDGES		FILE	
	OPERATION 7			
	COATING CHIMICAL OXIDATION			
			SHEET 7	NAME OF SHEETS 7

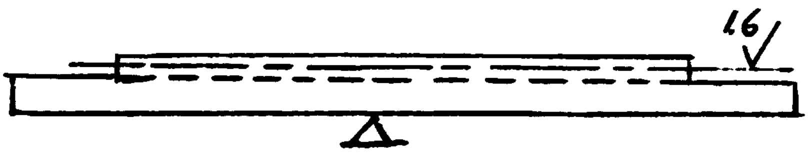
OPERATION DRAFT	NUMBER OF PIECES	OPERATION	
		BLANK	
SEE SHEET 2	140.016	PROFILE	DIMENSIONS
		ROUND SHEET BRASS	5×50h12×6h12

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	MILLING MACHINE VICE		
002	MILL THE SURFACE, MAINTAINING TO THE SIZE 3.3h11		END MILLING CUTTER	
003	MILL TWO GROOVES, MAINTAINING THE SIZES 8, 42h12			SLIDING CALLIPERS
004	CENTRE		CENTRING DRILL	
005	DRILL TWO HOLES ø 2.4H13		DRILL ø 2.4	
006	COUNTERSINK ø 4.6H13 × (90 ± 1)°		COUNTERSINK ∢ 90°	
	OPERATION 2			
001	MOUNT THE WORKPIECE	MILLING MACHINE VICE		MICROMETER
002	MILL TEETH OF RACK		FACING MILL	
	OPERATION 3			
	COATING : CHIMICAL OXIDATION			
			SHEET 1	NAME OF SHEETS 2

Operation 1



Operation 2



$m = 0.4$

$\beta = 18^\circ$

$z = 32$

$P_n = 1.256$

9 - F

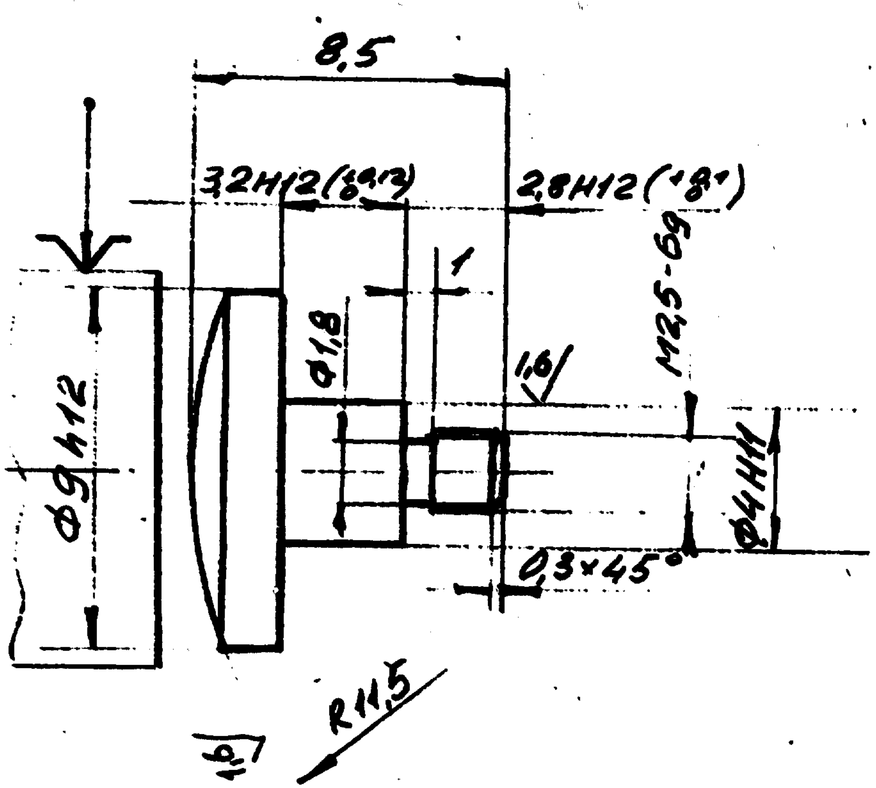
OPERATION DRAFT	NUMBER OF PIECES	OPERATION BLANK	
SEE SHEET 2	140.016	PROFILE	DIMENSIONS
		ROUND BAR STEEL	ø 10 × 20

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 12:5 3-JAWS CHUCK		
002	CUT THE END		TOOLHOLDER	
003	TURN ø 9 h12 TO THE LENGTH OF 10 mm		TOOLHOLDER	SLIDING CALLIPERS
004	TURN ø 4H11 TO THE LENGTH OF 6H12		TOOLHOLDER	SLIDING CALLIPERS
005	TURN FOR THE THREAD M2.5 - 6g		TOOLHOLDER	SLIDING CALLIPERS
	TO THE LENGTH OF 2.8H12			
006	TURN THE GROOVE 1 TO ø 1.8		GROOVE CUTTER	
007	TURN THE CHAMFER 0.3 × 45°		CHAMFER TOOL	

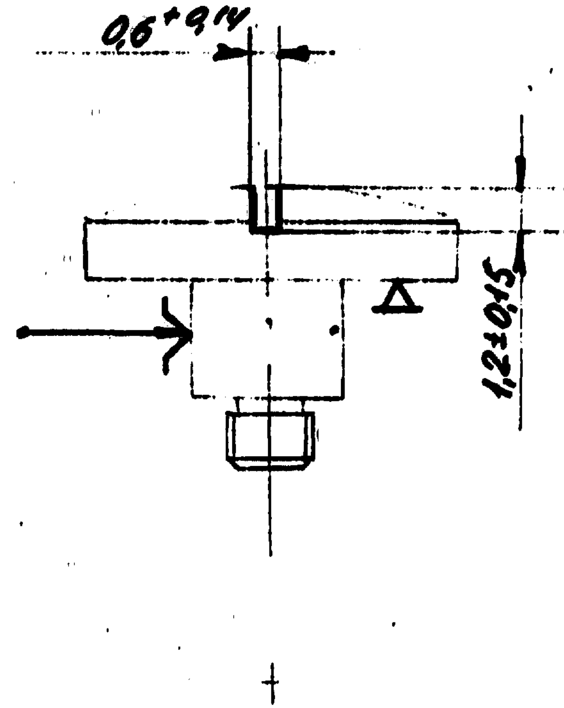
SHEET 1	NAME OF SHEETS 3

140.016

Operation 1



Operation 2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
008	CUT THE THREAD M2.5 - 6g		SCREW CUTTER	
009	CUT OFF THE WORKPIECE TO THE	PRISM		
	SIZE OF 8.5 mm FORMING A SPHERE R11.5		FORMING CUTTER	SLIDING CALLIPERS
	OPERATION 2			
001	MOUNT AND REMOVE THE WORKPIECE	MILLING MACHINE		
002	MILL GROOVE 0.6+0.14 OF 1.2±0.15	VICE	DISK MILLING	
	IN DEPTH TO BODY SIZE			
	OPERATION 3			
	COATING : Fe / Cr6 MAT			
	FINISH			

SHEET 3	NAME OF SHEETS 3

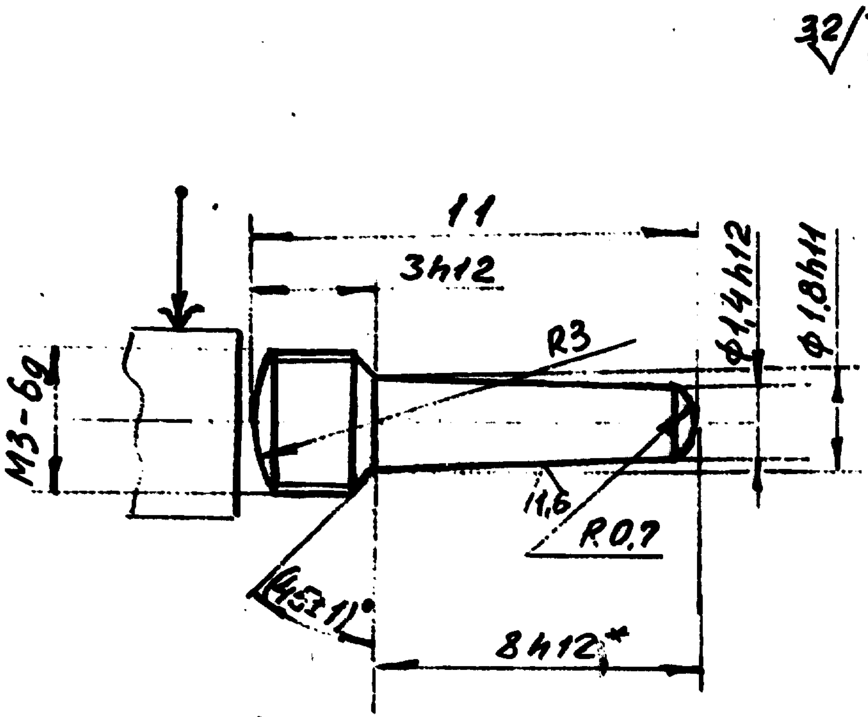
		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	140.017		
		PROFILE	DIMENSIONS
		ROUND BAR STEEL	

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 1215 3-JAWS CHUCK		
002	CUT THE END		TOOLHOLDER	
003	TURN o 1.8h11 TO THE LENGTH OF		FORM CUTTER	SLIDING CALLIPERS
	8h12 FORMING A CONICAL SURFACE < 45 ± 1°			
004	TURN FOR THREAD M3 - 6g TO THE LENGTH OF 4.5 mm		TOOLHOLDER	SLIDING CALLIPERS
005	CUT THE THREAD M3 - 6g			
006	TURN THE CONICAL SURFACE < 15°0' ± 0°30'			
007	TURN SPHERE R 0.7			
008	CUT OFF THE WORKPIECE TO THE			
	SIZE OF 11 mm FORMING A SPHERE R 3			

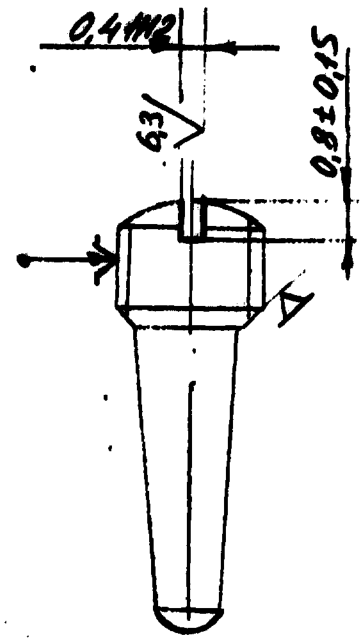
SHEET 1	NAME OF SHEETS 3

140.017

Operation 1



Operation 2

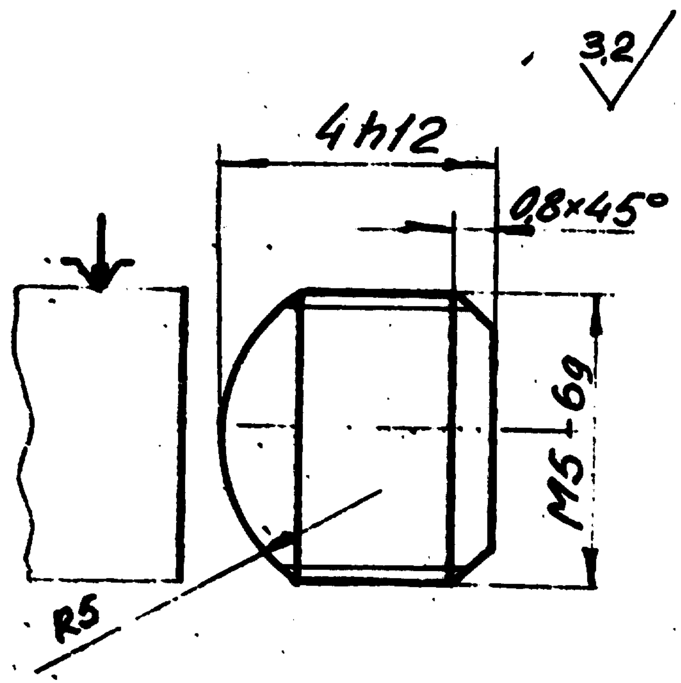


N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 2			
001	MOUNT AND REMOVE THE WORKPIECE	MILLING MACHINE		
	(CUT BUSHING IN ALUMINIUM ALLOY)	VICE		
002	MILL GROOVE 0.4H12 OF 0.8 ± 0.15		DISK MILLING 0.4H12	
	IN DEPTH TO BODY SIZE			
	OPERATION 3			
	COATING : Fe /Ni3			

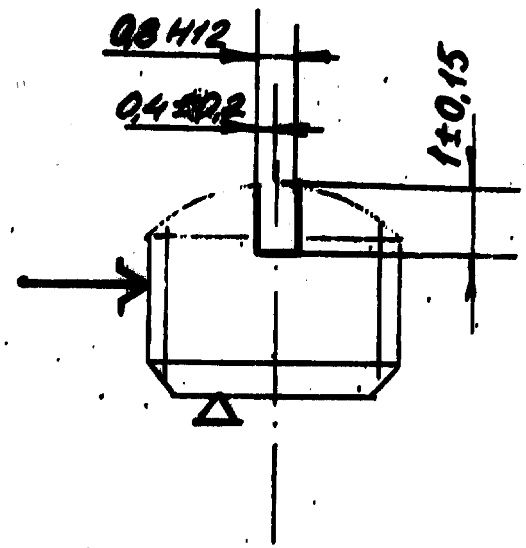
SHEET 3	NAME OF SHEETS 3

			OPERATION	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
SEE SHEET 2		140.018		
			PROFILE	DIMENSIONS
			ROUND BAR STEEL	o 6 x 10
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 1215 3-JAWS CHUCK		
002	CUT THE END		TOOLHOLDER	
003	TURN o 5 h9 TO THE LENGTH OF 6 mm FOR THE THREAD		TOOLHOLDER	SLIDING CALLIPERS
004	TURN THE CHAMFER 0.8 x 45° < 45 ± 1°		CHAMFER TOOL	
005	CUT THE THREAD M5 - 6g TO THE LENGTH OF 4 mm		SCREW CUTTER	
006	CUT OFF THE WORKPIECE TO THE SIZE OF 4h12 FORMING SPHERE R 5		FORMING CUTTER	
	OPERATION 2			
			SHEET 1	NAME OF SHEETS 3

Operation 1



Operation 2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE WORKPIECE	MILLING MACHINE		
	(CUT BUSHING IN ALUMINIUM ALLOY)			
002	MILL GROOVE 0.8H12 OF 1 ± 0.15 IN LENGTH TO BODY SIZE		DISK MILL 0.8H12	
	OPERATION 3			
	ELECTROPLATING			
	COATING CHEMICAL OXIDATION			
	IMPREGNATION BY OIL			

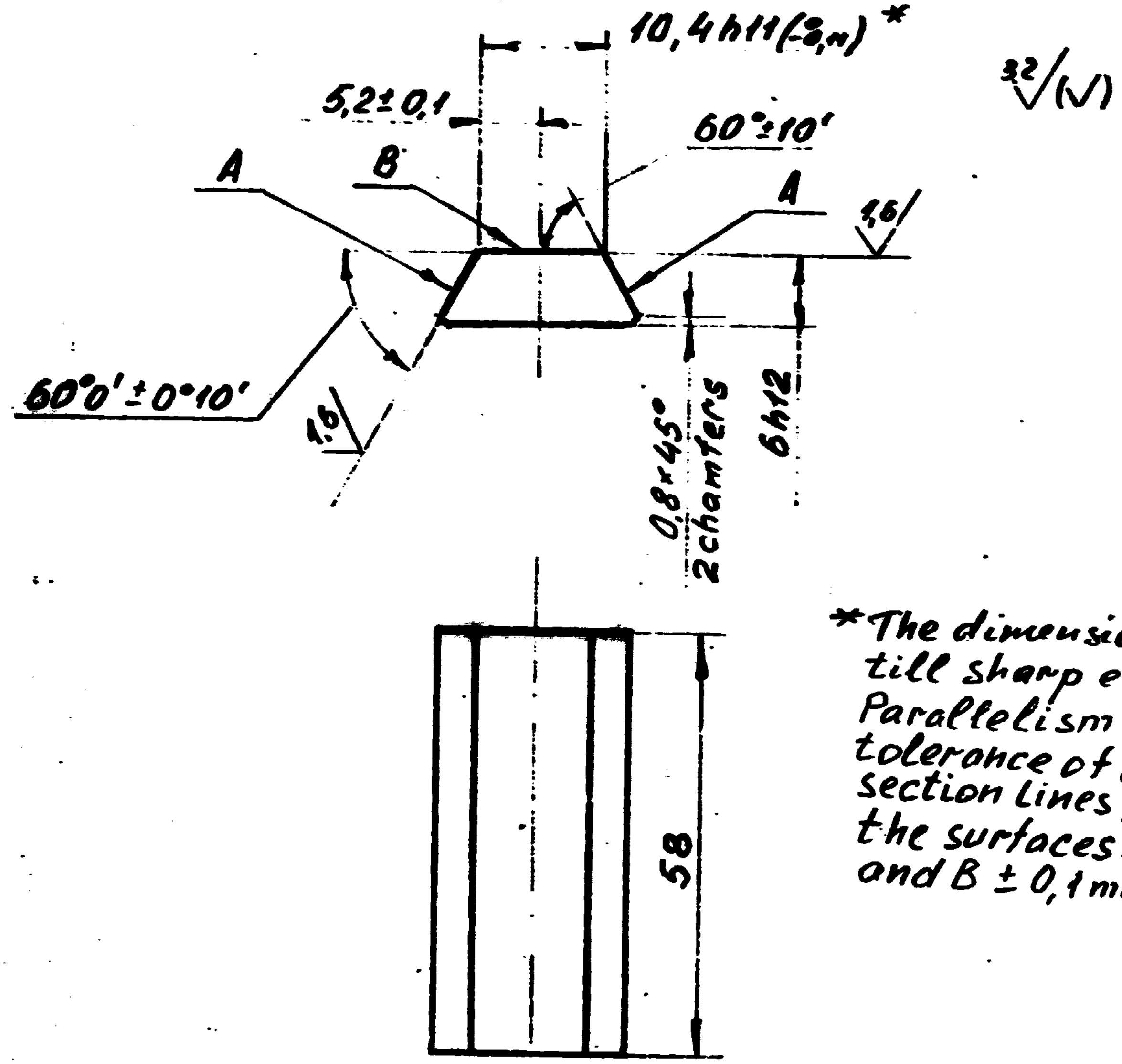
SHEET 3	NAME OF SHEETS 3

			OPERATION	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
SEE SHEET 2		140.024		
			PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE BLANK WITH RESETTING	MILLING MACHINE VICE		
002	MILLING WORKPIECE TO THE SIZES SPECIFIED		END MILL	SLIDING CALLIPERS
003	DULL SHARP EDGES		FILE	
	OPERATION 2			
001	MOUNT AND REMOVE THE WORKPIECE	MILLING MACHINE		
002	MILL GROOVE 6, MAINTAINING TO THE SIZE OF 3.7H11		END MILL	SLIDING CALLIPERS
003	DRILL BY MARKING OUT WITH CENTRING 2 HOLES ø 2.9H13		CENTRING DRILL DRILL ø 2.9	
	TO THE BODY SIZE			

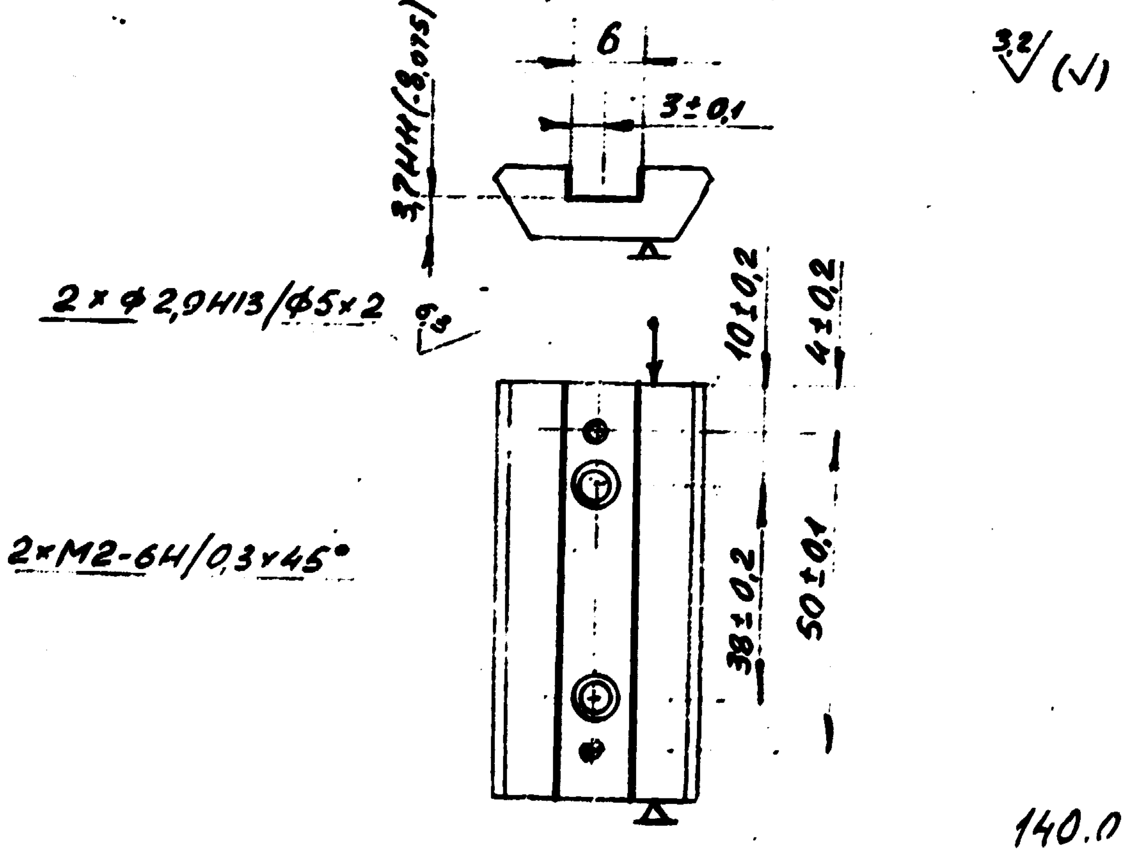
SHEET 1	NAME OF SHEETS 3

Operation 1



*The dimension till sharp edges
Parallelism tolerance of intersection lines for the surfaces A and B ± 0,1 mm

Operation 2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
004	COUNTERBORE TWO HOLES c 5 mm TO THE 2 mm DEPTH		COUNTERBORE o 5 mm	
005	DRILL BY MARKING OUT WITH CENTRING 2 HOLES FOR SCREW M 2			
	TO THE BODY SIZE			
006	COUNTERSINK 2 HOLES, MAINTAINING TO THE SIZE 0.3 x 45°		COUNTERSINK < 90 °	
007	CUT THREAD IN TWO HOLES M2 - 6H		TAP M 2	
	TO THE BODY SIZE			
	OPERATION 3			
	COATING CHEMICAL OXIDATION			

SHEET 3	NAME OF SHEETS 3

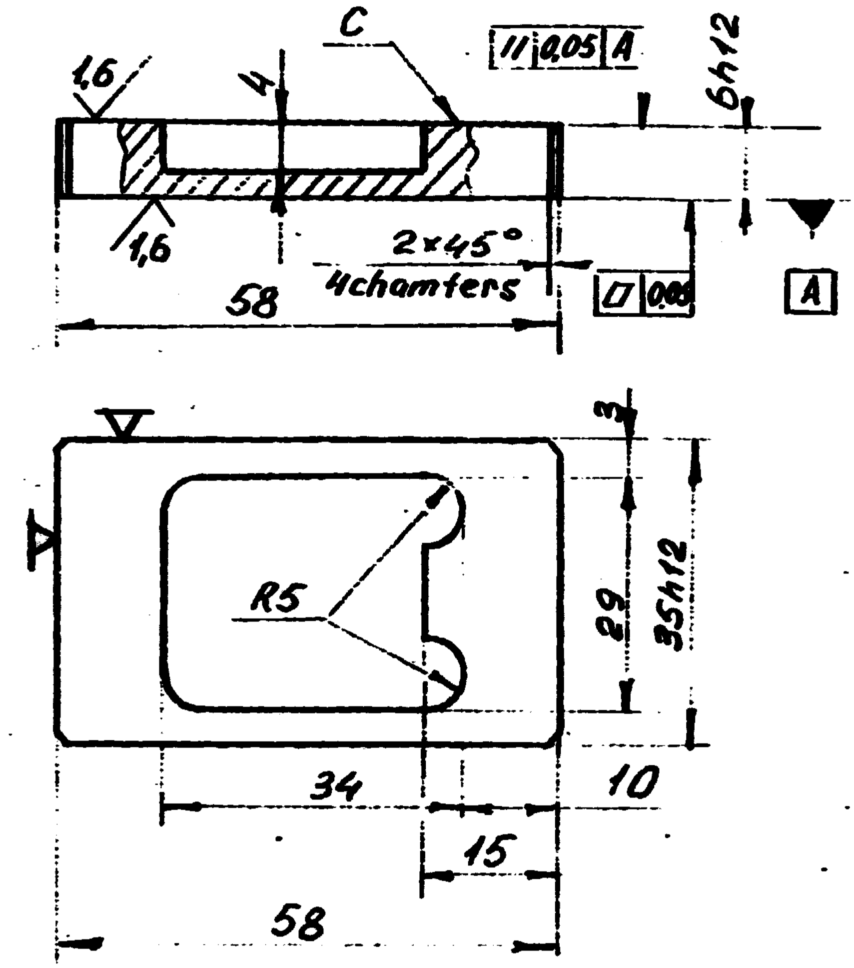
OPERATION DRAFT	NUMBER OF PIECES	OPERATION	
		BLANK	
SEE SHEET 2	140.026	PROFILE	DIMENSIONS
		ROUND SHEET ALUMINIUM ALLOY	58 x 35h12 x 8

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE BLANK	MILLING MACHINE VICE		
002	MILL SURFACE C MAINTAINING TO THE SIZE 7 mm		END MILLING CUTTER	
003	RESET WORKPIECE			
004	MILL SURFACE A , MAINTAINING TO THE SIZE 6h12		END MILLING CUTTER	
005	MILL 4 CHAMFERS 2 x 45°			
006	MILL GROOVE , MAINTAINING THE SIZES 34 x 29 AND 3 mm		END MILLING CUTTER c 10 mm	
	TO THE DEPTH 4 mm			
007	DULL SHARP EDGES		FILE	

SHEET 1	NAME OF SHEETS 3

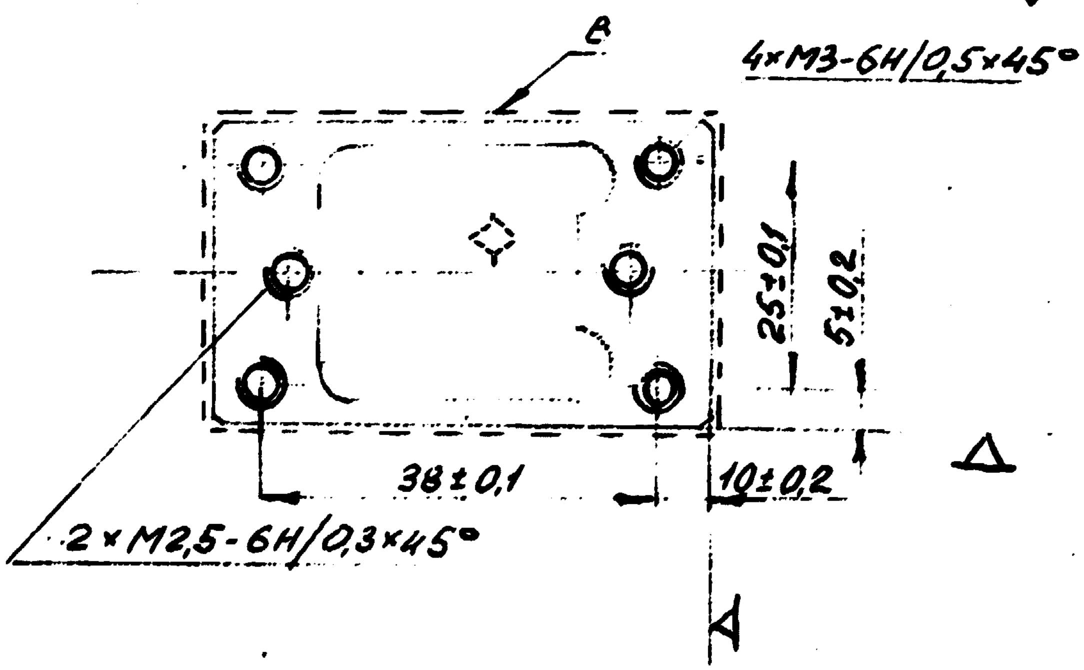
Operation 1

32 (√)



Operation 2

32



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 2	MILLING MACHINE VICE		
001	MOUNT AND REMOVE THE BLANK			
002	DRILL BY MARKING OUT WITH CENTRING 4 HOLES FOR SCREW		CENTRING DRILL, DRILL ø 2.5	
	M3 - 6H TO THE BODY SIZE			
003	DRILL BY MARKING OUT WITH CENTRING 2 HOLES FOR SCREW		CENTRING DRILL, DRILL ø 2.2	
	M2.5- 6H TO THE BODY SIZE			
004	REAM THE FOUR CHAMFERS 0.5 x 45°		COUNTERSINK ∠ 90°	
005	REAM THE TWO CHAMFERS 0.3 x 45°		COUNTERSINK ∠ 90°	
006	CUT THREAD IN FOUR HOLES M3 TO THE BODY SIZE		TAP M 3	
007	CUT THREAD IN TWO HOLES M2.5-6H TO THE BODY SIZE		TAP M 2.5	
008	DULL SHARP EDGES		FILE	
	OPERATION 3			
	COATING CHIMICAL OXIDATION THE SURFACE B - GREY ENAMEL			
	CHAGREEN			

SHEET 3	NAME OF SHEETS 3

19353
(4 of 7)

FINAL REPORT

Project DP/S[illegible]/85/011 Contract [illegible] 83/64

Annex 2.2

Leningrad Institute of Precision Mechanics and Optics

F I N A L   R E P O R T

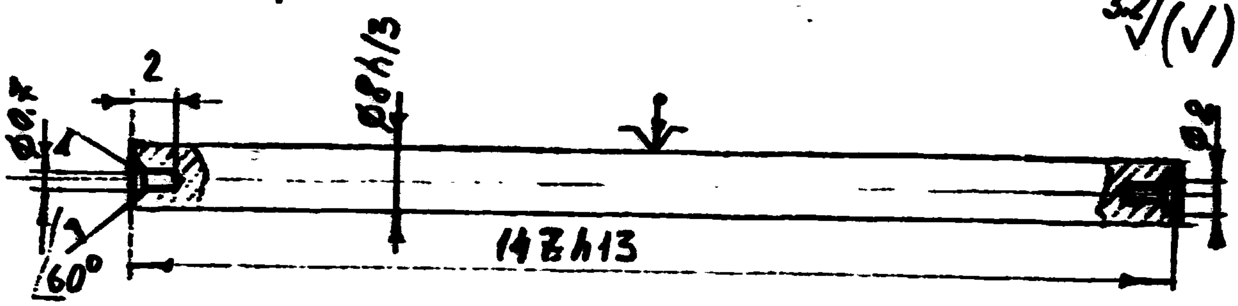
(project DP/SYR/86/011)
contract No 89/44

Annex 2.2

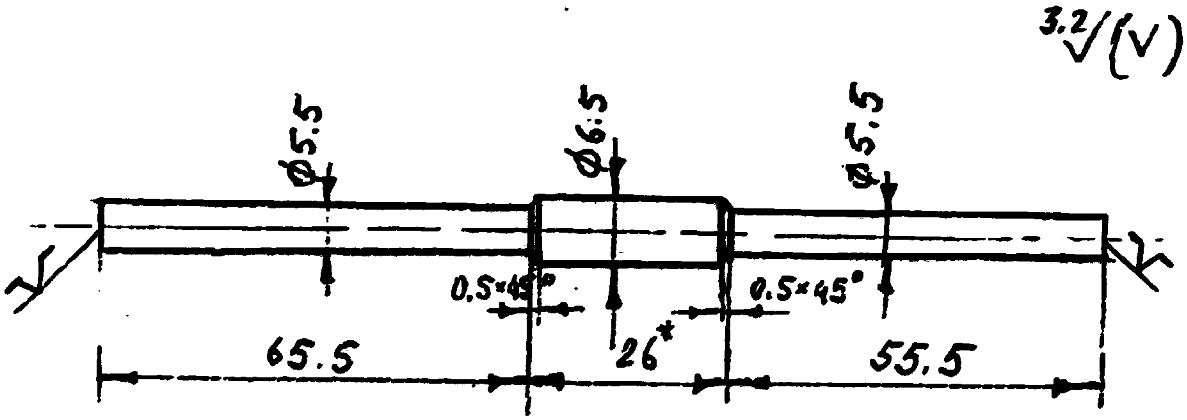
Route charts Technological Process of Manufacture of the Microscope Mechanical Parts

Leningrad
1991

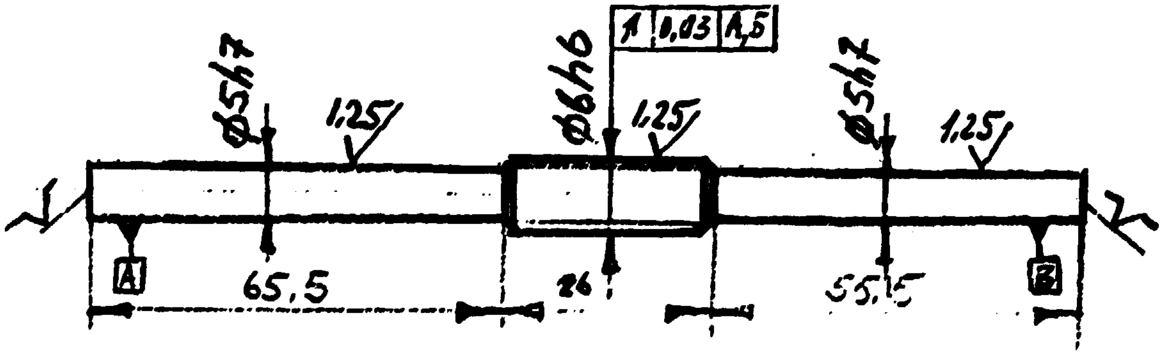
Operation 1



Operation 2



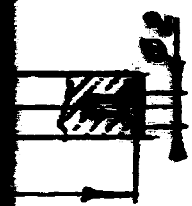
Operation 4

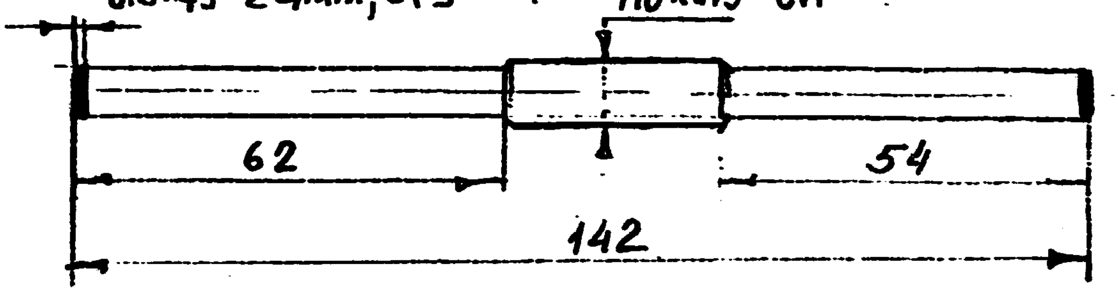


SECTION 1

Operation N6

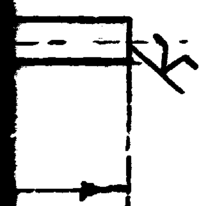
3.2√(√)

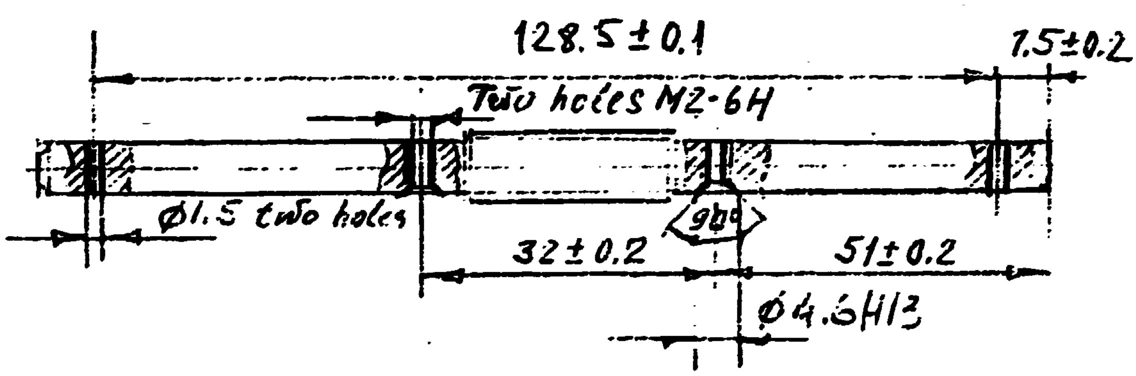


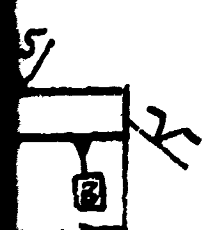


Operation 7

3.2√(√)







SECTION 2

N°	OPERATION STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
[illegible]	TURN [illegible] SIDE	[illegible]		
[illegible]	TURN SHAFT [illegible]	[illegible]		
[illegible]	TURN [illegible] DIMENSIONS [illegible]	[illegible]		
[illegible]	TURN [illegible]			
[illegible]	TURN [illegible]			
	OPERATION 2			
[illegible]	THERMAL TREATMENT TEMPERING [illegible]			
[illegible]	[illegible]			
	OPERATION 3			
[illegible]	TURN [illegible]	[illegible]	[illegible]	
[illegible]	TURN [illegible]	[illegible]	[illegible]	
[illegible]	TURN [illegible]	[illegible]		
[illegible]	TURN [illegible]	[illegible]		
[illegible]	TURN [illegible]			
[illegible]	TURN [illegible]	[illegible]		
[illegible]	[illegible]	[illegible]		

[illegible]

NO	JOB STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION [illegible]			
[illegible] CHEMICAL [illegible]				
	OPERATION [illegible]			
MEAS BORE [illegible]				
MEAS LEFT OFF HOLE [illegible]				
ON LEFT SIDE OF BORE [illegible] ON RIGHT SIDE OF BORE [illegible]				
MEAS THRU CHAMFERS ON BOTH SIDE OF BORE				

SHEET [illegible] NUMBER OF SHEETS [illegible]

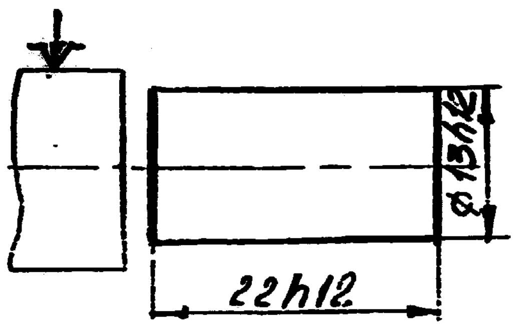
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]		
			[illegible]	[illegible]
			[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]		[illegible]	
[illegible]	[illegible]		[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]		[illegible]	
[illegible]	[illegible]			
			[illegible]	[illegible]

			[illegible]	
[illegible]		[illegible]	[illegible]	
[illegible]		[illegible]		
			[illegible]	[illegible]
			[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]		[illegible]	
[illegible]	[illegible]			
[illegible]	[illegible]		[illegible]	
[illegible]	[illegible]			
[illegible]				

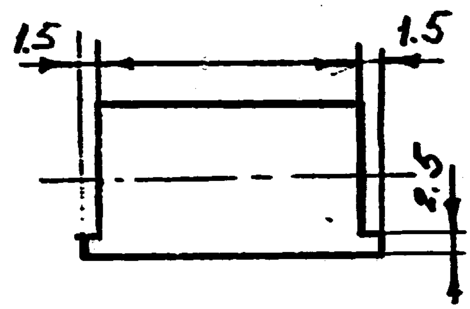
[illegible] [illegible]

I

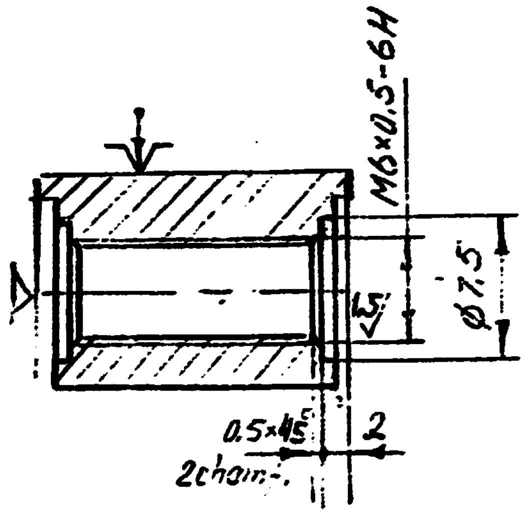
Rz20



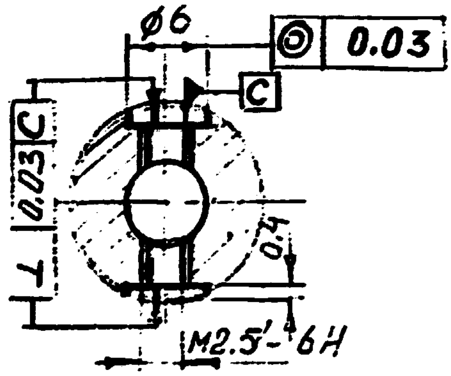
II



III



IV



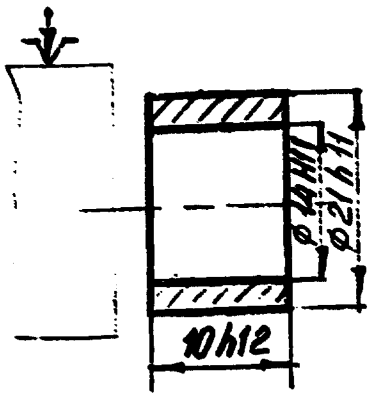
NO.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION TWO MILLING			
[illegible]	MOUNT STATE [illegible]	MILLING MACHINE [illegible]		
[illegible]	MOUNT STATE [illegible]	COLLET [illegible]		
[illegible]	TURN OUT [illegible] DIMENSION [illegible]		TOOL [illegible] ANGLE	SLIDING CALIPERS
[illegible]	BLUNT SHARP EDGES			
[illegible]	MILL THE [illegible] DIMENSIONS [illegible] AND [illegible]		MILL [illegible]	SLIDING CALIPERS
[illegible]	BLUNT SHARP EDGES		SCRAPER	
	OPERATION THREE			
[illegible]	MOUNT STATE [illegible]	[illegible]		
[illegible]	MOUNT STATE [illegible]	COLLET [illegible]		
[illegible]	TURN OUT [illegible] DIMENSION [illegible]		TOOL [illegible] ANGLE	SLIDING CALIPERS
[illegible]	BLUNT SHARP EDGES			
[illegible]	TURN [illegible] DIMENSION [illegible]	COLLET [illegible]	[illegible] TOOL	SLIDING CALIPERS [illegible]
[illegible]	[illegible]		[illegible] TOOL	
[illegible]	MOUNT [illegible]	COLLET [illegible]		
[illegible]	[illegible]			
[illegible]	[illegible]		[illegible] TOOL	
			[illegible]	[illegible]

No.	OPERATION	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION PLAN: MACHINE MILLING			
0010	MOUNT A BLANK (SEE PAGE [illegible])	DRILL MACHINE		
0020	CENTRE DRILL HOLES [illegible]		CENTERING DRILL	
0030	DRILL HOLE [illegible]		DRILL [illegible]	
0040	MILL [illegible]			
0050	RETURN BLANK			
0060	DRILL [illegible]			
0070	BLUNT SHARP EDGES		SCRAPER	
0080	[illegible]		[illegible]	

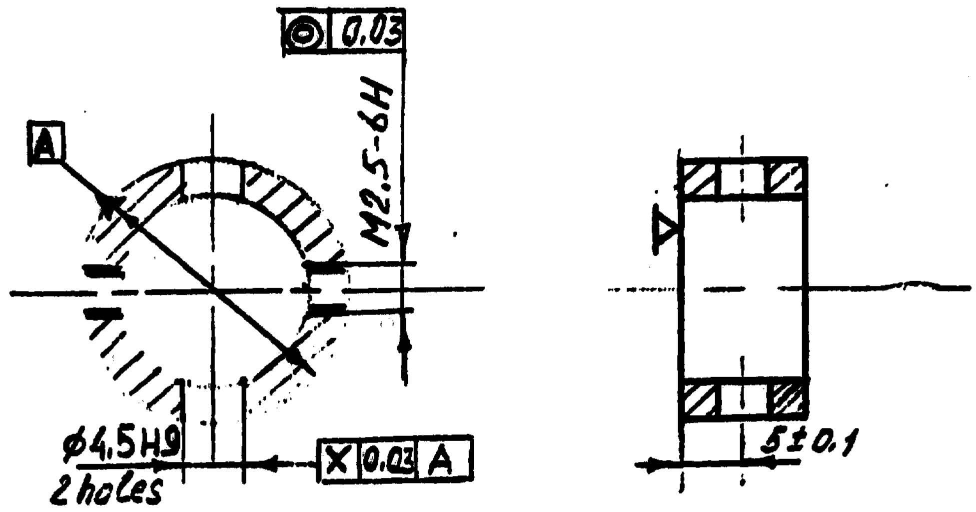
SHEET [illegible] | SHEET OF SHEETS [illegible]

		[illegible]	
OPERATION SHEET	NUMBER OF PIECES	PART	
SEE SHEET NO. 1	[illegible]		
		TOOLS	EQUIPMENT
		[illegible]	[illegible]
OPR. OPERATION	EQUIPMENT	TOOLS	MEASURING TOOLS
[illegible]	[illegible]	[illegible]	
[illegible]			
[illegible]		CENTERING DRILL [illegible]	
[illegible]			[illegible]
[illegible]		[illegible]	[illegible]
[illegible]		[illegible]	
[illegible]			
		SHEET 1	NUMBER OF SHEETS [illegible]

Rz20 N 1



N2



51?

		OPERATION [illegible]	
OPERATION CHART	NUMBER OF PIECES	BLANK	
SEE SHEET TWO N2	[illegible]	SEE SHEET TWO N2	
		PROFILE	DIMENSIONS
			[illegible]

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	MILLING MACHINE, DIVIDING ATTACHMENT		
		EXPENDING ARBOR		
002	DRILL TWO HOLES D4,4mm BEARING DIMENSION 5+0.1			
003	[illegible] TWO HOLES D4,5H7		REAMER D4,5H7	
004	RETURN DIVIDING ATTACHMENT BY [illegible]			
005	DRILL TWO HOLES [illegible]			
006	[illegible] TWO HOLES M[illegible]		TAP	
007	BLUNT [illegible] REMOVE [illegible]			

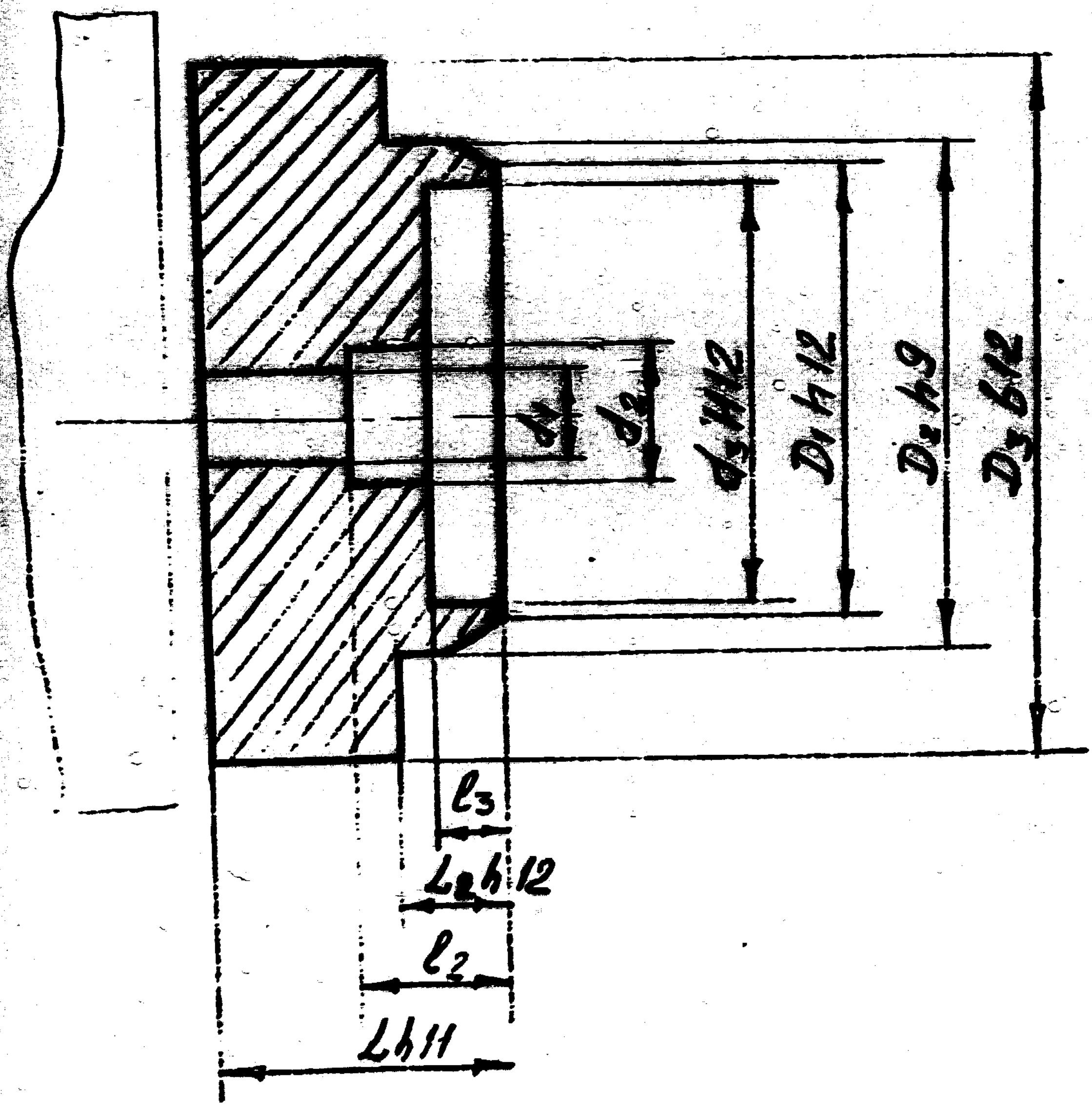
SHEET [illegible]	NUMBER OF SHEET

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET TWO	150004 150005 150009		
		PROFILE	DIMENSIONS
		BAR BRASS [illegible]	

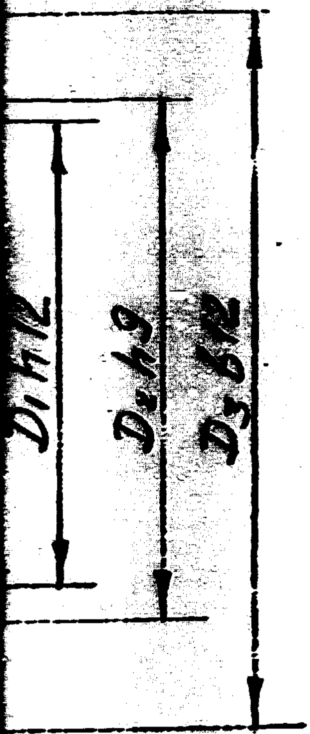
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	SHAUBLIN-125 3-JAWS CONCENTRIC CHUCK		
002	TURN OUT [illegible]	TOOLHOLDER APPROACH ANGLE 90°		
003	CENTRE DRILL	CENTRING DRILL [illegible] mm		
004	DRILL ø 1 FOR REAMER(150004,150009), FOR CUTTING(150005)[illegible] LONG		DRILL	SLIDING CALLIPERS
005	[illegible] ø 1 (150004,150009)		REAMER [illegible]	
006	CUTTING HOLE ø 1 150005 [illegible] LONG		CUTTING TOOL	SLIDING CALLIPERS
007	CUTTING [illegible] LONG		CUTTING TOOL	SLIDING CALLIPERS
008	CUTTING [illegible] LONG		CUTTING TOOL	

SHEET 1	NUMBER OF SHEET [illegible]

NN of p
150.004
150.005
150.03



SECTION 1



NN of piece	D_1	D_2	D_3	d_1	d_2	d_3	L	L_2	l_2	l_3
150.004	32	35	48	5H9	8	30	20.5	8	10	5
150.005	0	0	46	27H7	32	0	16	0	7±0.3	0
150.039	0	35	48	5H9	8	0	15.5	3	5	0

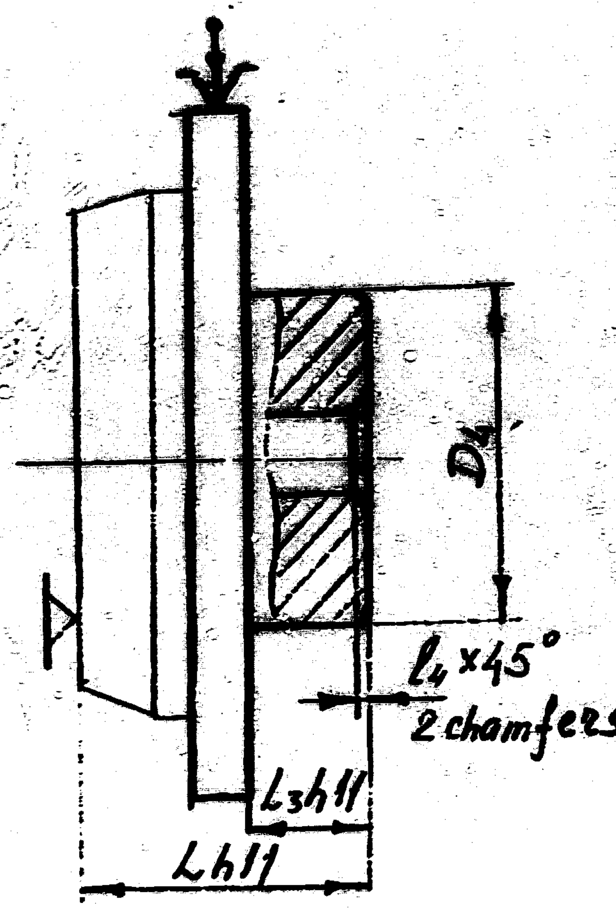
SECTION 2

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	TURN ø [illegible] ON [illegible] mm LONG		TOOLHOLDER APPROACH ANGLE 93°	SLIDING CALLIPERS
010	TURN ø [illegible] ON 12 mm			
011	TURN CONE BEARING ø[illegible] ON [illegible] mm			
012	SHARP BLUNT EDGES		SCRAPER, FILE	
013	CUTTING OFF, BEARING DIMENSION [illegible]		DETACHABLE CUTTER	SLIDING CALLIPERS

NN DE PIECE	D'1	D'2	D'3	D1	D2	D3	L	L2	L'2	L'3
150004	32	25	48	549	8	20	20.5	5	10	5
150005	0	0	44	2747	22	0	16	0	740.5	0
150039	1	25	48	549	8	0	15.5	3	5	0

			OPERATION	
OPERATION CHART		NUMBER OF PIECES	BLANK	
SEE SHEET 2		[illegible]		
			PROFILE	DIMENSIONS
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	SHPIDLIN-125 3-JAWS CONCENTRIC CHUCK		
002	TURN OUT END ON [illegible] LINE		TOOLHOLDER APPROACH ANGLE 90°	SLIDING CALLIPERS
003	TURN [illegible] DIMENSIONS [illegible]			
004	TURN CHAMFER [illegible]		CHAMFER TOOL	
005	TURN CHAMFER [illegible] IN HOLE		CHAMFER TOOL	
006	SHARP BLUNT EDGES		SCRAPER, FILE	
			SHEET 1	NUMBER OF SHEET [illegible]

II



Number pieces
150.00
150.03

SECTION 1

Number of pieces	D_4	l_3	l_4	L
150.004	22js6	8	0.5	20.5
150.039	22js6	8	0.5	15.5

o

lers

SECTION 2

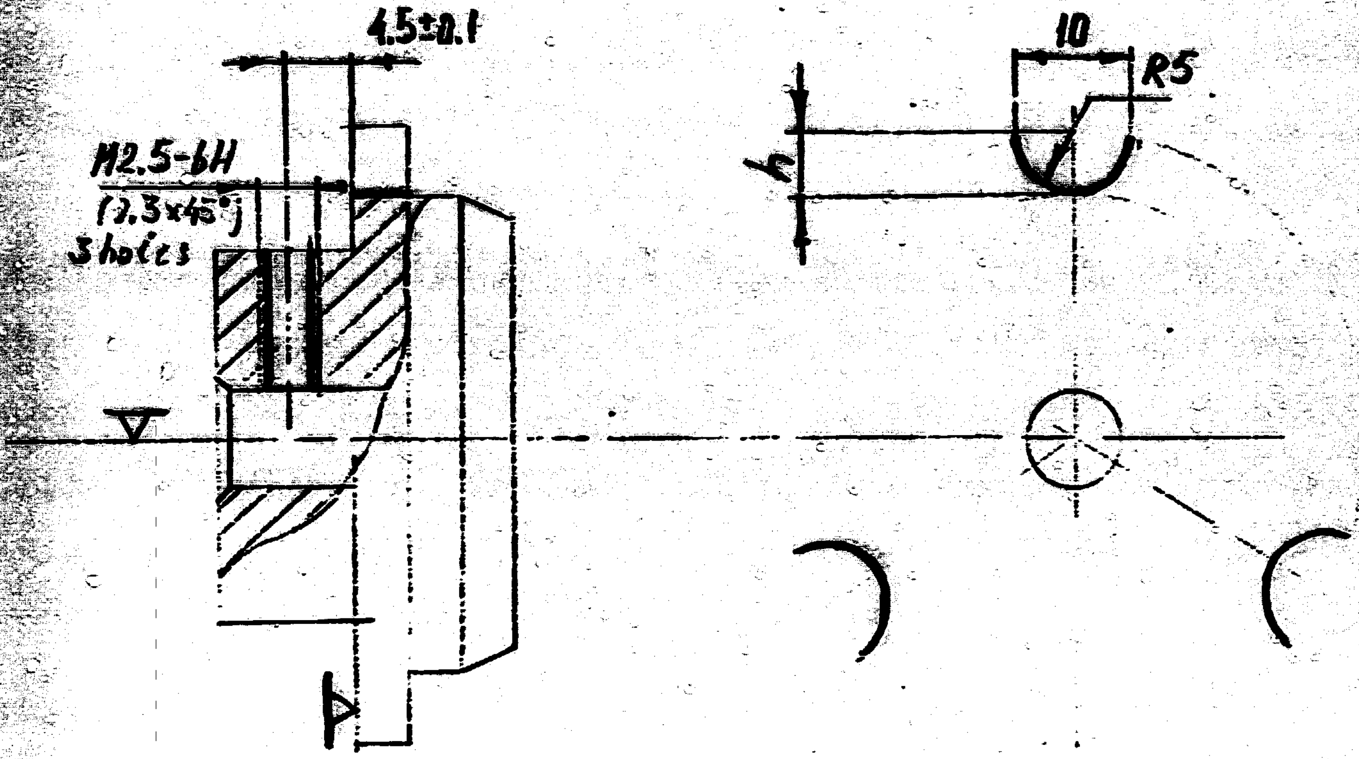
NOM DE PIECE	L-BA	L3	L4	L
150004	22736	9	0.5	180.5
150008	22736	8	0.5	15.5

OPERATION SKETCH	NUMBER OF PIECE	OPERATION THREE	
		BLANK	
SEE SHEET 5	[illegible]	PROFILE	DIMENSIONS

No.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT A BLANK	MILLING MACHINE, DIVIDING ATTACH-MENT, ARBOR WITH NUT		
0002	MILL THREE GROOVES [illegible] ON DEPTH [illegible] mm		FORM MILL ⌀30 mm	SLIDING CALLIPERS
0003	ENGRAVE FOUR LINE 0.2 mm			
0004	CENTRE DRILL THREE HOLES FROM SCREW ON MAKING OUT		CENTRE DRILL ⌀ 5 mm	
0005	DRILL THREE HOLES ⌀[illegible] mm		DRILL ⌀5.2 mm	
0006	SCREW M6.5-6H IN THREE HOLES		TAP M6.5	
0007	SHARP BLUNT EDGES		SCRAPER, FILE	

SHEET 4	NUMBER OF SHEET [illegible]

III



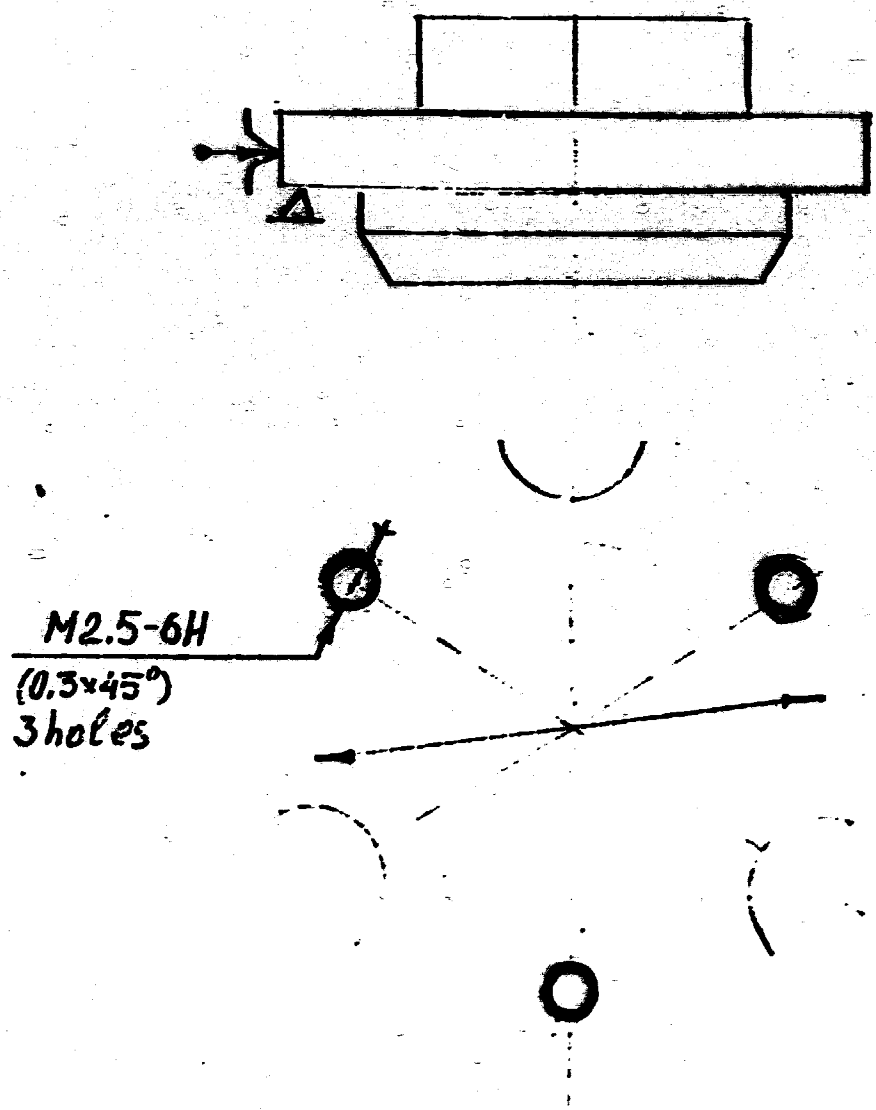
Number of details	h
150.004	6.2
150.039	6.0

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET	150004 150039		
		PROFILE	DIMENSIONS

	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	DRILLING MACHINE DIVIDING ATTACH-MENT,3-JAWS		
		CHUCK		
002	CENTRE DRILL THREE HOLES FROM SCREW ON MAKING OUT		CENTRING DRILL ⌀2 mm	
003	DRILL THREE HOLES ⌀2.2 mm		DRILL ⌀2.5 mm	
004	TURN THREE CHAMFERS 0.3x45°			
005	SCREW M3.5-6H		TAP	

SHEET 6	NUMBER OF SHEET 12

IV



SECTION 1

150.004
150.039

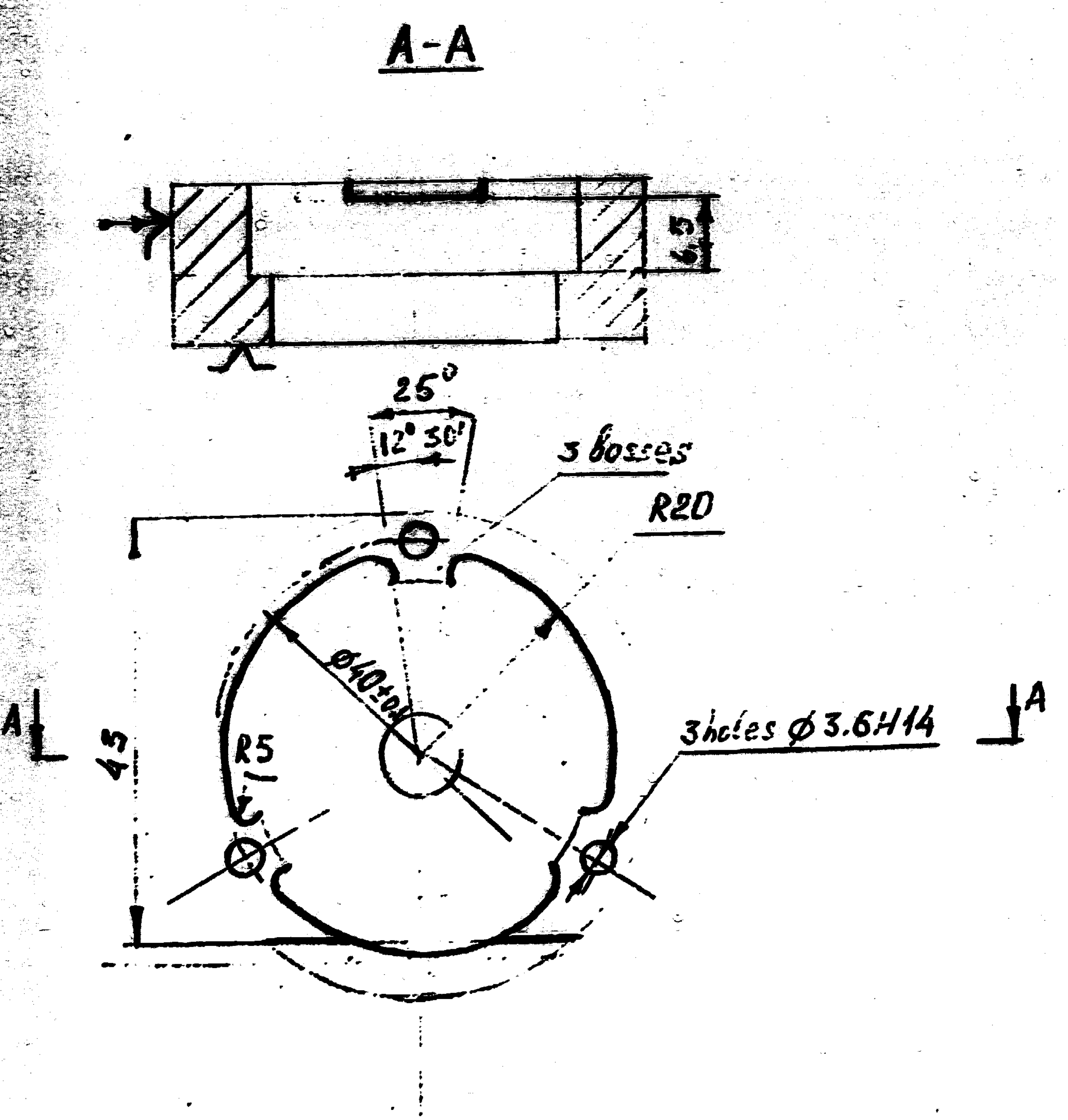
SECTION 2

		OPERATION THREE	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	150000		
		PROFILE	DIMENSIONS

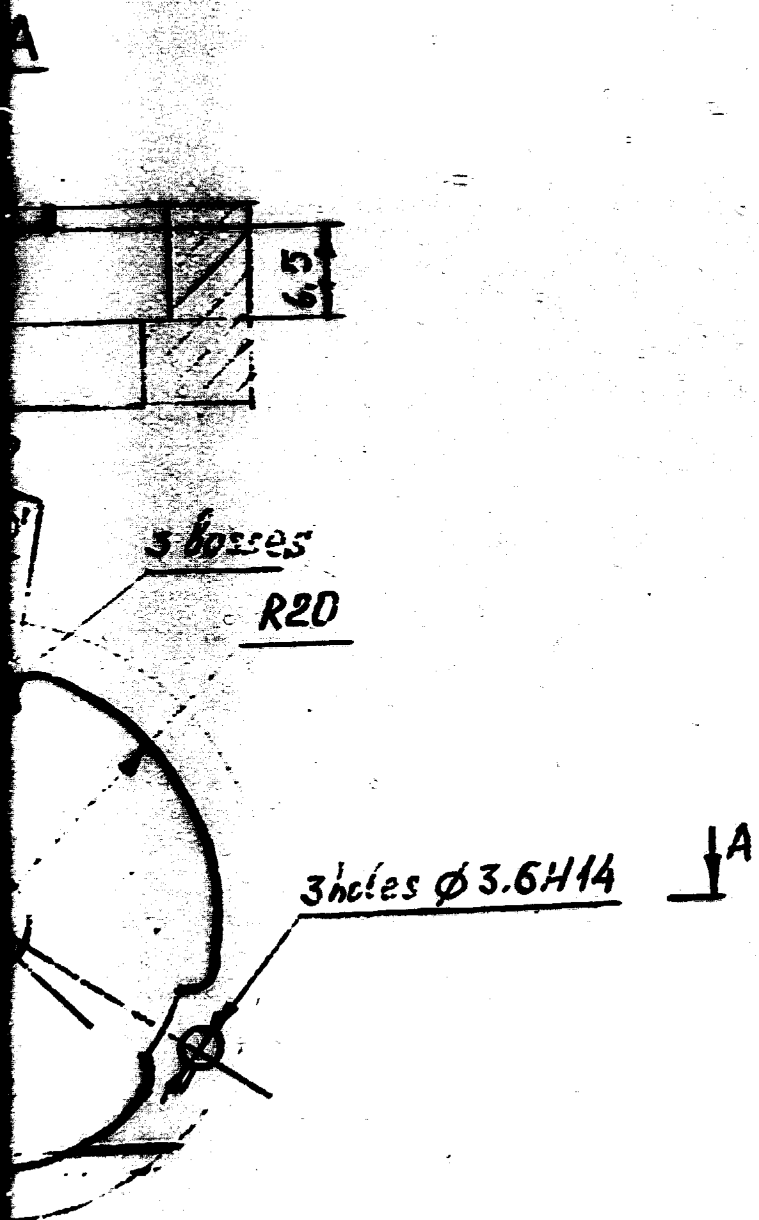
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	MILLING MACHINE, DIVIDING ATTACH-MENT		
002	MILL THREE GROOVERS R20mm ON DEPTH 7+0.3mm,WITH BEARING THREE BOSSES		MILL ⌀10mm	SLIDING CALLIPERS
003	MILL GROOVE,BEARING DIMENSIONS 43H10 6.5 mm			
004	DRILL THREE HOLES ⌀2.6H14			
005	SHARP BLUNT EDGES		SCRAPER,FILE	

SHEET 8	NUMBER OF SHEET 13

III



SECTION 1



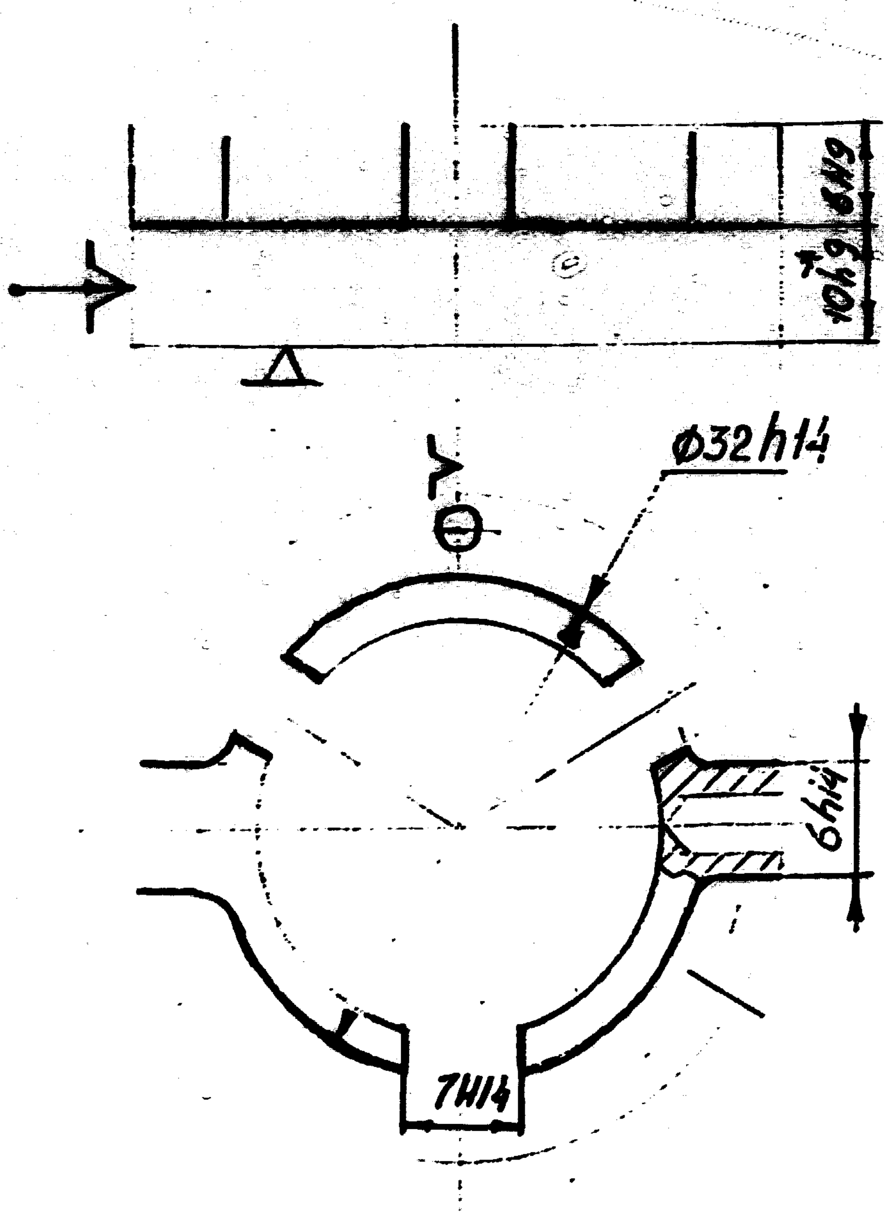
SECTION 2

		OPERATION FOLD	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 5	150005	PROFILE	DIMENSIONS

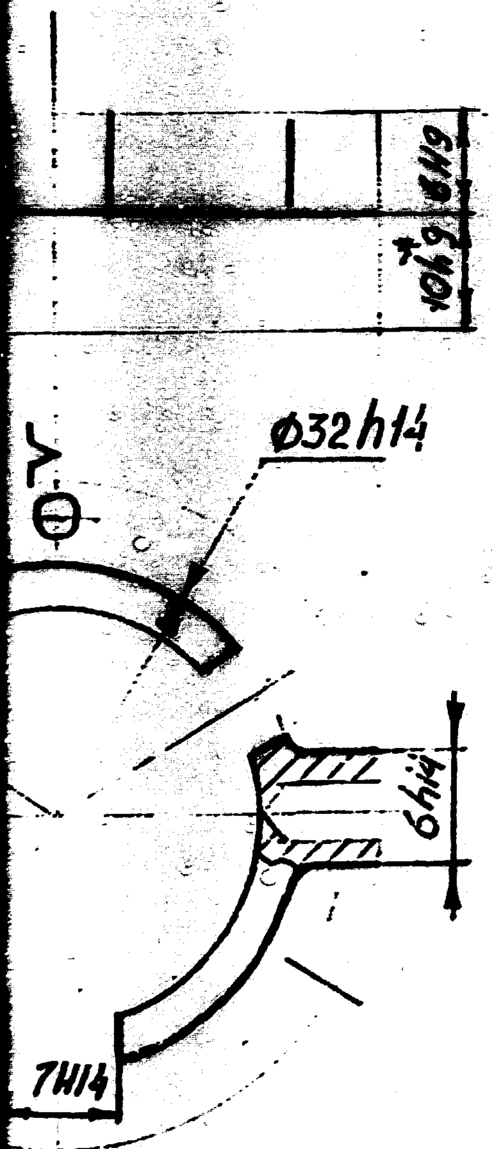
№	STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	MILLING MACHINE, DIVIDING ATTACH-MENT		
002	MILL TWO GROOVES 022H14 ON 6H9 mm DEPTH		MILL END. ⌀10 mm	
003	MILL THREE SLOTS 7H14mm ON 6H9 DEPTH			
004	SHARP BLUNT EDGES		SCRAPER,FILE	
	SEE DRAFT N4			
	OPERATION NE			
001	MOUNT STATE PURCHASED	DRILL MACHINE DIVIDING ATTACH-MENT		

SHEET 14	NUMBER OF SHEET 15

ĪY



SECTION 1



SECTION 2

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0002	CENTRE DRILL FROM MAKING OUT TWO HOLES ⌀3.2 mm(1)		CENTRING DRILL ⌀ 3 mm	
0003	DRILL TWO HOLES ⌀3.2H11 ON L=7.5 mm			
	OPERATION 5 [illegible]			
0001	ANODIC OXIDATION BLACK			
0002	COAT SURFACE & BLACK ENAMEL SHAGREEN			
	PIECE N 150004			
0001	FILL THE LINES WITH BLACK ENAMEL			
	PIECE N 150029			
	COATING:CHEMICAL OXIDATION			

SHEET 13	NUMBER OF SHEET 13

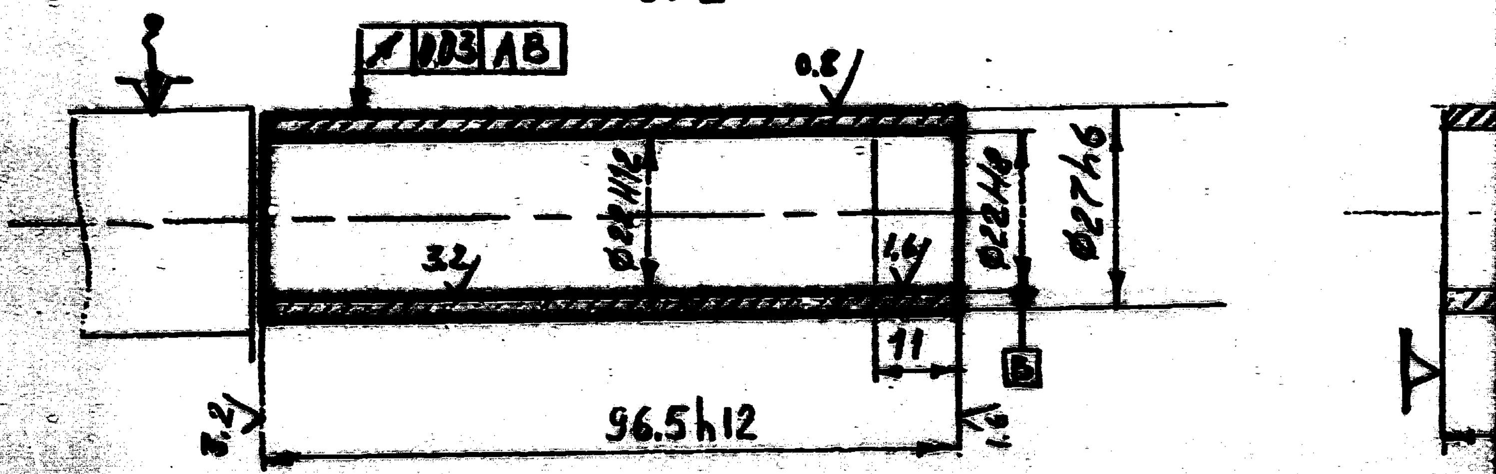
		OPERATION [illegible]	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET TWO NO	15000[illegible]		
		PROFILE	DIMENSIONS
		ROUND BAR BRASS ø 30 mm	30*200

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	SHAUBLIN-125 3-JAWS CHUCK		
002	TURN OUT END		TOOLHOLDER APPROACH 90°ANGLE	
003	CENTRING DRILL		CENTRING DRILL ø 2 mm	
004	DRILL HOLE ø20.5H12 ON L=100 mm		DRILL ø20.5 mm	SLIDING CALLIPERS
005	TURN HOLE ø21.5H12 ON L=[illegible] mm		CUTTING [illegible]	
006	TURN HOLE ø22H8 ON L=[illegible] mm		DIAMOND TOOL	SLIDING CALLIPERS
007	TURN ø27.[illegible] ON L=[illegible] mm		TOOLHOLDER	
008	TURN ø27[illegible] ON L=[illegible] mm		DIAMOND TOOL	

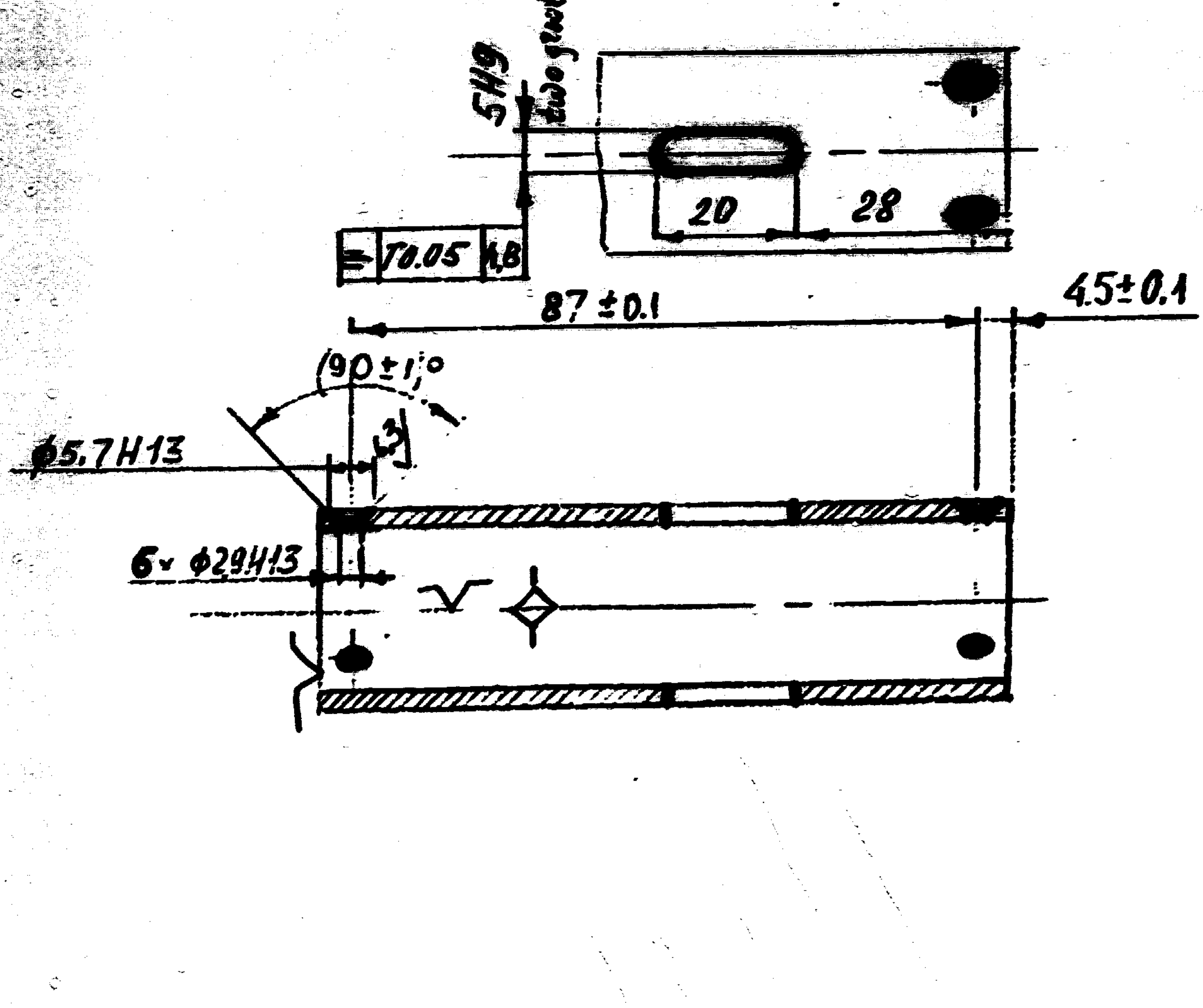
SHEET 1	NUMBER OF SHEET [illegible]

Operation N1

Pos. 1

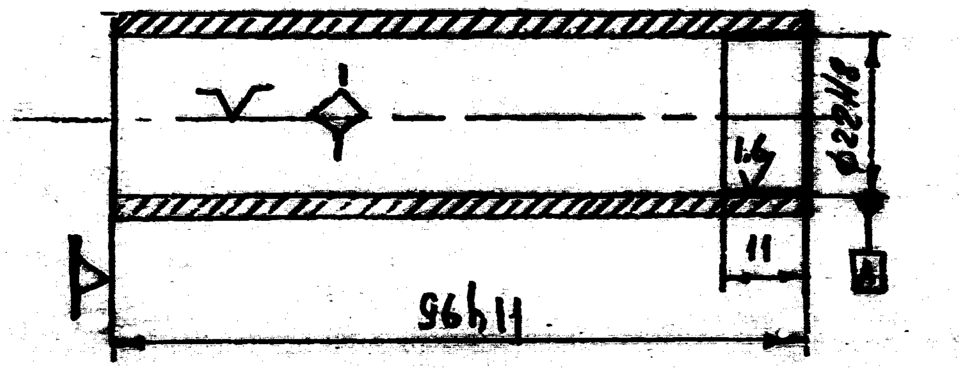


Operation N2



SECTION 1

Pos. 2



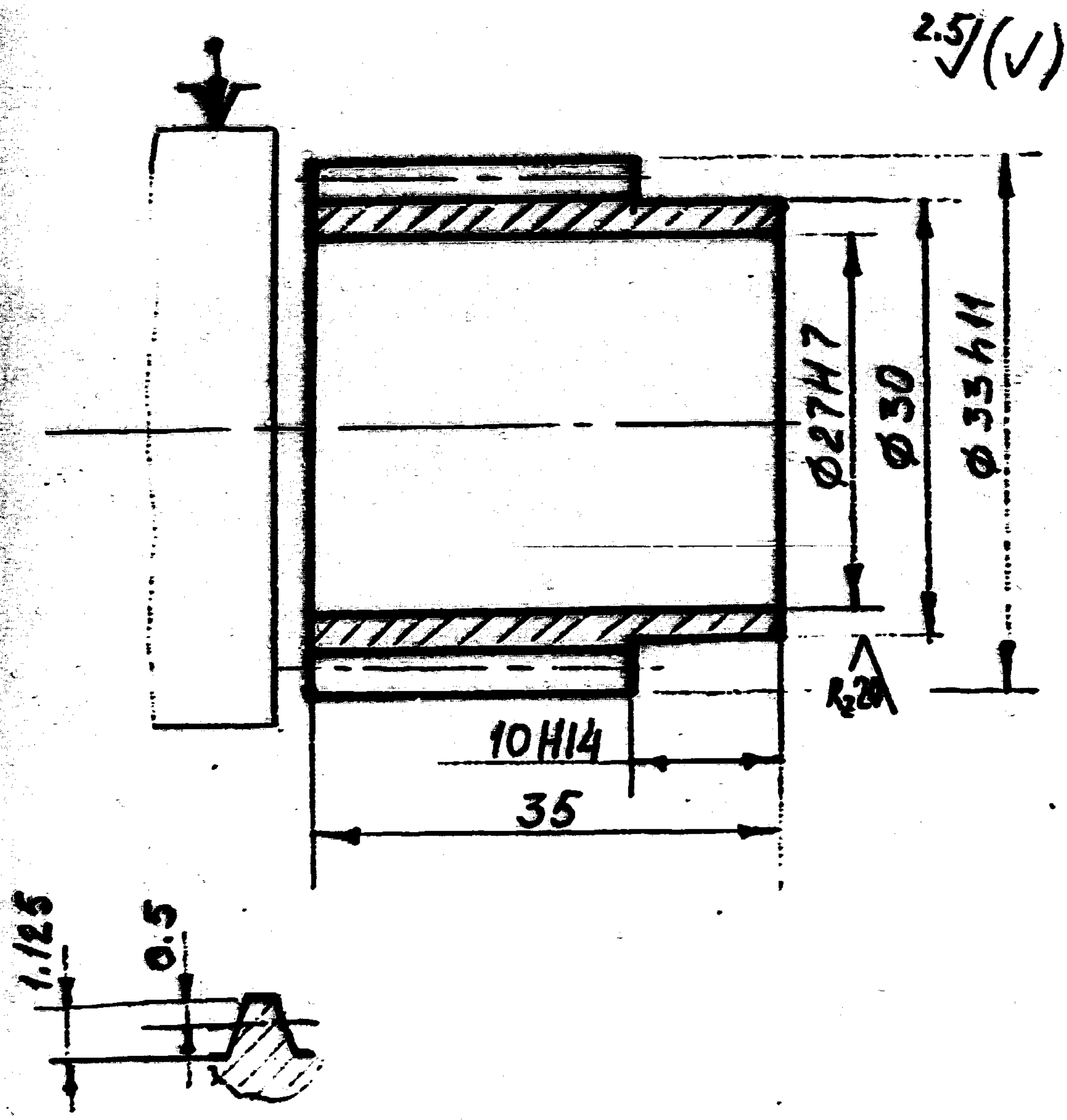
SECTION 2

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	CUTTING OFF ON L=[illegible] mm			
010	MOUNT A BLANK	SHAUBLIN-125		
011	TURN BUT END IN DIMENSION [illegible]	TYPE COLLET [illegible]	TOOLHOLDER	SLIDING CALLIPER
012	TURN HOLE [illegible] ON L=[illegible] mm		DIAMOND TOOL	
0[illegible]	BLUNT SHARP EDGES		SCRAPER, FILE	
	OPERATION 2			
001	MOUNT A BLANK	MILLING MACHINE DIVIDING ATTACH-		
		MENT, ARBOR		
002	MILL TWO GROOVES [illegible], BEARING DIMEN-SIONS 26 AND 29 mm			
003	DRILL 6 HOLES [illegible]		DRILL [illegible]	
004	TURN CHAMFERS [illegible]			
	OPERATION THREE			
001	REMOVE FAT			
002	COATING CHEMICAL OXIDATION			

SHEET [illegible]	NUMBER OF SHEET [illegible]

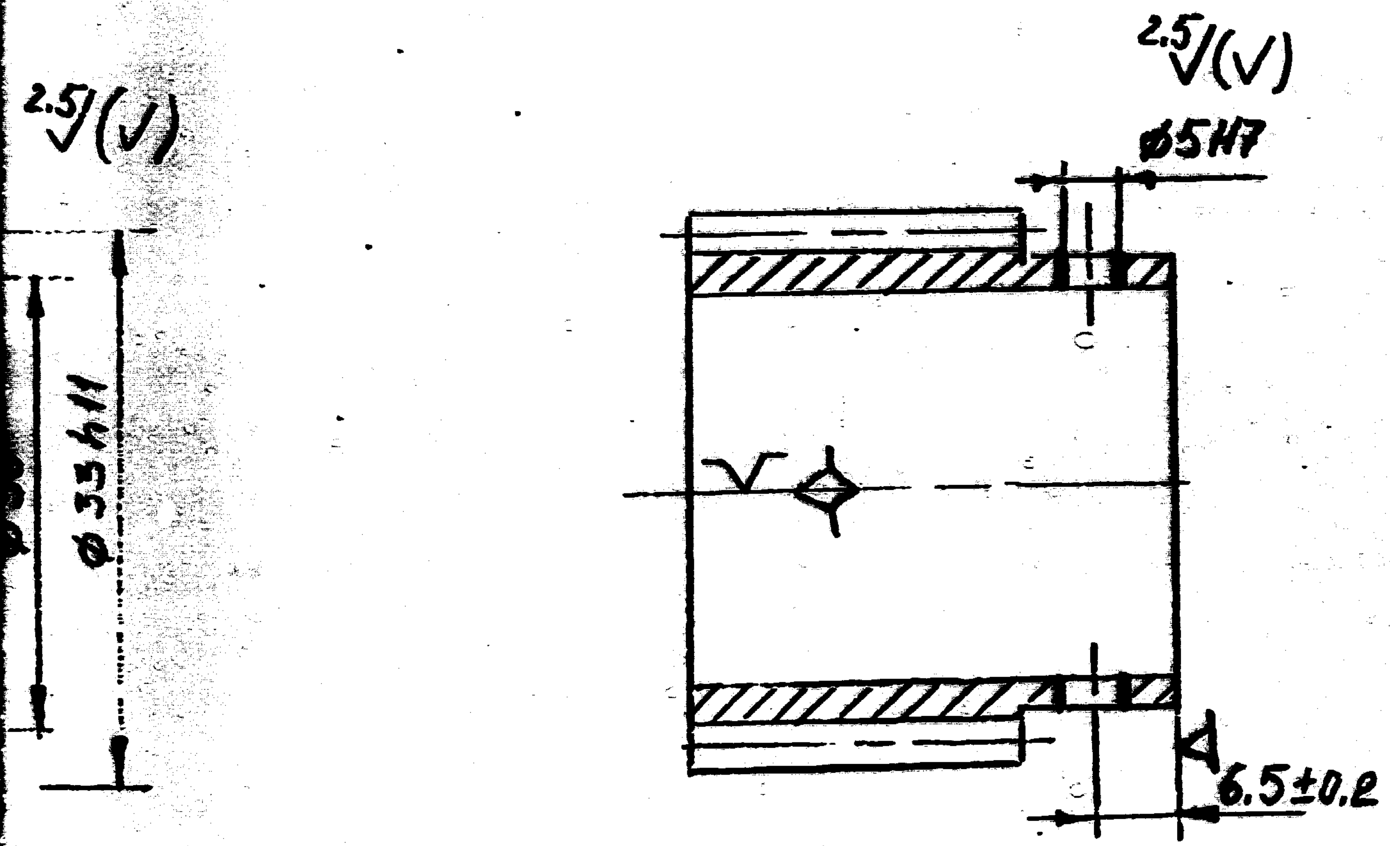
		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET TWO	150007		
		PROFILE	DIMENSIONS
		ROUND BAR BRASS	35x200
N WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001 MOUNT A BLANK	SHAUBLIN-125 3-JAWS CHUCK		
002 TURN BUTT END		TOOLHOLDER APPROACH ANGLE	SLIDING CALLIPERS
003 CENTRE DRILL		CENTRE DRILL d 3 mm	
004 DRILL HOLE d25H11 ON L=40 mm		DRILL d25H11	
005 TURN HOLE [illegible] FOR THE NEXT PASSAGE		CUTTER TOOL	SLIDING CALLIPERS
006 TURN d[illegible] ON L=[illegible] mm		CUTTER TOOL	SLIDING CALLIPERS
007 TURN d30h14 ON 11mm LONG		TOOLHOLDER	
008 TURN WITH H=1.125mm,P=1.57mm,I=8		FALING TOOL	MICROMETR
		SHEET 1	NUMBER OF SHEET 2

Operation N1



SECTION 1

Operation N2



№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	BLUNT SHARP EDGES		SCRAPER,FILE	SLIDING CALLIPERS
010	CUTTING OFF ON [illegible]		CUTTING TOOL	
	OPERATION [illegible]			
001	MOUNT AS BLANK	MILLING MACHINE DIVIDING ATTACH-		
		MENT,ARBOR		
002	CENTRE DRILL FOR MACHINING OUT			
003	DRILL TWO HOLES ⌀4,9H11		DRILL ⌀4,9H11	
004	REAMER TWO HOLES ⌀5H7		REAMER ⌀5H7	
	OPERATION [illegible]			
	CHEMICAL OXIDATION			

SHEET [illegible]	NUMBER OF SHEET [illegible]

	OPERATION		
OPERATION SHEET	NUMBER OF PIECES	BLANK	
	150000	PROFILE	DIMENSIONS
			ø8F8*100

No.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	BAHUBLIN-125 COLLET TYPE ø8		
002	TURN ø2.5h9 FOR THE PASSAGES L=3±12		TOOLHOLDER	SLIDING CALLIPERS
003	TURN GROOVE ø1.9-14 L=1.5 mm		GROOVING TOOL	
004	TURN CHAMFER ø0.3*45°		CHAMFER TOOL	
005	SCREW M2.5-6G		FEMALE SCREW CUTTER	
006	CUTTING OFF IN DIMENSION 7.5±0.1			
	OPERATION TWO			
001	METALL WORK CUT GROOVE 0.5±0.1		FILE	SLIDING CALLIPERS
	OPERATION THREE			
	CHEMICAL OXIDATION			

SHEET :	NUMBER OF SHEET :

			OPERATION	
	OPERATION DRAFT	NUMBER OF PIECES	BLANK	
		[illegible]		
			PROFILE	DIMENSIONS
			BAR-ROLL	D*L
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	SHAUBLIN-125 3-JAWS CONCENT-RIC CHUCK		
002	TURN BUTT END		TOOLHOLDER	
003	CENTRE DRILL		CENTRING DRILL d2 mm	
004	DRILL d 27 ON L=[illegible]		DRILL [illegible]	
005	TURN d32 ON L=[illegible]		TOOLHOLDER	SLIDING CALLIPERS
006	CUT OFF, BEARING DIMENSIONS 5 mm		FORM CUTTER	SLIDING CALLIPERS
			SHEET 1	NUMBER OF SHEET [illegible]

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET TWO AND TABLE 1	[illegible]	PROFILE	DIMENSIONS
		ROUND BAR ALUMINIUM ALLOY	ø[illegible]

N°	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	SCHAUBLIN-125 3-JAWS CHUCK		
002	TURN BUTT END	TOOLHOLDER		
003	TURN ø[illegible] ON (L'45mm) LONG	TOOLHOLDER		SLIDING CALLIPERS
004	TURN ø[illegible] ON L'[illegible]mm LONG WITH CHAMFER 45°			
005	TURN CHAMFER [illegible]		CHAMFER TOOL	
006	CENTRE DRILL		CENTRING DRILL	
007	DRILL HOLE ø[illegible] ON L'45 mm			SLIDING CALLIPERS
008	TURN HOLE ø [illegible] ON (L'45)mm LONG		CUTTING TOOL	
			SHEET :	NUMBER OF SHEET :

Operation one

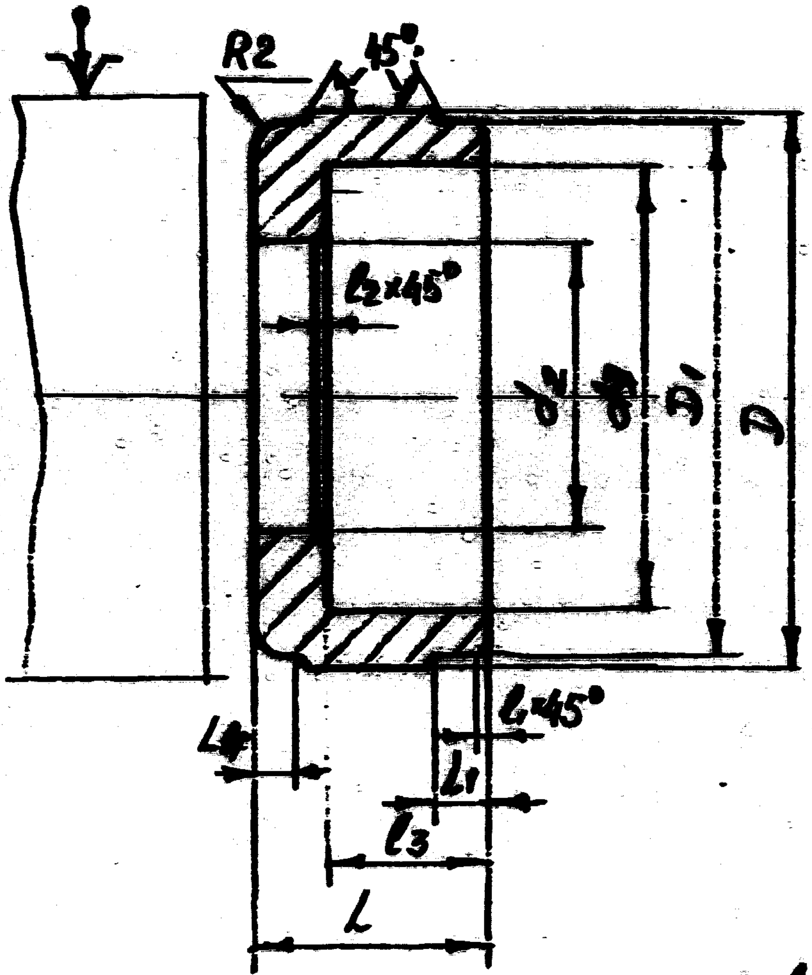


Table 1

Number of pieces	D	D_1	d_3	d_2	L	L_1	L_2	l_1	l_4	l_3
150015	54	32.5	15.5	8H9	20h12	5	0	1.0	1.0	4.5
150037	34	52.5	42	35H11	18.5	5	3H12	0.5	0	14H12

SECTION 1

Operation two

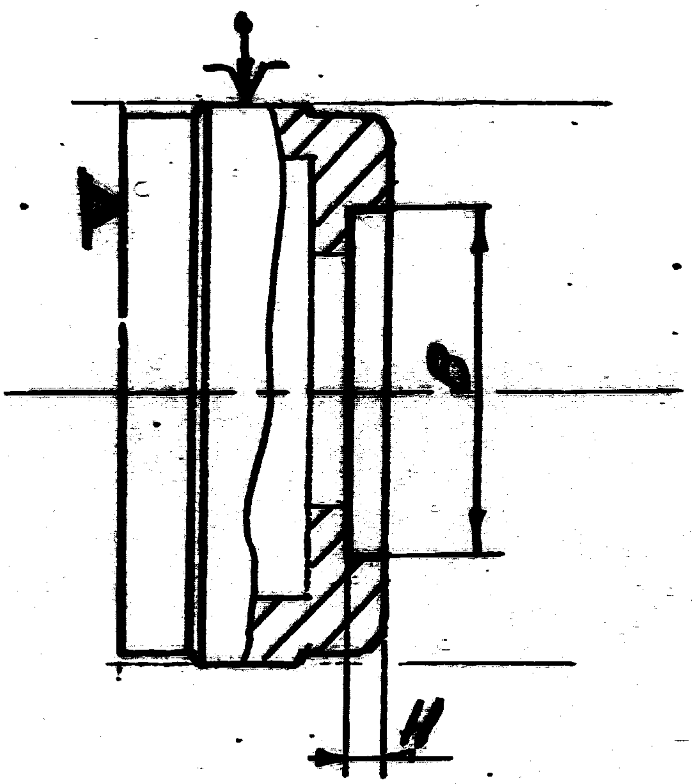


Table 1

h_2	l_1	l_4	l_3
0	1.0	1.0	4.5
3H12	0.5	0	14H12

Table 2

Number of pieces	B	H
150.015	∅24H12	4.0
150.037	∅42	3h12
150.037.01	∅49	3h12

SECTION 2

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	TURN HOLE [illegible] WITH BUTT END ON 12 mm LONG		CUTTING TOOL	
010	TURN CHAMFER 1x45°		CHAMFER TOOL	
011	TURN R2, CHAMFER 45° ON [illegible] mm LONG			
012	SHARP BLUNT EDGES		FILE, SCRAPER	
013	CUTTING OFF IN DIMENSION L=[illegible]±0.5 mm			

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2 AND TABLE 2	150015 150037 150037-01		
		PROFILE	DIMENSIONS

No	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	SHAUBLIN-125 TYPE COLLET		
002	CUTTING HOLE [illegible] MM LONG WITH BUTT END		CUTTING TOOL	SLIDING CALLIPERS
003	SHAPR BLUNT EDGES		FILE,SCRAPER	

SHEET 4	NUMBER OF SHEET 7

OPERATION DRAFT	NUMBER OF PIECES	OPERATION	
		BLANK	
SEE SHEET 5	150015 150037	SEE SHEET 5	
		PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	MILLING MACHINE DIVIDING ATTACHMENT		
002	MILL THREE GROOVES 8mm IN DEPTH 3±0.1 FOR PIECE N150037		MILL ⌀8 mm	SLIDING CALLIPERS DEPTHMETER
003	DRILL THREE HOLES ⌀2.7H12		DRILL ⌀2.7H12	
004	MILL CHAMFER IN THREE HOLES ⌀5.7H13×90°-1[illegible]		FACING MILL 90°	
005	DRILL HOLE ⌀1.5H11 FOR PIECE N150015 ON DEPTH 15 mm			DEPTHMETER
006	SHARP BLUNT EDGES		SCRAPER, FILE	

SHEET 5	NUMBER OF SHEET [illegible]

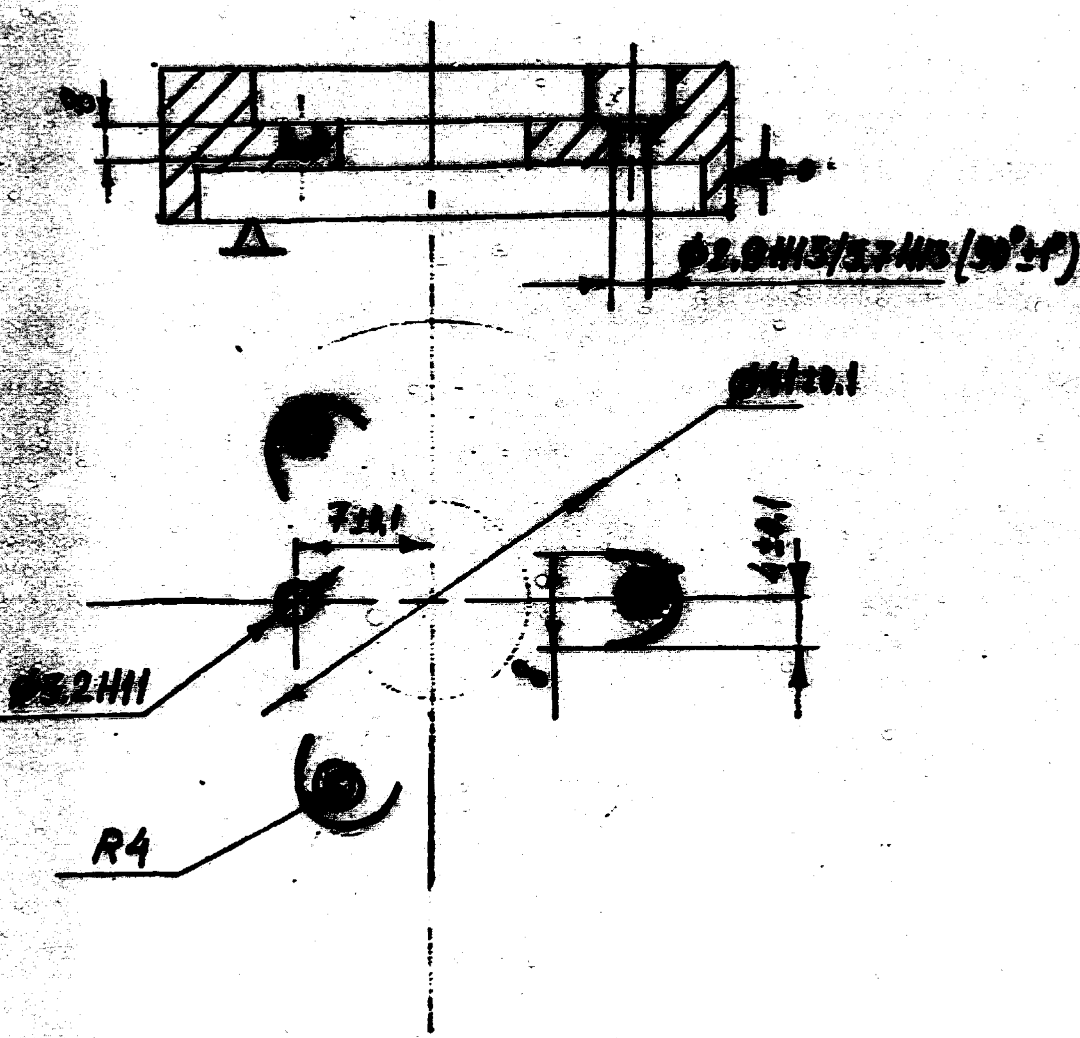
		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 5 (N4)	[illegible] [illegible]	SEE SHEET 5 (N3)	
		PROFILE	DIMENSIONS

N STEP	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	MILLING MACHINE DIVIDING ATTACHMENT		
002	MILL THIRTY GROOVERS,BEARING [illegible]		FACING MILL DISK	SLIDING CALLIPERS
	OPERATION FIVE			
001	REMOVE FAT			
002	ANODIC OXIDATION			
003	COATING SURFACE A ENAMEL BLACK			

SHEET [illegible]	NUMBER OF SHEET [illegible]

Operation 3

Opera



SECTION 1

150.015
150.037

Operation 4

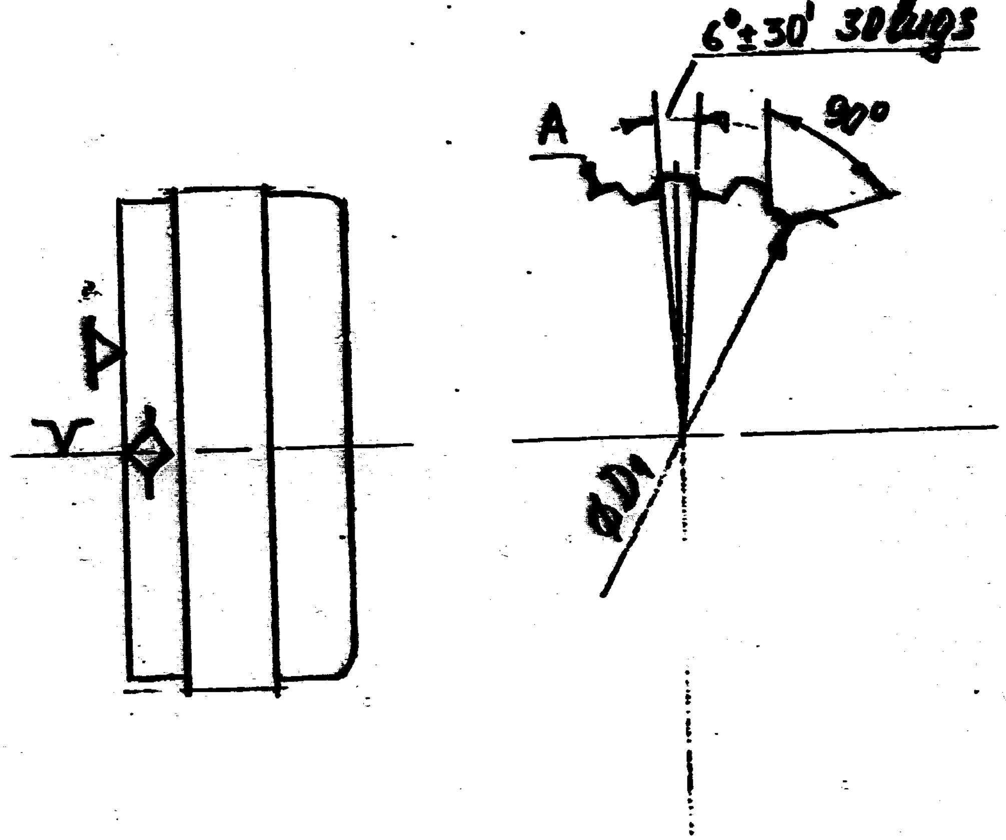
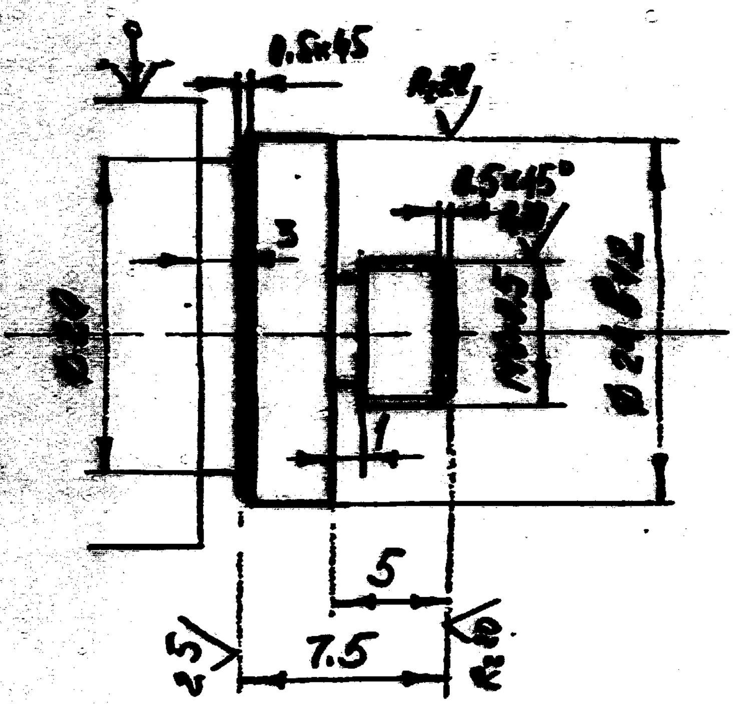


Table 3

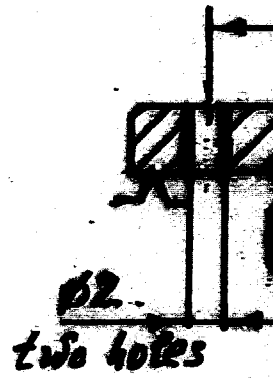
Number of pieces	D_1
150.015	32.5
150.037	52.5

			OPERATION	
OPERATION CHART		NUMBER OF PIECES	BLANK	
SEE SHEET 3		15001A	PROFILE	DIMENSIONS
			BAR ROUND	ø22×50
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	SHAUBLIN-125 3-JAWS CHUCK		
002	TURN ø24h12 ON L=13mm LONG		TOOLHOLDER	SLIDING CALLIPERS
003	TURN ø6 ON 5mm LONG			
004	TURN BUTT END AND GROOVE, BEARING DIMENSIONS ø5.2 AND 1 mm		GROOVE CUTTER	
005	TURN GROOVE, BEARING DIMENSION 0.5mm, ø20mm AND 3 mm		GROOVE CUTTER	
006	TURN TWO CHAMFERS 0,5×45°		CHAMFER TOOL	
007	SCREW M6×0.5-6g			
008	SHARP BLUNT EDGES		FILE, SCRAPER	
009	CUTTING OFF IN 7.5 mm			
			SHEET 1	NUMBER OF SHEET 3

Operation 1



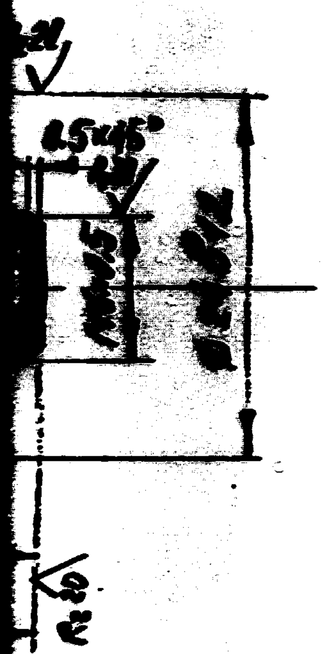
Opera

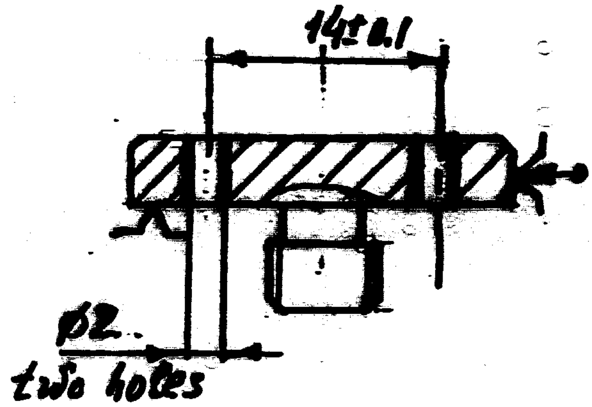


page

SECTION 1

Operation 2





SECTION 2

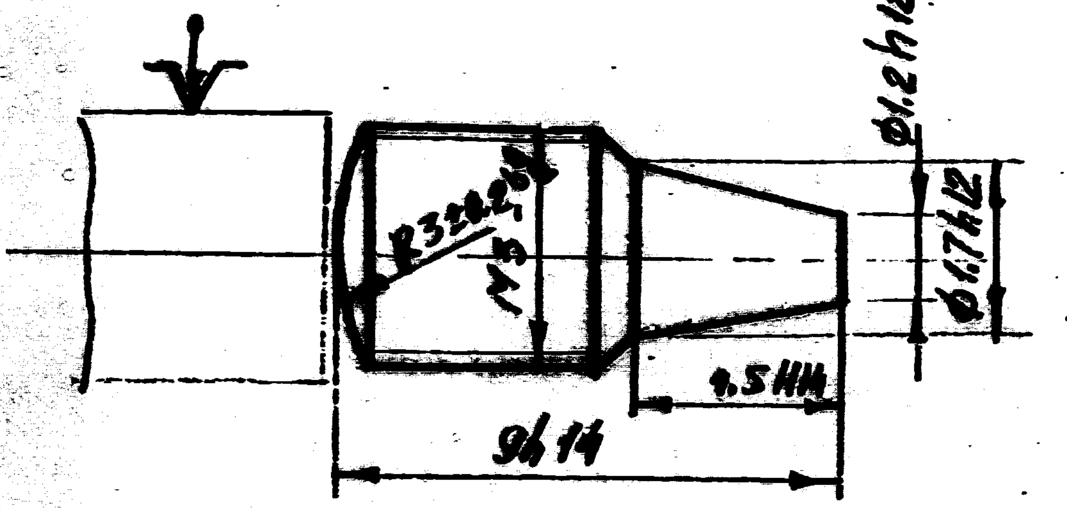
			OPERATION	
	OPERATION SHEET	NUMBER OF PIECES	BLANK	
	SEE SHEET 2	[illegible]		
			PROFILE	DIMENSIONS
No	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT A BLANK	DRILLING MACHINE		
0002	MARKING OUT TWO AXES OF HOLES			
0003	DRILL TWO HOLES d=[illegible], KEEPING DIMEN-SION [illegible]		DRILL [illegible]	
0004	BLUNT SHARP EDGES		SCRAPER, FILE	
	OPERATION THREE			
	CONTINUED [illegible]			
			SHEET 2	NUMBER OF SHEET

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET [illegible]	[illegible]		
		PROFILE	DIMENSIONS
		BAR ROUND	[illegible]

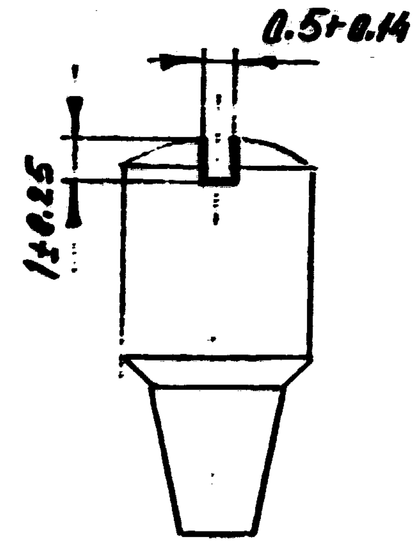
No.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT STATE PURCHASED	[illegible] COLLET TYPE		
002	TURN BUTT END	TOOLHOLDER		
003	TURN [illegible]	TOOLHOLDER		SLIDING CALLIPERS
004	TURN [illegible]	TOOLHOLDER		SLIDING CALLIPERS
005	TURN [illegible]	TOOLHOLDER		SLIDING CALLIPERS
006	SCREW [illegible]	CUTTER		
	OPERATION TWO			
007	MILLING GROOVE [illegible] BY DEPTH [illegible] MILLING [illegible]			
008	BLUNT SHARP EDGES, OPERATION THREE [illegible]			

SHEET [illegible]	NUMBER OF SHEET [illegible]

Operation 1

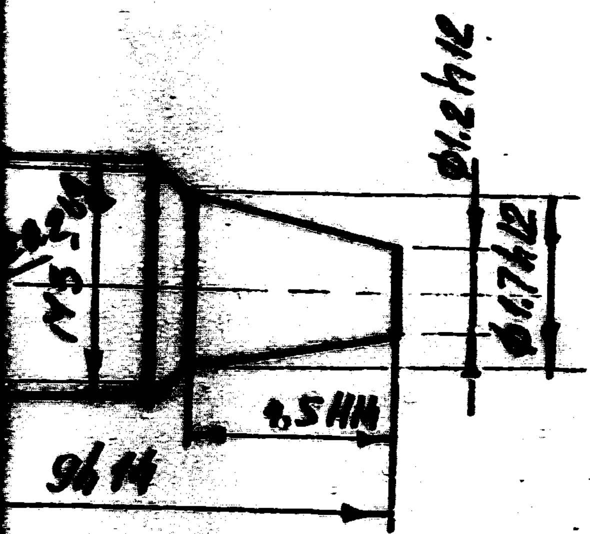


Operation 2

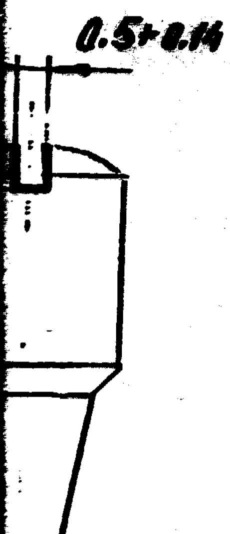


SECTION 1

on 1



2

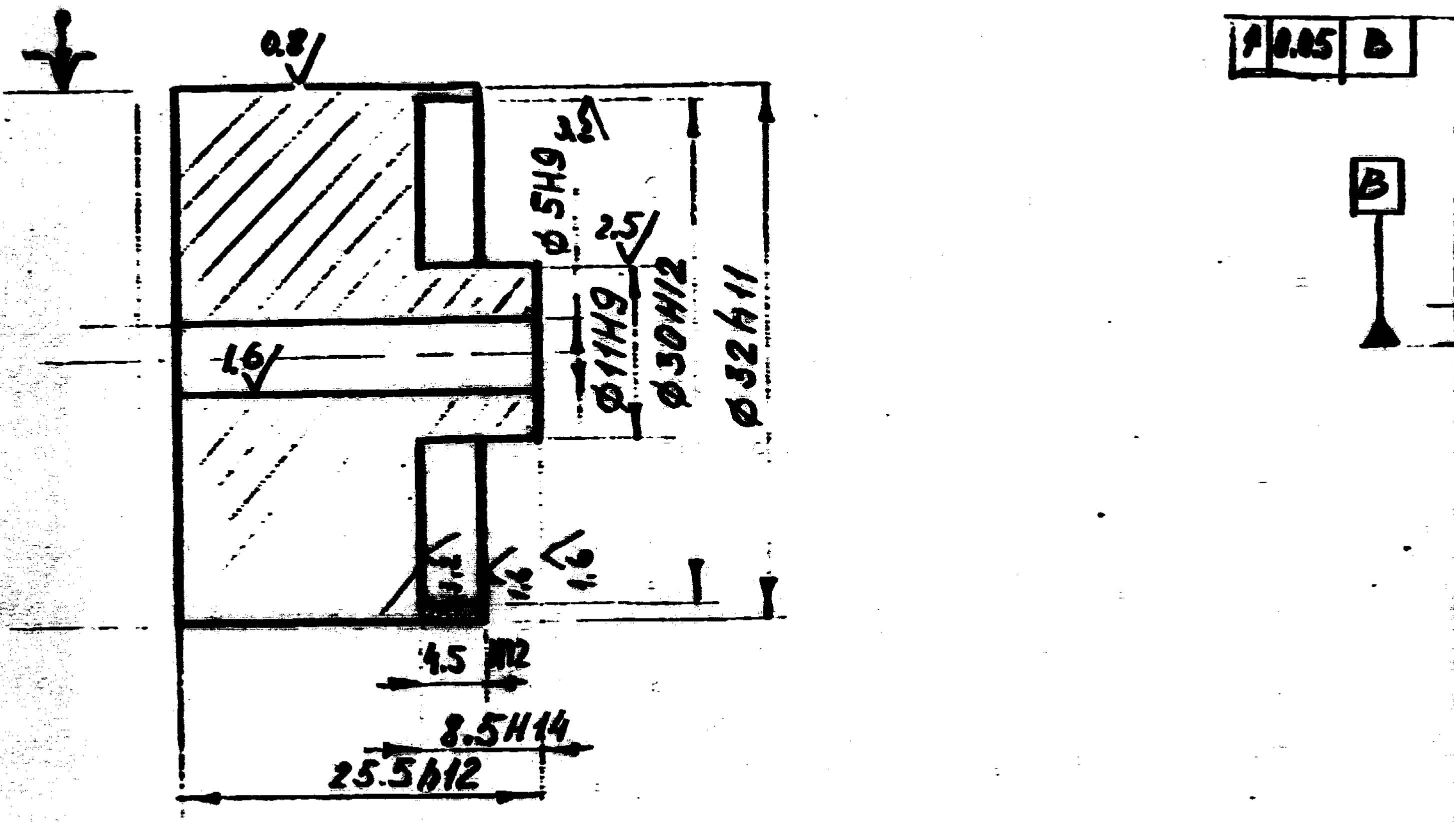


SECTION 2

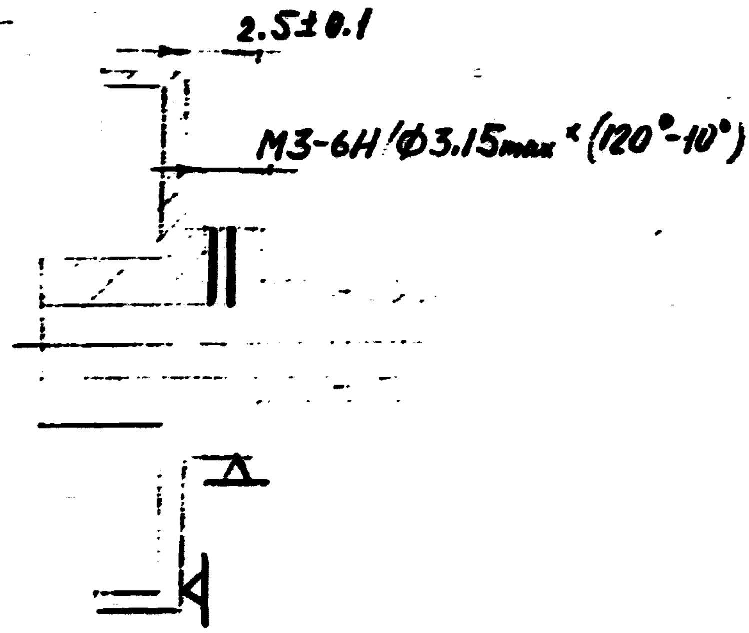
page two

			OPERATION	
OPERATION CHART		NUMBER OF DETAILED	BLANK	
SEE SHEET [illegible]		[illegible]		
			PROFILE	DIMENSIONS
			ROUND BAR BRASS	[illegible]
No.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT STATE PURCHASED	[illegible] [illegible]-JAWS CHUCK		
002	TURN [illegible] IN [illegible]		TOOL-HOLDER	SLIDING CALLIPERS
003	TURN BUTT END			
004	TURN [illegible] IN [illegible]		TOOL-HOLDER	
005	TURN BUTT END GROOVE [illegible] BEARING DIMENSION [illegible]		GROOVE CUTTER	SLIDING CALLIPERS DEPTH-METER
006	TURN [illegible] WITH BUTT END IN DIMENSION IN [illegible]			
007	CENTRE DRILL		CENTRING DRILL	
008	DRILL HOLE [illegible] IN [illegible]			
			SHEET 1	NUMBER OF SHEET

Operation 1



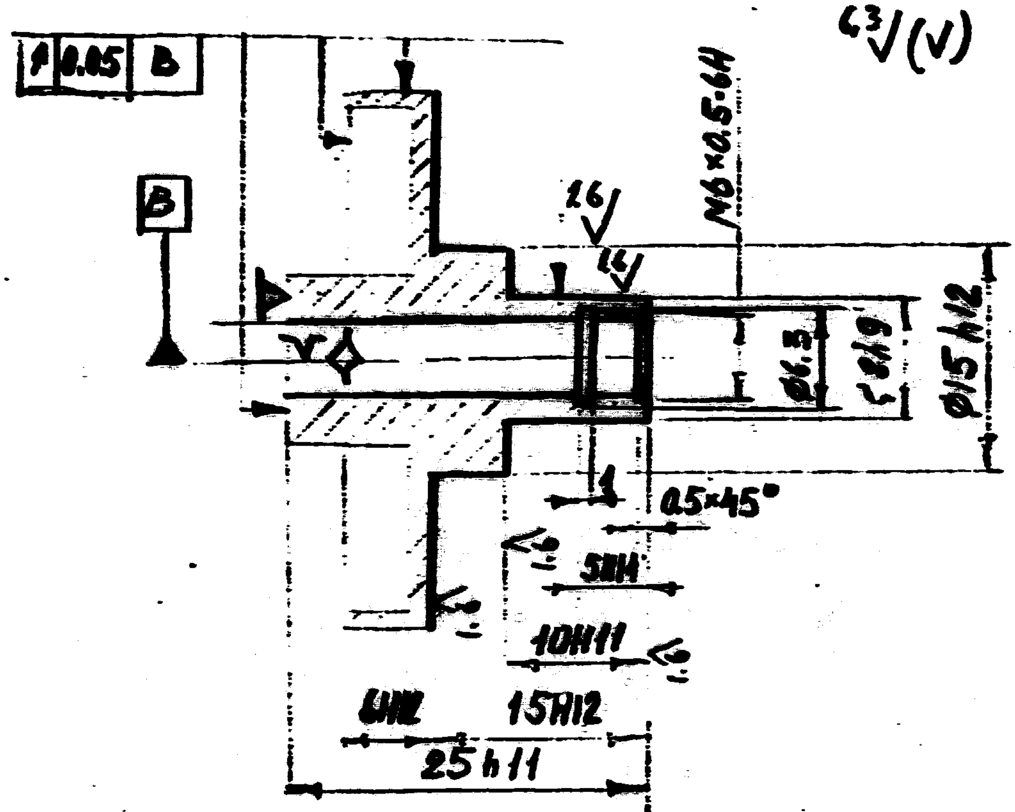
Operation 3



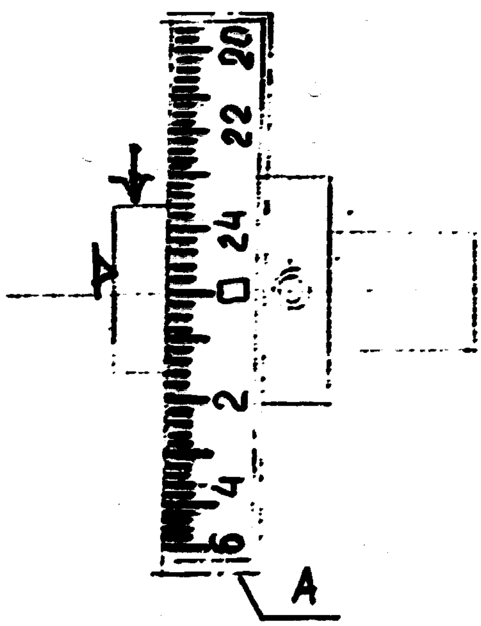
SECTION 1

N 150017

Operation 2



Operation 4



0°-10°)

SECTION 2

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
1009	TURN HOLE [illegible]		CUTTING TOOL	
1010	REAMER HOLE [illegible]		REAMER [illegible]	INDICATOR,DEPTH-METER
1011	CUTTING OFF IN DIMENSION [illegible]mm			

SHEET [illegible]	NUMBER OF SHEET

		OPERATION	
OPERATION START	NUMBER OF DETAILS	BLANK	
SEE SHEET TWO (N2)	1500 [illegible]	SEE SHEET TWO (N2)	
		PROFILE	DIMENSIONS
			Ø32*25.5

N	WORK STEP	EQUIPMENT	TOOL	MEASURING TOOL
001	MOUNT STATE [illegible]	[illegible]-125 COLLET TYPE [illegible]		
002	TURN BUTT END,BEARING DIMENSION 25h11		TOOLHOLDER	SLIDING CALLIPERS
003	TURN ø15h12 ON L=15H12		TOOLHOLDER	SLIDING CALLIPERS
004	TURN ø2 [illegible] ON L=10H11		TOOLHOLDER	
005	TURN CHAMFER [illegible]		CHAMFER TOOL	
006	TURN GROOVE [illegible],BEARING 5mm		FEMALE GROOVE CUTTER	INDICATOR
007	TURN HOLE ø[illegible] ON L=5.5mm		FEMALE CUTTER	INDICATOR
008	SCREW M[illegible]-6H		TAP	
009	SHARP BLUNT EDGES		FILE,SCRAPER	
			SHEET 1	NUMBER OF SHEET

		OPERATION	
OPERATION DRAFT	NUMBER OF DETAILES	BLANK	
SEE SHEET TWO (NO,4)	150017	PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT STATE PURCHASED	SHAUBLIN-125 PRISM		
002	MAKING OUT AXISE OF HOLE		DIVIDING POINT	
003	CENTRE DRILL		CENTRING DRILL ⌀2.5MM	
004	DRILL HOLE ⌀2.5MM		DRILL ⌀2.5	
005	MILL CHAMFER ⌀0.15X120°-10°		MILLING CHAMFER 120°	
006	SCREW M3-6H		TAP M3	
007	SHARP BLUNT EDGES		FILE,SCRAPER	
	OPERATION 4			
			SHEET 4	NUMBER OF SHEET

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT STATE PURCHASES	ENGRAVE MILLING MACHINE		
0002	ENGRAVE LINE AND FIGURES		ENGRAVE MILLING CUTTER	
	OPERATION 5			
0001	DULL SURFACE & COLOR			
0002	ENGRAVING TO FILL WITH BLACK ENAMEL			

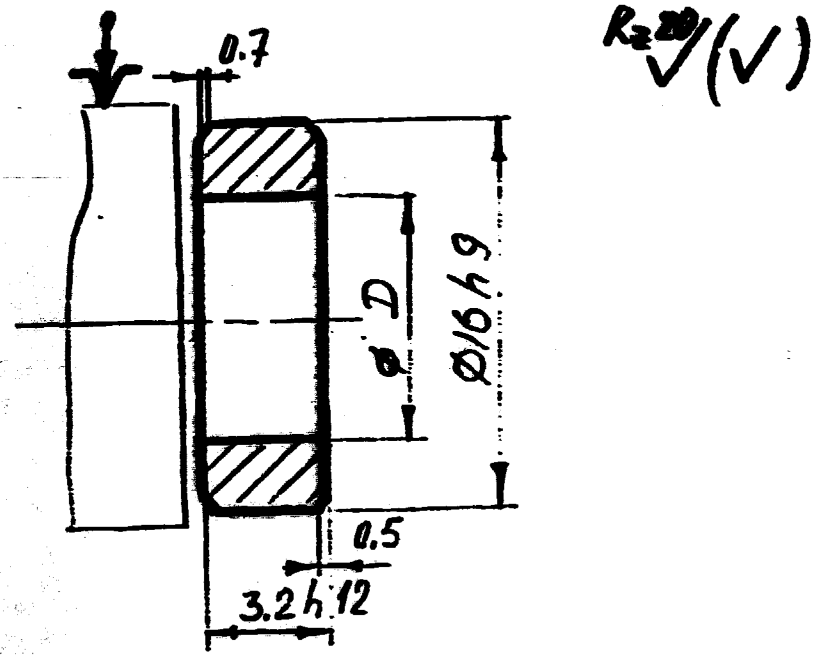
SHEET	NUMBER OF SHEET

OPERATION DRAFT	NUMBER OF PIECES	OPERATION BLANK	
SEE SHEET 2	150.018 150.018-0.1		
		PROFILE	DIMENSIONS
		STEEL BAR ROUND	0 20*20

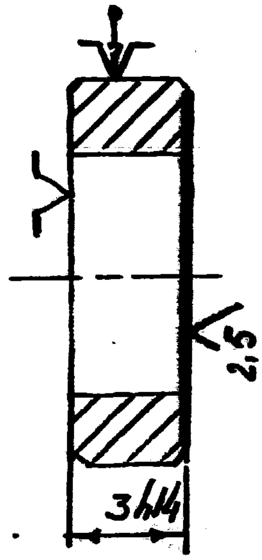
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE BLANK	SHAUBLIN - 125 3-JAWS CHUCK		
002	TURN BUTT END PIECE IN DIMENSION 1mm,BEARING 1mm		CUTTER	
003	TURN o 16H9 ON 20 mm LONG		TOOLHOLDER	SLIDING CALLIPERS
004	TURN CHAMFER 0.5*45°		CHAMFER TOOL	
005	TURN GROOVE o14 mm, BEARING 3.2H14		GROOV CUTTER	
007	TURN CHAMFER 0.7*45°			
008	CENTRE DRILL		CENTRING DRILL o 2 mm	
009	DRILL HOLE oD ON L=20 mm		DRILL o 20 mm	
010	CUTT OFF, BEARING 3.2H14			
011	MOUNT AND REMOVE THE BLANK			
012	TURN BUTT END, BERING 3H14			
013	SCREW M16*0.5-66		CUTTER	
014	FILL GROOV 1*1.2 mm			

SHEET 1	NUMBER OF SHEET 2

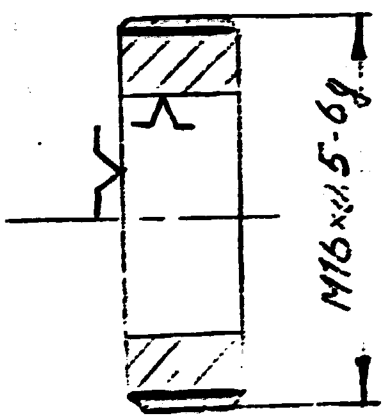
Operation N1



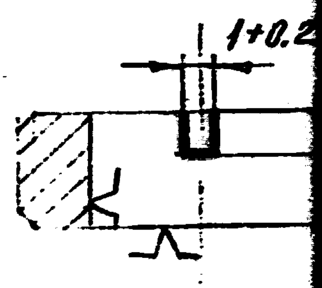
Operation



Operation N2



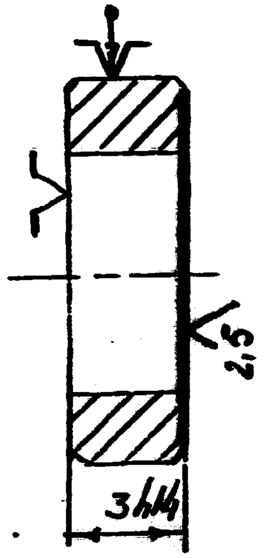
Operation



SECTION 1

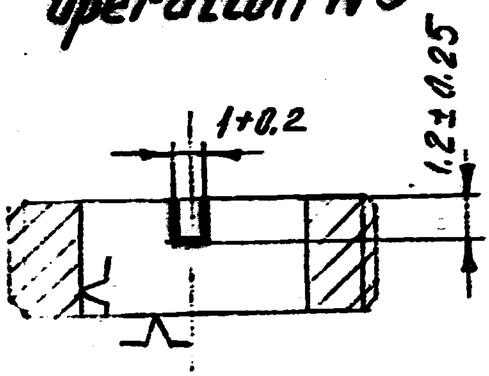
Operation N1

√(√)



Number of pieces	d
150.018	11H12
150.018-01	12H12

Operation N3



SECTION 2

Sheet 2

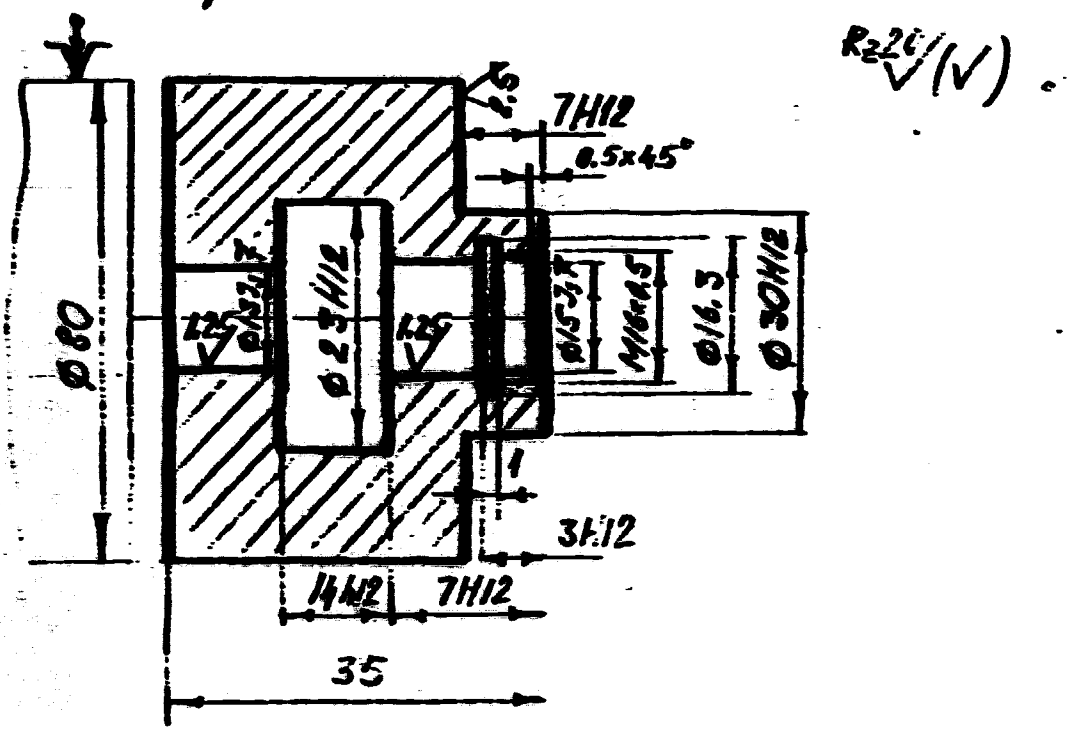
		OPERATION
OPERATION DRAFT	NUMBER OF PIECES	BLANK
SEE SHEET 2	150.019	

PROFILE	DIMENSIONS
ROUND BAR ALUMINIUM ALLOY	o 80

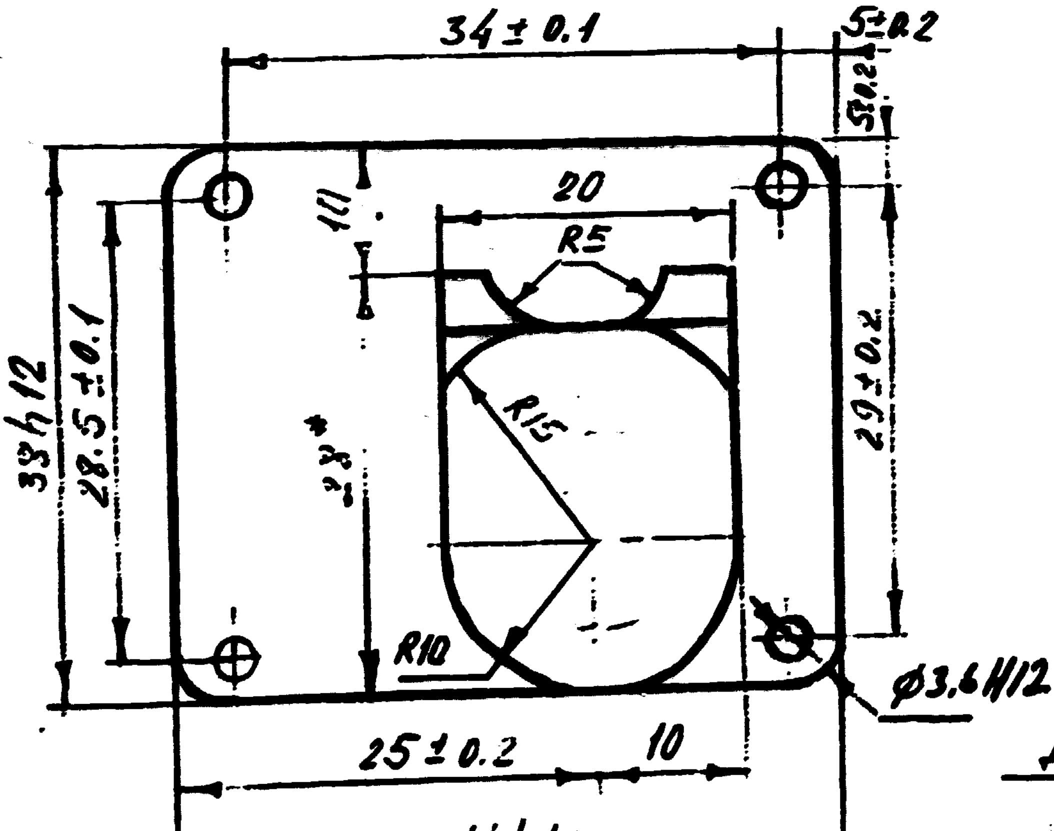
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE BLANK	SHAUBLIN - 125 3-JAWS CHUCK		
002	TURN BUTT END "AS PUTE" PIECE IN DIMENSION 1mm, BEARING 1mm		TOOLHOLDER	
003	TURN o 20H12 ON ZL=7H12 mm		TOOLHOLDER	SLIDING CALLIPERS
004	CENTRE DRILL		DRILL o 2 mm	
005	DRILL HOLE o 12 mm ON 40 mm LONG		DRILL o 12 mm	SLIDING CALLIPERS
006	TURN GROOVE o 30H12, BEARING SIZE 14H12 AND 12H12		CUTTER	INDICATOR
007	TURN o 13JS7 ON 40 mm LONG		CUTTER	SLIDING CALLIPERS
008	TURN o 15JS7 ON 13 mm LONG		CUTTER	
009	TURN GROOVE o 16.3H1 IN SIZE 3H12 AND CHAMFERS 0.5*45		GROOVE CUTTER	
010	TURN o 14.5H9		CUTTER	

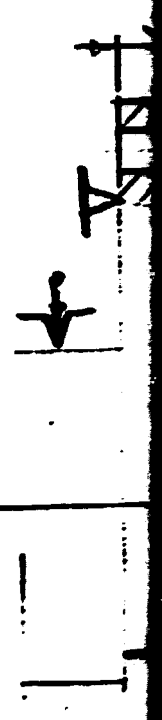
SHEET 1	NUMBER OF SHEET 5

Operation N1

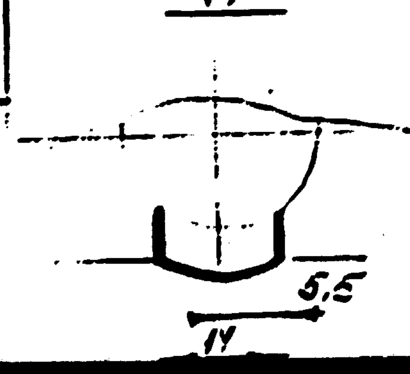


Operation N3



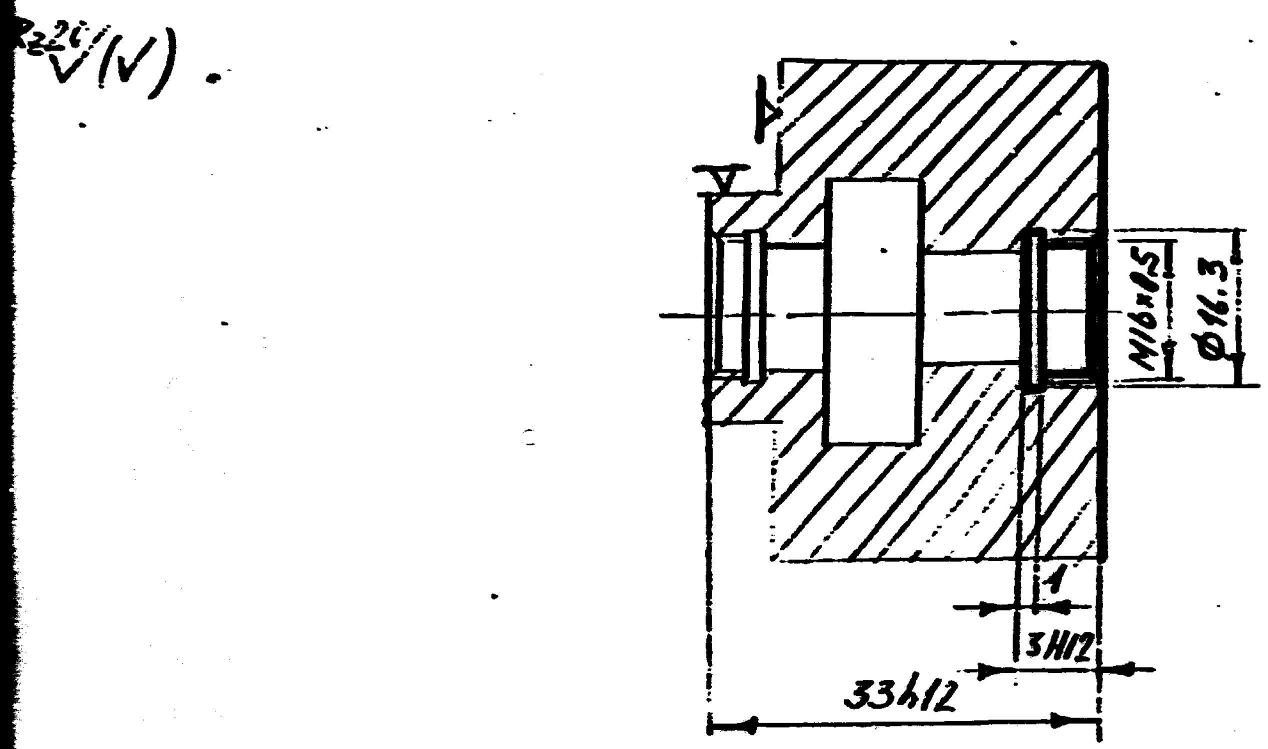


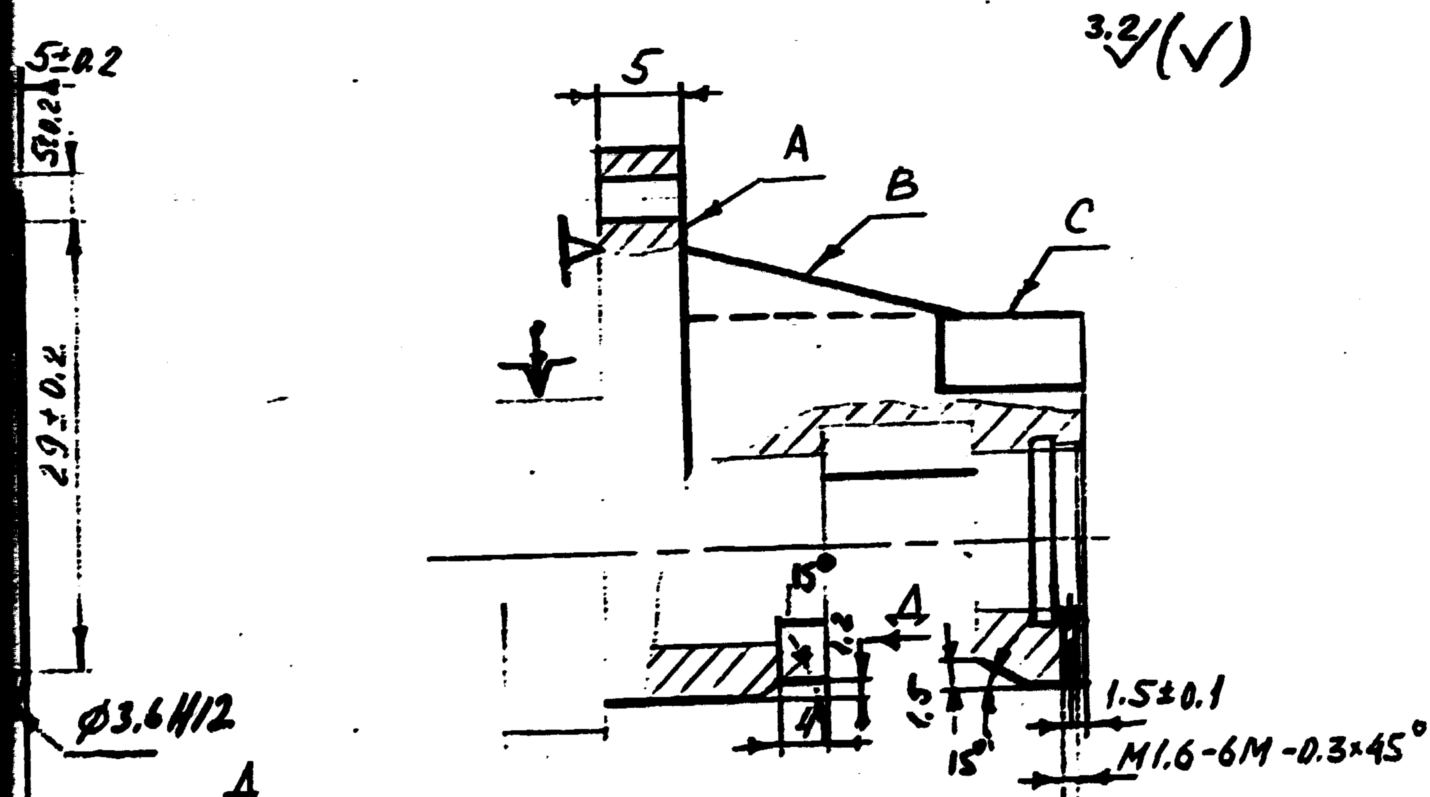
A

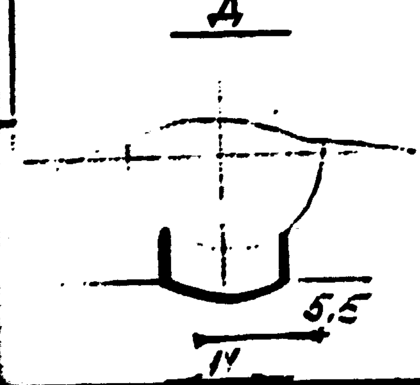


SECTION 1

Operation N2







SECTION 2

Sheet 2

			OPERATION N 2	
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
011	TURN SCREW M16X0.5-6H	SCREW CUTTER		
	OPERATION 2 (SEE SHEET 2 N2)			
001	MOUNT AND REMOVE THE BLANK	SHAUBLIN - 125		
002	TURN BUTT END IN SIZE 33H12		CUTTER	INDICATOR
003	TURN GROOVE o 16.3X1 IN SIZE 3H12		GROOVE CUTTER	
004	TURN o 14.5H9 ON 2 mm LONG		CUTTER	SLIDING CALLIPERS
005	TURN CHAMFER 0.5X45		CHAMFER TOOLS	
006	TURN SCREW M16X0.5-6H		SCREW CUTTER	
			SHEET 3	NUMBER OF SHEETS

		OPERATION N
OPERATION DRAFT	NUMBER OF PIECES	BLANK
SEE SHEET 2 (N 3)	150.019	

PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE BLANK	MILLING MACHINE, DIVIDING, ATTACHMENT		
002	MILL BY FOUR SIDE IN SIZE 38H12*44H12		MILL o 20 mm	SLIDING CALLIPERS
003	MILL FACE A IN SIZE 5 mm, BEARING 28*20 mm		MILL o 20 mm	
004	MILL CONER B AND FACE C		MILL o 10 mm	
005	MILL R10, R15, R5		MILL o 10 mm	
006	CENTRE DRILL FOUR HOLES BYG MARKING OUT		CENTRE DRILL	
007	DRILL FOUR HOLES o 3.6 mm		DRILL o 3.6H12	
008	MILL TWO CONER L15 IN SIZE 1.2 AND 1.5 mm		MILL o 10 mm	
009	TURN GROOVE o 16.3*1 IN SIZE 3H12 AND CHAMFERS 0.5*45°		GROOVE CUTTER	
010	TURN o 14.5 H9		CUTTER	

SHEET 4	NUMBER OF SHEET 5

OPERATION N 2

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	MILL SLOT 11 mm (SEE D) IN SIZE 4 mm		MILL ø 2 mm	SLIDING CALLIPERS
010	CENTRE DRILL TWO HOLES (M 1.6) BY MARKING OUT		CENTRE DRILL ø 1 mm	
011	DRILL TWO HOLES Ø 1.2 mm		DRILL ø 1.3 mm	
012	COUNTERSINK TWO HOLES 0.3*45°		COUNTERSINK	
013	SCREW M1.6-6H IN TWO HOLES		TAP M 1.6 mm	

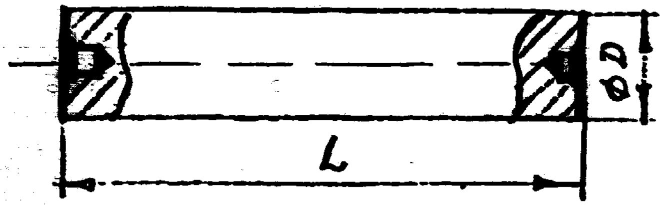
SHEET 5	NUMBER OF SHEET 5

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2 (N1 AND N2)	150.021 30.022		
		PROFILE	DIMENSIONS
		STEEL BAR ROUND	0 80

N	WORK STEP	NUMBER OF PIECES	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE BLANK SPECIAL DOUBLE - JAW PRISM VICE			
002	MILL TWO ENDS SIMULTANEOUSLY TO THE SIZE 1 mm		MILL o 20 mm	
003	CENTRE TWO ENDS SIMULTANEOUSLY			
	OPERATION N2 (TURNING)			
001	MOUNT AND REMOVE WORKPIES	SHAUBLIN - 125		
		CENTRES,DRIVING DOG,TRAVELLING		
		STEADY		
002	FACE "AS PURE"		TOOLHOLDER	
003	TURN o D7 FOR THE LENGTH L3			
004	TURN THE CHAMFER L7*45°		CHAMFER TOOL	
005	TURN o D6 TO THE SIZE L6		CUTTER	
006	TURN o D5 FOR THE LENGTH L2		CUTTER	

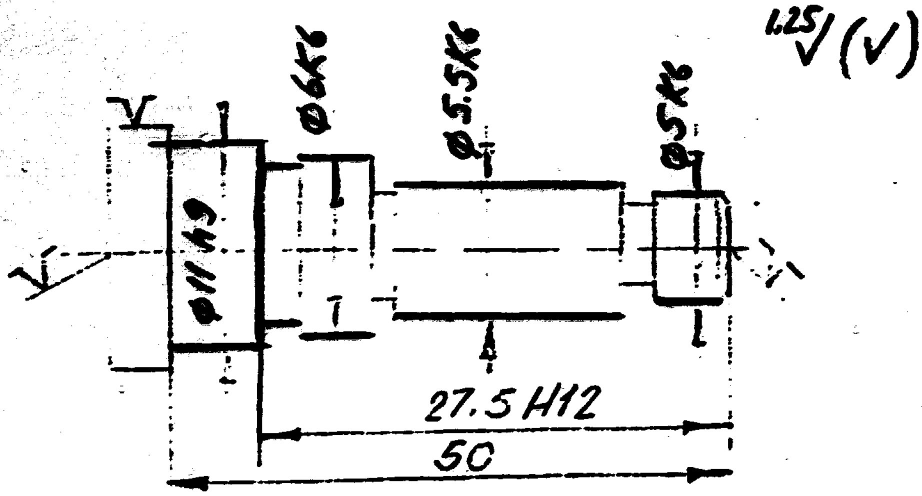
SHEET 1	NUMBER OF SHEET 4

Operation N1

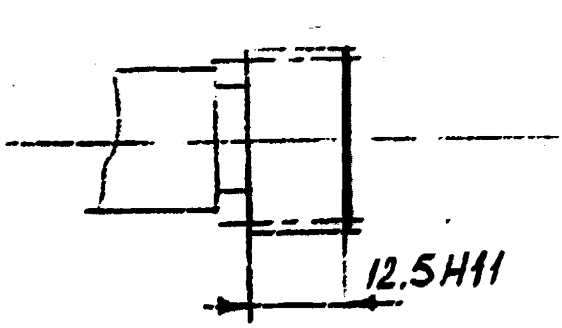


Number of piece	D	L
30.022	12	110
150.021	14	70

Operation N3

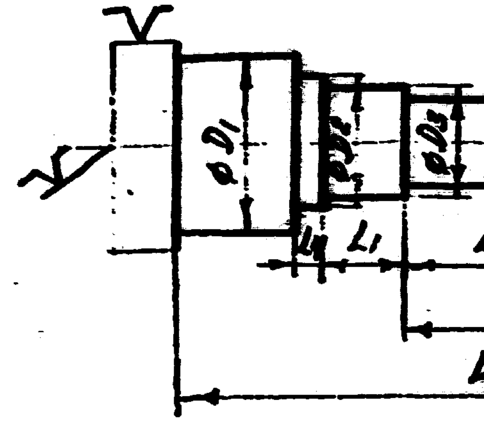


Operation N5

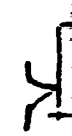


SECTION 1

Oper

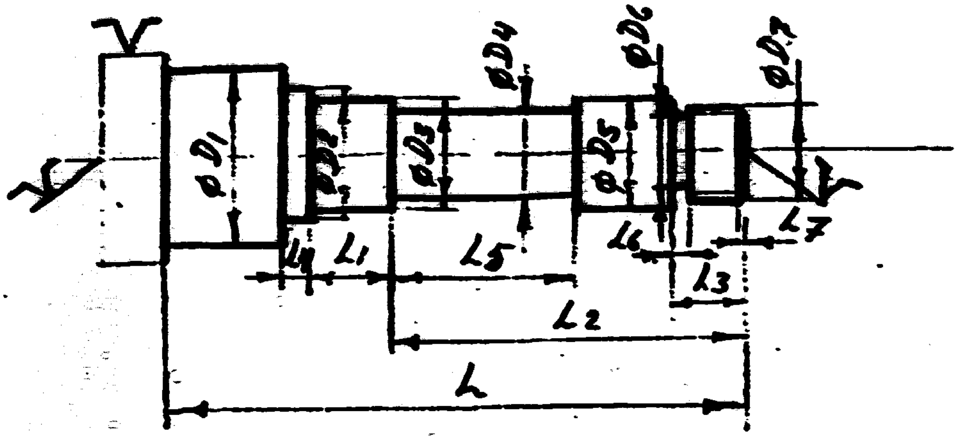


Op

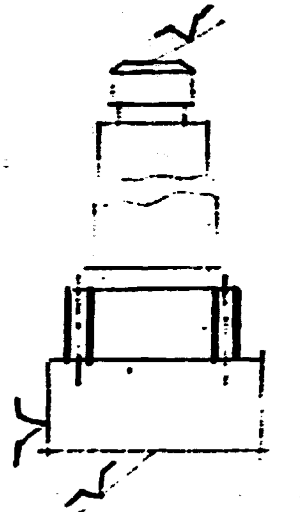


Number of piece	D_1	D_2	D_3
30.022	9.5	7.2	5.3
150.021	11.3	5.7	6.3

Operation N2



Operation N4



Number of piece	D_1	D_2	D_3	D_4	D_5	D_6	D_7	L	L_1	L_2	L_3	L_4	L_5	L_6	L_7	
30.022	9.5	7.2	5.3	4.8	5.3	3.7	NS	90	8	67	15	2	35	0.9	0.5	
150.021	11.3	5.7	6.3	5.2	5.8	4.7	6.3	50	2.5	23	4.8	1	1	1	0.3	

SECTION 2

Sheet 2

			OPERATION N	
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
007	TURN o D4 TO THE SIZE L5		CUTTER FACE	SLIDING CALLIPERS
008	TURN o D3 TO THE SIZE L1		CUTTER	
009	TURN o D2 TO THE SIZE L4		CUTTER	
010	SHARP BLUNT EDGES		FILE, SCRAPER	
	OPERATION 3 (GRINDING)	GRINDING MACHINE		
001	MOUNT AND REMOVE THE WORKPIECE	CENTRES,DRIVING DOG		MICROMETRE
002	GRIND o 5K6, o 5.5K6, o 6K6			SLIDING CALLIPERS
	AND THE END TO SIZE			
	27.5H12, o 11H9 TO THE SIZE 50 mm			
	OPERATION 4 (GEAR TOOTH MILLING) (SHEET 2, N4)			
001	MOUNT AND REMOVE THE WORKPIECE	GEAR TOOTH, MACHINE,CENTRE,	TOOTH MILL CUTTER M=0.5	
		CLIP		
002	MILL THE GEAR RING M=0.5, Z=10, D =20, H=1.125			
	OPERATION N5 (SHEET 2, N5)			
001	MOUNT AND REMOVE THE WORKPIECE	SHAUBLIN - 125		

			OPERATION N	
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
		COLLET TYPE		
002	CUT - OFF A FALSE (TECHNOLOGICAL) CENTRE		CUTTER	
003	FACE TO THE SIZE 12.5H11		TOOLHOLDER	SLIDING CALLIPERS
	OPERATION 5 (ELECTROPLATING) CHEMICAL OXIDE COATING			
	ATTENSION !			
1.	THE BLANK WILL MUST USE THERMAL			
	T=860°Cë50' J=2 min + 0.1 min COLD ON AIR			
2.	T=620°Cë10° J=3 min + 0.1 min COLD ON AIR			
	AFTER OPERATION TWO THERMAL:			
1.	T=450°ë10° J=3 min + 0.1 min COLD WITH FURNACE TO 150°Cë10°,			
	THAN COLD ON AIR			

SHEET 4	NUMBER OF SHEET 4

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	150.022		
		PROFILE	DIMENSIONS

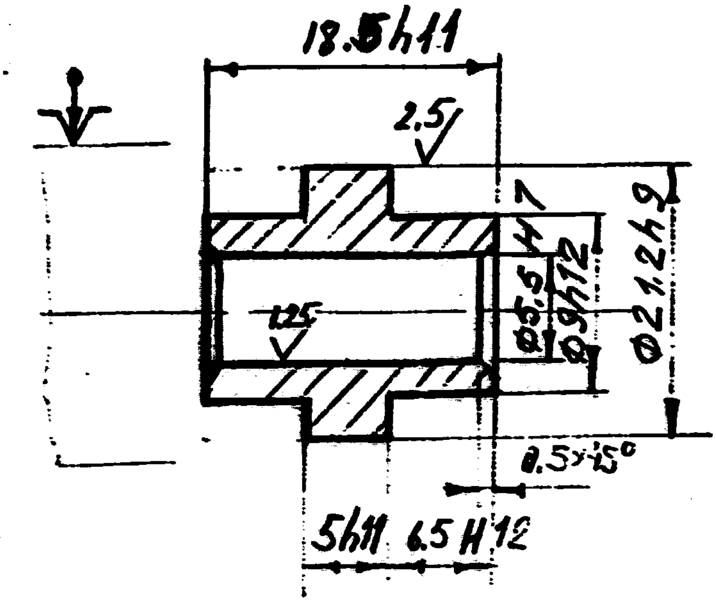
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT BLANK (SHEET 2 N1)	SHAUBLIN - 125 3-JAWS CHUCK		
002	TURN BUTT END		TOOLHOLDER	
003	TURN o 9H12 TO THE SIZE 6.5H12			SLIDING CALLIPERS
004	TURN o 21.2H9 TO THE SIZE 20H11		TOOLHOLDER	
005	CENTER DRILL		CENTER DRILL o 2 mm	
006	DRILL HOLE o 5.2H9 TO THE SIZE 22 mm			
007	TURN HOLE o 5.4H9 TO THE SIZE 22 mm		CUTTER	DEPTHMETER

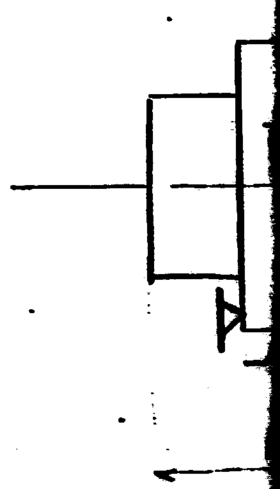
SHEET 1	NUMBER OF SHEET 4

I

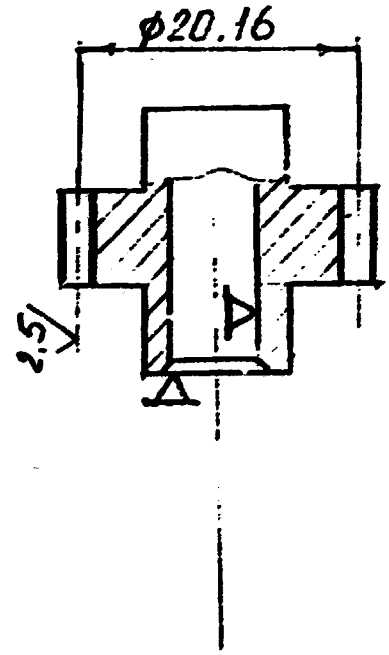
Rz20 (√)

II





III

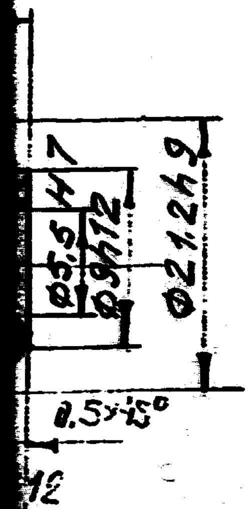


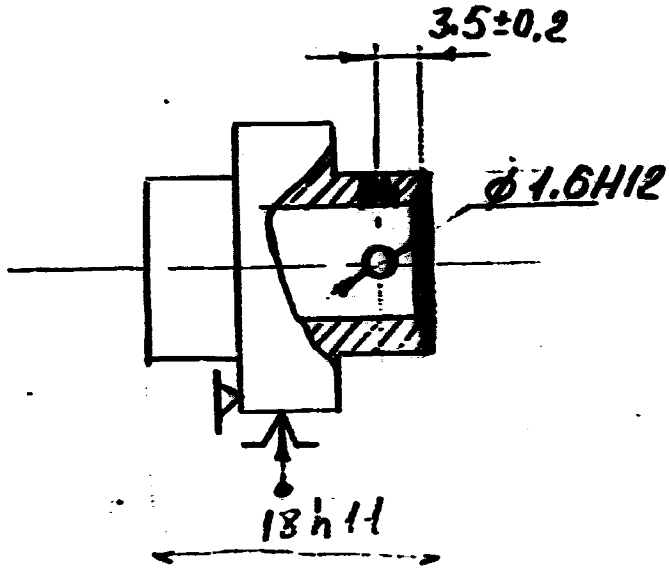
SECTION 1

$Rz\,20\sqrt{}\,(\sqrt{})$

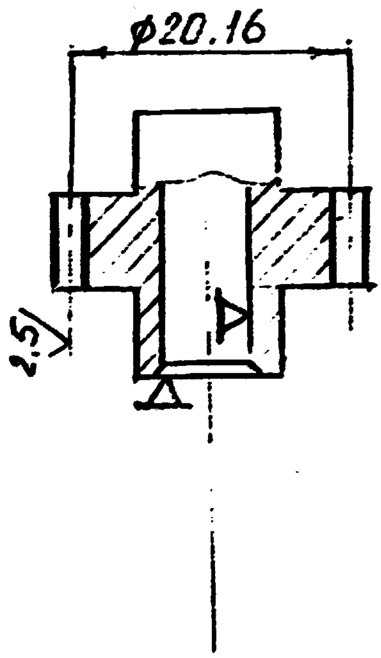
II

$Rz\,20\sqrt{}\,(\sqrt{})$





III



SECTION 2

			OPERATION N 2	
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
008	UNRGLE o 5.5H7		REAMER o 5.5H7	
009	TURN SHAFER 0.5*45°			
010	TURN o 9H12 TO SIZE 5H11, 20 mm		CUTTER	SLIDING CALLIPERS
011	CUT OFF WORKPIECE TO SIZE 18.5H11			
	OPERATION 2 (SEE SHEET 2 N1)			
001	MOUNT THE BLANK	COLLET TYPE		
002	TURN BUTT END TO SIZE 18H11			
003	TURN CHAMFER 0.5 * 45°			
004	SHARP BLUNT EDGES			
	OPERATION 3 (DRILLING)			
001	MOUNT BLANK	MILLING MACHINE DIVIDING ATTACHMENT		
002	CENTER DRILL BY MARKING OUT	CENTER DRILL		
003	DRILL HOLE o 1.7H9	DRILL o 1.7mm		
004	COUNTERSINK CHAMFER o 2.1 * 120°	COUNTERSINK 120°		
005	TURN SCREW M2 - 6H	TAP M2 - 6H		
006	RETURN DIVIDING ATTACHMENT			
007	CENTER DRILL	CENTER DRILL		
008	DRILL HOLE o 1.6H12	DRILL o 1.6 mm		

SHEET 3	NUMBER OF SHEET 4

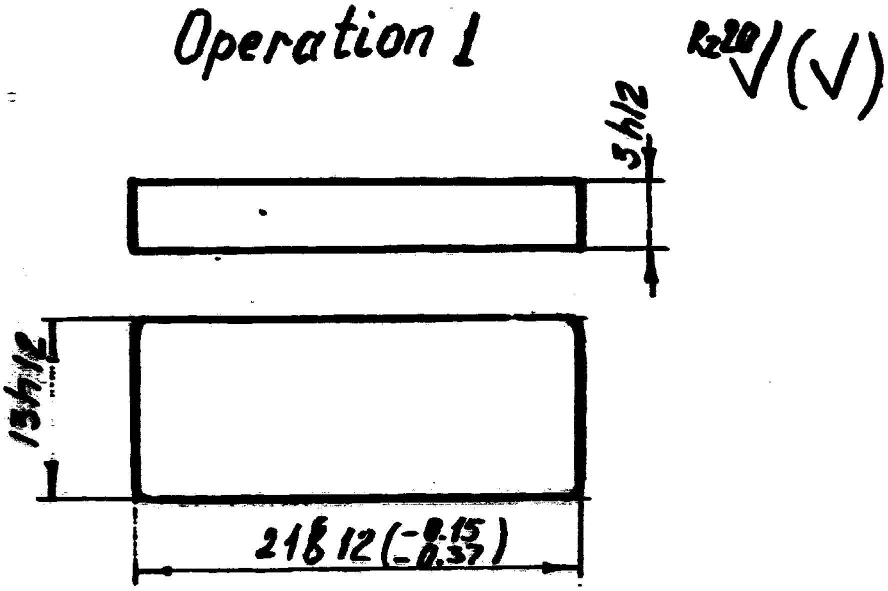
			OPERATION N 2	
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 4 (GEAR TOOTH MILLING)	MILLING MACHINE		
001	MOUNT AND REMOVE WORKPIECE		TOOTH MILL CUTTER M = 0.5	
002	MILL THE GEAR RING M = 0.5 , Z = 40 J = 7°10' (B-F), RIGHT, B = 20.16			

SHEET 4	NUMBER OF SHEET 4

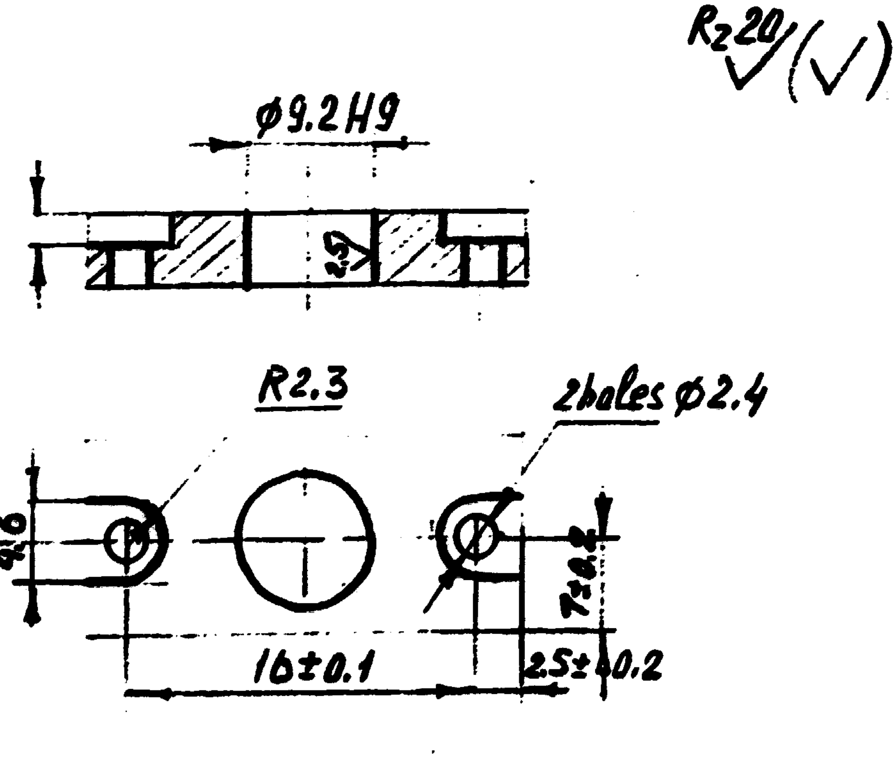
		OPERATION N 1	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	150.000		
		PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE WORKPIECE	VICE, MILLING MACHINE		
002	CONTOUR MILL MAINTAINING SIZES SPECIFIED (13h12*12*21b12*12) (13h12*12*21b12*3h12)		MILL ø 10 mm	SLIDING CALLIPERS
003	CENTRE A HOLE		CENTRE DRILL	
004	DRILL A HOLE FOR BORING TO BODY SIZE		DRILL ø 8.5 mm	
005	BORE THE HOLE ø 9.2H9 TO BODY SIZE		BORING ARBOR	
006	CENTRE 2 HOLES TO THE MARKING OUT		CENTRE DRILL	
007	DRILL 2 HOLES ø 2.4 TO BODY SIZE		DRILL ø 2.4 mm	
008	MILL 2 GROOVES 4.6H14 TO THE DEPTH OF 1.6 mm		MILL ø 4.6 mm	
	OPERATION 2			
001	COATING: ANODIC OXIDE BLACK			
			SHEET 1	NUMBER OF SHEET 2

Operation 1



Operation 2



SECTION 1

150.023

$^{Rz20}\surd(\surd)$

$^{Rz20}\surd(\surd)$

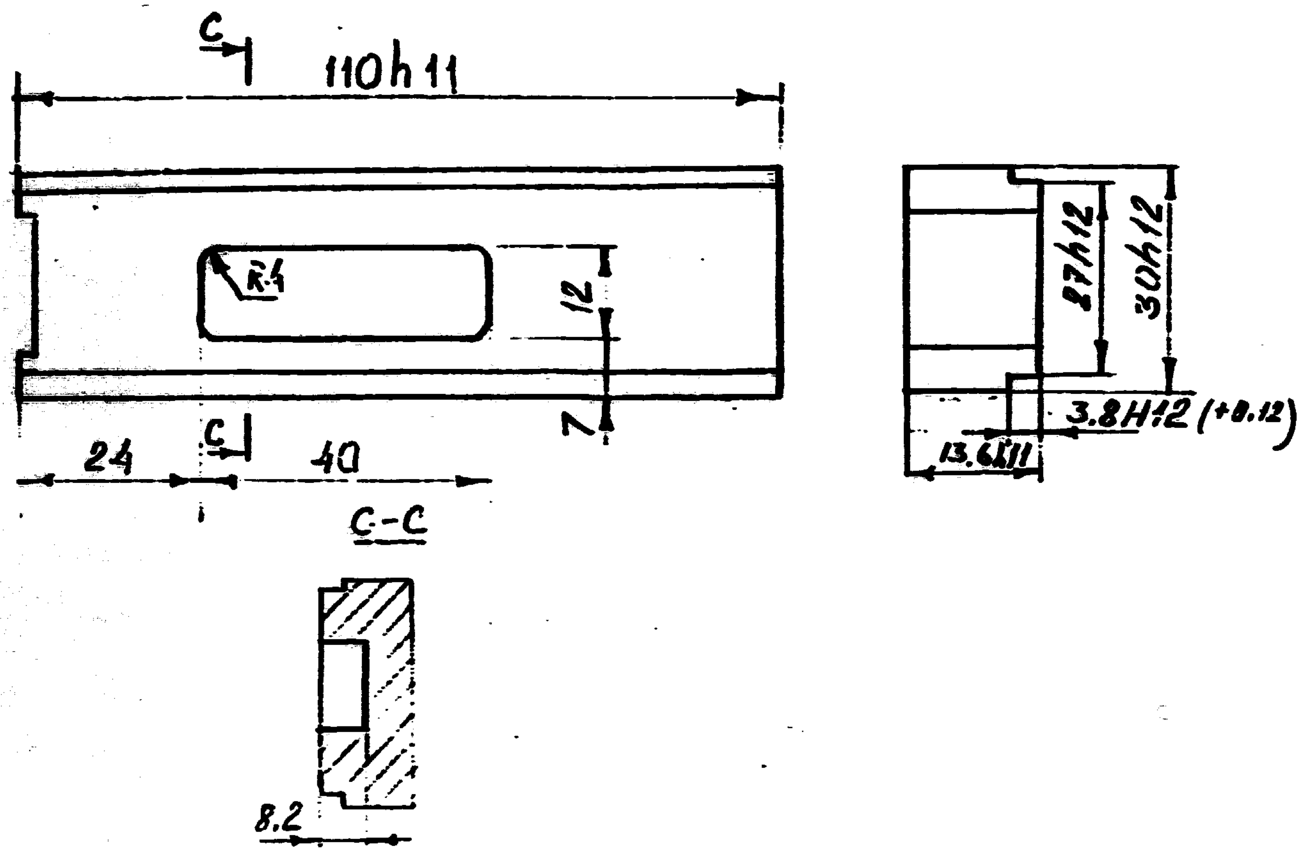
les ø2.4

.2

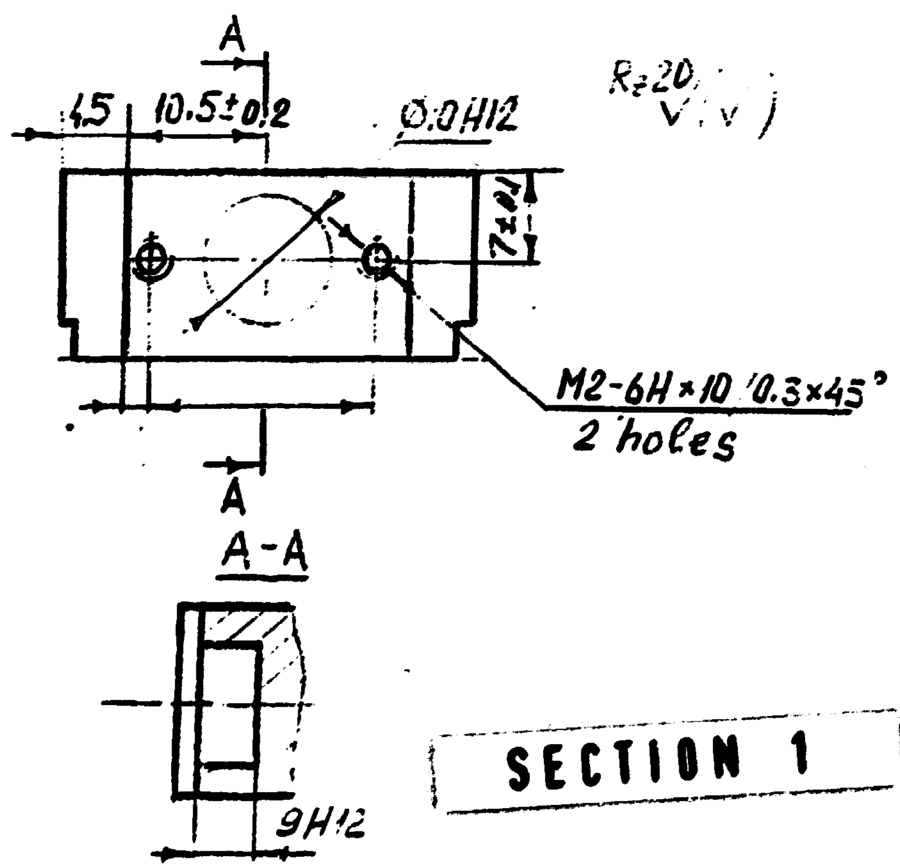
SECTION 2

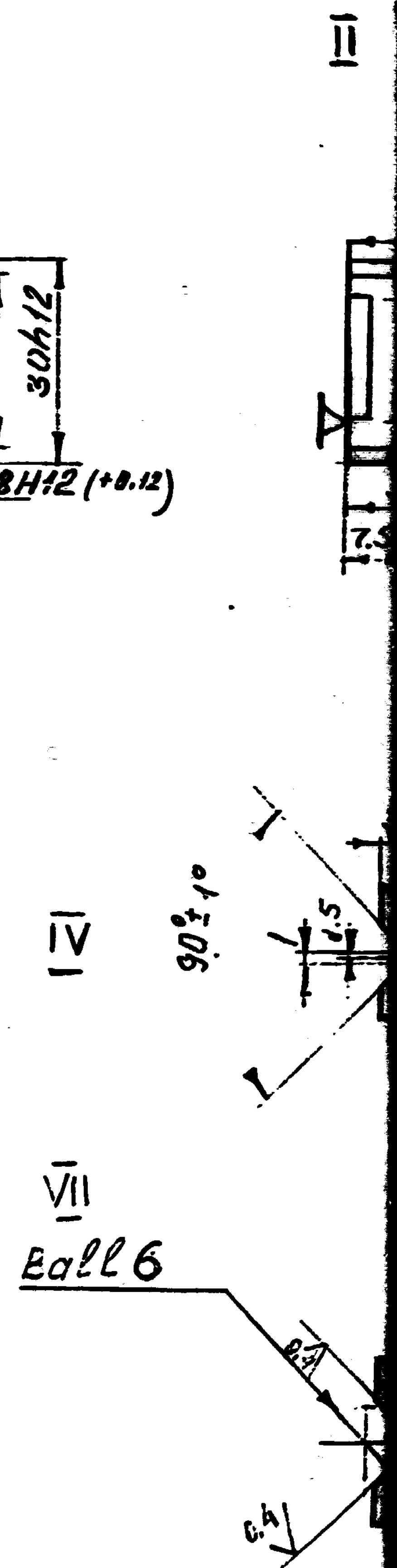
			OPERATION N 1	
	OPERATION DRAFT	NUMBER OF PIECES	BLANK	
		150.024		
			PROFILE	DIMENSIONS
				115 x 33 x 15
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE BLANK	MILLING MACHINE, VICE		
002	CONTOUR MILL MAINTAINING SIZES SPECIFIED		MILL	SLIDING CALLIPERS
003	DRILL HOLES c 6 mm FOR GROOVE MILLING TO THE DEPTH OF 4 mm		CENTRE DRILL	
004	MILL GROOVE 12 MAINTAINING		DRILL c 8.5 mm	
	THE SIZES 24 mm, 40 mm			
	PUSH 2			
005	DRILL 6 HOLES FOR THE THREAD		DRILL c 3.5 mm	
	M4 THE DEPTH OF 10 mm			
006	DRILL 2 HOLES FOR THE REAMER		DRILL 1.9 mm	
	c 2E7 TO THE BODY SIZE			
			SHEET 1	NUMBER OF SHEET 6

I Milling



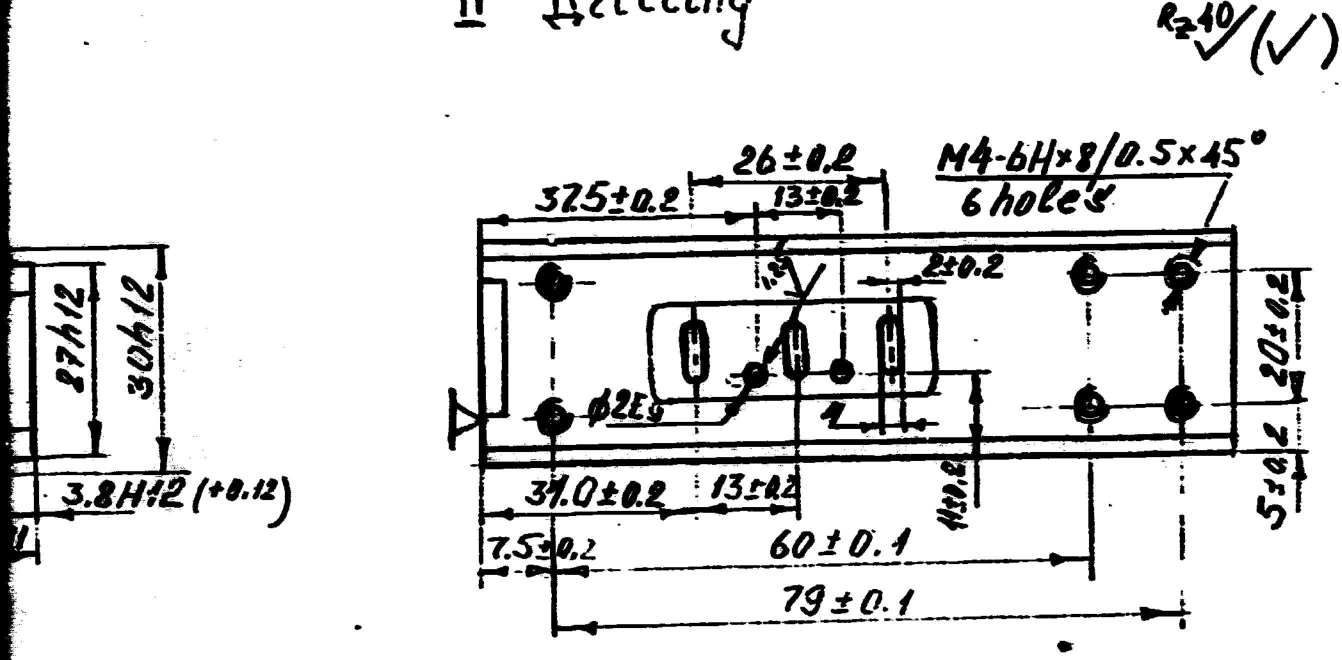
III



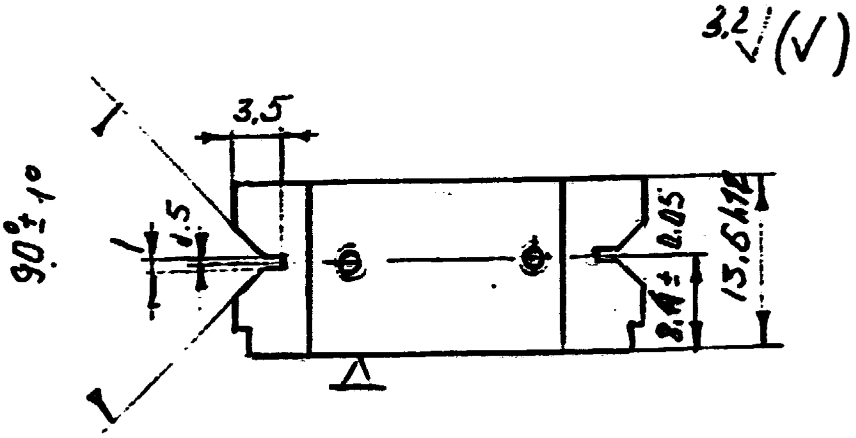


SECTION 1

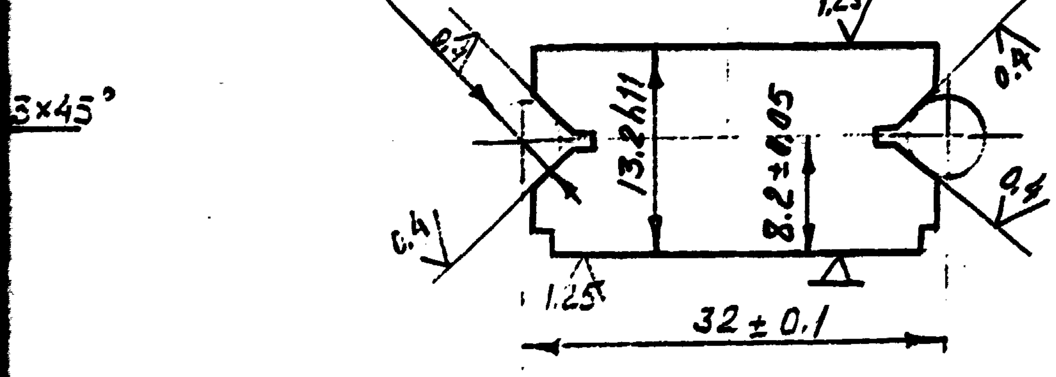
II Drilling



IV



VII



SECTION 2

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
007	DRILL 2 HOLES ø4 TO HAVE 3 GROOVES 4 mm TO BODY SIZE		DRILL ø 4 mm	
008	COUNTER-BORE 6 HOLES FOR THE THREAD 0.5 x 45°, 2 HOLES FOR THE REAMER ø2E9			
009	CUT THE THREAD M4-6H TO THE DEPTH OF 3 mm		TAP M4	
010	REAM 2 HOLES ø2E9 TO BODY SIZE			
011	MILL 3 GROOVES TO BODY SIZE ON 6 mm LONG		MILL ø 4 mm	
012	RESET THE WORKPIECE			
013	CENTRE 2 HOLES ø 3 TO MACHINE			
014	DRILL 2 HOLES ø 3 TO BODY SIZE		DRILL ø 3 mm	
	PLAN 2			
015	MOUNT AND REMOVE THE WORKPIECE			

SHEET 3	NUMBER OF SHEET 6

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
016	CENTRE 2 HOLES TO MARKING-OUT		CENTRE DRILL	
017	DRILL 2 HOLES FOR THE THREAD		DRILL ⌀ 1.7 mm	
	M2 THE DEPTH OF 10 mm; HOLE		DRILL ⌀ 6 mm	
	⌀ 8 mm FOR BORING TO THE DEPTH OF 6 mm			
018	COUNTER-BORE 2 HOLES FOR THE THREAD 0.3 x 45°		COUNTER DRILL	
019	CUT THE THREAD OF 2 HOLES M2-6H		TAP M2	
	TO THE DEPTH OF 8 mm			
020	BORE A HOLE ⌀ 10H12 WITH BOTTOM		COUNTER-BORE	
	CUTTING TO THE DEPTH OF 9H12(+0.15)			
	4. THERMAL TREATMENT			
	T = 200 ± 230°C, EXPOSE			
	FOR 1 HOUR, AIR COLLING			
	5. GRINDING			
001	MOUNT AND REMOVE THE WORKPIECE			

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
002	GRIND WITH RESETTING TO THE	GRINDING MACHINE		
	SIZE OF 13.2h11			
	6. BENCH - WORKING			
	STRAIGHTENING			
	7. THERMAL TREATMENT			
	T = 200±230°C, EXPOSE FOR 1 HOUR, AIR COOLING			
	8. MILLING OPERATION			
001	MOUNT AND REMOVE THE WORKPIECE			
002	MILL 2 GROOVES PRELIMINARY			
	AND FINALLY			
	9. BENCH-WORKING			
	STRAIGHTENING			
	10.THERMAL TREATMENT			

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	T=230°-220°C,EXPOSE FOR 1 HOUR,AIR COOLING			
	11.GRIDING			
001	PREGRIN 2 GROOVES			
	12.THERMAL TREATMENT			
	HARDENING HRC55-60			
001	HEATING UP TO 820-860°C (840±20°C),EXPOSE FOR 20min	FURNACE		
002	COOLING DOWN IN OIL TO 25±10°C	TANK FOR OIR		
003	HEATING UP TO 150-170°C,EXPOSE FOR 0.5HOUR,AIR COOLING			
	13.GRINDING			
001	FINISH GRIND 2 GROOVERS	GRINDING MACHINE		

SHEET 6	NUMBER OF SHEET 6

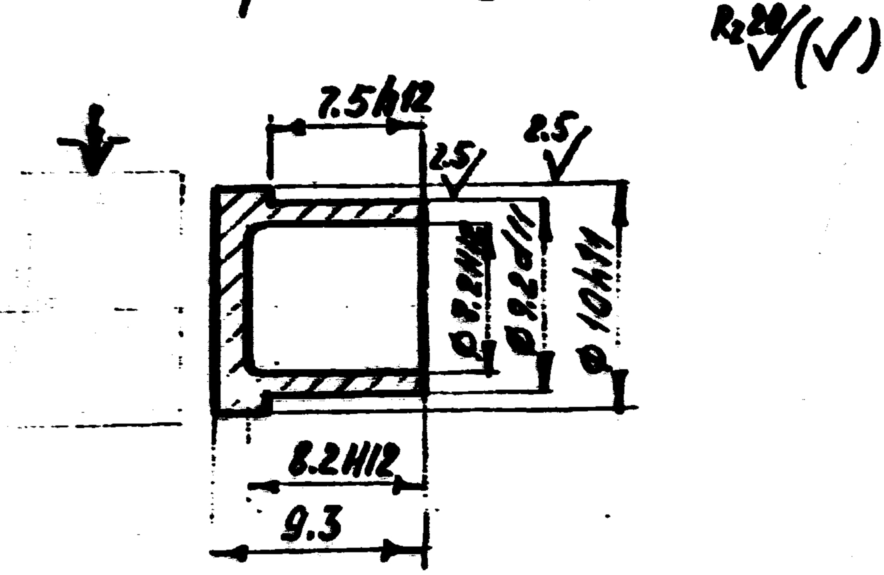
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
007	BORE THE HOLE ⌀68.2H12 WITH		CUTTING BORE	SLIDING CALLIPERS
	BOTTOM CUTTING TO THE DEPTH OF 5H12			
008	PART OFF THE WORKPIECE SIZE 9.3 MM			
	OPERATION 2			
001	MOUNT AND REMOVE THE WORKPIECE			
002	FACE THE WORKPIECE TO THE SIZE 9H12		TOOLHOLDER	SLIDING CALLIPERS
003	TURN THE CHAMFER 0.5 x 45°		CHAMFERTOOL	
	OPERATION 3			
	COATING ANODIC OXIDATION			
	BLACK			

SHEET 3	NUMBER OF SHEET 3

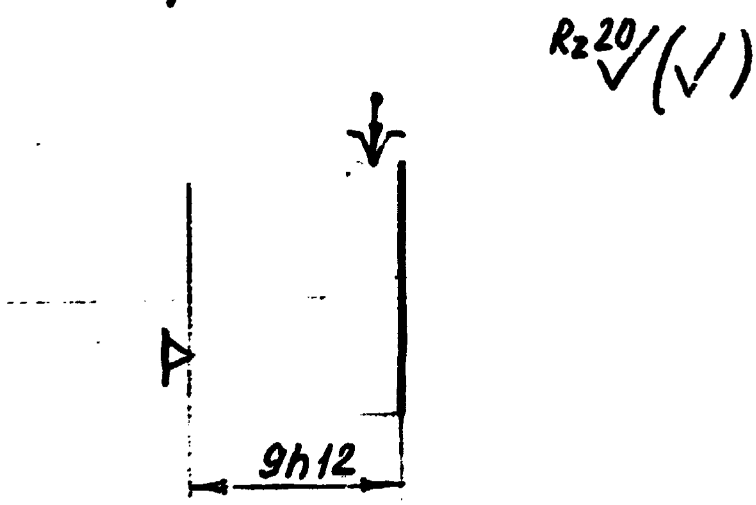
		OPERATION N 1	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	150.025	PROFILE	DIMENSIONS
		ROUND BAR BRASS	ø 12 x 50

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 125 3-JAWS CONCENTRIC CHUCK		
002	FACE THE BLANK		TOOLHOLDER	
003	TURN ø 10h11 TO THE LENGTH OF			SLIDING CALLIPERS
	12 mm			
004	TURN ø 9.2h11 TO THE LENGTH OF 7.5h12			SLIDING CALLIPERS
005	CENTRE		CENTRE DRILL	
006	DRILL A HOLE ø 6 TO THE DEPTH OF 6 mm		DRILL ø 6 mm	
			SHEET 1	NUMBER OF SHEET 3

Operation 1



Operation 2



SECTION 1

150.025

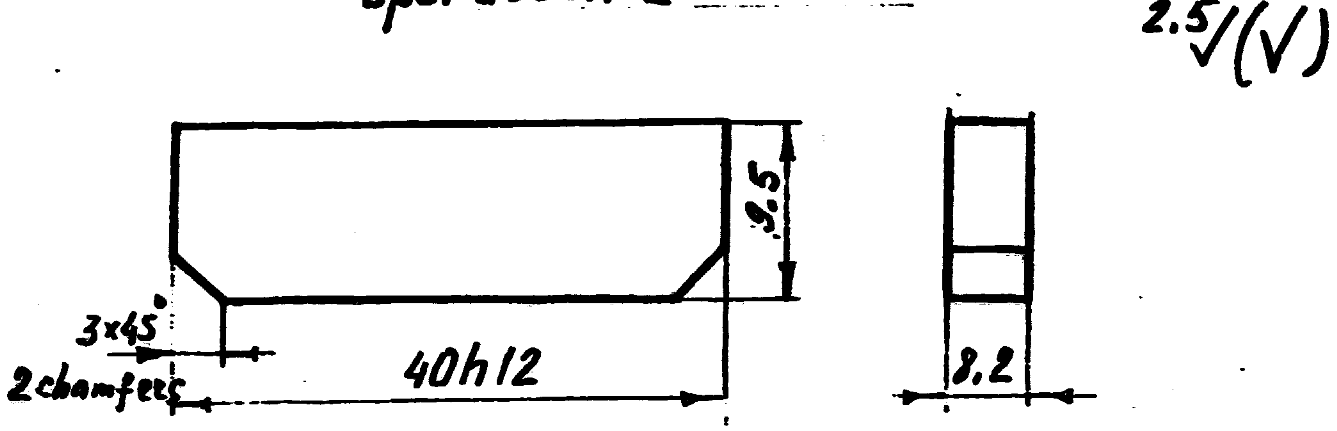
(√)

SECTION 2

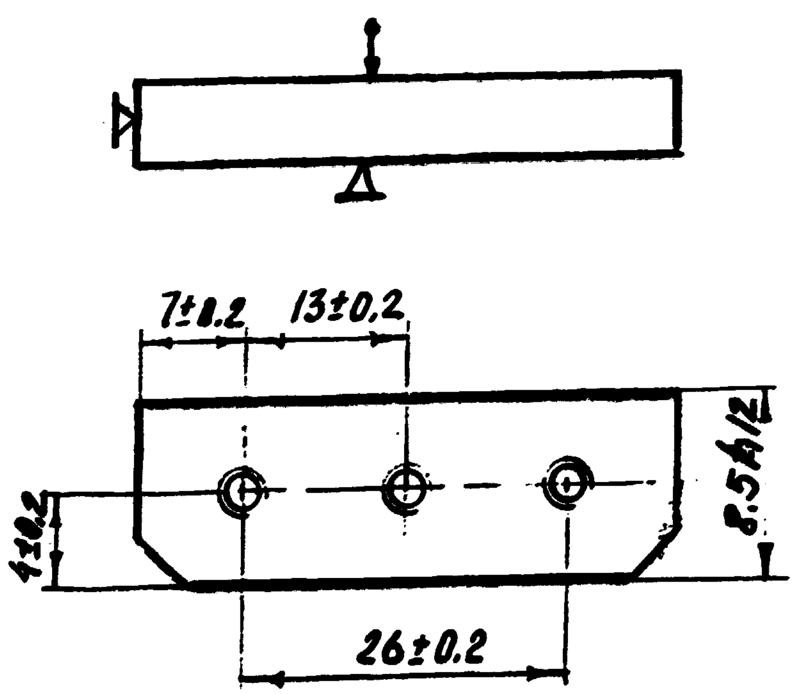
		OPERATION N 1	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	150026		
		PROFILE	DIMENSIONS
			115 * 33 * 15

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE BLANK	MILLING MACHINE, VICE		
002	CONTOUR MILL WITH RESETTING		MILL	SLIDING
	MAINTIANING THE SIZES SPECIFIED			CALLIPERS
	SURFACES A(BASE) AND B, ARE			
	PREMACHINED WITH A 1.0 mm ALLOWANCE FOR FINISHING			
	ALLOWANCE FOR FINISHING			
	OPERATION 2			
001	MOUNT AND REMOVE THE BLANK	MILLING MACHINE		
002	MILL THE SURFACES A AND B TO		END MILL	
	THE SIZE 8.5h12 IN ONE MOUNT USING			
			SHEET 1	NUMBER OF SHEET 3

Operation 1



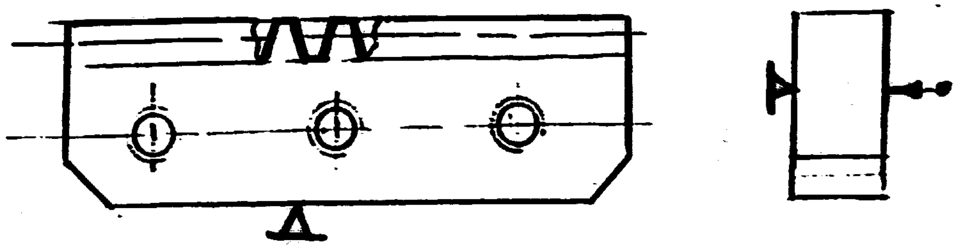
Operation 2



SECTION 1

Operation 3

$^{2.5}\!\sqrt{}(\sqrt{})$ $^{2.5}\!\sqrt{}(\sqrt{})$



$m = 0.5$ $z = 25$ $h = 1.125$ $P_n = 1.57$

8-F

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
003	CENTRE 3 HOLES TO THE MARKING OUT		CENTRE DRILL	
004	DRILL 3 HOLES FOR THE THREAD		DRILL ⌀ 2.5 mm	
	M3 TO BODY SIZE			
005	COUNTERSINK 3 HOLES ⌀ 3.15 max (120°- 10°)		COUNTERSINK	
006	CUT THE THREAD M3-6H IN 3 HOLES		TAP M3	
	TO BODY SIZE			
	OPERATION 3			
001	MOUNT AND REMOVE THE WORKPIECE			
002	MILL THE GEAR PROFILE m=0.5, z=25 h =1.125 ACCURACY 8F			
	OPERATION 4			
	COATING : CHEMICAL OXIDATION			

SHEET 3	NUMBER OF SHEET 3

OPERATION DRAFT	NUMBER OF PIECES	OPERATION BLANK	
	150.009 150.013 150.027 230.025 30.014 30.014-01 30.036 24.013	PROFILE	DIMENSIONS
		WIRE øD	øD×L

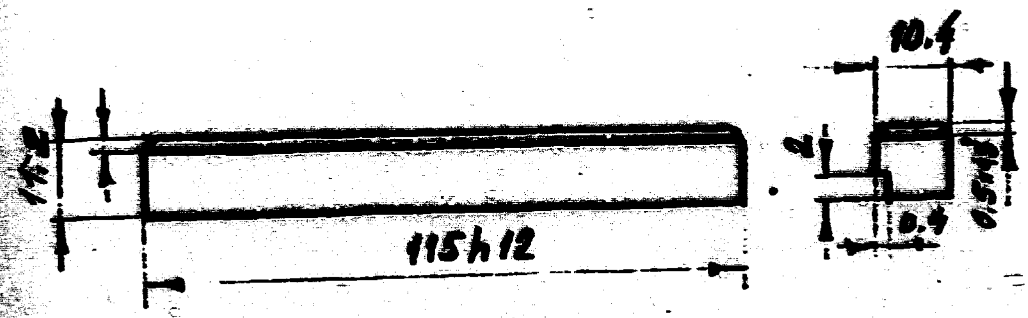
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	COIL SPRING IN L+3T mm LONG, WITH STEP T mm	SHAUBLIN - 125	ARBORS ø(B-D)	SLIDING CALLIPERS
002	CUT SPRINS L=L+T		WIRE CUTTER	
003	TEMPERING			
	t=220±20°C EXPOSE 60 min			
004	PRESS THE EXTREME COILS AS DRAWING (N1 OR N2)			
005	FILE ENDS OF SPRING		FILE	

SHEET 1	NUMBER OF SHEET 2

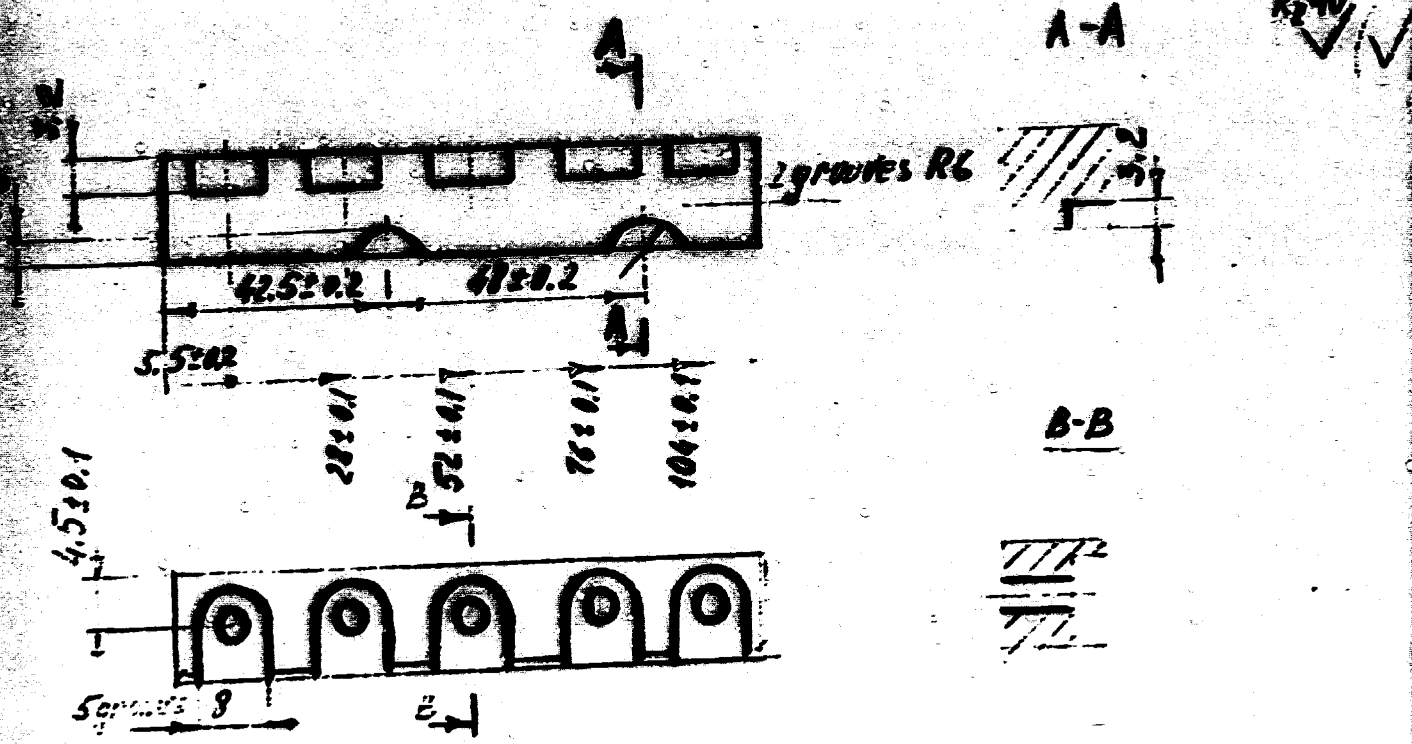
			OPERATION	
	OPERATION DRAFT	NUMBER OF PIECES	BLANK	
		150.028 150.025		
			PROFILE	DIMENSIONS
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	THERMAL TREATMENT HEATING UP TO 450°C±10°C EXPOSE	FURNACE		
	FOR 5±1 min			
002	FURNACE COOLING DOWN TO 150°C			
	OPERATION 1.			
001	MOUNT AND REMOTE THE WORKPIECE AS DRAWING (N1 OR N2)	MILLING MACHINE VICE		
002	MILL WITH RESETTING MAINTAINING		MILL	
	THE SIZES SPECIFIED			
003	MILL 5 GROOVES 8.0 mm		FINGER CUTTER ⌀ 8 mm	SLIDING CALLIPERS
002	MILL THE SURFACES A AND B TO			
	THE SIZE 8.5 12 IN ONE MOUNT USING			
			SHEET 1	NUMBER OF SHEET 5

6d?

Operation N1

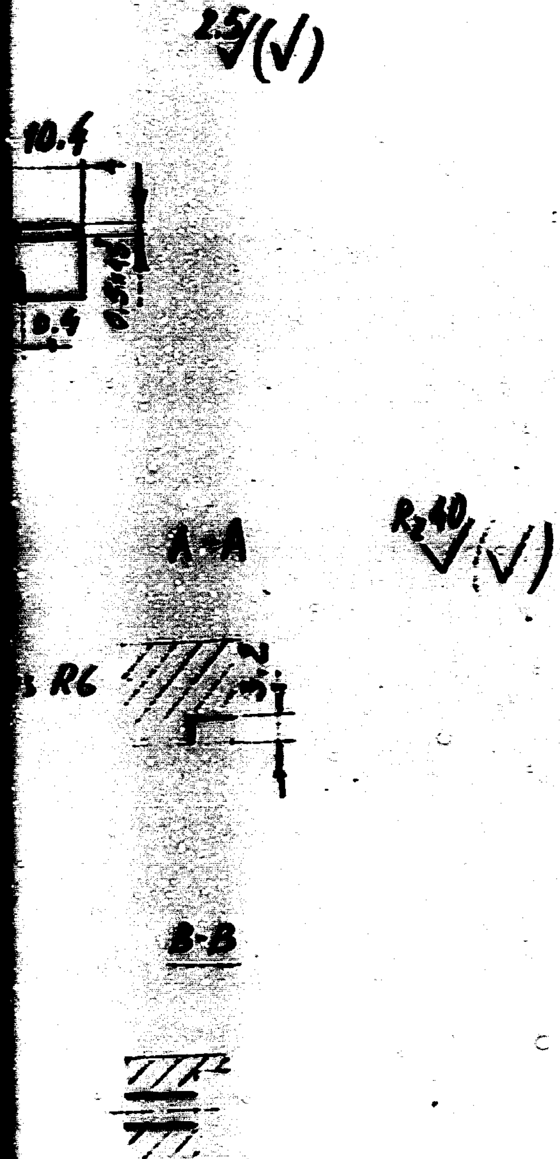


Operation N2

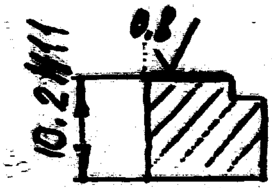


SECTION 1

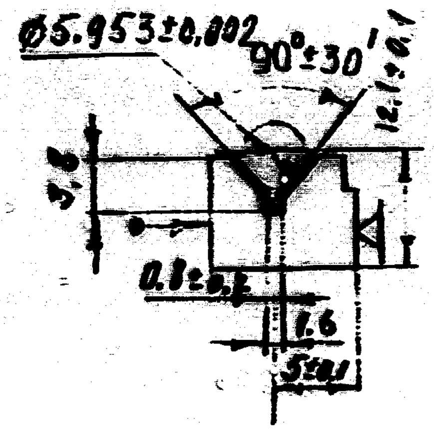
150028
150029



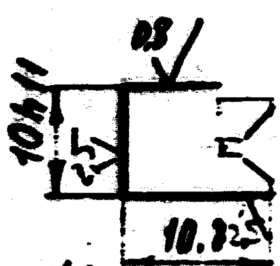
Operation N4



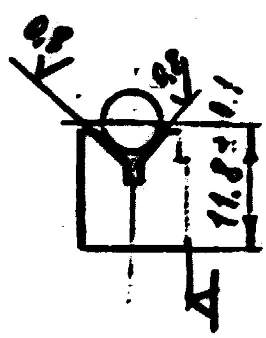
Operation N5



Operation 7



Operation 8



SECTION 2

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
004	MILL 2 GROOVES ø 12 MAINTAINING THE SIZE		FINGER CUTTER ø 12 mm	SLIDING CALLIPERS
005	DRILL 5 HOLES ø 4.5 MAINTAINING THE SIZE SPECIFIED		DRILL ø 4.5 mm	
	OPERATION 2			
	THERMAL TREATMENT	FURNACE		
	AS WORK STEP N 001			
	OPERATION 3			
	BENCH-WORKING (PRIOR TO			
	AND AFTER THERMAL TREATMENT			
	STRAIGHTANING)			
	OPERATION 5			
001	MOUNT AND REMOVE THE WORKPIECE	GRINDING MACHINE		
002	GRIND SURFACE F TO THE SIZE			
	10.2A11			

№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 6			
001	MOUNT AND REMOVE THE WORKPIECE	MILLING MACHINE		
002	MILL THE GROOVE WITH AN		DISK FORMING	
	ALLOWANCE FOR GRINDING		CUTTER	
	OPERATION 7			
	THERMAL TREATMENT AS WORK	FURNACE		
	STEP № 001.			
	OPERATION 8			
	THERMAL TREATMENT			
	HARDENING HRC 55-60			
001	HEAT TO 340±20°C EXPOSE FOR 20 min ± 1 min			
002	COOLING DOWN IN OIL TO 25±10°C			
003	HEATING UP TO 150÷170°C, EXPOSE FOR 0.5 HOUR, AIR COOLING			
			SHEET 4	NUMBER OF SHEET 5

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 9			
001	MOUNT AND REMOVE THE WORKPIECES			
002	PREGRIND THE GROOVE OF WORKPIECE			
	150028, 150029 IN PAIRS			
	OPERATION 10			
	BRENCH-WORKING			
001	MARKING-OUT IN PAIRS			
	OPERATION 11			
	CHEMICAL OXIDATION			
	OPERATION 12			
001	MOUNT AND REMOVE THE WORKPIECE			
	150028 AND 150029.			
002	FINISH GRIND THE GROOVE OF THE WORKPIECES.			

SHEET 5	NUMBER OF SHEET 5

			OPERATION N 1	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
		150.031		
			PROFILE	DIMENSIONS
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE THE WORKPIECE (WITH RESETTING)	MILLING MACHINE		
002	CONTOUR MILL WITH RESETTING MANUFACTORING THE SIZES :		MILL	
	160H11 * 65H12 * 60H12, MILL			
	CHAMFERS 2 * 45° INSTEAD OF R2			
003	DULL SHARP EDGES		FILL	
004	SCRAPE BASE SURFACES C AND 6 (0.003) AFTER CHECKING IF NECESSARY		SCRAPER	
005	MILL AS FOLLOWS :			
			SHEET 1	NUMBER OF SHEET 9

			OPERATION N 2	
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	GROOVE 28 mm TO BODY SIZE 7 mm IN DEPTH ;			
	2 SHOULDERS TO THE SIZE 56H12 7.5H12 IN DEPTH ;			
	RECESS 38H12 MAINTAINING R10, SIZES 10 AND 140 MM 9H12 IN DEPTH.			
	MAKE A 26 mm WIDE SHOUDER 2 MAINTAINING THE SIZE 7 mm ;			
	15 mm GROOVE TO BODY SIZE, MAINTAINING THE SIZE 9H12 ;			
	2 GROOVES 32 mm TO BODY SIZE MAINTAINING THE SIZE 7 mm			
006	MILL SHARP EDGES		FILL, SCRAPER	
007	MILL THREE SAMPLES 52 mm			
	IN WIDTH HAVING THE FOLLOWING			
	SIZES :			
	89 mm (BULKHEAD 4 MM) ;			
	TO THE SIZE 17.5H11 (MILL CHAMFERS 4 * 45° INSTEAD OF R6)			
			SHEET 2	NUMBER OF SHEET 9

			OPERATION N 2	
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	25 mm (BULKHEAD 4 mm, 22 mm IN			
	HEIGHT ;			
	16 mm MAINTAINING SIZES 13H11 ,			
	H5 ;			
	CONTOUR SAMPLE 154 * 54H12 IN			
	SIZE, 2.5 mm IN DEPTH .			
008	DRILL 2 HOLES TO MARKING - OUT			
	FOR THE THREAD M2.5-6H AS DEEP			
	AS 8 mm			
009	COUNTERSINK 2 HOLES 0.3 * 45°			
010	THREAD 2 HOLES M2.5-6H*6			
011	DRILL 4 HOLES TO THE MARKING-OUT			
	FOR THE THREAD M3-6H TO BODY SIZE			
012	COUNTERSINK 4 HOLES 0.5 * 45°			

			OPERATION N 2	
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
013	THREAD 4 HOLES M3-6H TO BODY			
	SIZE			
014	DULL SHARP EDGES			
015	SCRAPE (0.003) FITTING SURFACES			
	OF PLATES AFTER CHECKING, IF			
	NECCESARY .			
	OPERATION TWO (BORING)			
001	MOUNT THE WORKPIECE ON THE			
	BASE SURFACE C (MACHINING			
	TURN THE WORKPIECE AROUND			
	THE VERTICAL AXIS)			
002	DRILL 4 HOLES TO THE MARKING-OUT FOR THE THREAD M2.5-6H			
	TO BODY SIZE			
003	COUNTERSINK 3 HOLES 0.3 x 45°			

SHEET 4	NUMBER OF SHEET 9

			OPERATION № 2	
№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
004	THREAD 4 HOLES M3-6H TO BODY		TAP M3	
	SIZE .			
005	DRILL 10 HOLES TO BODY SIZE			
	TO THE MARKING-OUT FOR THE			
	THREAD M4-6H			
006	COUNTERSINK 10 HOLES 0.5 x 45°			
007	THREAD 10 HOLES M4-6H TO BODY			
	SIZE			
008	DRILL HOLES TO THE MARKING-OUT			
	FOR BORING ø 22 TO BODY SIZE .			
009	BORE THE HOLE ø 22 TO BODY SIZE			
010	TURN THE WORKPIECE BY 90 DEGREE.			
			SHEET 5	NUMBER OF SHEET 9

			OPERATION N 2	
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
011	MILL 2 GROOVES 12 mm TO THE DEPTH 3.5H12			
012	CENTRE 2 HOLES FOR THE THREAD M3-6H TO BODY SIZE			
013	DRILL 2 HOLES FOR THE THREAD M3-6H TO BODY SIZE			
014	COUNTERSINK 2 HOLES 0,5 * 45			
015	THREAD 2 HOLES M3-6H TO BODY SIZE			
016	CENTRE HOLES WITH COORDINATES			
	X = 28 + 0.1 Y = 42 + 0.1			
017	DRILL AND COUNTERSINK HOLE			
	o 30 TO BODY SIZE			
018	BORE THE HOLE o 33.2 TO BODY SIZE			
019	BORE A SEGMENT GROOVE R17			
	FOR THE SIZE 52 mm			
020	TURN AN END GROOVE D=o45 AND			
	o 53 TO THE DEPTH OF 0.5 mm			
			SHEET 6	NUMBER OF SHEET 9

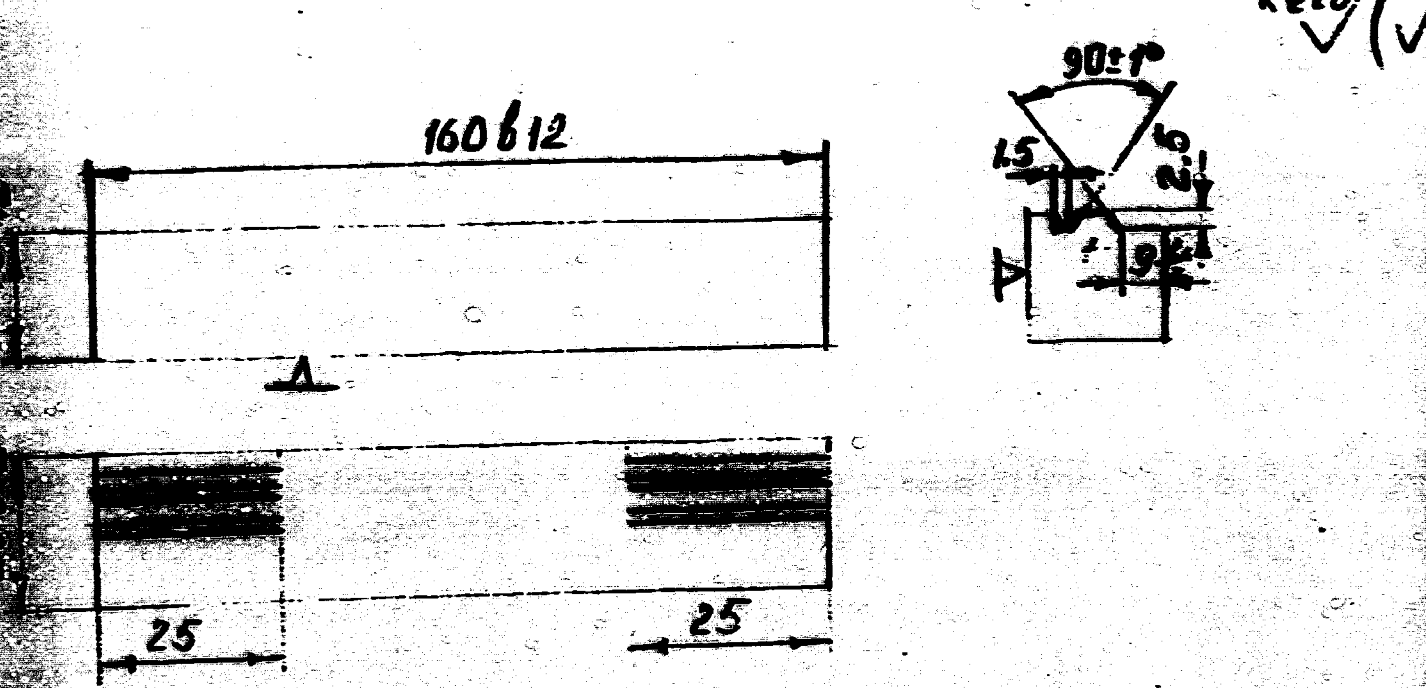
				OPERATION N 2	
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS	
021	CENTRE 3 HOLES FOR THE THREAD				
	M3-6H TO ø 40 + 0.1				
022	DRILL 3 HOLES FOR THE THREAD M3-6H TO BODY SIZE				
023	COUNTERSINK 3 HOLES 0.3 x 45°				
024	TURN THE WORKPIECE BY 180°				
	REPEAT STEPS 11 - 24 OF				
	OPERATION 2, EXCEPT FOR 19				
025	DULL SHARP EDGES				
	OPERATION 3 (BORING)				
001	MOUNT THE WORKPIECE ON THE				
	SURFACE N				
002	MILL GROOVE 28 MAINTAINING		END MILLING CUTTER		
	THE SIZE 10 mm AND R5 FOR THE DEPTH 3H11				
			SHEET 7	NUMBER OF SHEET 9	

			OPERATION № 2	
№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
003	CENTRE 4 HOLES FOR THE THREAD			
	M5-6H			
004	DRILL 4 HOLES FOR THE THREAD M5-6H			
005	COUNTERSINK 4 HOLES 0.5 x 45°			
006	THREAD 4 HOLES M5-6H TO BODY			
	SIZE			
007	CENTRE A HOLE ø 25			
008	DRILL AND COUNTERSINK A HOLE			
	ø 22 TO BODY SIZE			
009	BORE A HOLE ø 25 TO BODY SIZE			
010	TURN THE WORKPIECE BY 180°DEGREE			
011	MILL GROOVE 18 mm FOR THE			
	DEPTH 3H11, MAINTAINING			
			SHEET 8	NUMBER OF SHEET 9

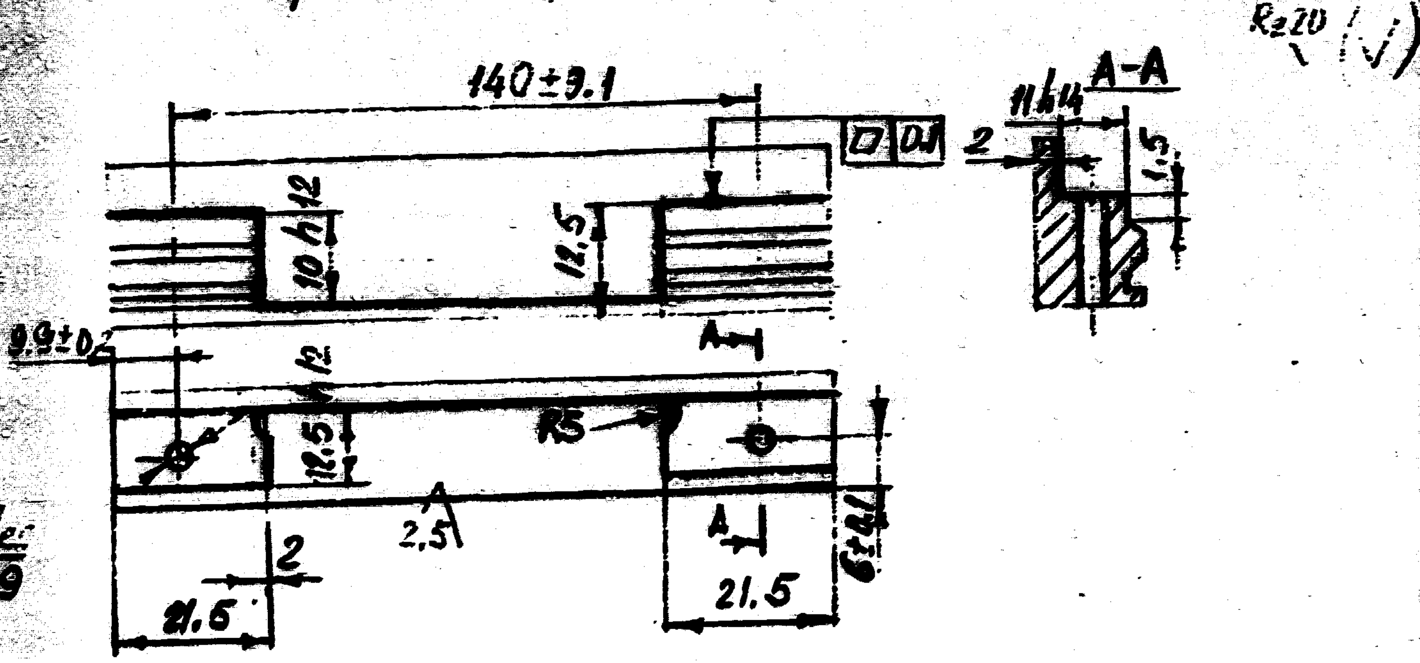
			OPERATION № 2	
№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	THE SIZE 10 MM AND R5		END MILLING CUTTER	
012	CENTRE 4 HOLES FOR THE THREAD			
	M5-6H			
013	DRILL 4 HOLES FOR THE THREAD			
	M5-6H TO BODY SIZE			
014	COUNTERSINK 4 HOLES 0.5 * 45°			
015	THREAD 4 HOLES M5-6H TO BODY			
	SIZE			
016	DULL SHARP EDGES			
	4 CHECING			
	5 ELECTROPLATING			
	COATING: ANODIC OXID.BLACK			
	6 PAINTING			
	SURFACES E,P - ENAMEL SHAGREEN LISHG - BLACK			

SHEET 9	NUMBER OF SHEET 9

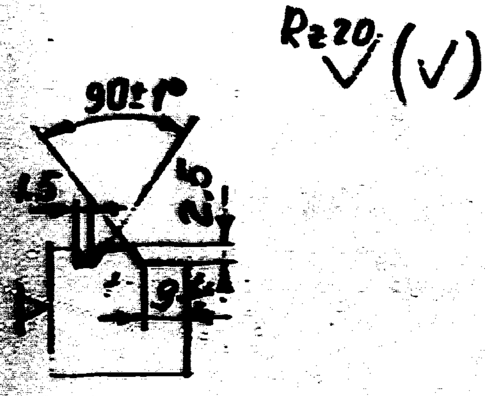
Operation 1



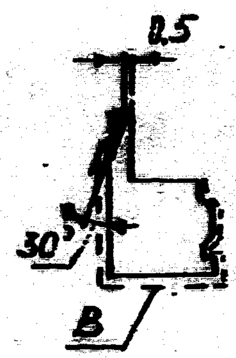
Operation 2

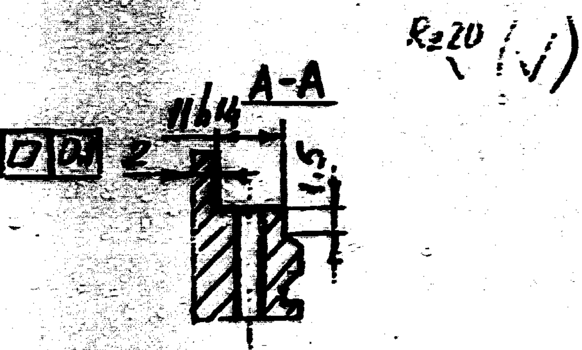


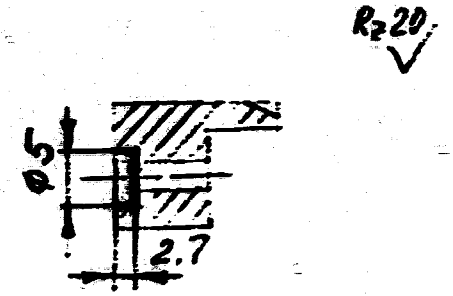
SECTION 1



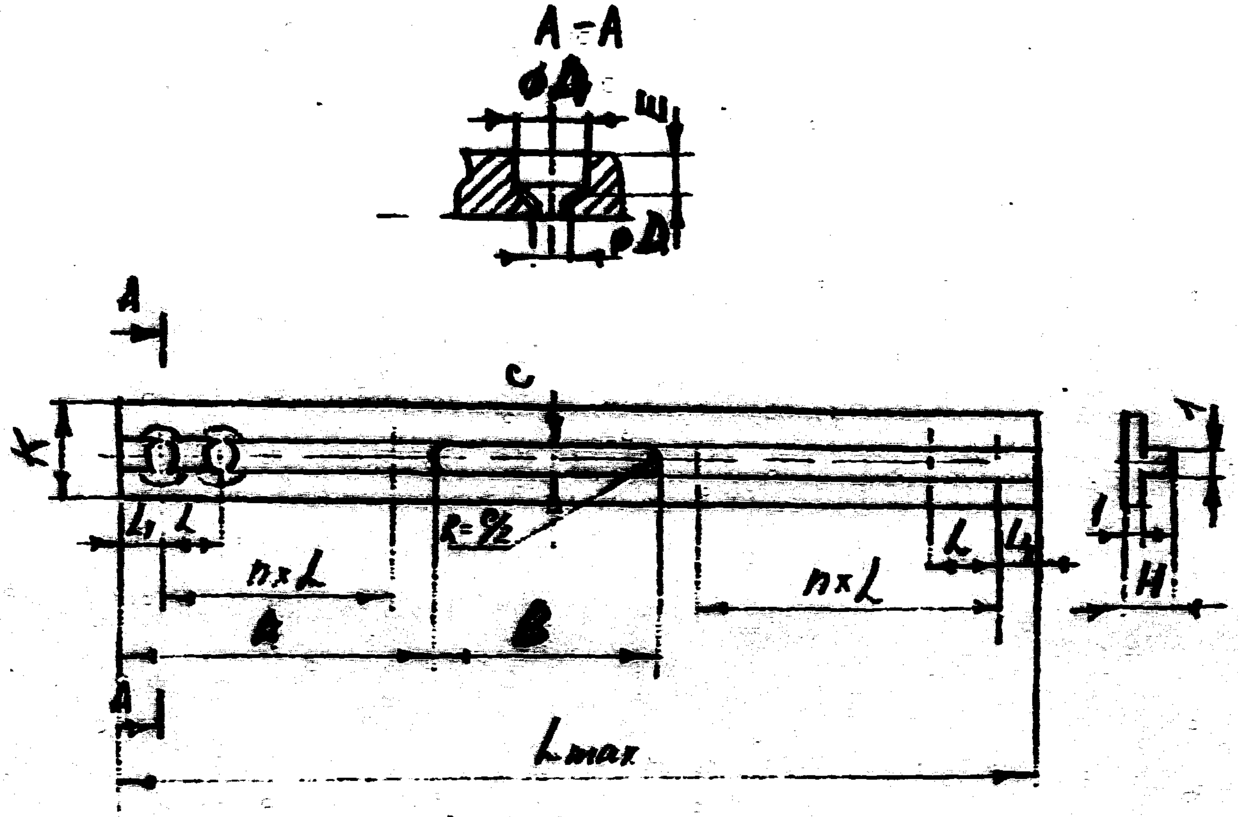
Operation 3







SECTION 2



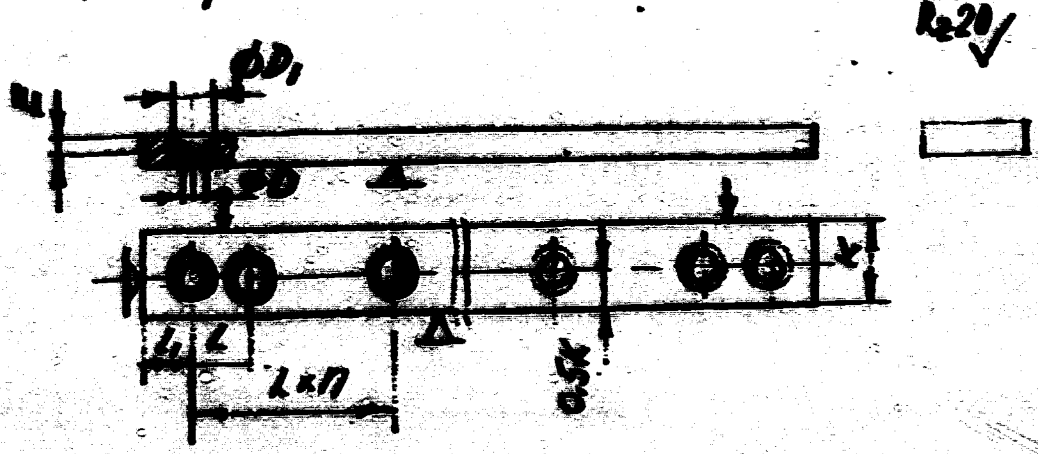
Number of pieces	Dimension											
	A	B	C	D	D_1	L	L_1	L_m	H	E	n	K
150.033	–	–	–	5.2	6.4	8	9	92	3	2	3	9
30.007	25	28	2	2	2,8	6	3	78	2	1.2	3	6
30.008	37	40	2	2	2.8	6	3	114	2	1.2	5	6

SECTION 1

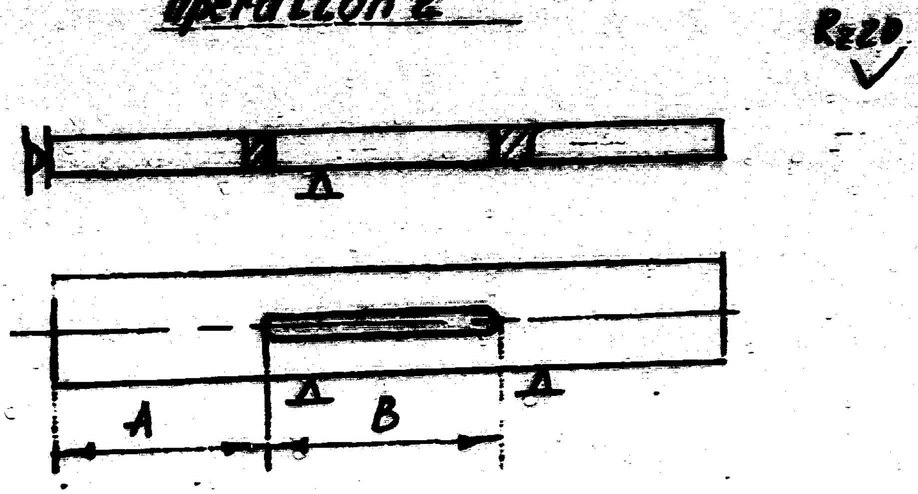
150.033
30.007
30.008

E	n	K
2	3	9
.2	3	6
.2	5	6

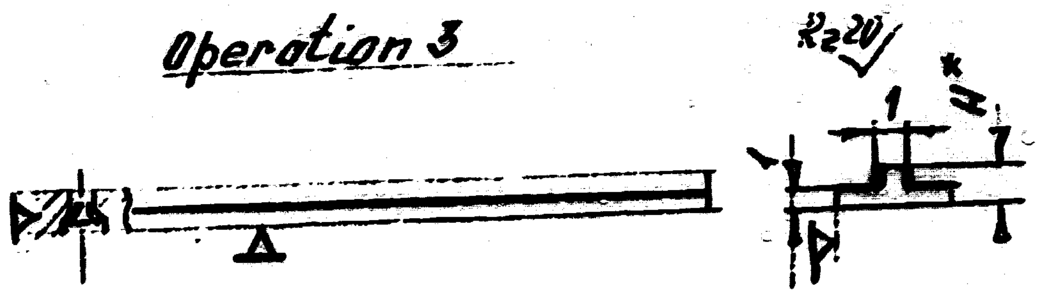
Operation 1



Operation 2



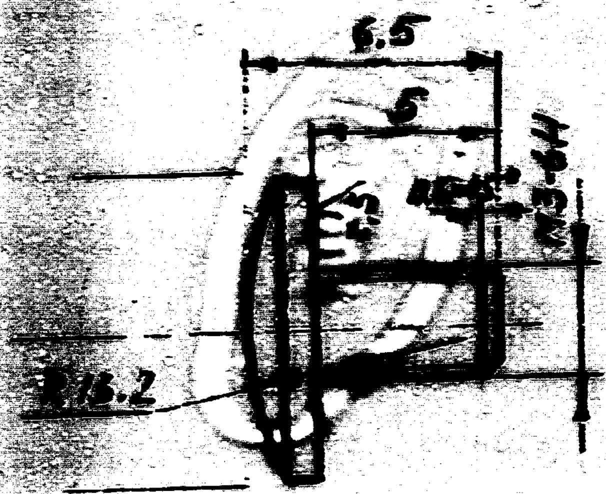
Operation 3



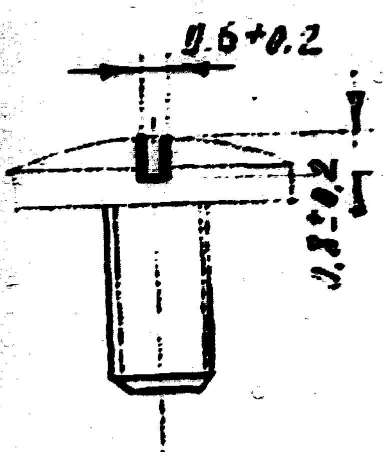
SECTION 2

Operation 1

Rz20 (V)



Operation 2

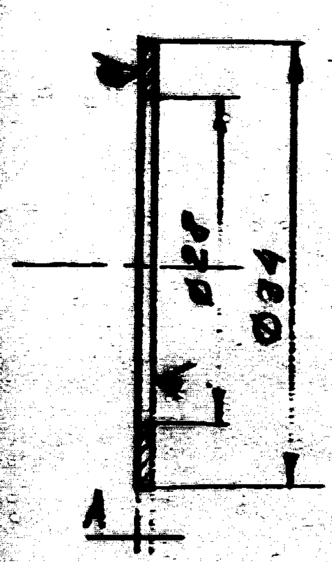


SECTION 1

150.034

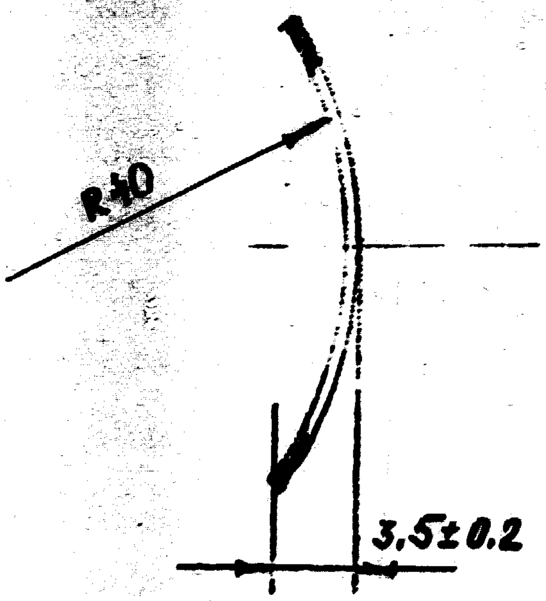
SECTION 2

Operation 1



Operatio

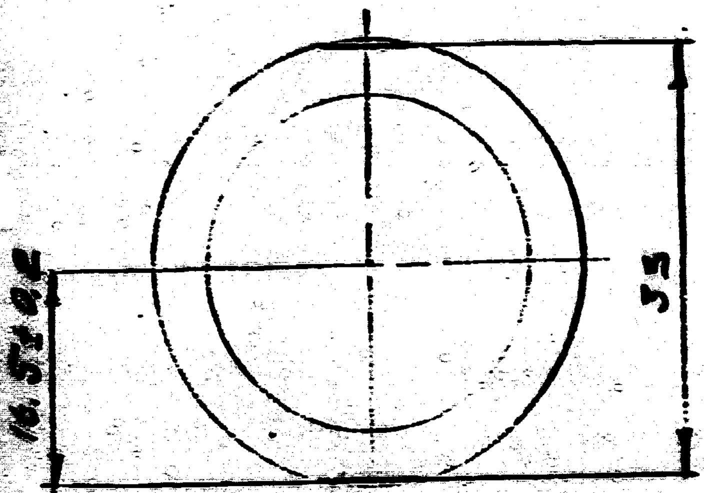
Operation 3



SECTION 1

150.035

Operation 2



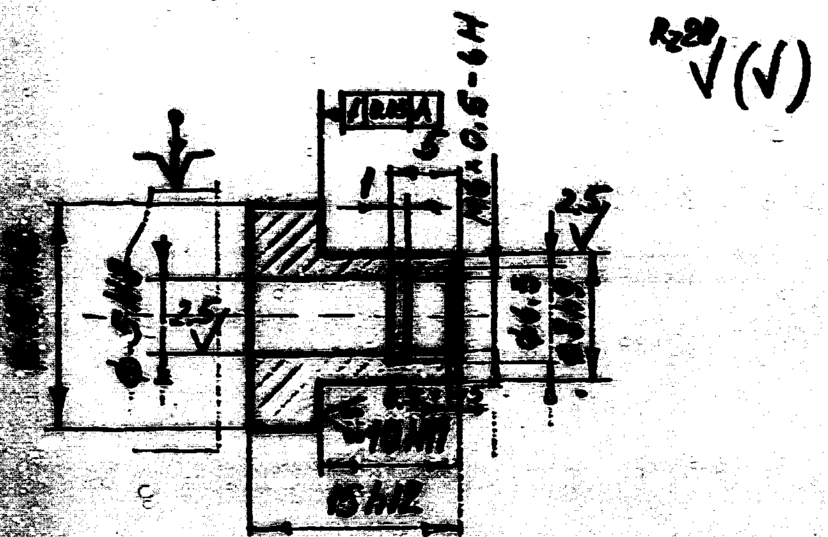
SECTION 2

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	150.036		
		PROFILE	DIMENSIONS
		ROUND BAR	ø 18 x 100

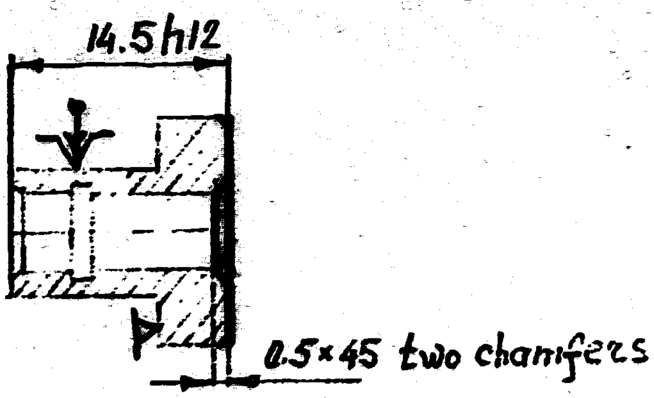
No	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN - 125		
002	FACE THE BLANK		TOOLHOLDER	SLIDING CALLIPERS
003	TURN ø 15h12 TO THE LENGTH OF 16 mm			
004	TURN ø 8.1 WITH FACING TO THE		TOOLHOLDER	SLIDING CALLIPERS
	SIZE OF 10.1 mm			
005	CENTRE		CENTRING DRILL	
006	DRILL A HOLE ø 4.8 mm TO THE LENGTH OF 20 mm		DRILL ø 4.8 mm	
007	BORE A GROOVE ø 6.3 TO THE DEPTH OF 5 mm.			
008	BORE HOLES ø 5H8 FOR THE		CUTTING BORE	
	THREAD M6, CHAMFERS 0.5 x 45°			

SHEET 1	NUMBER OF SHEET 4

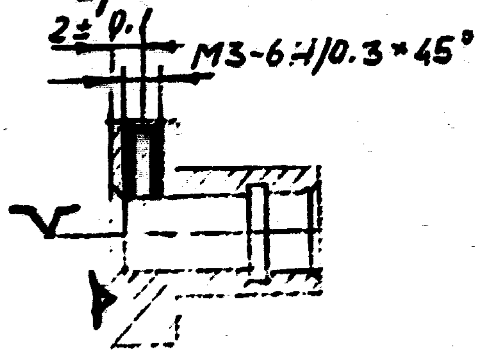
Operation 1



Operation 2



Operation 3



150.036

$\sqrt[1.25]{}(\sqrt{})$

5 two chamfers

SECTION 2

Nº	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	CUT THE THREAD M6 x 0.5-6H		TAP	
010	PART-OFF THE WORKPIECE TO THE		PART-OFF	SLIDING
	THE SIZE OF 14.7 mm		TOOL	CALLIPERS
	OPERATION 2			
001	MOUNT AND REMOVE THE WORKPIECE			
002	FACE THE WORKPIECE TO THE SIZE		TOOLHOLDER	
	OF 14.5h12(-0.2)			
003	TURN 2 CHAMFERS 0.5 * 45°		CHAMFERS TOOL	
	OPERATION 3			
001	MOUNT AND REMOVE THE WORKPIECE	MILLING MACHINE VICE, PRISMATIC		
		BACKING		
002	CENTRE TO THE MARKING-OUT		CENTRE DRILL	
			SHEET 3	NUMBER OF SHEET 4

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
003	DRILL FOR THE THREAD M3 TO		DRILL o 2.6 mm	
	BODY SIZE			
004	COUNTERSINK CHAMFER 0.3 * 45°		COUNTERSINK	
005	CUT THE THREAD		TAP M3	
	OPERATION 4			
001	MOUNT AND REMOVE THE	GRINDING MACHINE	ABRASIVE	
	WORKPIECE	MANDREL		
002	GRIND o 8h9 AND THE END			
	TO THE SIZE OF 10h11			
	OPERATION 5			
	UNLUBRICATION			
	CHEMICAL OXIDATION			

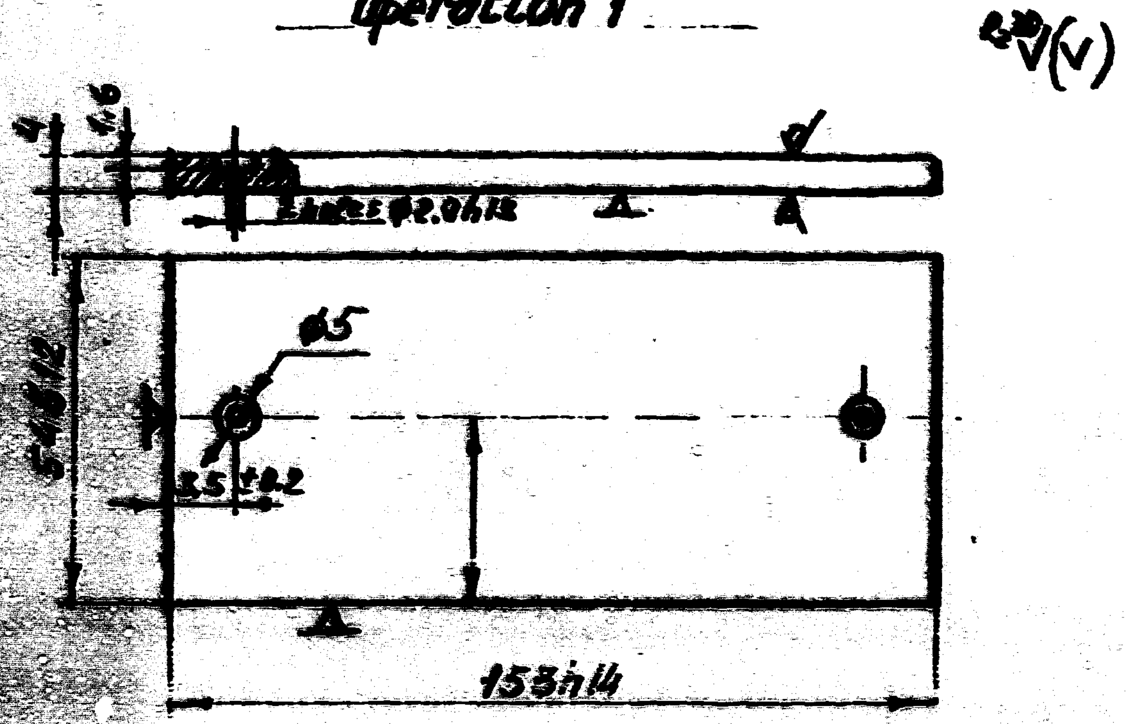
SHEET 4	NUMBER OF SHEET 4

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	150.038	PROFILE	DIMENSIONS
		ROUND	155 x 56 x 4

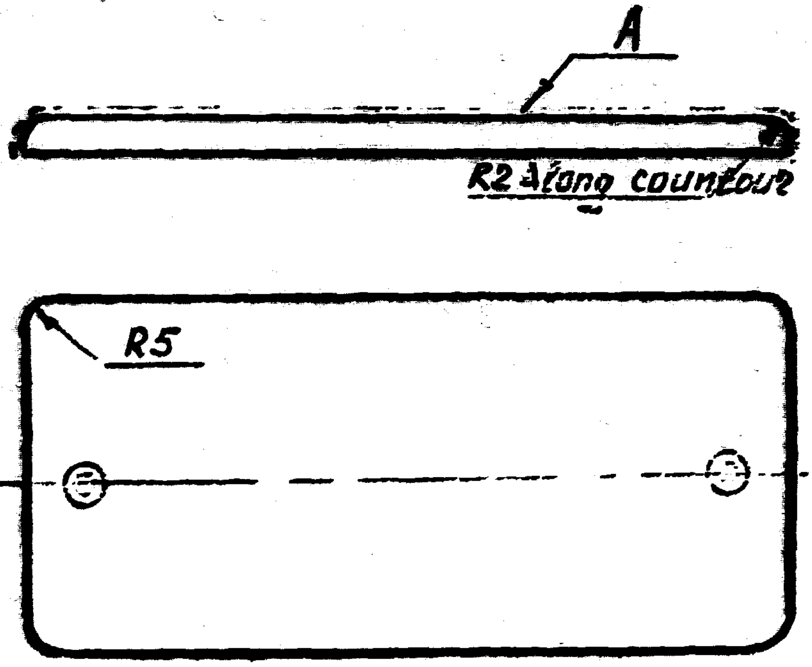
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT AND REMOVE BLANK	MILLING MACHINE		
002	CONTOUR MILL MAINTAINING		END MILL ø 30 mm	
	SIZES 153h14 AND 54h12			
003	DRILL 2 HOLES TO THE MARKING OUT TO BODY SIZE		DRILL ø 2.9mm	
004	COUNTERSINK 2 HOLES ø5 TO THE DEPTH OF 1.6 mm		COUNTERSINK ø5mm	
	OPERATION 2			
001	START THE KERF OF 4 RADIC R5			
002	CONTOUR FILE MAINTAINING R2			
	OPERATION 3			
001	COATING: ANODIC OXIDIZING BLACK			
	OPERATION 4			
001	SURFACE A IS TO BE PAINED WITH BLACK ENAMEL			

SHEET 1	NUMBER OF SHEET 2

Operation 1



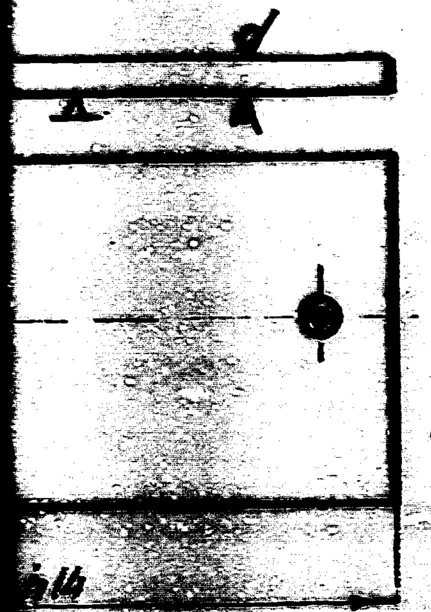
Operation 2



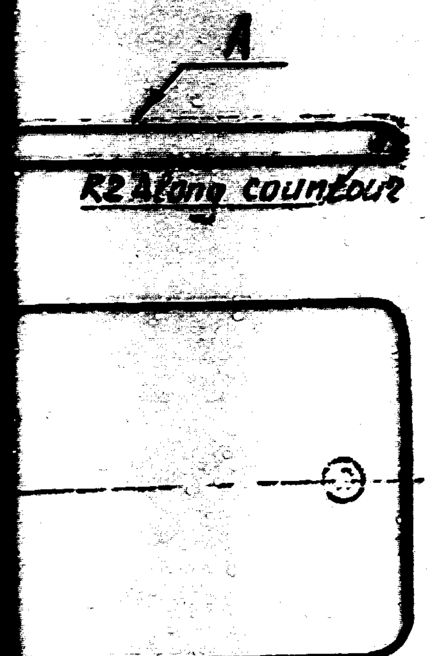
SECTION 1

150038

n 1



tion2



SECTION 2

FOCUSING MECHANISM 150.000

N	NAME AND CONTENT OF OPERATION.	EQUIPMENT	DEVICE TOOL	COMMENT
1.	MAKING UP A SET MAKE UP A SET OF ASEMBLING UNITS AND PIECES OF THE FOCUSING MECHANISM. ASSEMBLES SPUR GEARS 150.030 REF.N1. FEED MECHANISM 150.050 REF.N2 PIECES : COVER 150.038 REF.N4 . STANDART UNITS : SCREW M2 (2 PIECES) REF.N5 SCREW M3 (4 PIECES) REF.N6			
2.	ASSEMBLING . MOUNT THE ASSEMBLE 150.030 IN THE ASSEMBLE 150.050, FASTEN HIS THE FOURE SCREWS REBF.N6 PRELIMINARY. CLEARENC BETWEEN THE SPUR GEAR 150.022 AND THE WORM 150.007 IS 0.1 - 0.2 mm , BETWEEN THE SPUR GEAR 150.021 AND THE RACK 150.026 IS 0.1 - 0.2 mm. SCREW THE 4 SCREWS REF.N6 TO END. THE SCREW HEAD REF.N6 AND THE ADJOIN SURFASE REF.N1 TO COAT WITH GREY ENAMEL. MOUNT COVER 150.038 REF.N4 SCREW TWO SCREWS REF.N5 IN CASE -		INDICATOR 0 0.01 mm SCREW DRIVER INDICATOR 0 0.01 mm SCREW DRIVER HAIR - BRUCH SCREW DRIVER	

MICROSCREW WITH NUT N 150.010

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
1.	MAKING UP A SET MAKE UP A SET OF ASEMBLING UNITS AND PIECES N 150.010 SCREW 150.001 NUT 150.002 SCREW N 2	SCREW DRIVER		
2.	WASHING WASH PIECES WITH BENZIN AND DRY THEN DURING 15 min AT T=20°C	TANK	HAIR BRUSH	
3.	OILING SURFACE OF MICROSCREW N1 (150.001)	GRAPHITIC-OIL	HAIR BRUSH	
4.	SCREW NUT (150.002) N2 ON MICROSCREW (150.001) N1			
5.	SCREW IN TWO FIXING SCREW M2-6G		SCREW DRIVER	
6.	VERITY FIXATION OF THE NUT ABOUT FIXING SCREW. IN EXTREM POSITIONS			WITH NECES SITY FILING AND OF NUT

FINE FEED AXLE N 150.020

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
1.	MAKING UP A SET MAKE UP A SET OF ASEMBLING UNITS AND PIECES OF AXIS OF THE FINE MOTION ASEMBLES : 150.010 RING 150.003 REF. N2 BEARING 150.004 REF.N3 BEARING 150.005 REF.N4 BUSHING 150.006 REF.N5 WORM 150.007 REF.N6 SCREW 150.008 REF.N7 SPRING 150.009 REF.N8 WASHER 150.011 REF.N9 WASHER 150.012, 150.012-1,150.012-2 NN 10, 11, 12 SPRING 150.013 REF.N13 CUP 150.014 REF.N14 KNOB 150.015 REF.N15 SCREW 150.016 REF.N16 SCALE 150.017 REF.N17 SCREW M 2.5-6E REF.N18 BALL 03.175 REF.N19	-		
2.	WASHING WASH PIECES WITH BENZIN AND DRY THEN DURING 15 min AT T=20°C	TANK		
3.	OILING SURFACE OF PIECES NN 1, 2, 3, 5, 6.		HAIR BRUSH	
4.	ASSEMBLY MOUNT RING N2 (150.003) ON ASSEMBLING N 150.010 SCREW UP TWO SCREWES N7 (150.008) IN NUT (150.002) MOUNT INTO THE BUSHING ASSEMBLED 150.010. FITTING ON OF BUSHING N5 (150.006) WITH THE WORM N6 (150.007) MATCH THE AXLES OF HOLES IN RING N2, BUSHING N5 AND WORM N6. SCREW TWO SCREWES N7 IN RING N2		SCREW DRIVER SCREW DRIVER	
5.	MOUNT SPRING N8 (150.009), BEARING N4 WITH WASHER N9, TWO WASHERS N7 AND BEARING N3. MATCH THE AXLES OF HOLES IN BEARING N4, BUSHING N5 AND BEARING N3. SCREW THREE SCREWES N18 (M2.5) IN BEARING N3.		SCREW DRIVER	
6.	MOUNT WASHERS NN 10, 11, 12 AND SCALE N17 (150.017) CHECK DIMENSION 0.1 FASTEN SCALE N17 BY SCREW N16 MOUNT KNOB N15 (150.015), SPRING N13, BALL N19 AND SCREW CUP N 150.015 IN SCALE N17		PROVE	0.1 ÷ 0.2 CHECKING BY MOUNTED ONE OF DETAILES 10, 11, 12

SPUR GEAR N 150.030

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
1.	MAKING UP A SET MAKE UP A SET OF ASEMBLING UNITS AND PIECES N 150.030. HOLD RING N 150.018 REF.N1 HOLD RING N 150.018-01 REF.N2 RACK N 150.019 REF.N3 SPUR GEAR N 150.021 REF.N4 SPUR GEAR N 150.022 REF.N5 STANDART UNITS : SCREW M1.6 - 6G 2 PIECES N6 PIN 2 x 10 REF. N7 BALL - BEARING REF.N8 BALL - BEARING REF.N9			
2.	WASHING WASH PIECES WITH BENZIN AND DRY THEN DURING 15 min AT T=20°C		TANK HAIR BRUSH	
3.	ASSEMBLY FITT BALL-BEARING REF.N9 ON THE SPUR-GEAR 150.021 REF.N4			
4.	MOUNT SPUR- GEAR N 150.022 IN RACK (150.019) N3 FITT ASSEMBLY PRELIMINARY WORK STEP IN HOLE SPUR-GEAR N5. FASTEN THEN PIN REF.N7			
5.	SCREW HOLD RING (150.018-01) REF.N2 IN BALL (N3)			
6.	FITT BALL-BEARING REF.N8 SCREW HOLD-RING 150.010 REF. N1			

CARRIAGE WITH RACK 150.060

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
1.	MAKING UP A SET			
	MAKE UP A SET ASSEMBLIES PIECES OF			
	CARRIAGE WITH RACK. PIECES THE			
	CLEAT 150.023 REF.N1			
	CARRIAGE N 150.024 REF.N2			
	SPOT N 150.025 REF.N4			
	RACK N 150.026 REF.N5			
	SPRING N 150.027 REF.N7			
	SCREW M2 - 6G 2 PIECES REF.N8			
	SCREW M3 - 6G 3 PIECES REF.N9			
	WASHER 3 PIECES REF.N11			
	PIN 0240*10 2 PIECES REF.N13			
2.	WASHING			
	WASH PIECES WITH BENZIN AND DRY			
	THEM DURING 15 min AT T=20°C			
3.	ASSEMBLY	MAKING-	INDICATOR	
		PLAT	0.002	
			WITH POST	
	MOUNT THE RACK N5 ON THE CARRIAGE	COORDINATOR	TECHNOLO-	
	N2, SCREW IN 3 SCREWES AND THE 3	TABLE	GICAL PIN	
	WASHES REF.N9 AND N11 IN THE RACK	CLAMPS	SCREW	
	PRELIMINARY.		DRIVER	
	MOUNT 2 TECHNOLOGICAL PINS 03 IN HO-			
	LES OF CARRIAGE. PUSH RACK TILL		SLIDING	
	THE TECHNOLOGICAL PINS, TO THE SIZE	*	CALLIPERS	
	DIMENSION 16.5+0.1 AND PARALLELISM			
	BETWEEN LINE OF ACROSSING SURFACES		SCREW	
	B AND SURFACE A. FASTEN RACK WITH		DRIVER	
	HELP SCREW N9 FINNALY.			
4.	DRILLING	DRILL	DRILL	
		MACHINE	REAMER	
	DRILL AND UNROLLER TWO HOLES o 2 E9			
	FROM PIN 3			
5.	MOUNT TWO PINS REF.N13			
6.	TAKE OFF TWO TECHNOLOGICAL PINS AS-			
	SEMBLY.			
7.	MOUNT IN HOLE OF CARRIAGE SPRING			
	150.027 REF.N6; SPOT 150.025 REF.N4,			
	CLEAT 150.023 REF.N1 AND SCREW TWO		SCREW	
	SCREWES REF.N8 IN CARRIAGE .		DRIVER	

CASE CLEATS 150.040

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
1.	MAKING UP A SET			
	MAKE UP A SET ASSEMBLING UNITS AND PIECES OF THE CASE WITH CLEATS.			
	ASSEMBLES: 150.060			
	PIECES :			
	CLEAT N 150.028 REF.N4			
	CLEAT N 150.029 REF.N4			
	CASE N 150.031 REF.N5			
	CLEAT N 150.032 REF.N6 2 PIECES			
	SEPARATOR N 150.033 REF.N7 2 PIECES			
	SCREW N 150.034 REF.N8			
	SCREW M2.5-6G REF.N10 4 PIECES			
	SCREW M 4 -6G REF.N11 10 PIECES			
	BALL REF.N5 16 PIECES			
2.	WASHING			
	WASH PIECES WITH BENZIN AND DRY THEM DURING 15 min AT T=20°C			
3.	ASSEMBLY			
	MOUNT CLEAT 150.029 REF.N4 CASE 150.031 REF.N5 FASTEN CLEAT 5 SCREWS M4 REF.N11. MOUNT CLEAT 150.028 REF.N3 ON CASE. FASTEN CLEAT 5 SCREWES M4 N11 PRELIMINARY.		SCREW DRIVER	
	SCREW TWO SCREWES 150.034 REF.N8 PRELIMINARY.		SCREW DRIVER	
	MOUNT BALLS IN SEPARATOR 150.033 REF.N7. APPLY A DROP OF THE SURFACES OF PIECES REF.NN 1,2,3,4,6,7, 12. MOUNT CARRIAGE WITH SEPARATORS, BEARING DIMENSIONS 12+0.5 AND 2+0.5 mm BY SPOT.			
	SCREWES REF.N9 TESTING STRENGHT BEGINNING OF MOTION.		STRENGHT-METER	F = 2N
	FASTEN CLEAT REF.N3 WITH HELP SCREW REF.N11.		SCREW DRIVER	
	MOUNT TWO CLEATS REF.N6. SCREW TWO SCREWES REF.N10.			
	SEMBLY.			
7.	MOUNT IN HOLE OF CARRIAGE SPRING 150.027 REF.N6; SPOT 150.025 REF.N4, CLEAT 150.023 REF.N1 AND SCREW TWO SCREWES REF.N8 IN CARRIAGE .		SCREW DRIVER	

FEED MECHANISM 150.050

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
1.	MAKING UP A SET MAKE UP A SET ASSEMBLING UNITS AND PIECES OF THE FEED MECHANISM. ASSEMBLES: 150.060, 150.040 PIECES : BEARING N 150.005 REF.N5 WASHER N 150.011 REF.N6 SPRING N 150.013 REF.N7 5 PIECES CAP N 150.014 REF.N8 KNOB N 150.015 REF.N9 SCREW N 150.016 REF.N10 2 PIECES SPRING WASHER N 150.035 REF.N11 2 PIECES SPRING WASHER N 150.035 REF.N11 2 PIECES SPRING WASHER N 150.035-01 REF.N12 2 PIECES BUSHING N 150.036 REF.N13 FLY NUT N 150.037 REF.N17 2 PIECES BEARING N 150.039 REF.N15 STANDART UNITS : SCREW M 3 REF.N15 6 PIECES SCREW M 2.5 REF.N16 6 PIECES SCREW M 2.5 REF.N17 3 PIECES BALL 3.175 REF.N18 5 PIECES			
2.	WASHING WASH PIECES WITH BENZIN AND DRY THEM DURING 15 min AT T=20°C	TANK		
3.	ASSEMBLY. ASSEMBLE 150.020 FITT IN HOLE OF THE CASE 150.040 , FASTEN IN THREE SCREWES M3 REF.N15. APPLY A DROP OIL ON THE BEARING 150.005 REF.N5 SURFACE. MOUNT THE BEARING AND FASTEN HIS OF THREE SCREWES M3 REF.N15. MOUNT WASHER 150.011 REF.N6, TWO SPRING-WASHER 150.035 AND 150.035-01 REF.NN 11, 12 THE PIECE REF.N4. SCREW THREE SCREWES REF.N17 IN BEARING. MOUNT IN HOLES OF THE BEARING WITH BOTH SIDE 4 SPRING AND 4 BALLS.		SCREW DRIVER SCREW DRIVER	

N	NAME AND CONTENT OF OPERATION	EQUIPMENT	DEVICE TOOL	COMMENT
	MOUNT TWO THE FLY NUT 150.037 REF.N14. SCREW M6 SCREWES M2.5 REF.N16 IN THE BEARING.		SCREW DRIVER	
	MOUNT THE BUSHING 150.036 REF.N13 FASTEN HIS THE SCREW (150.616) REF.N10.			
	MOUNT THE KNOB 150.015 REF.N9 , THE SPRING 150.017 REF.N7, THE BALL REF.N18, THE CAP 150.014 REF.N18, THE CAP 150.014 REF.N8. THE CAPS REF.N8 MUST BE DRAWN UP TIGHT AS FAR AS THEY WILL GO IN ORDER TO , WHEN KNOB REF.N15 IS ROTATED. THEY ARE NOT UNSCREWED SPON TANE-OUSLY. IT IS PURMISSIBLE TO SECU-RE THE WRITH CEMENT .			
	THE SCREW HEAD REF.N15 AND THE ADJOIN SURFACE TO COAT WITH GREY ENAMEL .		HAIR BRUSH	

		OPERATION ONE	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 4 [illegible]	SEE TABLE ONE		
		PROFILE	DIMENSIONS
		ROUND BAR BRASS	16x80

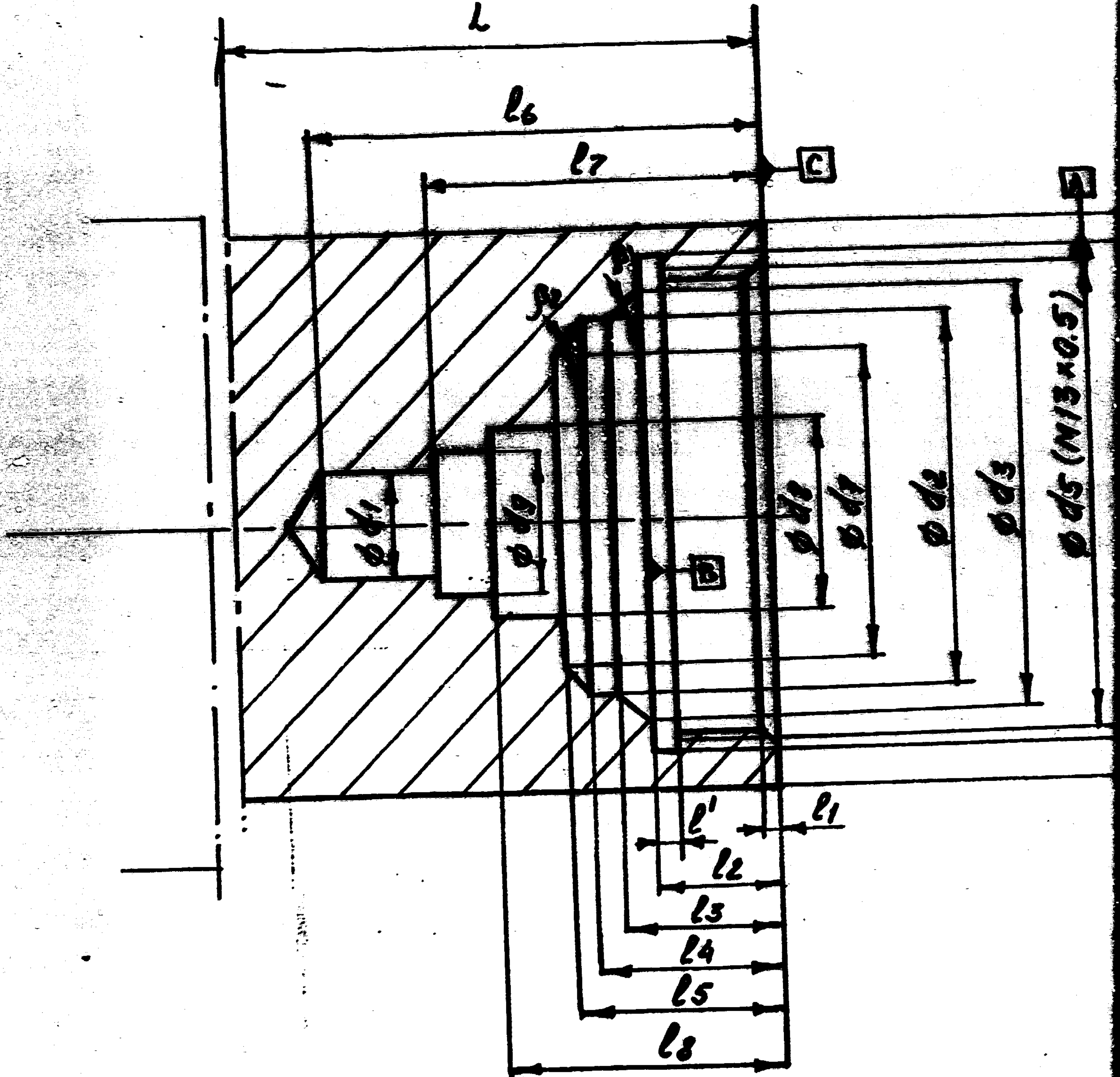
WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001 MOUNT BLANK	SHAUBLIN-135 3 JAWS CONCENTRIC CHUCK		
002 TURN BUTT END		TOOLHOLDER APPROACH ANGLE 90°	SLIDING CALLIPERS
003 TURN [illegible] ON 1 [illegible] LONG		TOOLHOLDER APPROACH ANGLE 90°	
004 CENTRE DRILL		CENTRING DRILL [illegible] 3 mm	
005 DRILL OPENING [illegible] LONG EXCEPT DETAIL NUMBER [illegible]		DRILL [illegible]	
006 TURN OPENING [illegible] LONG		BORING CUTTER	INSIDE CALLIPERS SLIDING CALLIPERS
007 TURN OPENING [illegible] LONG WITH CUT BUTT END		BORING CUTTER	INSIDE CALLIPERS
008 TURN OPENING [illegible] LONG WITH CUT BUTT OUT		BORING CUTTER	INSIDE CALLIPERS SLIDING CALLIPERS
		SHEET [illegible]	NUMBER OF SHEET [illegible]

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
1009	TURN D7 ON L[illegible] mm LONG		CUTTING TOOL	SLIDING CALLIPERS
1010	TURN D2 ON L3 mm LONG		CUTTING TOOL	SLIDING CALLIPERS
1011	TURN D5 ON L3		CUTTING TOOL	
1012	TURN CORNER R[illegible]		FACING TOOL	
1013	TURN CORNER R1		TOOLHOLDER	
1014	TURN CHAMFER L1 x 45°		CHAMFER TOOL	
1015	TURN GROOVE D6 ON L8 LONG, BEARING [illegible]		GROOVE TOOL	
1016	TURN SCREW D5(M13x0.5)		SCREW TOOL	
	ON L[illegible]=L + [illegible].5 mm			
				SLIDING CALLIPERS
			SHEET 2	NUMBER OF SHEET [illegible]

TABLE ONE

NUMBER OF DETAILEES	01	02	03	04	05	06	07	08	09	11	12	13	14	15	16	17	18	S1	S2	L'	L
200004	7.5 MH11	-	-	10.3 MH14	M13 10.5	10.5 MH12	-	-	-	10.5 MA5	5.3 MH11	-	-	-	10 MH12	-	-	-	-	1	11
200005	[illegible] MH11	-	11 MH11	10.3 MH14	M13 10.5	10.5 MH12	-	-	-	10.5 MA5	MH12	MH12	-	-	10 MH12	-	-	[illegible]	-	1	14
200006	MH11	[illegible]	10.4 MH11	10.3 MH14	M13 10.5	10.5 MH12	-	-	-	10.5 MA5	MH12	1.3 MH11	-	-	7.5 MH12	-	-	[illegible]	-	1	10.5
210006	MH11	11 MH11	-	10.3 MH14	M13 10.5	10.5 MH12	-	MH12	5.5 M6	10.5 MA5	13.3 MH12	13.5 MH12	6.8 MH12	7.5 MH12	13.5 MH12	10.5 MH12	5.3 MH12	[illegible]	[illegible]	1	12.5
210007	[illegible] MH11	6.6 MH11	12.4 MH12	10.3 MH14	M13 10.5	10.5 MH12	-	-	-	10.5 MA5	MH12	7.5 MH12	-	-	11 MH12	-	-	[illegible]	-	1	12
210008	10.3 MH11	10.3 MH11	14.4 MH12	10.3 MH14	M13 10.5	10.5 MH12	-	-	-	10.5 MA5	4.5 MH12	5.7 MH12	-	-	MH12	-	-	[illegible]	-	1	10
210009	[illegible] MH11	[illegible] MH11	-	10.3 MH14	M13 10.5	10.5 MH12	-	-	-	10.5 MA5	MH12	5.7 MH12	-	-	10 MH12	-	-	[illegible]	-	1	10
220005	[illegible] MH11	MH12	-	10.3 MH14	M13 10.5	10.5 MH12	MH12	-	-	10.5 MA5	MH12	-	7.3 MH12	5.3 MH12	10 MH12	-	-	-	[illegible]	[illegible]	1	10
220009	5.3 MH11	5.3 MH11	-	10.3 MH14	M13 10.5	10.5 MH12	-	-	-	10.5 MA5	5.5 MH12	5.7 MH12	-	-	10 MH12	-	-	[illegible]	-	1.25	10
[illegible]	[illegible] MH11	[illegible] MH11	-	10.3 MH14	M13 10.5	10.5 MH12	-	-	-	10.5 MA5	MH12	[illegible]	-	-	10.5 MH12	-	-	[illegible]	-	1.25	10.5
230012	[illegible] MH11	[illegible] MH11	-	10.3 MH14	M13 10.5	10.5 MH12	-	-	-	10.5 MA5	MH12	[illegible] MH12	-	-	10 MH12	-	-	[illegible]	-	1	[illegible]
230009	[illegible]	[illegible] MH12	10	10.3 MH14	M13 10.5	10.5 MH12	-	-	-	10.5 MA5	MH12	4.5	[illegible] MH11	10.5 MH11	-	-	-	[illegible]	[illegible]	1	10
230011	[illegible] MH11	[illegible] MH11	10 MH11	10.3 MH14	M13 10.5	10.5 MH12	-	-	-	10.5 MA5	MH12	-	[illegible] MH11	[illegible] MH11	[illegible]	-	-	[illegible]	[illegible]	1	10
230013	[illegible] MH11	[illegible] MH12	10 MH12	10.3 MH14	M13 10.5	10.5 MH12	-	-	-	10.5 MA5	MH12	[illegible] MH11	-	-	10	-	-	[illegible]	-	1	10
230015	[illegible]	[illegible] MH12	10 MH12	10.3 MH14	M13 10.5	10.5 MH12	-	-	-	10.5 MA5	[illegible] MH12	[illegible] MH11	-	-	[illegible]	-	-	[illegible]	-	1	10
230014	[illegible] MH11	[illegible] MH12	[illegible] MH11	10.3 MH14	M13 10.5	10.5 MH12	-	-	-	10.5 MA5	MH12	[illegible] MH11	-	-	10	-	-	[illegible]	-	1	[illegible]

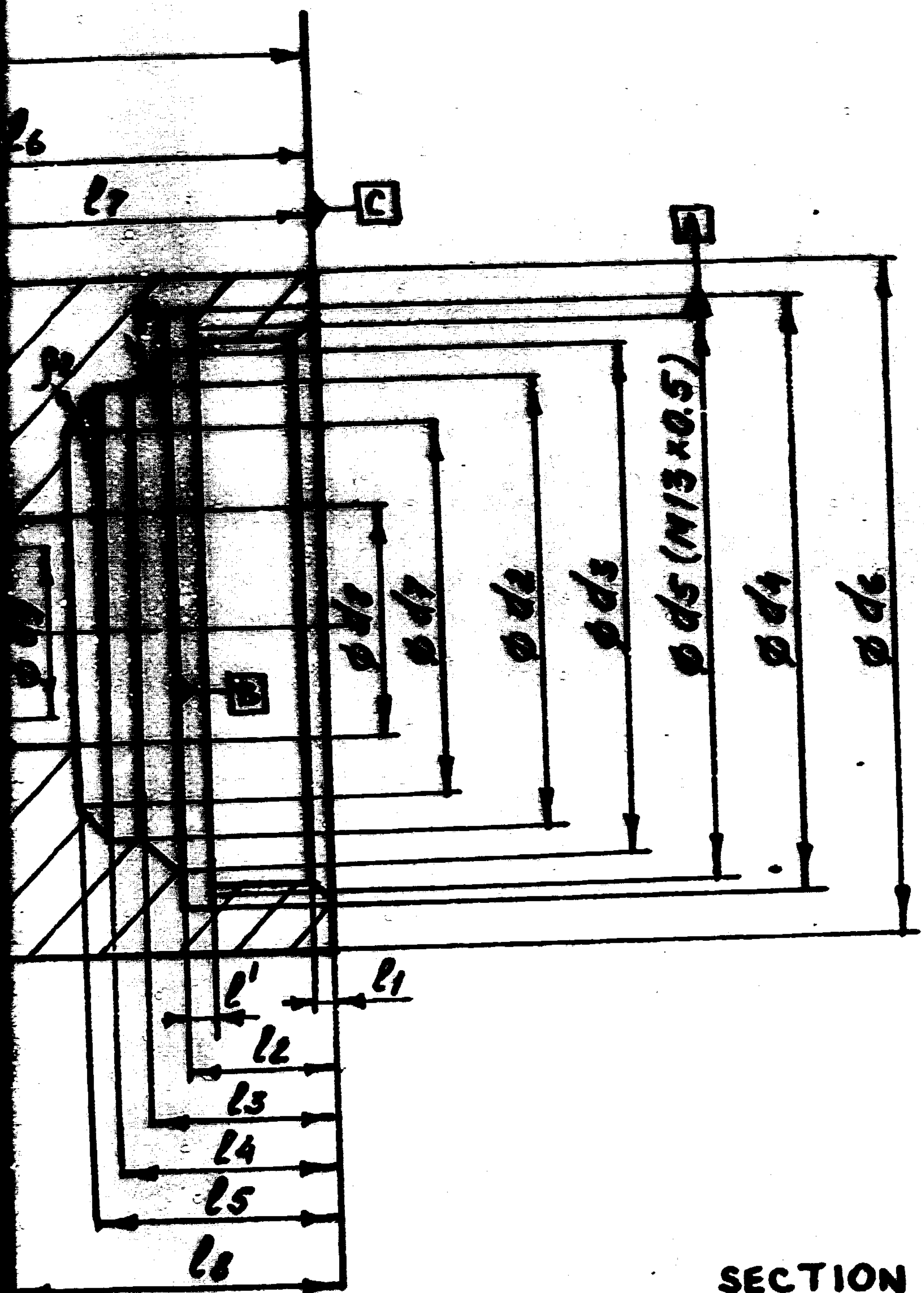
Ope



Page 4

SECTION 1

Operation one



SECTION 2

		OPERATION [illegible]	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 6	SEE TABLE TWO		
		PROFILE	DIMENSIONS
			[illegible]
NO. WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
1001 MOUNT BLANK	[illegible] COLLETS TYPE ø [illegible]		
1002 TURN BUTT END ON [illegible] LINE		TOOLHOLDER APPROACH ANGLE [illegible]	SLIDING CALLIPERS
1003 CENTRE DRILL [illegible]			
1004 DRILL ø 1.5 mm [illegible]		DRILL ø 1.5 mm	MICROMETER
1005 TURN ø 25 WITH CUT BUTT END ON LT OF LT LINE		TOOLHOLDER APPROACH ANGLE [illegible]	SLIDING CALLIPERS
1006 TURN ø 26 WITH CUT BUTT END ON LT OF LT LINE		TOOLHOLDER	INSIDE CALLIPERS
		SHEET 5	NUMBER OF SHEETS [illegible]

OPERATION NO

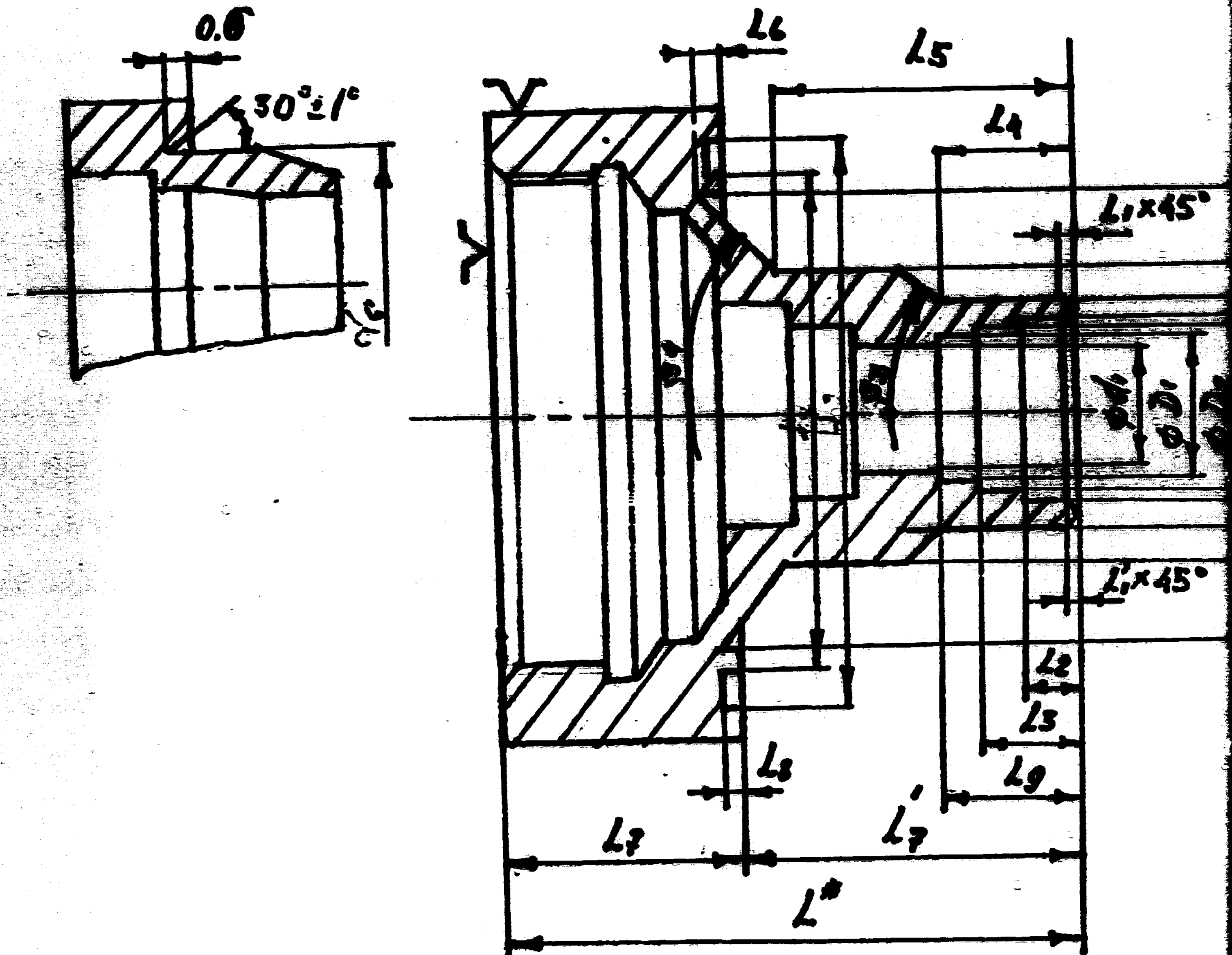
No	OPERATION	EQUIPMENT	TOOLS	MEASURING TOOLS
[illegible]	TURN [illegible]		TOOL-[illegible] [illegible]	SLIDING CALLIPERS
[illegible]	TURN CONE [illegible]		FORM CUTTER	
[illegible]	TURN CONE [illegible]		FORM CUTTER	
[illegible]	TURN ANGLE SLOT [illegible] LONG		FORM CUTTER	
[illegible]	TURN GROOVE [illegible] LONG		FORM CUTTER	SLIDING CALLIPERS DEPTH-METRE
[illegible]	TURN CHAMFER [illegible]		CHAMFER TOOL	
[illegible]	TURN [illegible]		[illegible] CUTTER	SLIDING CALLIPERS
[illegible]	CUTTER OPENING [illegible] LONG WITH OUT BUTT END		[illegible] CUTTER	SLIDING CALLIPERS
[illegible]	CUTTER OPENING [illegible] LONG WITH OUT BUTT END		[illegible] CUTTER	SLIDING CALLIPERS
[illegible]	CUTTER OPENING [illegible] LONG WITH OUT BUTT END		[illegible] CUTTER	SLIDING CALLIPERS
[illegible]	TURN CHAMFER [illegible]		CHAMFER TOOL	SLIDING CALLIPERS
[illegible]	BLUNT SHARP EDGES		SCRAPER	
	WASH PIECES [illegible] THE HOLES			
	[illegible] CHEMICAL [illegible]			

SHEET [illegible] | NUMBER OF SHEETS [illegible]

TABLE TWO

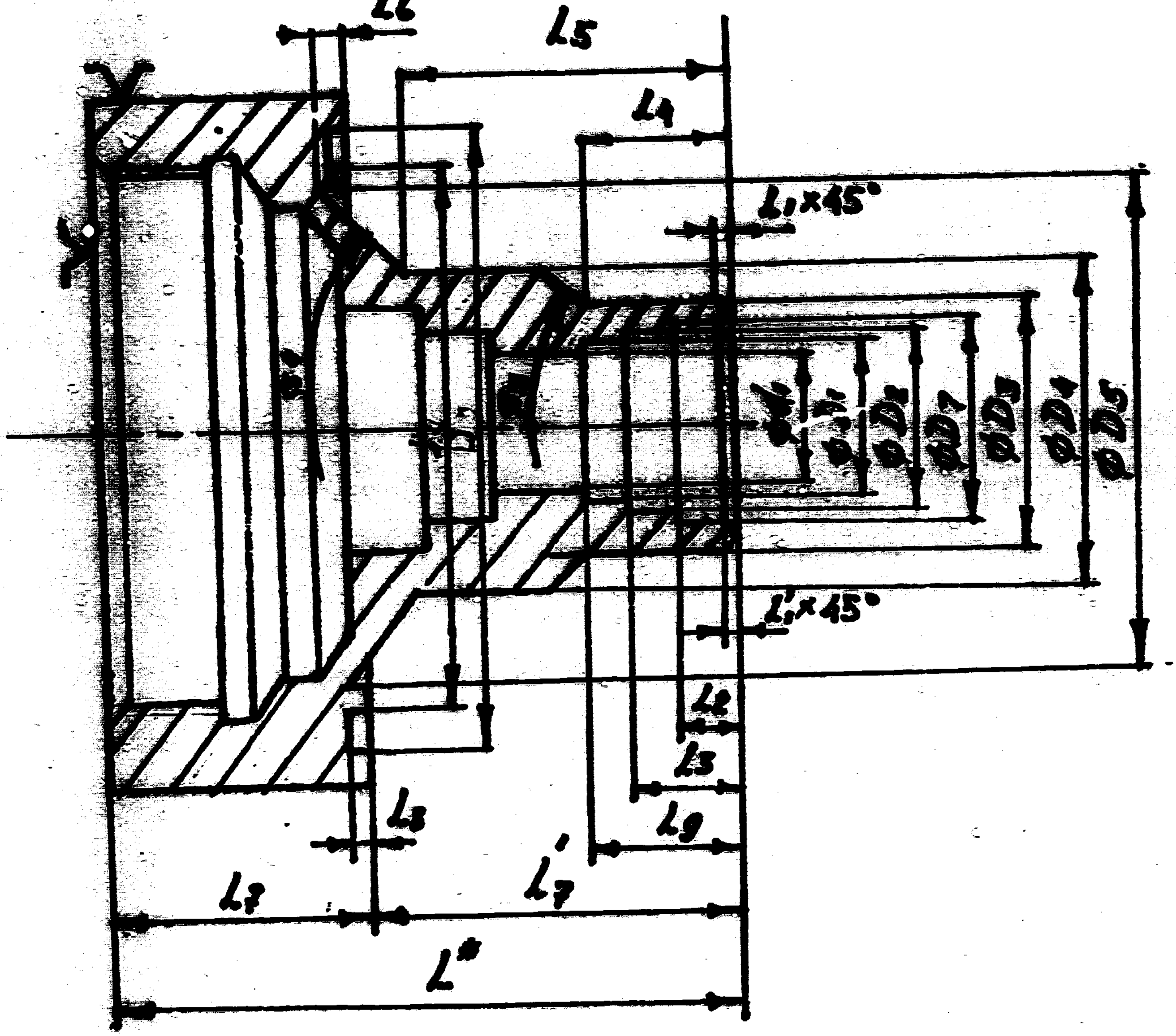
NUMBER OF DETAILS	DIMENSIONS
220004	[illegible]
220005	[illegible]
220006	[illegible]
210006	[illegible]
210007	[illegible]
210008	[illegible]
210009	[illegible]
220008	[illegible]
220007	[illegible]
220011	[illegible]
220012	[illegible]
220009	[illegible]
220011	[illegible]
220012	[illegible]
220013	[illegible]
220014	[illegible]

Dpez



Page

Operation two



SECTION 2

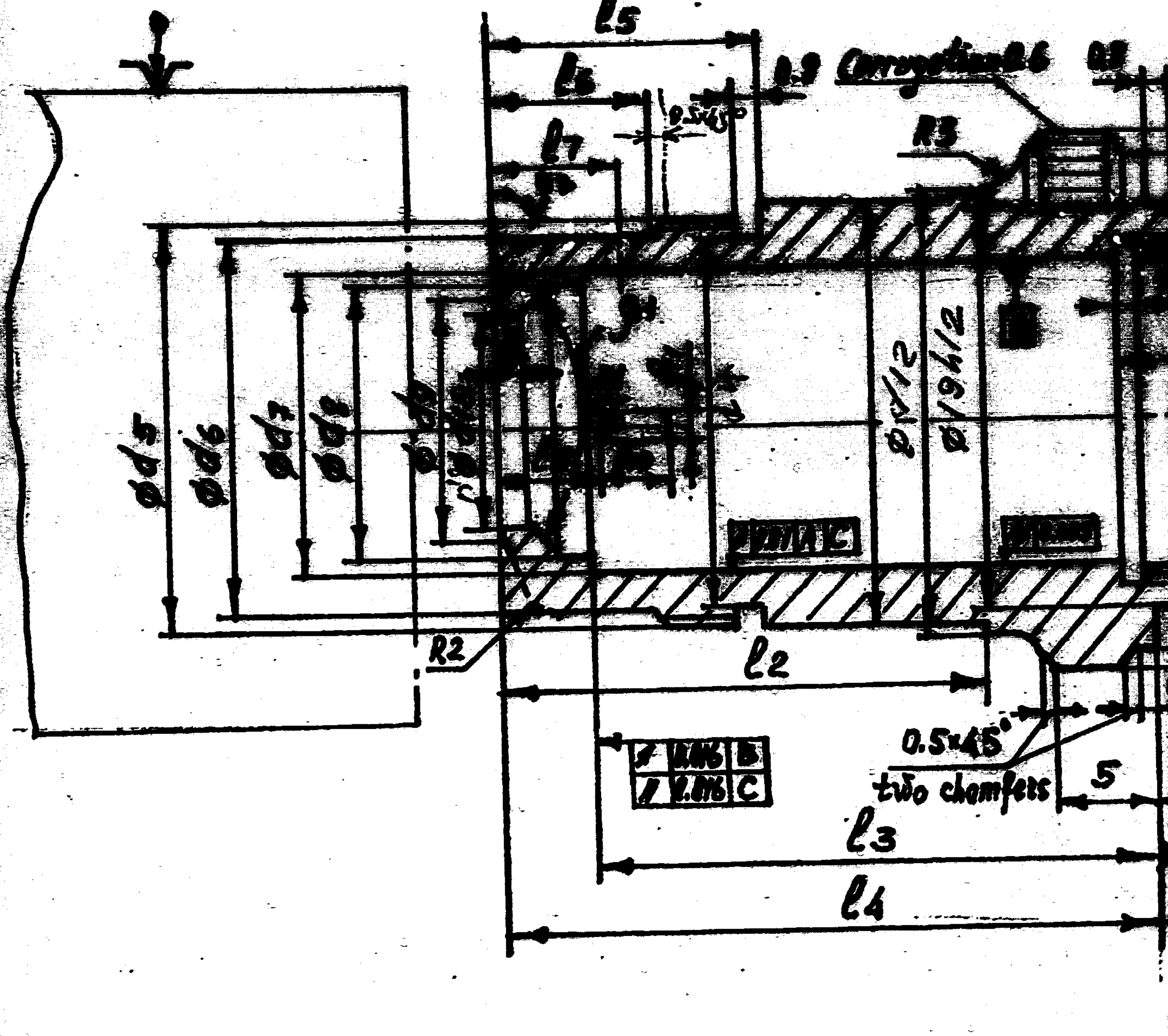
		OPERATION ONE	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 5 AND TABLE 3	200007 210014 220014	PROFILE	DIMENSIONS
		ROUND BAR BRASS	25x200

№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT BLANK	SHAUBLIN-125 3-JAWS CONCENTRIC CHUCK		
002	TURN BUTT OUT		TOOLHOLDER ANGLE 90°	
003	TURN ⌀24h14 ON (14+3+4.2)			SLIDING CALLIPERS
004	CENTRE DRILL		CENTRING DRILL ⌀2-MM	
004	DRILL (⌀10-1MM) ON (14+3+4.2)		DRILL ⌀(10-1)	
005	TURN ⌀23.5,BEGIN 5.7(4,2+5+0.5) FROM RIGHT END		TOOL ANGLE 45°	
006	ROLL CORRUGATION T=0,8 L=9.7		KNURLING	
007	TURN R3 BEARING ⌀13		FORM CUTTER	

SHEET 1	NUMBER OF SHEET

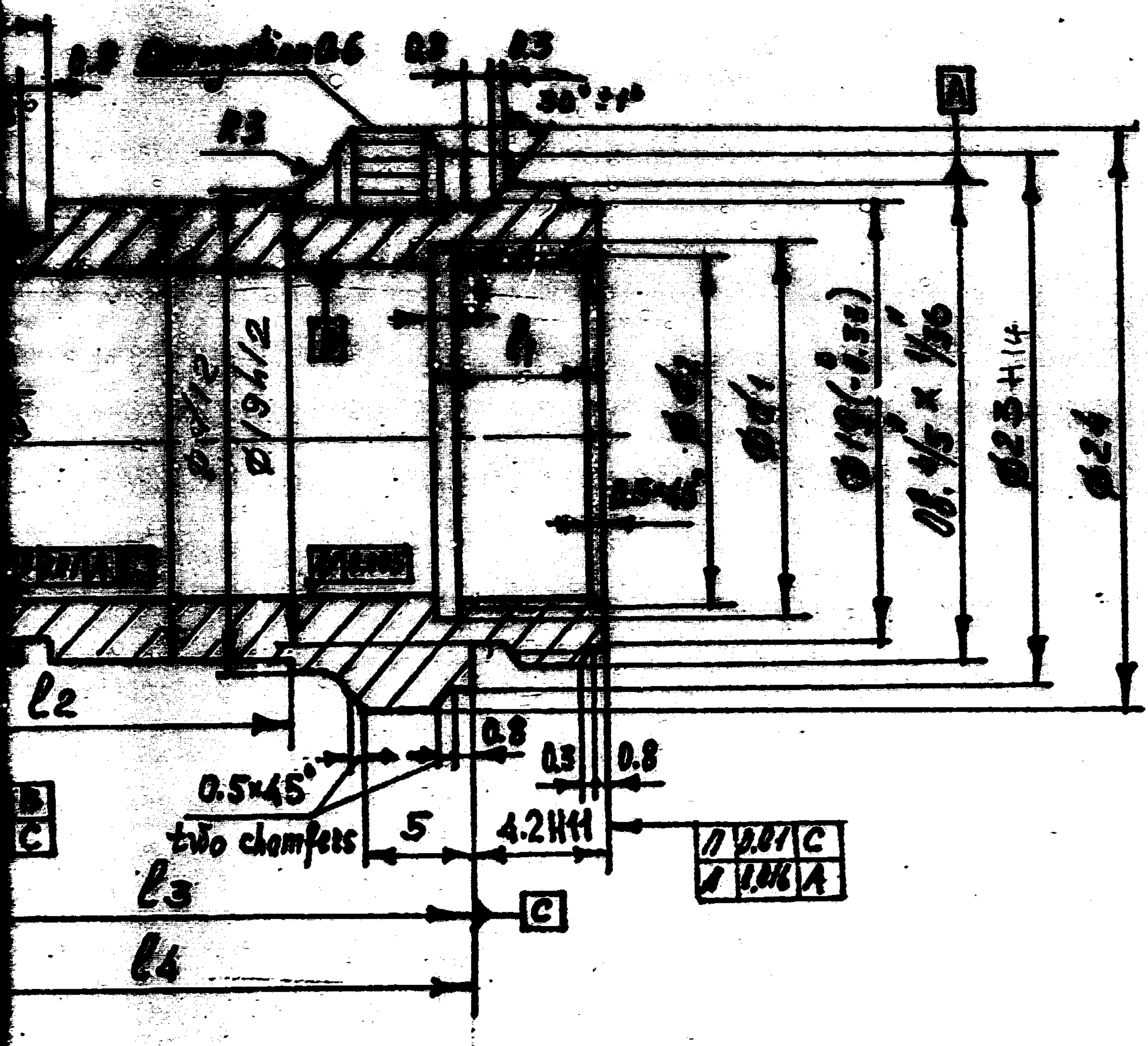
№	WORK STEP	EQUIPMENT	TOOL	MEASURING TOOL
008	TURN ⌀ 32		FACING TOOL	SLIDING CALLIPERS
009	TURN ⌀ 25 L=15±3		FACING TOOL	
010	TURN GROOVE ⌀8±0.2 IN DIMENSION (4.2±14-15) FROM RIGHT END		GROOVE TOOL	SLIDING CALLIPERS
011	TURN ⌀26 WIHT CHAMFER 0.5*45°		FACING TOOL	
012	TURN ⌀20 14 IN 5mm		TOOLHOLDER 90° ANGLE	SLIDING CALLIPERS
013	TURN GROOVE 0.2*15h18;L=4.2H11		GROOVE TOOL	
014	CUTT BUTT END 4.2H11		FACING TOOL	
015	TURN 021h12 (SCREW 4/5"*1/36")		TOOL HOLDER	
016	TURN ⌀ 20.2h9			
017	TURN ⌀ 19-0.23			
018	TURN THE CHAMFERS 0.3*30°		CHAMFER TOOL	
019	TURN SCREW 4/5"*1/36"		MALE SCREW TOOL PROFILE ANGLE 55°	
020	TURN SCREW ⌀25		MALE SCREW TOOL PROFILE ANGLE 55°	
021	TURN ⌀ 31		CUTTING TOOL	SLIDING CALLIPERS
			SHEET 2	NUMBER OF SHEET

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
022	TURN ø22		CUTTING TOOL	SLIDING CALLIPERS
023	TURN CONE B1		FORM CUTTER	SLIDING CALLIPERS
024	TURN (ø27-0.2)h7 FOR TWO PASSAGES		CUTTING TOOL	SLIDING CALLIPERS
025	ON ?LS-0.11LONG			
026	TURN GROOVE ø31?,BEARING L1		GROOVE TOOL	
027	TURN (ø32-0.5)h9 E46007 TURN ø 32h7		CUTTING TOOL	SLIDING CALLIPERS
028	TURN CHAMFER 0.5*45°		FEMALE CHAMFERING TOOL	
029	TURN SCREW ø52		FEMALE SCREW TOOL	
030	BLUNT SHAFT EDGES		SCREW,FILE	
031	CUTT OFF ON L4+0.5mm		DETACHABLE CUTTER	SLIDING CALLIPERS
			SHEET 3	NUMBER OF SHEET



SECTION 1

Operation 1



Page 5

SECTION 2

[illegible] DETAILS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
220007	16.2 [illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	-	-	[illegible]	-	-	-	-	-	[illegible]	[illegible]	[illegible]				
210016	16.2 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	[illegible]	[illegible]	[illegible]									
220016	17.2 [illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	-	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]									

		OPERATION
OPERATION CHART	NUMBER OF PIECES	BLANK
	[illegible]	SEE SHEET [illegible]

PROFILE	DIMENSIONS

No.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT BLANK	DRILL LATHE, DIVIDING ATTACHMENT, CLAMPING		
		[illegible]		
0002	DRILL CENTRE HOLE, KEEPING DIMENSION ([illegible])		DRILL [illegible]	
0003	BLUNT SHARP EDGES		DRILL [illegible]	

SHEET [illegible]	NUMBER OF SHEET

OPERATION SHEET	NUMBER OF PIECES	OPERATION NO.	
		PLAN	
	SERIAL	SEE SHEET [illegible]	
		PROFILE	DIMENSIONS

NO.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT BLANK	MILLING MACHINE, DIVIDING ATTACHMENT, EXPANDING ARBOR	MILLING TOOL	SLIDING CALIPERS
0002	MILL SLOT [illegible] [illegible], BEARING DIMENSIONS [illegible] [illegible] [illegible]			
0003	DISMOUNT SHAFT [illegible]			

SHEET	[illegible]	NUMBER OF SHEETS

		OPERATION TOOLS	
OPERATION CHART	NUMBER OF PIECES	BLANK	
	[illegible]	SEE SHEET [illegible]	
		PROFILE	DIMENSIONS

No	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT BLANK	[illegible]		
0002	TURN BUTT END [illegible]	[illegible]	TOOL HOLDER ANGLE [illegible]	SLIDING CALIPERS
0003	TURN [illegible]		FORM CUTTER	
0004	TURN [illegible]		FORM CUTTER	

SHEET [illegible]	NUMBER OF SHEET

			OPERATION FILE	
OPERATION SHEET		NUMBER OF PIECES	BLANK	
		[illegible] [illegible] [illegible]	SEE SHEET [illegible]	
			PROFILE	DIMENSIONS
W.N.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT BLANK	[illegible]		
0002	TURN [illegible] FOR TWO PASSAGES, BEARING [illegible]	[illegible] TYPE	DIAMOND TOOL	MICROSCOPE DEPTH-METER
	OPERATION END			
	REMOVE PART			
	COATING [illegible]			
			SHEET N	NUMBER OF SHEET

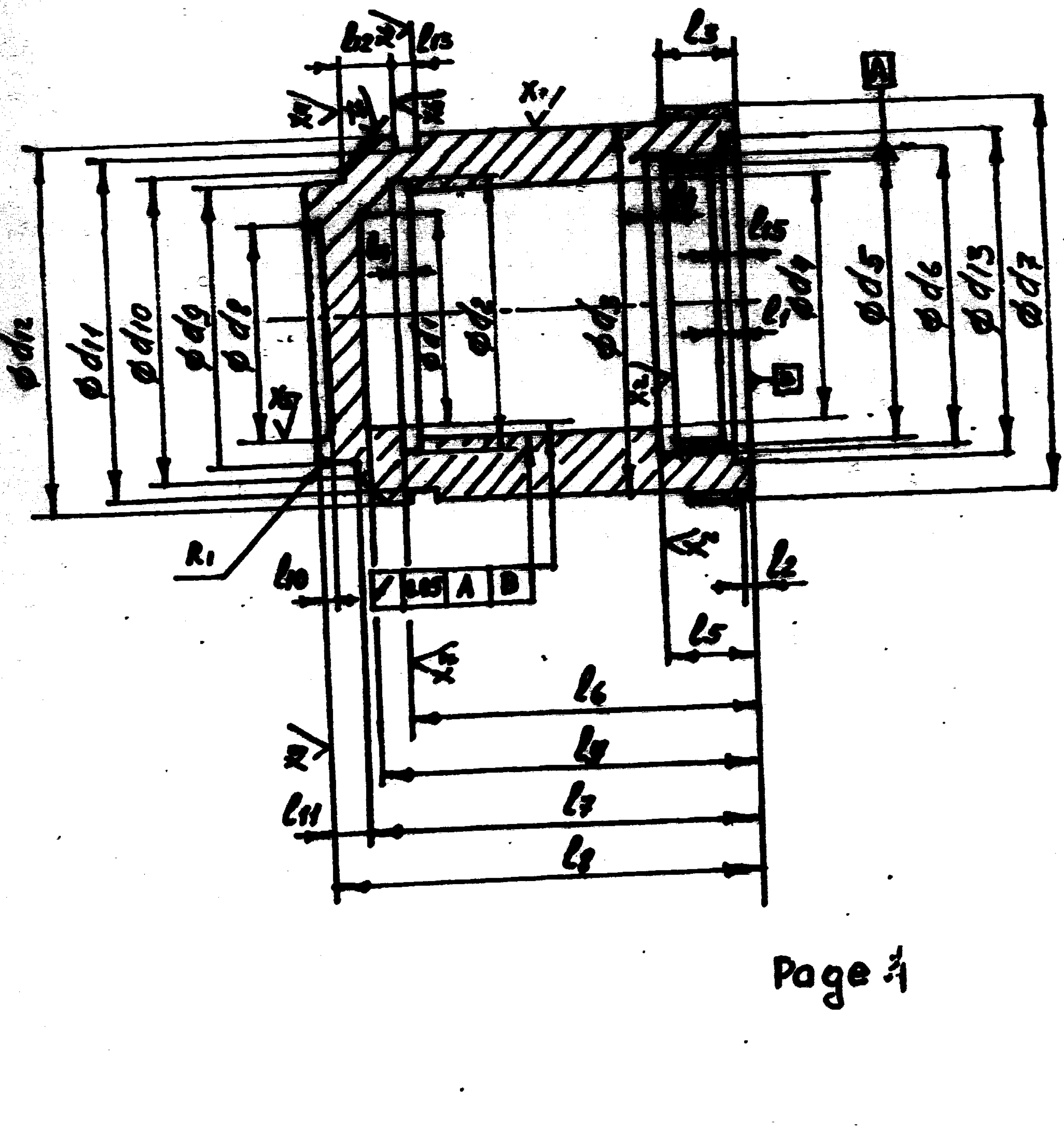
		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET - AND TABLE -	[illegible]	PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT BLANK	[illegible] 3-JAW CONCENTRIC CHUCK		
0002	TURN BUTT END		TOOL HOLDER ANGLE [illegible]	
0003	CENTRE DRILL		CENTRING DRILL [illegible]	
0004	DRILL [illegible]		DRILL [illegible]	SLIDING CALLIPERS
0005	TURN [illegible] BUTT END [illegible]			
0006	TURN [illegible]		CUTTING TOOL	SLIDING CALLIPERS
0007	TURN [illegible]		[illegible] TOOL	
0008	TURN [illegible]		CUTTING TOOL	SLIDING CALLIPERS
			SHEET 1	NUMBER OF SHEET

NO	OPERATION	EQUIPMENT	TOOLS	MEASURING TOOLS
[illegible]	TURN [illegible]		FACING TOOL	SLIDING CALLIPERS
[illegible]	TURN [illegible]		CUTTING TOOL	SLIDING CALLIPERS
[illegible]	TURN CHAMFER [illegible]		CHAMFER TOOL	
[illegible]	TURN [illegible]		[illegible]	
[illegible]	TURN [illegible]		[illegible]	
[illegible]	TURN CHAMFER [illegible]		CHAMFER TOOL	
[illegible]	TURN [illegible]		[illegible] TOOL	
[illegible]	TURN [illegible]			
[illegible]	TURN [illegible]			
[illegible]	TURN [illegible]			
[illegible]	TURN [illegible]			
[illegible]	TURN [illegible]			
[illegible]	TURN [illegible]			
[illegible]	[illegible]		[illegible]	SLIDING CALLIPERS
			SHEET [illegible]	NUMBER OF SHEET

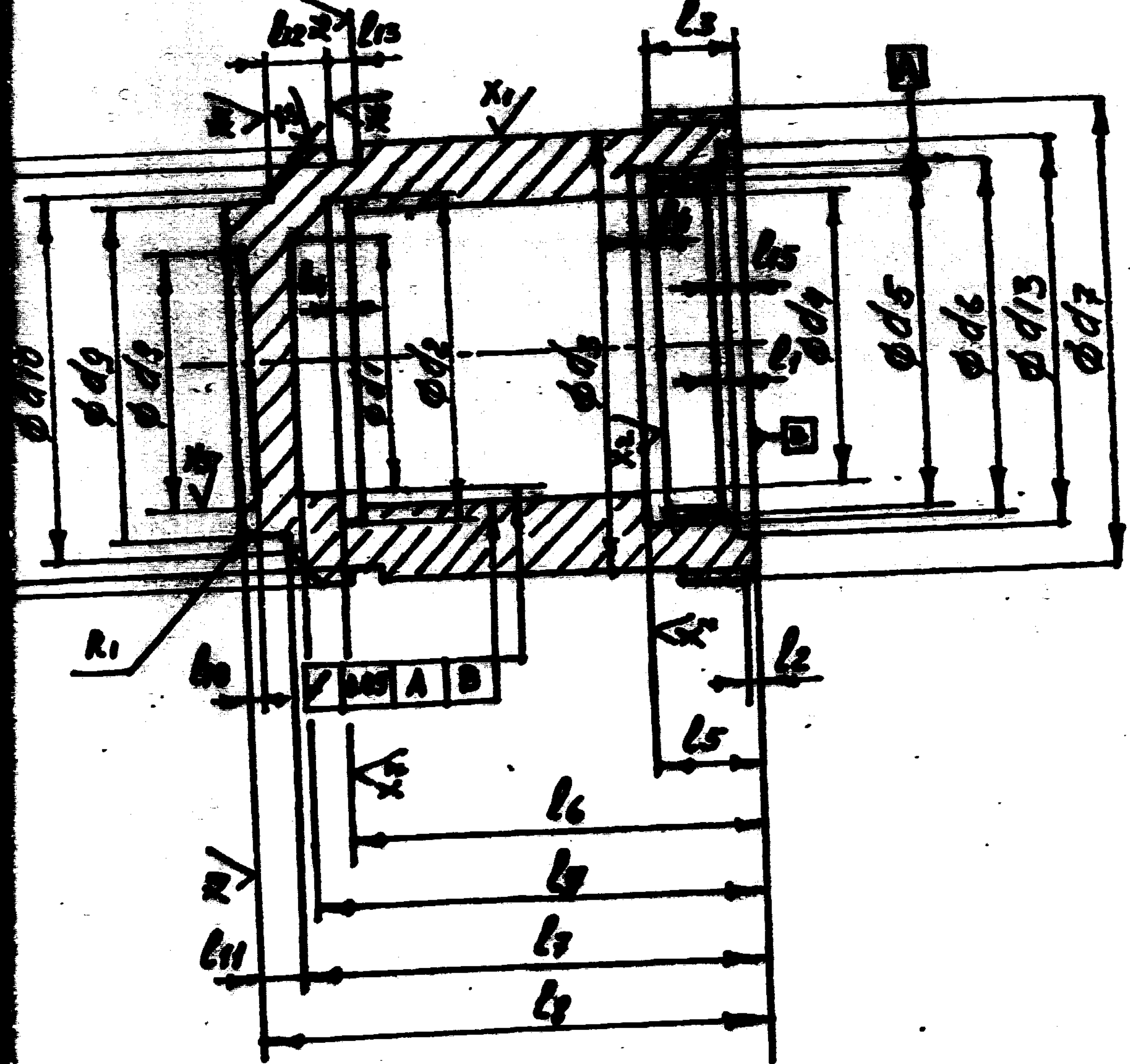
No	JOB STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	[illegible]			
0023	MOUNT [illegible]	[illegible]		
0024	TURN BUTT END FACE	LATHE TYPE [illegible]	FACING TOOL	SLIDING CALLIPERS
0025	TURN [illegible] [illegible]		[illegible] TOOL	
0026	TAKE OFF DETAILS [illegible] DETAILS IN FINISHING NOT LATE 24 HOURS			
0027	TURN [illegible]			

SHEET [illegible]	NUMBER OF SHEET


ℓ3
A
ℓ12
ℓ13
X1
ℓ15
ℓ1
ℓ4
ℓ9
Ød12
Ød11
Ød10
Ød9
Ød8
Ød1
Ød2
Ød3
Ød4
Ød5
Ød6
Ød13
Ød7
B
R1
ℓ10
ℓ2
0.05
A
B
ℓ5
ℓ6
ℓ8
ℓ7
ℓ11
ℓ8
45°

Page 1/1

COVER (23001?, 22001?, ...)



Page 3/1

SECTION 2

NUMBER OF DETAILS	DIMENSIONS																		
	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]																			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] TECHNOLOGY OF MANUFACTURING [illegible]

TABLE [illegible]

NUMBER OF DETAILS	DIMENSIONS													
	L10	L11	L12	L13	L14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2000009	0	0	0	0	0	-	1.6	-	-	-	-	-	-	1.6
2000015	0.5 [illegible]	2	0	0	0	1	1.6	1.6	-	1.6	2.2	-	-	1.6
2100012	0	0	0	0	0	0.2	0.4	-	0.4	-	-	-	-	0.4
2200015	0	0	0	0	0	-	0.4	1.6	0.4	-	-	-	-	0.4 [illegible]
2300017*														
2400009	0	0	[illegible]	1.0	1.8	1	0.2	4.0	0.2	-	-	6.0	1.6	1.6 [illegible]

			OPERATION	
OPERATION CHART		NUMBER OF PIECES	BLANK	
		[illegible]		
		[illegible]		
		[illegible]		
		[illegible]	PROFILE	DIMENSIONS
		[illegible]		
N°	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT [illegible]	[illegible] 3-JAWS CONCENTRIC CHUCK		
0002	TURN [illegible]		TOOL-HOLDER	
0003	CENTRE DRILL		CENTRING DRILL [illegible]	
0004	DRILL OPENING [illegible]		DRILL [illegible]	SLIDING CALLIPERS
0005	TURN OPENING [illegible]		CUTTING TOOL	
0006	[illegible]		[illegible]	
0007	TURN [illegible]		TOOL-HOLDER	SLIDING CALLIPERS
0008	CUTTING OFF [illegible]			
			SHEET 1	NUMBER OF SHEET

Nr	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0008	CUTTING OFF [illegible]			
0009	BLUNT SHARP EDGES			
0010	DELUBRICATION AVOID OXIDATION BLACK			

SHEET [illegible]	NUMBER OF SHEET

[illegible] TABLE.

NUMBER OF DETAILES	DIMENSION				
	[illegible]	[illegible]	[illegible]	[illegible]	COATING
210011	[illegible]	[illegible]	5.5±0.05	-	ANODIZING OXIDATION BLACK
220017	[illegible]	[illegible]	[illegible]	+	ANODIZING OXIDATION BLACK
230023	[illegible]	[illegible]	[illegible]	+	ANODIZING OXIDATION BLACK
240005	24.5h11	[illegible]	3h11	-	ANODIZING OXIDATION BLACK
240006	24.5h11	[illegible]	4.7h11	-	ANODIZING OXIDATION BLACK

		OPERATION	
OPERATION CHART	NUMBER OF PIECES	BLANK	
SEE SHEET FOUR	[illegible] [illegible] [illegible] [illegible] [illegible]	PROFILE	DIMENSIONS
		ROUND BAR BRASS	[illegible]

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT BLANK	CHAMBLIN-LEE 3-JAWS CONCENTRIC CHUCK		
0002	TURN BUTT END		TOOLHOLDER APPROACH ANGLE [illegible]	
0004	CENTRE DRILL		CENTRING DRILL [illegible]	
0005	DRILL DIAMETER [illegible] SEE TABLE 1		DRILL [illegible]	
0006	TURN OPENING [illegible] FOR THE THREE PASSAGES SEE TABLE 1		CUTTING TOOL	
0007	TURN OPENING [illegible] EXCEPT FOR DETAIL NUMBER [illegible] SEE TABLE 1		BORING CUTTER	INSIDE CALLIPERS SLIDING CALLIPERS
0008	CUTTER OPENING [illegible] LONG, SEE TABLE 1.		BORING CUTTER	INSIDE CALLIPERS SLIDING CALLIPERS
0009	TURN [illegible] GROOVE		CUTTER GROOVE	

SHEET 1	NUMBER OF SHEET [illegible]

NO.	OPN. STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0010	TURN CONE D2		FORM CUTTER	
0011	TURN CONE D1		FORM CUTTER	
0012	TURN FLAT 0.5x45°		FORM CUTTER 45°	
0013	SCREW CUTTER [illegible]		FORM CUTTER [illegible]	
0005	TURN [illegible] LENGTH		TOOLHOLDER APPROACH ANGLE [illegible]	
0014	CUT OFF [illegible] LENGTH		DETACHING CUTTER	SLIDING CALLIPERS
			SCRAPER	
0015	BLUNT SHARP EDGES			

SHEET [illegible]	NUMBER OF SHEET [illegible]

TABLE 1

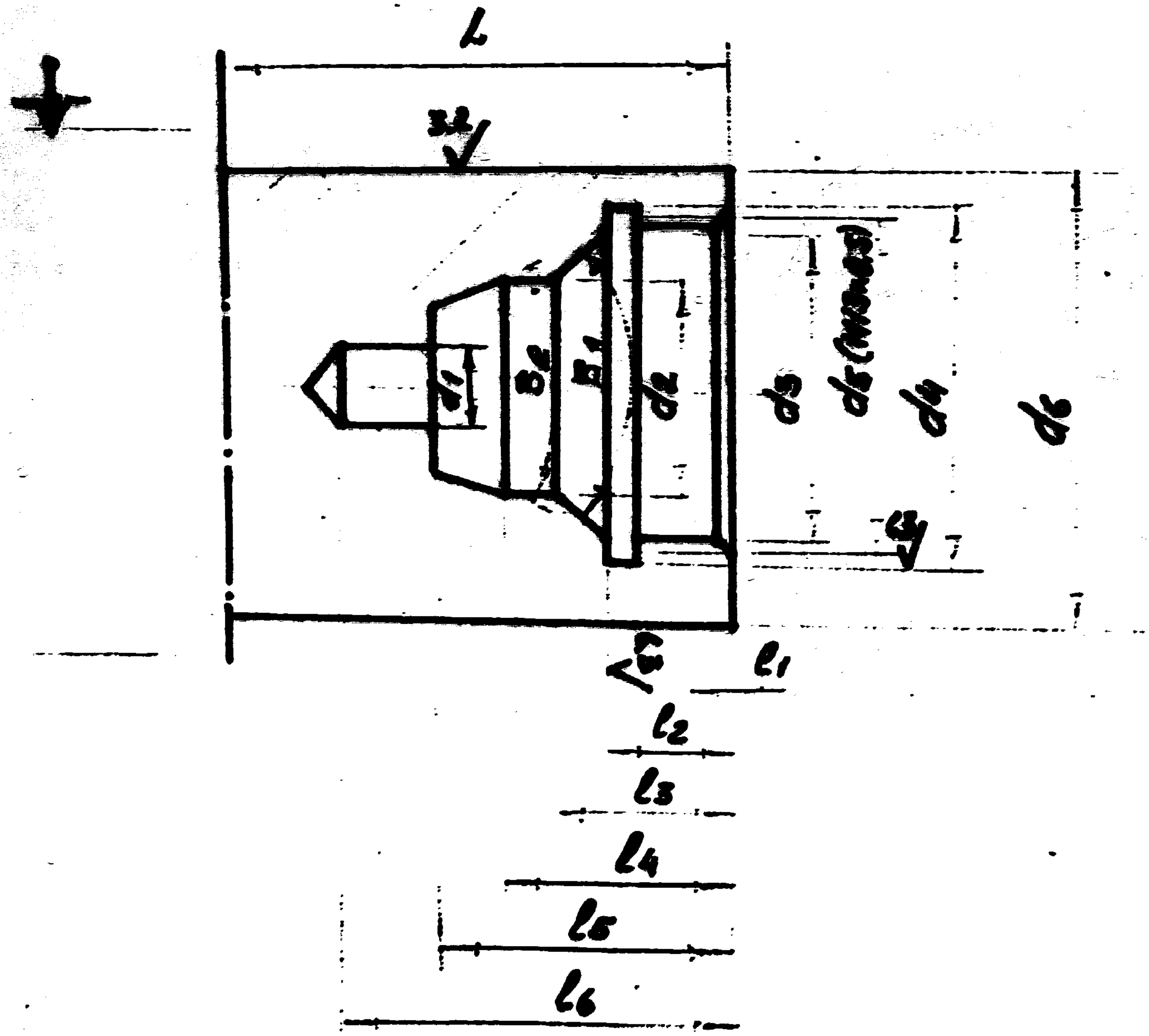
NUMBER OF DETAILS															
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	-

TABLE [illegible]

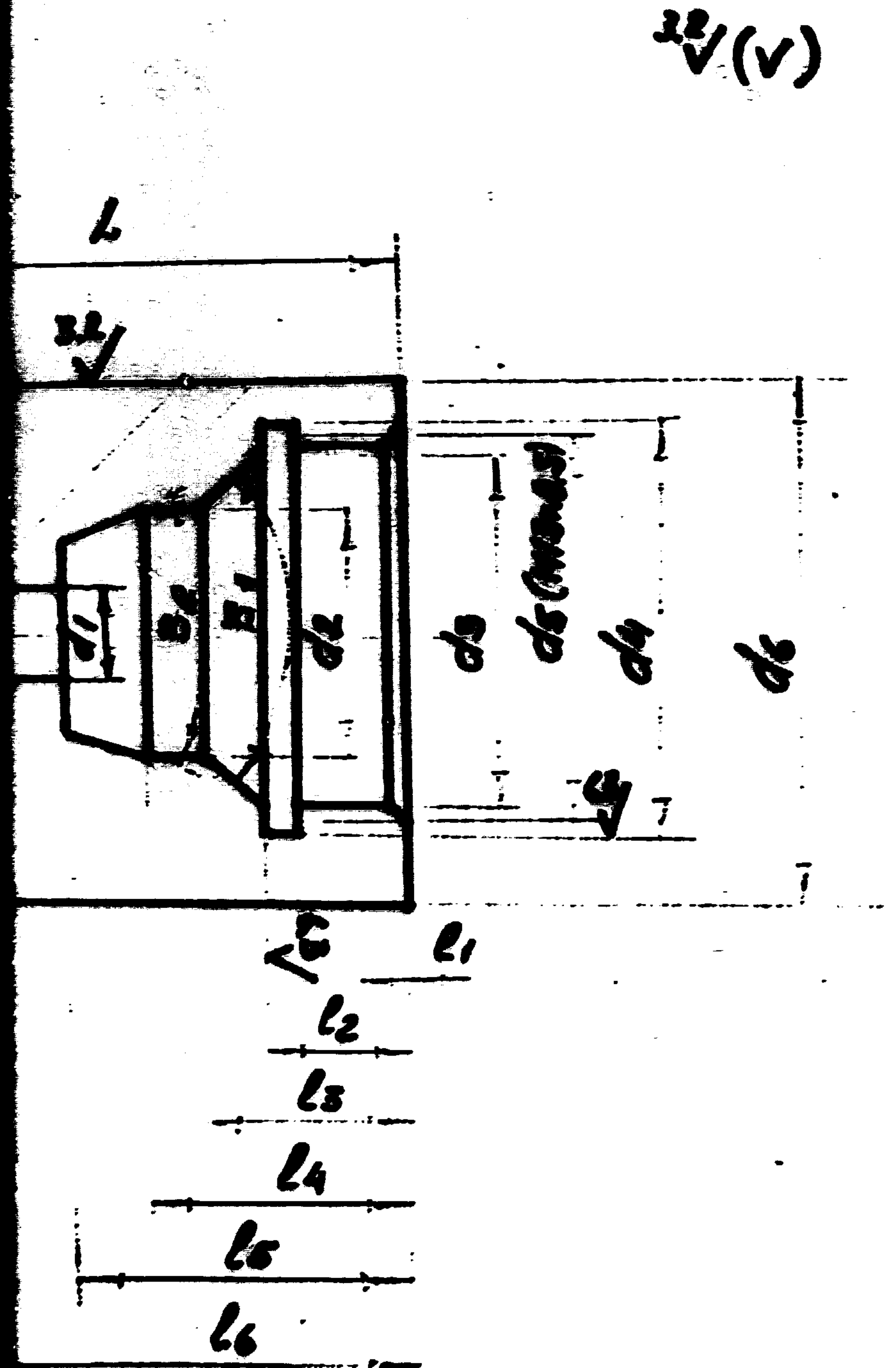
NUMBER OF DETAILS																		
230009	[illegible]	–	–	[illegible]	–	–	[illegible]	–	–	–	–	–	[illegible]	[illegible]	[illegible]	[illegible]	–	[illegible]
230011	[illegible]	[illegible]	–	[illegible]	[illegible]	[illegible]	–	[illegible]	[illegible]	–	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	–
230012	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	–	–	[illegible]	[illegible]	[illegible]	–	[illegible]	[illegible]	[illegible]	–	[illegible]	–
230013	[illegible]	[illegible]	[illegible]	[illegible]	–	[illegible]	–	[illegible]	[illegible]	[illegible]	[illegible]	–	[illegible]	[illegible]	[illegible]	[illegible]	–	–
230014	[illegible]	[illegible]	[illegible]	[illegible]	–	–	[illegible]	–	[illegible]	[illegible]	[illegible]	–	[illegible]	[illegible]	[illegible]	[illegible]	–	[illegible]

2300
2300
2300
2300
2300

$^{3.2}\sqrt{}(\sqrt{})$

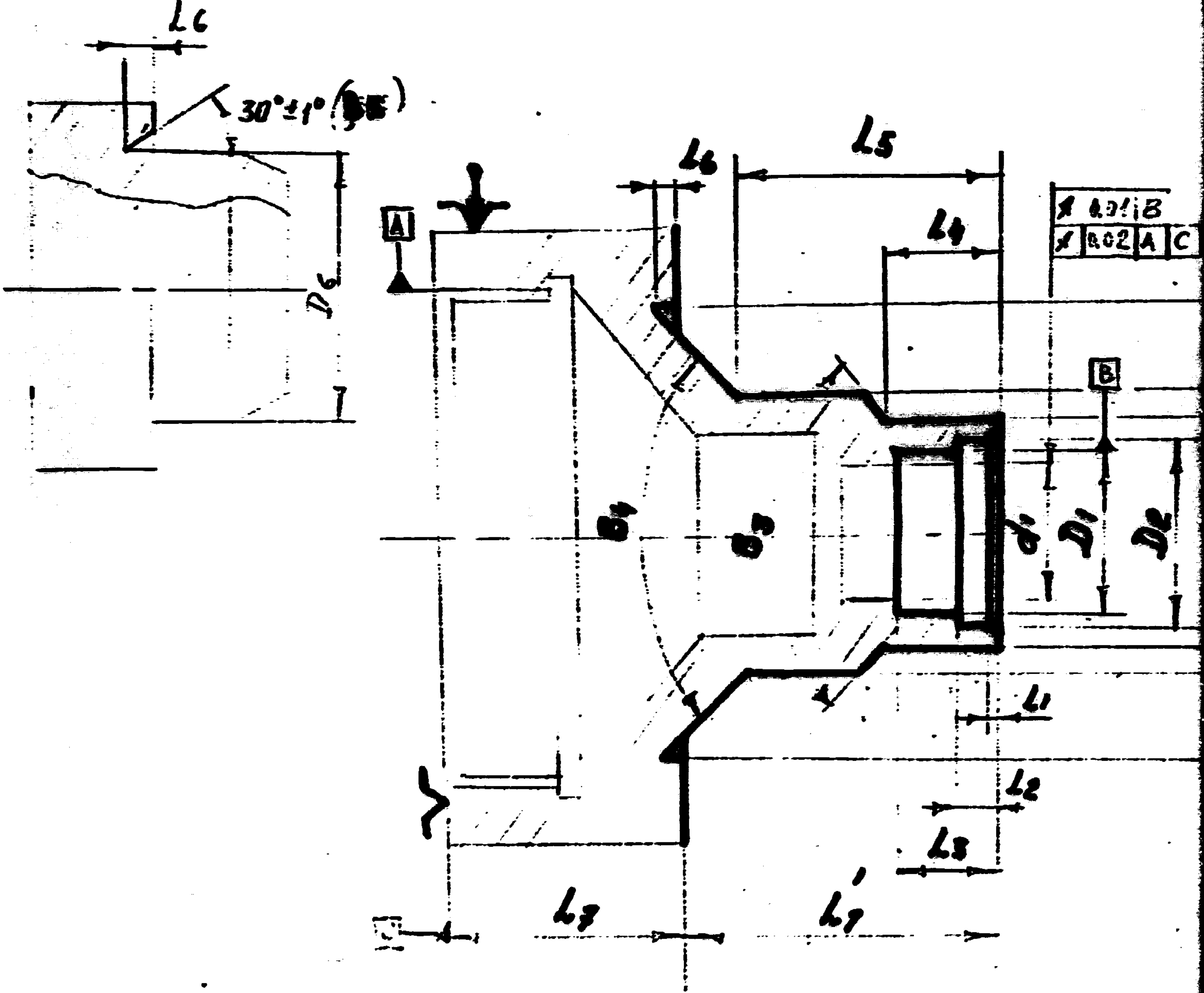


230009
230011
230012
230014
230013



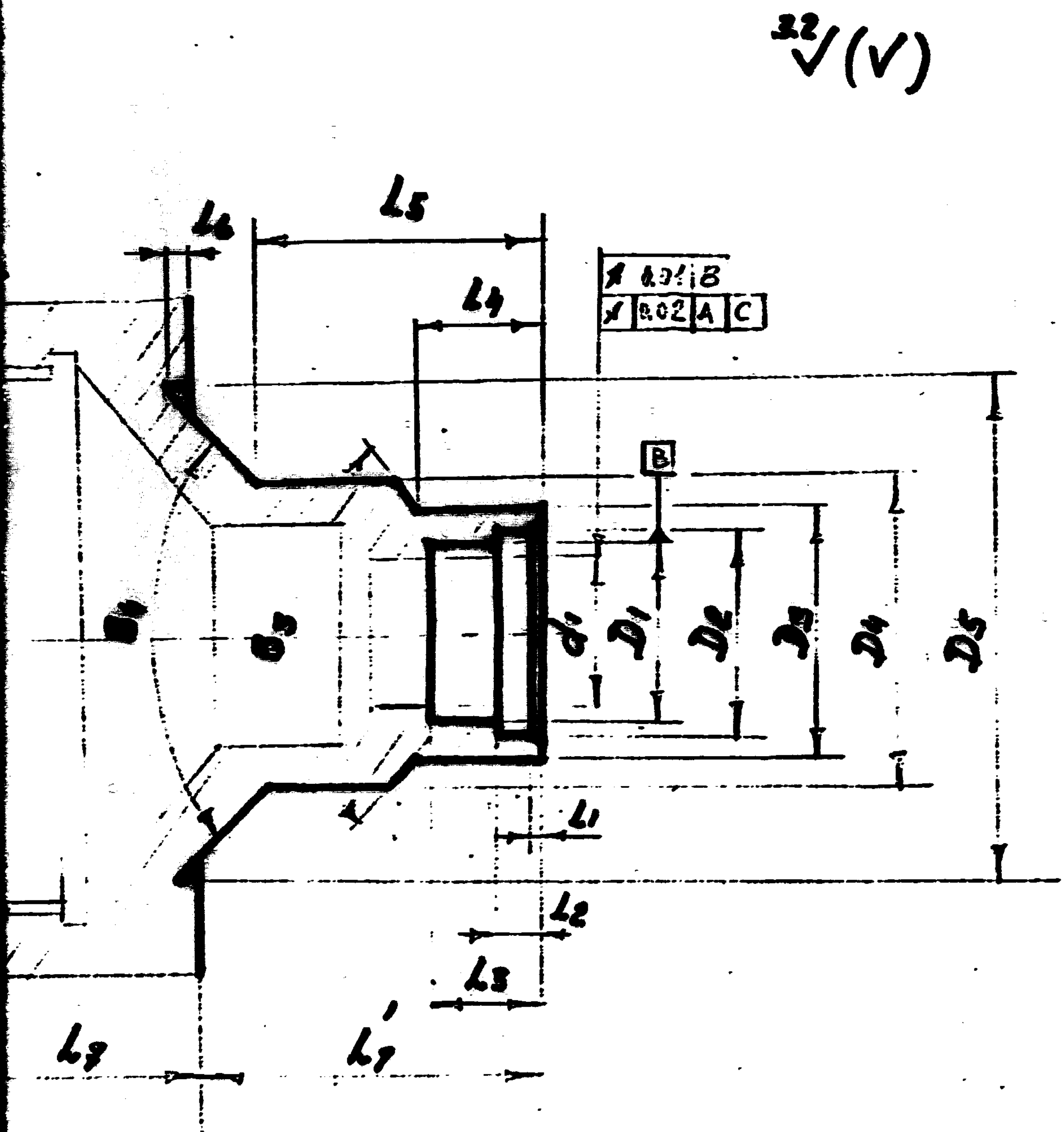
SECTION 2

Fos 230.009
230.014



SECTION 1

Po



SECTION 2

		OPERATION	
OPERATION SHEET	NUMBER OF PIECES	BLANK	
SEE SHEET 2	[illegible] [illegible] [illegible] [illegible] [illegible]	PROFILE	DIMENSIONS
			15.5ØL

N°	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT BLANK	[illegible] COLLETS TYPE Ø15.5 MM		
0002	TURN BUTT END [illegible] LONG		TOOLHOLDER APPRO-ACH ANGLE 90°	SLIDING CALLIPERS
0003	CENTRE DRILL ONLY FOR [illegible]		CENTRING DRILL	
0004	DRILL DIAMETER Ø1.2MM		DRILL Ø1.2MM	
0005	TURN Ø[illegible] WITH [illegible] LONG FOR [illegible] AND [illegible] TURN [illegible]		TOOLHOLDER APPRO-ACH ANGLE 90°	SLIDING CALLIPERS
0006	TURN Ø[illegible] ON 15 LONG		TOOLHOLDER APPRO-ACH ANGLE 90°	SLIDING CALLIPERS
0007	TURN Ø[illegible] ON 14 LONG		TOOLHOLDER APPRO-ACH ANGLE 90°	SLIDING CALLIPERS
0008	TURN CONE [illegible]		FORM CUTTER	

SHEET 2	NUMBER OF SHEET [illegible]

N	WORK STEP	EQUIPMENT	TOOL	MEASURING TOOL
009	TURN [illegible]		FORM CUTTER	
010	TURN ANGLE SLOT [illegible] LONG		FORM CUTTER	
011	TURN [illegible] LONG			
012	CUTTER OPENING [illegible] LONG		BORING CUTTER	INSIDE CALLIPERS SLIDING CALLIPERS
013	CUTTER OPENING [illegible] LONG		BORING CUTTER	INSIDE CALLIPERS SLIDING CALLIPERS
014	TURN [illegible] LONG			
015	TURN FLAT [illegible]		CUTTER ANGLE 45°	
016	BLUNT SHARP EDGES		SCRAPER	
017	WASH DETAILS			
018	ANNEALING [illegible] HOURS			
019	REMOVE [illegible]			
020	CHEMICAL OXIDATION			
021	CONTROL			

SHEET [illegible] NUMBER OF SHEET [illegible]

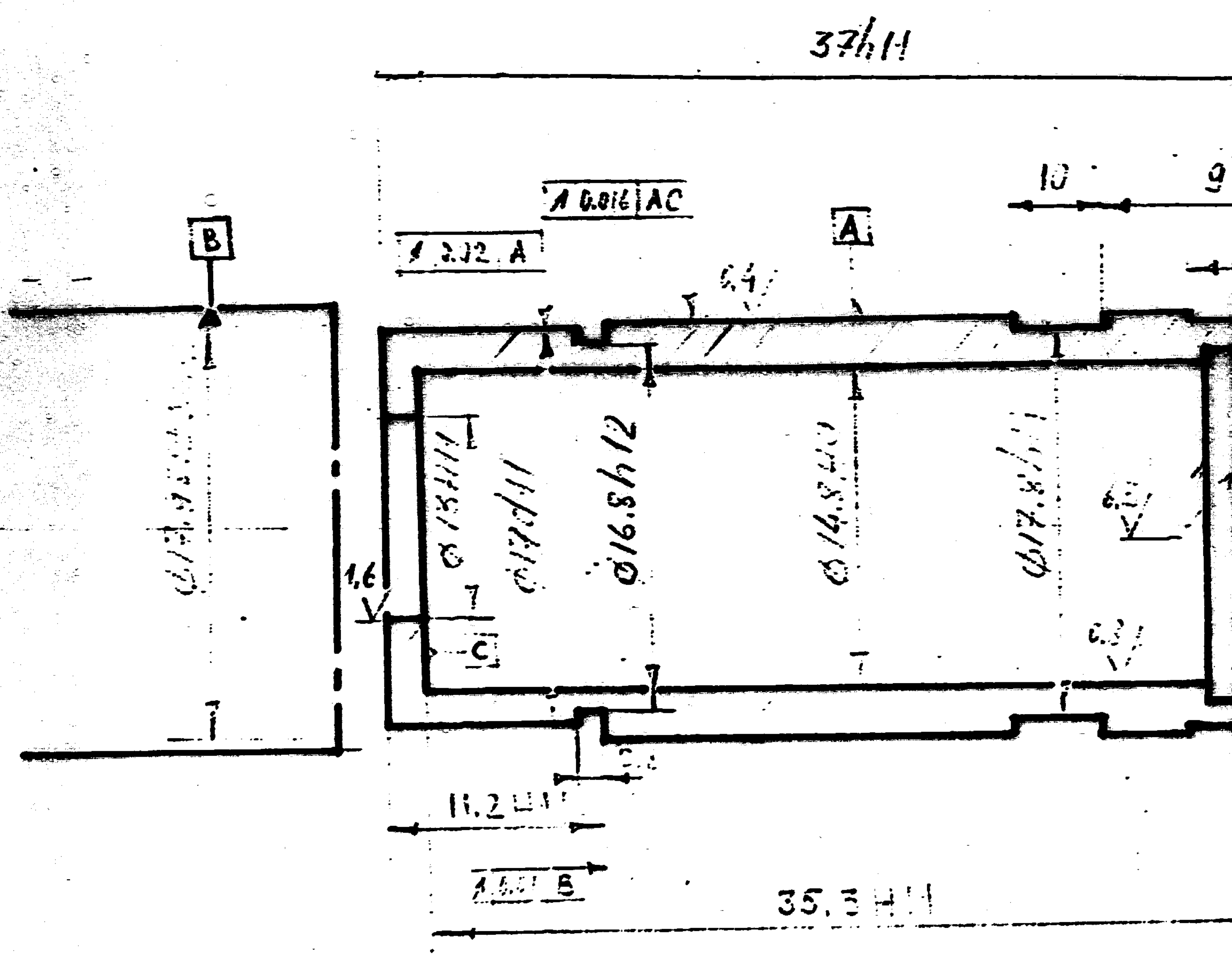
OPERATION ONE

OPERATION CHART	NUMBER OF PIECES	BLANK	
	E30C15		
		PROFILE	DIMENSIONS
			21x210

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0001	MOUNT STATE PURCHASED	[illegible] 3-JAWS CONCENTRIC CHUCK		
0002	TURN BUTT END		TOOLHOLDER APPROACH ANGLE 90	
0003	CENTRE DRILL		CENTRING DRILL [illegible]	
0004	DRILL OPENING [illegible] 35mm LONG		DRILL [illegible]	SLIDING CALLIPERS INSIDE CALLIPERS
0005	TURN [illegible] ON 35mm LONG		TOOLHOLDER APPROACH ANGLE 90	
0006	TURN [illegible] ON 35mm LONG		TOOLHOLDER APPROACH ANGLE 90	SLIDING CALLIPERS MICROMETER
0007	TURN [illegible] ON 5mm LONG		TOOLHOLDER APPROACH ANGLE 90	SLIDING CALLIPERS
0008	TURN [illegible] GIVING DIMENSIONS 3 AND [illegible]		DETACHABLE CUTTER	SLIDING CALLIPERS
			SHEET 1	NUMBER OF SHEETS [illegible]

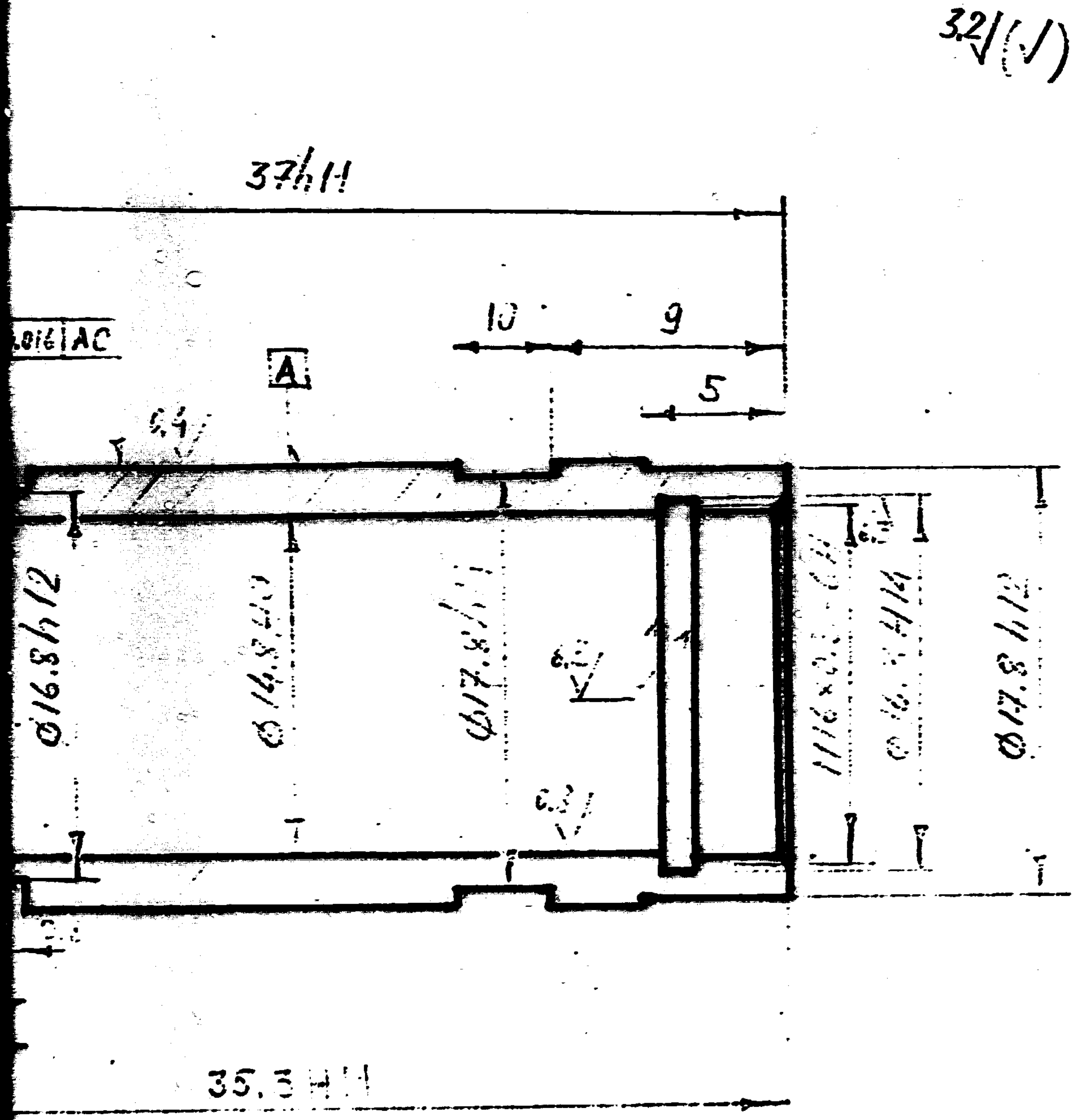
N	WORK STEP	EQUIPMENT	TOOL	MEASURING TOOL
009	CUTTING OFF [illegible] ON [illegible] LONG		DETACHABLE CUTTER	SLIDING CALLIPERS
010	TURN SLOT ⌀16.8[illegible] ON [illegible] LONG		CUTTER SLOT TOOL [illegible]	
011	TURN ⌀17h11 FROM GROOVE TO GROOVE		FORM CUTTER	SLIDING CALLIPERS
012	CUTTER OPENING ⌀15.8[illegible] ON ALL LONG		CUTTER TOOL FOR ANGLE	SLIDING CALLIPERS
013	CUTTER OPENING ⌀14.8[illegible] ON L=35.8[illegible]		CUTTER TOOL FOR ANGLE	SLIDING CALLIPERS DEPTHMETER
014	CUTTER OPENING ⌀15.8H8 ON 4mm LONG		CUTTER TOOL FOR ANGLE	SLIDING CALLIPERS
015	TURN GROOVE ⌀16.8[illegible]		SLOT CUTTER	
016	TURN FLAT 0.5×45°		CUTTER 45° ANGLE	
017	TURN SCREW M18×0.5-[illegible]		SCREW CUTTER	SCREW GAGE
018	TURN ⌀17.[illegible]		DIAMOND CUTTER	MICROSCOPE
019	BLUNT SHARP EDGES		SCRAPER, FILE	
020	CUT OFF ON [illegible] LONG		CUTTER TOOL	SLIDING CALLIPERS

SHEET 2	NUMBER OF SHEET [illegible]



SECTION 1

230.015



SECTION 2

OPERATION TWO

OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	[illegible]	PROFILE	DIMENSIONS
			ø17.985+0.035 IT 11

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	DRILL LATHE, DIVIDING ATTACHMENT.		
		ARBOR WITH NUT		
002	DRILL POLE OPENING ø1.3+0.2 BEARING DIMENSIONS 5±0.2		DRILL ø1.3mm	SLIDING CALLIPERS
003	DRILL OPENING ø1.3H11		DRILL ø1.3mm	
004	BLUNT SHARP EDGES		DRILL ø3.5mm	
005	MILL 4±0.5±0.2			
006	SCREW M1.6-6H		TAP M1.6-6H	

SHEET [illegible]	NUMBER OF SHEET [illegible]

	OPERATION FREE

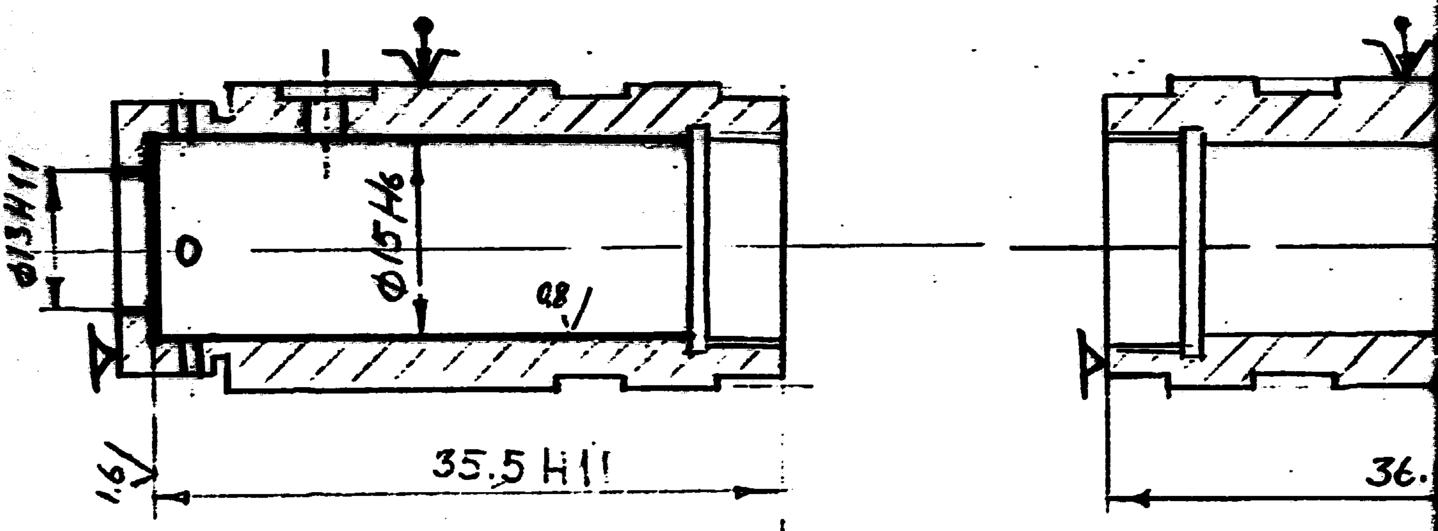
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	E00015		
		PROFILE	DIMENSIONS
			Ø17,988+0,0E[illegible] 37 11

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	CHAUBLIN-125 COLLET TYPE [illegible]		
002	TURN Ø15h[illegible] ON 35.5h11 LONG WITH BUT BUT		DIAMOND CUTTER	INSIDE CALLIPERS
003	TURN BORING [illegible]			
004	MOUNT THE BLANK			
005	TURN BUTT END BEARING DIMENSION [illegible]h11 FOR THE TWO PASSAGES AND [illegible]		TOOLHOLDER APPRO-ACH ANGLE CONFORM	MICROMETER
			CUTTER	
006	TURN CHAMFER 1.0x[illegible] DELIBERATE COAT THE SURFACE [illegible] WITH [illegible]		FORM CUTTER [illegible]	

SHEET 5	NUMBER OF SHEET 6

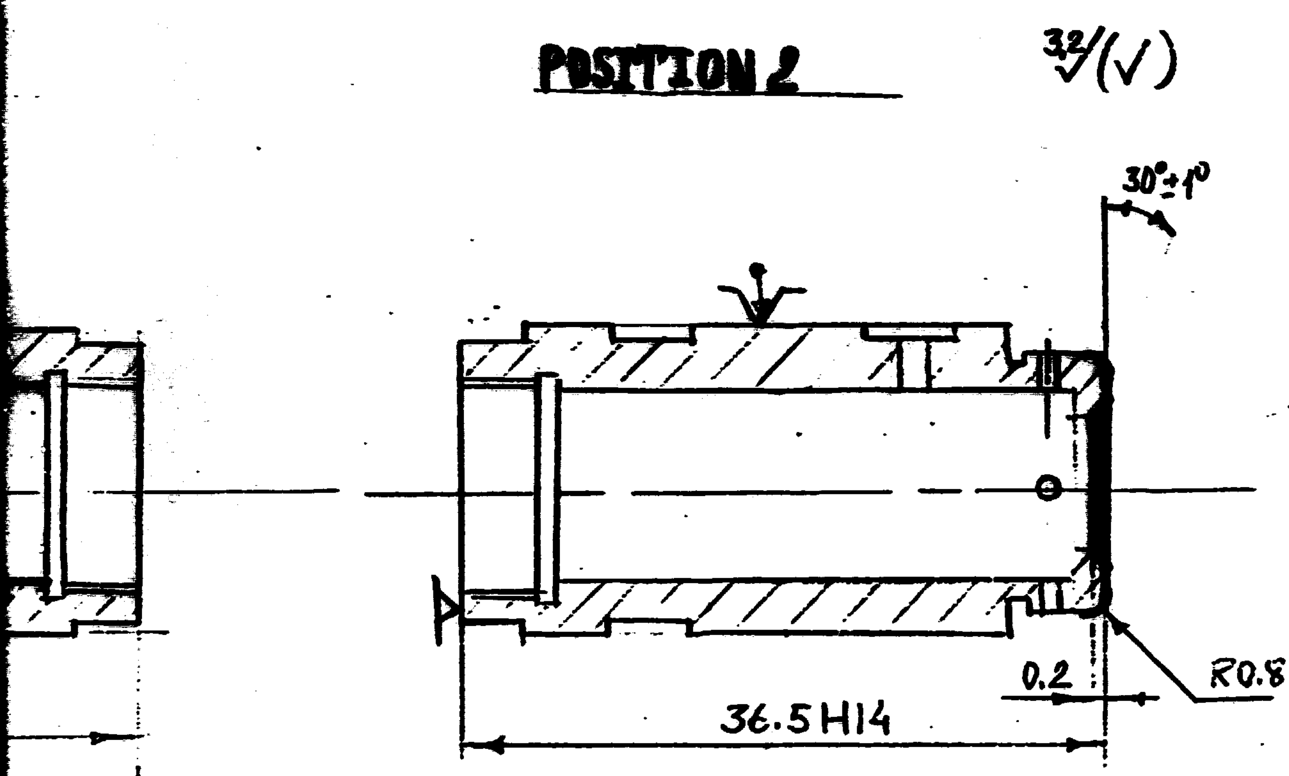
POSITION 1

POSITION



SECTION 1

POSITION 2

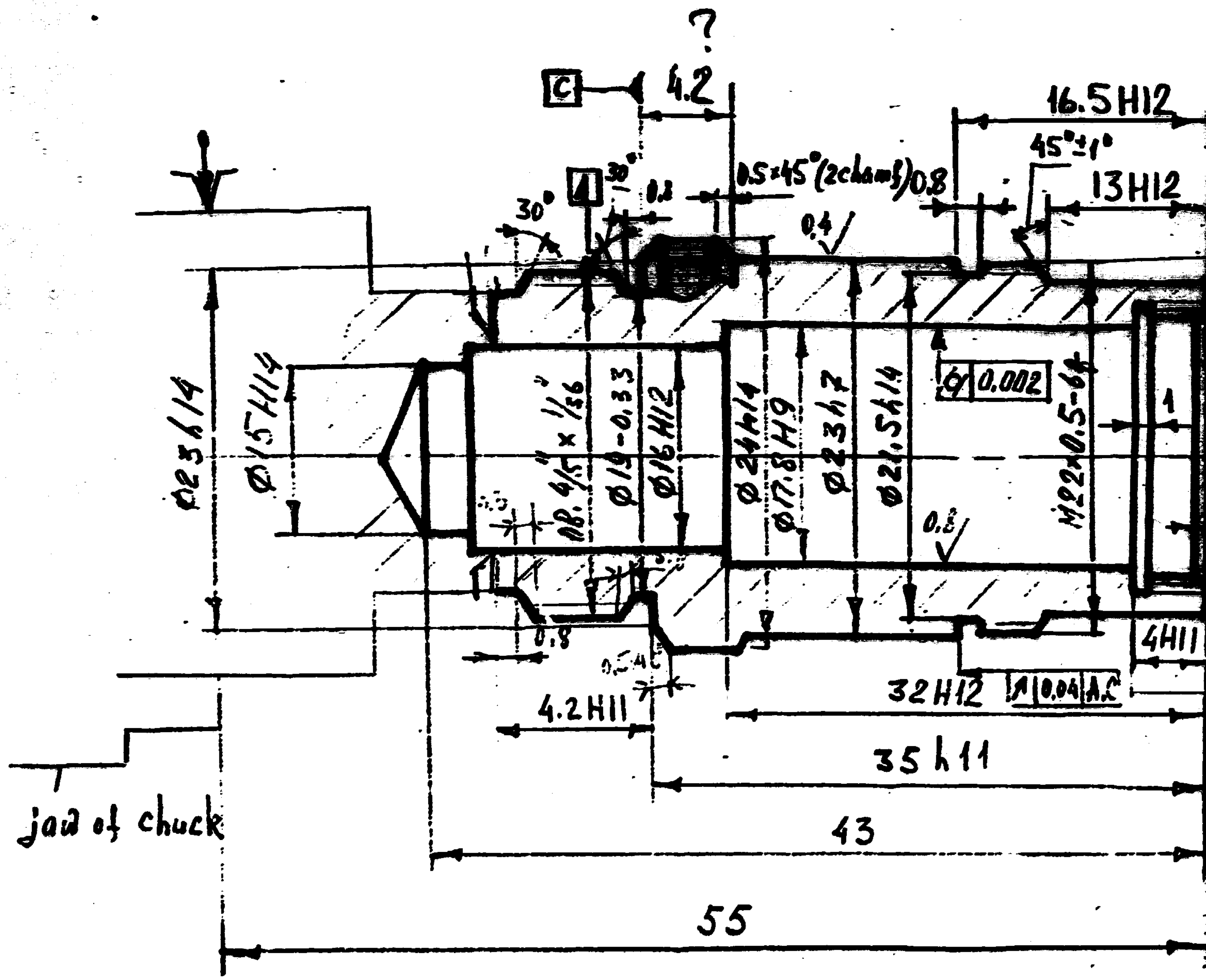


SECTION 2

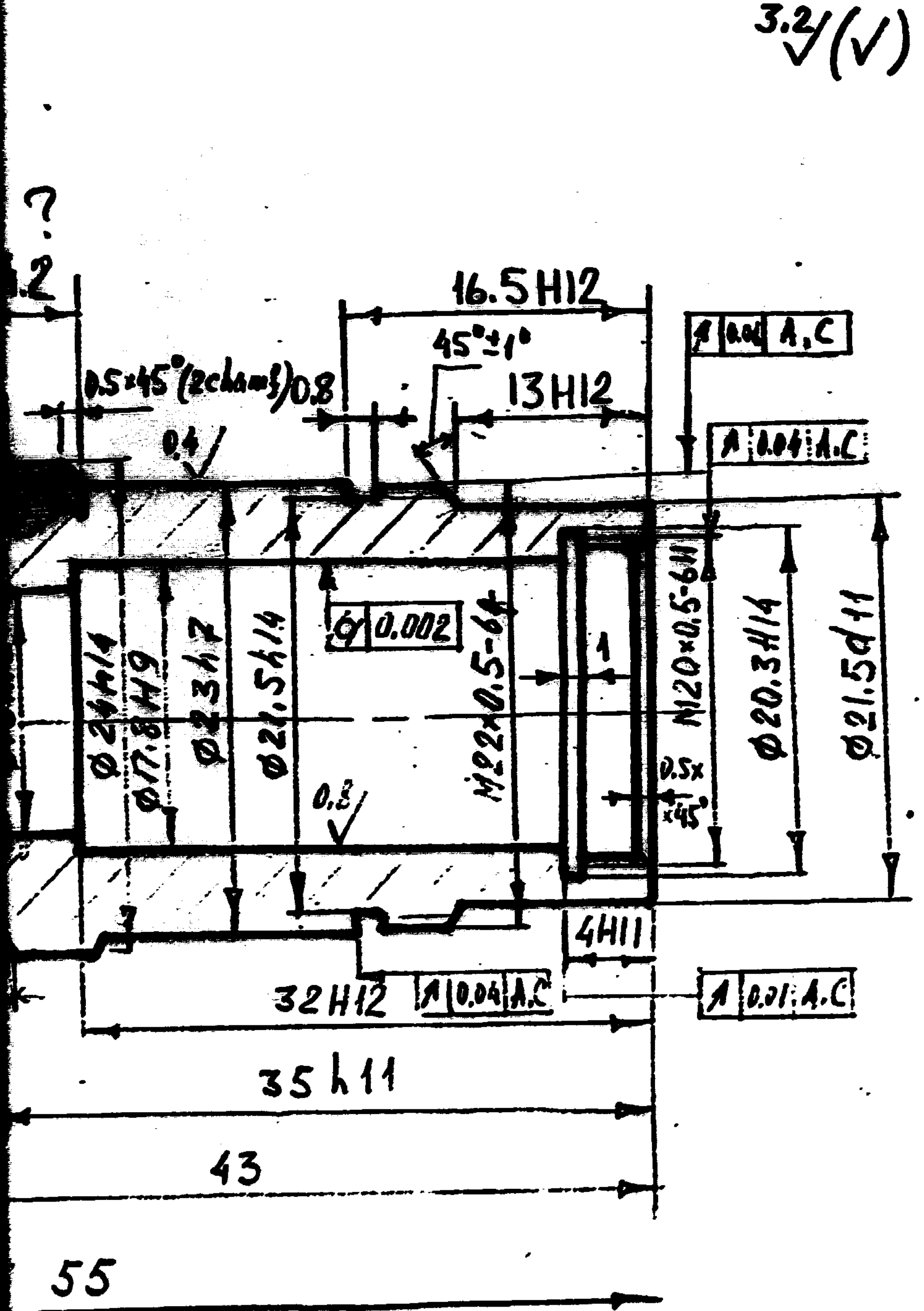
			OPERATION [illegible]	
OPERATION CHART		NUMBER OF PIECES	BLANK	
[illegible] SHEET [illegible]		[illegible]		
			PROFILE	DIMENSIONS
			ROUND BAR BRASS	[illegible]
N°	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	[illegible]-LATHE [illegible] TAKE [illegible] CHUCK		
002	TURN BUTT END		TOOL-HOLDER [illegible] 45° ANGLE [illegible]	
003	CENTRE DRILL		CENTERING DRILL BIT	
004	DRILL [illegible]		DRILL BIT	SLIDING CALLIPERS
005	TURN [illegible]		TOOL-HOLDER [illegible] 45° ANGLE [illegible]	SLIDING CALLIPERS
006	TURN [illegible]			
007	ROLL [illegible]		[illegible] KNURLING	
008	TURN [illegible]		TOOL-HOLDER [illegible] 45° ANGLE [illegible]	SLIDING CALLIPERS
			SHEET [illegible]	[illegible] OF SHEETS [illegible]

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	TURN [illegible] WITH CHAMFER [illegible]		TOOL-HOLDER [illegible] ANGLE [illegible]	
010	TURN SLOT [illegible]		FORM CUTTER	
011	TURN [illegible] BEARING DIMENSION [illegible]		FORM CUTTER	SLIDING CALLIPERS
012	TURN SLOT [illegible] BEARING DIMENSIONS [illegible] WITH TURN END		FORM CUTTER	SLIDING CALLIPERS
013	TURN [illegible]		FORM CUTTER	SLIDING CALLIPERS
014	TURN [illegible]		FORM CUTTER	SLIDING CALLIPERS
015	TURN [illegible]		FORM CUTTER	
016	TURN TWO CHAMFERS [illegible]		CUTTER 45° ANGLE	
017	TURN TWO CHAMFERS [illegible]		CUTTER 30° ANGLE	
018	TURN SCREW [illegible]		SCREW CUTTER	
019	TURN SCREW [illegible]		SCREW CUTTER	
020	CUT OPENING [illegible]		CUTTER TOOL [illegible] ANGLE	SLIDING CALLIPERS CENTIMETER
021	CUT OPENING [illegible]		CUTTER TOOL [illegible] ANGLE	SLIDING CALLIPERS CENTIMETER
022	CUT OPENING [illegible]		CUTTER TOOL [illegible] ANGLE	SLIDING CALLIPERS CENTIMETER
			SHEET [illegible]	NUMBER OF SHEETS [illegible]

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
023	TURN SLOT [illegible]		FORM CUTTER TOOL GROOVING TOOL	
024	TURN CHAMFER [illegible]		CHAMFERING TOOL	
025	TURN SCREW M[illegible]		[illegible] SCREW TOOL	
026	BLUNT SHARP EDGES		SCRAPER,FILE	
027	CUT OFF THE PIECE [illegible] BUTT END,[illegible] DIMENSION [illegible]		TOOL	


?
C
4.2
16.5 H12
45°±1°
13 H12
0.5×45° (2 chamf) 0.8
30°
0.4
Ø23 h14
Ø15 H14
Ø19-0.33
Ø16 H12
Ø24 h14
Ø17.8 H9
Ø23 h7
Ø21.5 h14
0.002
M22×0.5-6H
0.8
4H11
32 H12
0.04 A,C
4.2 H11
35 h11
43
55
jaw of chuck

SECTION 1


3.2 √(√)
16.5H12
45°±1°
0.5×45° (2 chamf.)
0.8
13H12
0.4
0.8
Ø24h14
Ø17.8H9
Ø23h7
Ø21.5h14
M22×0.5-6h
M20×0.5-6H
Ø20.3H14
Ø21.5d11
0.002
0.5×45°
4H11
32H12
A 0.04 A,C
A 0.01 A,C
35h11
43
55

SECTION 2

			OPERATION	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
		[illegible]	SEE SHEET 4	
			PROFILE	DIMENSIONS
N	OP. STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT STATE PURCHASES	[illegible]-125 EX- PENDING ARBORS TYPE [illegible]		
		[illegible] [illegible], LENGTH [illegible]		
002	TURN CHAMFERS 0.5x45°		CHAMFERING TOOL	
003	CUT GROOVE [illegible] BEARING DI- MENSION [illegible]		GROOVING TOOL	
004	TURN [illegible]		FEMALE CUTTER TOOL	
005	TURN SCREW M17x0.5-6H		FEMALE SCREW TOOL	
006	BLUNT SHARP EDGES		SCRAPER, FILE	
			SHEET 5	NUMBER OF SHEETS [illegible]

OPERATION DRAFT	NUMBER OF PIECES	OPERATION	
		BLANK	
		SEE SHEET 5	
		PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	MILLING MACHINE		
002	MILL SLOT 5H11, BEARING DIMENSIONS 5 AND 7mm	DIVIDING ATTACHMENT EXPENDING	MILLING TOOL ø3mm	SLIDING CALLIPERS
		ARBOR ø17.8x35		
003	BLUNT SHARP EDGES		SCRAPER, FILE	

SHEET [illegible]	NUMBER OF SHEET [illegible]

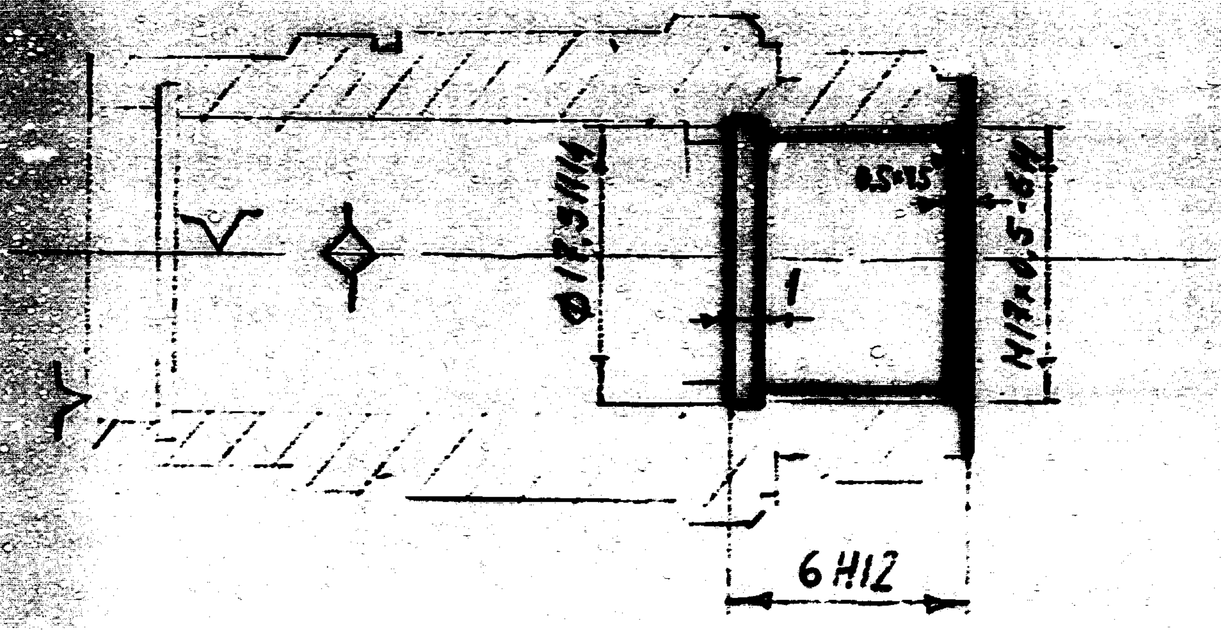
			OPERATION	
C	OPERATION DRAFT	NUMBER OF PIECES	BLANK	
		200016		
			PROFILE	DIMENSIONS

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN-135		
002	TURN [illegible] FOR THE PASSAGES	[illegible]	DIAMOND TOOL	MICROSCOPE DEPTH-METER CONTROL AP-
	OPERATION E RELUBRICATE			DIP INDICATOR <0.001
	COAT THE SURFACE [illegible] WITH [illegible]			

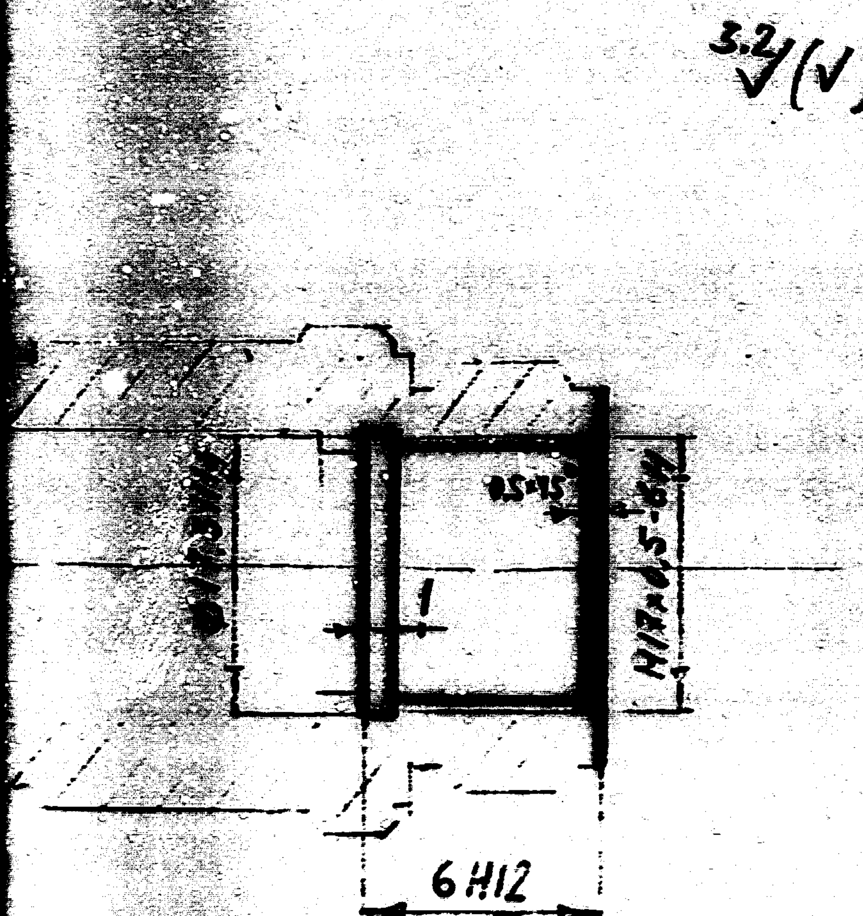
SHEET [illegible]	NUMBER OF SHEET [illegible]

230.016 Operation [illegible]

3.2 √(√)



SECTION 1



SECTION 2

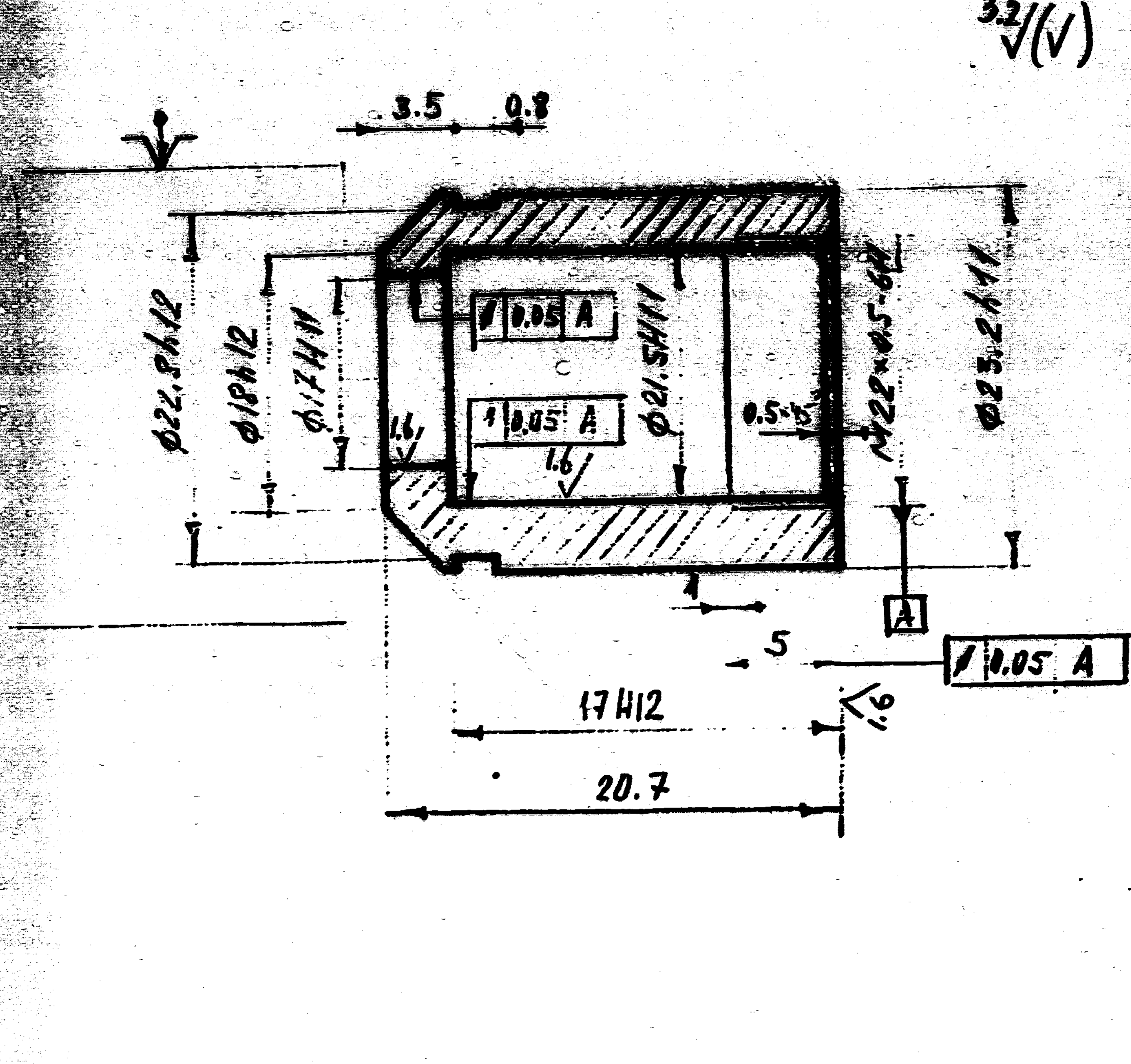
OPERATION DRAFT	NUMBER OF DETAILES	OPERATION	
		BLANK	
	230017 (COVER)	PROFILE	DIMENSIONS
		ROUND BAR ALUMINIUM ALLOY	

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN-125 3-JAWS CONCENTRIX CHUCK		
002	TURN BUTT END		TOOLHOLDER	
003	CENTRE DRILL		CETRING DRILL ø2mm	
004	DRILL OPENING ø15mm ON 25mm LONG		DRILL ø15mm	SLIDING CALLIPERS
005	TURN ø20.8h11 ON 25mm LONG		TOOLHOLDER	SLIDING CALLIPERS
006	TURN GROOVE 3H14 IN DIMENSION 20,7h12 ø18H13		GROOVE TOOL	
007	TURN GROOVE ø22.3±0.2 L=3.7mm		GROOVE TOOL	
008	TURN (45° BEARING ø18-13		FORM TOOL	[illegible]

SHEET 1	NUMBER OF SHEET 3

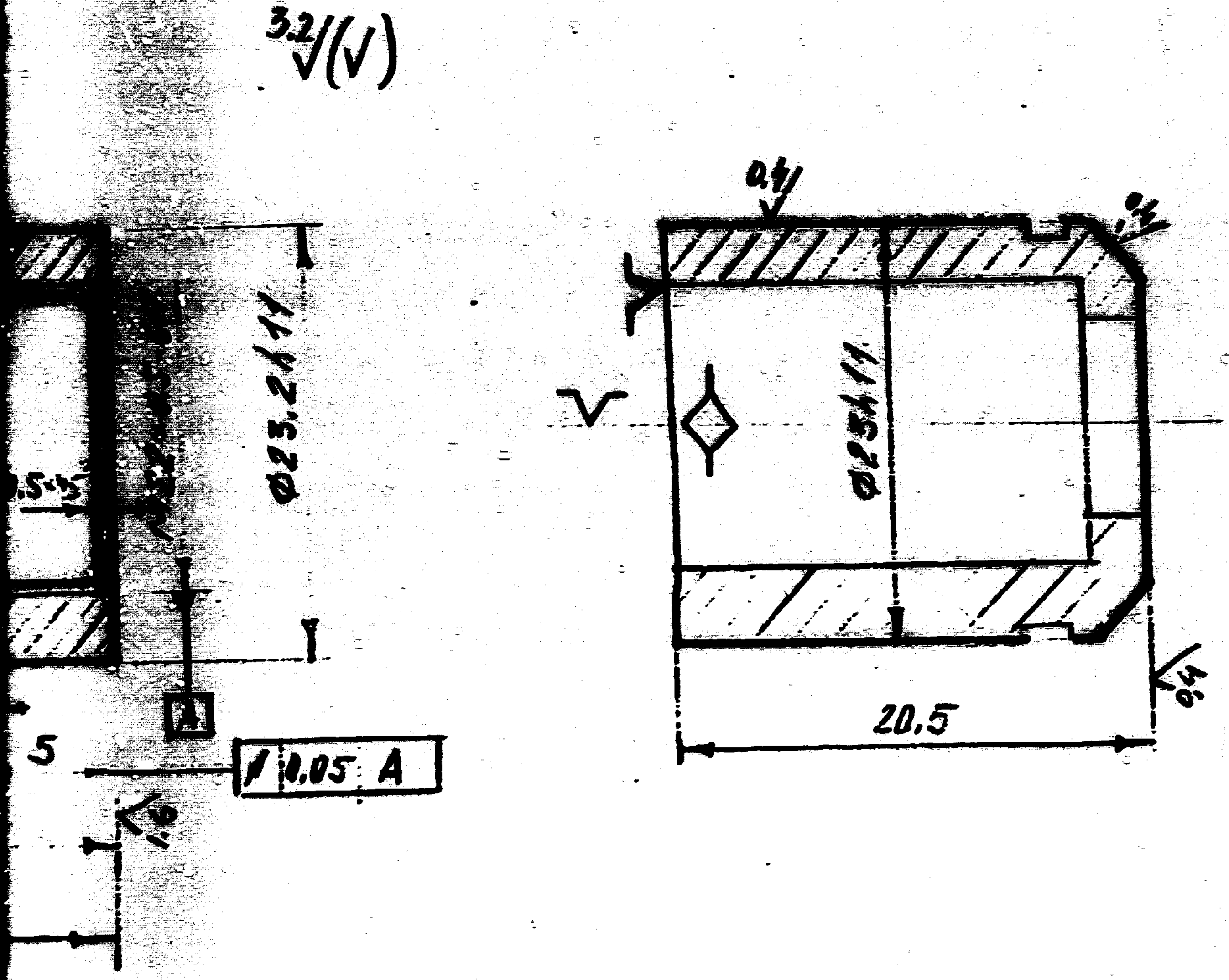
№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
009	TURN OPENING d17H11		CUTTING TOOL	SLIDING CALLIPERS
010	TURN OPENING d21.5H11 ON L=17H12			
011	TURN OPENING d21.5H11		CUTTING TOOL	
012	TURN CHAMFER 0.5*45°		CHAMFER TOOL	
013	TURN SCREW M22*0.5-6H ON 5mm LONG		FEMALE SCREW TOOL	
014	CUT OFF L=20.7		DETACHING CUTTER	SLIDING CALLIPERS
	SECOND PUSH			
015	MOUNT THE BLANK	EXPANDING ARBORS TYPE 832 N160-		
016	TURN BUTT END L=20.5H12	TOO d21.5H11 L=17	FACING TOOL	SLIDING CALLIPERS
017	TURN d22H11		(BIASED) TOOL	
018	TAKE OFF DETAIL IN GLOVE			
	SEND DETAIL FOR FINISHING NOT LATER THAN 24 HOURS			
			PAGE 2	ALL PAGES 2

1. One push



SECTION 1

2. Two push



SECTION 2

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION TWO			
001	ENGRAVE LINES AND SIGNS	ENGRAVMILLING MACHINE	ENGRAVE MILL	
	REMOVE DELUBRICATE CHROME-PLATE WITH DUPLEX 3			
	ENGRAVING AND GROOVE TO FILL WITH BLACK ENAMEL			

SHEET 3	NUMBER OF SHEET 3

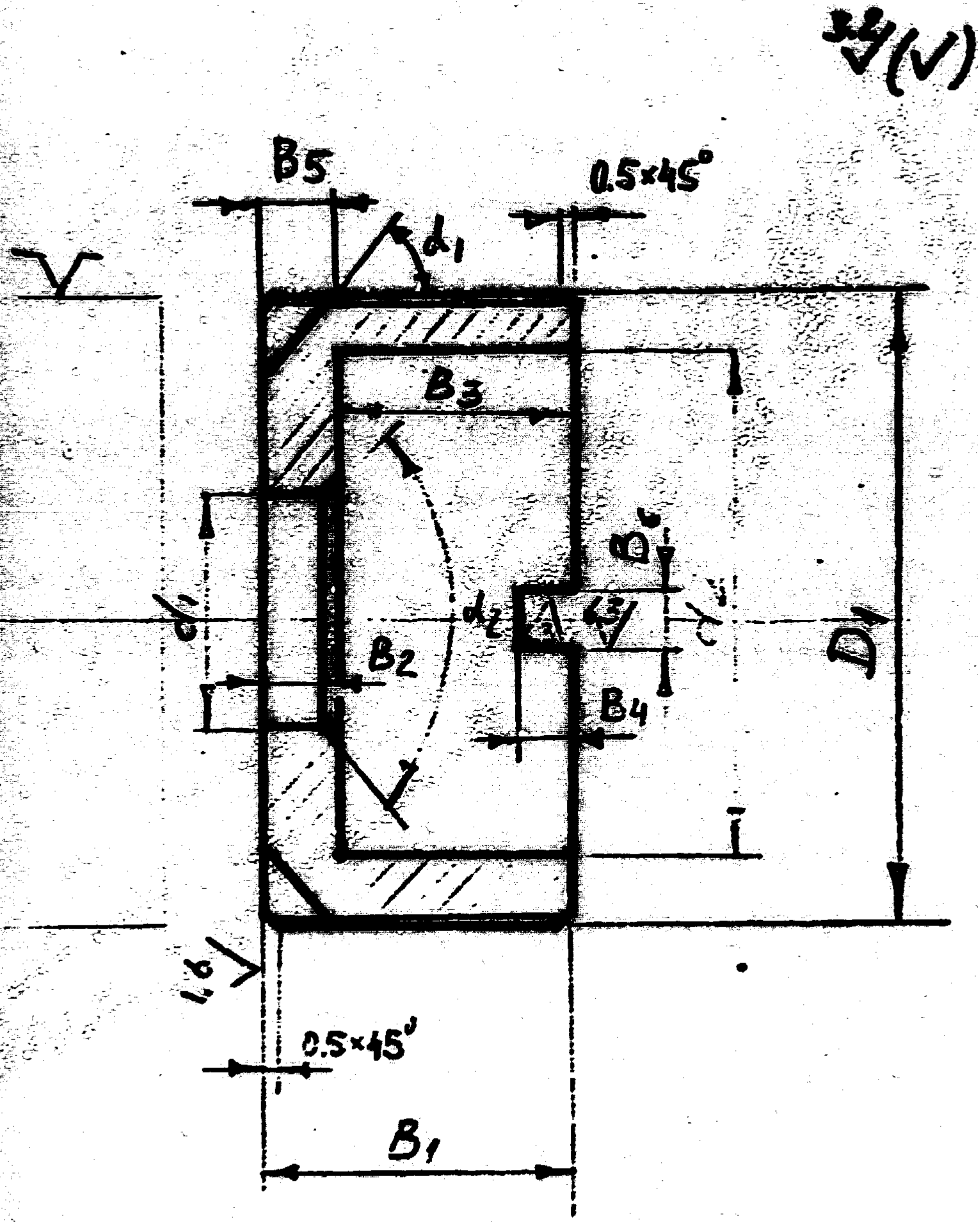
OPERATION DRAFT	NUMBER OF PIECES	OPERATION	
		BLANK	
	230019 230021 230022		
		PROFILE	DIMENSIONS
		ROUND BAR ALUMINIUM ALLOY	

No.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	SHAUBLIN-125,3-JAWS CONCENTRIK CHUCK		
002	TURN BUTT END		TOOLHOLDER	
003	CENTRE DRILL		CENTRING DRILL ø2mm	
004	DRILL OPENING ø D1-1,3mm ON L'		DRILL	SLIDING CALLIPERS
005	TURN D1 ON (L1+3)mm LENGHT		CUTTING TOOL	SLIDING CALLIPERS
006	TURN GROOVE øD1H13x3,BEARING DIMENSION (D1-0,2)		GROOVE TOOL	
007	TURN BUTT END IN GROOVE,BEARING DIMENSION D1'		FACEING TOOL	SLIDING CALLIPERS
	-REPITE 005,006,007 FOR THE NEXT PIECES			

SHEET 1	NUMBER OF SHEET [illegible]

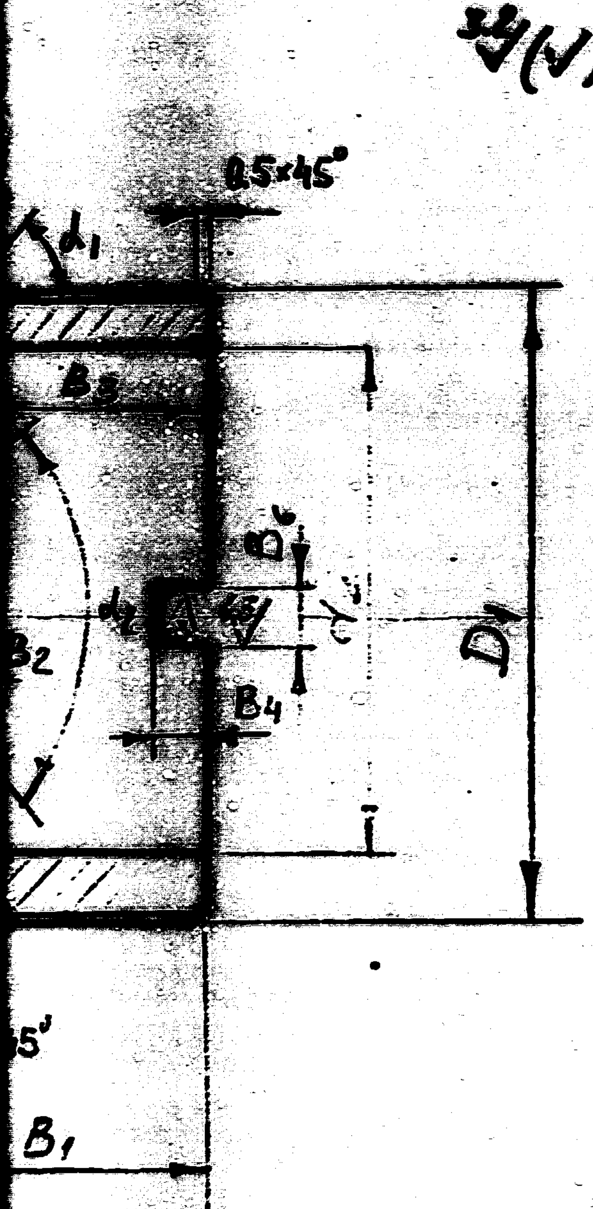
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
008	TURN CHAMFERS 0.5x45° FROM BOTH SIDE		CHAMFER TOOL	
009	CUTTING OPENING øD2 ON B3 LONG WITH TURN PUT OUT B3		CUTTER TOOL	SLIDING CALLIPERS
010	TURN ANGLE A2		FORM TOOL	
011	TURN SCREW øD1		MALE SCREW TOOL	
012	BLUNT SCARP EDGES		SCRAPER	
013	DRILL OPENING øD1		CUTTER TOOL	SLIDING CALLIPERS
	MILLING OPERATION N 2			
001	MOUNT THE BLANK	MILLING MACHINE	MILLING TOOL	
002	MILL GROOVE B4x86			DEPTHMETER
003	MOUNT THE BLANK		DIVIDING ATTACHMENT	
004	MILL CONER GROOVE IN DIMENSION B5x45°			
005	BLUNT SHARP EDGES		SCRAPER	
	REMOVE DELUBRICATE ANODIC OXIDATION BLACK			
			SHEET 3	NUMBER OF SHEET 3

230.019
230.021
230.022



SECTION 1

[illegible].019
2[illegible].021
2[illegible].022



SECTION 2

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	STATE	PURCHASED (DRAFT)
	[illegible]		
		PROFILE	DIMENSIONS
		ROUND BAR ALUMINIUM ALLOY	D18*200

No.	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT THE BLANK	[illegible] 3-JAWS CONCENTRIC CHUCK		
002	TURN BUTT END		TOOLHOLDER	
003	CENTRE DRILL		CENTRING DRILL [illegible]	
004	DRILL OPENING [illegible]		DRILL [illegible]	SLIDING CALIPERS
005	TURN OPENING [illegible]		CUTTING TOOL	SLIDING CALIPERS
006	[illegible]		[illegible]	
007	TURN [illegible]		TOOLHOLDER	SLIDING CALIPERS
008	CUTTING OFF [illegible]			
			PAGE 1	ALL PAGES 1

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
0090	BLUNT SHARP EDGES			
0100	DELUBRICATE,ANODIC OXIDATION BLACK			

SHEET 2 | NUMBER OF SHEET 2

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	203024 203024-01 203024-02 203024-03 203024-04 203024-05	PROFILE	DIMENSIONS
			100*100L

	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	METAL WORKER'S OPERATION CUT OUT RING 08*D (15B12*15h12)	BENCH	PUNCH,SUPPORT	MICROSCOPE

SHEET 1	NUMBER OF SHEET 1

			OPERATION		
	OPERATION DRAFT	NUMBER OF PIECES	BLANK		
		20000			
			PROFILE	DIMENSIONS	
			WIRE II-063	0.63L(513MM)	
No	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS	
001	COIL SPRING L=160mm,T=2.7mm	SCHAUBLIN-125	ARBOR	SLIDING CALLIPERS	
002	CUT SPRING L=22mm		WIRE CUTTER		
003	TEMPERING T=200-260°C T'=60'	FURNACE			
004	PRESS EXTREME COILS				
005	FILE ENDS OF SPRING		FILE		
			SHEET 1	NUMBER OF SHEET 1	

OPERATION DRAFT	NUMBER OF PIECES	OPERATION	
		BLANK	
SEE SHEET 2	240.007		
		PROFILE	DIMENSIONS
		ROUND BAR ALUMINIUM ALLOY	ø30 x 100

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	BLANK PREPARATION CUT BLANKES TO THE SIZE			
	OF 30 x 100			
002	FACE	SHAUBLINE - 125 3 JAWS CHUCK		
003	CENTRE			
004	DRILL A HOLE ø18H12 ON l=3.5mm DEPTH OF 1.6 mm		DRILL ø18H12	SLIDING
005	BORE A HOLE ø19.2H11 ON l=3.5mm		BORING CUTTER	CALLIPERS
006	DRILL SHARP EDGES			
007	FACE TO THE SIZE OF 2.3h11		FACINGTOOL	

SHEET 1	NUMBER OF SHEET 3

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
008	FACE TO THE SIZE OF 2h11			
009	TURN (1:50[illegible]) MAINTAINING			
	⌀ 22h11			
010	TURN THE CHAMFER 0.5 x 45°			
011	TURN ⌀27h10 FOR THE THREAD		TOOLHOLDER	
012	CUT THREAD M27 x 0.5		SCREWCUTTER	
013	PART-OFF TO THE SIZE OF 2.8h11			
	OPERATION 2	MILLING MACHINE		
001	MOUNT AND REMOVE THE WORKPIECE			
002	MILL 2 SLOTS TO THE SIZE			
	OF 0.6H12 x 0.7±0.15			
003	DEBURR THE GROOVE	SCRAPER		
004	DEBURR THE THREAD			
	OPERATION 3			
	DEGREASING			
	ANODIC OXIDATION			

SHEET 3	NUMBER OF SHEET 3

			OPERATION	
OPERATION DRAFT		NUMBER OF PIECES	BLANK	
		240.006		
			PROFILE	DIMENSIONS
			ROUND BAR ALUMINIUM ALLOY	ø35 x 100
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT BLANK	SHAUBLIN - 125 3-JAWS CHUCK		
002	FACE		TOOLHOLDER	
003	CENTRE		CENTRING DRILL	
004	DRILL A HOLE ø19.2H12		DRILL ø19.2H12	
005	TURN ø32h11 (TECHNOLOGICAL)		TOOLHOLDER	
006	DULL SHARP EDGES		SCRAPER	
007	PART-OFF THE WORKPIECE TO		PART - OFF CUTTER	
	THE SIZE OF 8.5h12			
			SHEET 1	NUMBER OF SHEET 4

№	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 2		TYPE COLLET ⌀ 32 mm	
001	FACE TO THE SIZE OF 8h11		TOOLHOLDER	SLIDING CALLIPERS,
002	TURN ⌀ 28c11			MICROMETER
003	TURN THE GROOVE 90°±1°		GROOVE TOOL	MICROSCOPE
004	TURN THE CHAMFER			
005	TURN TAPER (50±1)°			
006	BORE ⌀19.2H12			
007	APPLY KNURLING 0.5		KNURLING	
008	FACE TO 7.5h11VE THE WORKPIECE		TOOLHOLDER	
009	TURN ⌀27h10 FOR THE THREAD		TOOLHOLDER	
	M27 × 0.5-6H TO l=2.5h11			
010	TURN CHAMFER 0.5 × 45°			
011	TURN GROOVE 0.5 ⌀26.2		GROOVE TOOL	
012	CUT THE THREAD M27 × 0.5-6H		SCREW CUTTER	
			SHEET 3	NUMBER OF SHEET 4

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
	OPERATION 3			
001	DEGREASING. ANODIC OXIDATION			
002	PAINTING OF SURFACE A			
	ENAMEL BLACK			

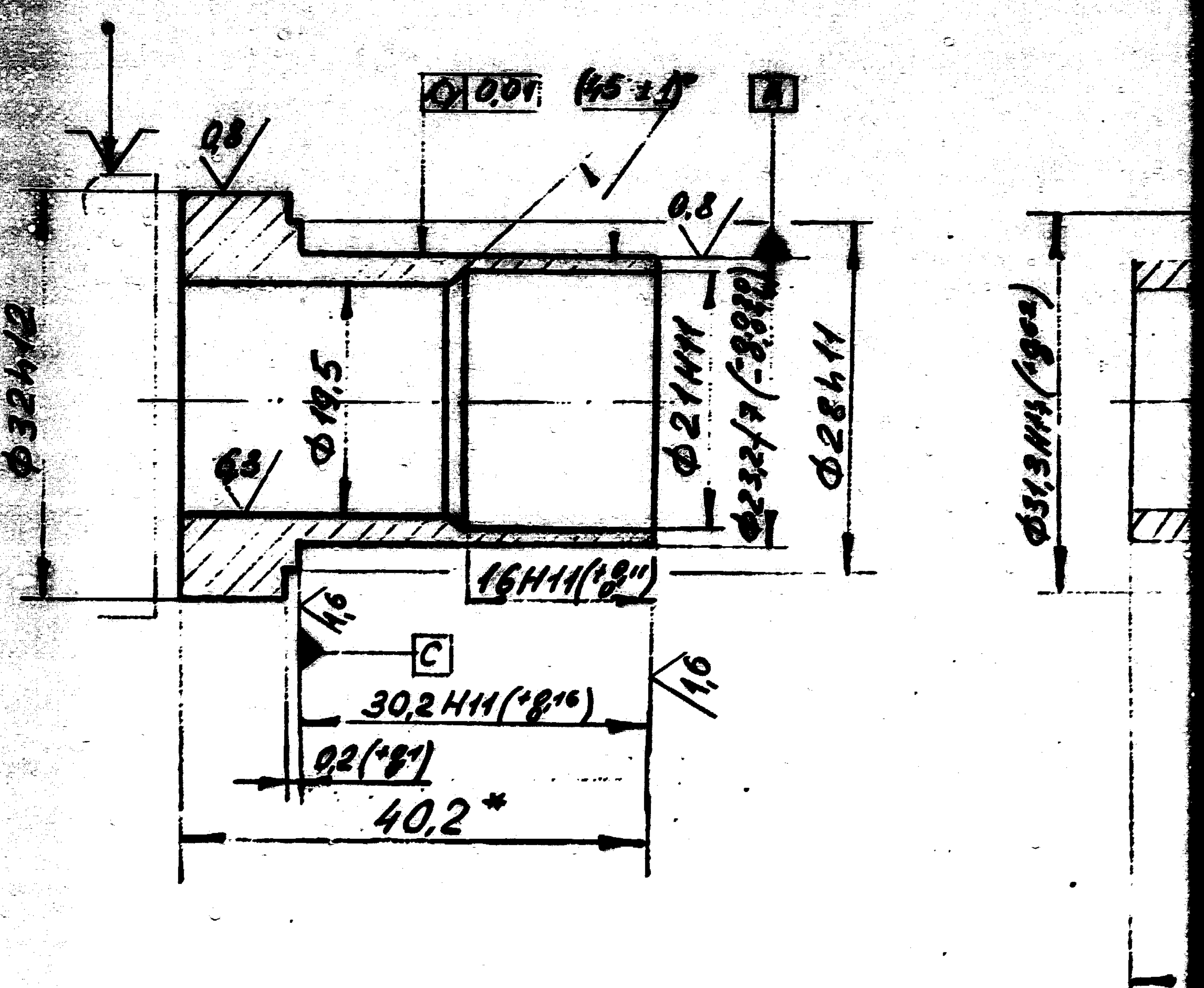
SHEET 4	NUMBER OF SHEET 4

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
	240.012		
		PROFILE	DIMENSIONS
		ROUND BAR	ϕ35 x 100

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	SHAUBLIN - 125 3-JAWS CONCEN-TRIC CHUCK		
002	FACE THE BLANK		TOOLHOLDER	
003	CENTRE		CENTRING DRILL	
004	DRILL A HOLE ϕ19.5 TO THE DEPTH		DRILL ϕ19.5 mm	SLIDING CALLIPERS
	OF 40.2 mm			
005	BORE A HOLE ϕ21H11 MAINTAINING		BORING CUTTER	SLIDING CALLIPERS
	THE SIZE 16H11 AND ANGLE 45°±1°			
006	TURN ϕ 23.4 (DRAWING ϕ 23.2f7) TO THE LENGTH OF 30.1H11 (DRAWING			
	30.2H11)			

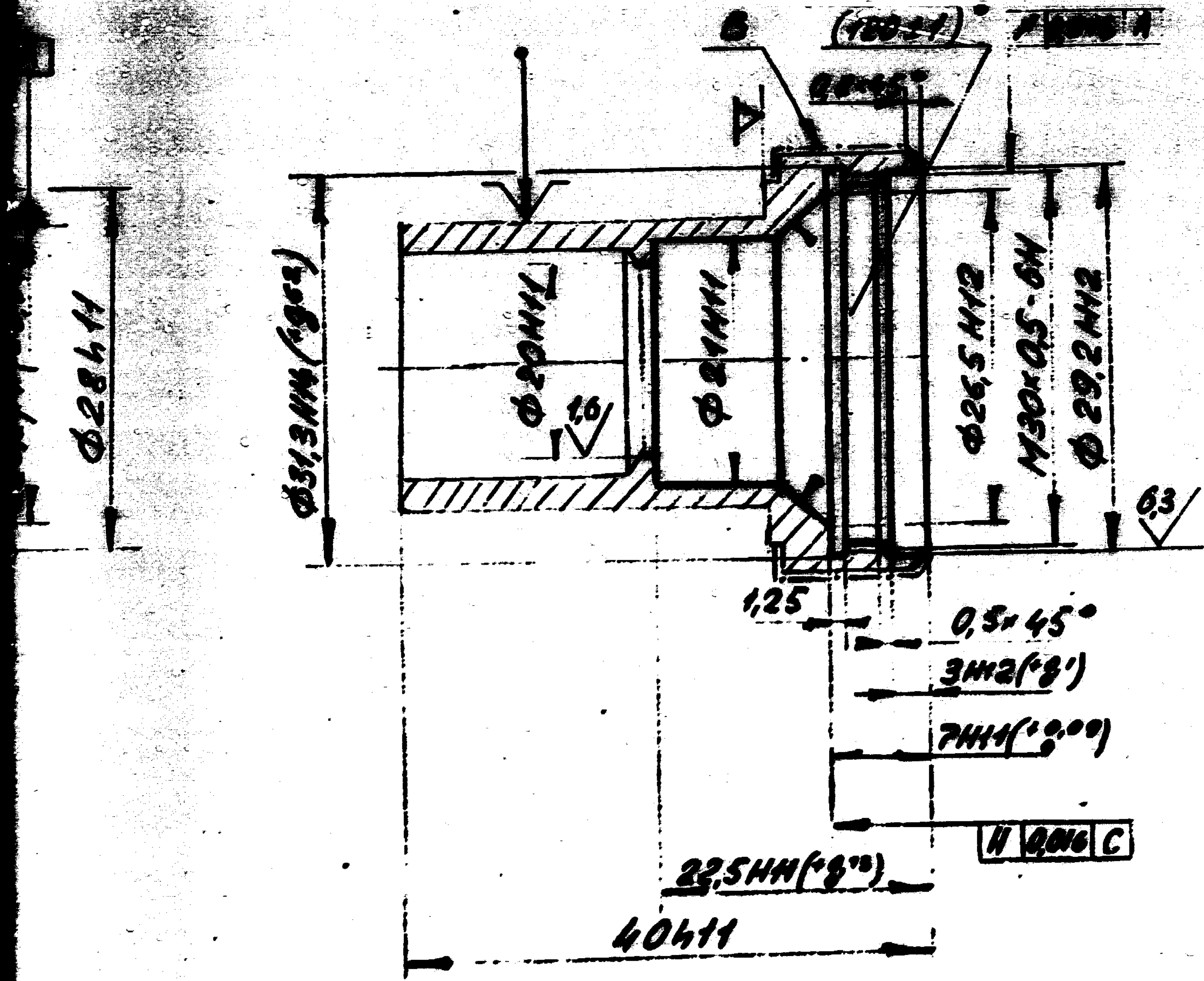
SHEET :	NUMBER OF SHEET 4

Operation 1



SECTION 1

Operation 2



SECTION 2

N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
007	TURN ø 28h11, MAINTAINING		TOOLHOLDER	SLIDING CALLI-
	THE SIZE 0.3 (DRAWING 0.7+0.1)			PERS
008	TURN ø32.2 (DRAWING ø32h12)			
	MAINTAINING THE SIZE 40.2 mm			
009	TURN ø23.2f7 TO THE LENGTH		DIAMOND TOOL	MICROMETR
	OF 30.2H11			
010	TURN ø32h12 MAINTAINING		DIAMOND TOOL	
	THE SIZE OF 40.2			
011	CUT-OFF THE WORKPIECE TO THE SIZE 40.2 mm			
012	DULL SHARP EDGES			
	OPERATION 2			
001	MOUNT AND REMOVE THE WORKPIECE			
002	FACE THE WORKPIECE TO THE SIZE		TOOLHOLDER	SLIDING CALLIPERS
	OF 40h11			

SHEET 3	NUMBER OF SHEET 4

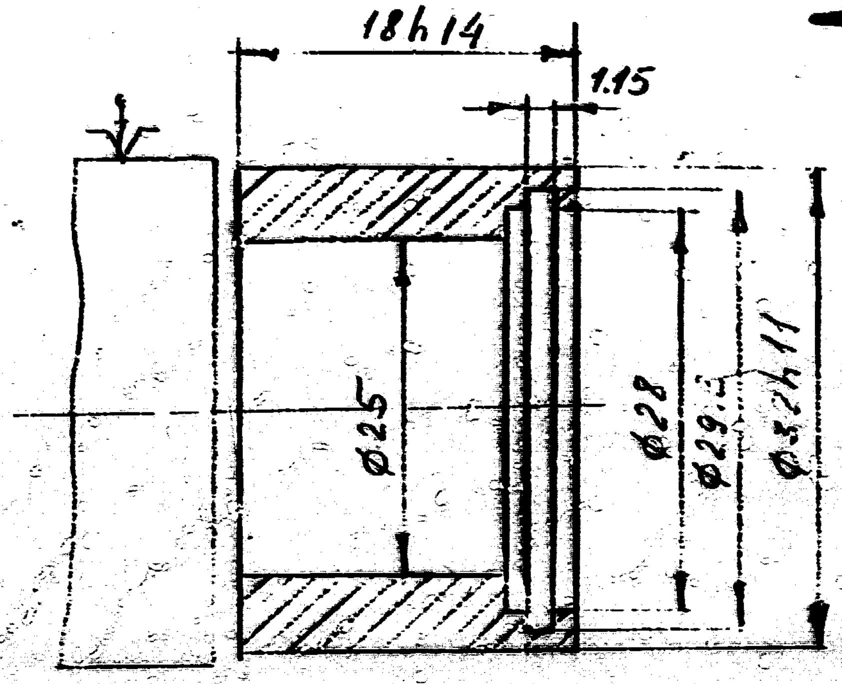
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
003	TURN THE CHAMFER 0.8 * 45°		CHAMFER TOOL	
004	BORE ⌀ 20H11 TO BODY SIZE		BORING TOOL	SLIDING CALLIPERS
005	BORE ⌀ 21H11 WITH BOTTOM CUTTING			
	TO THE SIZE OF 22.5H11			
006	BORE ⌀ 29.54H11 FOR THE THREAD		BORING TOOL	SLIDING CALLIPERS
	M30 * 0.5-6H			
007	BORE GROOVE 1.85 ⌀ 31.3H14		GROOVE TOOL	
	MAINTAINING THE SIZE 7H11			
008	BORE ⌀ 27.2H12 MAINTAINING THE SIZE 3H12		BORING TOOL	SLIDING CALLIPERS
009	BORE THE CHAMFER 0.5 * 45°			
010	BORE (120°±1° MAINTAINING THE			ANGLEMETER
	SIZE 26.5H12			
011	THREAD M30 * 0.5-6H		SCREW CUTTER	SLIDING CALLIPERS
012	DULL SHARP EDGES		SCRAPER	
			SHEET 4	NUMBER OF SHEET 4

		OPERATION	
OPERATION DRAFT	NUMBER OF PIECES	BLANK	
SEE SHEET 2	240.014		
		PROFILE	DIMENSIONS
		BAR EBONITE	ø35 * 100

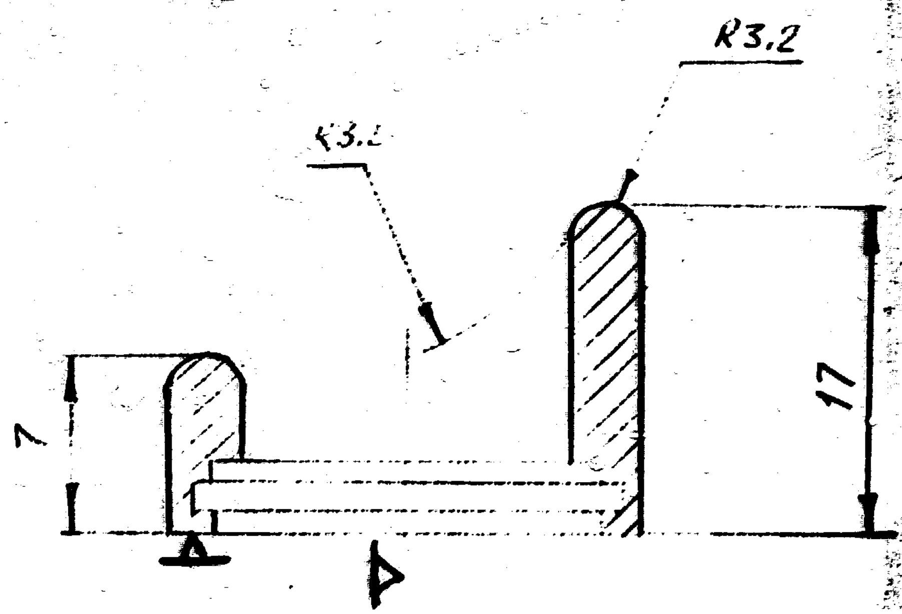
N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
001	MOUNT A BLANK	SHAUBLIN - 125 3-JAWS CHUCK		
002	FACE		TOOLHOLDER	
003	CENTRE		CENTRING DRILL	
004	TURN ø 32h11		TOOLHOLDER	SLIDING CALLIPERS
005	BORE ø 28H12 TO THE LENGTH OF			
	3.5h14(±0.3)			
006	TURN A GROOVE ø 27.2H17		GROOVE TOOL	DEPTHMETER
	MAINTAINING THE SIZE OF 2.5H14 1.15: IN LENGTH			
	30.2H11			

SHEET 1	NUMBER OF SHEET 3

Operation 1 N240014



Operation 2



N	WORK STEP	EQUIPMENT	TOOLS	MEASURING TOOLS
007	DULL SHARP EDGES			
008	PART-OFF THE WORKPIECE TO			
	THE SIZE 17			SLIDING CALLIPERS
	OPERATION 2			
001	MOUNT WORKPIECE	MILLING MACHINE, VICE, PRISME		
002	MILL R31, MAINTAINING THE		MILL ø 62 mm	SLIDING CALLIPERS
	SIZE 7 mm.			
	OPERATION 3			
	BENCH - WORKING			
001	FILE THE EDGES OF THE EYEGUARD			
	ACCORDING THE WORKPIECE DRAWING, MAINTAINING		FILE, ABRASIVE,	
	R3.2		OIL	
			SHEET 3	NUMBER OF SHEET 3

19353

(5 of 7)

FINAL REPORT

Project DP/SYR/88/011 Contract No 89/44

Annex 3

Leningrad Institute of Precision Mechanics and Optics

F I N A L   R E P O R T

(project [illegible])
contract No 80/44

Annex 3

Route charts Technological Process of Assembling and Centring of the Lenses in the Holders for Microobjectives 4x0,1; 10x0,25; 40x0,65; 100x1,25

Technological Process of Assembling, Adjusting and Testing of the Microobjectives.

Technological Process of Adjusting of the Eyepiece 10x.

Technical Requirements for Microscopes- S,L, Microobjectives, Eyepiece

Leningrad
1991

Route charts Technological Process of Assembling and Centring of the Lenses in the Holders for Microobjectives 4x0,1; 10x0,25; 40x0,65; 100x1,25

[illegible]
[illegible]
[illegible]
[illegible] LENS IN THE HOLDER
[illegible]

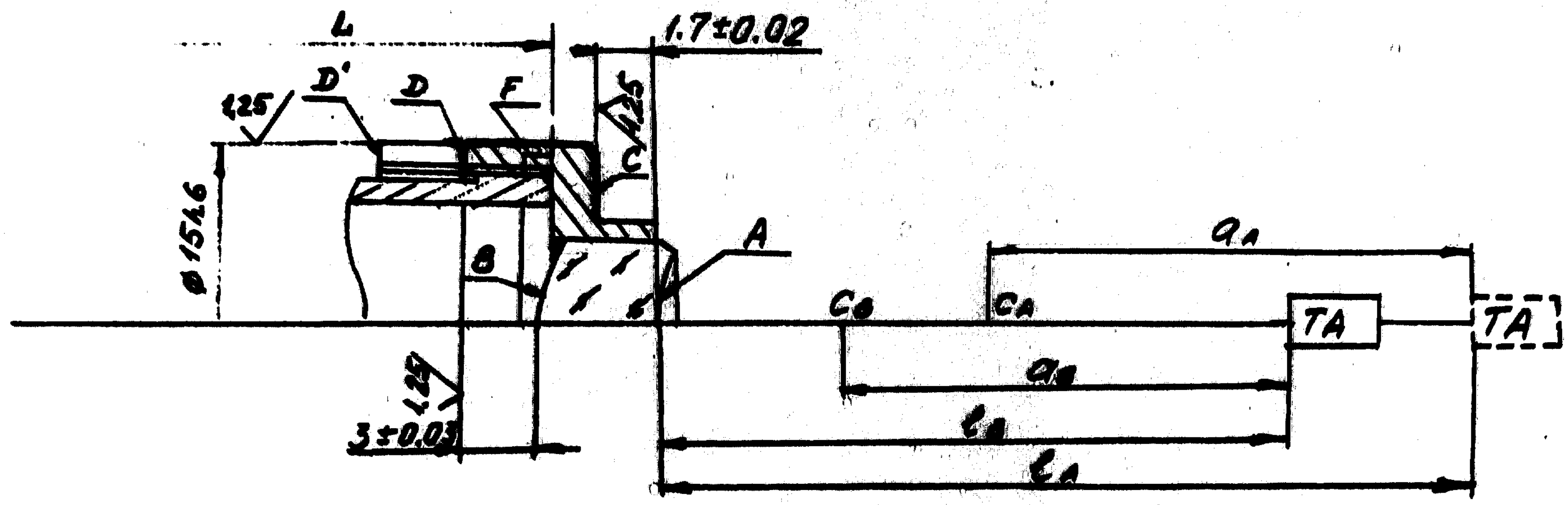
No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set. Make up a set of pieces of the assembling unit Holder - [illegible] Lens - [illegible]			
2	Washing Wash the holder in benzine and dry it during 15 min.		Tank	
3	Assembly			
3.1	Degrease the holder groove with benzine and dry it during 15 min. at t=20°C.		Bamboo stick Forceps	
3.2	Mount the lens in the holder.			
3.3	Apply thin uniform layer of the hermetic cement in the holder groove.		Injector	
3.4	Mount the assembly in the chuck of the lathe (bases are the thread M15x0,5 and the inside holder end "F").	Bench lathe	Thread chuck	
3.5	Remove superfluous hermetic cement by a cotton wad wetted in acetone.		Bamboo stick Magnifying glass 6x-8x	Preliminary centring
3.6	Centre the lens in the holder observing visually the run-out of the flashes from two lens surfaces and pressing the stick to strive for the flashes to be stationary while the holder is being rotated.		Bamboo stick	
3.7	Remove the assembly from the lathe and put it on the horizontal plate on the holder end "Ж", dry the assembly during 24 hours at t=20C		Horizontal plate	

No	Name and content of operation	Equipment	Device, tool	Comment
4	Centring (see drawing) Bases are „M15×0,5" and " F ".			
4.1	Measure the size from the holder end " D " to the lens surface " B " and calculate the holder end cutting value to size (3 ±0,03) mm.		Depth indicator chuck templet for the size (3 ±0,03) mm.	
4.2	Mount the assembled unit in the centring chuck holder.	Lathe	Centring chuck with a gap depth of [illegible] mm. Holder length L-17,4 mm.	
4.3	Centre the lens in the holder, admissible shift of the " A " and " B " surfaces curvature centre image being no more than 0,01 mm. and 0,01 mm. respectively. Centre the lens surface " A " by moving it over the plane surface of the centring chuck; and surface " B " by inclining it over the spherical surface of the centring chuck.		Test-adjusting device - CA	
4.4	Turn the holder smoothly to dimension ∅ 15h6 in two passes, and cut the holder end " C " as a preliminary operation.		Cutter micrometer	The turning of the holder to D15h6 is made as follows: 1-st pass-0.15mm 2-d pass-0.09mm 3-d pass-0.01mm After every pass to check the lens centring and to centre the lens if necessary
4.5	Measure the size from the holder end " C " to the lens surface " A " and calculate the holder end cutting value to size (1,7 ±0,02) mm.		Depth indicator chuck templet to the size 1,7±0,02 mm	
4.6	Cut the holder end " C " to the value, calculated in the operation 4.5.		Cutter	3
4.7	Cut the holder end " D " to the value calculated in the operation 4.1.			Page 2
4.8	Dull sharp edges.		Mill blunt scraper	Pages 3

No	Name and content of operation	Equipment	Device, tool	Comment
4.9	Remove the assembly from the lathe.			
5	Cleaning Clean lens in holder with optical mixture.		Bamboo stick Optical mixture Cotton wad	
6	Checking Check the assembly centring, cleanness, sizes (3±0,05) and (1,7±0,02)mm.		Magnifying glass -6x-8x templet for [illegible] templet for (1,7±0,02) indicator. Testing device- CD	Page 3 Pages 3

Erection drawing

200.018
Lens in holder



Surface	ai mm	li mm	Limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
„A"	60	64.13	0.01	0.005	2
„B"	60	61.6	0.01	0.005	2

Surface	ai mm	li mm	Limit decentric mm	Scale division TA-2 mm	Number divisions TA-2
„A"	60	64,13	0,01	0,002	5
„B"	60	61,6	0,01	0,002	5,5

200.020
LENS IN HOLDER

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND CENTERING
THE LENS IN THE HOLDER
[illegible]

No	Name and content of operation	Equipment	Device, tool	Comment
1	<u>Making-up a set.</u> Make up a set of pieces of the assembling unit Holder - [illegible] Lens - 200.002			
2	<u>Washing</u> Wash the holder in benzine and dry it during 15 min.		Tank	
3	<u>Assembly</u>			
3.1	Degrease the holder groove with benzine and dry it during 15 min. at t-20°C .		Bamboo stick Forceps	
3.2	Mount the lens in the holder .			
3.3	Apply thin uniform layer of the hermetic cement in the holder groove.		Injector	
3.4	Mount the assembly in the chuck of the lathe (bases are the thread M13×0.5 and the inside holder end "F").	Bench lathe	Thread chuck	
3.5	Remove superfluous hermetic cement by a cotton wad wetted in acetone.		Bamboo stick Magnifying glass 6x-8x	Preliminary centring
3.6	Centre the lens in the holder observing visually the run-out of the flashes from two lens surfaces and pressing the stick to strive for the flashes to be stationary while the holder is being rotated.		Bamboo stick	3
3.7	Remove the assembly from the lathe and put it on the horizontal plate on the holder end "D", dry the assembly during 24 hours at t-20C		Horizontal plate	

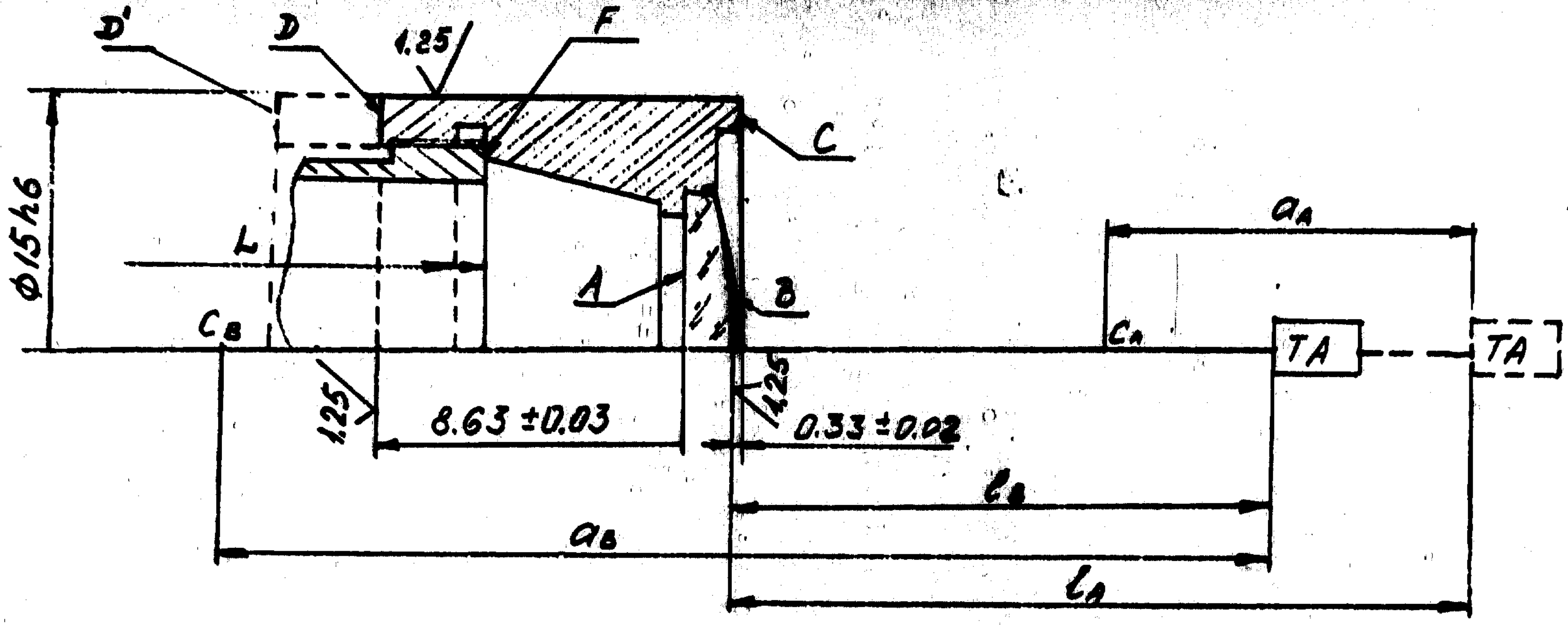
No	Name and content of operation	Equipment	Device, tool	Comment
4.	Centring (see drawing) Bases are M15 x 0,5 and " F."			
4.1	Measure the size from the holder end "D" to the lens surface "A" and calculate the holder end cutting value to size (2,65±[illegible]) mm.		Depth indicator check templet for the size [illegible] mm.	
4.2	Mount the assembled unit in the centring chuck holder.	Lathe	Centring chuck with a [illegible] depth of [illegible] mm. Holder length L- 25,33 mm.	
4.3	Centre the lens in the holder, admissible shift of the "A" and "B" surfaces curvature centre image being no more than 0,03 mm. and 0,01 mm. respectively. Centre the lens surface "B" by moving it over the plane surface of the centring chuck; and surface "A" by inclining it over the spherical surface of the centring chuck.		Test-adjusting device - CA	
4.4	Turn the holder smoothly to dimension Ø 15h6 in two passes, and cut the holder end "C" as a preliminary operation.		Cutter micrometer	The turning of the holder to D15h6 is made as follows: 1-st pass-0.15m 2-d pass-0.09m 3-d pass-0.01m After every pass to check the lens centring and to centre the lens if necessary
4.5	Measure the size from the holder end "C" to the lens surface "B" and calculate the holder end cutting value to size (0,33±0,0[illegible]) mm.		Depth indicator chuck templet to the size (0,33±0,02) mm	
4.6	Cut the holder end "C" to the value, calculated in the operation 4.5.		Cutter	
4.7	Cut the holder end "D" to the value calculated in the operation 4.1.			
4.8	Dull sharp edges.		Mill blunt scraper	

No	Name and content of operation	Equipment	Device, tool	Comment
4.9	Remove the assembly from the lathe.			
5	<u>Cleaning</u> Clean lens in holder with optical mixture.		Bamboo stick Optical mixture Cotton wad	
5	<u>Checking</u> Check the assembly centric; cleanness, sizes (63 ±0,05) and (0,33 ±0,02)		Magnifying glass -6x-8x templet for [illegible] templet for (0,33 ±0,02) indicator. Testing device- CD	

Erection drawing

200.020

Lens in holder



Surface	a_i mm	l_i mm	Limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
„B"	60	48.44	0,01	0,005	2
„A"	60	71,35	0.03	0.005	2

Surface	a_i mm	l_i mm	Limit decentric mm	Scale division TA-2 mm	Number divisions TA-2
„B"	60	48,44	0,01	0,002	5
„A"	60	71,56	0,03	0,002	6

200.030
LENS IN HOLDER

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND CEMENTING
THE LENS IN THE HOLDER
[illegible]

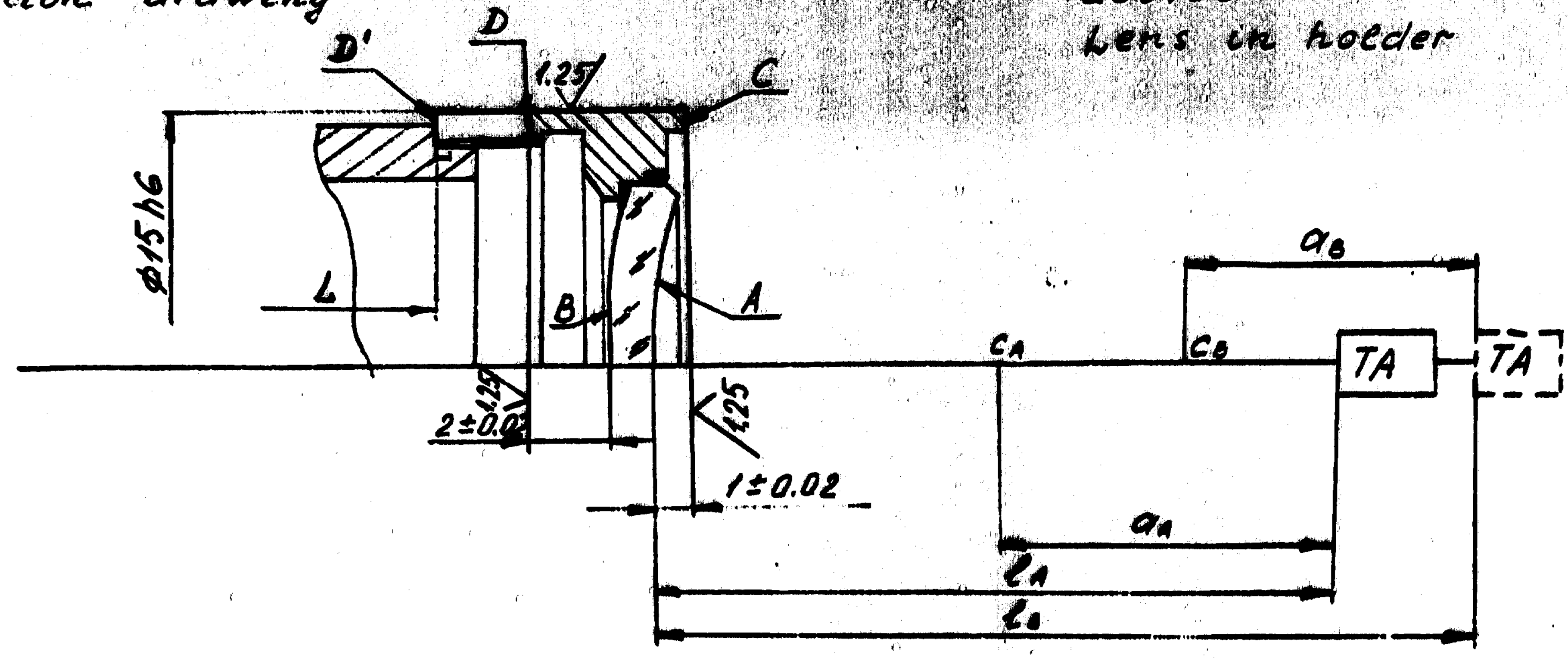
No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set. Make up a set of pieces of the assembling unit Holder - [illegible] Lens - 200.003.			
2	Washing Wash the holder in benzine and dry it during 15 min.		Tank	
3	Assembly			
3.1	Degrease the holder groove with benzine and dry it during 15 min. at t=20°C.		Bamboo stick Forceps	
3.2	Mount the lens in the holder.			
3.3	Apply thin uniform layer of the hermetic cement in the holder groove.		Injector	
3.4	Mount the assembly in the chuck of the lathe (bases are the thread M15x0,5 and the outside holder end "D").	Bench lathe	Thread chuck	
3.5	Remove superfluous hermetic cement by a cotton wad wetted in acetone.		Bamboo stick Magnifying glass 6x-8x	Preliminary centring
3.6	Centre the lens in the holder observing visually the run-out of the flashes from two lens surfaces and pressing the stick to strive for the flashes to be stationary while the holder is being rotated.		Bamboo stick	
3.7	Remove the assembly from the lathe and put it on the horizontal plate on the holder end "D", dry the assembly during 24 hours at t=20C		Horizontal plate	Page 1 Pages 3

No	Name and content of operation	Equipment	Device, tool	Comment
4	<u>Centring (see drawing)</u> Bases are Ø13 ±0,5 and " D' "			
4.1	Measure the size from the holder end " D' " to the lens surface " B " and calculate the holder end cutting value to size (2 ±0,02) mm.		Depth indicator check templet for the size (2 ±0,02) mm.	
4.2	Mount the assembled unit in the centring chuck holder	Lathe	Centring chuck with a gap depth of 55 mm. Holder length L- 57,24 mm.	
4.3	Centre the lens in the holder, admissible shift of the " A " and " B " surfaces curvature centre image being no more than 0,01 mm. and 0,02 mm. respectively. Centre the lens surface " A " by moving it over the plane surface of the centring chuck; and surface " B " by inclining it over the spherical surface of the centring chuck.		Test-adjusting device - CA	
4.4	Turn the holder smoothly to dimension Ø 15h6 in two passes, and cut the holder end " C " as a preliminary operation.		Cutter micrometer	The turning of the holder to D15h6 is made as follows: 1-st pass-0.15mm 2-d pass-0.09mm 3-d pass-0.01mm After every pass to check the lens centring and to centre the lens if necessary
4.5	Measure the size from the holder end " C " to the lens surface " A " and calculate the holder end cutting value to size (1 ±0,02) mm.		Depth indicator chuck templet to the size (1 ±0,02) mm	
4.6	Cut the holder end " C " to the value, calculated in the operation 4.5		Cutter	
4.7	Cut the holder end " D " to the value calculated in the operation 4.1.			
4.8	Dull sharp edges.		Mill blunt scraper	

No	Name and content of operation	Equipment	Device, tool	Comment
4.9	Remove the assembly from the lathe.			
5	Cleaning Clean lens in holder with optical mixture.		Bamboo stick Optical mixture Cotton wad	
6	Checking Check the assembly centric, cleanness, sizes (2 ±0,02) and (1 ±0,02) mm		Magnifying glass -6x-8x templet for 2±0,02 templet for (1 ±0,02) indicator. Testing device- CD	
				Page 3 Pages 3

Erection drawing

200.030
Lens in holder



Surface	a_i mm	l_i mm	limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
„A"	60	70.7	0.01	0.005	2
„B"	100	161,36	0.02	0,01	10

Surface	a_i mm	l_i mm	limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
„A"	60	70,7	0,01	0,002	5
„B"	140	201,36	0,02	0,012	8

210.020
LENS IN HOLDER
(Front lens)

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND [illegible]
THE LENS IN THE HOLDER
[illegible]

No	Name and content of operation	Equipment	Device, tool	Comment
1	<u>Making-up a set</u>			
1.1	Make up a set of pieces of the assembling unit. Holder - 210005 Lens - 210001			
2	<u>Washing</u> Wash the holder in benzine and dry it during 15 min.		Tank	
3	<u>Assembly</u> (See drawing)			
3.1	Mount the lens in the holder.		Forceps	
3.2	Measure the size from the outside holder end to the plane lens surface and calculate the holder end cutting value to size 0,3 -0.02 mm		Depth indicator Support	
3.3	Remove the lens from the holder put it into a special container, having numbers.		Special cell container	
3.4	Mark the holder surface Ø15,5h12 with the lens number.		Marking tool Scraper	
4	<u>Turning the holder prior to chromatizing</u> Bases are the thread M11x0,5 and the end "C'" (See drawing).			
4.1	Mount the holder in the lathe collet.	Diamond turning Lathe	Thread collet (M11x0,5) Diamond tool	
4.2	Turn the holder surface " E " prior to chromatizing to size D6h12 and cut the holder end to the value, calculated in the operation 3.2.	Lathe	Micrometer	
4.3	Remove the holder from the lathe .			

No	Name and content of operation	Equipment	Device, tool	Comment
4.4	Mount the holder in a device for chromatizing protecting the surfaces Ø5,5H9 and Ø5H11 and leaving uncovering only the surface " E ".			
5	Chromatizing		Chromium-plating tank	
6	Assembly			
6.1	Select the holder and the lens with the same number.			
6.2	Degrease the holder fitting diameter Ø5,5H9 and the groove with benzine and dry them during 15 min at t=20C		Bamboo stick Cotton wad	
6.3	Mount the lens in the holder.		Forceps	
6.4	Apply thin uniform layer of hermetic cement in the holder groove.		Injector Bamboo stick Magnifying glass 6x-8x	
6.5	Remove superfluous hermetic cement by a cotton wad wetted in acetone.		Bamboo stick	
7	Preliminary centring			
7.1	Mount the assembly in the chuck of the lathe.	Bench lathe	Tread chuck (M13x0,5)	
7.2	Centre the lens in the holder observing visually the run out of the light flashes from the two lens surfaces and pressing the lens by a stick to strive for the flashes to be stationary while the holder is being rotated.		Magnifying glass 6x-8x Bamboo stick	
7.3	Remove the assembly from the lathe and put it on a horizontal plate on the holder end "F", dry the assembly during 24 hours at t=20° C.		Horizontal plate	210.020 Page 2 Pages 4

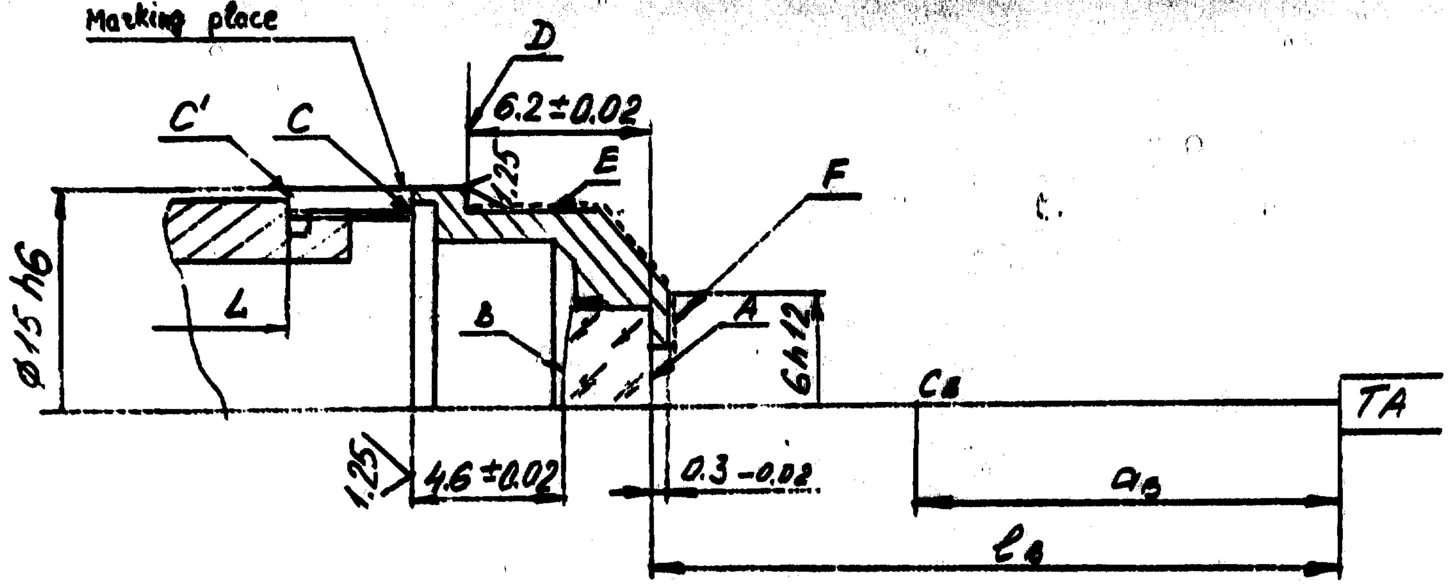
No	Name and content of operation	Equipment	Device, tool	Comment
8.	<u>Centring</u>			
8.1	Measure the size from the holder end "C" to the lens surface "B" and calculate the holder end cutting value to size (4,6± 0,02)mm.		Depth indicator Check templet for size (4,6±0,02)mm	
8.2	Mount the assembly in the centring chuck holder.	Lathe	Centring chuck with gap depth of 55mm Holder length L=38,66	
8.3	Centre the lens in the holder: admissible shift of the lens surface "B" curvature centre image must be no more than 0,05mm; admissible departure of the lens surface "A" from being normal to the holder outside diameter is 2'. Centre the lens surface "B" by moving it over the plane surface of the centring chuck and the lens surface "A" by inclining it over the spherical surface of the centring chuck.		Test-adjusting device - CA	
8.4	Turn the holder smoothly to dimension Ø15h6 in two passes and cut the holder end "D" as a preliminary operation.		Micrometer Cutter	The turning of the holder to D15h6 is made as follows: 1-st pass-0.15mm 2-d pass-0.09mm 3-d pass-0.01mm After every pass to check the lens centring and to centre the lens if necessary
8.5	Measure the size from the holder end "D" to the lens surface "A" and calculate the holder end cutting value to size (6,2± 0,02)mm.		Depth indicator Check templet for size (6,2±0,02)mm	
8.6	Cut the holder end "D" to the value calculated in the operation 8.5		Cutter	
8.7	Cut the holder end "C" to the value calculated in the operation 8.1		Cutter	

No	Name and content of operation	Equipment	Device, tool	Comment
8.8	Dull sharp edges.		Scraper	
9.	Cleaning		Cleaning set	
9.1	Clean the lens in the holder with optical mixture		Optical mixture composition (10-15)%-ethylin hydrolysic alhohol 85% - petroleum ether	
10.	Checking		Testing device	
10.1	Check the assembly centric, cleanness and the sizes (6,2± 0,02), (4,6± 0,02)mm		Magnifying glass 8x Indicator check temples for sizes (6,2± 0,02), (4,6±0,02)mm	

Erection drawing

210.020

Lens in holder



Surface	a_i mm	l_i mm	Limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
B	100	103.92	0.05	0.01	5
A	∞	–	2'	20"	6

Surface	a_i mm	l_i mm	Limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
B	100	103,92	0,05	0,009	5
A	∞	–	2'	15"	8

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND CENTRING
THE LENS IN THE HOLDER
[illegible]

No	Name and content of operation	Equipment	Device, tool	Comment
1	<u>Making-up a set.</u> Make up a set of pieces of the assembling unit Holder - 210007 Lens - 210002			
2	<u>Washing</u> Wash the holder in benzine and dry it during 15 min.		Tank	
3	<u>Assembly</u>			
3.1	Degrease the holder groove with benzine and dry it during 15 min. at t-20°C .		Bamboo stick Forceps	
3.2	Mount the lens in the holder .			
3.3	Apply thin uniform layer of the hermetic cement in the holder groove.		Injector	
3.4	Mount the assembly in the chuck of the lathe (bases are the thread M10x0,5 and the [illegible]side holder end "A").	Bench lathe	Thread chuck	
3.5	Remove superfluous hermetic cement by a cotton wad wetted in acetone.		Bamboo stick Magnifying glass 6x-8x	Preliminary centring
3.6	Centre the lens in the holder observing visually the run-out of the flashes from two lens surfaces and pressing the stick to strive for the flashes to be stationary while the holder is being rotated.		Bamboo stick	3
3.7	Remove the assembly from the lathe and put it on the horizontal plate on the holder end "A", dry the assembly during 24 hours at t=20C		Horizontal plate	Page 1 Pages 3

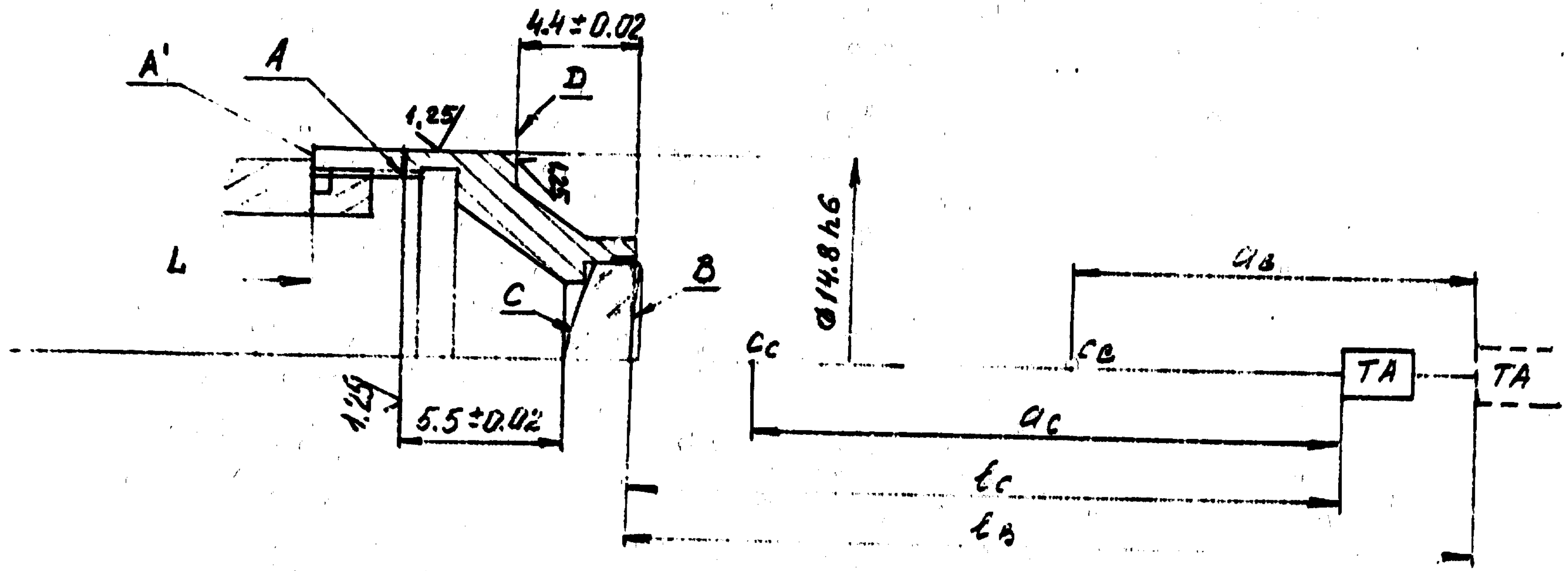
No	Name and content of operation	Equipment	Device, tool	Comment
4	Centring (see drawing) Bases are M13x0,5 and " A' "			
4.1	Measure the size from the holder end " A' " to the lens surface " C " and calculate the holder end cutting value to size (5,5±0,02) mm.		Depth indicator check templet for the size (5,5±0,02) mm.	
4.2	Mount the assembled unit in the centring chuck holder	Lathe	Centring chuck with a gap depth of 55 mm. Holder length L= ~~30,03~~ mm. 24,97	
4.3	Centre the lens in the holder, admissible shift of the " B " and " C " surfaces curvature centre image being no more than 0,05 mm, and 0,05 mm. respectively. Centre the lens surface " B " by moving it over the plane surface of the centring chuck; and surface " C " by inclining it over the spherical surface of the centring chuck.		Test-adjusting device - CA	
4.4	Turn the holder smoothly to dimension Ø14,8h6 in two passes, and cut the holder end "D" as a preliminary operation.		Cutter micrometer	The turning of the holder to D15h6 is made as follows: 1-st pass-0.15mm 2-d pass-0.09mm 3-d pass-0.01mm After every pass to check the lens centring and to centre the lens if necessary
4.5	Measure the size from the holder end " D " to the lens surface " B " and calculate the holder end cutting value to size (4,4±0,02) mm.		Depth indicator chuck templet to the size (4,4±0,02) mm	
4.6	Cut the holder end " D " to the value, calculated in the operation 4.5		Cutter	
4.7	Cut the holder end " A " to the value calculated in the operation 4.1.			
4.8	Dull sharp edges.		Mill blunt scraper	

No	Name and content of operation	Equipment	Device, tool	Comment
4.9	Remove the assembly from the lathe.			
5	Cleaning Clean lens in holder with optical mixture.		Bamboo stick Optical mixture Cotton wad	
6	Checking Check the assembly centric; cleanness, sizes (5,5±0,02) and (4,4±0,02)mm		Magnifying glass -6x-8x templet for (5,5±0,02) templet for (4,4±0,02), indicator. Testing device- CD	Page 3 Pages 3

Erection drawing

210.030

Lens in holder



Surface	a_i mm	ℓ_i mm	Limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
„B"	100	120.09	0.05	0.01	5
„C"	100	106.37	0.05	0.01	5,5

Surface	a_i mm	ℓ_i mm	Limit decentric mm	Scale division TA-2 mm	Number divisions TA-2
„B"	100	120,09	0,05	0,009	5
„C"	100	106,37	0,05	0,009	6

210.040
LENS IN HOLDER

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND CEMENTING
THE LENS IN THE HOLDER
[illegible]

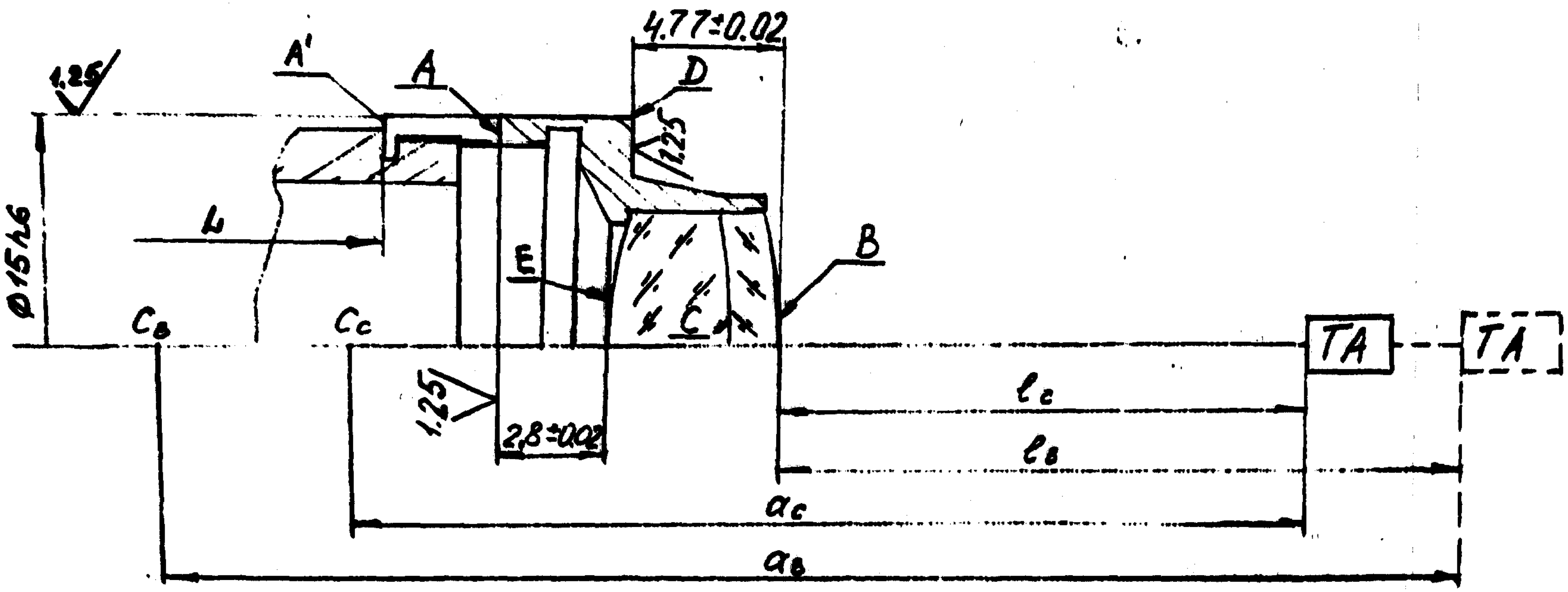
No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set. Make up a set of pieces of the assembling unit Holder - 210.008 Lens - 210.010			
2	Washing Wash the holder in benzine and dry it during 15 min.		Tank	
3	Assembly			
3.1	Degrease the holder groove with benzine and dry it during 15 min. at t=20°C.		Bamboo stick Forceps	
3.2	Mount the lens in the holder.			
3.3	Apply thin uniform layer of the hermetic cement in the holder groove.		Injector	
3.4	Mount the assembly in the chuck of the lathe (bases are the thread M13x0,5 and the inside holder end "A").	Bench lathe	Thread chuck	
3.5	Remove superfluous hermetic cement by a cotton wad wetted in acetone.		Bamboo stick Magnifying glass 6x-8x	Preliminary centring
3.6	Centre the lens in the holder observing visually the run-out of the flashes from two lens surfaces and pressing the stick to strive for the flashes to be stationary while the holder is being rotated.		Bamboo stick	3
3.7	Remove the assembly from the lathe and put it on the horizontal plate on the holder end "A", dry the assembly during 24 hours at t=20C		Horizontal plate	Page 1 Pages 3

No	Name and content of operation	Equipment	Device, tool	Comment
4	<u>Centring (see drawing)</u> Bases are M13 x0,5 and " A' ".			
4.1	Measure the size from the holder end "A" to the lens surface " E " and calculate the holder end cutting value to size (2,8 ±0,02) mm		Depth indicator check templet for the size (2,8±0,02) mm.	
4.2	Mount the assembled unit in the centring chuck holder.	Lathe	Centring chuck with a gap depth of 26 mm (55mm) Holder length L= [illegible] mm 43,98 (72,49)	
4.3	Centre the lens in the holder, admissible shift of the " B " and " C " surfaces curvature centre image being no more than 0,02 mm, and 0,01 mm, respectively. Centre the lens surface " B " by moving it over the plane surface of the centring chuck; and surface " B " by inclining it over the spherical surface of the centring chuck.		Test-adjusting device - CA	
4.4	Turn the holder smoothly to dimension Ø 15h6 in two passes, and cut the holder end "D" as a preliminary operation.		Cutter micrometer	The turning of the holder to D15h6 is made as follows: 1-st pass-0.15mm 2-d pass-0.09mm 3-d pass-0.01mm After every pass to check the lens centring and to centre the lens if necessary
4.5	Measure the size from the holder end " D " to the lens surface " B " and calculate the holder end cutting value to size (4,77±0,02) mm.		Depth indicator chuck templet to the size (4,77±0,02) mm	
4.6	Cut the holder end "D" to the value, calculated in the operation 4.5		Cutter	
4.7	Cut the holder end " A " to the value calculated in the operation 4.1.			Page 2
4.8	Dull sharp edges.		Mill blunt scraper	Pages 3

No	Name and content of operation	Equipment	Device, tool	Comment
4.9	Remove the assembly from the lathe.			
5	<u>Cleaning</u> Clean lens in holder with optical mixture.		Bamboo stick Optical mixture Cotton wad	
6	<u>Checking</u> Check the assembly centric; cleanness, sizes (2,8±0,02) and (4,77±0,02)mm.		Magnifying glass -6x-8x templet for [illegible] templet for (4,77±0,02) indicator. Testing device- CD	
				Page 3 Pages 3

Erection drawing

210.040
Lens in holder



Surface	a_i mm	l_i mm	limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
„B"	100	71.16	0.02	0.01	2
„C"	70	61.63	0.01	0.07	1,5

Surface	a_i mm	l_i mm	limit decentric mm	Scale division TA-2 mm	Number divisions TA-2
„B"	60	31,16	0,02	0,002	10
„C"	60	51,64	0,01	0,002	6

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND CENTRING
THE LENS IN THE HOLDER
[illegible]

No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set Make up a set of pieces of the assembling unit. Holder - 210.009 Lens - 210.005			
2	Washing Wash the holder in benzine and dry it during 15 min.		Tank	
3	Assembly			
3.1	Degrease the holder fitting diameter Ø11,5H9 and groove Ø12H12 with benzine and dry it during 15 min at t=20°C		Bamboo stick Cotton wool Forceps	
3.2	Apply thin uniform layer of the hermetic cement in the holder groove.		Bamboo stick Magnifying glass 6^x-8^x Forceps	
3.3	Mount lens 210.005 in the holder and press it to the holder end.			
3.4	Mount the assembly in the chuck of the lathe (bases are the thread M13x0.5 and the inside holder end).	Bench lathe	Thread chuck	
3.5	Remove superfluous hermetic cement by a cotton wad-wetted in acetone.		Bamboo stick	
3.6	Centre the lens in the holder observing the run-out of the flashes of light from two lens surfaces visually and pressing the lens by the stick to strive for the flashes to be stationary while the holder is being rotated.		Magnifying glass 6x-8x	Preliminary centring 3 210.050 Page 1 Pages 3

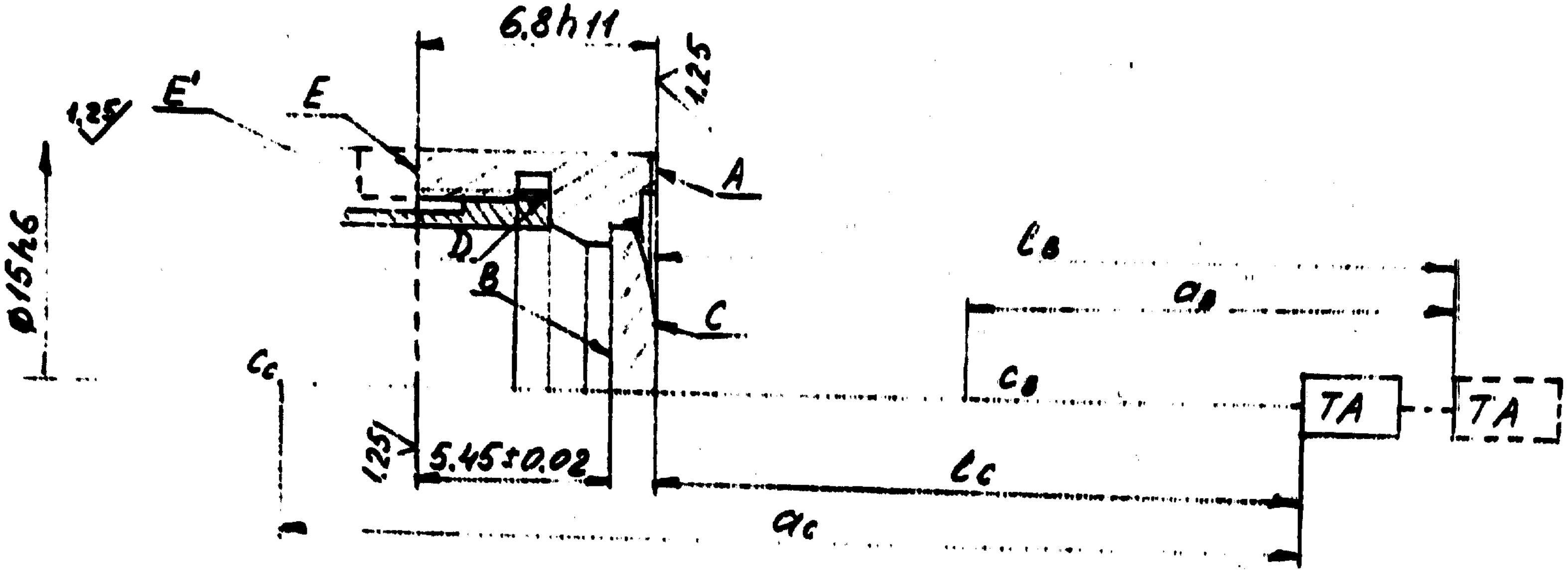
No	Name and content of operation	Equipment	Device, tool	Comment
3.7	Remove the assembly from the lathe and put it on the horizontal plate on the holder end " E ", dry the assembly during 24 hours at t-20C		Horizontal plate	
4	<u>Centring</u>			
4.1	Measure the size from the holder end " E " to the lens surface " B " and calculate the holder end cutting value to size (5,45±0,02)mm		Depth indicator check templet for the size (5,45±0,02) mm	
4.2	Mount the assembled unit in the centring chuck holder	Lathe	Centring chuck with a gap depth of 26 mm. Holder length L-47,04 mm.	
4.3	Centre the lens in the holder: admissible shift of the " B " and " C " surfaces curvature centre image being no more than 0,1 mm, and 0,03 mm, respectively. Centre the lens surface " C " by moving it over the plane surface of the centring chuck, and surface " B " by inclining it over the spherical surface of the centring chuck.		Test-adjusting device - CA	The turning of the holder to D15h6 is made as follows: 1-st pass-0.15mm 2-d pass-0.09mm 3-d pass-0.01mm After every pass to check the lens centring and to centre the lens if necessary
4.4	Turn the holder smoothly to dimension Ø15h6 in two passes, and cut the holder end " A " as a preliminary operation.		Cutter Micrometer	
4.5	Cut the holder end " E " to the value calculated in the operation 4.1 to to size (5,45±0,02)mm .			
4.6	Dull sharp edges		Mill blunt Scraper	210.050 Page 2 Pages 3

No	Name and content of operation	Equipment	Device, tool	Comment
5	Assembly Bases are Ø15h6 and holder end "E".			
5.1	Measure the real size of the holder height calculate the holder end cutting value to size 6,8h11.		Thickness gauge	
5.2	Cut the holder end " A " to the value calculated in operation 5.1.		Cutter	
5.3	Dull sharp edges			
5.4	Remove the assembly from the lathe		Mill blunt scraper	
6	Cleaning Clean the assembled unit with optical mixture.		Bamboo stick Cotton wad Optical mixture	
7	Checking Check the assembly centric, cleanness and size (5.45±0,02)mm		Testing device Magnifying glass -8x Indicator Check templet for size (5,45±0,02) mm	210.050 Page 3 Pages 3

Erection drawing

210.050

Lens in holder



Surface	ai mm	li mm	Limit decentric mm	Scale division TA-2 mm	Number divisions TA-2
„B"	∞-700	–	0,1	0,1	1
„C"	70	45,68	0,03	0,006	5

Surface	ai mm	li mm	Limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
„B"	∞-640	-	0.1	-	1
„C"	100	75.68	0.03	0.01	3

220.040
LENS IN HOLDER
(front lens)

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND CENTRING
THE LENS IN THE HOLDER
[illegible]

No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set			
1.1	Make up a set of pieces of the assembling unit. Holder - 220008 Lens - 220001			
2	Washing Wash the holder in benzine and dry it during 15 min.		Tank	
3	Assembly (See drawing)			
3.1	Mount the lens in the holder.		Forceps	
3.2	Measure the size from the outside holder end to the plane lens surface and calculate the holder end cutting value to size 0,2-0,05.		Depth indicator Support	
3.3	Remove the lens from the holder put it into a special container, having numbers.		Special cell container	
3.4	Mark the holder diameter D13,5h11 with the lens number.		Marking tool Scraper	
4	Turning the holder prior to chromatizing Bases are the thread M11x0,5 and the end "D'" (See drawing).			
4.1	Mount the holder in the lathe collet.	Diamond turning Lathe	Thread collet	
4.2	Turn the holder surface " C " prior to chromatizing to size D5h11 and cut the holder end to the value, calculated in the operation 3.2.	Diamond turning Lathe	Diamond tool Micrometer	220.040 Page 1 Pages 4

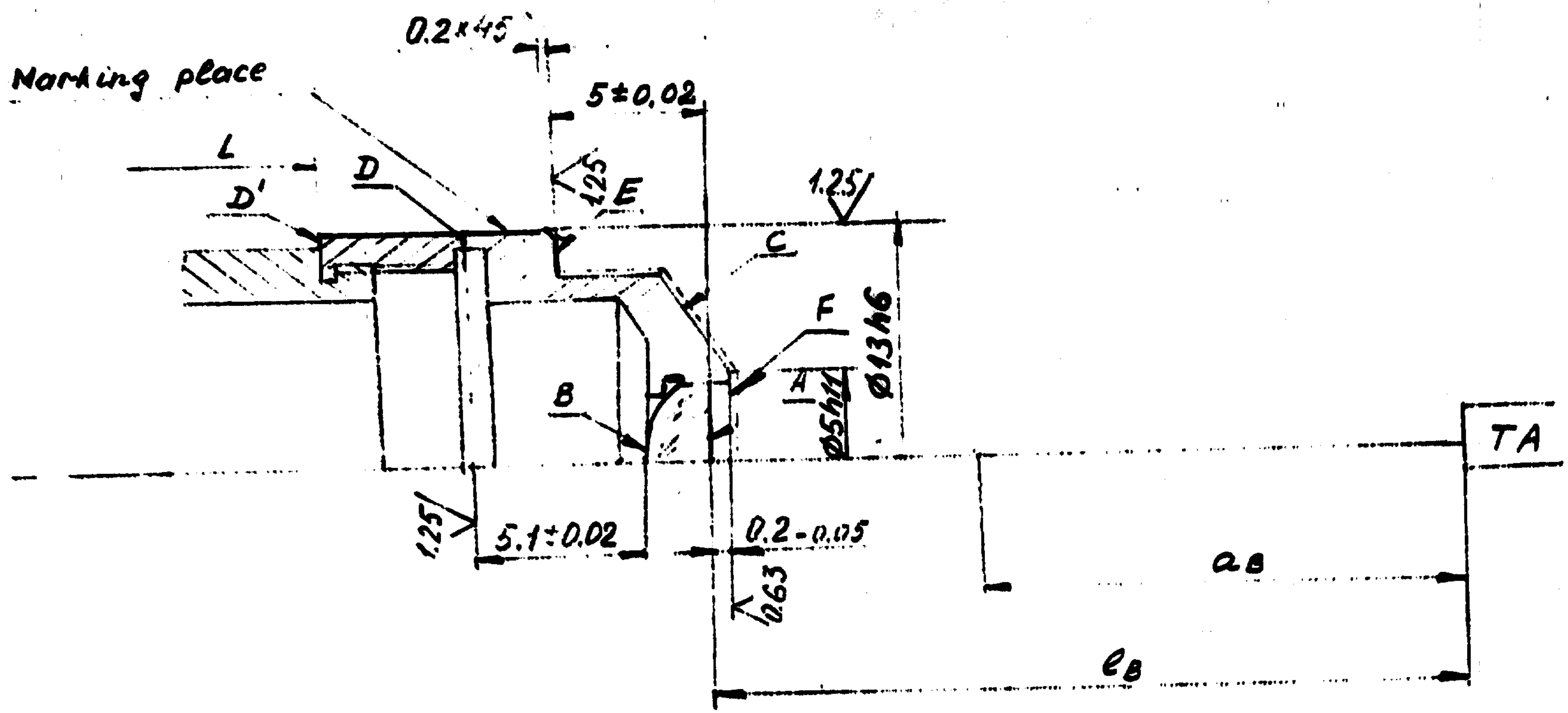
No	Name and content of operation	Equipment	Device, tool	Comment
4.3	Remove the holder from the lathe .			
4.4	Mount the holder in a device for chromatizing protecting the surfaces Ø4,2H9 and Ø13H12 and leaving uncovering only the surface " C ".			
5	<u>Chromatizing</u>		Chromium-plating tank	
6	<u>Assembly</u>			
6.1	Select the holder and the lens with the same number.			
6.2	Degrease the holder fitting diameter Ø4,2H9 and the groove with benzine and dry them during 15 min at t-20C		Bamboo stick Cotton wad	
6.3	Apply thin uniform layer of hermetic cement in the holder groove.		Injector Bamboo stick Magnifying glass 6x-8x	
6.4	Mount the lens in the holder		Forceps	
6.5	Remove superfluous hermetic cement by a cotton wad wetted in acetone. NOTE: If epoxide compound is used instead of hermetic cement, the operations 6.3 and 6.4 are exchanged, namely:		Bamboo stick	
6.3	Mount the lens in the holder and apply uniform layer of epoxied compound into the clearance between the holder and the lens. Remove superfluous epoxies by a cotton wad, wetted in acetone.			220.040 Page 2 Pages 4
7	<u>Preliminary centring</u>			
7.1	Mount the assembly in the chuck of the lathe.	Bench lathe	Tread chuck (M11x0,5)	

No	Name and content of operation	Equipment	Device, tool	Comment
7.2	Centre the lens in the holder observing visually the run out of the light flashes from the two lens surfaces and pressing the lens by a stick to strive for the flashes to be stationary while the holder is being rotated.		Magnifying glass 6x-8x Bamboo stick	
7.3	Remove the assembly from the lathe and put it on a horizontal plate on the holder end "[illegible]", dry the assembly during 24 hours at t-20°C.		Horizontal plate	
8.	<u>Centring</u>			
8.1	Measure the size from the holder end "D" to the lens surface "B" and calculate the holder end cutting value to size (5,1± 0,02)mm.		Depth indicator Check templet for size (5,1±0,02)mm	
8.2	Mount the assembly in the centring chuck holder.	Lathe	Centring chuck with gap depth of 26mm Holder length L-14,[illegible]	
8.3	Centre the lens in the holder: admissible shift of the lens surface "B" curvature centre image must be no more than 0,01mm; admissible departure of the lens surface "A" from being normal to the holder outside diameter is 2'. Centre the lens surface "B" by moving it over the plane surface of the centring chuck and the lens surface "A" by inclining it over the spherical surface of the centring chuck.		Test-adjusting device	220.040 Page 3 Pages 4

No	Name and content of operation	Equipment	Device, tool	Comment
8.4	Turn the holder smoothly to dimension Ø13h6 in two passes and cut the holder end "E" as a preliminary operation.		Micrometer Cutter	The turning of the holder to D13h6 is made as follows: 1-st pass-0.15mm 2-d pass-0.09mm 3-d pass-0.01mm After every pass to check the len centring and to centre the lens if necessary
8.5	Measure the size from the holder end "E" to the lens surface "A" and calculate the holder end cutting value to size (5±0,02)mm		Depth indicator Check templet for size (5±0,02)mm	
8.6	Cut the holder end "E" to the value calculated in the operation 8.5		Cutter	
8.7	Turn the chamber 0,2x45°		Cutter	
8.8	Cut the holder end "D" to the value calculated in the operation 8.1		Cutter	
8.9	Dull sharp edges.		Scraper	
9.	<u>Cleaning</u>		Cleaning, set	
9.1	Clean the lens in the holder with optical mixture		Optical mixture composition (10-15)%-ethylin hydrolysic alhohol 85% - petroleum ether	
10.	<u>Checking</u>		Testing device	
10.1	Check the assembly centric, cleanness and the sizes (5,1± 0,02), (5± 0,02)mm.		Magnifying glass 8x Indicator check temples for sizes (5,1 ± 0,02), (5± 0,02)mm	

Erection drawing

220.040
Lens in holder



Surface	ai mm	li mm	Limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
„B"	60	60.15	0.01	0.005	2
„A"	∞	60.15	2'	20"	6

Surface	ai mm	li mm	Limit decentric mm	Scale division TA-2 mm	Number divisions TA-2
„E"	60	60,15	0,01	0,002	5
„A"	∞	–	2'	15"	8

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND CENTRING
THE LENS IN THE HOLDER
[illegible]

No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set. Make up a set of pieces of the assembling unit Holder - 220.009 Lens - 220.010			
2	Washing Wash the holder in benzine and dry it during 15 min.		Tank	
3	Assembly			
3.1	Degrease the holder groove with benzine and dry it during 15 min. at t=20°C .		Bamboo stick Forceps	
3.2	Mount the lens in the holder .			
3.3	Apply thin uniform layer of the hermetic cement in the holder groove.		Injector	
3.4	Mount the assembly in the chuck of the lathe (bases are the thread M11x0,5 and the inside holder end "F").	Bench lathe	Thread chuck	
3.5	Remove superfluous hermetic cement by a cotton wad wetted in acetone.		Bamboo stick Magnifying glass 6x-8x	Preliminary centring
3.6	Centre the lens in the holder observing visually the run-out of the flashes from two lens surfaces and pressing the stick to strive for the flashes to be stationary while the holder is being rotated.		Bamboo stick	3
3.7	Remove the assembly from the lathe and put it on the horizontal plate on the holder end "A ", dry the assembly during 24 hours at t=20C		Horizontal plate	

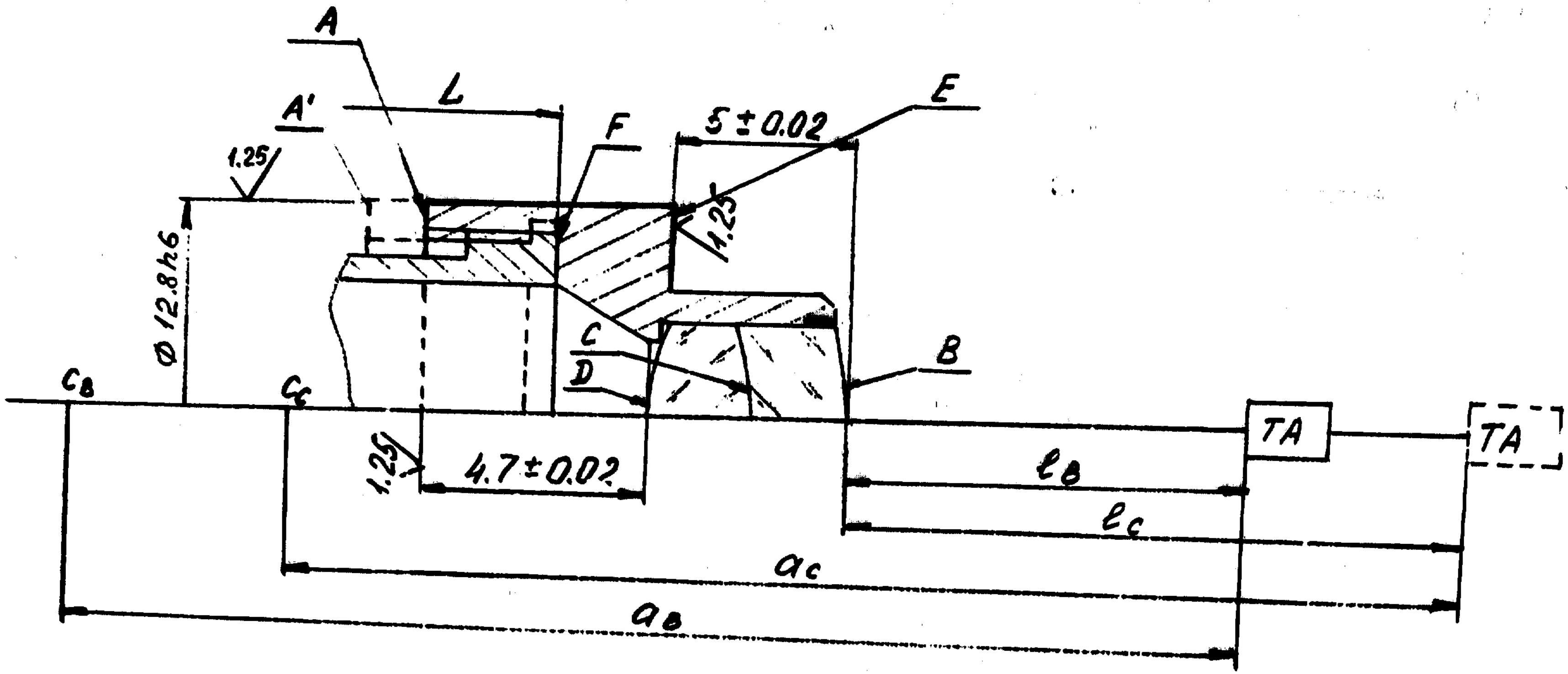
No	Name and content of operation	Equipment	Device, tool	Comment
4	Centring (see drawing) Bases are M11x0,5 and "F"			
4.1	Measure the size from the holder end "A" to the lens surface "D" and calculate the holder end cutting value to size (4,7±0,02) mm		Depth indicator check templet for the size (4,7±0,02) mm.	
4.2	Mount the assembled unit in the centring chuck holder	Lathe	Centring chuck with a gap depth of 26 mm. Holder length L=[redacted] mm. 40,2 mm	
4.3	Centre the lens in the holder, admissible shift of the "C" and "D" surfaces curvature centre image being no more than 0,01 mm, and 0,01 mm, respectively. Centre the lens surface "B" by moving it over the plane surface of the centring chuck; and surface "E" by inclining it over the spherical surface of the centring chuck.		Test-adjusting device - CA	
4.4	Turn the holder smoothly to dimension Ø12,8h6 in two passes, and cut the holder end "E" as a preliminary operation.		Cutter micrometer	The turning of the holder to D13h6 is made as follows: 1-st pass-0.15mm 2-d pass-0.09mm 3-d pass-0.01mm After every pass to check the lens centring and to centre the lens if necessary
4.5	Measure the size from the holder end "E" to the lens surface "B" and calculate the holder end cutting value to size (5±0,02) mm.		Depth indicator chuck templet to the size (5±0,02) mm	
4.6	Cut the holder end "E" to the value, calculated in the operation 4.5		Cutter	
4.7	Cut the holder end "A" to the value calculated in the operation 4.1.			Page 2
4.8	Dull sharp edges.		Mill blunt scraper	Pages 2

No	Name and content of operation	Equipment	Device, tool	Comment
4.9	Remove the assembly from the lathe.			
5	Cleaning Clean lens in holder with optical mixture.		Bamboo stick Optical mixture Cotton wad	
6	Checking Check the assembly centric; cleanness, sizes (4,7±0,02) and (5 ±0,02)mm		Magnifying glass -6x-8x templet for (4,7±0,02) templet for (5 ±0,02) indicator. Testing device- CD	

Erection drawing

220.050

Lens in holder



Surface	a_i mm	l_i mm	Limit decentric mm	Scale division TA-1mm	Number divisions TA-1
„B"	100	79.16	0.01	0.01	1
„C"	70	63.67	0.01	0.007	1,5

Surface	a_i mm	l_i mm	Limit decentric mm	Scale division TA-2mm	Number divisions TA-2
„B"	60	39,16	0,01	0,002	5
„C"	60	53,67	0,01	0,002	6

LENS IN HOLDER 220.060

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND CENTRING
THE LENS IN THE HOLDER
[illegible]

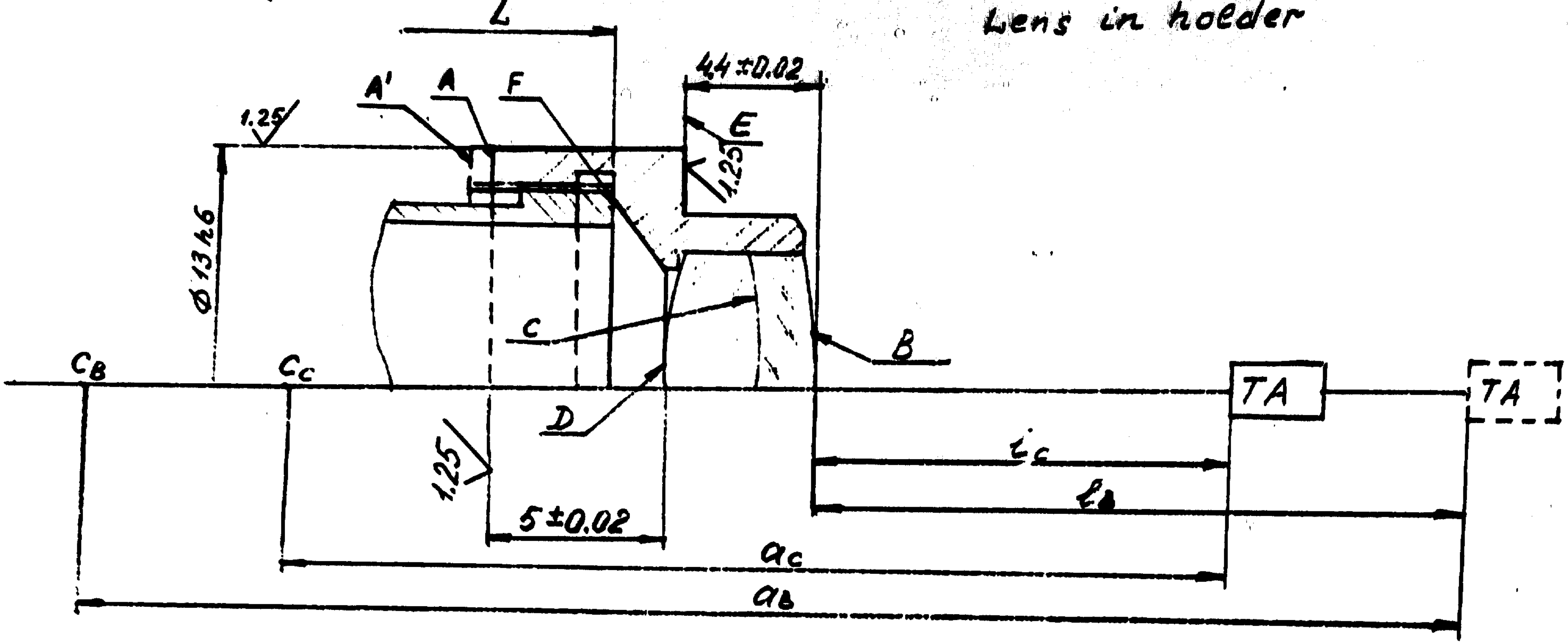
No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set. Make up a set of pieces of the assembling unit Holder - 220.011 Lens - 220.020			
2	Washing Wash the holder in benzine and dry it during 15 min.		Tank	
3	Assembly			
3.1	Degrease the holder groove with benzine and dry it during 15 min. at t-20°C .		Bamboo stick Forceps	
3.2	Mount the lens in the holder .			
3.3	Apply thin uniform layer of the hermetic cement in the holder groove.		Injector	
3.4	Mount the assembly in the chuck of the lathe (bases are the thread M11x0,5 and the inside holder end "F").	Bench lathe	Thread chuck	
3.5	Remove superfluous hermetic cement by a cotton wad wetted in acetone.		Bamboo stick Magnifying glass 6x-8x	Preliminary centring
3.6	Centre the lens in the holder observing visually the run-out of the flashes from two lens surfaces and pressing the stick to strive for the flashes to be stationary while the holder is being rotated.		Bamboo stick	
3.7	Remove the assembly from the lathe and put it on the horizontal plate on the holder end "A", dry the assembly during 24 hours at t-20C		Horizontal plate	

No	Name and content of operation	Equipment	Device, tool	Comment
4	Centring (see drawing) Bases are H 11x0,5 and " F "			
4.1	Measure the size from the holder end " A " to the lens surface " D " and calculate the holder end cutting value to size (5±0,02) mm.		Depth indicator check templet for the size (5±0,02) mm	
4.2	Mount the assembled unit in the centring chuck holder.	Lathe	Centring chuck with a gap depth of 25 mm. Holder length L=36,6 mm	
4.3	Centre the lens in the holder, admissible shift of the " C " and " B " surfaces curvature centre image being no more than 0,01 mm, and 0,01 mm, respectively. Centre the lens surface " B " by moving it over the plane surface of the centring chuck; and surface " E " by inclining it over the spherical surface of the centring chuck.		Test-adjusting device - CA	
4.4	Turn the holder smoothly to dimension Ø13h6 in two passes, and cut the holder end " E " as a preliminary operation.		Cutter micrometer	The turning of the holder to D13h6 is made a: follows: 1-st pass-0.15m 2-d pass-0.09m 3-d pass-0.01m After every pas. to check the le: centring and to centre the lens if necessary
4.5	Measure the size from the holder end " E " to the lens surface " B " and calculate the holder end cutting value to size (4,4±0,02) mm.		Depth indicator chuck templet to the size (4,4±0,02) mm	
4.6	Cut the holder end " E " to the value, calculated in the operation 4.5		Cutter	
4.7	Cut the holder end " A " to the value calculated in the operation 4.1.			Page 2
4.8	Dull sharp edges.		Mill blunt scraper	Pages 3

No	Name and content of operation	Equipment	Device, tool	Comment
4.9	Remove the assembly from the lathe.			
5	<u>Cleaning</u> Clean lens in holder with optical mixture.		Bamboo stick Optical mixture Cotton wad	
6	<u>Checking</u> Check the assembly centric; cleanness, sizes (5±0,02) and (4,4±0,02)mm		Magnifying glass -6x-8x templet for (5±0,02) templet for (4,4±0,02) indicator. Testing device- CD	Page 3 Pages 3

Erection drawing

220.060
Lens in holder



Surface	ai mm	li mm	Limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
„B"	100.	73.56	0.01	0.01	1
„C"	60.	47.95	0.01	0.005	2

Surface	ai mm	li mm	Limit decentric mm	Scale division TA-2 mm	Number divisions TA-2
„B"	60	43,56	0,01	0,002	5
„C"	60	65	0,01	0,002	6

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND CENTRING
THE LENS IN THE HOLDER
KNOW-HOW

No	Name and content of operation	Equipment	Device, tool	Comment
1	Make-up a set Make up a set of pieces of the assembling unit. Holder - 220.012 Lens - 220.030			
2	Washing Wash the holder in benzine and dry it during 15 min.		Tank	
3	Assembly			
3.1	Degrease the holder groove with benzine and dry it during 15 min at t-20°C		Bamboo stick Forceps Cotton wool	
3.2	Mount the lens in the holder			
3.3	Apply thin uniform layer hermetic cement in the holder groove.		Injector	
3.4	Mount the assembly in chuck of the lathe(bases are the thread M11x0.5 and the inside holder end)	Bench lathe	Thread chuck	
3.5	Remove superfluous hermetic cement by a cotton wad-wetted in acetone.		Bamboo stick	
3.6	Centre the lens in the holder observing visually the run-out of the light flashes from two lens surfaces and pressing the lens by the stick to strive for flashes to be stationary while the holder is being rotated.		Bamboo stick Magnifying glass 6x-8x	Preliminary centring
3.7	Remove the assembly from the lathe and put it on the horizontal plate on the holder end " E' ", dry the assembly during 24 hours at t-20C		Horizontal plate	220.070 Page 1 Pages 3

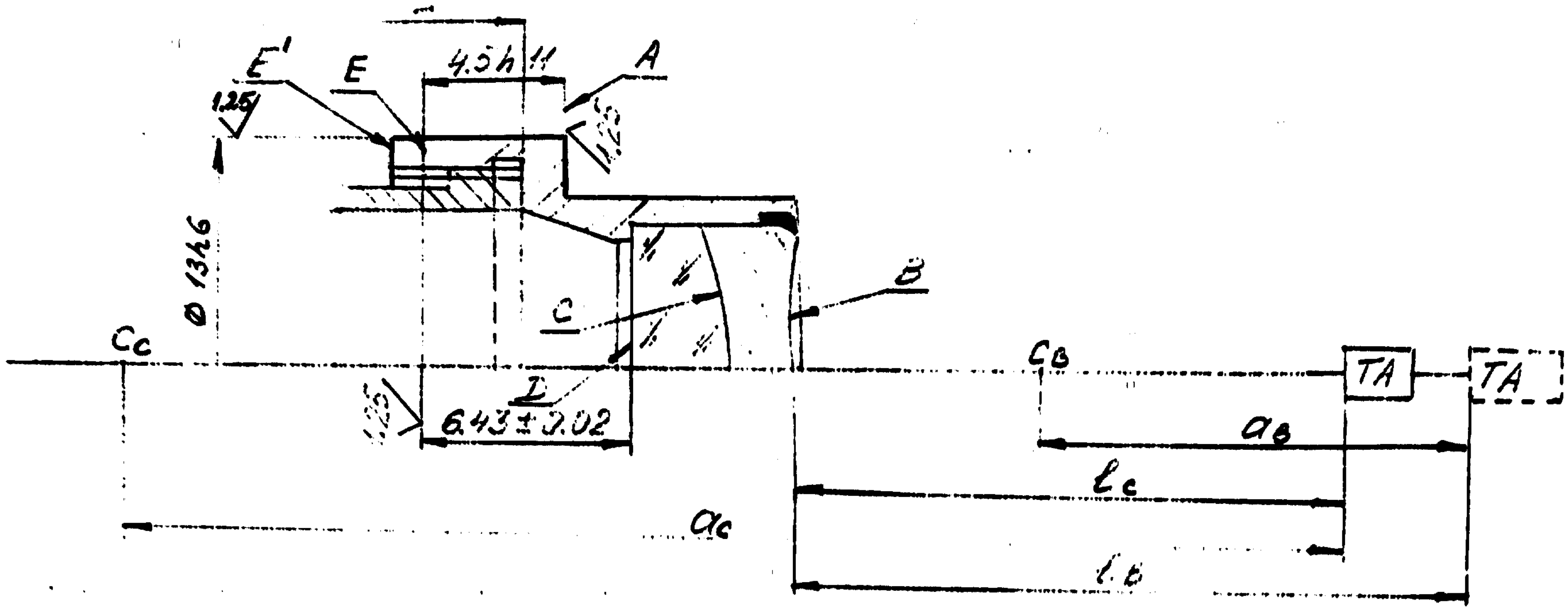
No	Name and content of operation	Equipment	Device, tool	Comment
4	Centring (See drawing)			
4.1	Measure the size from the holder end " E " to the lens surface " D " and calculate the holder end cutting value to size (6,43±0,02) mm		Depth indicator check templet for the size (6,43±0,02) mm	
4.2	Mount the assembled unit in the centring chuck holder	Lathe	Centring chuck with a gap depth of 26 mm. Holder length L-27,90 mm.	
4.3	Centre the lens in the holder: admissible shift of the " C " and " B " surfaces curvature centre image being no more than 0,02 mm, and 0,05 mm, respectively. Centre the lens surface " C " by moving it over the plane surface of the centring chuck, and surface " B " by inclining it over the spherical surface of the centring chuck.		Test-adjusting device - CA	
4.4	Turn the holder smoothly to dimension O13h6 in two passes, and cut the holder end " A " as a preliminary operation.		Cutter micrometer	The turning of the holder to D13h6 is made a: follows: 1-st pass-0.15m: 2-d pass-0.09m: 3-d pass-0.01m After every pas: to check the le: centring and to centre the lens if necessary
4.5	Cut the holder end " E " to the value calculated in the operation 4.1 .		Cutter	
4.6	Dull sharp edges		Mill blunt scraper	
5	Assembly			
5.1	Measure the real size of the holder height and calculate the holder end cutting value to the size 4,5h11		Thickness gauge-block Depth-indicator	220.070 Page 2 Pages 3

No	Name and content of operation	Equipment	Device, tool	Comment
5.2	Cut the holder end " A " to the value calculated in operation 5.1.		Cutter	
5.3	Dull sharp edges		Mill blunt scraper	
5.4	Remove the assembly from the lathe			
6	Checking Check the assembly centric, cleanness and size(6,43+0,02)mm		Magnifying glass 6x-8x Indicator 0,002 on Ø13h6 templet for the size (6,43±0,02) mm	
7	Cleaning Clean the assembled unit with by optical mixture.		Testing device- CD Optical mixture Cotton wad Bamboo stick mm	
				220.070 Page 1 Pages 3

Erection drawing

220.070

Lens in holder



Surface	ai mm	li mm	Limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
„B"	60	115,85	0.05	0.005	10
„C"	100	93,42	0.05	0.01	2

Surface	ai mm	li mm	Limit decentric mm	Scale division TA-2 mm	Number divisions TA-2
„B"	60	115,85	0,05	0,004	9
„C"	60	53,42	0,02	0,004	5

**ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND CENTERING
THE LENS IN THE HOLDER
[illegible]**

No	Name and content of operation	Equipment	Device, tool	Comment
1	<u>Making-up a set</u>			
1.1	Make up a set of pieces of the assembling unit. Holder - 230009 Lens - 230001			
2	<u>Washing</u> Wash the holder in benzine and dry it during 15 min at t=20C.		Tank	
3	<u>Assembly</u> (See drawing)			
3.1	Mount the holder in the lathe collet. Bases are the surface Ø15,5 and the end "E".	Lathe	Collet	
3.2	Turn the groove Ø3,5H12 to a depth of 0,3±0,02mm.		Cutter Check gauge for size 0,3±0,02mm	
3.3	Dull sharp edges.		Scraper	
3.4	Remove the holder from the lathe.			
3.5	Mount the holder in the lathe collet. Bases are the thread M13x0,5 and the end "C′"	Lathe	Thread collet(M13x0,5)	
3.6	Turn the through hole Ø1,56H9.		Cutter Check gauge for size Ø1,56H9	
3.7	Turn the cone surface 8°±30′, keeping the size (3,5 ± 0.02) mm		Depth indicator Tip with lens	
3.8	Remove the holder from the lathe.			
4	<u>Chemical oxidation</u>		Chromium-plating tank	230.040 Page 1 Pages 5
5	<u>Assembly</u>			
5.1	Mount the lens in the holder		Forceps	

No	Name and content of operation	Equipment	Device, tool	Comment
5.2	Measure the size from the outside holder end to the plane lens surface and calculate the holder end cutting value to size 0,05 mm.		Depth indicator	
5.3	Remove the lens from the holder put it into a special container having numbers.		Special cell container	
5.4	Mark the holder surface Ø15,5h12 with the lens number.		Marking tool Scraper	
6	<u>Turning the holder prior to chromatizing</u> Bases are the thread M13x0,5 and the end"C'". (See drawing)			
6.1	Mount the holder in the lathe collet.	Diamond turning lathe	Thread collet(M13x0,5)	
6.2	Turn the holder surface "F" prior to chromatizing to size Ø5h12 and cut the holder end to the value calculated in the operation 5.2.		Diamond tool	
6.3	Remove the holder from the lathe.			
6.4	Mount the holder in a device for chromatizing protecting the surfaces Ø1,56H9, Ø15,5H12,cone surface 8°±30' and leaving uncovering only the surface "F".			
7	<u>Chromatizing</u>		Chromium-plating tank	
8.	<u>Assembly</u>			
8.1	Select the holder and the lens with the same number.			
8.2	Degrease the holder fitting surface Ø1,56H9 and cone surface 8°± 30' with benzine and dry them during 15 min at 20C.		Bamboo stick Cotton wad	230.040 Page 2 Pages 5

No	Name and content of operation	Equipment	Device, tool	Comment
8.3	Mount the lens in the holder.		Forceps	
8.4	Apply thin uniform layer epoxies compound into the clearance between the holder and the lens.		Bamboo stick Cotton wad Magnifying glass 6x-8x	
8.5	Remove superfluous compound by the cotton wad, wetted in acetone.			
9.	<u>Preliminary centring</u>			
9.1	Mount the assembly in the chuck of the lathe. Bases are: the thread M13x0,5 and the end "C'"	Bench lathe	Thread chuck (M13x0,5)	
9.2	Centre the lens in the holder observing visually the run out of the light flashes from the two lens surfaces and pressing the lens by a a stick to strive for flashes to be stationary while the holder is being rotated.		Bamboo stick Magnifying glass 6x-8x	
9.3	Remove the assembly from the lathe and put it on a horizontal plate on the holder end "C", dry the assembly during 24 hours at t-20C.		Horizontal plane	
10.	<u>Centring</u>			
10.1	Measure the size from the holder end "C" to the lens surface "A" and calculate the holder end cutting value to size 5,5-0,01.		Depth indicator Check template for size 5,5-0,01	
10.2	Mount the assembly in the centring chuck holder.	lathe	Centring chuck with gap depth of 26 mm Holder length L-15,93	230.040 Page 3 Pages 5
10.3	Centre the lens in the holder: admissible shift of the lens surface "A"		Test-adjusting device - TA	

No	Name and content of operation	Equipment	Device, tool	Comment
	curvature centre image must be no more than 0,005 mm; admissible departure of the lens surface "B" from being normal to the holder outside diameter -2'. Centre the lens surface "A" by moving it over the plane surface of the centring chuck and the lens surface "B" by inclining it over the spherical surface of the centring chuck.			
10.4	Turn the holder smoothly to dimension D15h6 in two passes and cut the holder end "E" as a preliminary operation .		Cutter Micrometer	The turning of the holder to D15h6 is made as follows: 1-st pass-0.15mm 2-d pass-0.09mm 3-d pass-0.01mm After every pass to check the lens centring and to centre the lens if necessary
10.5	Measure the size from the holder end "E" to the lens surface "B" and calculate the holder end cutting value to size (4± 0,02) mm		Depth indicator Check templet for size (4±0.02) mm	
10.6	Cut the holder end "E" to the value calculated in the operation 10.5.			
10.7	Dull sharp edges		Scraper	
10.8	Cut the holder end "C" to the value, calculated in the operation 10.1.			
11	<u>Cleaning</u>			
11.1	Clean the lens in the holder with optical mixture.		Cleaning set	Optical mixture composition: (10-15)%-ethyl hydrolysis alcohol 85%-petroleum ether
12	<u>Checking</u>			
12.1	Check the assembly centring, cleanness, the sizes (4±0,02), 5;5$_{-0,01}$.		Testing device Magnifying glass 6x-8x	230.040 Page4 Pages 5

No	Name and content of operation	Equipment	Device, tool	Comment
			Check temp-- lets for sizes(4±0,02) 5,[illegible]$_{-0,01}$ mm.	

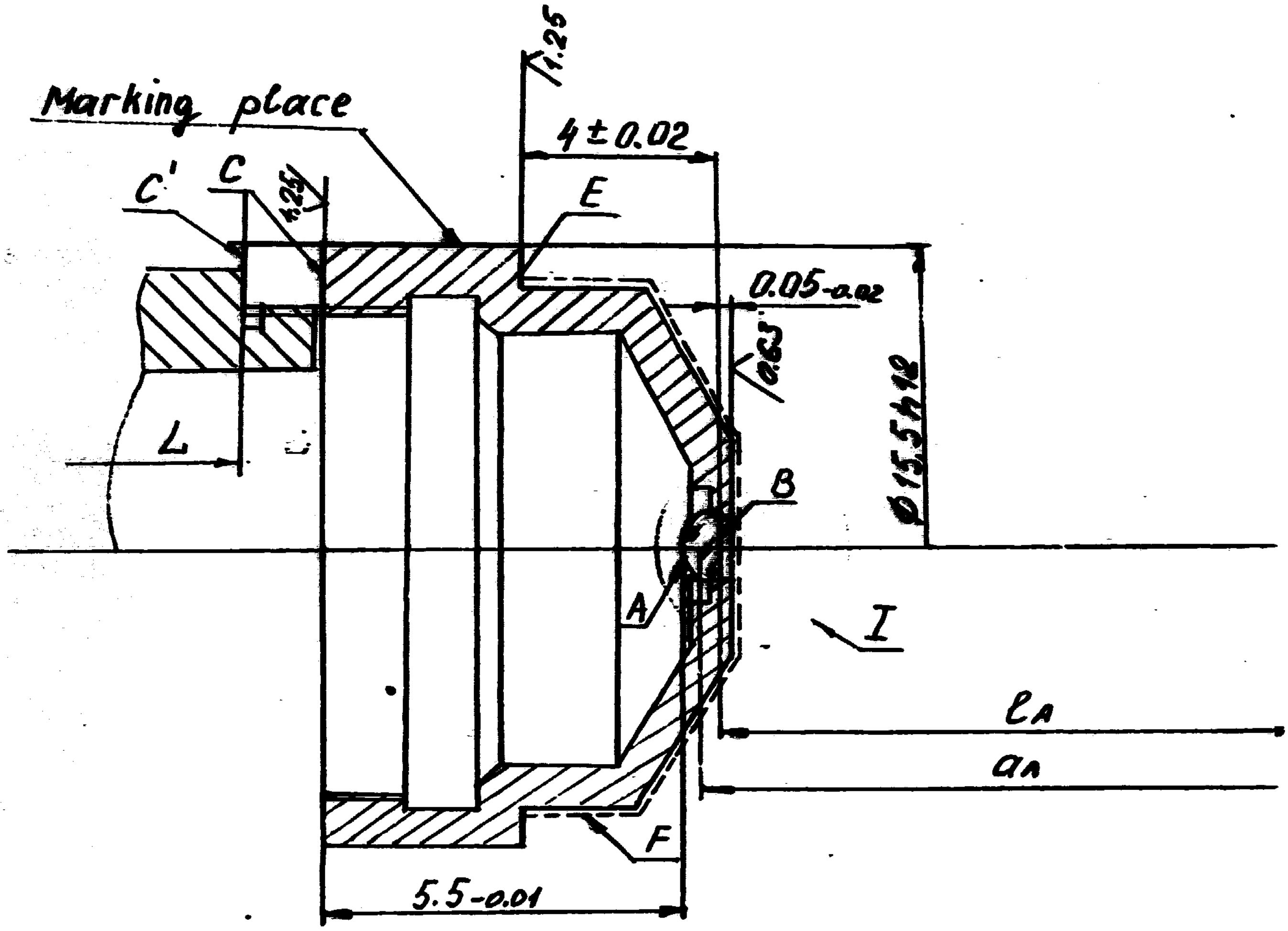
Lens in holder

TA

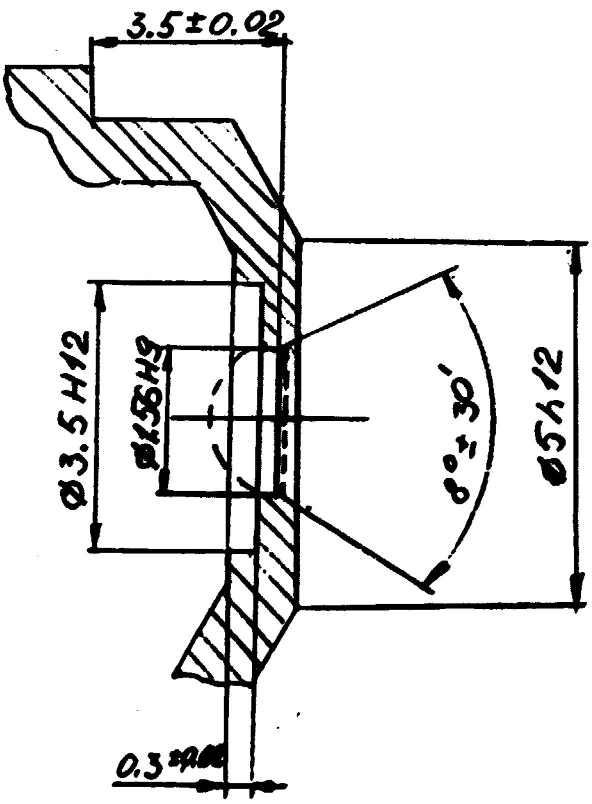
: n	limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
91	0,005	0,003	1,5
	2'	20"	6

Surface	ai mm	li mm	limit de[illegible]tric [illegible]	Scale division TA-2 mm	Number divisions TA-2
A	60	59,[illegible]	0,005	0,002	2,5
B	∞	–	2'	15"	8

Erection drawing



I



Surface	a_i mm	
A	50	4
B	∞	

LENS IN HOLDER

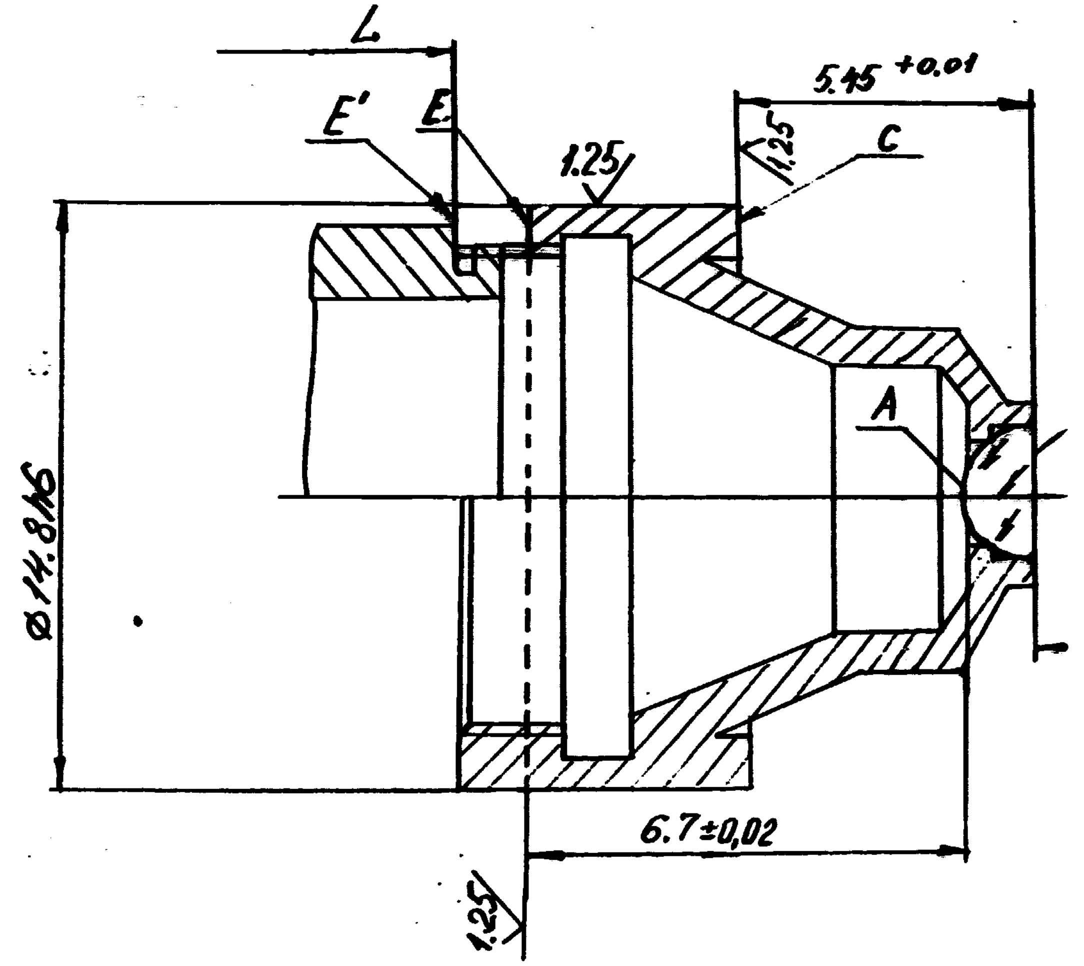
**ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND CENTRING
THE LENS IN THE HOLDER
[illegible]**

No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set. Make up a set of pieces of the assembling unit Holder - 230.011 Lens - 230.002			
2	Washing Wash the holder in benzine and dry it during 15 min.		Tank	
3	Assembly			
3.1	Degrease the holder groove with benzine and dry it during 15 min. at t-20°C.		Bamboo stick Forceps	
3.2	Mount the lens in the holder.			
3.3	Apply thin uniform layer of the hermetic cement in the holder groove.		Injector	
3.4	Mount the assembly in the chuck of the lathe (bases are the thread $M13\times0{,}5$ and the outside holder end „E").	Bench lathe	Thread chuck	
3.5	Remove superfluous hermetic cement by a cotton wad wetted in acetone.		Bamboo stick Magnifying glass 6x-8x	Preliminary centring
3.6	Centre the lens in the holder observing visually the run-out of the flashes from two lens surfaces and pressing the stick to strive for the flashes to be stationary while the holder is being rotated.		Bamboo stick	
3.7	Remove the assembly from the lathe and put it on the horizontal plate on the holder end "E", dry the assembly during 24 hours at t-20C		Horizontal plate	

No	Name and content of operation	Equipment	Device, tool	Comment
4	Centring (see drawing) Bases are $M13 \times 0{,}5$ and " E' "			
4.1	Measure the size from the holder end " E' " to the lens surface " A " and calculate the holder end cutting value to size ($6{,}7 \pm 0{,}02$) mm		Depth indicator check templet for the size ($6{,}7 \pm 0{,}0$[illegible]) mm	
4.2	Mount the assembled unit in the centring chuck holder	Lathe	Centring chuck with a gap depth of 26 mm. Holder length L-14,00 mm	
4.3	Centre the lens in the holder, admissible shift of the " A " and " B " surfaces curvature centre image being no more than 0,005 mm, and 2', (mm) respectively. Centre the lens surface " A " by moving it over the plane surface of the centring chuck; and surface " B " by incli-ning it over the spheri-cal surface of the cent-ring chuck.		Test-adjus-ting device - CA	
4.4	Turn the holder smoothly to dimension Ø 14,8h6 in two passes, and cut the holder end " C " as a preliminary operation.		Cutter micrometer	
4.5	Measure the size from the holder end " C " to the lens surface " B " and calculate the holder end cutting value to size ($5{,}45^{+0,1}$ mm		Depth in-dicator chuck temp-let to the size ($5{,}45^{+0,1}$ mm	
4.6	Cut the holder end " C " to the value, cal-culated in the operation 4.5		Cutter	
4.7	Cut the holder end " E " tb the value calculated in the operation 4.1.			Page 2
4.8	Dull shark edges.		Mill blunt scraper	Pages 3

No	Name and content of operation	Equipment	Device, tool	Comment
4.9	Remove the assembly from the . the.			
5	Cleaning Clean lens in holder with optical mixture.		Bamboo stick Optical mixture Cotton wad	
6	Checking Check the assembly centric; cleanness, sizes $5{,}45^{+0{,}01}$ and $6{,}7 \pm 0{,}02$		Magnifying glass -6x-8x templet for $5{,}45^{+0{,}01}$ templet for $6{,}7 \pm 0{,}02$ indicator. Testing device- CD	Page 3 Pages 3

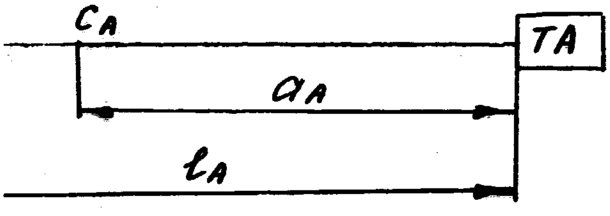
Erection drawing



Surface	a_i mm	
A	60	6
B	∞	

230.050

Lens in holder



limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
0.005	0.005	1
2'	20"	6

Surface	ai mm	li mm	limit decentric mm	Scale division TA-2 mm	Number divisions TA-2
A	60	60,97	0,005	0,002	2
B	∞	–	2'	15"	8

LENS IN HOLDER 230.060

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND CENTRING
THE LENS IN THE HOLDER
KNOW-HOW

No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set. Make up a set of pieces of the assembling unit Holder - 230.012 Lens - 230.010			
2	Washing Wash the holder in benzine and dry it during 15 min.		Tank	
3	Assembly			
3.1	Degrease the holder groove with benzine and dry it during 15 min. at t-20°C.		Bamboo stick Forceps	
3.2	Mount the lens in the holder.			
3.3	Apply thin uniform layer of the hermetic cement in the holder groove.		Inje[illegible]tor	
3.4	Mount the assembly in the chuck of the lathe (bases are the thread M13×0,5 and the [illegible]side holder end „D").	Bench lathe	Thread chuck	
3.5	Remove superfluous hermetic cement by a cotton wad wetted in acetone.		Bamboo stick Magnifying glass 6x-8x	Preliminary centring
3.6	Centre the lens in the holder observing visually the run-out of the flashes from two lens surfaces and pressing the stick to strive for the flashes to be stationary while the holder is being rotated.		Bamboo stick	
3.7	Remove the assembly from the lathe and put it on the horizontal plate on the holder end "D", dry the assembly during 24 hours at t-20C		Horizontal plate	

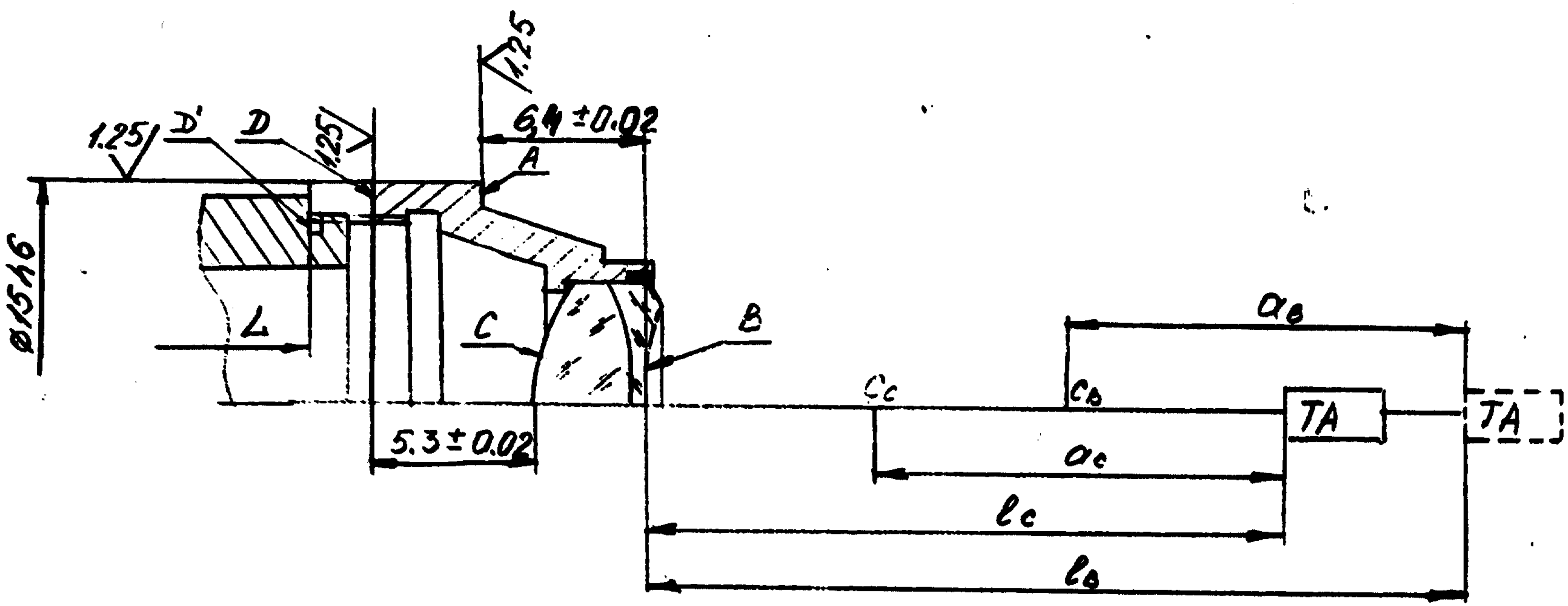
No	Name and content of operation	Equipment	Device, tool	Comment
4	Centring (see drawing) Bases are M13 x 0,5 and "D"			
4.1	Measure the size from the holder end "D" to the lens surface "C" and calculate the holder end cutting value to size (5,3 ± 0,02) mm		Depth indicator check templet for the size (5,3 ± 0,02) mm.	
4.2	Mount the assembled unit in the centring chuck holder	Lathe	Centring chuck with a gap depth of 26 mm. Holder length L- 13,28 mm.	
4.3	Centre the lens in the holder, admissible shift of the "B" and "C" surfaces curvature centre image being no more than 0,04 mm, and 0,01 mm, respectively. Centre the lens surface "C" by moving it over the plane surface of the centring chuck; and surface "B" by inclining it over the spherical surface of the centring chuck.		Test-adjusting device - CA	
4.4	Turn the holder smoothly to dimension Ø15h6 in two passes, and out the holder end "A" as a preliminary operation.		Cutter micrometer	
4.5	Measure the size from the holder end "A" to the lens surface "B" and calculate the holder end cutting value to size (6,4 ± 0,02) mm.		Depth indicator chuck templet to the size (6,4 ± 0,02) mm	
4.6	Cut the holder end "A" to the value, calculated in the operation 4.5		Cutter	
4.7	Cut the holder end "D" th the value calculated in the operation 4.1.			Page 2
4.8	Dull sharp edges.		Mill blunt scraper	Pages 3

No	Name and content of operation	Equipment	Device, tool	Comment
4.9	Remove the assembly from the lathe.			
5	Cleaning Clean lens in holder with optical mixture.		Bamboo stick Optical mixture Cotton wad	
6	Checking Check the assembly centric; cleanness, sizes (5,3±0,02) and (6,4±0,02)mm		Magnifying glass -6x-8x templet for 5,3±0,02 templet for 6,4±0,02 indicator. Testing device- CD	Page 3 Pages 3

Erection drawing

230.060

Lens in holder



Surface	ai mm	li mm	Limit decentric mm	Scale division TA-1 mm	Number divisions TA-1
„B"	60	130.96	0.04	0.005	8
„C"	90	90.86	0.01	0.009	1

Surface	ai mm	li mm.	Limit decentric mm.	Scale division TA-1 mm	Number divisions TA-1
„B"	60	130,96	0,04	0,004	10
„C"	60	60,86	0,01	0,002	5

230.070

LENS IN HOLDER

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND CENTRING
THE LENS IN THE HOLDER
KNOW-HOW

No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set. Make up a set of pieces of the assembling unit Holder - 230.013 Lens - 230.020			
2	Washing Wash the holder in benzine and dry it during 15 min.		Tank	
3	Assembly			
3.1	Degrease the holder groove with benzine and dry it during 15 min. at t-20°C .		Bamboo stick Forceps	
3.2	Mount the lens in the holder .			
3.3	Apply thin uniform layer of the hermetic cement in the holder groove.		Injector	
3.4	Mount the assembly in the chuck of the lathe (bases are the thread M13×0,5 and the inside holder end „D").	Bench lathe	Thread chuck	
3.5	Remove superfluous hermetic cement by a cotton wad wetted in acetone.		Bamboo stick Magnifying glass 6x-8x	Preliminary centring
3.6	Centre the lens in the holder observing visually the run-out of the flashes from two lens surfaces and pressing the stick to strive for the flashes to be stationary while the holder is being rotated.		Bamboo stick	
3.7	Remove the assembly from the lathe and put it on the horizontal plate on the holder end "E'", dry the assembly during 24 hours at t-20C		Horizontal plate	

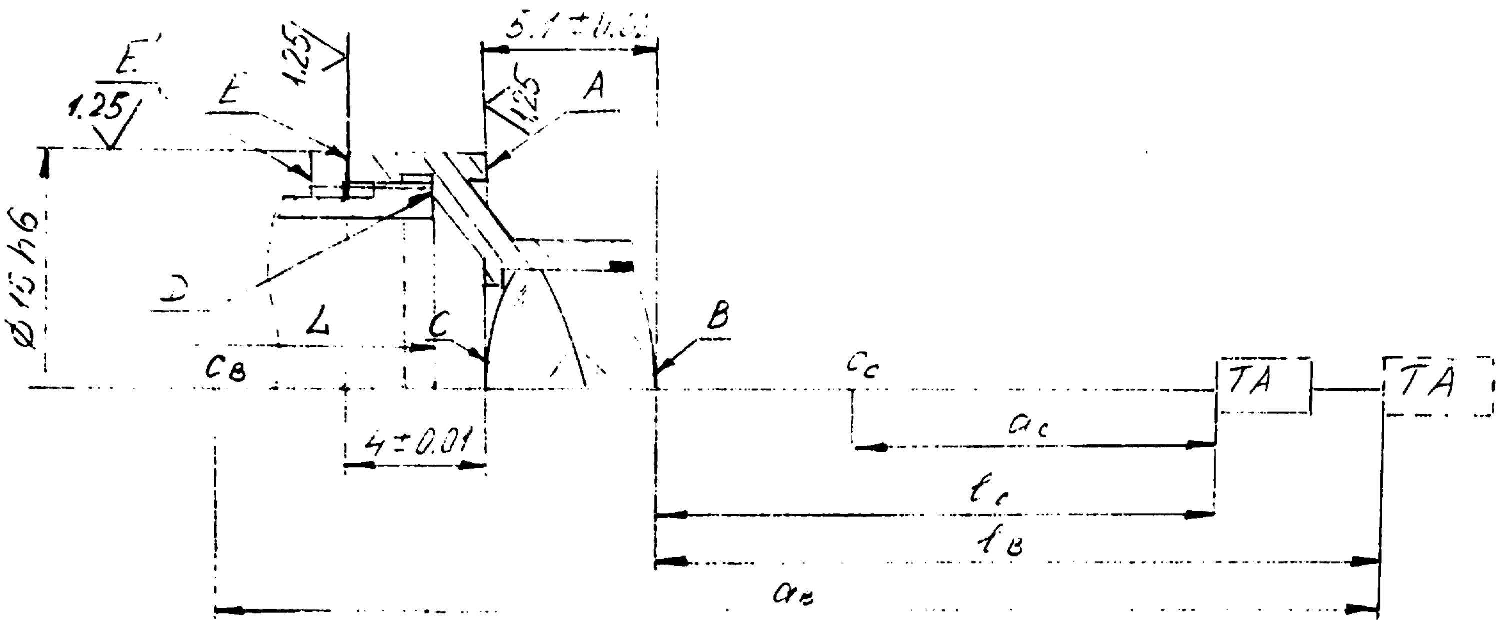
No	Name and content of operation	Equipment	Device, tool	Comment
4	Centring (see drawing) Bases are M13×0,5 and " D "			
4.1	Measure the size from the holder end " E' " to the lens surface " C " and calculate the holder end cutting value to size (4±0,01) mm		Depth indicator check templet for the size (4±0,01) mm.	
4.2	Mount the assembled unit in the centring chuck holder	Lathe	Centring chuck with a gap depth of 25 mm. Holder length L- 15,87 mm.	
4.3	Centre the lens in the holder, admissible shift of the " B " and " C " surfaces curvature centre image being no more than 0,02 mm, and 0,01 mm, respectively. Centre the lens surface " C " by moving it over the plane surface of the centring chuck, and surface " B " by inclining it over the spherical surface of the centring chuck.		Test-adjusting device - CA	
4.4	Turn the holder smoothly to dimension Ø 15h6 in two passes, and out the holder end " A " as a preliminary operation.		Cutter micrometer	
4.5	Measure the size from the holder end " A " to the lens surface " B " and calculate the holder end cutting value to size (5,1±0,02) mm.		Depth indicator chuck templet to the size (5,1±0,02) mm	
4.6	Cut the holder end " A " to the value, calculated in the operation 4.5		Cutter	
4.7	Cut the holder end " E " to the value calculated in the operation 4.1.			Page 2
4.8	Dull sharp edges.		Mill blunt scraper	Pages 3

No	Name and content of operation	Equipment	Device, tool	Comment
4.9	Remove the assembly from the lathe.			
5	<u>Cleaning</u> Clean lens in holder with optical mixture.		Bamboo stick Optical mixture Cotton wad	
6	<u>Checking</u> Check the assembly centric; cleanness, sizes (4 ±0,01) and (5,2 ± 0,02)mm		Magnifying glass -6x-8x templet for 4±0,01 templet for 5,1±0,02 indicator. Testing device- CD	
				Page 3 Pages 3

Erection drawing

230.070

Lens in holder



Surface	a_i mm	e_i mm	e_{limit} decentric mm	Scale division TA-1 mm	Number divisions TA-1
B'	100	77.14	0.02	0.01	2
C''	70	73.35	0.01	0.007	1

Surface	a_i mm	e_i mm	e_{limit} decentric mm	Scale division TA-1	Number divisions TA-1
E	60	37,14	0,02	0,002	10
[illegible]	60	63,35	0,01	0,002	5

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING AND CENTRING
THE LENS IN THE HOLDER
KNOW-HOW

No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set Make up a set of pieces of the assembling unit. Holder - 230.014 Lens - 230.030			
2	Washing Wash the holder in benzine and dry it during 15 min at t-20C.		Tank	
3	Assembly			
3.1	Degrease the holder fitting diameter D8,5H9 and the and dry it during 15 min at t-20C		Bamboo stick Cotton wool Forceps	
3.2	Apply thin uniform layer of the hermetic cement in the holder groove.		Injector	
3.3	Mount lens 210.005 in the holder .			
3.4	Mount the assembly in the chuck of the lathe (bases are the thread M13x0.5 and the inside holder end-"E").	Bench lathe	Thread chuck	
3.5	Remove superfluous hermetic cement by a cotton wad-wetted in acetone.		Bamboo stick	
3.6	Centre the lens in the holder observing the run-out of the flashes of light from two lens surfaces visually and pressing the lens by the stick to strive for the flashes to be stationary while the holder is being rotated.		Magnifying glass 6x-8x Bamboo stick	Preliminary centring

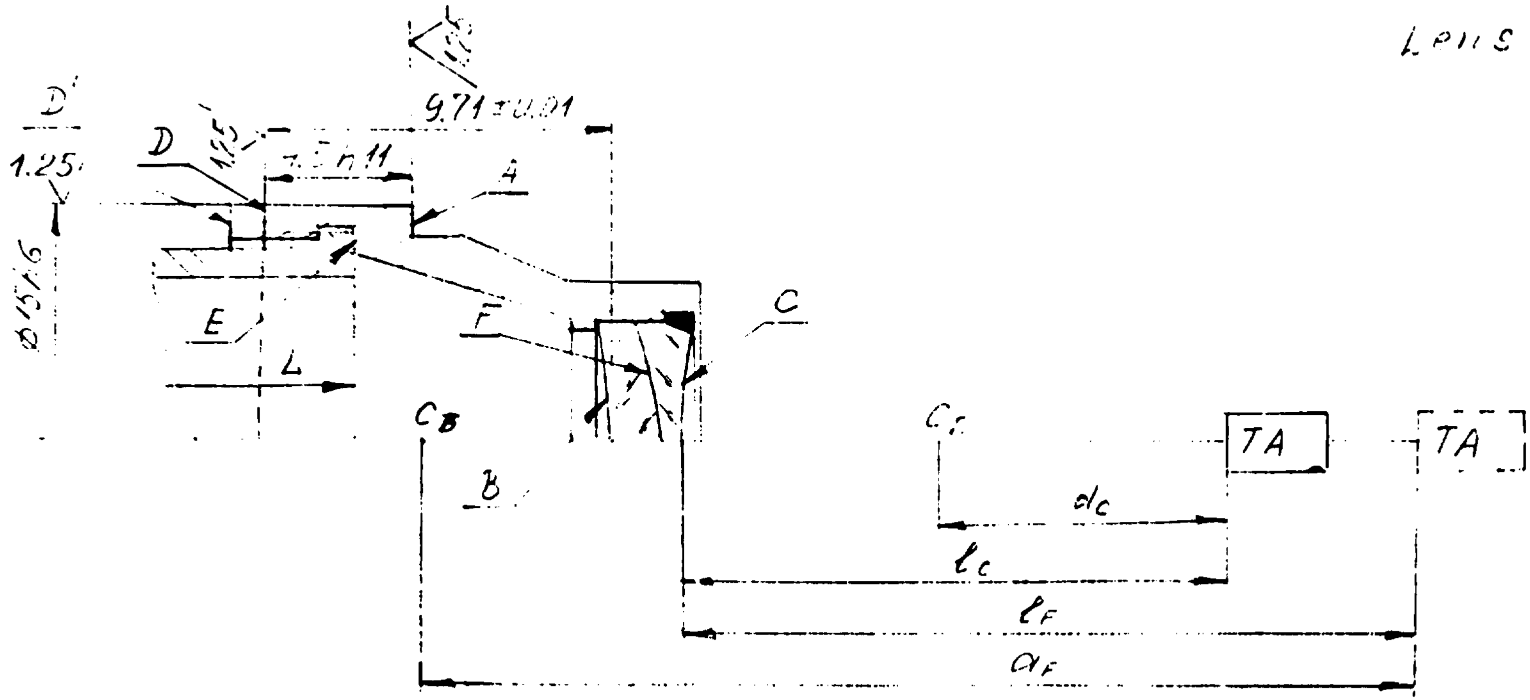
No	Name and content of operation	Equipment	Device, tool	Comment
3.7	Remove the assembly from the lathe and put it on the horizontal plate on the holder end " D ", dry the assembly during 24 hours at t-20C		Horizontal plate	
4	Centring (See drawing) Bases are M13x0.5 and end "E".			
4.1	Measure the size from the holder end " D " to the lens surface " B " and calculate the holder end cutting value to size (9.71±0,01)mm		Depth indicator check templet for the size (9.71±0,01) mm	
4.2	Mount the assembled unit in the centring chuck holder	Lathe	Centring chuck with a gap depth of 26 mm. Holder length L-24,86mm	
4.3	Centre the lens in the holder: admissible shift of the " F " and " C " surfaces curvature centre image being no more than 0,02 mm, and 0,05 mm, respectively. Centre the lens surface " F " by moving it over the plane surface of the centring chuck, and surface " C " by inclining it over the spherical surface of the centring chuck.		Test-adjusting device - CA	The turning of the holder to D15h6 is made a follows: 1-st pass-0.15m 2-d pass-0.09m 3-d pass-0.01m After every pas to check the le centring and to centre the lens if necessary
4.4	Turn the holder smoothly to dimension Ø15h6 in two passes, and cut the holder end " A " as a preliminary operation.		Cutter Micrometer	230.080 Page 2
4.5	Cut the holder end " D " to the value calculated in the operation 4.1.			Pages 3

No	Name and content of operation	Equipment	Device, tool	Comment
4.6	Dull sharp edges		Mill blunt Scraper	
5	<u>Assembly</u> Bases are Ø15h6 and holder end "D".			
5.1	Measure the real size of the holder height calculate the holder end cutting value "A" to size 4,5h11.		Thickness gauge	
5.2	Cut the holder end " A " to the value calculated in operation 5.1.	Lathe	Cutter	
5.3	Dull sharp edges			
5.4	Remove the assembly from the lathe		Mill blunt scraper	
6	<u>Checking</u> Check the assembly centric, cleanness and size (9.71±0,01)mm		Magnifying glass 6x-8x Indicator 0.002 on Ø13H6 templet for size (9,71±0,01) mm Testing device - CD	
7	<u>Cleaning</u> Clean the assembled unit with optical mixture.		Optical mixture Cotton wad Bamboo stick	

Erection drawing

230.1.8

Lens in housing



Surface	ai mm	ei mm	limit decentring mm	Scale division TA 1mm	Number divisions TA-1
„F"	60	54.78	0.02	0.005	4
C	-120	3.38	0.05	0.01	5

Surface	ai mm	ei mm	limit decentring mm	Scale division TA 1mm	Number divisions TA-1
„F"	60	54,78	0,02	0,004	5
„C"	60	184,45	0,05	0,004	12

**Technological Process of Assembling,
Adjusting and Testing of the Microobjectives**

**ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING, ADJUSTING
AND TESTING THE MICROOBJECTIVE
CF 4 x0.1
KNOW-HOW**

No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set Make up a set of assembles and pieces of the objective assemblies: 200.010, 200.020, 200.030 Bushing 200.012 Cap 200.007			
2	Washing Wash mechanical pieces with benzine and dry them during 15 min at 20C.		Tank	
3	Cleaning			
3.1	Blow and clean fitting inner surface of the case with optical mixture.		Cleaning set Rubber hand pumk	Optical mixture compositi-on: (10-15)% -ethyl hydrolysic alcohol, 85% petroleum ether
3.2	Clean lenses in the holders 200.010, 200.020, 200.030 with optical mixture.			
4	Assembly			
4.1	Mount assembls 200.010 200.020, 200.030 in the case sequentially and fix them with the bushing 200.012.		Forceps Wrench	
5	Provision of the objective parfocal distance of (45±0.03)mm in size.			
5.1	Mount the objective in the inspection microscope (1314) and bring the object into focus.		Inspection microscope (1314) Linear object	

No	Name and content of	Equipment	Device, tool object	Comment
			Standard objective in parfocal distance.	
5.2	Measure the deviation of the parfocal distance from that of the standard objective with regard to its sign.			
5.3	Select a distance ring of required thickness and insert it into the gap between the assembly 200.010 and the case 200.007 in the case of the deviation measured is positive (microscope stage is lowered). *Go to 5.5*			
5.4	Cut the case end as much as obtained in 5.2 if the deviation is negative (microscope stage is raised). *Go to 5.6.*			
5.5	Release the bushing 200.012 and put the distance ring as in 5.3 through the clearance between ass. 200.010 and the case 200.007. Tighten the bushing. *Go to 5.7*			
5.6	Unscrew the bushing 200.012 and produce the assembls 200.030, 200.020, 200.010, and rings from the case on a support. Cut the inner end of the case as in 5.4 as much as obtained in 5.2 Reassemble the objective as in 4.1.	Lathe	Wrench Cutter Support for assembly	
5.7	Check the parfocal distance as in 5.2.			
6.	<u>Objective centring</u>			200.000 Page 2 Pages 3
6.1	Mount the objective in the inspection microscope (1314) and bring the object into focus.		Inspection microscope (1314)	
6.2	Coincide the object		Centring plate	

No	Name and content of operation	Equipment	Device, tool	Comment
	point image with the center of eyepiece re - ticle by moving the object on the stage. Rotate the stage with the object and define the point image shift. If it's beyond the tolerance the objective centring must be done.			Depending on the microscope design it is possible to rotate the rotating bushing with microobjective
6.3	Remove the objective from the inspection microscope. Unscrew the bushing 200.012 and produce the assembls 200.030, 200.020 and 200.010 from the case, as the pole on a support . Mark the pole and the case by the same position two lines and rotate the case by 90° at first Reassemble the objective as in 4.1.		Wrench Forceps Support for assembly Marking tool	
6.4	Repeat 6.1, 6.2, 6.3 to provide the centric required by selecting the case angle of rotation regarding to the pole.			
7.	<u>Coating</u>			
7.1	Coat bushing end "B" with enamel and microtalc followed by drying.		Squirrel hair-brush	
8.	<u>Finish testing</u>			
8.1	Test microobjective perfomace according to microobjective documentation and "Technical requirements for objectives".			200.000 Page 3 Pages 3

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING, ADJUSTING
AND TESTING THE MICROOBJECTIVE
CF 4 x0.1
KNOW-HOW

No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set Make up a set of assembles and pieces of the objective assemblies: 200.010, 200.020, 200.030 Bushing 200.012 Cap 200.007			
2	Washing Wash mechanical pieces with benzine and dry them during 15 min at 20C.		Tank	
3	Cleaning			
3.1	Blow and clean fitting inner surface of the case with optical mixture.		Cleaning set Rubber hand pumk	Optical mixture composition: (10-15)% -ethyl hydrolysic alcohol, 85% petroleum ether
3.2	Clean lenses in the holders 200.010, 200.020, 200.030 with optical mixture.			
4	Assembly			
4.1	Mount assembls 200.010 200.020, 200.030 in the case sequentially and fix them with the bushing 200.012.		Forceps Wrench	
5	Provision of the objective parfocal distance of (45±0.03)mm in size.			
5.1	Mount the objective in the inspection microscope (1314) and bring the object into focus.		Inspection microscope (1314) Linear object	

No	Name and content of	Equipment	Device, tool object	Comment
			Standard objective in parfocal distance·	
5.2	Measure the deviation of the parfocal distance from that of the standard objective with regard to its sign.			
5.3	Select a distance ring of required thickness and insert it into the gap between the assembly 200.010 and the case 200.007 in the case of the deviation measured is positive (microscope stage is lowered). *Go to 5.5*			
5.4	Cut the case end as much as obtained in 5.2 if the deviation is negative (microscope stage is raised). *Go to 5.6.*			
5.5	Release the bushing 200.012 and put the distance ring as in 5.3 through the clearance between ass. 200.010 and the case 200.007. Tighten the bushing. *Go to 5.7*			
5.6	Unscrew the bushing 200.012 and produce the assembls 200.030, 200.020, 200.010, and rings from the case on a support. Cut the inner end of the case as in 5.4 as much as obtained in 5.2 Reassemble the objective as in 4.1.	Lathe	Wrench Cutter Support for assembly	
5.7	Check the parfocal distance as in 5.2.			
6.	<u>Objective centring</u>			200.000 Page 2 Pages 3
6.1	Mount the objective in the inspection microscope (1314) and bring the object into focus.		Inspection microscope (1314) Centring plate	
6.2	Coincide the object			

No	Name and content of operation	Equipment	Device, tool	Comment
	point image with the center of eyepiece reticle by moving the object on the stage. Rotate the stage with the object and define the point image shift. If it's beyond the tolerance the objective centring must be done.			Depending on the microscope design it is possible to rotate the rotating bushing with microobjective
6.3	Remove the objective from the inspection microscope. Unscrew the bushing 200.012 and produce the assembls 200.030, 200.020 and 200.010 from the case, as the pole on a support . Mark the pole and the case by the same position two lines and rotate the case by 90° at first Reassemble the objective as in 4.1.		Wrench Forceps Support for assembly Marking tool	
6.4	Repeat 6.1, 6.2, 6.3 to provide the centric required by selecting the case angle of rotation regarding to the pole.			
7.	<u>Coating</u>			
7.1	Coat bushing end "B" with enamel and microtalc followed by drying.		Squirrel hair-brush	
8.	<u>Finish testing</u>			
8.1	Test microobjective perfomace according to microobjective documentation and "Technical requirements for objectives".			200.000 Page 3 Pages 3

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING, ADJUSTING
AND TESTING THE MICROOBJECTIVE
CF 10x0.25
KNOW-HOW

No	Name and content of operation	Equipment	Device, tool	Comment
1	<u>Making-up a set</u> Make up a set of assembling units and pieces of the objective assembles: 210.020, 210.030, 210.040, 210.050 Ring 210.011(2 pieces) Case 210.014 Bushing 210.012 Cap 210.013			
2	<u>Washing</u> Wash mechanical pieces with benzine and dry them during 15 min at 20°C.		Tank	
3	<u>Cleaning</u>			
3.1	Blow and clean fitting inner surface of the case with optical mixture.		Cleaning set Rubber hand pumk	Optical mixture composition: (10-15)% -ethylin hydrolysic alcohol, 85% petroleum ether
3.2	Clean assemblies 210.020, 210.030, 210.040, 210.050, with optical mixture.			
3.3	Set a pole from the assemble 210.050, the ring 210.011, assemble 210.040, the ring 210.011 the assembls 210.030, 210.020 on a support.		Support for assembly	
3.4	Fit the case 210.014 on the assembled pole and overturn the pole and screw in the bushing 210.012 into the case against the stop to fix reliable.		Wrench	

No	Name and content of operation	Equipment	Device, tool	Comment
4	Adjustment			
4.1	One must make this operation in accordance with the "Typical micro-objective adjustment". unit in the centring chuck holder			Adjusting the objective on coma is made by transverse movingass. 210.030
5	Provision of the objective parfocal distance of (45±0.015)mm in size.			
5.1	Mount the objective in the inspection microscope (1314) and bring the object into focus.		Inspection microscope (1314) Linear object Standard objective in parfocal distance	
5.2	Measure the deviation of the parfocal distance from that of the standard objective with regard to its sign.			
5.3	Select a distance ring of required thickness and insert it into the gap between the assembly 210.020 and the case 210.014 in case the deviation measured is positive (microscope stage is dipped). *Go to 5.5*			
5.4	Cut the case end as much as obtained in 5.2 if the deviation is negative (microscope stage is raised). *Go to 5.6*			
5.5	Release the bushing 210.012 and put the distance ring as in 5.3 through the clearance between ass. 210.020 and the case 210.014. Tighten the bushing. *Go to 5.7*			210.000 Page 2 Pages 4
5.6	Unscrew the bushing 210.012 and produce the assembls 210.050, 210.040, 210.030,	Lather	Wrench Cutter Support for assembly	

No	Name and content of operation	Equipment	Device, tool	Comment
	210.020 and rings 210.011 from the case on a support. Cut the inner end of the case as in 5.4 as much as obtained in 5.2. Reassemble the objective as in 3.3, 3.4			
5.7	Check the parfocal distance as in 5.2.			
6.	Objective centring			
6.1	Mount the objective in the inspection microscope (1314) and bring the object into focus.		Inspection microscope (1314) Centring plate	
6.2	Coincide the object point image with the center of eyepiece reticle by moving the object on the stage. Rotate the stage with the object and define the point image shift. If it's beyond the tolerance the objective centring must be done.			
6.3	Remove the objective from the inspection microscope. Unscrew the bushing 210.012 and produce the assembls 210.050, 210.040, 210.030, 210.020, rings 210.011 from the case as the pole on a support. Mark the pole and the case by the same position two lines and rotate the case by 90 at first. Reassemble the objective as in 3.3, 3.4.		Wrench Forceps Support for assembly Marking tool	
6.4	Check the objective coma and astigmatism. If they are beyond the tolerance the corection of these must be done in accordance with the "Typical microobjective adjustment".			210.000 Page 3 Pages 4

No	Name and content of operation	Equipment	Device, tool	Comment
6.5	Repeat from 6.1 to 6.4 to provide the decentric required by selecting the case angle of rotation regarding to the pole and checking the objective coma and astigmatizm evry step.			
7.	<u>Coating</u>			
7.1	Coat bushing end "B" with enamel and microtalc followed by drying.		Squirrel hair-brush	
8.	<u>Assembly</u>			
8.1	Fill in the objective case holes with hermetic sealant.		Bamboo stick	
8.2	Remove hermetic sealant excess by cotton wad wetted in acetone.		Bamboo stick	
8.3	Screw in the objective cap 210.013 onto the case.			
8.4	Clean front lens by cotton wad wetted in optical mixture.		Cleaning set	
8.5	Put the objective in the container.			
9.	<u>Finish</u>			
9.1	Test microobjective perfomace according to microobjective decementation and "Technical requirements for objectives".			210.000 Page 4 Pages 4

220.000
CF 40x0.65

ROUTE CHART
TECHNOLO GICAL PROCESS
OF ASSEMBLING, ADJUSTING
AND TESTING THE MICROOBJECTIVE
CF 40x0.65
KNOW-HOW

No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set Make up a set of assembling units and pieces of the objective assembles: 220.040, 220.050, 220.060,210.070 Holder 220.013 Case 220.014 Rings 220.017,220.013, 220.018 Iris 220.019 Screw 220.021 Spring 220.022 Cover 220.016.			
2	Washing Wash mechanical pieces with benzine and dry them during 15 min at 20C.		Tank	
3	Fitting in of the holder with the case			
3.1	Screw in the thread bushing "A" in the holder.		Thread bushing "A"	
3.2	Apply a grop of oil on the holder surface and fit the case on the holder.		Hair-brush	
3.3	Provide the easy and dense running of the holder in the case by reciprocuting motion.			
3.4	Remove the holder screw out the thread bushing.			
3.5	Clean the holder and the case by a napkin wetted in benzine.			220.000
3.6	Apply a grop of oil on the holder and the case and fit the case on the holder , then fix it with the screw 220.021.		Hair-brush Screw-driver	Page 1 Pages 5

No	Name and content of operation	Equipment	Device, tool	Comment
4	Assembly (see drawing 220.000)			
4.1	Blow and clean fitting inner surface Ø13H6 with optical mixture.		Cleaning Rubber hand pump	Optical mixture compositi-on: (10-15)% -ethyl hydrolysic alcohol, 85% petroleum ether
4.2	Clean the lenses in the holders with optical mixture.			
4.3	Set a pole from the assemble 220.070, the ring 220.017, the assemb. 220.060, 220.050, the ring 220.023, the assemb. 220.040 on a support.		Support for assembly	
4.4	Fit the holder with the case (operation 3) on the assembled pole; overturn the pole and screw in the thread ring 220.018 into the holder against the stop to fix reliable.		Wrench	
4.5	Screw in the thread bu-shing "B" into the case 220.014 against the stop with the holder .		Thread bu-shing "B" Wrench	
5	Adjustment			
5.1	One must make this ope-ration in accordance with the "Typical micro-objective adjustment".			Disassembly the objec-tive as follows: screw out the thread bushing "B" then thread ring and produce the assembls. from the holder but front lens, the thread ring 220.023

No	Name and content of operation	Equipment	Device,tool	Comment
				must be stoped in the holder. Required set of distance rings providing air gap"C" ingredient must be placed on the ring 220.023
6	Provision of the objective parfocal distance of (45±0,015)mm in size.			
6.1	Mount the objective in the inspection microscope (1314) and bring the object into focus.		Inspection microscope (1314) Linear object Standard objective in parfocal distance	
6.2	Measure the deviation of the parfocal distance from that of the standard objective with regard td its sign.			
6.3	Select a distance ring of required thickness and insert it into the gap between the assembly 220.040 and the holder 220.013 in case the deviation measured is positive (microscope stage is dipped).			
6.4	Cut the case end (see drawing) as much as obtained in.6.2 as if the deviation is negative (microscope stage is raised).			
6.5	Unscrew the upper thread bushing "B", release the ring 220.018 and put the distance ring as in 6.3 through the cleara-		Wrench	220.000 Page 3 Pages 5

No	Name and content of operation	Equipment	Device, tool	Comment
	nce between ass. 220.040 and the holder 220.013. Tighten the ring and screw in the thread bushing "B".			
6.6	Unscrew the upper thread bushing and the screw 220.021, and produce the holder from the case. Cut the inner end of the case as in. 6.4 as mush as obtained in 6.2. Reassemble the objective as follows: mount the holder in the case drive the screw and the thread bushing.	Lathe	Cutter Wrench	
6.7	Check the parfocal distance as in 6.2.			
7.	<u>Objective centring</u>			
7.1	Mount the objective in the inspection microscope (1314) and bring the object into focus.		Inspection microscope (1314) Centring plate	
7.2	Coincide the object point image with the center of eyepiece reticle by moving the object on the stage. Rotate the stage with the object and define the point image shift. If it's beyond the tolerance the objective centring must be done.			Depending on the micro scope design it is possible the rotation of the rotatio nal bushing with objective
7.3	Remove the objective from the inspection microscope. Release the thread bushing "B", drive the screw 220.021 out and rotate the holder 220.013 by 90° until the next hole coincides with the case groove. Drive the screw into this hole and tighten the thread bushing.		Wrench	220.000 Page 4 Pages 5
7.4	Repeat 7.1, 7.2 and 7.3			

No	Name and content of operation	Equipment	Device, tool	Comment
	to provide the decentring required.			
8.	Assembly			
8.1	Screw out the thread bushing "B" from the case.		Wrench	
8.2	Mount the spring 220.022 and screw in the iris 220.019 into the case.			
8.3	Check smooth running of the holder in the case.			
9.	Checking			
9.1	Check the objective cleanness		Magnifying glass 6x-8x	
9.2	Check the objective centring and parfocal distance.		Inspection microscope (1314)	
10.	Coating Coat iris 220.019 end "B" with enamel and dry it.		Hair-brush	
11.	Assembly			
11.1	Fill in the holder holes with hermetic sealant.		Bamboo stick	
11.2	Remove hermetic sealant excess by cotton wad wettted in acetone.		Bamboo stick	
11.3	Screw in the cover 220.016 onto the case.			
11.4	Clean front lens by cotton wad wetted in optical mixture.		Cleaning set	
11.5	Put the objective in the container.			
12.	Finish testing			
12.1	Test microobjective perfomance according to microobjective documentation and "Technical requirements for objectives".			220.000 Page 5 Pages 5

**ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING, ADJUSTING
AND TESTING THE MICROOBJECTIVE
CF 100x1.25
KNOW-HOW**

No	Name and content of operation	Equipment	Device, tool	Comment
1	Making-up a set Make up a set of assembling units and pieces of the objective assemblies: 230.040, 230.050, 230.060, 230.070 230.080. Holder 230.015 Case 230.016 Rings 230.019, 230.022, 230.023, 230.024. Iris 230.021 Screw 220.021 Spring 230.025 Cover 230.018.			
2	Washing Wash mechanical pieces with benzine and dry them during 15 min at 20C.		Tank	
3	Fitting in of the holder with the case			
3.1	Screw in the thread bushing "A" in the holder.		Thread bushing "A"	
3.2	Apply a grop of oil on the holder surface and fit the case on the holder.		Hair-brush	
3.3	Provide the easy and dense running of the holder in the case by reciprocating motion.			
3.4	Remove the holder from the case and screw out the thread bushing.			
3.5	Clean the holder and the case by a napkin wetted in benzine.			
3.6	Apply a grop of oil on the holder and the case and fit the case on the holder, then fix it with the screw 220.021.		Hair-brush Screw-driver	

No	Name and content of operation	Equipment	Device, tool	Comment
4	<u>Assembly</u> (see drawing 230.000)			
4.1	Blow and clean fitting inner surface Ø15H6 with optical mixture.		Cleaning Rubber hand pump	Optical mixture compositi-on: (10-15)% -ethyl hydrolysic alcohol, 85% petroleum ether
4.2	Clean the lenses in the holders with optical mixture and put in the container.			
4.3	Set a pole from the assemblies 230.080, bush 230.023 230.070, 230.060, 230.050, the ring 230.024 the assembly 230.040, on a support.		Support for assembly	
4.4	Fit the holder with the case on the assembled pole. Overturn the pole and screw in the thread ring 230.019 into the holder against the stop to fix reliable.		Wrench	
4.5	Screwin in the thread ring 230.022 into the case 230.016 from the side of the front lens against the stop with the holder end.		Wrench	
4.6	Screw in the thread bu-shing "B" into the case againts the stop with the holder end.		Thread bu-shing "B" Wrench	
5	<u>Adjustment</u>			
5.1	One must make this ope-ration in accordance with the "Typical micro-objective adjustment".			Disassembly the objec-tive as follows: screw out the thread bushing "B" and the thread ring 230.019.

No	Name and content of operation	Equipment	Device, tool	Comment
				Produce the assemblies from the holder but front lens, ring 230.024 must be stopped in the holder. Required set of distance rings must be placed in air gaps "B"and"C"
6	Provision of the objective parfocal distance of (44,7±0.1)mm in size.			
6.1	Mount the objective in the inspection microscope (1314) and bring the object into focus.		Inspection microscope (1314) Linear object Standard objective in parfocal distance	It is necessary to apply the grop of immersion (oil) on the object plane
6.2	Measure the deviation of the parfocal distance from that of the standard objective with regard to its sign.			
6.3	Select a distance ring of required thickness and insert it into the gap between the assembly 230.040 and the holder 230.015 in case the deviation measured is positive (microscope stage is lowered). *Go to 6.5.*			
6.4	Cut the ring 230.022 end as much as obtained in 6.2 if the deviation is negative (microscope stage is raised). *Go to 6.6*			230.000 Page 3 Pages 5
6.5	Unscrew the upper thread bushing "B", release		Wrench	

No	Name and content of operation	Equipment	Device, tool	Comment
	the ring 230.019 and put the distance ring as in 6.3 through the clearance between ass. 230.040 and the holder 230.015. Tighten the ring and screw in the thread bushing "B". *Go to 6.7*			
6.6	Unscrew the thread ring 230.022 and cut it as in 6.4 as much as obtained in 6.2. Screw in the ring into the case.	Lathe	Cutter Micrometer Wrench	
6.7	Check the parfocal distance as in 6.2.			
7.	<u>Objective centring</u>			
7.1	Mount the objective in the inspection microscope (1314) and bring the object into focus.		Inspection microscope (1314) Centring plate	
7.2	Coincide the object point image with the center of eyepiece reticle by moving the object on the stage. Rotate the stage with the object and define the point image shift. If it's beyond the tolerance the objective centring must be done.			Depending on the microscope design it is possible to rotate the rotating bushing with the microobjective
7.3	Remove the objective from the inspection microscope. Release the thread bushing "B", drive the screw 220.021 out and rotate the holder 230.015 by 90° until the next hole coincides with the case groove. Drive the screw into this hole and tighten the thread bushing.		Wrench	
7.4	Repeat 7.1, 7.2 and 7.3 to provide the centring required.			230.000 Page 4 Pages 5
8.	<u>Assembly</u>			
8.1	Screw out the thread bushing "B"from the case		Wrench	

No	Name and content of operation	Equipment	Device, tool	Comment
8.2	Mount the spring 230.025 and screw in the iris 230.021 into the case.			
8.3	Check smooth running of the holder in the case.			
8.4	Clean front lens by cotton wad wetted in optical mixture.		Cleaning set	
8.5	Put the objective in the container.			
9.	Checking			
9.1	Check the objective cleanness		Magnifying glass 6x-8x	
9.2	Check the objective centring and parfocal distance.		Inspection microscope (1314)	
10.	Coating			
	Coat iris 220.019 end "B" with enamel and dry it.		Hair-brush	
11.	Assembly			
11.1	Fill in the holder holes with hermetic sealant.		Bamboo stick	
11.2	Remove hermetic sealant excess by cotton wad wettted in acetone.		Bamboo stick	
11.3	Screw in the cover 230.018 onto the case.			
11.4	Clean front lens by cotton wad wetted in optical mixture.		Cleaning set	
11.5	Put the objective in the container.			
12.	Finish testing			
12.1	Test microobjective perfomace according to microobjective documentation and "Technical requirements for objectives".			

TYPICAL MICROOBJECTIVES ADJUSTMENT KNOW-HOW

Objectives: 10x0,25
40x0,65
100x1,25

ASSEMBLY AND ADJUSTMENT OF MICROOBJECTIVE USING STAR-TEST

No	Operation content	Device, tool	Comment
1	<u>Set-up the check-microscope for microobjective testing based on image quality.</u>	Check-microscope with telescopic tube	Outside telescopic tube surface must be graduated in the tube length scale. Base tube length (160 mm)is marked bearing. Illumination system consists of: - condensor with an aperture iris diaphragm, mounted on the microscope; - illumination (built-in or independent which includes a lamp, collector, field iris diaphragm)
1.1	Place the illuminator in front of the check-microscope.	Illuminator	
1.2	Screw in the objective 40x0,65 in the nosepiece and place the eyepiece 10x into the tube.	Microobjective 40x0,65 Eyepiece 10x from the check-microscope set	
1.3	Set telescopic tube in the base position - 160 mm.		
1.4	Place the star-test-specimen on the microscope stage and focus the microscope at it.	Star-test specimen	
1.5	Set up illumination so that the condensor aperture diaphragm image is coincided with the objective exit pupil, filling it fully, and collector field diaphragm image coincided with the specimen. (Kohler type illumination)		
1.6	Select some star-test specimen object points of a proper form and fix the specimen onto the stage observing through the microscope.		
1.7	Screw out the objective from the microscope		

No	Operation content	Device, tool	Comment
1.8	Screw in the objective under testing in the nosepiece (without the outside cap).		
1.9	Set up mounting jig on the objective case	Mounting jig	
1.10	Focus the microscope at the specimen with the tube length equal to 160 mm.		For objective 100x1,25 put on the drop of immersion (oil) on the specimen
1.11	Place the image point in the center of the eyepiece field of moving the microscope stage.		
2.	<u>Check coma aberration in the microobjective and adjust it.</u>		
2.1	Focus the microscope to the best image of the object point in the center of the field of view using focusing mechanisms. The image of the point due to diffraction is a central core disc surrounded by a bright ring.		
2.2	Check the coma aberration by viewing the diffraction image of the central point. If the coma is present the ring in diffraction image has one dark discontinuity (break) from one side and is non symmetrical form. If the size of the ring discontinuity is more than 0,3 of the whole ring the coma value is non-tolerable. If coma is tolerable go to item 3.		
2.3	Eliminate the coma error by moving the second objective component in transverse direction using mounting jig	Screwdriver	

No	Operation content	Device, tool	Comment
	screws to strive for the coma to be in tolerable viewing image of the point during process.		
3.	Check the spherical aberration and eliminate it if neccessery. (For objectives - 40x0,65and 100x1,25 only)		
3.1	Check the spherical aberration presence. Refocus the microscope at equal values up and down using fine focusing mechanism and observe the changes of the diffraction image of the central point during refocusing. If there is a marked difference between up and down refocused images of point changes, there is a non-tolerable value of spherical aberration. If spherical aberration is non visiable go to item 4.		For objective 10x0,25 the following operation will be made on item 4, after item 2.
3.2	If spherical aberration is present, it is eliminated by objective air gap adjusting. The first step is to determine the value of spherical aberration.		
3.3	Set up the tube length equal to 165 mm and repeat item 3.1. It the spherical aberration value is reduced (i.e. non symmetricality of refocused images changes is reduced, refocusing value being equal) it is necessary to increase tube length step by step (step value is equal to 5 mm) with spherical aberration checkin at each step in		Page 3 Pages 6

No	Operation content	Device,tool	Comment
	accordar e with item 3.1 Stop if spherical aberration is not visible. Read tube length which corresponds to spherical aberration absence. If the tube length equal to 165 mm leads to increasing the spherical aberration value instead of reducing it, it is necessary to set up the tube length equal to 155 mm, then check the spherical aberration to eliminate it by reducing the tube length step by step (step value 5 mm) Read the final value of the tube length, corresponding to the absence of the spherical aberration.		
3.4	Using a special adjustment table for this microobjective one must determine required air gap increments, corresponding to the tube length reading.		
3.5	Remove the mounting jug from the objective case and screw out the objective from microscope. Disassemble the microobjective, then add required set of distance rings providing air gap ingredient and re-assemble.	Wrench Distance Micrometer	
3.6	Repeat the adjusting process starting with item 1.8		
4.	<u>Check astigmatism of the microobjective and adjust it.</u>		
4.1	Set up tube length equal to 160 mm.		Page 4 Pages 6

No	Operation content	Device, tool	Comment
4.2	Observing diffraction image of central object point estimate the astigmatism value. Presence of astigmatism leads to two dark discontinuities in the bright ring surrounding the central image, core. These discontinuities (breaks) are symmetrical at both sides of core . In fine defocusing the discontinuities rotate by 90°. If the size of the discontinuities is less than 1/4 of the whole ring the astigmatism is tolerable and the adjustment of the objective is finished. Screw out the objective from the check-microscope. If the objective astigmatism is a non-tolerable it is necessary to try to eliminate it.	Standard objective	
4.3	One must screw out and disassemble the microobjective and rotate the front lens or last microobjective component around the optical axis at the angle of 45° and then re-assemble the objective. Repeate the adjusting process starting with item 1.8. (without checking and adjusting spherical aberration).	Wrench	
4.4	If astigmatism is not eliminated, rotate this component by the angle of 45° once more and repeat item 2.		
4.5	If astigmatizm is not eliminated rotate in the same manner the next		Page 5 Pages 6

No	Operation content	Device, tool	Comment
	component and so on.		
4.6	If after all components being rotated but astigmatism not eluminated, objective is waster If on fails to eliminate the astigmatism by rotating all the objective components the objective is to be rejected.		

CALCULATION OF ADJUSTMENT TABLE FOR
40x0.65 MICROOBJECTIVE

1. Fragment of the table of parameters variation influence on spherical aberration coefficient W_{0040}

Parameters name	Parameters increment	Spherical aberration coefficient incremens
Tube lenght	$\Delta L = 10$ mm	$\Delta W_L = 0.030$
Air gap 1-2	$\Delta g_{1-2} = 0.05$ mm	$\Delta W_{g1-2} = 0.083$

2. Calculation of the δg_{1-2} required increment of the air gap for the spherical aberration compensation under condition the tube lenght is changed by 1 mm:

$$\delta g_{1-2} = \frac{\Delta W_L \quad \Delta g_{1-2}}{\Delta W_{g1-2} \quad \Delta L} = \frac{0.030 \quad 0.05}{0.083 \quad 10} = 0.0018 \text{ mm}$$

3. Adjustment table for 40x0.65 microobjective

Tube lenght under condition spherical aberration compensation	Air gap increment required δy_{1-2}
130	- 0.06
135	- 0.05
140	- 0.04
145	- 0.03
150	- 0.02
155	- 0.01
<u>160</u>	0
165	0.01
170	0.02
175	0.03
180	0.04
185	0.05
190	0.06

CALCULATION OF ADJUSTMENT TABLE FOR **100x1.25** MICROOBJECTIVE

1. Fragment of the table of parameters variation influence on spherical aberration coefficient W

Parameters name	Parameters increment	Spherical aberration coefficient incremens
Tube lenght	$\Delta L = 10$ mm	$\Delta W_L = 0.040$
Air gap 1-2	$\Delta g_{1-2} = 0.05$ mm	$\Delta W_{g_{1-2}} = 0.050$
Air gap 2-3	$\Delta g_{2-3} = 0.05$ mm	$\Delta W_{g_{2-3}} = 0.105$

2. Calculation of the δg - required increments of the air gaps for the spherical aberration compensation under condition the tube lenght is changed by 1 mm:

$$\delta g1\text{-}2 = \frac{\Delta W_L \quad \Delta g_{1-2}}{\Delta W_{g_{1-2}} \, \Delta L} = \frac{0.040 \quad 0.05}{0.050 \quad 10} = 0.004 \text{ mm}$$

$$\delta g2\text{-}3 = \frac{\Delta W_L \quad \Delta g_{2-3}}{\Delta W_{g_{2-3}} \, \Delta L} = \frac{0.04 \quad 0.05}{0.105 \quad 10} = 0.002 \text{ mm}$$

3. Adjustment table for 100x1.25 microobjective

Tube lenght under condition spherical aberration compensation	Air gap increment required δg 1-2	δg2-3
130	- 0.12	- 0.06
135	- 0.10	- 0.05
140	- 0.08	- 0.04
145	- 0.06	- 0.03
150	- 0.04	- 0.02
155	- 0.02	- 0.01
<u>160</u>	0	0
165	0.02	0.01
170	0.04	0.02
175	0.06	0.03
180	0.08	0.04
185	0.10	0.05
190	0.12	0.06

Technological Process of Adjusting of the Eyepiece 10x

ROUTE CHART
TECHNOLOGICAL PROCESS
OF ASSEMBLING THEE YEPIECE 10x
KNOW-HOW

No	Name and content of operation	Equipment	Device, tool	Comment
1	<u>Making-up a set.</u> Make up a set of pieces: a ring 240005, a ring 240006; a ring 240007; a bushing 240008; a holder 240011, a case 240012, a lens 240003, a lens 240004, an assembly 240010.			
2	<u>Washing</u>		Tank	
2.1	Wash the following parts in benzine and dry them during 15 min at t-20 C: the ring 240005; the ring 240006, the ring 240007, the bushing 240008, the holder 240011, the case 240012.			
2.2	Put washed parts into the container.		Container	
3	<u>Cleaning</u>			
3.1	Examine visually the holder 240011 to have no fin, burrs, mechanical damages and coating disturbance.		Magnifying glass 6x-8x	
3.2	Blow the holder 240011 by air using a rubber hand pump.		Rubber hand pump	
	Clean the 240011 holder inside surface with optical mixture.		Bamboo stick Optical mixture composition (10-15)% ethylin hydrolysic alcohol 85% petroleum ether	
3.3	Remove the lenses 240003, 240004 and the assembly 240.010 from the container.		Forceps	
3.4	Check the lenses 240003, 240004 and 240010 visually to have		Magnifying glass 6x-8x Cleaning set	Page 1 Pages 2

No	Name and content of operation	Equipment	Device, tool	Comment
	no damages of the lens surfaces.			
3.5	Clean the lenses 240003, 240004, 240010 with optical mixture at least 3-5 times per one surface.			
3.6	Put the lenses into the container.		Container	
4.	Assembly			
4.1	Mount subsequently the lens 240011, the ring 240005, the lens 240003, the ring 240006, the lens 240004 in the holder 240011 and screw in the ring 240007.		Forceps Wrench	
4.2	Clean the outside surface of the lens 240010 with optical mixture.		Cleaning set	
4.3	Screw the case 240012 onto the holder 240011.			
4.4	Screw the bushing 240008 onto the holder 240011.			
5.	Finish checking according to eyepiece Technical Requirements			
5.1	Check the eyepiece for cleanness.			
5.2	Check overall and attachment dimensions according to the drawing Ø33; Ø70,5; Ø28 h12; Ø23,2f7.			
5.3	Check the eyepiece focal dictance.			Page 2 Pages 2

Technical Requirements for
Microscopes - S,L; Microobjectives, Eyepiece

Microscopes - "BIOMEM - S,L"

TECHNICAL REQUIREMENTS

1 9 9 0

The present technical requirements extend to biological medical laboratory "BIOMEM - L" and student "BIOMEM - S" microscopes - hereinafter referred to as microscope intended for bright field transmitted light visual investigation of specimens.

Microscopes are used for laboratory research and studies in the field of biology, zoology, cytology, histology, hematology et al.

MIcroscopes are designed under modular concept and offer a choice of accessories sets.

Maximal microscopes magnification:

"BIOMEM - L" 1000x

"BIOMEM - S" 400x

Minimal magnification of microscopes "BIOMEM - L" and "BIOMEM - S" 40x

Mechanical length of microscope tube . . . . .160 mm

Object co-ordinate stage of microscope "BIOMEM- L" provides the specimen displacements in two inter-perpendicular directions within at least 26x76 mm expiration with 0.1 mm verniers.

Illuminating system of microscope "BIOMEM - L" uses a halogen lamp КГМ 6-20 supplied from a built-in power unit of 6v, 20wt of supply line (220 ±22)v, 50Hz alternative current.

Microscopes "BIOMEM - L" and "BIOMEM - S" are manufactured to operate in rooms with the air temperature from +15° to 35°C.

1. Technical requirements.

MIcroscopes must meet the present technical requirements and documentation sets, and also specifications on objectives for microscopes and specifications on eyepiece.

1.1. Main parameters and characteristics.

1.1.1. Overall sizes should be no more than:

"BIOMEM -L" - 382 x 375 x 250 mm

"BIOMEM -S" - 342 x 242 x 200 mm

1.1.2. "BIOMEM - L" microscope mass should not exceed 9.0 kg and "BIOMEM - S" microscope - 6.5 kg.

1.1.3. The displacement of the condenser in the microscope must be sufficient to obtain an image of the illumination system field diaphragm in the object plane.

1.1.4. MIcroscope must provide for the coincidence of the field diagram image centre of the illuminating system with the centre of the microscope linear field in the image plane.

1.1.5. Any object point image brought into coincidence with eyepiece cross-hairs must stay there after the action of (10±1) N force on the object stage stand (in any direction). Residual displacement within the object plane should not exceed 5 μm.

1.1.6. After the microscope is focused the specimen image must remain sharp under the action of load (10.0±0.1)N being applied normal to the object stage for 5 min.

1.1.7. Microscope stage must move along the focusing mechanism guide parallel to the axis of sight of the microscope; the value of deviation must be no more than 15' of arc.

1.1.8. Aperture diaphragm image of the condenser must be concentric to the exit pupil of the 40x objective; the value of deviation must be no than 0.2 mm.

1.1.9. Lost motion of the fine feed mechanism should not exceed 4 μm throughout the working range.

Comment: Movement range of the stage actuated by the fine feed mechanism under one turn from the stops is inoperative.

1.1.10. Specimen image on which the microscope is focused must continue to remain sharp when the stage is moved by rotation of its knobs in both directions to the value of 5 mm; defocusing must not exceed 6 μm.

1.1.11. Any point image of the focused microscope must remain sharp when objective power is changed over from greater magnification objective to any other of its set (except for 4x and 100x); defocusing must not exceed 50 μm.

1.1.12. Any point of the specimen stage brought coincident with the eyepiece cross-hairs must stay there while any microscope objective of its set is changed over; image shift must not exceed 6 mm.

1.2. Marking.

1.2.1. As specified by the drawing each microscope must have the following marking:

microscope legend, microscope type, trade mark of producer plant and an ordinal number in which two last figures mean two last figures of the microscope production year.

3. Test regulations

3.1. Manufactured microscope must be tested to check the conforming of its parameters to the present technical requirements.

3.2. The scope and sequence of tests is given in Table 1.

Table 1.

Test feature	Item	
	Technical requirements	Test methods
1	2	3
Microscope overall dimensions	1.1.1.	4.11.
Microscope mass	1.1.2.	4.12.
Possibility to obtain a field diaphragm image	1.1.3.	4.1.
Possibility to make the field diaphragm image centre coincident with that of the linear		

field of the microscope	1.1.4.	4.2.
Location of the specimen image after the action of the load on the stage stand	1.1.5.	4.3.
Specimen image sharpness under the load on the specimen stage	1.1.6.	4.4.
Parallelism of the stage motion of the microscope axis of sight	1.1.7.	4.5.
Concentricity of the condenser aperture diaphragm image and the objective exit pupil	1.1.8.	4.6.
Lost motion of the fine feed mechanism	1.1.9.	4.7.
Sharpness of the specimen image when moving it by co-ordinate specimen stage mechanisms in horizontal plane in both directions as far as 5 mm.	1.1.10.	4.8.
Specimen image sharpness when renewing the objectives	1.1.11.	4.9.
Location of specimen image when renewing the objectives	1.1.12.	4.10.
Marking	1.3.1.	4.14.

3.3. All tests must be carried out under normal weather conditions: air temperature $(25 \pm 10)^{\circ}C$, relative air humidity 45-80%, atmospheric pressure $8.4 \times 10^4 - 10.7 \times 10^4$ Pa.

4. Test methods

The list of equipment to check microscopes is given in the Appendix of the present technical requirements.

"BIOMEM-L" is checked to meet the requirements in items 1.1.3.,1.1.4.,1.1.5.,1.1.6.,1.1.7.,1.1.8.,1.1.9.,1.1.11., 1.1.12. when the light source - halogen lamp 6v 20wt is on.

"BIOMEM-S"is checked to meet items 1.1.5., 1.1.6., 1.1.7.,1.1.8.,1.1.9.,1.1.11.,1.1.12. when the outside illuminator (OU-19type) with a filament lamp is on.

4.1. Ref.1.1.3. "BIOMEM-L" is checked using a centring plate,objective CF 40x0.65 and 10x eyepiece of the set as follows:

4.1.1. Mount the eyepiece into the eyepiece tube.

4.1.2. Place the centring plate on the microscope specimen stage.

4.1.3. Screw in the objective 40x0.65 into the nosepiece of the microscope.

4.1.4. Set up illumination (Koehler type) after having focused the microscope on the cross-hairs of the centring plate.

4.1.5. Close the field diaphragm of the illuminating system to the half of the microscope image field size.

4.1.6. By moving the condenser along the optical axis of the microscope make sure visually that an adequate sharp image of the field diaphragm in the eyepiece field is quite possible.

4.2. Ref.1.1.4. "BIOMEM-L" is checked using a centring plate, 7x eyepiece, objectives CF 4x0.1 and CF100x1.25 of the microscope set as follows:

4.2.1.Direct the eyepiece 7x to face the light source which provides visually uniform illumination of the background, for example, an area of the sky or a uniformly illuminated sheet of white paper.

4.2.2.Viewing through the eyepiece and moving its eye lens reach a sharp image of the eyepiece cross-hairs.

4.2.3.Insert the eyepiece into the microscope tube.

4.2.4. Place the centring plate on the stage of the microscope.

4.2.5. Screw the objective CF4x0.1 into the nosepiece of the microscope.

4.2.6. Bring the front lens of the condenser out of the path of rays.

4.2.7. Remove the holder with a frosty glass from the condenser.

4.2.8. Focus the microscope on the centring plate cross-hairs image.

4.2.9. Bring the image of the field diaphragm of the illumination system into focus by moving the condenser along the optical axis of the microscope.

4.2.10. Make visually sure that the field diaphragm image centre can be brought into coincidence with the eyepiece cross -hairs by centring the field diaphragm image moving the condenser horizontally using screws in the condenser stand.

4.2.11. Bring the front lens of the condenser into the ray path, and closing partly the field diaphragm check, as above, the possibility to bring the centre of the field diaphragm image into coincidence with the cross-hairs of the eyepiece for objective CF100x1.25.

4.3. Ref. 1.1.5. checking is done using object-micrometer ОМП, eyepiece 7x, objective CF40x0.65 of the microscope set, pressure gauge БИОЛАМ-Ш-1(Ю-42.13.131) in the following way:

4.3.1. Repeat ii 4.2.1.-4.2.3.

4.3.2. Screw the objective 40x0.65 into the microscope nosepiece and put it into the ray path.

4.3.3. Put the object-micrometer ОМП on the microscope stage.

4.3.4. Set up illumination with the microscope being focussed on the object-micrometer.

4.3.5. Bring the image of any point of the object-micrometer line (boundary one is preferable) into coincidence with the eyepiece cross-hairs.

4.3.6. Press the stage stand with a pressure gauge until the marks on the pressure gauge probe coincide with the edge of stationary bushing, first from the right side and then from the left.

4.3.7. Viewing through the eyepiece take the reading and make sure that the displacement of the object-micrometer line relative to the eyepiece cross-hairs does not exceed 1.5 division of the eyepiece scale which corresponds to the requirement in 1.1.5.

4.3.8. Repeat items 4.6.6. and 4.6.7. pressing with a pressure gauge upon the stand first from the left ,then from the right side.

4.4. Ref.1.1.6. checking must be done using a lined specimen (КЮ-836-020), eyepiece 7x, weight (ЕИОЛАМ Р-11), (Ю-33.23.394) as follows:

4.4.1. Repeat 4.2.1. - 4.2.3.

4.4.2. The greatest magnification objective of the microscope set is screwed into the microscope nosepiece and brought into the ray path.

4.4.3. Place the lined specimen (КЮ-836-020) and weight (ЕИОЛАМ Р-11);(Ю-33.23.394)on the stage.

4.4.4. Repeat 4.3.4. with the lined specimen.

4.4.5. Make sure that in 5 minutes the specimen image remained sharp watching time by a stop-watch with the minute counter scale capacity of 30 minutes and minute counter scale factor of 0.5 minute.

4.5. Ref.1.1.7 checking is done using the objective CF4x0.1 (of the microscope set), eyepiece 15x, plane-parallel plate КЮ -924 М-004 with a cross-hairs applied to one side and silver plating to the other, a lamp КГМ 6-20 of the microscope set or a lamp РН 8-20-1 with the appropriate supply units being used as follows:

4.5.1. Repeat 4.2.1. with an eyepiece 15x

4.5.2. Reach a sharp image of the eyepiece graticule by viewing through the eyepiece and moving the running part of the eyepiece over the thread.

4.5.3. Repeat 4.2.3.

4.5.4. Put the plate KIO -924M-004 on the microscope stage with the silver plated surface downward.

4.5.5. Repeat 4.3.2. with the objective 4x0.1.

4.5.6. Switch on the lamp KTM 6-20 or PH8-20-1.

4.5.7. Observe in reflected light, illuminating plate from above.

4.5.8. Focus the microscope on the plate cross-hairs image and make it coincident with the cross-hairs of the eyepiece, then focus the microscope on the plate cross-hairs image reflected from the silver plated surface and ensure that the displacement of the plate cross-hairs does not exceed 2 divisions of the eyepiece scale which corresponds to the requirements in 1.1.7.

4.6. Ref.1.1.8. checking is done using the centring plate, microscope (MMP-4type), objective CF 40x0.65 and eyepiece 10x of the microscope set, as follows:

4.6.1. Mount the eyepiece in the microscope tube.

4.6.2. Place the centring plate (KO-28.41.921) on the stage.

4.6.3. Repeat 4.3.2.

4.6.4. Repeat 4.3.4. with the centring plate.

4.6.5. Remove the eyepiece and mount the microscope (MMP-4) instead; focus it on the objective exit pupil; observing the image of the condenser aperture diaphragm on it so much that its one edge could touch the circumference defining the objective exit pupil, and ensure that the exactly opposite edge of the aperture diaphragm image is spaced no more than two divisions of the microscope scale from the exit pupil of the objective.

4.7. Ref.1.1.9. checking is done using the objective CF40x0.65, lined specimen (KIO-836-020) and eyepiece 10x of the microscope set, as follows:

4.7.1. Repeat 4.3.2. with the objective 40x0.65

4.7.2. Repeat 4.3.3.

4.7.3. Put the lined specimen (KIO-836-020) on the microscope stage.

4.7.4. Repeat 4.4.4.

4.7.5. Focus microscope on the sharp image of the lined specimen by turning the fine feed knob clockwise and take the first reading (odd) from the scale of the fine feed knob. Defocus the microscope by turning the fine feed mechanism knob clockwise; refocus it by turning the fine feed mechanism knob counterclock and take the second reading (even).

4.7.6. Repeat 4.7.5. two times more, and calculate the arithmetic mean (a_1) of three odd readings, calculate the arithmetic mean (a_2) of three even readings find the difference (a_1 $-a_2$) of the arithmetic means of even and odd readings. Ensure that the difference obtained does not exceed two divisions of the fine feed mechanism knob scale. Measurements are made in three points: in two extreme points during two revolutions of the knob up to the upper and lower stops and approximately in the middle of the operation range of the fine focusing mechanism.

4.8. Ref. 1.1.10. checking is done by means of the objective CF40x0.65 and eyepiece 10x of the microscope set using a lined specimen (KKO-1318-000) to check the mechanisms of the specimen stage travel, as follows:

4.8.1. Repeat 4.3.2.

4.8.2. Repeat 4.2.3.

4.8.3. Put the lined specimen (KKO-1318-000) on the stage securing it between the holder and clamp.

4.8.4. Repeat 4.3.4. with the lined specimen (KKO-1318-000).

4.8.5. By means of the stage co-ordinate travel mechanism displace the lined specimen to the position in which the specimen line edge falls within the eyepiece field; refocus the microscope on the stage image of the specimen line.

4.8.6. Focus microscope on a sharp image of the specimen line by moving the lined specimen longitudinally 8 times every 5 mm (deviation no more than 0.5mm) and taking readings from the fine feed mechanism knob scale.

4.8.7. Make sure that the difference between two successive readings does not exceed 3 divisions of the fine feed mechanism knob scale.

4.8.8. Focus microscope on a sharp image of the specimen lines by moving the lined specimen in transverse direction within the whole range of the specimen lines 6 times every 5mm (deviation no more than 0.5mm) and taking readings from the fine feed mechanism knob scale.

4.8.9. Repeat 4.8.7.

4.9. Ref.1.1.11. checking is done using a line specimen KIO -836-020, eyepiece 7x, as follows:

4.9.1. Repeat 4.2.1.-4.2.3.

4.9.2. Repeat 4.7.3.

4.9.3. Screw objectives CF10x0.20 and CF40x0.65 of the microscope set into the nose piece of the microscope and bring the objective CF 40x0.65 into the ray path.

4.9.4. Repeat 4.4.4.

4.9.5. Focus the microscope on a sharp image of the lined specimen.

4.9.6. Take the first reading from the scale of the fine feed mechanism knob.

4.9.7. Bring the objective 10x0.20 into the ray path by turning the nosepiece, and focus the microscope on the sharp image of the field specimen by returning the knob of the fine feed mechanism.

4.9.8. Take the second reading from the scale of the fine feed mechanism knob and ensure that two readings differ no more than by 25 divisions of the fine feed mechanism knob scale.

4.10. Ref.1.1.12. all objectives of the microscope set are alternatively checked using a centring plate Ю-28.41.921 and eyepiece 15x, as follows:

4.10.1. Repeat 4.2.1.,4.5.2.,4.1.1. with eyepiece 15x.

4.10.2. Repeat 4.6.2.

4.10.3. Bring the least magnification objective into the ray path.

4.10.4. Repeat 4.6.4.

4.10.5. Make the image of the centring plate cross-hairs coincident with the cross-hairs of the 15x eyepiece and focus the microscope , if necessary.

4.10.6. Any other objective is brought into the rav path by turning the nosepiece, focus the microscope and make sure that the plate cross-hairs image remains within the eyepiece field diaphragm which corresponds to the requirements in 1.1.12.

4.10.7. Repeat 4.10.6. with the rest of objectives of the microscope set. The objective position in the nosepiece must be changed four times.

4.11. Ref.1.1.1. overall dimensions of the microscope are checked by measuring using a measuring reel with the upper limit of the range of 2m , the scale factor of 1mm and the third class of precision. Ensure that the requirements in 1.1.1. are met.

4.12. Ref.1.1.2. the microscope mass is checked by weighting using the balance with the weighting range (0.1 - 10)kg, scale factor 15g, error 0.5 division within the scale range (100-2500)g, and 1.0 division within (2500-10000)g.

Make sure that the requirements in 1.1.2. are met.

APPENDIX

List of the required equipment for microscope testing.

Name and designation of equipment	Main feature	Item of TR using the equipment	Comment
1	2	3	4
Microscope (МИР-4 type)		4.6	to be purchased
Centring plate		4.1.,4.2. 4.6,4.10.	to be purchased
Eyepiece 7x (eyepiece-micrometer)	Magnification 7x scale factor of the graticule (0.100 ± 0.005) mm	4.2.,4.3, 4.4.,4.9.	to be purchased
Transmitted light specimen-micrometer (ОМП)	Measurement range 1 mm, scale factor 0.01 mm.	3.	to be purchased
Pressure gauge (БИОЛАМ Ш-1)	1 mark 10N (deviation no more than the line width)	4.3.	to be purchased
Lined specimen		4.4.,4.7., 4.9.	
Weight	Mass (1.000±0.005) kg	4.4	
15x eyepiece	15x magnification, graticule scale factor (0.100±0.005) mm	4.5., 4.10.	to be purchased

Plane-parallel plate		4.5.	
Illuminator (ОИ-19 type)		4.5., 4.3., 4.4., 4.6., 4.7., 4.9., 4.10.	to be purchased
Lined specimen for checking stage travel mechanisms		4.8.	
Measuring reel	Measurement range 2m, scale factor 1mm, 3-d precision class	4.11.	to be purchased
Balance	Weighting range 0.1-10kg, scale factor 5 g, error within the scale range(100-2500)g +0.5 division,(2500-10000)g ± 1.0 division	4.12.	to buy
Stop-watch	Minute counter scale capacity - 30 minutes, scale factor of the counter - 0.5 minute	4.4.	to buy

---

Note: It is allowed to use alternative equipment for testing in case it provides for adequate test parameters according to the technical requirements.

Objectives for microscopes
BIOMEM - S,L

Technical requirements

1 9 9 0

The present technical requirements cover objectives for biological and medical microscopes BIOMEM-S,L.

The objectives are manufactured to be used in rooms with the air temperature from +15°C to 35°C.

1. *Technical requirements*

The objectives must meet the present requirements and those contained in the set of documentation for objectives.

An example of designation of objectives to be ordered and in documentation for other products is as follows:

"Objective CF 40x0.65 tube 160/0.17".

1.1. Main parameters and dimensions.

Actual values of numerical apertures of objectives must correspond to those engraved on the objective case.

Value deviations should not exceed those given in Table 1.

Table 1.

Aperture value engraved on the objective case	Limiting deviation from objective aperture engraved values
Up to 0.500	+0.025
From 0.500 to 1.300	-0.010
1.300	±0.025
	±0.030

1.1.2. Objective magnification values are to meet the requirements specified.

1.2. Characteristics.

1.2.1. Exterior design of the an objective, coating and attachment means must meet the drawing requirements.

1.2.2. Surface finish defects of optical surfaces of units (lenses in holders) within light apertures must correspond to surface finish classes specified in drawings for optical parts.

Surfaces of optical parts must be clean. Grease stains,drop films, traces of cement and optical mixture are not allowed.

1.2.2.1. In addition to defects allowed by the given surface finish class a deposit as some dust, cotton hairs, naps is allowed on the inner surfaces of objective lenses. Their number and sizes should not exceed the values of the surface finish given in Table 1a.

Table 1a.

Objective numerical aperture	Allowable surface finish class ГОСТ11141-84
Up to 0.3 inclusive	4 class for all surfaces
from 0.3 to 0.65 inclusive	3 class for 1-st and 2-nd surfaces of the 1-st gap 4 class for subsequent surfaces
From o.65 to 1.40 inclusive	2 class for the 1-st inner surface of the 1-st gap 3 class for the 2-nd and 3-d inner surface of the 2-nd gap 4 class for subsequent surfaces

The number of specks of dust and points to 0.004 mm in diameter, as well as the number of scratches and hair to 0.002 mm in width is neglected.

1.2.3. Attachment thread and a collar end of the objective case must be clean without having any cavities or chipping.

1.2.4. Diffraction image of a point given by the objective should represent a bright core with a concentric ring around it.

The objectives with the aperture up to 0.3 a discontinuity up to 0.5 of the ring circumference length is allowed, and with the aperture above 0.3 - up to 0.3 of the circumference length.

1.2.5. The image quality of the objectives must be as good as that of the reference objective.

1.2.6. An object points located on the perpendicular to the collar plane of the objective passing the intersection point of the thread and the collar plane must be projected by the objective on this perpendicular.

The deviation reduced to the object plane should not exceed the values shown in the values in the drawings.

1.2.7. Parfocal distance must meet the values in the drawings.

1.2.8. Objectives to aperture with an immersion liquid must be sealed against it. Ingress of immersion liquid onto the inner surface of the objective lenses is not allowed.

1.2.9. Attachment sizes of objectives and microscope tubes must meet the standard ISO 4/5"x1/36" ISO 8038-85 "Screw thread to objective"

1.3. Marking

1.3.1. Each objective must have in a special place a mark indicating the name of the producer plant, magnification value, aperture, mechanical length of the tube and the thickness of the cover glass, and also, an ordinal number in which two first figures mean the last two figures of the issue year.

Depending on the type of the corrected aberration the objectives have the following designation: CF for chromatic free.

2. *Objective testing*

2.1. In order to test the quality of objectives quality control is performed.

2.2. The present requirements, a set of design documentation and a reference objective confirmed in a routine way are the main documents for tests.

2.3. The sequence of tests is given in Table 2.

Table 2.

Objective test feature	Item	
	Technical requirements	Test methods
Objective aperture	1.1.1.	3.1.
Magnification	1.1.2.	3.2.
Objective exterior design	1.2.1.	3.3
Objective surface finish	1.2.2.	3.4.
Thread and collar end surface finish	1.2.3.	3.4.
Objective centring and image quality	1.2.4., 1.2.5.	3.5.
Object point on the perpendicular to the collar plane of the objective	1.2.6.	3.6.
Parfocal distance	1.2.7.	3.7.
Frontal lens tightness	1.2.8.	3.8.
Attachment sizes of objectives	1.2.9.	3.9.
Marking	1.3.1.	3.10.

2.4. If the tests yield negative results the objective is to be returned to analyze reasons of defects and to find the ways to remove them.

After the removal of defects the objective is retested.

2.5. If the retest results are still negative the testing of the objective is terminated and the objective is rejected.

2.6. All tests and checks must be carried out under normal wether conditions:

Ambient temperature $(25 \pm 10)^{\circ}C$,

relative humidity 45 - 80%

atmospheric pressure 8.4×10^{4} - 1.7×10^{4} Pa

3. *TEST METHODS*

The list of the equipment to test the objectives is given in the appendix.

3.1. Ref. 1.1.1. the objectives are checked using a desk disk-apertometer.

The objectives are checked with the desk disk-apertometer as follows: locate a glass plate on the stage of the check-microscope; set the mechanical length of the microscope tube to 160 mm; insert a 7x magnification eyepiece into the microscope tube and screw in the test objective; focus the microscope to the upper surface of the plate exposing it to an illuminator (ou -19 type); place the disc-apertometer instead of the plate on the stage of the microscope; subsequent the eyepiece with auxiliary microscope (МИР-4 type) being the pupil of the objective and the disk-apertometer into a sharp focus; determine the disc-apertometer ring which can be still visible in the exit pupil and find the value of the objective aperture from it.

Repeat the observation at least three times and make sure that the objective aperture value does not exceed the limiting deviations given in Table 1.

3.2. Ref. 1.1.2. when measuring linear magnification of the objective the microscope mechanical length of the tube should be set to 160 mm. Place an objective-micrometer on the microscope stage to operate in transmitted light; insert an eyepiece with gratitude into the microscope tube. Bring the image of lines of the object-micrometer into a sharp focus and find within what number of divisions of the eyepiece scale falls.

Linear magnification of the objective is calculated from

$$V_{OB} = \frac{n1.0.1}{n2.0.01}$$

where V_{OB} - linear magnification of the test objective,
n1 - number of divisions of the eyepiece scale,
n2 - number of divisions of the object-micrometer ,mm,
0.1- scale factor of the eyepiece , mm,
0.01- scale factor of the object-micrometer, mm

Make sure that the actual linear magnification of the objective corresponds to that given in the drawing and the deviations do not exceed 5% in the absolute value.

3.3. Ref. 1.2.1. meeting the drawings during production of the objective parts and units should be checked.

3.4. Ref.1.2.2. the units (lenses in holders) are checked to the standard technique (ГОСТ 1141-84).

3.4.1. Ref. 1.2.2.1. assembled objectives are checked in transmitted scattered light using a 4x magnifying glass according to Table 1a in the present technical requirements.

3.4.2. Ref. 1.2.3. the objectives are checked in scattered transmitted light with a 4x magnifying glass.

3.5. Ref. 1.2.4., 1.2.5. checking is done using checking microscope incorporating an illuminator (OU-19type); a set of eyepieces (7x,10x,15x), a set of diffraction (point) and lined specimens, rotational holder and a standard objective based on the image quality.

When checking the objectives the mechanical length of the tube is set to 160 mm.

Centring (coma on the axis) of the objective is checked as follows: when focusing the microscope to a point specimen the point image looks like a bright central core to which the first bright ring adjoins; evaluate visually the width of the bright ring discontinuity and make sure that the latter does not exceed the allowable value.

When checking residual spherical aberration in objectives using diffraction and lined specimens it is necessary to compensate for the residual spherical aberration by changing the tube length and to make sure that it is within the allowable value.

All other residual aberrations should be checked using a point specimen in comparison with aberrations of the standard objective.

Make sure that the aberration of the test objective is within that of the standard objective.

When checking an objective with A≥1.0 using a lined specimen it is necessary to apply immersion liquid onto the frontal lens of the condenser.

3.6 . Ref. 1.2.6 checking should be performed with the inspection microscope (1314) incorporating 15x magnification eyepiece with a graticule, object as a cross-hairs (centring plate)

Objectives are checked as follows : screw in the test objective in the inspection microscope (1314) and bring the object image to a sharp focus; bring the image of a selected point of the object on the microscope stage.

Rotate the microscope stage and make sure by the eyepiece graticule that the value of the shift of the object point image does not exceed the value specified.

Comment: Depending on the microscope design this checking may carried by rotating of the rotational bushing with tested objective.

3.7. Ref. 1.2.7. the checking is carried out using inspection microscope (1314) incorporating a set of objectives in the required parfocal distance, a set of lined specimens, measuring eyepieces.

Checking is done as follows: screw in the standard objective in parfocal distance into the tube; put the lined specimen on the microscope stage. Focus the objective to a sharp object image by moving the stage of the microscope(1314) set a stop and take the reading from fine feed knob scale with the scale factor 0.002 mm. This reading is taken as zero. Substitute the standard objective by the test one. Bring the microscope stage to the stop with a coarse feed knob viewing through the eyepiece. Focus the objective to a sharp image of the object by turning the fine feed knob and take the reading "n" from the knob scale. Determine the parfocal distance of the objective from:

$$H_T = H_{ST} \pm 0.002.n \quad ,$$

where H_T - parfocal distance of the test objective, mm

H_{ST} - parfocal distance of the standard objective taken from the certificate, mm;

n - number of divisions of the scale of the microscope stage displacement fine feed knob.

3.8. Ref. 1.2.8. checking is done as follows: place the test objectives on the stage with the front lens upwards. Apply a drop of an immersion liquid onto the surface of the front lens and allow the objective to stand in this position for at least 4 hours, then disassemble the objectives.

Make sure that there is no immersion liquid inside the objectives.

3.9. Ref. 1.2.9. checking is done using gauges and snap gauges classes.

3.10. Ref. 1.3.1. checking is done by comparing the objective set with that given in the present requirements.

4. *Service instructions*

4.1. Objectives should be protected against shocks falling down and contamination.

4.2. It is essential to remove dust from outer surface of objectives with a clean soft brush prewashed in ethyl alcohol and dried.

4.3. Immersion objectives should be used at the ambient temperature not lower than 15^{o}C.

4.4. After operation the immersion liquid should be removed by a napkin wetted in benzine or alcohol.

APPENDIX

List of equipment to test the objectives

Name	Feature	Technical requirements item using the equipment	Comment
Disk-apertometer		3.1.	Developed by LITMO
Glass plate		3.1.	Developed by LITMO
Check-microscope with a telescopic tube		3.1.,3.2.,3.5.	to buy
Huygenian eyepieces	7x,10x,15x	3.1.,3.5.	to buy
Illuminator ОИ-19		3.1.,3.2.,3.5.	to buy
Auxiliary microscope МИР-4 (MIR-4)		3.1.	to buy

Object-micrometers		3.2.	To buy
Eyepiece with a gratifule	10x	3.2.	To buy
Magnifying glass	4x	3.4	To buy
Diffraction (point) specimens		3.5.	To buy
Lined specimens		3.5.,3.6.	To buy
Standard objective in image quality		3.5.	To buy
Inspection microscope(1314)		3.6., 3.7.	Technical docum is developed by LITMC
Standard objective in parfocal distance		3.7.	to buy

Note: Any alternative equipment application is allowed in case test parameters can be provided for in compliance with the present technical requirements.

EYEPIECE-10x FOR MICROSCOPE "BIOMEM-S,L"

TECHNICAL REQUIREMENTS

1990

The present technical requirements extend to eyepiece of microscopes BIOMEM-S,L.

The eyepiece is designed for visual observation.

The eyepiece for BIOMEM-S,L microscopes is manufactured to be used in rooms with air temperature from 10C to 40C and relative humidity no more than 80% at the temperature of 20C.

1. TECHNICAL REQUIREMENTS

The eyepiece must meet the present specification conditions and relevant documentation.

1.1. Main parameters

i.1.1. Actual values of focal distances should meet those given in the appropriate drawings.

1.2. Characteristics

1.2.1. Exterior design of an eyepiece, coating and attachment means should meet the drawing requirements.

1.2.2. Surface finish of optical parts should meet the requirements given in drawings.

In addition to these defects a deposit as points and specks of dust visible at the edge of the eyepiece field of view can be allowed of their total amount is no more than five units of up to 0.03 mm in diameter.

The distance between the front focus and the collar end should meet the requirements in the drawings.

1.2.3. Eyepiece - to- microscope tube attachment sizes should meet the requirements (ГОСТ 3361-75).

2. TEST REGULATIONS

2.1. Eyepiece should be quality control tested.

2.2. The present requirements, documentation are the main documents.

2.3. The scope and sequence of tests are given in Table 1.

Test feature	Item	
	Technical requirements	Test methods
Focal distance	1.1.1.	3.1
Exterior design, coating and attachment means	1.2.1.	3.2
Surface finish of optical parts	1.2.1.	3.3
Attachment sizes	1.2.3.	3.4

2.4. Tests should be carried out under normal conditions:
ambient art temperature $(25 \pm 10)^{\circ}C$,
relative humidity 45 - 80 %,
atmospheric pressure $8.4 . 10^{4}$ $10.7 . 10^{4}$ Pa

3. TEST METHODS

The list of equipment required for testing eyepiece is given in Appendix.

3.1. Ref. 1.1.1. checking is done as follows using focometer. Consisting of a collimator with a scale in the focal plane, a stage with a holder for the test eyepiece and measuring microscope with eyepiece-micrometer.

Insert the test eyepiece into the stage holder with the eye lens facing the collimator. Bring the collimator scale image into a sharp focus and find within what number of the eyepiece scale divisions the selected number of the collimator scale divisions falls. Calculate the focal distance of the eyepiece from the following equation

$$f'_{eyep.} = f'_{coll} \frac{N' . a_E}{N . b . V_{obj.}}$$

where f'_{eye} - focal distance of the test eyepiece, mm

f'_{coll} - focal distance of the collimator objective;

N' - number of divisions of the microscope eyepiece scale;

N - number of divisions of the collimator scale;

V_{obj} - microscope objective magnification;

a_E - scale factor of the microscope eyepiece scale, mm

b - scale factor of the collimator scale, mm.

Make sure that the focal distance of the eyepiece differs from that in the drawing no more than by 5%.

3.2. Ref. 1.2.1. meeting the drawings is checked.

3.3. Ref. 1.2.2. checking is performed using 4x magnifying glass by focusing it on the surface of each optical part.

3.4. Ref. 1.2.3. meeting the drawings is checked using limiting gauges.

4. SERVICE INSTRUCTIONS

4.1. Eyepieces should be protected against shocks and falling.

4.2. When using eyepieces it is necessary to remove dust from outer surfaces of lenses with a soft brush prewashed in alcohol or ether and dried.

Appendix

List of equipment to test eyepieces.

Name of equipment	Feature	Technical requirements item using the equipment	Comment
Focometer (optical bench)	Measurement range from 0 to 100 mm	3.1	be purchased
Magnifying glass	Magnification 4x	3.3	be purchased
Limiting gauges		3.4	be purchased

Note: Any alternative testing equipment application is allowed in case it provide test parameters in compliance with the present technical requirements.

19353

(6 of 7)

4.1

Leningrad Institute of Precision Mechanics and Optics

F I N A L R E P O R T

(project DP/SYR/86/011)
contract No 89/44

Annex 4.1

Technical Documentation on Equipment for Assembling and Adjusting of the Microscope

300.000 Centring chuck
(the air gap 55 mm)
310.000 Centring chuck
(the air gap 26 mm)
320.000 Auto-collimated tube
(Centring Adjusting Device)

Leningrad
1991

300.000 CENTRING CHUCK
(the air gap 55 mm)

Ref	Designation	Name	Quo	Comment
		Specification		
	300. 000Ass	Assembling drawing		
		Pieces		
1	300. 001	Bushing	1	
2	300. 002	Segment	1	
3	300. 003	Pin	2	
4	300. 004	Bushing	6	
5	300. 005	Thrust bearing	6	
6	300. 006	Pusher	3	
7	300. 007	Fly nut	6	
8	300. 008	Sheath	6	
9	300. 009	Insert	1	
11	300. 011	Pin	3	
12	300. 012	Mushroom	1	
13	300. 013	Flange	1	
14	300. 014	Body	1	
15	300. 015	Pusher	3	
16	300. 016	Holder	1	
17	300. 017	Cover	1	
18	300. 018	Tube	1	

300. 000

Centring chuck

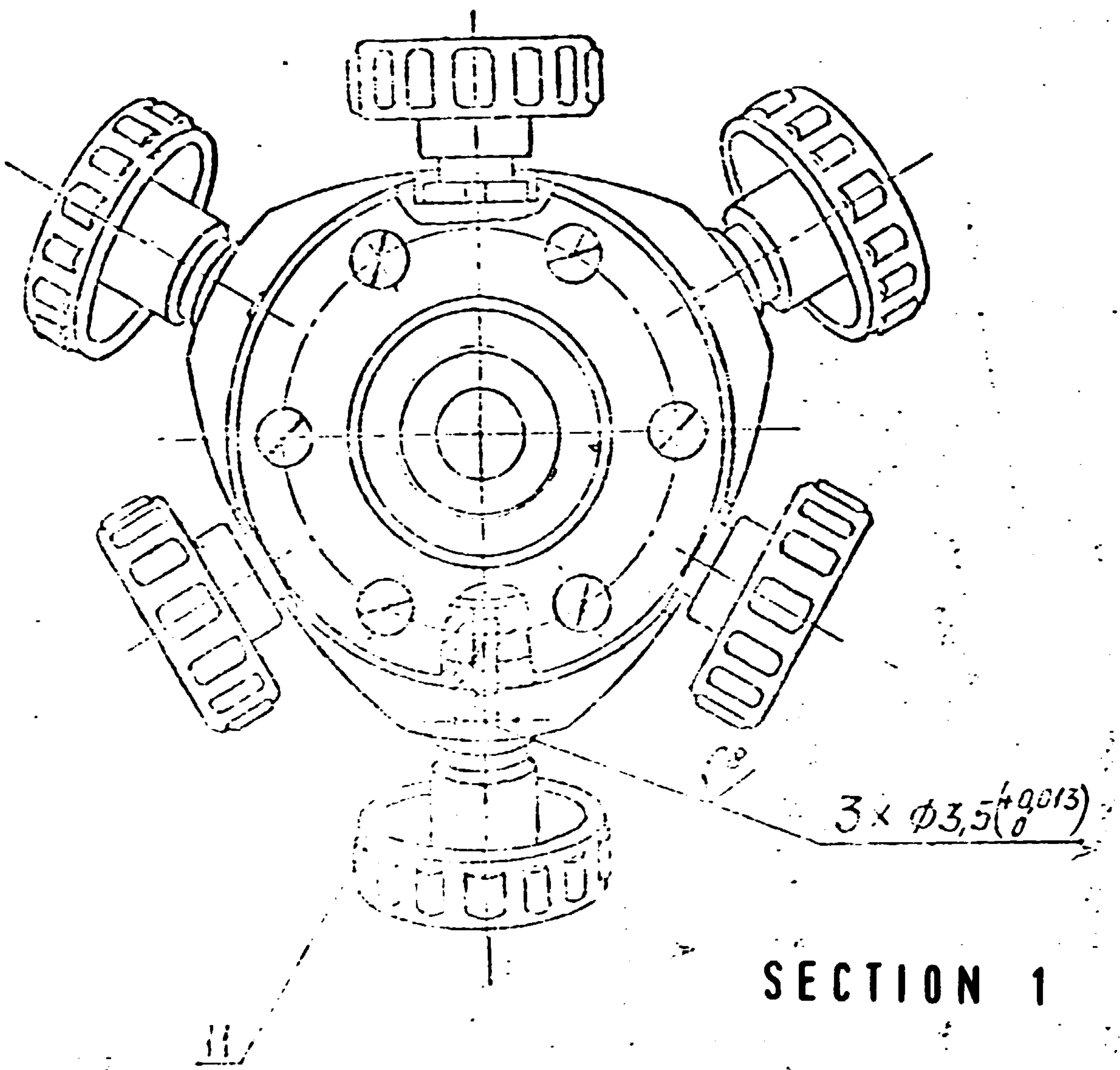
Sheet	Sheets
1	

LITMO

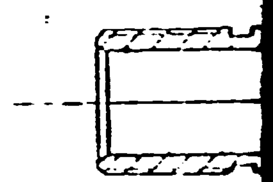
Form A4

Format	Zone	Ref.	Designation	Name	Q-ty	Comment
A4		19	300.019	Nut	1	
A4		21	300.021	Spring	1	
				Standard units		
		31		Screw B M3-6g x 10	1	
				ГОСТ 1476-84		
		32		Screw B M5-6g x 14	3	
				ГОСТ 1491-80		
		33		Screw B M4-6g x 12	6	
				ГОСТ 17475-80		
		34		Pin 4 u 8 x 14	1	
				ОСТ3-2234-80		

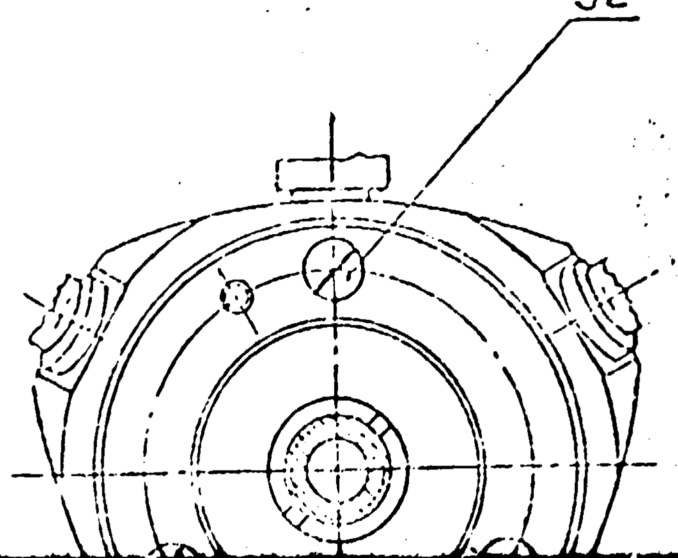
300.000

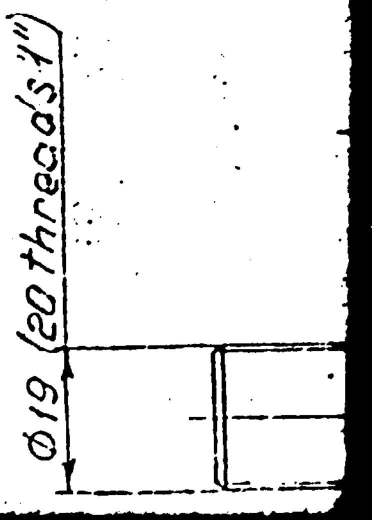


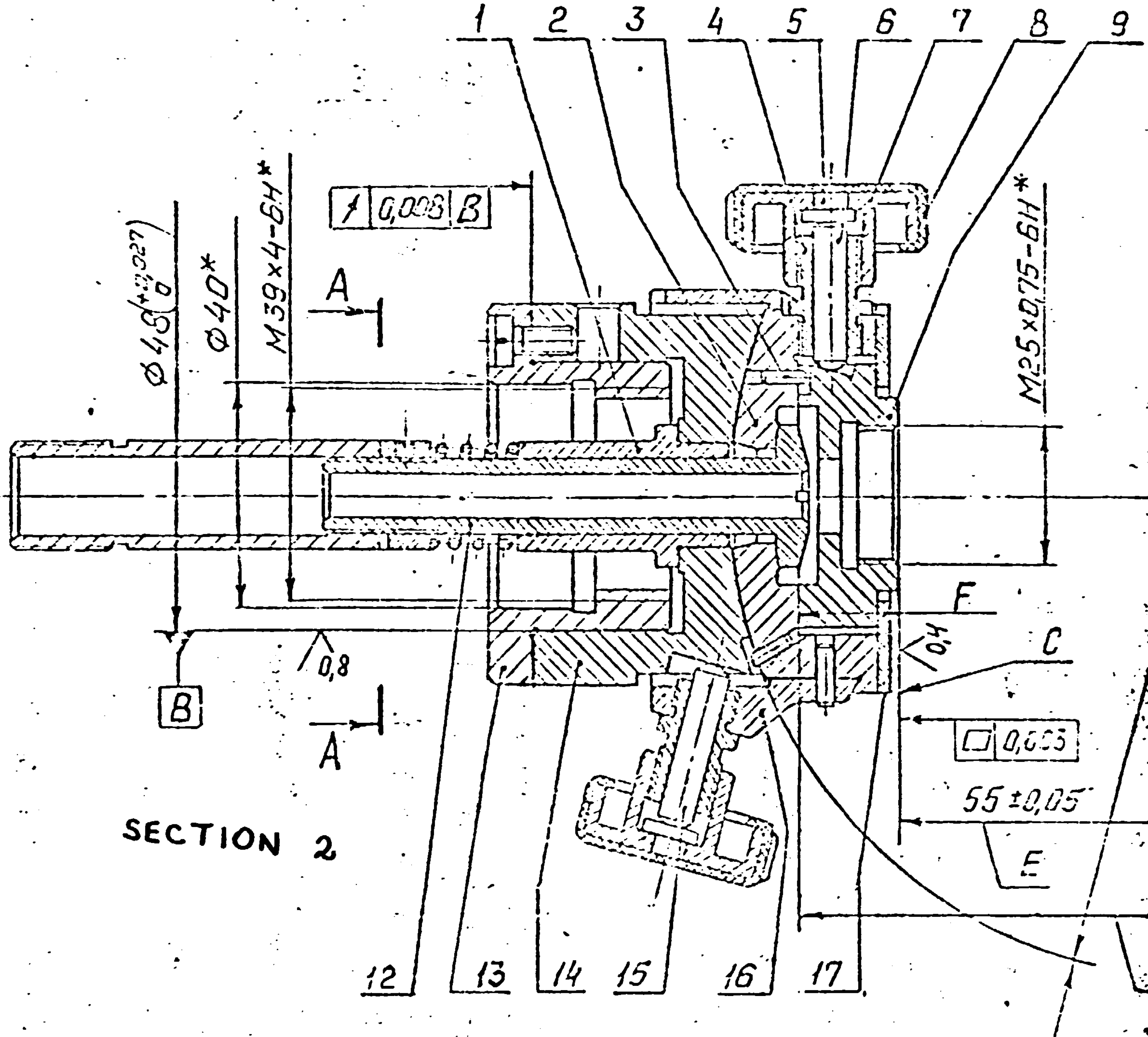
SECTION 1



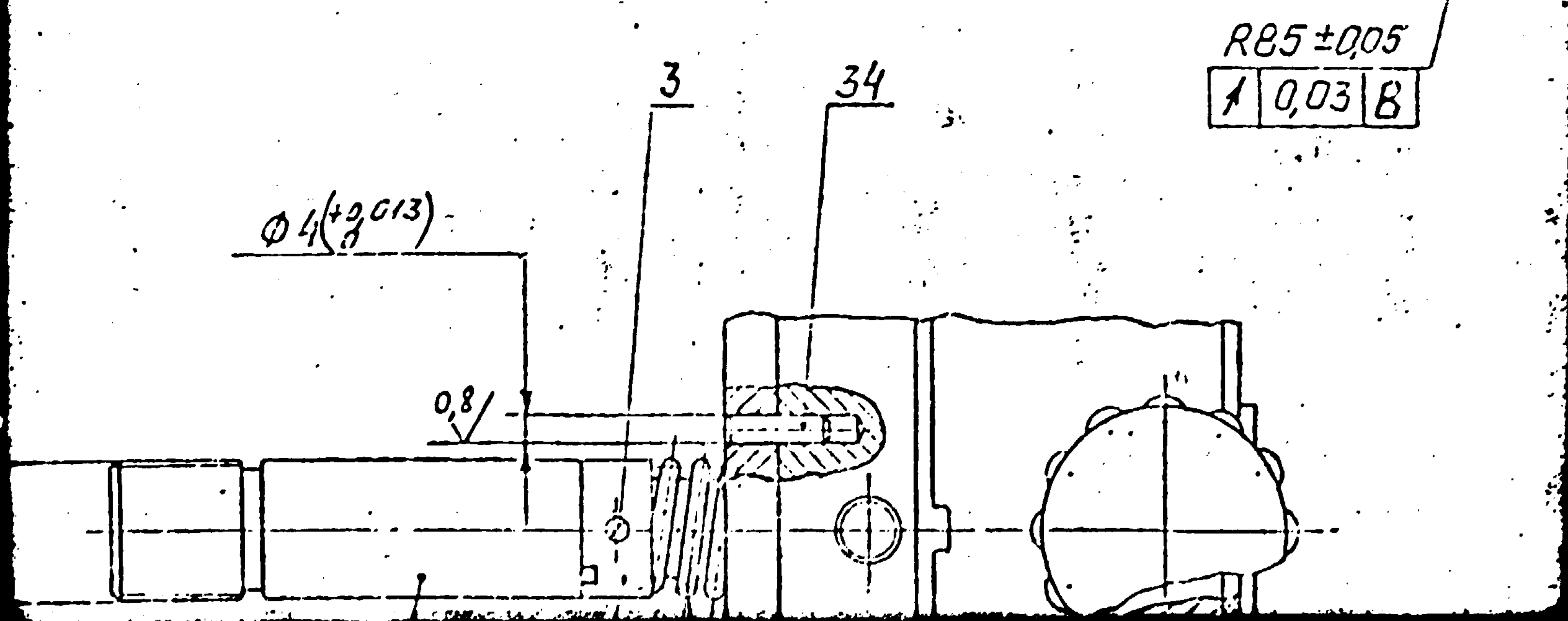
A-A



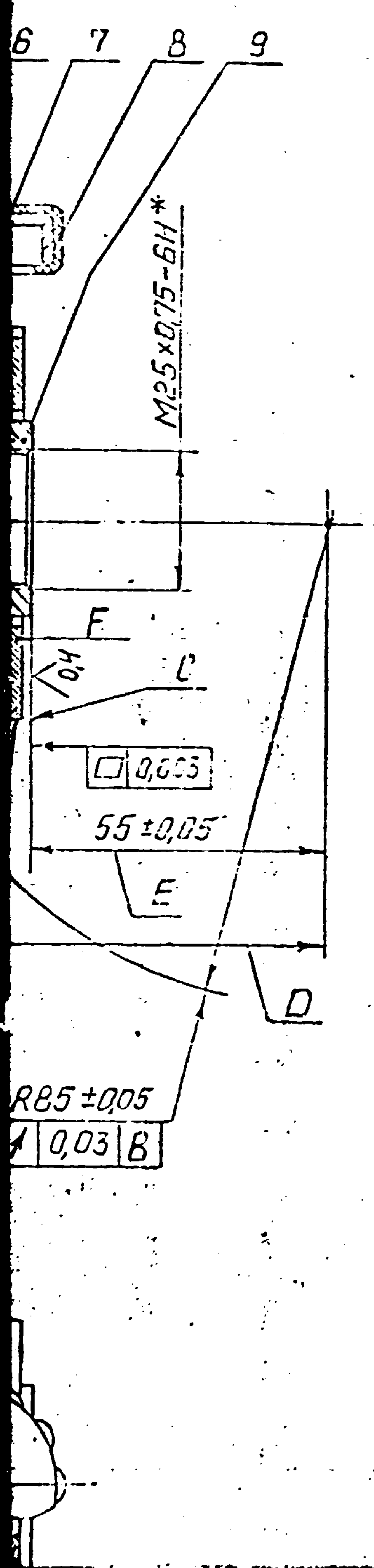




1 2 3 4 5 6 7 8 9
0,008 B
Ф48(+0,027 0)
Ф40*
M39×4-6H*
M25×0,75-6H*
A
A
B
0,8
F
C
0,4
0,005
55 ±0,05
E
SECTION 2
12 13 14 15 16 17
R85 ±0,05
0,03 B

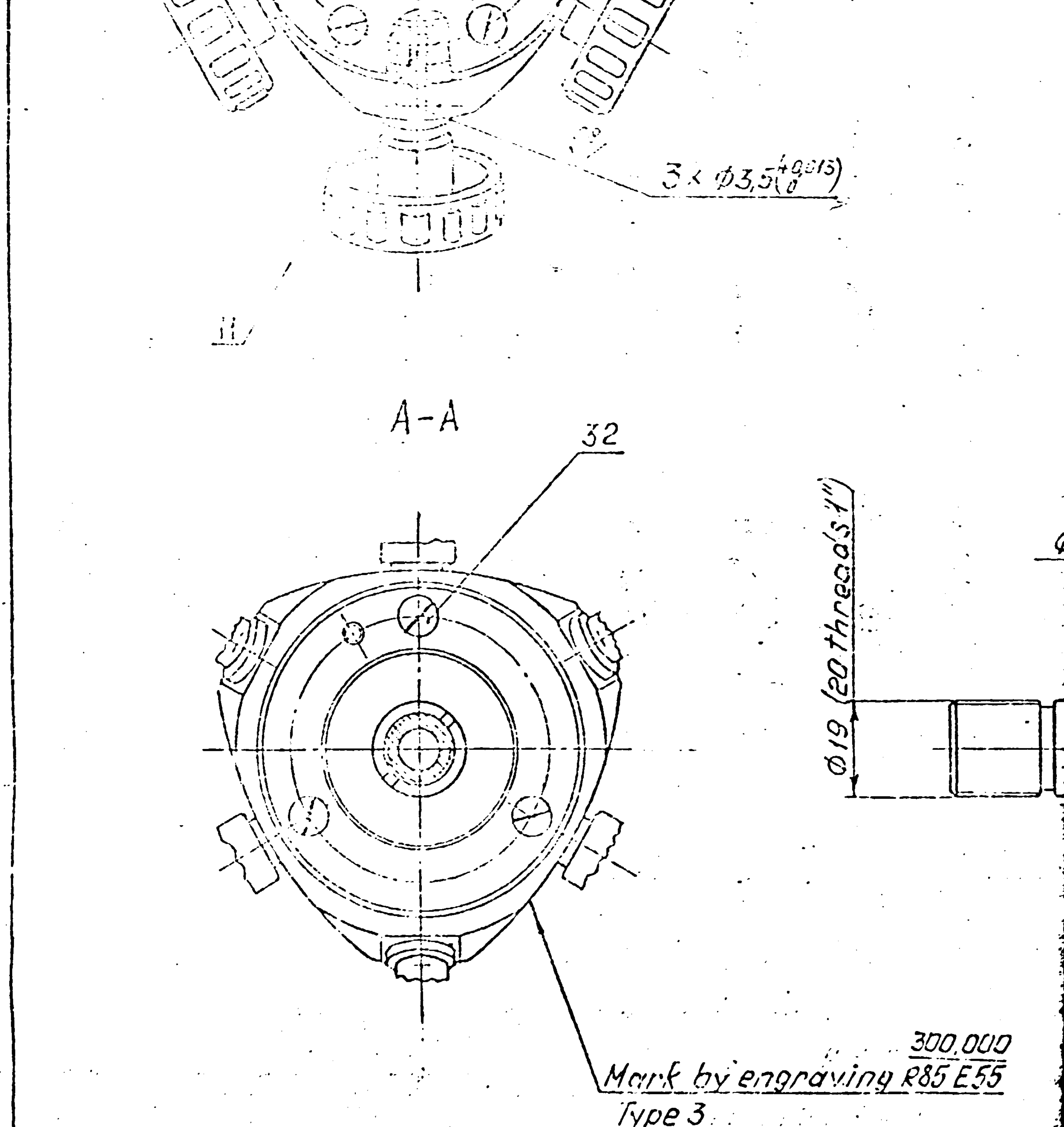


3
34
Ф4(+0,013 0)
0,8



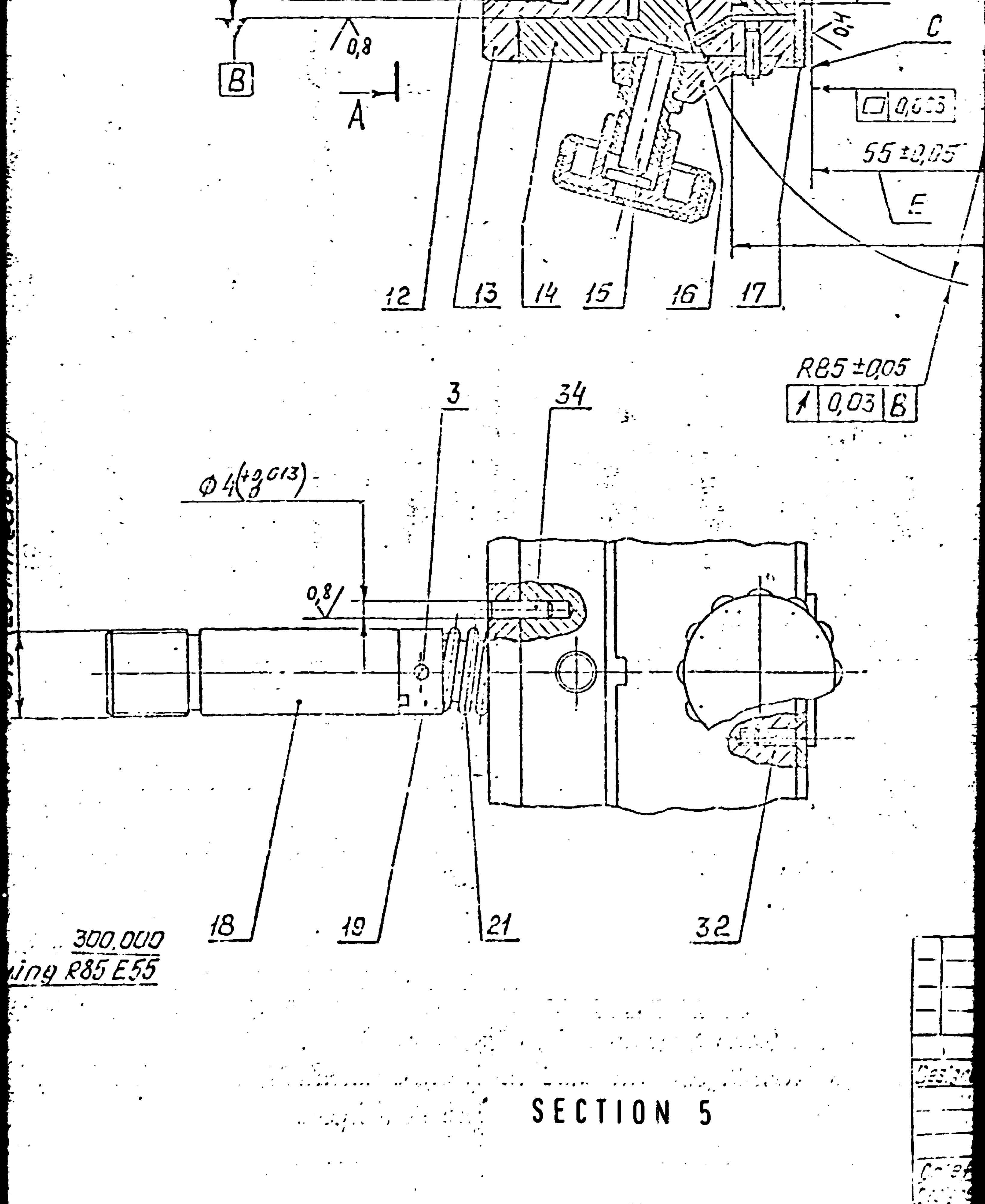
SECTION 3

1. *The dimensions for information.
2. Determine the dimension D till assembly.
3. Produce the dimension E by grinding and finishing of the end C to reach the dimension F and F=D-55
4. Mobile parts displacement must be smooth without jams.
5. Fit in the sphere surfaces of the pieces p.2 and p.14. Intimate contact of these mating surfaces must be not less than 95%. Check pieces for contact by paint.
6. Fit in the sphere surfaces of the pieces p.12 and p.2. Intimale contact of these mating surfaces must be not less than 85%. Check pieces for contact by paint.
7. Fit in the pieces p.6, p.15 and the bushings p.4 to smooth and dense displacement. Backlash must be not more than 0,003mm. Force for pieces p.15 displacement must be 4,9...14,7H using grease ЦИАТИМ-201.
8. Piece p.9 displacement must be dense and smooth. Backlash of the pieces p.17 and p.2 is not admitted. Interfence must be not more than 0,005mm. Force for piece p.9 displacement must be 11,8...29,4H using grease ЦИТИМ-201.
9. Backlash of the pieces p.7 and the bushing p.4 must be not more than 0,01mm.
10. Produce the bushing p.4 thread snugly in correspondence with hole thread of the pieces p.2 and p.16.
11. Secure the pieces p.4, p.2 and p.16 with enamel ЭП-51...
12. One may secure the pieces p.6 with cement ЭД6-8.
13. Secure the piece p.8 with cement 88...



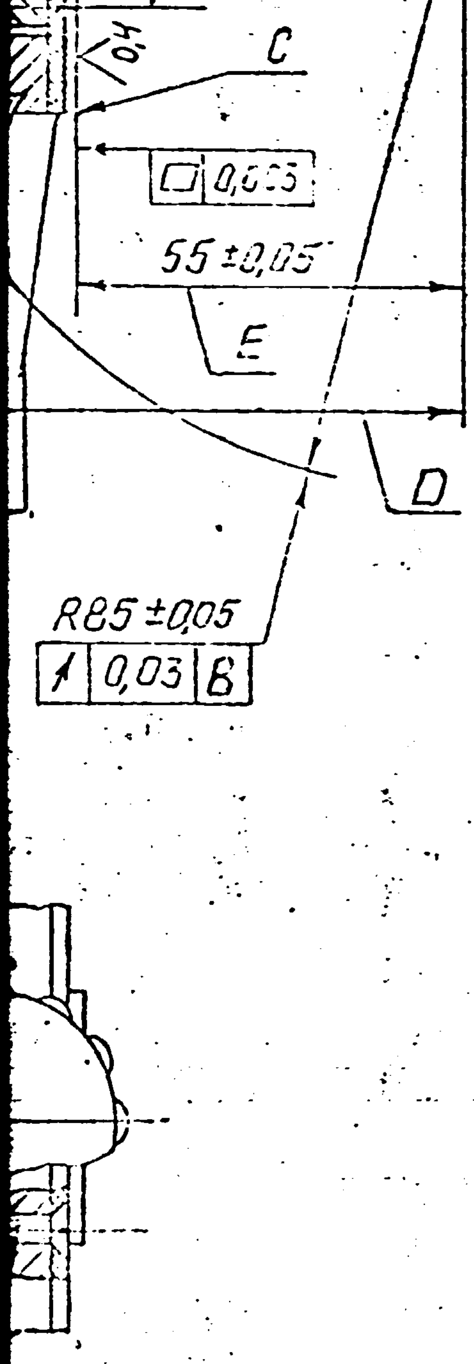
3 × Φ3,5(+0,015 0)
II
A-A
32
Φ19 (20 threads/1")
300,000
Mark by engraving R85 E55
Type 3

SECTION 4



0,8
B
A
C
0,4
55 ±0,05
E
12
13
14
15
16
17
R85 ±0,05
0,03
B
3
34
Φ4(+0,013 0)
0,8
18
19
21
32
300.000
ing R85 E55

SECTION 5



Check pieces for contact of paint.

7. Fit in the pieces p.6, p.15 and the bushings p.4 to smooth and dense displacement. Backlash must be not more than 0,003mm. Force for pieces p.15 displacement must be 4,9...14,7H using grease ЦИАТИМ-201.

8. Piece p.9 displacement must be dense and smooth. Backlash of the pieces p.17 and p.2 is not admitted. Interfence must be not more than 0,005mm. Force for piece p.9 displacement must be 11,8...29,4 H using grease ЦИТИМ-201.

9. Backlash of the pieces p.7 and the bushing p.4 must be not more than 0,01mm.

10. Produce the bushing p.4 thread snugly in correspondence with hole thread of the pieces p.2 and p.16.

11. Secure the pieces p.4, p.2 and p.16 with enamel ЭП-51.

12. One may secure the pieces p.6 with cement ЭД6-8.

13. Secure the piece p.8 with cement 88.

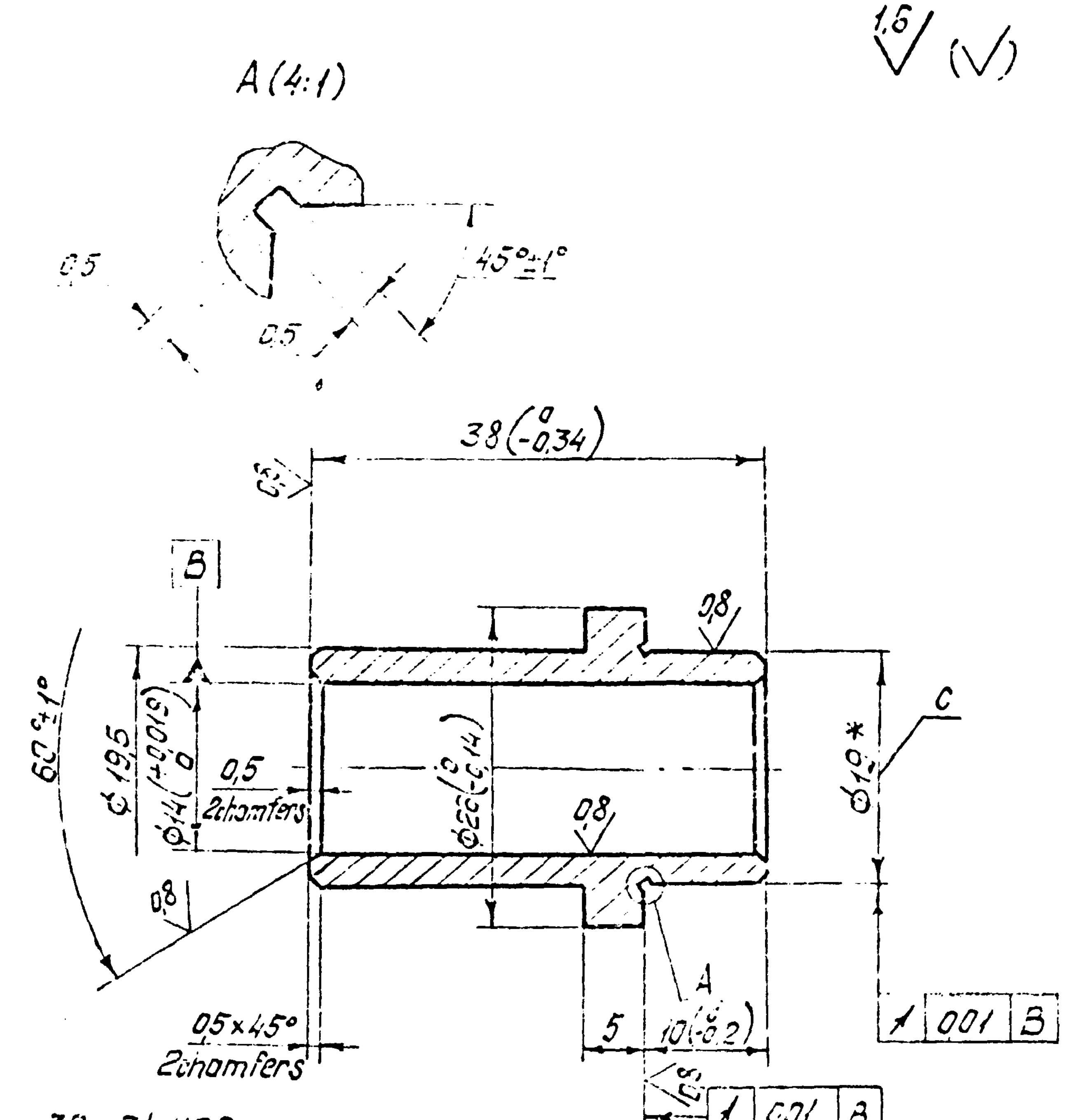
14. Mobile parts of the chuck must be grease with grease ЦИАТИМ-201.

SECTION 6

300.000 Ass		
Centring chuck	Mass	Scale
		1:1
	Sheet	Sheets 1
	LITMO	

Design

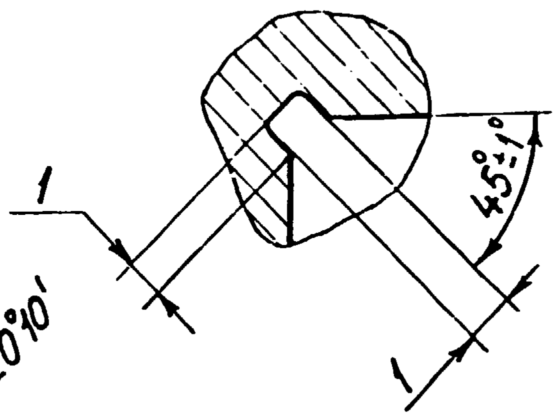
Chief

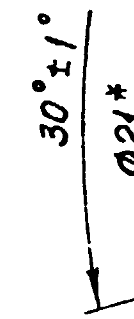


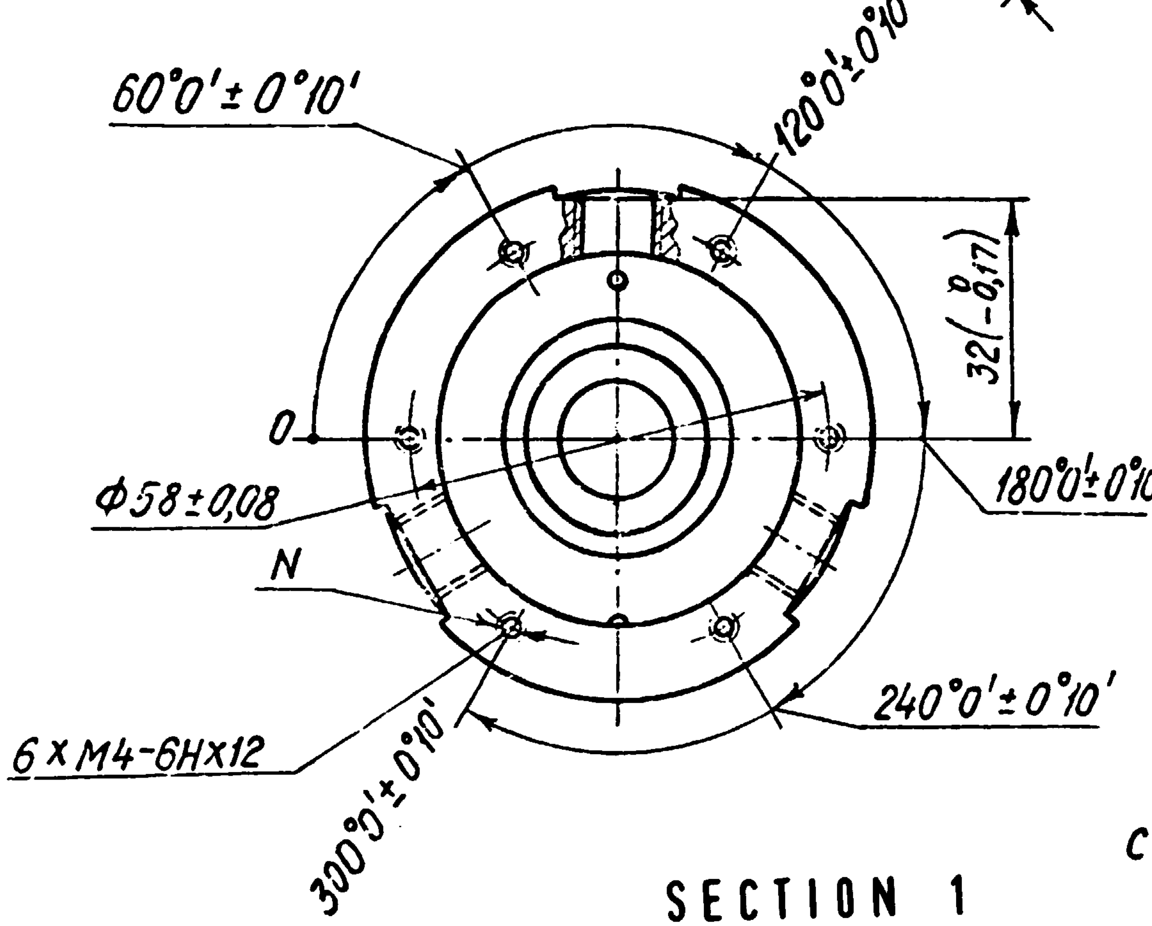
1. 30...34 HRCэ
2.* Machine the dimension C to the piece 300.014 and an interference must be 0,010...0,015mm
3. H14; h14; $\pm \frac{IT14}{2}$
4. Coating Chemical oxidation.

300.001		
Bushing	Mass	Scale: 2:1
Steel 20	Sheet	
Designer		
Chief Designer		

B (5:1)

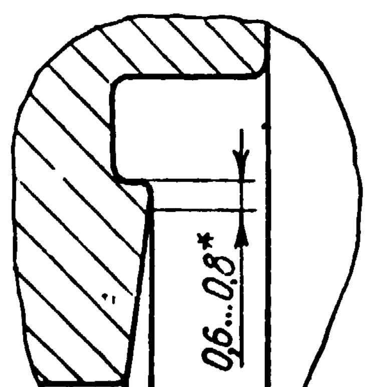




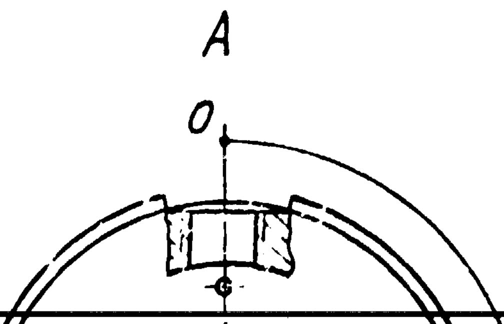


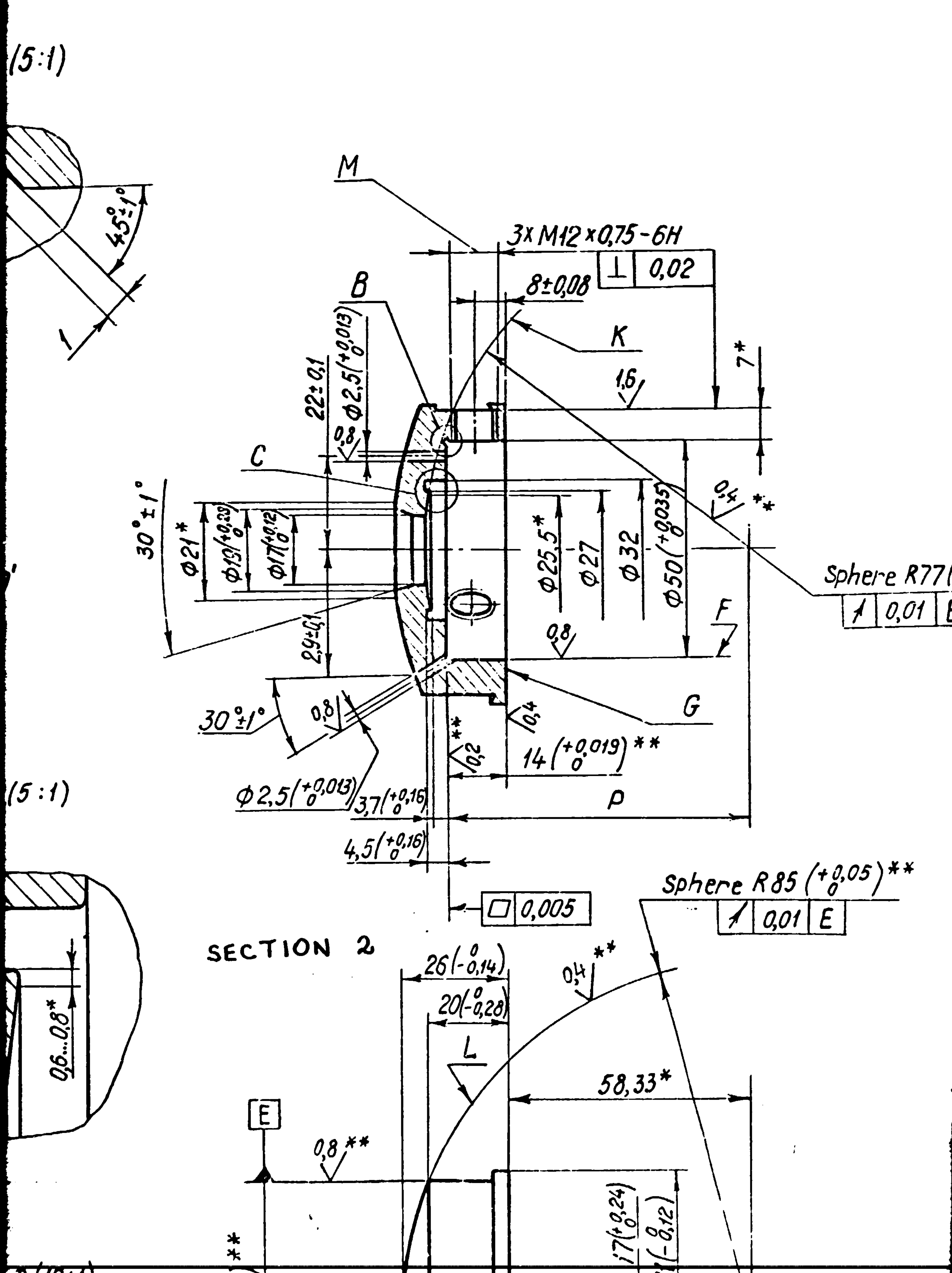
SECTION 1

C (5:1)



A

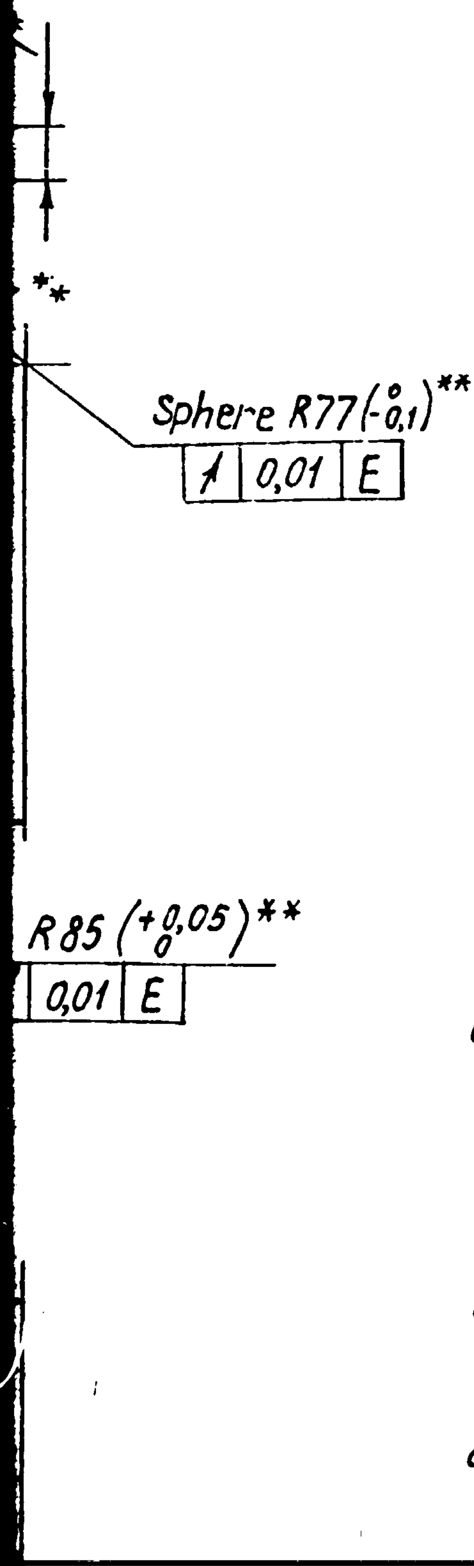




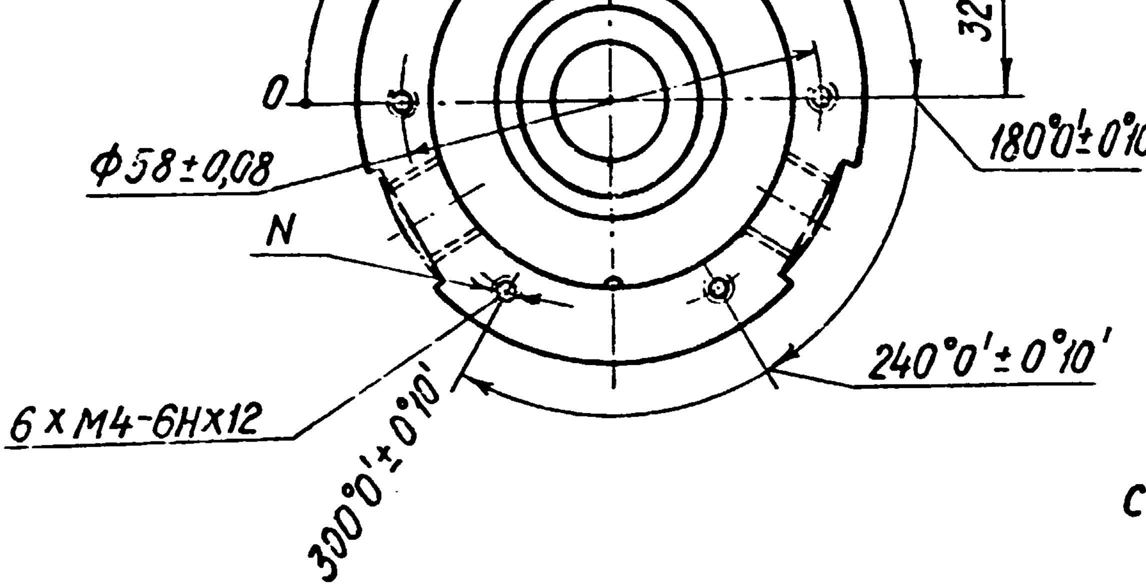
(5:1)
45°±1°
1
M
3x M12x0,75-6H
⊥ 0,02
8±0,08
B
K
7*
1,6
22±0,1
Φ2,5(+0,013 0)
0,8
C
30°±1°
Φ21*
Φ19(+0,23 0)
Φ17(+0,12 0)
Φ25,5*
Φ27
Φ32
Φ50(+0,035 0)
0,4 **
Sphere R77
0,01
F
0,8
2,9±0,1
G
30°±1°
0,8
0,4
0,2 **
14(+0,019 0)**
(5:1)
Φ2,5(+0,013 0)
3,7(+0,16 0)
P
4,5(+0,16 0)
□ 0,005
Sphere R85 (+0,05 0)**
0,01 E
SECTION 2
26(0 -0,14)
0,4 **
20(0 -0,28)
0,6...0,8*
L
58,33*
E
0,8 **
17(+0,24 0)
(0 -0,12)
**

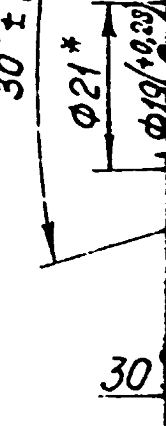
3,2 √ (√)

SECTION 3

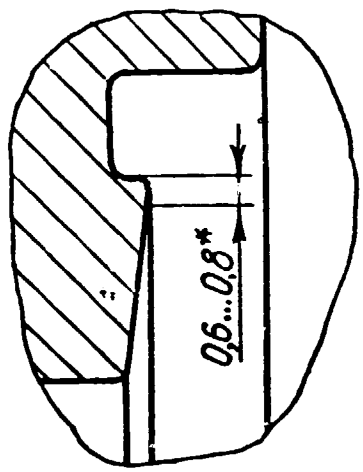


1. Carburize in depth h 0,8 ... 1,2 except for the surfaces E, F, G, H and thread holes M and N. 51,5 ... 56 HRC э
2. H14; h14; $\pm \frac{IT14}{2}$
3. * The dimensions for information
4. ** The dimensions and roughness are after coating
5. Check the dimension L by the template R85 before the fitting in.
   Fit in the dimension L and the piece 300.014
   Contact must be no less than 95%. Check the pieces for contact by paint.
6. Check the dimension K by the template R77 before fitting in. Fit in the dimension K and the piece 300.012.
   Contact must be no less than 85%.
   Check for contact by paint
7. Measure the dimension P accurate to 0,01mm
8. Coating Chemical oxidation

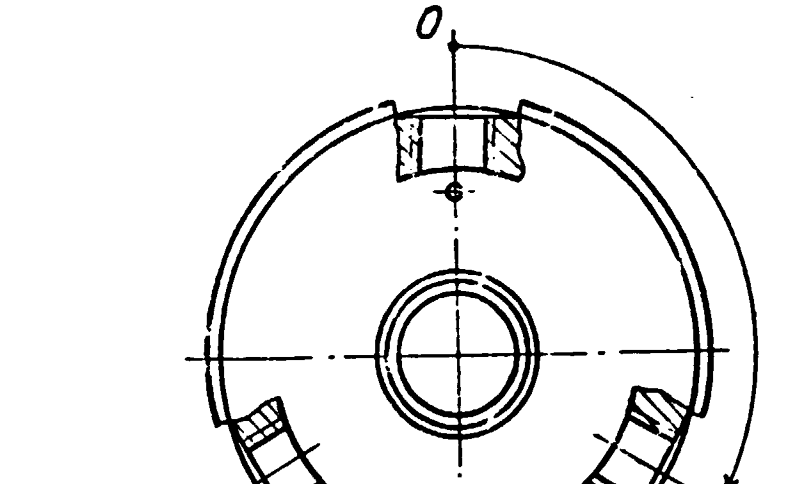




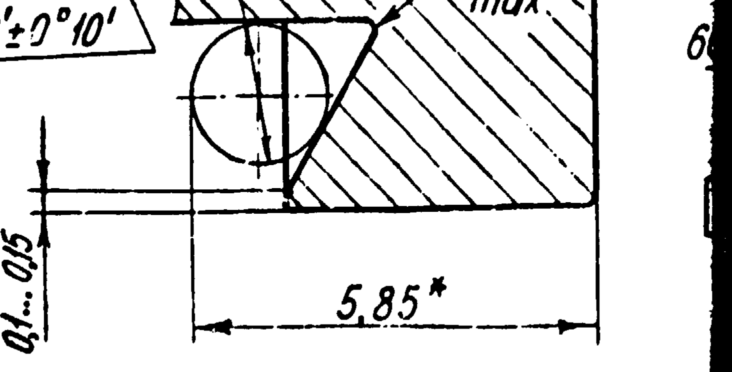
C (5:1)



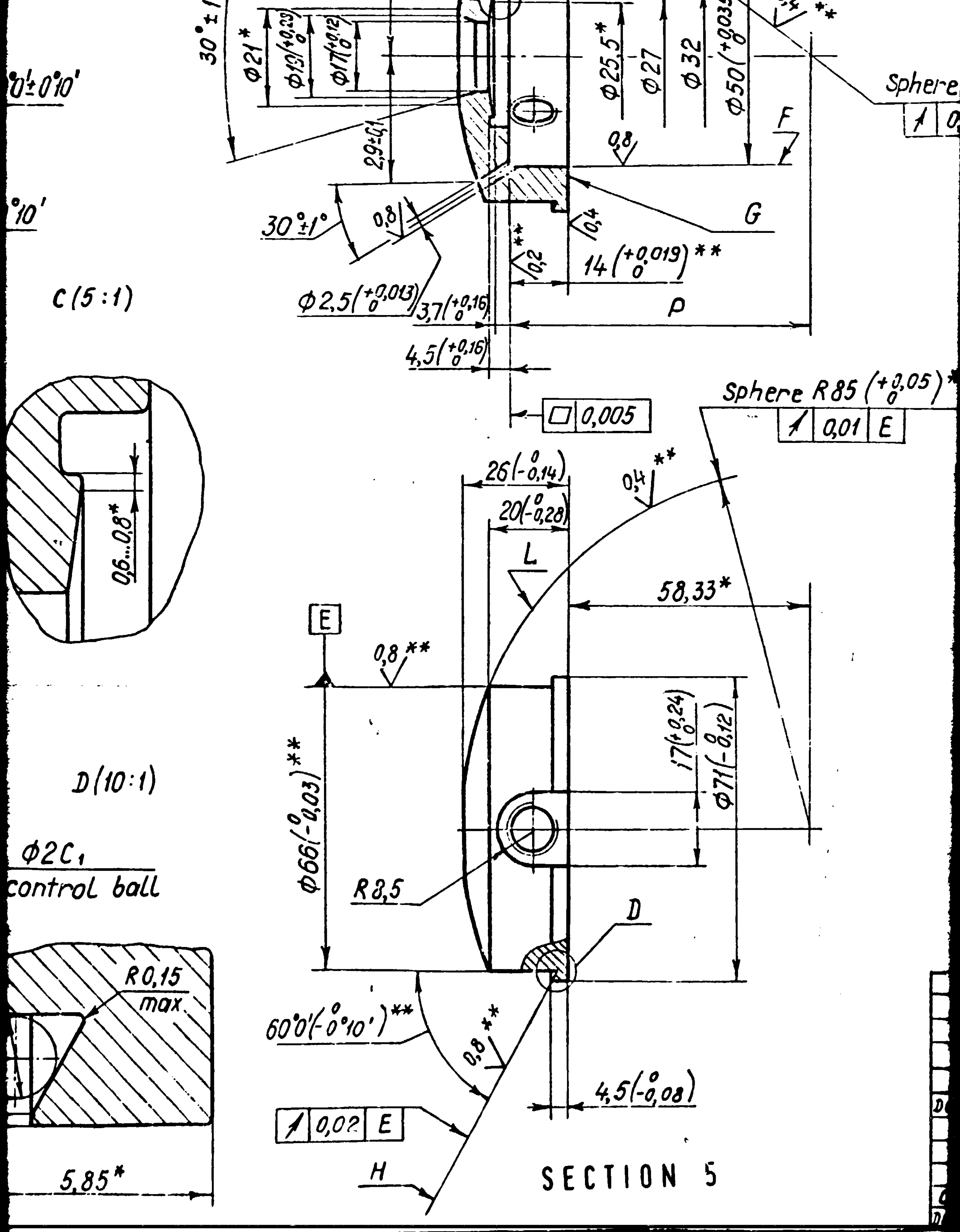
A



D (10:1)



SECTION 4



C (5:1)
D (10:1)
SECTION 5
Sphere R85 (+0,05/0)*
Sphere
0,01 E
0,005
0,02 E
Φ2C₁
control ball
R0,15 max
5,85*
0,6...0,8*
26(0/-0,14)
20(0/-0,28)
58,33*
17(+0,24/0)
Φ71(0/-0,12)
Φ66(0/-0,03)**
R8,5
60°0'(0/-0°10')**
4,5(0/-0,08)
30°±1°
Φ2,5(+0,013/0)
3,7(+0,16/0)
4,5(+0,16/0)
14(+0,019/0)**
P
Φ21*
Φ19(+0,23/0)
Φ17(+0,12/0)
Φ25,5*
Φ27
Φ32
2,9±0,1
E
F
G
H
L
D

Sphere R77$\left({}^{0}_{-0,1}\right)$**

⫽	0,01	E

R85$\left({}^{+0,05}_{0}\right)$**

0,01	E

1. Carburize in depth h 0,8 ... 1,2 except for the surfaces E, F, G, H and thread holes M and N. 51,5 ... 56 HRC э
2. H14; h14; $\pm \frac{IT14}{2}$
3. * The dimensions for information
4. ** The dimensions and roughness are after coating
5. Check the dimension L by the template R85 before the fitting in.
   Fit in the dimension L and the piece 300.014.
   Contact must be no less than 95 %. Check the pieces for contact by paint.
6. Check the dimension K by the template R77 before fitting in. Fit in the dimension K and the piece 300.012.
   Contact must be no less than 85 %.
   Check for contact by paint
7. Measure the dimension P accurate to 0,01 mm
8. Coating Chemical oxidation

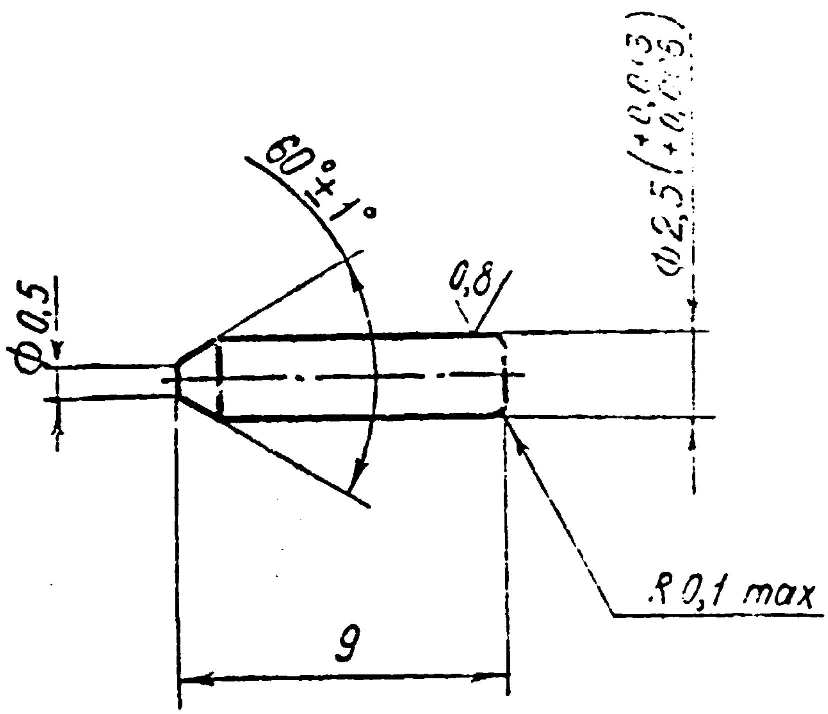
SECTION 6

300.002			
Segment		Mass	Scale
			1:1
	Sheet	Sheets 1	
Steel 12XH3A	LITMO		

Designer

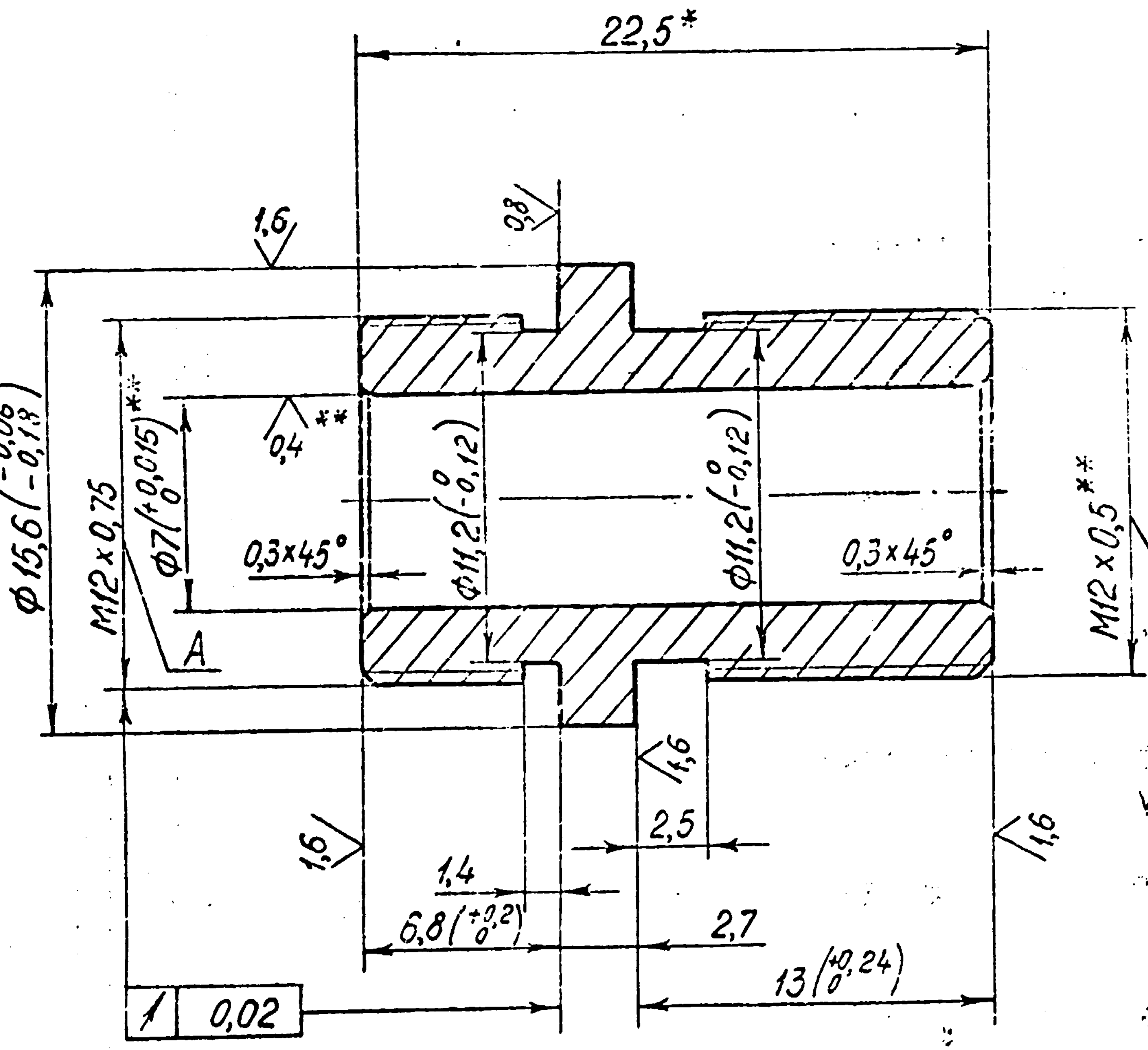
Chief Designer

1,5 √ (√)



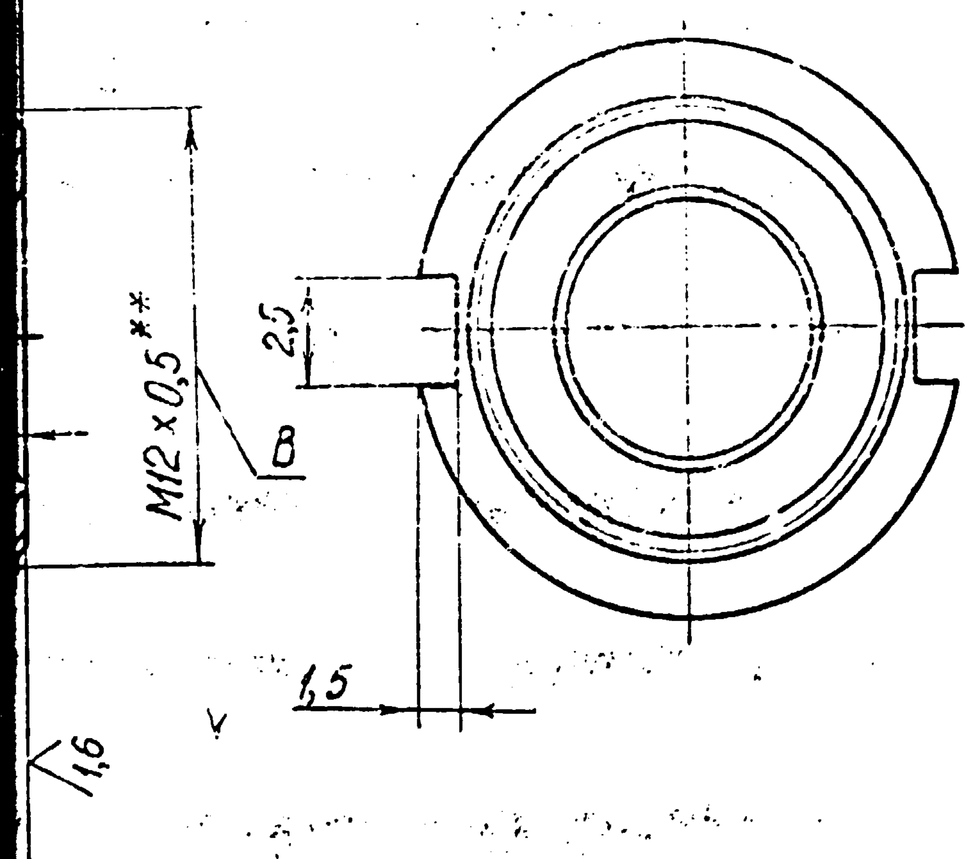
1. 37… 42 HRCэ
2. H14; h14; $\pm \frac{IT14}{2}$

300.003		
Pin	Mass	Scale
		5:1
	Sheet	Sheets 1
Steel 50	LITMO	
Designer		
Chief designer		


22,5*
0,8
1,6
Φ15,6(-0,06 -0,18)
M12×0,75
Φ7(+0,015 0)**
0,4 **
0,3×45°
Φ11,2(0 -0,12)
Φ11,2(0 -0,12)
0,3×45°
M12×0,5**
A
1,6
1,6
1,6
2,5
1,4
6,8(+0,2 0)
2,7
13(+0,24 0)
0,02

SECTION 1

3,2 √ (√)

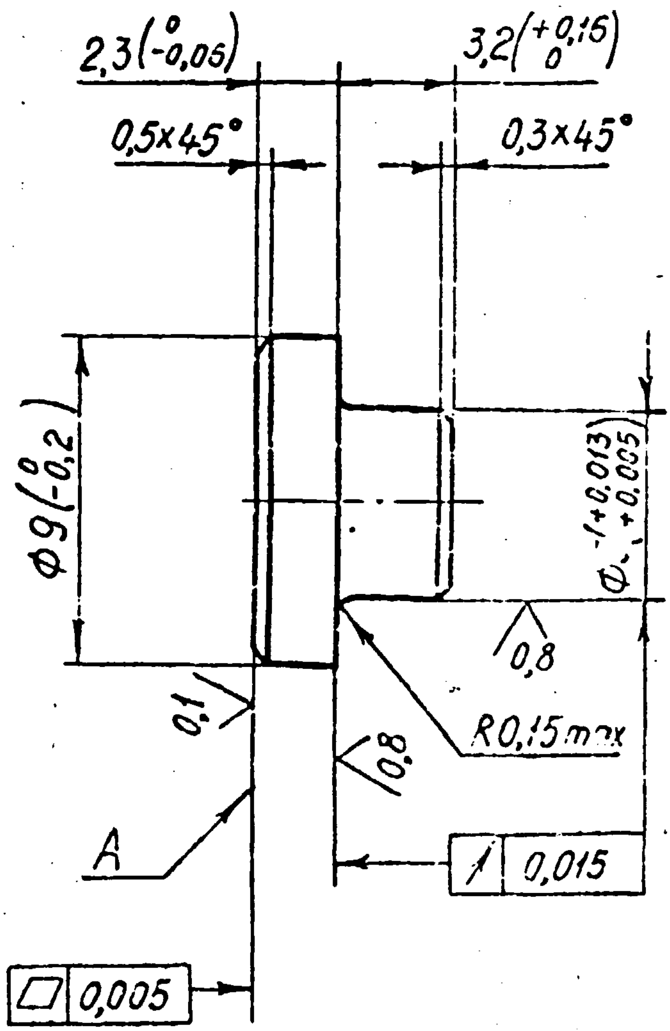


1. 37...41,5 HRCэ
2. *The dimension for information
3. H14; h14; $\pm \frac{IT14}{2}$
4. **The dimensions and roughness are after coating
5. Cut the thread A with a single-point tool according to the pieces 300.002 or 300.016
6. Fit in the dimension B with the piece 300.007 and clearance must be no more than 0.01 mm

SECTION 2

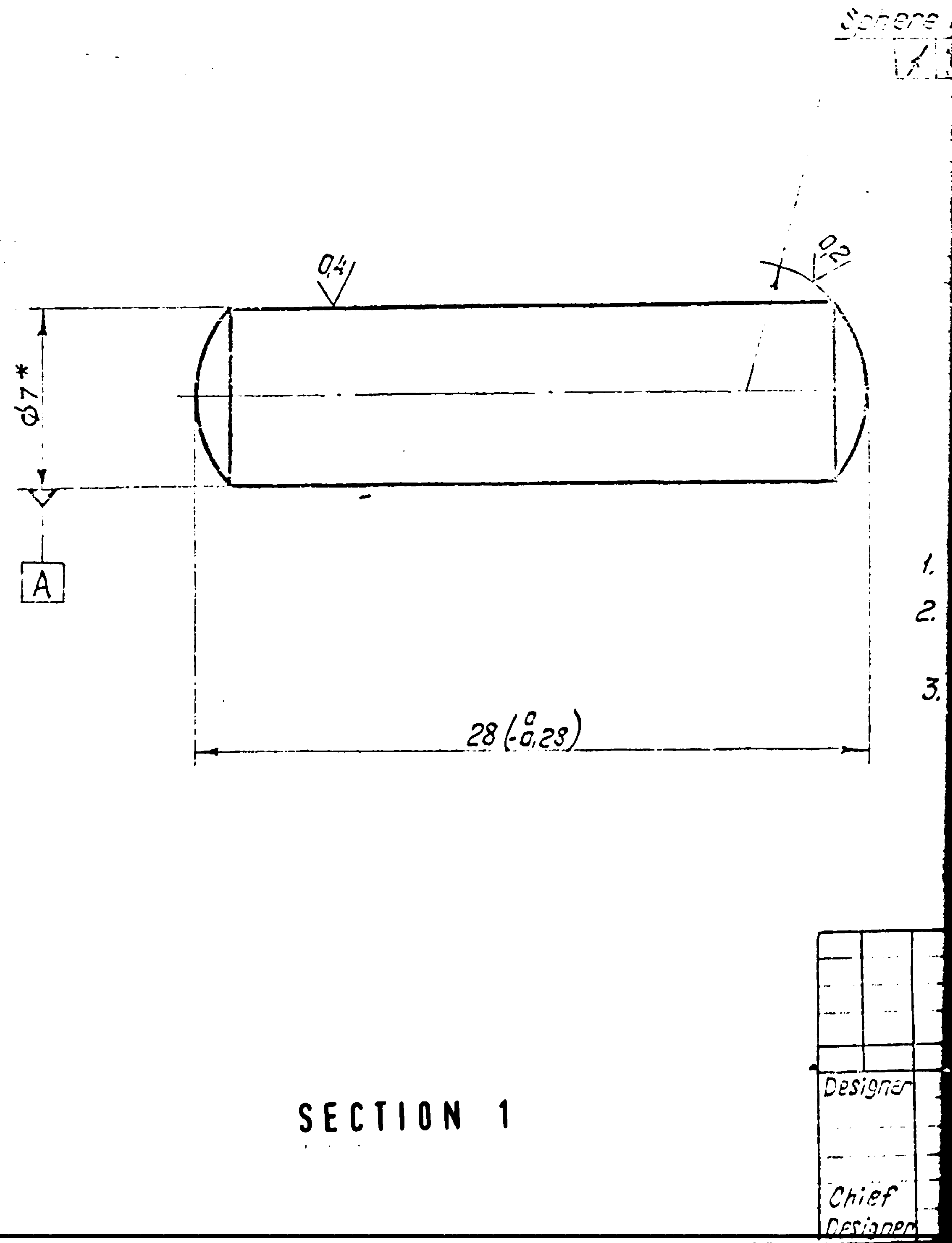
300.004		
Bushing	Mass	Scale 5:1
	Sheet	Sheets 1
Steel 40X	LITMO	
Designer		
Chief		

1,6 (√)

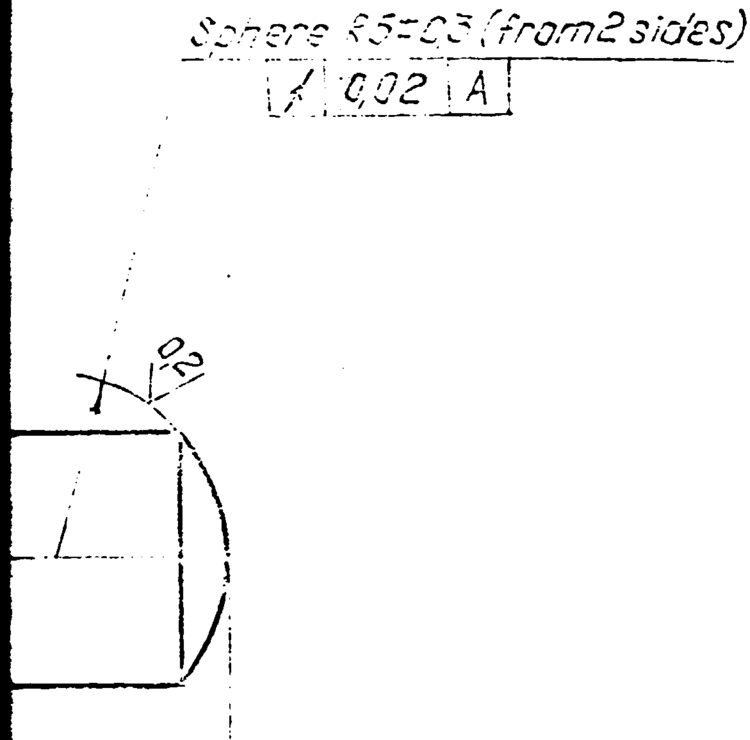


1. 61…65 HRCэ
2. Centring hole is not allowed on the end A.

300. 005		
Thrust bearing	Mass	Scale
		5:1
	Sheet	Sheets 1
Steel У12A	LITMO	
Designer		
Chief		



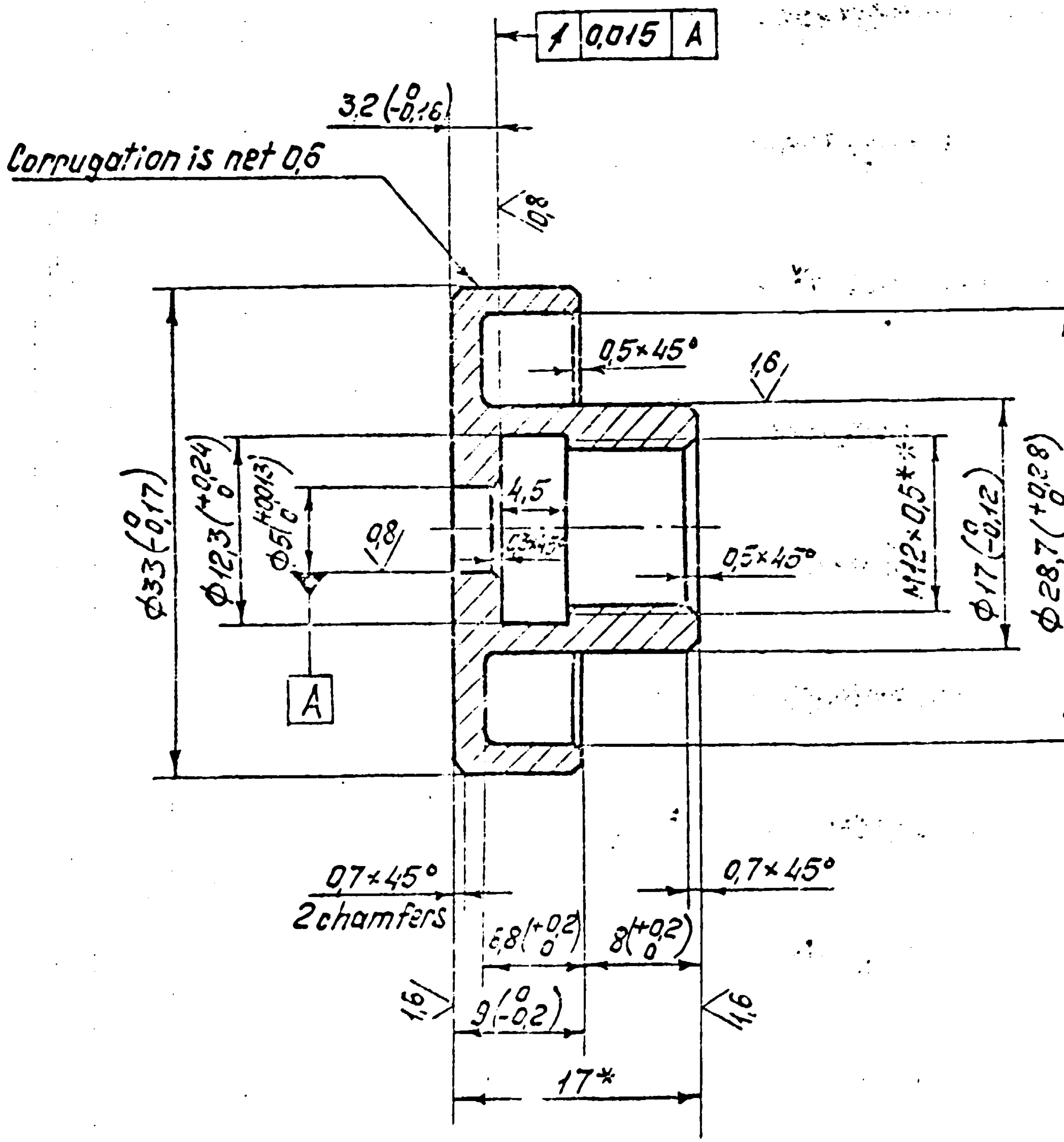
SECTION 1



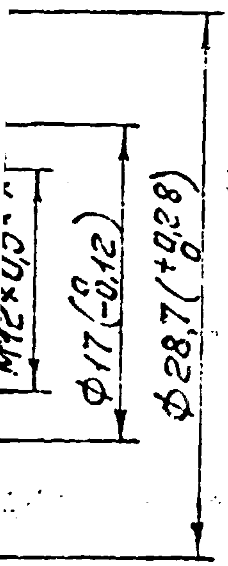
1. 61...65 HRCэ .
2. * Fit in with the piece 300.004 and a clearance must be no more than 0,003 mm .
3. Centring holes are not allowed

SECTION 2

	300.006		
	Pusher	Mass	Scale
Designer			5:1
		Sheet	Sheets 1
Chief Designer	Steel ШХ-15	LITMO	


0,015 A
3,2 (-0,16)
Corrugation is net 0,6
0,8
0,5×45°
1,6
Φ33 (-0,17)
Φ12,3 (+0,24)
Φ5 (+0,013)
4,5
0,8
0,5×45°
M12×0,5*
Φ17 (-0,12)
Φ28,7 (+0,28)
A
0,7×45°
2 chamfers
0,7×45°
6,8 (+0,2)
8 (+0,2)
1,6
9 (-0,2)
1,6
17*

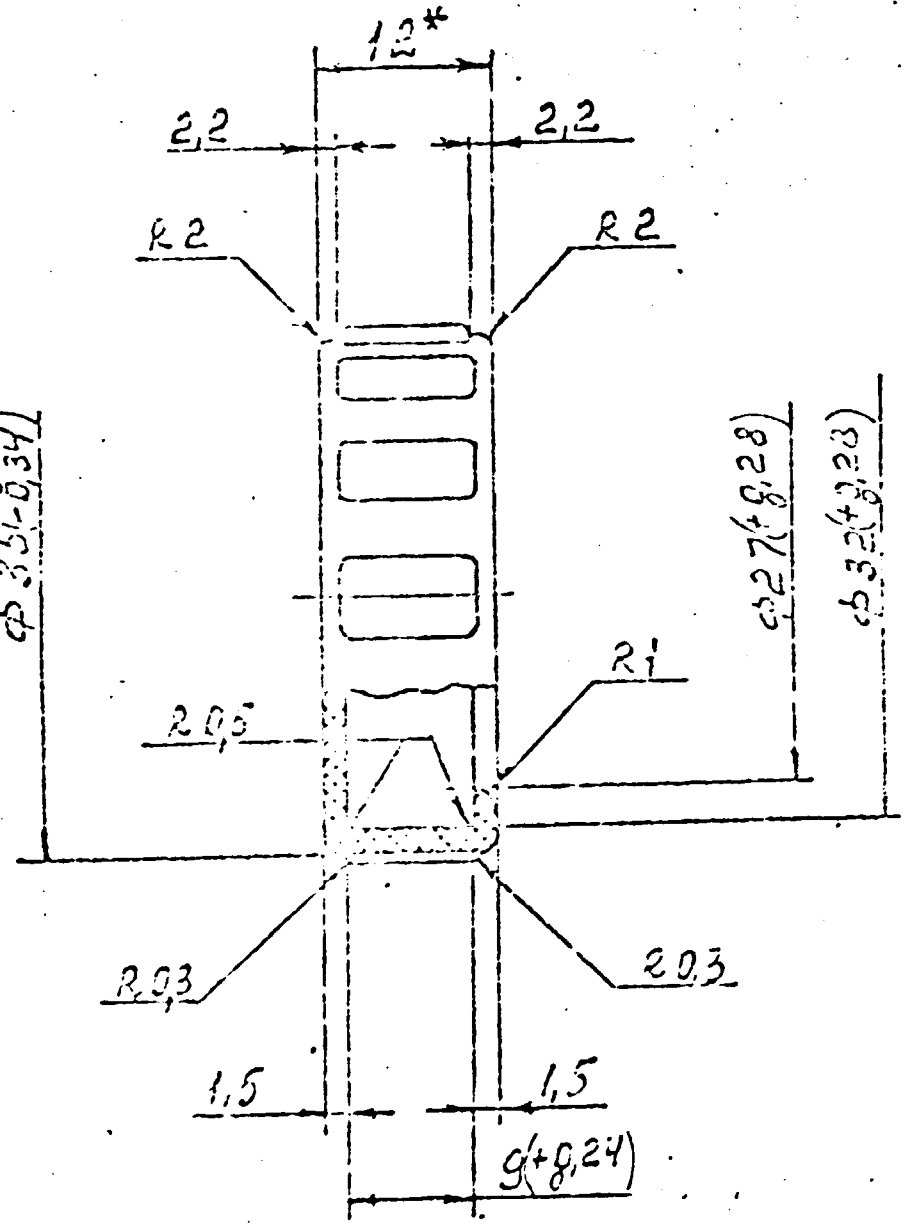
SECTION 1



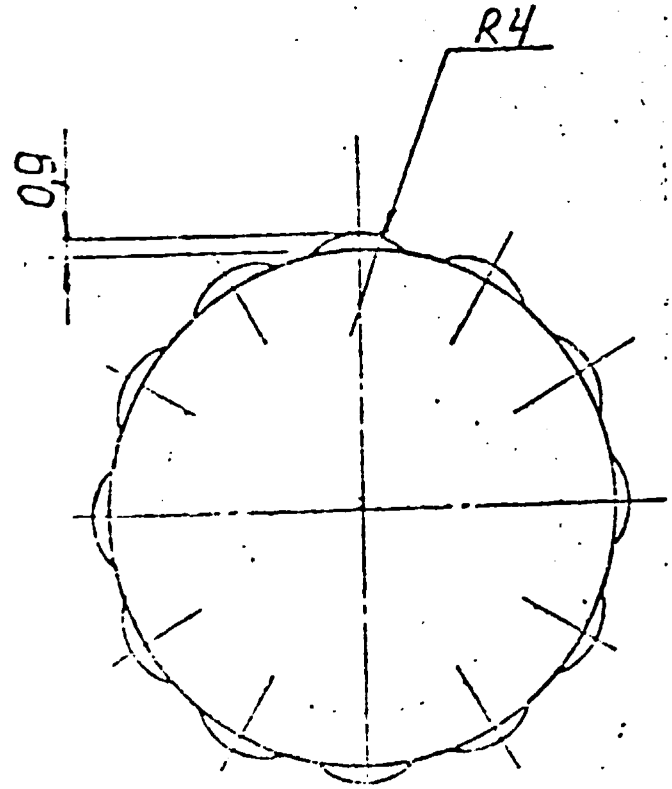
1. 32...36,5 HRCэ
2. * The dimension for information.
3. ** Fit in with the piece 300.004 and clearance is allowed no more than 0,01 mm.
4. H14, h14, $\pm \frac{IT14}{2}$.

SECTION 2

	300.007		
	Fly nut	Mass	Scale
Designer			2:1
		Sheet	Sheets 1
	Steel 50	LITMO	



SECTION 1



SECTION 2

1.* The dimension for information

2. $h14, H14, \pm \frac{IT14}{2}$

300.008

Sheath.

Mass | Scale

2:1

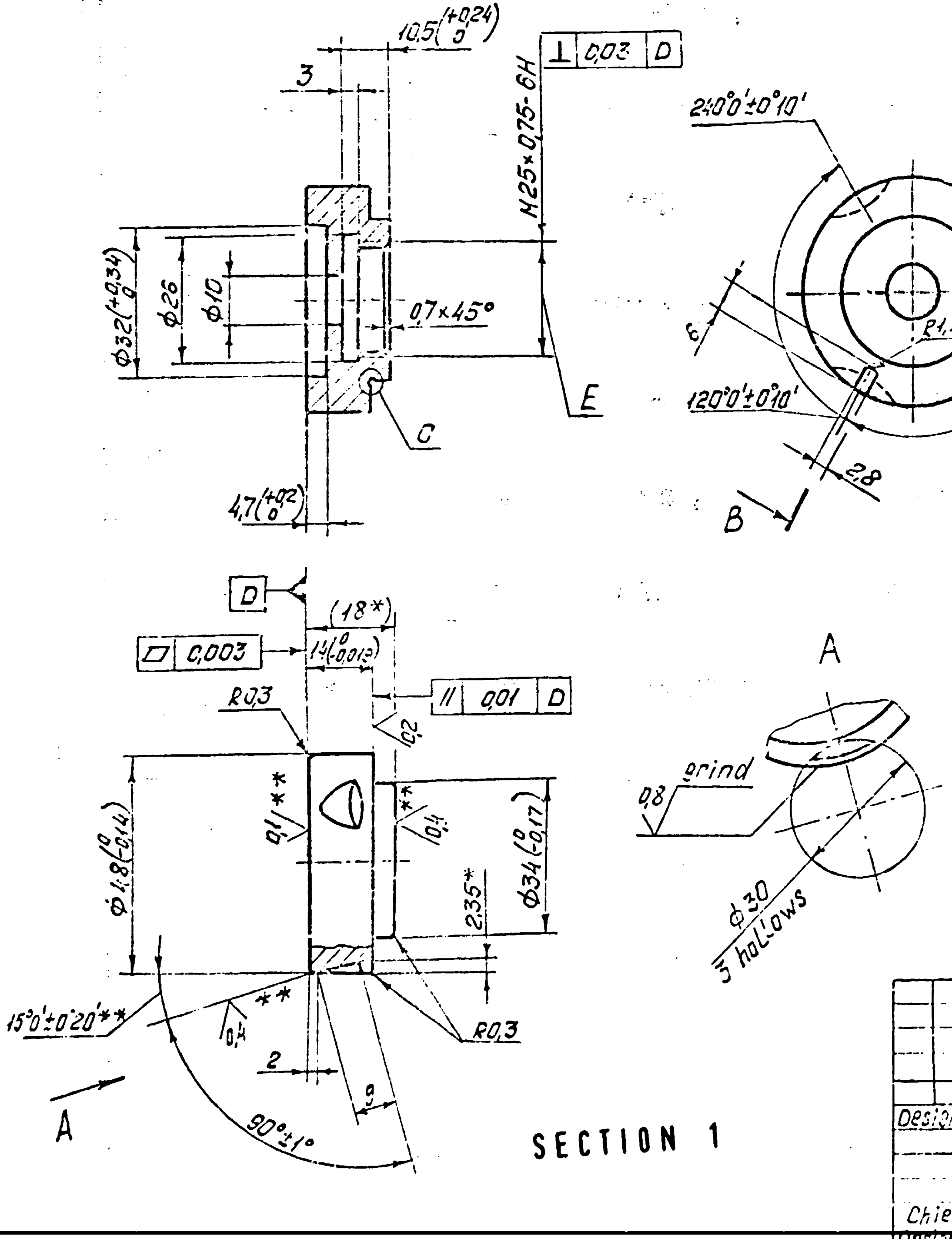
Sheet | Sheets 1

Designer

Rubber

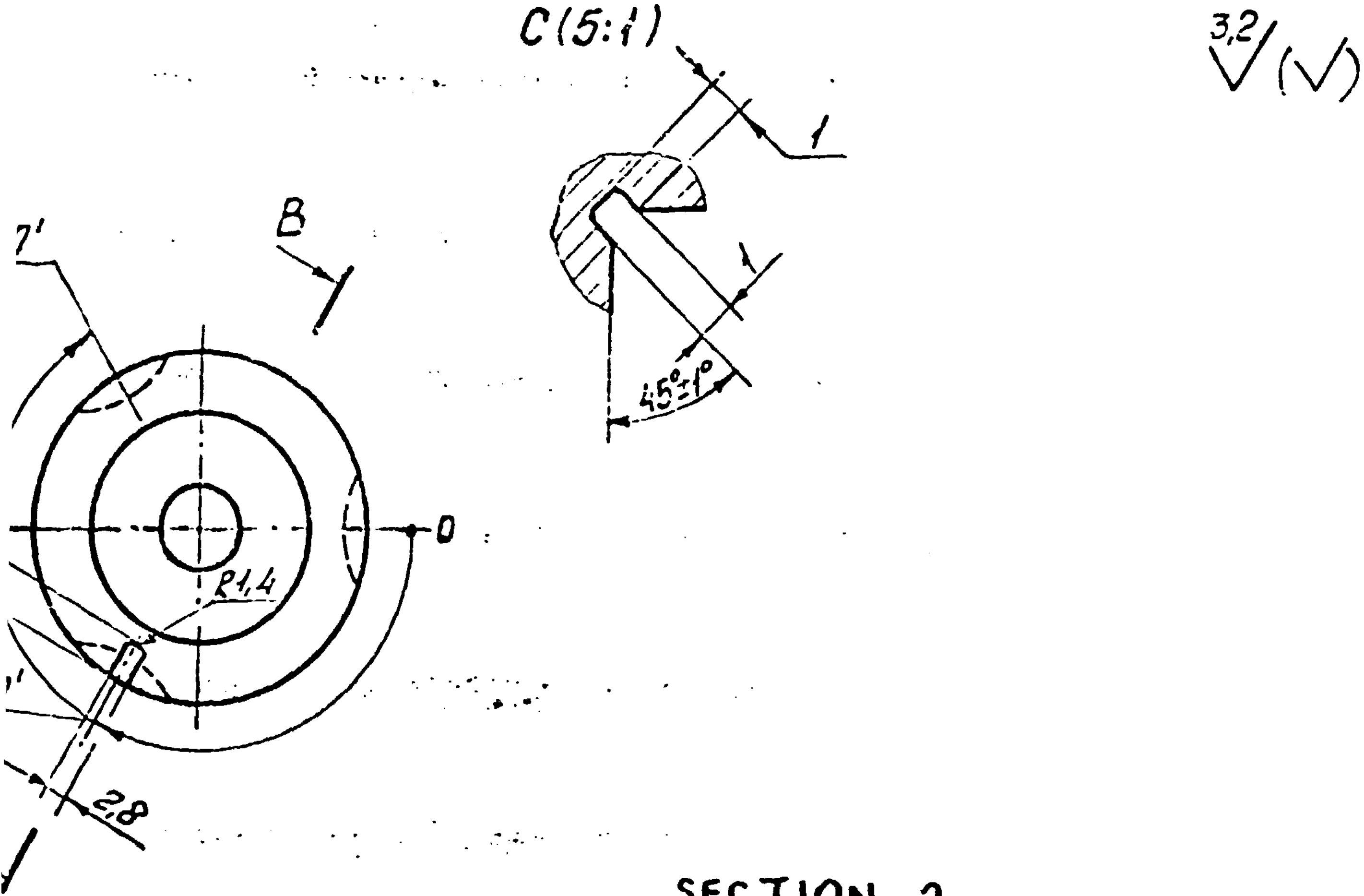
LITMO

Chief

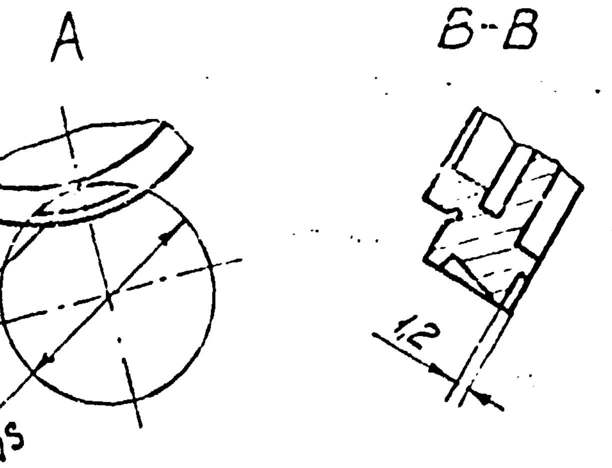


10,5(+0,24 / 0)
3
⊥ 0,03 D
M25×0,75-6H
240°0'±0°10'
Φ32(+0,34 / 0)
Φ26
Φ10
0,7×45°
6
120°0'±0°10'
E
C
2,8
4,7(+0,2 / 0)
B
D
(18*)
▱ 0,003
14(0 / -0,012)
// 0,01 D
R0,3
0,2
A
grind
0,8
0,1 **
** 0,4
Φ48(0 / -0,14)
Φ34(0 / -0,17)
2,35*
Φ30
3 hollows
15°0'±0°20'**
** 0,4
R0,3
2
9
A
90°±1°
Design
Chie

SECTION 1



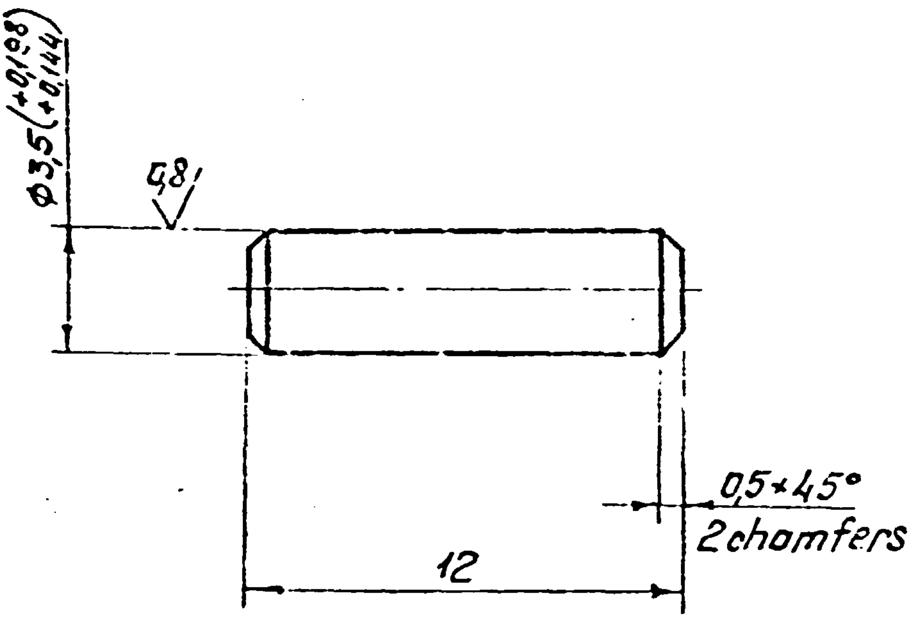
SECTION 2



1. Carburize h0,8...1,2mm except the thread Б
59...65 HRCэ.
2. * The dimensions for information.
3. ** The dimensions and roughness are after coating.
4. The dimensions put in brackets must b[e] maintained after the assembly.
5. H14; h14; $\pm\frac{IT14}{2}$
6. Coating Chemical oxidation

	300.009		
		Mass	Scale
Designer	Insert		1:1
		Sheet	Sheets 1

$\sqrt[3,2]{}\ (\sqrt{})$



1. 41,5... 46,5 HRCэ
2. h14; $\pm \frac{IT14}{2}$

300.011

Pin

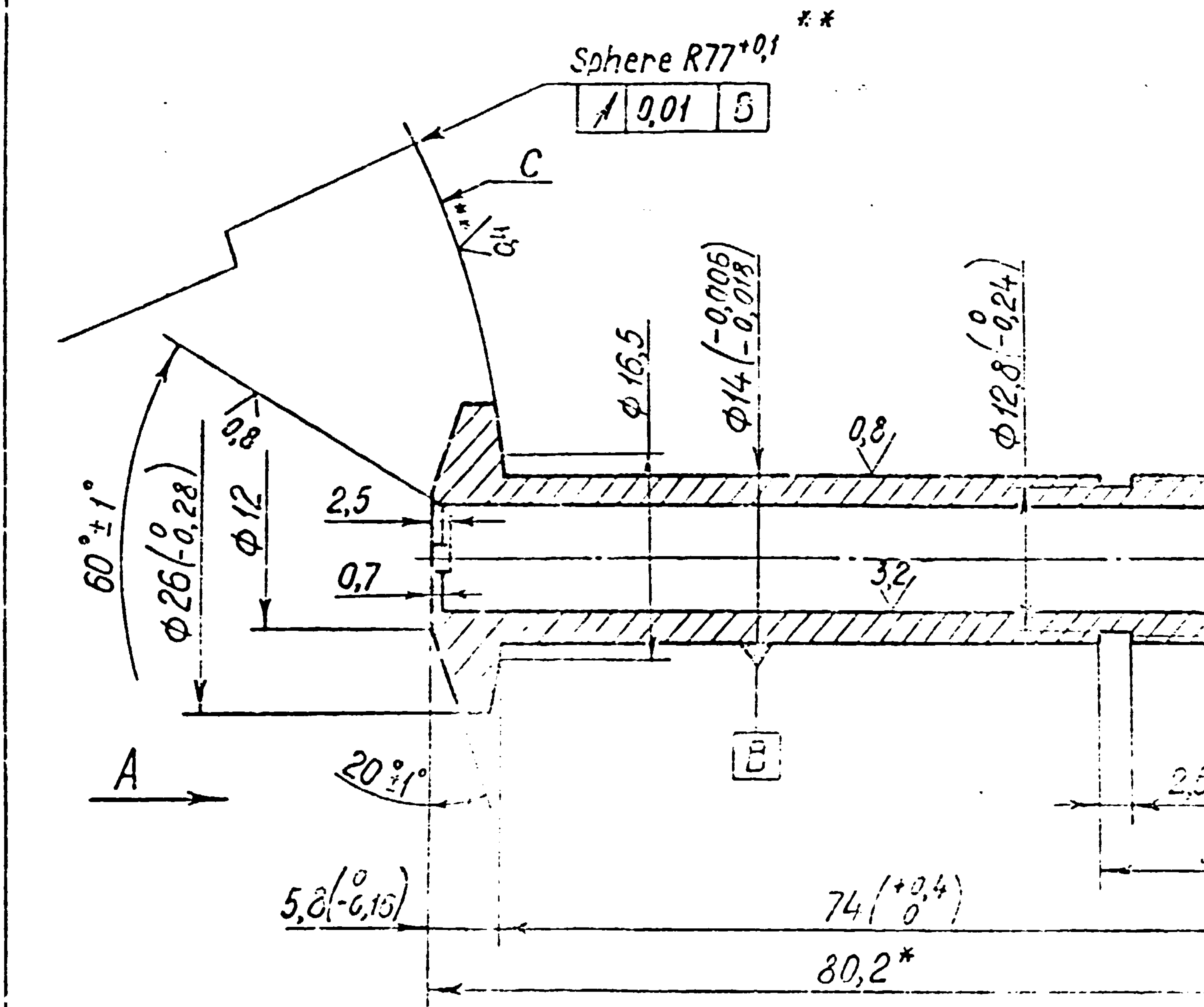
Mass | Sca
5:
Sheet | Sheets

Designer

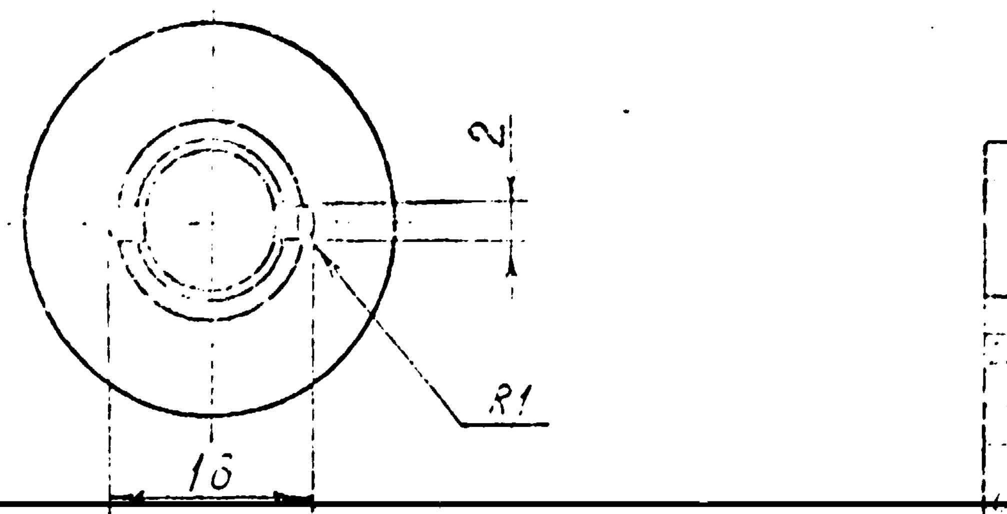
Chief

Steel 50

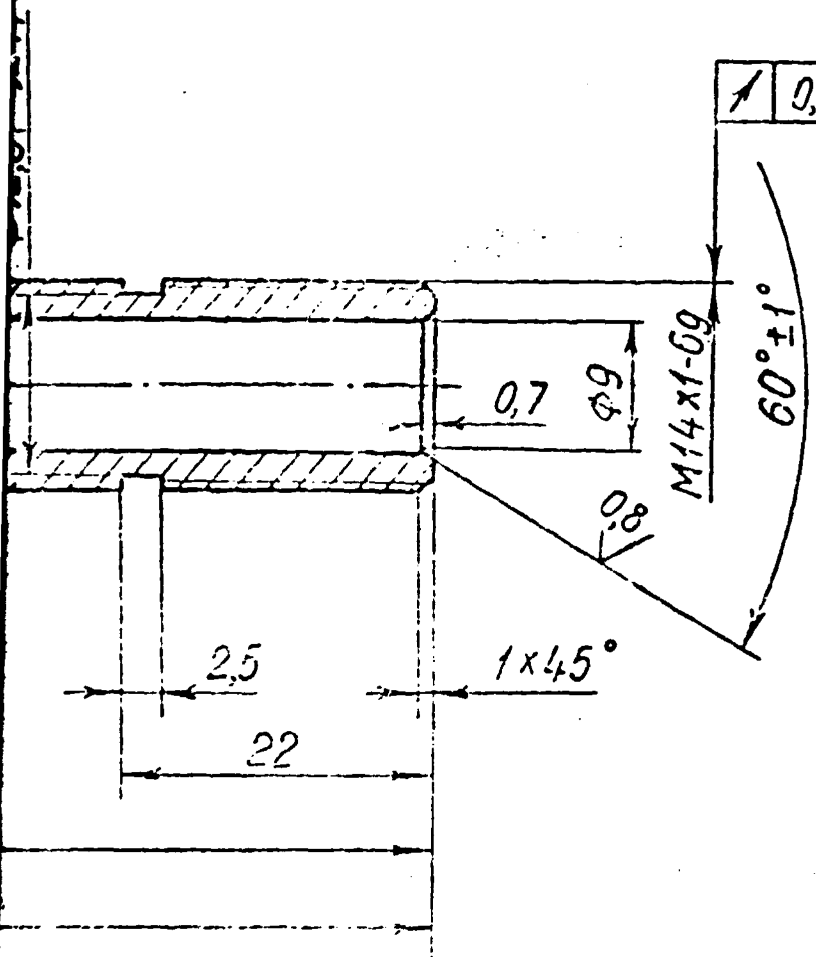
LITMO


Sphere R77+0,1 **
0,01
C
Φ16,5
Φ14(-0,006 -0,018)
Φ12,8(0 -0,24)
0,8
Φ12
Φ26(0 -0,28)
60°±1°
2,5
0,7
3,2
A
20°±1°
5,8(0 -0,15)
74(+0,4 0)
80,2*

SECTION 1 A


2
R1
16

V (V)



1. 35,5 ... 41,5 HRC э
2. * The dimension for information
3. H14, h14, $\pm \frac{IT14}{2}$
4. ** The dimension and roughness are after coating
5. Check the dimension C by the template R77 before fitting in.
6. Fit in the dimension C with the piece 300.002. Contact must be no less than 35 %. Check for contact by paint.

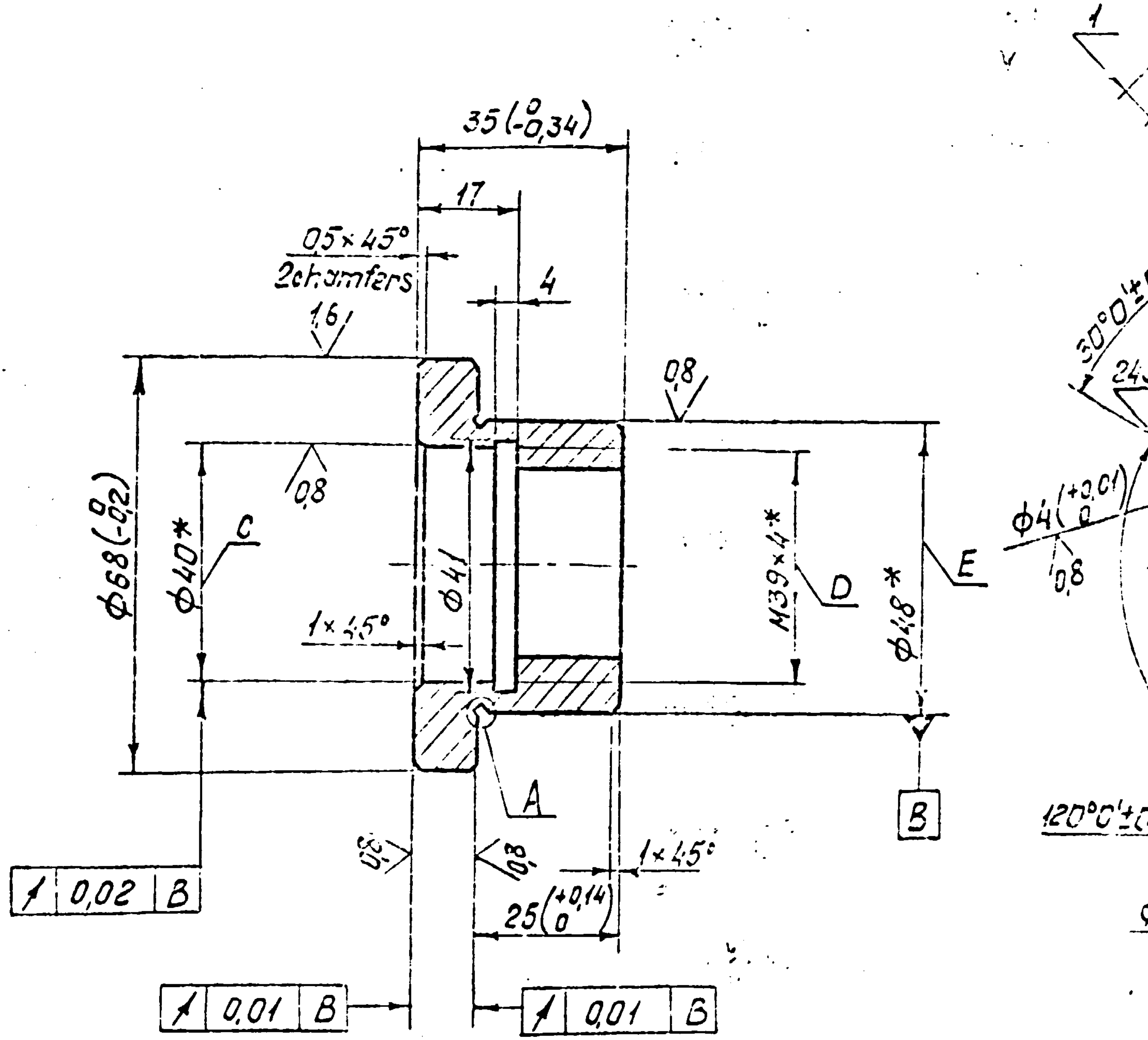
SECTION 2

300. 012

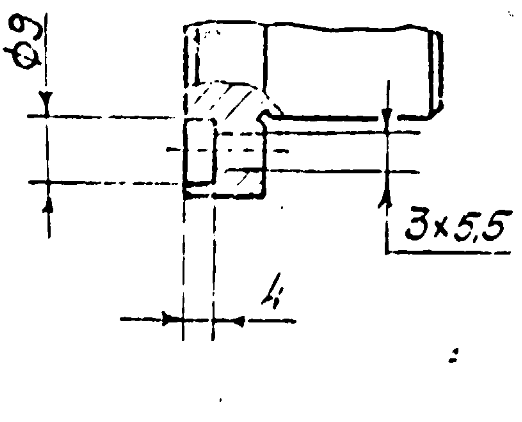
Mushroom

Mass	Scale
	2:1
Sheet	Sheets 1

Steel 50



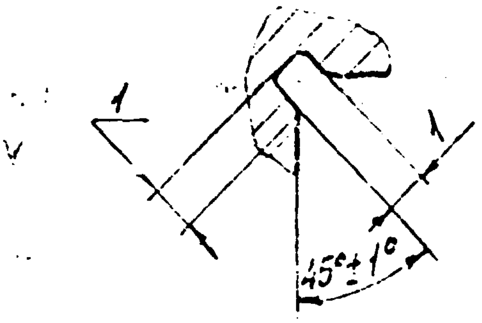
SECTION 1



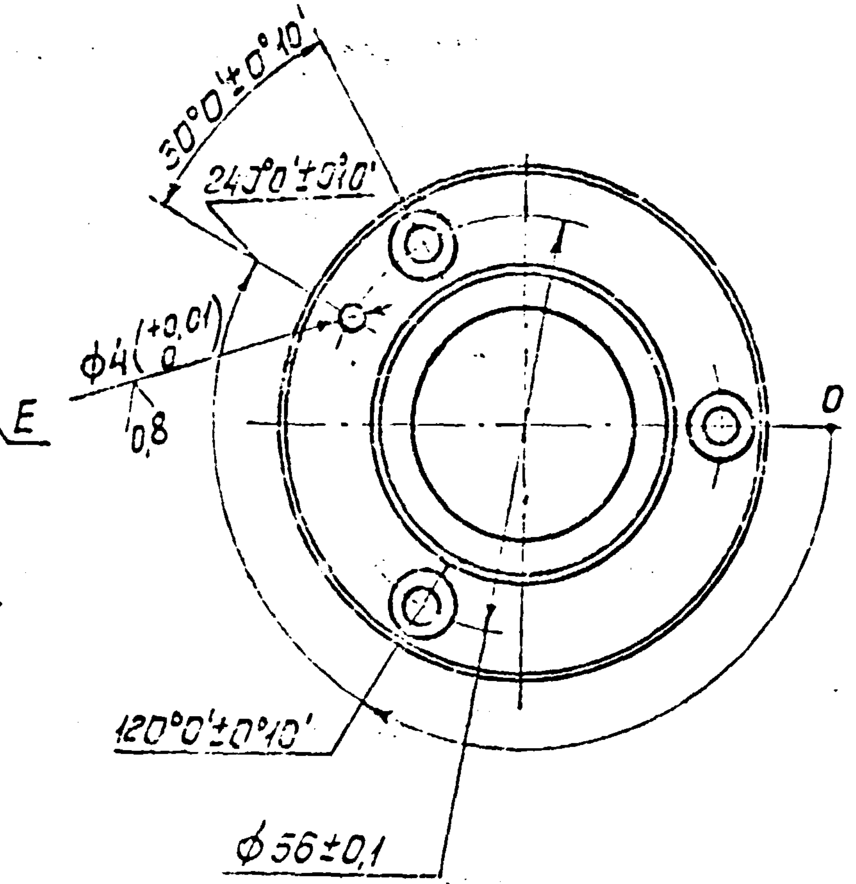
Designe

Chief

A (5:1)



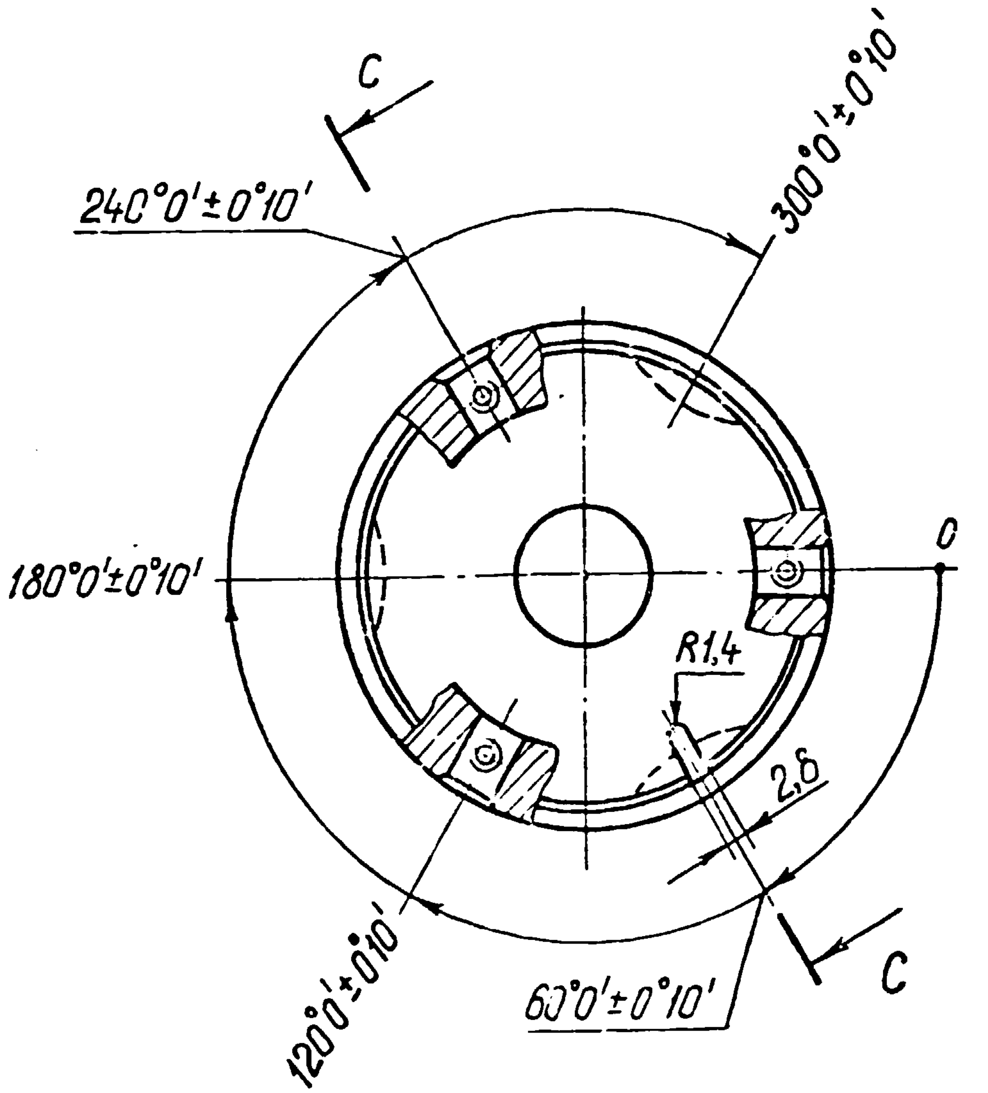
3,2 √ (√)



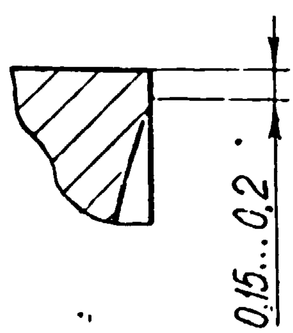
SECTION 2

1.* Produce the bore C according to the spindl
and clearance must be no more than 0,02 mm
Produce the thread D according to the spindle
of machine.
Produce the dimension E according to the piece
300.014 and clearance must be no more than 0,0
2. H14, h14, $\pm \frac{IT14}{2}$
3. Coating: Chemical oxidation

					300. 013		
Designer					Flange	Mass	Scale
							1:1
						Sheet	Sheets 1
Chief					Steel 50	LITMO	



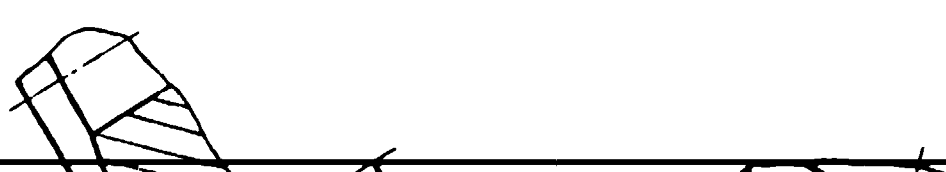
B (5:1)

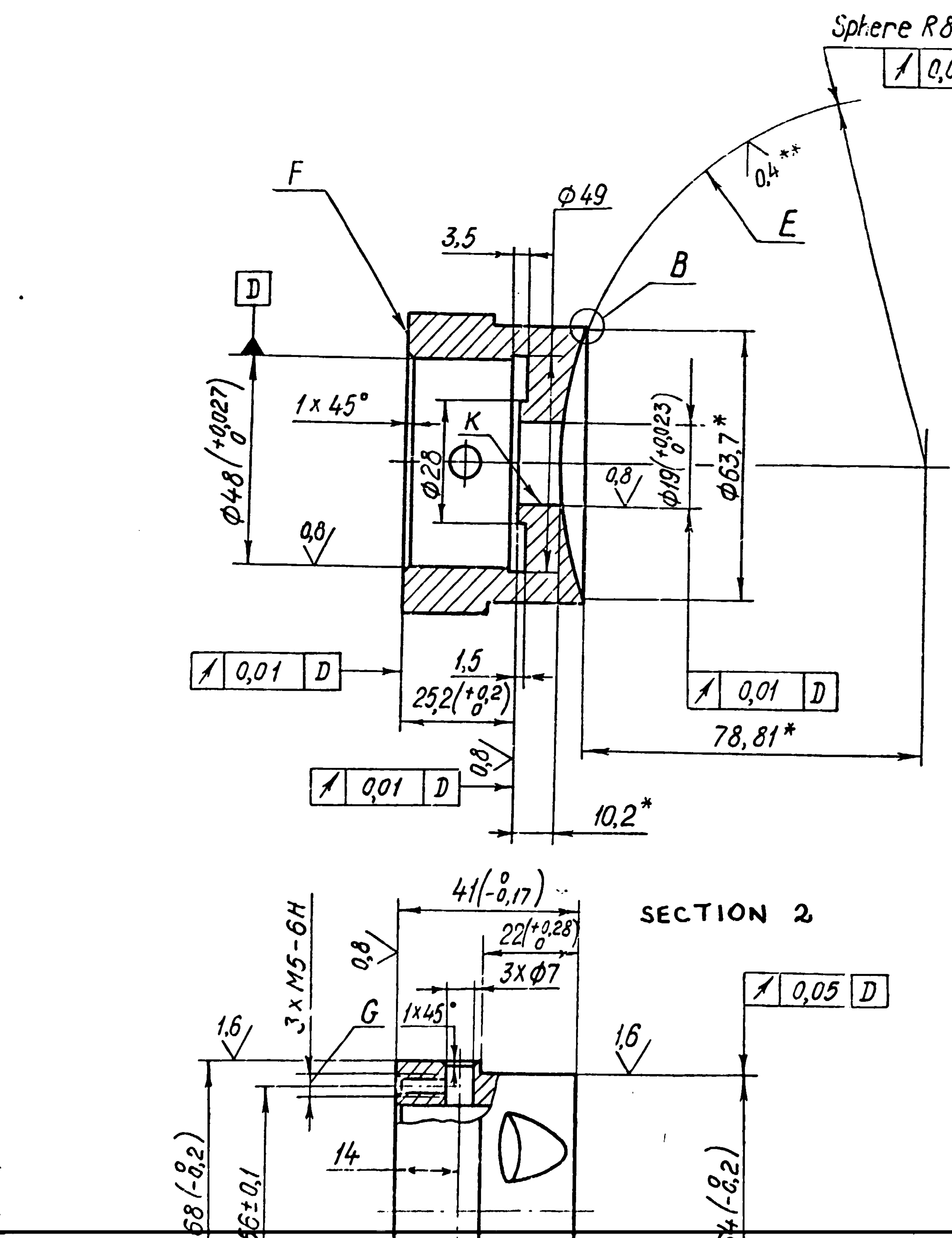


SECTION 1

C–C

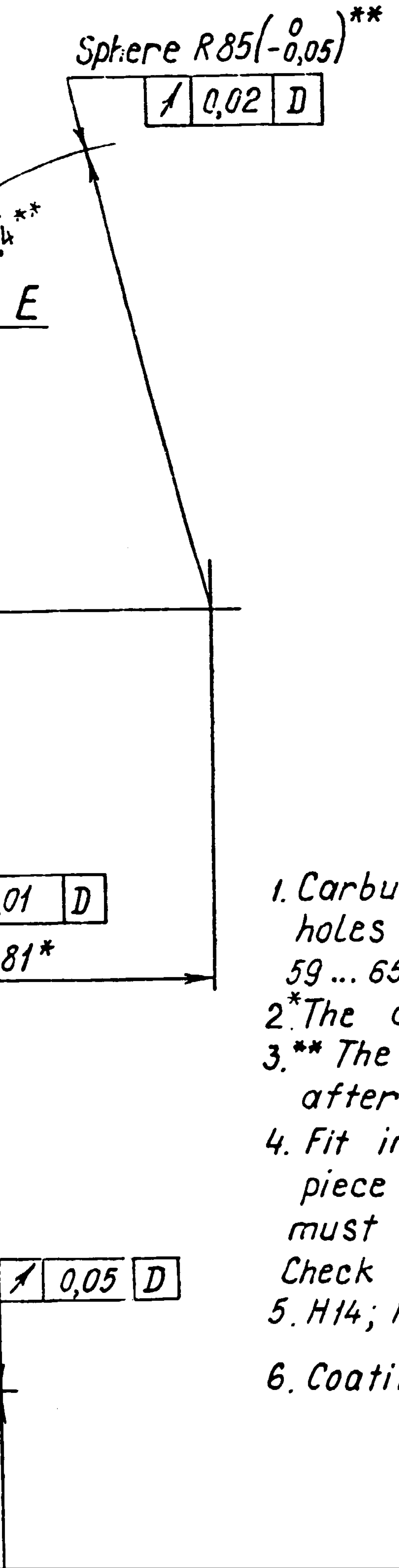
A





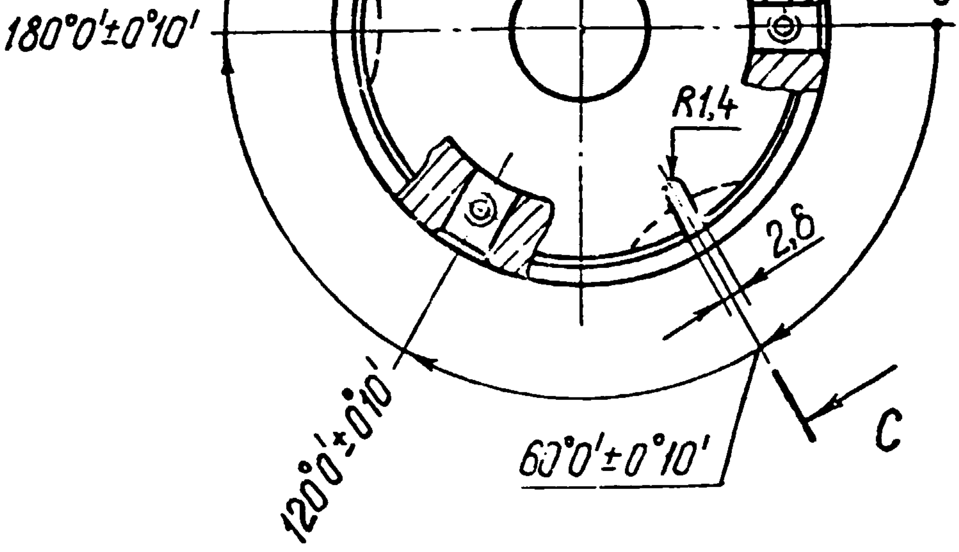
Sphere R8
F
Φ49
3,5
E
B
D
1×45°
K
Φ28
Φ48(+0,027/0)
0,8
Φ19(+0,023/0)*
Φ63,7
0,01 D
1,5
25,2(+0,2/0)
78,81*
10,2*
41(0/-0,17)
SECTION 2
22(+0,28/0)
3×Φ7
3×M5-6H
0,05 D
G
1×45°
1,6
14

3,2 √ (√)

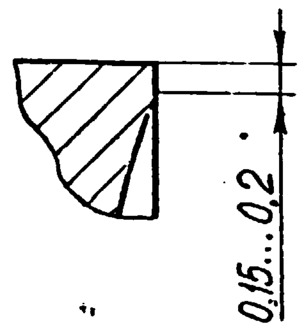


SECTION 3

1. Carburize in depth 0,8 ... 1,2 mm except the holes F, K and the surface G
   59 ... 65 HRCэ
2. *The dimensions for information
3. ** The dimensions and roughness are after coating
4. Fit in the sphere surface E and the piece 300.002. Contact of these surfaces must be not less than 95 %
   Check pieces for contact by paint.
5. H14; h14; $\pm \frac{IT14}{2}$
6. Coating: Chemical oxidation

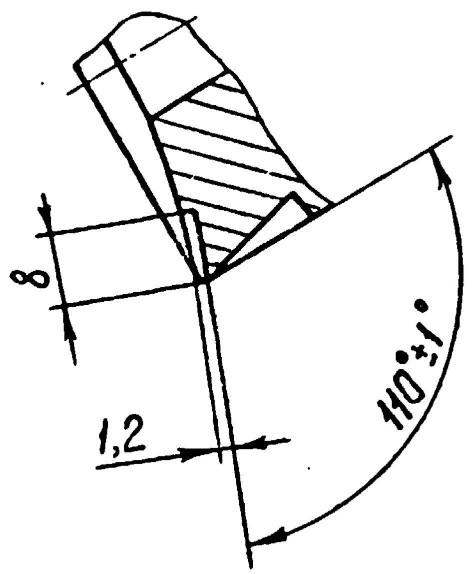


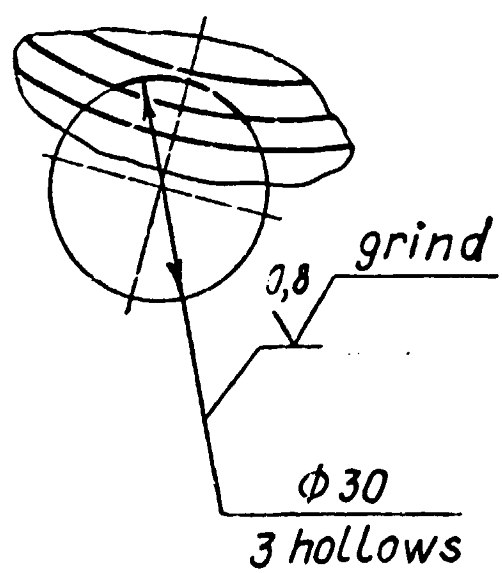
B (5:1)



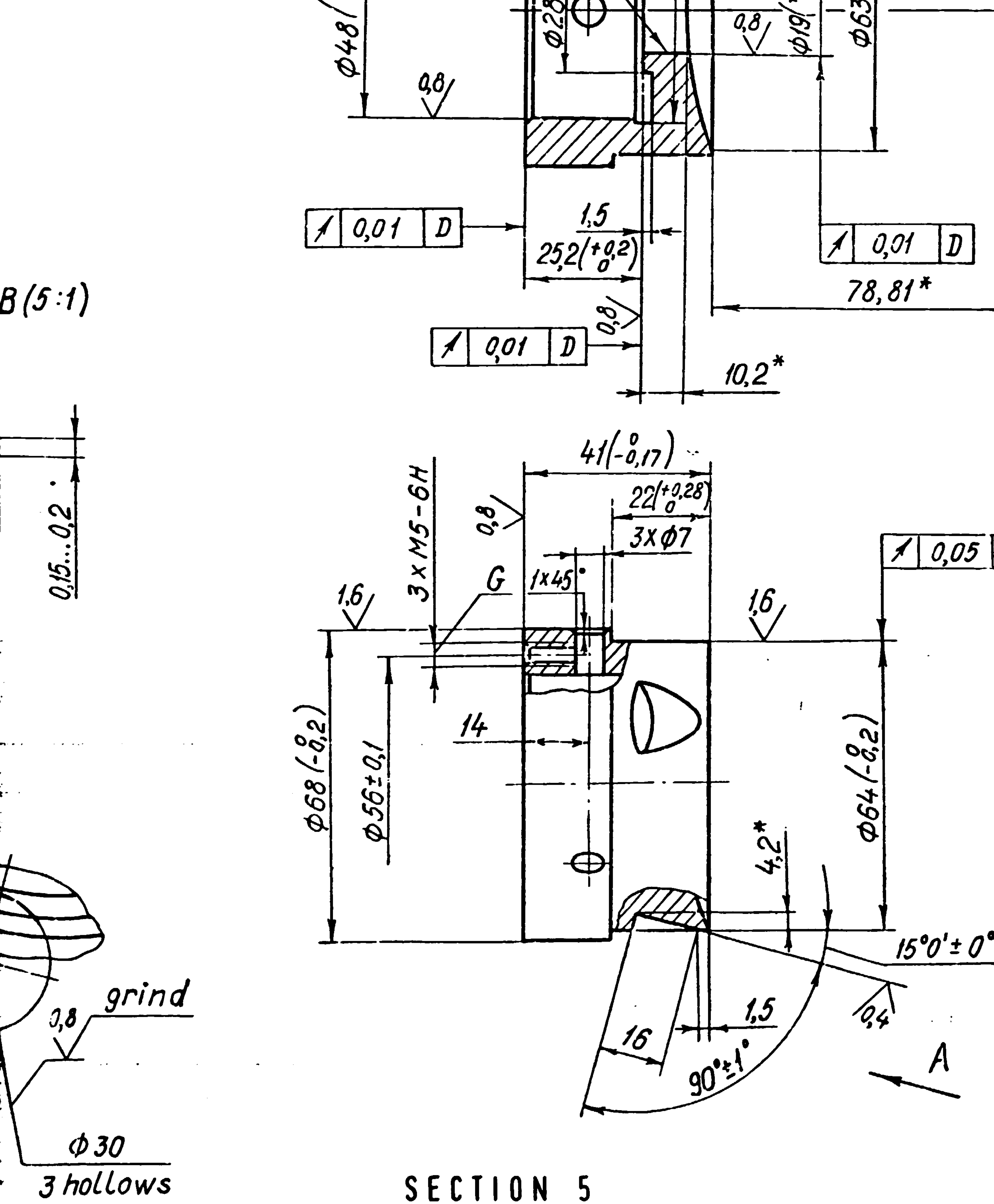
C–C

A



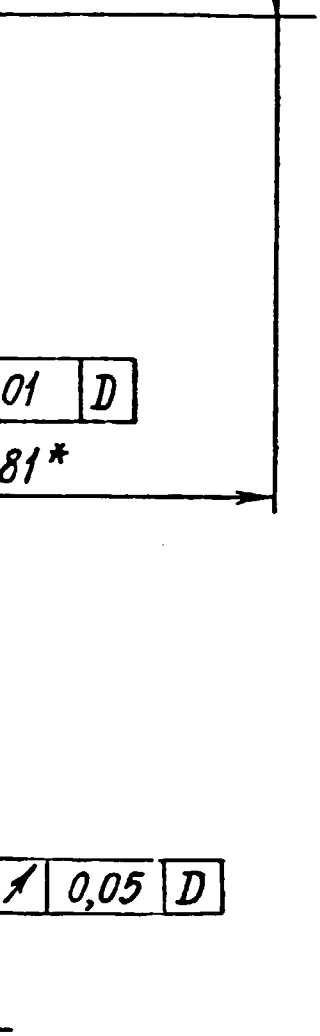


SECTION 4



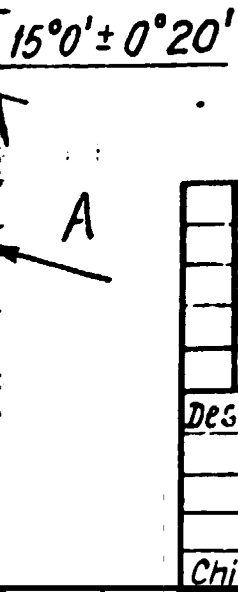
B (5:1)
Φ48
0,8
Φ28
0,8
Φ19
Φ63
0,01 D
1,5
25,2(+0,2 0)
0,01 D
78,81*
0,8
0,01 D
10,2*
0,15...0,2
41(0 -0,17)
22(+0,28 0)
0,8
3×M5-6H
3×Φ7
0,05
G
1×45°
1,6
1,6
14
Φ68 (0 -0,2)
Φ56±0,1
Φ64 (0 -0,2)
4,2*
15°0'±0°
0,4
1,5
16
90°±1°
A
grind
0,8
Φ30
3 hollows

SECTION 5

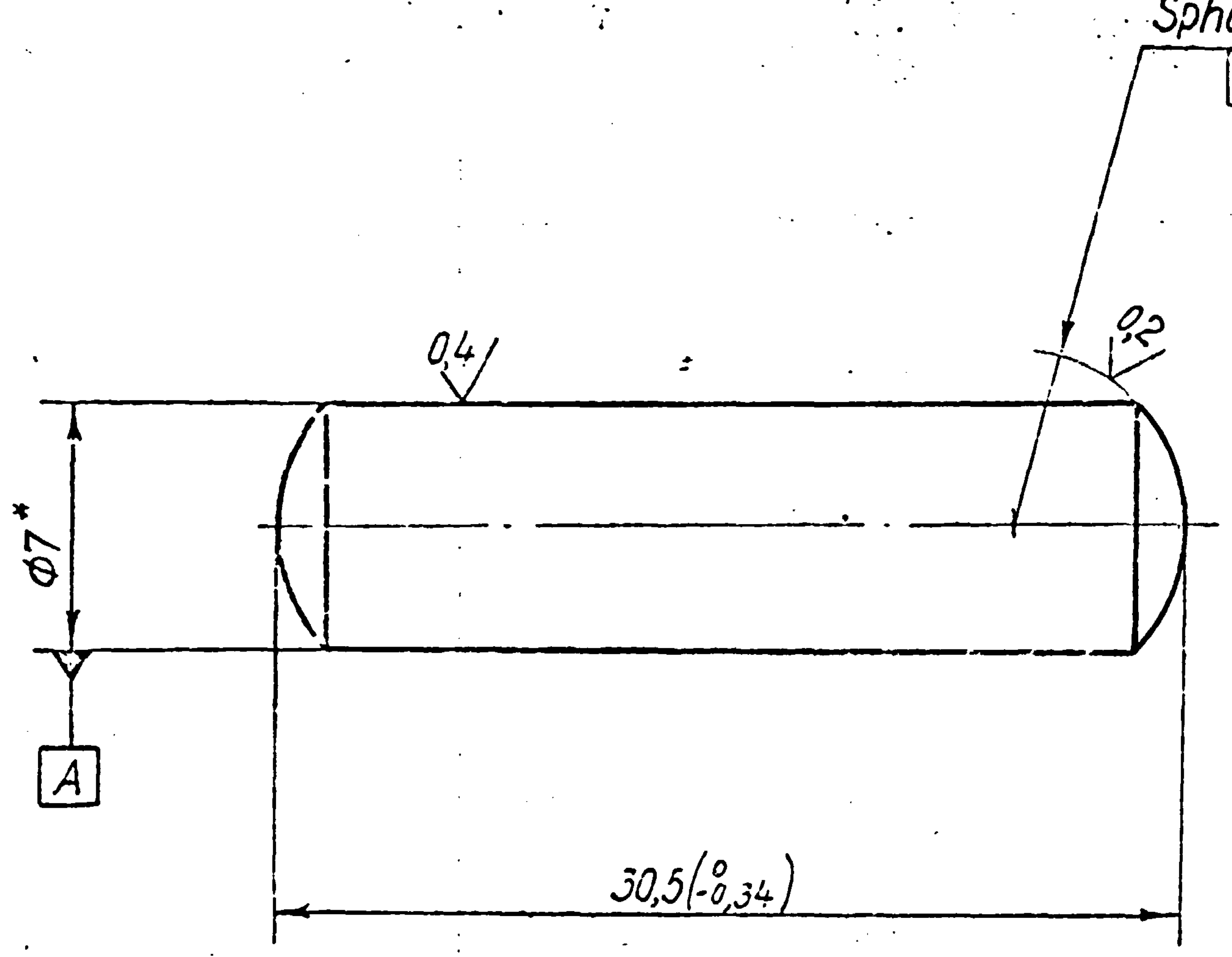


1. Carburize in depth 0,8 ... 1,2 mm except the holes F, K and the surface G
59 ... 65 HRCэ
2.* The dimensions for information
3.** The dimensions and roughness are after coating
4. Fit in the sphere surface E and the piece 300.002. Contact of these surfaces must be not less than 95 %
Check pieces for contact by paint.
5. H14; h14; $\pm \frac{IT14}{2}$
6. Coating: Chemical oxidation

SECTION 6



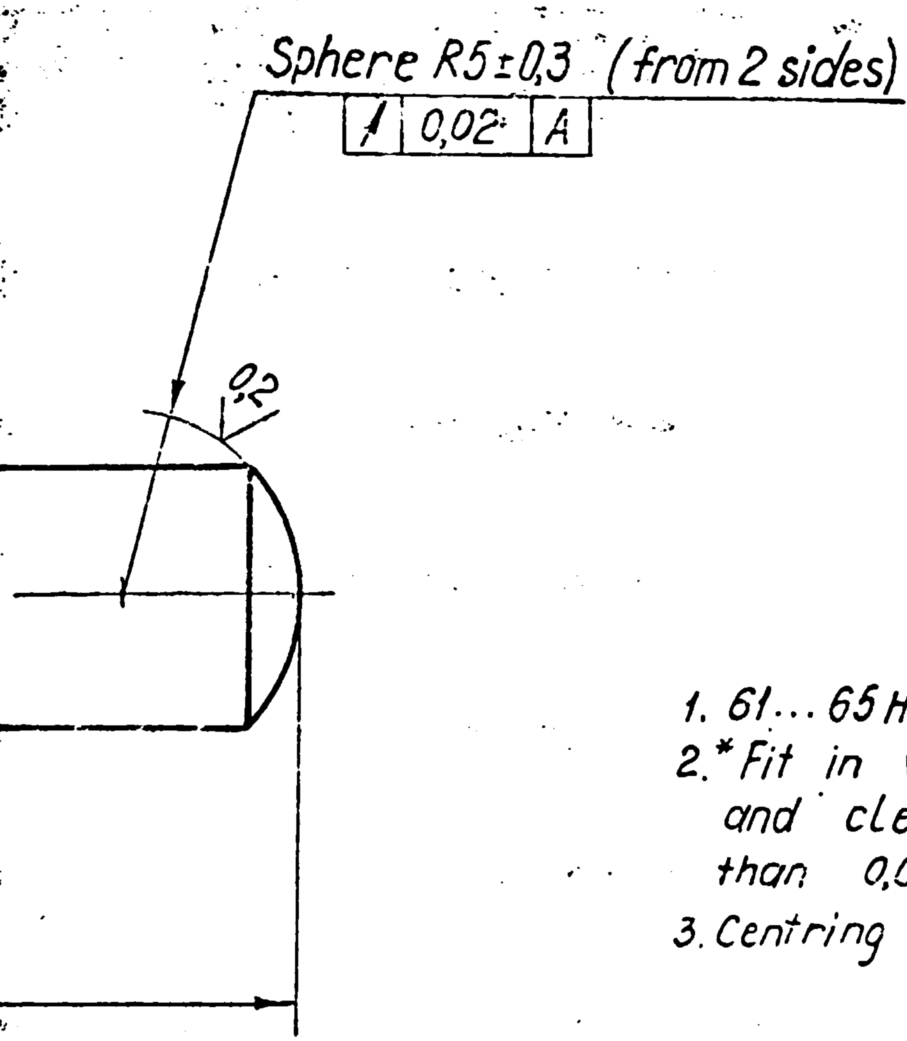
	300.014	
Designer	Body	Mass / Scale 1:1
		Sheet / Sheets 1
Chief	Steel 12XH3A	LITMO



SECTION 1

Designer

Chief

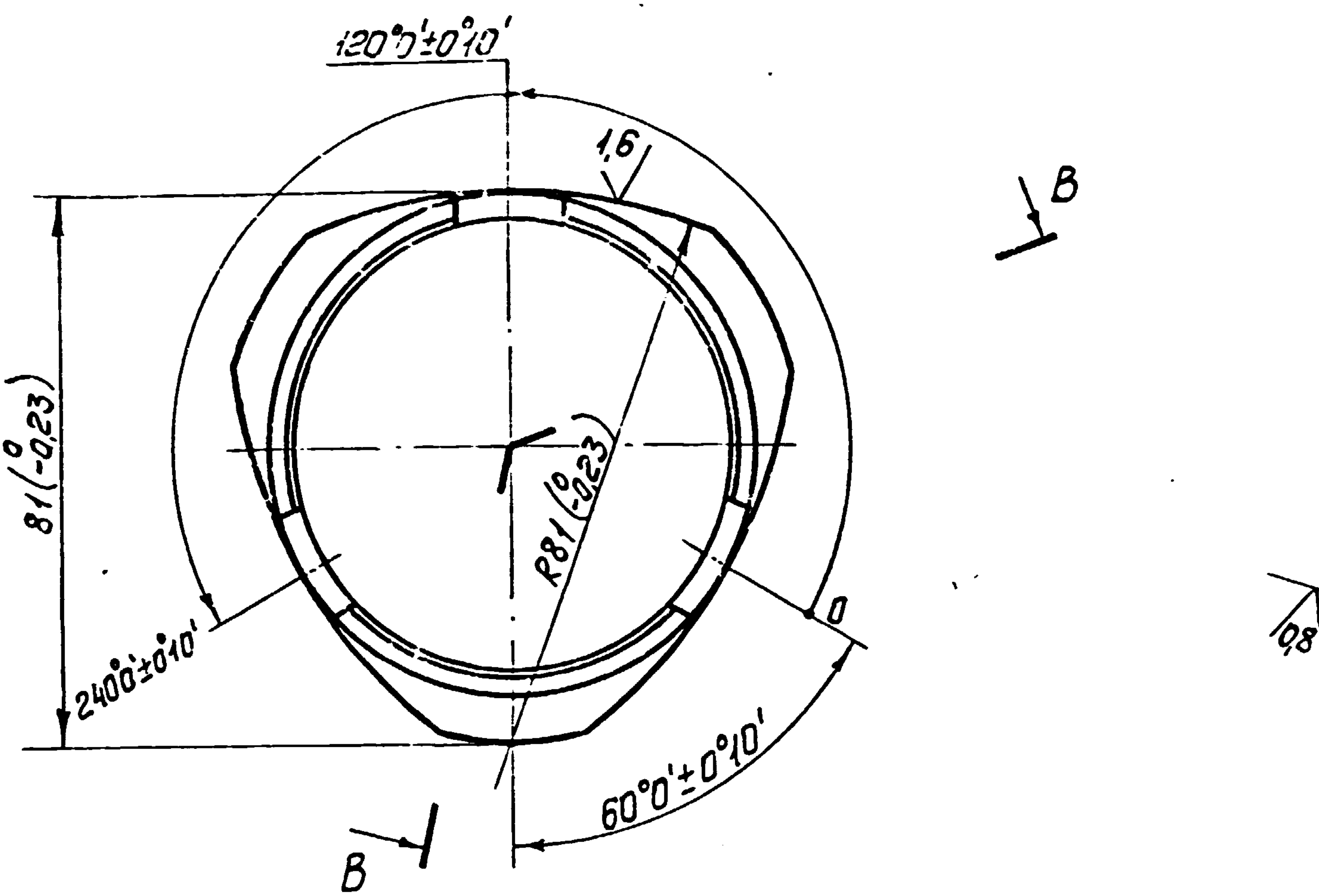


1. 61...65 HRCэ
2.* Fit in with the piece 300. 004 and clearance must be no more than 0,003 mm.
3. Centring holes are not allowed.

SECTION 2

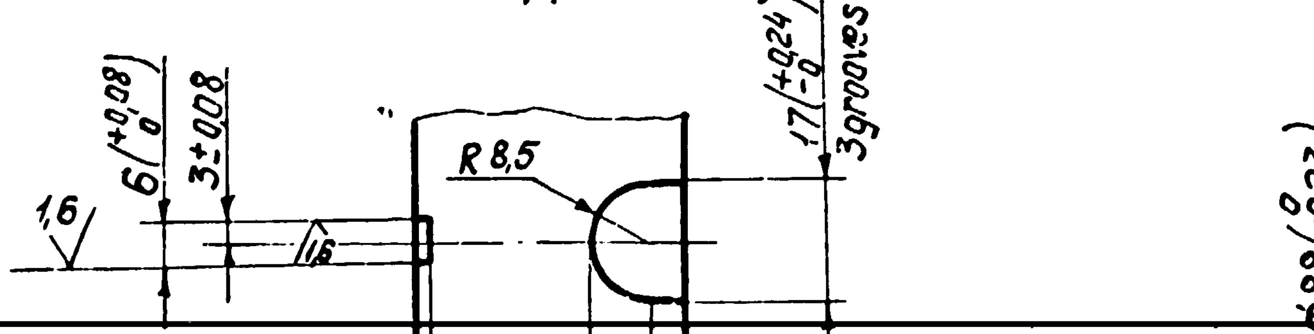
300. 015			
Pusher		Mass	Scale
			5:1
	Sheet	Sheets 1	
Steel WX-15	LITMO		

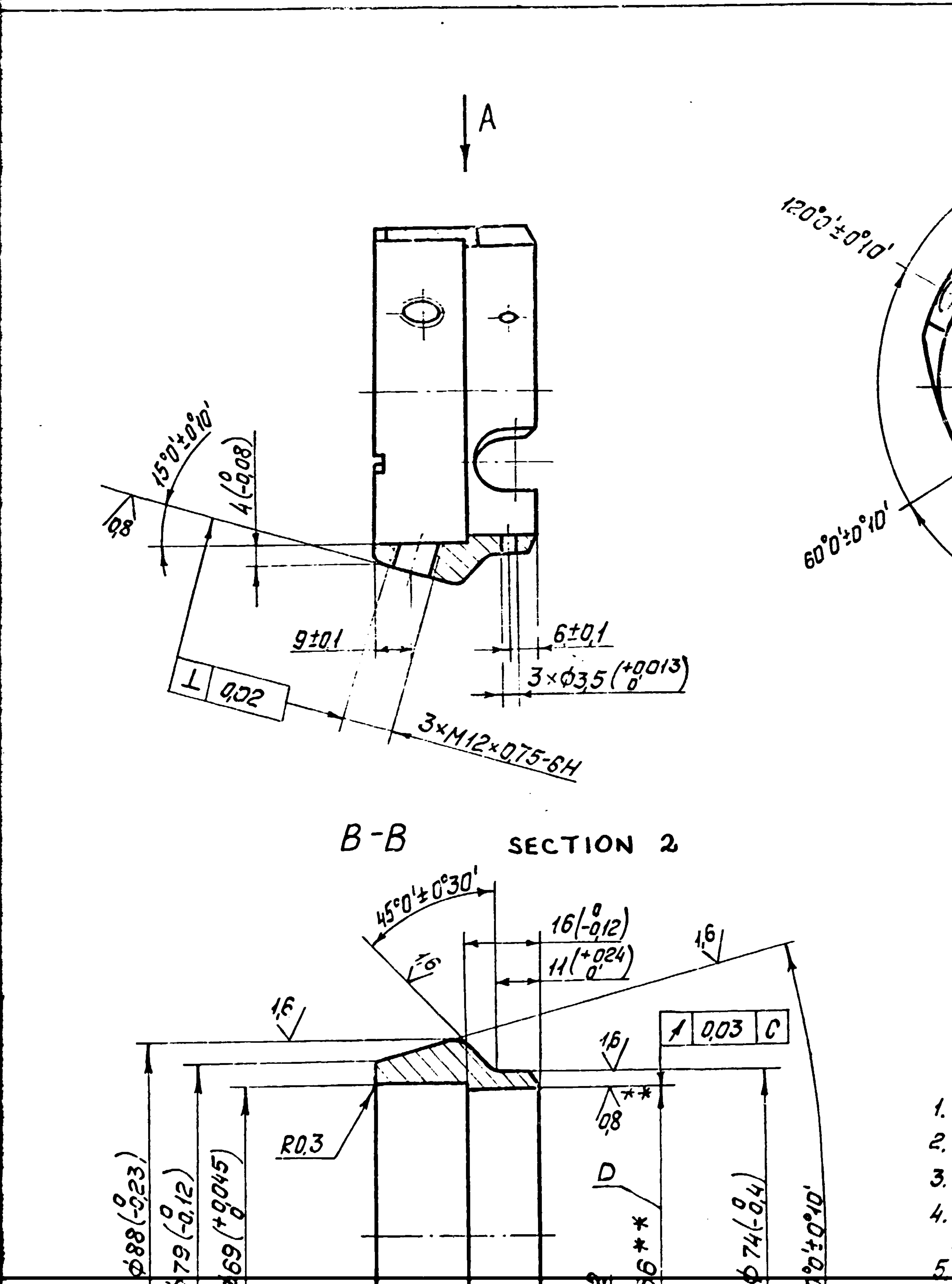
Designer	
Chief Designer	


120°0'±0°10'
1,6
B
81(0 -0,23)
R81(0 -0,23)
240°0'±0°10'
0
60°0'±0°10'
B
0,8

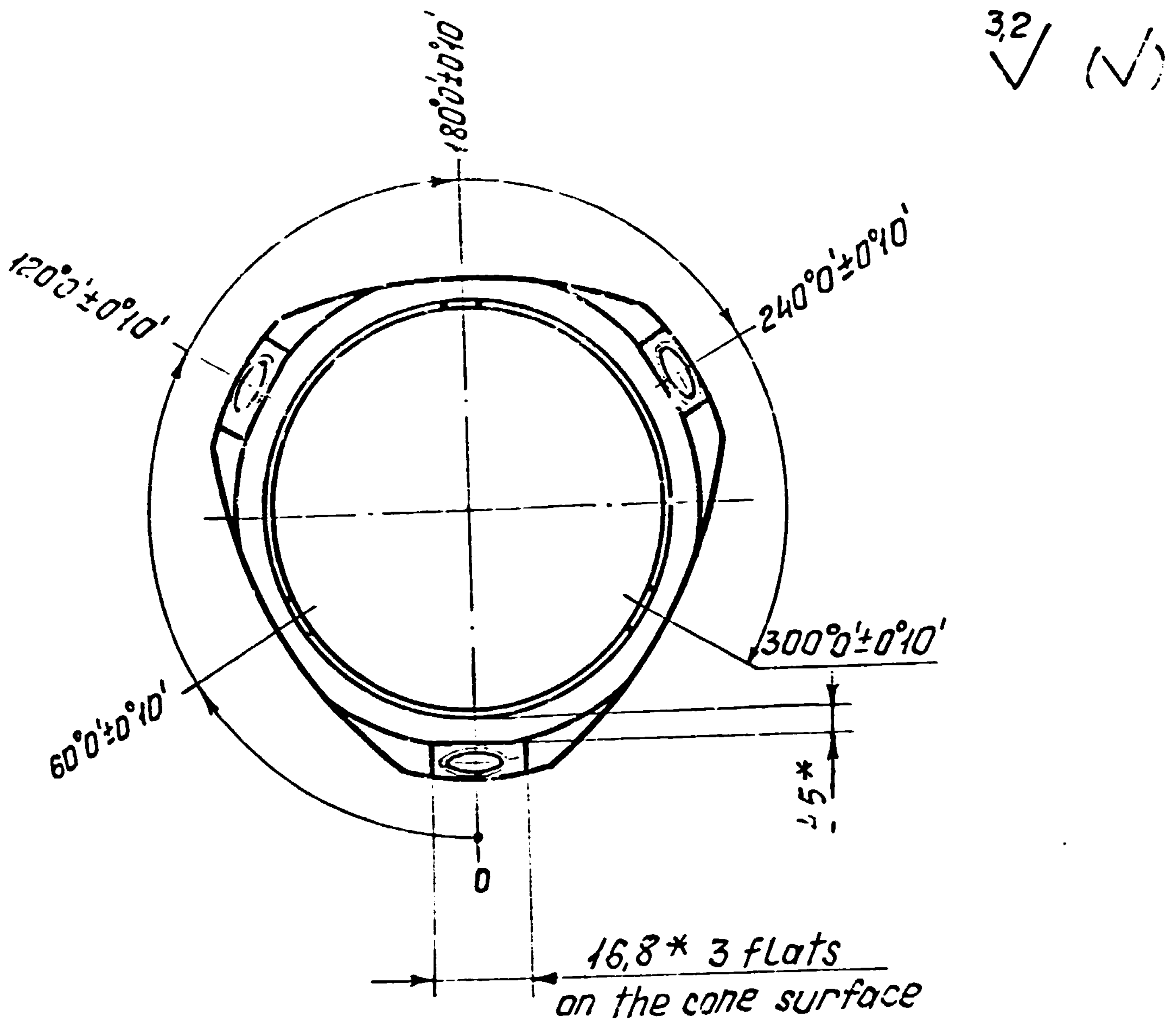
SECTION 1

A

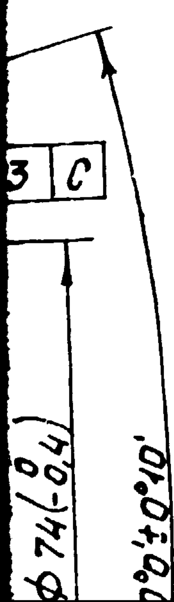

6(+0,08 0)
3±0,08
1,6
1,6
R 8,5
17(+0,24 -0)
3grooves



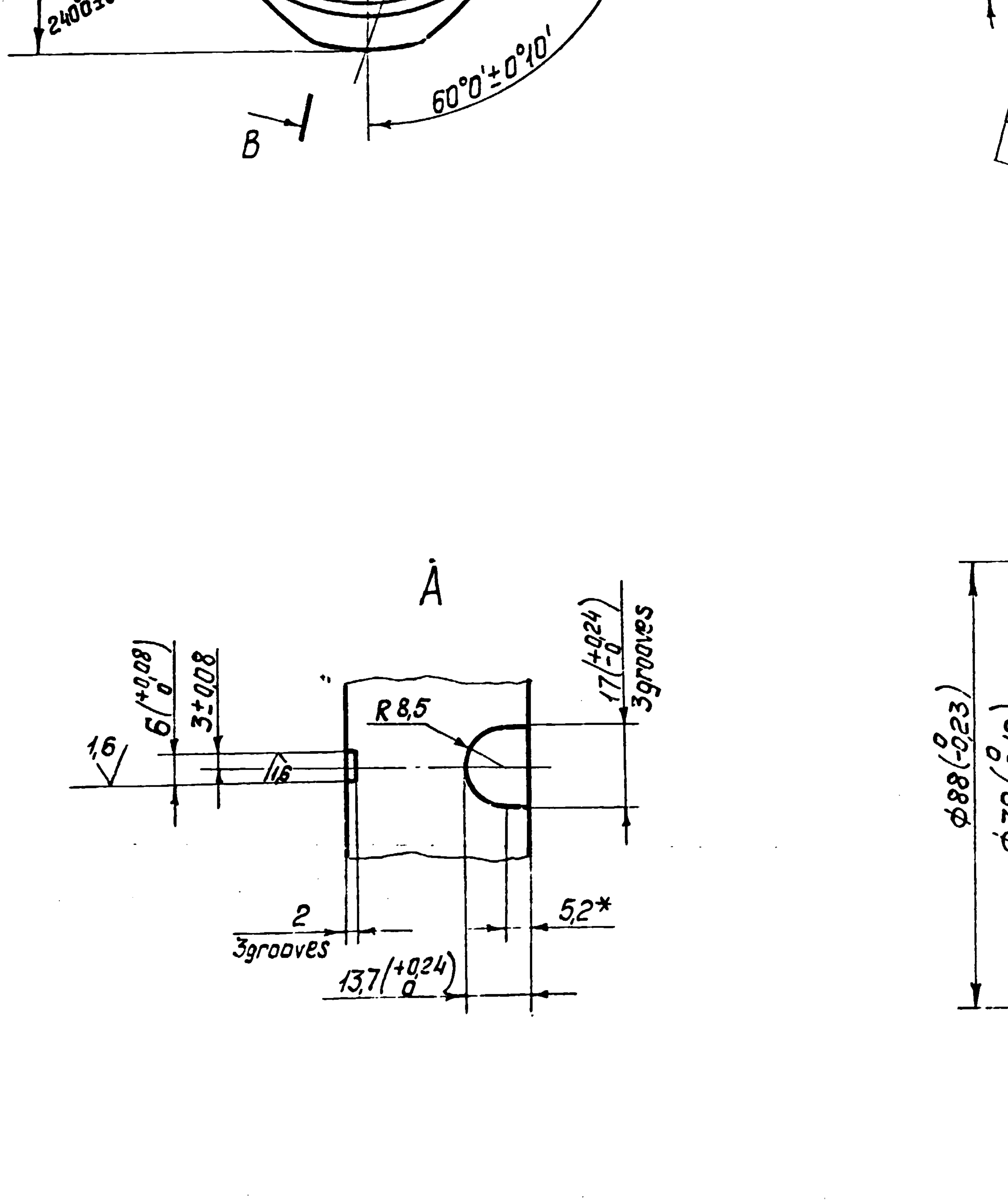
A
15°0'±0°10'
4(0/-0,08)
0,8
⊥ 0,02
9±0,1
6±0,1
3×Φ3,5(+0,013/0)
3×M12×0,75-6H
120°0'±0°10'
60°0'±0°10'
B-B
SECTION 2
45°0'±0°30'
16(0/-0,12)
11(+0,24/0)
1,6
0,03
C
R0,3
0,8
D
Φ88(0/-0,23)
79(0/-0,12)
69(+0,045/0)
Φ74(0/-0,4)
1.
2.
3.
4.
5



SECTION 3

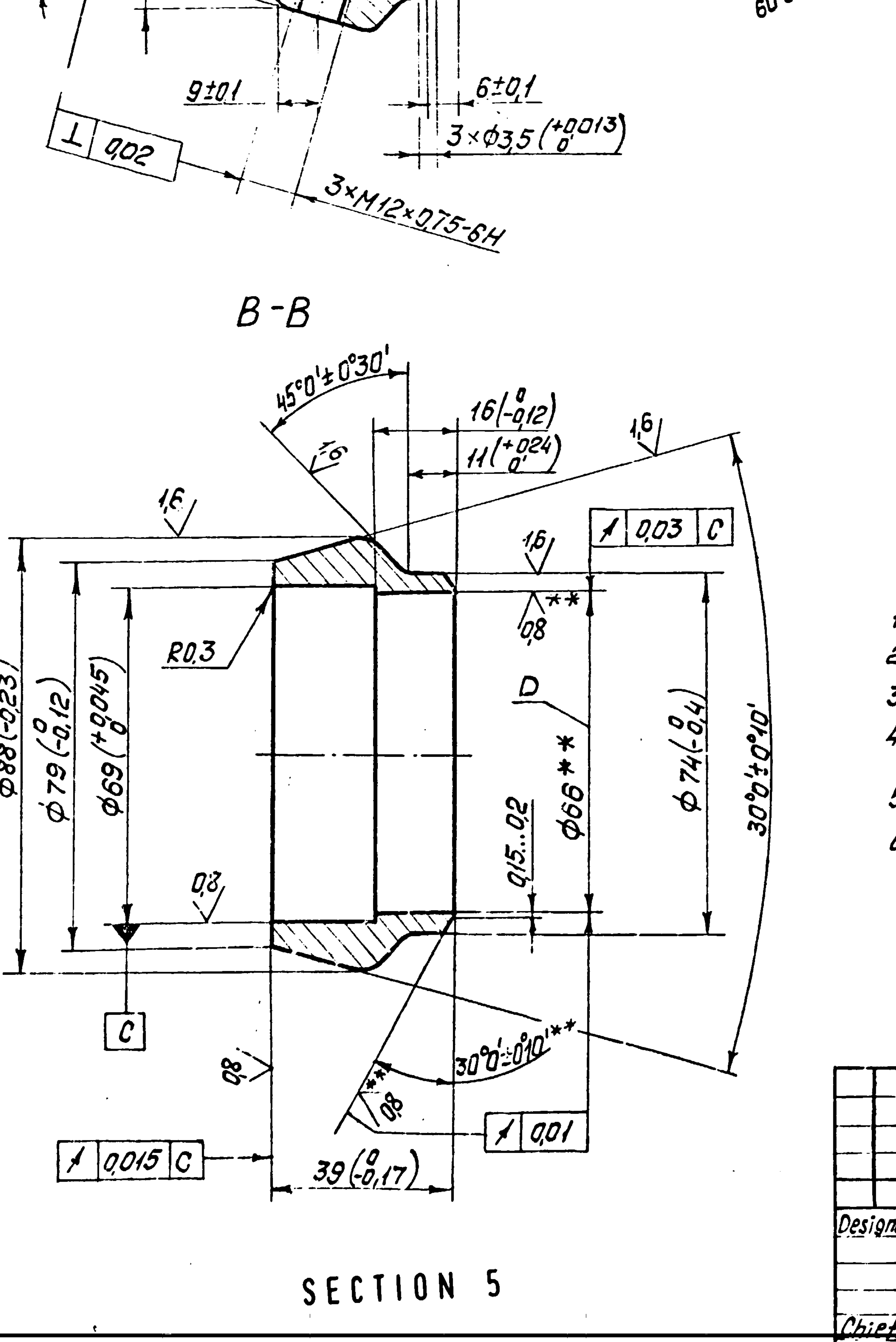


1. 32...36,5 HRCэ
2. * The dimensions for information
3. ** The dimensions and roughness are after coating
4. Finish the dimension D to the piece 300.002 interferenc
must be no more than 0,015mm
5. H14; h14; $\pm \frac{IT14}{2}$



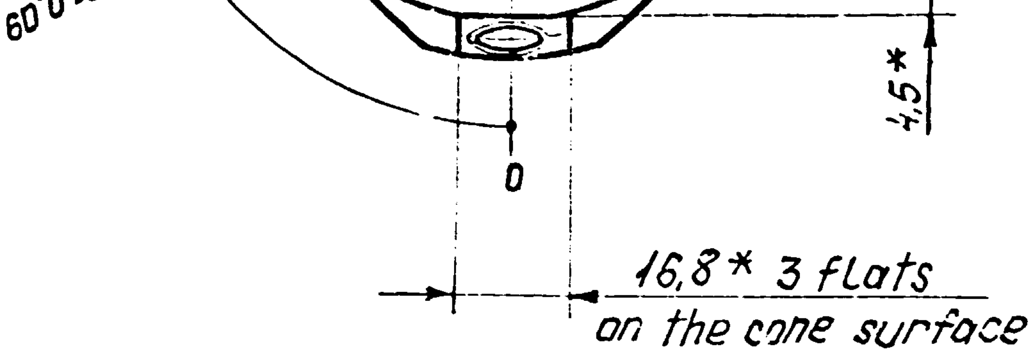
60°0'±0°10'
B
A
R 8,5
6(+0,08 0)
3±0,08
1,6
17(+0,24 -0)
3grooves
2
3grooves
5,2*
13,7(+0,24 0)
Φ88(0 -0,23)

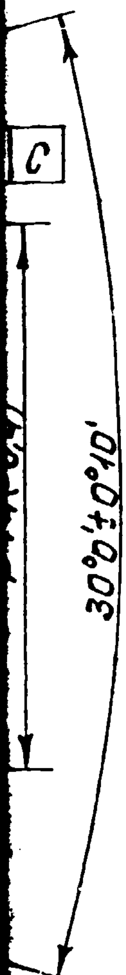
SECTION 4



9±0,1
6±0,1
3×Φ3,5 (+0,013 / 0)
⊥ 0,02
3×M12×0,75-6H
B-B
45°0'±0°30'
16 (0 / -0,12)
11 (+0,024 / 0)
1,6
1,6
1,6
1,6
0,03 C
0,8
R0,3
D
Φ88 (0 / -0,23)
Φ79 (0 / -0,12)
Φ69 (+0,045 / 0)
0,15...0,2
Φ66**
Φ74 (0 / -0,4)
30°0'±0°10'
0,8
C
0,8
30°0'±0°10'**
0,8
0,01
0,015 C
39 (0 / -0,17)
Design
Chief

SECTION 5

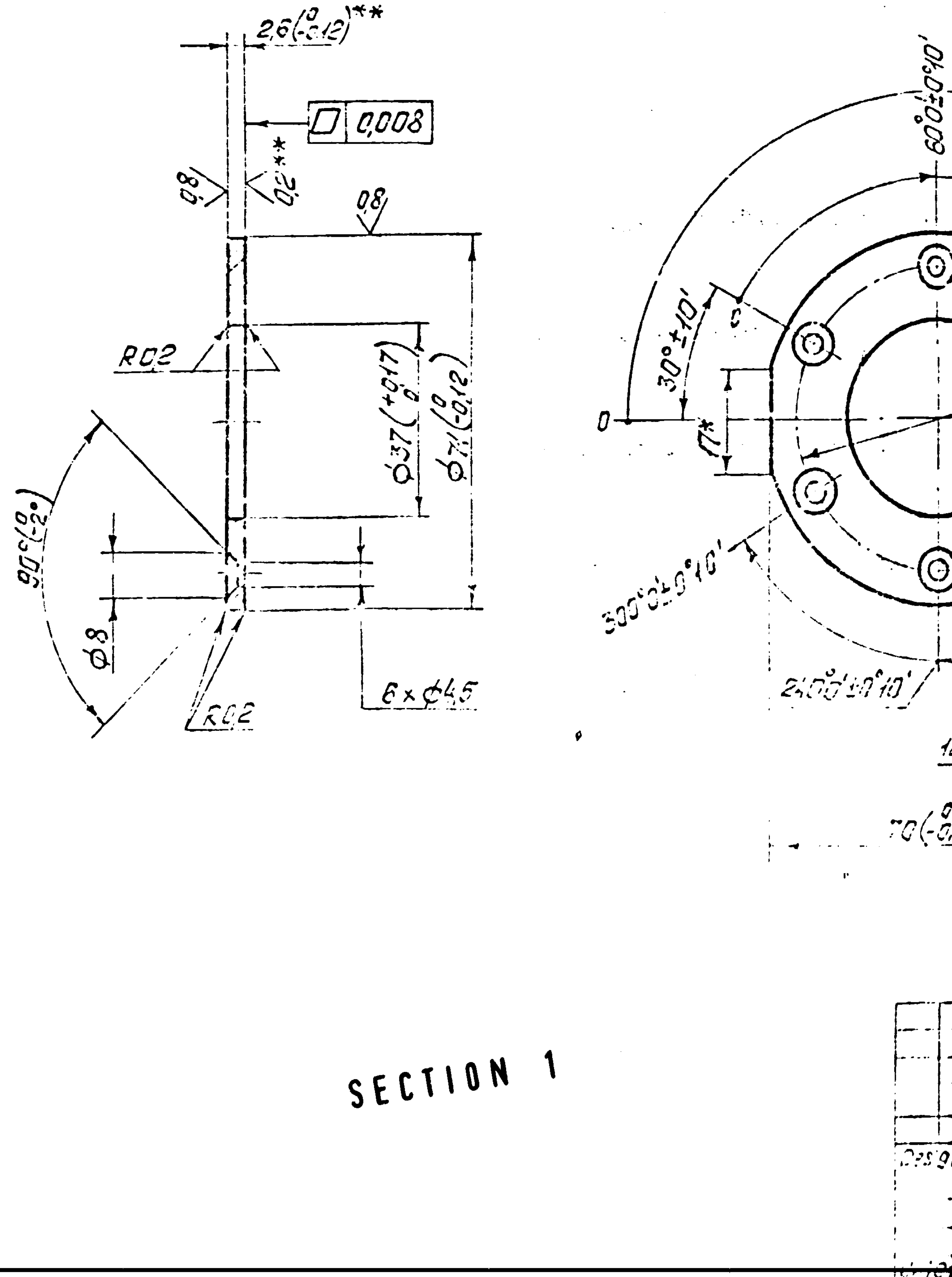




1. 32...36,5 HRCэ
2. * The dimensions for information
3. ** The dimensions and roughness are after coating
4. Finish the dimension D to the piece 300.002 interferenc
   must be no more than 0,015mm
5. H14; h14; $\pm \frac{IT14}{2}$
6. Coating: Chemical oxidation

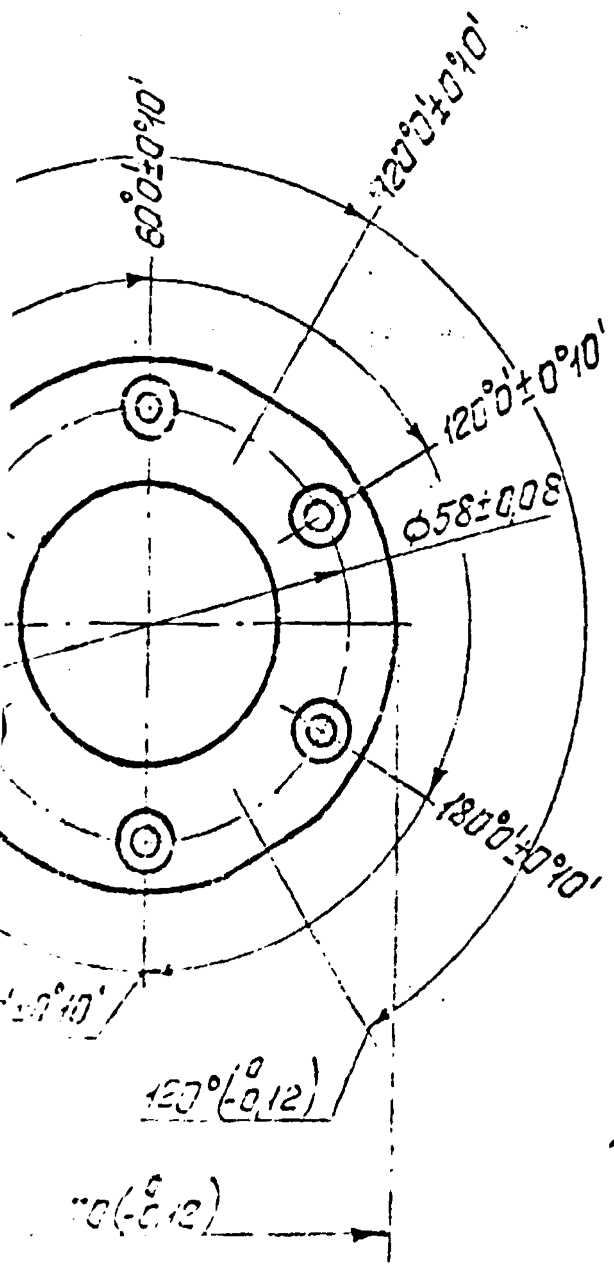
SECTION 6

300.016			
Holder		Mass	Scale
Designer			1:1
	Sheet	Sheets 1	



2,6(0/-0,12)**
0,008
0,8
0,2**
0,8
R0,2
φ37(+0,17/0)
φ71(0/-0,12)
90°(0/-2°)
φ8
R0,2
6×φ4,5
60°0'±0°10'
30°±10'
0
17*
300°0'±0°10'
240°0'±0°10'

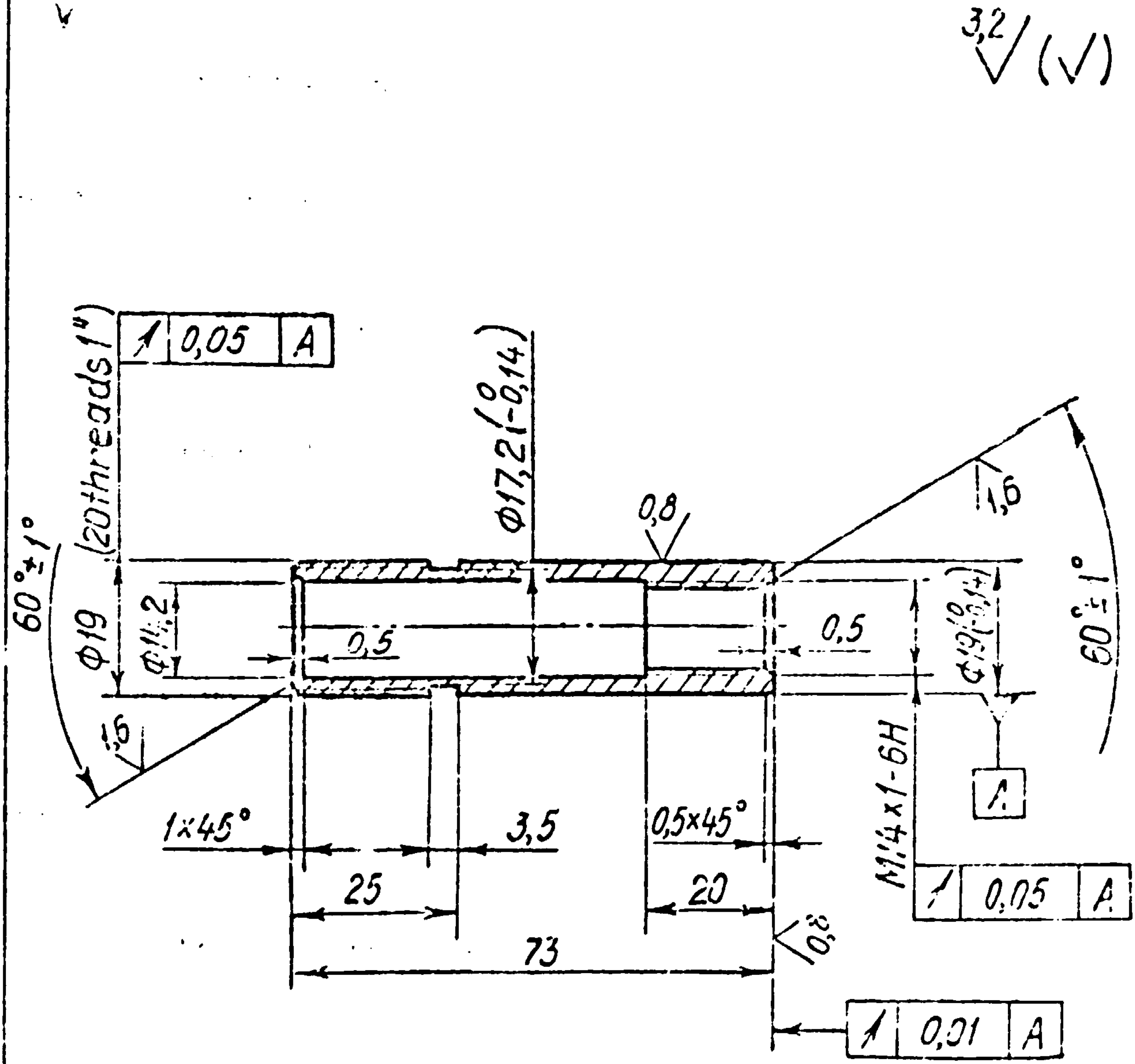
SECTION 1



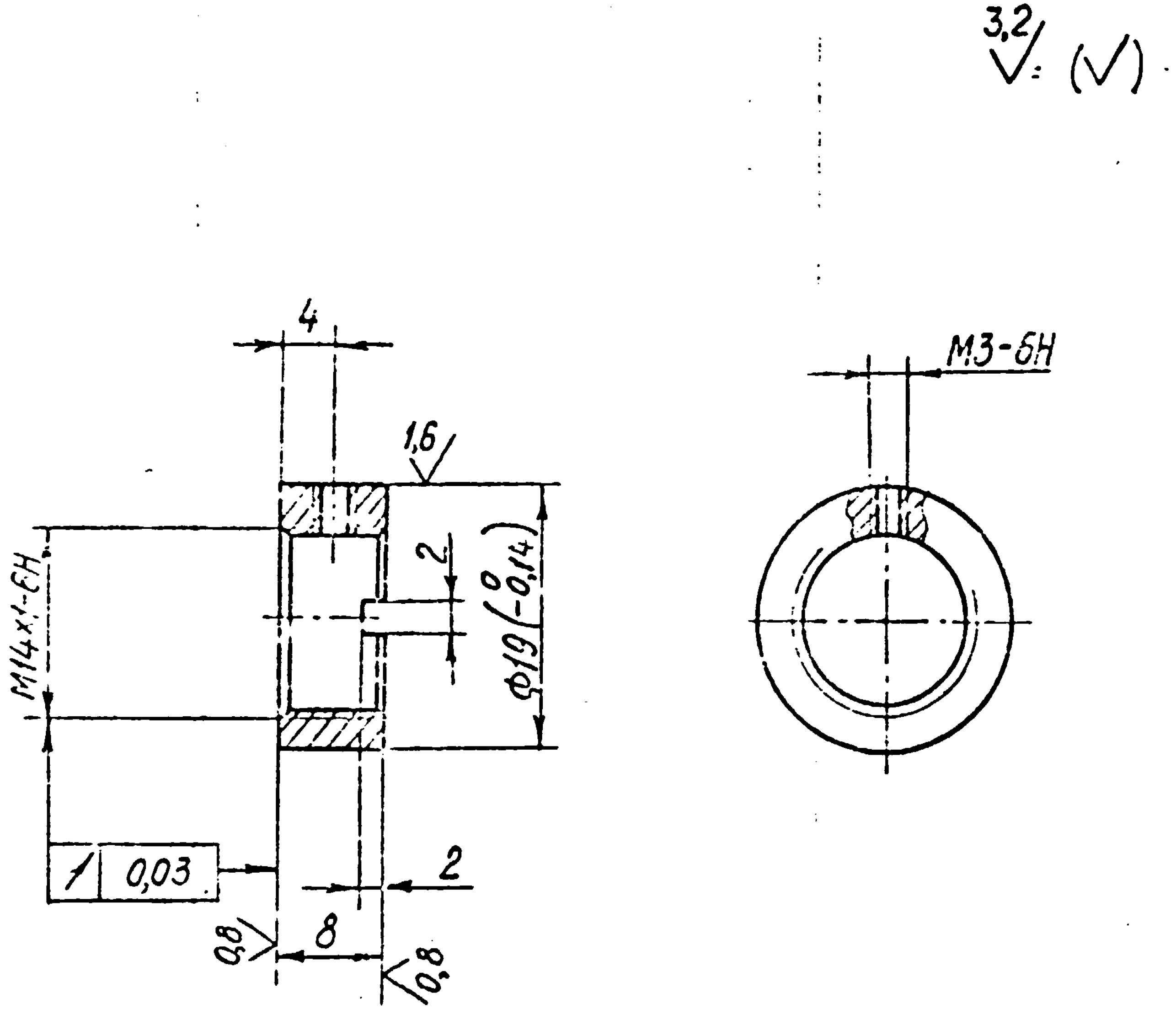
SECTION 2

1. Carburize h 0,5...0,8mm, 51,5...56 $HRC_э$
2. *The dimension for information.
3. **The dimension and the roughness are after coating.
4. H14, h14, $\pm \frac{IT14}{2}$
5. Coating chemical oxidation.

300.017			
Cover		Mass	Scale
			1:1
	Sheet	Sheets 1	
Steel 20	LITMO		



1. 30…34 HRC э
2. H14; h14; ± $\frac{IT14}{2}$
3. Coating : Chemical oxidation

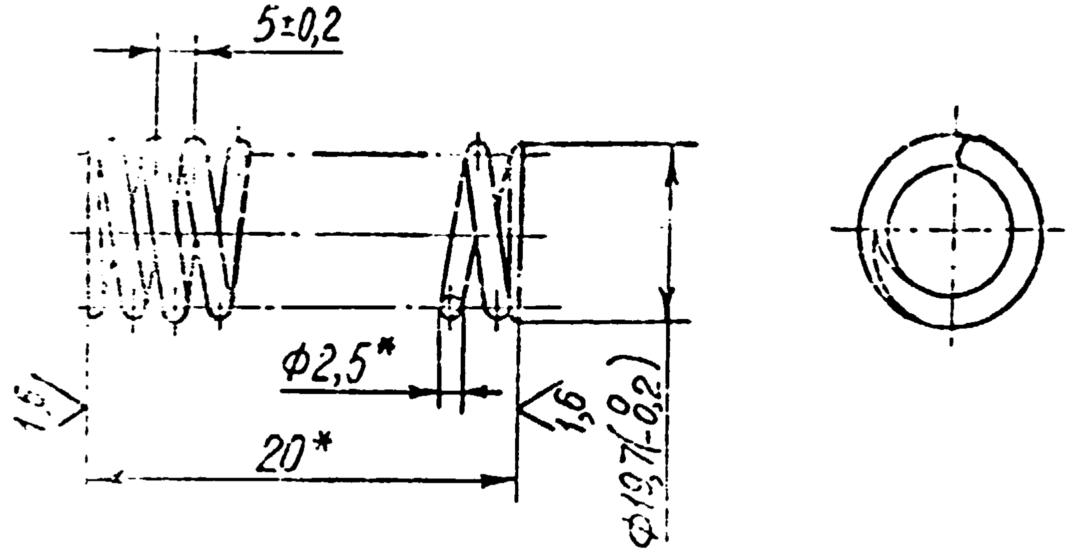


1. H14; h14; $\pm \frac{IT14}{2}$

2. Coating Chemical oxidation

					300. 019

$\forall\!\!/\ (\surd)$



1. *The dimensions for information
2. The working coils are 3
3. Spring coilling direction - right
4. Tighten up the first and the last coils. Grind the ends till 3/4 of the circle.
5. Dull the sharp edges
6. Harden the spring by tempering.

300.021

Spring		mass	Scale
			1:1
	Sheet	Sheets 1	

Designer

310.000 CENTRING CHUCK

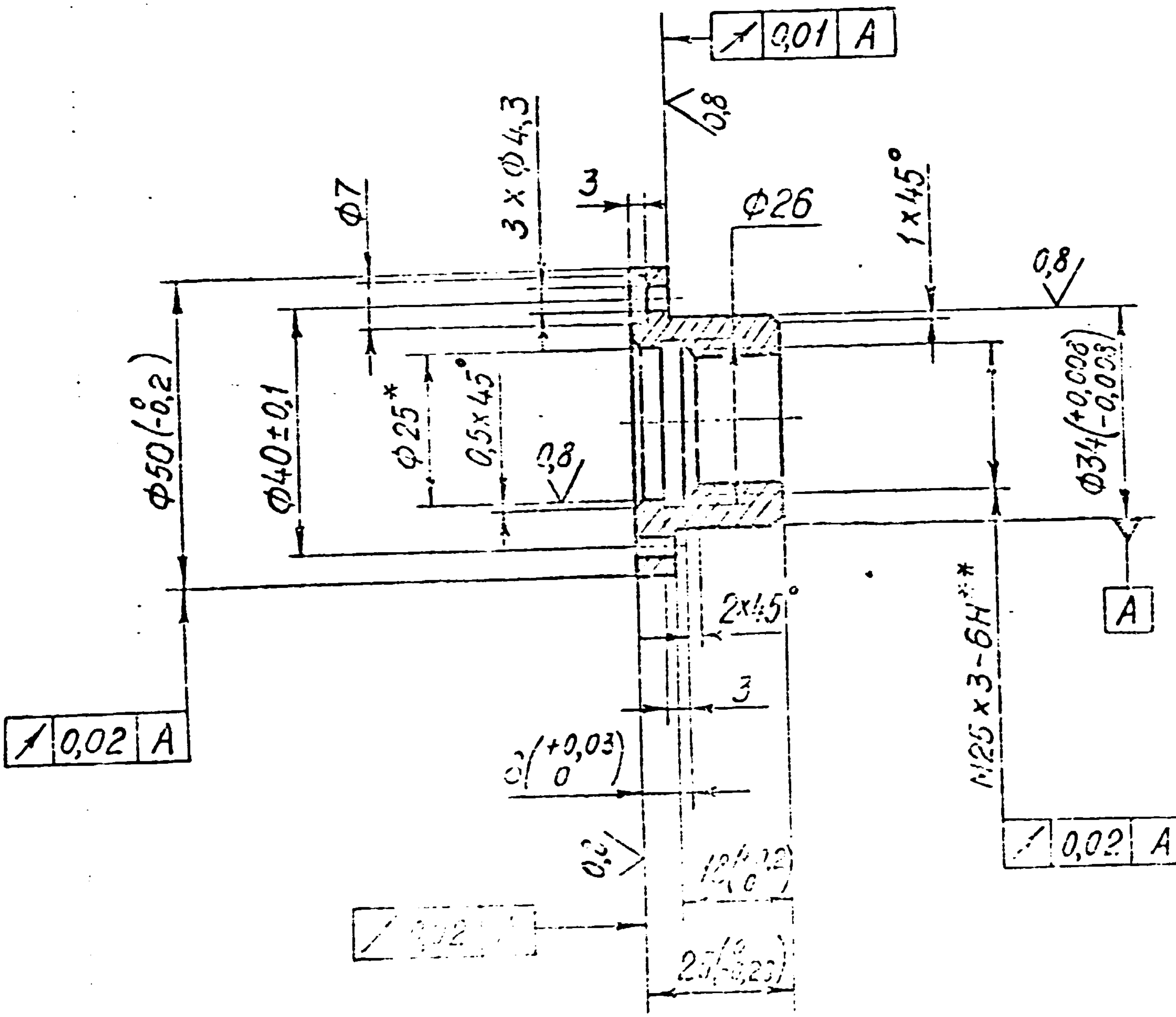
(the air gap 26 mm)

Form	Zone	Ref. No	Designation	Name	Quantity	Comments
				<u>Specification</u>		
A2			310. 000 Ass	Assembling		
				<u>Pieces</u>		
A3		1	310. 001	Flange	1	
A2		2	310. 002	Holder	1	
A3		3	310. 003	Sheath	6	
[illegible]		4	[illegible] 004	[illegible]	6	
[illegible]		5	310. 005	Thrust bearing	6	
[illegible]		6	310. 006	Bushing	6	
[illegible]		7	310. 007	Pusher	6	
[illegible]		8	310. 008	Cover	1	
[illegible]		9	310. 009	Insert	1	
[illegible]		11	310. 011	[illegible]	1	
[illegible]		12	310. 012	[illegible]	1	
[illegible]		[illegible]	[illegible] 013	[illegible]	1	
[illegible]		[illegible]	310. 014	[illegible]	1	
[illegible]		[illegible]	[illegible] 015	[illegible]	1	
[illegible]		[illegible]	[illegible]	[illegible]	1	
[illegible]		17	[illegible]	[illegible]	1	
A1		18	310. 018	[illegible]	2	

310. 000

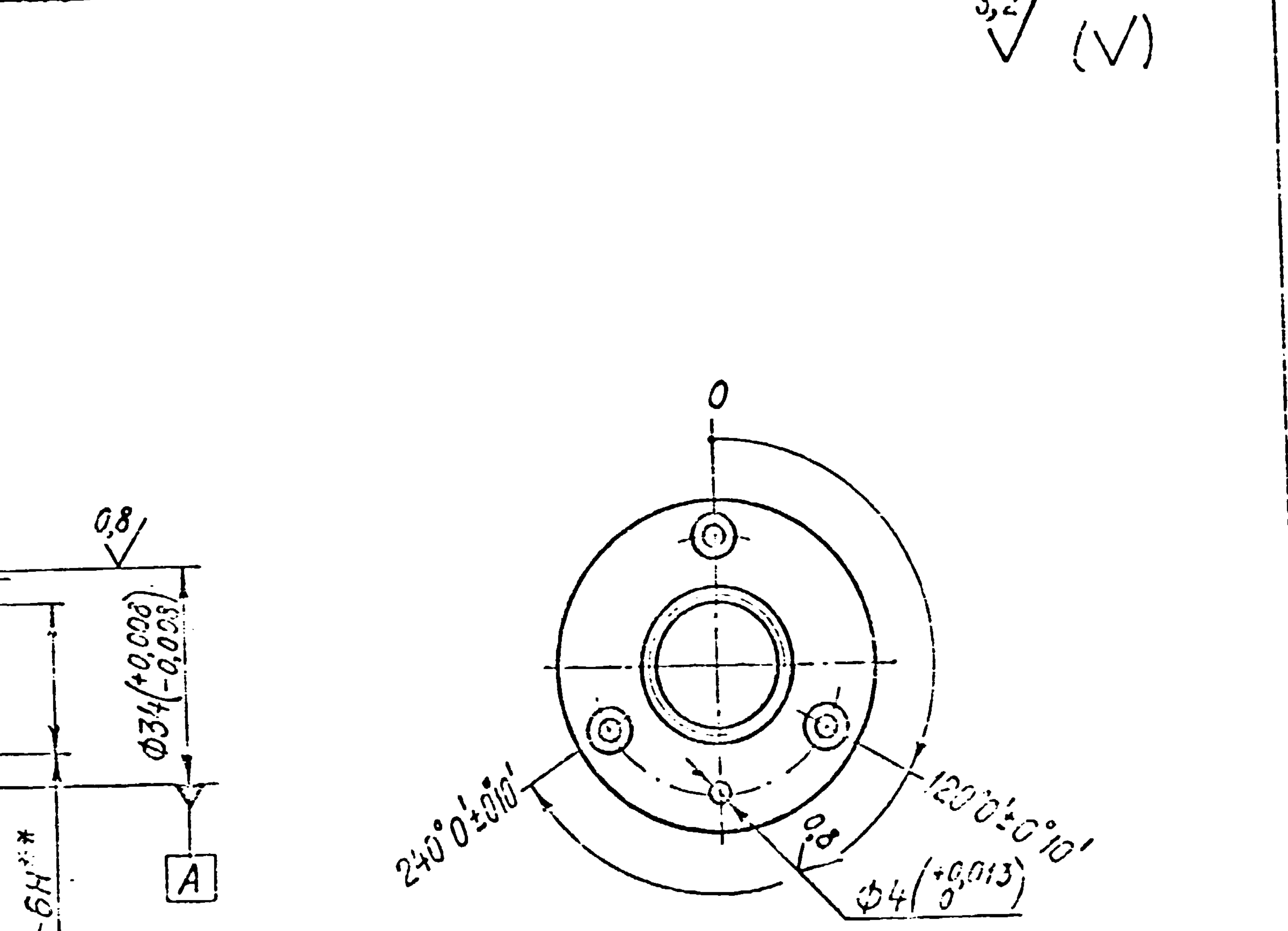
Designer		Centring chuck	Sheet 1 / Sheets 2
Chief			LITMO

Format	Zone	Ref. No	Designation	Name	Quantity	Comment
				Standard units		
		24		Screw B.M4-6g x 10. 58.05 ГОСТ 1491-80	3	
		25		Screw B.M4-6g x 10. 58.05 ГОСТ 17475-80	6	
		27		Pin 3 u8 x 10 ОСТ3-2234-80	1	
		28		Pin 4 u8 x [illegible] ОСТ3-22[illegible]-[illegible]	1	



0,01 A
0,8
3 x Ø4,3
Ø7
3
Ø26
1x45°
0,8
Ø50
Ø40±0,1
Ø25*
0,5x45°
0,8
A
2x45°
3
0,02 A
0,02 A

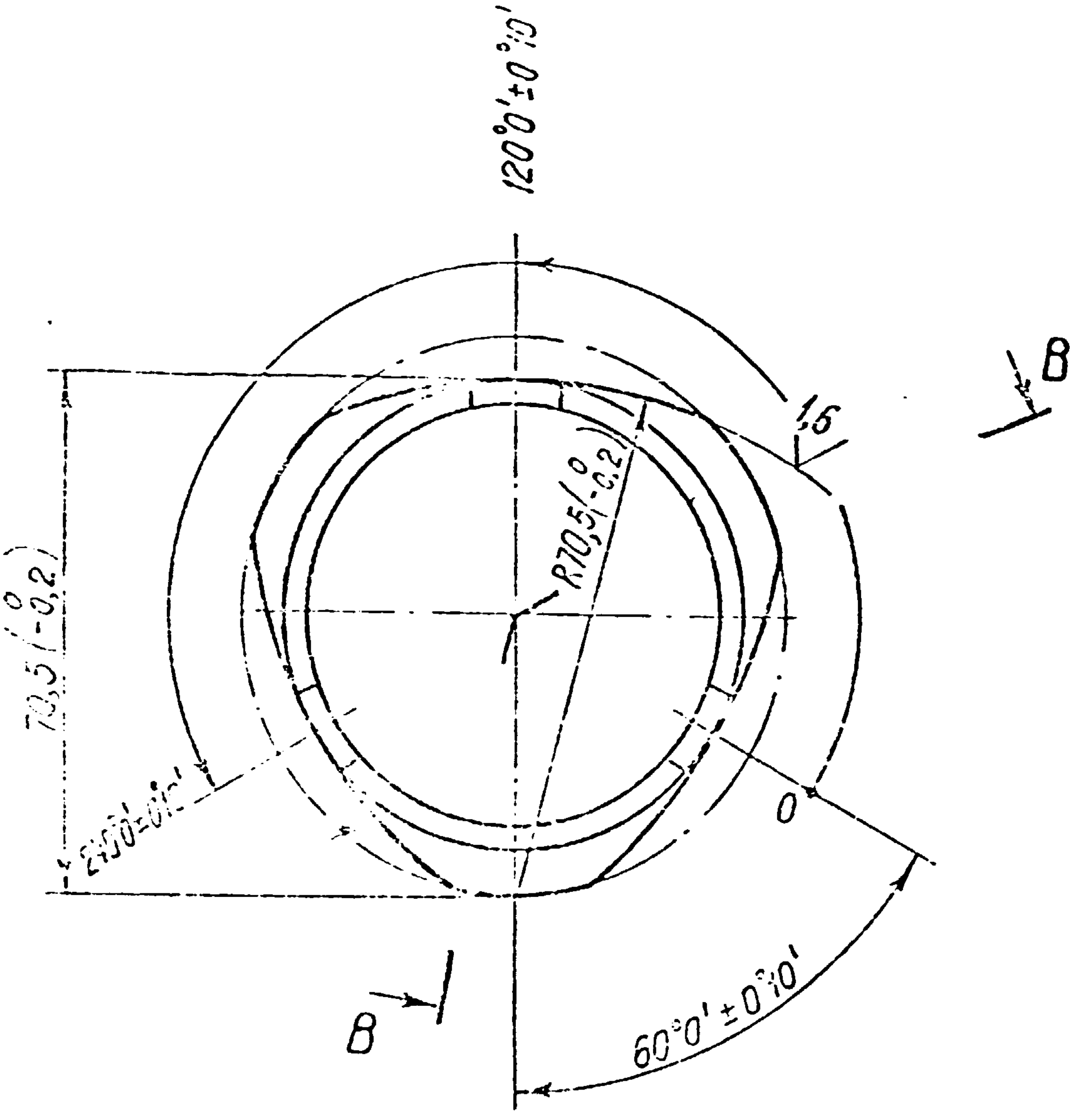
SECTION 1



1. *Produce the bore correspondly to spindle
2. **Produce the thread correspondly to spindle of machine
3. H14; h14; $\pm \frac{IT14}{2}$
4. Coating: Chemical oxidation

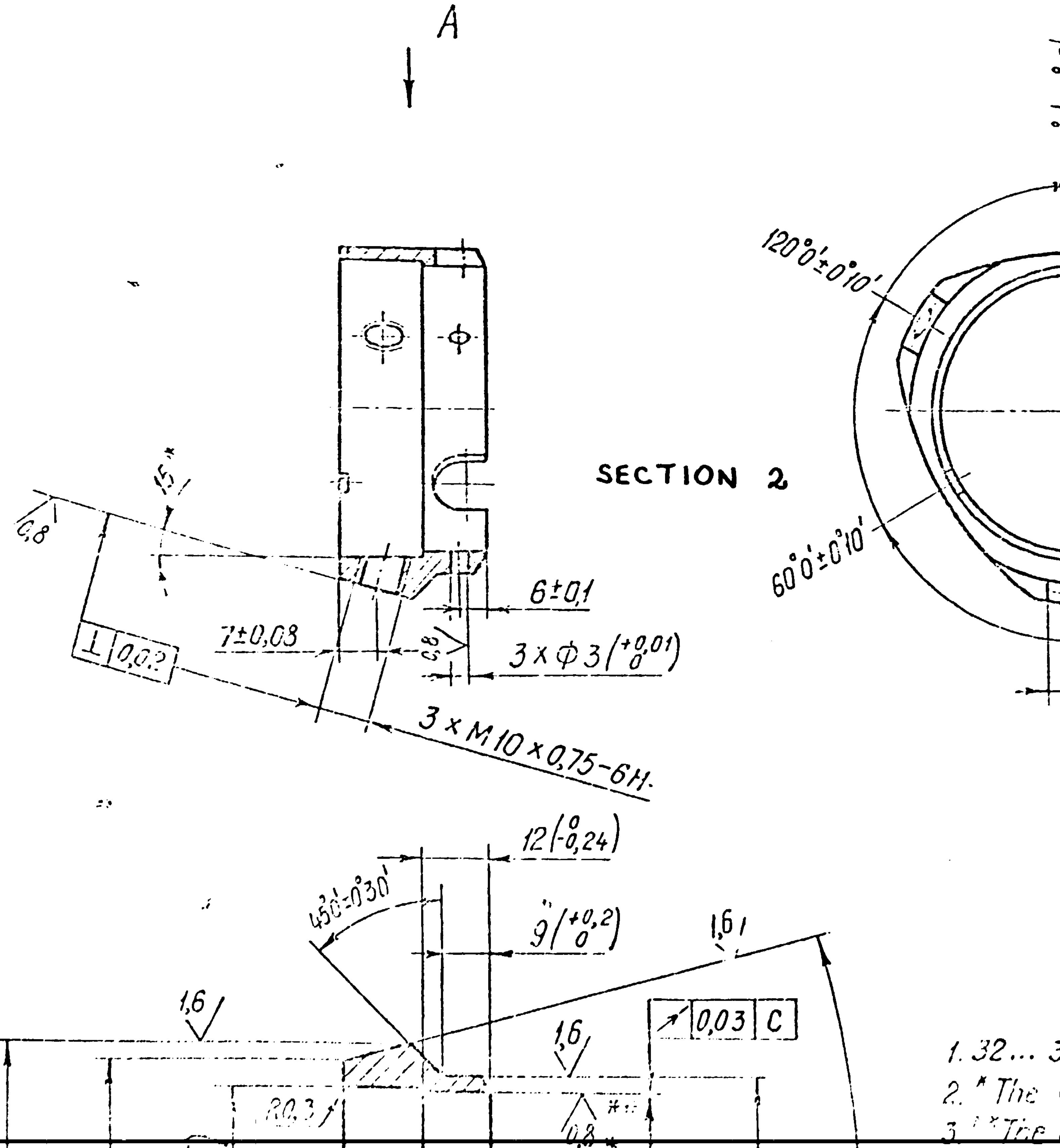
SECTION 2

310. ...		
Flange		Scale 1:1
	Sheet	Sheets 1
Steel 50	LITMO	

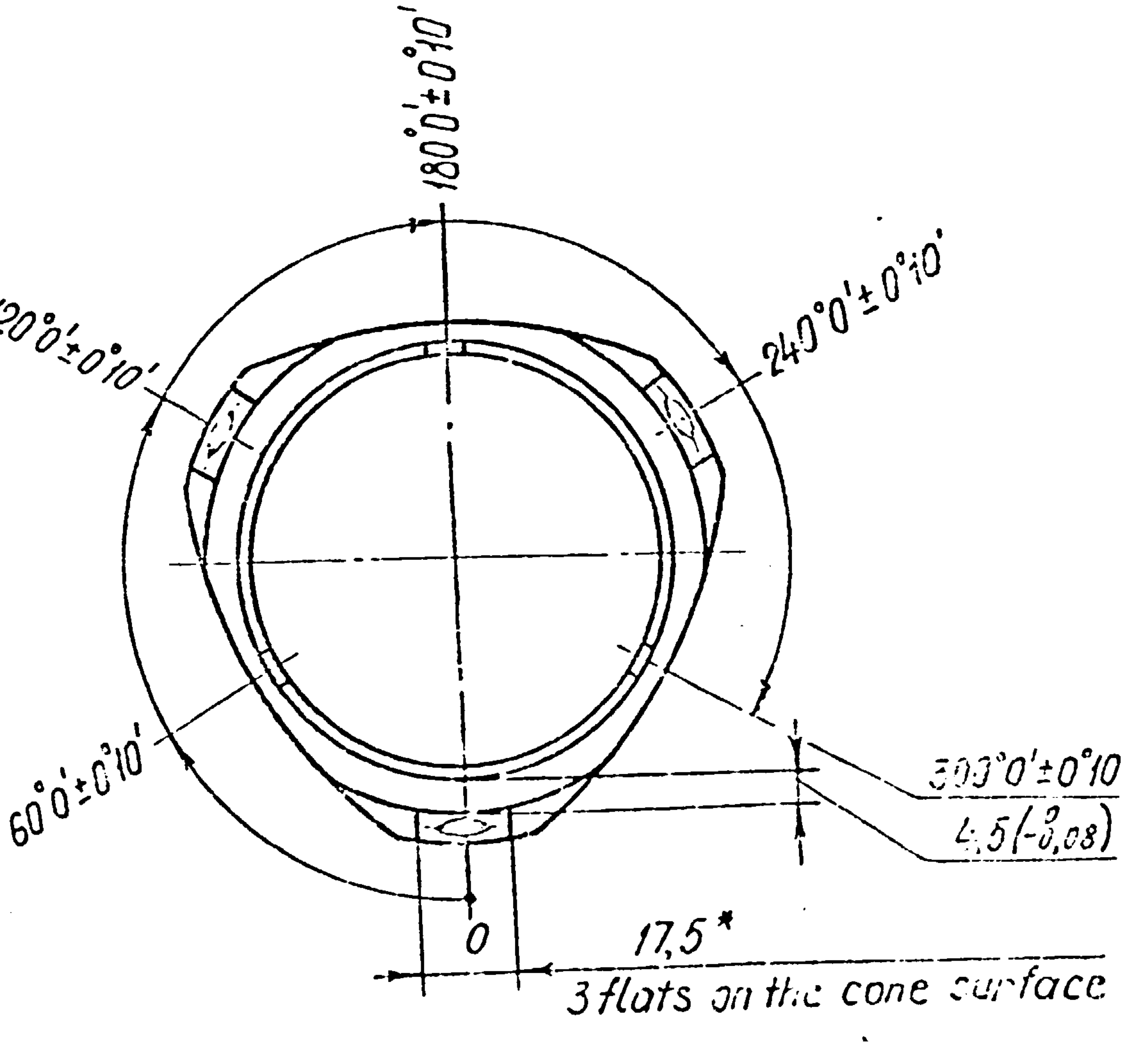


SECTION 1

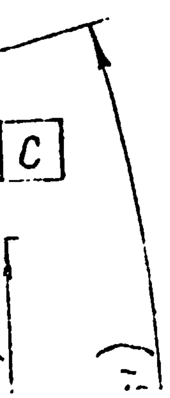
A


A
SECTION 2
120°0'±0°10'
60°0'±0°10'
15°
0,8
⊥ 0,02
7±0,08
6±0,1
0,8
3 × Φ3 (+0,01 0)
3 × M10 × 0,75–6H.
12 (0 -0,24)
45°0'±0°30'
9 (+0,2 0)
1,6
1,6
1,6
0,03 C
0,8
R0,3
1. 32... 3
2. * The
3. * The

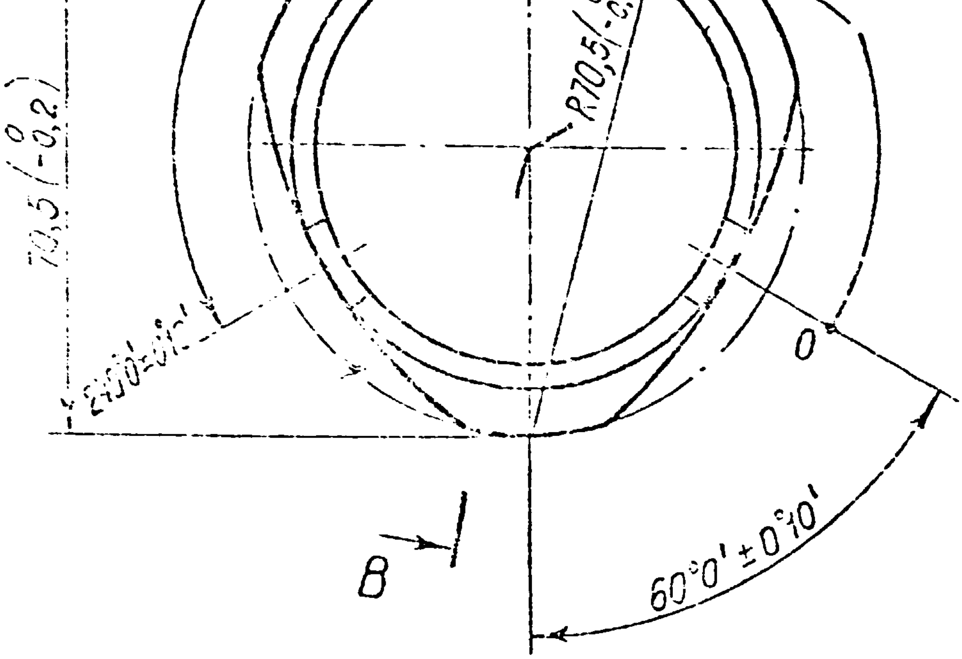
3,2 √ (√)



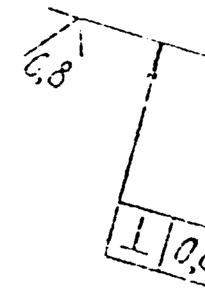
SECTION 3



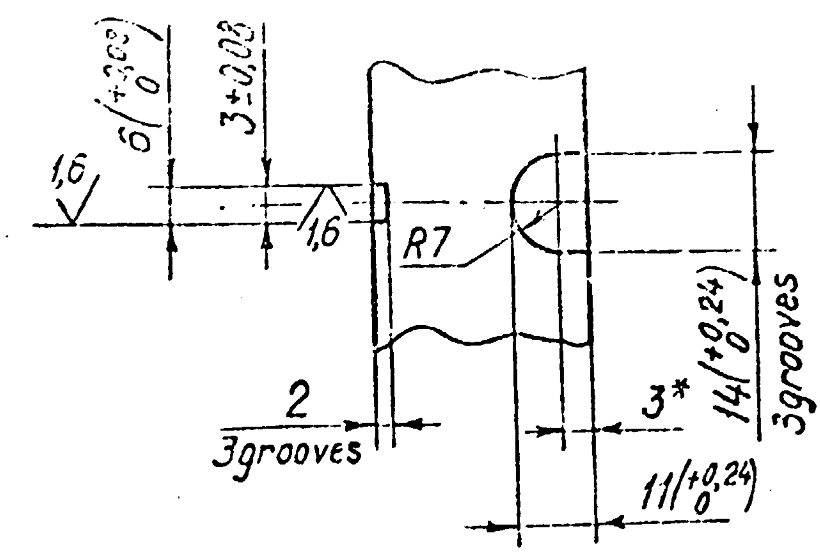
1. 32... 36,5 HRCэ
2. * The dimensions for information
3. ** The dimensions and roughness are after coating
4. Coating: Chemical oxidation



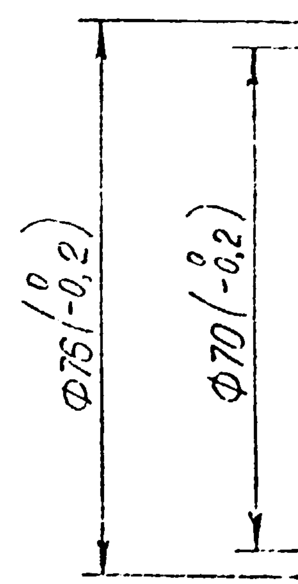
R70,5
0
B
60°0' ±0°10'



A

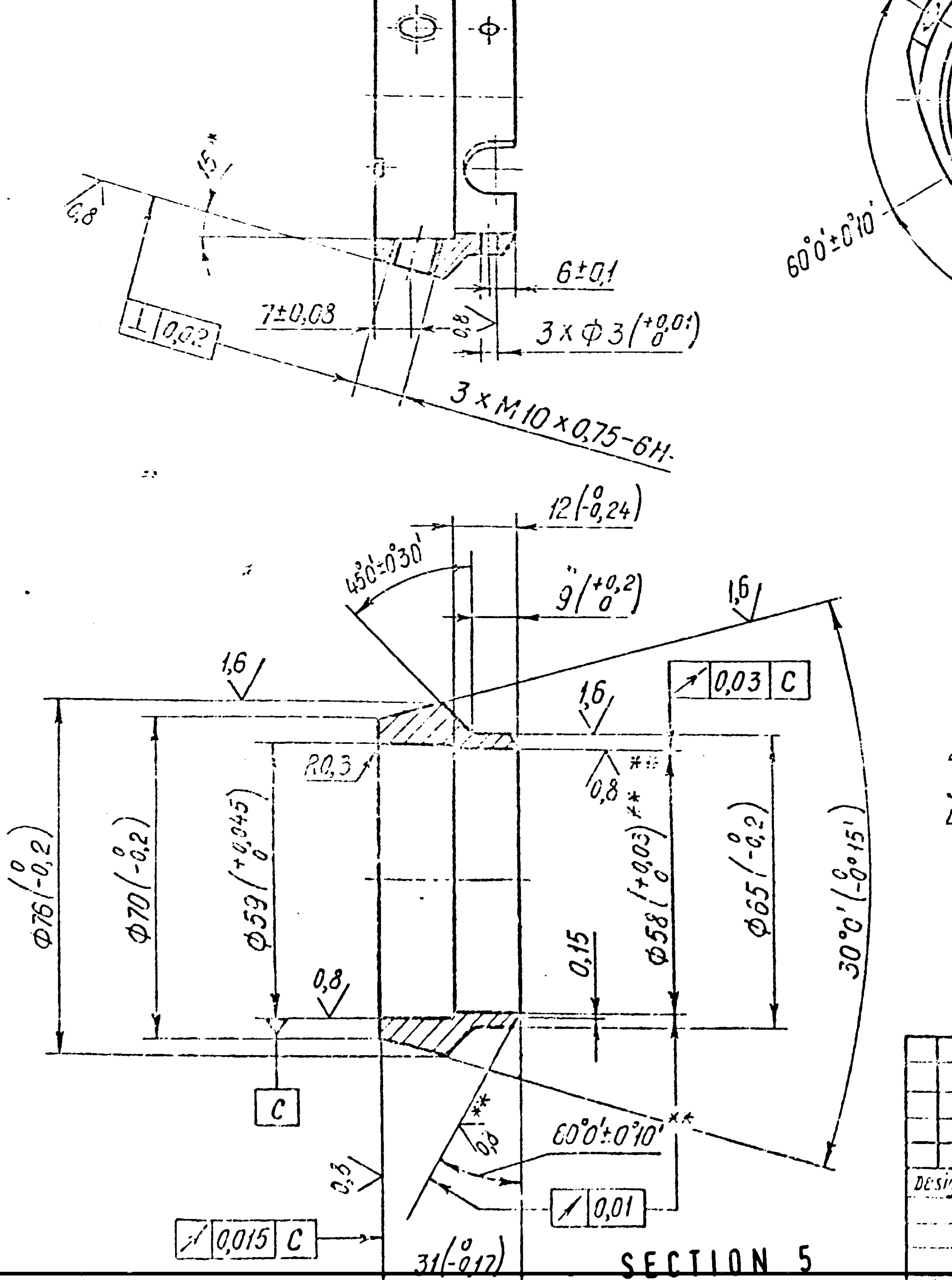


1,6
3±0,08
1,6
R7
2
3grooves
3*
14(+0,24 / 0)
3grooves
11(+0,24 / 0)



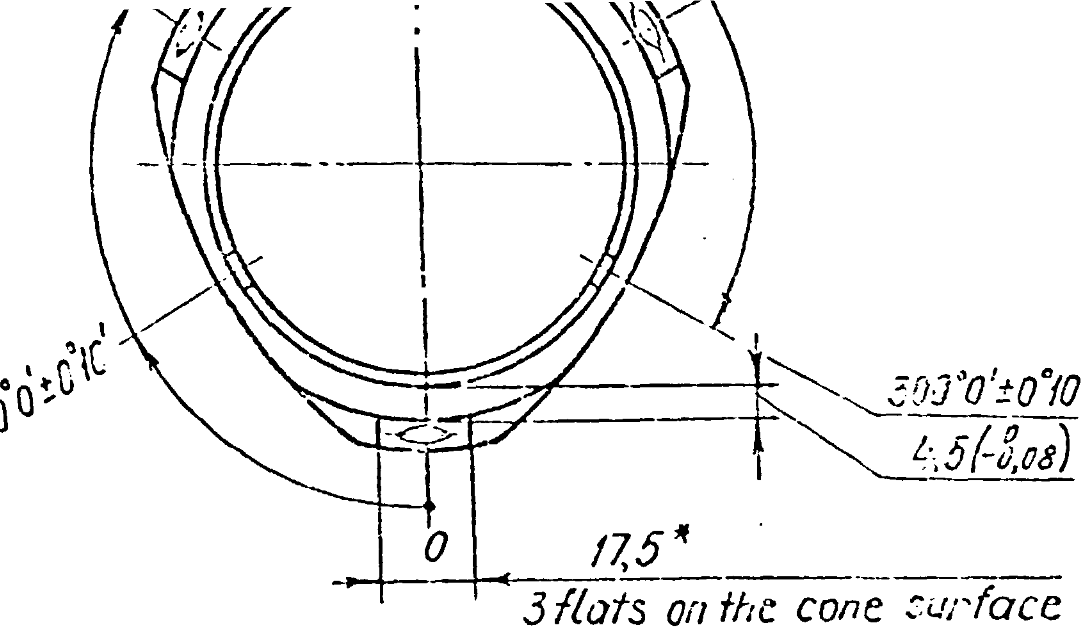
Φ75(0 / -0,2)
Φ70(0 / -0,2)

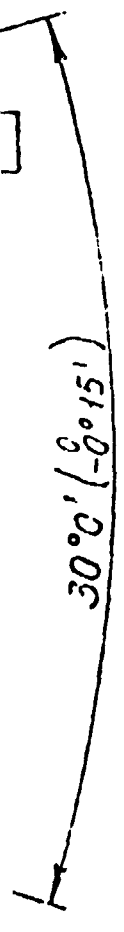
SECTION 4



15°
0,8
6±0,1
7±0,03
0,8
3 x Φ3 (+0,01 0)
⊥ 0,02
3 x M10 x 0,75-6H
12 (0 -0,24)
45°0'±0°30'
9 (+0,2 0)
1,6
1,6
1,6
0,03 C
R0,3
0,8
Φ76 (0 -0,2)
Φ70 (0 -0,2)
Φ59 (+0,045 0)
Φ58 (+0,03 0)
Φ65 (0 -0,2)
30°0' (0 -0°15')
0,15
0,8
C
0,8
60°0'±0°10'
0,8
0,01
0,015 C
31 (0 -0,17)
60°0'±0°10'
DESI

SECTION 5

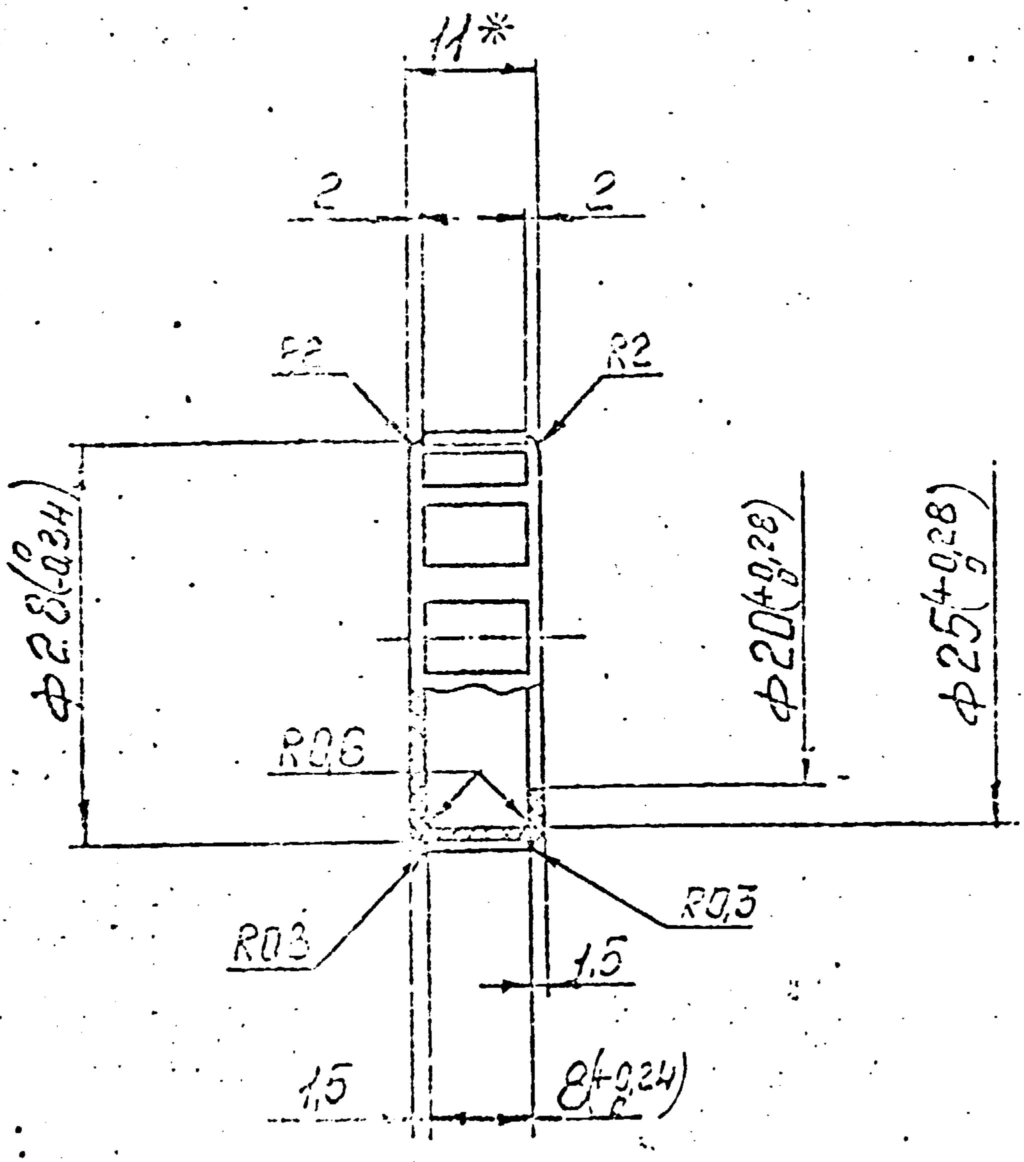




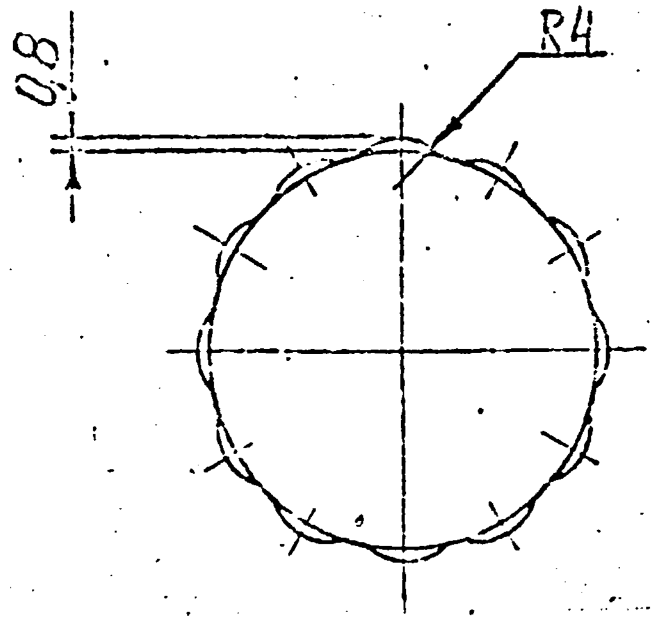
1. 32… 36,5 HRCэ
2. *The dimensions for information
3. **The dimensions and roughness are after coating
4. Coating: Chemical oxidation

SECTION 6

	310.002		
	Holder	Mass	Scale
Designer			1:1
		Sheet	Sheets 1



SECTION 1



1. *The dimension for information

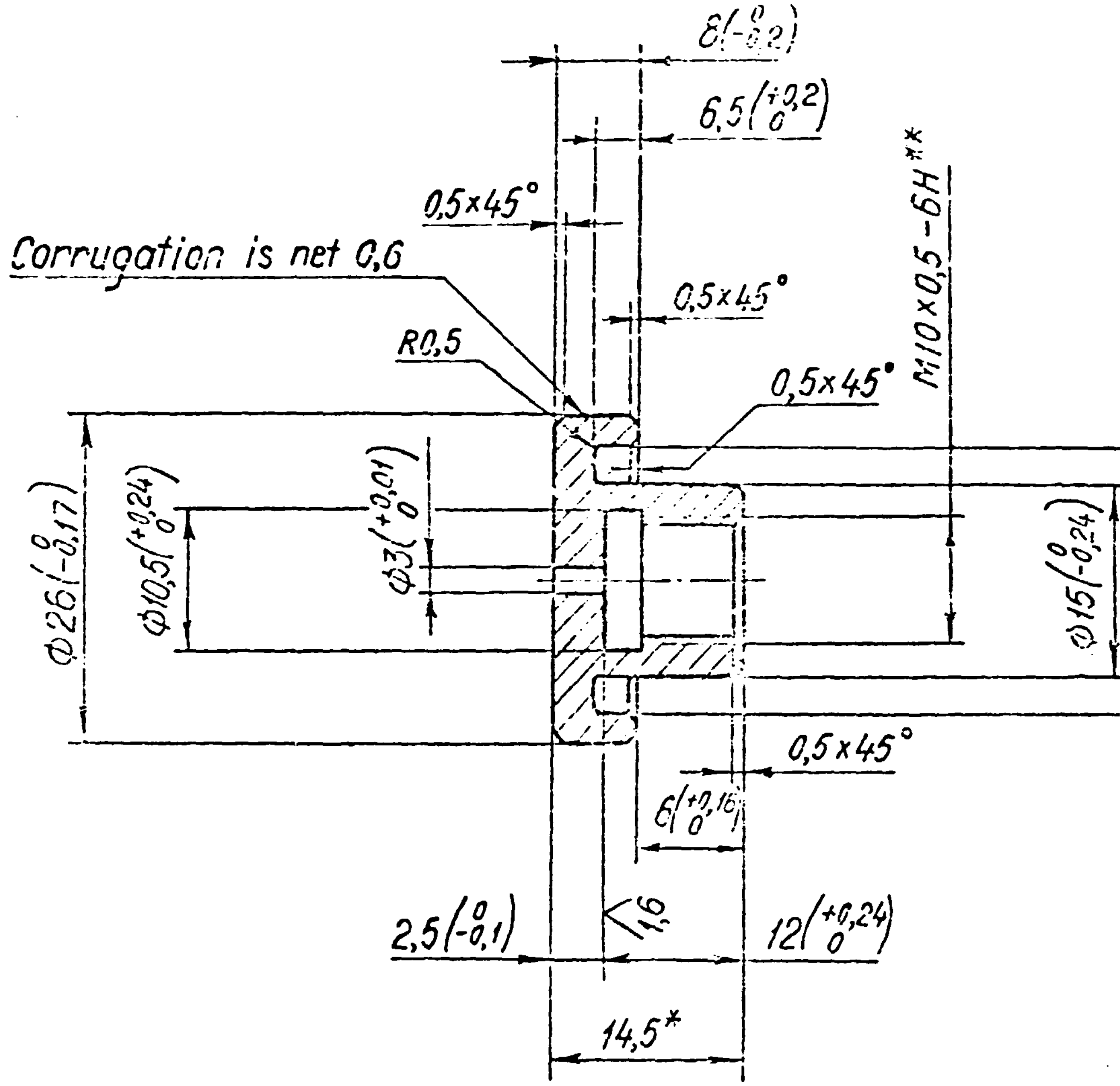
2. H14; h14; $\pm \frac{IT14}{2}$

SECTION 2

310. 003		
Sheath	Mass	Scale
		2:1
	Sheet	Sheets 1
Rubber	LITMO	

Designer

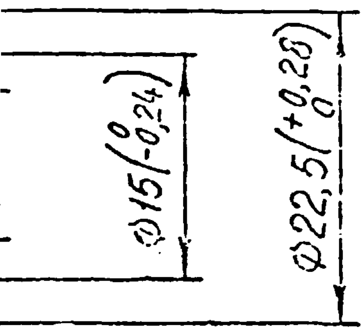
Chief



8(-0,2)
6,5(+0,2 0)
0,5×45°
Corrugation is net 0,6
0,5×45°
R0,5
0,5×45°
M10×0,5-6H**
Φ26(0 -0,17)
Φ10,5(+0,24 0)
Φ3(+0,01 0)
Φ15(0 -0,24)
0,5×45°
6(+0,16 0)
2,5(0 -0,1)
1,6
12(+0,24 0)
14,5*

SECTION 1

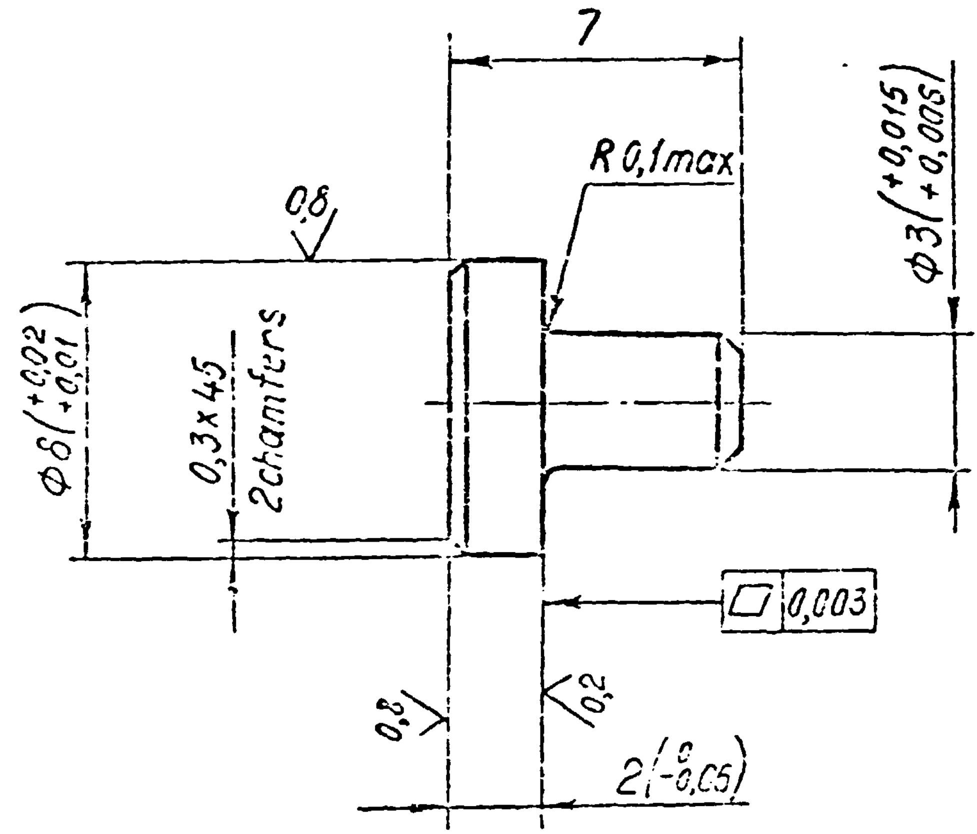
$\sqrt[3,2]{}$ ($\sqrt{}$)



1.* The dimension for information
2.** Fit in the thread and the thread of the piece 310.006 and clearance is allowed no more than 0,01 mm.
3. Coating Chemical oxidation

SECTION 2

	310. 004	
Designer	Fly nut	Mass / Scale: 2:1
		Sheet / Sheets 1
Chief	Steel 50	LITMO

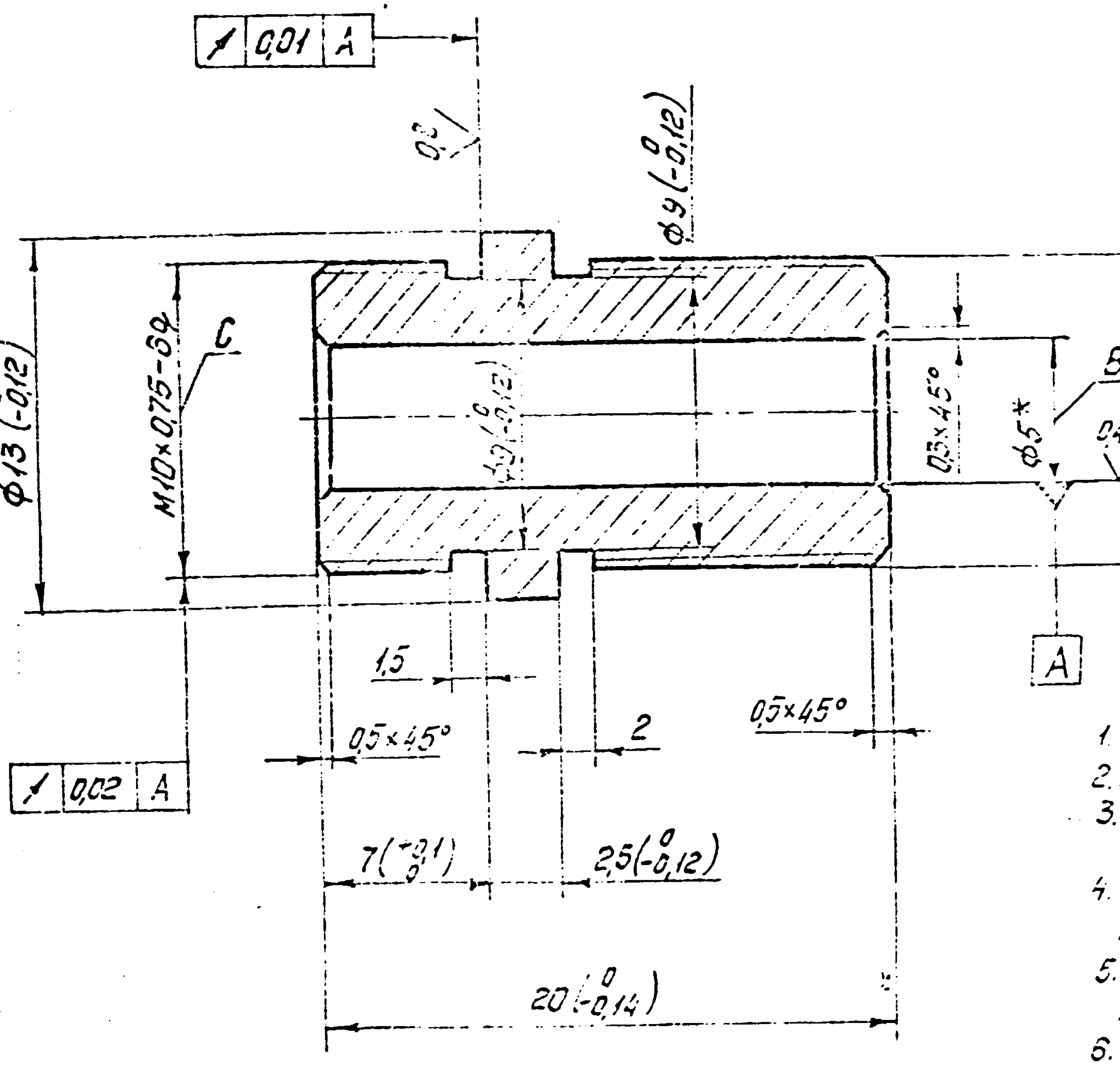


1. h 14
2. 61 ... 65 HRCэ

310. 005			
Thrust bearing		Mass	Scale
			5:1
	Sheet	Sheets 1	
Steel Y12A	LITMO		

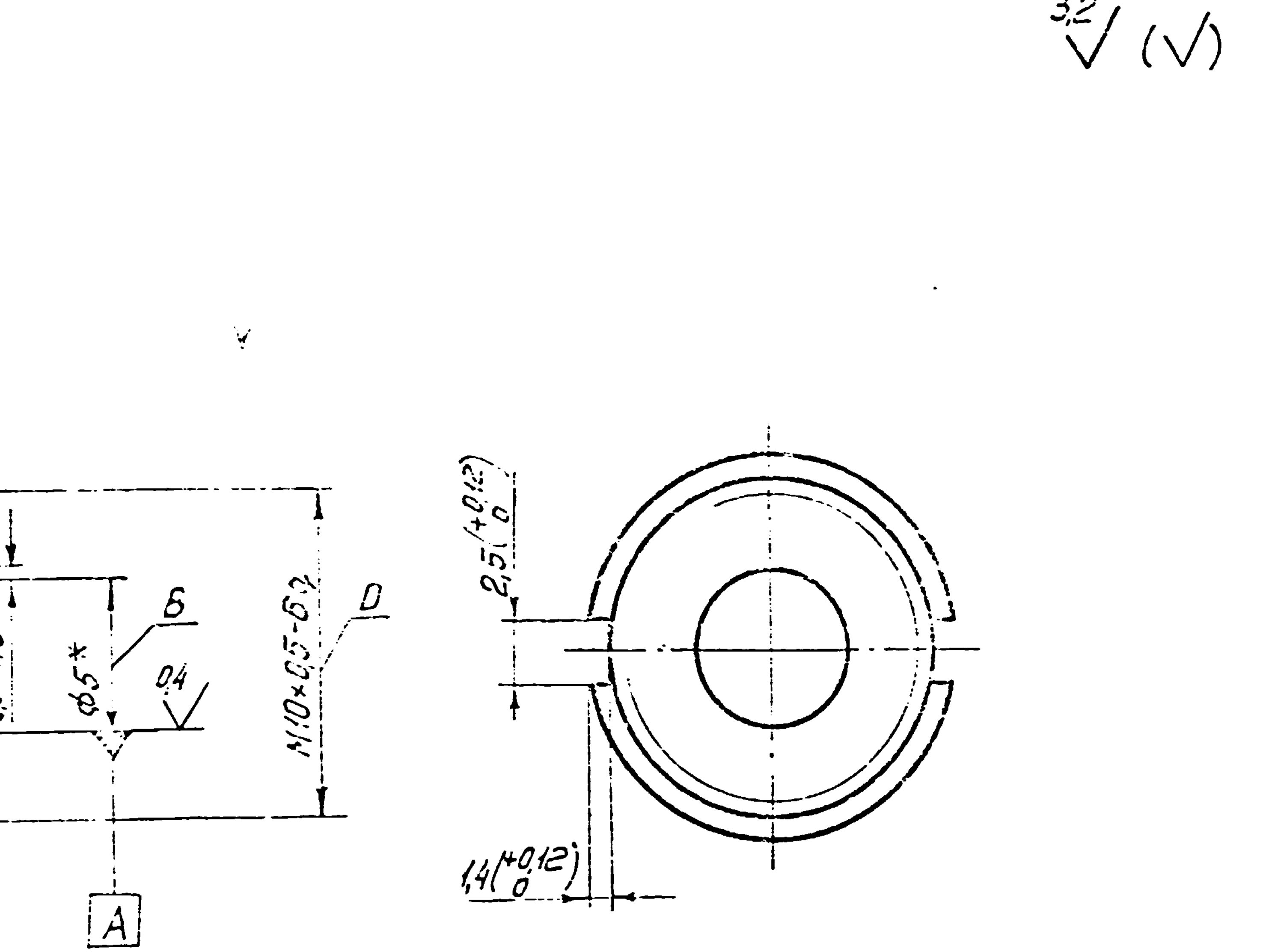
Designer

Chief



0,01 A
0,8
Φ9 (-0,12)
Φ13 (-0,12)
M10×0,75-6g
C
0,5×45°
Φ5*
A
1,5
0,5×45°
2
0,5×45°
0,02 A
7(+0,1)
2,5(-0,12)
20 (-0,14)

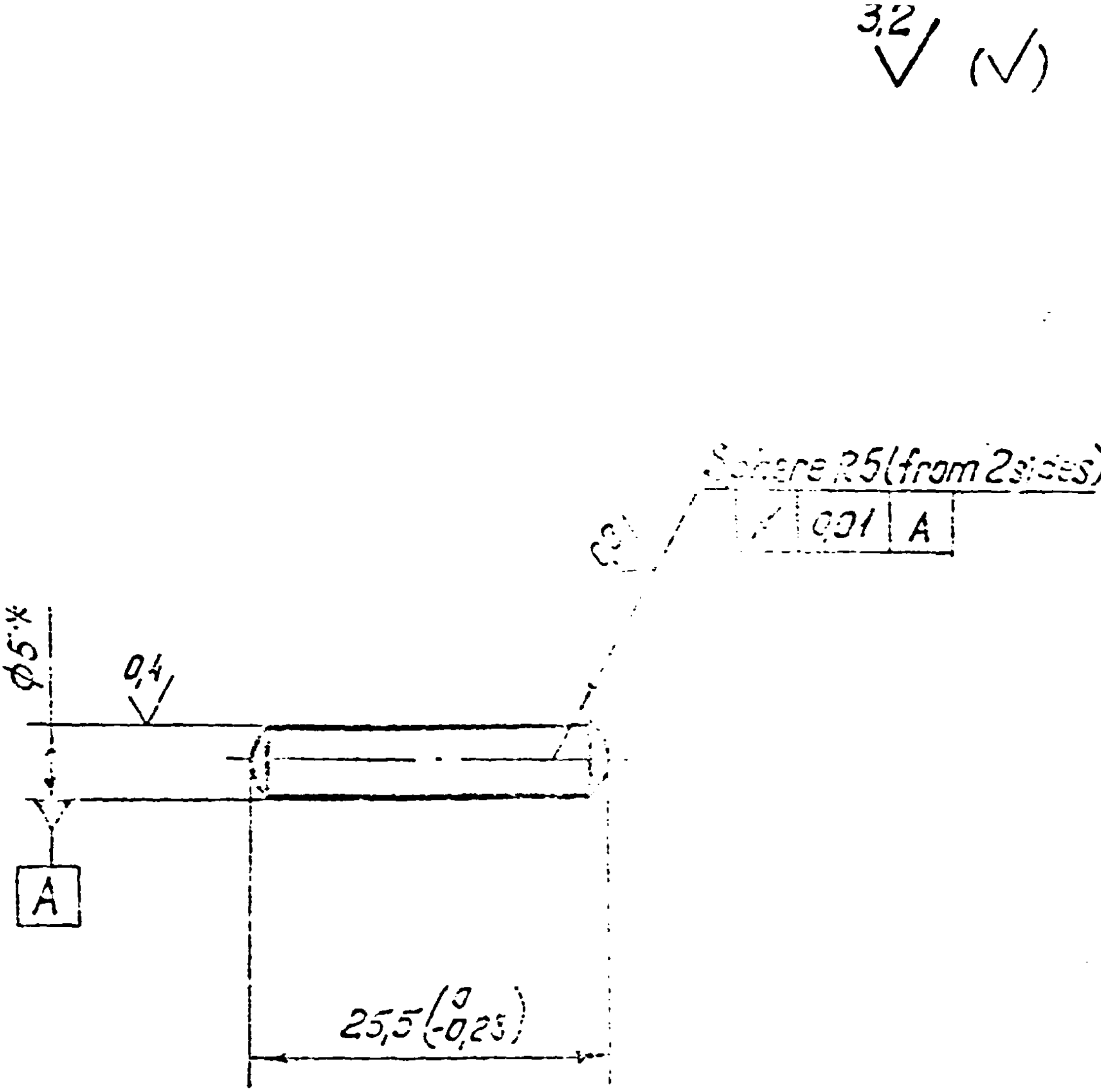
SECTION 1



1. 36...41,5 HRCэ
2. H14; h14; ± IT14/2
3. * Produce the dimension B according to the piece 310.007 and clearance must be no more than 0,003 mm
4. Cut the thread C with a single-point tool according to the pieces 310.002
5. Fit in the thread D with piece 310.004 and clearance must be no more than 0,01 mm
6. Coating: Chemical oxidation

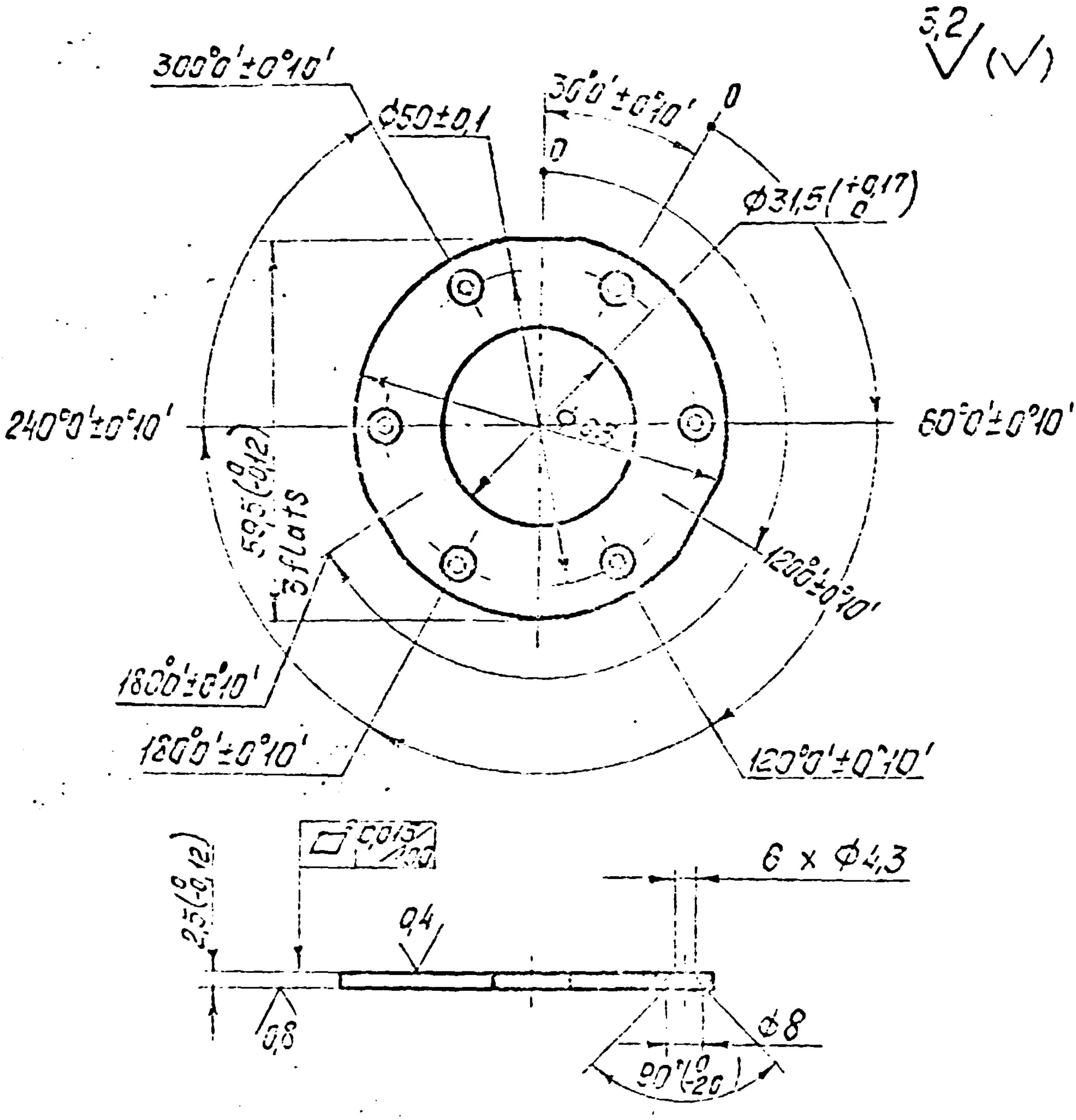
SECTION 2

	310.006		
	Bushing	Mass	Scale 5:1
Designer		Sheet	Sheets 1
Chief Designer	Steel 40X	LITMO	



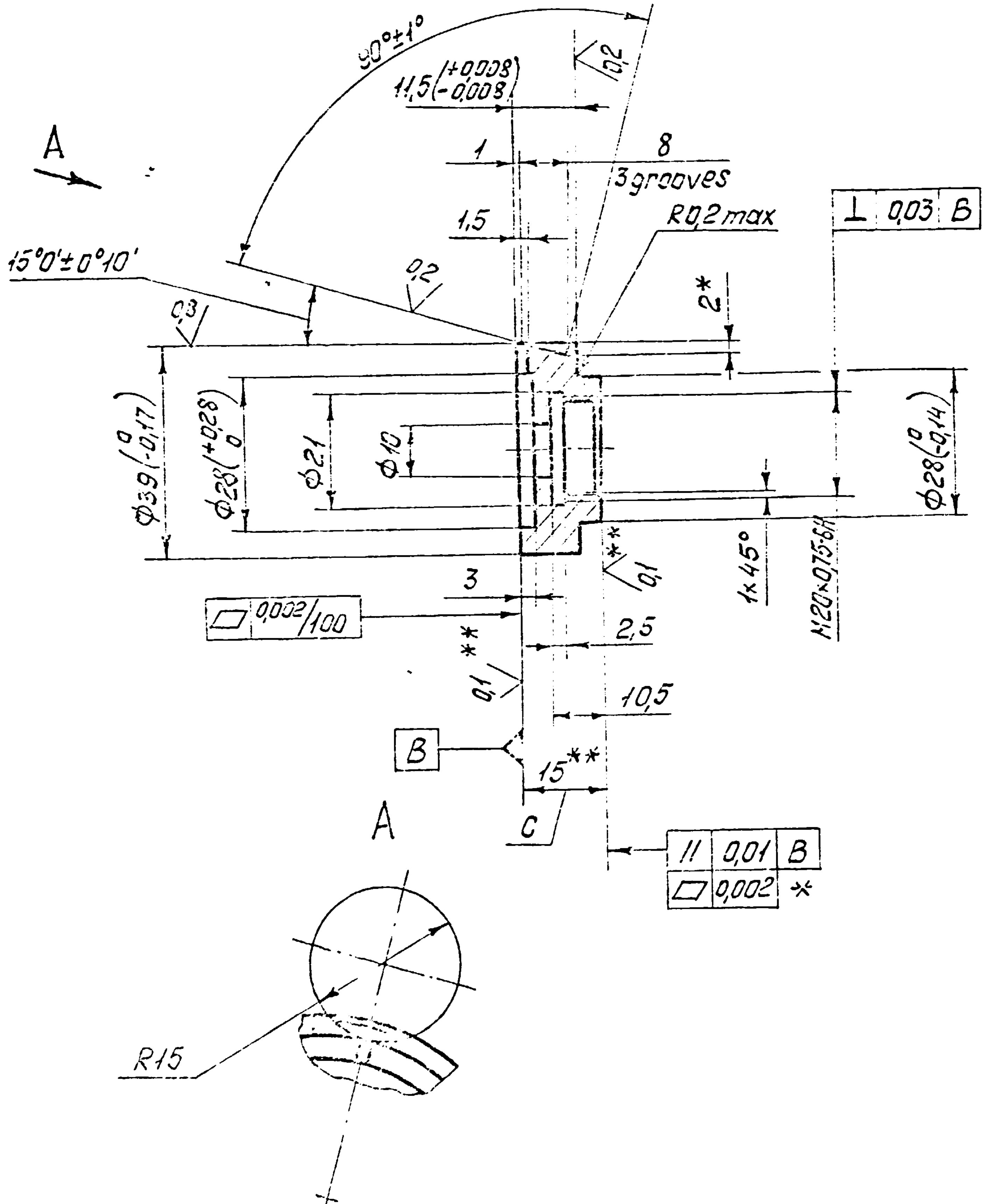
1. 61...65 $HRC_э$
2.* Fit in with the piece 310.006 and clearance is allowed no more than 0,003mm

	310.007		
Designer	Pusher	Mass	Scale
			2:1
		Sheet	Sheets 1
Chief Designer	Steel ШХ-15	LITMO	



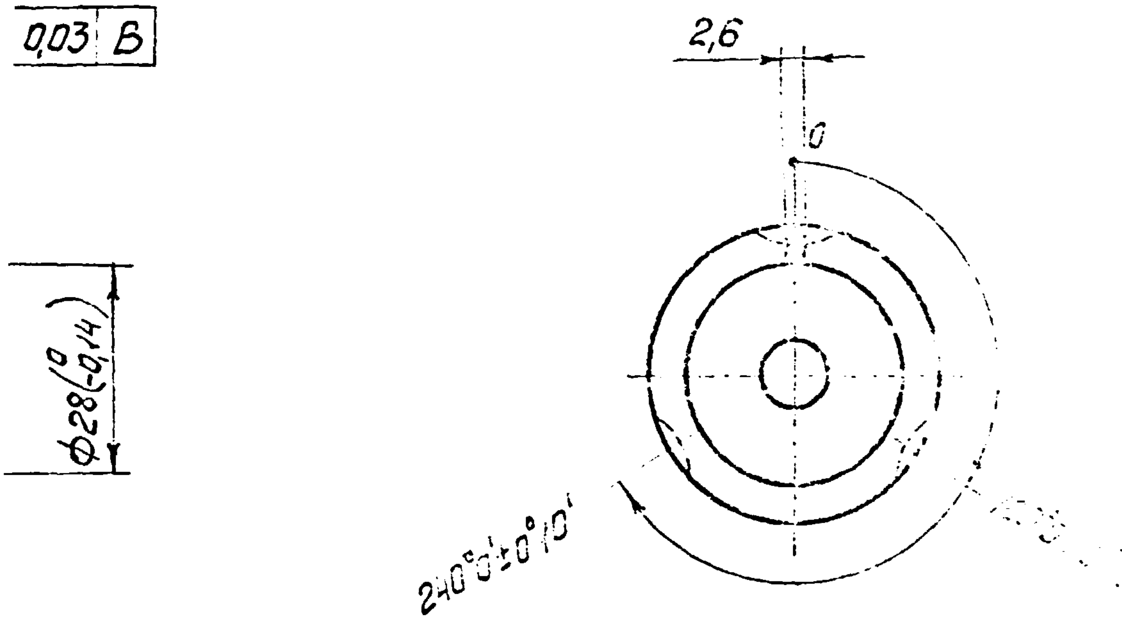
1. Caseharden by cyaniding in depth 0,8...1,2mm
2. 56...61 HRC$_э$
3. H14; h14; $\pm\frac{IT14}{2}$
4. Coating: Chemical oxidation

	310.008	
	Cover	Mass: — ; Scale: 1:1
Designer		Sheet — Sheets 1
Chief Designer	Steel 20	LITMO



90°±1°
11,5(+0,008 -0,008)
0,2
A
1
8
3 grooves
1,5
R0,2 max
⊥ 0,03 B
15°0'±0°10'
0,2
0,3
2*
Φ39(0 -0,17)
Φ28(+0,28 0)
Φ21
Φ10
Φ28(0 -0,14)
0,1
1x45°
M20x0,75-6H
3
0,002/100
2,5
0,1**
10,5
B
15**
C
A
// 0,01 B
0,002 *
R15

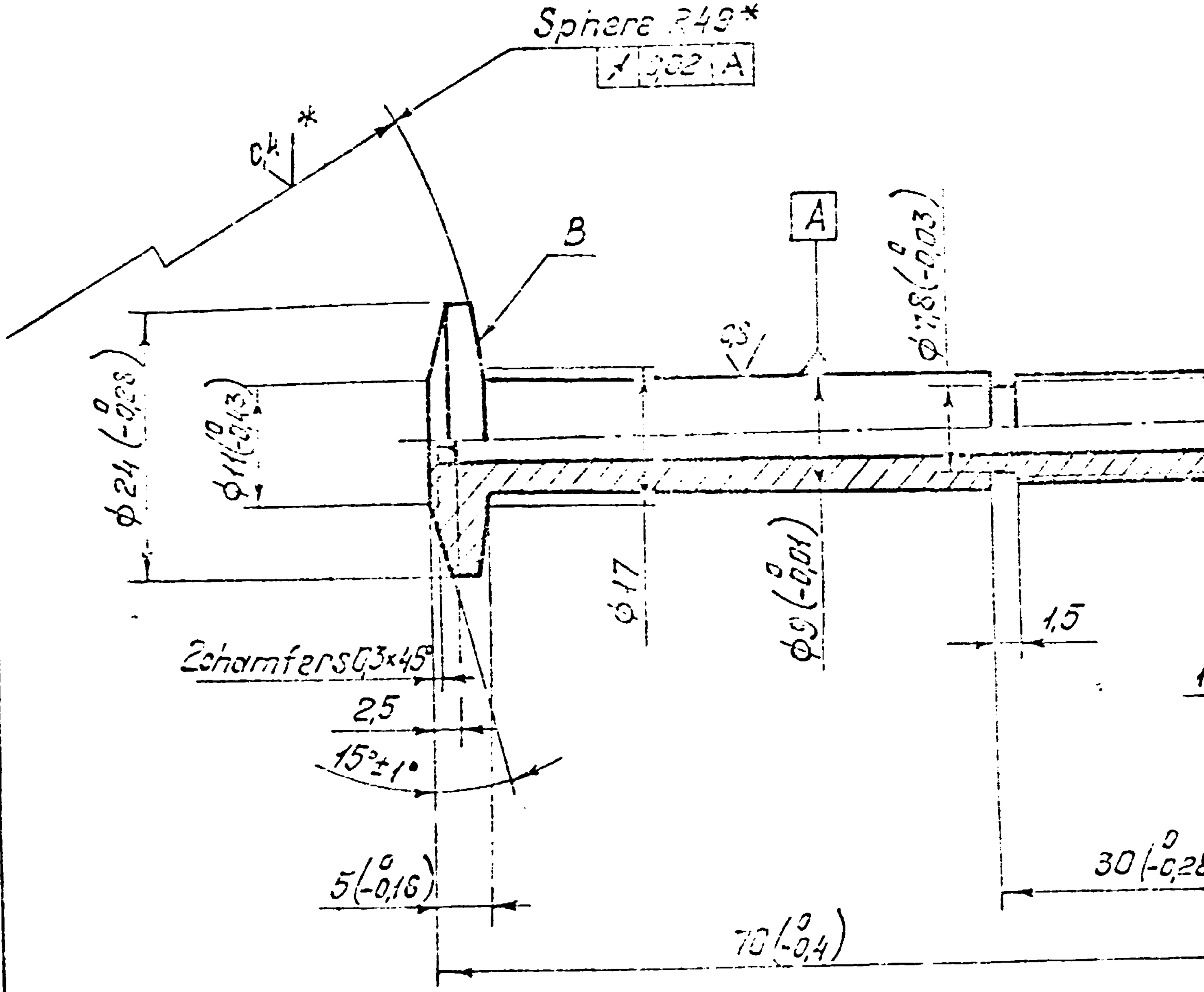
SECTION 1



1. Carburize h 0,8...1,2mm, except the thr...
2. 56...61 HRCэ
3. H14; h14; $\pm\frac{IT14}{2}$
4. *The dimension for information.
5. ** The dimensions and roughness are ...
6. The dimensions put in brackets mu... ...ed after the assembly

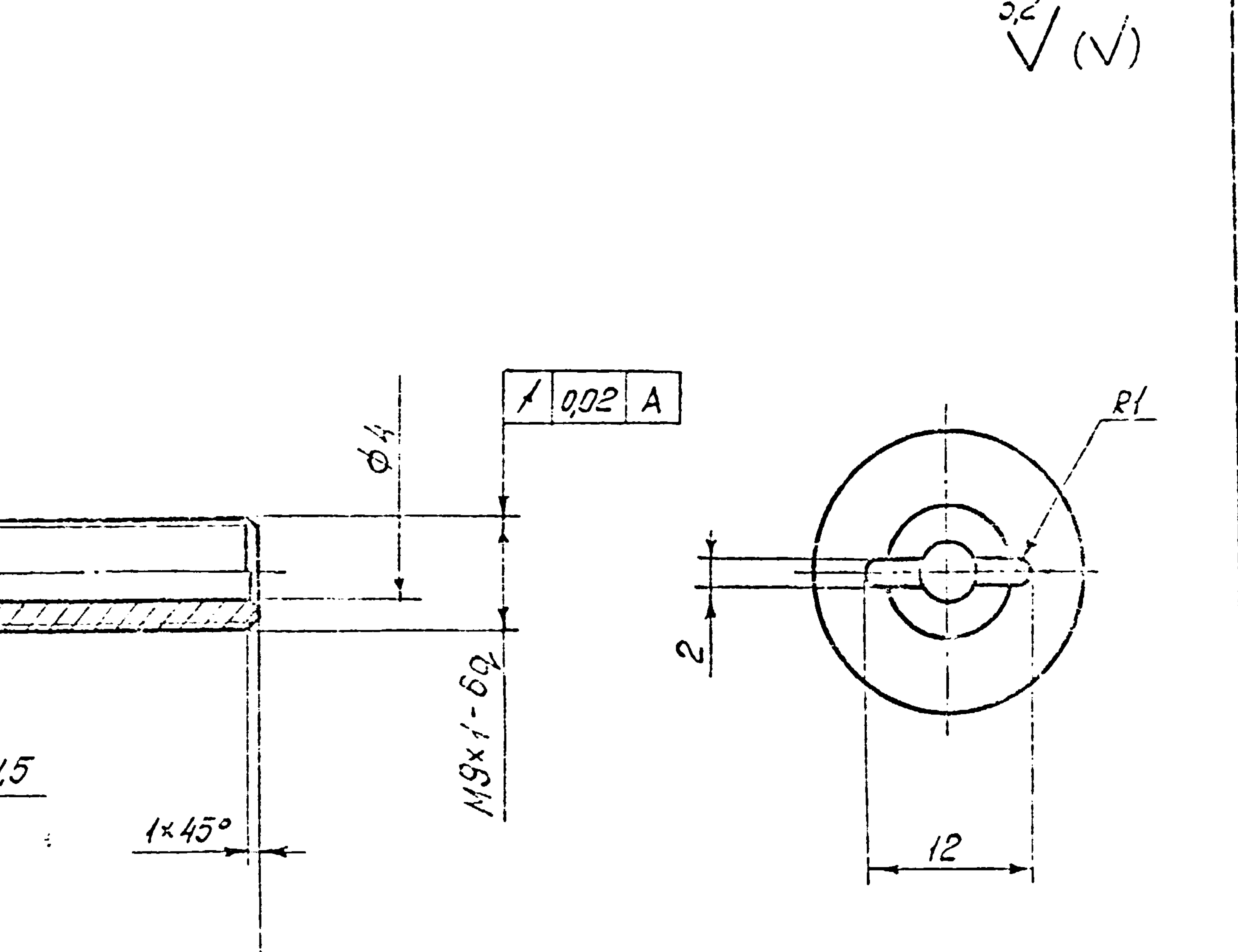
SECTION 2

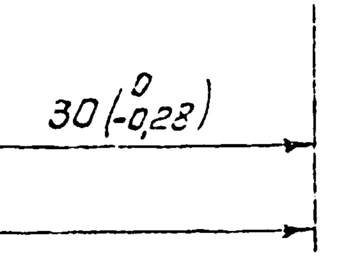
Designer	Insert	Scale
Chief Designer	Steel 12XH3A	LITMO



Sphere R49*
0,02 A
0,4 *
B
A
0,8
ϕ 24 (0 / -0,28)
ϕ 11 (0 / -0,43)
ϕ 17
ϕ 9 (0 / -0,01)
ϕ 11,8 (0 / -0,03)
1,5
2chamfers 0,3×45°
2,5
15°±1°
5 (0 / -0,16)
30 (0 / -0,28
70 (0 / -0,4)

SECTION 1





1. 36...43,5 $HRC_э$
2. H14; h14; $\pm\frac{IT14}{2}$
3. *The dimension and roughness are after coating.
4. Fit in the dimension B with the piece 310.012
   Contact must be no Less than 95%
   Check for contact by paint
5. Coating: Chemical oxidation

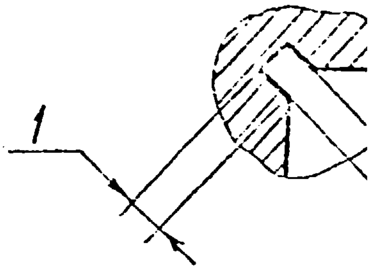
SECTION 2

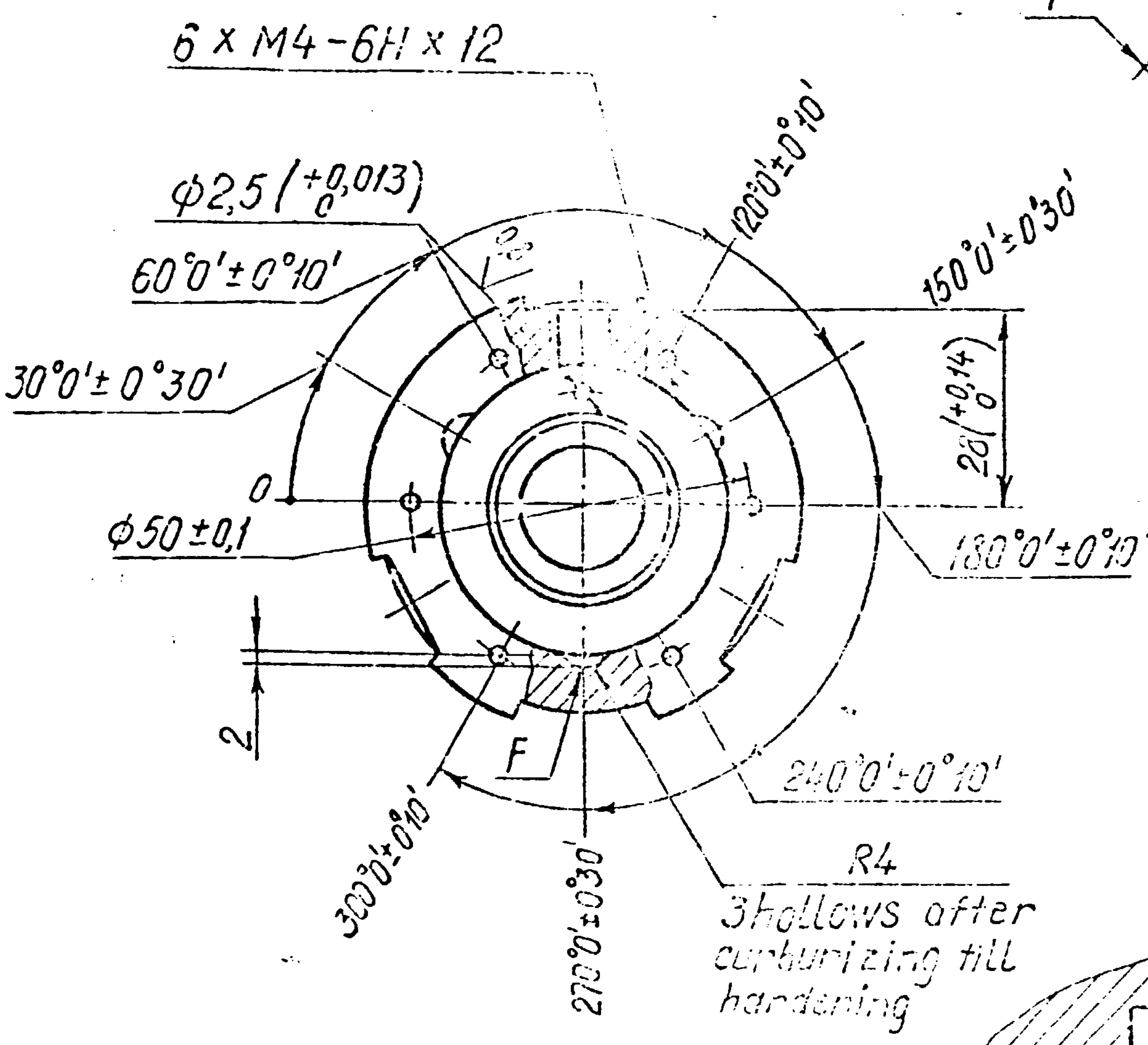
310.011		
Mushroom	Mass	Scale
		2:1
Steel 40X	LTTMO	

Designer

Chief Designer

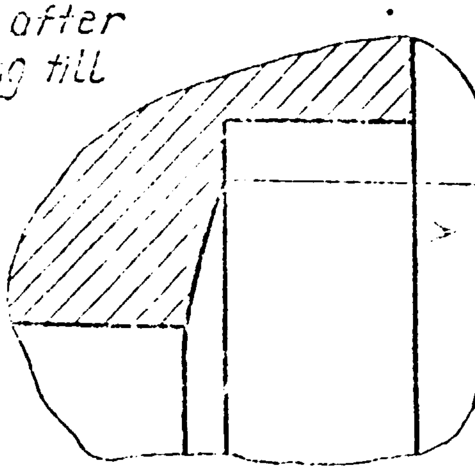
B (5:



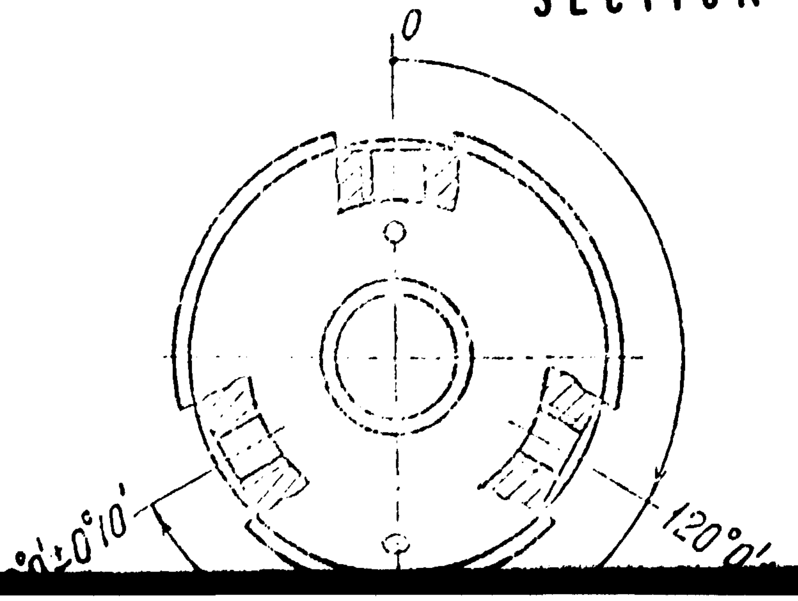


A

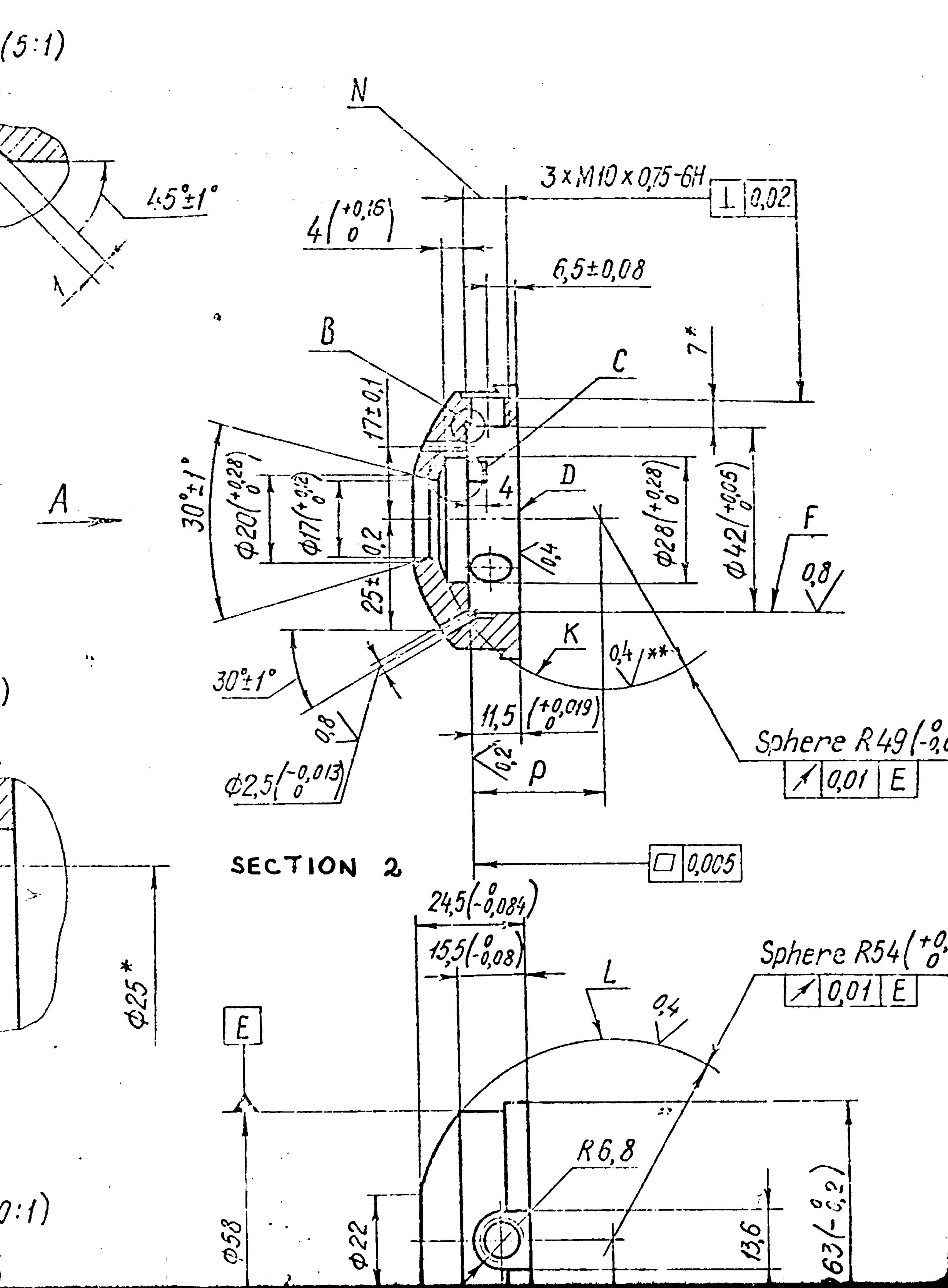
C (5:1)

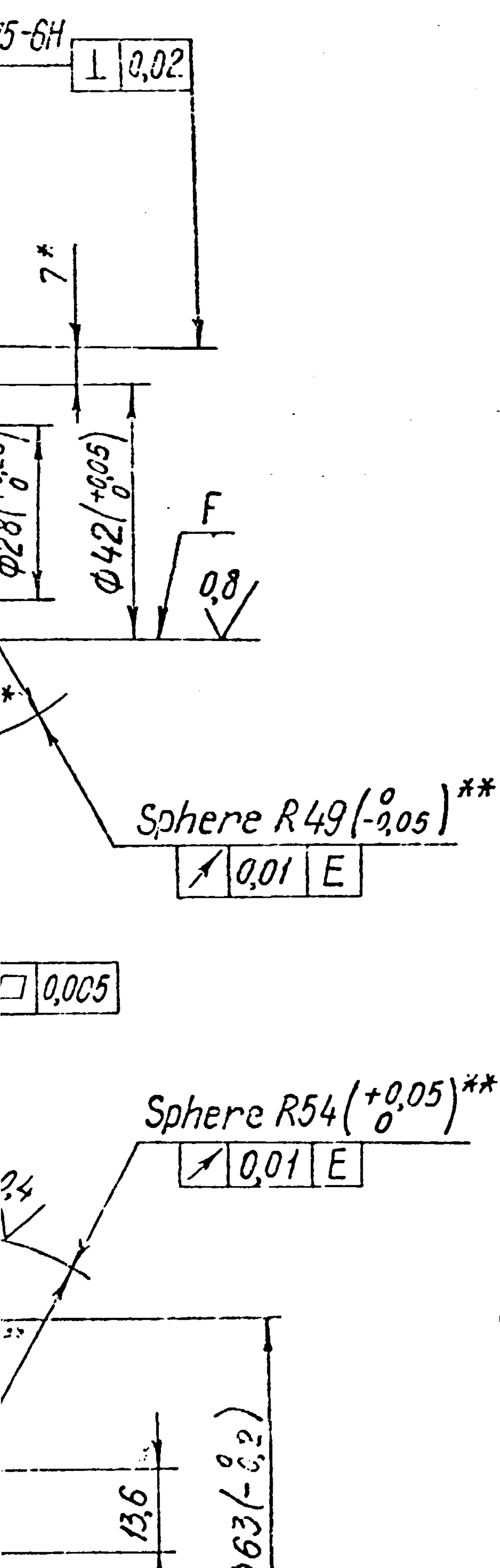


SECTION 1



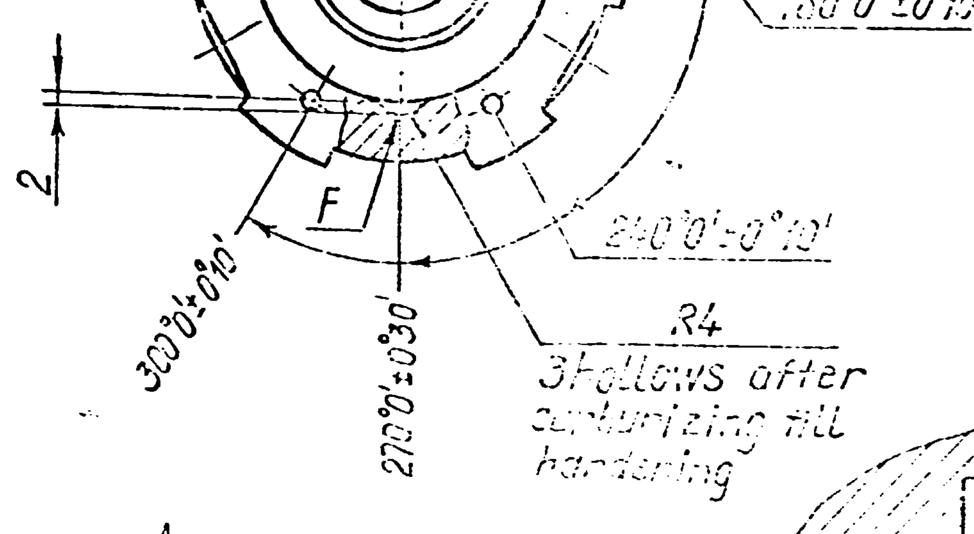
D(10:1)


(5:1)
N
3 x M10 x 0,75-6H
⊥ 0,02
4 (+0,16 0)
45°±1°
6,5±0,08
B
C
7*
17±0,1
30°±1°
A
Φ20 (+0,28 0)
Φ17 (+0,12 0)
0,2
4
D
Φ28 (+0,28 0)
Φ42 (+0,05 0)
F
0,8
0,4
25±
K
0,4 **
30°±1°
0,8
11,5 (+0,019 0)
Φ2,5 (-0,013 0)
0,2
P
Sphere R49
↗ 0,01 E
SECTION 2
□ 0,005
24,5 (0 -0,084)
15,5 (0 -0,08)
Φ25*
Sphere R54
↗ 0,01 E
L
0,4
E
R6,8
Φ58
Φ22
13,6
63 (0 -0,2)
0:1)

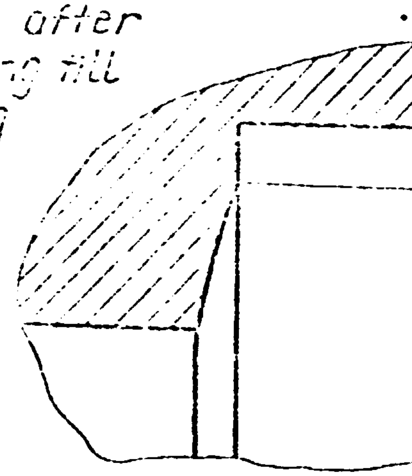


SECTION 3

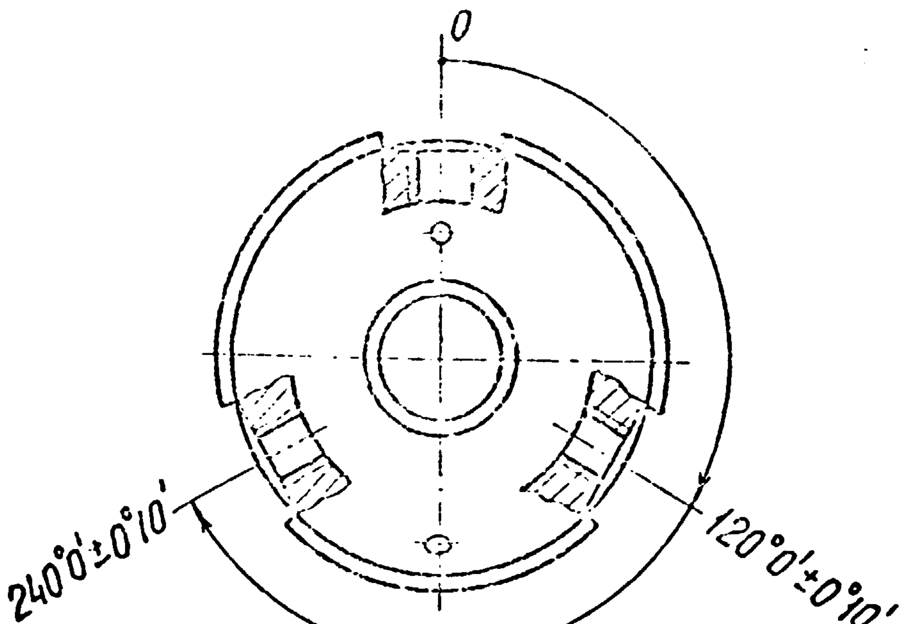
1. Carburize in depth h0,8 ... 12 except the surfaces E, F, G, H and thread holes M and N
51,5 ... 56 HRCэ
2. H14, h14, $\pm \frac{IT14}{2}$
3. *The dimensions for information
4. **The dimensions and roughness are after coating
5. Check the dimension L by the template R54 before the fitting in.
Fit in the dimension L and the piece 310.016. Contact must be no less than 95 %. Check the pieces for contact by paint.
6. Check the dimension K by the template R49 before fitting in. Fit in the dimension K and the piece 310.011
Contact must be no less than 85 %. Check for contact by paint.
7. Measure the dimension P accurate



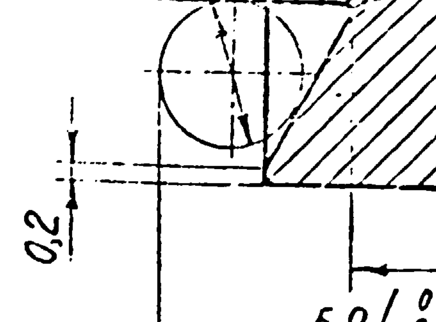
C (5:1



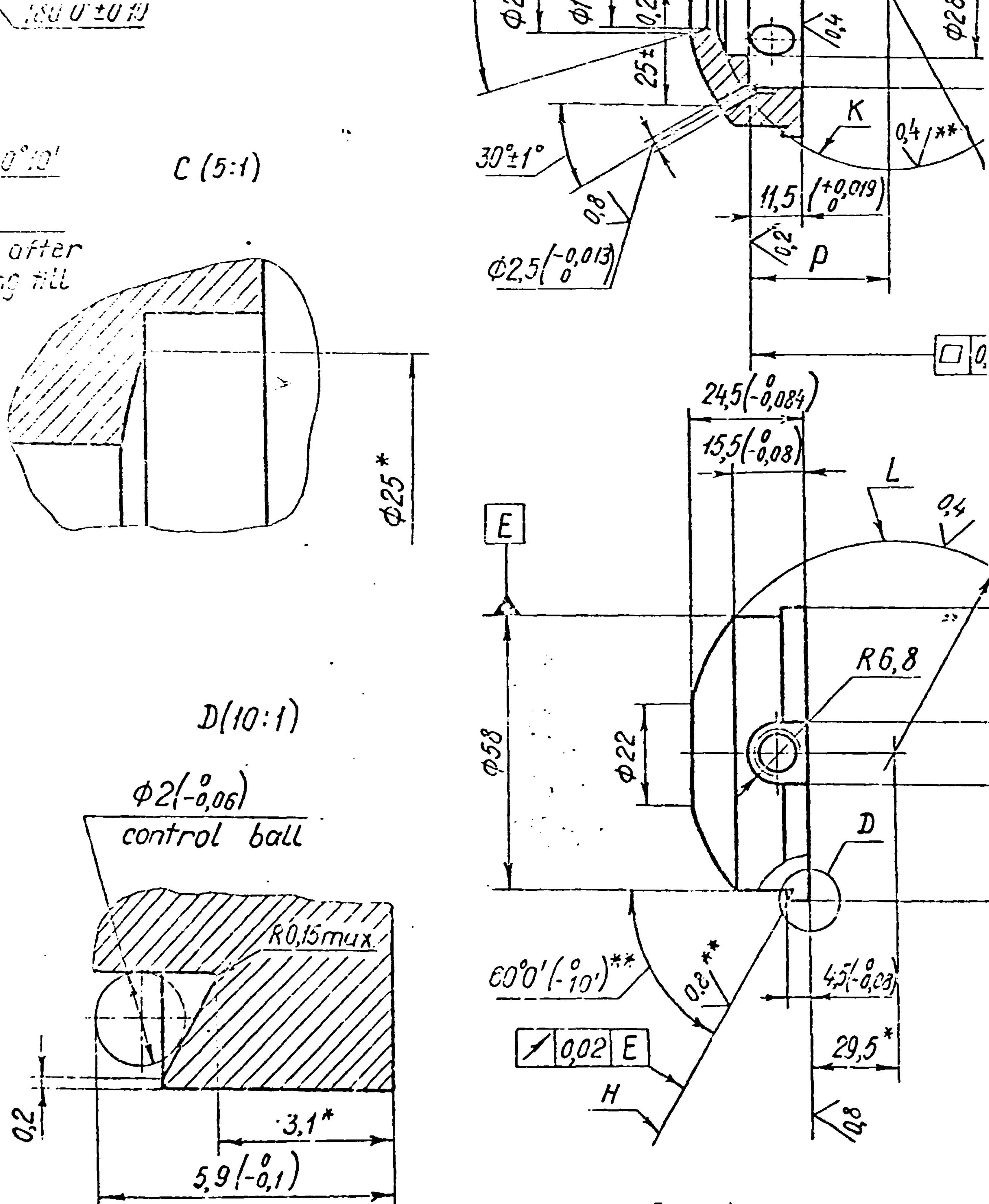
A



D(10

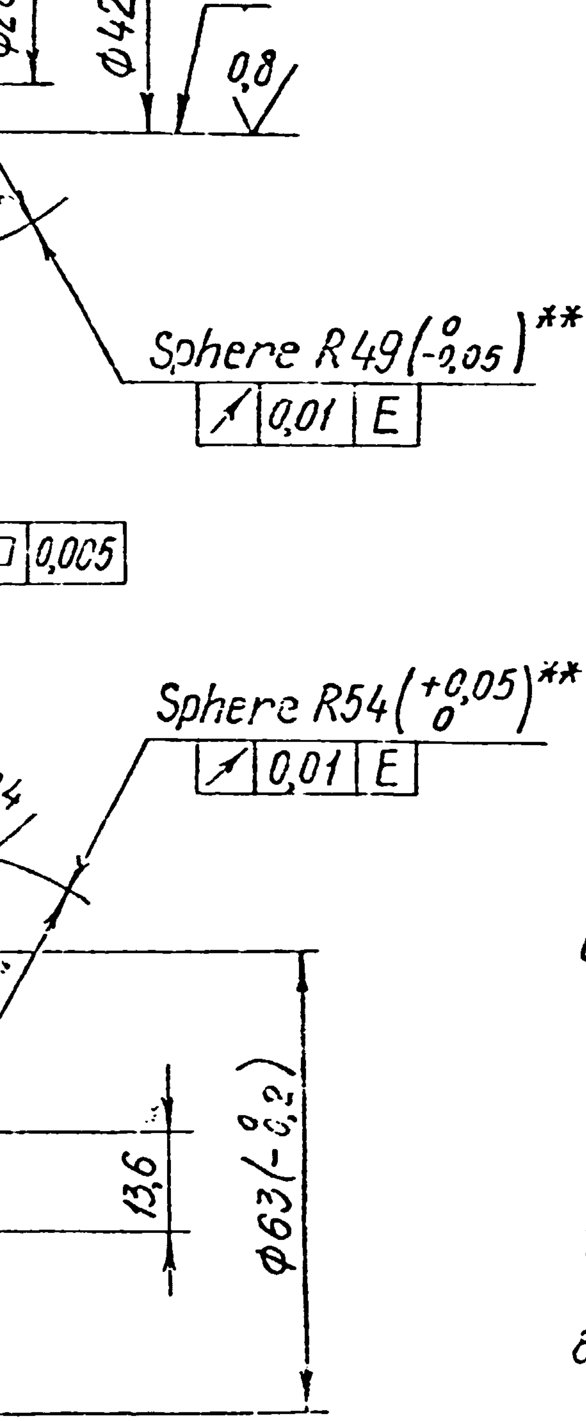


SECTION 4



C (5:1)
after
Φ25*
D(10:1)
Φ2(-0,06 / 0)
control ball
R0,15max
0,2
3,1*
5,9(-0,1 / 0)
30°±1°
0,8
Φ2,5(-0,013 / 0)
25±
K
0,4
11,5
(+0,019 / 0)
P
24,5(-0,084 / 0)
15,5(-0,08 / 0)
L
E
Φ58
Φ22
R6,8
D
60°0'(-10' / 0)**
0,8**
4,5(-0,03 / 0)
0,02
H
29,5*

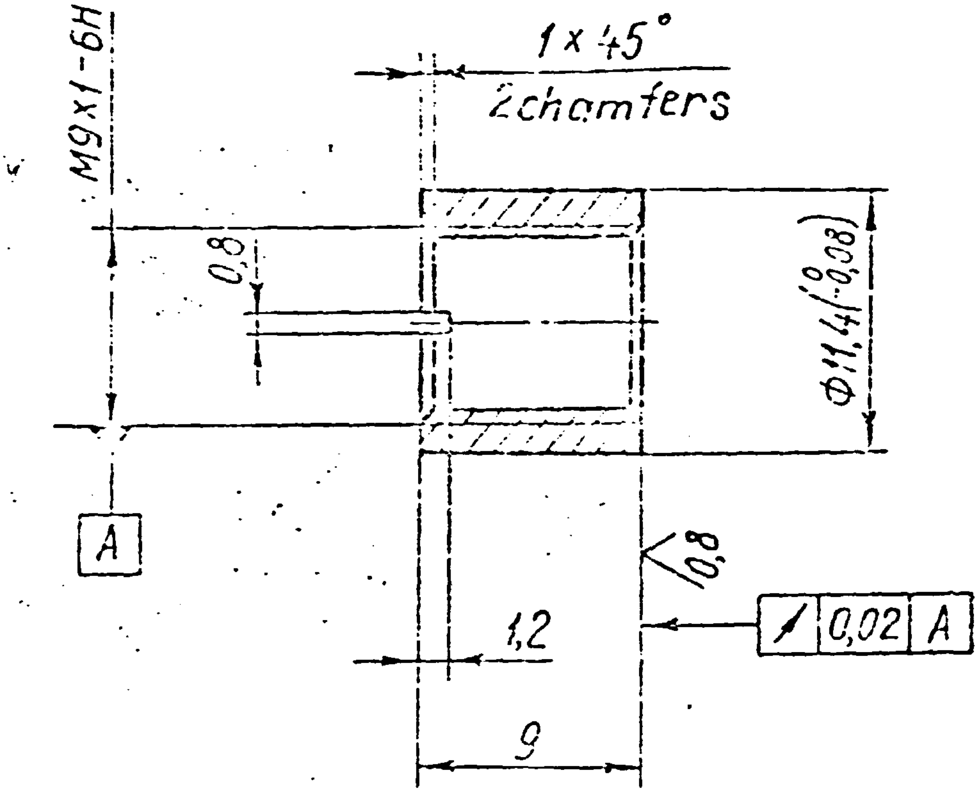
SECTION 5



1. Carburize in depth h0,8 ... 12 except the surfaces E, F, G, H and thread holes M and N 51,5 ... 56 HRC э
2. H14, h14, $\pm \frac{IT14}{2}$
3. *The dimensions for information
4. **The dimensions and roughness are after coating
5. Check the dimension L by the template R54 before the fitting in. Fit in the dimension L and the piece 310.016. Contact must be no less than 95%. Check the pieces for contact by paint.
6. Check the dimension K by the template R49 before fitting in. Fit in the dimension K and the piece 310.011 Contact must be no less than 85%. Check for contact by paint.
7. Measure the dimension P accurate to 0,01mm. using the basic holder
8. Fit in the piece 310.002 with interference 0,01 ... 0,015 mm.
9. Coating Chemical oxidation

SECTION 6

	310.012		
Designer	Segment	Mass	Scale 1:1
		Sheet	Sheets 1
Chief Designer	Steel 20X	LITMO	

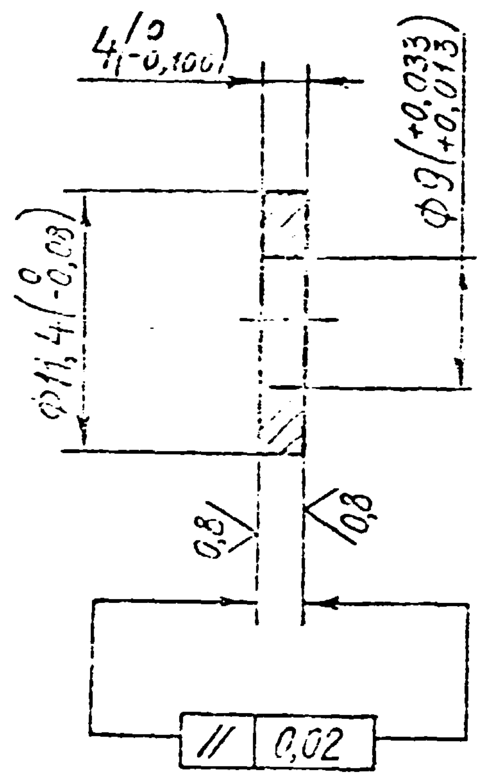


1. H14, h14; $\pm \frac{IT14}{2}$
2. Coating: Chemical oxidation.

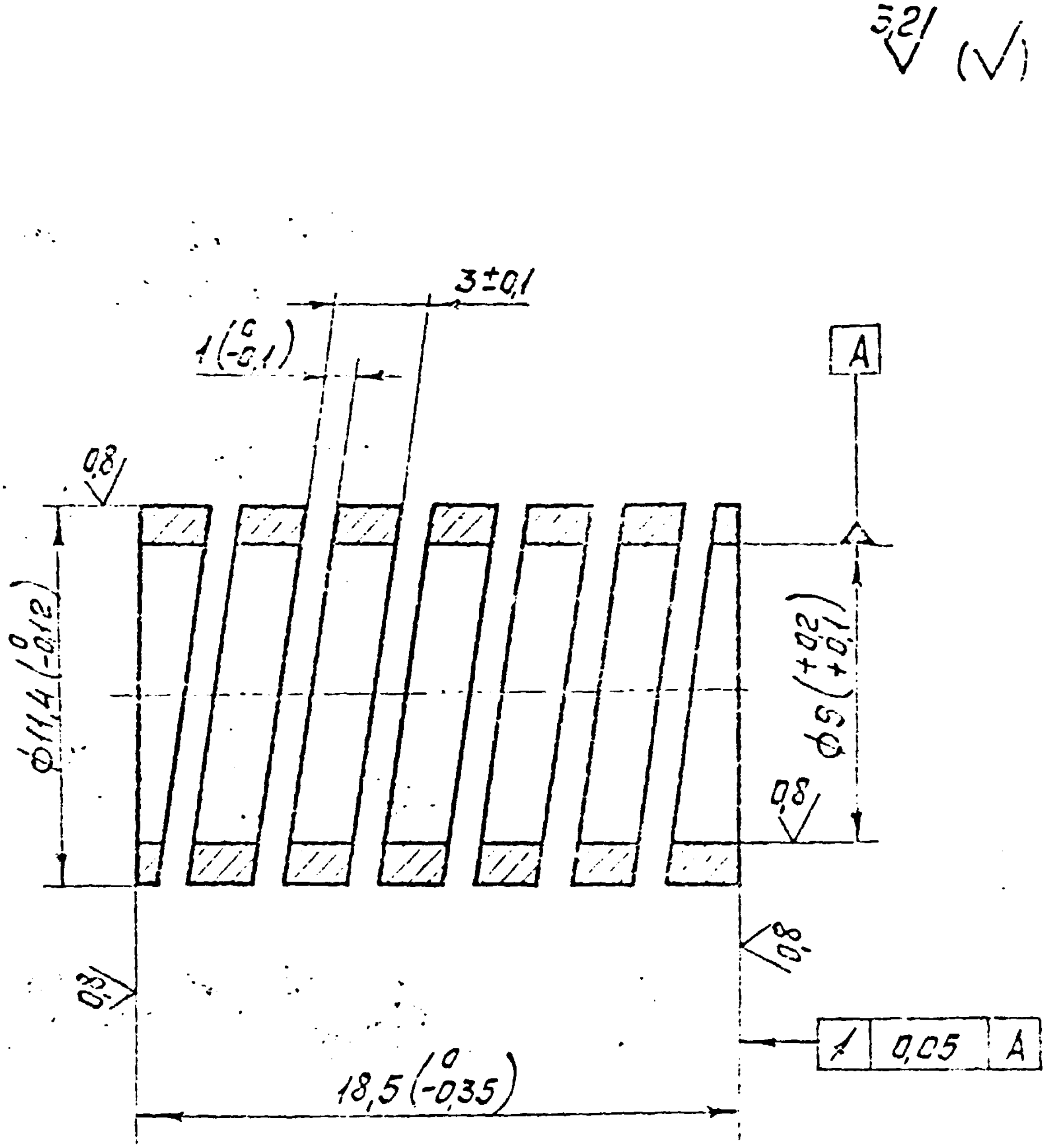
	310. 013	
Designer	Nut	Mass / Scale 2:1
		Sheet / Sheets 1
Chief designer		LITMO

Form A4

V(√)

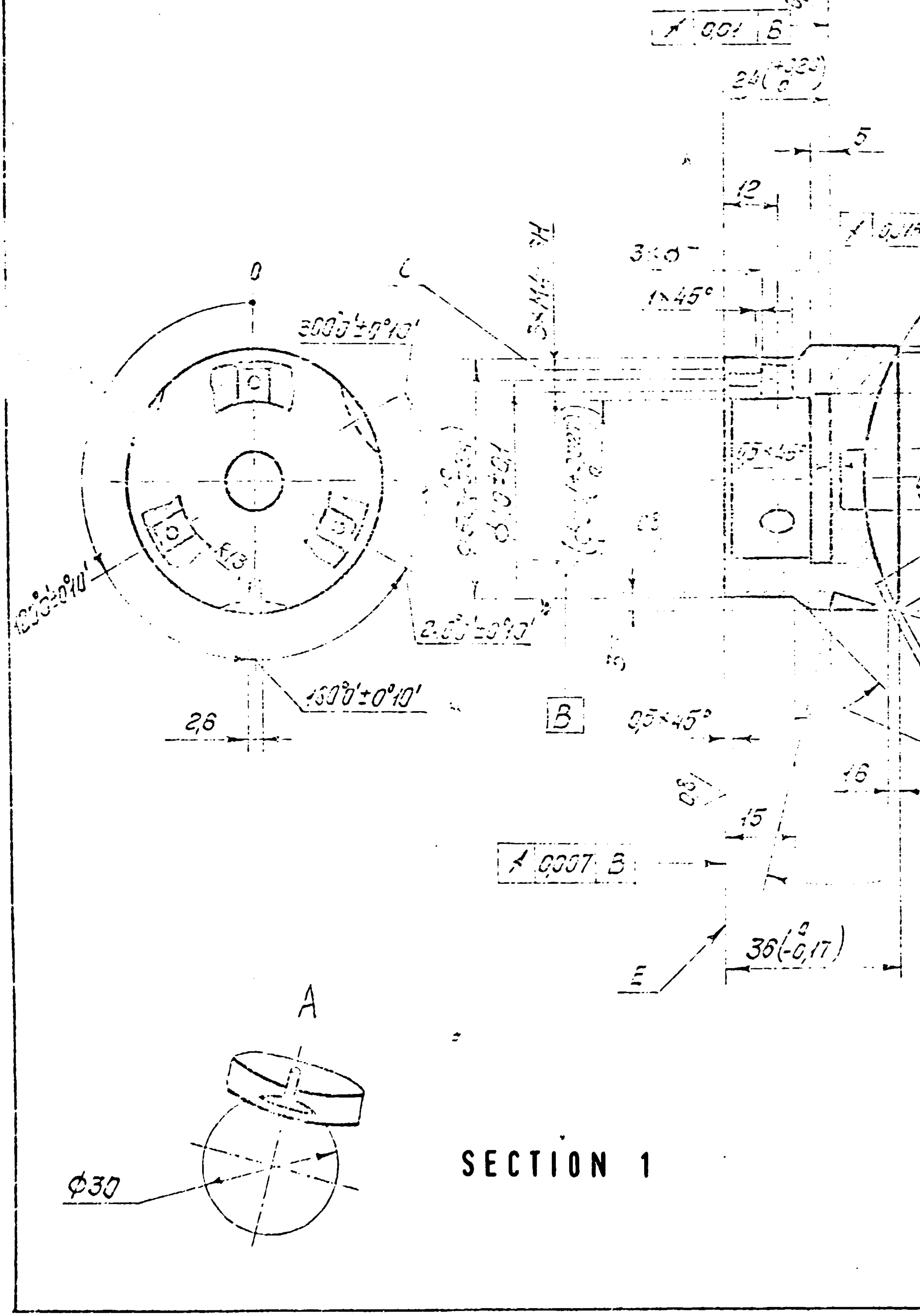


010. 014		
Washer	Mass	Scale
		2:1
	Sheet	Sheets 1
Designer		
Chief Designer		
Steel 50	LITMO	

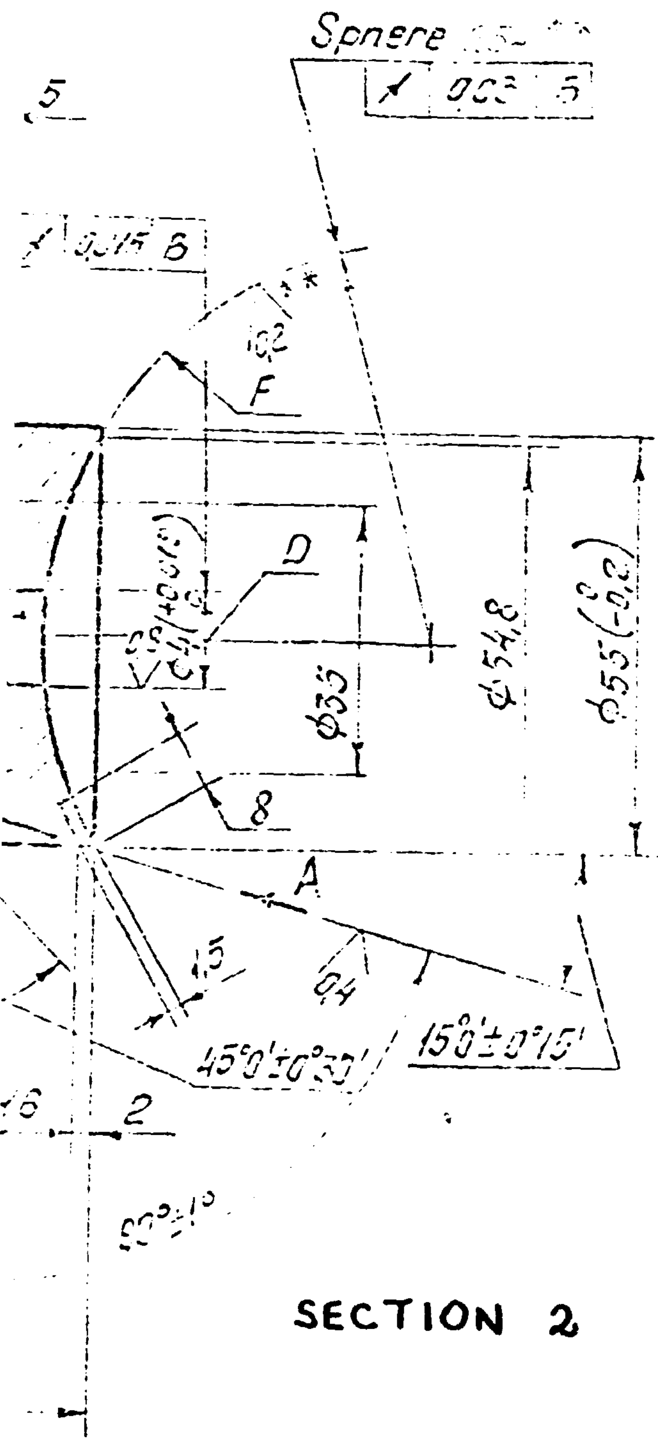


1. 51,5...56 HRC$_э$
2. Coating Chemical oxidation.

Designer	310.015	
Chief Designer	Spring	Mass / Scale 5:1
		Sheet / Sheets 1
	Steel У8А	LITMO



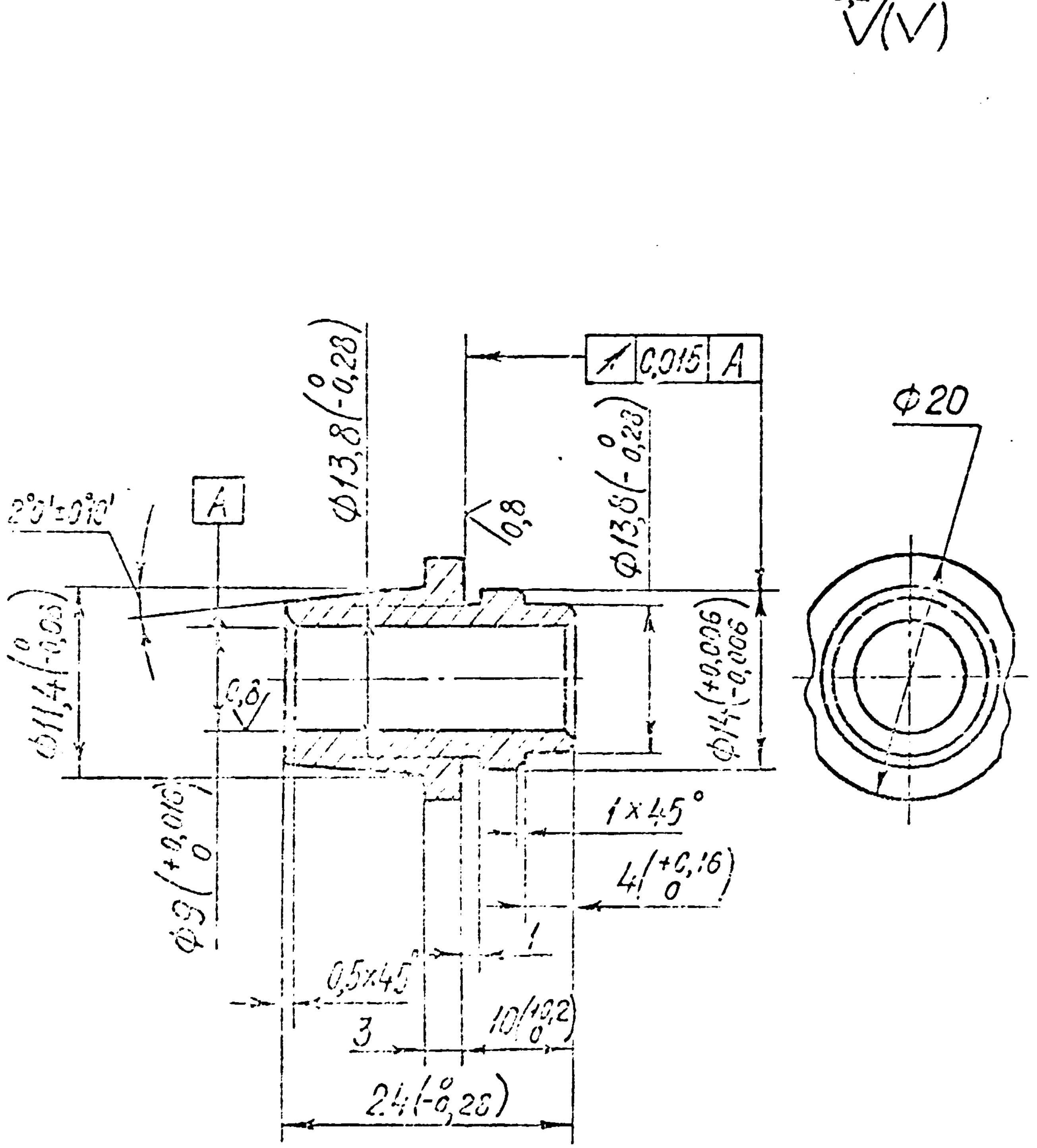
SECTION 1



SECTION 2

1. Carburize in depth 0,8... mm except the holes C and D and surface
2. 61...66 HRCэ
3. H14; h14; ± IT14/2
4. * The dimension for information
5. ** The dimensions and the r... are after coating
6. Fit in the sphere surface F and piece 310.012. Contact of these surfaces must be not less than 95%. Check pieces for contact by paint.
7. Bracket dimension must be carry out after assembly
8. Coating Chemical oxidation

	310.016	
	Body	Mass
Designer		
Chief Designer	Steel 15X	LITMO



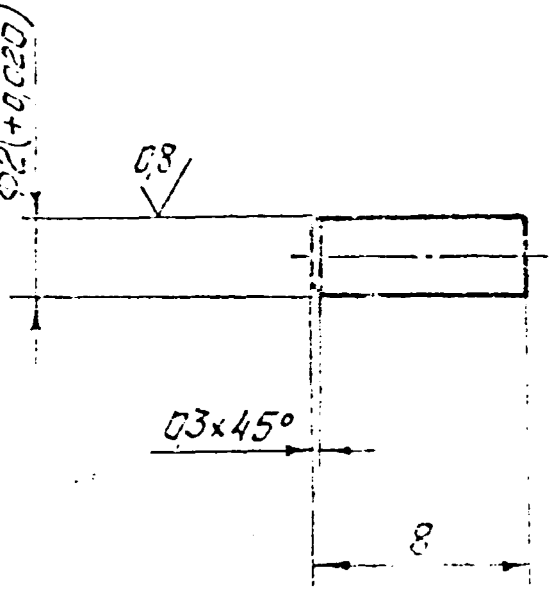
1. H14; h14
2. Coating Chemical oxidation

310. 017				
		Mass	Scale	

Bushing

Steel 50

$\sqrt{3,2}$ ($\sqrt{}$)



1. h14
2. 41,5 ... 46,5 HRC$_Э$

					310. 018	
					Pin	Mass / Scale: 5:1
Designer						Sheet / Sheets 1
Chief Designer					Steel 50	LITMO

320.000 AUTO-COLLIMATED TUBE
(Centring Adjusting Device for centring of lenses in holders)

AUTO-COLLIMATED TUBE FOR THE CENTRING LENSES IN THE MOUNTS
(centring device)

Technical description and service manual

1990

Content

page

Appendix 1. Table of positions of autocollimation points according to device scales (positive autocollimation distances).

Appendix 2. Table of positions of autocollimation points according to microscope scales (negative autocollimation distances).

1. PURPOSE

Auto-collimated tube is designed to the centring lenses in the mounts directly during centring on the lathe and to test centring of lenses in the mounts at the technical inspection. Microscope provides the centring test of single and cemented lenses also. Centring of lenses of any thickness from 3 to 200 mm in diameter can be tested with this device.

2. Technical data

Angula magnification (when setting the objective to infinity) .... 19^{x}

Eyepiece magnification .... 15^{x}

Minimum scale factor of the eyepiece graticule, mm 0.002

Scale factor of the eyepiece graticule when setting the objective to infinity:

in angular measure .... 15''

in linear measure, mm 0.1

Measurement ranges of the distance between the objective tube end and the plane observed, mm .... from +60 to + ∞ and from - ∞ to - 160

Focal distance of the objective, mm 40

3. Arrangement and operation of the device

An autocollimation method is used to test lens centring.

The device consists of an autocollimation tube and a stage which has a fitting socked for fluoroplastic rings and a vacuum channel connecting with a pump via a rubber hose.

In the autocollimation tube rays of light from lamp 1 (Fig. 1) via the condensor 2 illuminate the mark (cross-hairs) cut in the aluminium layer of the mirror 3. When the objective consisting of lenses 4 and 5 is moved along the optical axis of the device the mark is projected to the curvature centre of the first spherical of the test lens 6. The image of the luminous mark after reflecting from the surface is projected on to the mirror 3 and examined through the microscope. If the optical axis of the lens (the axis passing the curvature centres of the both surfaces of the lens) does not coincide with its rotation axis, there will be observed a beating of the luminous mark image in the field of vision of the eyepiece. Decentring is evaluated from the scale of the graticule 7. This is the way to find the decentring of the upper surface of the lens. The lower surface lies with its sphere on the support ring, so its curvature centre is on the geometrical axis of the lens, if lenses are centred.

Shield glass 8 protects the device from chippings when the autocollimation tube is being mounted on the centring machine.

The base 9 (Fig. 2) of the device has a vertical column 10 with a linear scale. Autocollimation tube 12 is secured on the column by means of the stand 11. The stand can move along the column together with the tube with the help of the nut 13.

The tube is an alternative magnification autocollimation microscope. The tube 14 with an objective in the holder 15 moving inside the tube is screwed into the case of the autocollimation microscope. The tube has scales of positive and negative specimen distances in centimetres and relevant scale factors of the eyepiece graticule in micrometers.

When setting the objective to the positive specimen distances the specimen point of the microscope must be outside the tube end and when it is done to the negative distances - inside the tube (the opposite side of the objective).

The illumination system is mounted in the chuck 16. The light source (lamp PH12-30) is fastened inside the chuck. There are two screws 17 to adjust the illumination system on the chuck case.

There is a vacuum channel 18 at the base of the device which is connected with the pump through a hose. The vacuum device presses the lens to the support ring during its checking. Whén being rotated the lens rests on the prism 19 with its lateral surface. Screws 20 are intended to mount the prism according to the diameter and height of the test piece.

Inter-perpendicular inclination of the tube is done using control screws 21. A knurled nut 22 serves for micrometric displacement of the objective in the tube.

4. Operational sequence

4.1. Select a ring and prism for the lens according to its diameter. The ring is selected so that its diameter could be a bit less than that of the test lens since the latter must rest with its base surface on the sphere.

4.2. Screw the ring into the socket on the device stage.

4.3. Adjust the position of the tube by checking the position of the autocollimation glare (ghost image) when setting the objective to "∞" and the position of the light spot when setting the objective to "6".

Put a plane-parallel plate in the centre of the specimen stage. Set the objective alternatively to "∞" and "6" according to the positive specimen distances an autocollimation image of the mark of the plate when setting the objective to "∞" must be near the centre of the tube field of vision. At the same time the light spot of the objective in the position "6" when focussed to the plate (using cigarette paper) must be in the centre of the socket for rings.

4.4. Mount a matching prism.

4.5. Put the test lens on the ring of the base surface, the lens being centred relative to the ring (by sight).

4.6. Mount the prism with respect to the lens so that the lens end is against the prism (in a cemented lens the end of the lens which is a filling one in assembly, is resting on the prism).

In order to check decentring of a single lens it is essential to know the radius of the upper surface and for a cemented lens - the position of the autocollimation points for all surfaces relative to the upper surface (upper surface is the lens surface closest to the tube). The test surface curvature centre shown through upper surfaces is identified as an autocollimation point.

The positions of autocollimation points are found from calculations and indicated in the drawing of the test piece (cementing). If one knows the position of an autocollimation point it is necessary to find the position of the objective and tube for the test surface from the table (see appendix) or by calculation. The lens decentring is checked by beating of the autocollimation image of the mark in the eyepiece field of vision when the test lens is rotating around its axis.

For fast checking it is necessary to keep a log as follows:

Base surface radius	Test surface radius	Distance between autocollimation point of the test surface and upper surface	Specimen distance scale objective position	Tube position on the column	Allowable decentring	Allowable beating of a mark in divisions
1	2	3	4	5	6	7

Data for the columns 1,2,3 and 6 can be taken from drawings for test pieces whereas those for the columns 4 and 5 - from Tables (See appendices). Data for the column 7 are obtained by calculations. The Tables can be applied only if in zero position of the linear scale on the column 10 the tube end touches the upper plane of the fluoroplastic ring.

The data in the Tables are calculated from the formula

$$a + k + d = n \qquad (1)$$

where a - distance between an autocollimation point and the lens upper surface;

k - objective specimen distance (position according to the scale of tube specimen distances);

d - lens thickness;

n - position of the tube on the column.

N o t e: When calculating it is necessary to take into account the sign of values "a" and "k"; the design value of "k" must be in millimetres.

4.7. Set the objective and tube on the column to the divisions relevant to the test surface. The luminous mark which starts moving with the lens displacemenet must be visible in the field of vision.

If the distance between the autocollimation point of the test surface and the upper surface is not large then autocollimation image of the mark can be easily found without using the tables.

In this case it is required:

4.7.1. To set the objective to the division "6" according to the scale of specimen distances.

4.7.2. To bring the light spot from the objective into focs on the upper surface of the lens by moving the tube along the column (using cigarette paper); care must be taken that it should be in the centre.

4.7.3. To notice using the linear scale the position of the tube on the column which must correspond to that of the focussed light spot on the lens surface.

4.7.4. To lower (if the surface is convex) or to lift (if the surface is concave) the tube by the value of the curvature radius of the test surface.

4.7.5. An autocollimation image of the luminous mark must appear in the field of vision of the eyepiece.

5. Technical condition examination

5.1. Align the position of the tube as indicated in subdivision 5.2. If the conditions of this subdivision are met when screws 21 are in a mid-position, the instrument should be adjusted by tilting the tube with the released screws 23 which fasten the tube to the stand axis and the axis to the stand.

5.2. Put an object-micrometer on the stage. Mount the objective against the scale factor tested. Strive for a sharp image of the graticule of the object-micrometer by moving the tube along the vertical column. Count the number of "ℓ" divisions of the eyepiece graticule in "m" divisions of the object-micrometer graticule image and find the scale factor L of the eyepiece graticule in micrometers to measure decentring from the formula

$$L = \frac{m \cdot 1000}{4\,\ell} \qquad (2)$$

In this manner check whether the scale factor of the graticule in its different positions.

Departure from the scale factor engraved on the tube must not exceed 10 pct.

6. Maintenance

Device should be maintained clean as any precision measuring instrument.

The outer surfaces of optical pieces are cleaned from dust with an ether degreased squirrel hair brush and then with a clean napkin. If there is a grease stain on the glass surface the napkin should be slightly wetted with ether, making sure there is no ether under the lens chuck.

7. Storage

When idle the instrument must be stored in a tool box. Unpacking and storage can be done in a dry heated room free from acid or alkaline vapours. The temperature of (20+10)°C and relative humidity no more than 80% must be maintained in the room.

For a long-term storage unpainted parts must be covered with an anti-corrosive grease.

Appendix 1

Table of autocollimation points positions on the scales of autocollimated tube.

(Autocollimation distances are positive)

Autocollimation distance+ lens thickness, mm a	Scale position of		Scale factor, 1
	objective, cm k	vertical column, mm l	
1	2	3	4
0	+6	60	2 or 4
+10	+6	70	2 or 4
+20	+6	80	2 or 4
+30	+6	90	2 or 4
+40	+6	100	2 or 4
+50	+6	110	2 or 4
+60	+6	120	2 or 4
+70	+6	130	2 or 4
+80	+6	140	2 or 4
+90	+6	150	2 or 4
+100	+6	160	2 or 4
+110	+6	170	2 or 4
+120	+6	180	2 or 4
+130	+6	190	2 or 4
+140	+6	200	2 or 4
+150	+6	210	2 or 4
+160	+6	220	2 or 4
+170	+6	230	2 or 4
+170	-16	10	9
+180	-16	20	9

+190	-16	30	9
+200	-16	40	9
+210	-16	50	9
+220	-16	60	9
+230	-16	70	9
+240	-16	80	9
+250	-16	90	9
+260	-16	100	9
+270	-16	110	9
+280	-16	120	9
1	2	3	4
+290	-16	130	9
+300	-16	140	9
+300	-20	100	13
+320	-20	120	13
+340	-20	140	13
+360	-20	160	13
+360	-30	60	21
+380	-30	80	21
+400	-30	100	21
+450	-30	120	21
+500	-30	200	21
+550	-50	50	34
+600	-50	100	34
+700	-50	200	34

The factor is 15 "when the autocollimation distance + lens thickness is more than + 700 mm with " " position on the objective scale and any position on the vertical column scale.

Appendix 2

Table of autocollimation points positions on the scales of tube.

(Autocollimation distances are negative)

1	2	3	4
0	+6	60	2 or 4
-10	+6	50	2 or 4
-20	+6	40	2 or 4
-30	+6	30	2 or 4
-40	+6	20	2 or 4
-40	+7	30	6
-50	+7	20	6
-60	+10	40	9
-70	+10	30	9
-80	+10	20	9
-80	+12	40	11
-90	+12	30	11
-100	+12	20	11
-100	+14	40	12
-110	+14	30	12
-120	+14	20	12
-120	+20	80	17
-130	+20	70	17
-140	+20	60	17
-150	+20	50	17
-160	+20	40	17
-170	+20	30	17

1	2	3	4
-180	+20	20	17
-190	+20	10	17
-190	+30	110	25
-200	+30	100	25
-210	+30	90	25

-220	+30	80	25
-230	+30	70	25
-240	+30	60	25
-250	+30	50	25
-260	+30	40	25
-270	+30	30	25
-280	+30	20	25
-290	+30	10	25
-300	+30	0	25
-300	+50	200	35
-340	+50	100	35
-380	+50	120	35
-400	+50	100	35
-440	+50	60	35
-480	+50	20	35
-490	+50	10	35
-500	+50	0	35

The scale factor is 15 "when the autocollimation distance + lens thickness is more than - 500 mm with " " position on the objective scale and any position on the vertical column scale.

Fig.1 - Optical layout of the instrument.
Fig.2 - General view of the instrument.

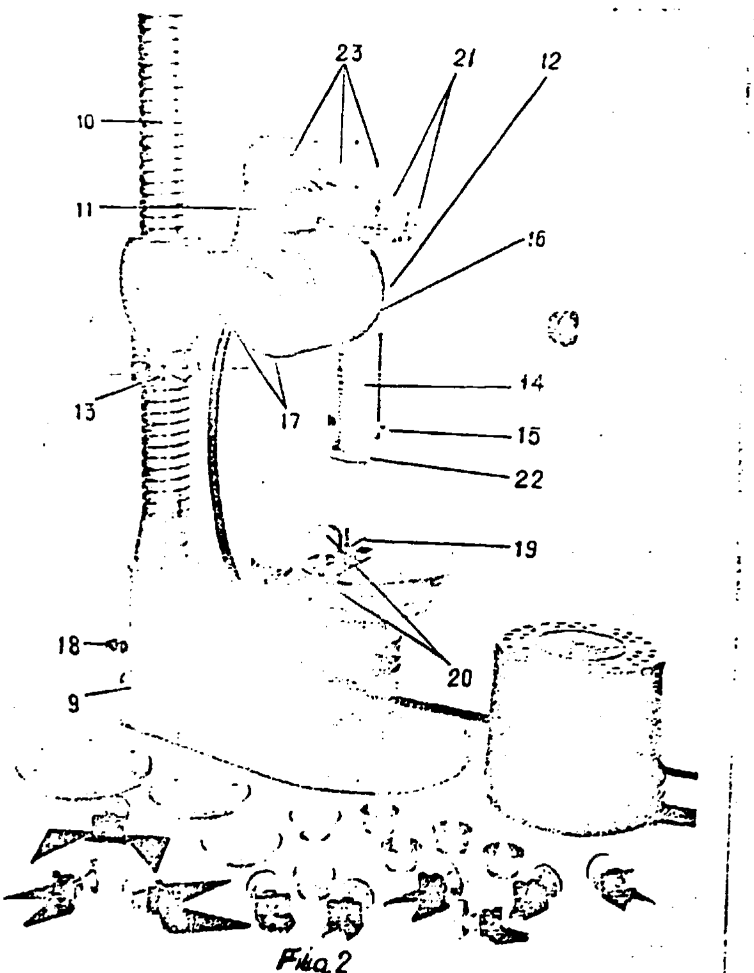


Fig.2

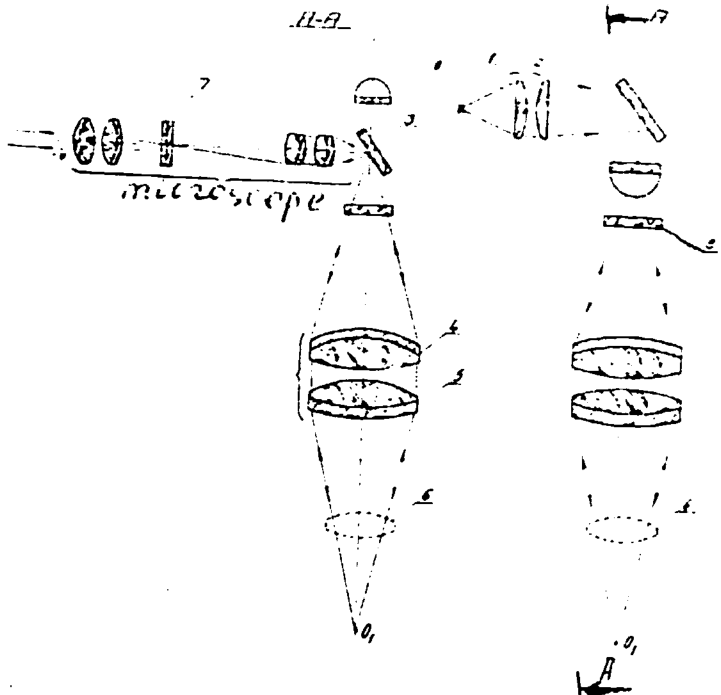


Fig. 1

Optical scheme

Zone	Ref.N	Designation	Name	Quanti	Commen
			<u>Specification</u>		
		320.000 Ass	Assembling drawing		
			<u>Assembling units</u>		
	1	320.150	Testing device	1	
	2	320.160	Bushing with key	1	
	3	320.170	Bibb	1	
	4	320.190	Knife-edge support	1	
	5	320.200	Knife-edge support	1	
			<u>Pieces</u>		
	14	320.151	Bushing		1piece. ... is allowe... to repla... by the piec...

320.000		
Centring adjusting device	Sheet 1	Sheets 5
	LITMO	

...igner

...er

15	320.152	Bushing		is allowab… to replac… by the piec…
16	320.153	Base	1	
17	320.154	Stand	1	
18	320.155	Column	1	
19	320.156	Nut	1	
20	320.157	Ring	1	
21	320.158	Index	1	
22	320.159	Scale	1	
23	320.161	Knob	4	
24	320.162	Axle	1	
25	320.163	Head	1	
26	320.164	Label	1	
27	320.165	Flange	1	
28	320.166	Stage	1	
29	320.167	Segment	1	
30	320.168	Bushing	1	
31	320.169	Ring	1	
32	320.171	Cover	1	
33	320.172	Spacer	1	
34	320.173	Union	1	
35	320.174	Union	1	
36	320.175	Tube	1	
38	320.177	Pipe	1	
39	320.178	Guide	1	
40	320.179	Hook	1	
41	320.181	Pivot	1	
42	320.182	Plate	1	
43	320.183	Angle piece	1	

			320.000	Shee… 2

Zone	Ref.	Designation	Name	Quantity	Comments
			Standard units		
	50		Bolt M5-6g×20.58.05 ГОСТ 7805-70	3	
	51		Screw B.M5-6g×6.14H.05 ГОСТ 1476-84	1	
	52		Screw B.M8-6g×20.14H.05 ГОСТ 1476-84	1	
	53		Screw B.M5-6g×12.14H.05 ГОСТ 1477-84	2	
	54		Screw B.M3-6g×6.58.05 ГОСТ 1491-80	2	
	55		Screw B.M3-6g×8.58.05 ГОСТ 1491-80	2	
	56		Screw B.M3-6g×12.58.05 ГОСТ 1491-80	3	
	57		Screw B.M4-6g×8.58.05 ГОСТ 1491-80	3	
	58		Screw B.M4-6g×14.58.05 ГОСТ 1491-80	4	
	59		Screw B.M5-6g×20.58.05 ГОСТ 11644-75	2	

320.000

Sh

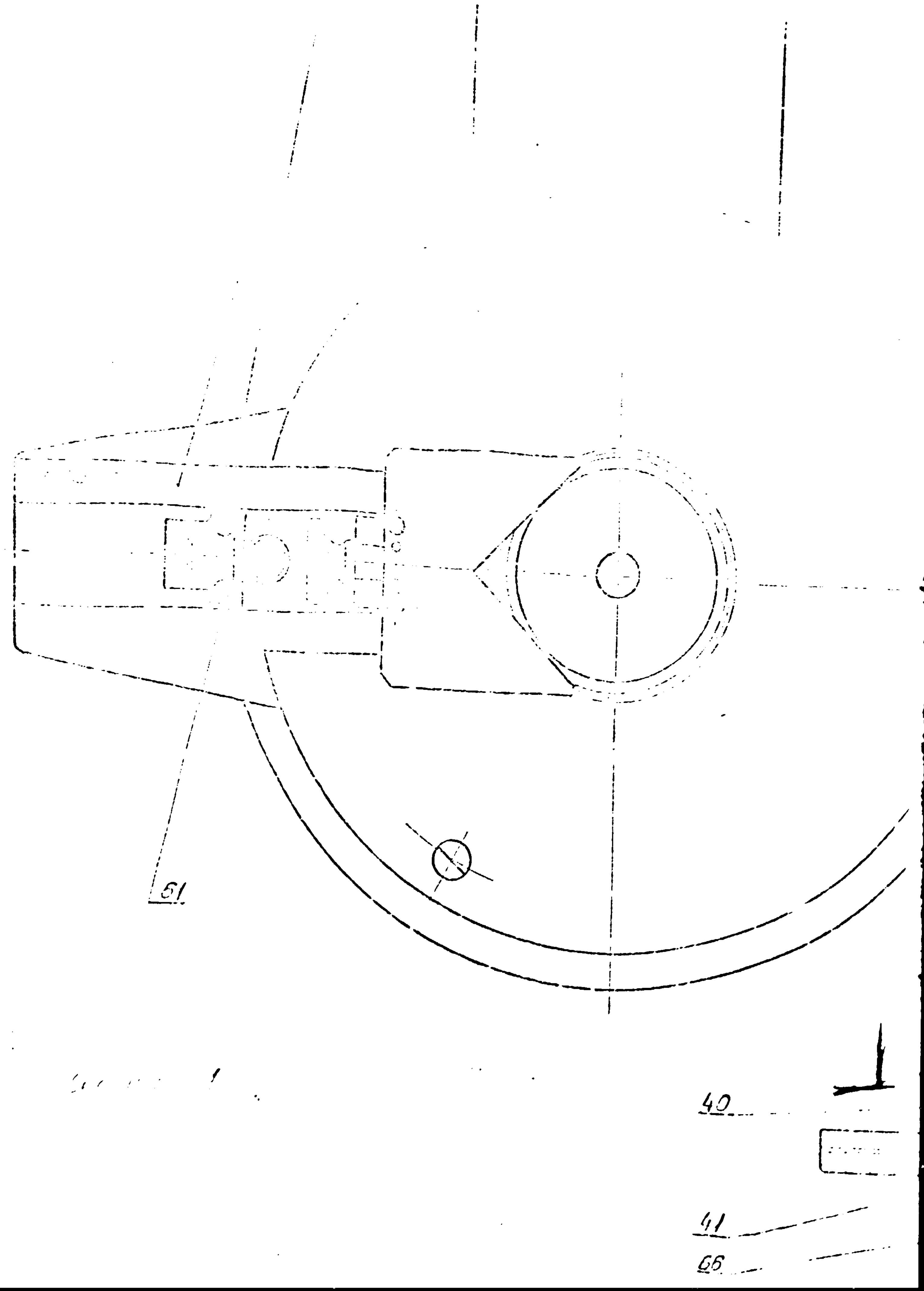
60		Screw B.M2-6g×5.58.04	9	
		ГОСТ 17473-80		
61		Screw B.M2,5-6g×4.58.04	3	
		ГОСТ 17473-80		
62		Screw B.M3-6g×12.58.05	3	
		ГОСТ 17475-80		
63		Screw B.M5-6g×14.58.04	3	
		ГОСТ 17475-80		
65		Screw B.M3-6g×15.58.04	1	
		ГОСТ 21332-75		
66		Screw B.M4-6g×18.58.04	1	
		ГОСТ 21332-75		
70		Washer 5.01.05	3	
		ГОСТ 11371-78		
71		Pin 2m6×8	2	
		ГОСТ 3128-70		
72		Pin 2m6×12	2	
		ГОСТ 3128-70		
73		Pin 4m6×16	3	
		ГОСТ 3128-70		

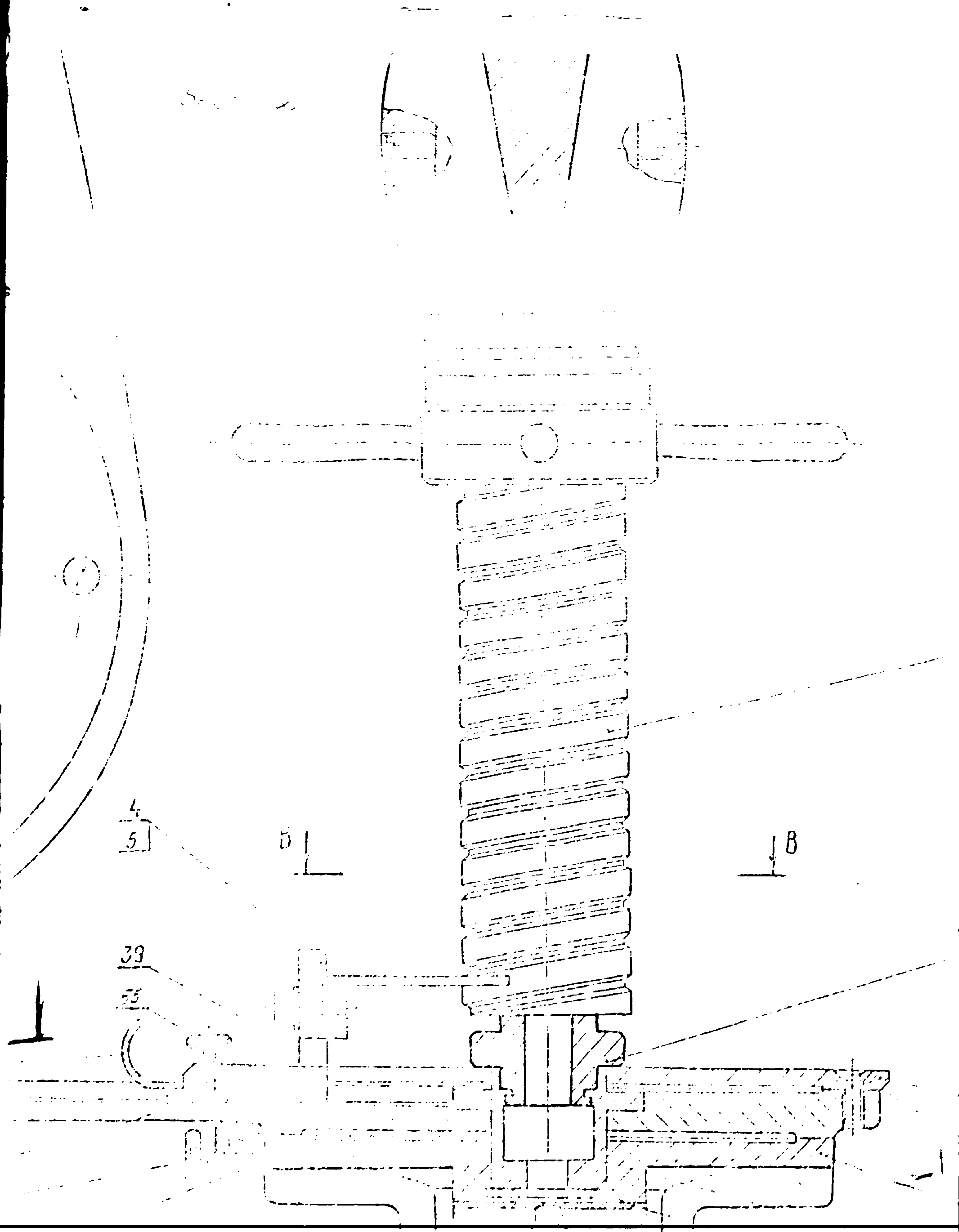
320 000

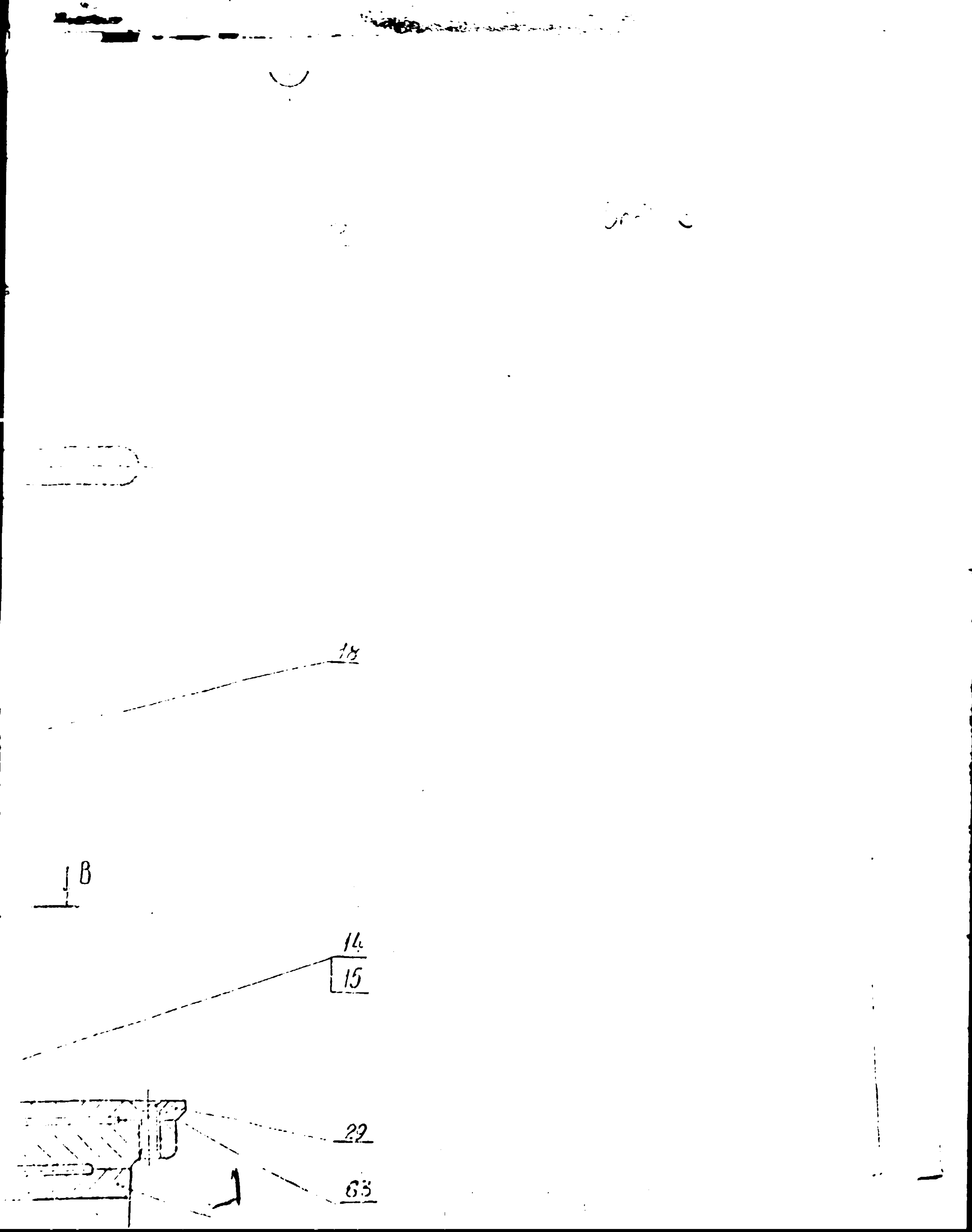
Shee

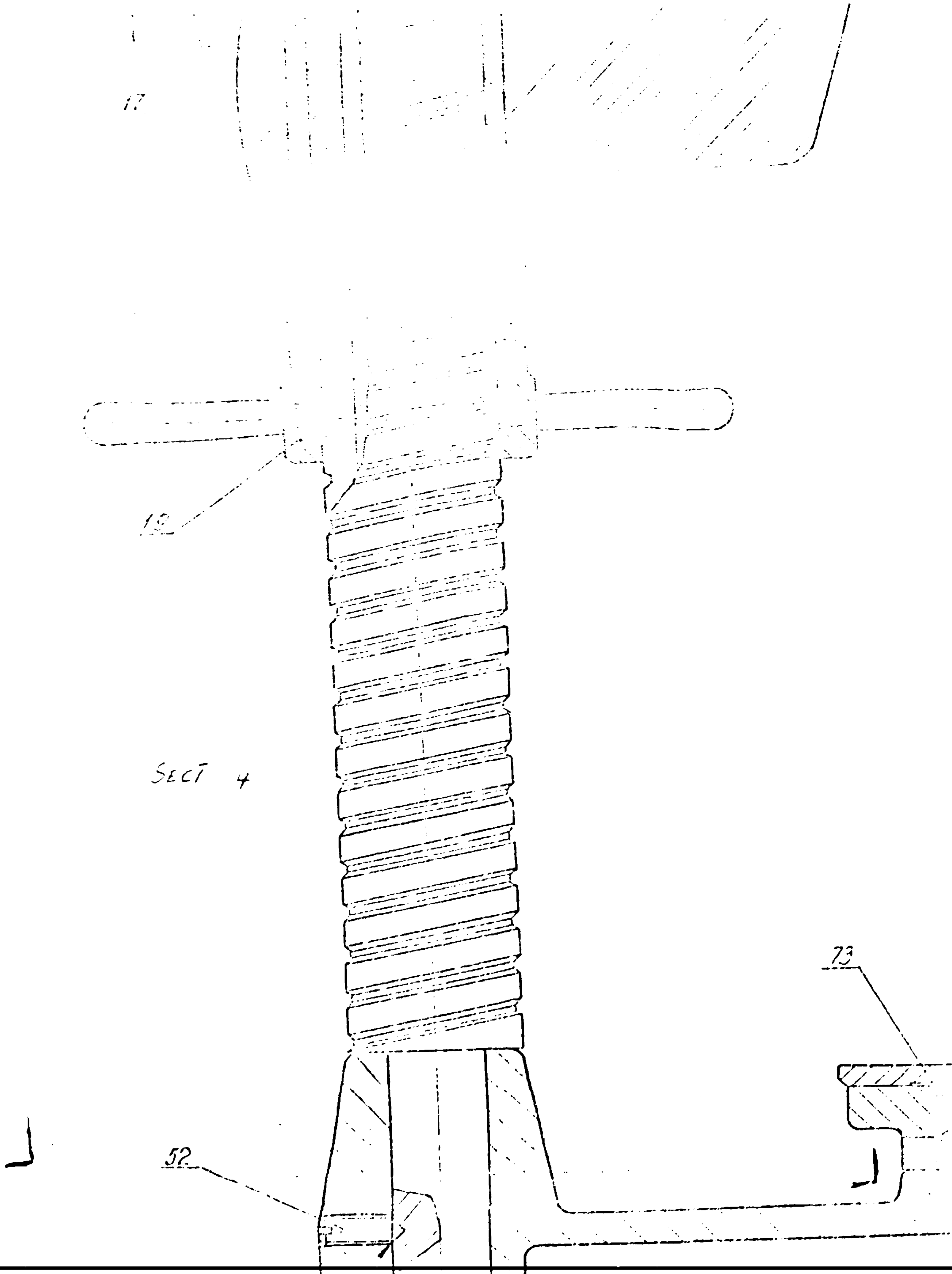
Sets

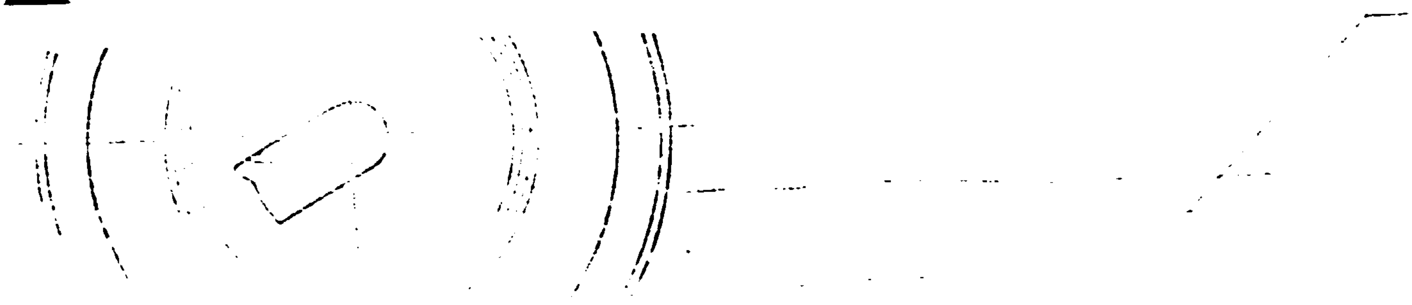
	320.550	Set of assessory units	1	

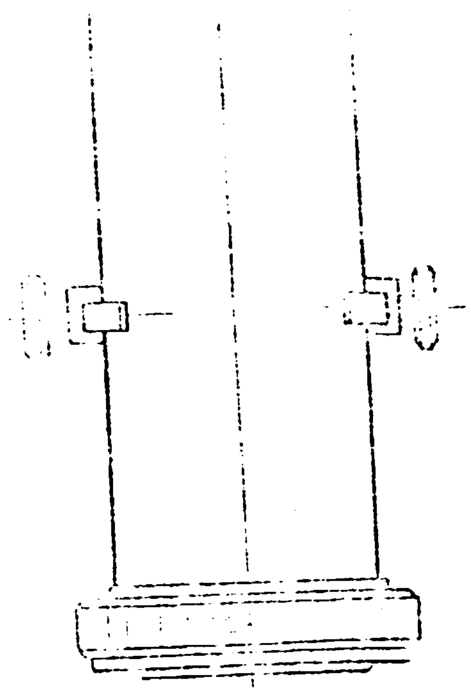

51
40
41
66


4
5
Б
В
39
35

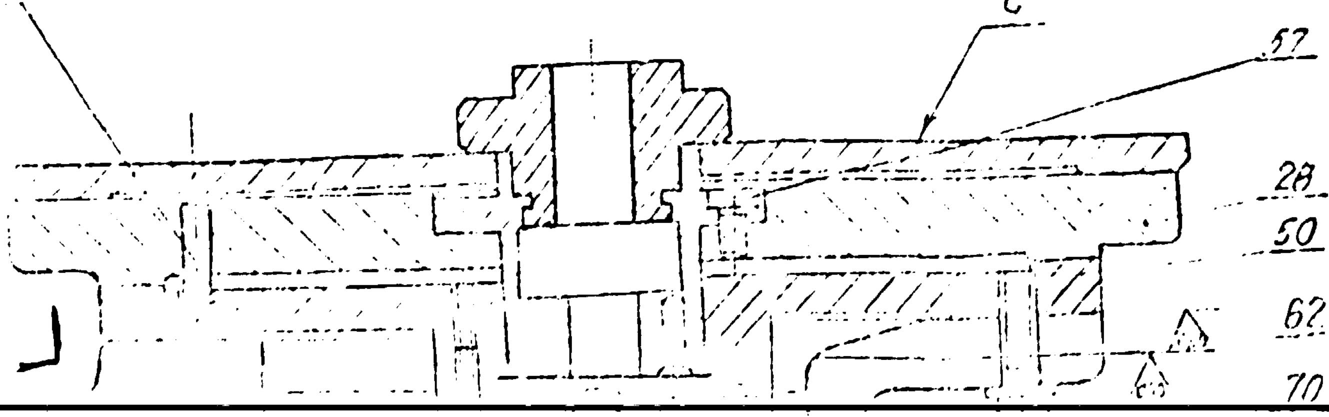

18
B
14
15
22
63


17
12
SECT 4
73
52





SECT E



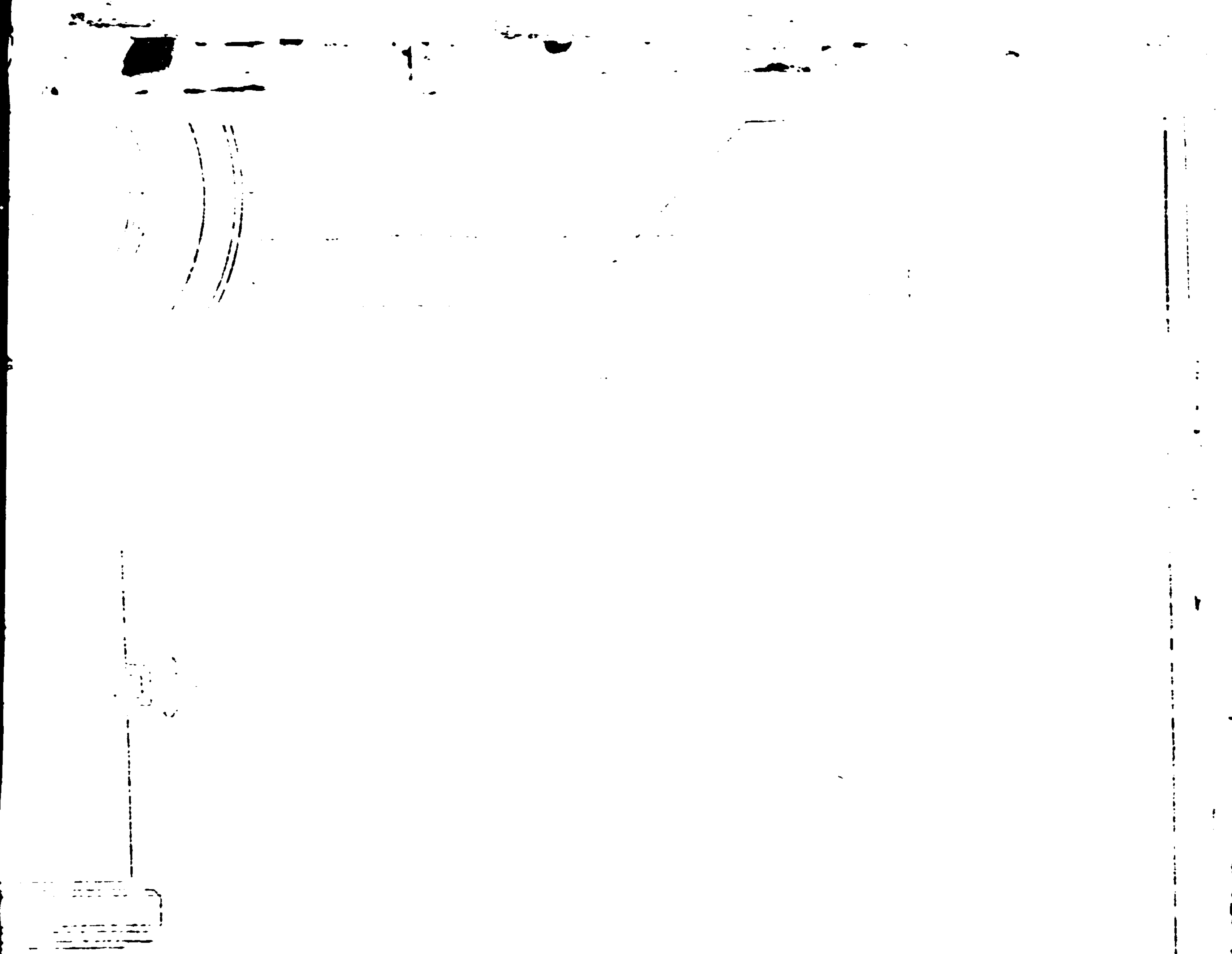
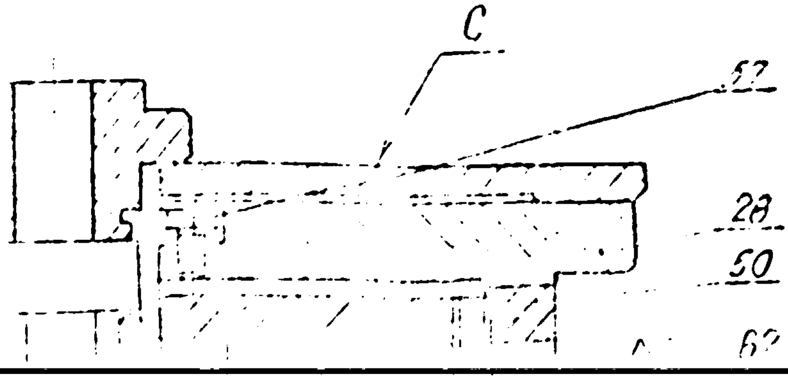
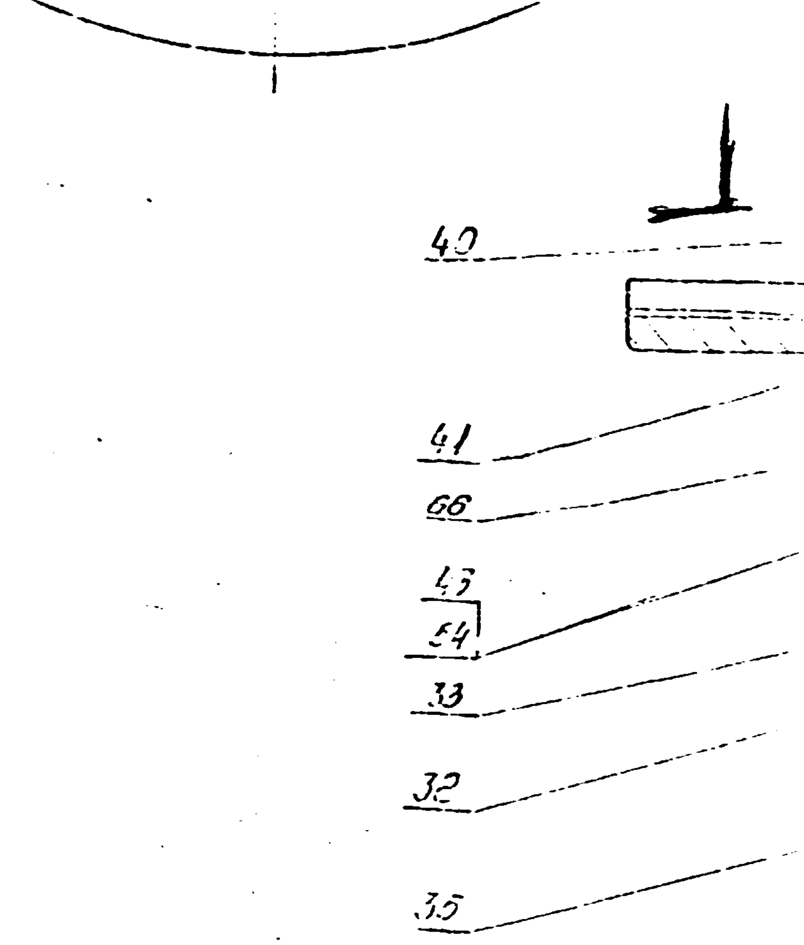
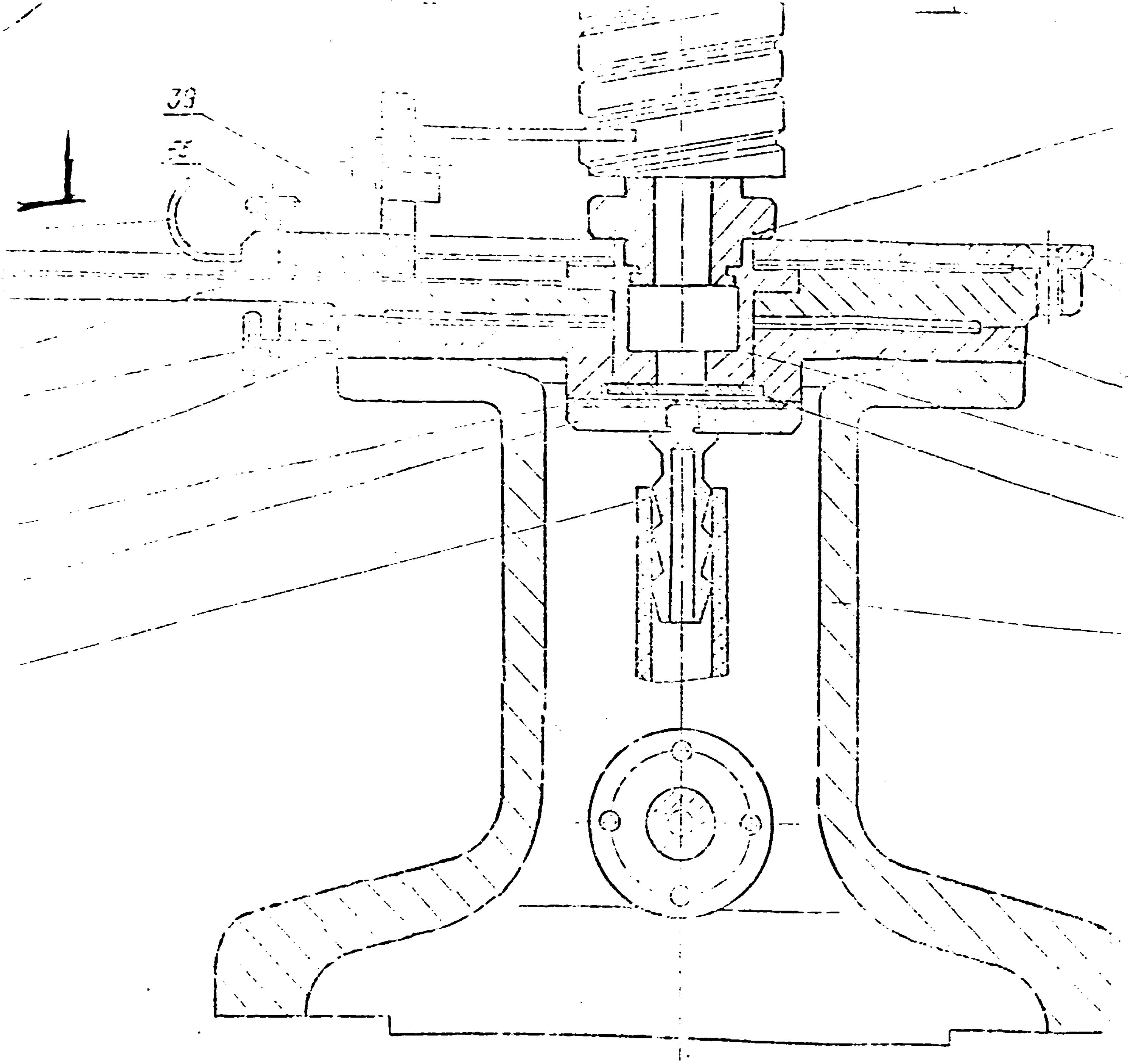


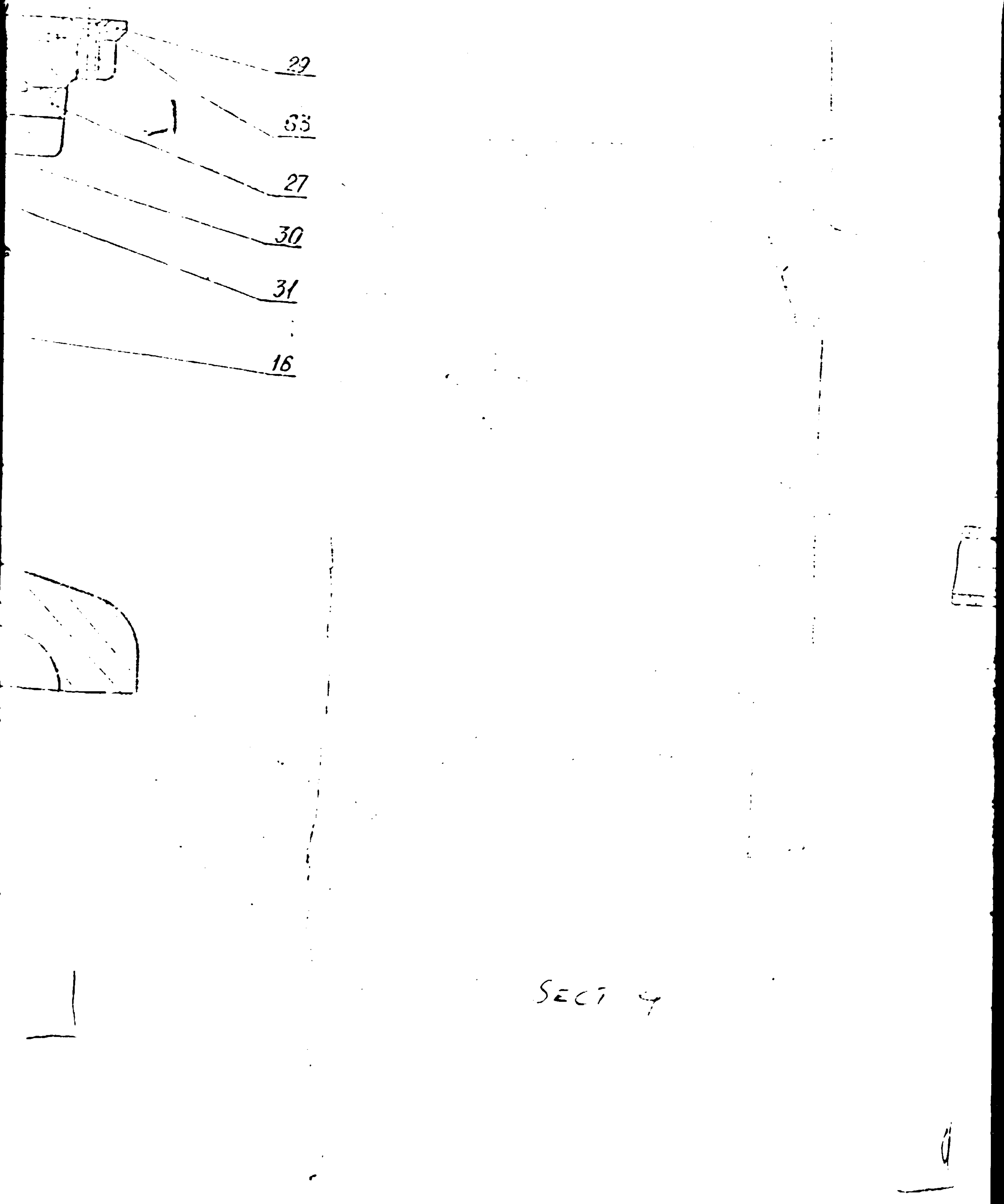
FIG 6



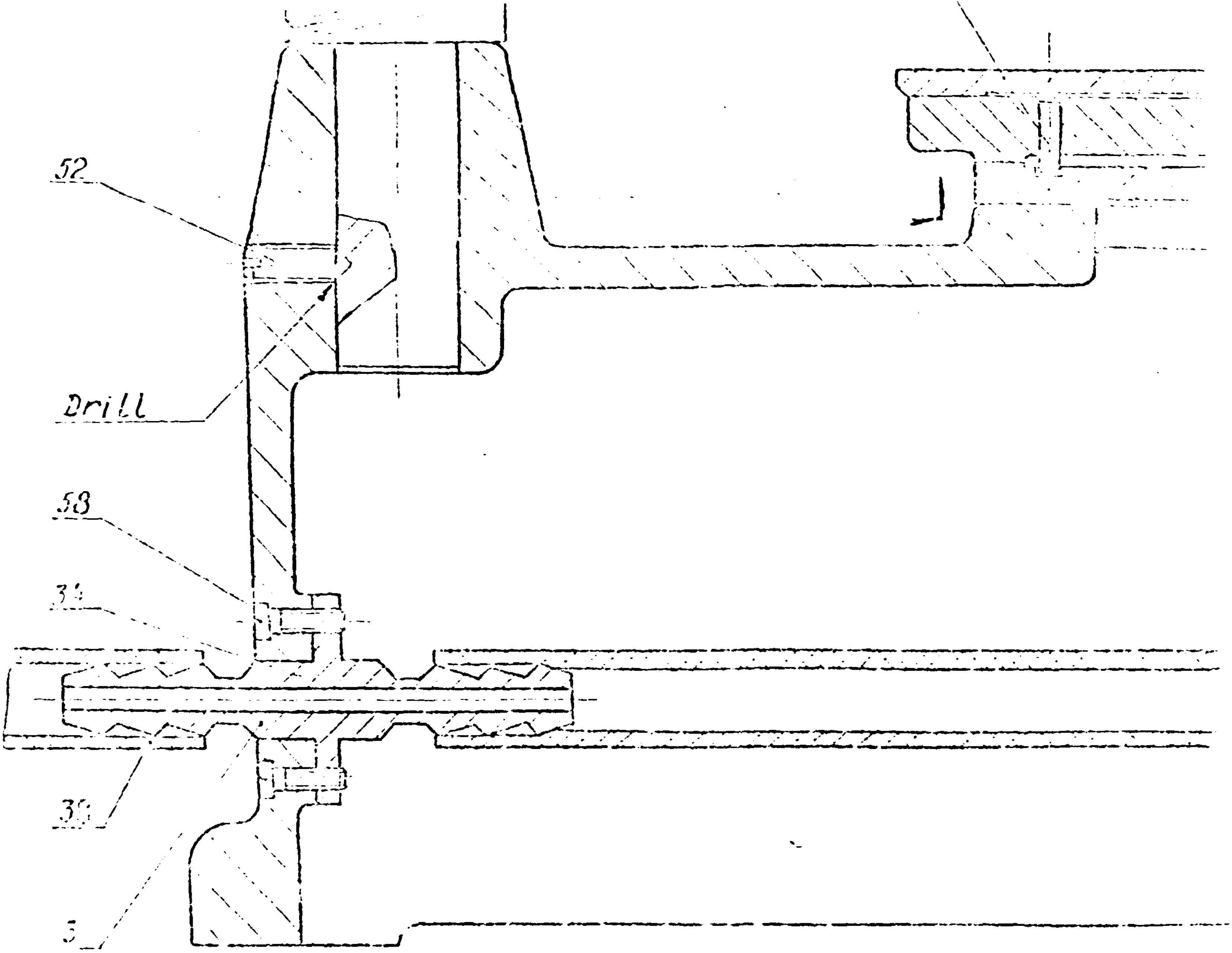

40
41
66
43
54
33
32
35



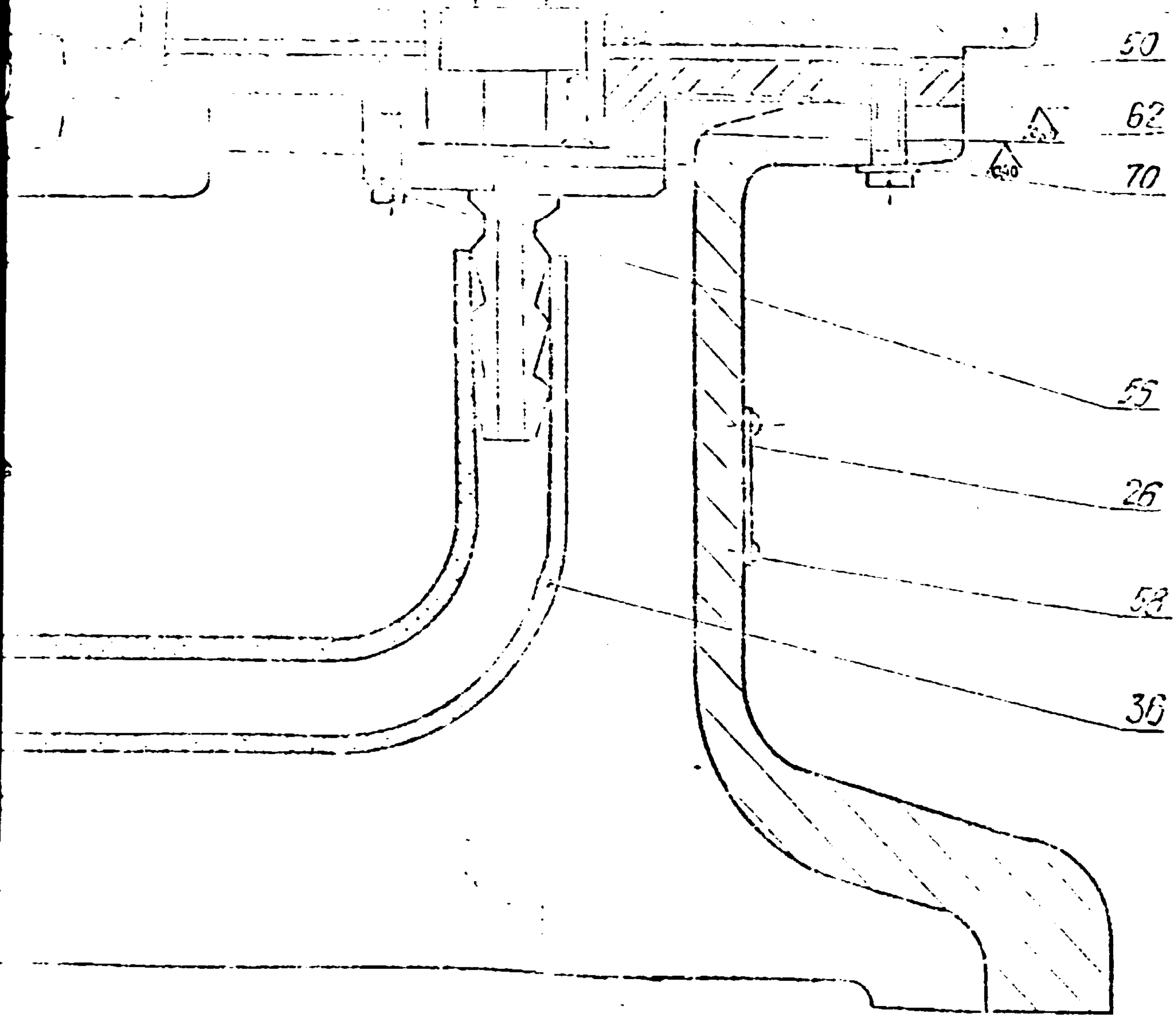
SECT. 2



29
27
30
31
16
SECT 4



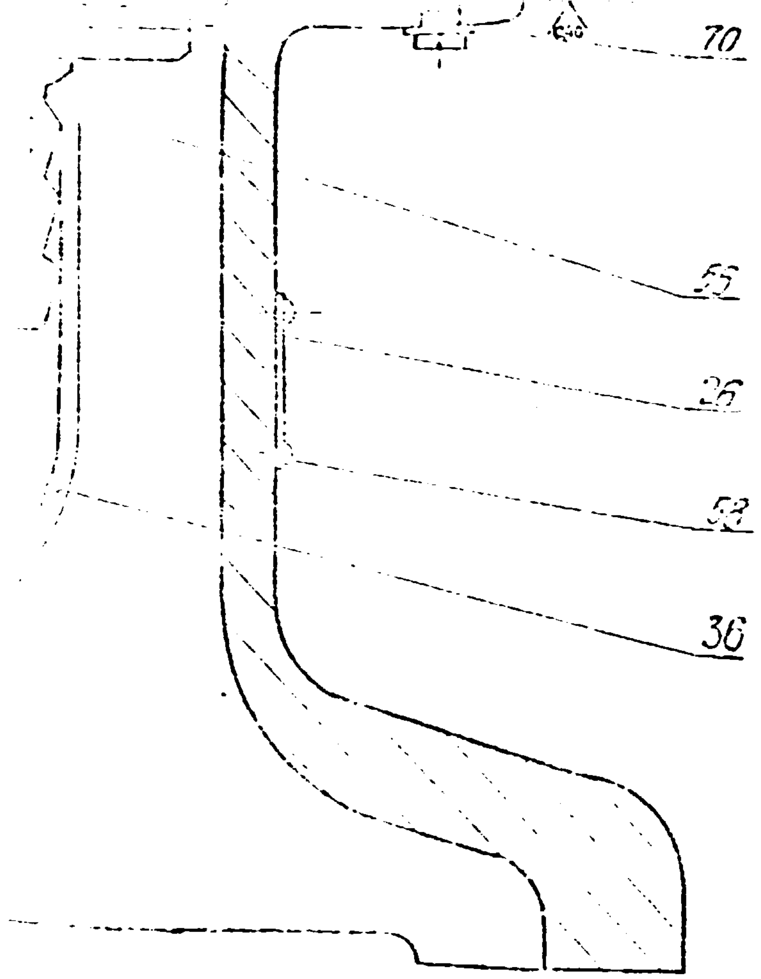
SECT. 10



1. Plane C must be normal to the axis c
to the accuracy 0'5' which correspon
graticule of the autocollimator pos.
2. Align the sight axis of the autocoll.
fitting socket pos.30 to the accur
positions of the instrument l
moving the instrument in the
in the fixing joints. The cen
to check the alignment.

Design
Chief

Centring
adjusting
device

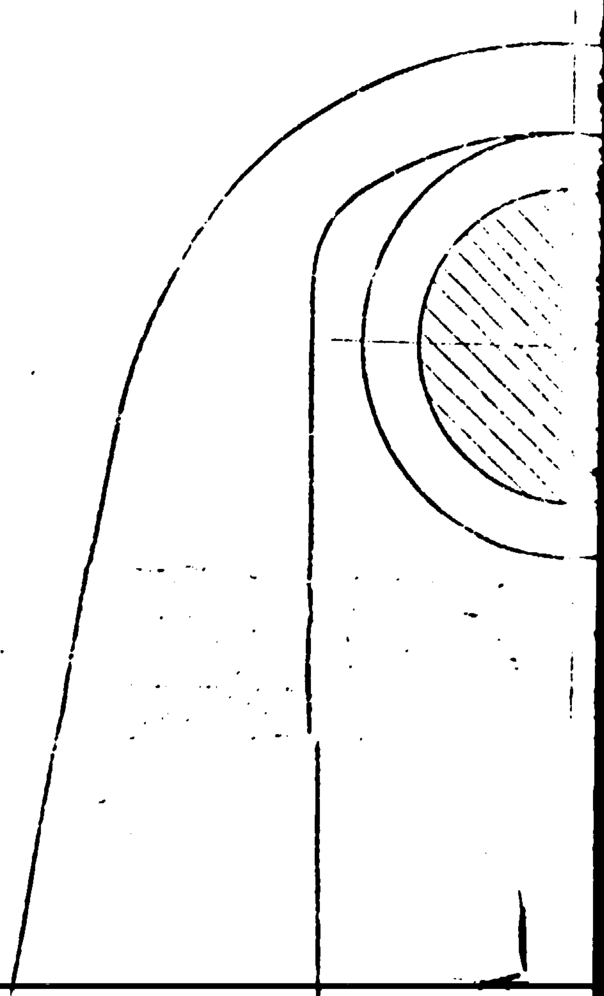


1. Plane C must be normal to the axis of the column pos. 18 to the accuracy 0,5' which corresponds to 5 divisions of the graticule of the autocollimator pos. 1

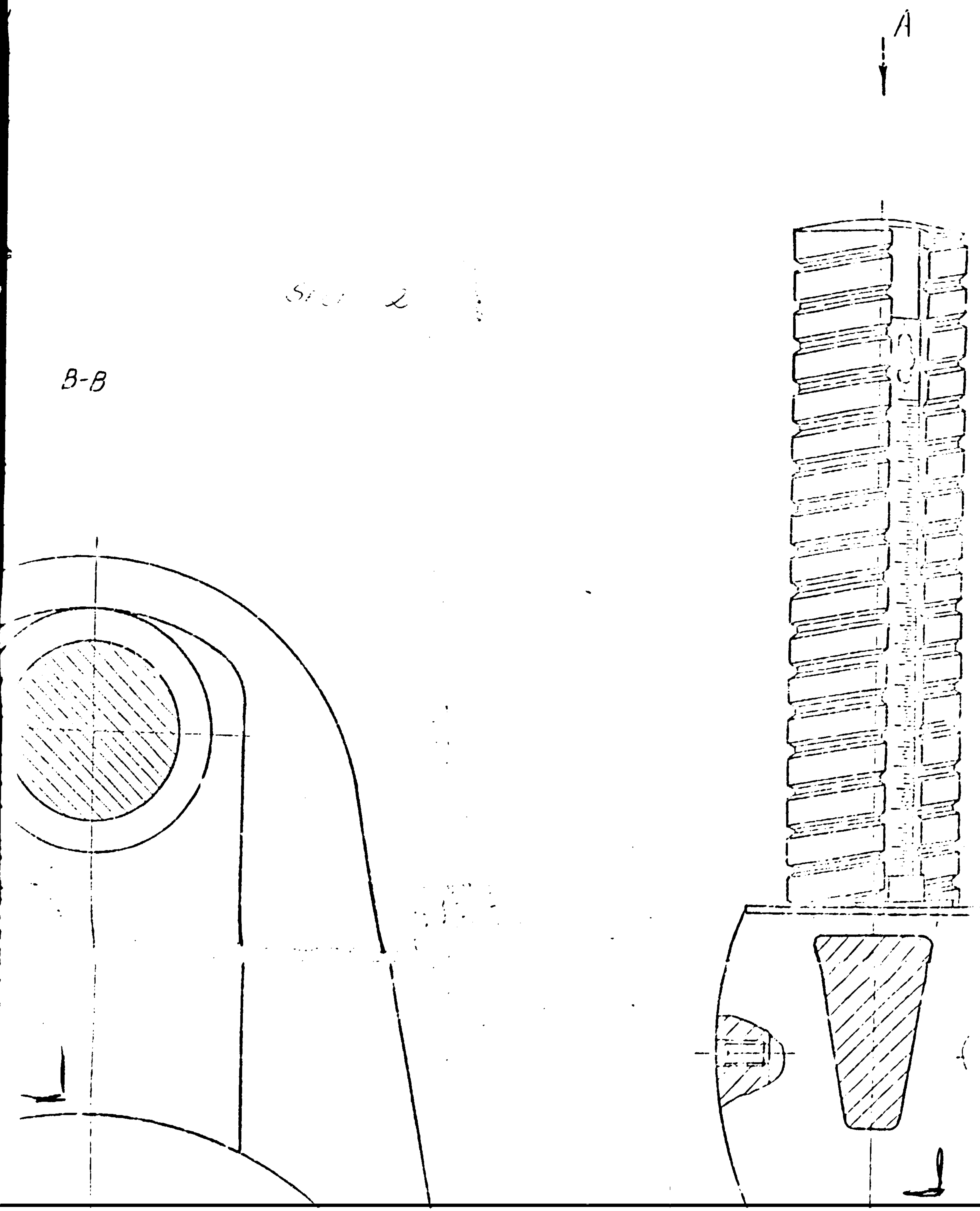
2. Align the sight axis of the autocollimator with that of the fitting socket pos. 30 to the accuracy 0,05 mm at all positions of the instrument by turning and moving the instrument in the arm. Then use pins in the fixing joints. The centring tube is used to check the alignment.

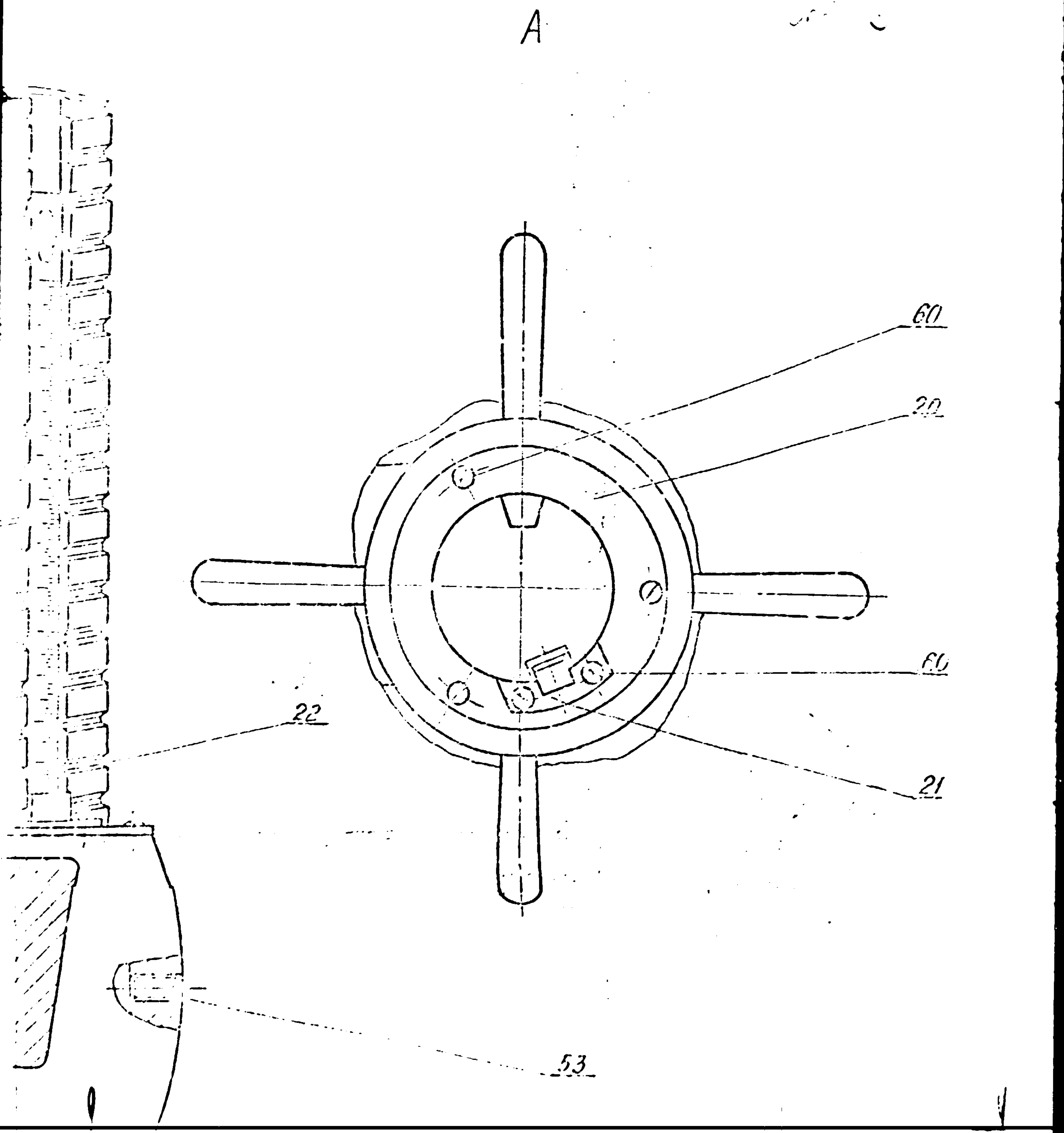
	320. 000	
Designer / Chief	Centring adjusting device	Mass / Scale 1:1 / Sheet / Sheets 1
		LITMO

B-B

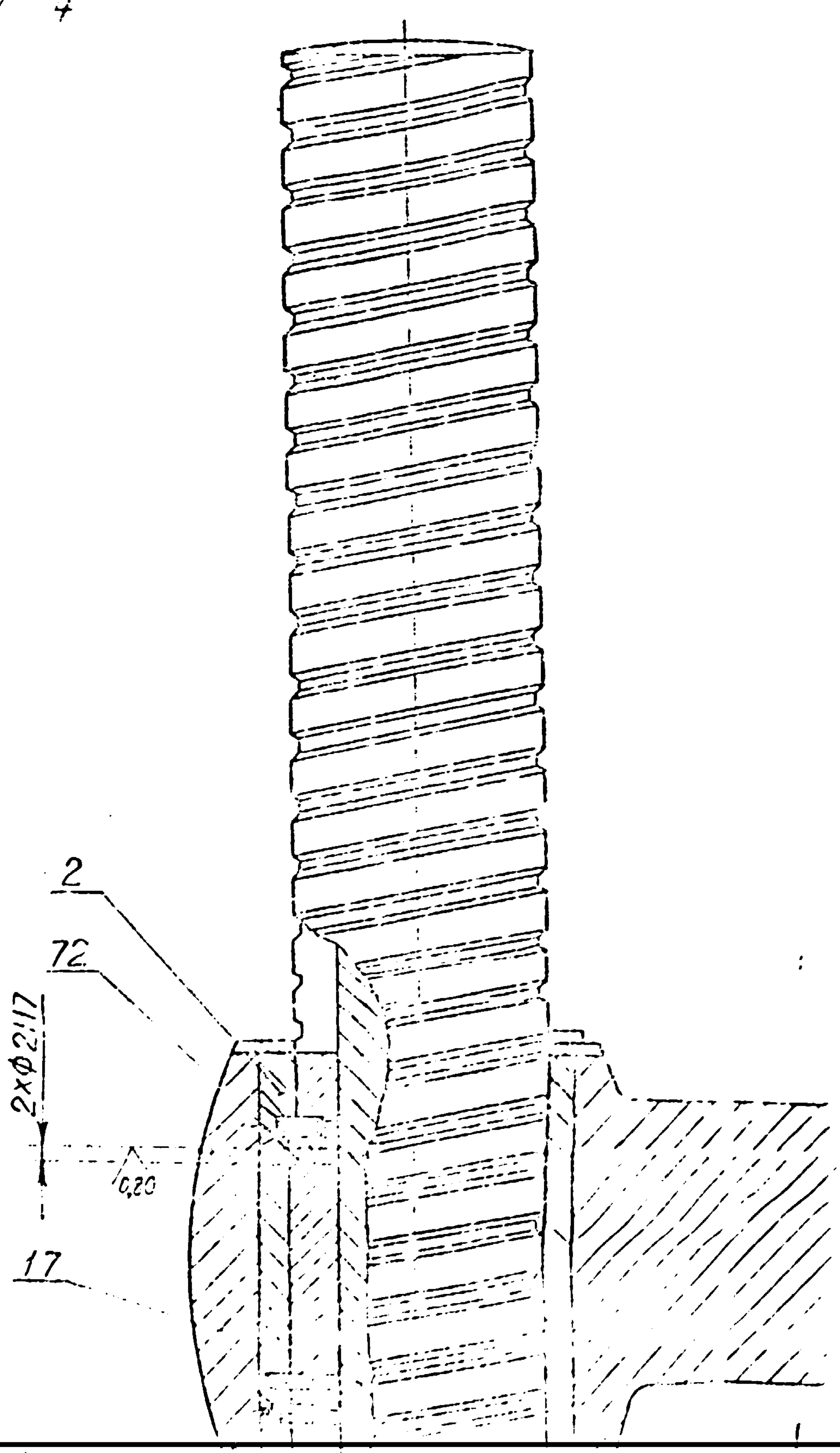


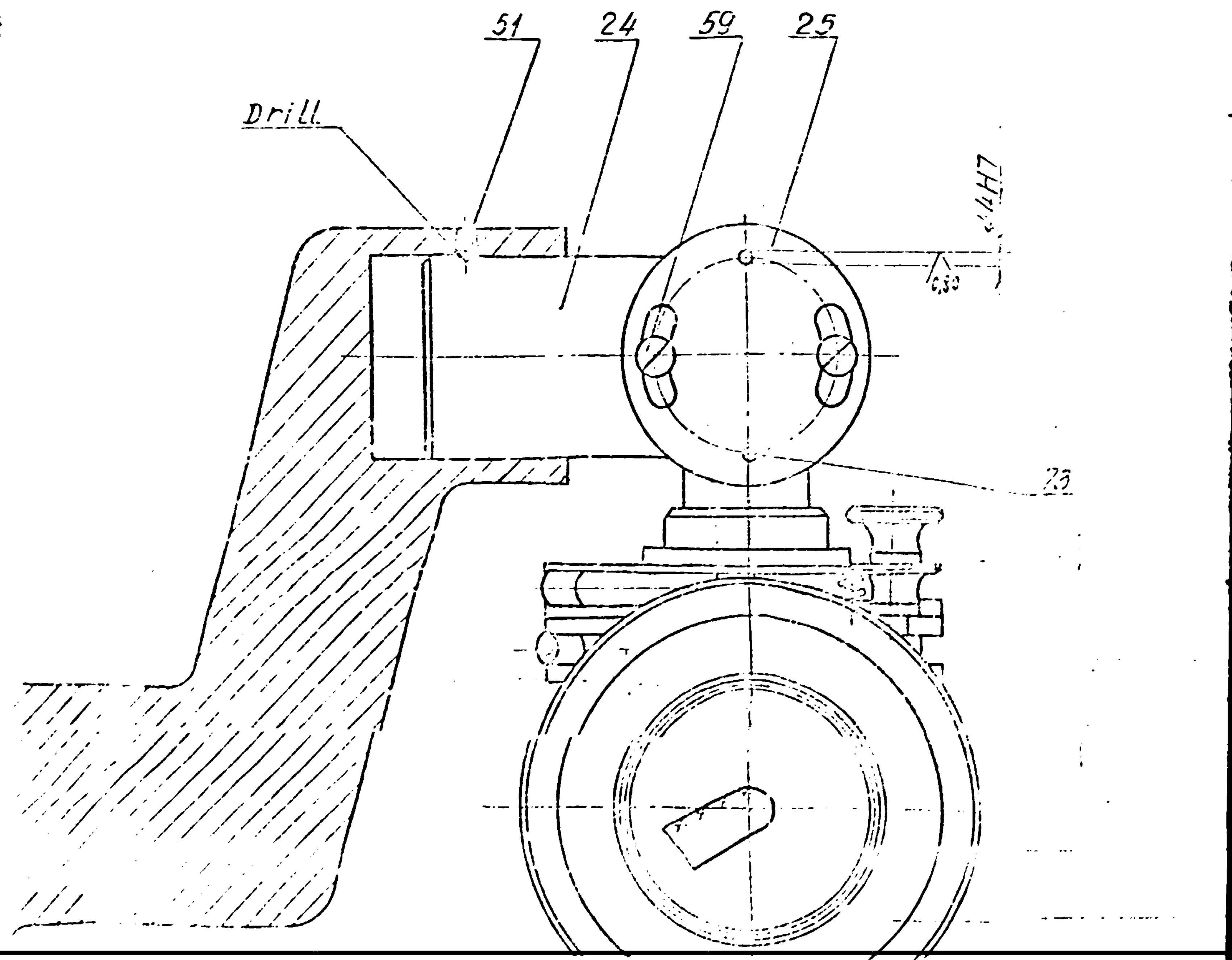
SECTION 1


A
B-B


A
60
20
60
22
21
53

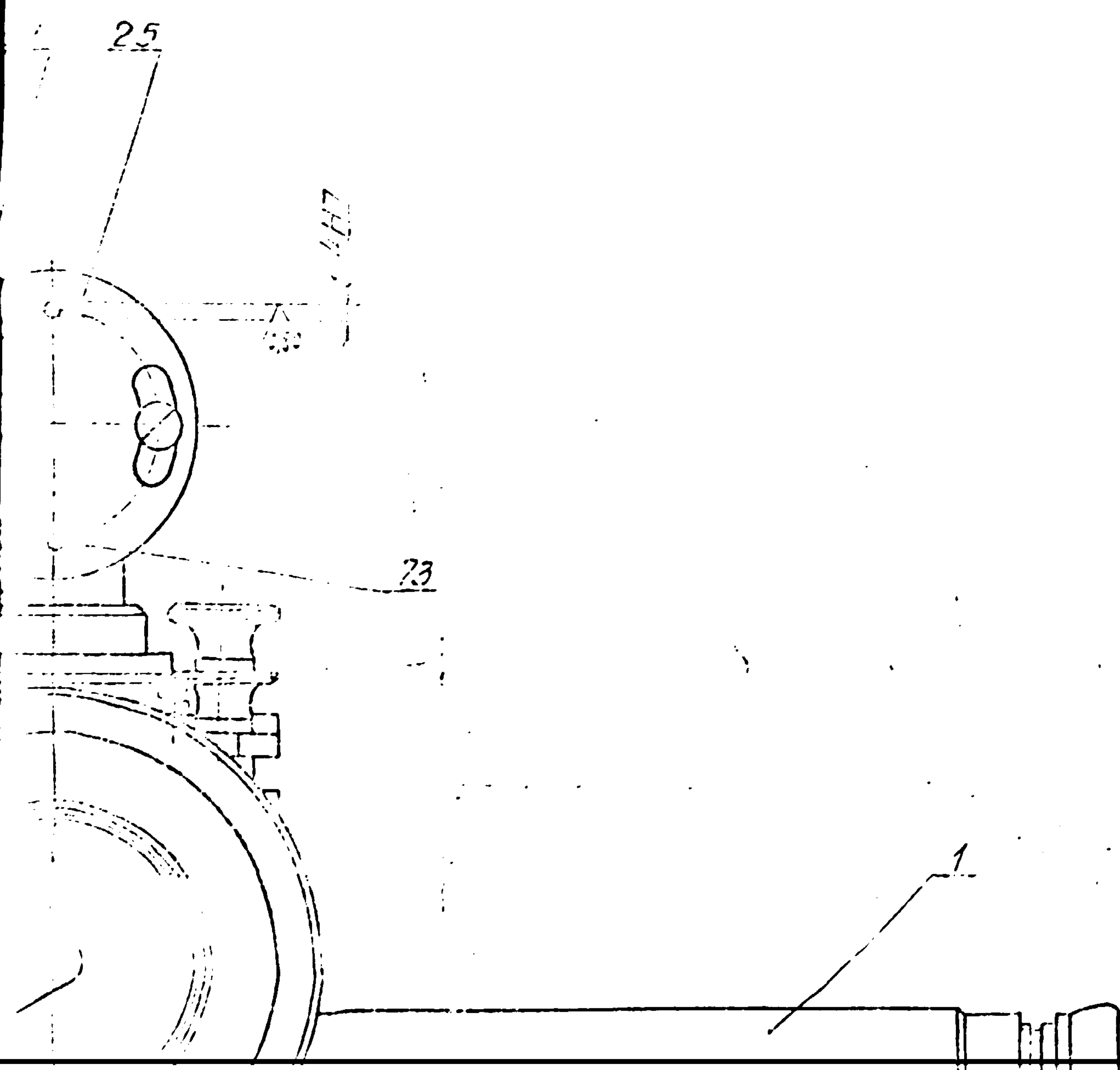
SECT 4

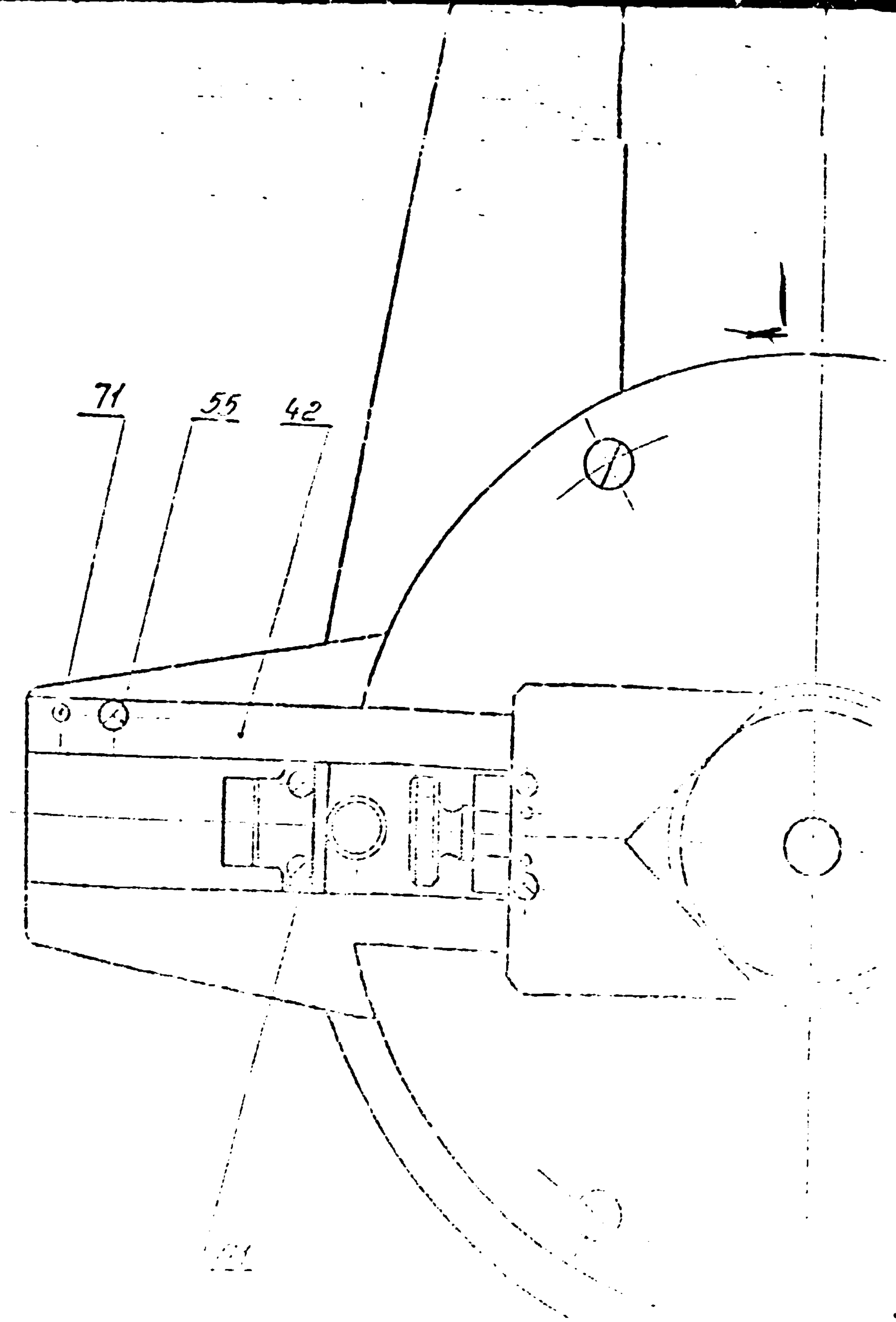


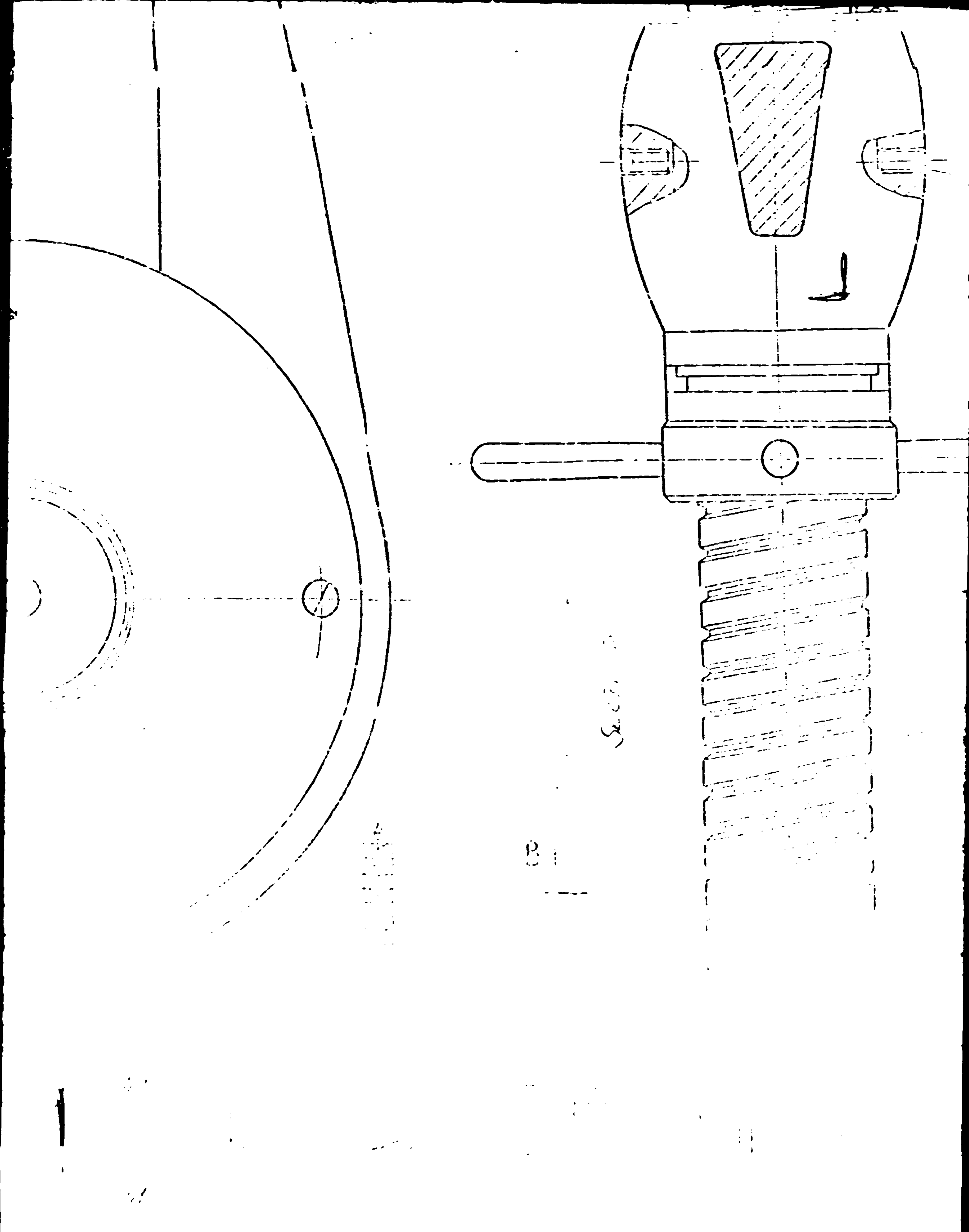


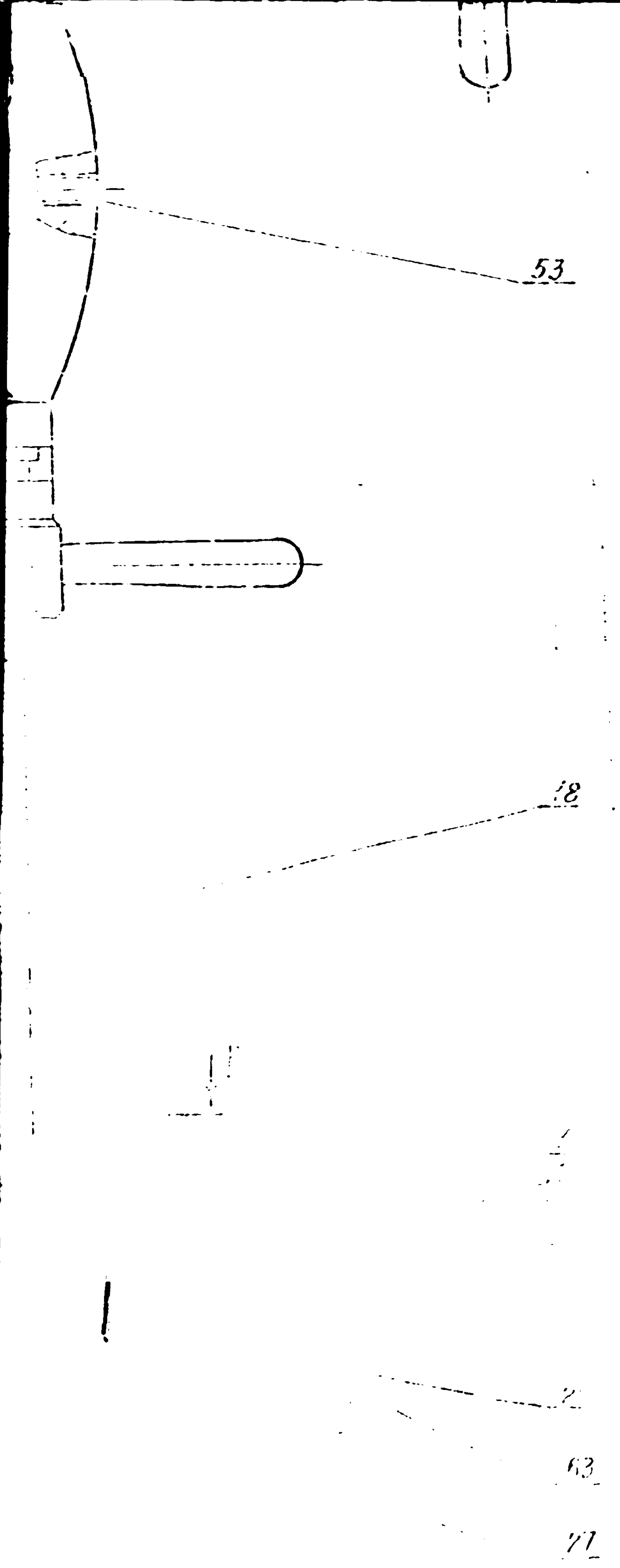
Drill
51
24
59
25

SECT 4

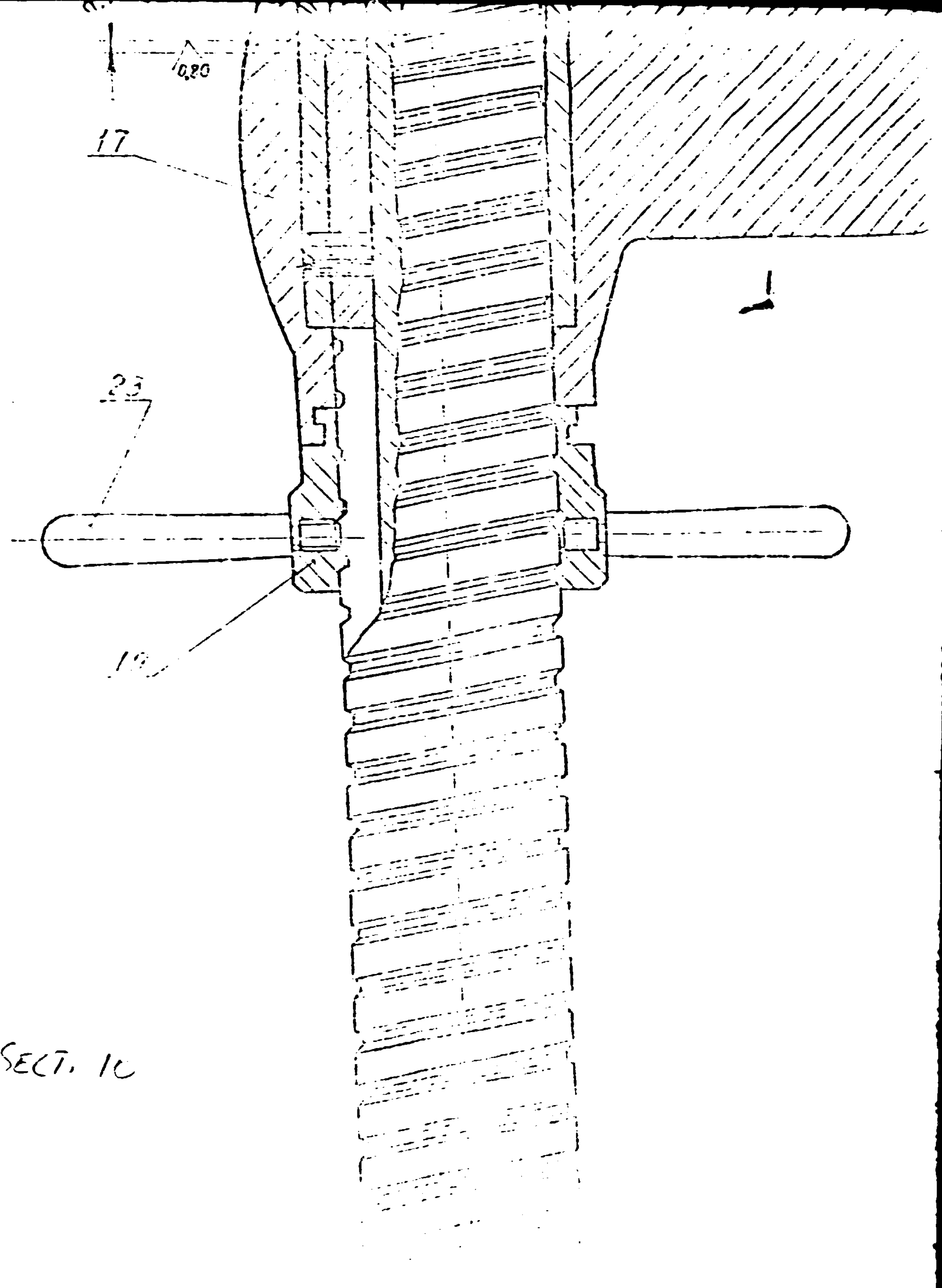



71
55
42

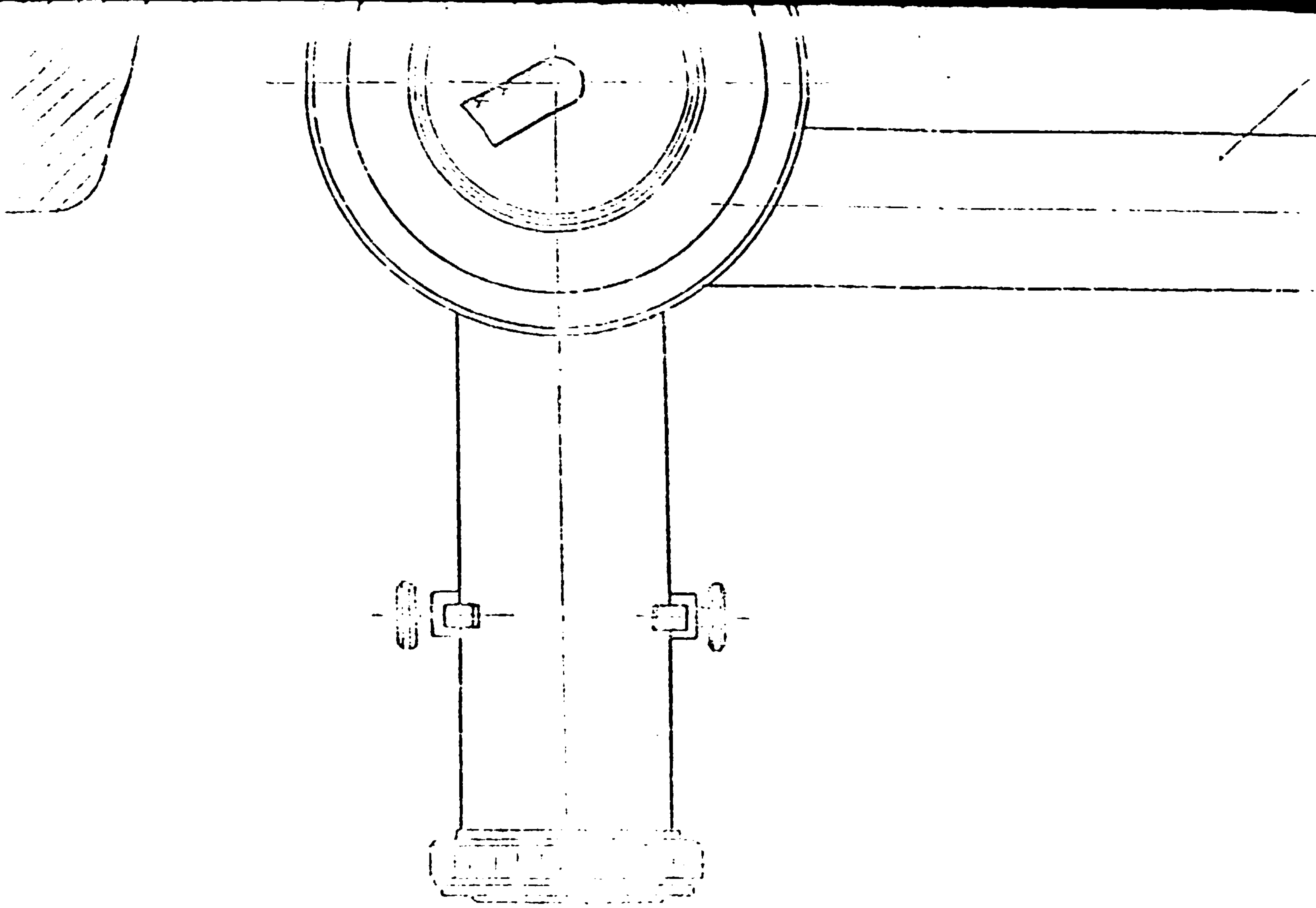




SECT 4



SECT. 1C



Form	Zone	Ref №	Designation	Name	Quant.	Comment
				Specifications		
A2			320.010 Ass	Assembling drawing		
				Assembling units		
A4		1	320.020	Condenser	1	
A4		2	320.030	Lamp-holder	1	
				Pieces		
A4		5	320.001	Ring	1	
A4		6	320.002	Ring	1	
A4		7	320.003	Ring	13	
A4		8	320.004	Ring	1	
A2		9	320.005	Ring	1	
A4		10	320.006	Bushing	39	
A4		11	320.007	Axle	3	
A4		12	320.008	Stop	1	
A3		13	320.009	Stop	1	
A4		14	320.011	Mirror	1	
A3		15	320.012	Holder	1	

320.010

Designer

Chief Designer

Illuminator

Sheet	Sheets
1	

LITMO

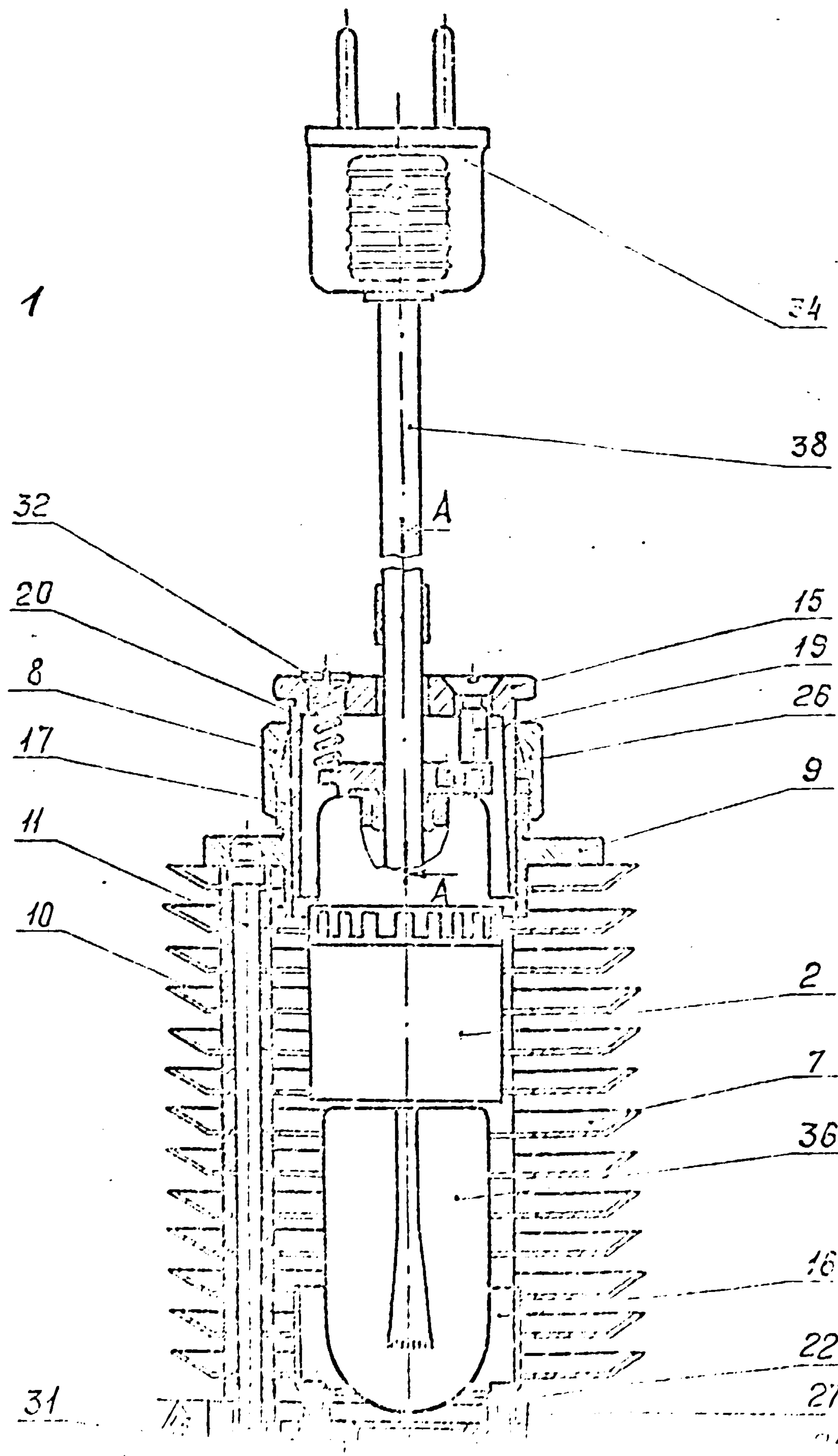
Format	Zone	Ref No	Designation	Name	Quant.	Comment
		16	320.013	Screen	1	
		17	320.014	Flange	1	
		18	320.015	Screw	2	
		19	320.016	Screw	1	
		20	320.017	Spring	1	
		21	320.018	Illuminator body	1	
		22	320.019	Ring	4	
		23	320.021	Ring	1	
				<u>Standard units</u>		
		25		Screw B.M2-6g×5.	3	
				14H.05 ГОСТ 1476-84		
		26		Screw B.M3-6g×6.	1	
				14H.06 ГОСТ 1476-84		
		27		Screw B.M2-6g×10.	4	
				58.04 ГОСТ 1491-80		
		29		Nut M5-6H.5.06	3	
				ОСТ3-1076-86		
		31		Washer 5.65Г.06	3	
				ГОСТ 6402-70		
		32		Pin 1 m6×10	1	
				ГОСТ 3128-70		

Form	Zone	Ref No	Designation	Name	Quantity	Comment
		34		Plug 6A, 220 W	1	
		36		Lamp	1	
				Material		
		38		Wire $2\times0{,}75 mm^2$	5m	

320.010

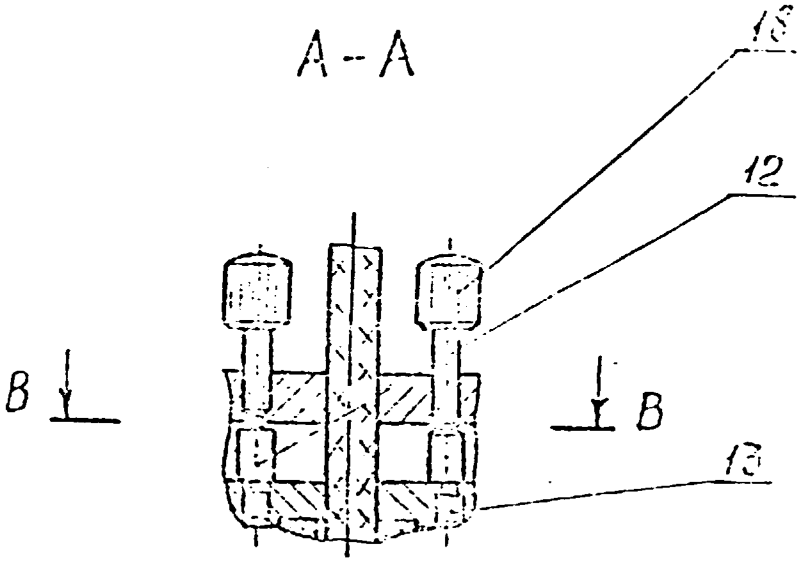
Form A4

SECTION 1

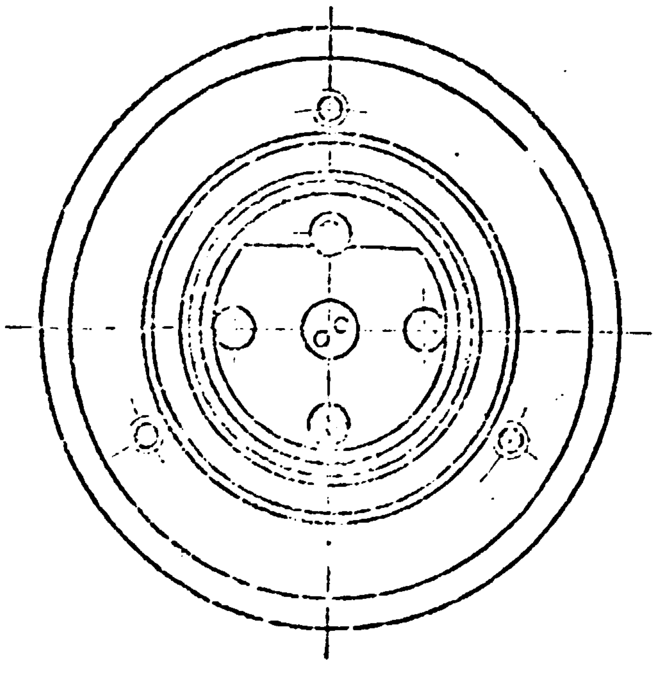


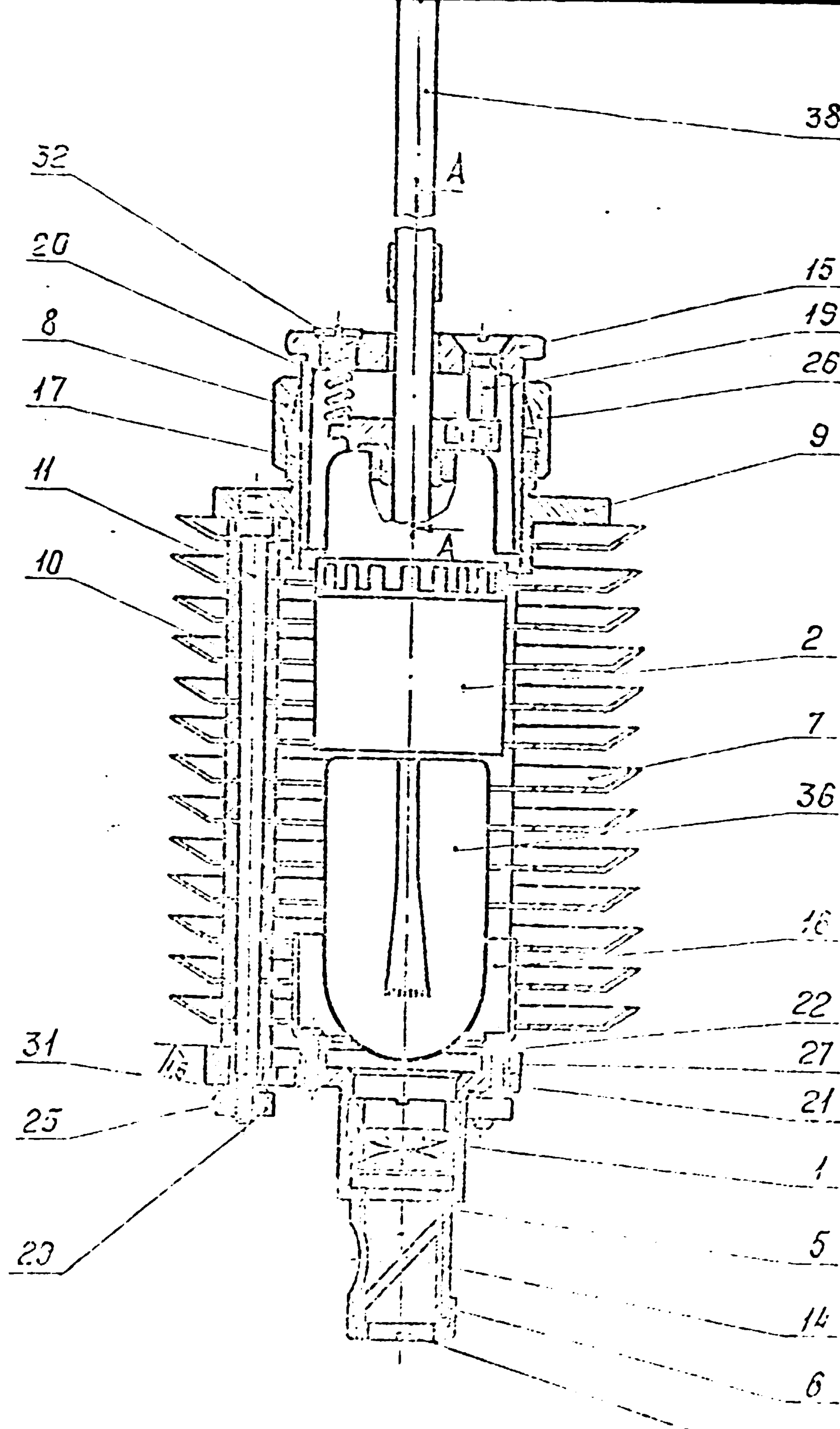
Фиг. 2

A - A



B - B




38
A
32
20
8
17
11
10
15
19
26
9
A
2
7
36
16
22
27
21
31
25
1
5
29
14
6
23

SECT 4

320.010 Ass

Illuminator

Scale

1:1

Form	Zone	Ref.No	Designation	Name	Quantity	Comment
				Specifications		
A4			320. 020 Ass	Assembling drawing		
				Pieces		
A4		1	320. 025	Ring	1	
A4		2	320. 026	Lens	1	
A4		3	320. 027	Lens	1	
A4		4	320. 028	Holder	1	

320. 020

Designer

Check

Designer

Condenser

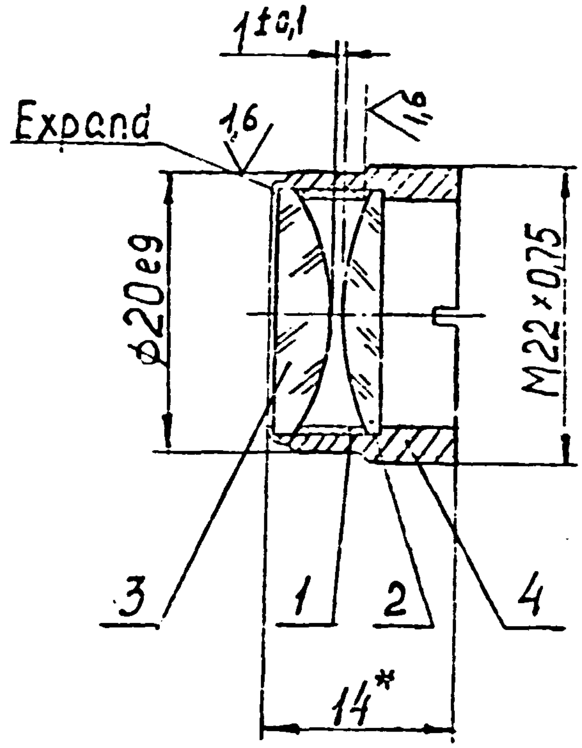
Sheet | Sheets 1

1

LITMO

Form A4

f'	17,79
S_F	15,22
$S'_{F'}$	14,79
$0\,\Phi$	17



1.*The dimension for information

2. Coat the expanding position with black enamel

320.020 Ass.			
Condenser		Mass	Scale
			2:1
		LITMO	

Form	Zone	Pos.	Designation	Name	Quantity	Comment
				Specification		
A4			320. 030 A ss	Assembling drawing		
				Standard units		
		1		Lamp-holder	1	OKП
				E27 H12П-01		3461113121
				ГОСТ 2746.2-80		

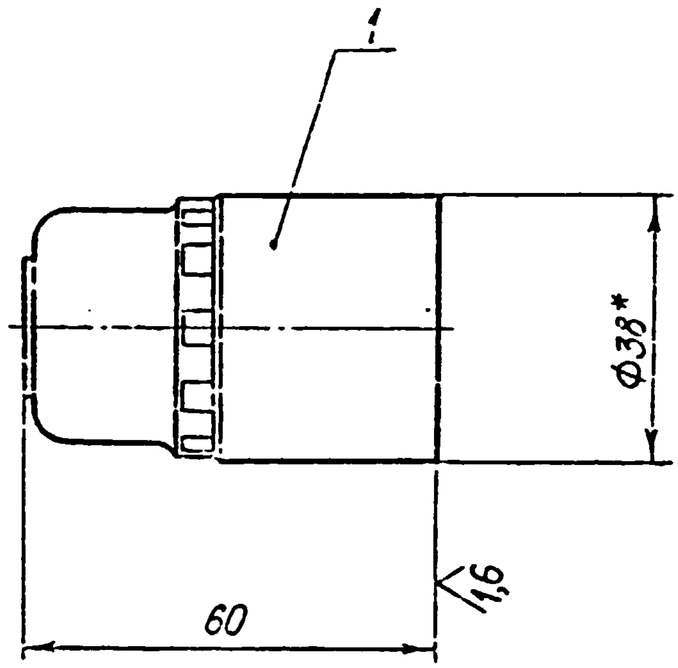
320. 030

Lamp-holder

Sheet	Sheets
	1

LITMO

Form A4



1. h14
2.* The dimension for information

320.030 Ass

Lamp-holder

Mass	Scale	
	1:1	
Sheet	Sheets 1	

Designer

Chief designer

Blank E27H12П-01
ГОСТ 2746.2-80

LITMO

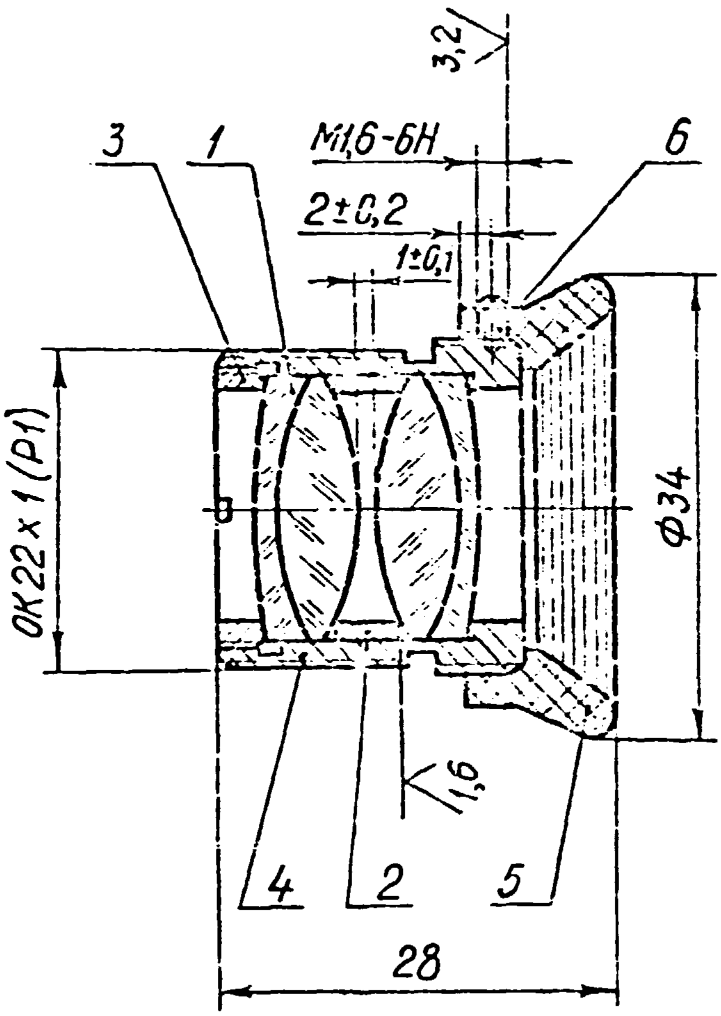
Form A4

Form	Zone	Ref.No	Designation	Name	Quantity	Comment
				Specification		
			320.040Ass	Assembling drawing		
				Assembling units		
		1	320.050	Lens	2	
				Pieces		
		2	320.035	Ring	1	
		3	320.036	Thread ring	1	
		4	320.037	Holder	1	
		5	320.038	Eyeguard	1	
				Standard units		
		6		Screw BM1,6-6g×2.14H.05 ГОСТ 1476-84	1	

320.040		
Designer	Eyepiece	Sheet:	Sheets: 1
		LITMO

Form A4

f'	17,01
S_F	- 11,75
$S'_{F'}$	11,75
0ϕ	18



The dimensions for information

320.040Ass		
Eyepiece	Mass	Scale
		2:1
	Sheet	Sheets 1

Form A4

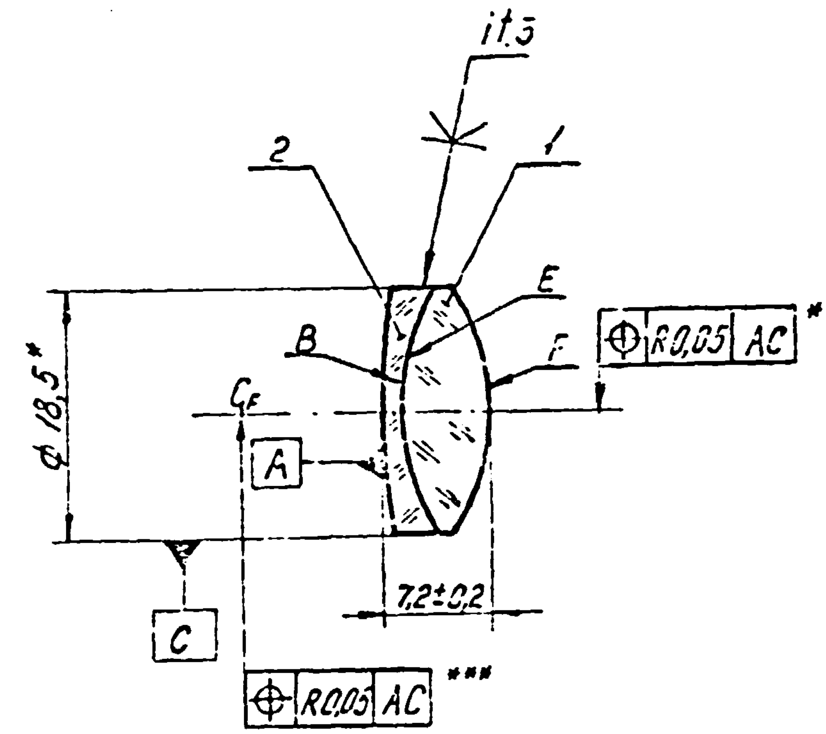
Form	Zone	Pos.	Designation	Name	Quant.	Comment
				Specifications		
A4			320.050. Ass	Assembling drawing		
				Pieces		
A4		1	320.041	Lens	1	
A4		2	320.042	Lens	1	

320.050

Designer

Lens

Sheet | Sheets



N	5
ΔN	1
Surf. qual.	0,1**

f'	33,26
S_F	-28,78
$S'_{F'}$	33,02
$D\varnothing$	18

1.* The dimension for information.
The tolerance for information.
2.** Permitted total area of scratches, pits (mm^2)
3. Balsam
4.*** Shift in focal plane of light beam passing through the lens must be no more than 0,05mm

320.050 Ass.			
Lens		Mass	Scale
			2:1
		Sheet	Sheets 1
Designer		LITMO	
Chief Designer			

Form A4

Form	Zone	Ref. No	Designation	Name	Quantity	Comment
				Specification		
A4			320.070 Ass	Assembling drawing		
				Assembling units		
A4			320. 080	Graticule with plate	1	
				Pieces		
A4		2	320. 045	Thread ring	1	
A3		3	320. 046	Holder	1	
				Standard units		
		4		Screw B M2-6g×3.14H.05 ГОСТ 1476-84	1	

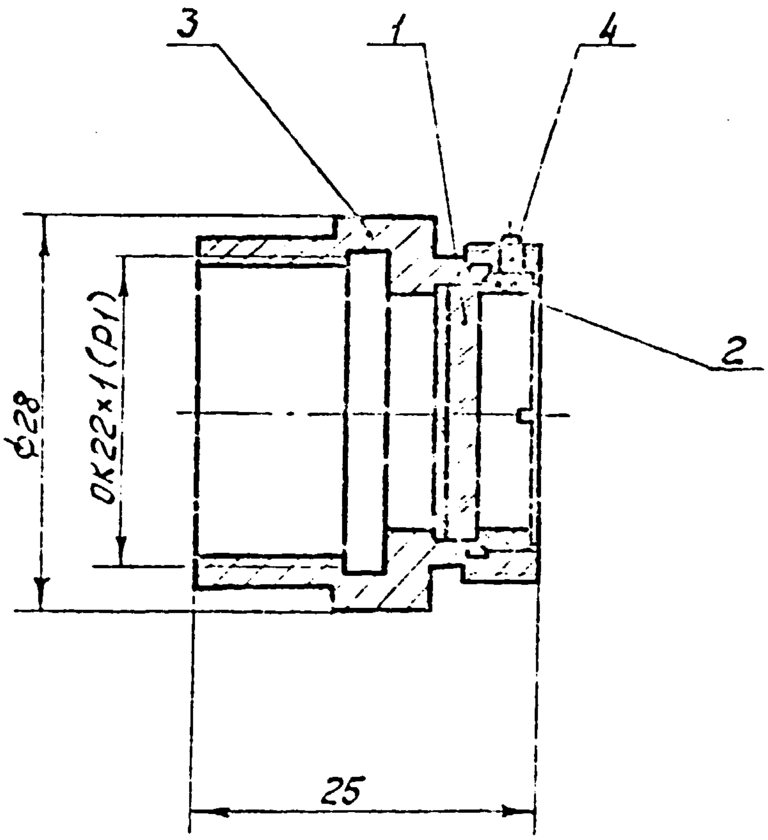
320. 070

Graticule with protective glass in holder

Mass | Scale
1

LITMO

Form A4



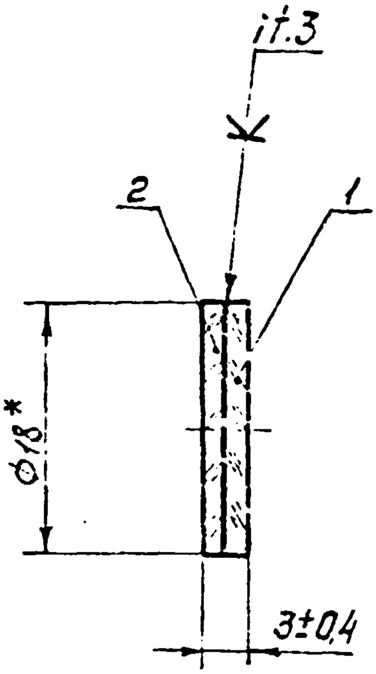
The dimensions for information

	320.070 Ass	
Designer	Graticule with protective glass in holder	Mass / Scale 2:1 / Sheet / Sheets 1
Chief Designer		LITMO

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				Specification		
A4			320.080 Ass	Assembling drawing		
				Pieces		
A2		1	320.048	Graticule	1	
A4		–	320.049	Plate	1	
				Blank for		
				320.048		
A4		2	320.049	Plate	1	

	320.080		
Designer	Graticule with plate	Sheet	Sheets
			1
Chief designer		LITMO	

$\Delta\nu$	—
ΔN	—
Surf. qual	0-20**

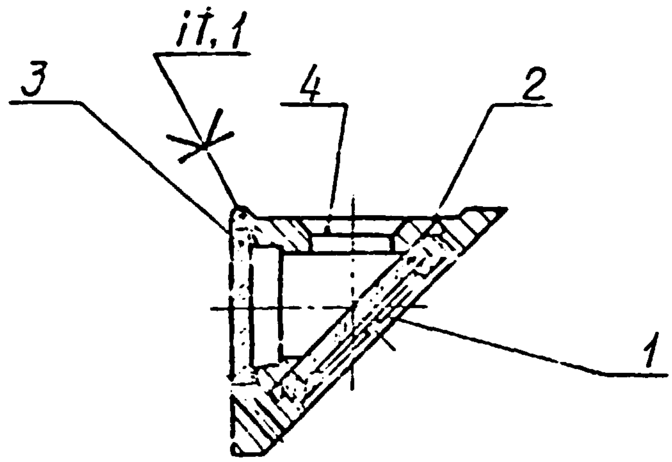


1. *The dimension for information
2. **(0-20) means that focal length of following sustem is 20mm and scratches thicknesses, point diameters must be no more than 0,001mm across the area with 1/3 clear aperture diameter.
3. Balsamin M

	320.080 Ass	
Designer	Graticule with plate	Mass / Scale 2:1
		Sheet / Sheets 1
Chief Designer		LITMO

Form	Zone	Ref №	Designation	Name	Quantity	Comment
				Specifications		
A4			320.090	Assembling drawing		
				Pieces		
A4		1	320.055	Ring	1	
A3		2	320.056	Graticule	1	
A4		3	320.058	Protective glass	1	
A3		4	320.059	Holder	1	

Designer	Graticule with protective glass in holder	Sheet	Sheets: 1
Chief Designer		LITMO	



Fill in with hermetic cement УТ-34

320. 090Ass				
Graticule with protective glass in holder		Mass	Scale	
			2:1	
	Sheet	Sheets 1		
Designer				
Chief Designer		LITMO		

Form A4

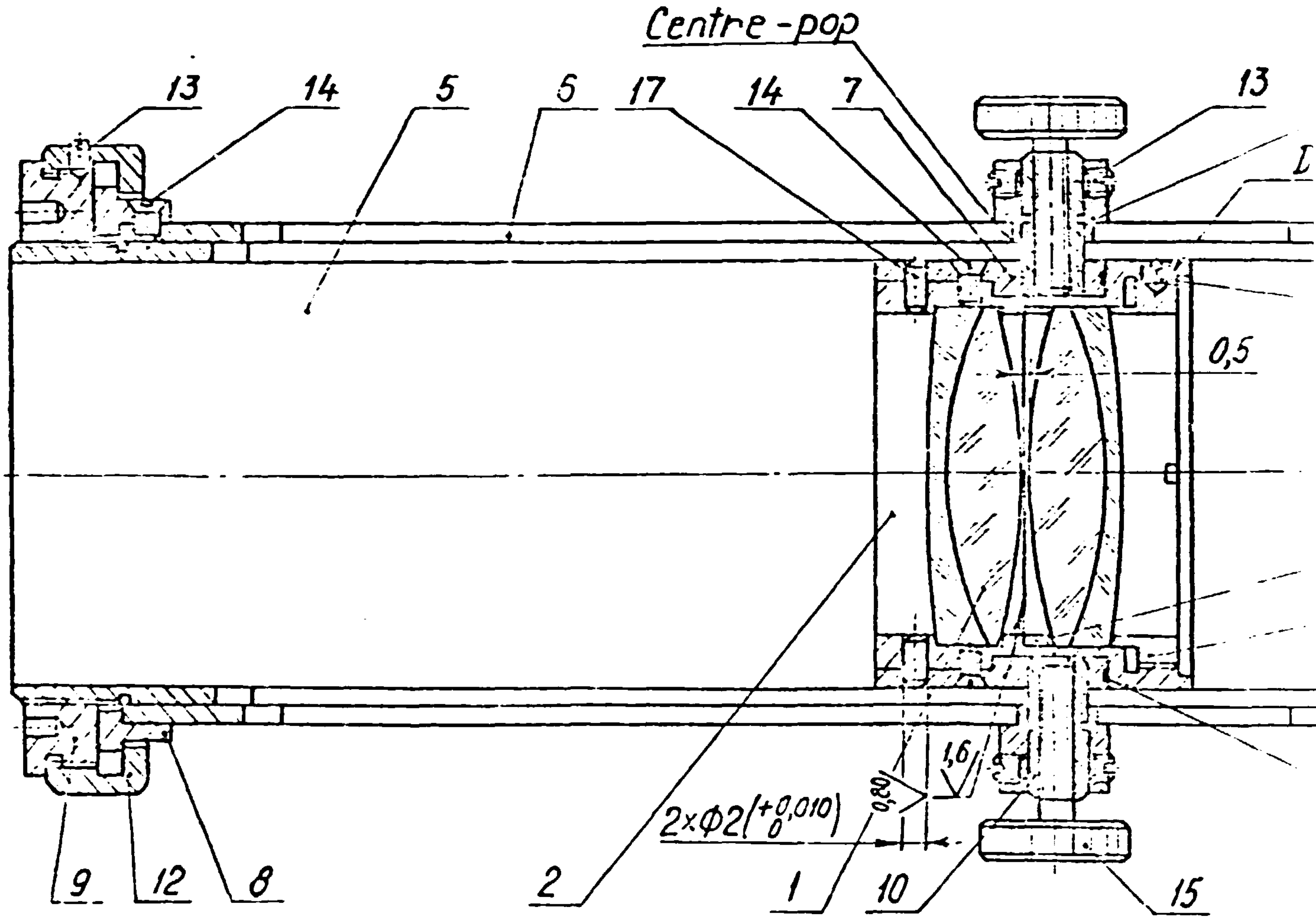
Format	Zone	Ref No	Designation	Name	Quant.	Comment
				Specification		
A3			320.100 Ass	Assembling drawing		
				Assembling units		
A4		1	320.110	Lens	2	
				Pieces		
A3		2	320.069	Holder	1	
A4		3	320.071	Ring	2	
A4		4	320.072	Ring	1	
A3		5	320.073	Tube	1	
A2		6	320.074	Tube	1	
A4		7	320.075	Insert	2	
[illegible]		8	320.07[illegible]	Ring	1	
[illegible]		9	320.[illegible]	[illegible]	1	
A4		10	320.078	Bushing	2	
A3		11	320.079	Index	2	
A4		12	320.081	Nut	1	

Designer	320.[illegible]	
Chief Designer	Varyable power objective in tube	LITMO

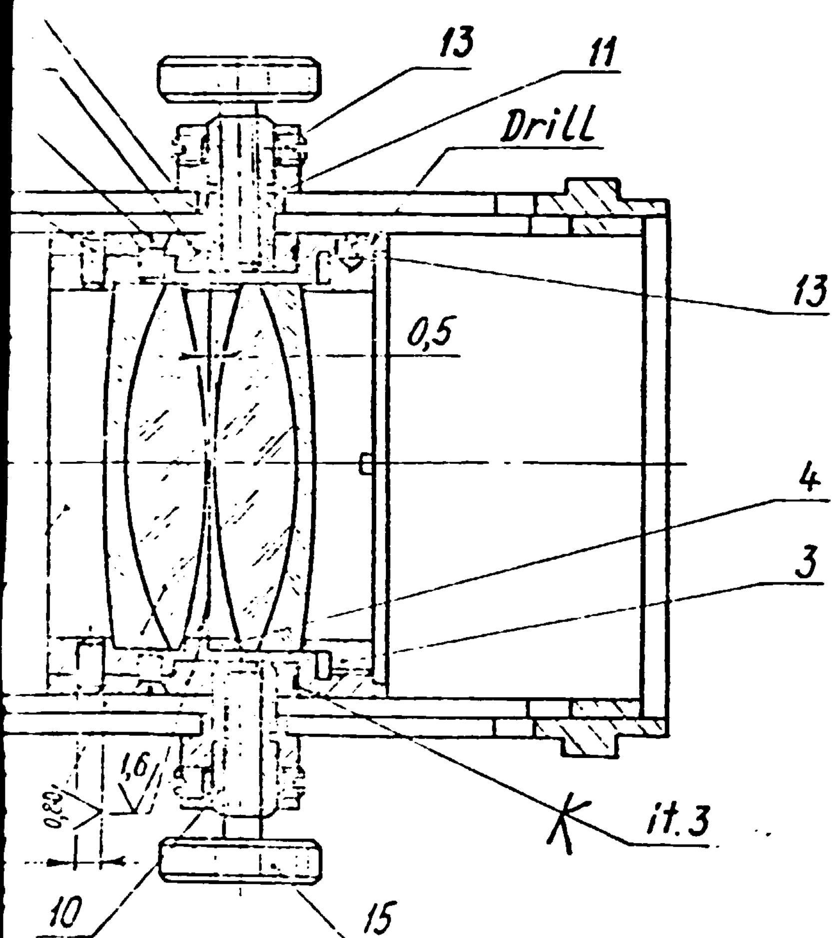
Format	Zone	Ref No	Designation	Name	Quantity	Comment
				<u>Standard units</u>		
		13		Screw B M2-6g×3.14H.04 ГОСТ 1476-84	8	
		14		Screw B M2-6g×3.58.04 ГОСТ 17475-80	5	
		15		Screw B M3-6g×12.58.04 ГОСТ 21332-75	2	
		17		Pin 2m6×4 ГОСТ 3128-70	2	

320.100

Sheet 2



SECTION 1



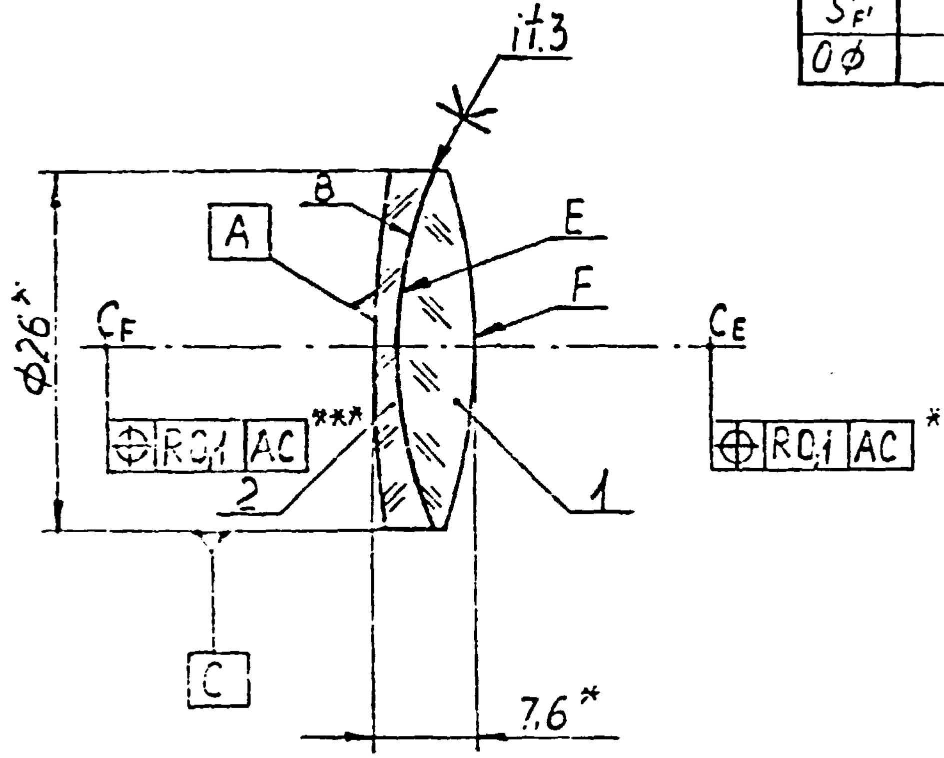
1. The holder p.2 with all the pieces must move quietly by hand without any rocking
2. The tube p.5 with all the pieces must move quietly inside the basis tube p.6 while the ring p.12 is being rotated.
3. Cement ЭД-6

320. 100 A ss						
Varyable power objective in tube				Mass	Scale
					2:1
			Sheet	Sheets 1	
Designer				LITMO	
Chief Designer					

Form.	Zone	Pos. №	Designation	Name	Quant.	Comment
				Specification		
A4			320.110 Ass	Assembling drawing		
				Pieces		
A4		1	320.065	Lens	1	
A4		2	320.066	Lens	1	

	320.110	
Designer	Lens	Sheet: Sheets: 1
Chief Designer		LITMO

N	3
ΔN	0,3
Surf. qual	0,1**
f	79,88
S_F	-75,73
$S'_{F'}$	79,03
Oφ	25



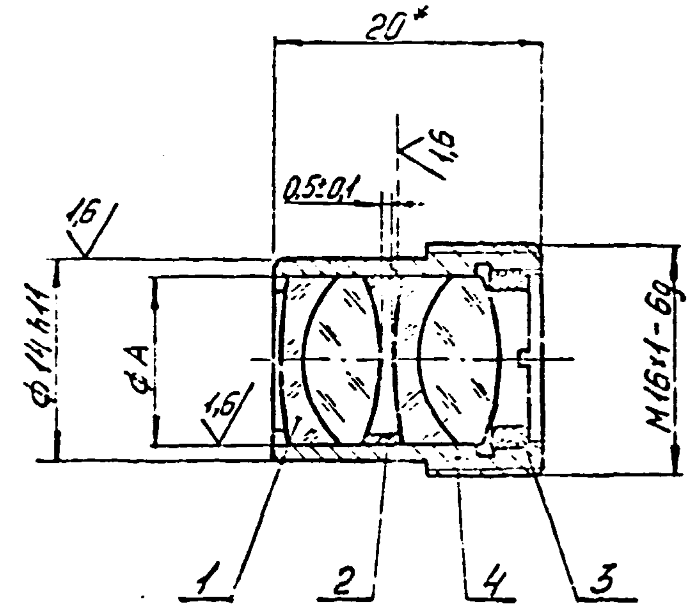
1.* The dimension for information
2** Permitted total area of scratches, pits (mm²)
3. Balsam
4.*** Shift in focal plane of light beam passing through the lens be not more than 0,12 mm

320.110 Ass.		
Lens	Mass	Scale 2:1
Designer	Sheet	Sheets 1
	LITMO	

Form	Zone	Ref.No	Designer	Name	Quant.	Comment
				Specification		
A4			320.120 Ass	Assembling drawing		
				Assembling units		
A4			320.130	Lens	2	
				Pieces		
A4			320.088	Ring	1	
A4			320.089	Ring	1	
A4			320.091	Holder	1	

320.120			
Designer / Chief Designer	Microscope objective	Sheet	Sheets: 1
		LITMO	

f'	14,18
S_F	6,41
$S'_{F'}$	9,77
$O\phi$	11



1.* The dimension for information
2. Turn the surface A according to the assembly pos.1

320.120 Ass			
Microscope objective		Mass	Scale
			2:1
	Sheet	Sheets 1	
	LITMO		

Designer

Chief Designer

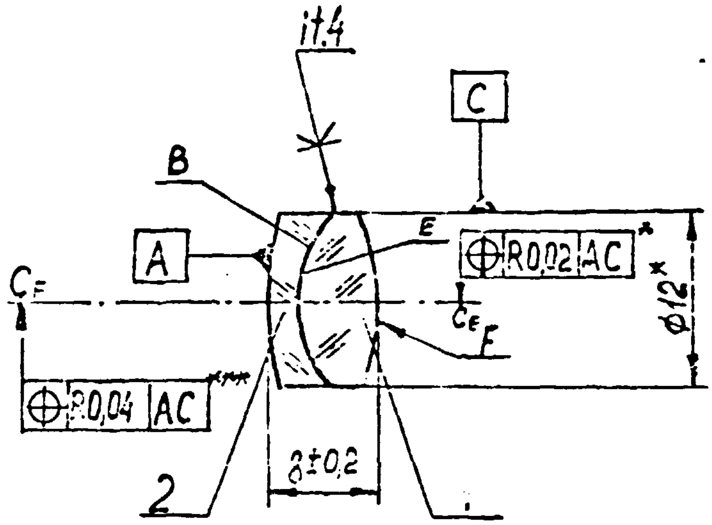
Form. A4

Form	Zone	Ref.No	Designation	Name	Quant.	Comment
				Specification		
A4			320.130 ASS	Assembling drawing		
				Pieces		
A4			320.085	Lens	1	
A4			320.086	Lens	1	

320. [illegible]

Designer	Lens	Sheet	Sheets
Chief Designer			1
		LITMO	

N	2
ΔN	0,3
Surf. qual	0,1**
f	25,00
S_F	-20,60
$S'_{F'}$	23,97
0 ⌀	11



1.* The dimension for information
2.** Permitted total area of scratches, pits (mm²)
3.*** Shift in focal plane of light beam passing through the lens be not more than 0,035mm
4. Balsam

320.130 Ass.		
Lens	Mass	Scale
		2:1
	Sheet	Sheets 1
	LITMO	
Designer		
Chief designer		

Pos No	Designation	Name	Qty
		Specifications	
	320. 150 A SS	Assembling drawing	
	320. 150 L3	Optical scheme	
		Assembling units	
1	320. 010	Illuminator	1
2	320. 040	Eyepiece	1
3	320. 070	Graticule with protective glass in holder	1
4	320. 090	Graticule with protective glass in holder	1
5	320. 100	Varyable power objective in tube	1
6	320. 120	Microscope objective	1

320. 150

Designer

Checker

Testing device

Sheet	Sheets
1	3

LITMO

Form A4

			...ignation	Name	Quantity	Comment
				Pieces		
A3		7	320. 101	Cover	1	
A1		8	320. 102	Body	1	
A4		9	320. 103	Screw	2	
A3		10	320. 104	Cover	1	
A4		11	320. 105	Ring	1	
A4		12	320. 106	Ring	2	
A3		13	320. 107	Tube	1	
A4		14	320. 108	Flange	1	
A3		15	320. 109	Nut	1	
A4		16	320. 111	Pin	4	
A4		17	320. 112	Spacer	1	
A3		18	320. 113	Hinge	1	
A3		19	320. 114	Hinge	1	
A3		20	320.115	Hinge	1	
A3		21	320.116	Hinge	1	
A4		22	320.117	Spring	2	
				Standard units		
		29		Screw B M2-6g x3.14H.	7	
				04 ГОСТ 1476-84		
		30		Screw B M2-6g x5.14H.04	1	
				ГОСТ 1476-84		
		31		Screw B M3-6g x10.14H.04	1	
				ГОСТ 1476-84		

320. 150

Sheet 2

Form A4

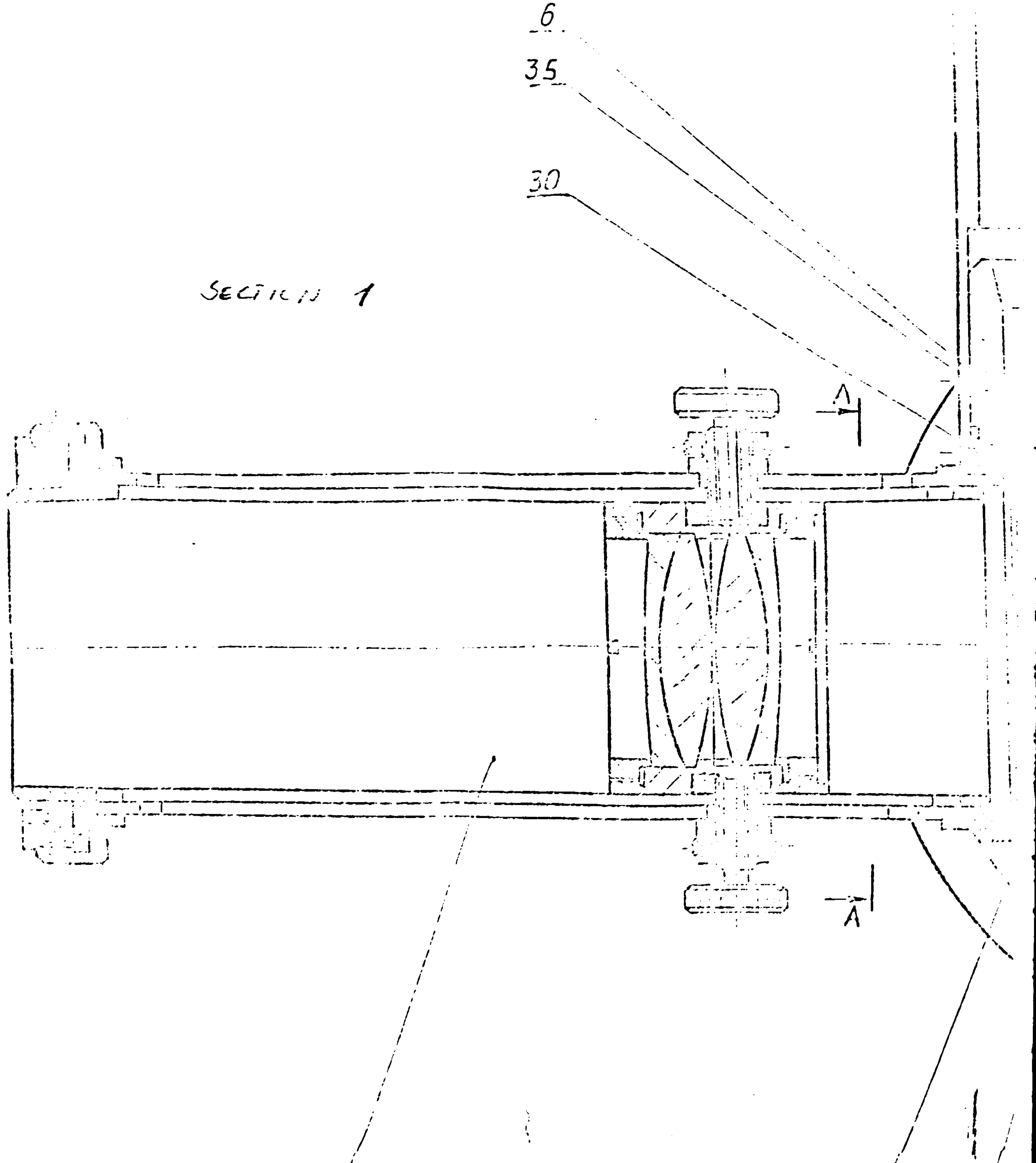
Form.	Zone	Ref. No	Designation	Name	Quantity	Comment
		33		Screw B M2-6g × 6.58.	3	
				05 ГОСТ 1491-80		
		34		Screw B M3-6g×12.58.	4	
				04 ГОСТ 1491-80		
		35		Screw B M2-6g×5.58.	3	
				04 ГОСТ 17475-80		
		36		Screw B M2-6g×8.58.	10	
				04 ГОСТ 17475-80		
		37		Screw B M4-6g×8.58.	6	
				04 ГОСТ 17475-80		
		38		Screw B M4-6g × 16.	3	
				58.04 ГОСТ 17475-80		
		40		Pin 2 m6 × 10	2	
				ГОСТ 3128-70		

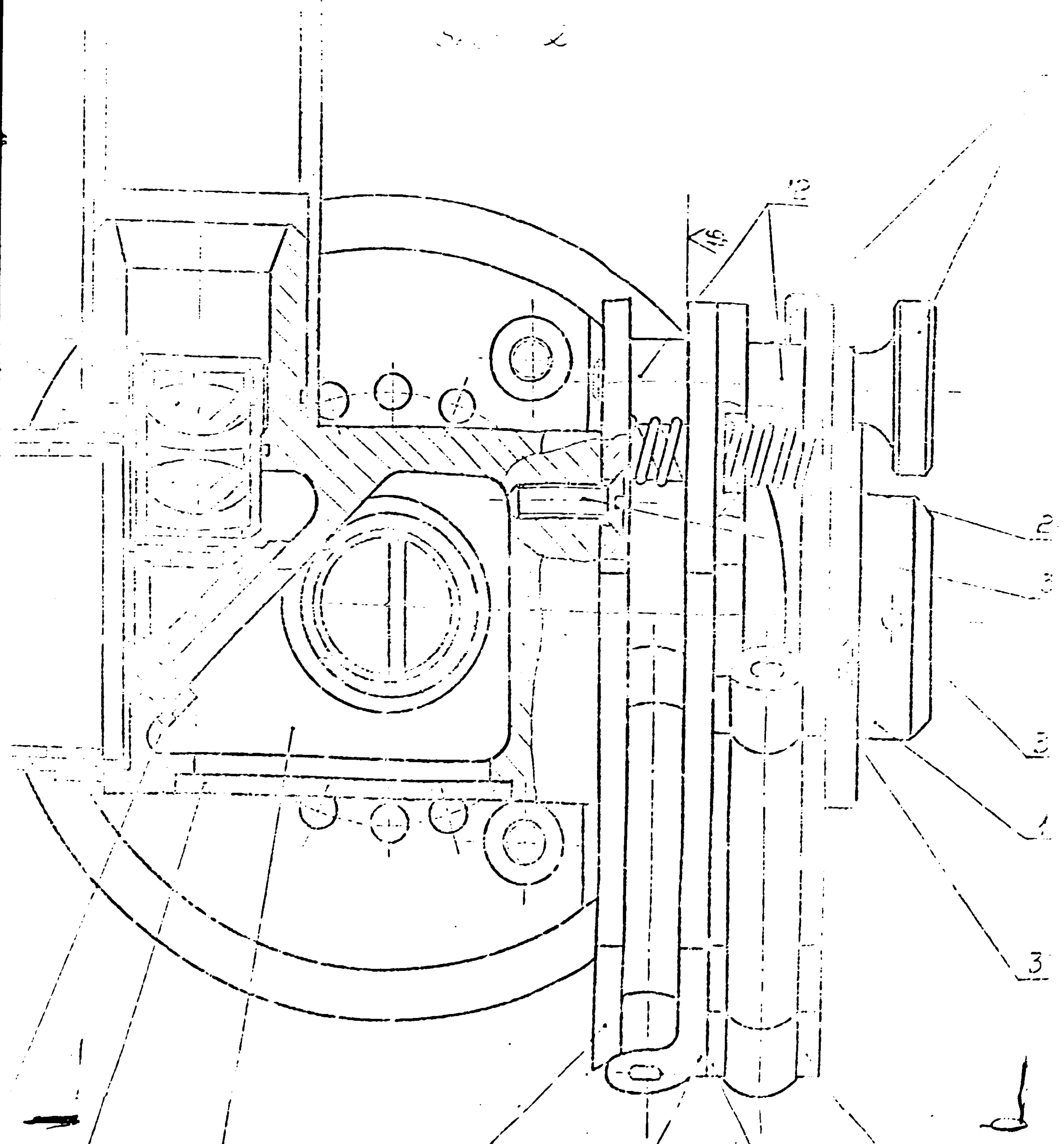
320.150

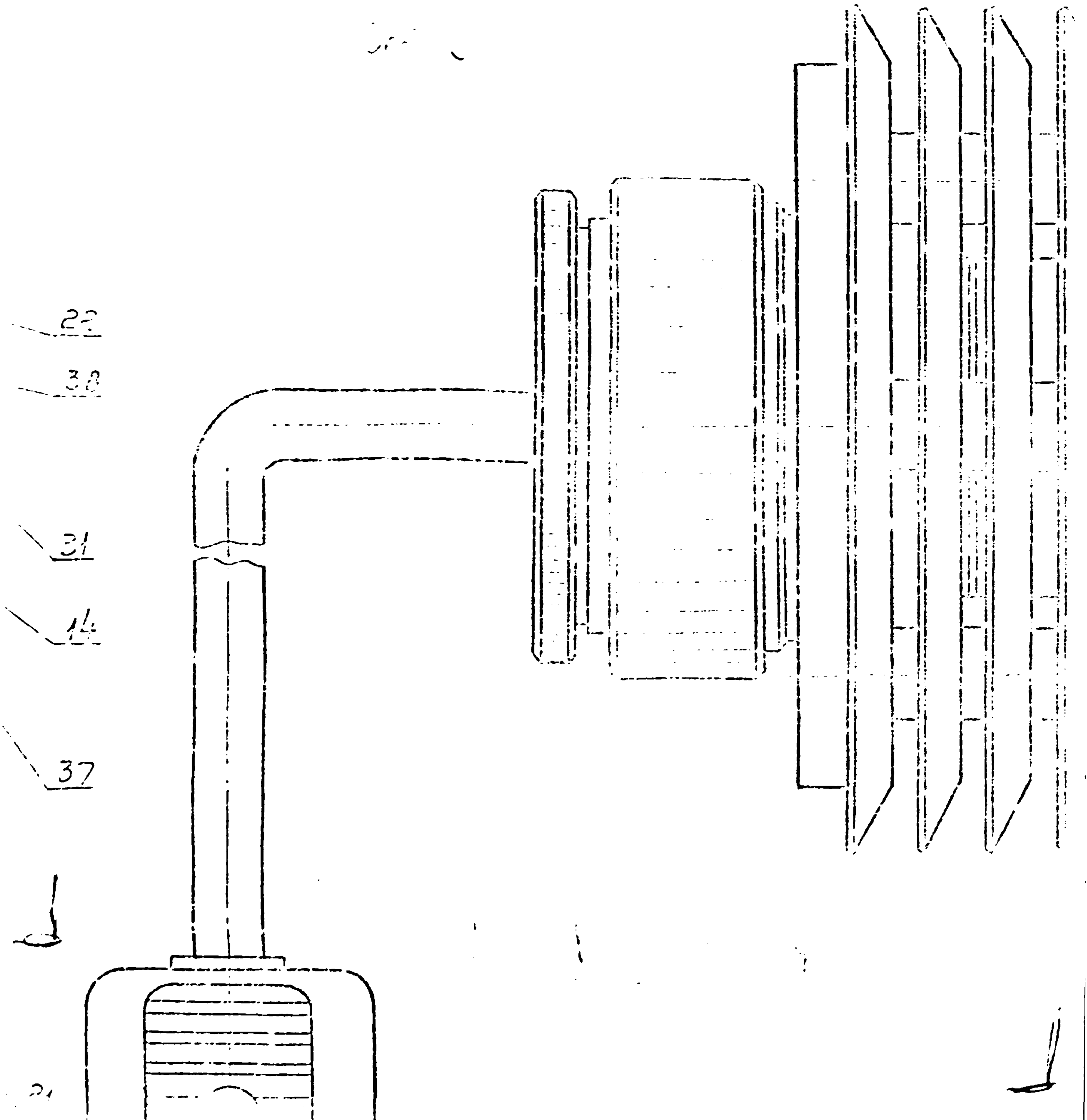
Sheet 3

Form A4

SECTION 1

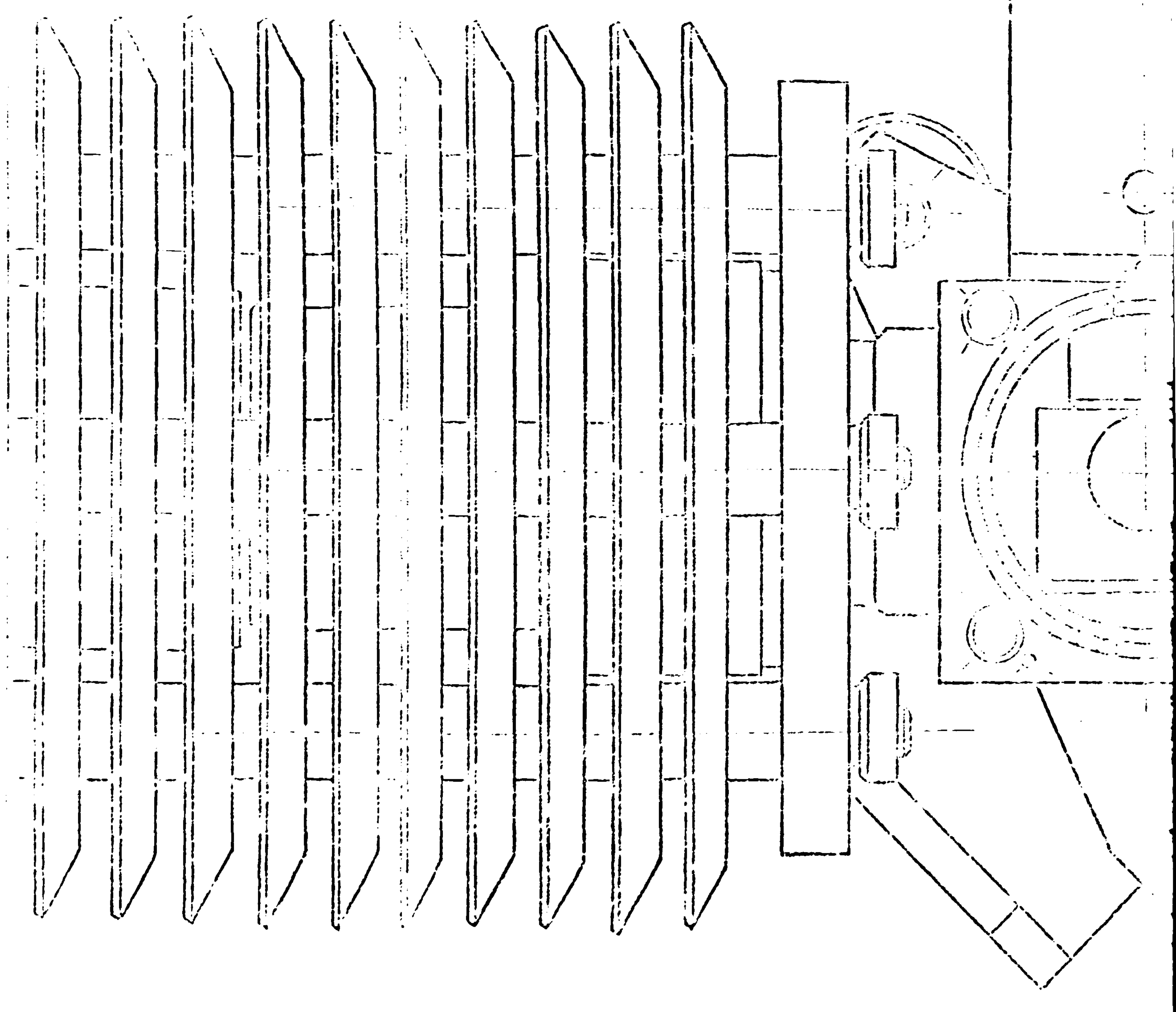




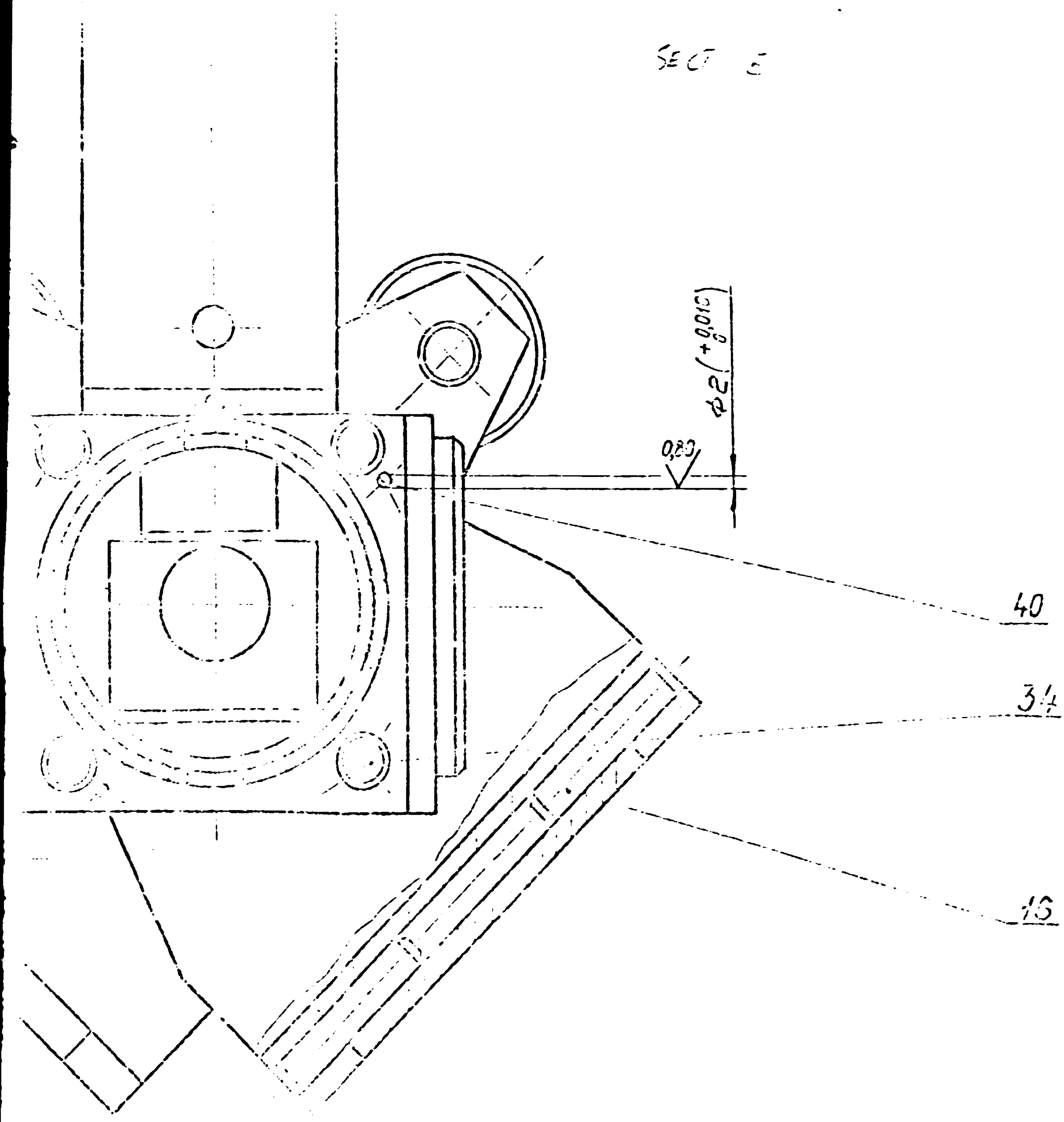


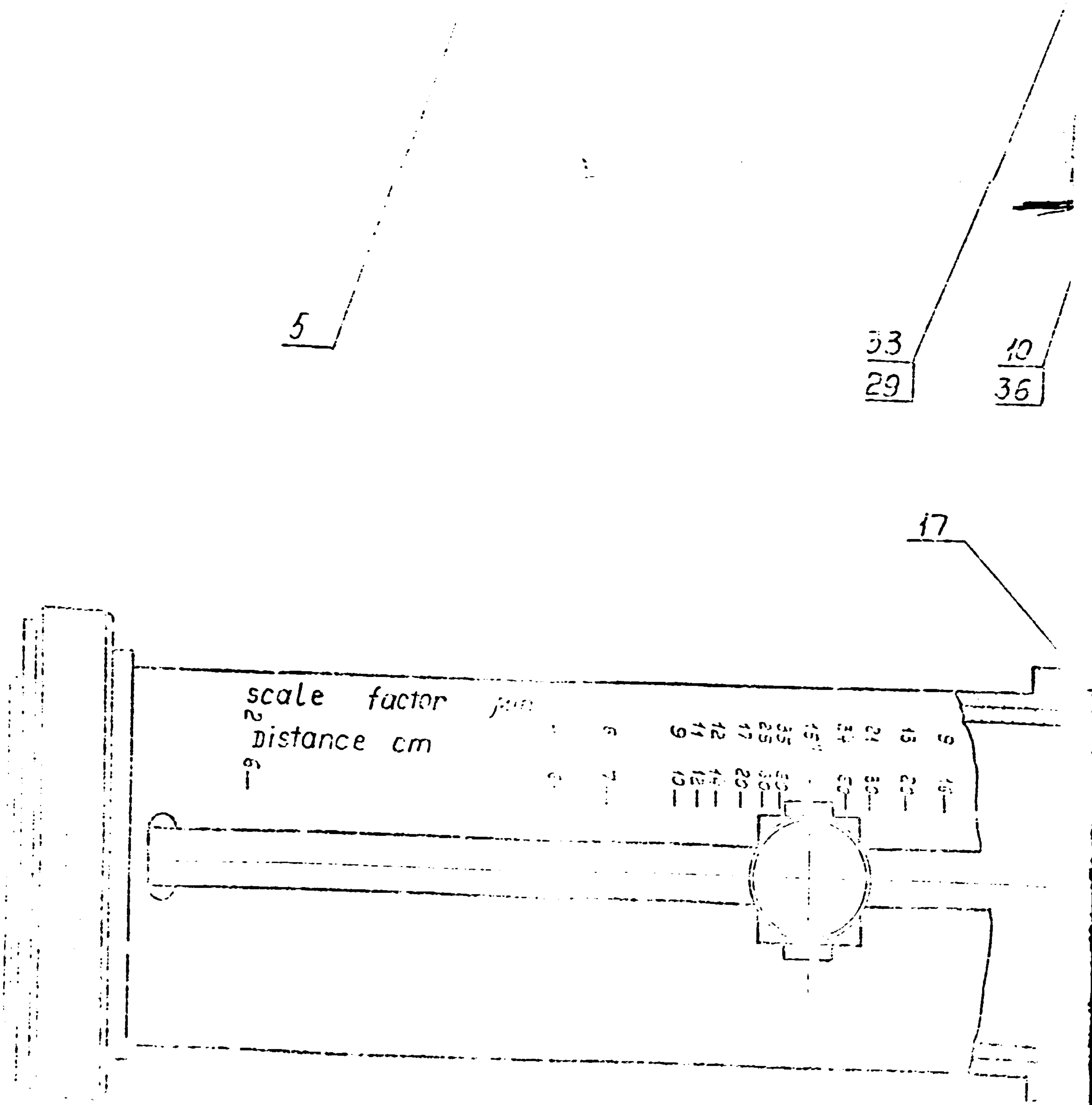
38
31
14
37

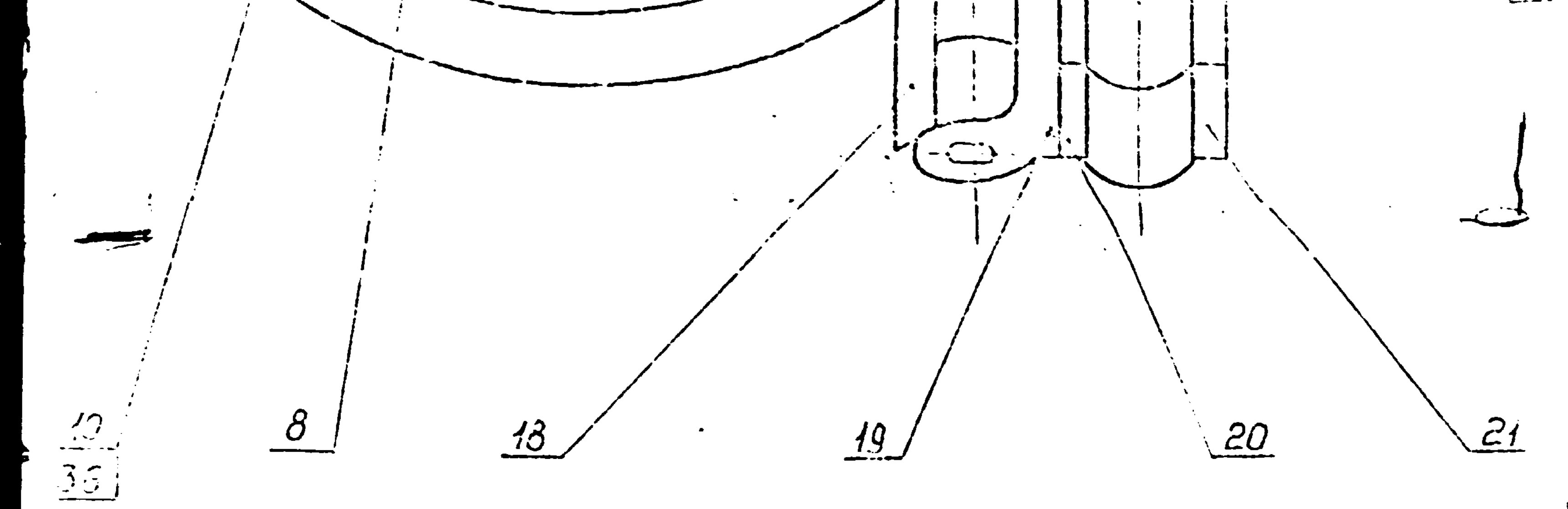
SECT +

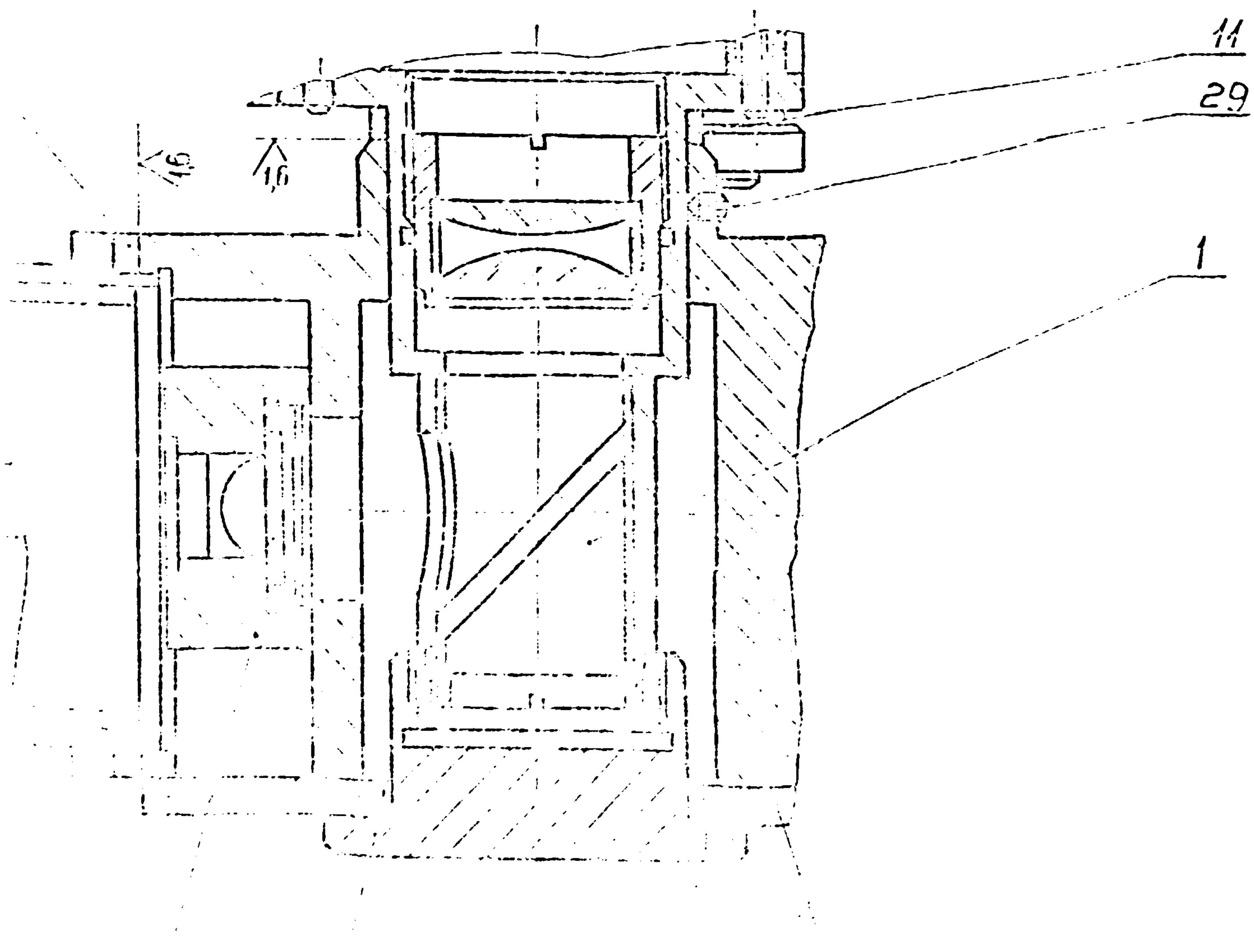


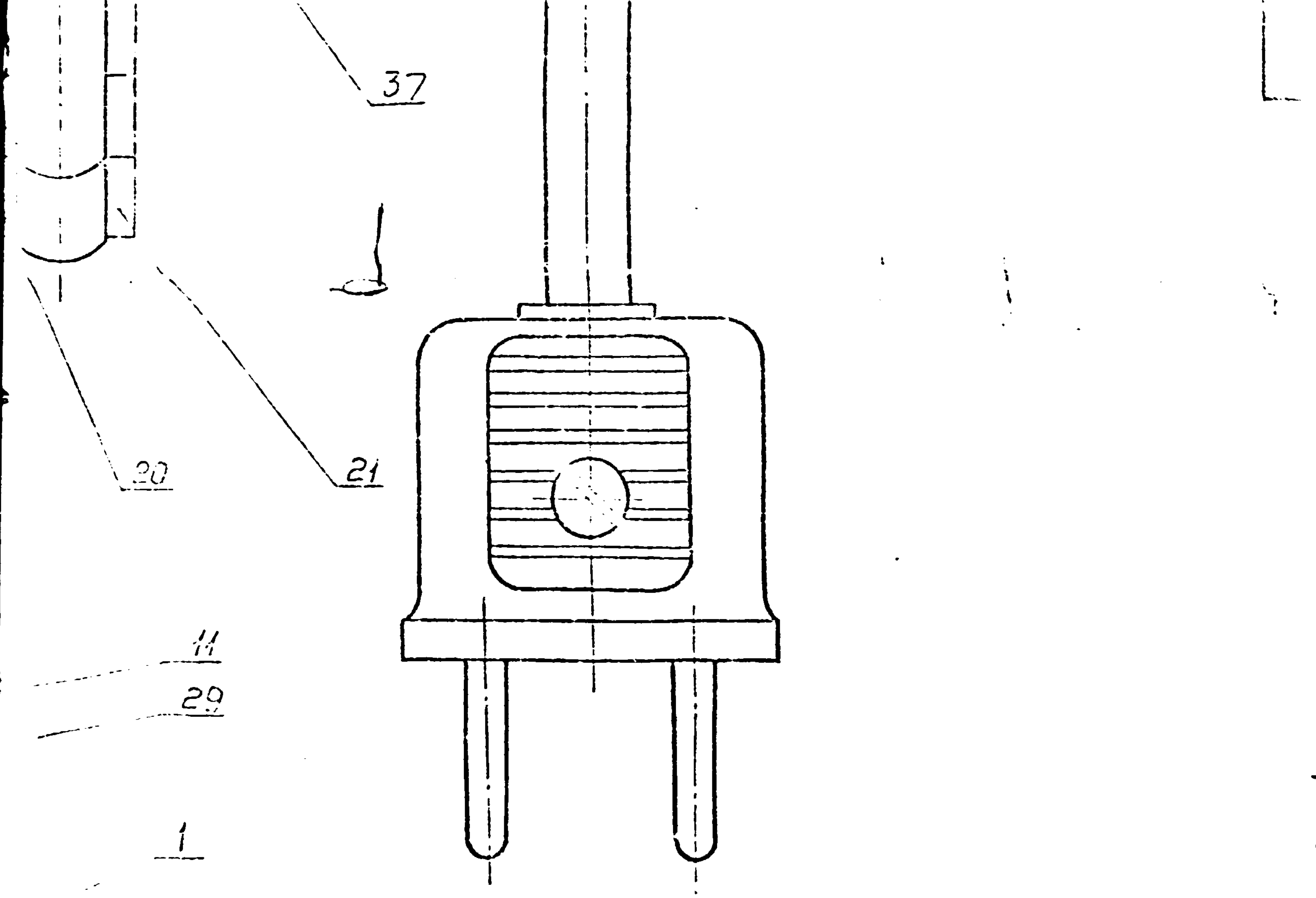
SECT E




5
33
29
10
36
17
scale factor
Distance cm

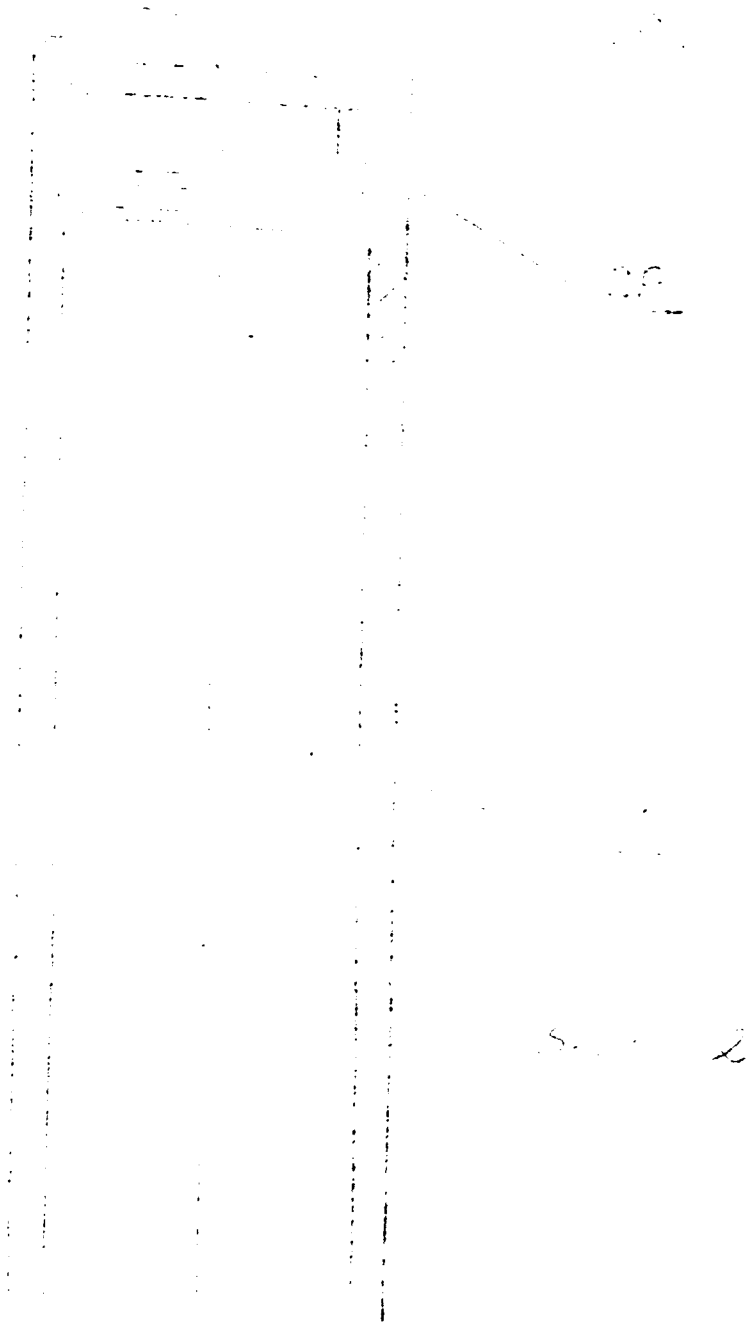

8
18
19
20
21


11
29
1


37
20
21
11
29
1

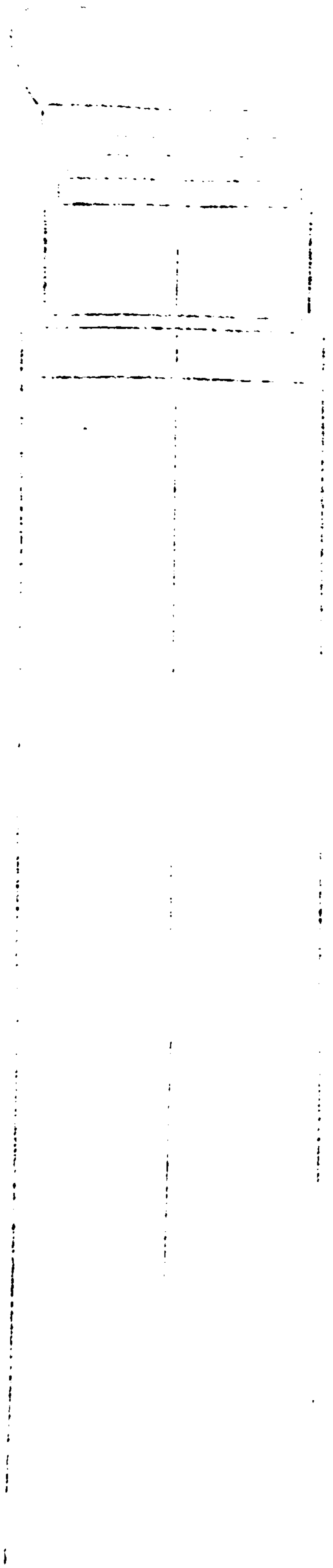
SECT 4

SECTION 1



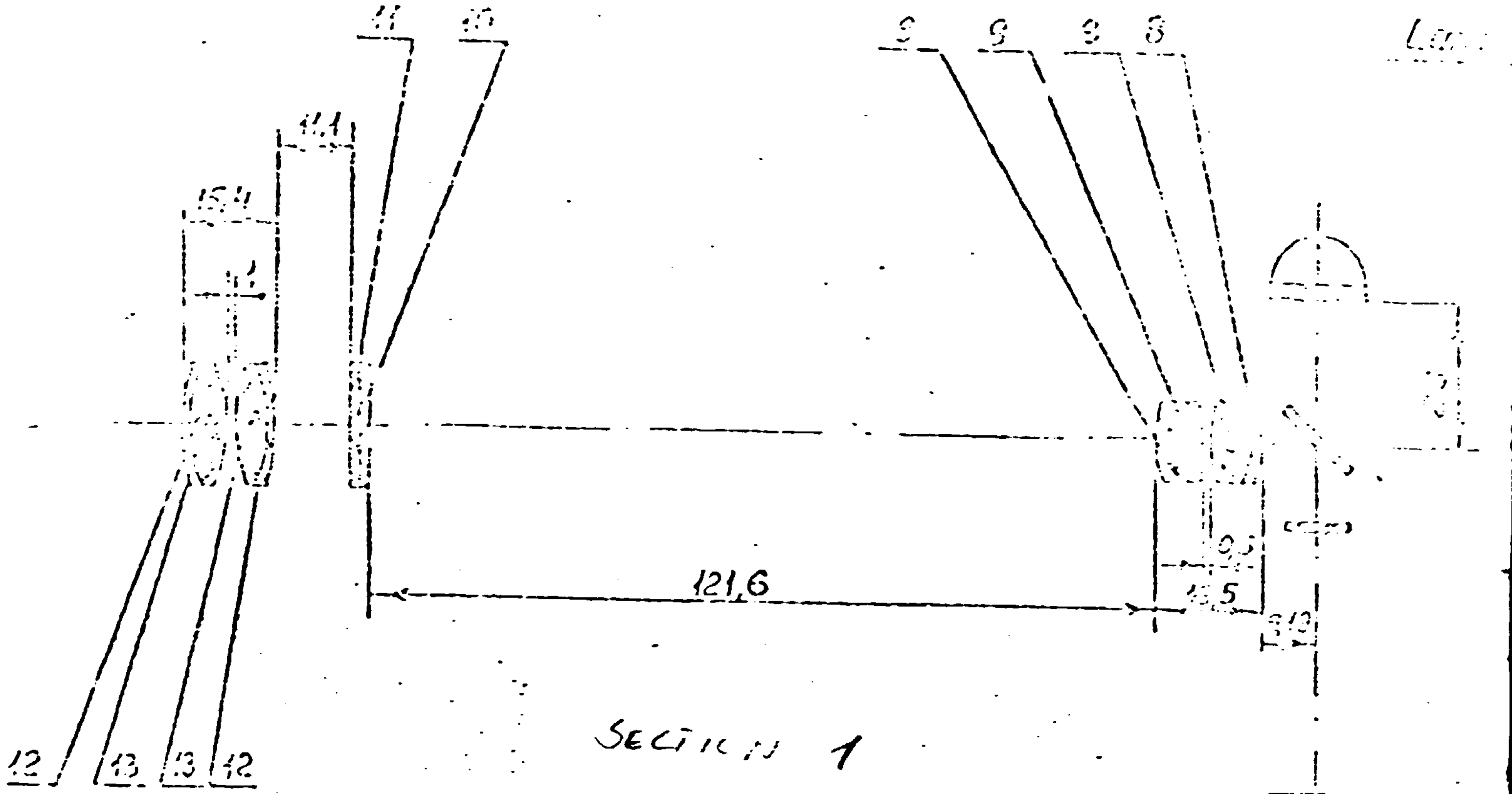
SECT 4

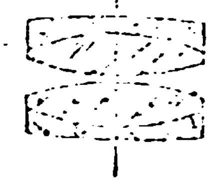
SECT E



Sect 6

A-A



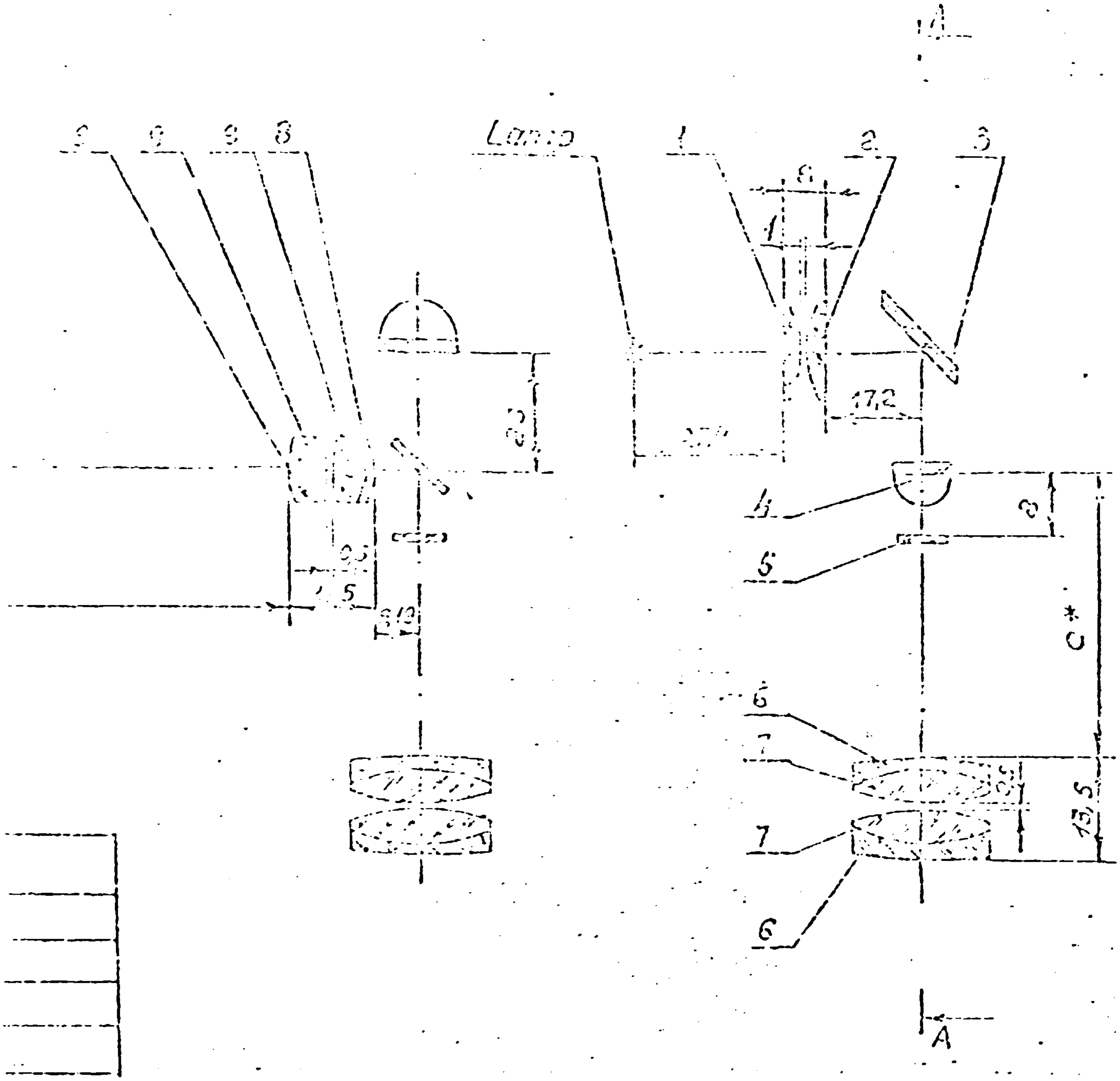


SECTION 1

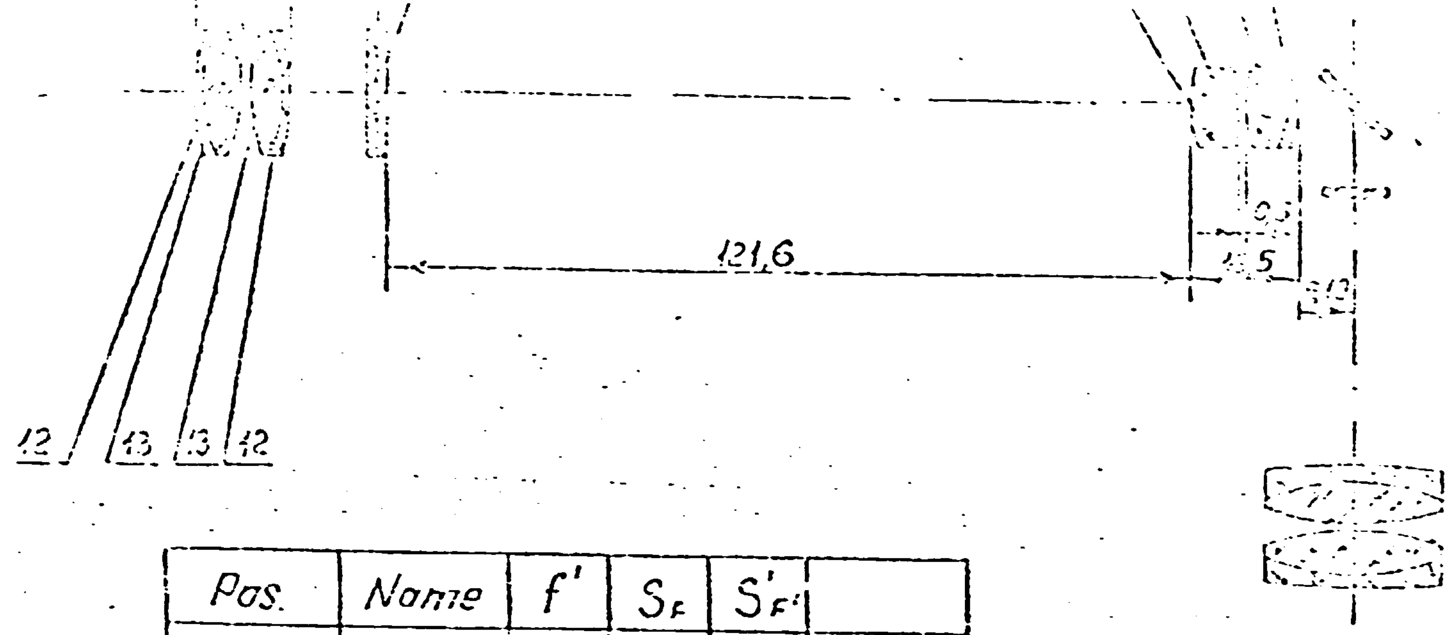
Pos.	Name	f'	S_F	$S'_{F'}$	
1,2	Condenser	17,72	-14,73	15,22	
6,7,7,6	Objectiv	40,60	-35,33	35,23	
9,9,8,8	Objectiv	14,81	-6,41	9,77	
12,12,13,13	Eyepiece	17,04	-11,75	11,75	

Pos.	$Ø_{Φ1}$	Sag $Ø_{Φ1}$	$Ø_{Φ2}$	Sag $Ø_{Φ2}$	Thickness
1	17	-	17	1,71	3
2	17	2,6	17	–	4
3	14,5	–	--	–	1
4	11	--	11	–	1,5
5	9	--	9	--	1

[illegible]	C *)
2	95,64
4	62,66
6	57,04
9	49,91
11	41,50



C*
95,54
62,66
57,04
49,91
41,[illegible]



Pos.	Name	f'	S_F	$S'_{F'}$	
1,2	Condenser	17,73	−14,73	15,22	
6,7,7,6	Objectiv	40,60	−35,33	35,33	
8,9,8,9	Objectiv	14,81	−6,41	9,77	
12,13,13,13	Eyepiece	17,01	−11,75	11,75	

Pos.	$Ø_{01}$	Sag $Ø_{01}$	$Ø_{02}$	Sag $Ø_{02}$	Thickness
1	17	–	17	1,71	3
2	17	2,6	17	–	4
3	14,5	–	–	–	1
4	11	–	11	–	1,5
5	9	–	9	–	1
6	25	0,57	25	2,43	1,6
7	25	2,43	25	1,71	6
8	11	0,53	11	2,74	2
9	11	2,74	11	1,35	6
10	16	–	16	–	1,5
11	16	–	16	–	1,5
12	17,7	0,47	17,7	2,29	1,2
13	17,7	2,33	17,7	2,40	6

Scale	$C^{*)}$
2	95,64
4	62,66
6	57,04
9	49,91
11	47,50
12	45,32
17	42,81
25	40,44
35	38,67
45	35,33
54	31,60
21	33,14
13	25,17
9	21,41

SECT 4

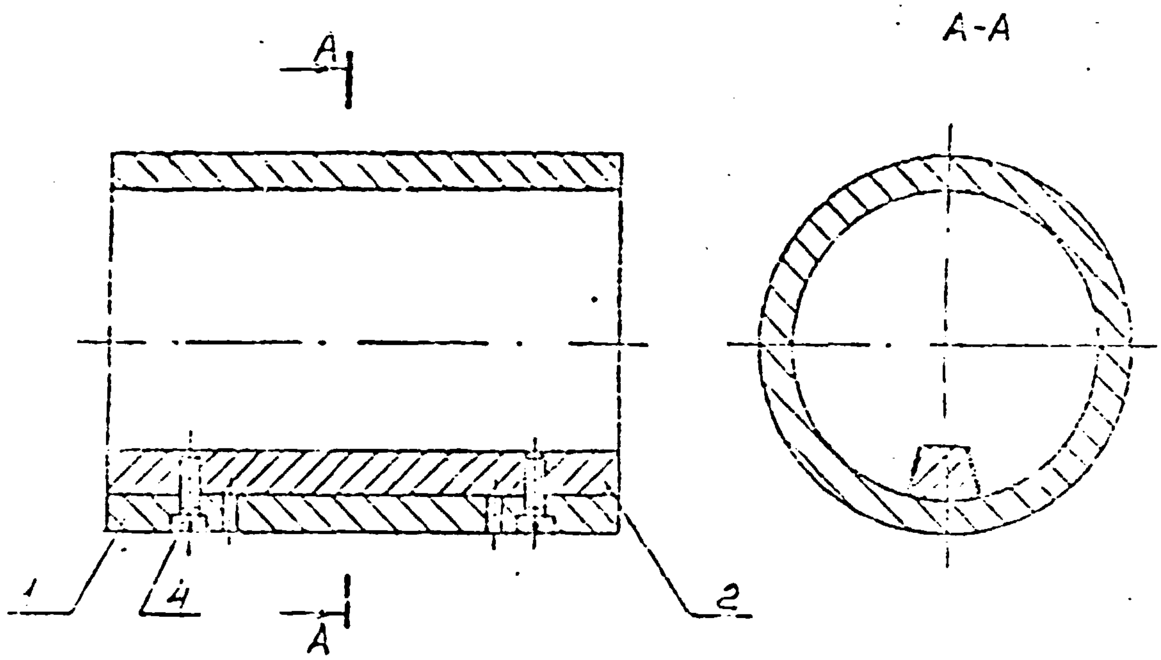
Zone	Pos	Designation	Name	Qty	Comment
	1	320.026	Lens	1	
	2	320.027	Lens	1	
	3	320.011	Mirror	1	
	4	320.056	Graticule	1	
	5	320.058	Protective glass	1	
	6	320.066	Lens	1	
	7	320.065	Lens	1	
	8	320.086	Lens	2	
	9	320.085	Lens	2	
	10	320.048	Graticule	1	
	11	320.049	Plate	1	
	12	320.042	Lens	2	
	13	320.041	Lens	2	

* The dimension C is given ignoring protective glass p.5 thickness

320.150 L3	
Testing device Optical scheme	Mass · Scale 1:1 Sheet · Sheets 1
Designer	
Chief Designer	

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				<u>Specification</u>		
A4			320.160 Ass	Assembling drawing		
				<u>Pieces</u>		
A4		1	320.121	Bushing	1	
A4		2	320.122	Key	1	
				<u>Standard units</u>		
		4		Screw B. M3×10.58.0 ГОСТ 1491-80	2	

	320.160		
Designer Chief	Bushing with key	Sheet	Sheets 1
		ЛИТМО	

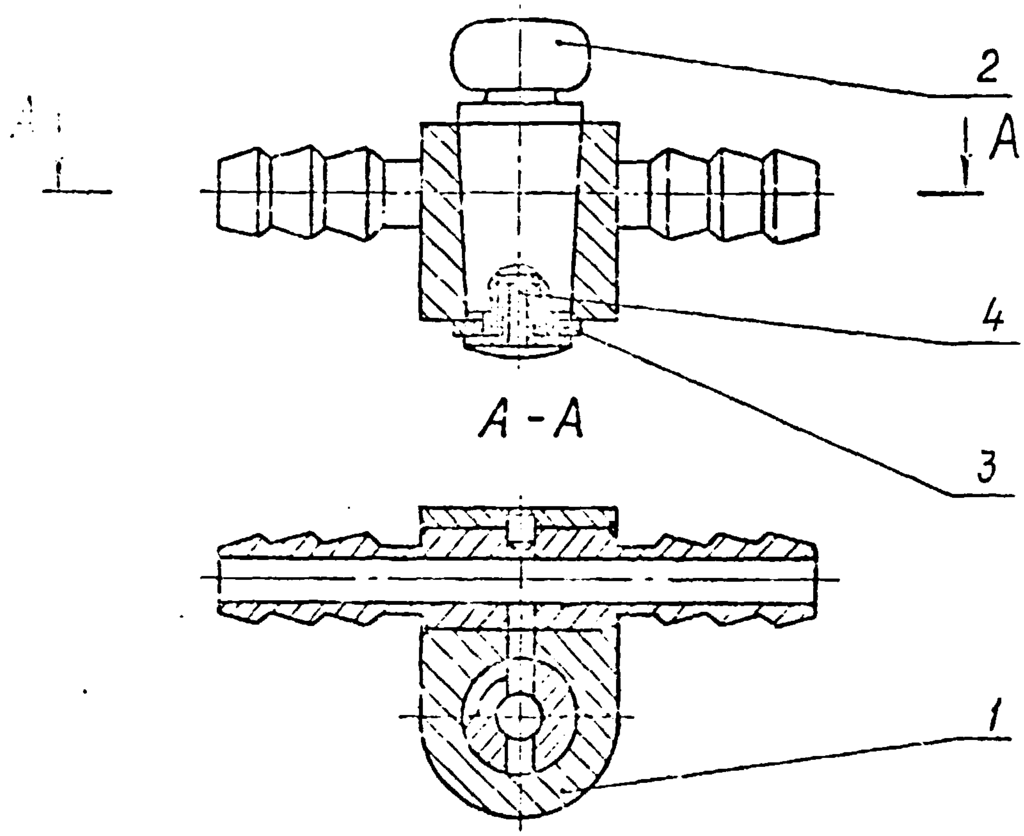


320.160 Ass			
Bushing with key		Mass	Scale
			1:1
	Sheet	Sheets 1	
	LITMO		

Form	Zone	Ref. N.	Designation	Name	Quantity	Comment
				Specification		
A4			320.170 Ass	Assembling drawing		
				Assembling units		
A4		1	320.180	Bibb body	1	
				Pieces		
A3		2	320.123	Distributer	1	
A4		3	320.124	Washer	1	
A4		4	320.125	Screw	1	

	320.170		
Designer	Bibb	Sheet	Sheets
			1
Chief Designer		LITMO	

Form A4



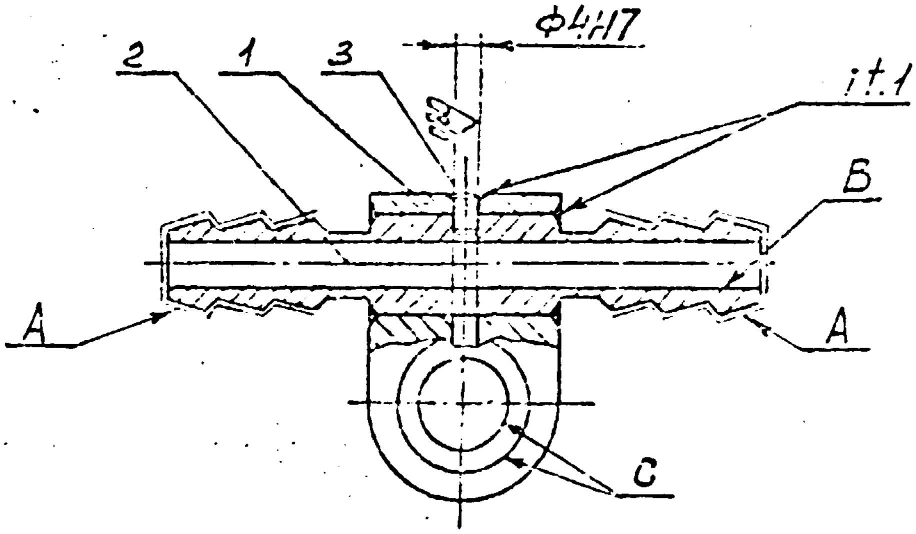
320. 170 Ass

Bibb		Mass	Scale
			1:1
	Sheet	Sheets 1	
	LITMO		

Form A4

Pos.	Designation	Name	Quant.	Comment
		Specification		
	320.180 Ass	Assembling drawing		
		Pieces		
1	320.126	Body	1	
2	320.127	Coupling	1	
		Standard units		
3		Pin 4m 6×8 ГОСТ 3128-70	1	

320.180		
Bibb body	Sheet	Sheets
		1
	LITMO	



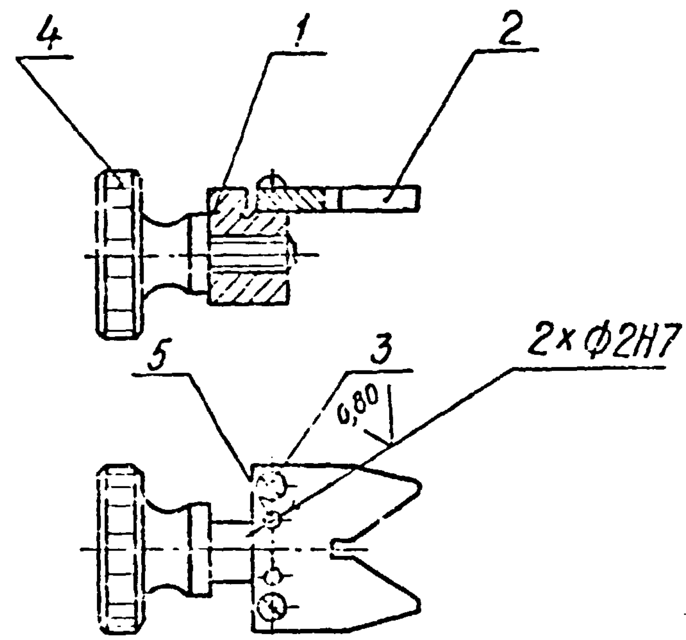
1. Solder ПОС-40
2. Coating grey enamel except the surface A,B,C

320.180 Ass		
Bibb body	Mass	1:1
Designer	Sheet	Sheets 1
Chief Designer	LITMO	

Form	Zone	Ref. No	Designation	Name	Quantity	Comment
				<u>Specification</u>		
A4			320. 190 Ass	Assembling drawing		
				<u>Pieces</u>		
A4		1	320. 128	Support	1	
A4		2	320. 129	Knife-edge	1	
				<u>Standard units</u>		
		3		Screw B. M2-6g × 6. 58.04 ГОСТ 17473-80	2	
		4		Screw B. M6-6g × 10. 58. 04 ГОСТ 21331-75	1	
		5		Pin 2m6 × 6 ГОСТ 3128-70	2	

	320. 190		
Designer	Knife-edge support	Sheet	Sheets 1
Chief Designer		LITMO	

Form A4



Mount the knife edge pos. 2 against a test roller and pin it

320. 190 Ass			
Knife - edge support		Mass	Scale
			1:1
		Sheet	Sheets 1
		LITMO	

Designer

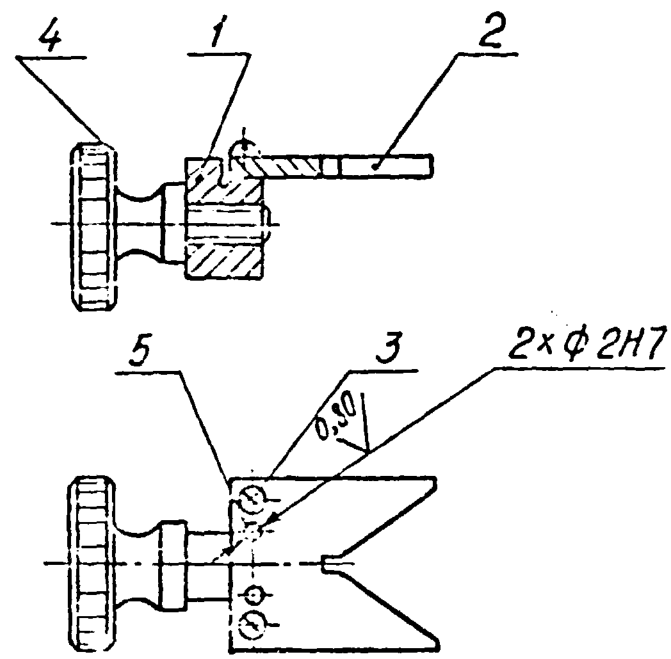
Chief designer

Form A4

Form	Zone	Ref. No	Designation	Name	Quantity	Comment
				Specification		
A4			320. 200 Ass	Assembling drawing		
				Pieces		
A4		1	320. 128	Support	1	
A4		2	320. 131	Knife-edge	1	
				Standard units		
		3		Screw B.M2-6g×6.58.04 ГОСТ 17473-80	2	
		4		Screw B.M6-6g×10.58.04 ГОСТ 21331-75	1	
		5		Pin 2m6×6 ГОСТ 3128-70	2	

	320.200		
Designer	Knife - edge support	Sheet	Sheets
			1
Chief Designer		LITMO	

Form A4

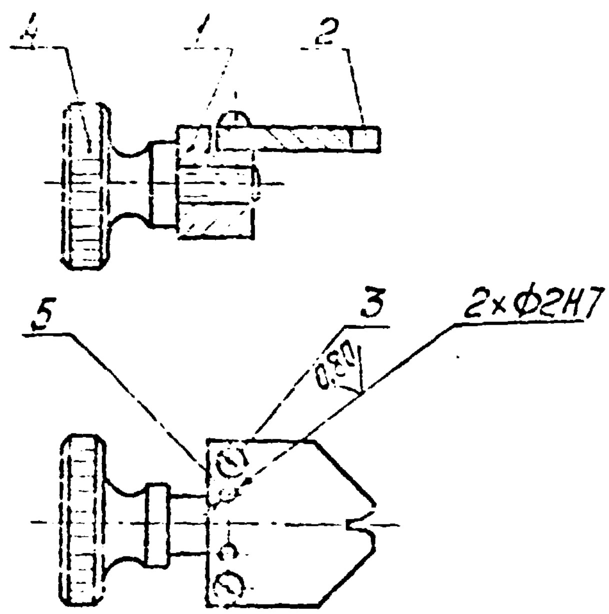


Mount the knife edge pos.2 against a test roller and pin it

320. 200 Ass		
Knife - edge support	Mass	Scale
		1:1
	LITMO	

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				Specification		
A4			320.310 Ass	Assembling drawing		
				Pieces		
A4		1	320.128	Support	1	
A4		2	320.201	Knife-edge	1	
				Standard units		
		3		Screw B.M2-6g×6. 58.04 ГОСТ 17473-80	2	
		4		Screw B.M6-6g×10. 58.04 ГОСТ 21331-75	1	
		5		Pin 2m6×6 ГОСТ 3128-70	2	

	320.310	
Designer	Knife-edge support	Sheet / Sheets 1
Chief Designer		LITMO

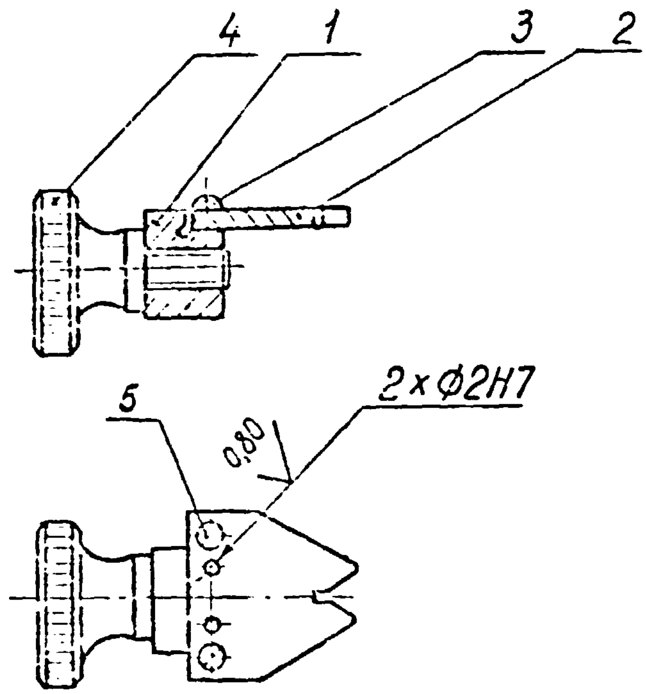


Mount the knife edge pos. 2 against a test roller and pin it.

320.310 Ass			
Knife-edge support		Mass	Scale
			1:1
	Sheet 1 Sheets 1		
	LITMO		

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				<u>Specification</u>		
A4			320.320 ASS	Assembling drawing		
				<u>Pieces</u>		
A4		1	320.128	Support	1	
A4		2	320.202	Knife-edge	1	
				<u>Standard units</u>		
		3		Screw B.M2-6g×6.58.04 ГОСТ 17473-80	2	
		4		Screw B.M6-6g×10.58.04 ГОСТ 21331-75	1	
		5		Pin 2m6×6 ГОСТ 3128-70	2	

	320.320		
Designer	Knife-edge support	Sheet	Sheets
Chief Designer		LITMO	



Mount the knife edge pos. 2 against a test roller and pin it

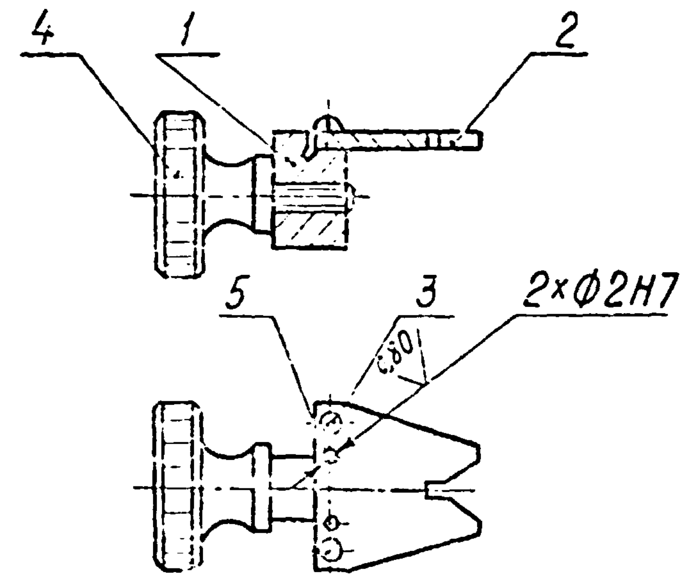
320. 320 Ass	
Knife - edge support	Mass	Scale 1:1
	Sheet	Sheets 1
	LITMO

Form A4

Form	Zone	Ref.No	Designation	Name	Quantity	Comment
				Specification		
A4			320.330Ass	Assembling drawing		
				Pieces		
A4		1	320.128	Support	1	
A4		2	320.203	Knife-edge	1	
				Standard units		
		3		Screw B.M2-6g×6.58.04 ГОСТ 17473-80	2	
		4		Screm B.M6-6g×10.58.04 ГОСТ 21331-75	1	
		5		Pin 2m6×6 ГОСТ 3128-70	2	

	320.330	
Designer	Knife-edge support	Sheet / Sheets
Ch. of Designer		LITMO

Form A4



Mount the knife edge pos.2 against a test roller and pin it

320. 330A ss		
Knife - edge support	Mass	Scale
		1:1
	Sheet	Sheets 1
	LITMO	

Form A4

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				Specification		
A4			320.340 Ass	Assembling drawing		
				Pieces		
A4		1	320.128	Support	1	
A4		2	320.204	Knife-edge	1	
				Standard units		
		3		Screw B.M2-6g×6.58.04 ГОСТ 17473-80	2	
		4		Screw B.M6-6g×10.58.04 ГОСТ 21331-75	1	
		5		Pin 2m6×6 ГОСТ 3128-70	2	

320.340

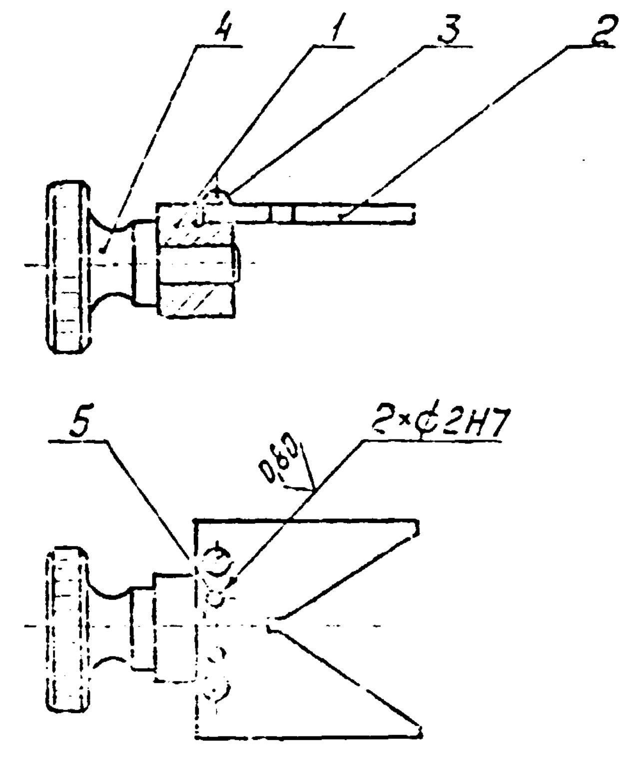
Designer

Chief Designer

Knife-edge support

Sheet	Sheets
	1

LITMO

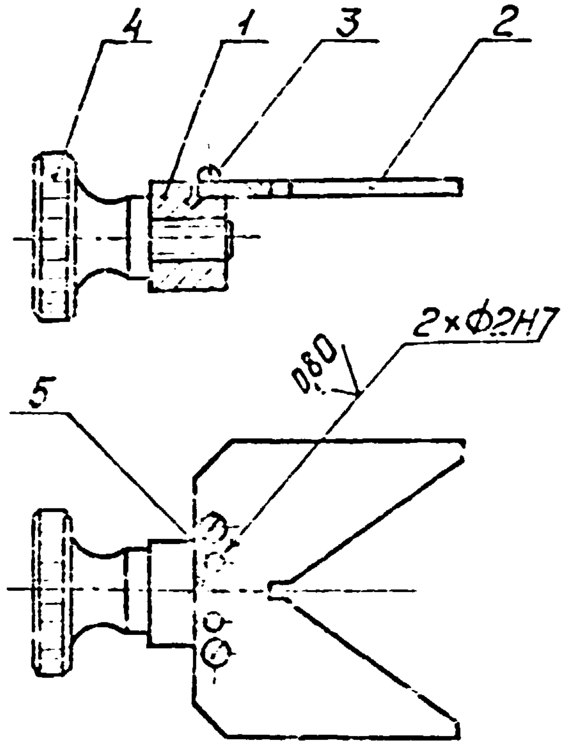


Mount the knife edge pos.2 against a test roller and pin it.

320.340 Ass			
Knife-edge support		Mass	Scale
			1:1
	Sheet	Sheets 1	
	LITMO		

Form	Zone	Ref No	Designation	Name	Quantity	Comment
				<u>Specification</u>		
A4			320.350 Ass	Assembling drawing		
				<u>Pieces</u>		
A4		1	320.128	Support	1	
A4		2	320.205	Knife-edge	1	
				<u>Standard units</u>		
		3		Screw B.M2-6g×6.58.04 ГОСТ17473-80	2	
		4		Screw B.M6-6g×10.58.04 ГОСТ21331-75	1	
		5		Pin 2 m6×6 ГОСТ3128-70	2	

	320.350		
Designer	Knife-edge support	Sheet	Sheets
			1
Chief Designer		LITMO	

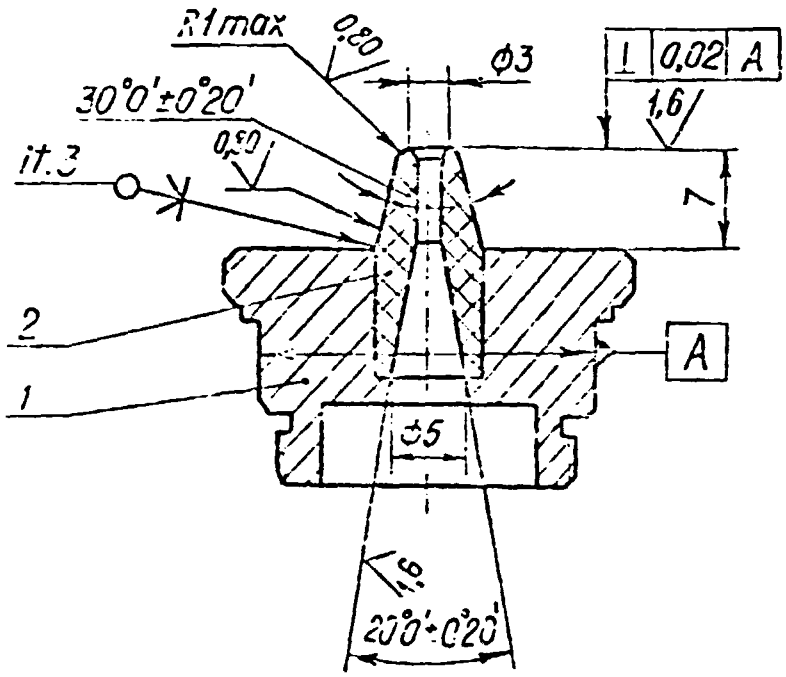


Mount the knife-edge pos. 2 against a test roller and pin it.

320. 350 Ass			
Knife-edge support		Mass	Scale
			1:1
	Sheet	Sheets 1	
	LITMO		

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				Specification		
A4			320.400 Ass	Assembling drawing		
				Pieces		
A4		1	320.221	Bushing	1	
A4		2	320.222	Ring	1	

	320.400	
Designer	Ring	Sheet / Sheets: 1
Chief Designer		LITMO



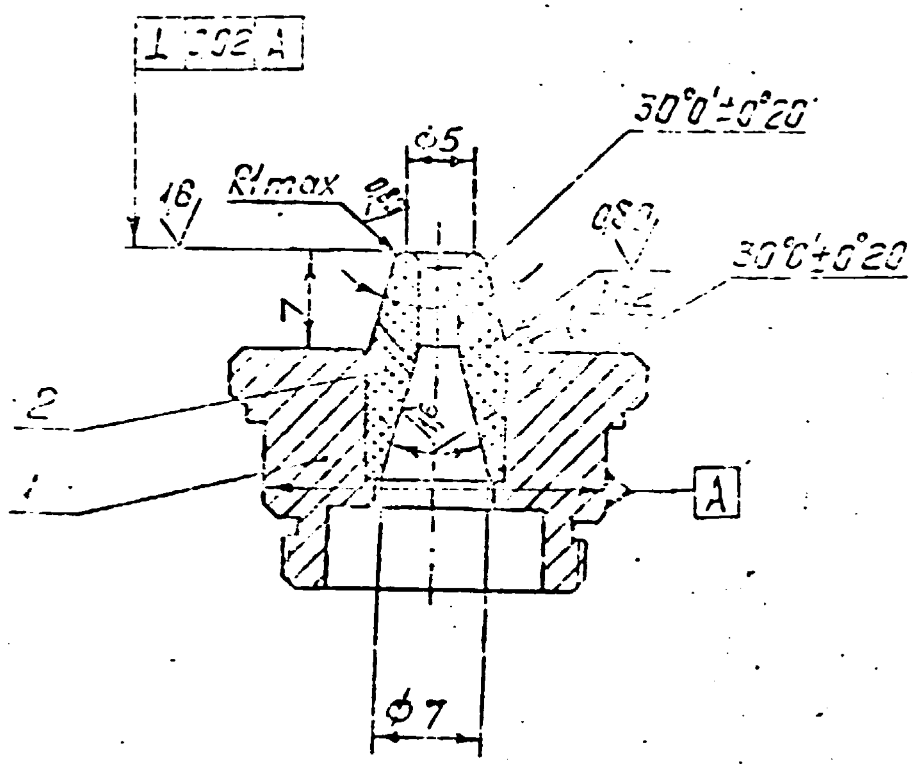
1. H14, h14, $\pm \frac{IT14}{2}$
2. Cement ЭД-6

320.400 Ass			
Ring		Mass	Scale
			2:1
	Sheet	Sheets 1	
	LITMO		

Form A4

Format	Zone	Ref No	Designation	Name	Quant.	Comment
				<u>Specification</u>		
A4			320.410 ASS	Assembling drawing		
				<u>Pieces</u>		
A4		1	320.223	Bushing	1	
A4		2	320.224	Ring	1	

	320.410	
Designer	Ring	Sheet: 1 / Sheets: 1
Chief Designer		LITMO



1. $H14$; $h14$; $\pm \frac{IT14}{2}$
2. Cement ЭД-6

320.410 Ass			
Ring		Mass	Scale
			2:1
		Sheet	Sheets 1
	LITMO		

Form	Zone	Ref No	Designation	Name	Quant	Comment
				Specification		
A4			320. 420 Ass	Assembling drawing		
				Pieces		
A4		1	320.225	Bushing	1	
A4		2	320. 226	Ring	1	

320. 420

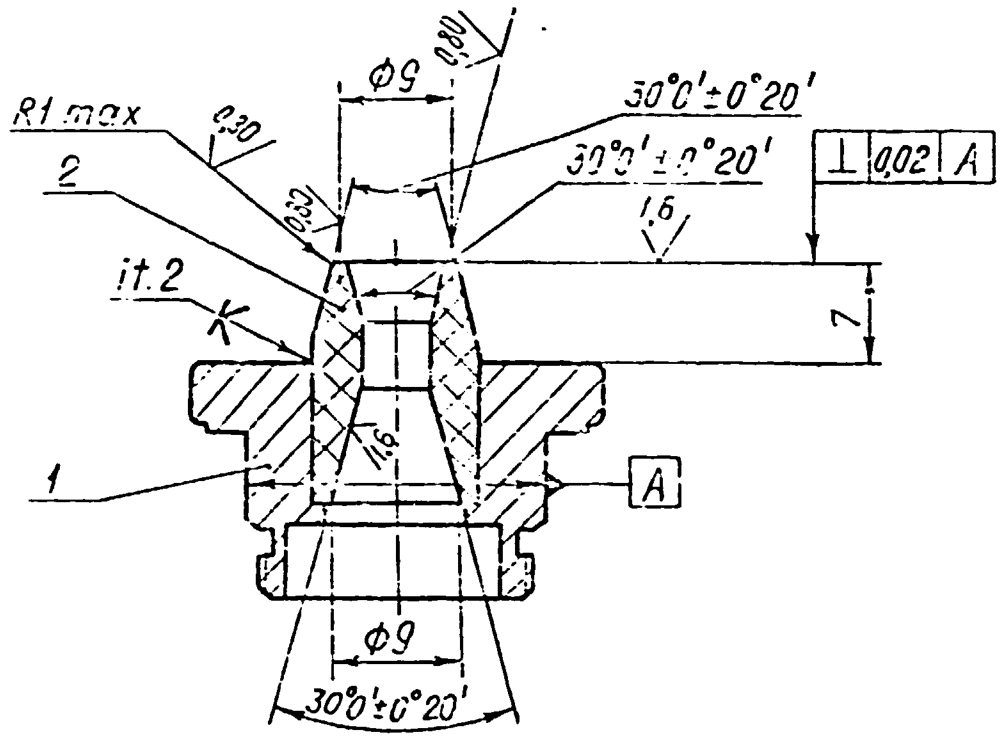
Ring

Sheet	Sheets
	1

LITMO

Designer

Chief Designer



1. H14, h14, $\pm \frac{IT14}{2}$

2. Cement ЭД-6

320. 420 Ass			
Ring	Mass	Scale	
		2:1	
	Sheet	Sheets 1	
	LITMO		

Form A4

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				Specification		
A4			320.430 ASS	Assembling drawing		
				Pieces		
A4		1	320.227	Bushing	1	
A4		2	320.228	Ring	1	

320.430

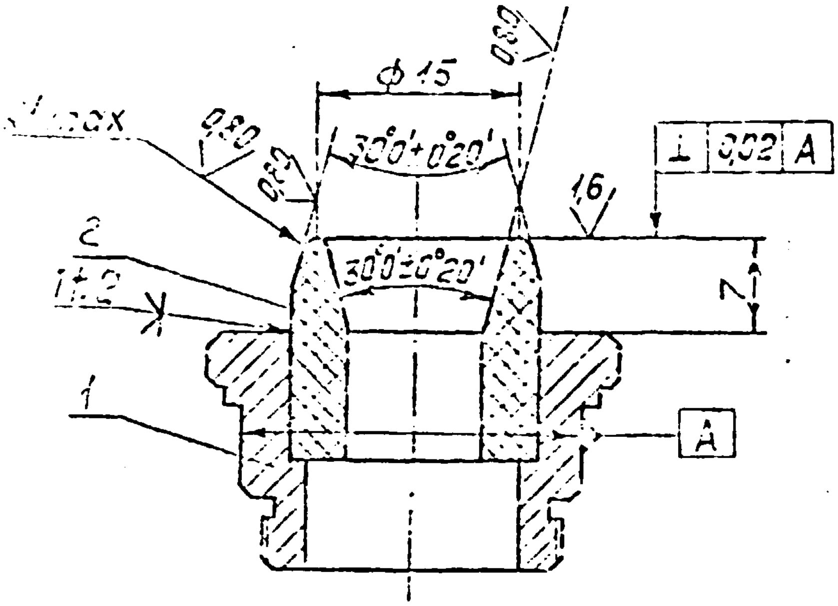
Designer

Chief Designer

Ring

Sheet	Sheets
	1

LITMO



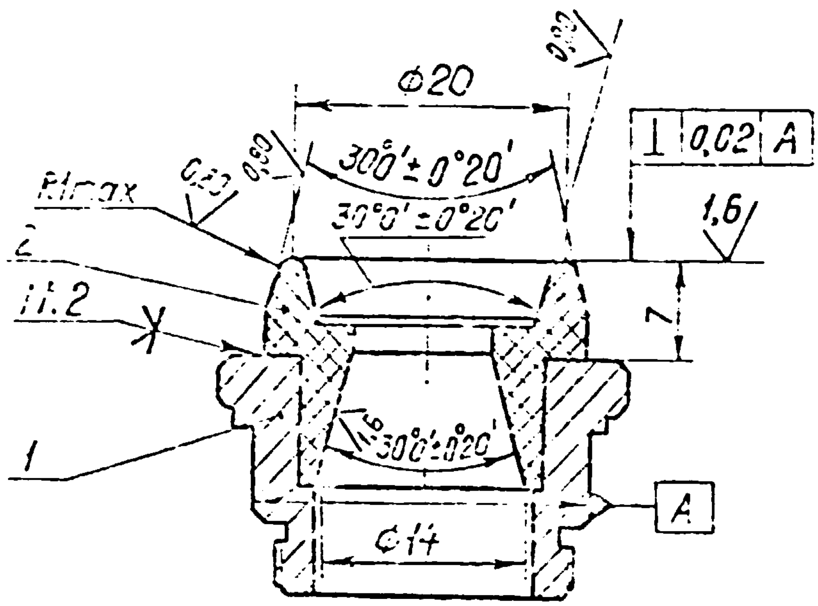
1. H14; h14; $\pm\frac{IT14}{2}$
2. Cement ЭЛ-6

320.430 Ass		
Ring	Mass	Scale
		2:1
	Sheet	Sheets 1
	LITMO	

			Designation	Name	Quantity	Comment
				Specification		
A4			320.440A ss	Assembling drawing		
				Pieces		
A4		1	320.227	Bushing	1	
A4		2	320.229	Ring	1	

320.440		
Designer / Chief Designer	Ring	Sheet / Sheets 1
		LITMO

Form A4



1. H14, h14, $\pm\frac{IT14}{2}$
2. Cement ЭД-6

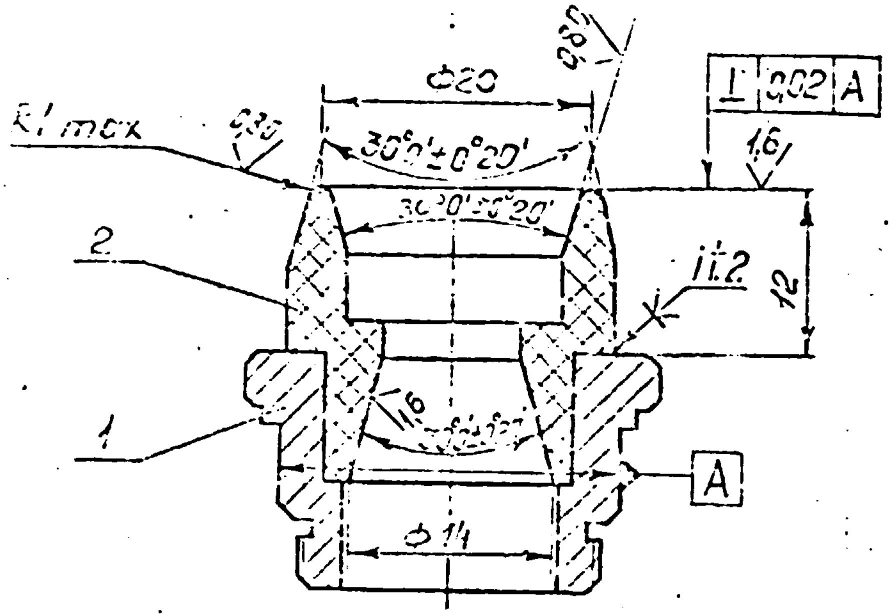
320. 440Ass			
Ring		Mass	Scale
			2:1
		Sheet	Sheets 1
		LITMO	

Folio A4

Form	Zone	Ref. No	Designation	Name	Quantity	Comment
				Specification		
A4			320. 450 Ass	Assembling drawing		
				Pieces		
A4		1	320. 227	Bushing	1	
A4		2	320. 231	Ring	1	

Chief Designer	320. 450	
	Ring	LITMO

Format A4

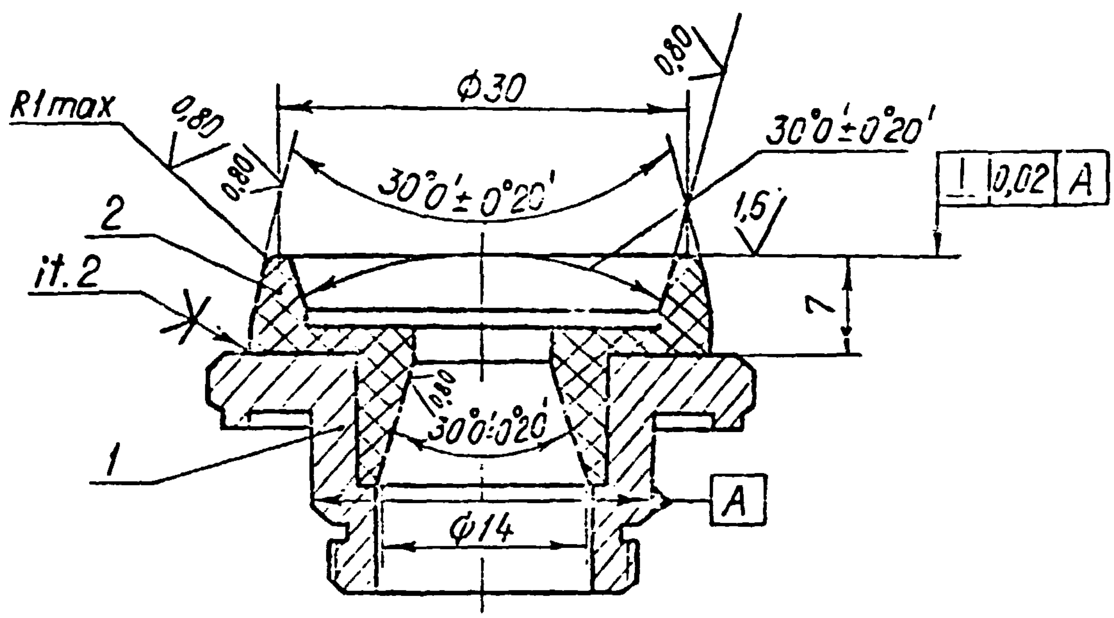


H14; h14; $\pm\frac{IT14}{2}$
Cement ЭД-6

320.450 Ass		
Ring	Mass	Scale
		2:1
	Sheet	Sheets
	LITMO	

Format	Zone	Ref No	Designation	Name	Quantity	Comment
				<u>Specification</u>		
A4			320.460 Ass	Assembling drawing		
				<u>Pieces</u>		
A4		1	320.191	Bushing	1	
A4		2	320.232	Ring	1	

320.460		
Ring	Sheet	Sheets 1
	LITMO	



1. H14, h14, $\pm \frac{IT14}{2}$

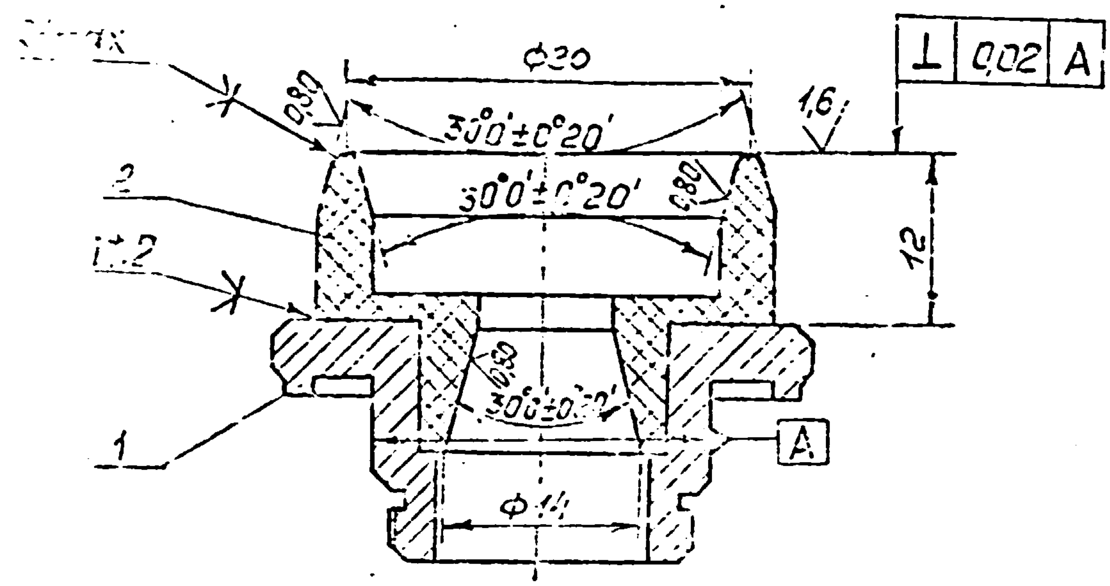
2. Cement ЭД-6

320. 460 Ass	
Ring	Mass · Scale 2:1
	Sheet · Sheets 1
Des.proc.	
Chief designer	LITMO

Form	Zone	Ref №	Designation	Name	Quantity	Comment
				Specification		
A4			320.470 A ss	Assembling drawing		
				Pieces		
A4		1	320.191	Bushing	1	
A4		2	320.233	Ring	1	

320.470		
Designer	Ring	Sheet:	Sheets: 1
Chief Designer		LITMO

Form A4



H14; h14; $\pm\frac{IT14}{2}$

Cement ЗД-5

320.470 Ass

Ring

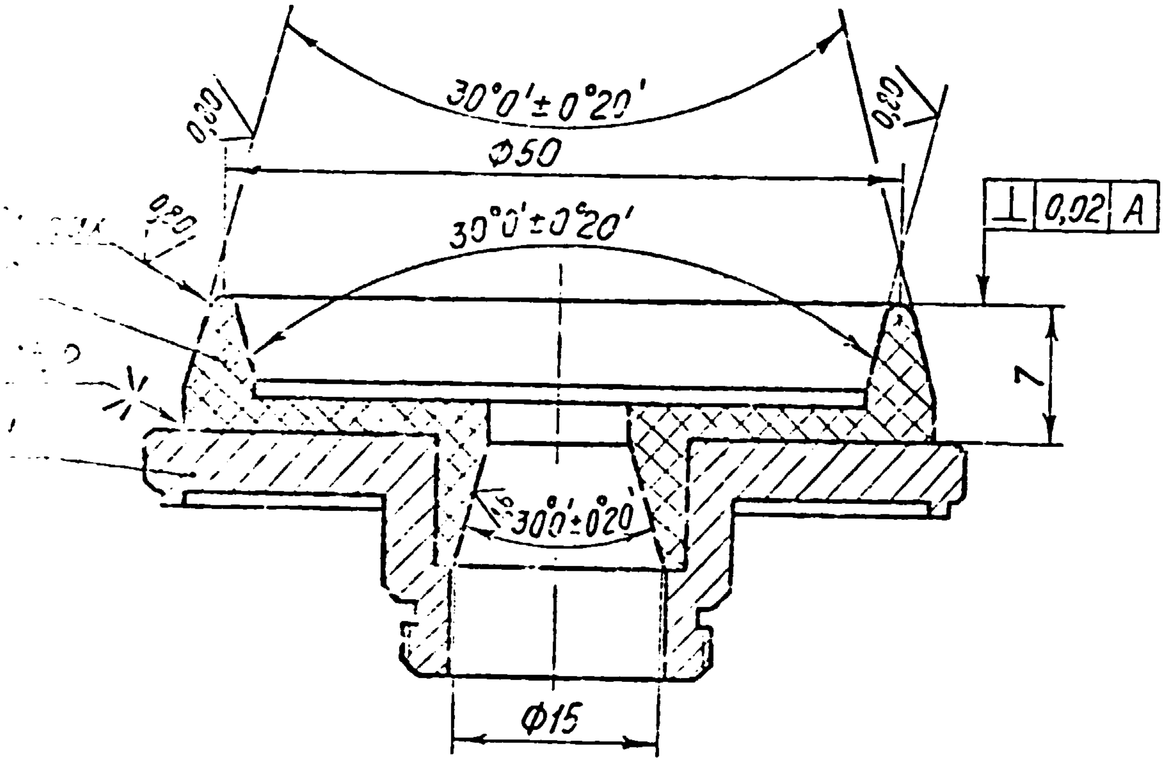
2:1

LITMO

Form	Zone	Ref. No	Designation	Name	Quantity	Comment
				Specification		
A4			320.480 Ass	Assembling drawing		
				Pieces		
A4		1	320.234	Bushing	1	
A4		2	320.235	Ring	1	

320.480

Designer	Ring	Sheet 1 / Sheets 1
Chief Designer		LITMO



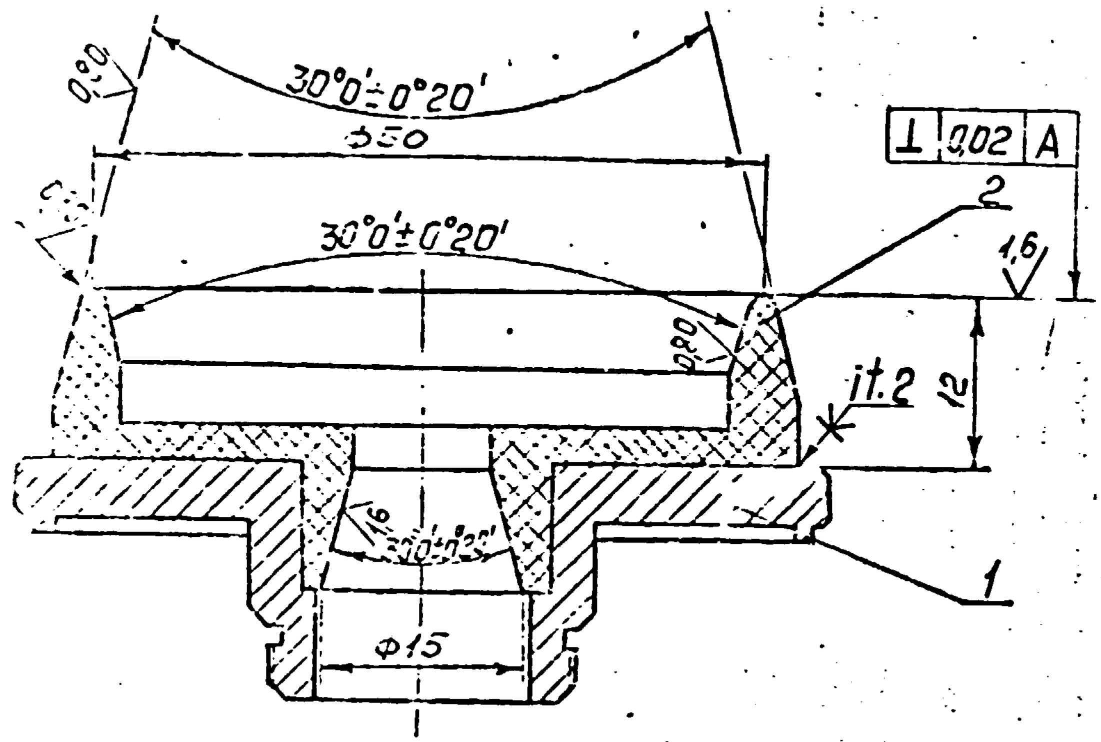
1. H14, h14, $\pm \frac{IT14}{2}$
2. Cement ЭД-6

320. 480Ass			
Ring		Mass	Scale
			2:1
	Sheet	Sheets 1	
	LITMO		

Form A4

Form	Zone	Ref.No	Designation	Name	Quantity	Comment
				Specification		
A4			320. 490Ass	Assembling drawing		
				Pieces		
A4		1	320. 234	Bushing	1	
A4		2	320. 236	Ring	1	

	320. 490	
Designer	Ring	Sheet: / Sheets: 1
Chief Designer		LITMO

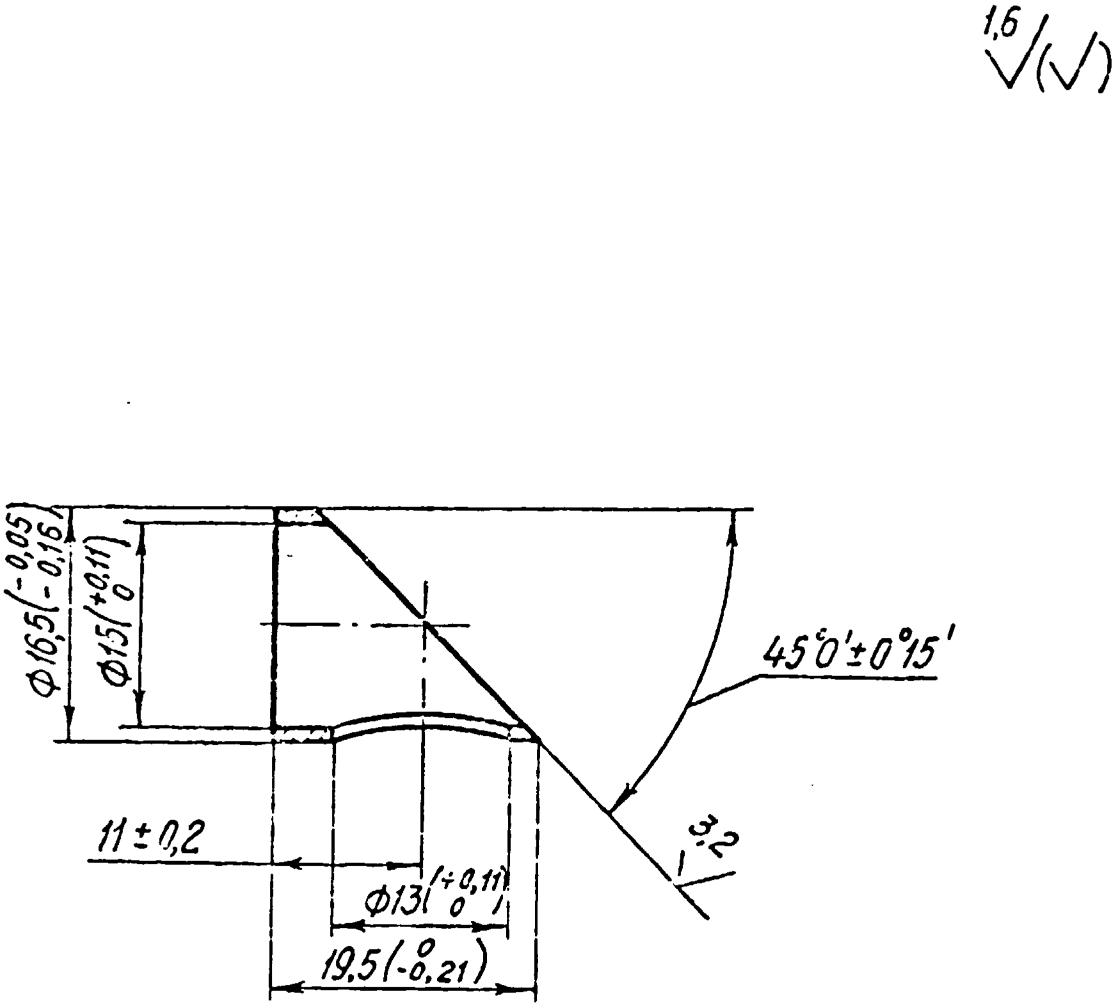


1. H14; h14; $\pm\frac{IT14}{2}$
2. Cement ЭД-2

320.490 Ass			
Ring		Mass	Scale
			2:1
		Sheet	Sheets 1
		LITMO	

Form	Zone	Ref No	Designation	Name	Quantity	Comment
				Assembling units		
A4			320. 310	Knife-edge support	1	
A4			320. 320	Knife-edge support	1	
A4			320. 330	Knife-edge support	1	
A4			320. 340	Knife-edge support	1	
A4			320. 350	Knife-edge support	1	
A4			320. 400	Ring	1	
A4			320. 410	Ring	1	
A4			320. 420	Ring	1	
A4			320. 430	Ring	1	
A4			320. 440	Ring	1	
A4			320. 450	Ring	1	
A4			320. 460	Ring	1	
A4			320. 470	Ring	1	
A4			320. 480	Ring	1	
A4			320. 490	Ring	1	

	320. 550		
Designer	Centring adjusting device Set of accessory units	Sheet	Sheets
			1
Chief designer		LITMO	



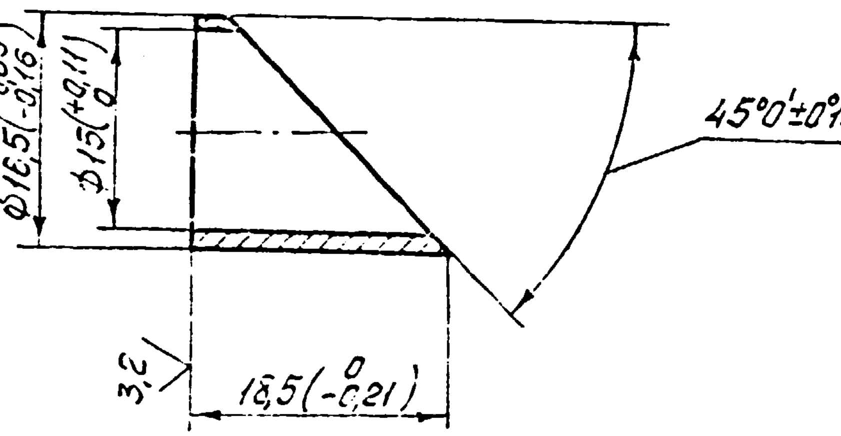
Coating Chemical oxidation

320. 001		
Ring	mass	Scale 2:1
	Sheet	Sheets 1
Brass Cu Zn 40	LITMO	

Designer

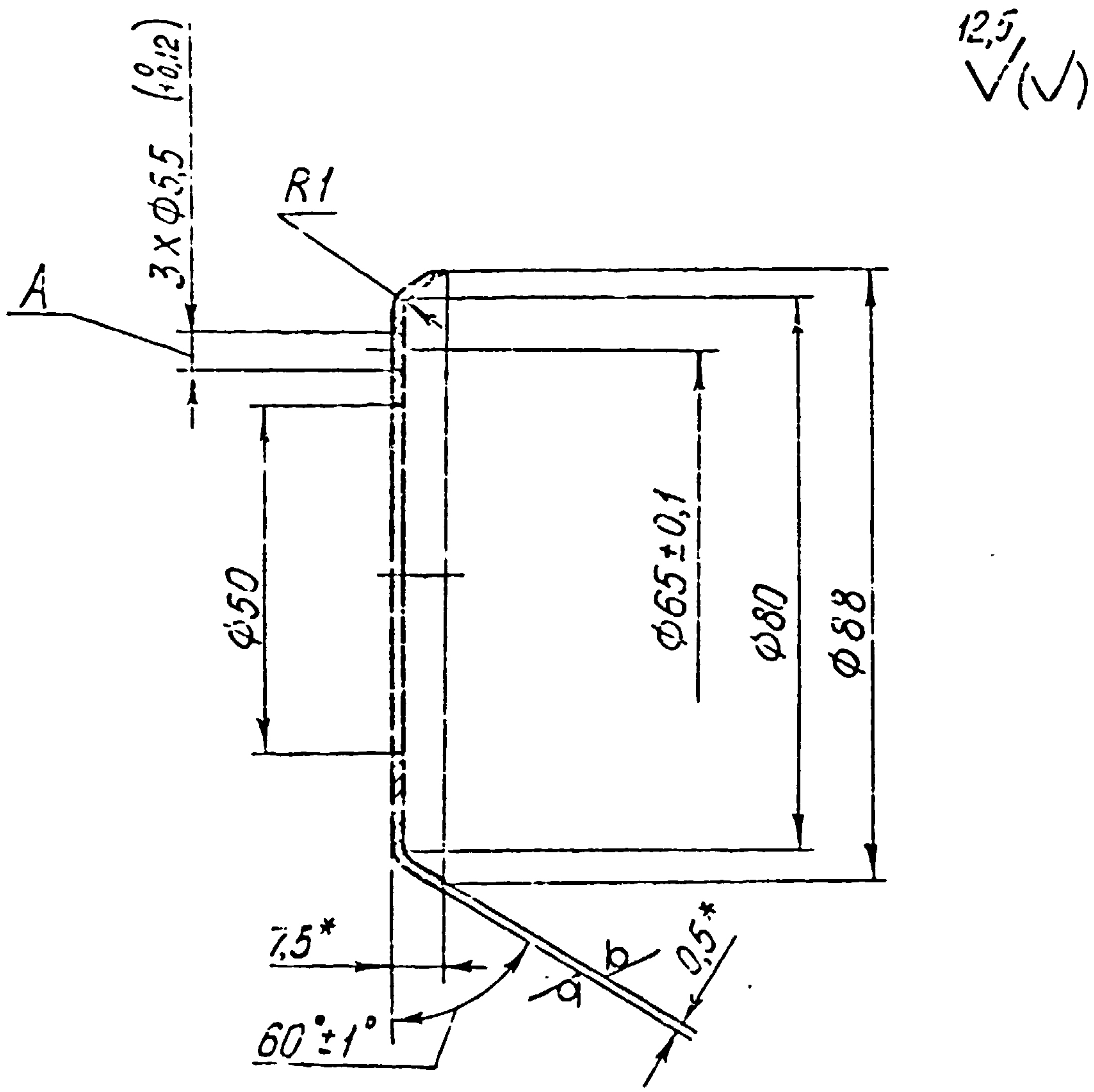
Chief Designer

1,6 (√)



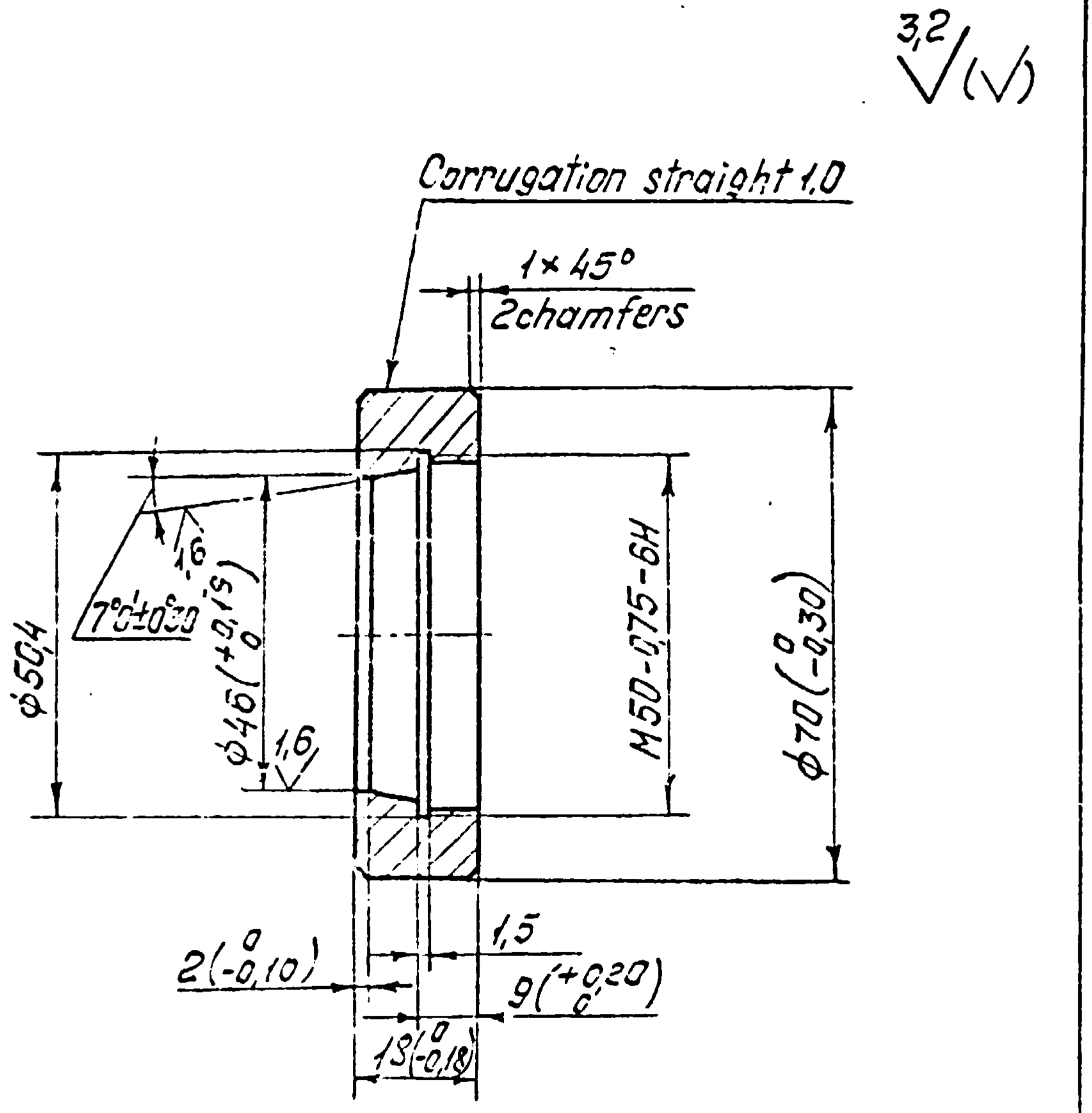
Coating: Chemical oxidation

320.002			
Ring		Mass	Scale
			2:1
		Sheet	Sheets 1
Designer			
Chief Designer	Brass CuZn40	LITMO	



1. *The dimension for information
2. H14, h14, ± $\frac{IT14}{2}$
3. Central angle limiting deviation between axes of two any holes A ±20'
4. Coating Chemical oxidation

		320. 003					
		Ring			Mass	Scale	
Designer						1:1	
			Sheet		Sheets 1		
Chief Designer		Sheet steel 08кп	LITMO				

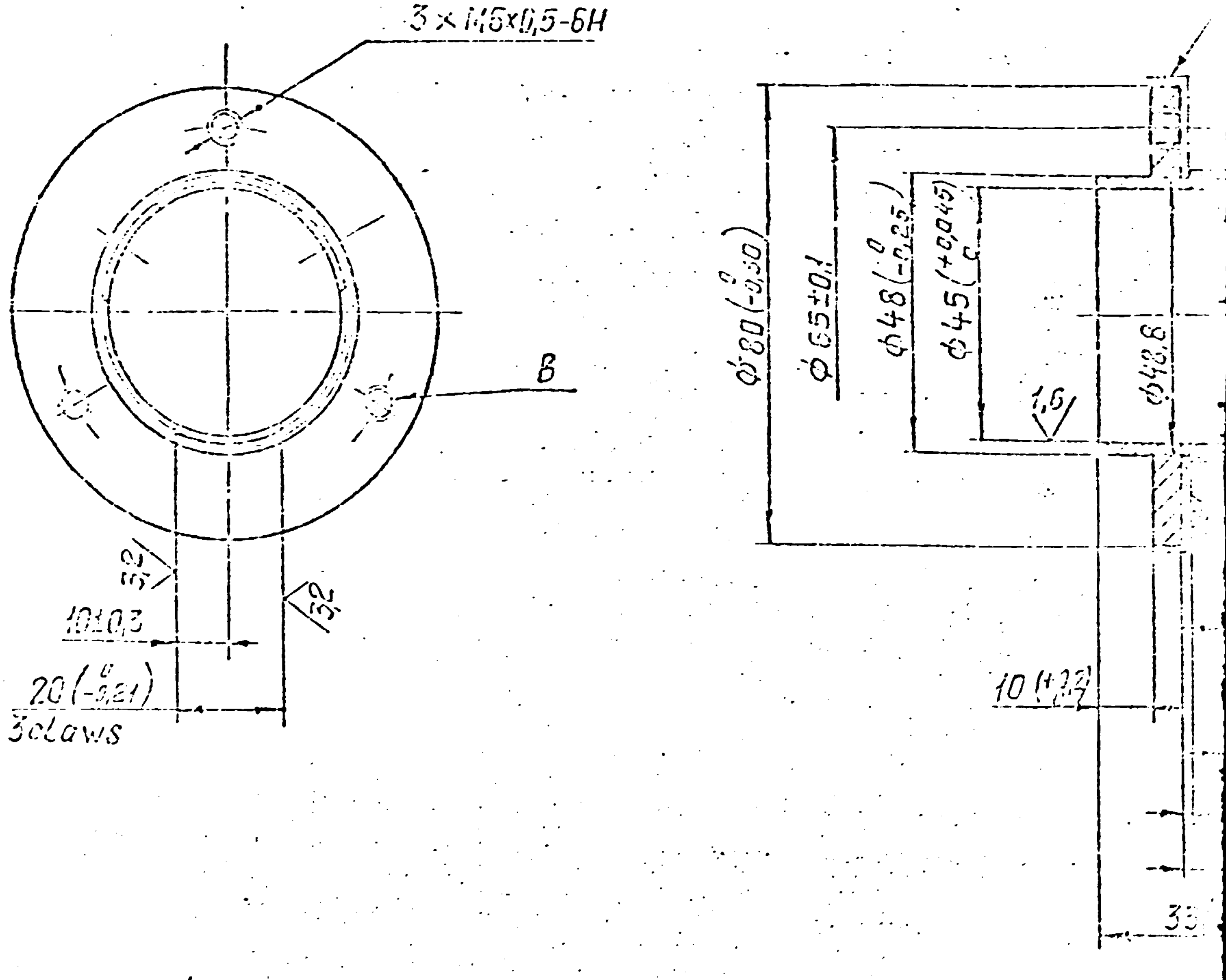


1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating: The inside surface chemical oxidation
   The outside surface - Fe/Ni 9 Cr mat finish

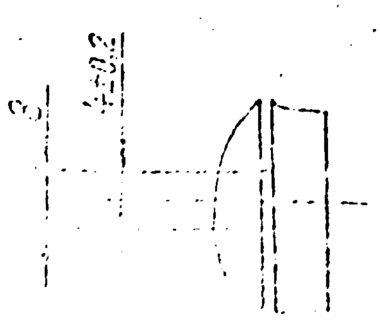
320.004		
Ring	Mass	Scale
		1:1
	Sheet	Sheets 1
Steel 50	LITMO	

Designer

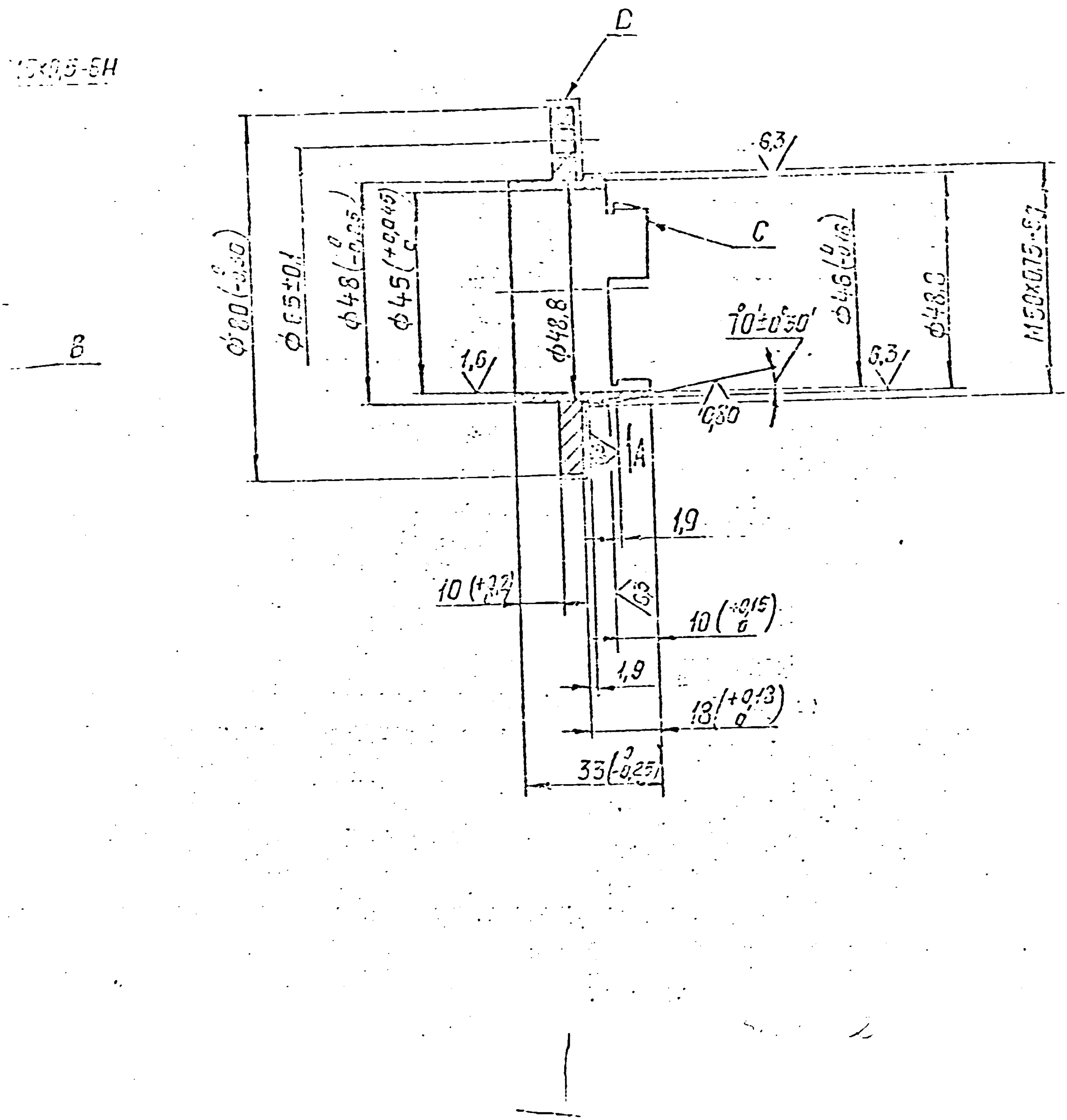
Chief Designer


3 × M5x0,5-6H
B
32
32
10±0,3
20 (0/-0,21)
3claws
φ80 (0/-0,30)
φ65±0,1
φ48 (0/-0,25)
φ45 (+0,045/0)
1,6
φ48,6
10 (+0,2)
33

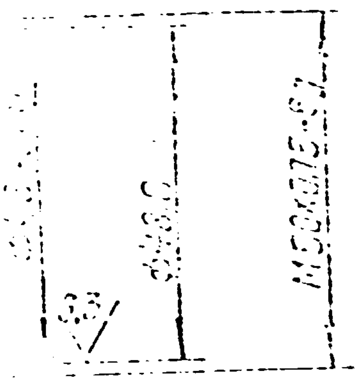
A



SECTION 1



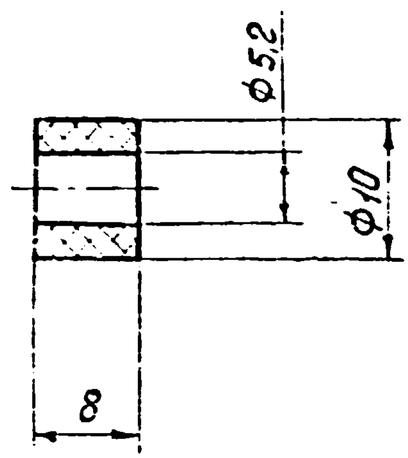
C
C
6,3
6,3
1,6
ф48,8
ф48,0
M50×0,75
A
B
1,9
1,9
0,80
33



1. H14; h14; $\pm \frac{IT14}{2}$
2. Central angle limiting deviation between axes of two any holes B and claws C must be no more than $\pm 0°30'$.
3. Coating: chemical oxidation
   The surface D - grey enamel

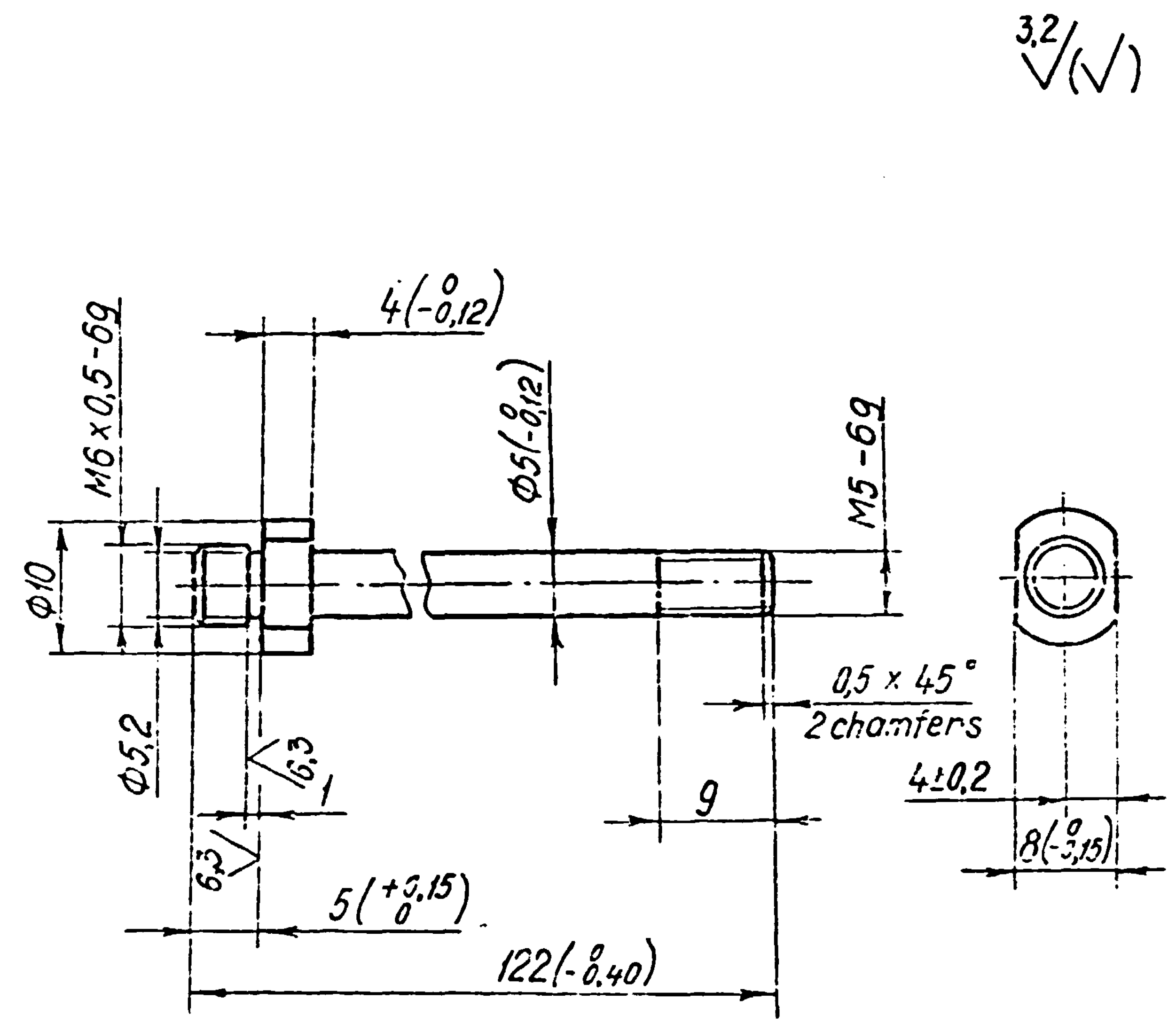
320.005		
Ring	Mass	Scale
		1:1
	Sheet	Sheets 1
Steel 20	LITMO	

3,2



H14; h14

320.006			
Bushing		Mass	Scale
			2:1
		Sheet	Sheets 1
Constructive textile	LITMO		



1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating: chemical oxidation impregnation by oil

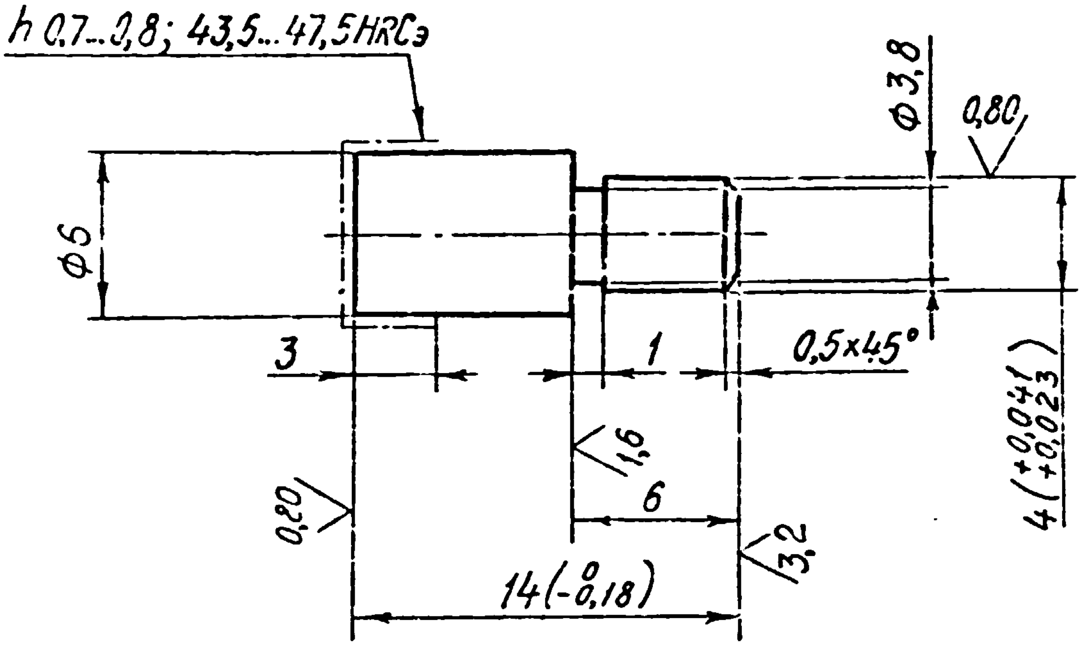
320.007		
Axle	Mass	Scale
		2:1
	Sheet	Sheets 1
Steel 20	LITMO	

Designer

Chief Designer

Form A4

6,3 √ (√)



1. H14; h14; $\pm\frac{IT14}{2}$

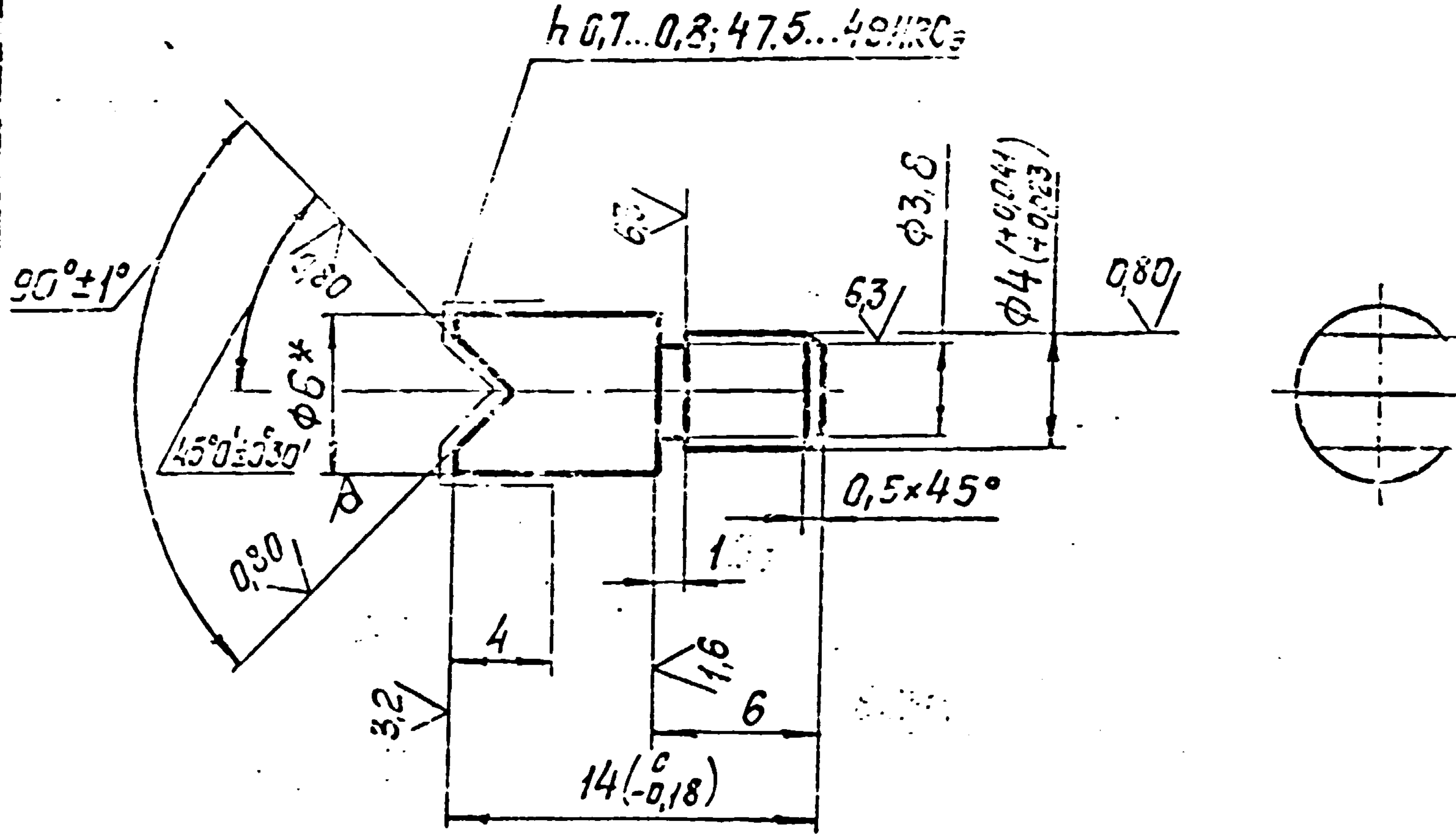
2. Coating: chemical oxidation
impregnation by oit.

320.008		
Stop	Mass	Scale
		5:1
	Sheet	Sheets 1
Steel 45	LITMO	

Designer

Chief

Form A4

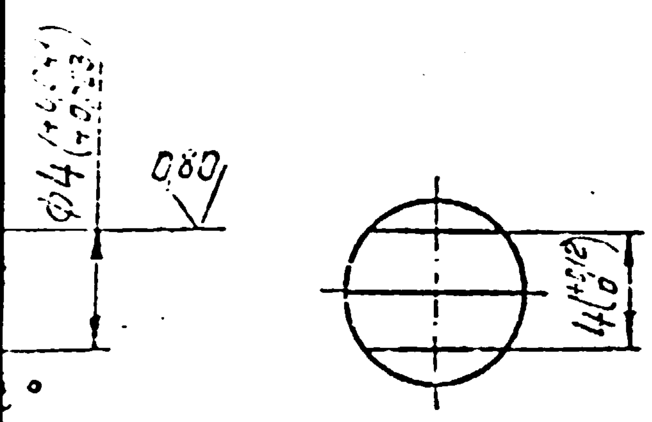


1. H14;
2. Coa

Designer		
Chief Designer		

SECTION 1

3,2 (√)

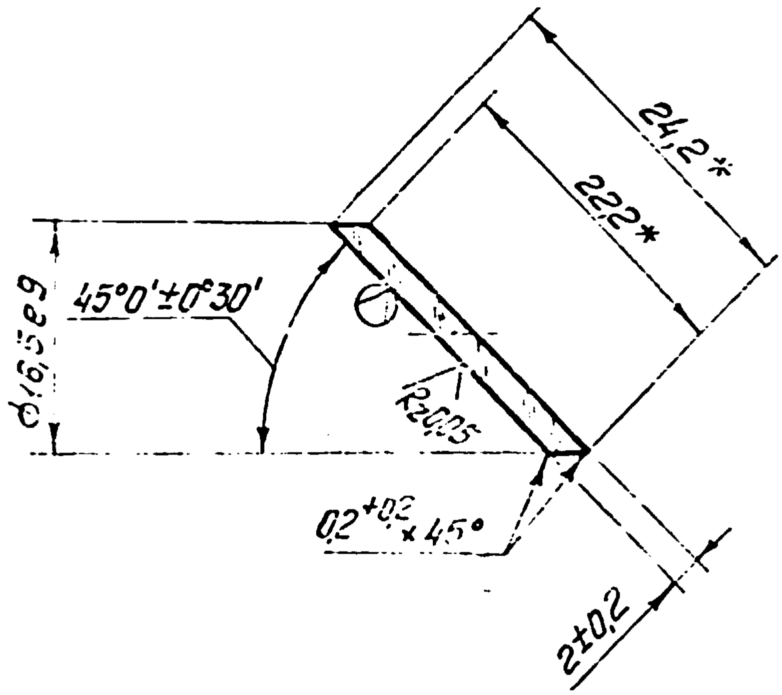


1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating Chemical oxidation impregnation by oil.

	320.009	
	Stop	Mass / Scale 5:1
Designer		Sheet / Sheets 1
Chief Designer	Steel 45	LITMO

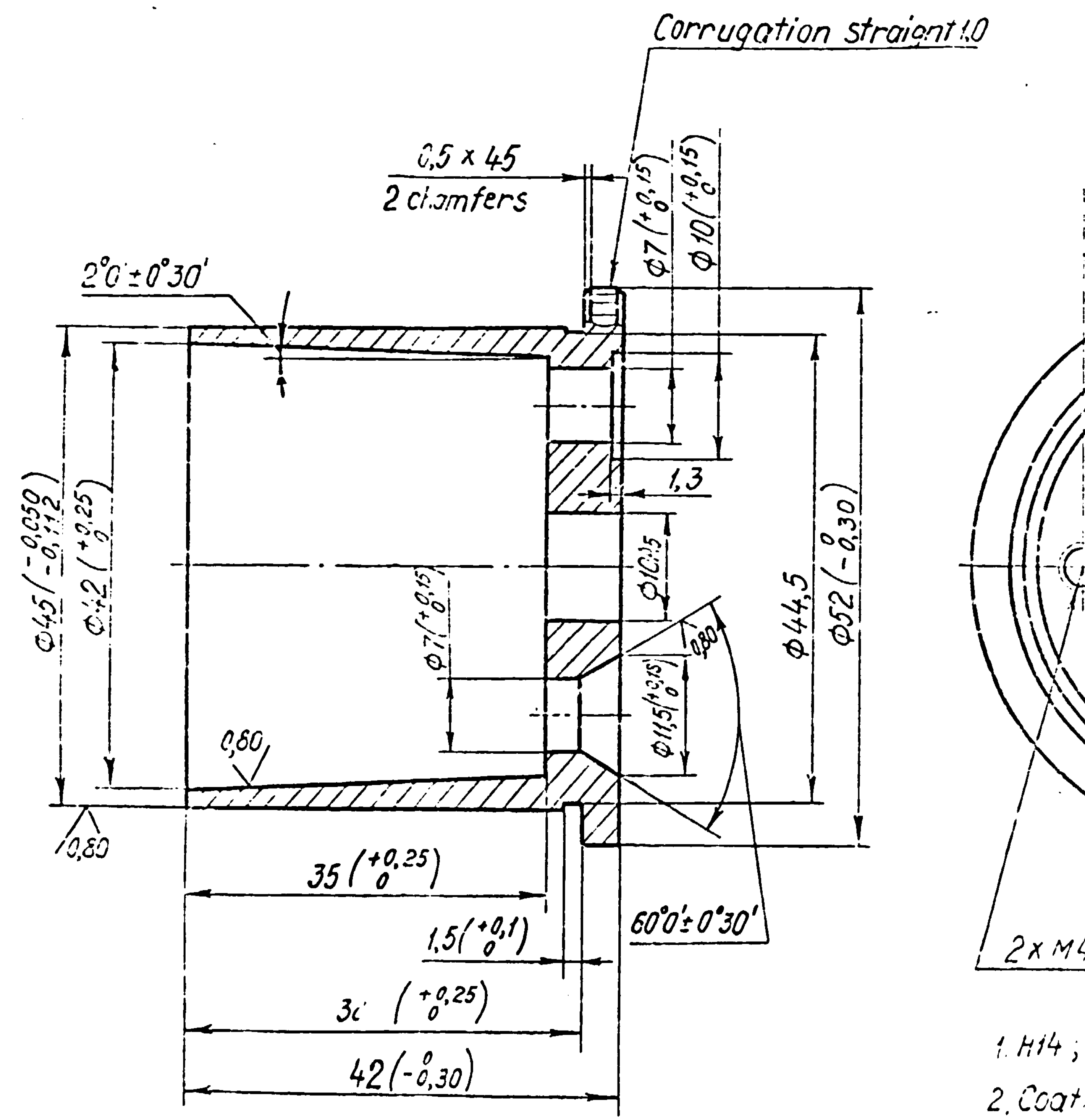
1,6 (√)

Δn_e	—
$\Delta(n_F' - n_C')$	—
Homogeneity	—
Birefringence	—
μ_A	—
Veins	—
Inclusions	52
N	5
ΔN	1
θ	10'
P	[illegible]
CΦ	14



1. ⊘ Aluminised
2. * The dimensions for information
3. ** Permitted total area of scratches, pits (mm²)

Designer	320.011		
Chief Designer	Mirror	Mass	Scale
			2:1
		Sheet	Sheets 1
	Glass BK7	LITMO	

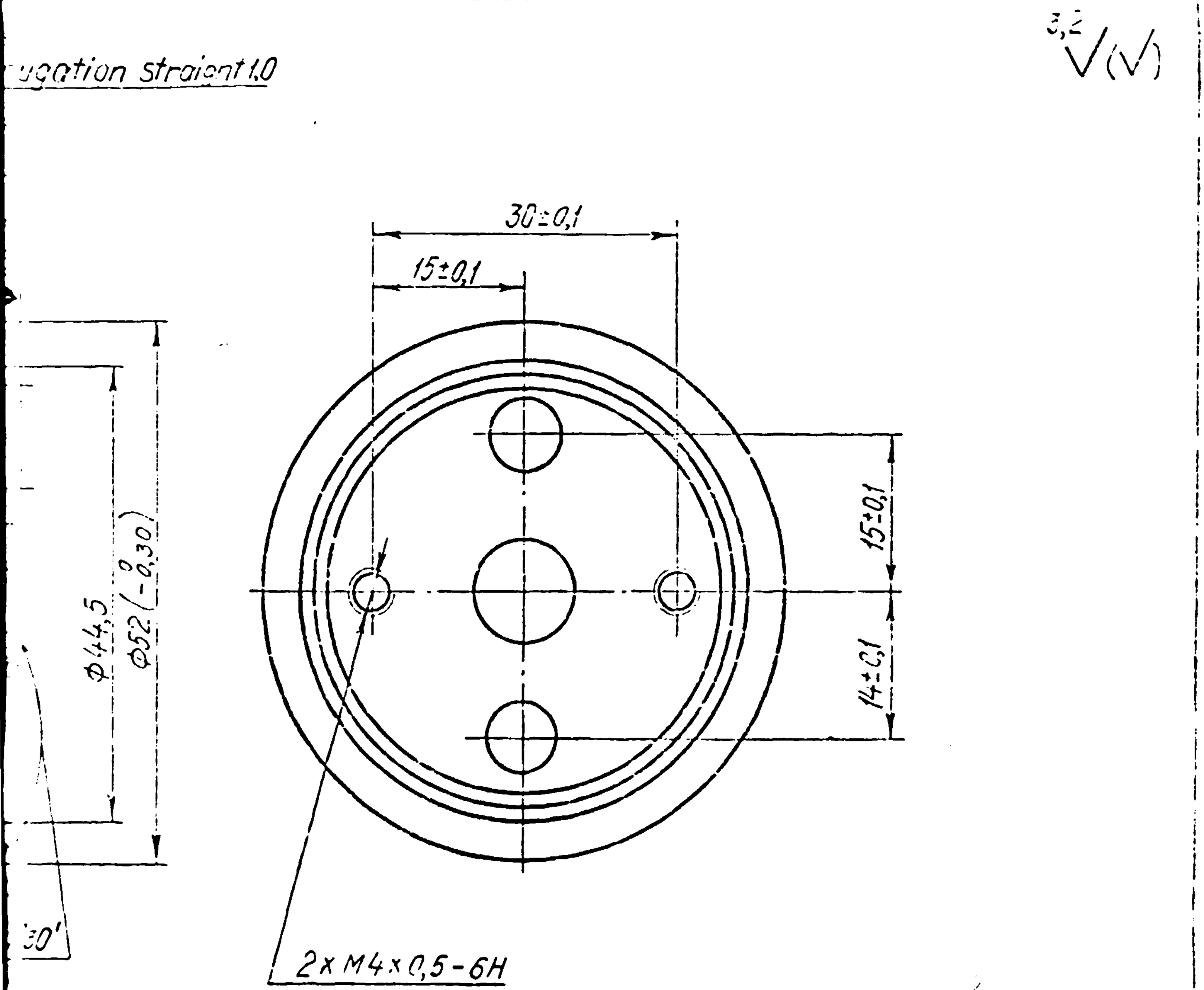


1. H14 ;

2. Coat

SECTION 1

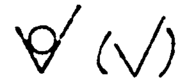
Designer		
Chief		
Designer		

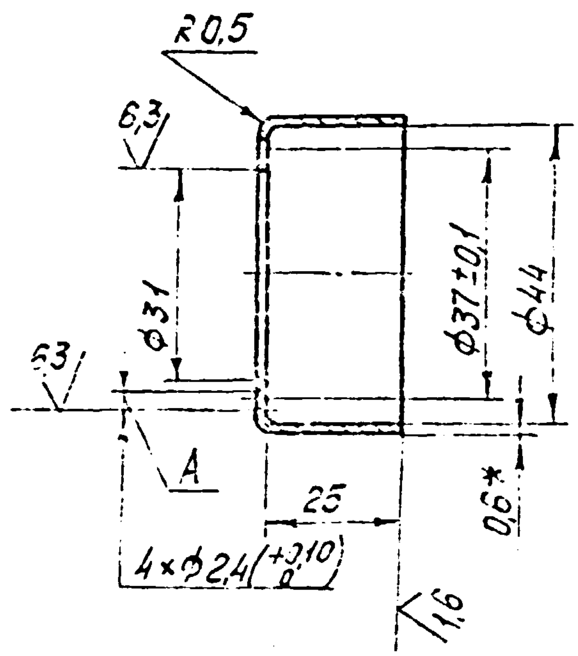


1. H14 ; h14 ; $\pm \frac{IT14}{2}$

2. Coating : Chemical oxidation

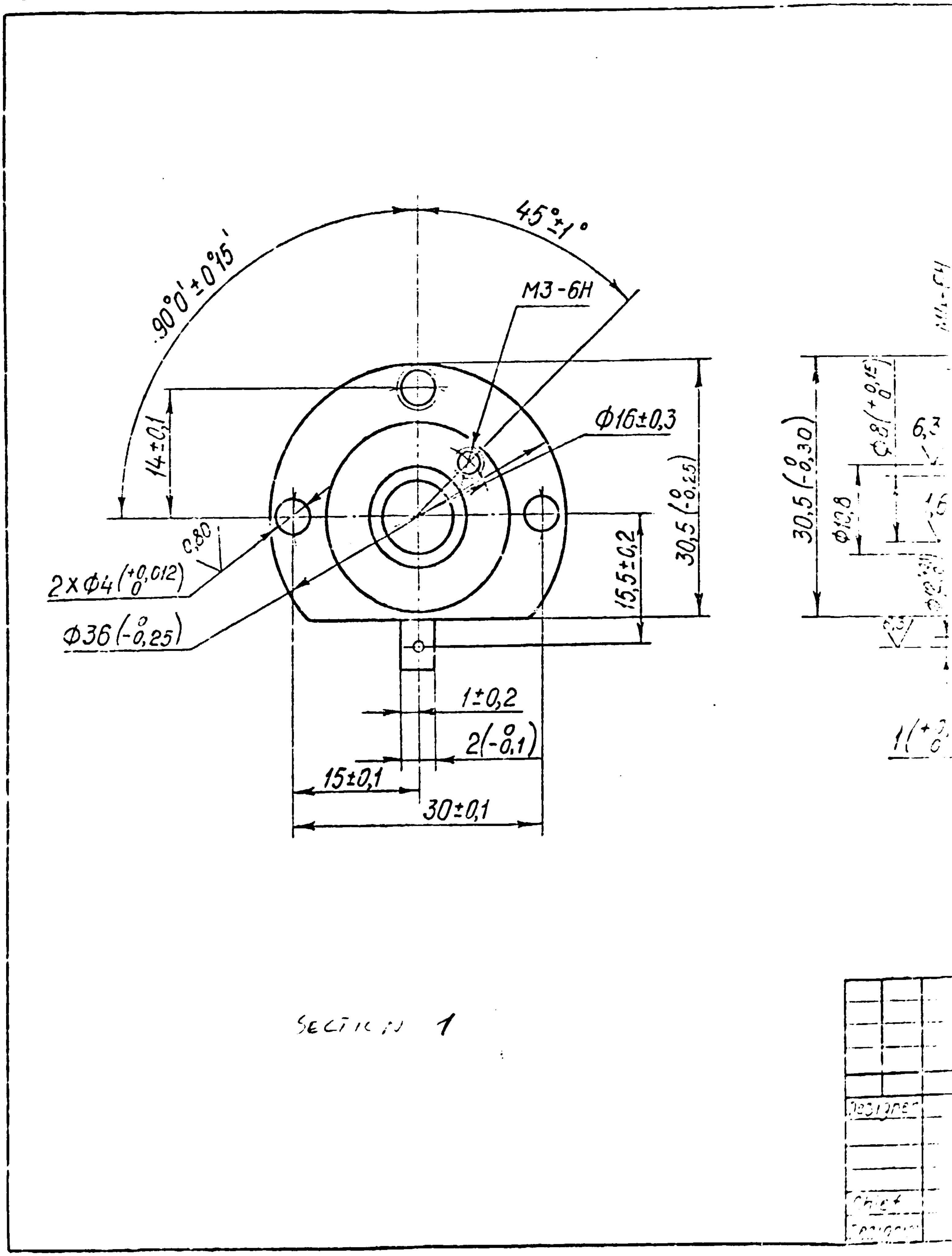
	320.012	
Designer	Holder	Mass: / Scale: 2:1
		Sheet / Sheets
Chief Designer	Steel 20	LITMO





1. *The dimension for information
2. H14; h14; ± $\frac{IT14}{2}$
3. Central angle limiting deviation between axes of any two holes A ± 0°20′
4. Coating Chemical oxidation

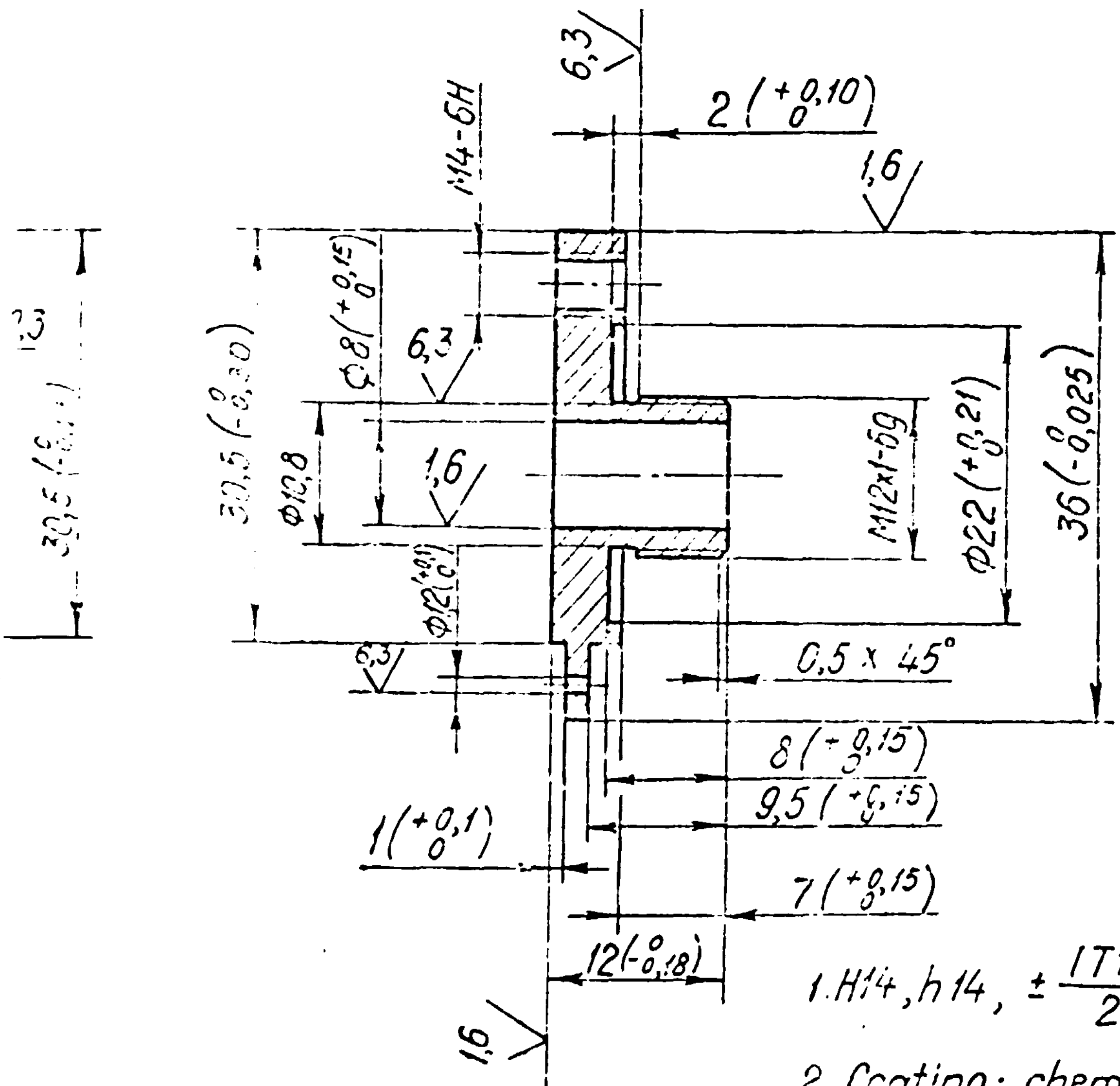
320.013			
Screen		Mass	Scale
			1:1
	Sheet	Sheets 1	
Strip Brass CuZn37	LITMO		



45°±1°
90°0'±0°15'
M3-6H
Φ16±0,3
14±0,1
30,5 (-0,25)
15,5±0,2
2×Φ4 (+0,012 / 0)
Φ36 (-0,25)
1±0,2
2 (-0,1)
15±0,1
30±0,1
30,5 (-0,30)
6,3
Designer
Chief

SECTION 1

3,2 √ (√)



1. H14, h14, $\pm \frac{IT14}{2}$

2. Coating: chemical oxidation impregnation by oil

320.014

Flange

Mass | Scale
2:1

Sheet | Sheets 1

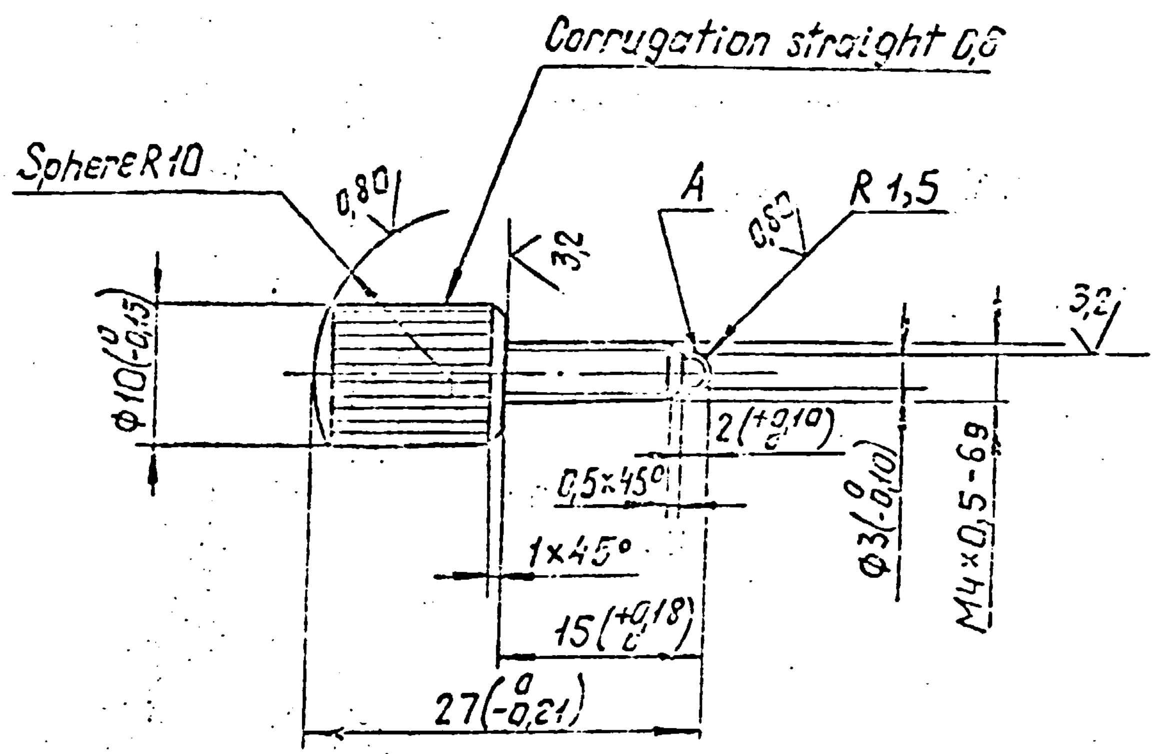
Designer

Chief Designer

Steel 20

LITMO

3,2 √ (√)



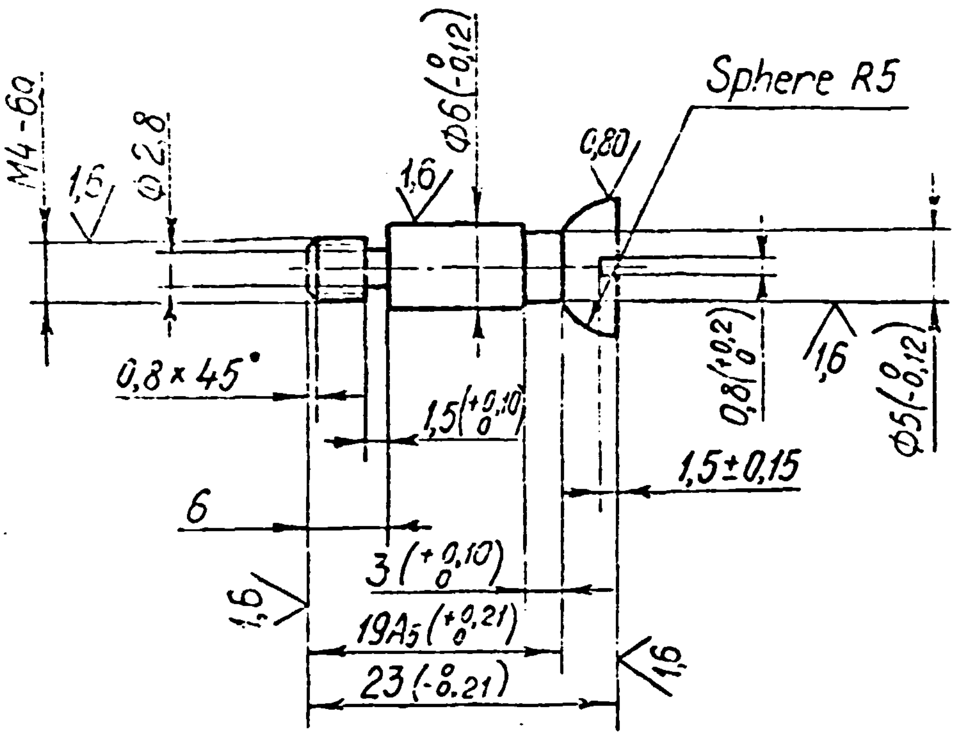
1. The surface A 43,5...47,5 HRCэ
2. H14; h14; $\pm \frac{IT14}{2}$
3. Coating: chemical oxidation impregnation by oil

320.015		
Screw	Mass:	Scale: 2:1
	Sheet	Sheets 1
Steel 45	LITMO	

Designer

Chief Designer

$\sqrt{6,3}\ (\sqrt{})$



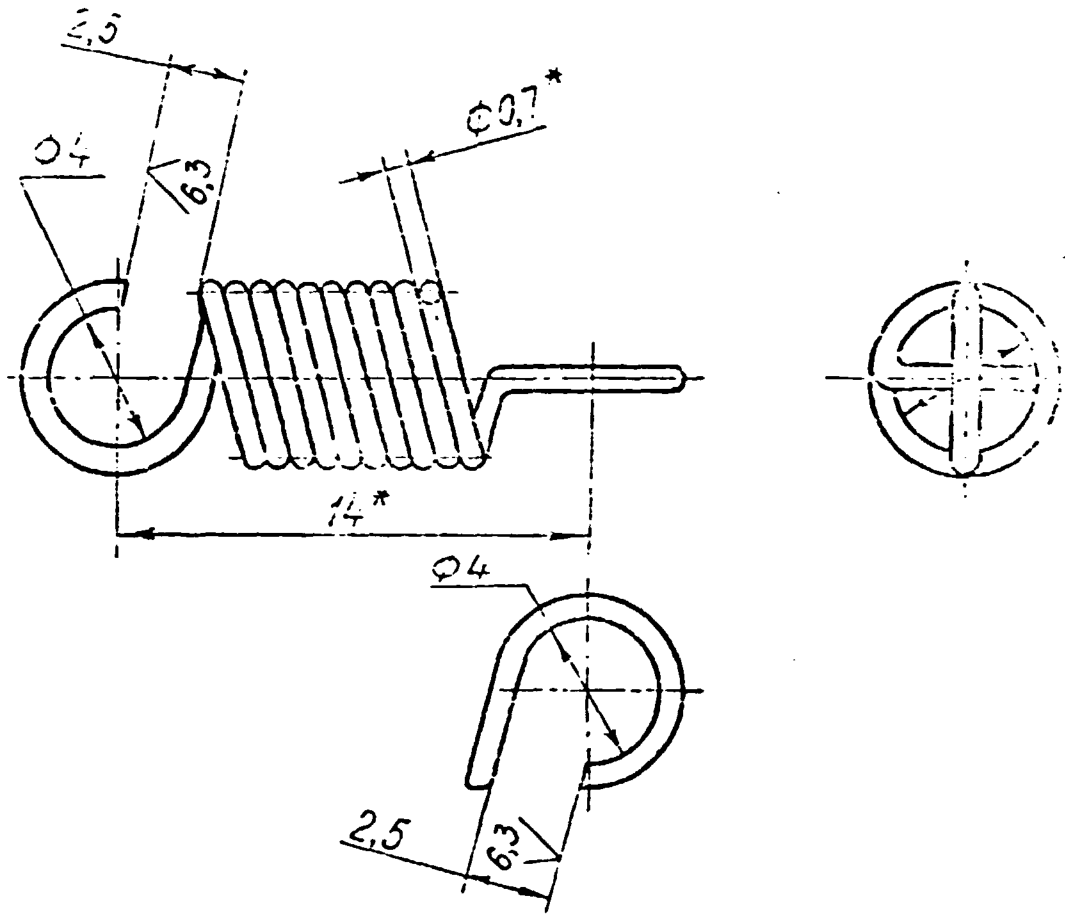
1. H14, h14, $\pm\frac{IT14}{2}$
2. Coating: Chemical oxidation impregnation by oil

320. 016		
Screw	mass	Scale
		2:1
	Sheet	Sheets 1
Steel 20	LITMO	

Designer

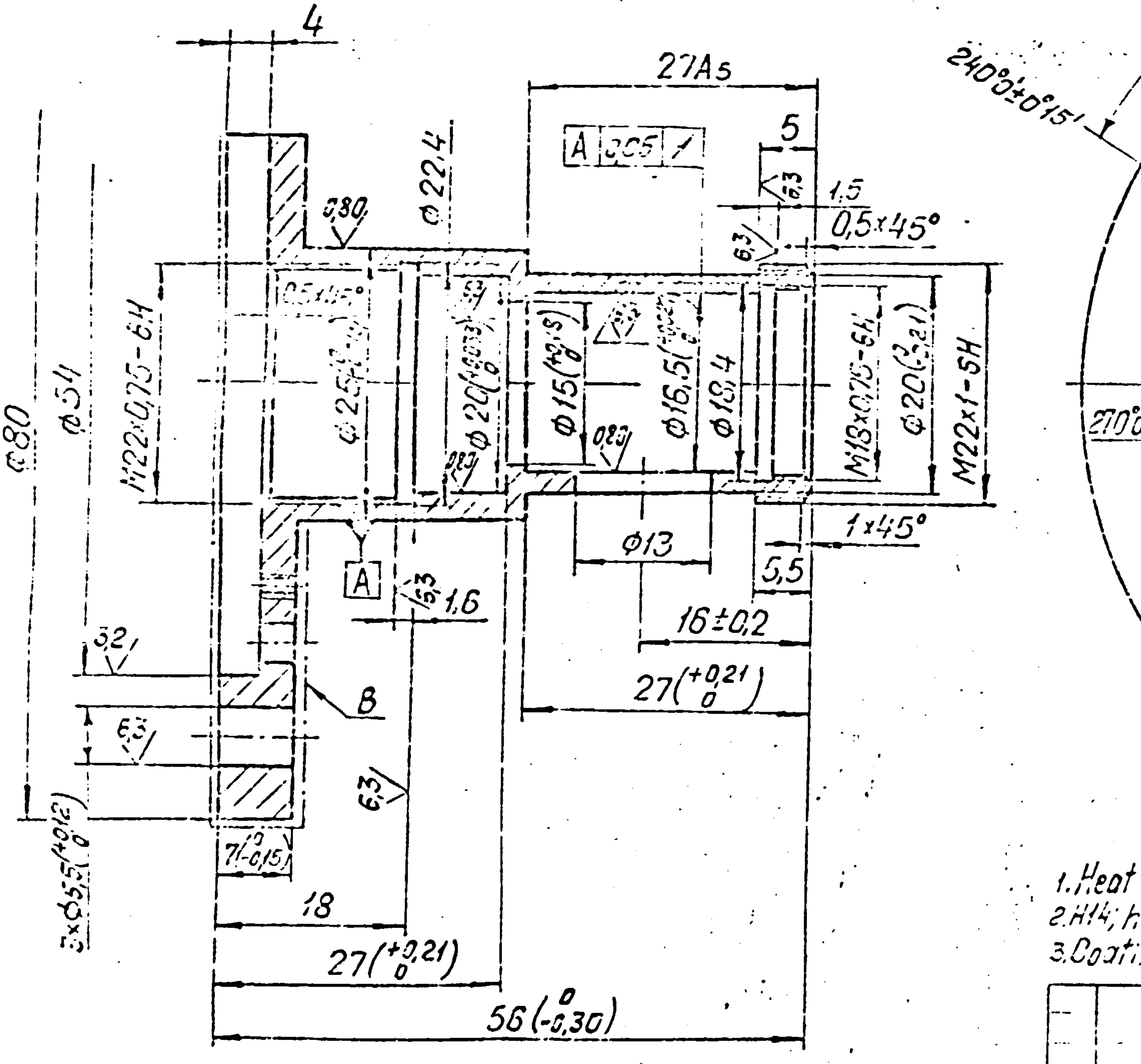
Chief Designer

Form A4



1. *The dimensions for information
2. The working coils are 10
3. The total coils are 12
4. The unfold spring lenght L ≈ 176 mm
5. Tempering t° 200 ... 220°C - 60 minutes
6. Coating Chemical oxidation impregnation by oil

Designer	320. 017	
	Spring	Sheet
Chief Designer	Wire II - 0,7	LITMO

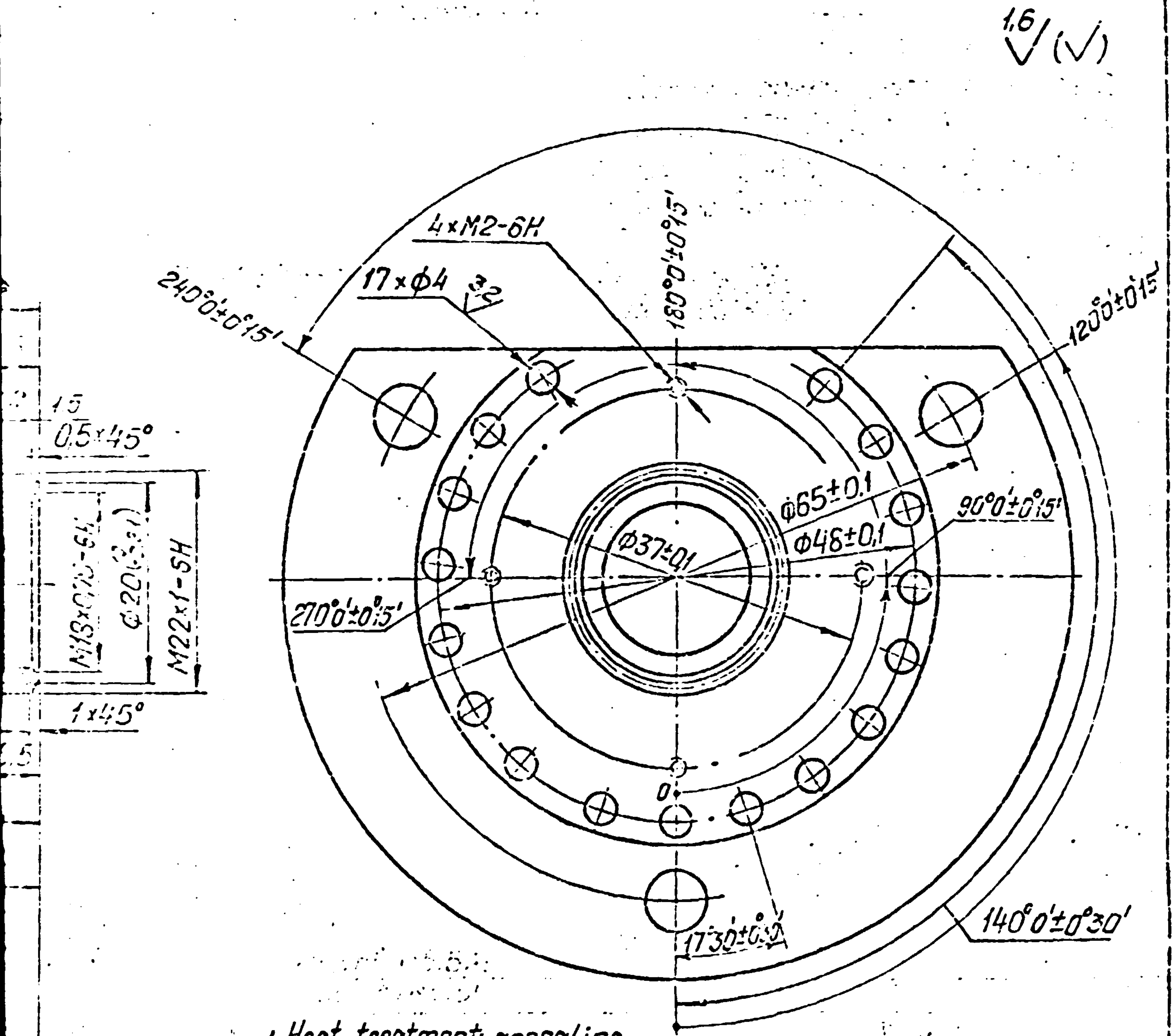


SECTION 1

1. Heat
2. H14; h
3. Coati

Designed

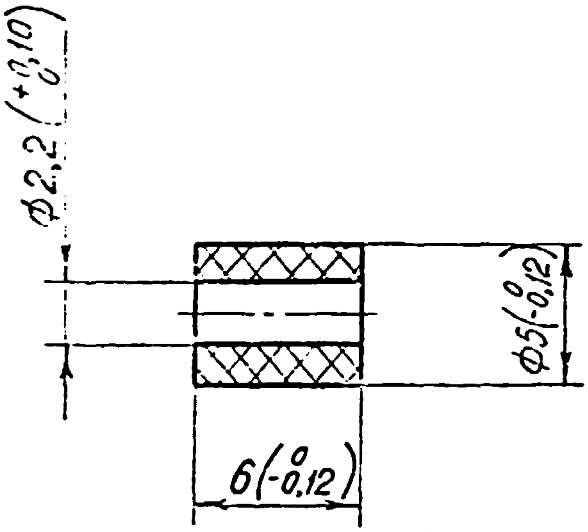
Chief designer



1. Heat treatment: annealing
2. H14; h14; $\pm \frac{IT14}{2}$
3. Coating: Chemical oxidation. The surface A-grey enamel

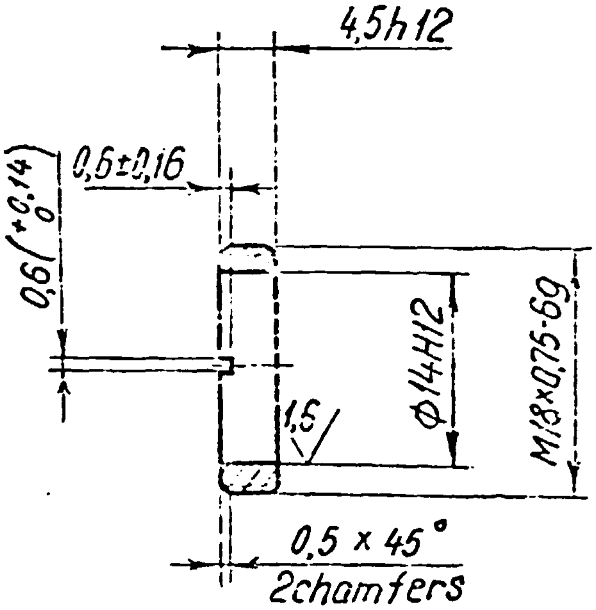
Designer	320.018	
	Illuminator body	Mass / Scale 2:1
		Sheet / Sheets
Chief designer	Steel 20	LITMO

3,2



320. 019		
Ring	Mass	Scale
		4:1
	Sheet	Sheets
Designer		
Chief Designer		
Constructive textile	LITMO	

Form A4



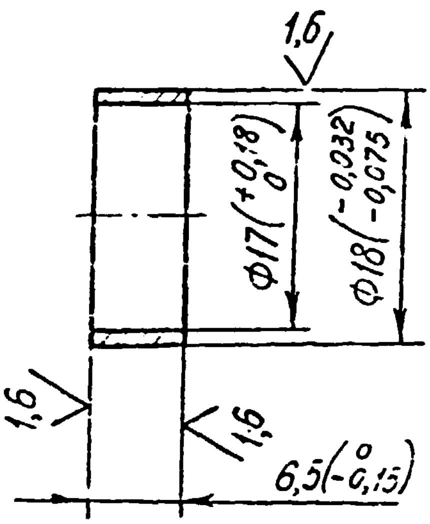
1. H14, h14, $\pm \frac{IT14}{2}$

2. Coating Anodic oxidation black

320.021	
Ring	Sheet
Aluminium alloy Al-Cu4 Mg Mn Fe Si	LITM

Designer

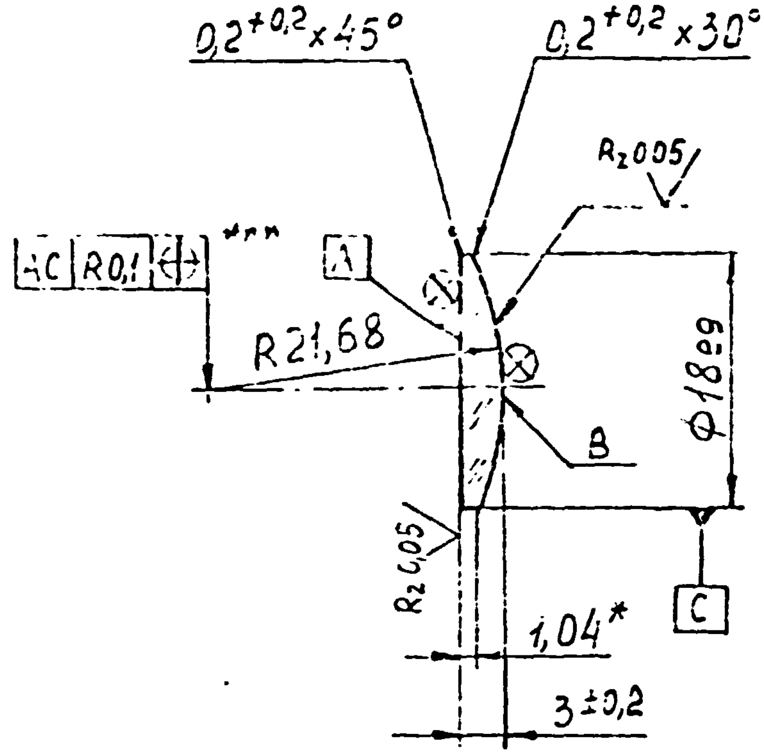
3,2 √ (√)



Coating : Chemical oxidation

	320.025			
	Ring		Mass	Scale
Designer				2:1
		Sheet	Sheets 1	
Chief Designer	Brass CuZn 37	LITMO		

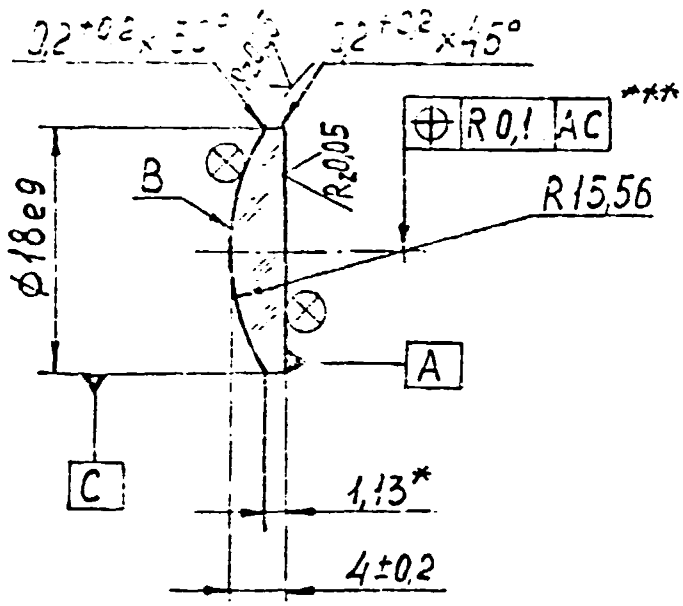
Form A4



Δn_e	
$\Delta(n_F - n_C)$	
Homogeneity	
Birefringence	
μ	
Veins	
Inclusions	
N	
ΔN	
Surface	
ΔR_A	
ΔR_B	
f	
S_F	[illegible]
S'_F	
[illegible]	

1. ⊗ L_2 (Anti-reflection coating)
   $R_\lambda \leq 2\%$ L_2 - MgF_2
   $\lambda_0 = 550$ nm
2.* The dimension for information
3.** Permitted total area of scratches, pits (mm²)
4.*** Wedge angle =10'

	320.026	
Designer	Lens	Sheet
Chief designer	Glass BK7	LIT[illegible]

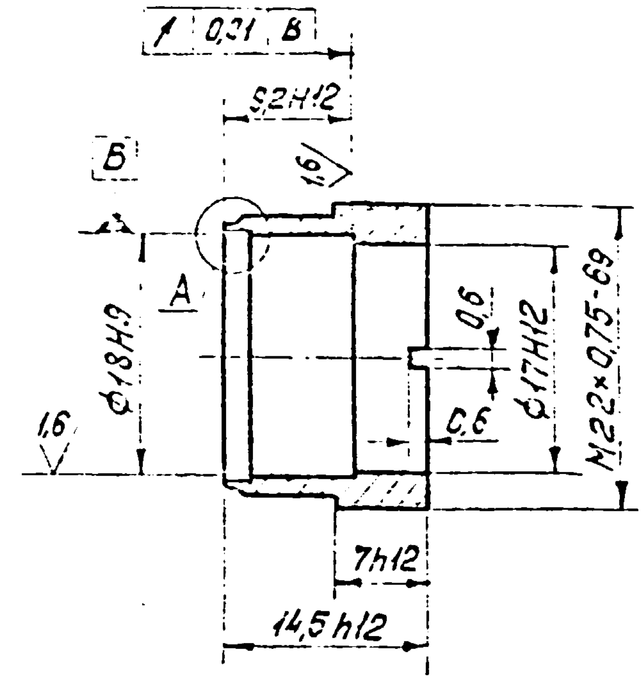


ΔNe	[illegible]
ΔNF-C	[illegible]
Homogeneity	[illegible]
Birefringence	[illegible]
μA	[illegible]
Veins	[illegible]
Inclusions	[illegible]
N	[illegible]
ΔN	[illegible]
Surface	[illegible]
ΔR_A	[illegible]
ΔR_C	[illegible]
f	[illegible]
S_F	[illegible]
S'_F	[illegible]
O ϕ	[illegible]

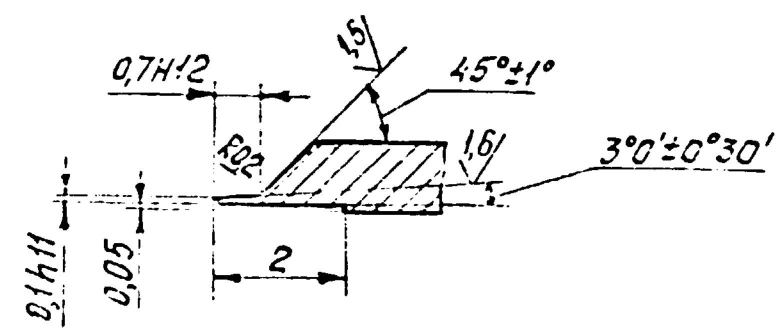
1. ⊗ L_2 (Anti-reflection coating)
   $R_\lambda \leq 2\%$ $L_2 - MgF_2$
   $\lambda_0 = 550\,nm$
2. * The dimension for information
3. ** Permitted total area of scratches, pits (mm^2)
4. *** Wedge angle = 20′

	320.027
Designer	Lens
Chief Designer	Glass BK7
Sheet	LITM

3,2 (√)



A (10:1)



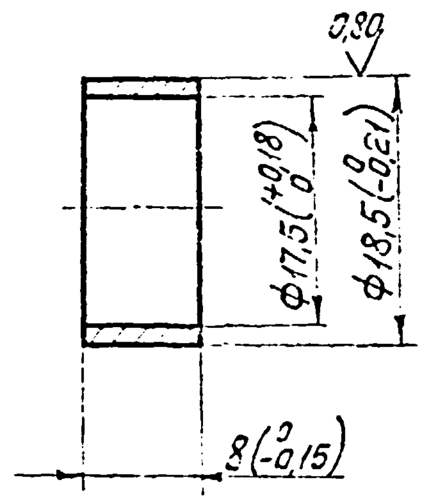
1. H14, h14, $\pm \frac{IT14}{2}$

2. Coating: Chemical oxidation

	320. 028	
Designer	Holder	Mass: — Scale: 2:1
		Sheet — Sheet 1
Chief Designer	Brass CuZn40	LITMO

Form 4

1,6 (√)

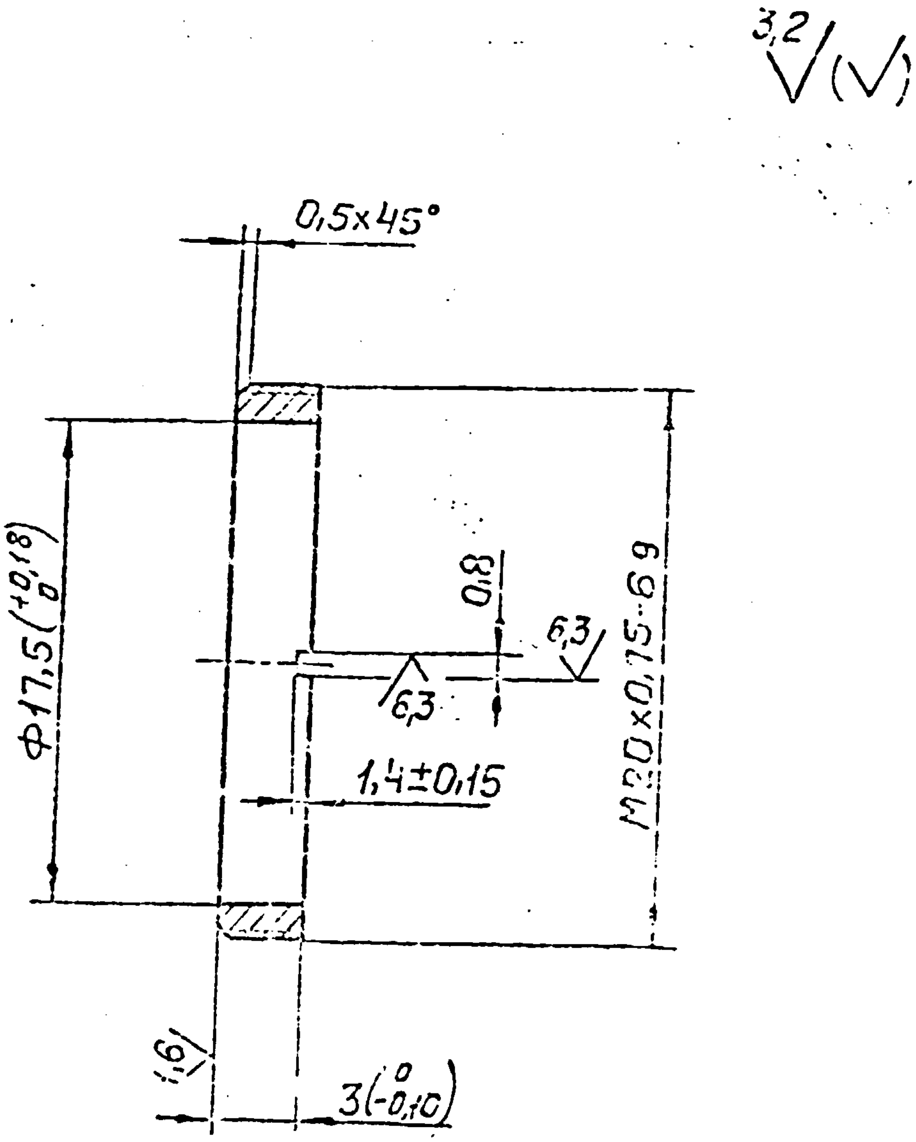


Coating: Anodic oxidation black

320.035		
Ring	Mass	Scale
		2:1
	Sheet	Sheets 1
Aluminium alloy AL-Cu 4 Mg Mn Fe Si	LITMO	

Designer

Chief Designer



Coating: Chemical oxidation

320.036

Thread ring

Mass	Scale
	5:1

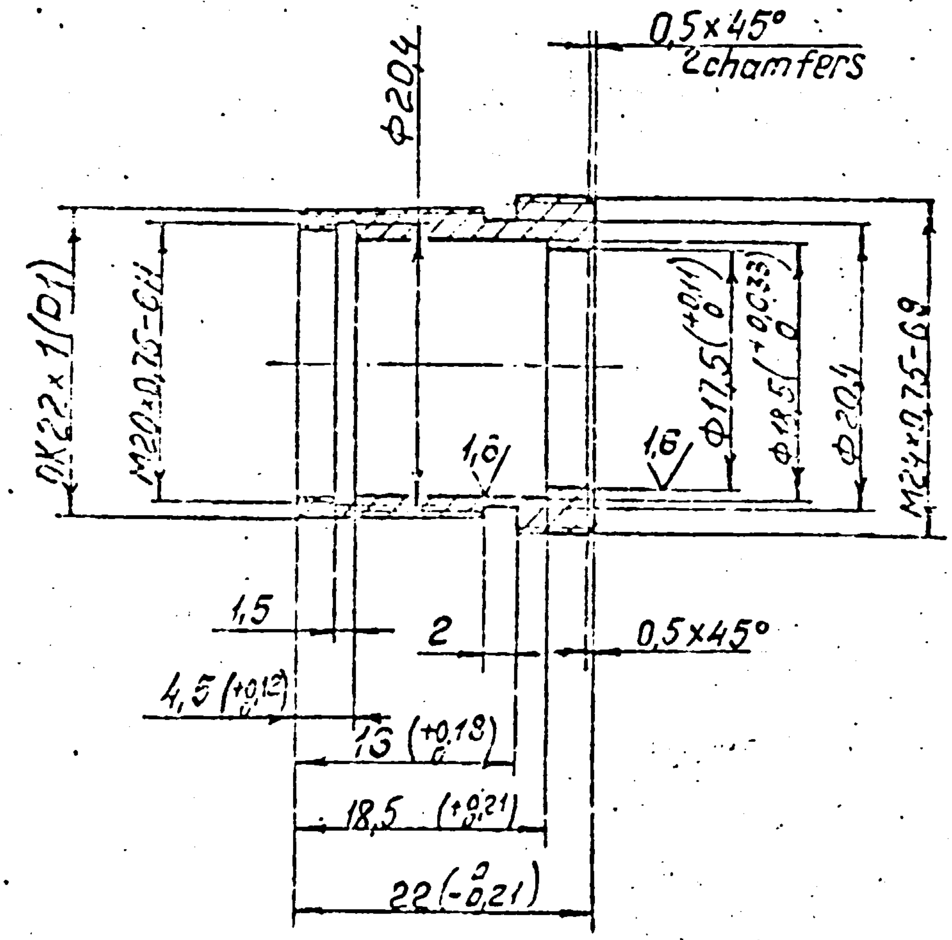
Sheet | Sheets 1

Steel 20

LITMO

Designer

Chief Designer



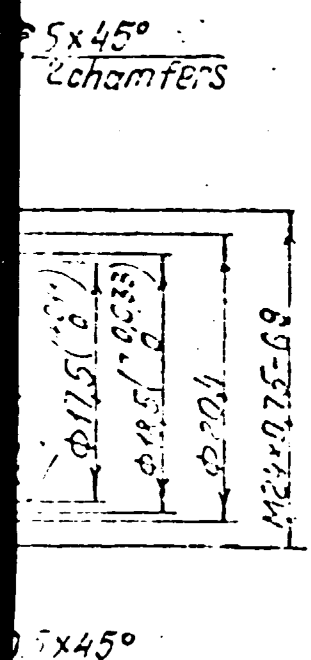
1. H1-
2. Coa

SECTION 1

Designer

Chief Designer

$\sqrt[3,2]{}(\surd)$



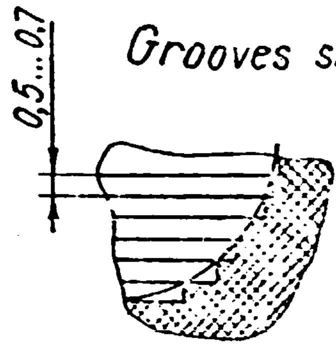
1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating: Chemical oxidation

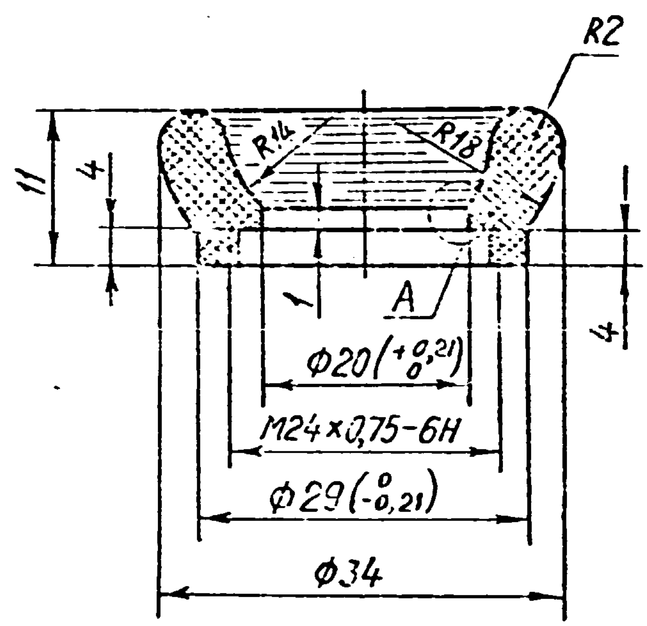
320.037		
Holder	Mass	Scale
		2:1
	Sheet	Sheets 1
Designer		
Chief Designer		
Brass CuZn 37	LITMO	

0,80

A (5:1)

Grooves shape





1. Moulding
2. H14, h14, $\pm \frac{IT14}{2}$

320. 038			
Eyeguard	Mass	Scale	
		2:1	
	Sheet	Sheets 1	
Ebonite electrotechical	LITMO		

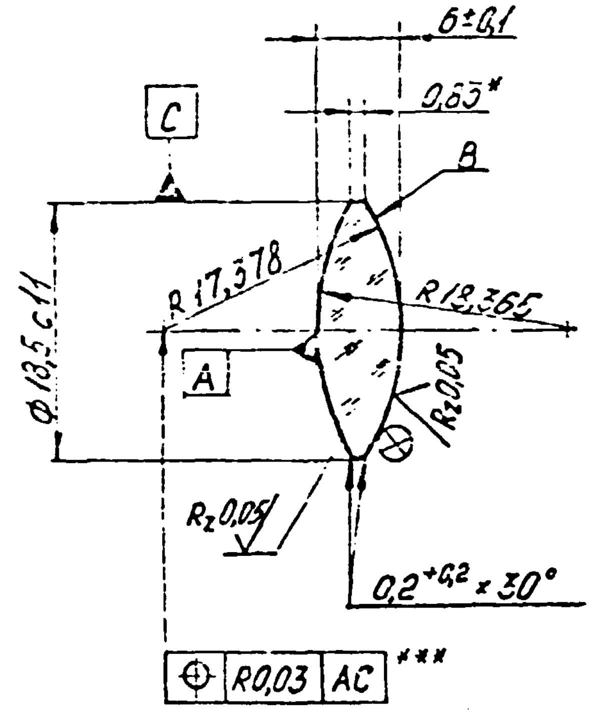
Designer

Ch. of Designer

Form A4

1,6 √(√)

Δn_e	4N
$\Delta(n_{F'}-n_{C'})$	—
Homogeneity	H1
Birefringence	1!
μ_A	—
Veins	P2
Inclusions	B2
N	5
ΔN	1
Surf. qual.	0,1**
ΔR	0,04%



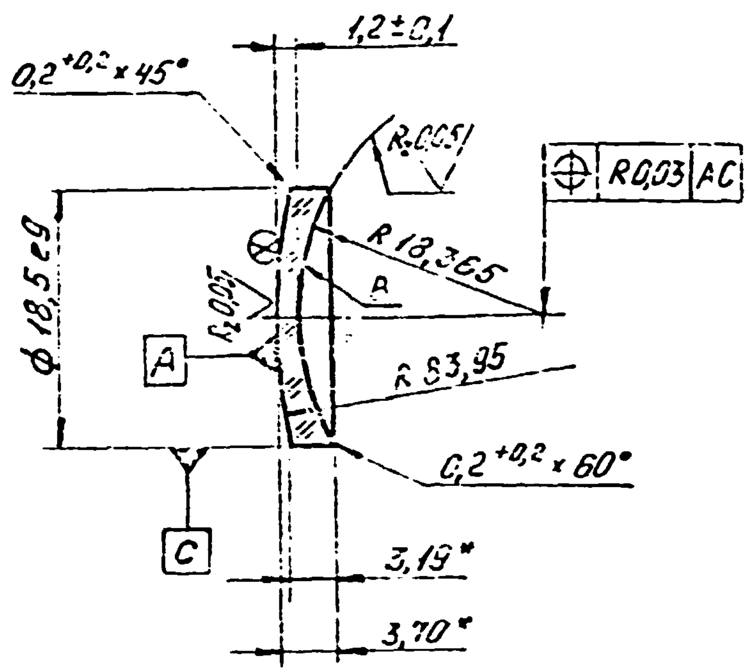
f'	18,27
S_F	-13,12
$S'_{F'}$	16,24
DØ	18

1.* The dimension for information
2.** Permitted total area of scratches, pits (mm^2)
3. ⊗ - L_2 (Anti-reflection coating)
L_2 MgF_2
λ_0 = 550nm
4. *** Wedge angle 5'

320.041		
Lens	Mass	Scale
		2:1
	Sheet	Sheets 1
Glass BK7	LITMO	

Form A4

$\sqrt[4,5]{}(\sqrt{})$



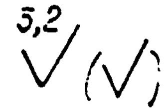
Δn_e	4H
$\Delta(n_{F'}-n_{C'})$	–
Homogeneity	H1
Birefringence	N
μ_A	–
Veins	P2
Inclusions	B2
N	5
ΔN	1
Surf. qual.	0,1**
ΔR_A	0,05%
$\angle R_B$	0,04%

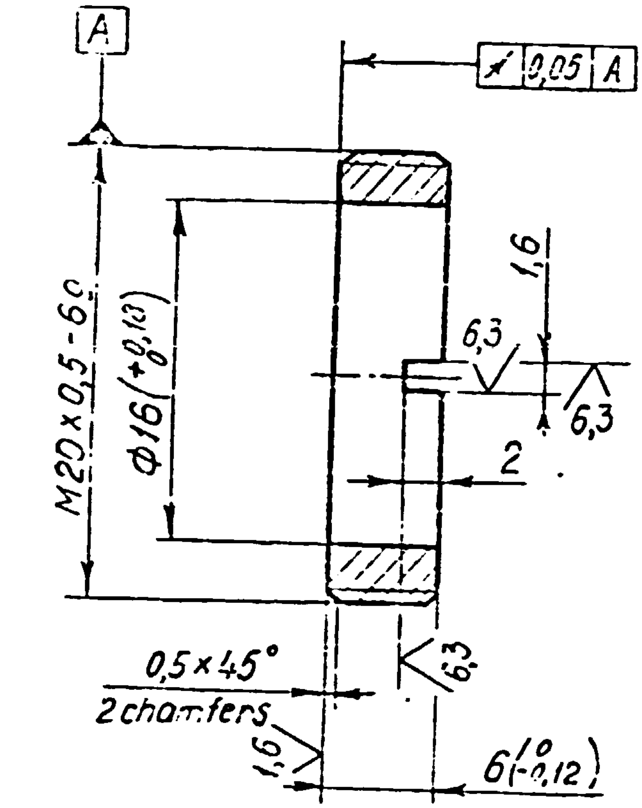
f'	-36,17
S_F	37,10
$S'_{F'}$	-35,36
Oφ	18

1. * The dimensions for information
2. ** Permitted total area of scratches, pits (mm^2)
3. ⊗ L_2 (Anti-reflection coating) $R_\lambda \leq 2\%$
   L_2 MgF_2
   $\lambda_0 = 550\ nm$
4. *** Wedge angle 5'

320.042		
Lens	Mass	Scale
		2:1
	Sheet	Sheets 1
Designer		
Chief Designer		
Glass EDF 651/33,6	LITMO	

Form. A4





1 $H14$, $h14$, $\pm\frac{IT14}{2}$

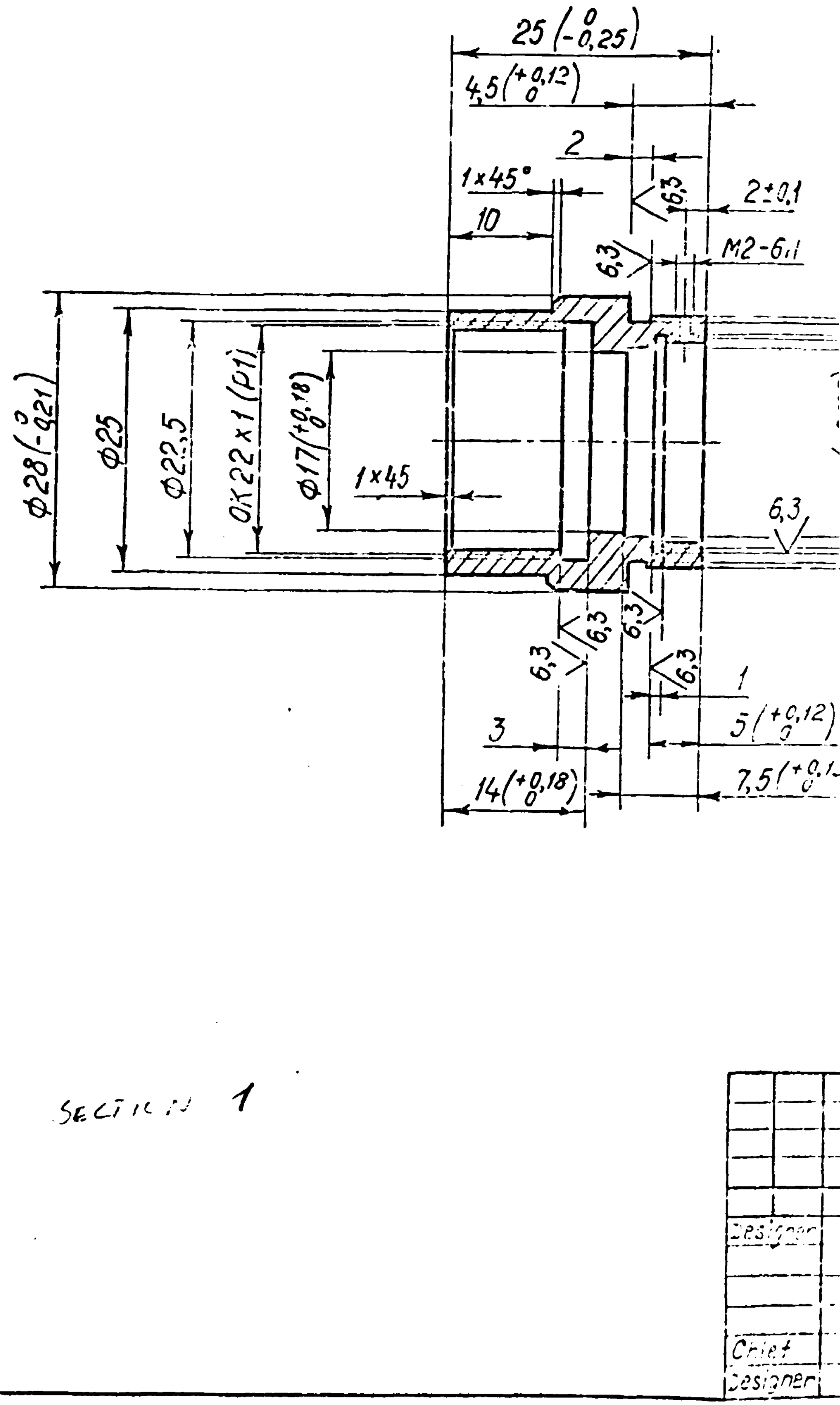
2. Coating: Chemical oxidation impregnation by oil

320.045		
Thread ring	Mass	Scale 5:1
	Sheet	Sheets 1
Steel 20	LITMO	

Designer

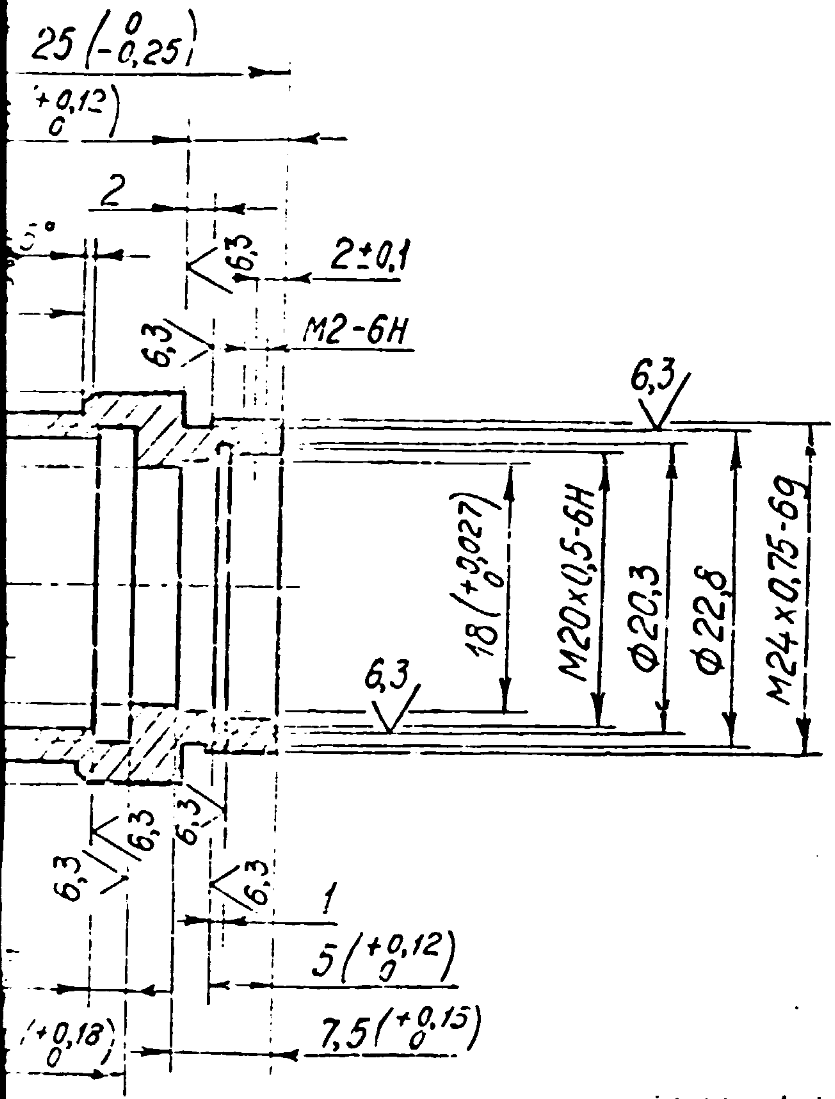
Chief Designer

Form A4



25 (0/-0,25)
4,5 (+0,12/0)
2
1×45°
2±0,1
10
6,3
M2-6H
Φ28 (0/-0,21)
Φ25
Φ22,5
OK22×1 (P1)
Φ17 (+0,18/0)
1×45
6,3
1
5 (+0,12/0)
3
14 (+0,18/0)
7,5 (+0,1…
Designer
Chief
Designer

SECTION 1

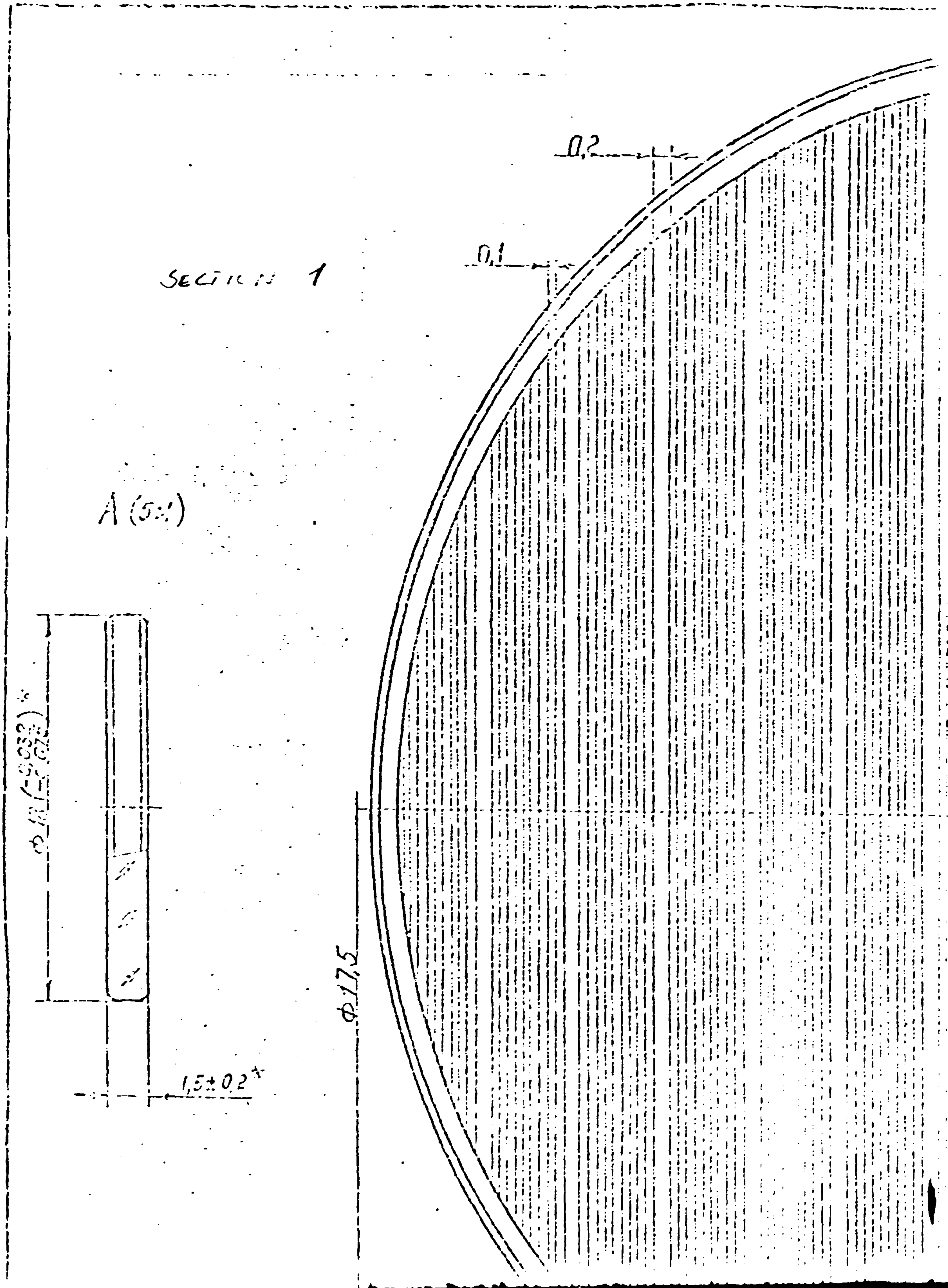


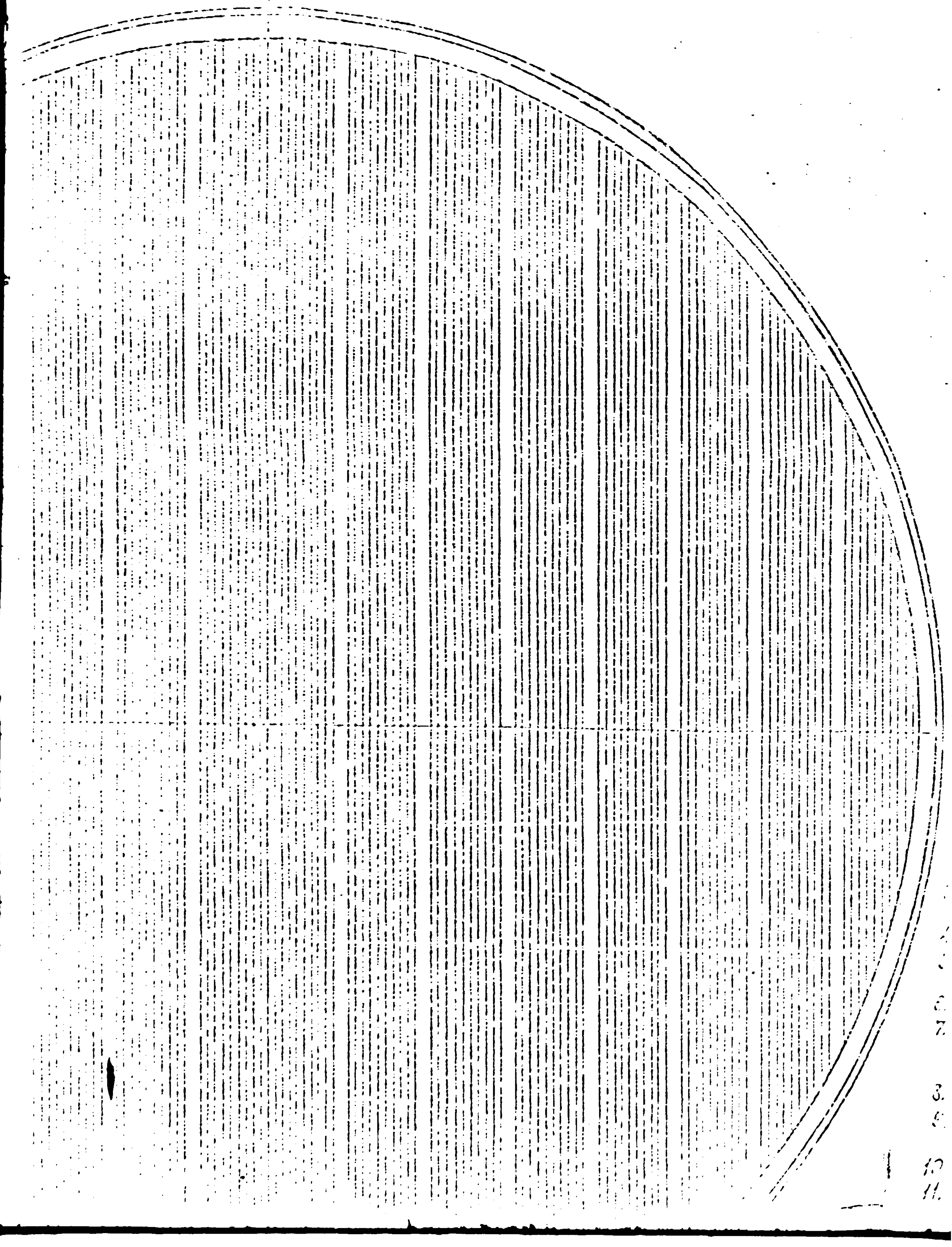
1. H14; h14; $\frac{IT14}{2}$

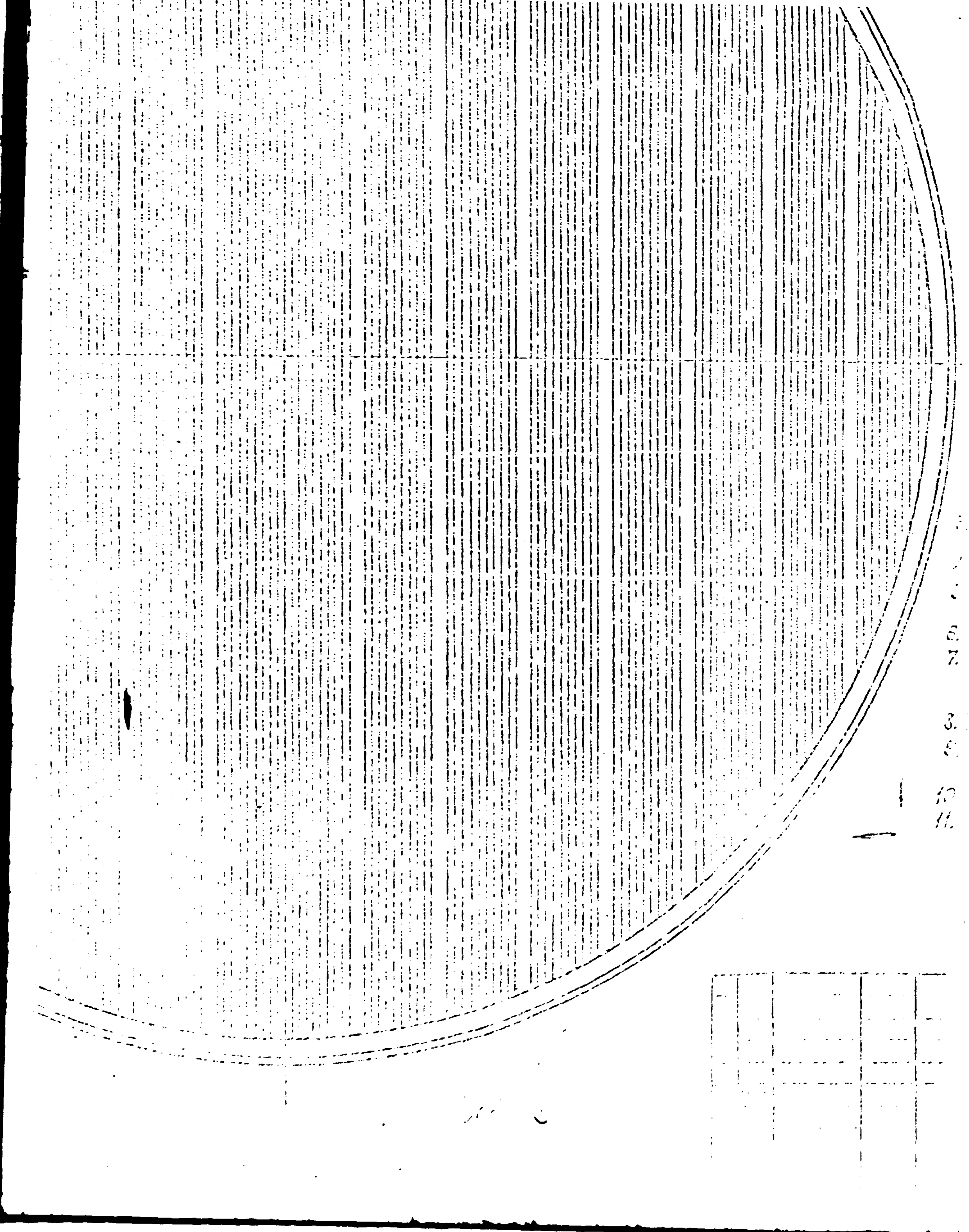
2. Coating: Chemical oxidation

	320.046	
Designer	Holder	Mass / Scale 2:1
		Sheet / Sheets
Chief Designer	Brass CuZn40	LITMO

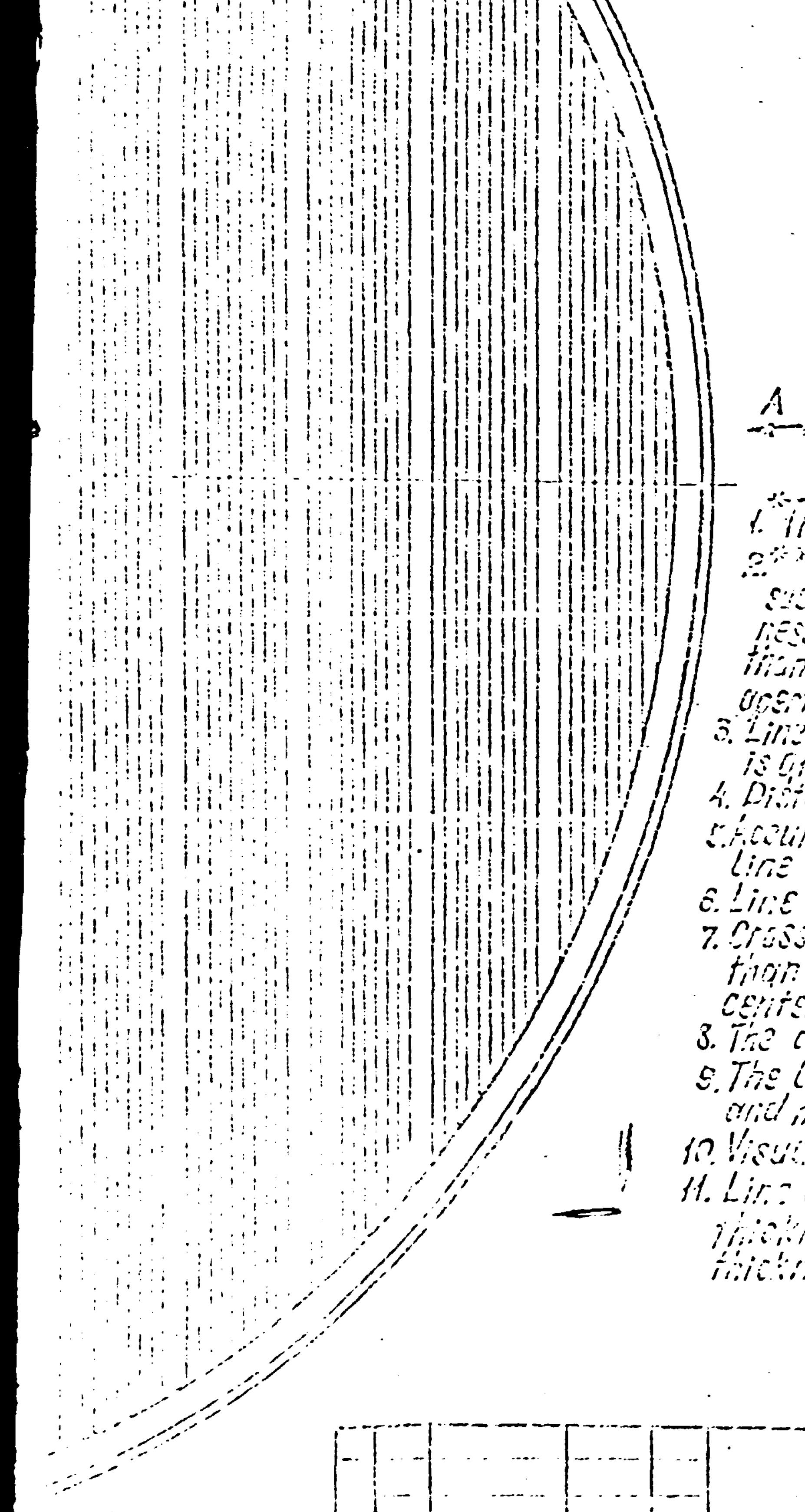
Form: A3


0,2
0,1
SECTION 1
A (5:1)
Φ17,5
1,5±0,2*


7.
8.
11.



SECT 4



1. *The dimensions for information
2. **0-20 means than focal length of ... system (eyepiece) is 20mm and ... thicknesses, point diameters must be no more than 0,001mm across the area ... clear aperture diameter.
3. Line-to-line distance in the group of 9 lines is 0,1mm
4. Distance between each lines group is 0,2...
5. Accuracy of line marking from the first line to any other is ...
6. Line thickness is ...
7. Cross-hairs must be ... no more than 0,2mm relative to the graticule center.
8. The cross-hairs measures ...
9. The lines and the cross-hairs ... black and made by photography ...
10. Visual magnification is ...
11. Line discontinuity and line ... thickness must be no more ... thickness

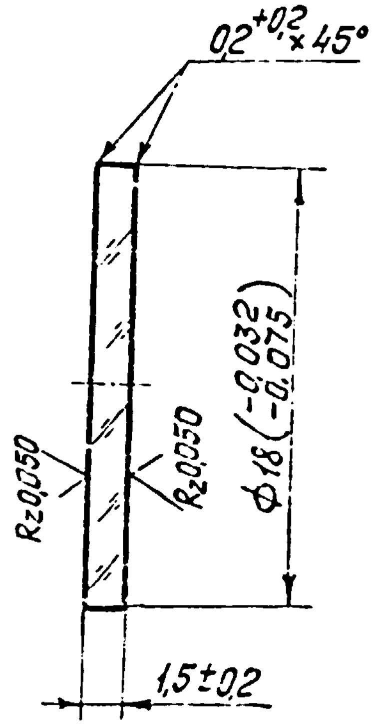
320.048

Graticule

20:1

0,80 √ (√)

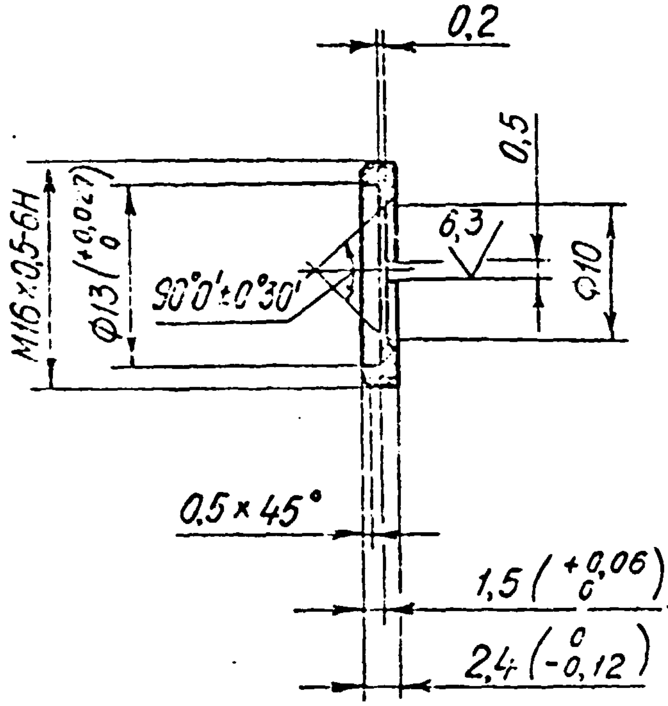
Δn_e	5N
$\Delta(n_{F'}-n_{C'})$	–
Homogeneity	H1
Birefringence	N
μ_A	–
Veins	P2
Inclusions	B0
N	10
ΔN	–
Surf. qual	0-20*
θ	15'
Oφ	15



*(0-20) means that focal length of following sustem is 20mm and scratches thicknesses, point diameters must be no more than 0,001mm across the area with 1/3 clear aperture diameter.

	320.049		
	Plate	Mass	Scale
Designer			5:1
		Sheet	Sheets 1
Chief Designer	Glass BK7	LITMO	

1,5 √ (√)



1. H14, h14, $\pm \frac{IT14}{2}$

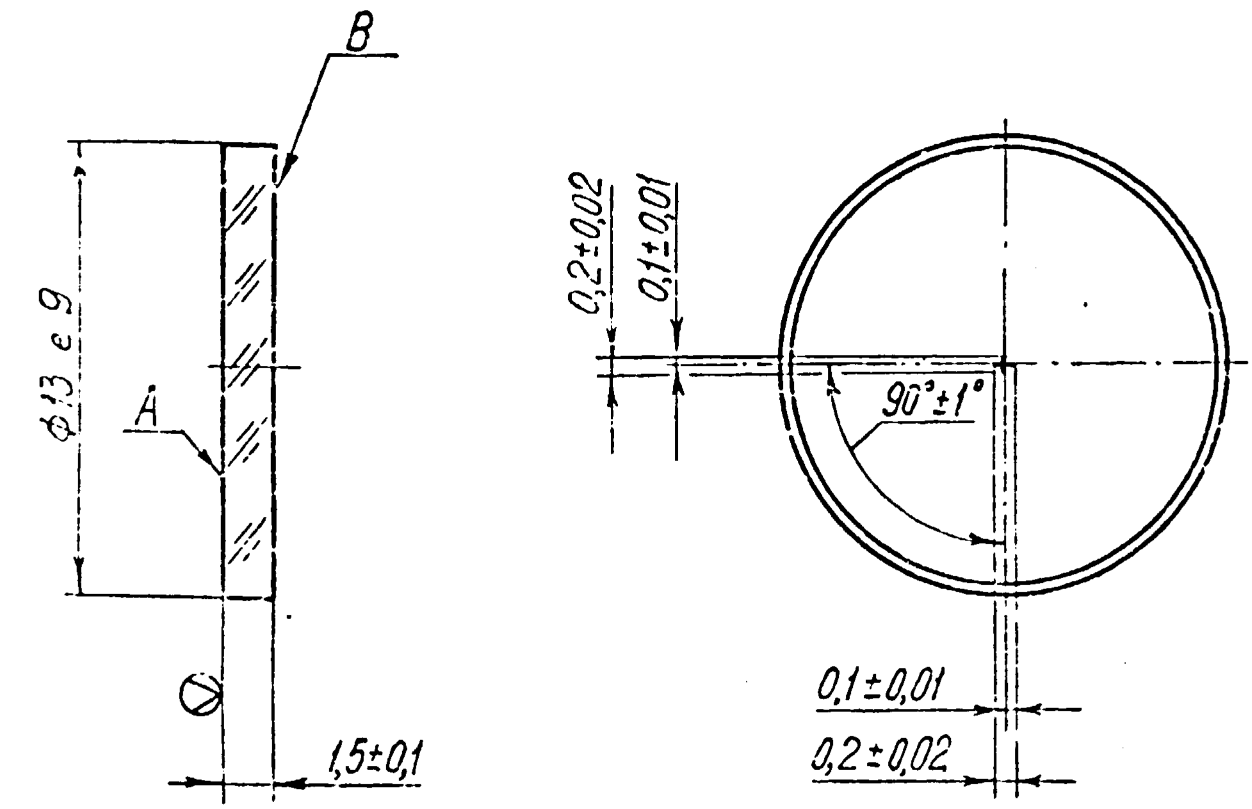
2. Coating Anodic oxidation black

320. 055		
Ring	Mass	Scale
		2:1
	Sheet	Sheets 1
Aluminium alloy AL-Cu 4 Mg Mn Fe Si	LITMO	

Designer

Chief Designer

Form A4



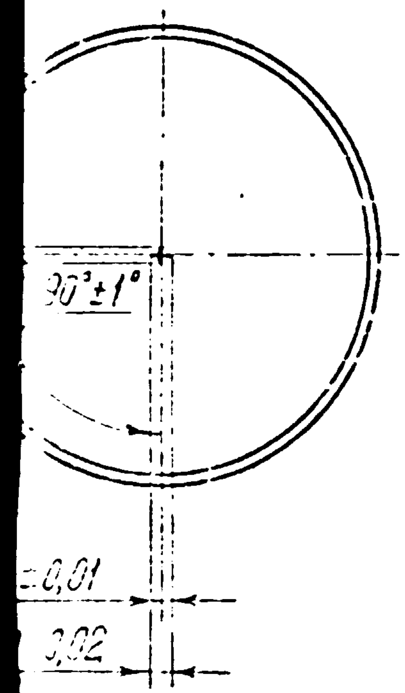
1.
2.
3.
4.
5.
6.
7.
8.

SECTION 1

Designer

Chief Designer

N	—
ΔN	—
ϑ	—
Surf. qual	0-10**



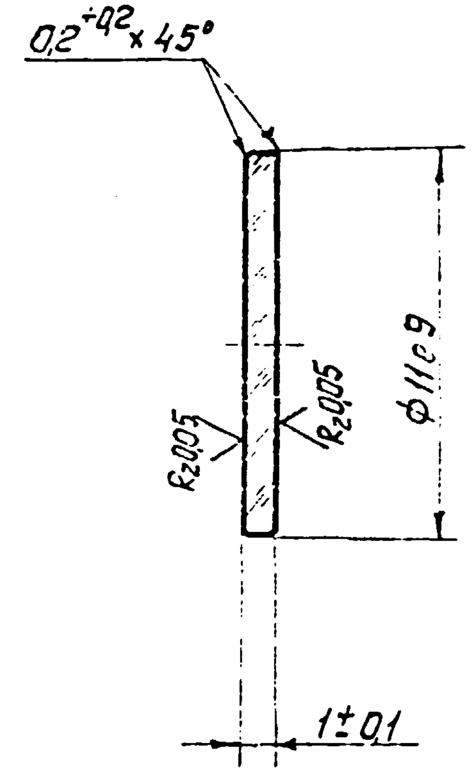
1.* The dimensions for information
2.** Surface quality in the central ϕ 2 mm area is 0-10 (it means that focal length of following system is 10mm and scratch thicknesses, point diameters must be no more than 0,001mm) and out of this area the permitted total area of scratches, pits is 0,1mm².
3. $\bigcirc\!\!\!\!\vee_A$ Aluminised
4. Mark transparent cross-hairs on the surface A.
5. The mismatch of the cross-hairs centre and the piece centre must be no more than 0,1mm.
6. The cross-hairs line thickness is (0,015 ± 0,003) mm
7. The surface B coating - black enamel except for the central area of ϕ 2 mm.
8. Visual magnification $\Gamma = 12^*$

	320. 056	
Designer	Graticule	Mass: — Scale: 5:1
		Sheet
Chief designer	Glass BK7	LITMO

Form A3

$\sqrt[1{,}6]{}\ (\surd)$

Δn_e	–
$\Delta(n_{F'}-n_{C'})$	–
Homogeneity	H1
Birefringence	N
μ_A	–
Veins	P2
Inclusions	32
N	–
ΔN	–
θ	10'
Surf.qual	0,02*
O_ϕ	9

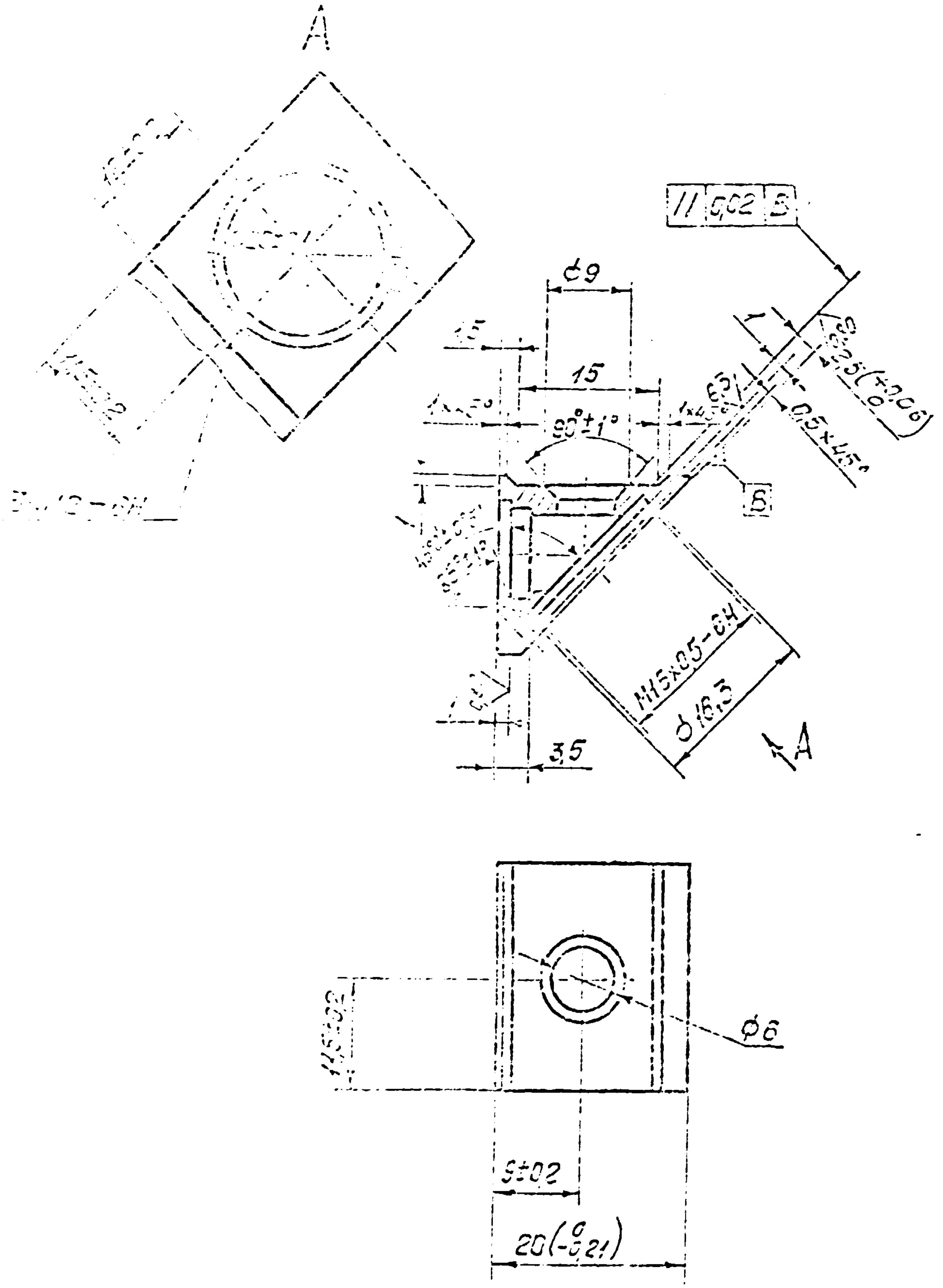


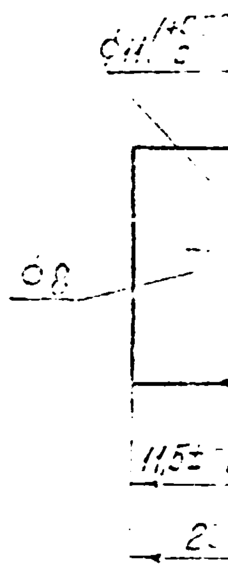
*Permitted total area of scratches, pits (mm^2)

320.058			
Protective glass		Mass	Scale
			5:1
	Sheet	Sheets 1	
Glass BK7	LITMO		

Designer

Chief Designer

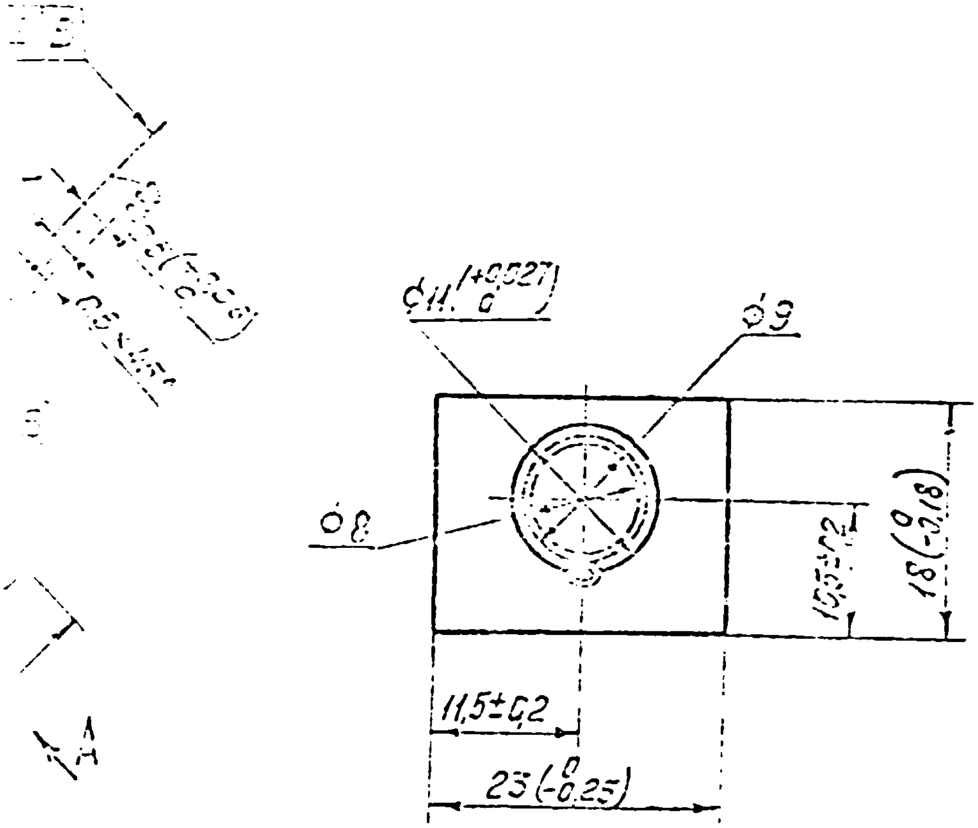




1.H14; ...
2.Coat...

SECTION 1

$\sqrt{1{,}6}\ (\sqrt{})$



1. H14; h14; $\pm \frac{IT14}{2}$

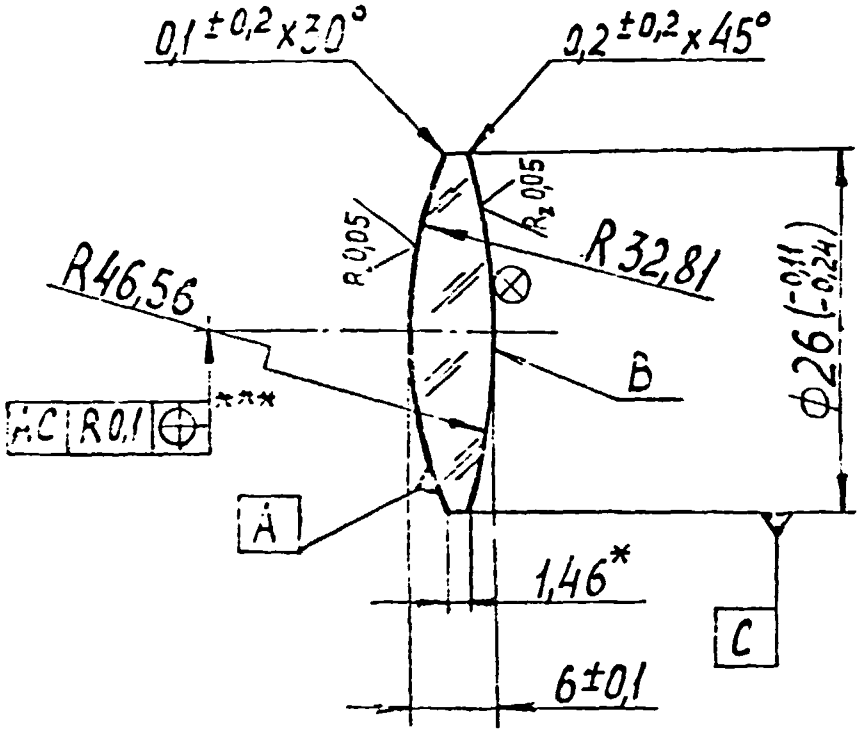
2. Coating: Anodic oxidation black

320.059		
Holder	Mass	Scale
		2:1
	Sheet	Sheets 1
Aluminium alloy AlCu4MgMnFeSi	LITMO	

Designer

Chief

1,6 (√)



Δn_e	4N
$\Delta(n_F' - n_C')$	—
Homogeneity	H 2
Birefringence	N
μ_A	—
Veins	P 2
Inclusions	B 2
N	5
ΔN	0,3
Surf. qual	0,1**
ΔR_A	0,04%
ΔR_B	0,03%

f	36,09*
S_F	-36,41*
S'_F	35,71*
$D_{\odot A,B}$	25

1.* The dimension for information

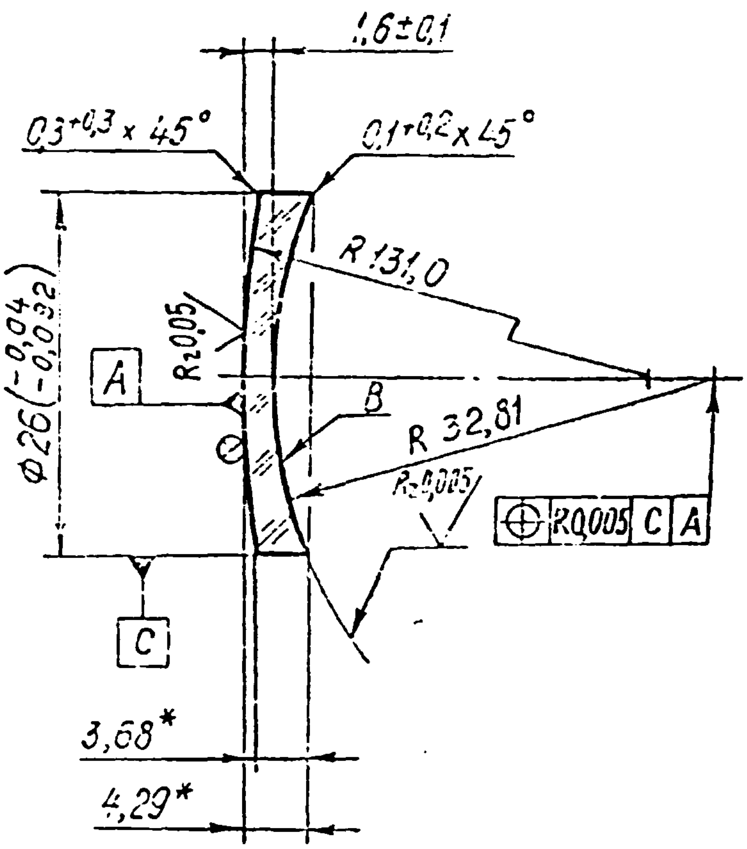
2** Permitted total area of scratches, pits (mm²)

3.*** Wedge angle = 7'

4.⊗ L_2 (Anti-reflection coating)
$R_\lambda \leq 2\%$ L_2-MgF_2
$\lambda_0 = 550$ nm

320.065			
Lens		Mass	Scale
			2:1
	Sheet	Sheets 1	
Glass BK7	LITMO		
Designer			
Chief Designer			

1,6 (√)

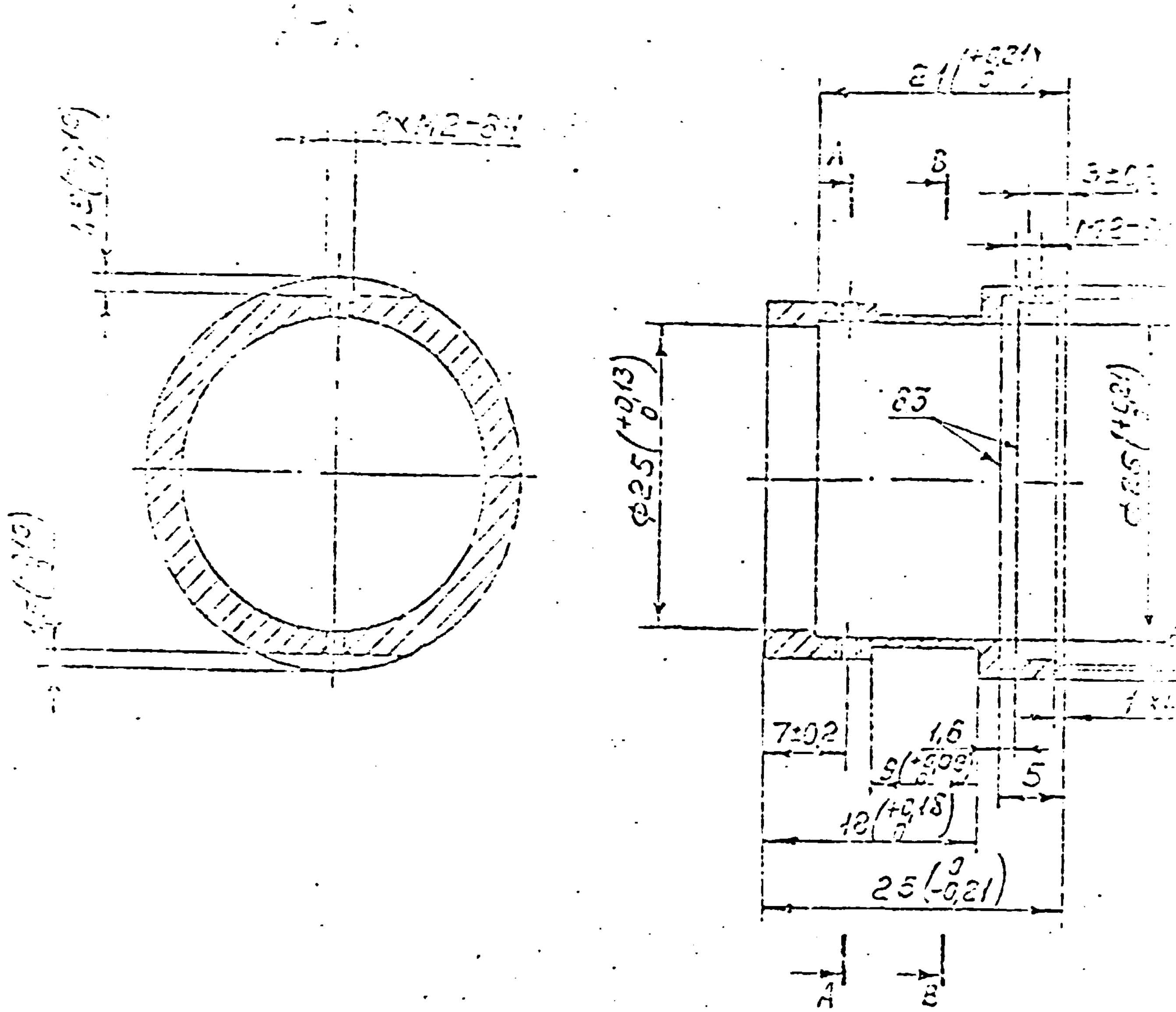


Δn_e	4N
$\Delta(n_{F'}-n_{C'})$	4Г
Homogeneity	3П2
Birefringence	3N
μ_A	7
Veins	P2
Inclusions	B2
N	3
ΔN	0,3
Surf. qual	0,1**
ΔR_A	0,03 %
ΔR_B	0,04 %
f'	−70,18
S_F	71,50*
$S'_{F'}$	−69,85*
$O\Phi_{A,B}$	25

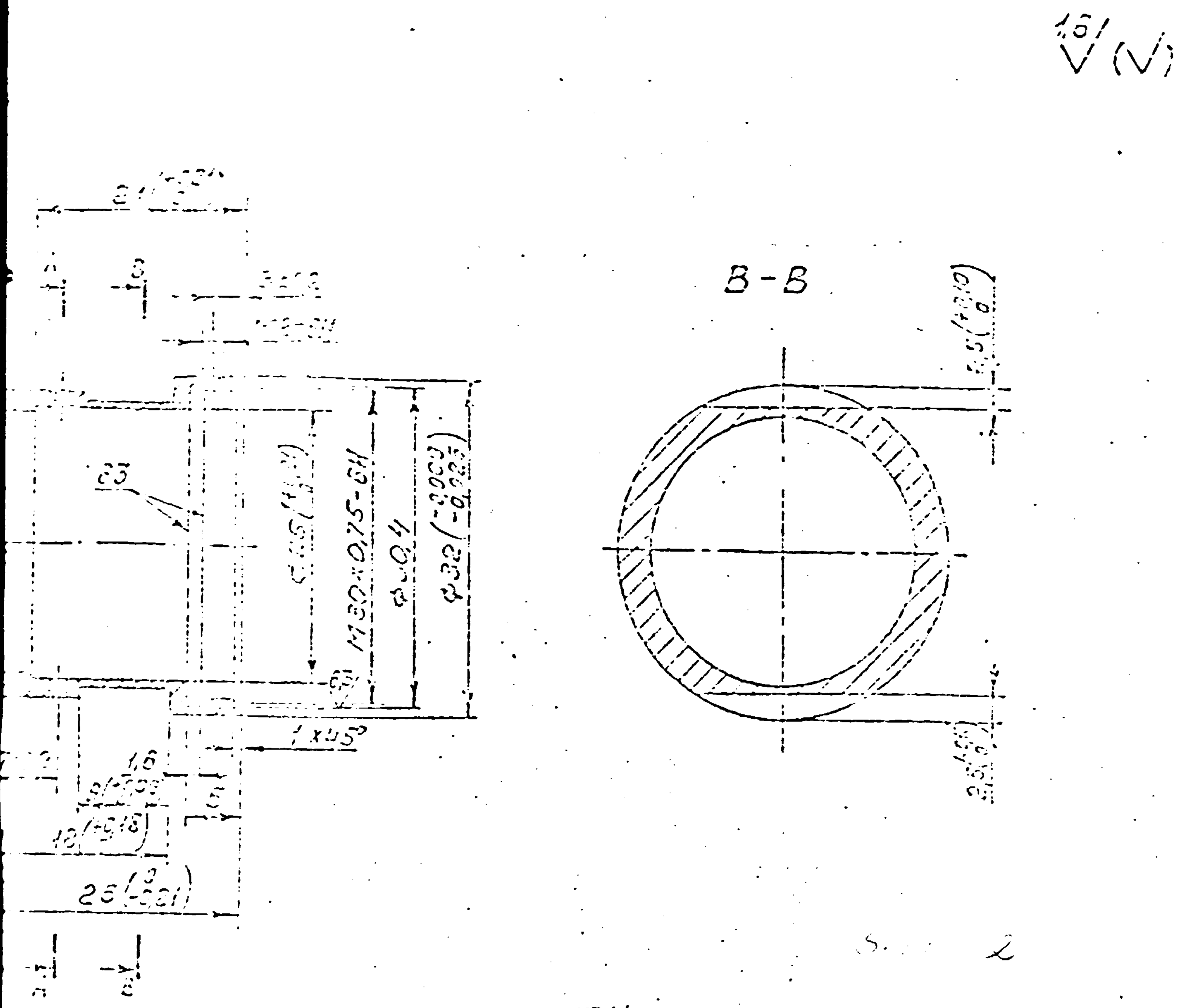
1.* The dimensions for information
2. ⊗ L_2 (Anti-reflection coating)
   $R_\lambda \leq 2\%$ $L_2 = MgF_2$
   $\lambda_0 = 550$ nm
3.** Permitted total area of scratches pits (mm^2).

	320. 066		
Designer	Lens	Mass	Scale
			2:1
		Sheet	Sheets 1
Chief Designer	Glass DF 623/360	LITMO	

Form A4



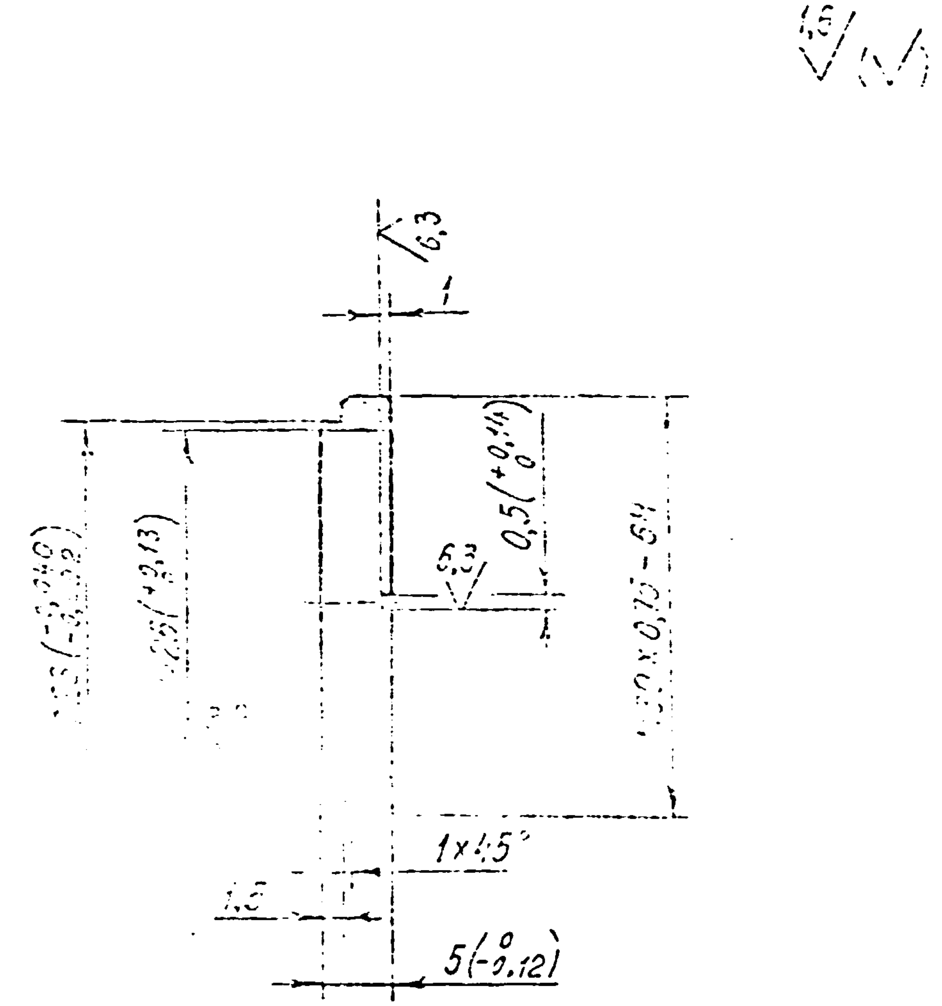
SECTION 1



1. H14; h14; $\pm \frac{IT14}{2}$

2. Coating: anodic oxidation

320.009	
Holder	Mass / Scale: 2:1
	Sheet / Sheets 1
Brass CuZn40	LITMO

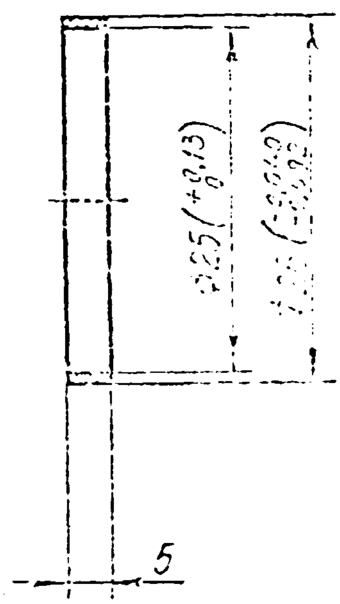


1. H14, h14, $\pm \frac{IT14}{2}$
2. Coating: Anodic oxidation black

320.071			
Ring		Mass	Scale
			2:1
		Sheet	Sheets 1
Aluminium alloy AL-Cu4 Mg Mn Fe Si	LITMO		

Form A4

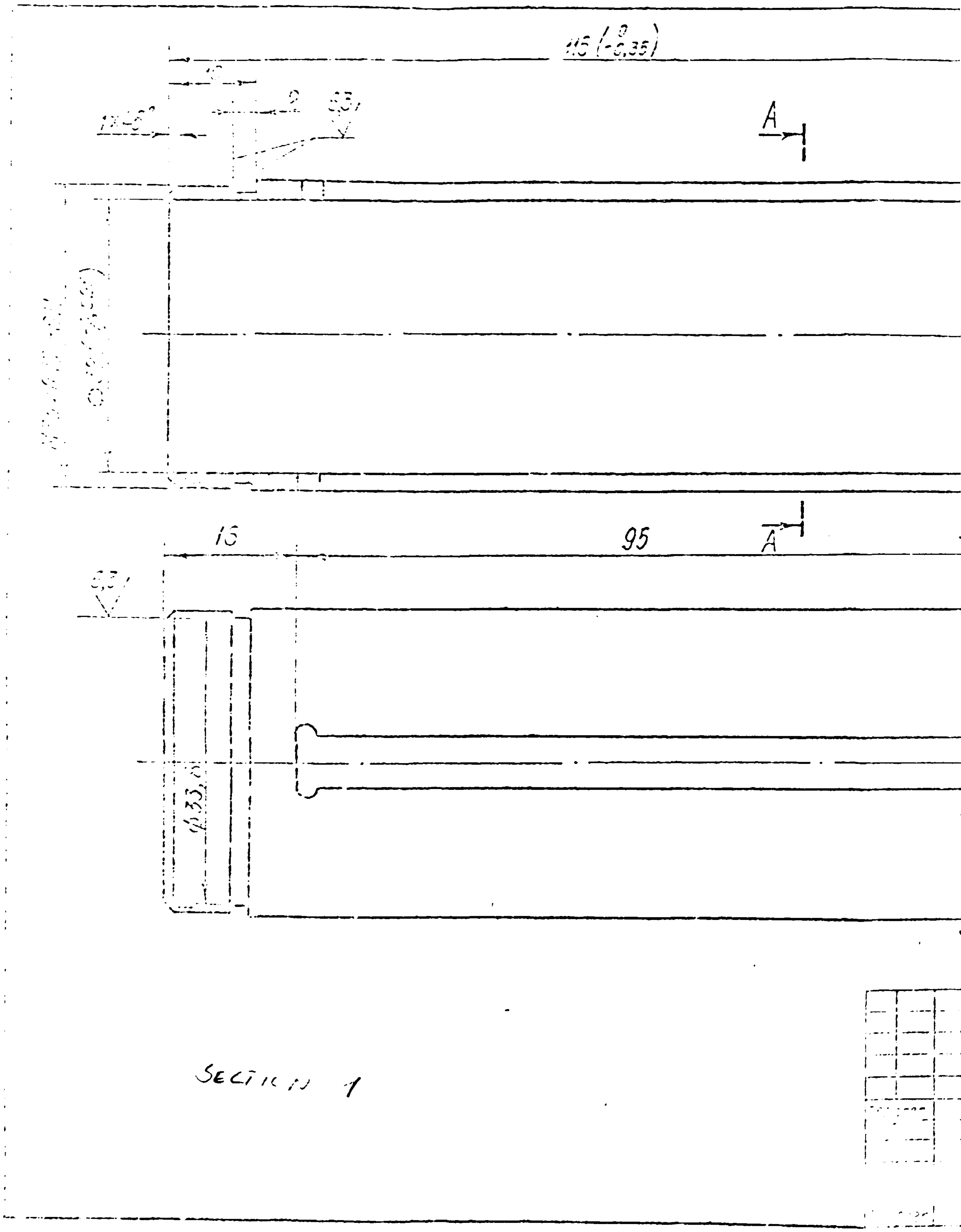
1,6



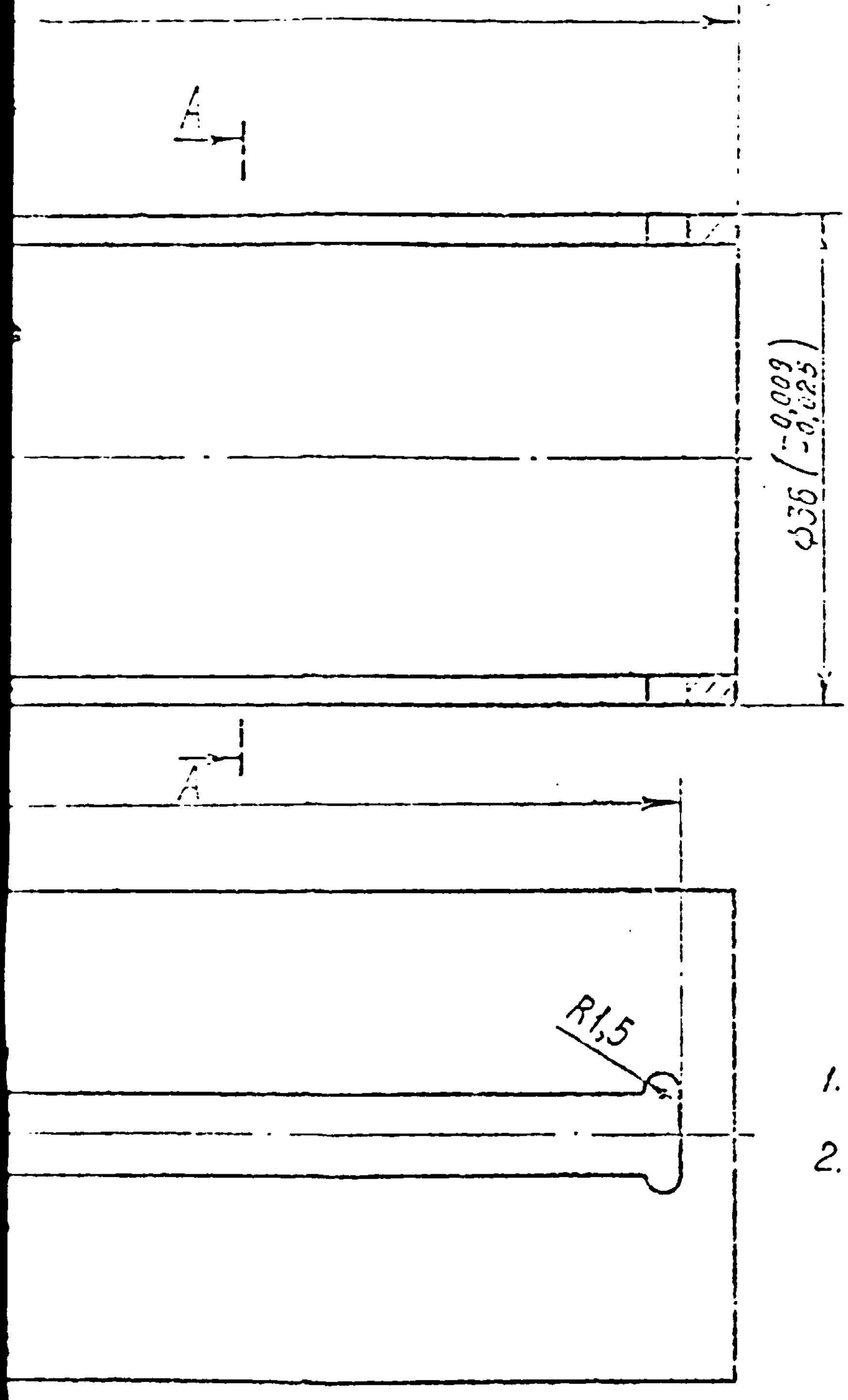
1. h14
2. Coating Chemical oxidation

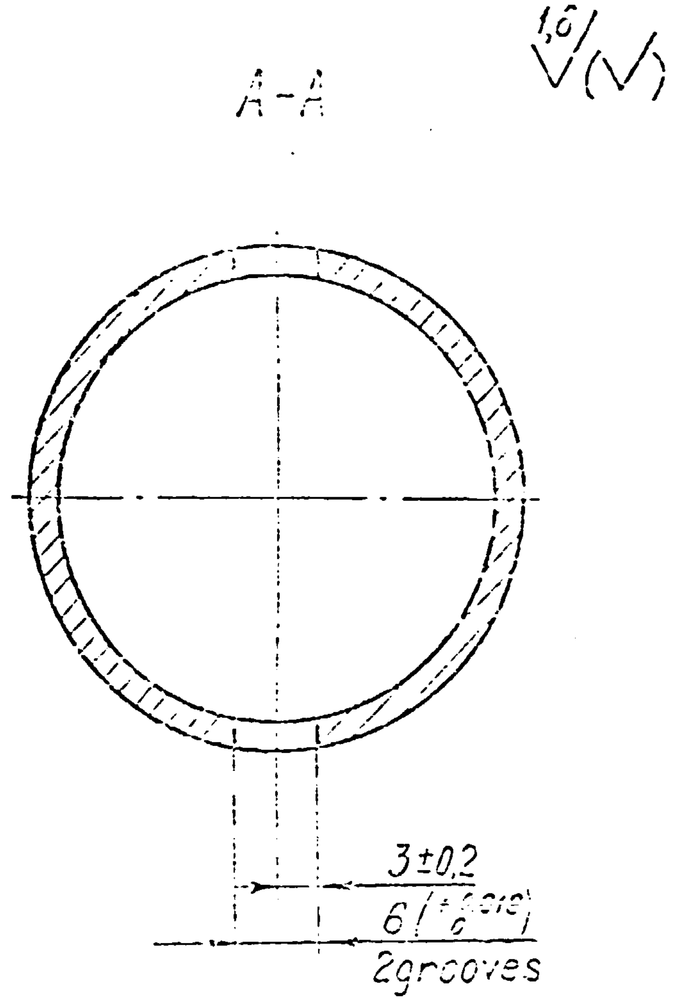
320.072			
Ring	Mass	Scale	
		2:1	
	Sheet	Sheets 1	
Brass CuZn40	LITMO		

Form A4



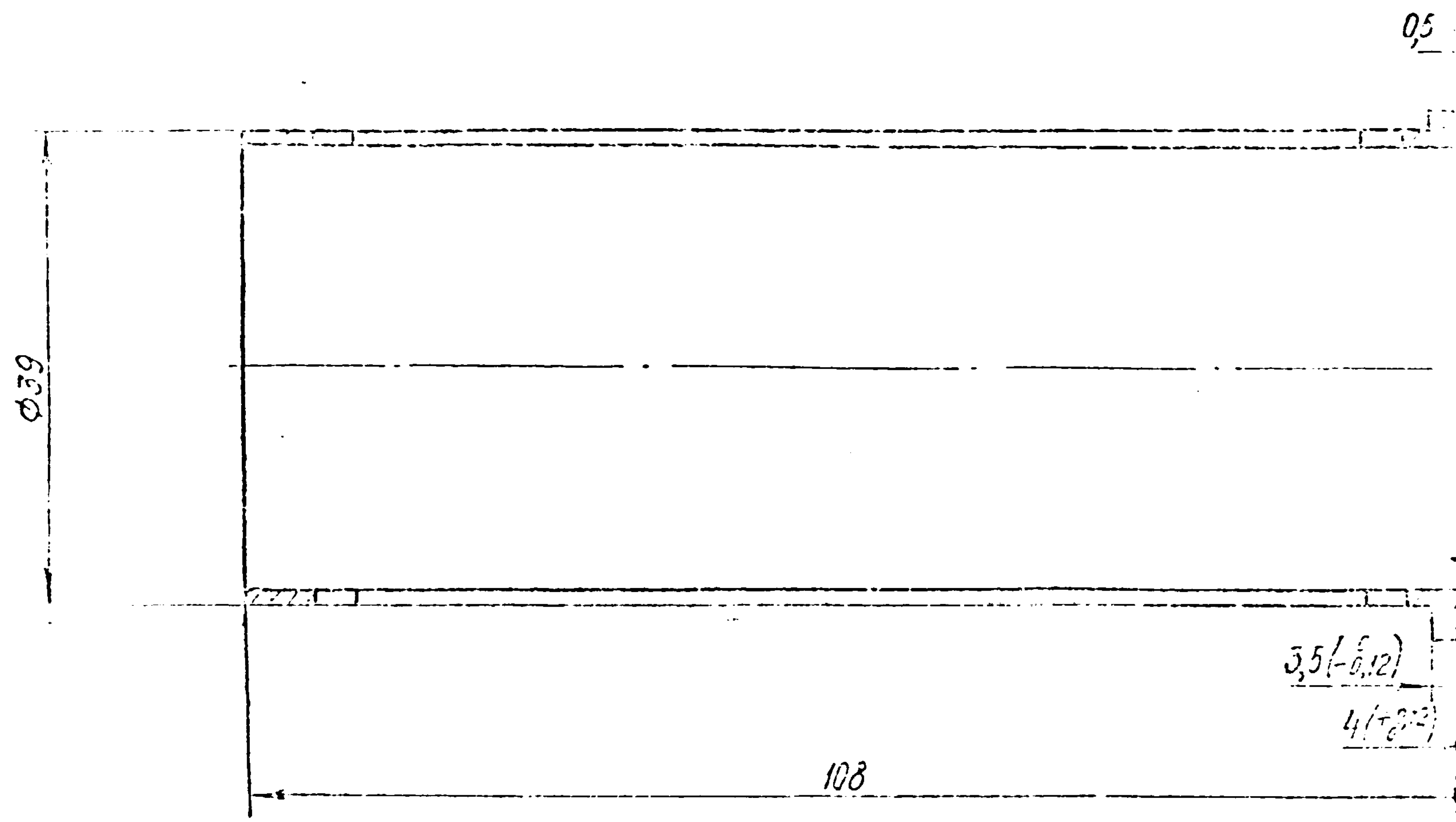
SECTION 1



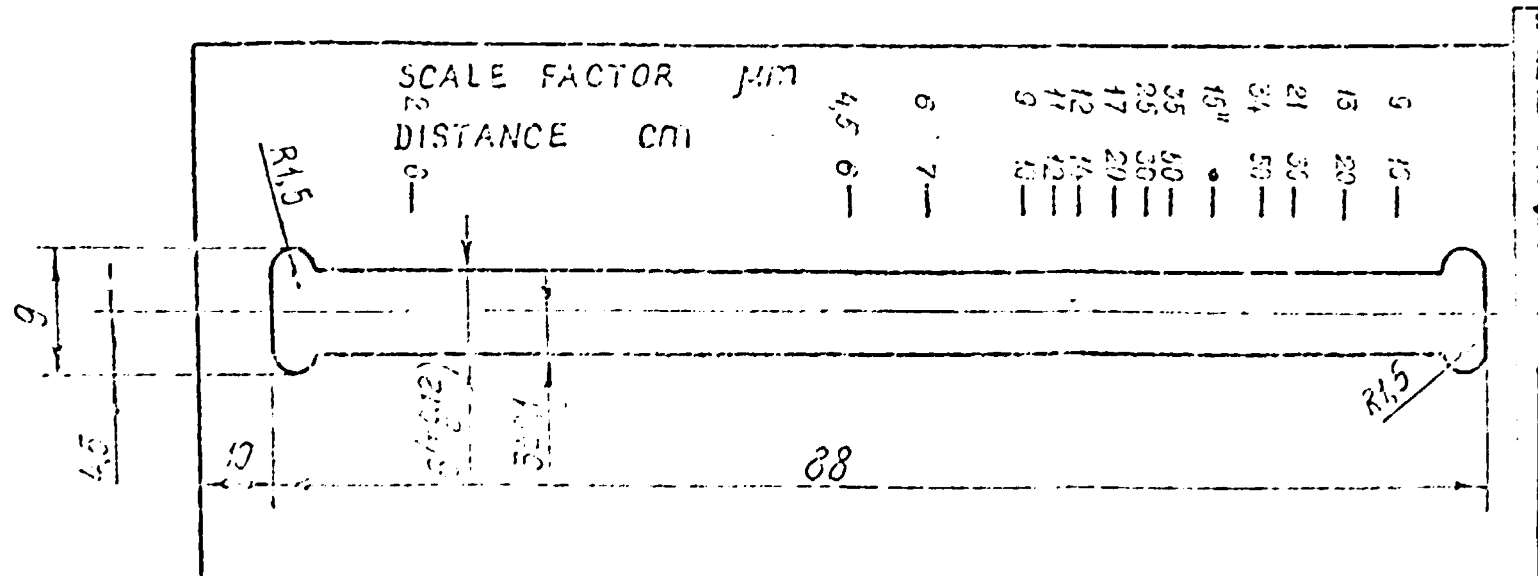


1. H14, h14, $\pm \frac{IT14}{2}$
2. Coating Chemical oxidation chromatizing

320: 073		
Tube	Mass	Scale 2:1
	Sheet	Sheets 1
Steel 20		

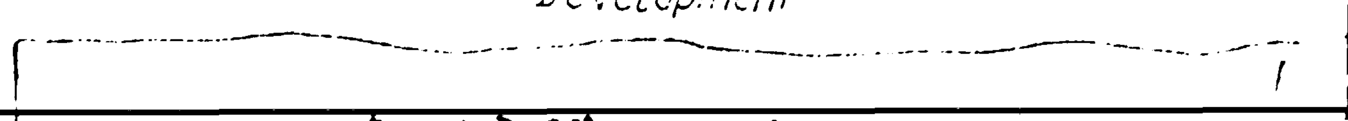


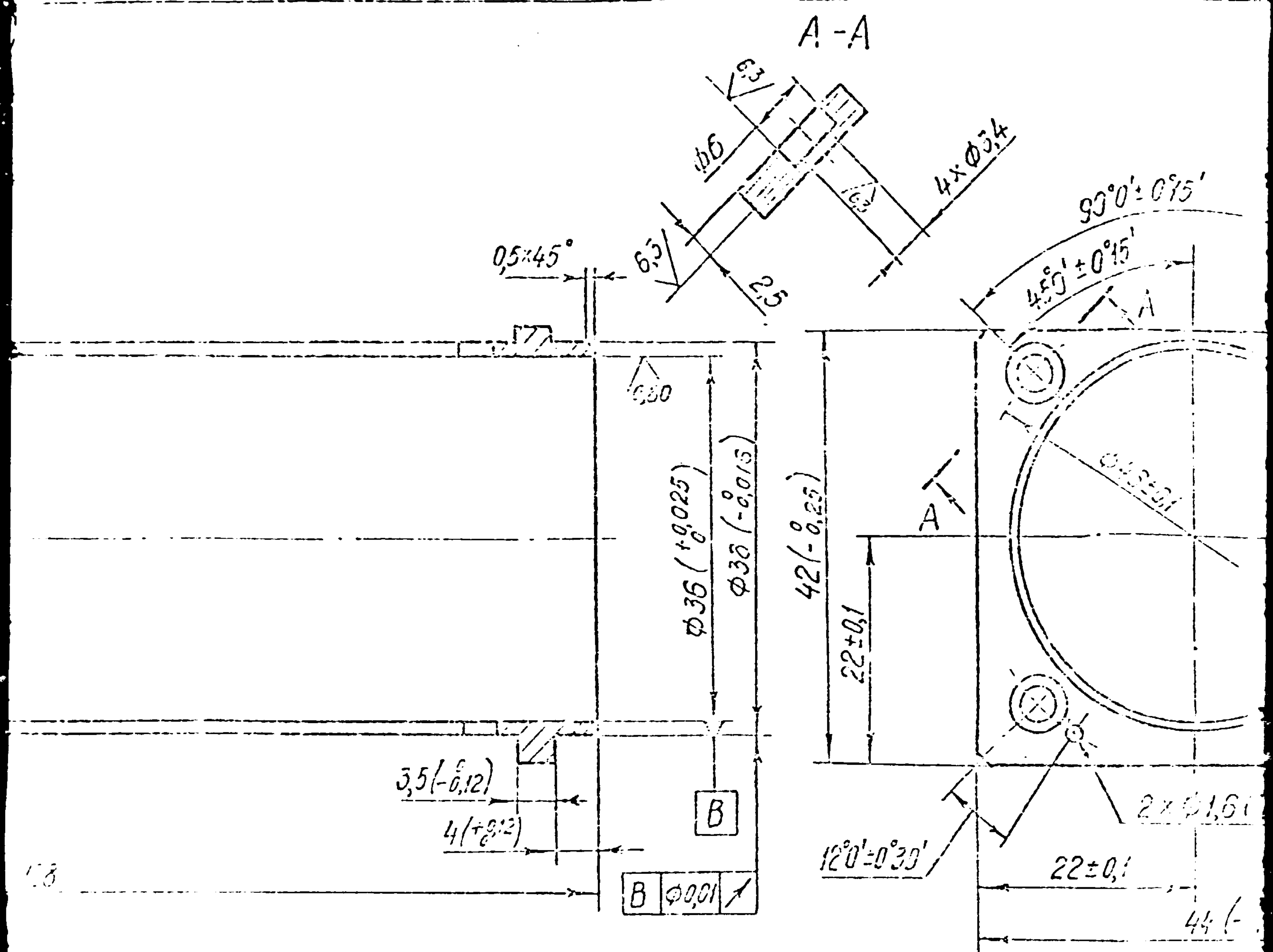
SECTION 1



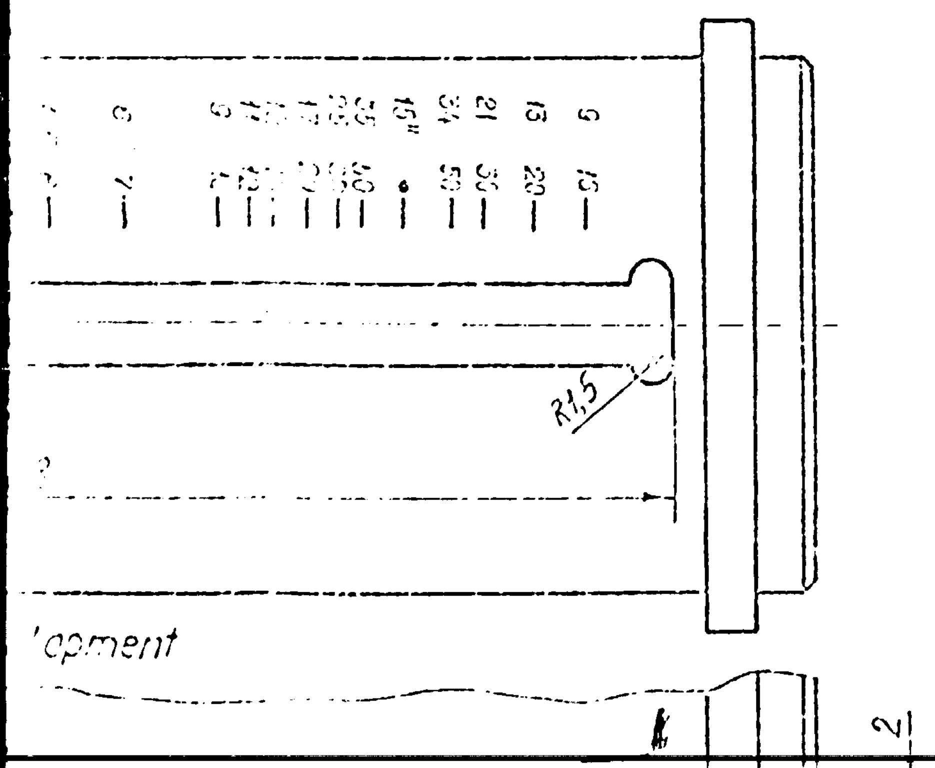
Development

Type 2

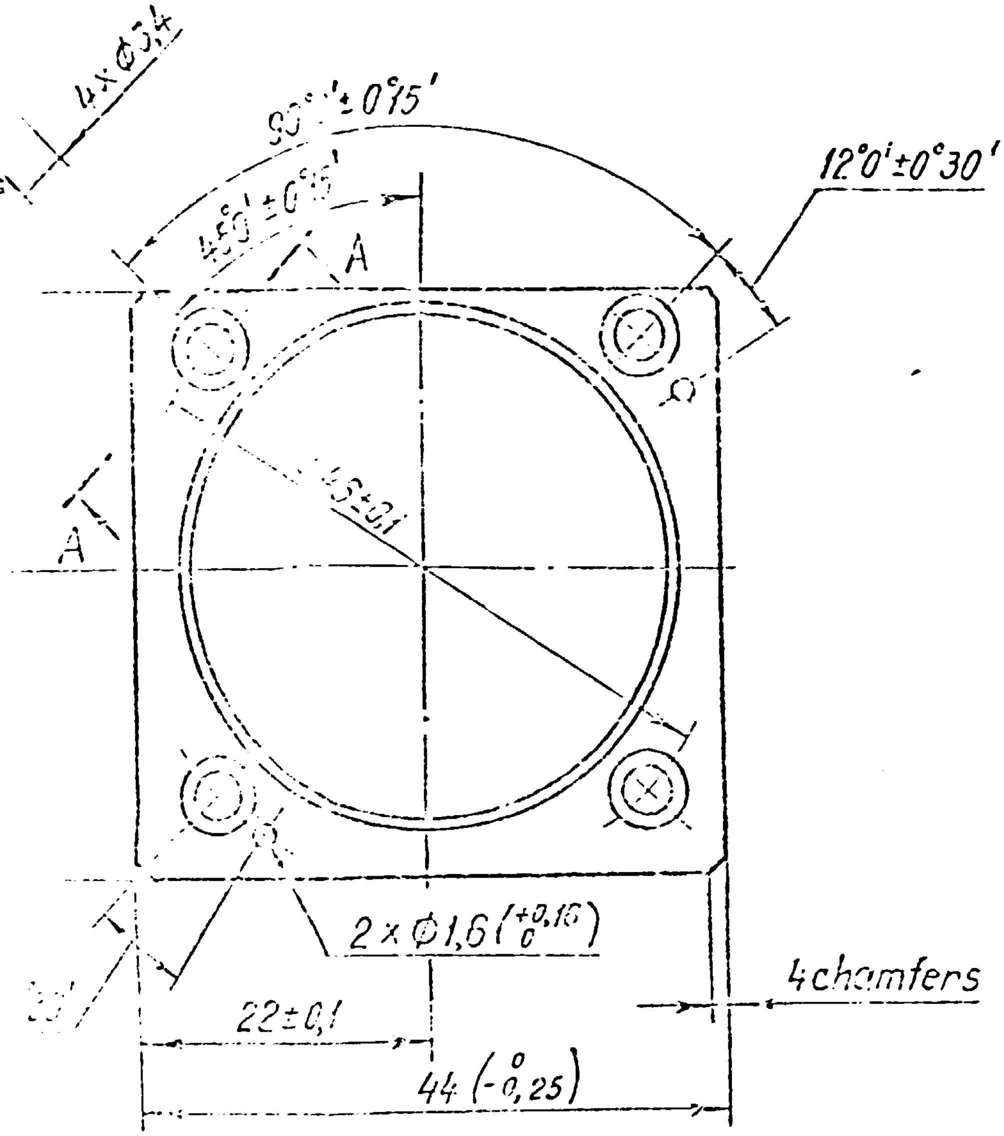




able for scale divisions



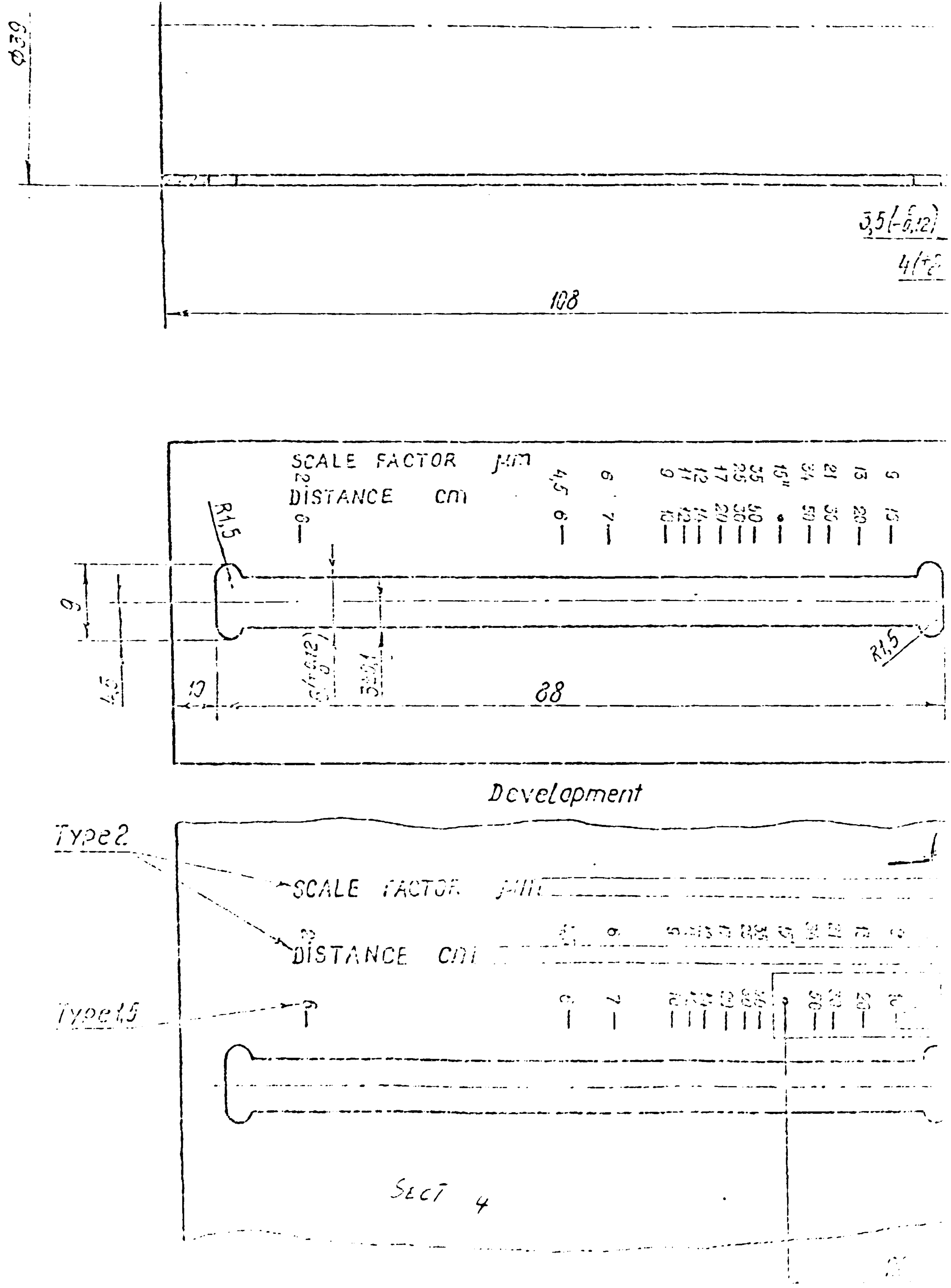
Division value	Distance from [illegible] to the division (mm)
6	60,31
6	27,53
7	[illegible]
10	[illegible]
12	12,17
14	10,49
20	7,46
30	5,11



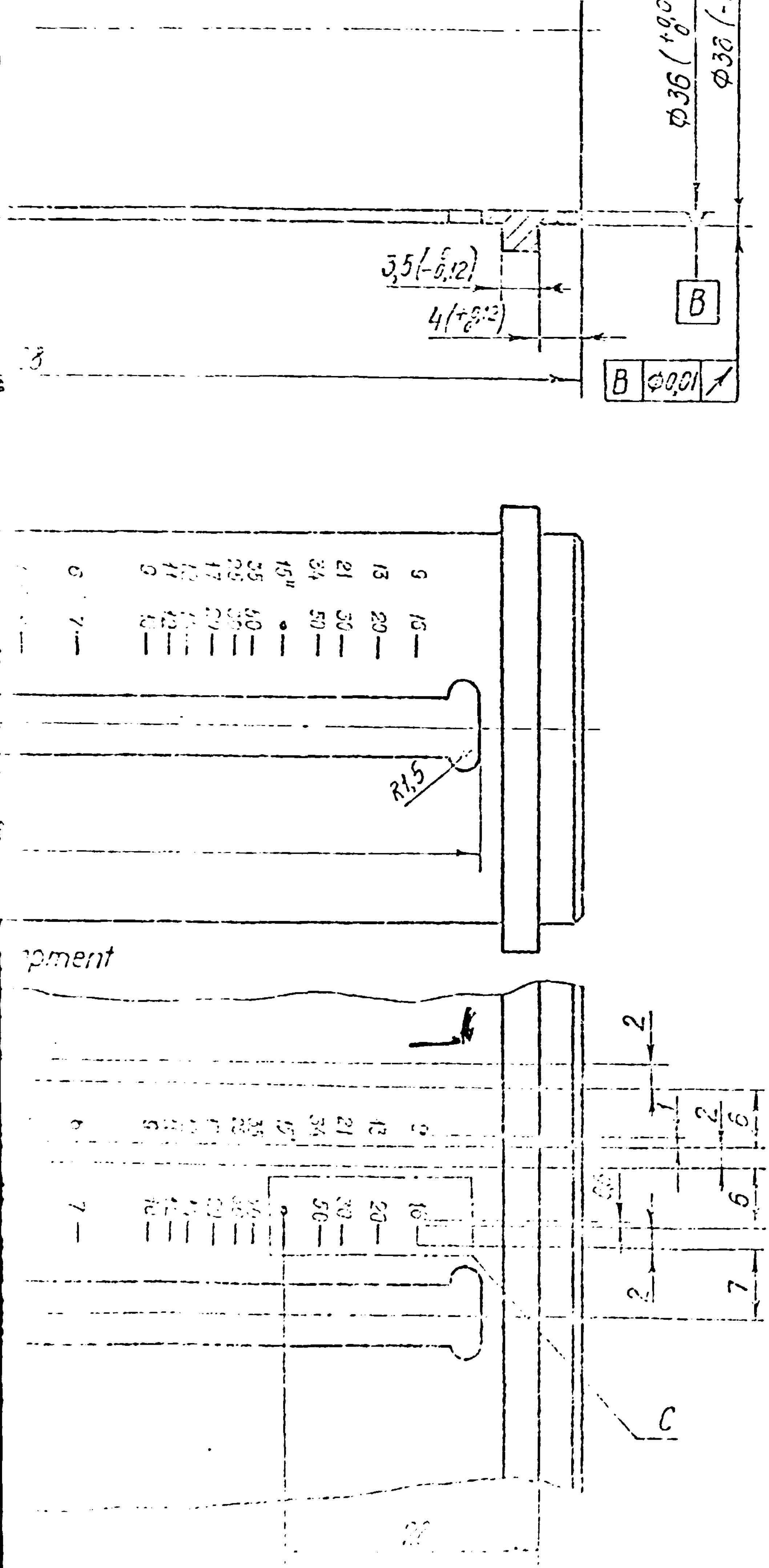
...le for scale divisions marking

...ision ...alue	...stance from ...
6	[illegible]
6	[illegible]
7	[illegible]
[illegible]	[illegible]
12	[illegible]
14	[illegible]

1. H14, h14, $\pm \frac{IT14}{2}$
2. Scale factor tolerance from (·) ∞ till any scale division is ±0,02 mm.



108
SCALE FACTOR µm
DISTANCE cm
R1,5
88
10
Development
Type 2
SCALE FACTOR µm
DISTANCE cm
Type 15
SECT 4



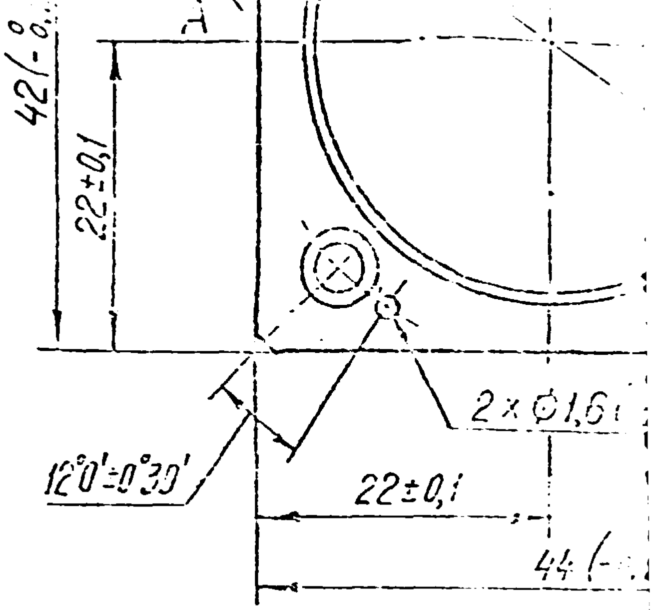
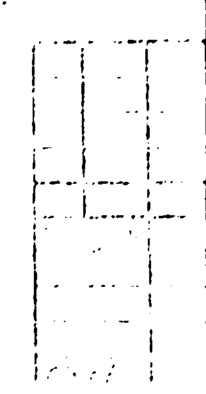
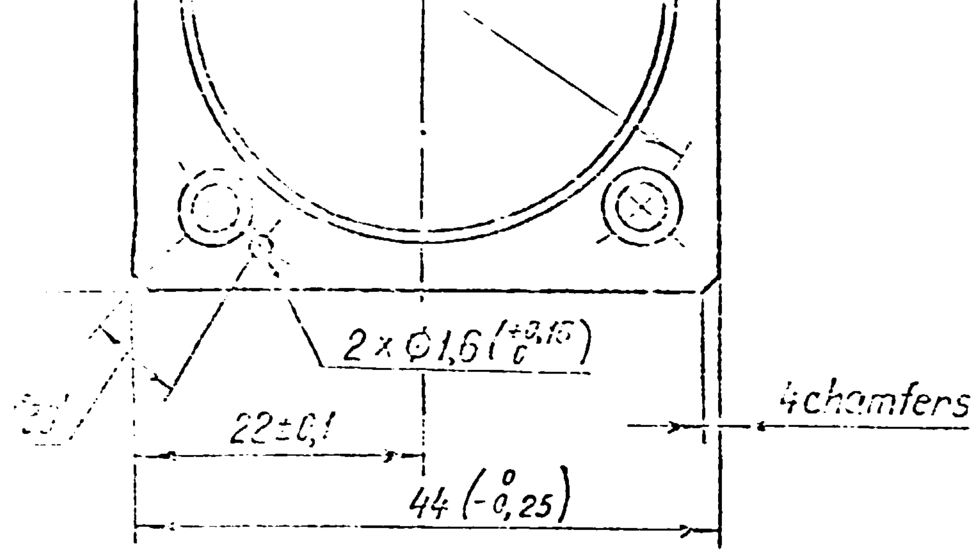


Table for scale divisions

Division value	Distance from (·) ∞ to the division (mm)
6	60,31
6	27,53
7	21,71
10	[illegible]
12	12,17
14	10,49
20	7,46
30	5,11
50	3,34
·(∞)	
50	[illegible]
30	6,19
20	10,1[illegible]
16	13,[illegible]

SECT E



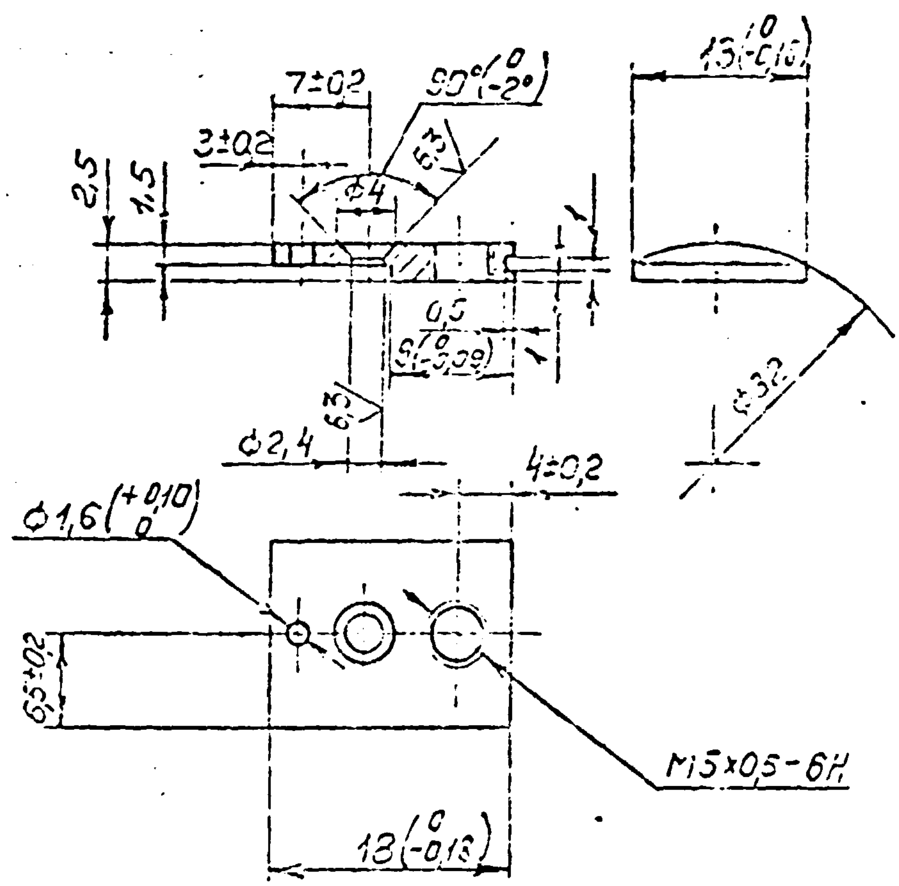


le for scale divisions marking

Division value	Distance from [illegible]
6	30,31
6	27,33
7	[illegible]
10	[illegible]
12	12,17
14	10,40
20	7,46
30	5,11
50	3,34
(∞)	
50	[illegible]
30	[illegible]
20	10,[illegible]
15	13,[illegible]

1. H14, h14, $\pm \frac{IT14}{2}$
2. Scale factor tolerance from (·) ∞ till any scale division is ±0,02 mm.
3. Engraving depth is 0,3 mm
   Fill in black paint. Engraving C - in red paint.
4. Coating: Chemical oxidation chromatizing
   Fe/Cr 12 for outside surface

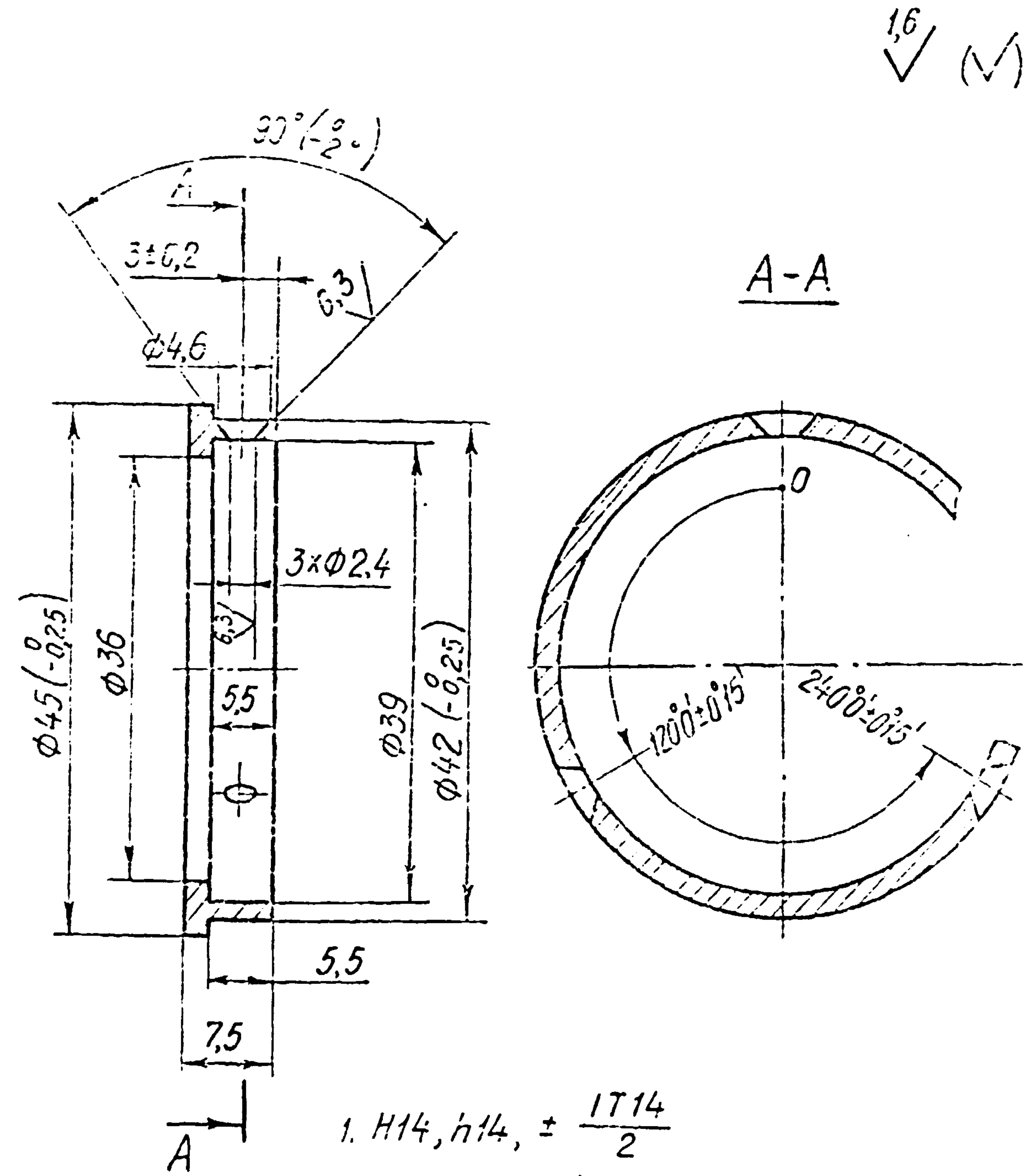
320.074		
Tube		2:1
Steel 20		LIT:A0



1. H14; h14; $\pm \frac{IT14}{2}$

2. Coating: Chemical oxidation chromatizing

	320.075	
	Insert	Mass / Scale 2:1
Designer		Sheet / Sheets 1
Chief Designer	Steel 20	LITMO

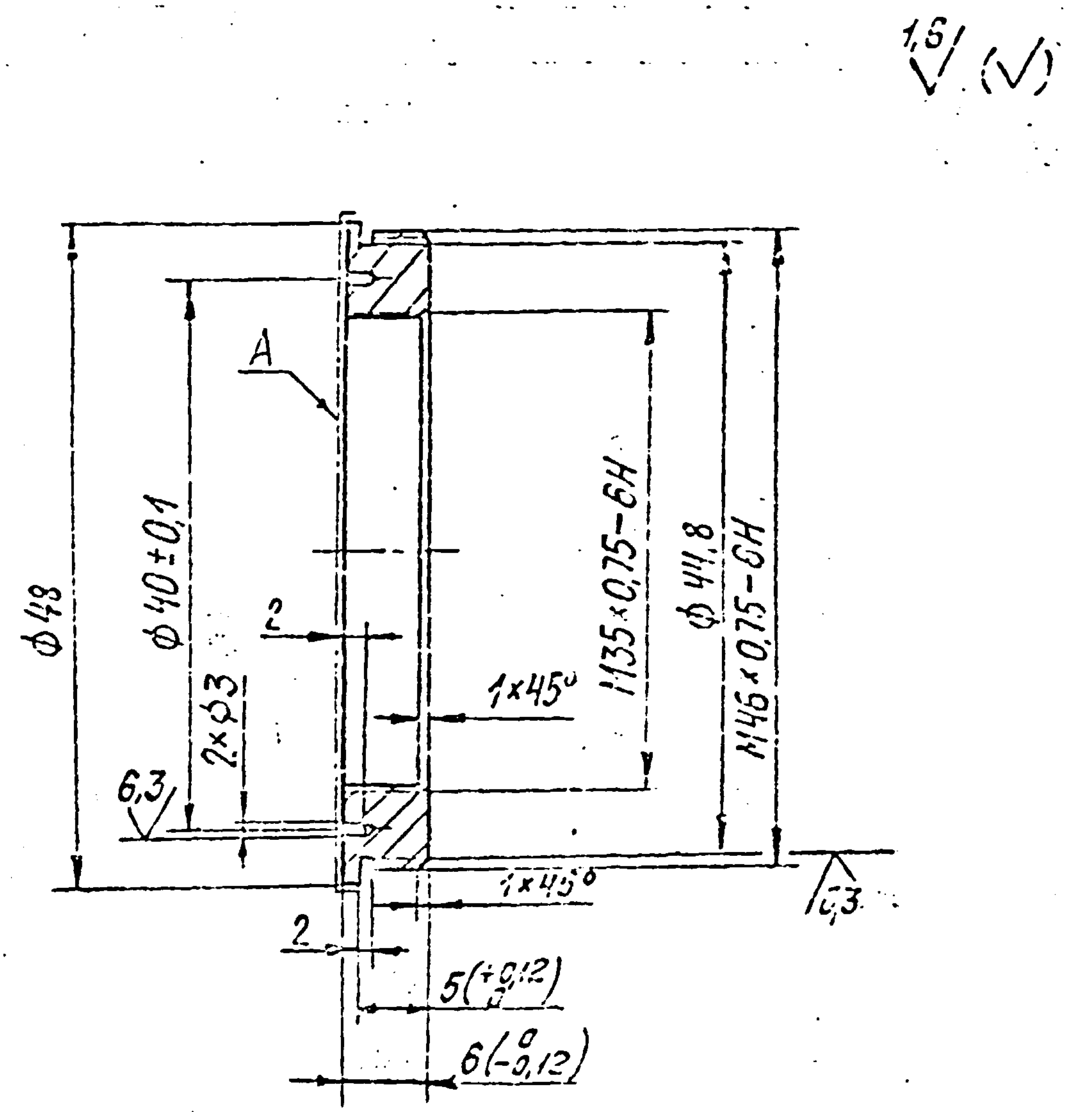


1. H14, h14, $\pm \frac{IT14}{2}$

2. Coating Fe/Ni Cr 12 mat finish

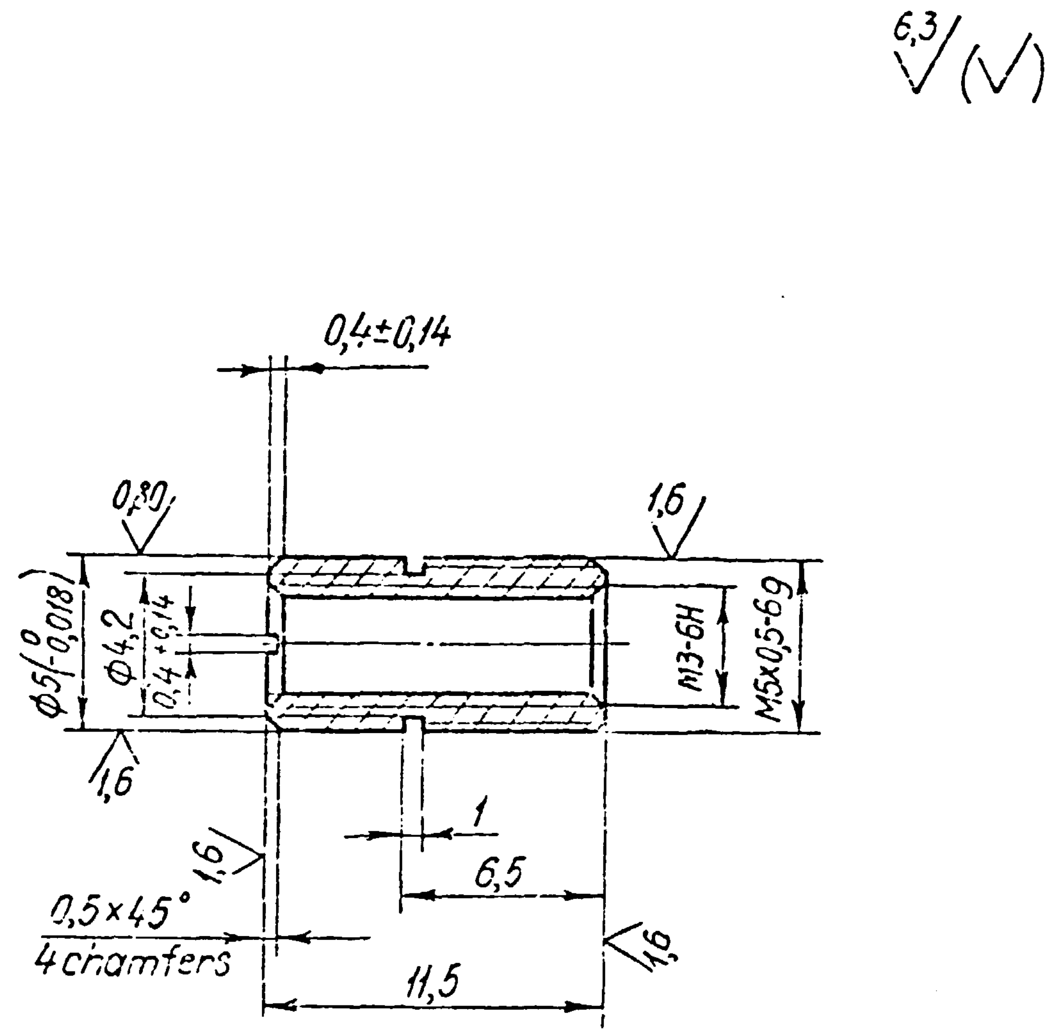
	320.076		
Designer	Ring	Mass	Scale
			2:1
		Sheet	Sheets 1
Chief designer	Steel 20	LITMO	

Form ...



1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating: Chemical oxidation
   The surface A-enamel

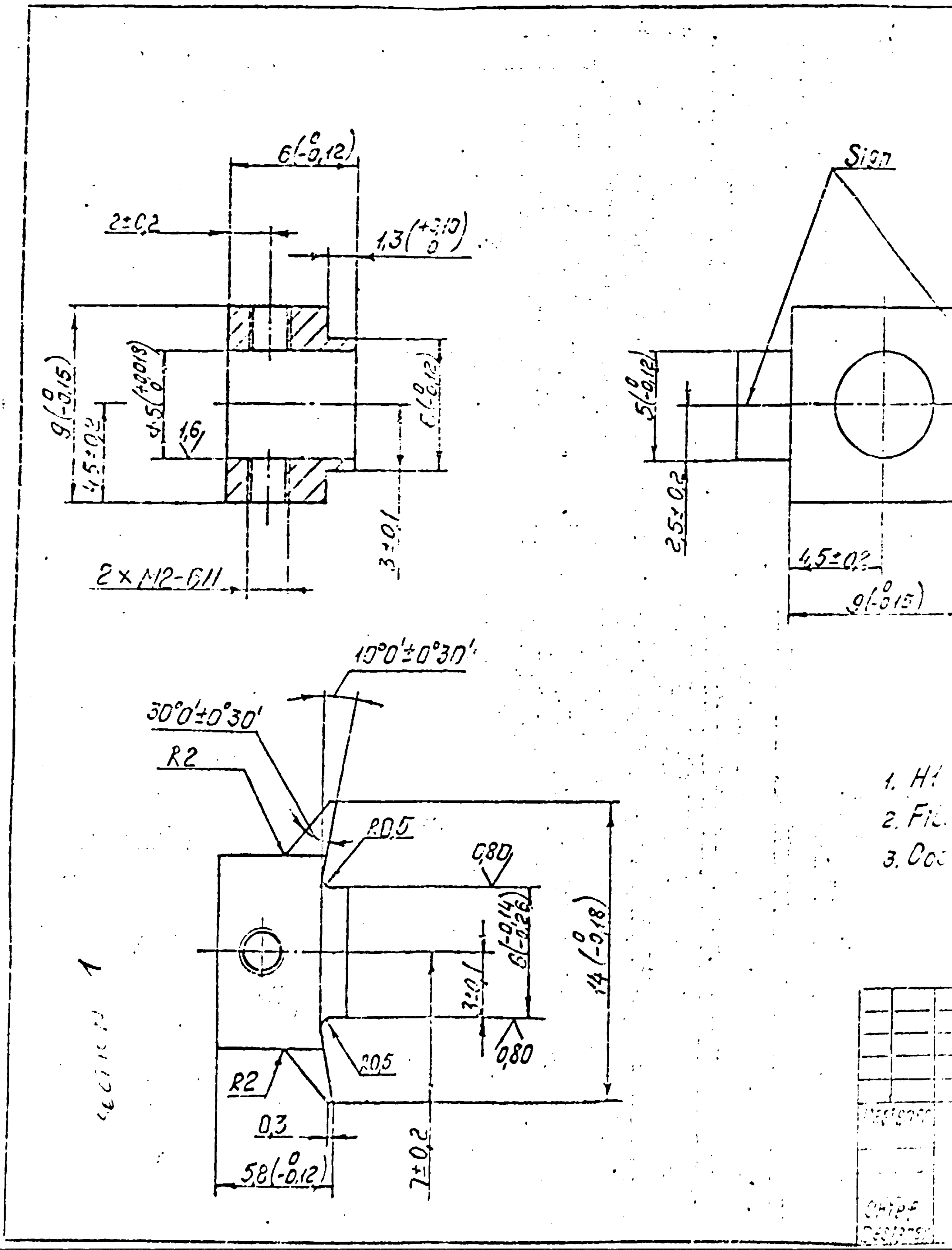
320.077				
Ring		Mass	Scale	
Designer			2:1	
		Sheet	Sheets 1	
Chief Designer	Steel 20	LITMO		



1.* The dimensions for information
2. H14, h14, $\pm \frac{IT14}{2}$
3. Coating: Chemical oxidation impregnation by oil.

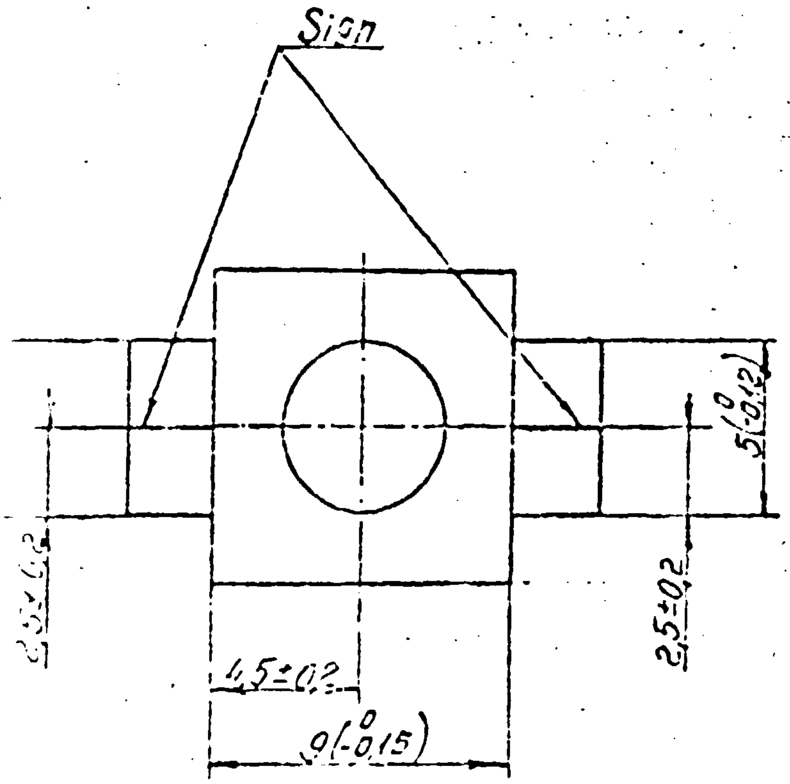
	320. 078	
Designer	Bushing	Mass: — Scale: 5:1
		Sheet — Sheets 1
Chief Designer	Steel 20	LITMO

Form A4



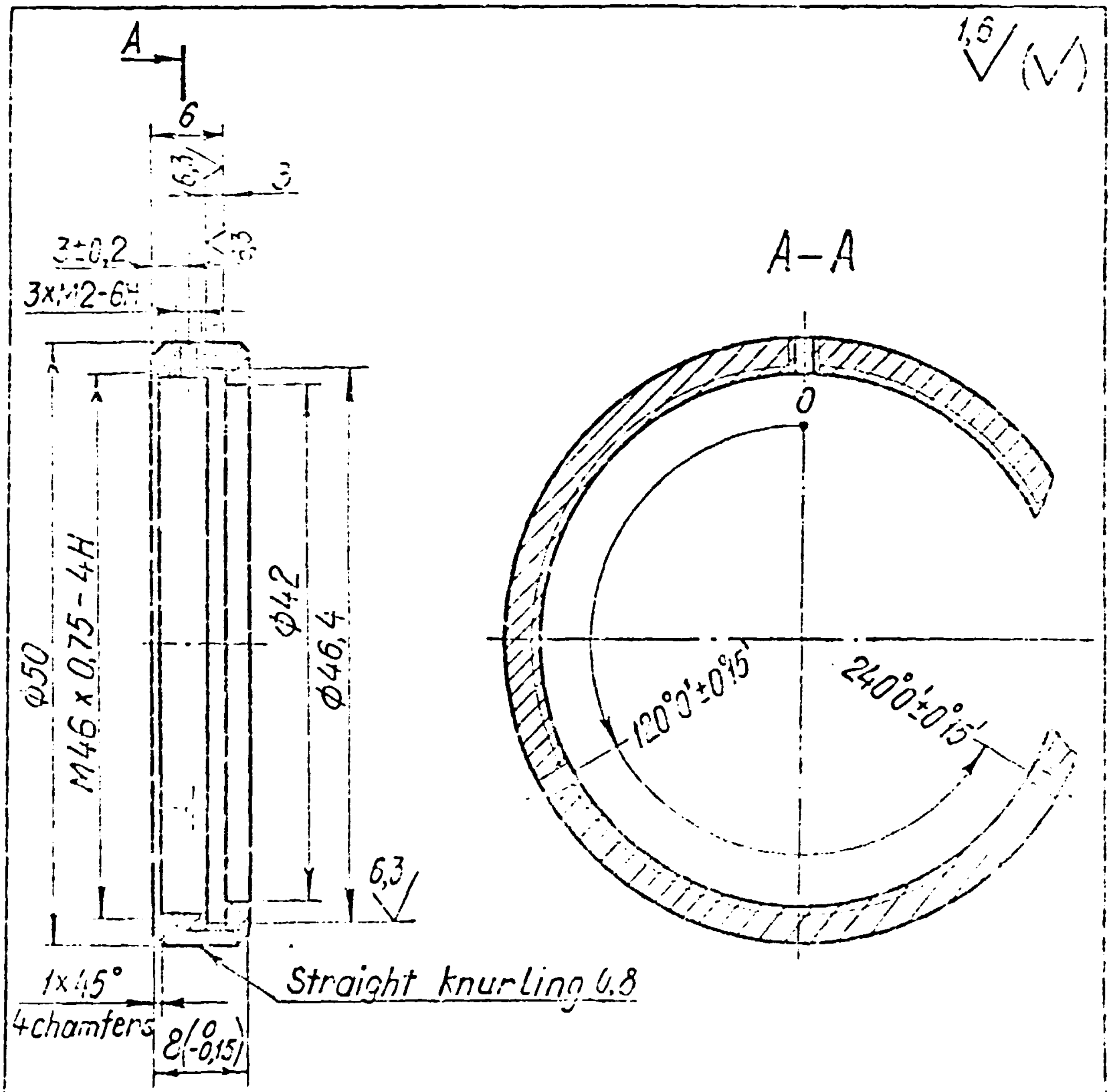
6(-0,12)
2±0,2
1,3(+0,10)
9(-0,15)
4,5(+0,018)
4,5±0,2
1,6
6(-0,12)
3±0,1
2 × M2-6H
Sign
5(-0,12)
2,5±0,2
4,5±0,2
9(-0,15)
10°0'±0°30'
30°0'±0°30'
R2
R0,5
0,80
6(-0,14 -0,26)
14(-0,18)
3±0,1
0,80
R0,5
R2
0,3
5,8(-0,12)
7±0,2
1. H
2. Fi
3. Co

32/(√)



1. H14; h14; $\pm \frac{IT14}{2}$
2. Fill in the engraving with black enamel
3. Coating: Fe / Ni Cr12

320.079		
Index	Mass	Scale
		5:1
Designer	Sheet	Sheets 1
Chief Designer / Steel 50	LITMO	



A

1. H14, h14, $\pm \frac{IT14}{2}$

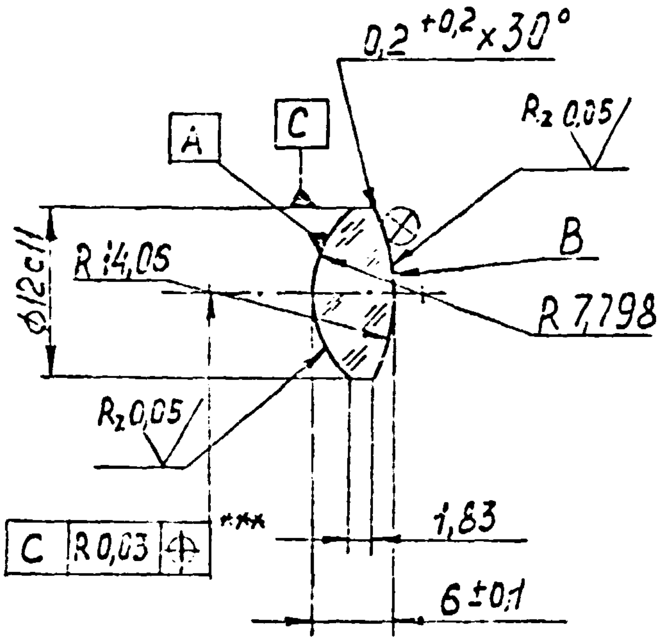
2. Coating: Fe/NiCr6

	320, 081		
	Nut	Mass	Scale 2:1
Designer		Sheet	Sheets 1
Chief Designer	Steel 20	LITMO	

Format A4

$\sqrt{1,6}\,(\sqrt{\ })$

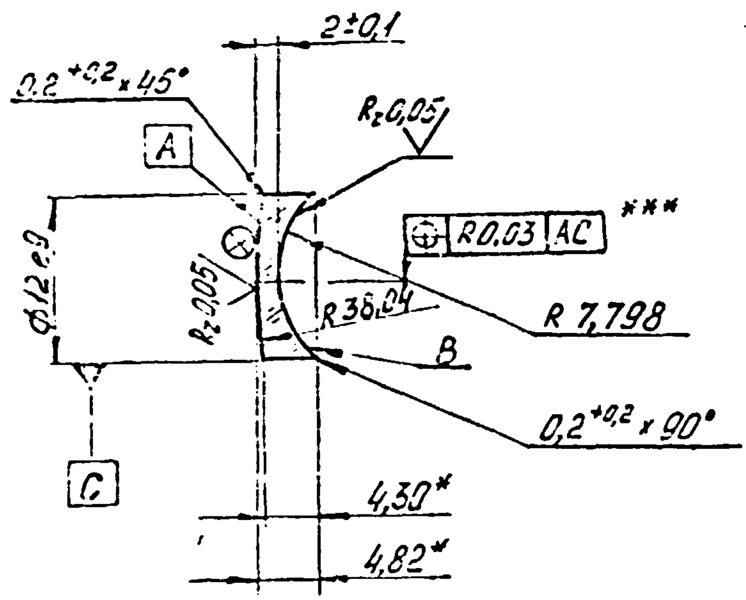
Δn_e	4N
$\Delta(n_{F'}-n_{C'})$	–
Homogeneity	H1
Birefringnce	N
μ_A	–
Veins	P2
Inclusions	3.2
N	2
ΔN	0,3
Surf. qual	0,1**
ΔR_A	0,06%
ΔR_S	0,05%



f	10,58
S_F	-9,12
$S'_{F'}$	7,83
DØ	11

1. ⊗ L_2 (Anti-reflection coating)
   $R_\lambda \leq 2\%$ L_2 – MgF_2
   $\lambda_0 = 550$ nm
2* The dimension for information
3** Permitted total area of scratches, pits (mm^2)
4.*** Wedge angle = 7'

320.085		
Lens	Mass	Scale
		2:1
Designer	Sheet	Sheets 1
Chief Designer	Glass BK7	LITMO



Δn_e	4N
$\Delta(n_{F'}-n_{C'})$	—
Homogeneity	H1
Birefringence	N
μ_A	—
Veins	P2
Inclusions	B2
N	2
ΔN	0,3
Surf qual.	0,1**
ΔR_A	0,03%
ΔR_B	0,06%

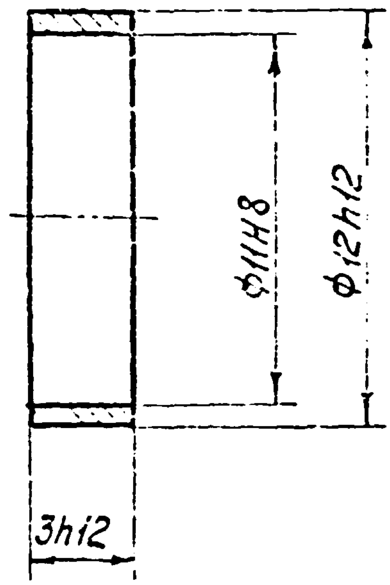
f'	-15,58
S_F	18,22
$S'_{F'}$	-16,21
$O_\varnothing$	11

1.* The dimensions for information
2.** Permitted total area of scratches, pits (mm^2)
3. L_2 (Anti-reflection coating)
   L_2 MgF_2
   λ_0 = 550nm
4.*** Wedge angle 13'

320.086			
Lens		Mass	Scale
			2:1
		Sheet	Sheets 1
Glass F1		LITMO	

Form. A4

1,6

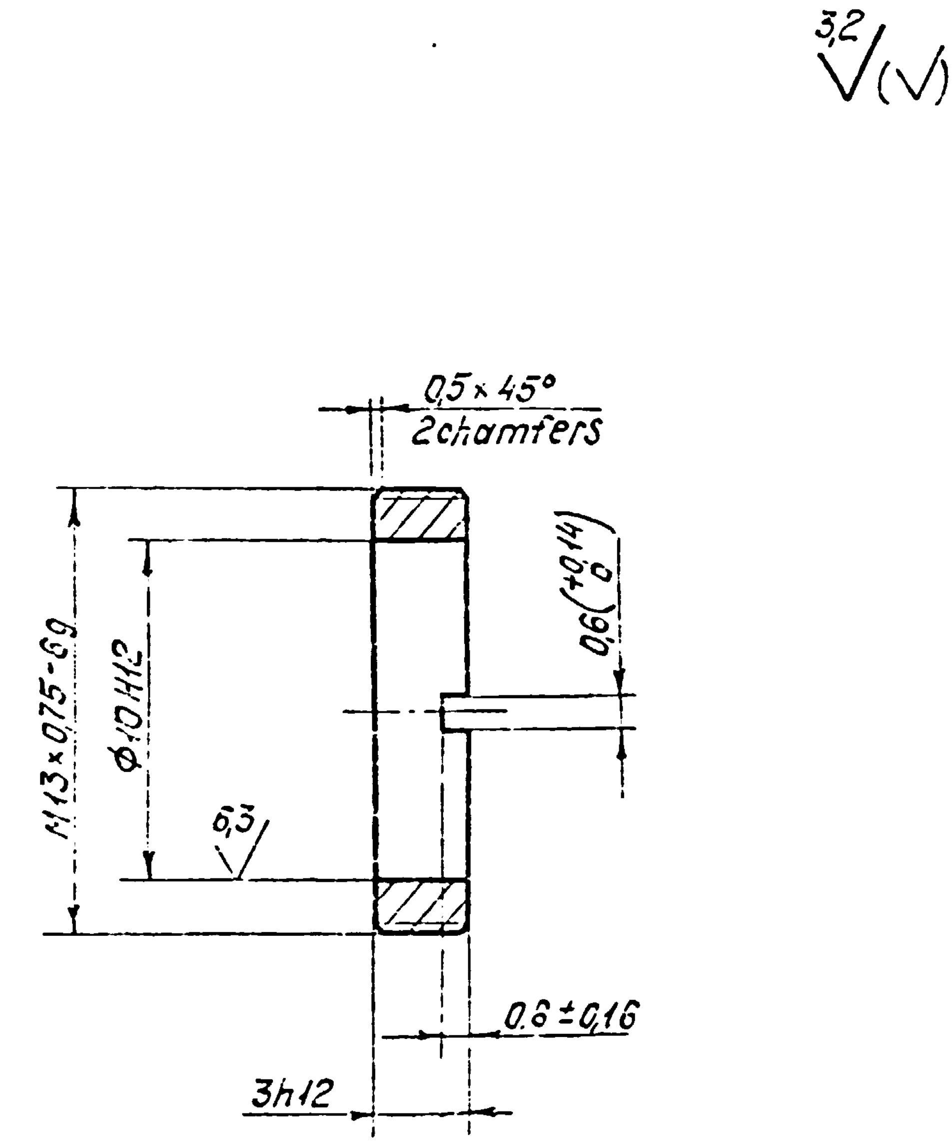


Coating: Chemical oxidation impregnation by oil

320.088			
Ring		Mass	Scale
			5:1
	Sheet	Sheet 1	
Brass Cu Zn 40	LITMO		

Designer

Chief Designer



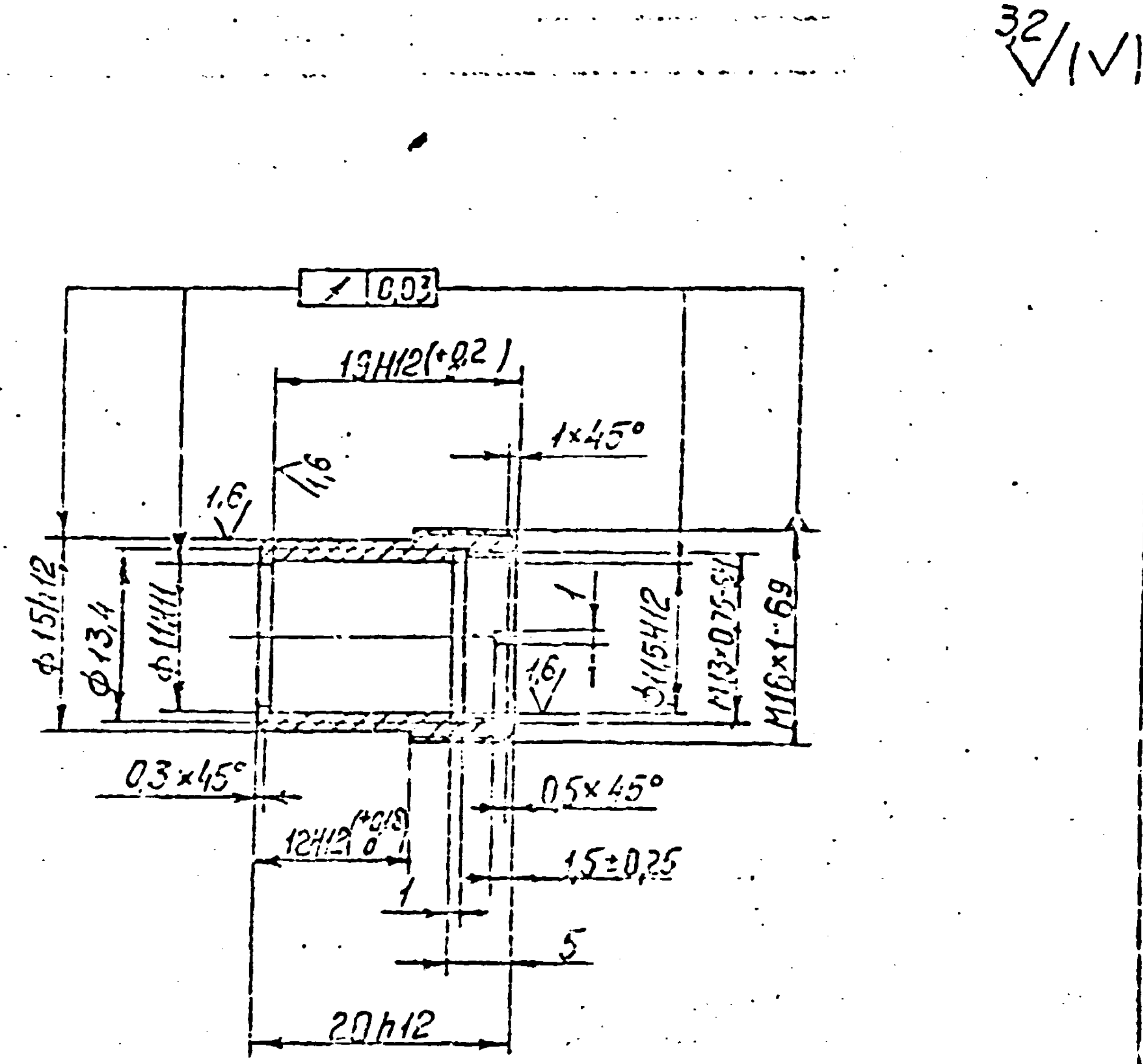
1. H14; $\pm\frac{IT14}{2}$

2. Coating: Anodic oxidation

320.089		
Ring	Mass	Scale
		5:1
	Sheet	Sheets 1
Aluminium alloy Cu4 Mg Mn Fe Si	LITMO	

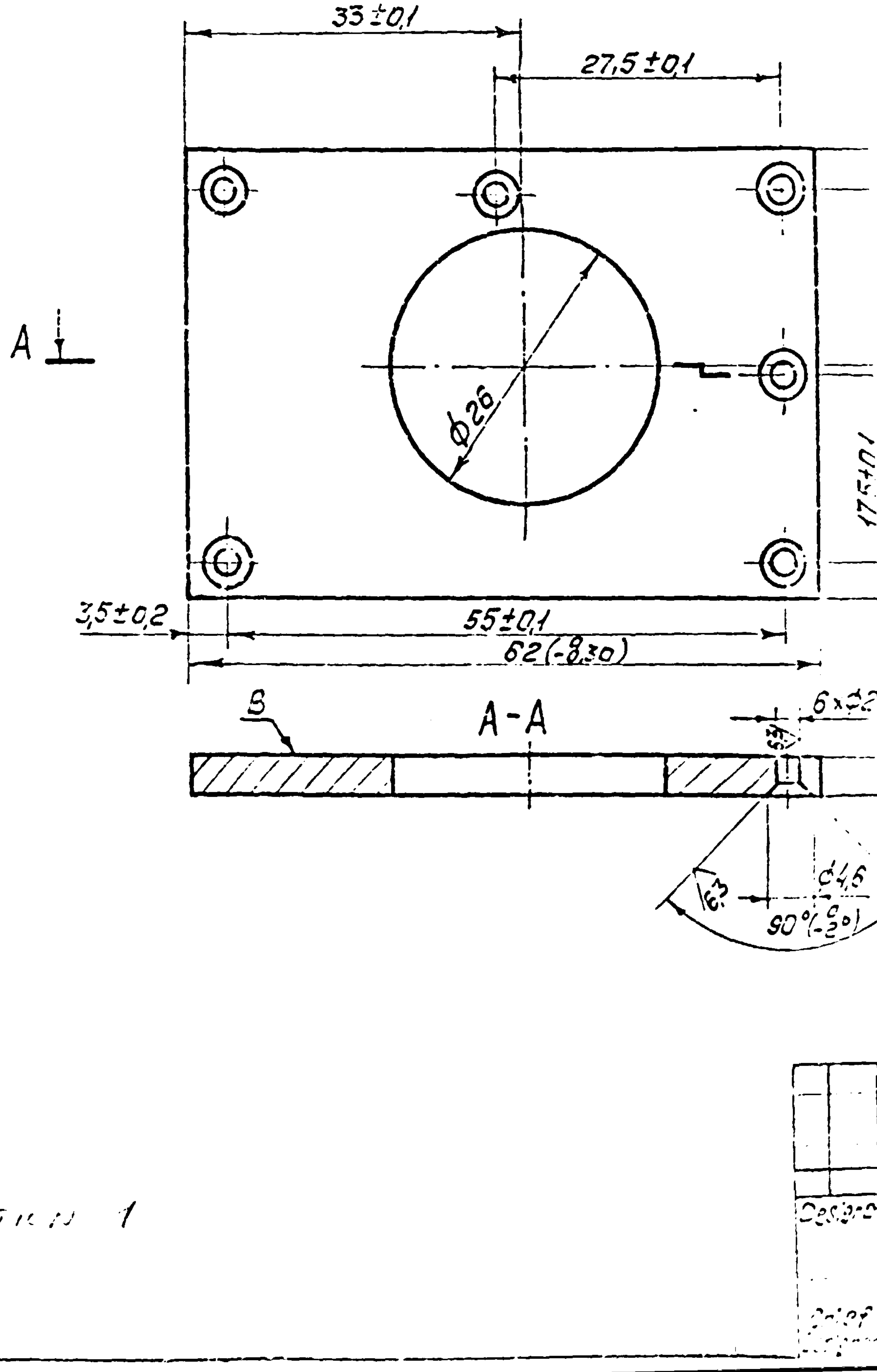
Designer

Chief designer



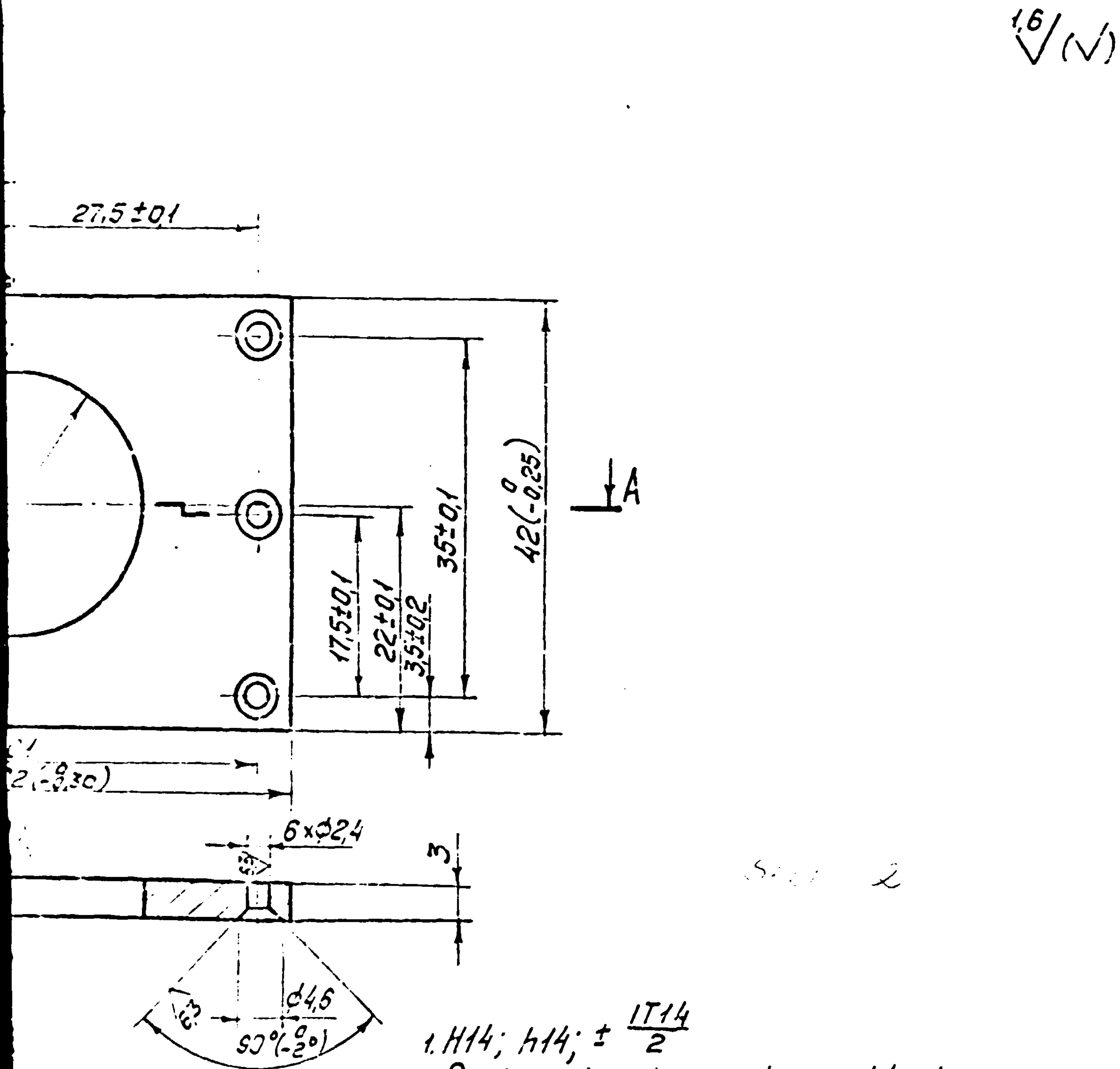
1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating: Chemical oxidation

320.091		
Holder	Mass	Scale
		2:1
	Sheet	Sheets 1
Designer		
Chief Designer		
Brass CuZn40	LITMO	



33±0,1
27,5±0,1
A
φ26
17,5±0,1
3,5±0,2
55±0,1
62(-0,30)
B
A-A
6×φ2
6,3
6,3
φ4,6
90°(-2°)
Designed
Chief

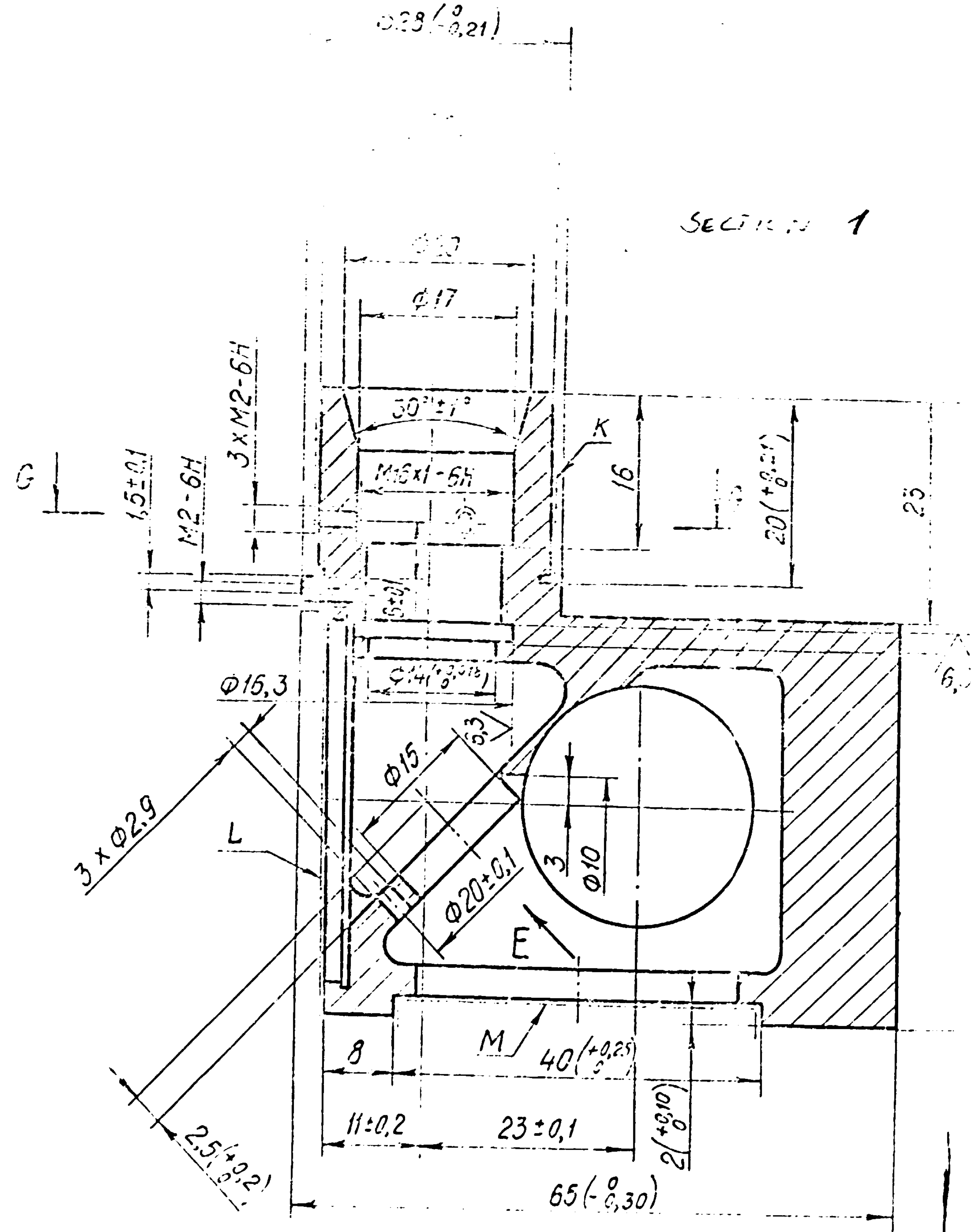
SECTION 1



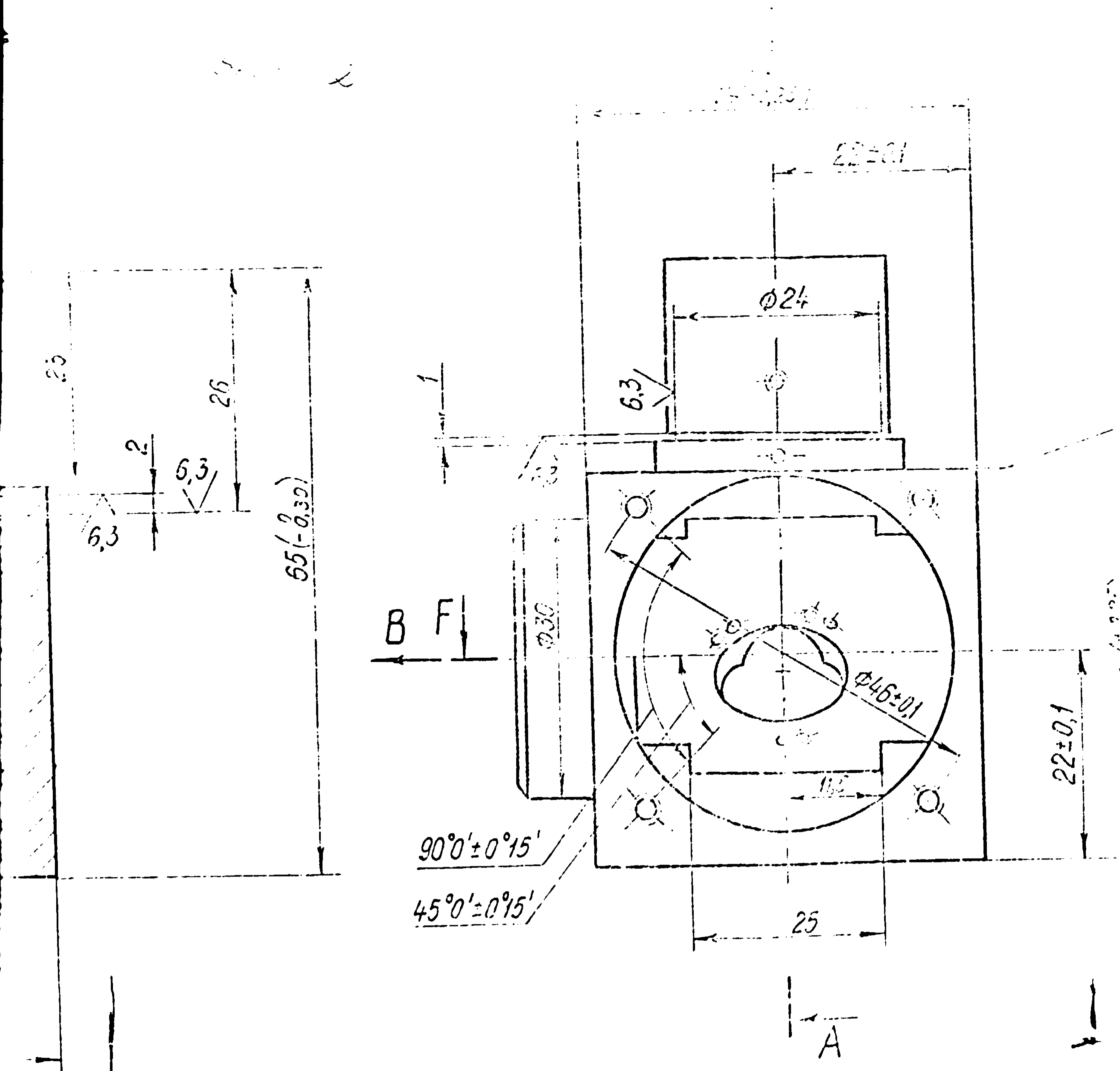
1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating: Anodic oxidation, black grey enamel except the surface B

320. 101			
Cover		Mass	Scale
		Sheet	Sheets 1
Designer			
Chief	Aluminium alloy AlCu4 Mg MnFe Si	LITMO	

A-A

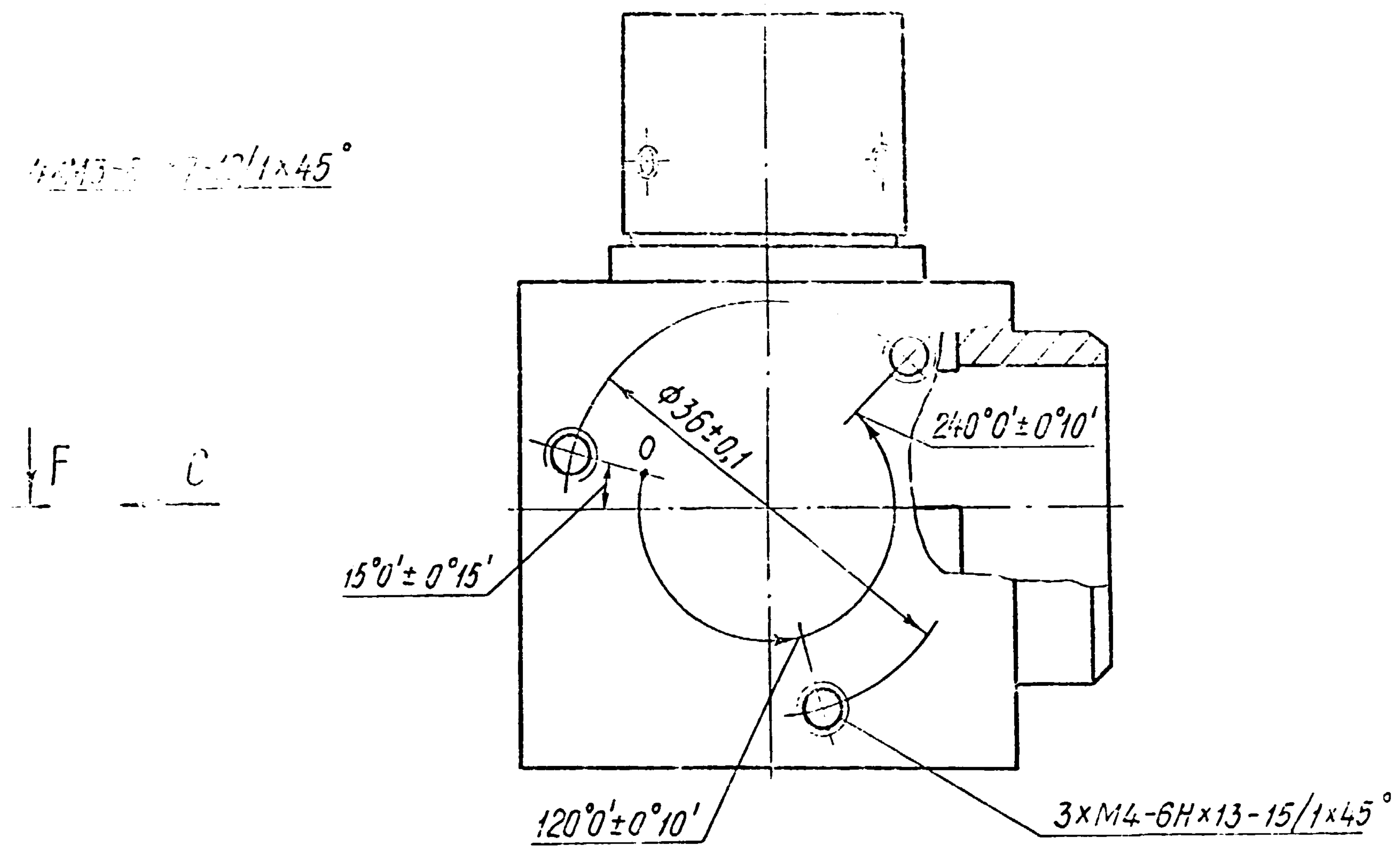


Φ28 (-0,21)
SECTION 1
Φ20
Φ17
30°±1°
3 x M2-6H
M2-6H
1,5±0,1
G
M16x1-6H
K
16
20 (+0,21)
25
Φ14 (+0,018)
Φ16,3
3 x Φ2,9
Φ15
6,3
L
Φ20±0,1
3
Φ10
E
M
8
40 (+0,25)
11±0,2
23±0,1
2 (+0,10)
2,5 (+0,2)
65 (-0,30)

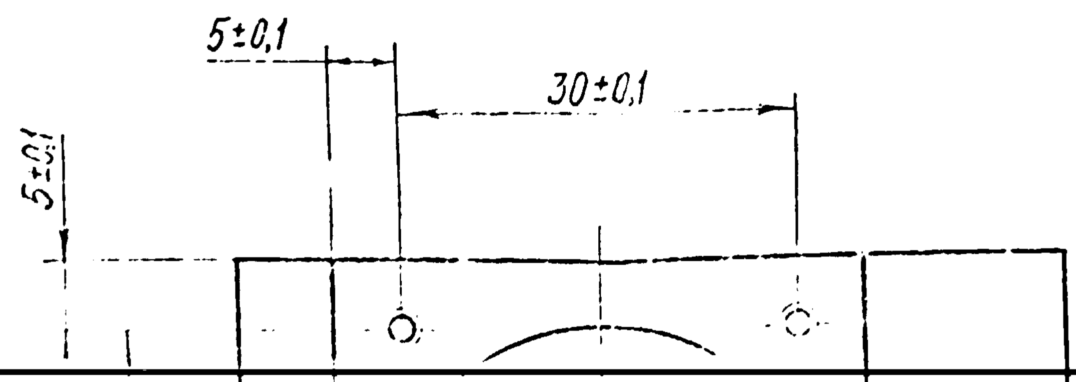


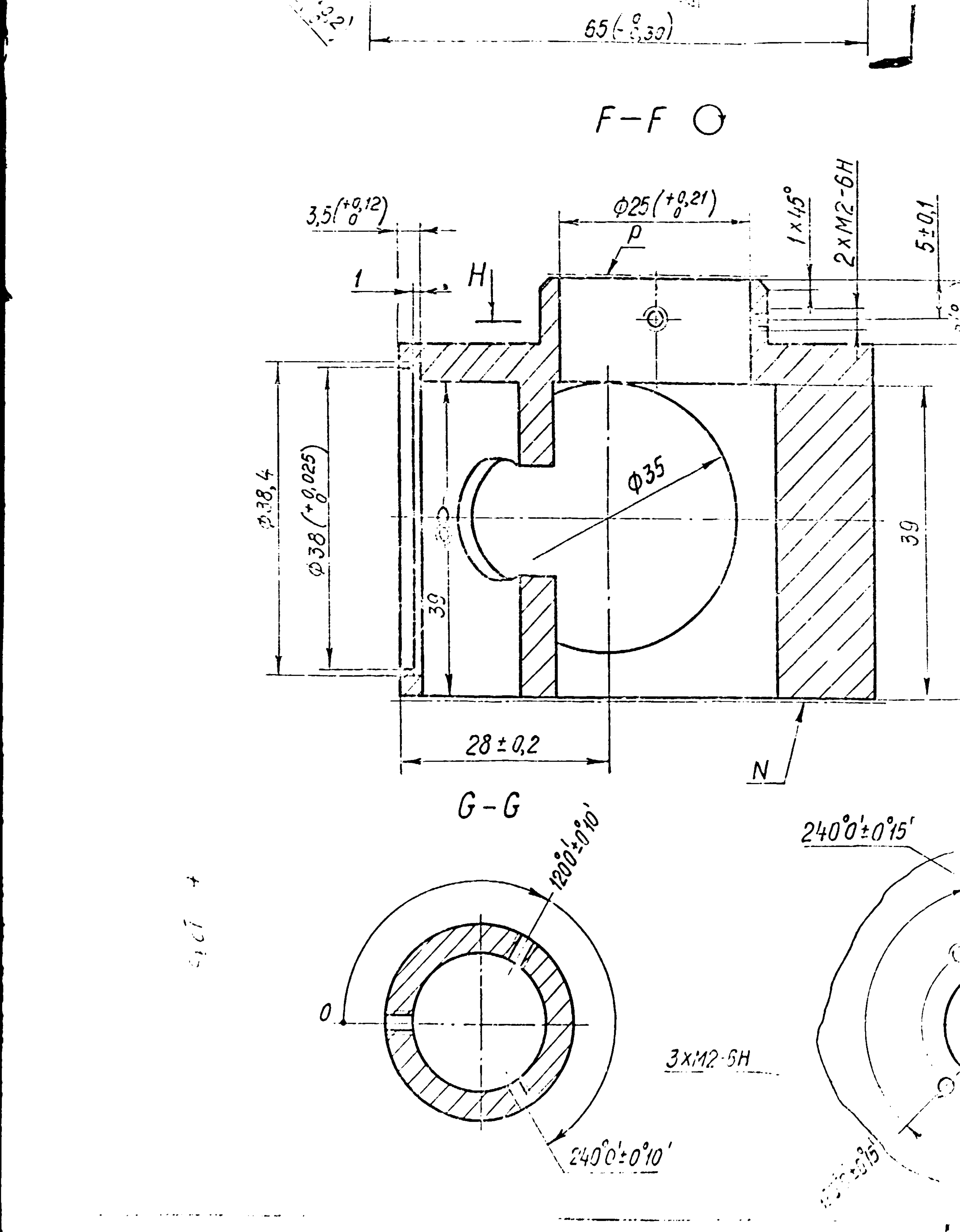
22±0,1
Φ24
6,3
1
26
2
6,3
6,3
65(0 / -0,39)
B
F
Φ30
Φ46±0,1
22±0,1
90°0'±0°15'
45°0'±0°15'
25
A

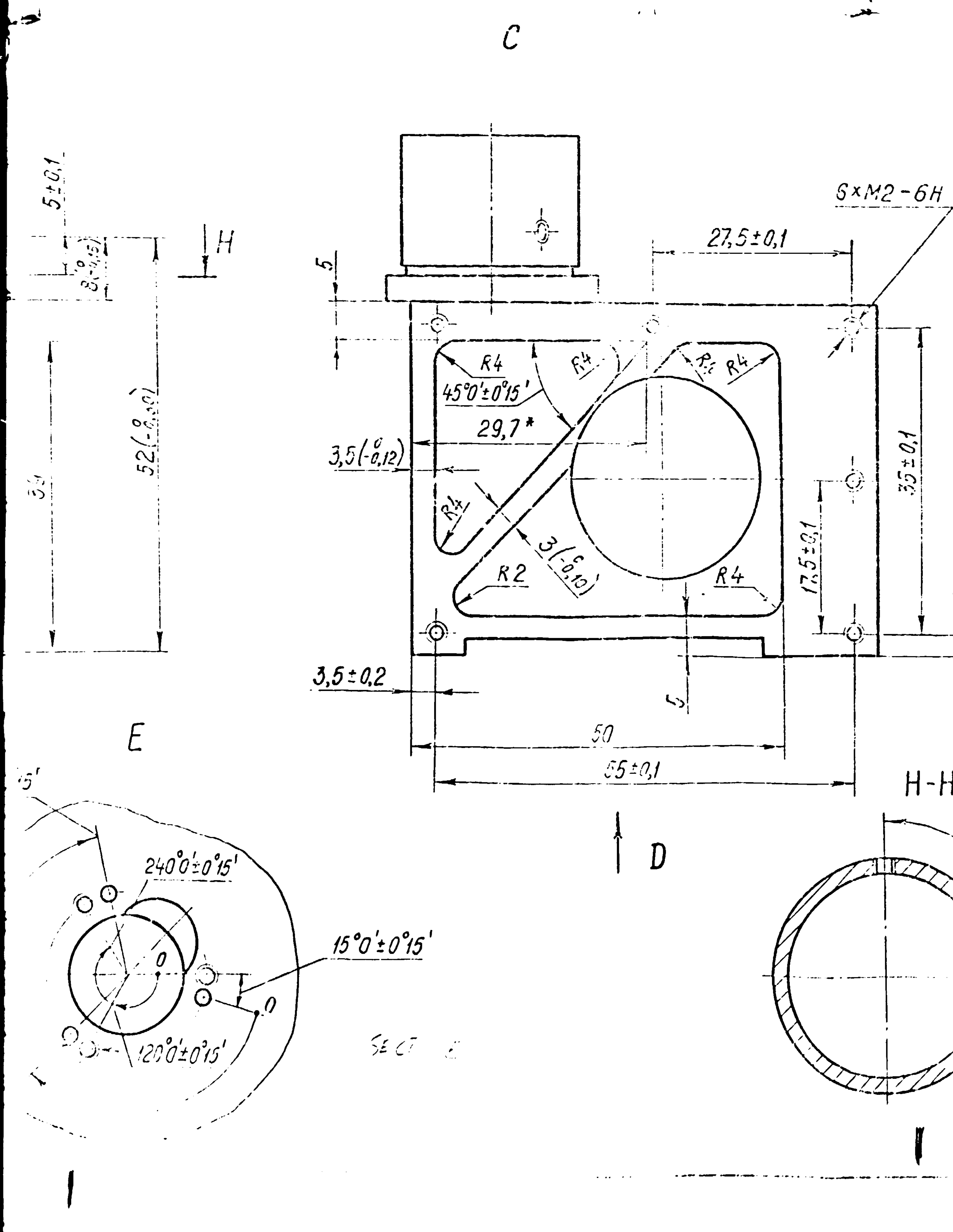
C



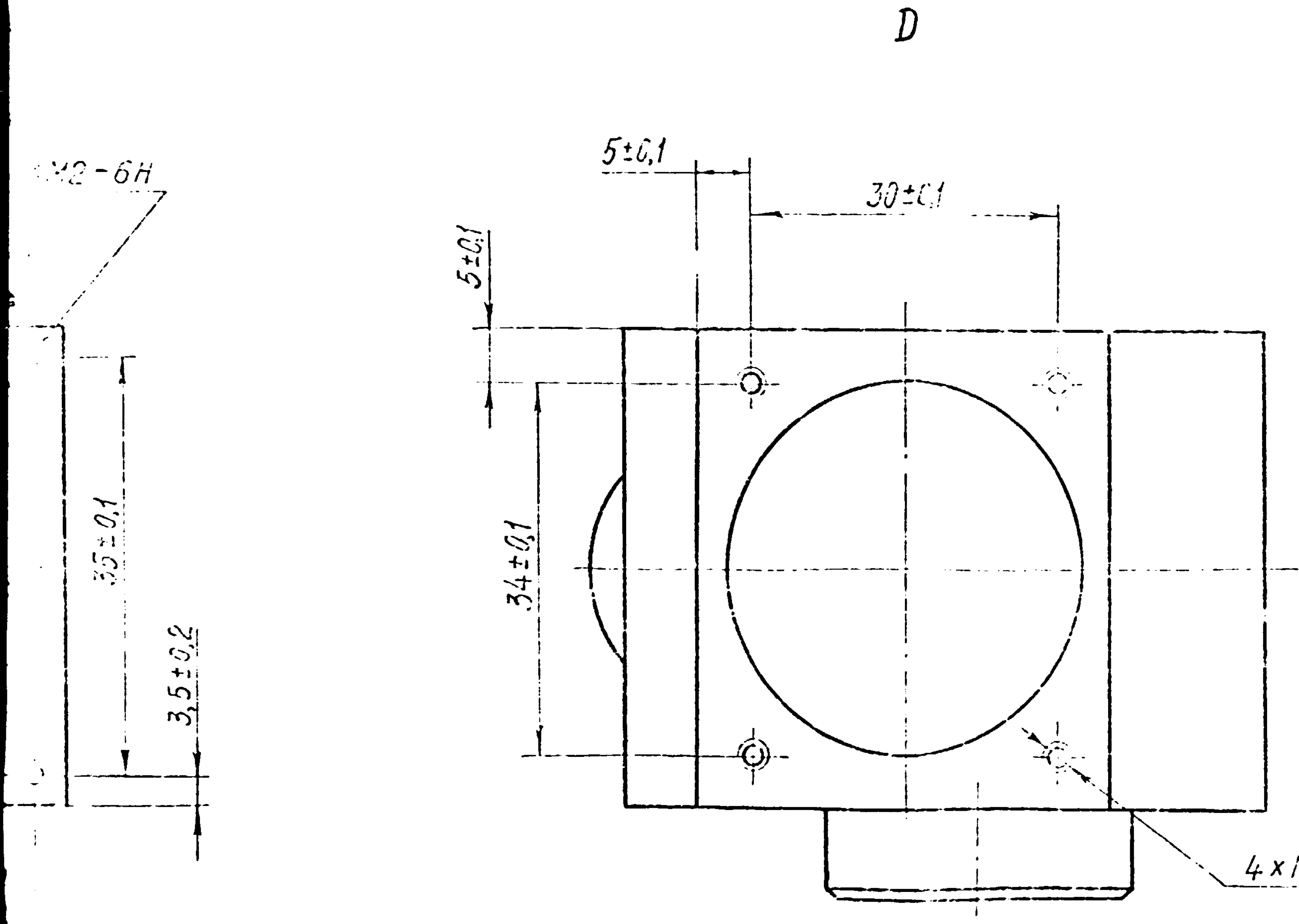
D

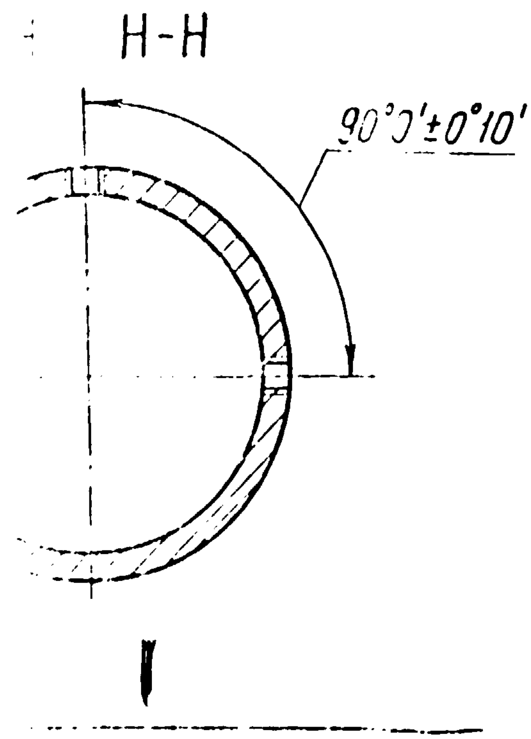



65(-0,30)
F–F
3,5(+0,12 0)
Φ25(+0,21 0)
P
1×45°
2×M2-6H
5±0,1
1
H
Φ38,4
Φ38(+0,025 0)
Φ35
39
39
28±0,2
N
G–G
120°0'±0°10'
240°0'±0°15'
0
3×M2-6H
240°0'±0°10'



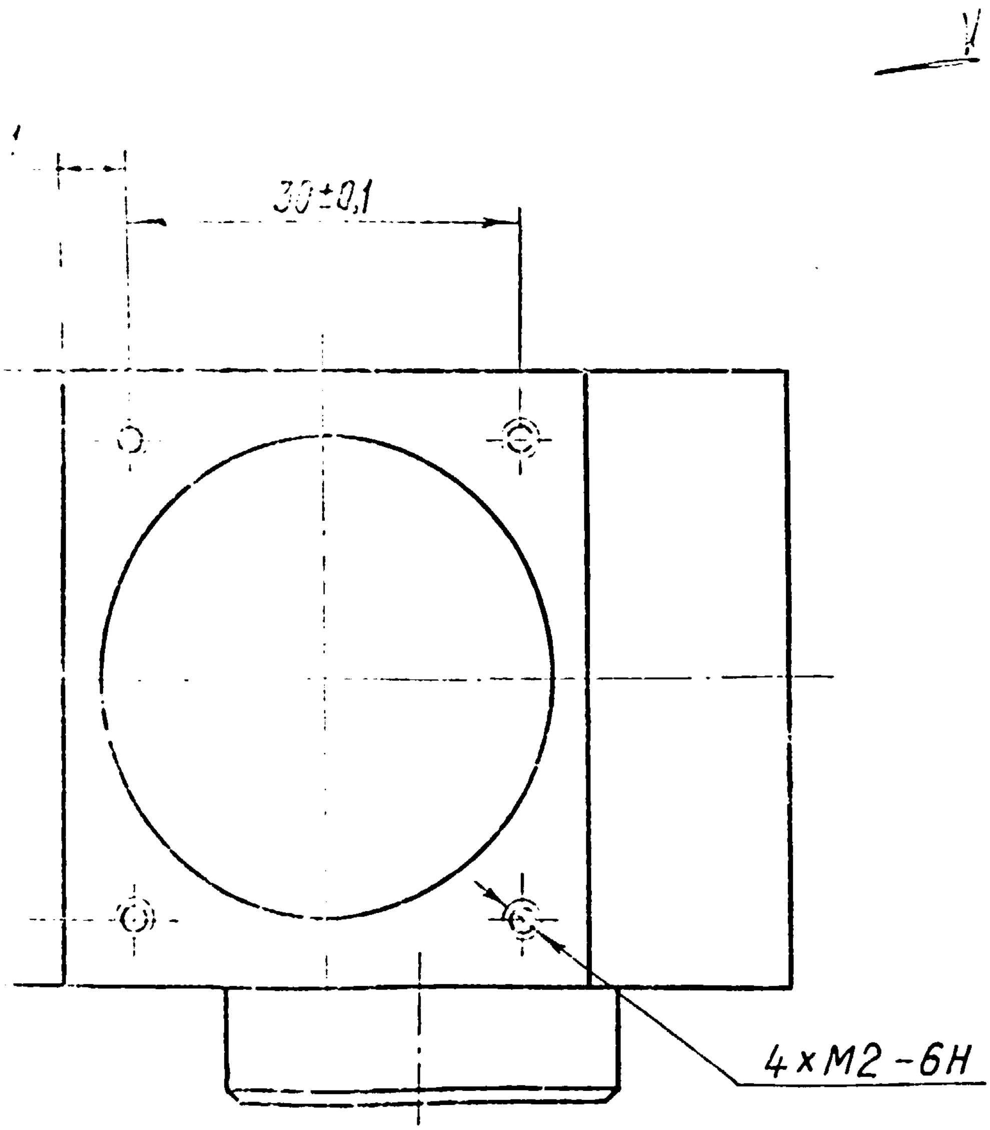
C
5±0,1
H
5
27,5±0,1
6×M2-6H
R4
R4
R4
45°0'±0°15'
29,7*
3,5(-0,12)
52
R4
3(-0,10)
R2
R4
35±0,1
17,5±0,1
3,5±0,2
5
50
55±0,1
E
D
H-H
240°0'±0°15'
15°0'±0°15'
120°0'±0°15'
I
II





1 Annealing and
2.* The dimension
3. H14, h14, ± $\frac{IT}{2}$
4. Coating Anodi
except the su

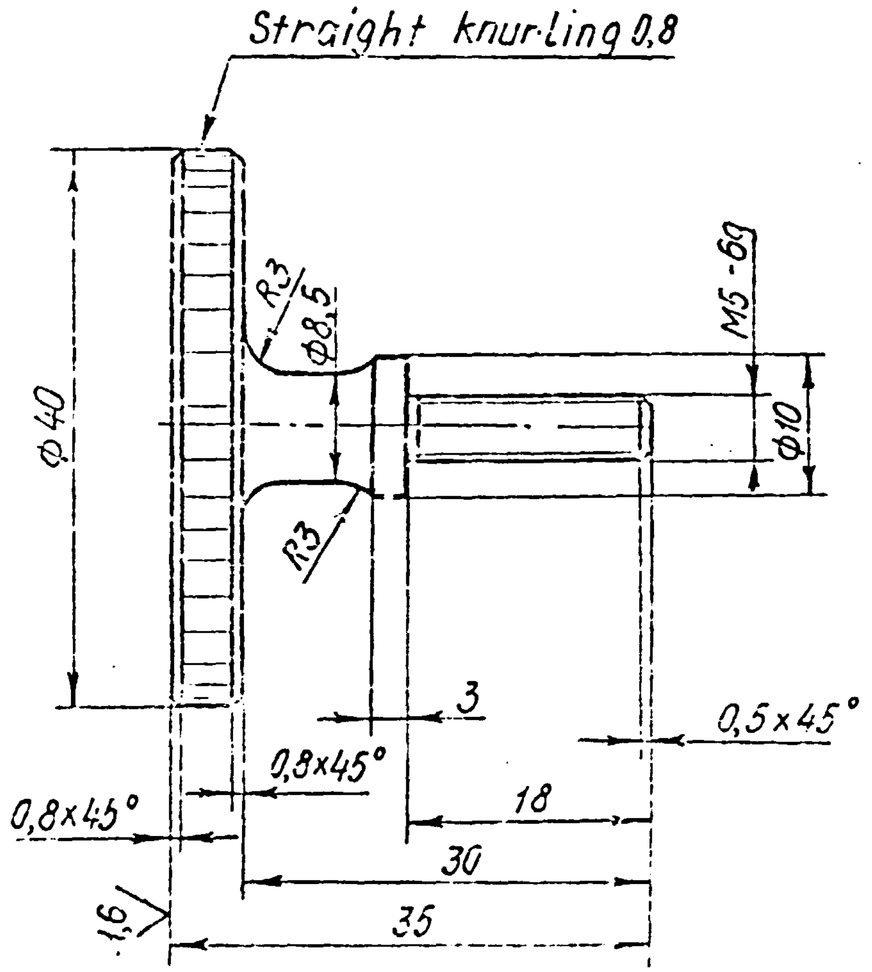
D



1. Annealing and artificial ageing
2.* The dimension for information
3. H14, h14, $\pm \frac{IT14}{2}$
4. Coating Anodic oxidation black, grey anamel except the surfaces K, L, M, N, P.

320. 102		
Body	Mass	Scale
		2:1
	Sheet	Sheets 1
Aluminium alloy AL-Cu4Mg1Mn Si	LITMO	

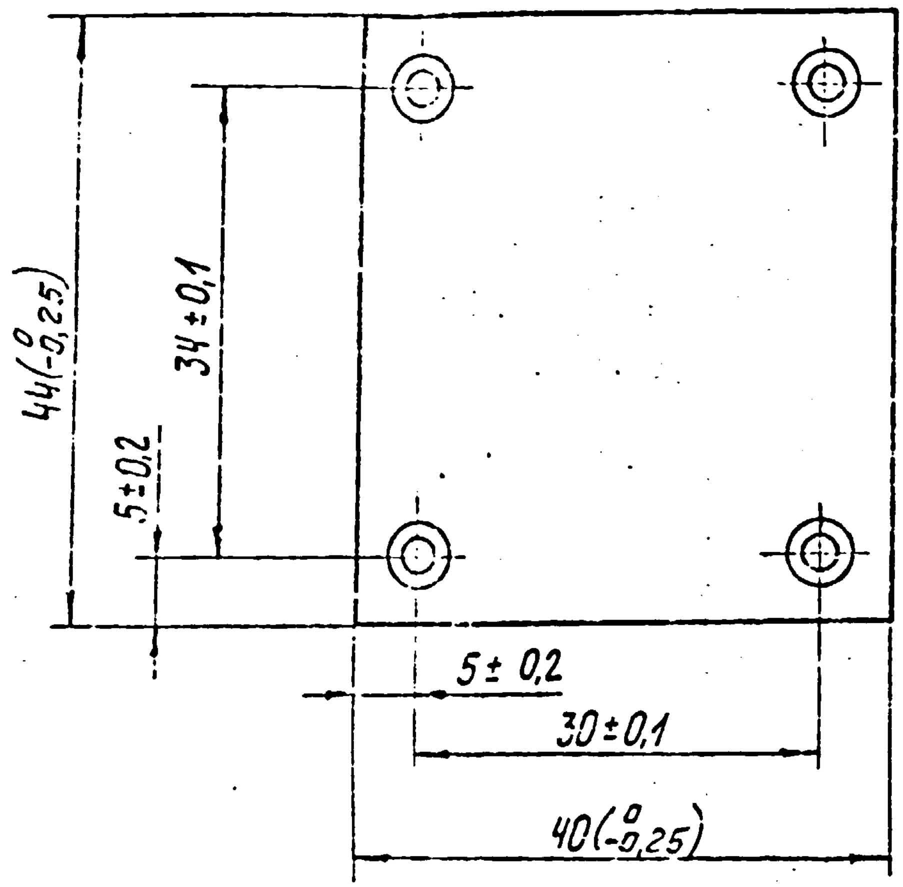
$^{3,2}\surd(\surd)$

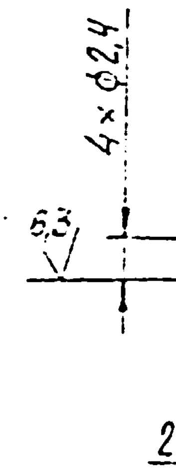


1. H14, h14, $\pm \frac{IT14}{2}$
2. Coating Fe/Ni Cr6

320.103			
Screw	Mass	Scale	
		2:1	
	Sheet	Sheets 1	
Steel 50	LITMO		

Form A4

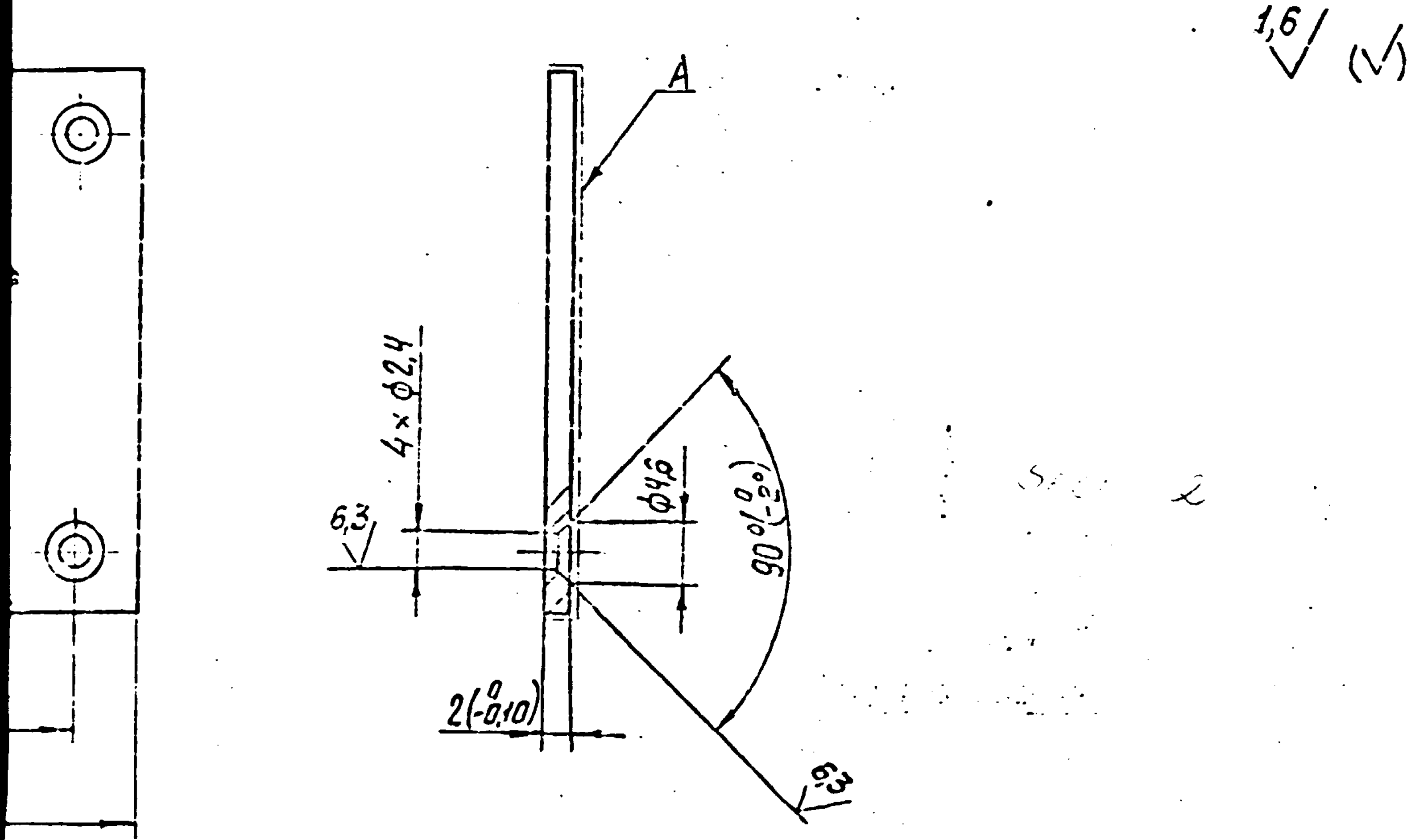




1. H1-
2. Coo
Su.

Designer		
Chief Designer		

SECTION 1



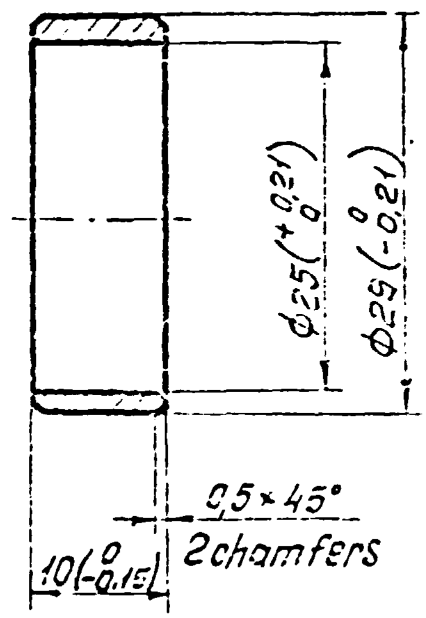
1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating Anodic oxidation
   Surface A-grey enamel

320.104		
Cover	Mass: 0,015	Scale: 2:1
	Sheet	Sheets 1
Aluminium alloy Al-Cu4MgMnFeSi	LITMO	

Designer

Chief Designer

1,5



1. $\pm \frac{IT14}{2}$

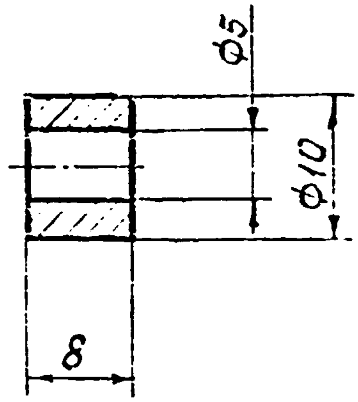
2. Coating Chemical oxidation

320.105			
Ring		Mass	Scale
			2:1
		Sheet	Sheets 1
Brass CuZn40	LITMO		

Designer

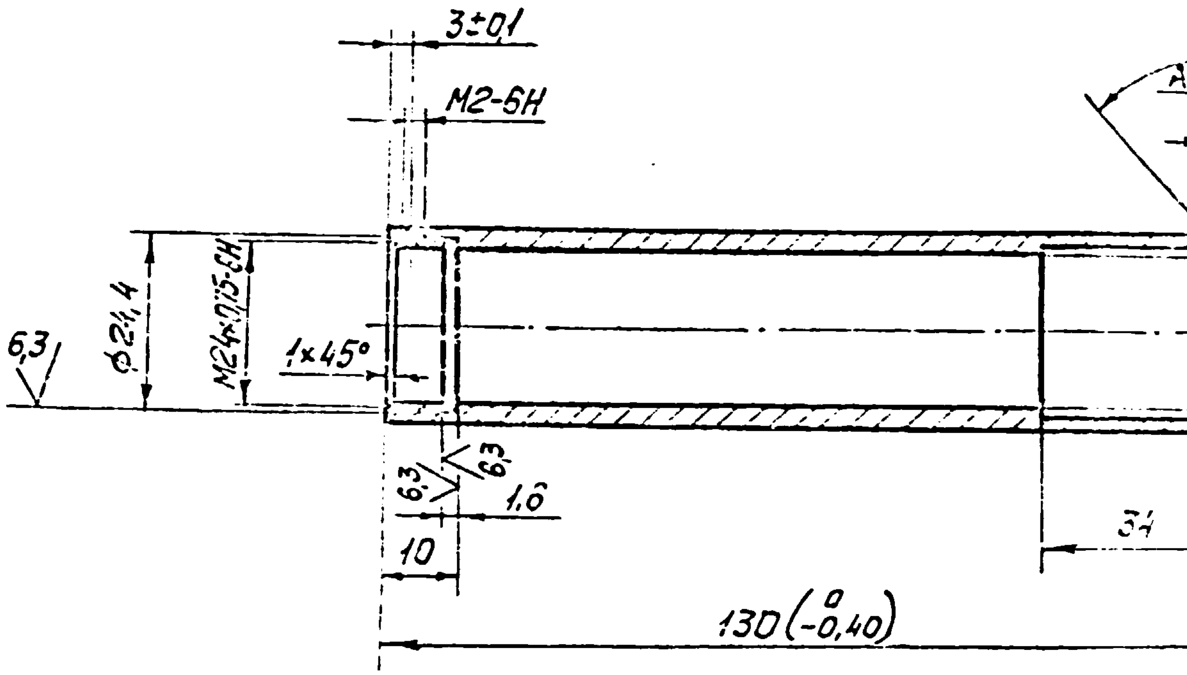
Chief Designer

3,2 ∨



1. H14; h14
2. Coating Chemical oxidation chromatizing impregnation by oil

	320.106					
	Ring			Mass	Scale
Designer					2:1
		Sheet		Sheets 1	
Chief Designer	Steel 20	LITMO			



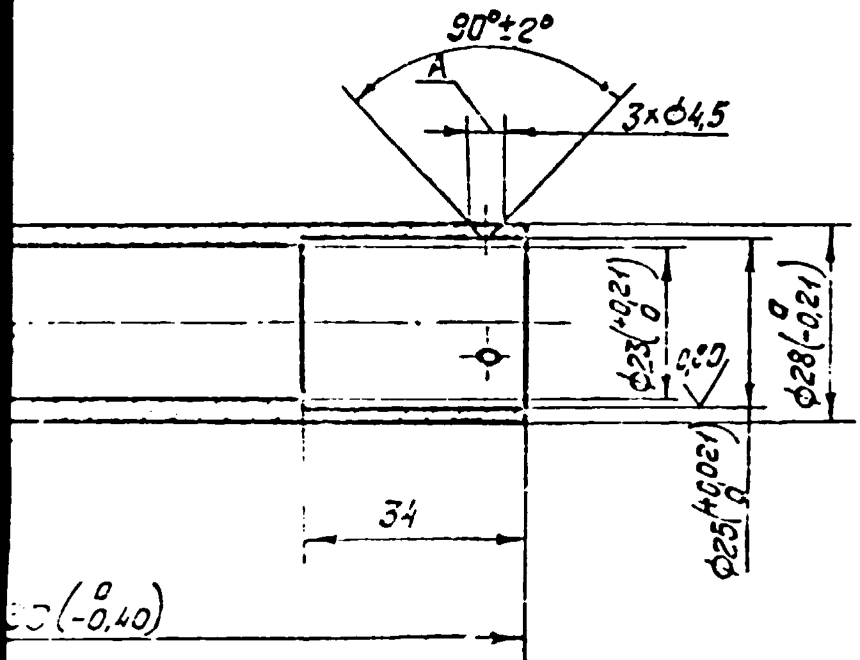
1. H1
2. Ce
of
3. Coo

SECTION 1

Design

Chief

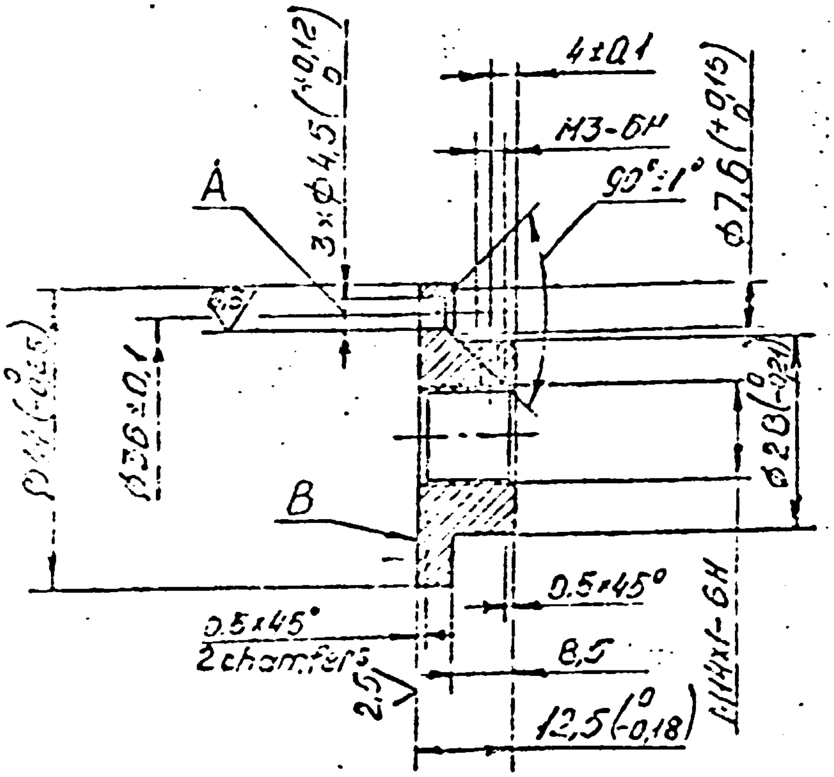
1,6 (√)



1. H14; h14; $\pm \frac{IT14}{2}$
2. Central angle limiting deviations between the axes of any two holes A must be no more than ±0°15'.
3. Coating: Chemical oxidation
   Outside surfaces coating-grey enamel.

	320.107		
	Tube	Mass	Scale
Designer			1:1
		Sheet	Sheets 1
Chief Designer	Steel 20	LITMO	

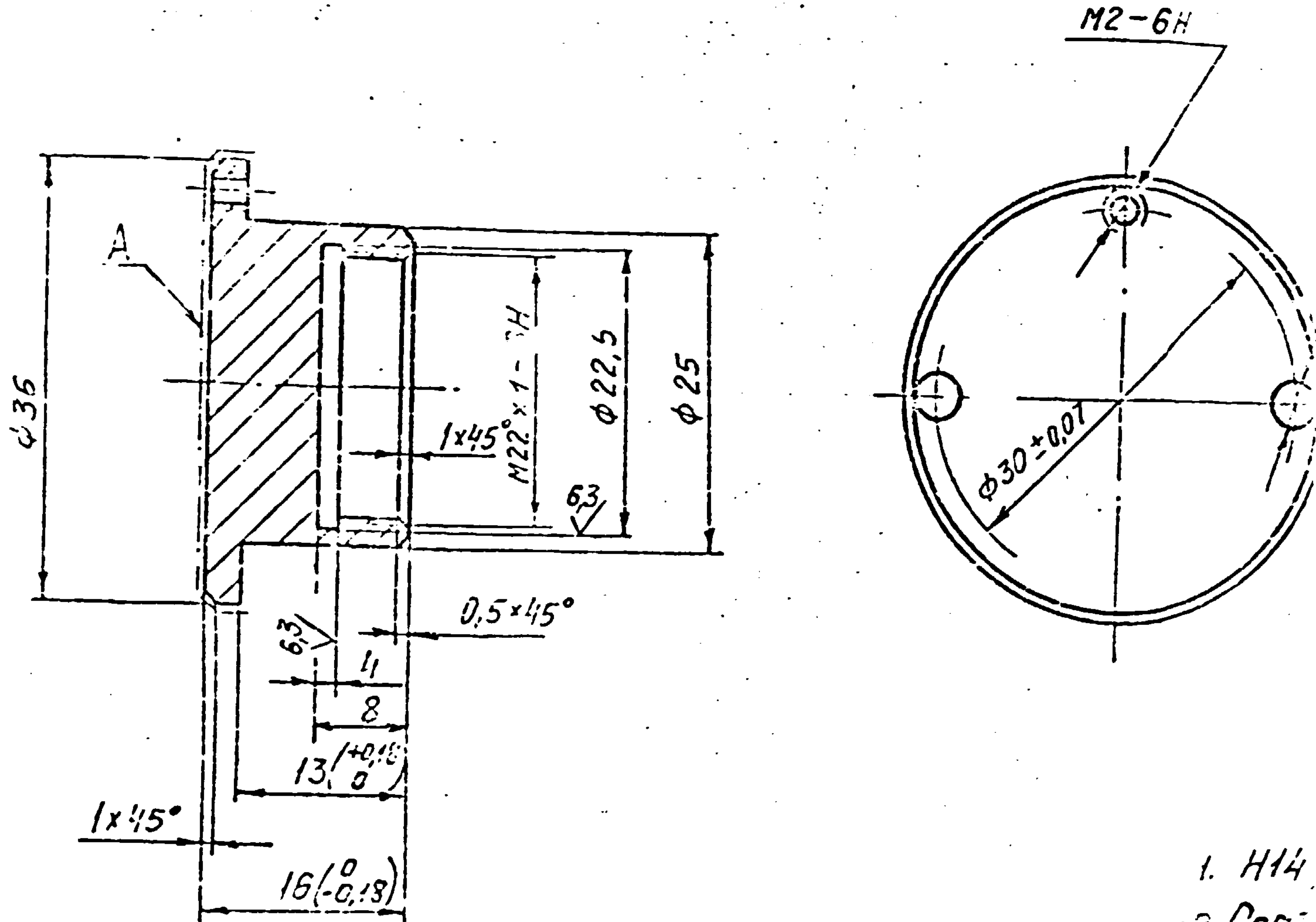
3,2 √ (√)



1. Central angle limiting devitions between the axes of any two holes A must be no more than ±30'

2. Coating Chemical oxidation chromatizing. Outside surfaces coating - grey enamel except the surface B

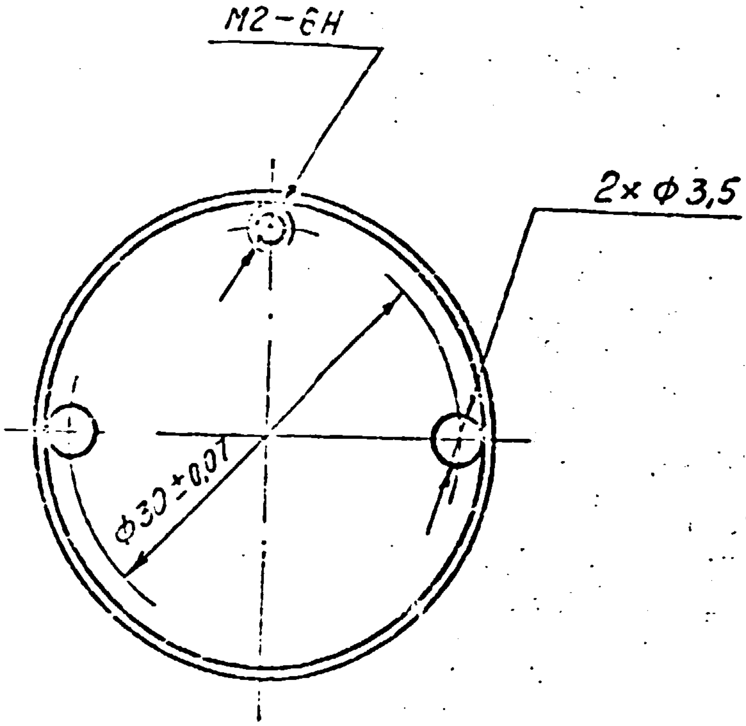
320.108		
Flange	Mass	Scale
		1:1
	Sheet 1	Sheets 1
Steel 20	LITMO	



1. H14
2. Coat
Surf

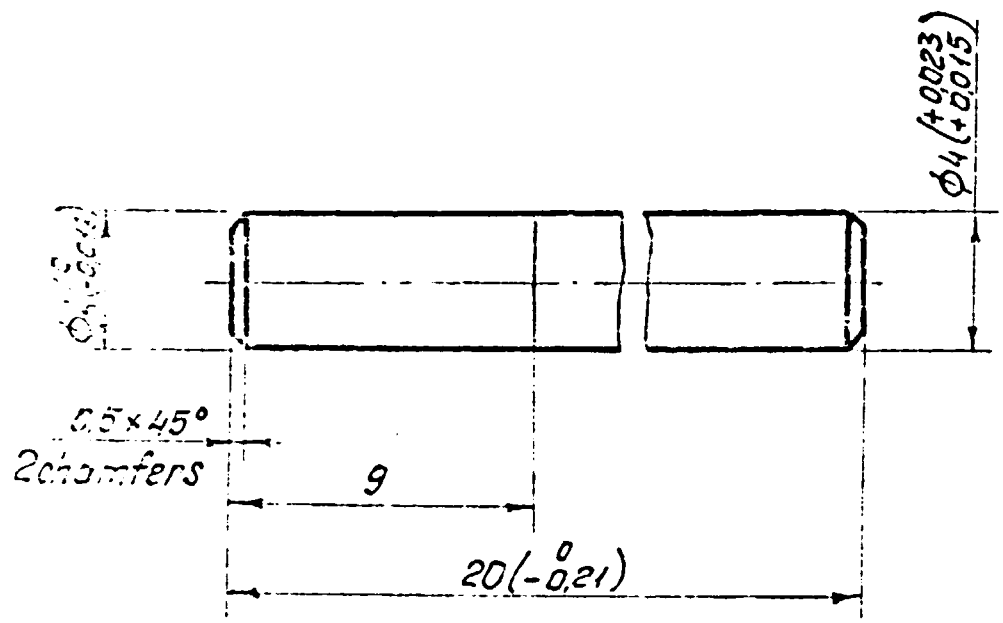
SECTION 1

$\overset{1.5}{\surd}$ ($\surd$)



1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating Anodic oxidation black
   Surface A-grey enamel

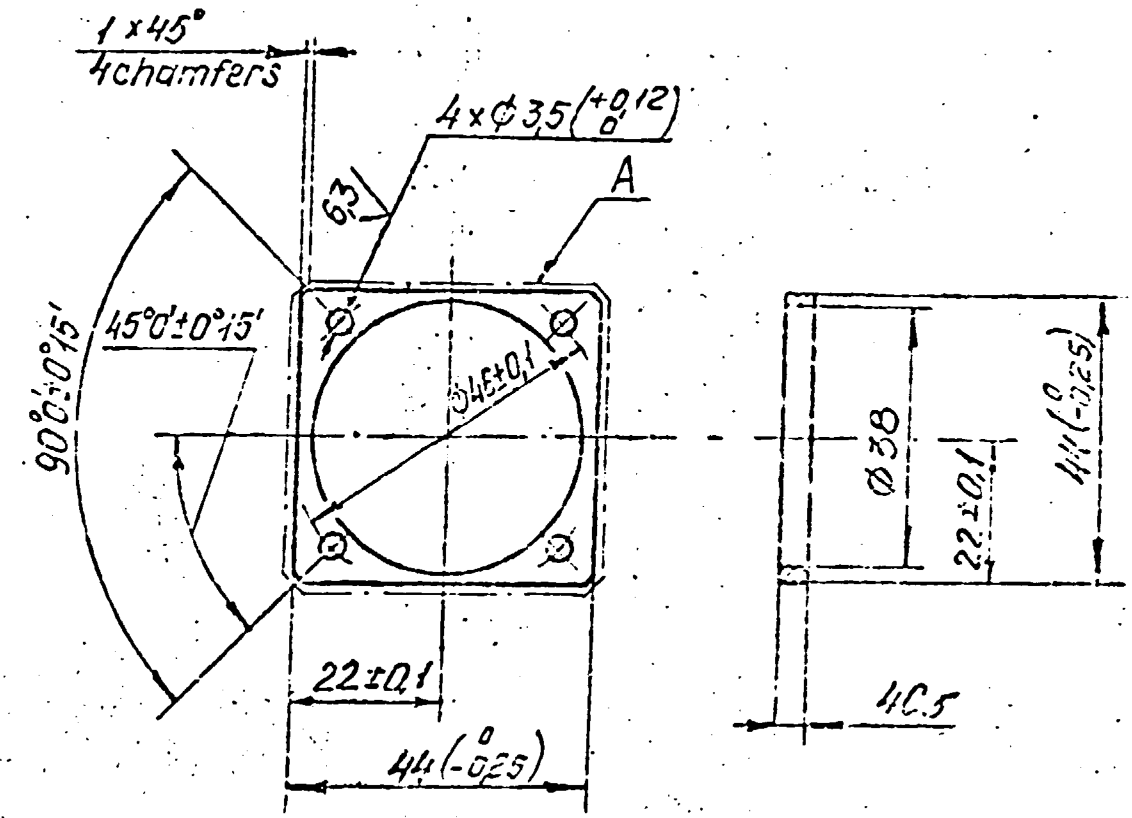
320.109			
Nut		Mass	Scale
			2:1
Designer		Sheet	Sheets 1
Chief Designer	Aluminium alloy Al-Cu 4 Mg Mn Fe Si	LITMO	



1. H14; h14; ± $\frac{IT14}{2}$
2. Coating Fe / Cr 6

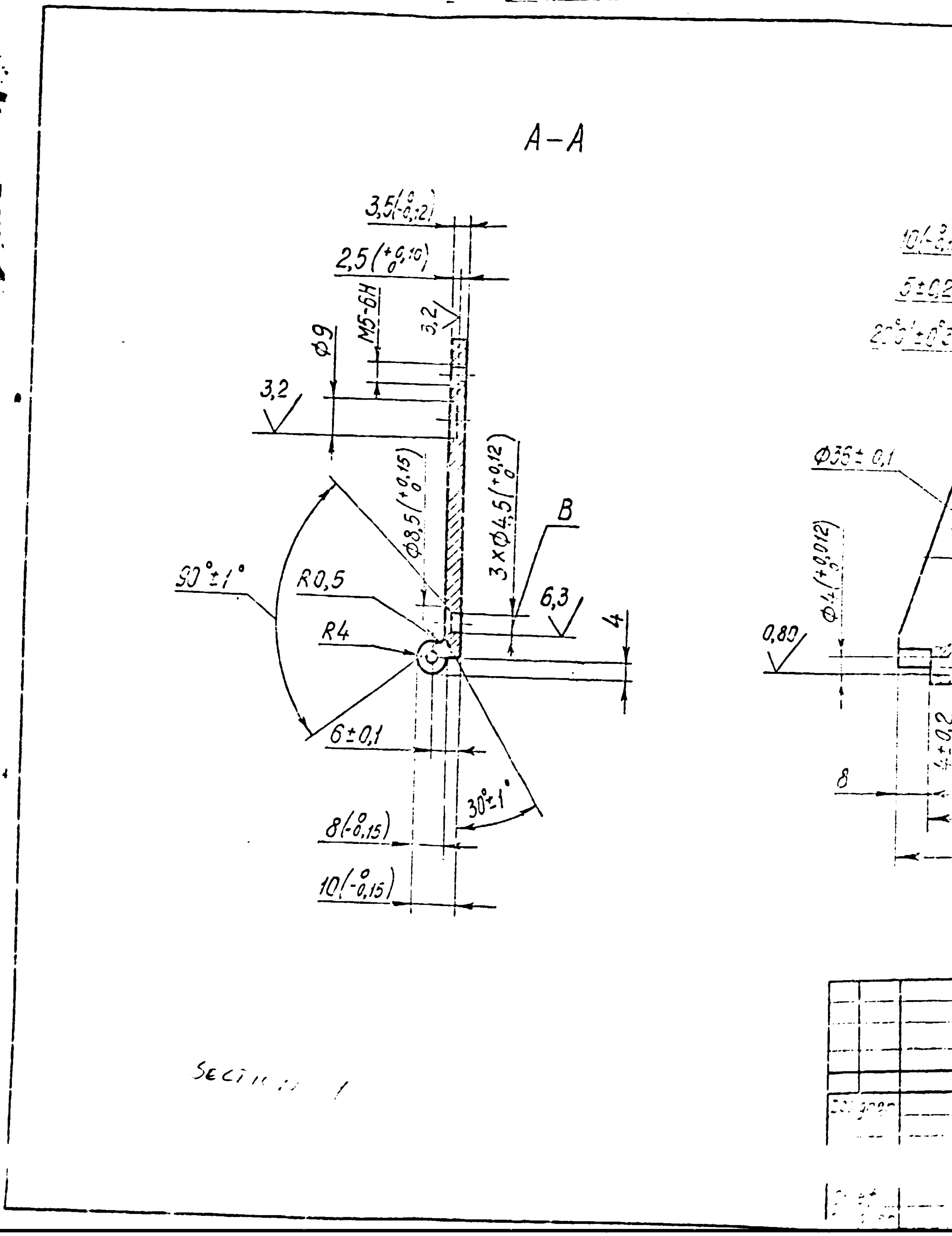
320.111		
Pin	Mass	Scale
		5:1
	Sheet	Sheets 1
Steel 20	LITMO	

1,5 √ (√)

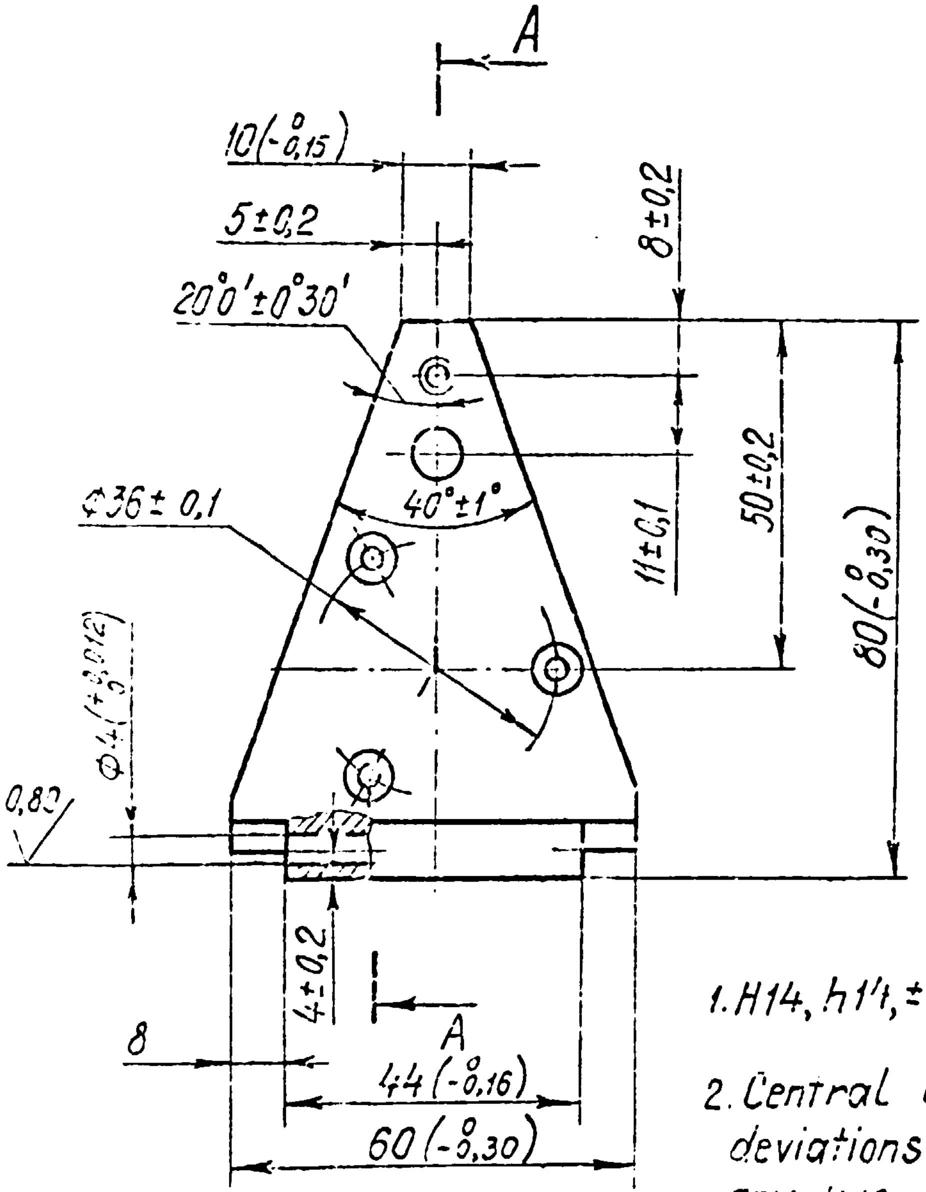


1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating Chemical oxidation
The surface A - grey enamel

	320.112	
Designer	Spacer	Mass / Scale 1:1
		Sheet / Sheets 1
Chief Designer	Steel 20	LITMO


A–A
3,5(-0,2)
2,5(+0,10)
M5-6H
Φ9
3,2
3,2
Φ8,5(+0,15)
3×Φ4,5(+0,12)
B
90°±1°
R0,5
R4
6,3
4
6±0,1
30°±1°
8(-0,15)
10(-0,15)
5±0,2
Φ35±0,1
Φ4(+0,012)
0,80
8

1,6 (√)



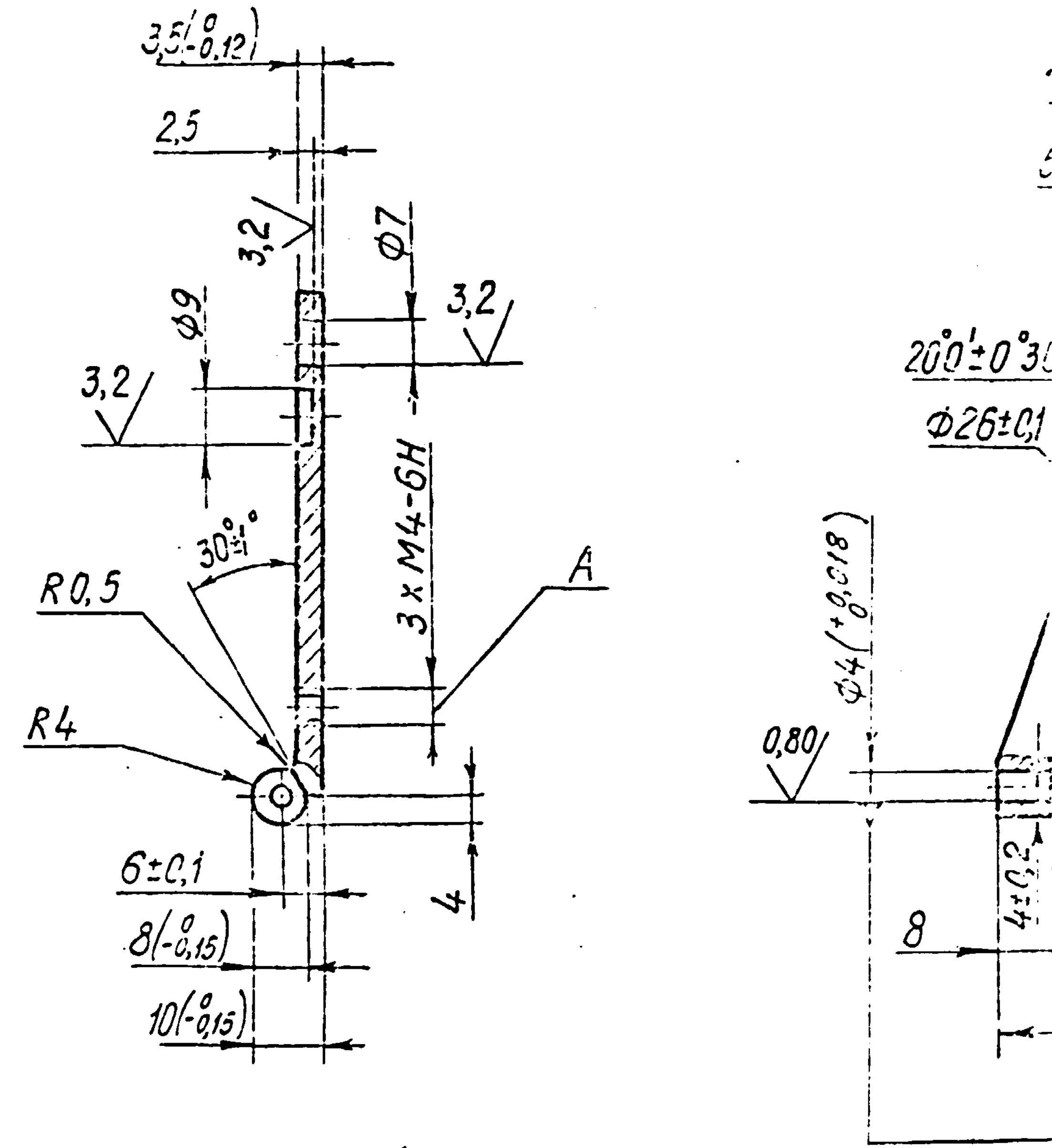
1. H14, h14, ± $\frac{IT14}{2}$

2. Central angle limiting deviations between the axes of any two holes B must be no more than ±30'

3. Coating Fe/Ni 9 Cr mat finish

320. 113		
Designer	Hinge	Mass / Scale: 1:1
		Sheet / Sheets 1
Chief Designer	Steel 20	LITMO

Form A3

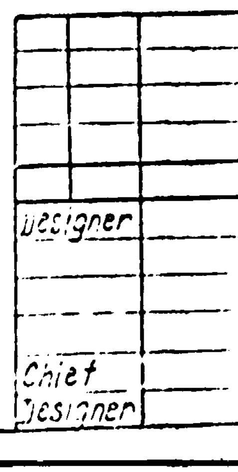


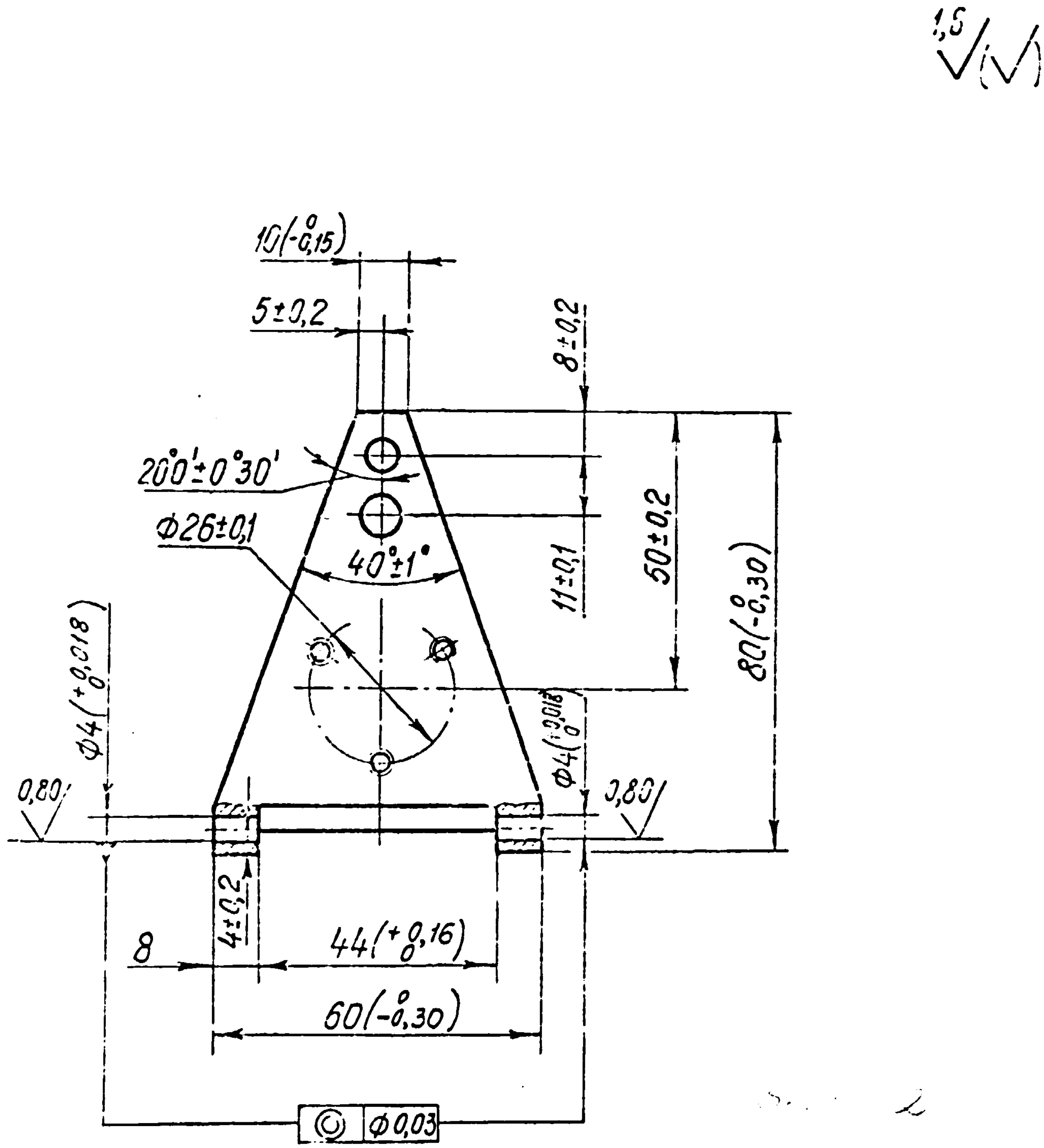
SECTION 1

1. H14, h14, $\pm \frac{IT14}{2}$

2. Central angle limiting deviations between the axes of any two holes A must be no more than ± 30'

3. Coating: Fe/Ni 9 Cr mat finish





viations
wo holes A
inish

Designer	
Chief Designer	

320.114

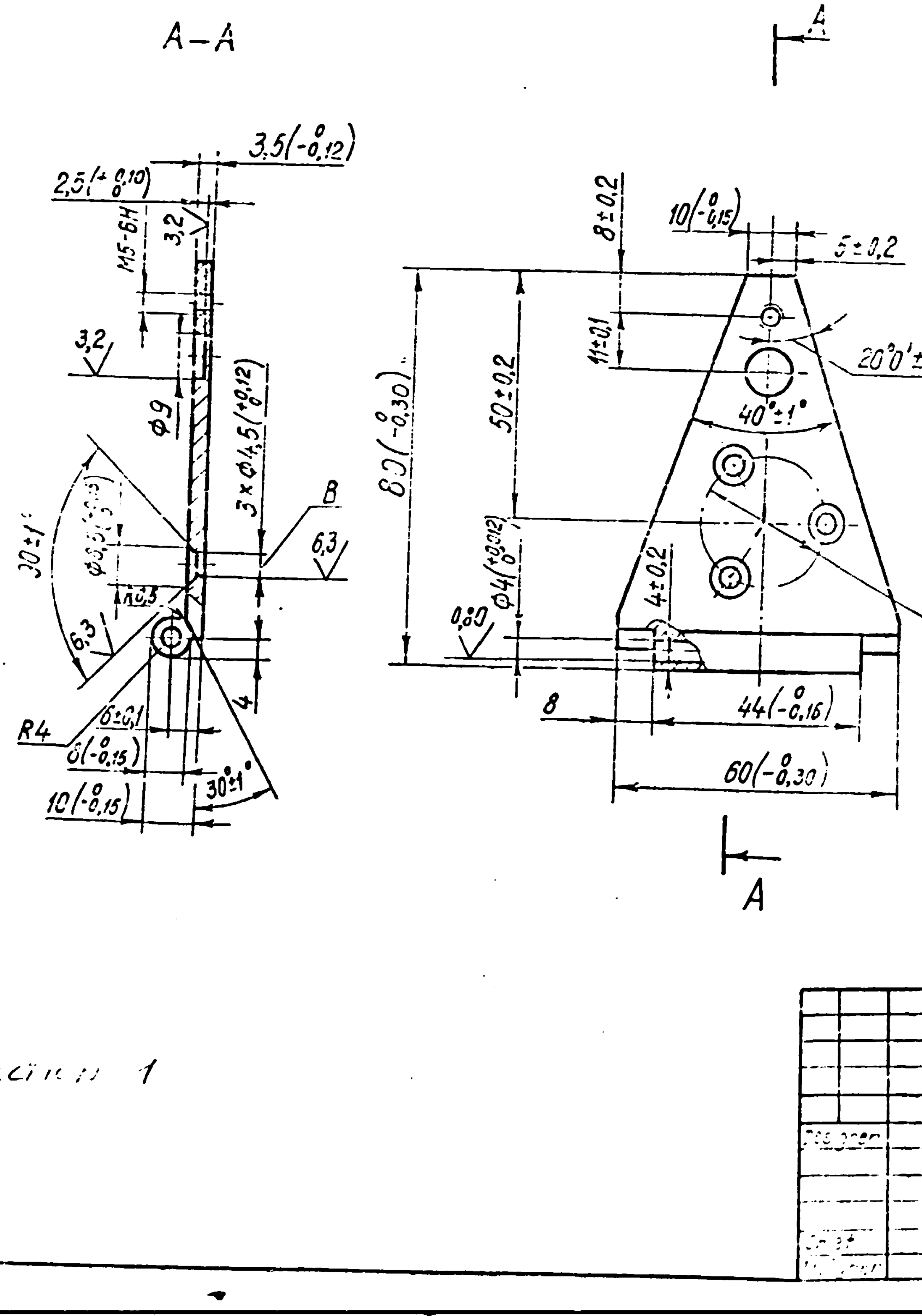
Hinge

Steel 20

Mass	Scale
	1:1
Sheet	Sheets 1

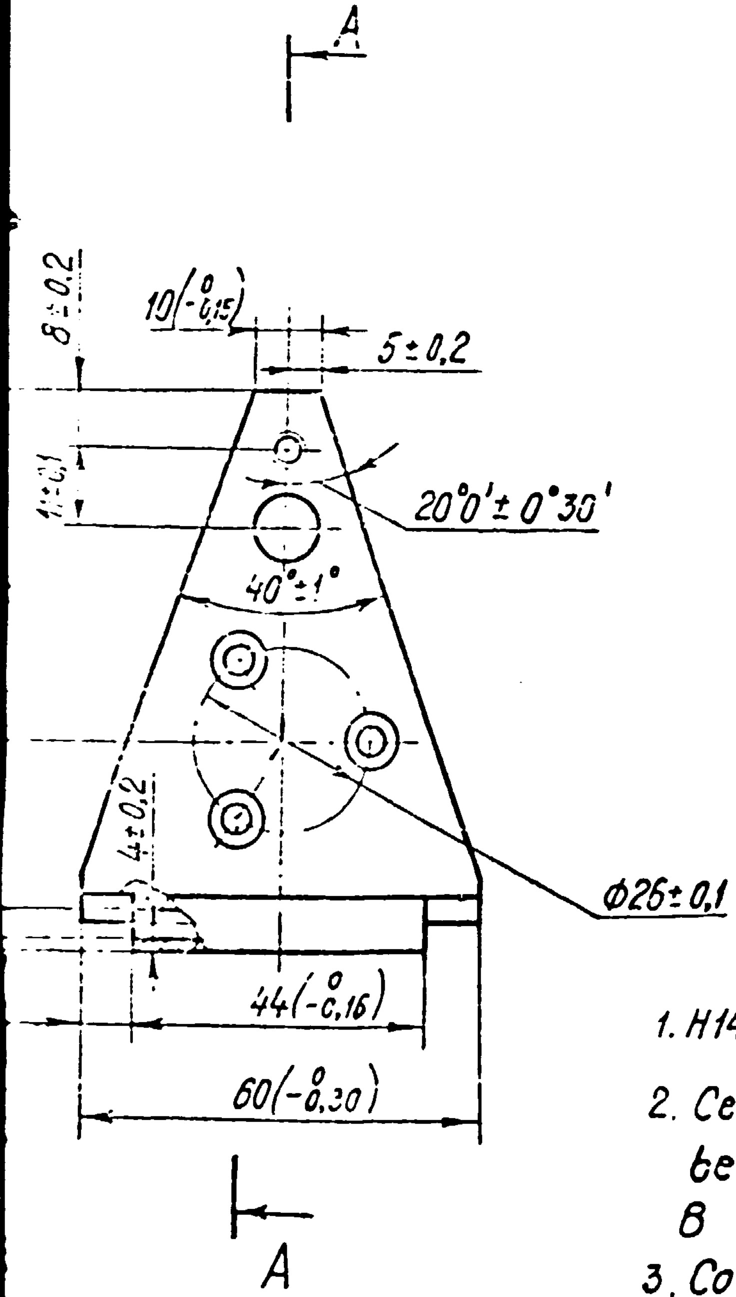
LITMO

Form A3


A–A
A
3,5(-0,12)
2,5(+0,10)
M5-6H
3,2
Φ9
3×Φ4,5(+0,12)
B
6,3
30±1°
R4
6±0,1
8(-0,15)
10(-0,15)
30°±1°
4
8±0,2
10(-0,15)
5±0,2
11±0,1
20°0'
40°±1°
80(-0,30)
50±0,2
Φ4(+0,012)
4±0,2
0,80
8
44(-0,16)
60(-0,30)
A

SECTION 1

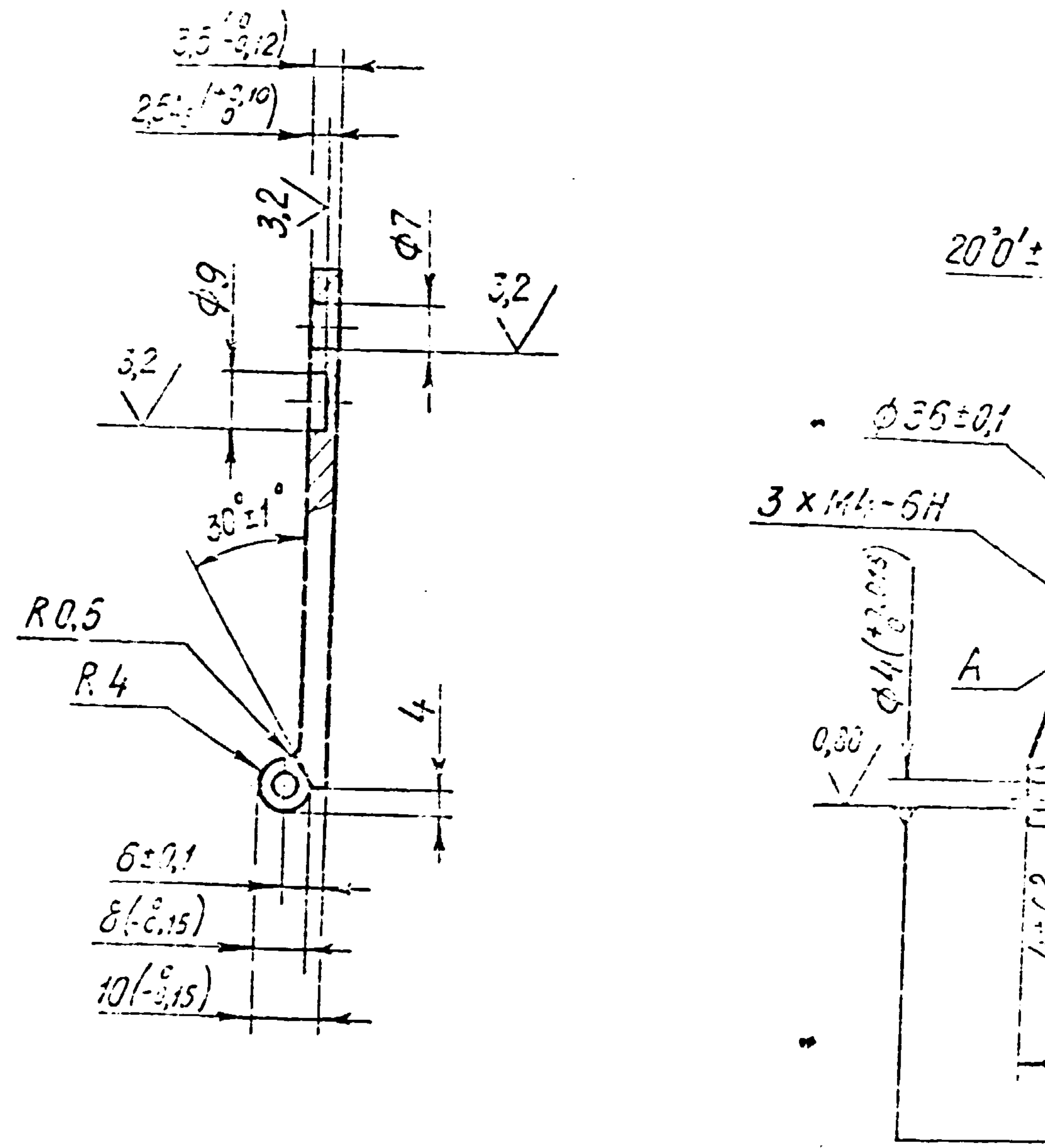
1,6 √ (√)



1. H14, h14, $\pm\frac{IT14}{2}$
2. Central angle limiting deviations between the axes of any two holes B wust be no more than 30'
3. Coating Fe/Ni 9Cr mat finish

	320. 115		
	Hinge	Mass	Scale
Designer			1:1
		Sheet	Sheets 1
Chief designer	Steel 20	LITMO	

Form A3



SECTION 1

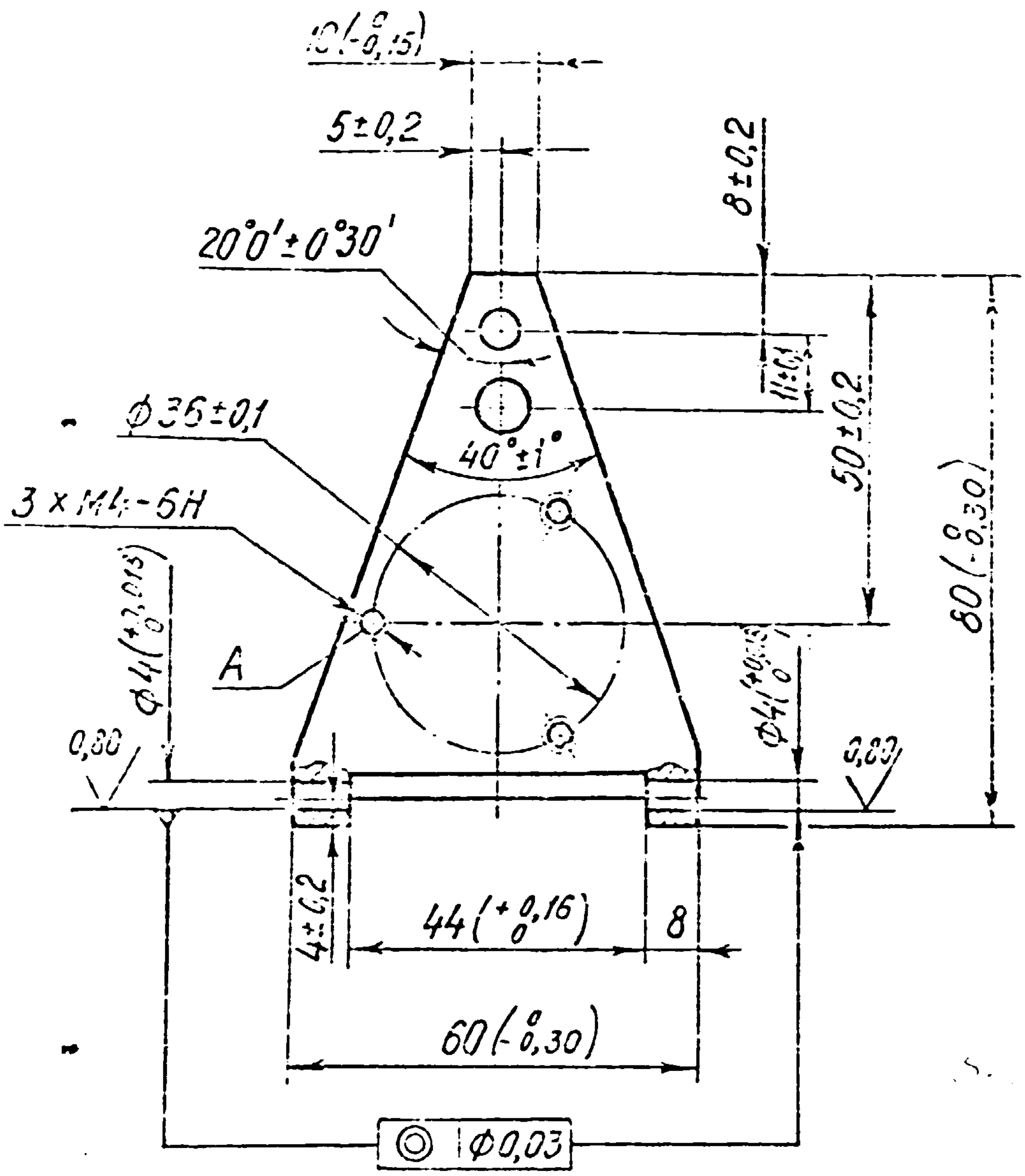
1. H14, h14

2. Centra
axes

3. Coating: Fe/Ni9 Cr mat finish

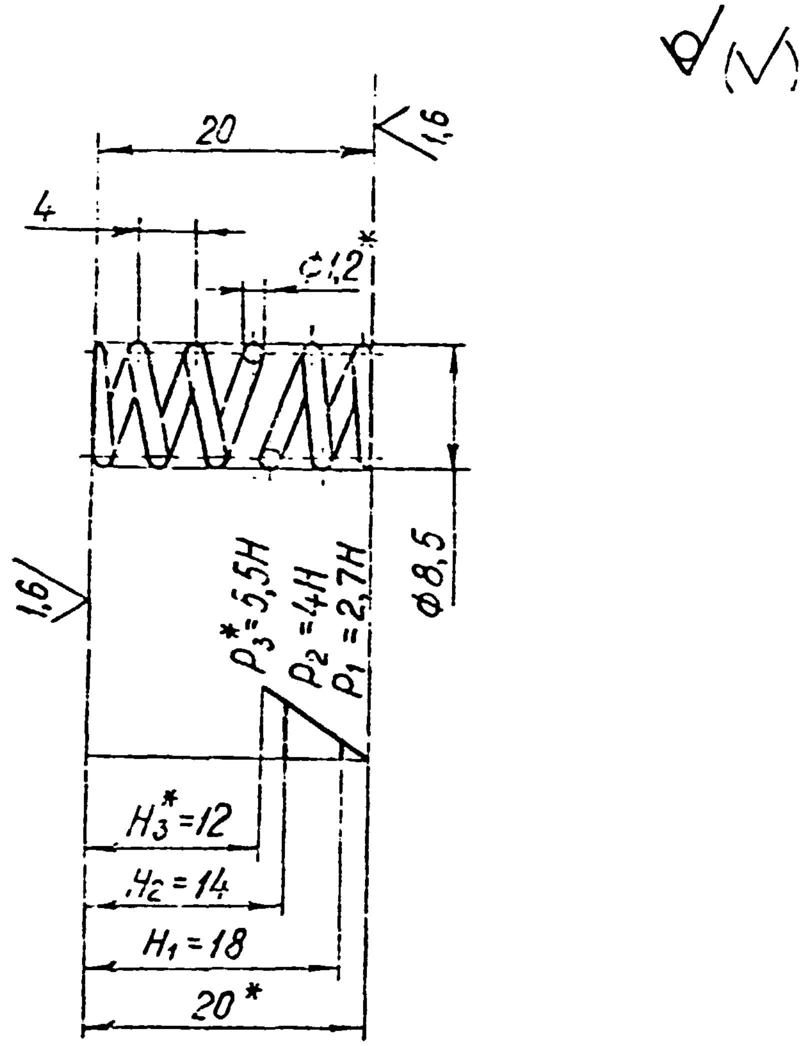
Designer

Chief



1. H14, h14, $\pm \frac{IT14}{2}$
2. Central angle limiting deviations between the axes of any two holes A must be no more than ±30'

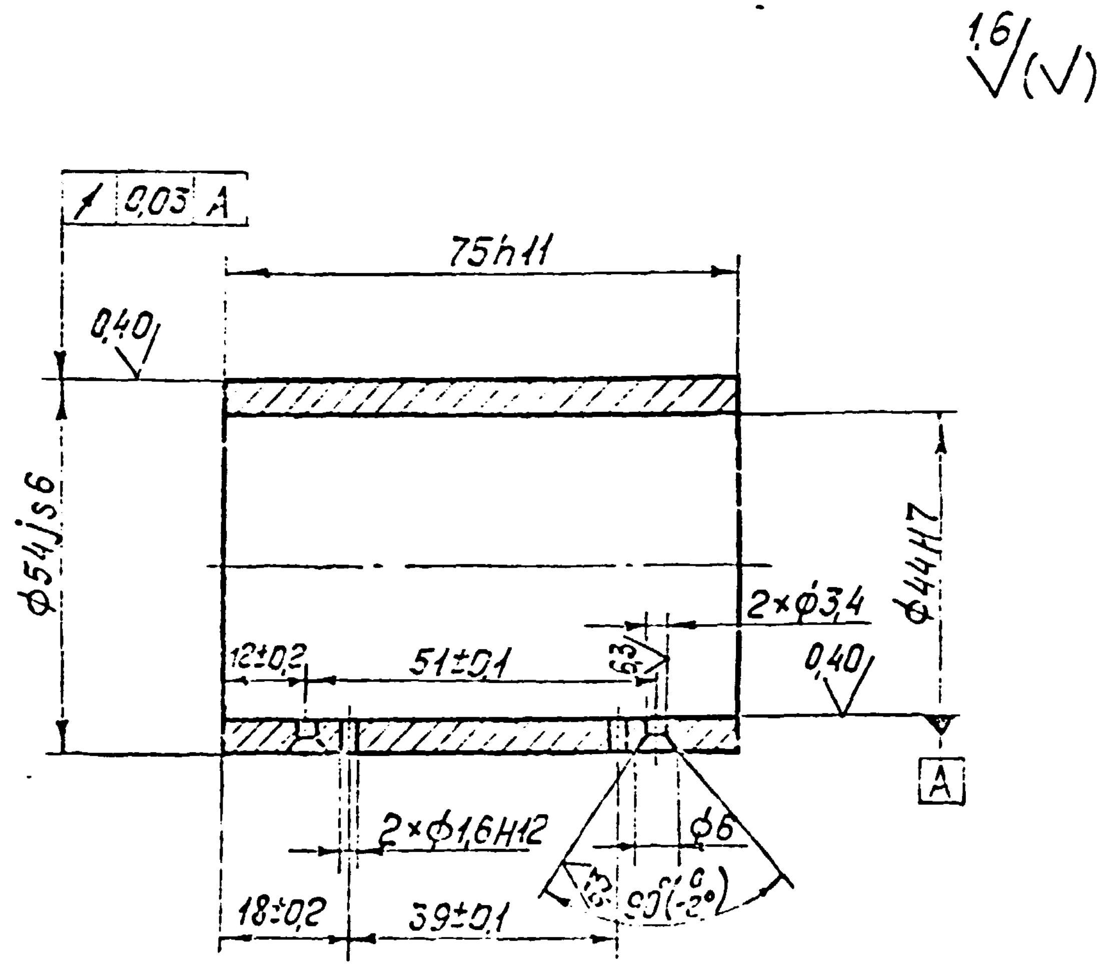
	320. 116
Designer	Hinge
Chief designer	Steel 20
	LITMO



1. *The dimensions for information
2. H14, h14, $\pm \frac{IT14}{2}$
3. Spring coilling direction right
4. $n = 5$
5. $n_1 = 6$
6. Harden the spring by tempering 200-220°C, 60 minutes, air cooling
7. Keep the spring when the spring length is 12 mm for 24 hours

320. 117		
Spring	Mass	Scale
		2:1
	Sheet	Sheets 1
Wire II - 1,2	LITMO	

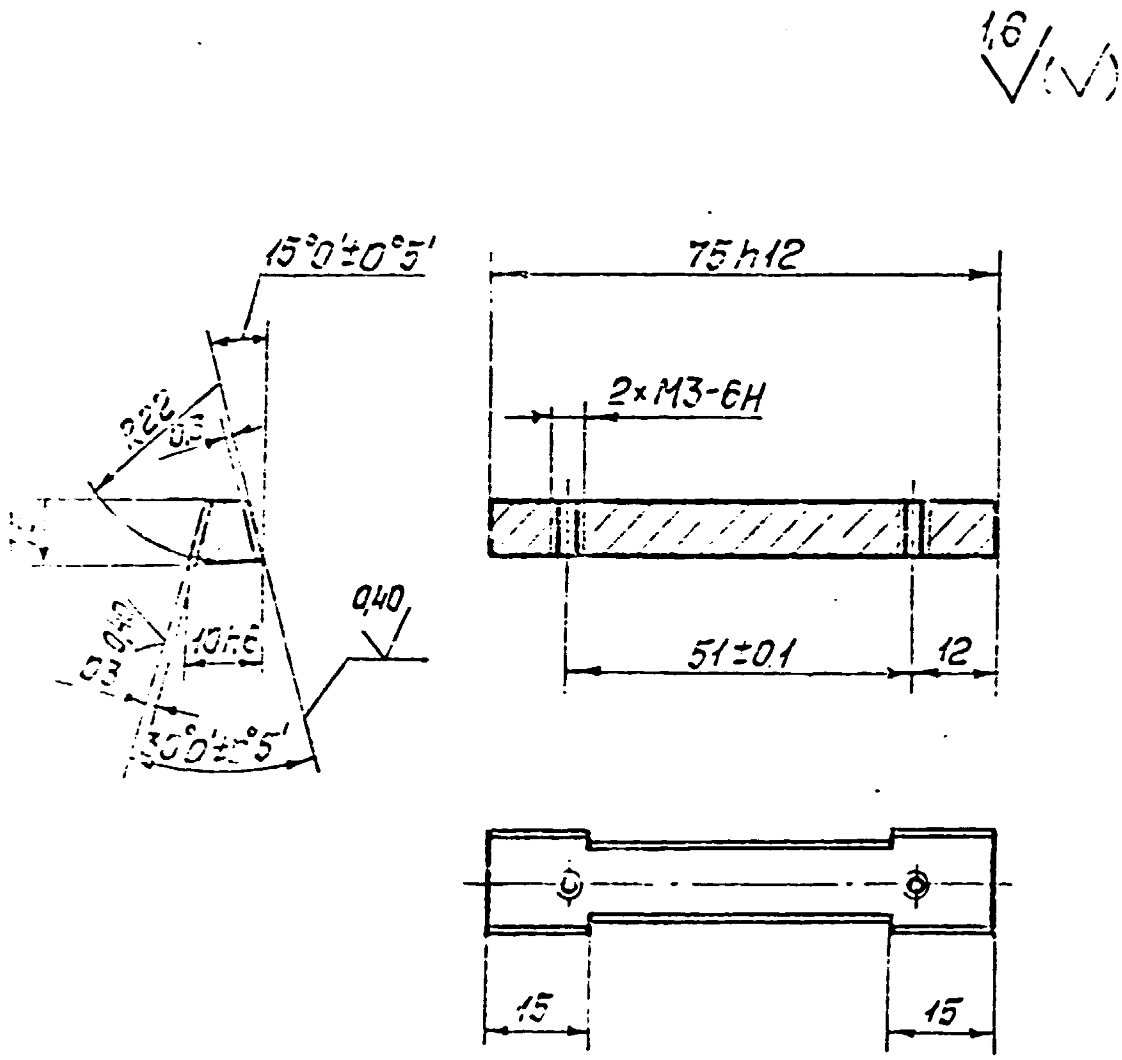
form A4



1. H14; h14; $\pm \frac{IT14}{2}$

2. Coating: Chemical oxidation chromatizing

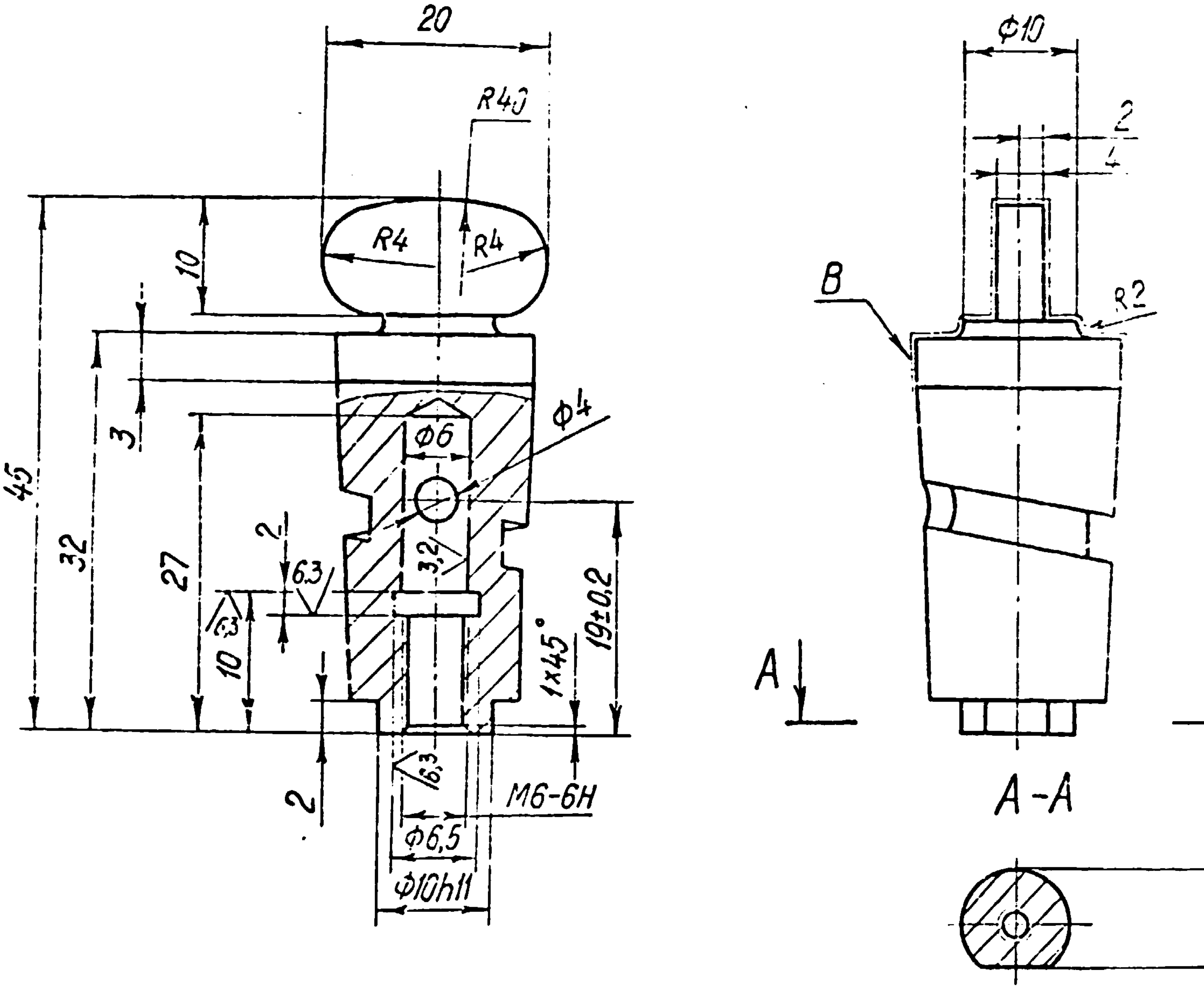
	320. 121	
Designer	Bushing	Mass / Scale 1:1
		Sheet / Sheets 1
Chief Designer	Steel 20	LITMO



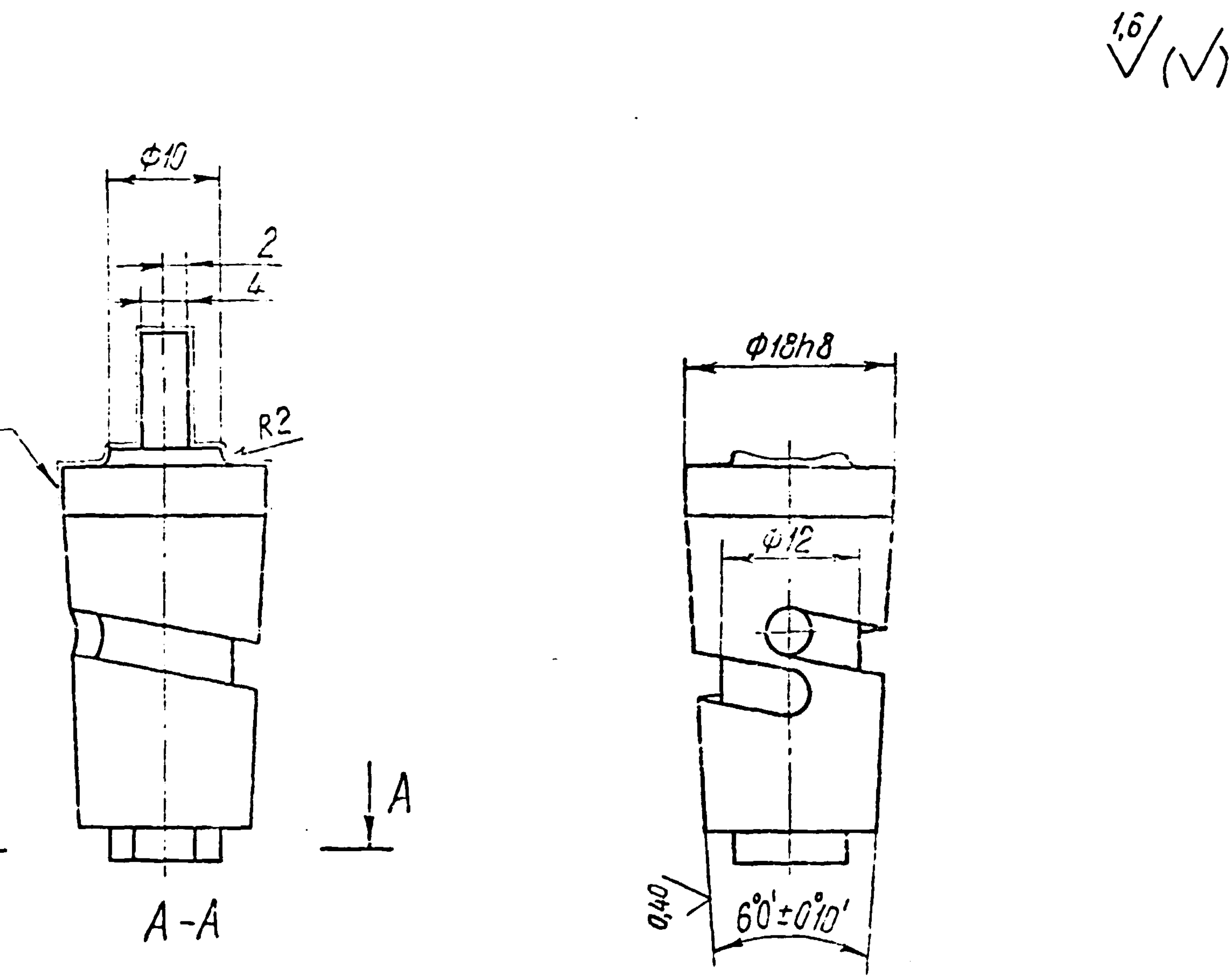
1. H14; h14; $\pm \frac{IT14}{2}$

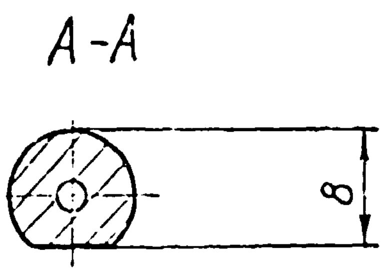
2. Coating Chemical oxidation chromatizing

520.122			
Key		Mass	Scale
			1:1
		Sheet	Sheets 1
Steel 45		LITMO	


20
R40
R4
R4
10
45
32
3
27
Φ6
Φ4
2
6,3
3,2
10
19±0,2
1x45°
2
M6-6H
Φ6,5
Φ10h11
Φ10
2
4
B
R2
A
A-A

SECTION 1



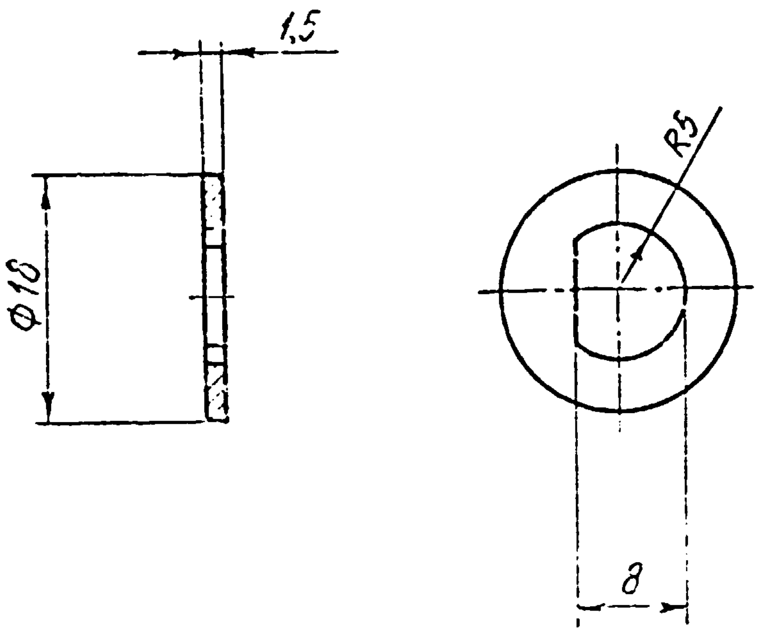


1. H14, h14, $\pm \frac{IT14}{2}$
2. Coating Chemical oxidation
   The surface B - grey enamel

320. 123			
Distributer		Mass	Scale
			2:1
		Sheet	Sheets 1
Brass Cu Zn 40		LITMO	
Designer			
Chief Designer			

Form A4

1,6



1. H14, h14, $\pm \frac{IT14}{2}$

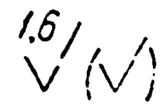
2. Coating: Chemical oxidation chromatizing

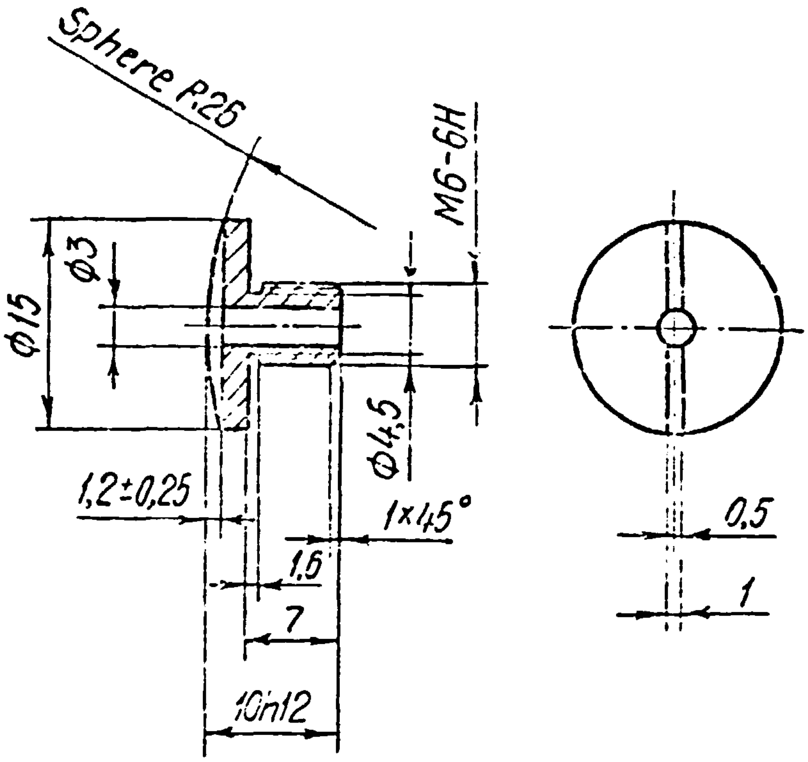
320. 124		
Washer	Mass	Scale
		2:1
	Sheet	Sheets 1
Steel 20	LITMO	

Designer

Chief

Form A4



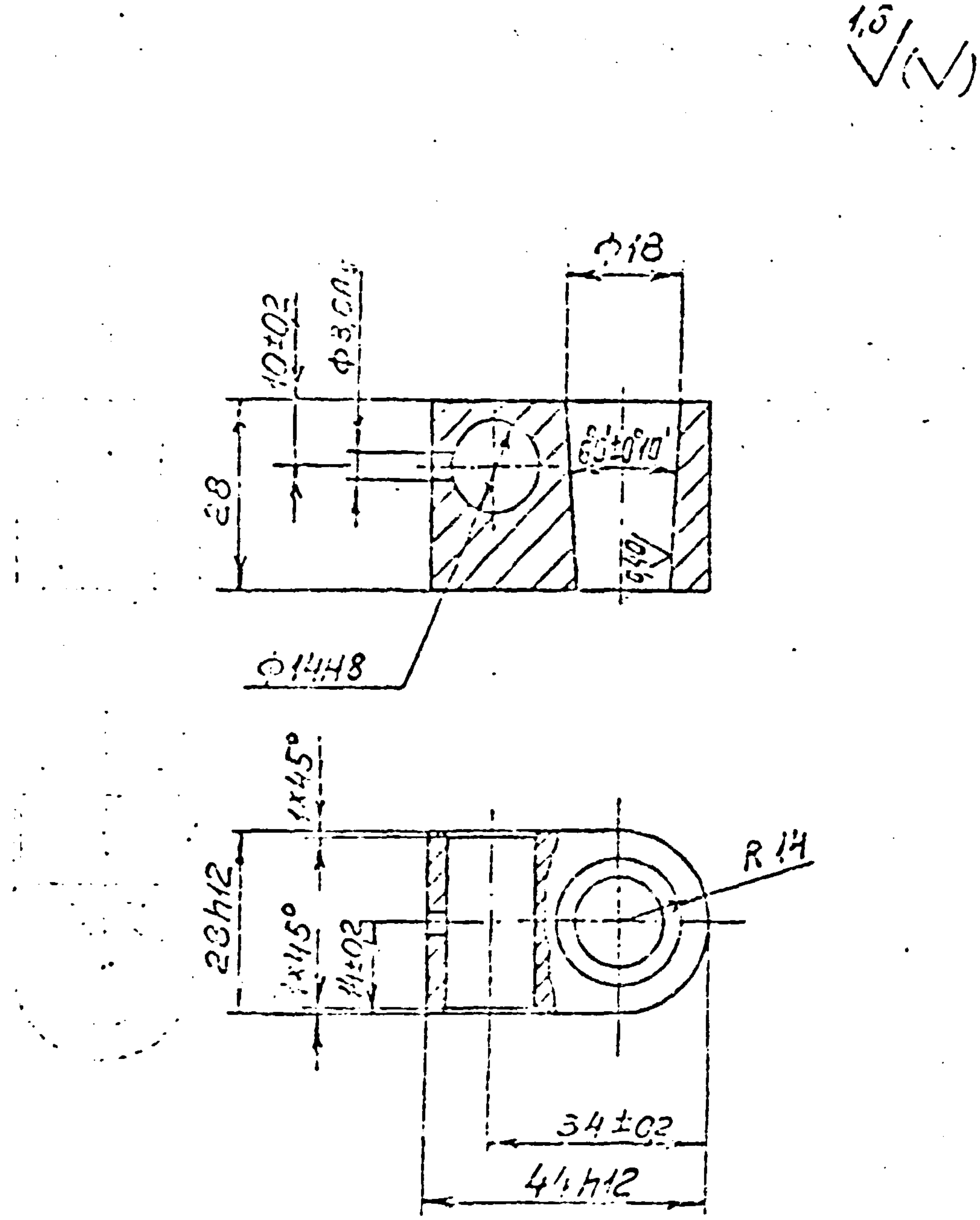


1. H14, h14, $\pm \frac{IT14}{2}$

2. Coating Chemical oxidation chromatizing

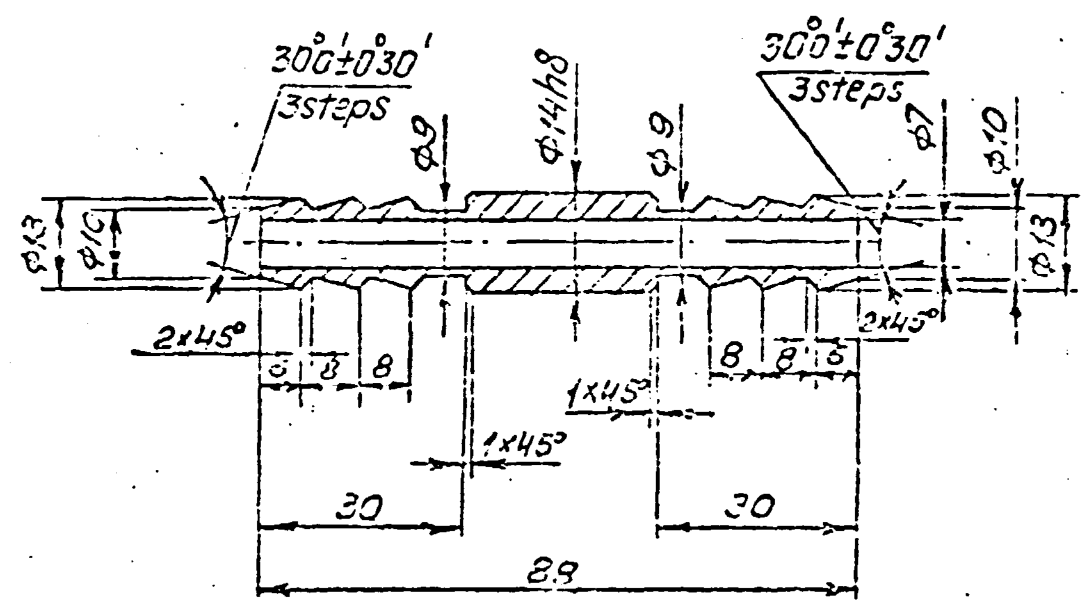
320. 125			
Screw		Mass	Scale
			2:1
		Sheet	Sheets 1
Steel 20		LITMO	
Designer			
Chief Designer			

Form A4



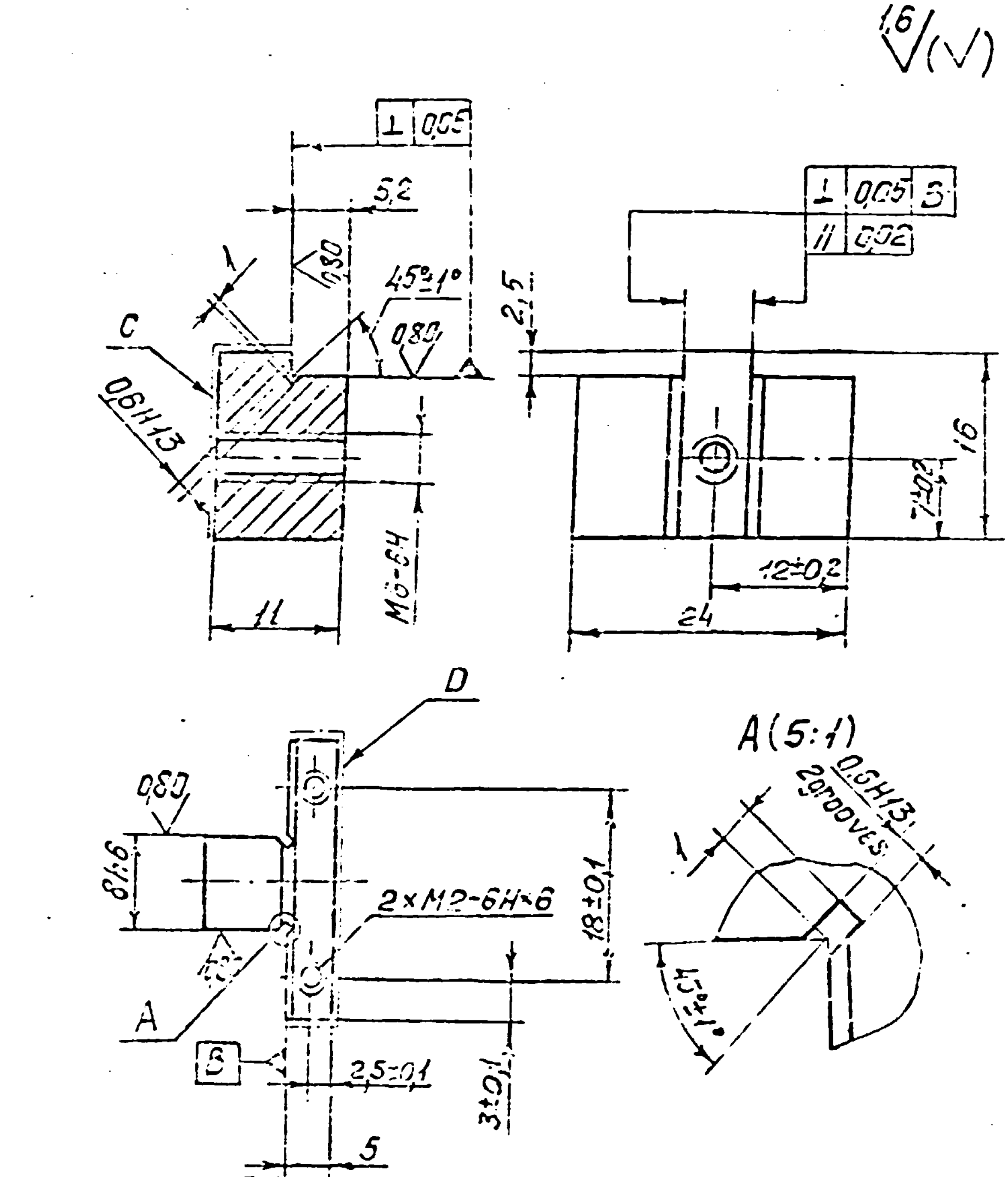
1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating: Chemical oxidation chromatizing

320.126	
Body	Mass / Scale: 1:1 — Sheet / Sheets 1
Steel 20	LITMO



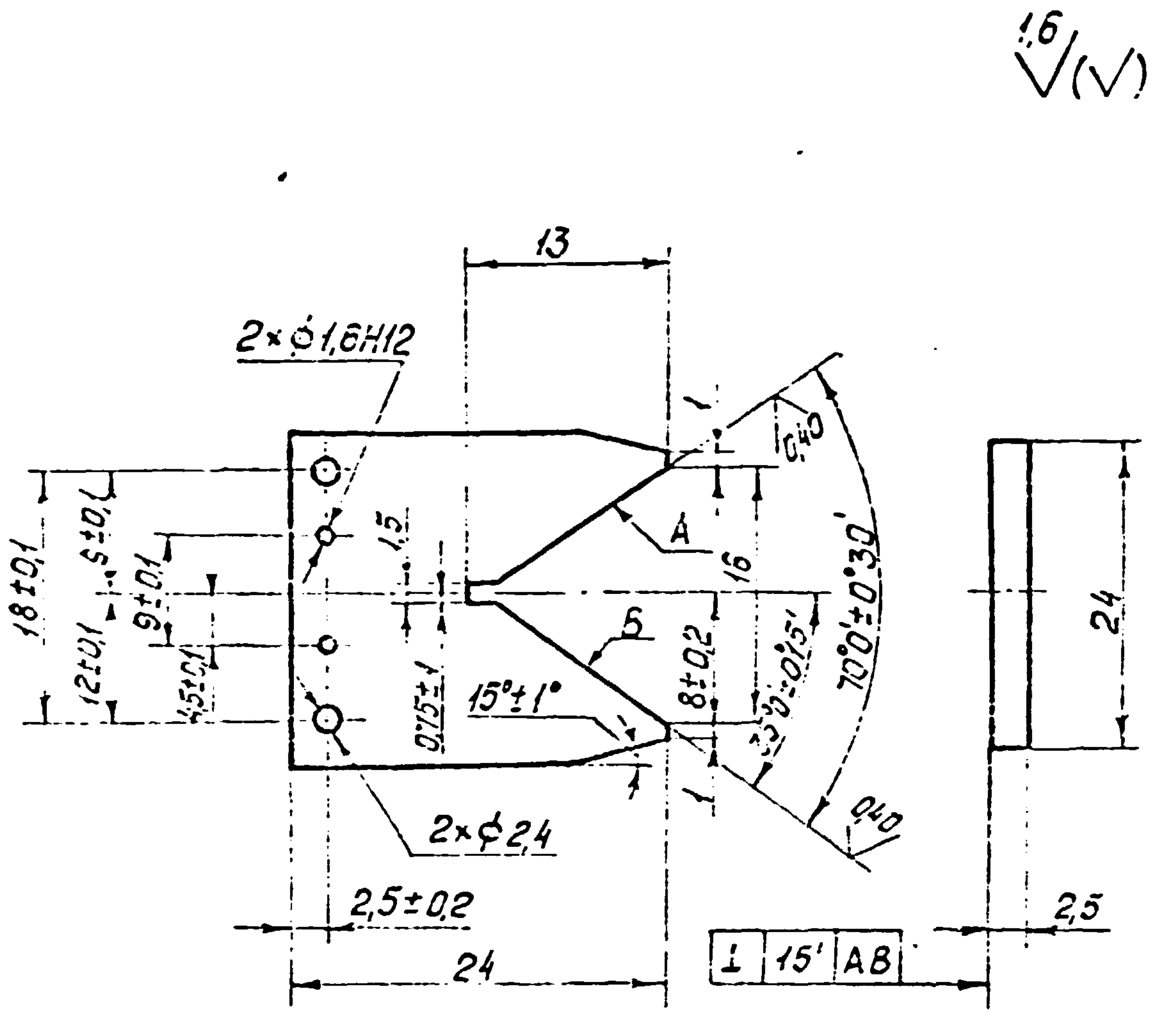
1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating: Chemical oxidation chromatizing

320.127		
Union	Mass	Scale
Designer	Sheet	Sheets 1
Chief designer	Steel 20	LITMO



1. $H14; h14; \pm\frac{IT14}{2}$
2. Coating: Chemical oxidation chromatizing, grey enamel except for the surfaces C, D

320.128			
Support	Mass	Scale	
		2:1	
	Sheet	Sheets 1	
Steel 20	LITMO		



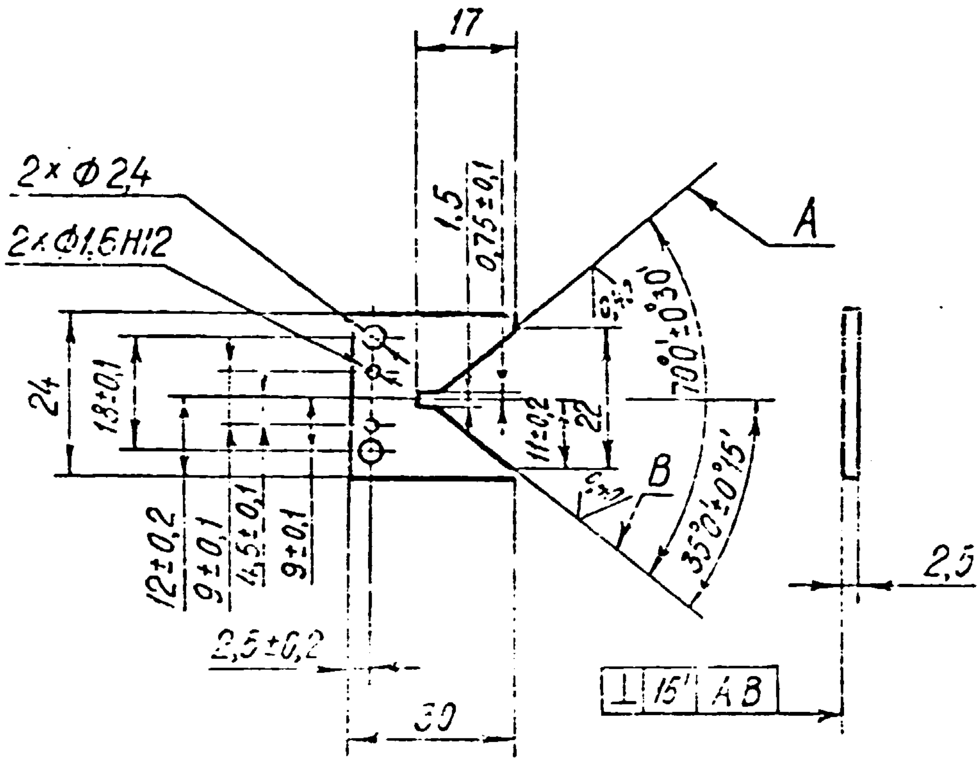
1. Carburize in depth 0,8...1,2mm
2. H14; h14; $\pm\frac{IT14}{2}$
3. Coating: Chemical oxidation chromatizing

320.129		
Knife-edge	Mass	Scale
		2:1
	Sheet	Sheets 1
Steel 20	LITMO	

Designer

Chief Designer

$\sqrt[1{,}6]{\ }\ (\sqrt{\ })$

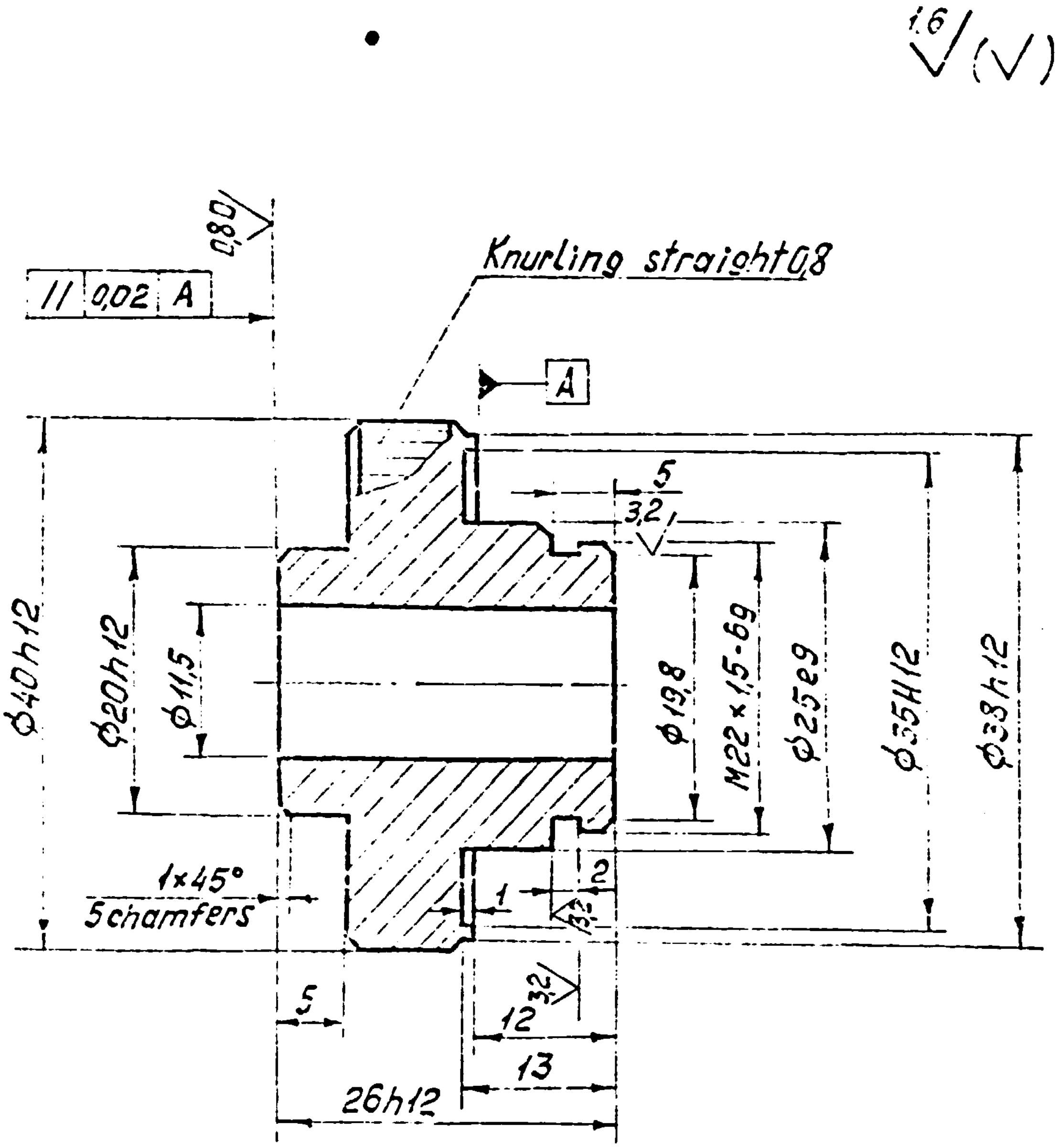


1. Carburize in depth 0,8 ... 1,2 mm. 59 ... 63 HRCэ
2. H14, h14, $\pm\frac{IT14}{2}$
3. Coating Chemical oxidation chromatizing

320.131			
Knife - edge	Mass	Scale	
		1:1	
	Sheet	Sheets 1	
Steel 20	LITMO		

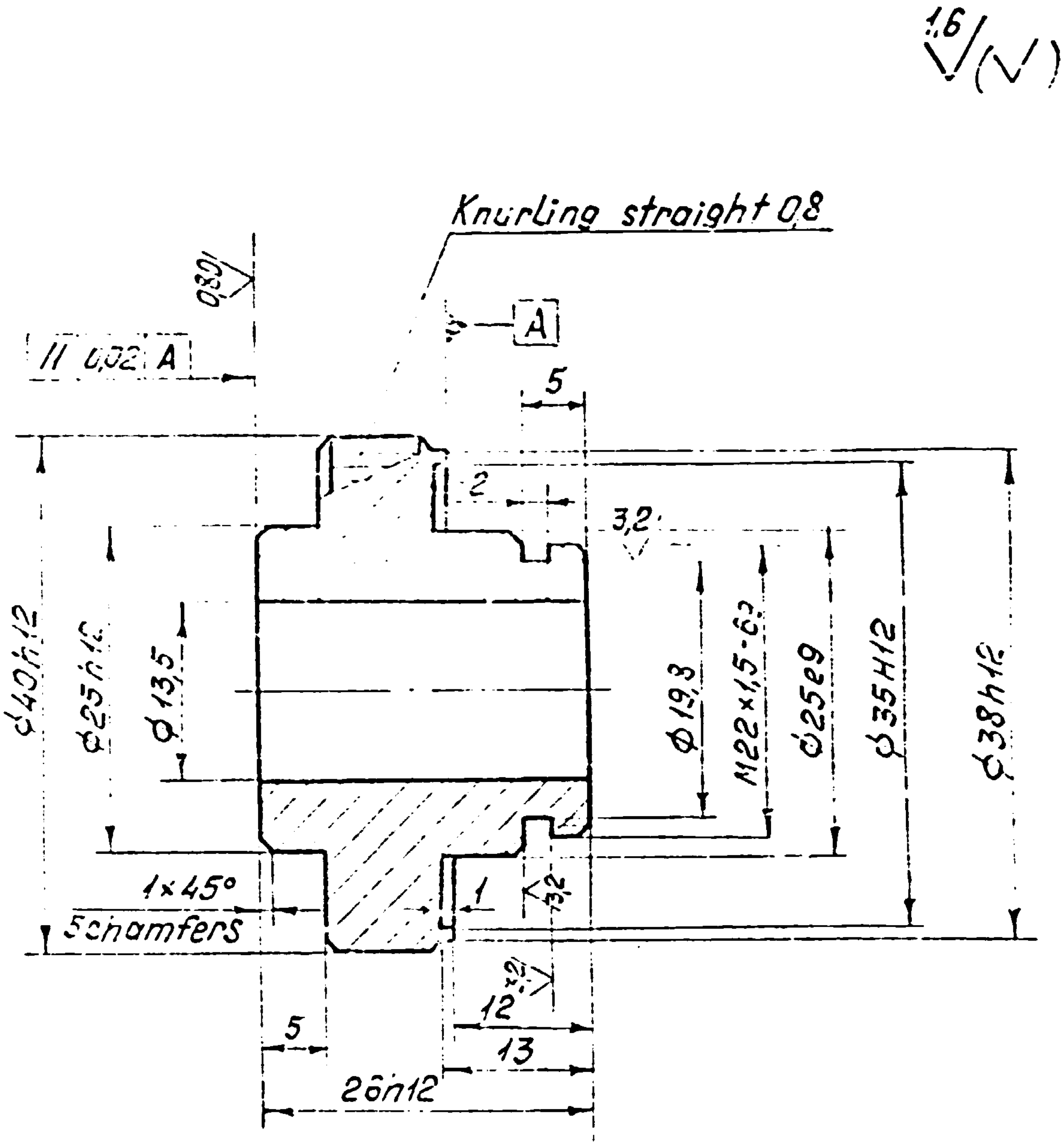
Designer

Form A4



1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating Fe/NiCr9 mat finish

	320.151					
	Bushing			Mass	Scale	
Designer					2:1	
			Sheet	Sheets 1		
Chief Designer	Steel 20	LITMO				

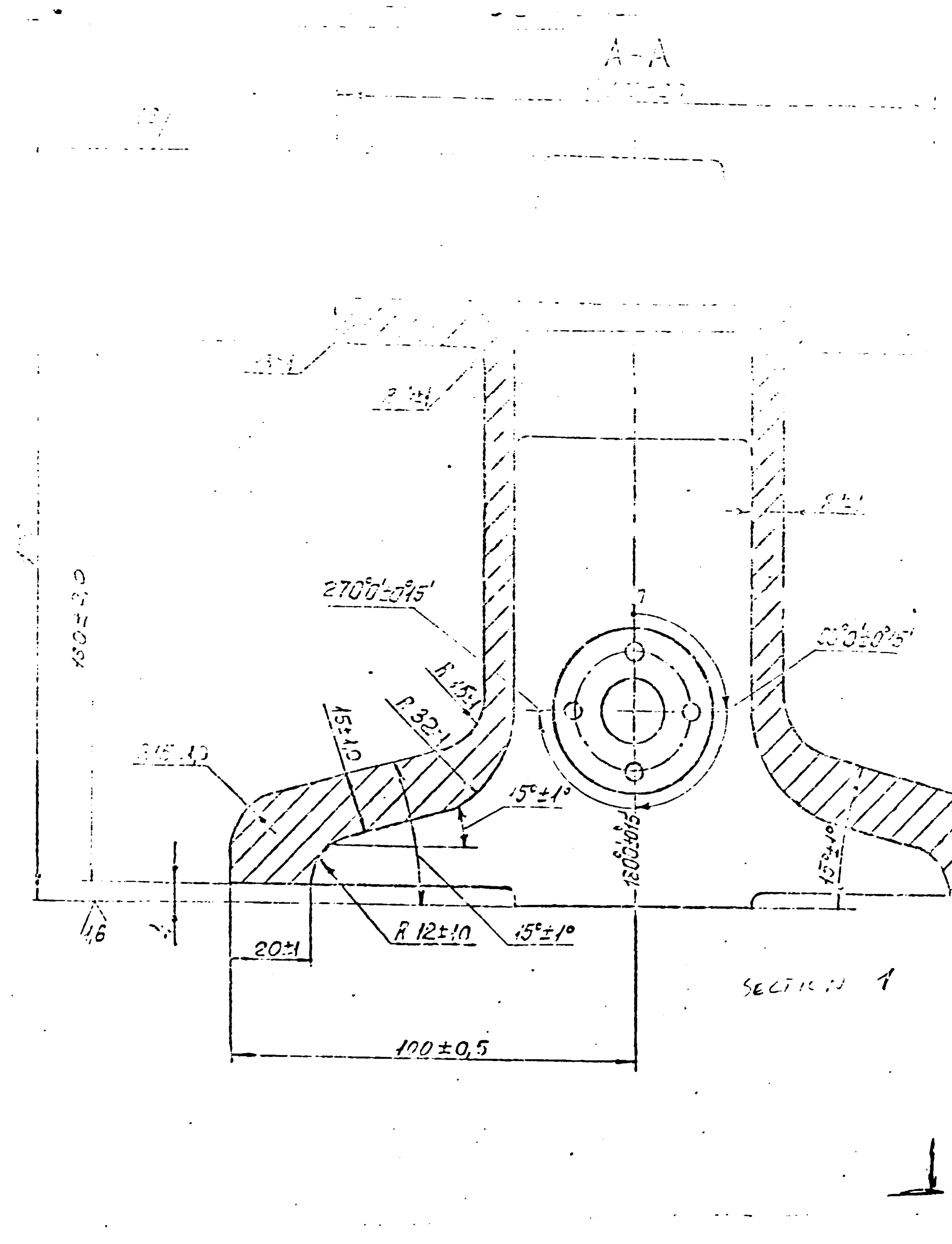


1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating: Fe/NiCr9 mat finish

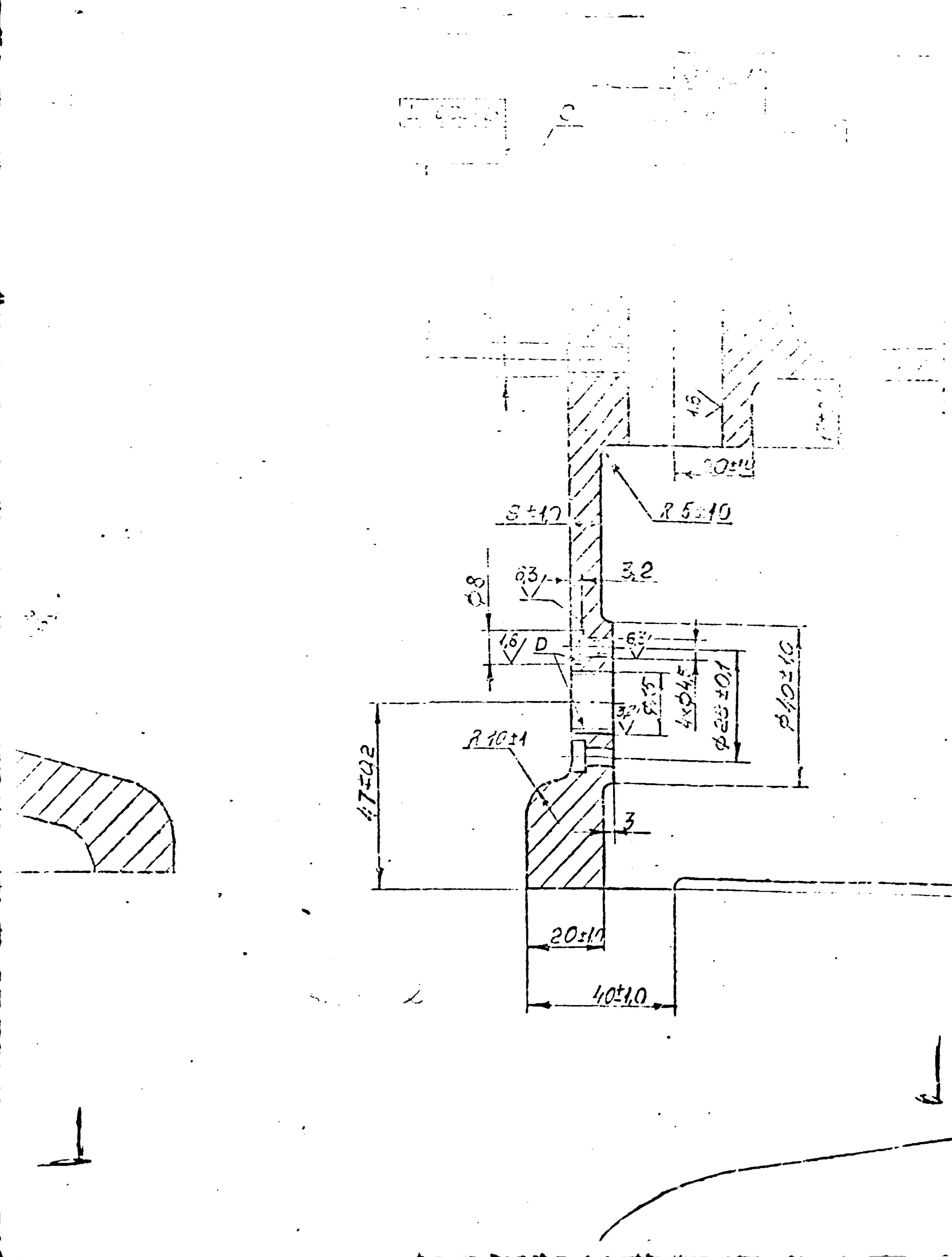
320.152		
Bushing	Mass	Scale
		2:1
	Lit.	Sheets 1
Steel 20	LITMO	

Designer

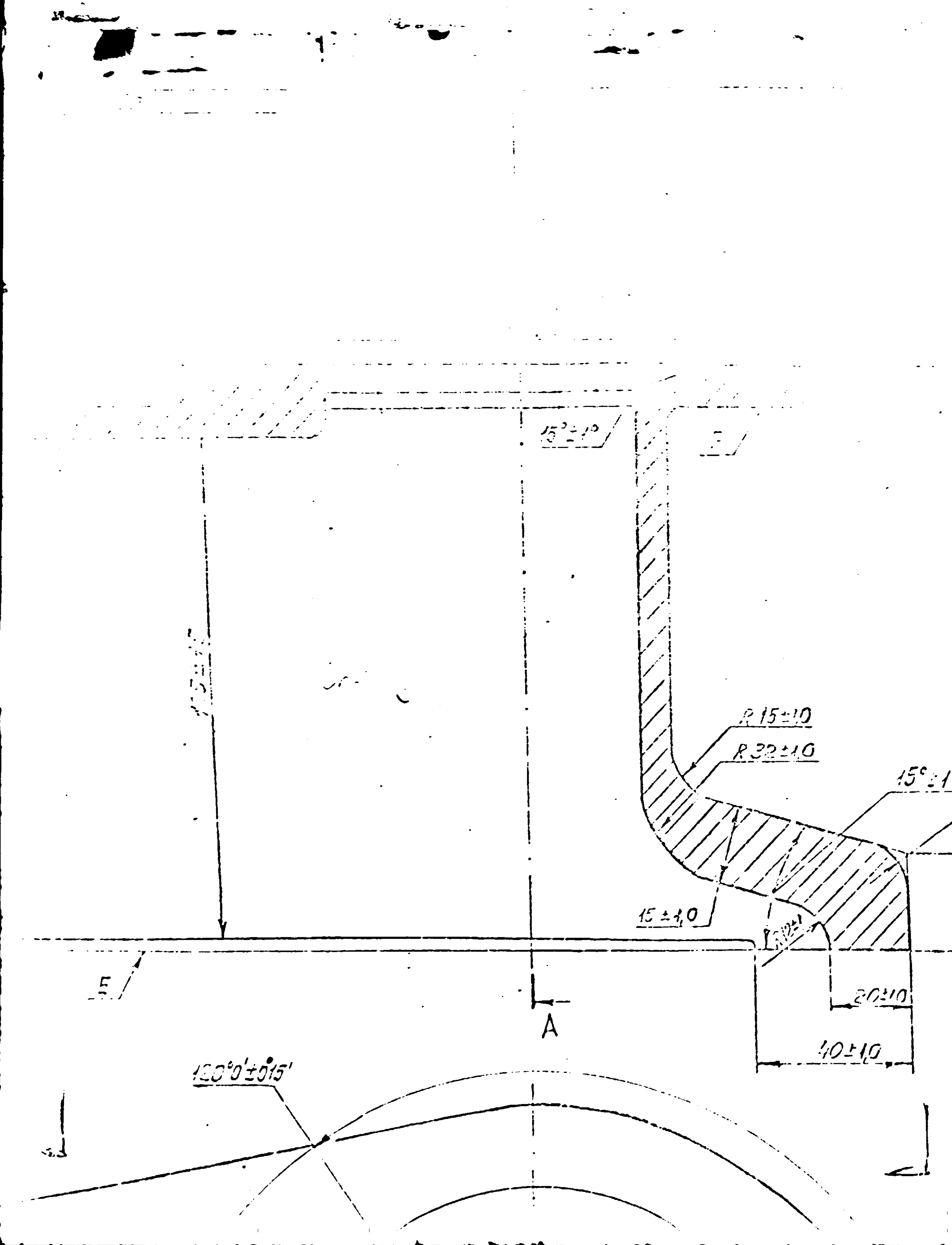
Chief Designer



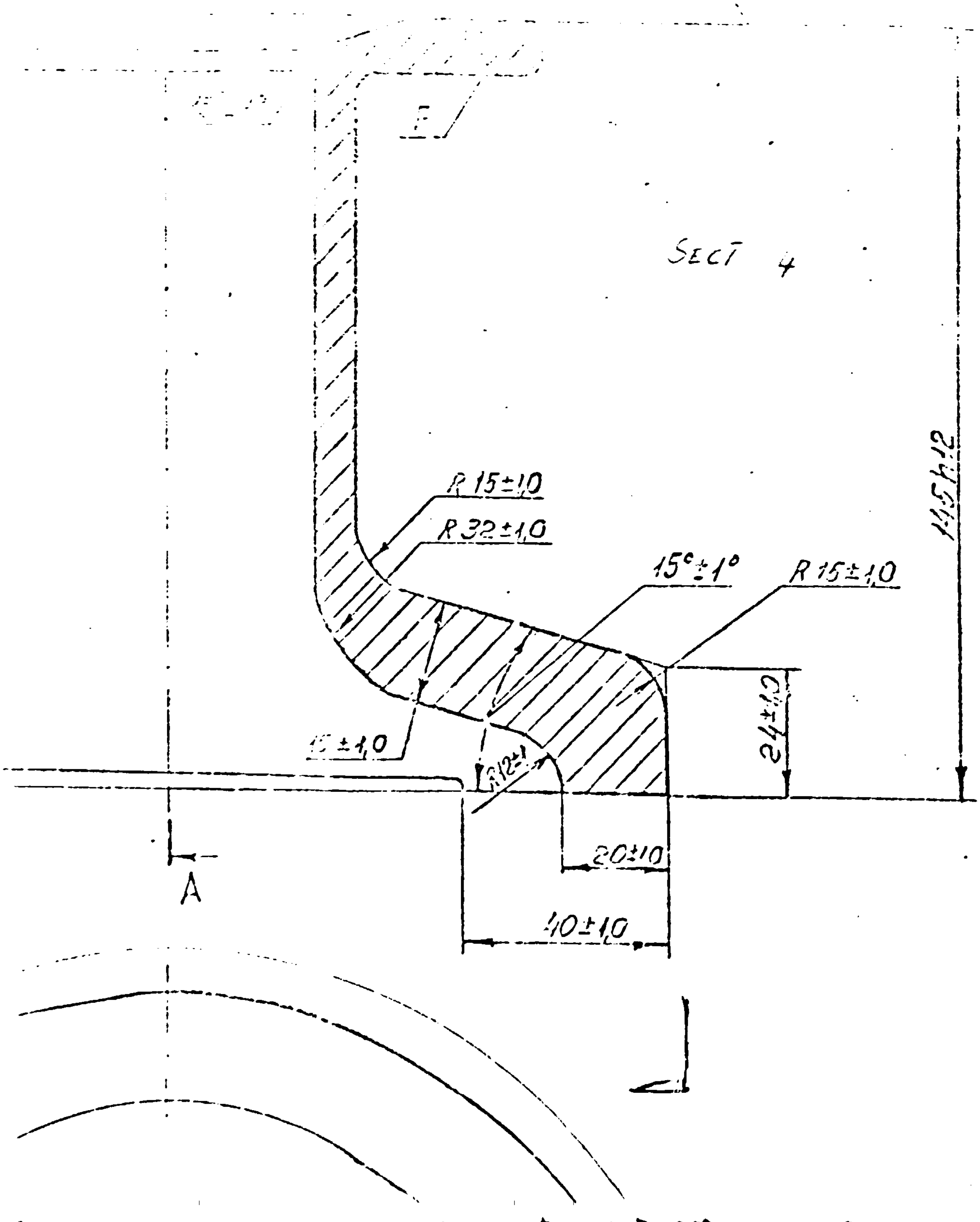
A-A
270°0'±0°15'
R 15±1
R 32±1
15±1,0
15°±1°
R 12±1,0
15°±1°
20±1
100±0,5
180°0'±0°15'
SECTION 1

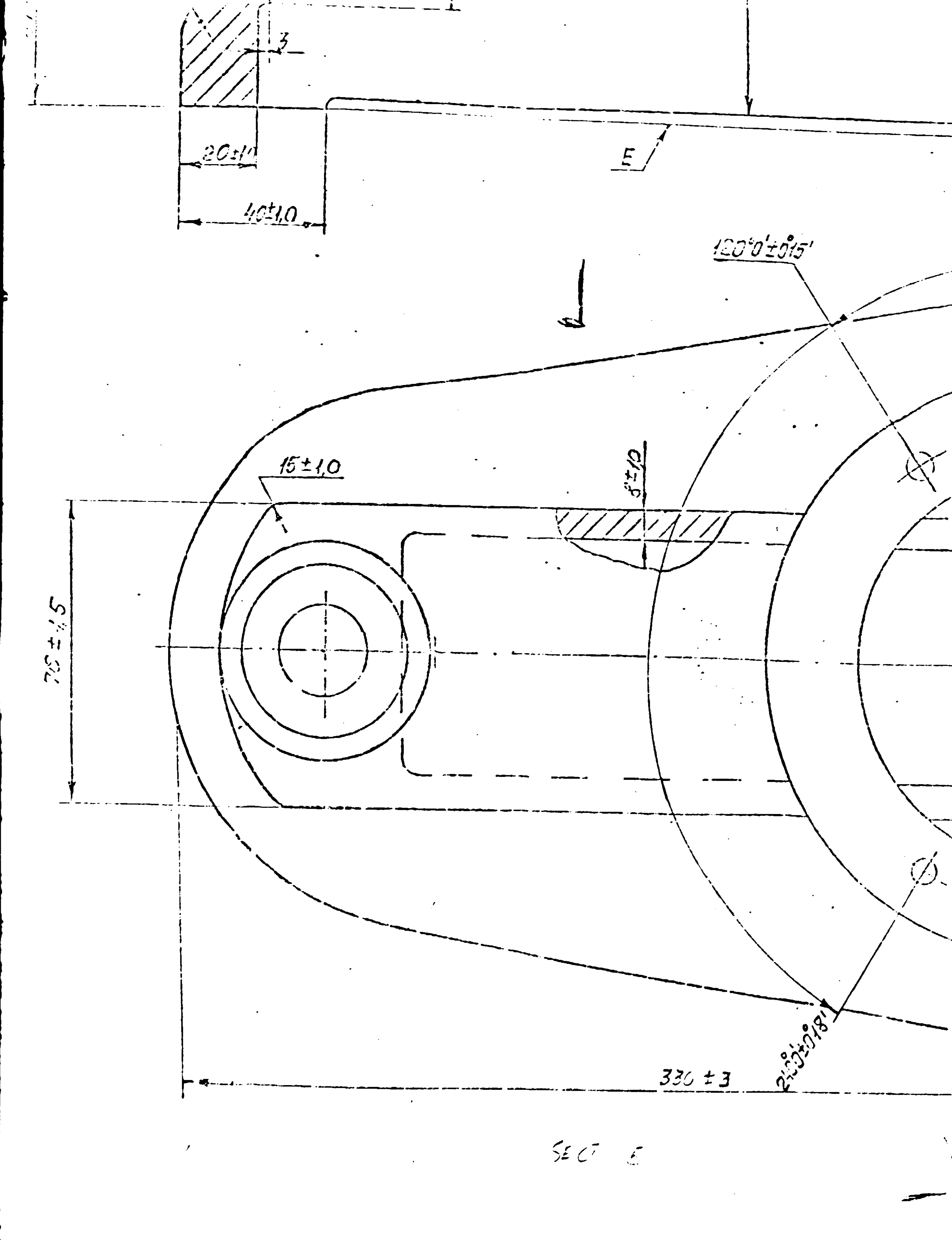


20±1,0
R 5±1,0
8 ±1,0
3,2
6,3
0,8
1,6
D
6,3
4×Φ4,5
Φ28 ±0,1
R 10±1
47±0,2
3
20±1,0
40±1,0

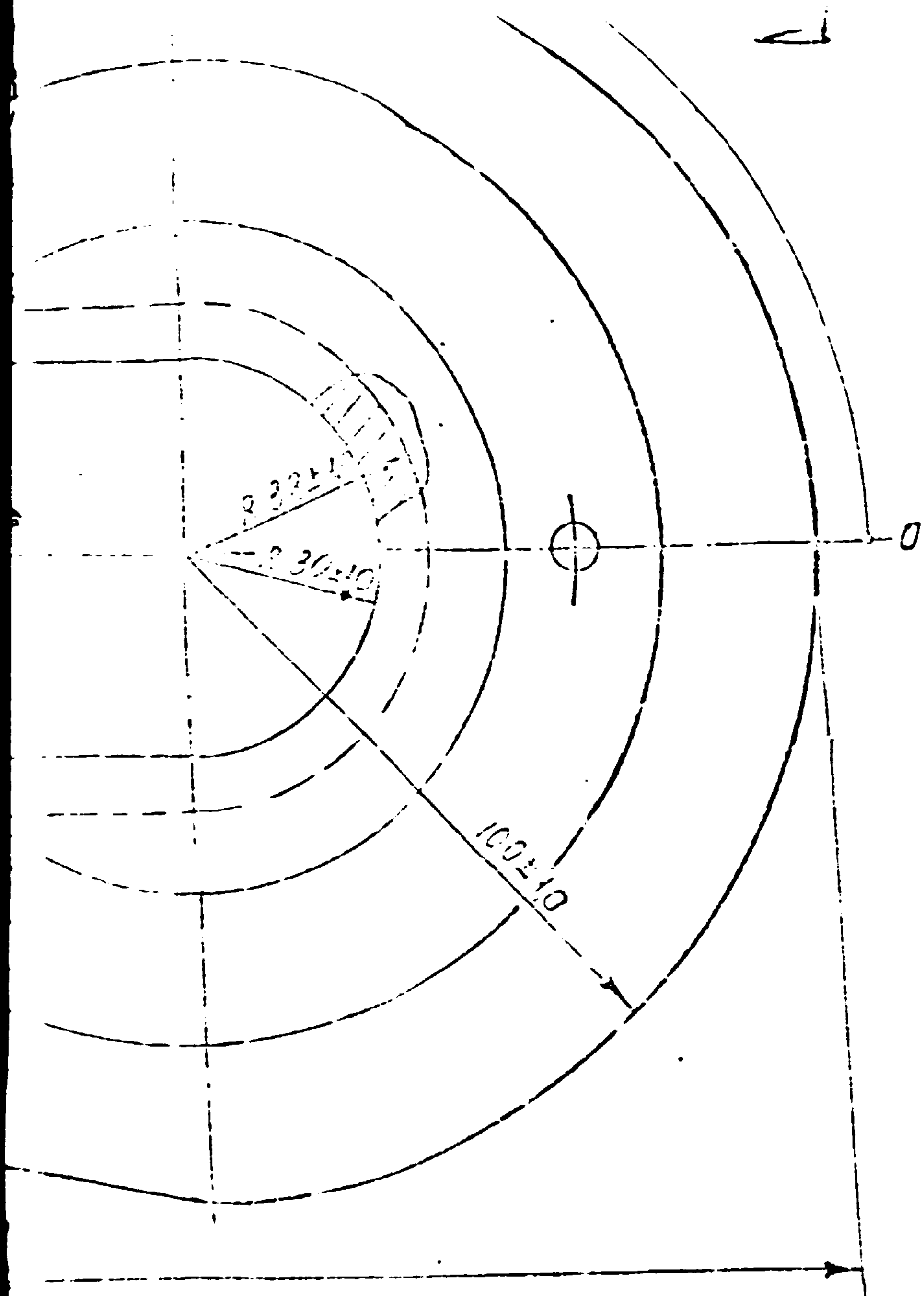


15°±1°
R 15±1,0
R 32±1,0
15 ±1,0
20±1,0
40±1,0
A
120°0'±0°15'


SECT 4
R 15±1,0
R 32±1,0
15°±1°
R 15±1,0
145 h12
24±1,0
15±1,0
R12±1
20±1,0
40±1,0
A



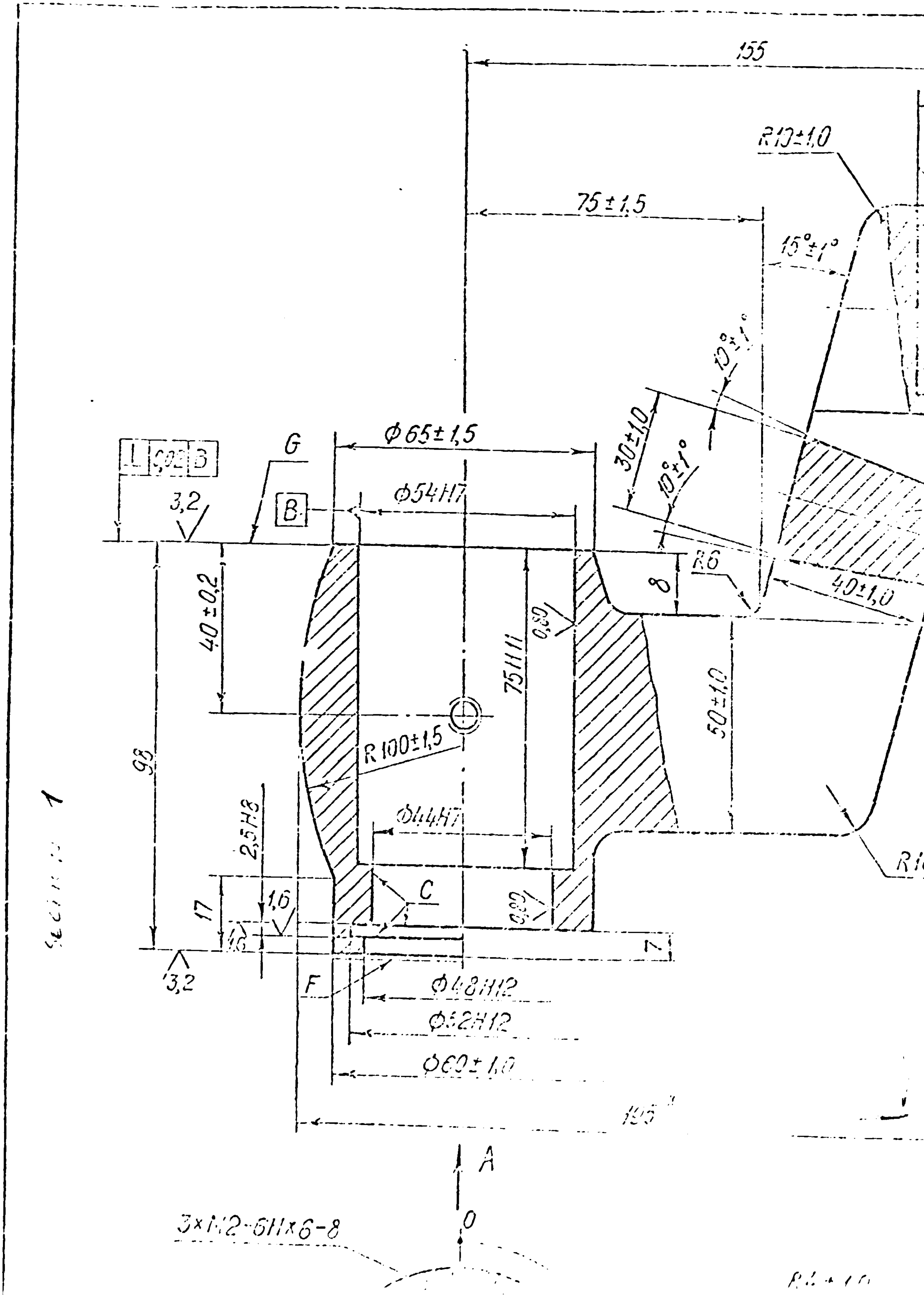
3
20±1,0
40±1,0
E
120°0'±0°15'
15±1,0
8±1,0
70±1,5
240°0'±0°18'
330 ±3
SECT E



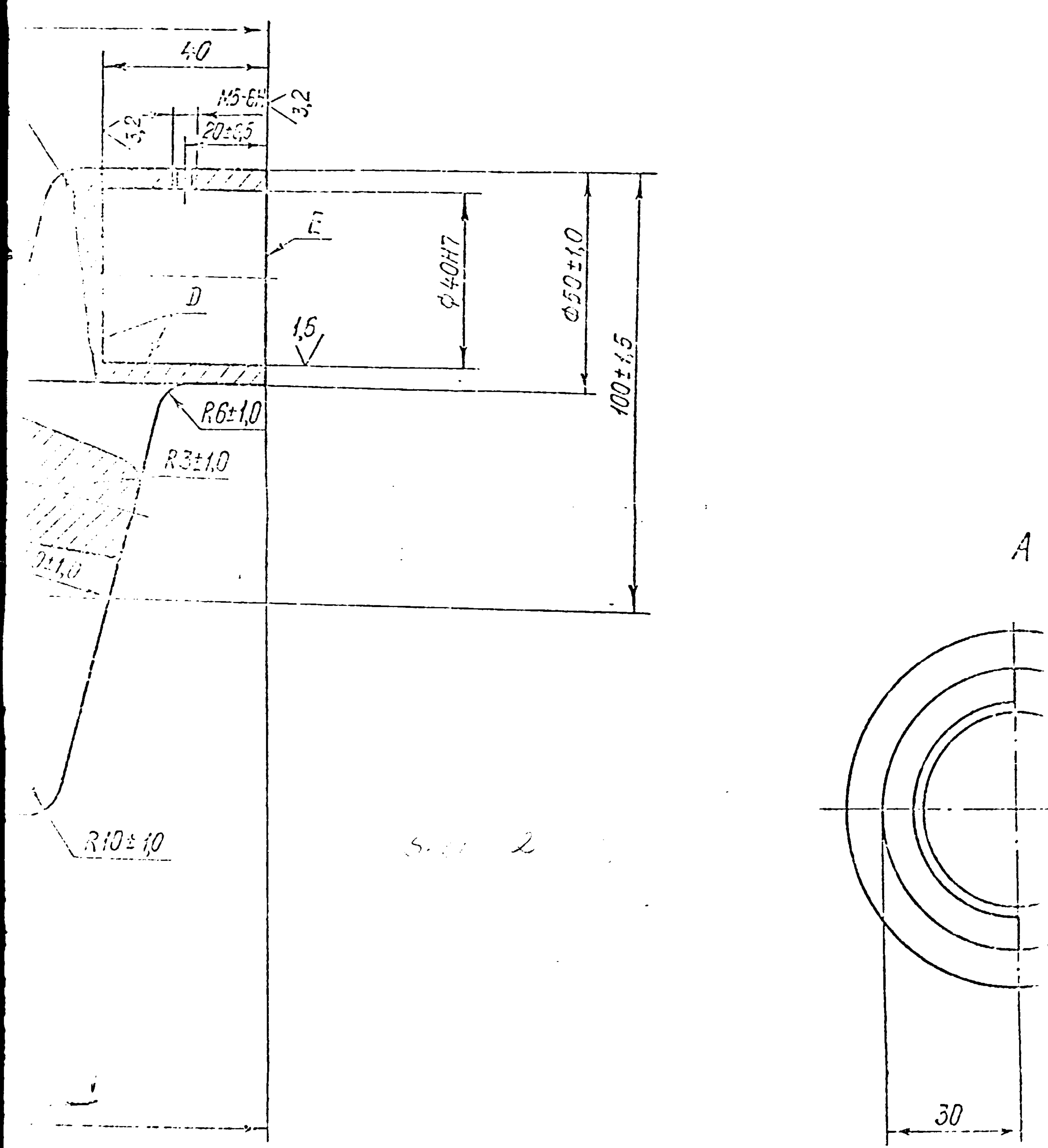
1. H14; h14; $\pm\frac{IT14}{2}$
2. Casting radiuses which are not indicated are 3mm
3. Coating Chemical phosphating chromatizing grey enamel except for the surfaces B, C, D, E, F

320.153	
Base	Mass / Scale 1:1
	Sheet / Sheets 1
Grey iron	

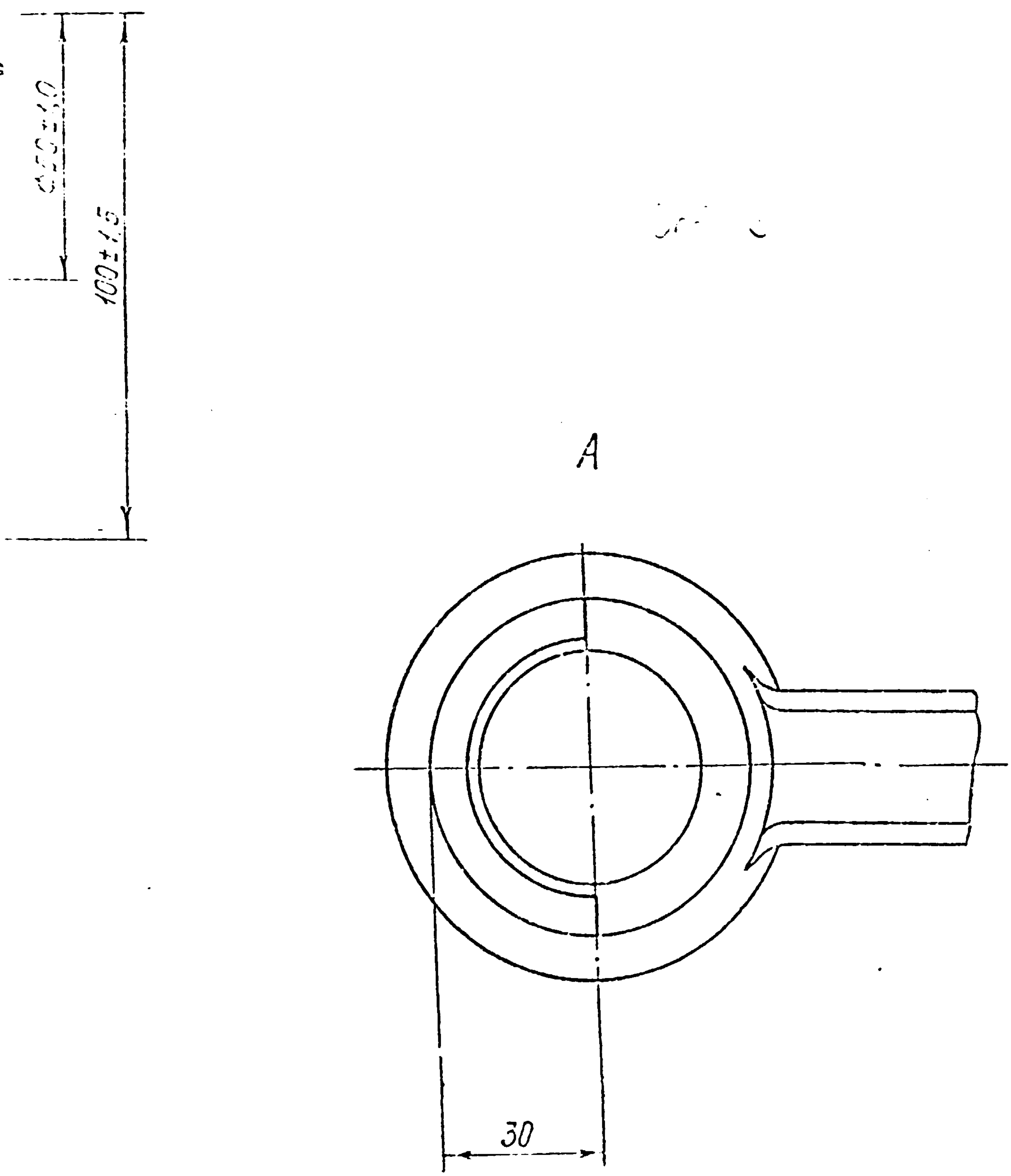
Chief



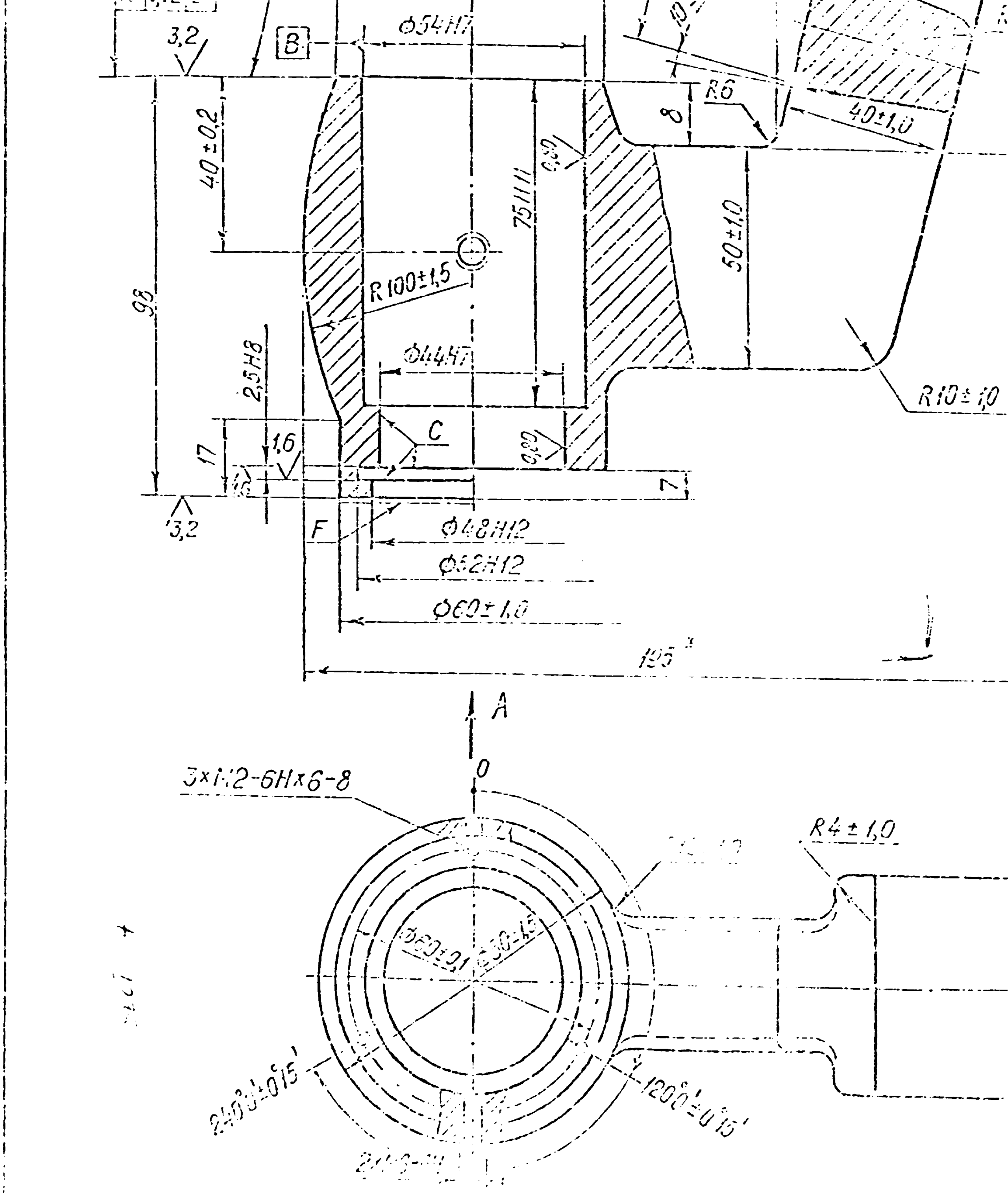
155
R10±1,0
75±1,5
15°±1°
10°±1°
30±1,0
10°±1°
Φ65±1,5
G
0,02 B
B
Φ54H7
3,2
R6
8
40±1,0
40±0,2
0,80
75H11
50±1,0
R100±1,5
98
2,5H8
Φ44H7
C
17
1,6
0,80
7
3,2
F
Φ48H12
Φ52H12
Φ60±1,0
A
0
3×M2-6H×6-8



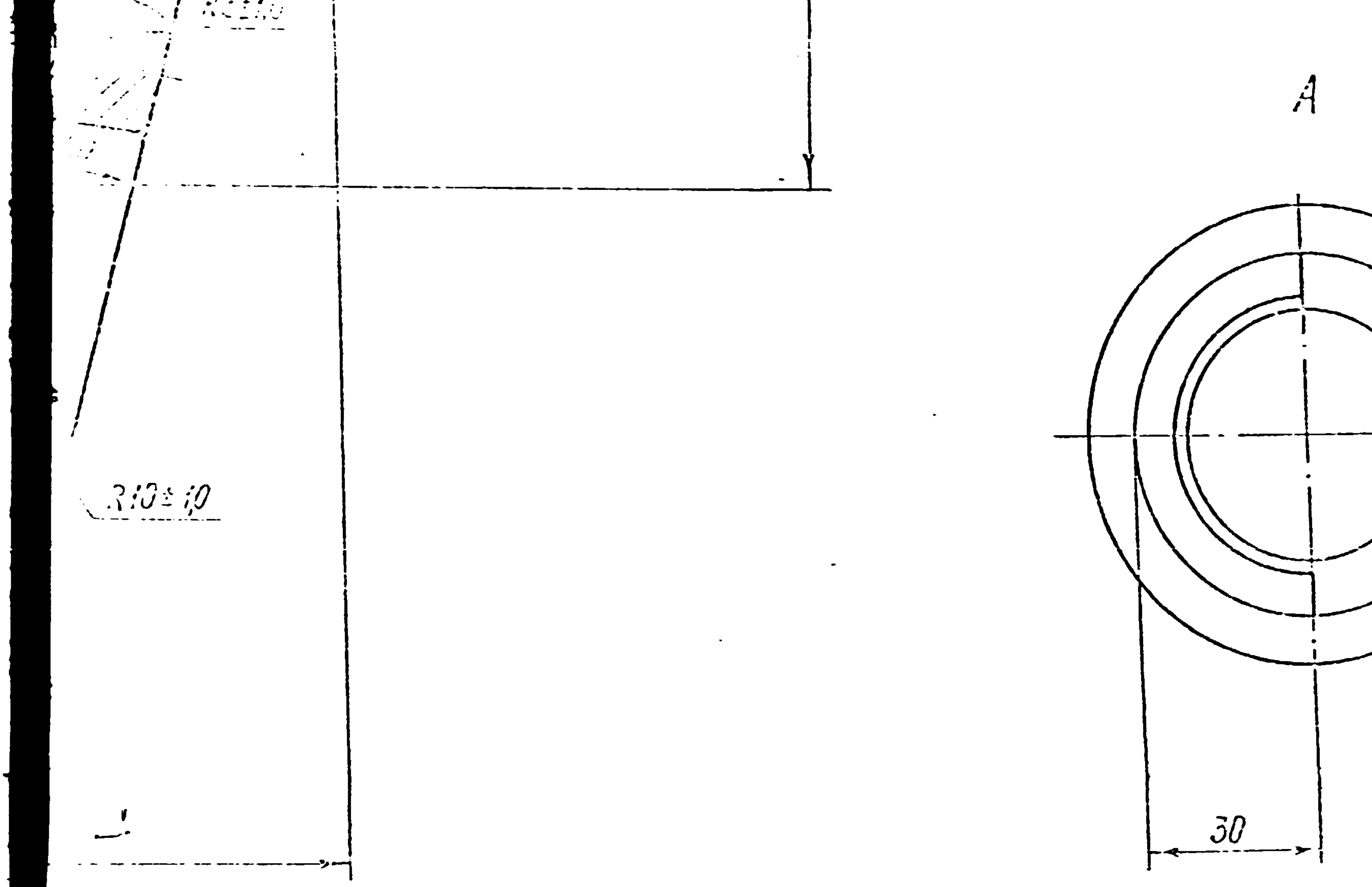
1. H14, h14, $\pm \frac{IT14}{2}$



H14, h14 ± $\frac{IT14}{2}$



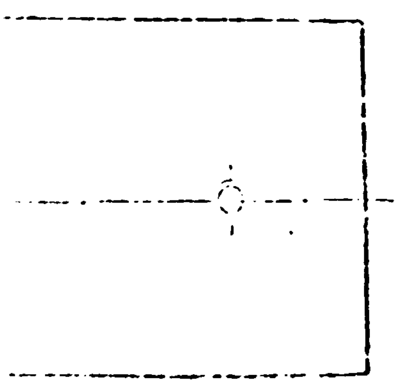
3,2
B
Ф54H7
40±0,2
98
R100±1,5
75H11
R6
8
40±1,0
50±1,0
R10±1,0
Ф44H7
2,5H8
C
17
1,6
7
3,2
F
Ф48H12
Ф60±1,0
195
A
0
3×M12-6H×6-8
R4±1,0
Ф60±0,1
120°±0°15'
240°±0°15'



1. $H14, h14, \pm \frac{IT14}{2}$

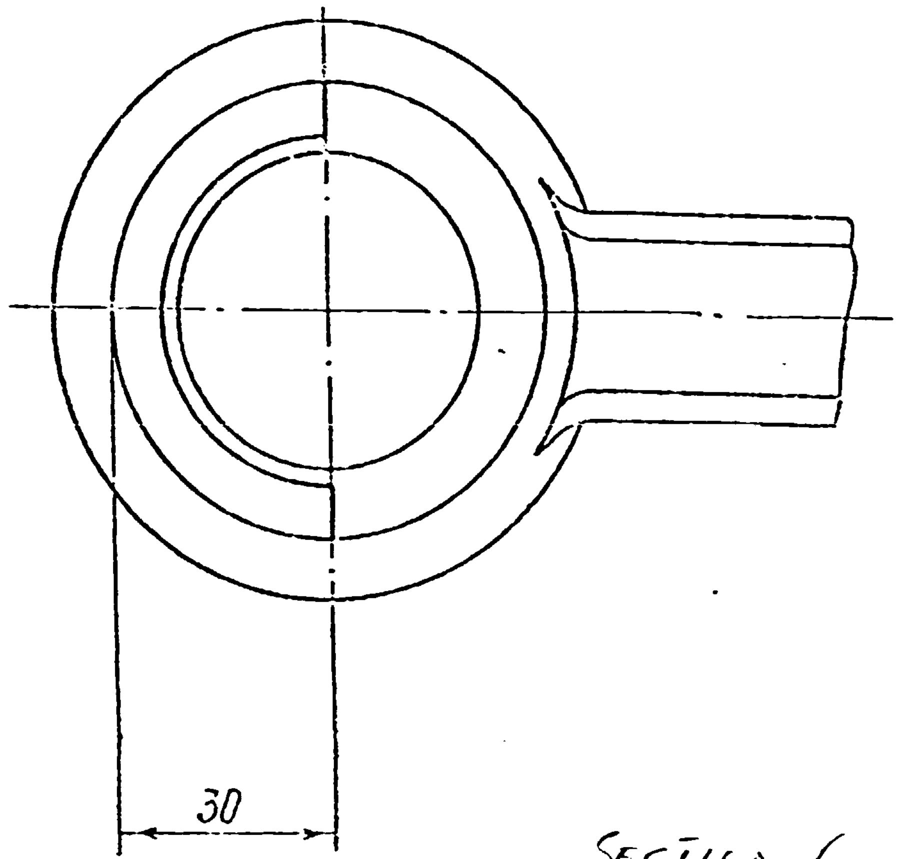
2. Gasting radius
are 3 mm

3. Casting Chemi
grey enamel
B, C, D, E, F, G



SECT E

A



SECTION 6

1. H14, h14, $\pm \frac{IT14}{2}$

2. Casting radiuses which are not indicated are 3 mm

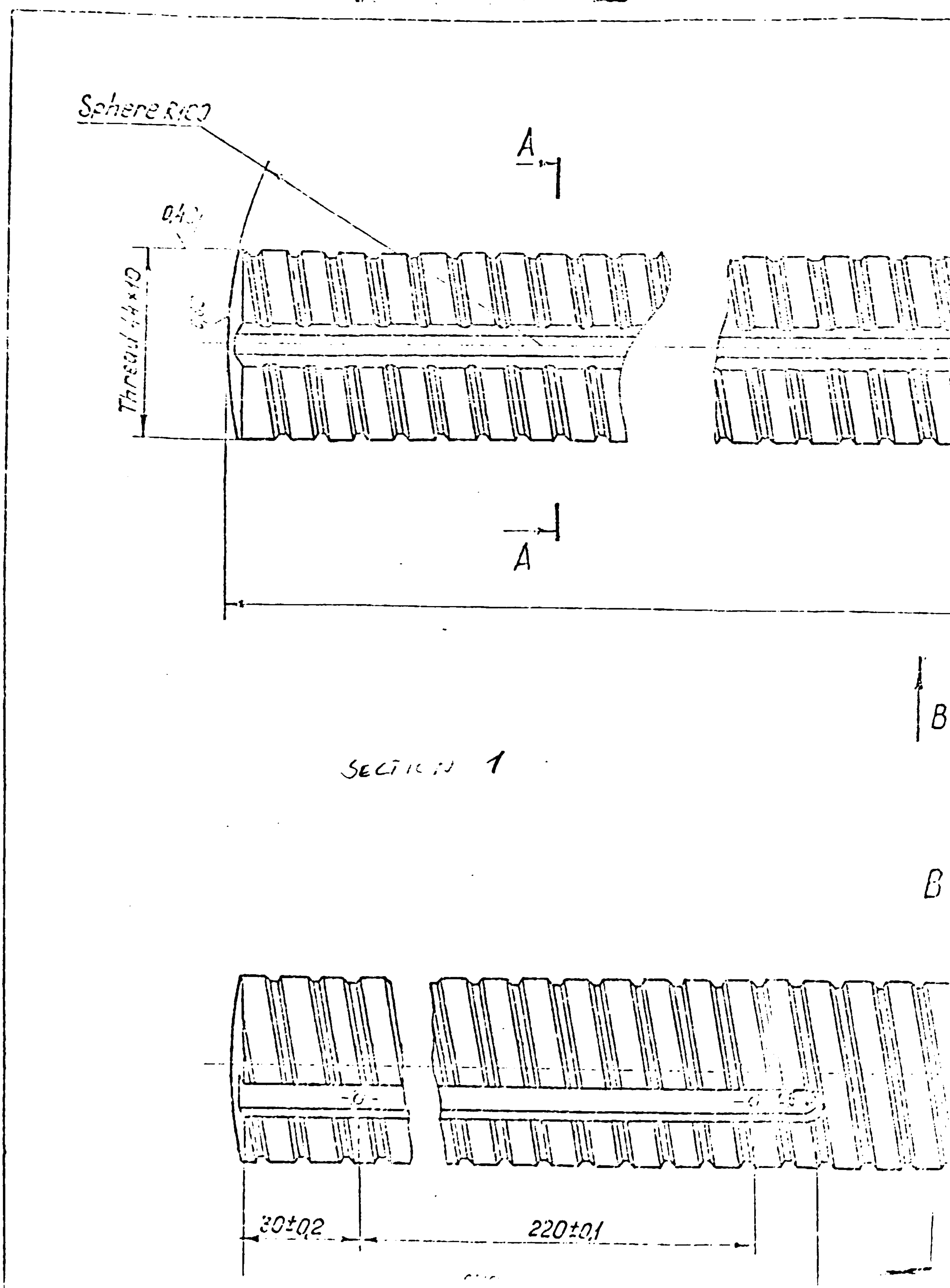
3. Coating Chemical phosphating chromatizing grey enamel except for the surfaces B, C, D, E, F, G

320.154

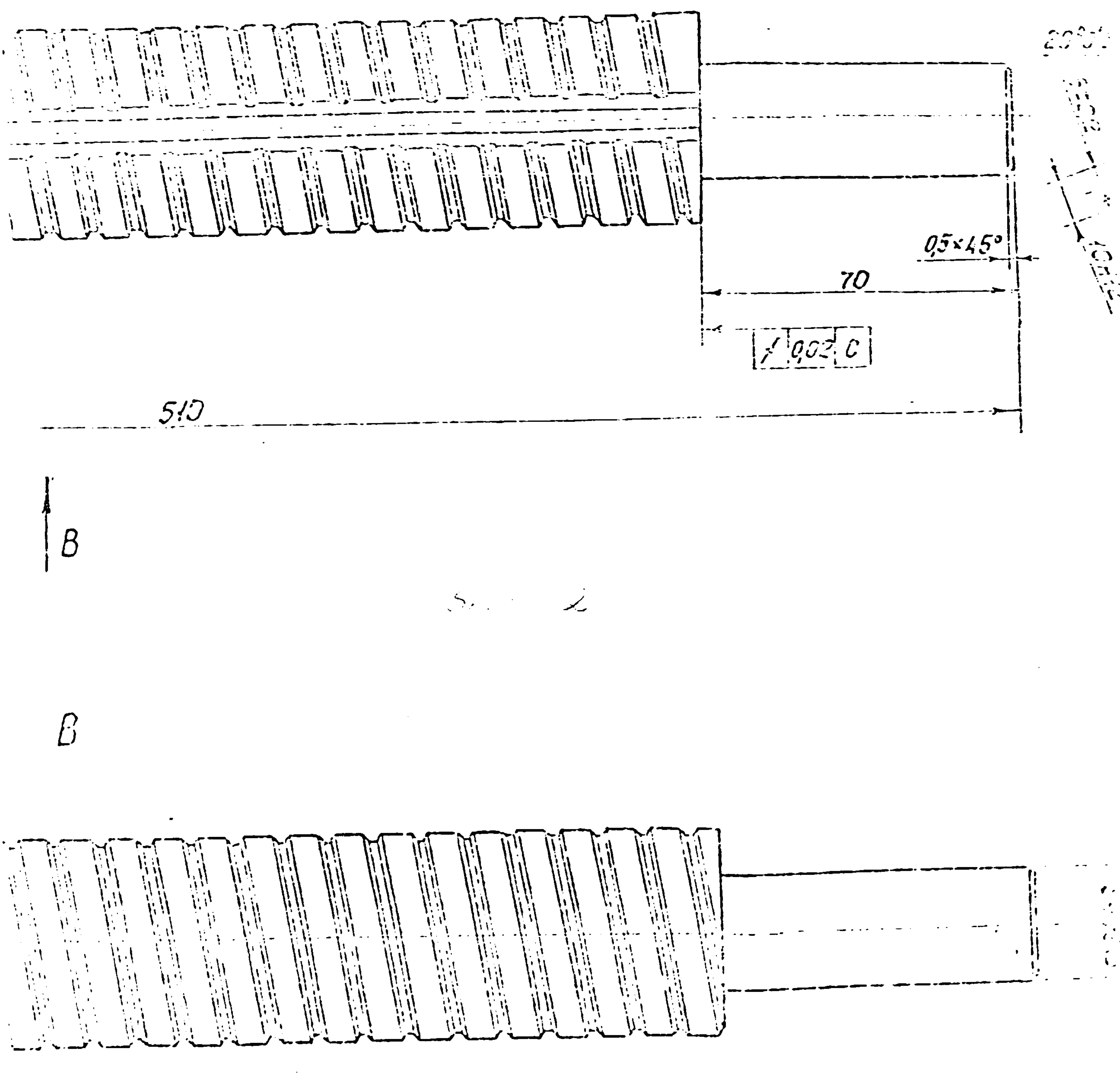
Stand

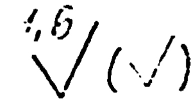
1:1

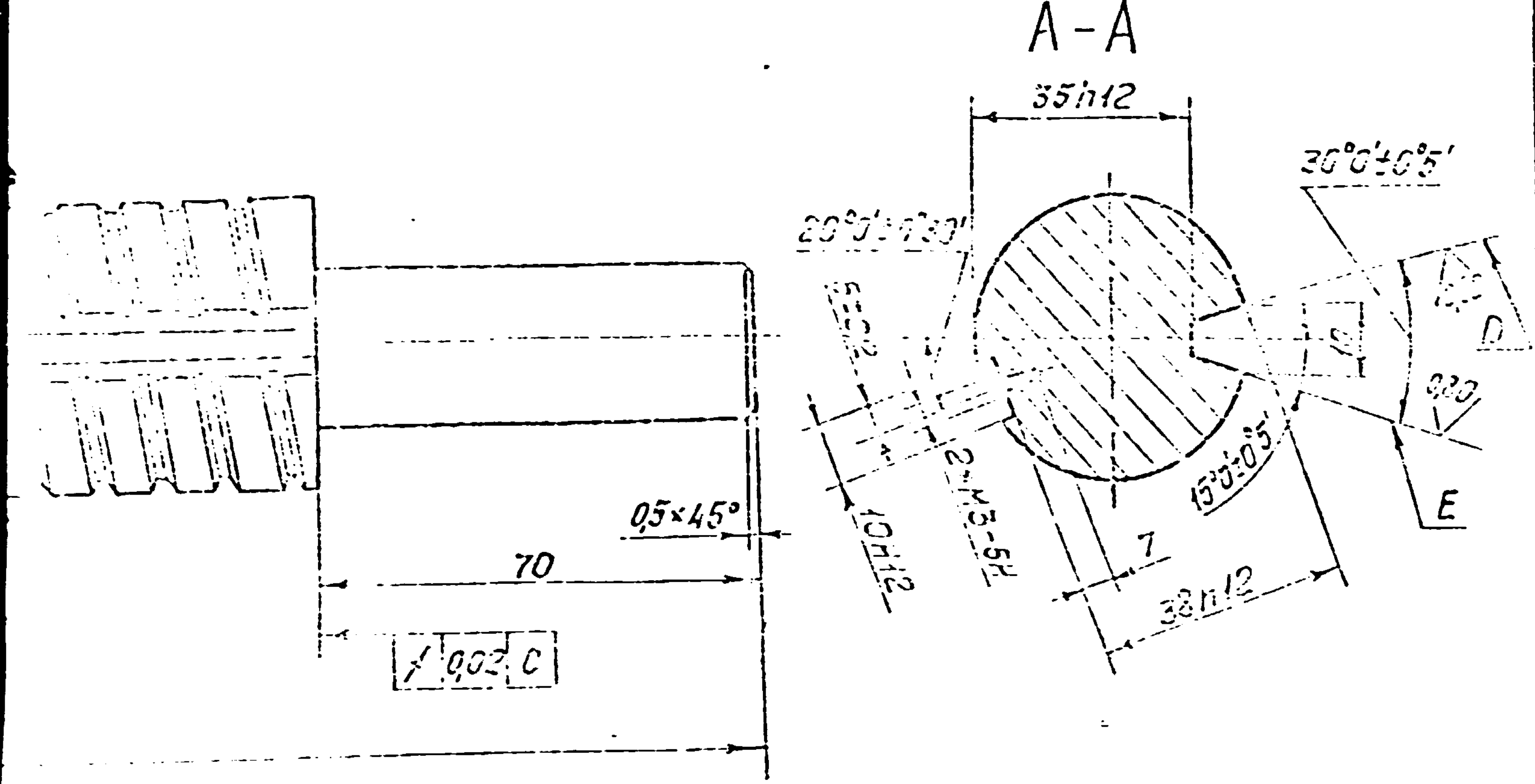
Grey iron castings

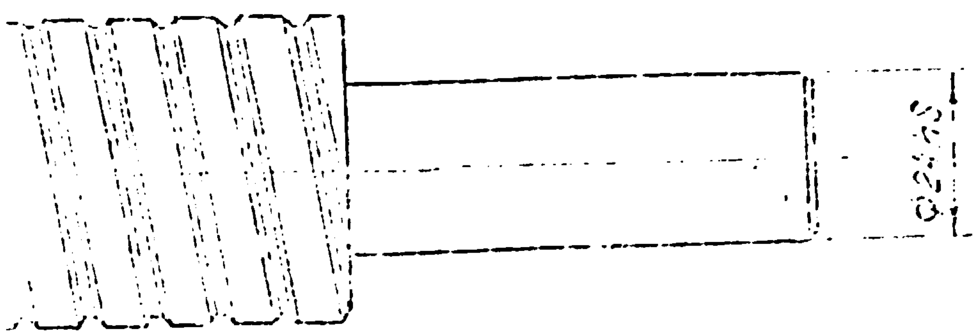


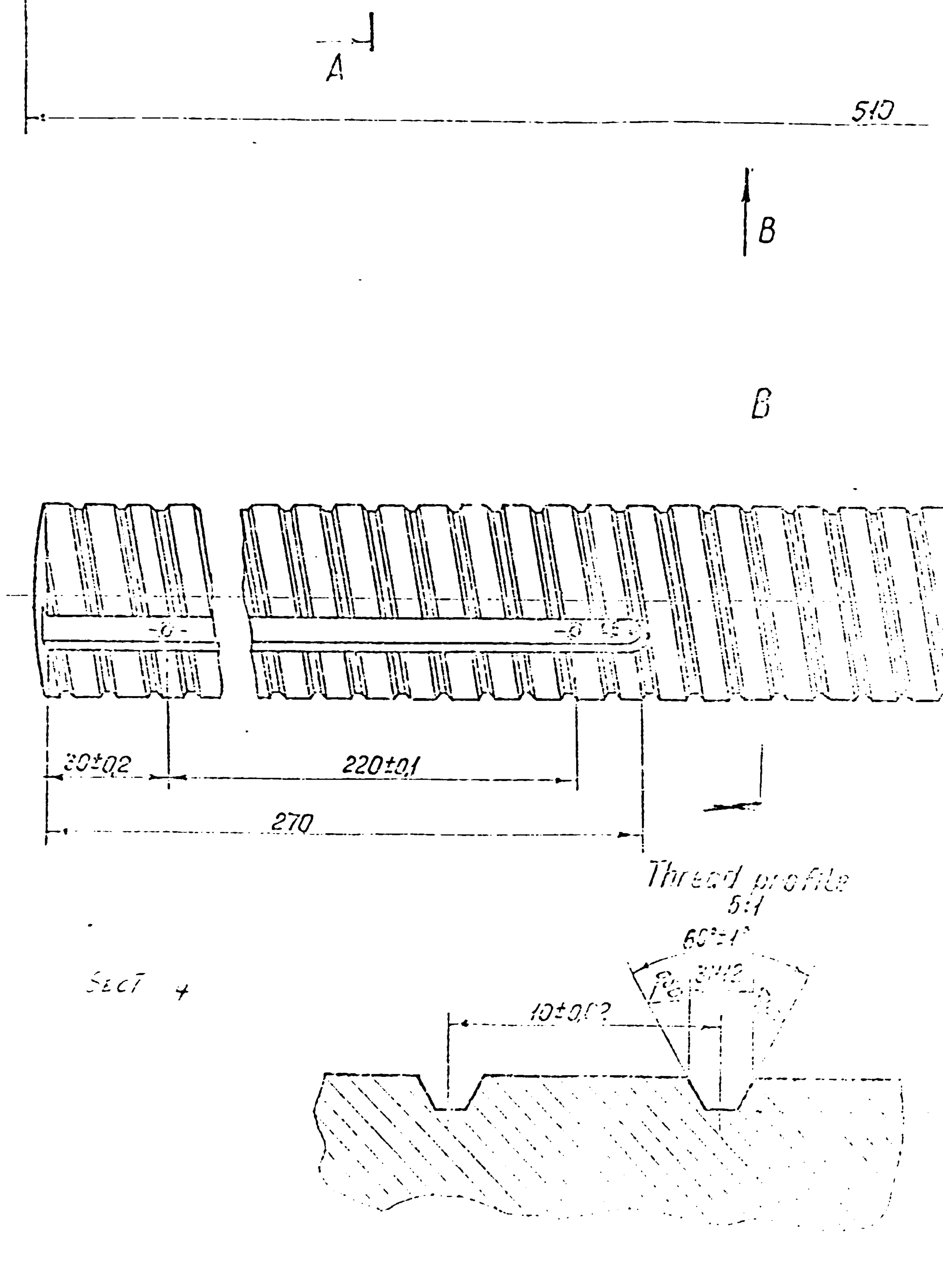
Sphere R100
A
0,4
Thread 44×10
A
B
SECTION 1
B
30±0,2
220±0,1

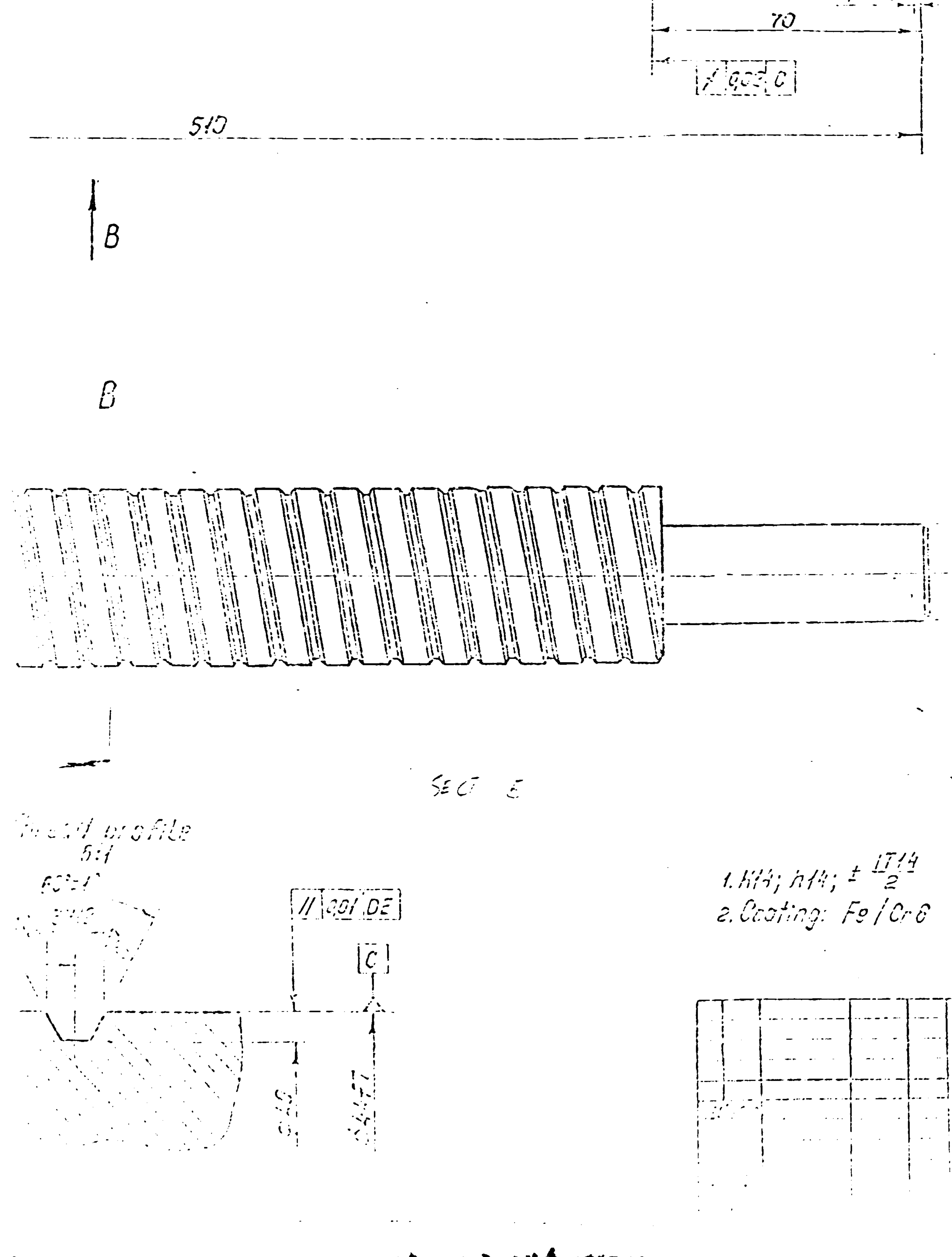

0,5×45°
70
0,02 C
510
B
B

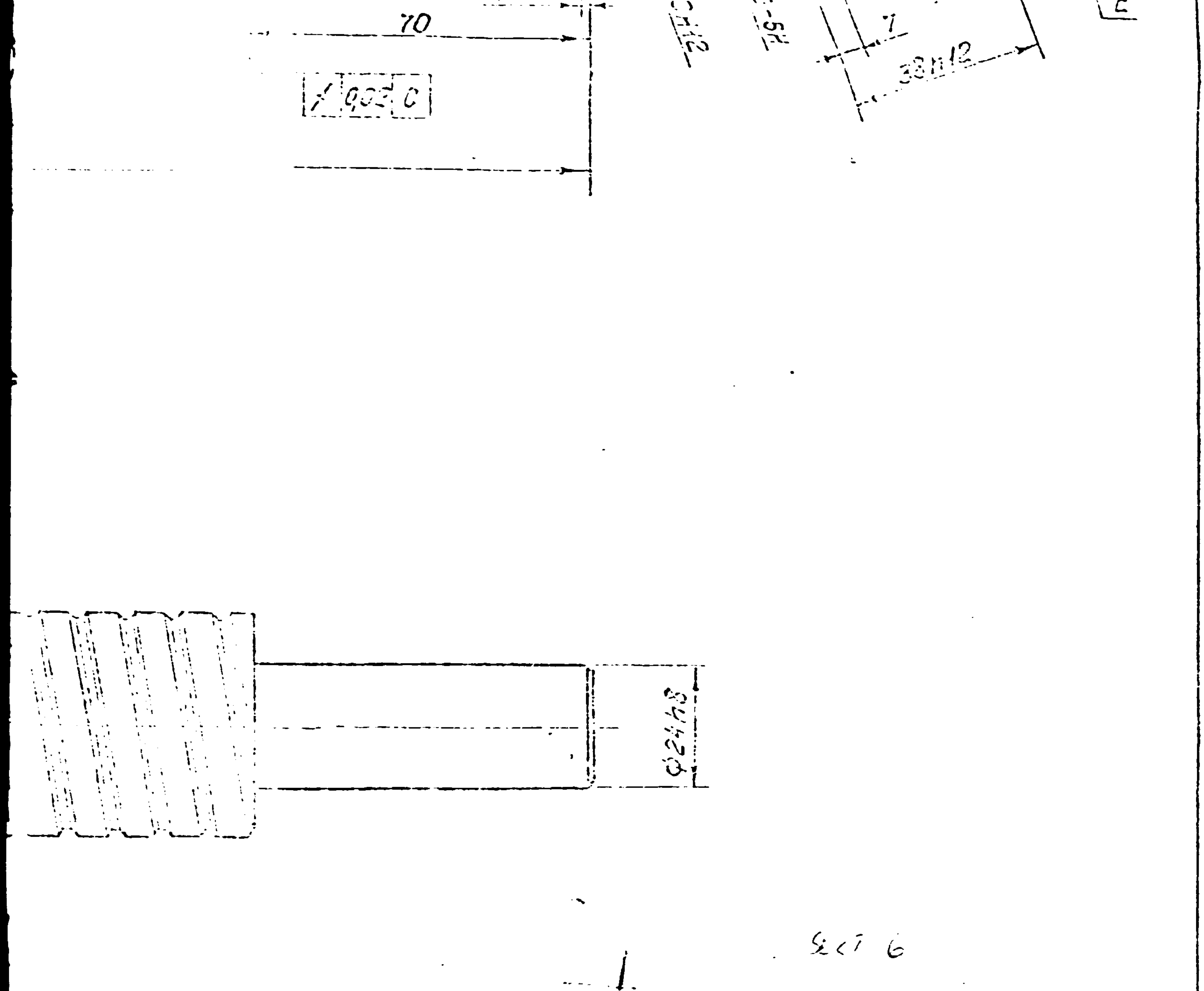

1,6


A-A
35h12
30°0'±0°5'
20°0'±1°30'
0,5×45°
70
0,02 C
10h12
2-M5-5H
7
38h12
15°0'±0°5'
D
E




A
510
B
B
30±0,2
220±0,1
270
Thread profile
5:1
60°±1°
10±0,02


70
510
B
B
profile
5:1
// 0.01 DE
C
1. h14; h14; ± IT14/2
2. Coating: Fe/Cr6

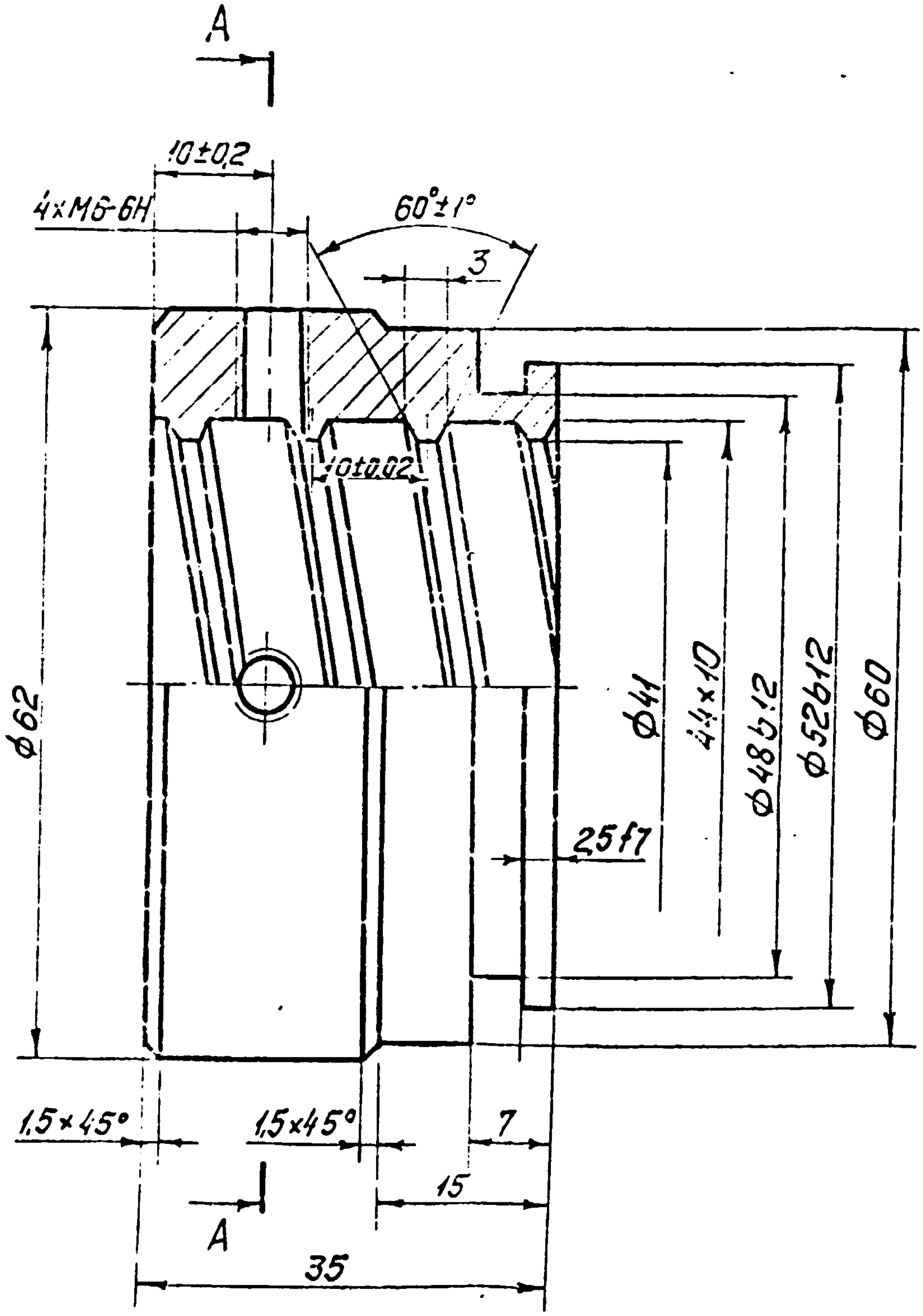


1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating: Fe/Cr6

320.155

Column

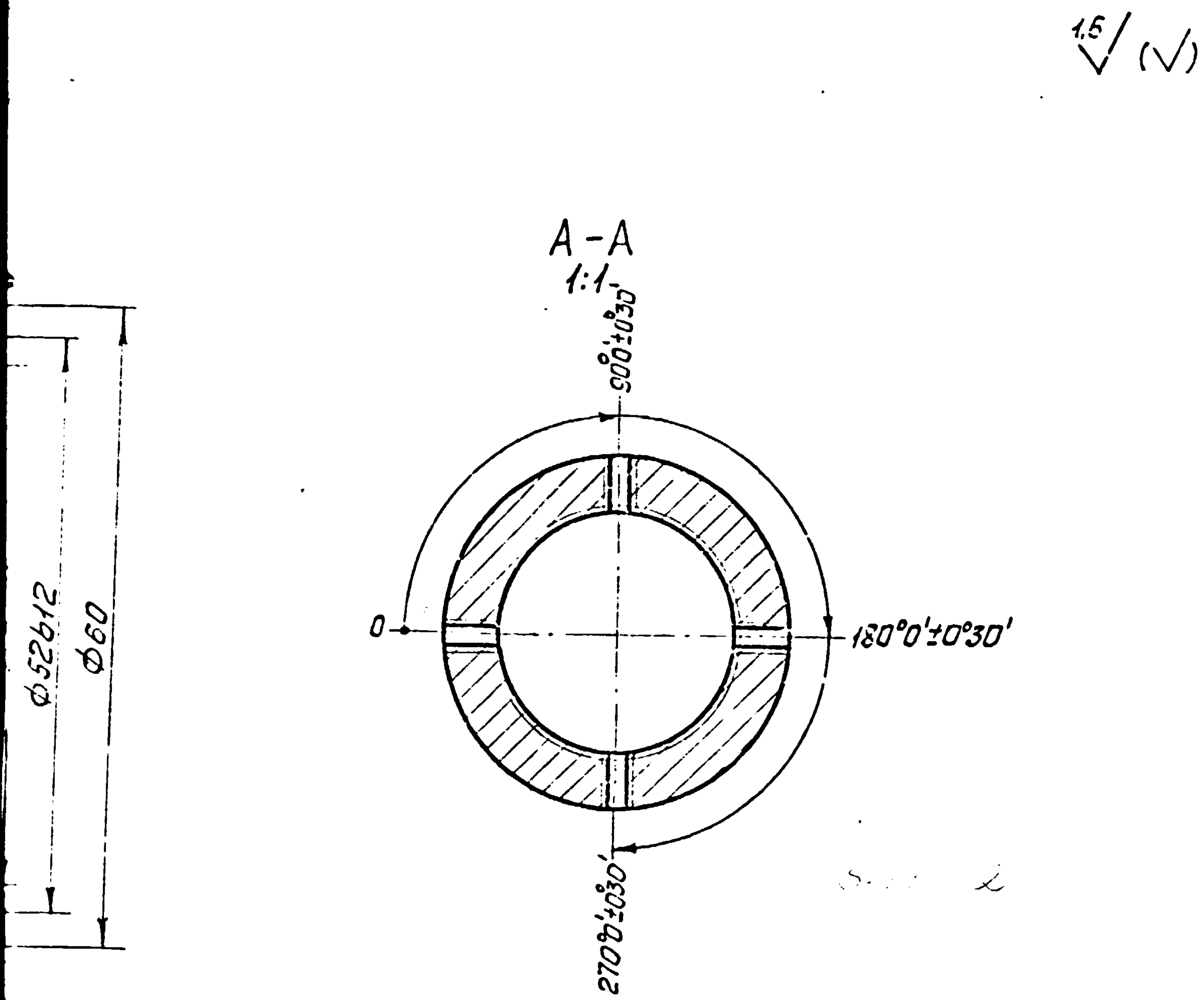
1:1



1. H!4;
2. Coat

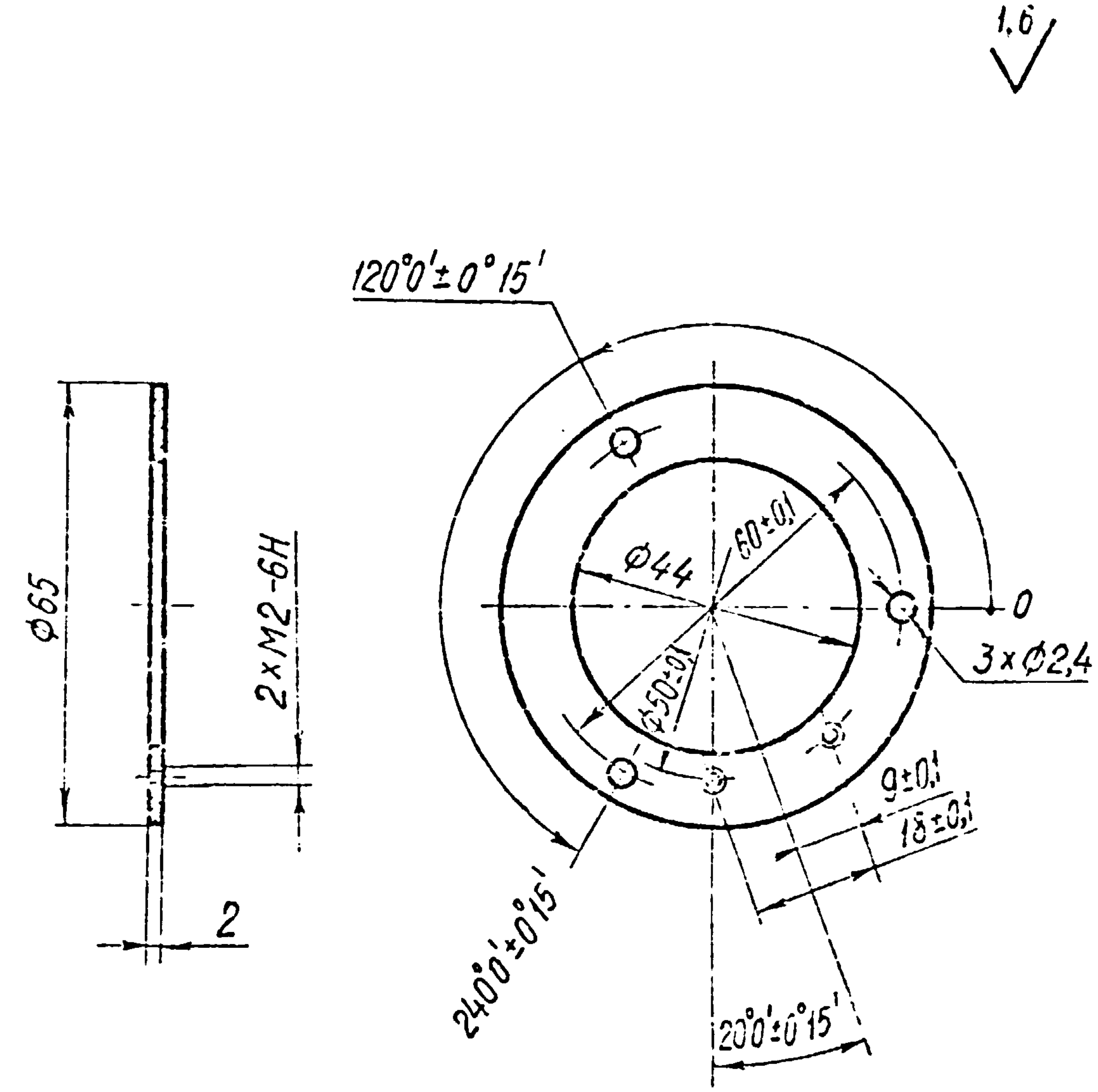
SECTION 1

Designer



1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating: Fe/Ni Cr6 for outside surfaces
   Fe/Ni 6 for inside surfaces

320.156			
Nut		Mass	Scale
			2:1
		Sheet	Sheets 1
Steel 20	LITMO		
Designer			
Chief Designer			

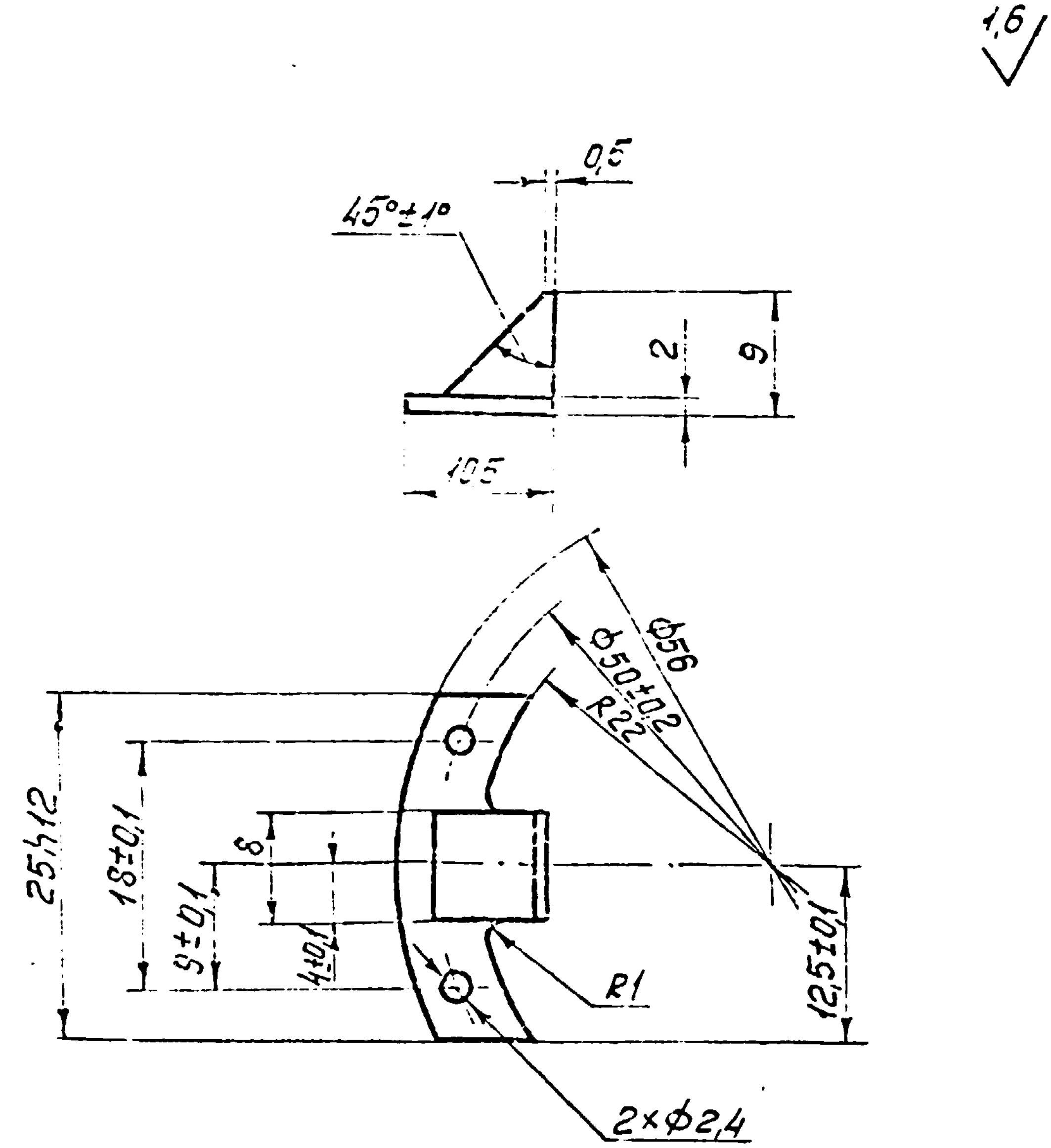


1. H14, h14, $\pm \frac{IT14}{2}$

2. Coating Fe/Ni Cr12

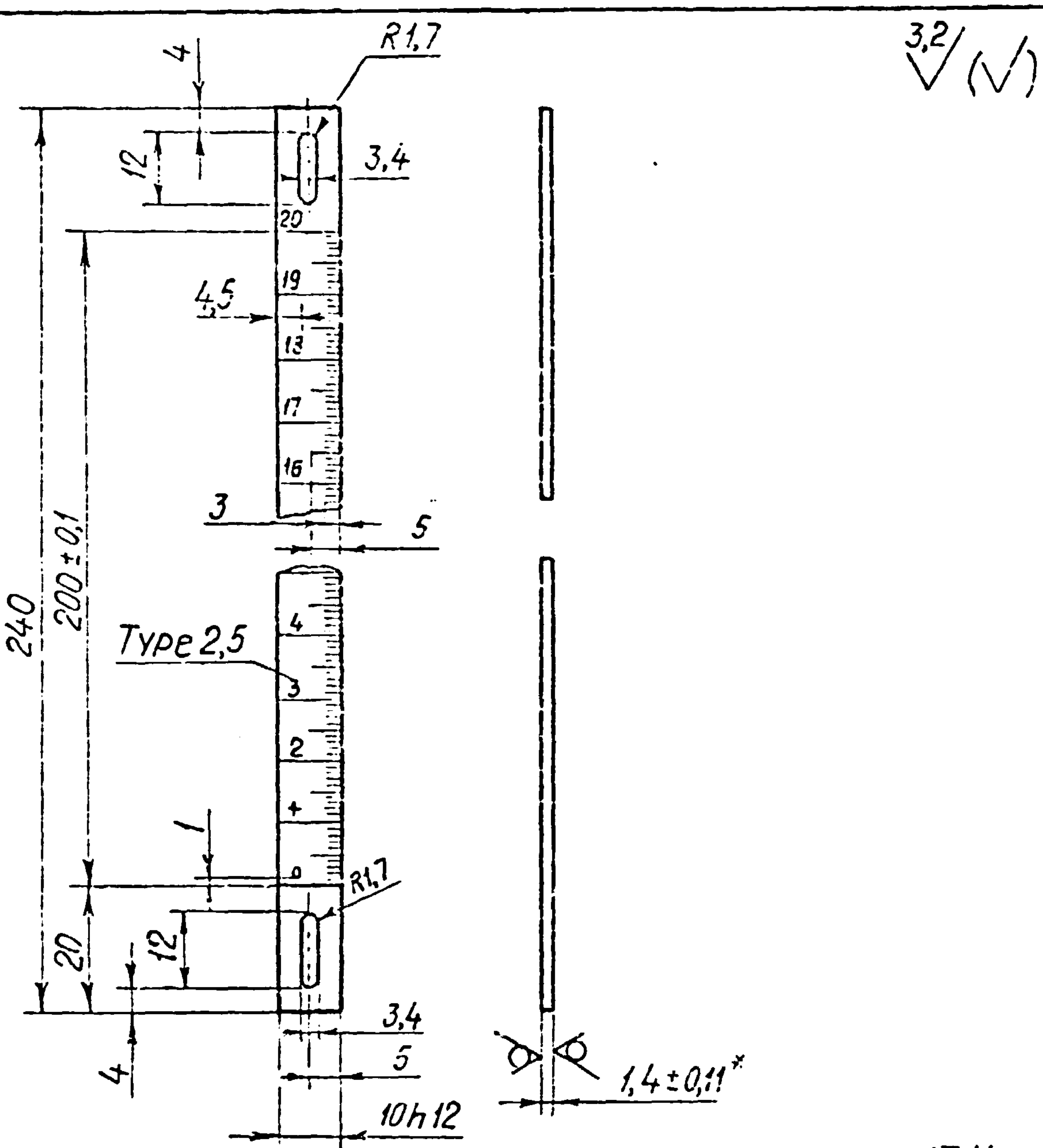
320. 157		
Ring	Mass	Scale
		1:1
Designer	Sheet	Sheets
Chief Designer	Steel 20	LITMO

Form A4



1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating: Fe/Ni Cr12

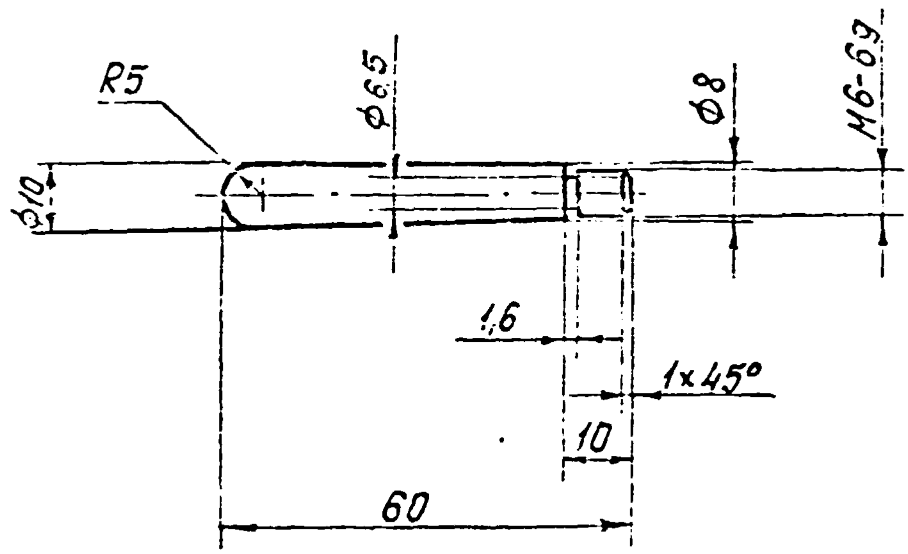
320.158			
Index	Mass	Scale	
		2:1	
	Sheet	Sheets 1	
Steel 20	LITMO		



1.* The dimension for informamion. H14, h14, ± $\frac{IT14}{2}$
2. Scale factor 1 mm
3. Scale factor tolerance from the zero line up to any one to follow is ±0,1 mm
4. Line thickness 0,2±0,05 mm
5. Engrave the scale and the figures. Fill black enamel
6. Coating Fe/Ni Cr12 mat finish

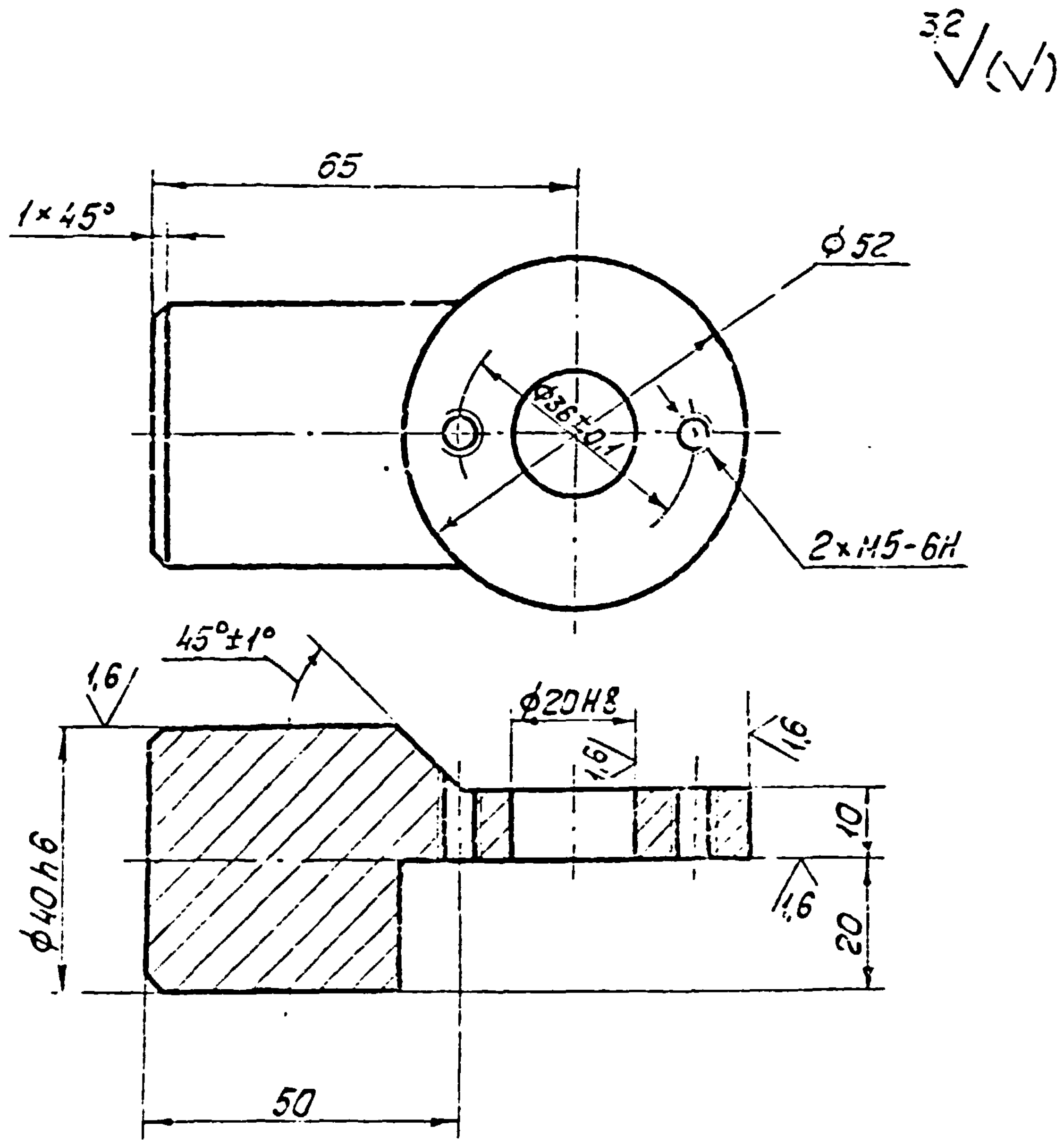
320.159				
Designer	Scale	Mass	Scale	
			1:1	
		Sheet	Sheets 1	
Chief Designer	Steel 10kn	LITMO		

1,6 √(√)



1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating: Fe/NiCr6 mat finish

320.161		
Knob	Mass	Scale
		1:1
	Sheet	Sheets 1
Steel 20	LITMO	

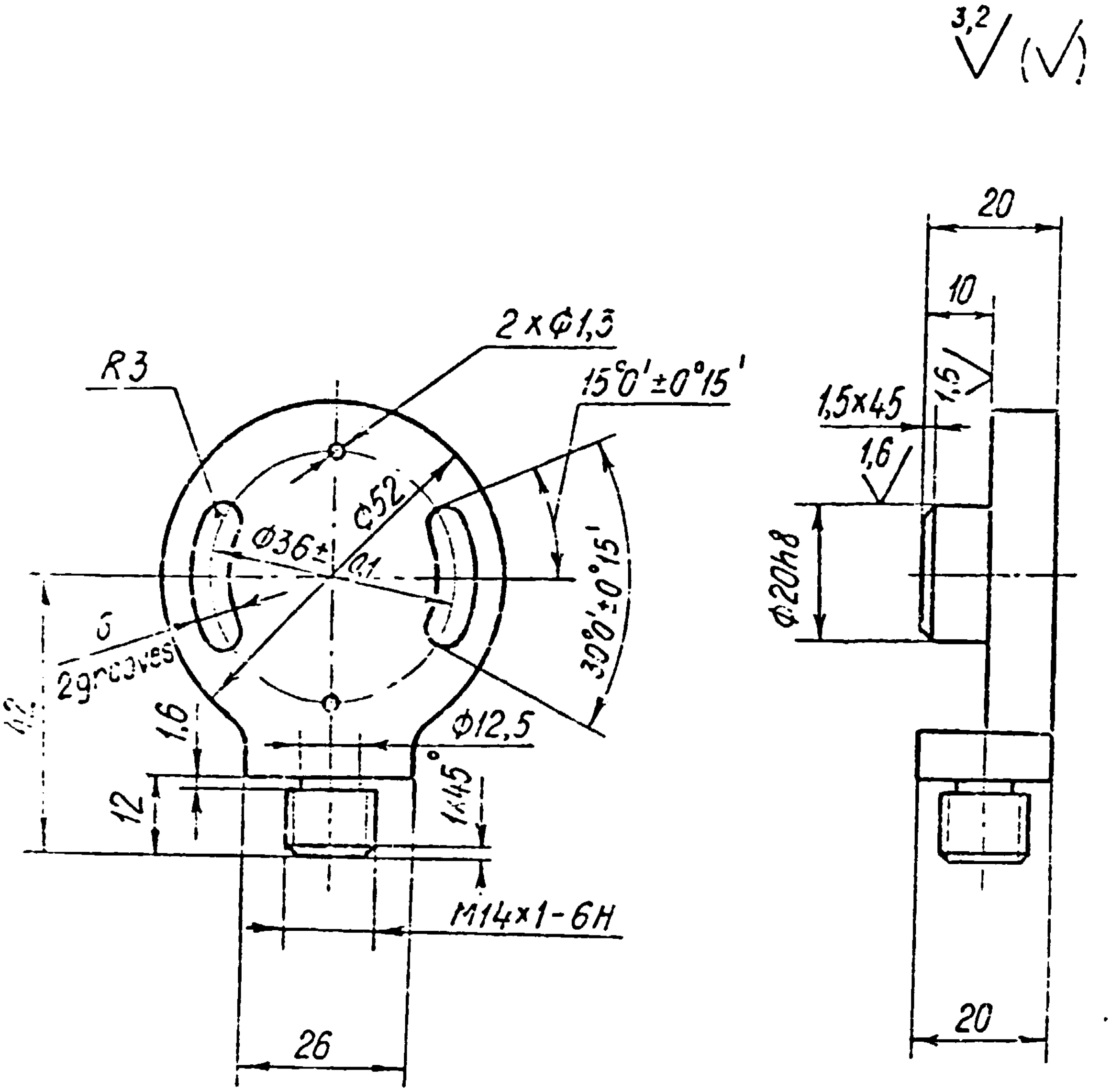


1. H14, h14, $\pm\frac{IT14}{2}$
2. Coating: Fe/Ni Cr 6 mat finish

320.162			
Axle	Mass	Scale	
		1:1	
	Sheet	Sheets 1	
Steel 20	LITMO		

Designer

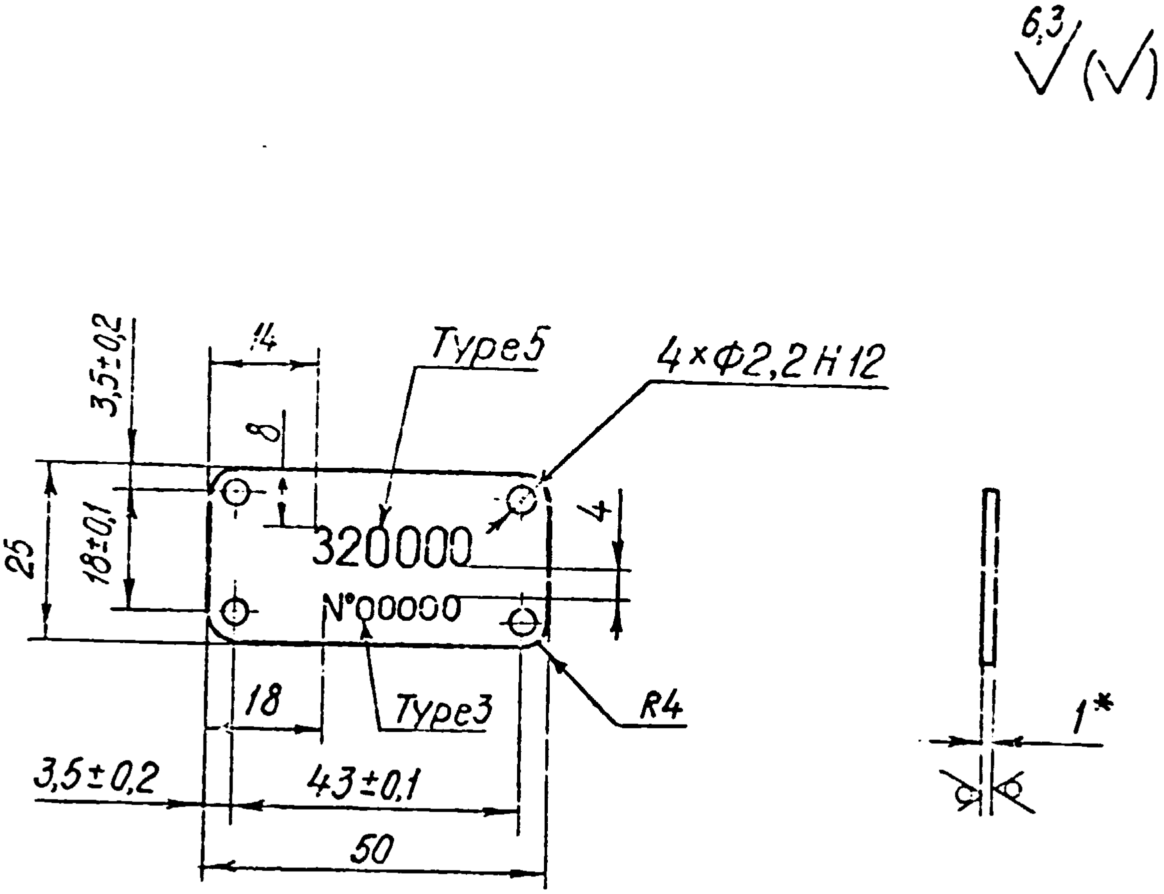
Chief Designer



1. H14, h14, $\pm \frac{IT14}{2}$
2. Coating Fe/Ni Cr9 mat finish

320. 163		
Head	Mass	Scale
		1:1
	Sheet	Sheets 1
Steel 20	LITMO	

Form A4



1. The dimension for information
2. H14, h14; $\pm \frac{IT14}{2}$
3. Engrave the figures

The first two figures - year of production, the others - order number of the unit

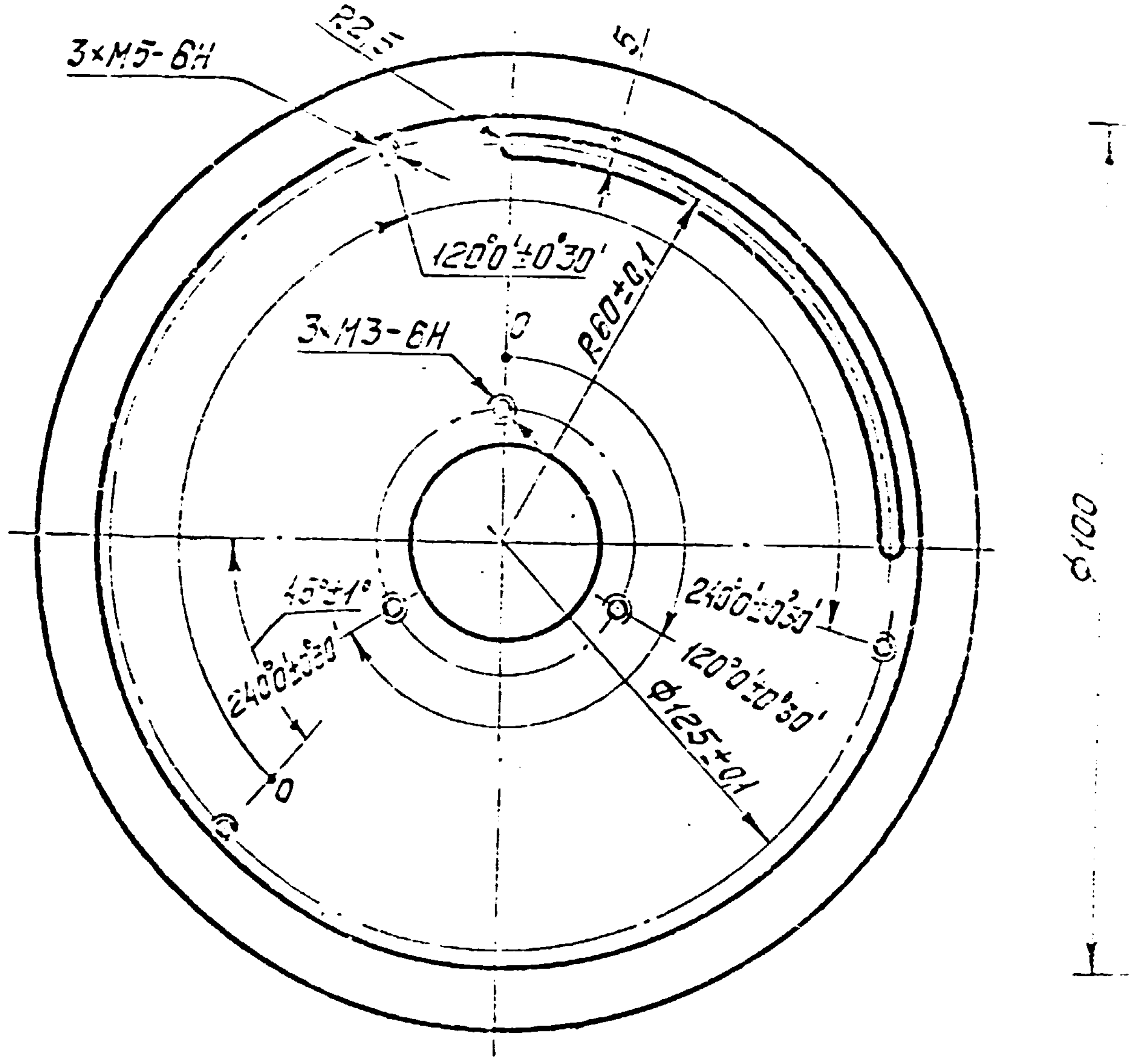
4. Fill in the engraving with black enamel
5. Coating Fe/Ni Cr12 mat finish

320.164			
Label	Mass	Scale	
		1:1	
	Sheet	Sheets 1	
Steel 08кп	LITMO		

Designer

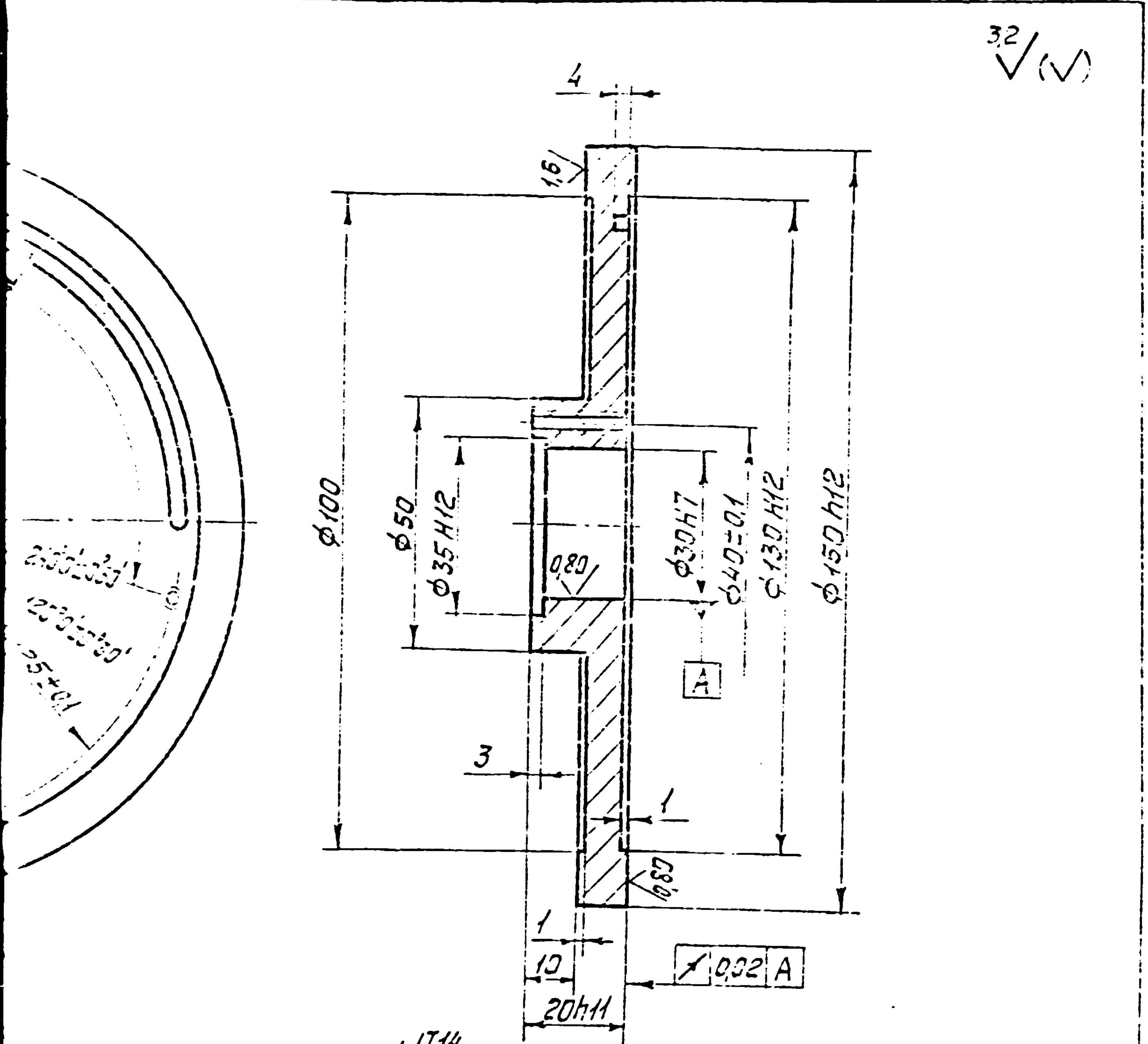
Chief Designer

Form A4



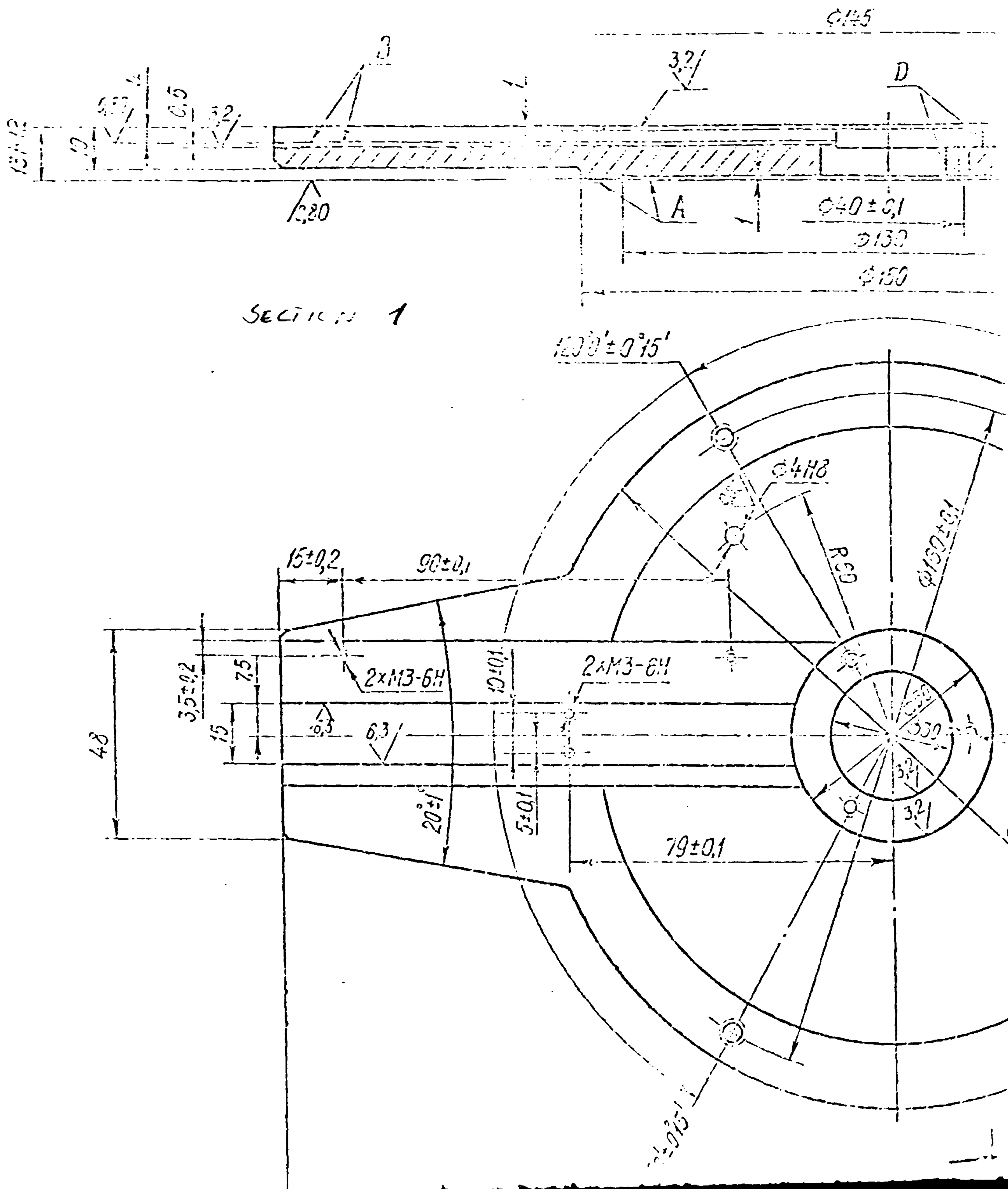
1.H14;h1-
2.Coatin

SECTION 1

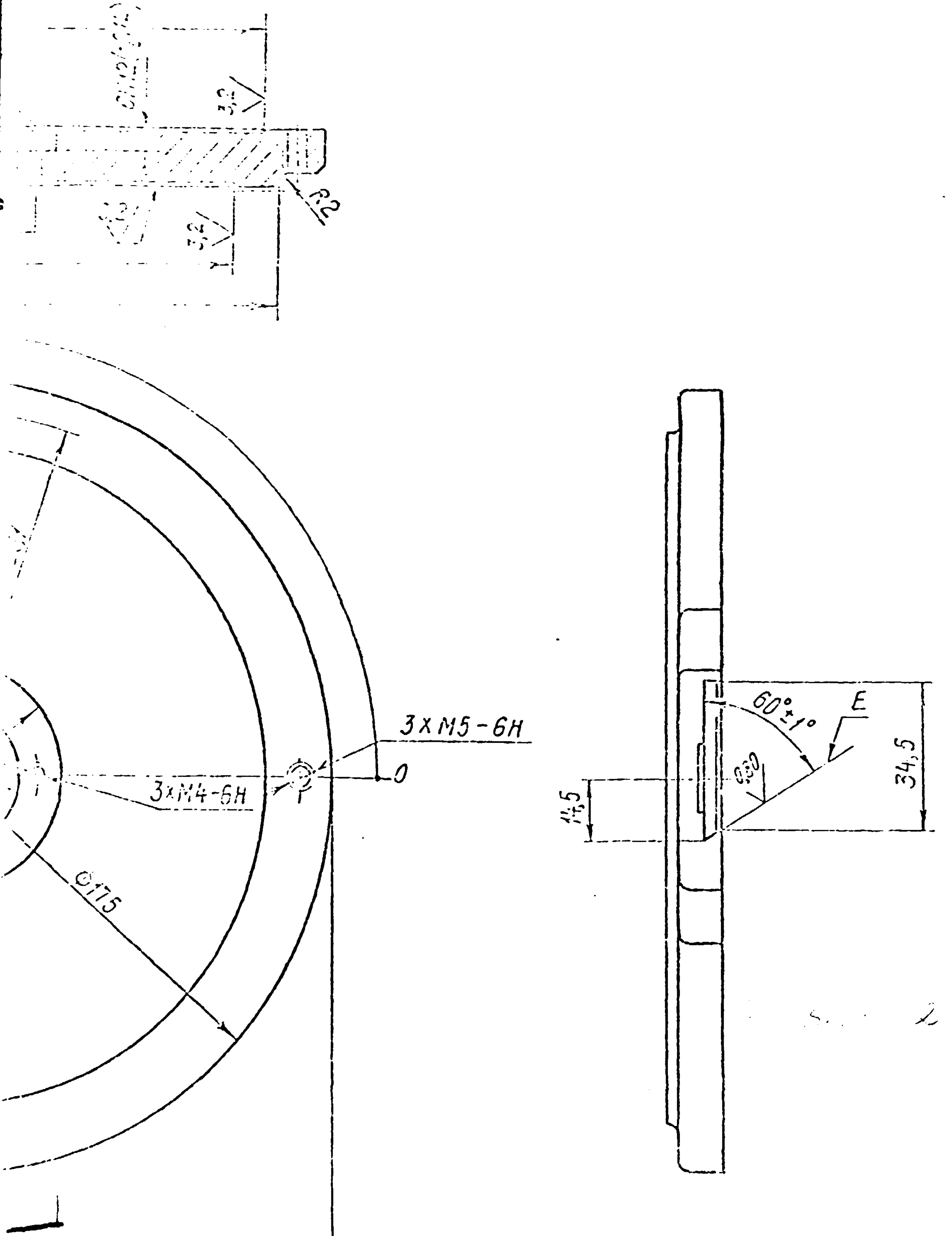


1. $H14; h14; \pm \frac{IT14}{2}$
2. Coating: Fe/Ni Cr6 mat finish

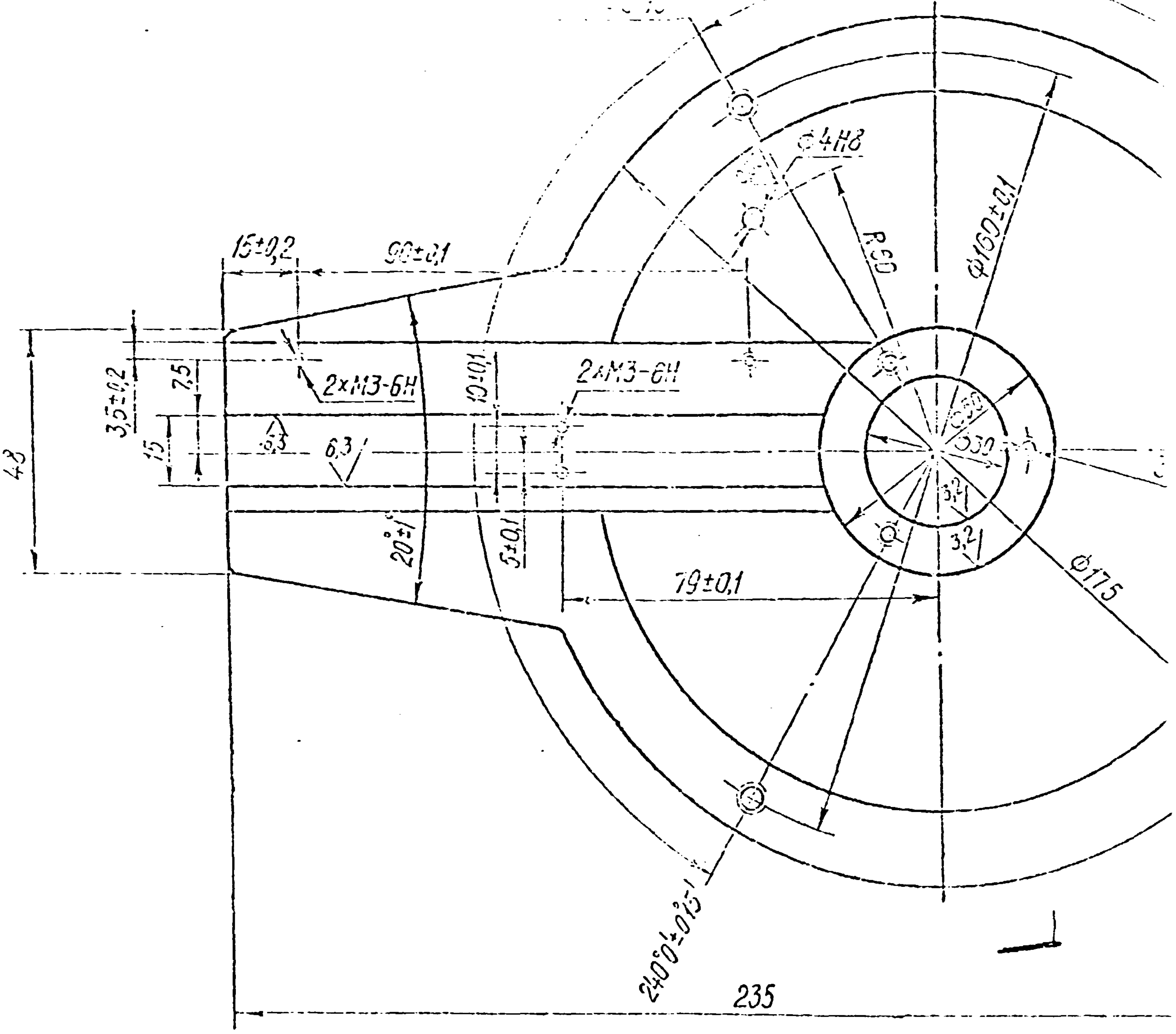
Designer	320.165	
	Flange	Mass / Scale
Chief Designer	Steel 20	LITMO



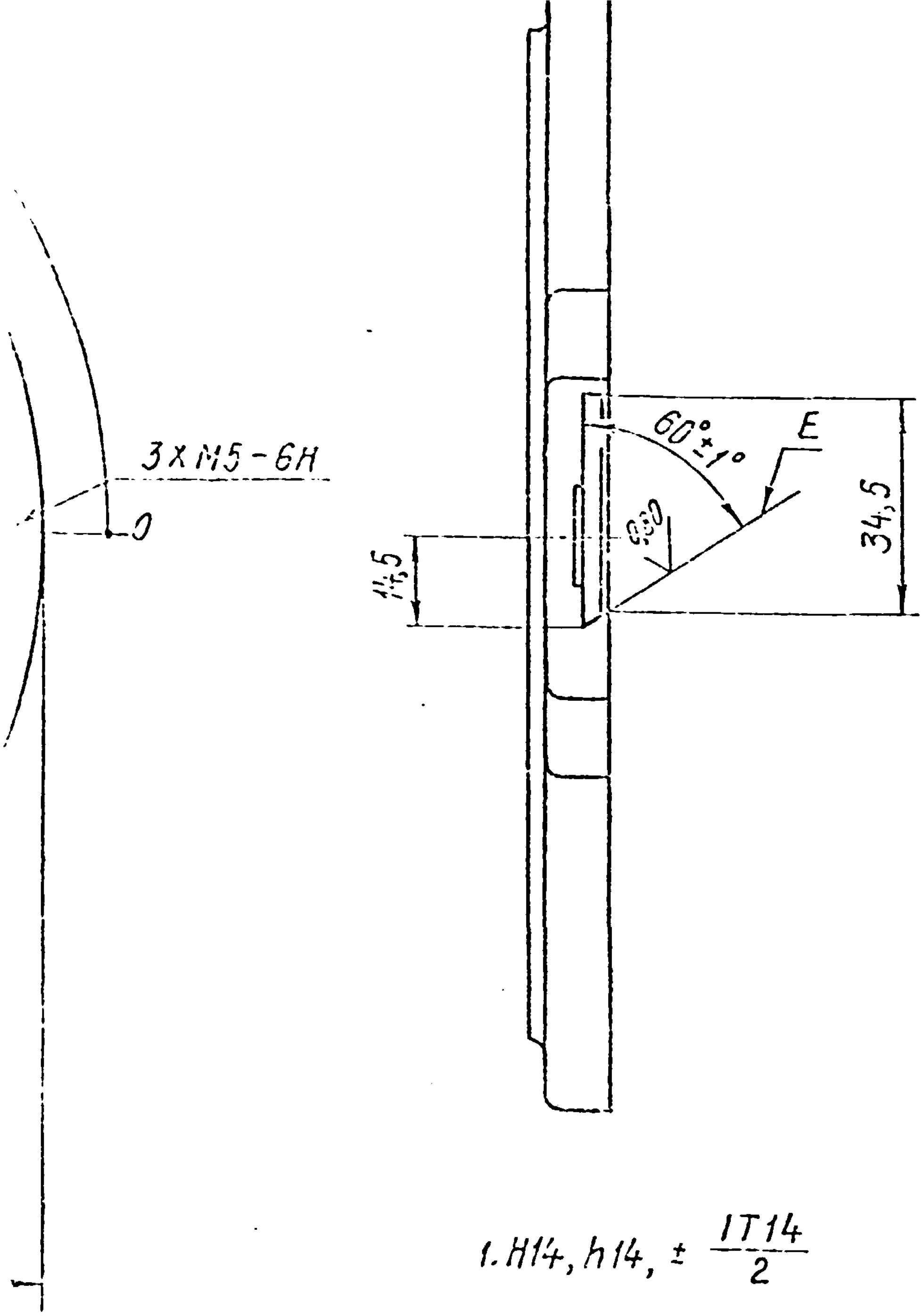
Ф145
3,2
D
A
Ф40±0,1
Ф130
Ф150
0,80
SECTION 1
120°0'±0°15'
Ф4H8
R90
Ф160±0,1
15±0,2
90±0,1
2×M3-6H
2×M3-6H
48
3,5±0,2
7,5
15
6,3
20°±1°
5±0,1
79±0,1



1. H14, h14, $\pm\frac{IT14}{2}$



Φ4H8
R90
Φ160±0,1
15±0,2
90±0,1
3,5±0,2
7,5
2×M3-6H
10±0,1
2×M3-6H
48
15
6,3
20°±1°
5±0,1
79±0,1
Φ175
3,2
240°0'±0°15'
235



SECT 4

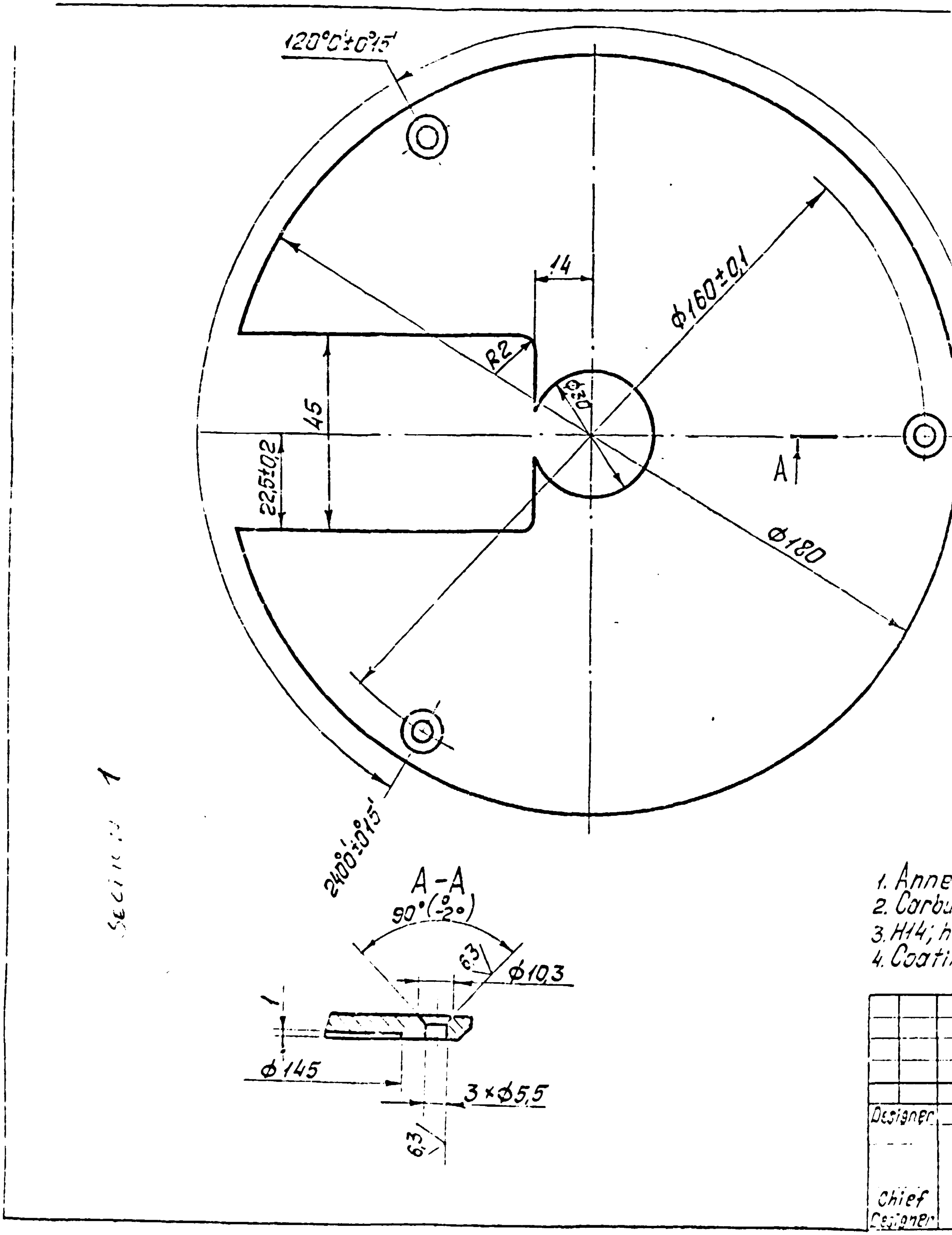
1. H14, h14, $\pm\frac{IT14}{2}$

2. Coating Chemical oxidation chromatizing grey enamel except the surfaces A, B, C, D, E

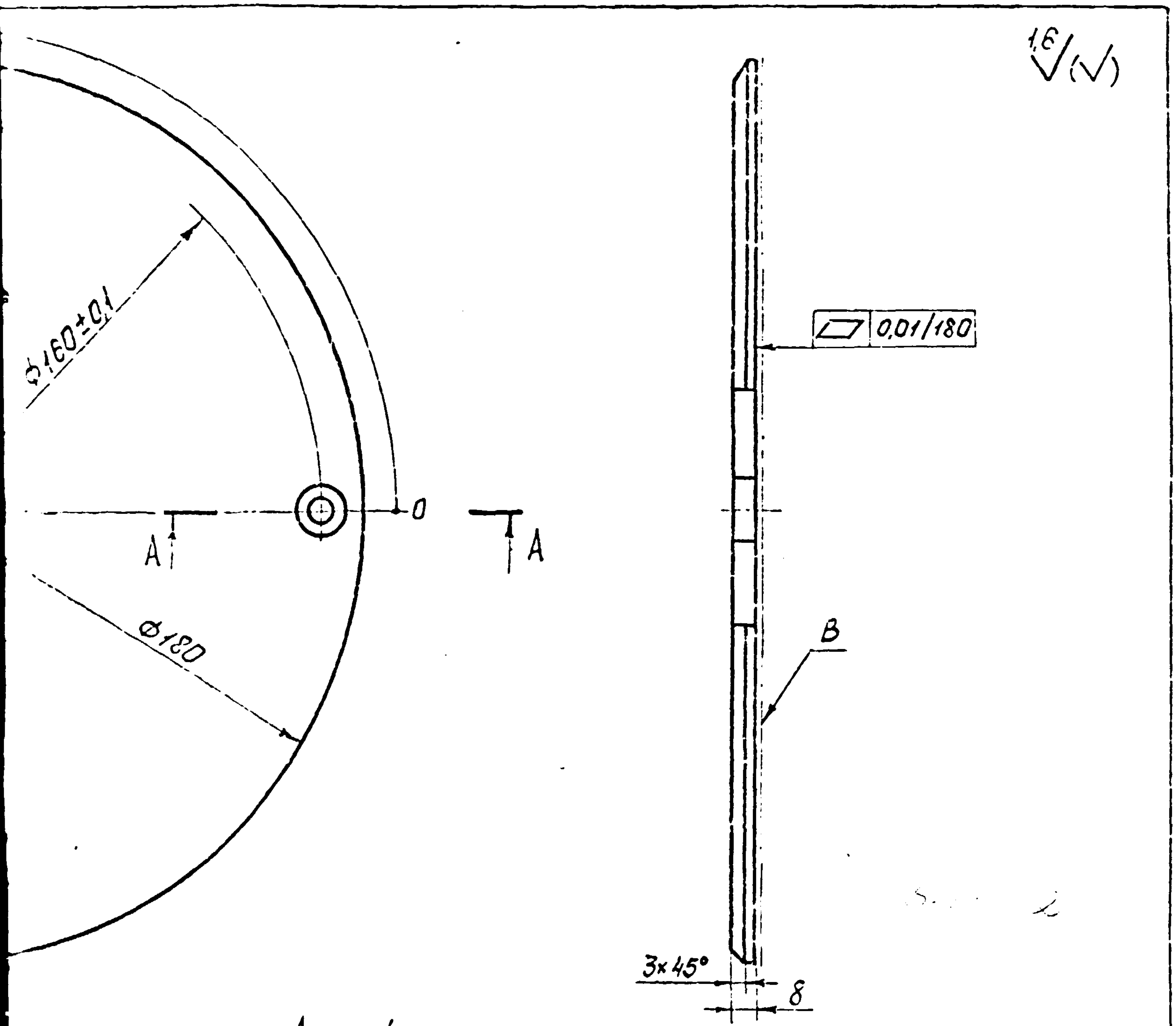
320. 166

Stage	Mass	Scale	
		1:1	
	Sheet	Sheets 1	
Steel 50	LITMO		

Designer
Chief



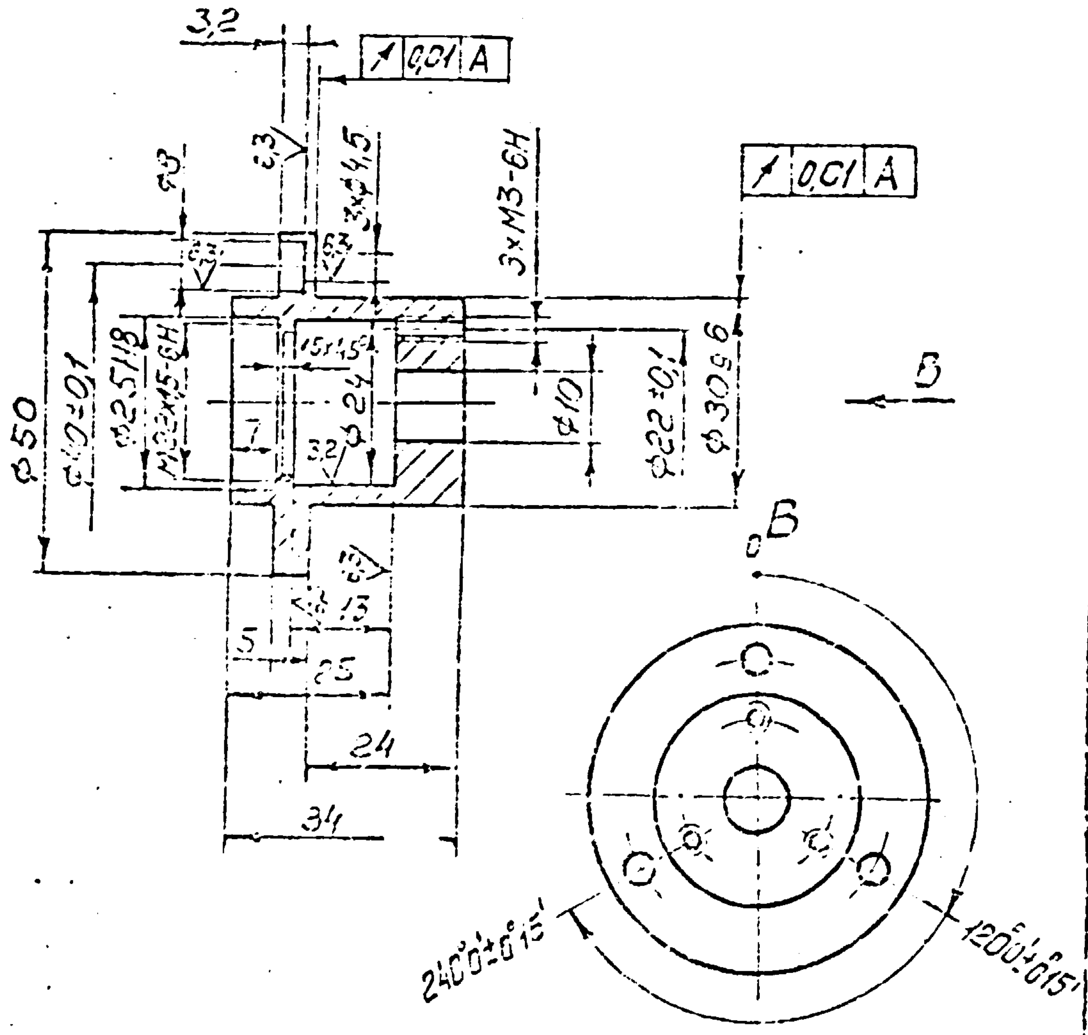
120°0'±0°15'
14
ϕ160±0,1
R2
ϕ30
45
22,5±0,2
A
Ø180
240°0'±0°15'
A-A
90°(-2°)
6,3
ϕ10,3
1
ϕ145
3×ϕ5,5
6,3
1. Anne
2. Carbu
3. H14; h
4. Coati
Designer
Chief Designer



1. Anneal
2. Carburize h0,7...0,8mm, harden 47,5...49,5 HRCэ
3. H14; h14; $\pm \frac{IT14}{2}$
4. Coating: Fe/NiCr12 mat finish

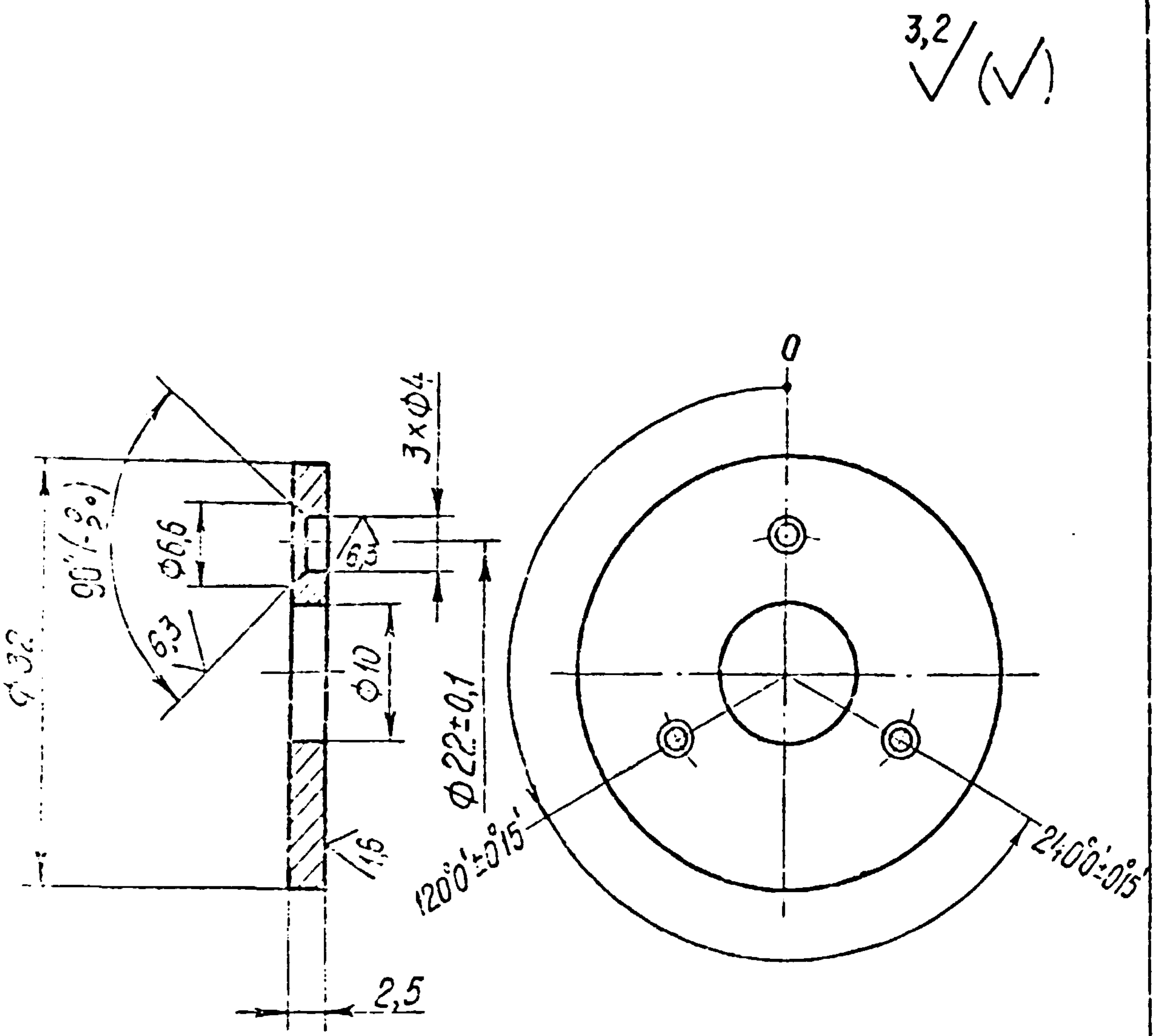
	320.167	
	Segment	Mass: / Scale: 1:1
Designer		Sheet / Sheets 1
Chief Designer	Steel 20	LITMO

$\sqrt{1.6}\ (\sqrt{\ })$



1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating: Chemical oxidation chromatizing

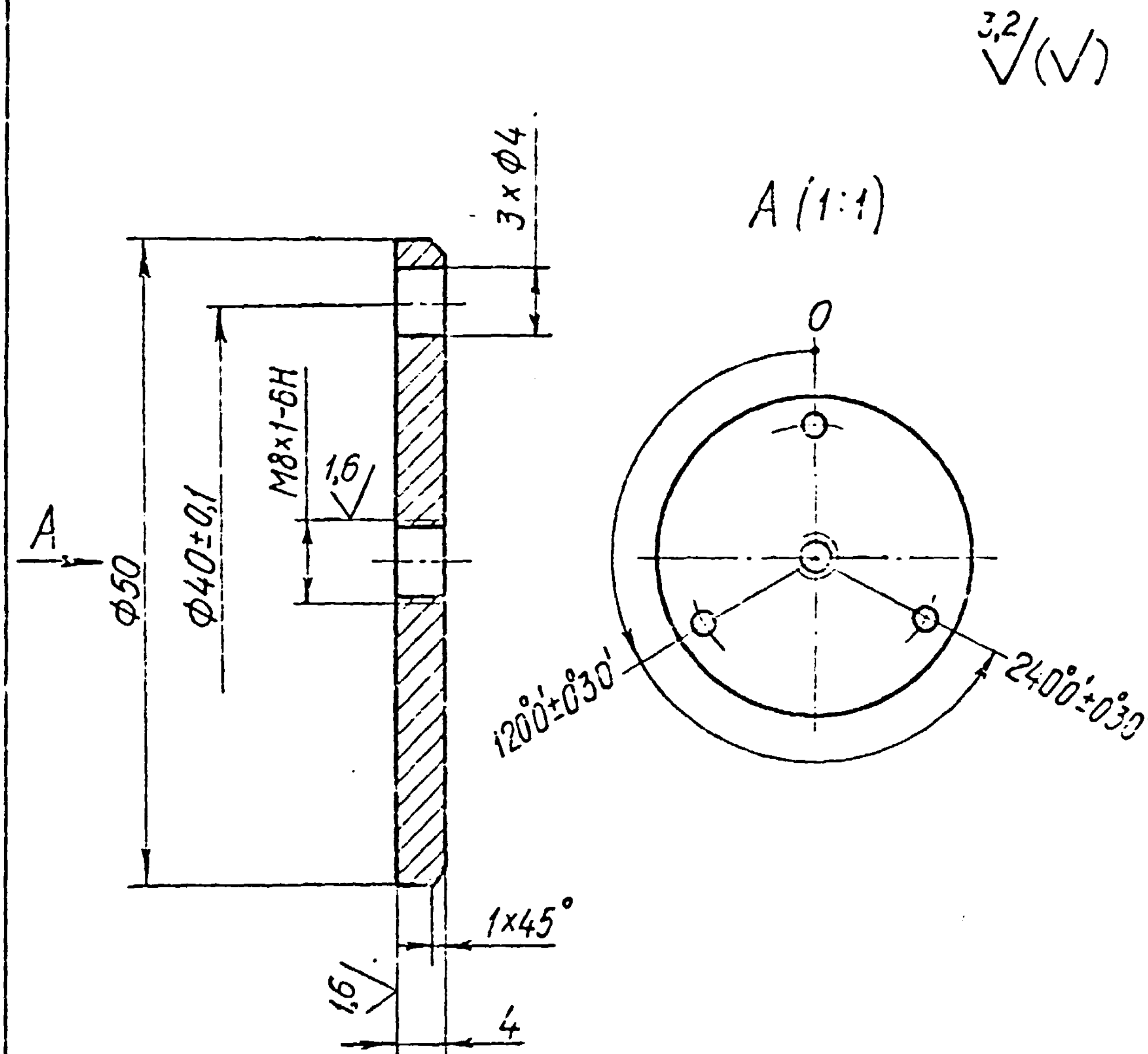
	32...		
Designer	Bushing	Mass	Scale
			1:1
		Sheet	Sheets 1
Chief Designer	Steel 50	LITMO	



1. H14, h14, $\pm \frac{IT14}{2}$
2. Coating Chemical oxidation chromatizing

320. 169			
Ring		Mass	Scale
			2:1
	Sheet	Sheets 1	
Steel 20	LITMO		

Form A4

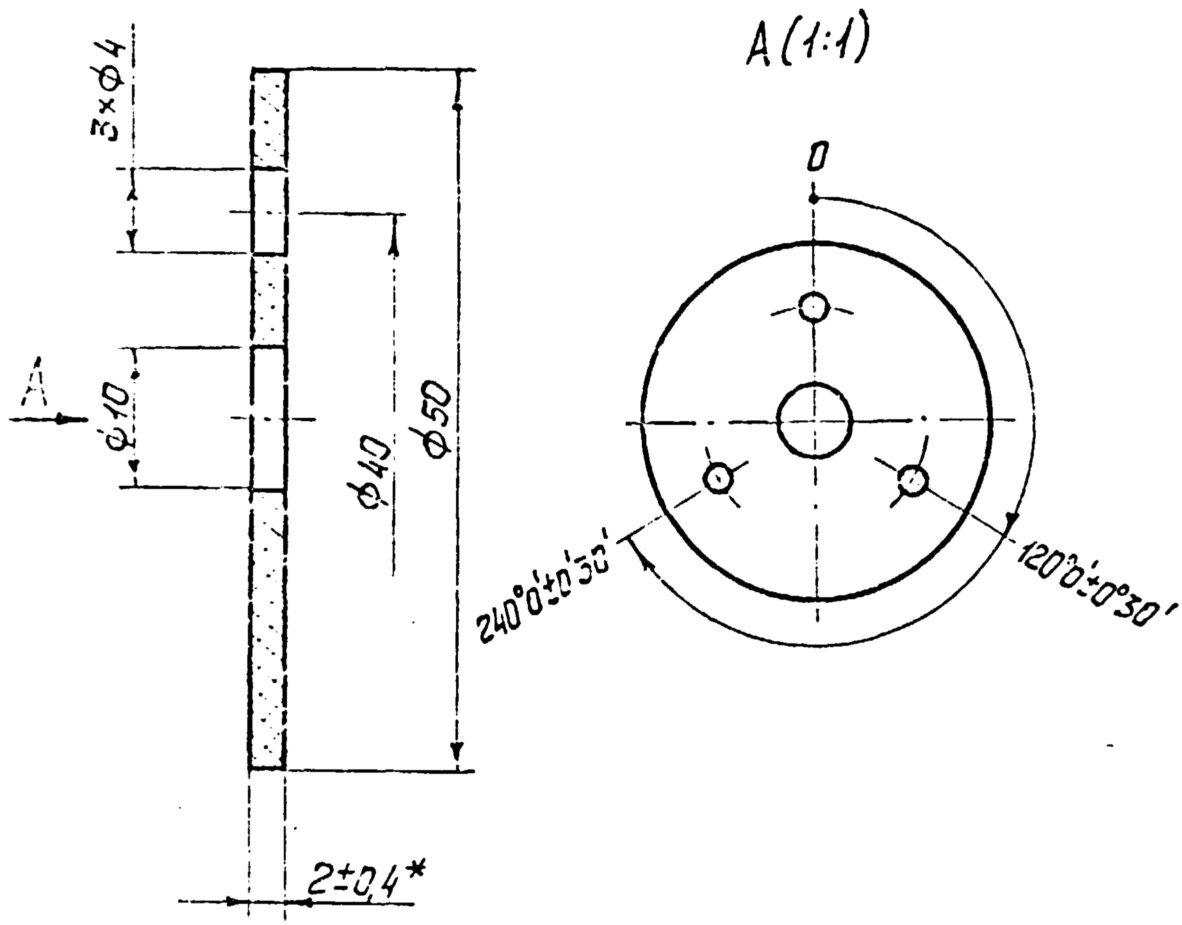


1. H14, h14, $\pm \frac{IT14}{2}$

2. Coating: chemical oxidation chromatizing

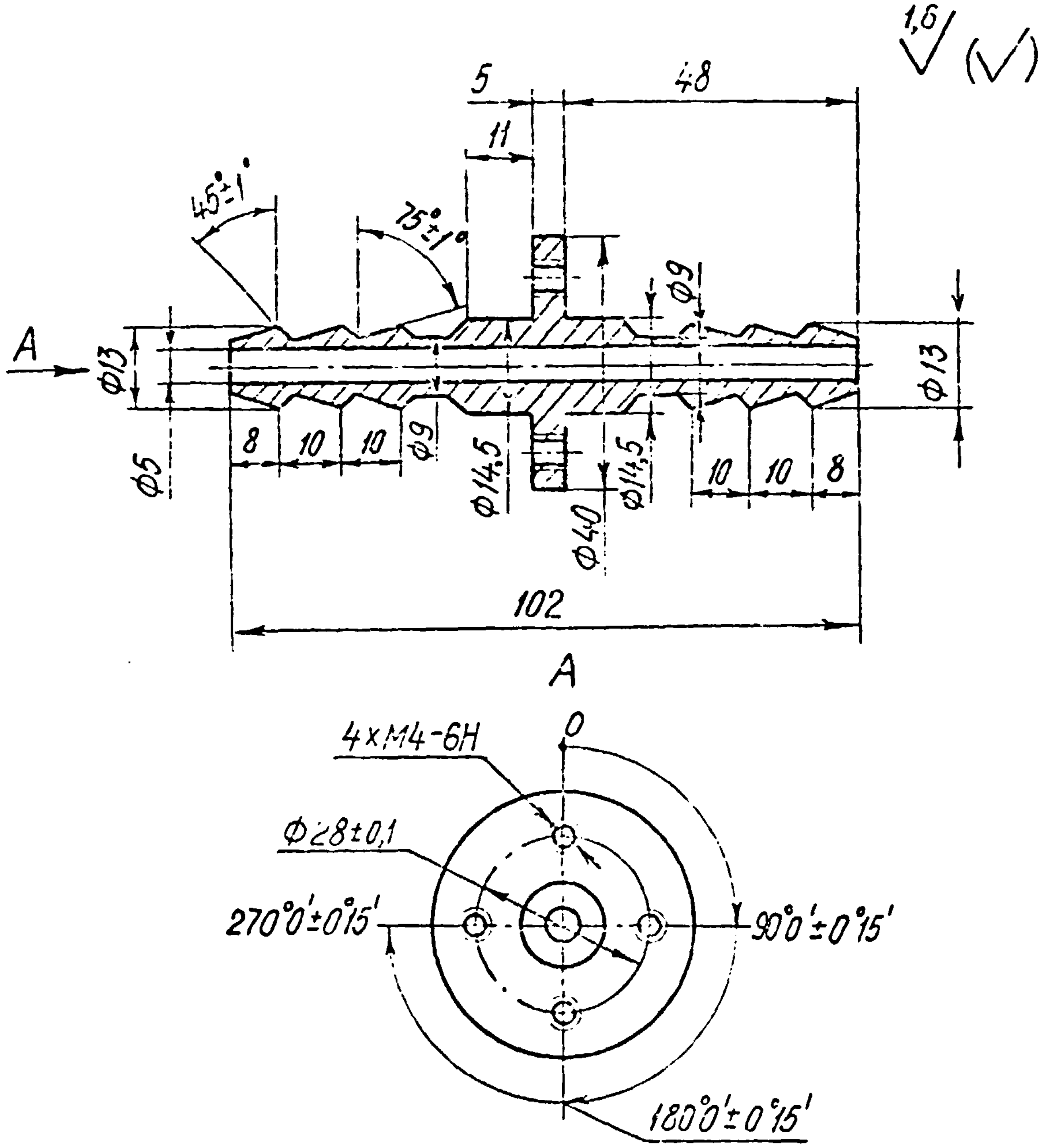
320.171			
Cover	Mass	Scale	
		2:1	
	Sheet	Sheets 1	
Designer			
Chief Designer	Steel 20	LITMO	

Form



1. *The dimension for information
2. H14; h14; $\pm \frac{IT14}{2}$

320.172		
Spacer	Mass	Scale
		2:1
	Sheet	Sheets 1
Rubber	LITMO	

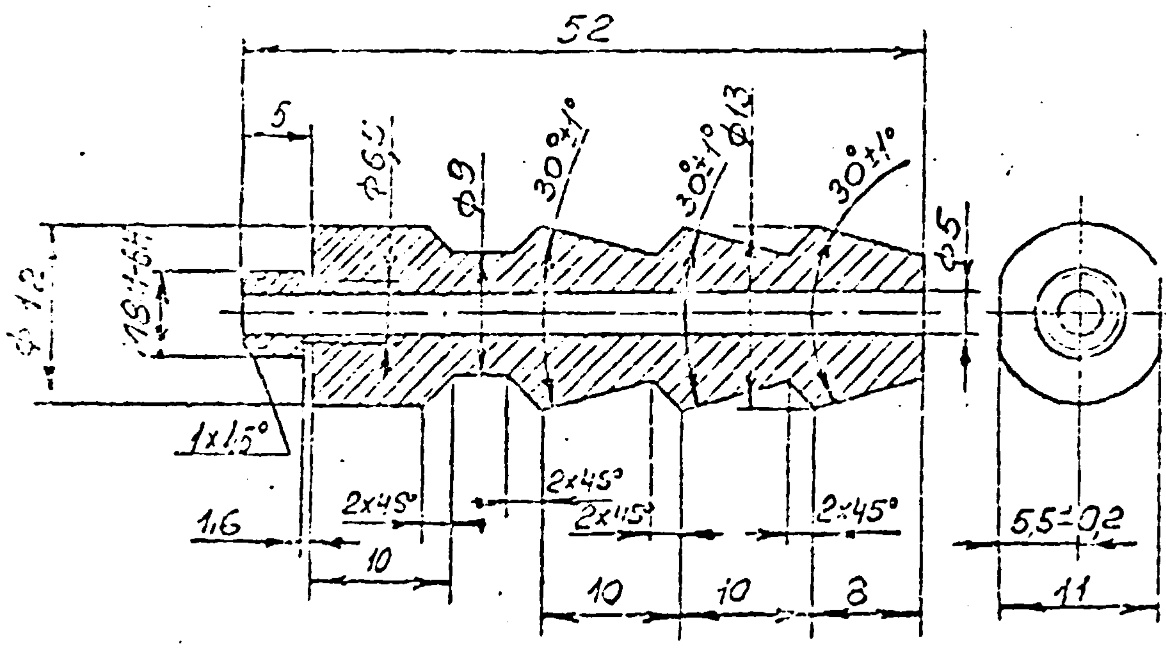


1. H14, h14, $\pm \frac{IT14}{2}$

2. Coating Anodic oxidation

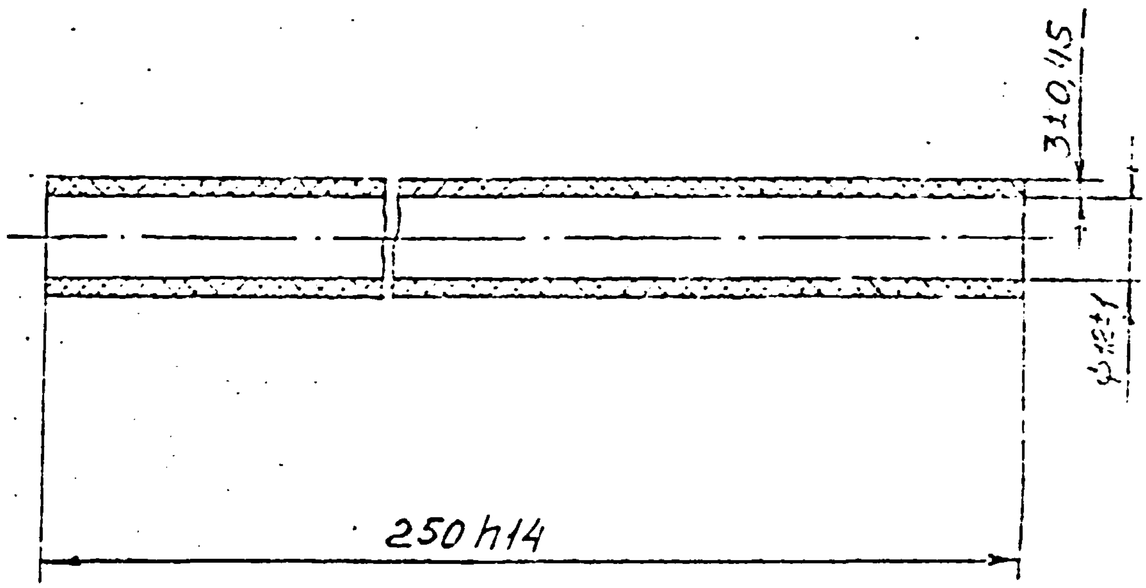
320. 173					
Designer	Union		Mass	Scale	
				1:1	
		Sheet	Sheets 1		
Chief Designer	Aluminium alloy Al-Cu4MgMnFeSi	LITMO			

3,2

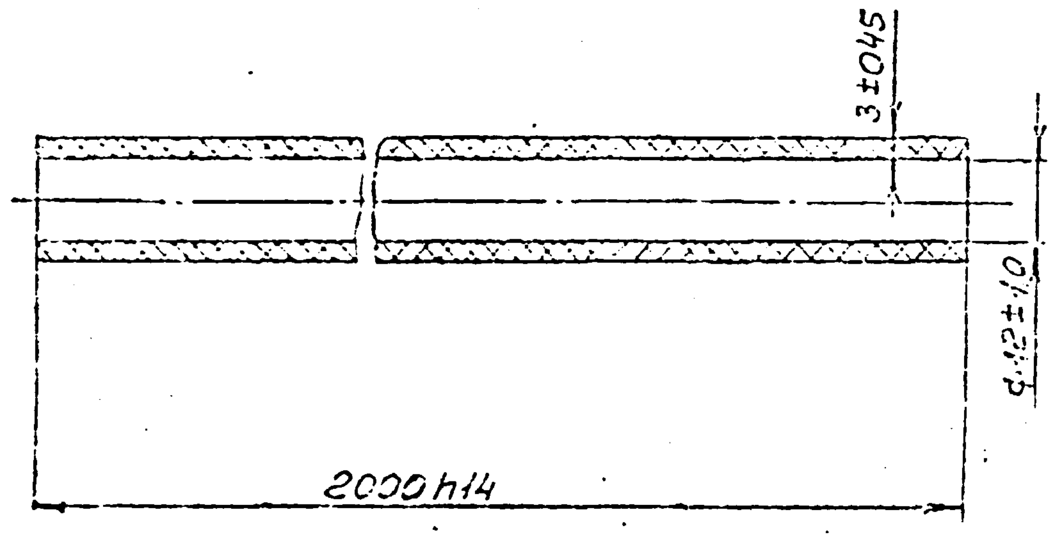


1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating: Anodic oxidation black

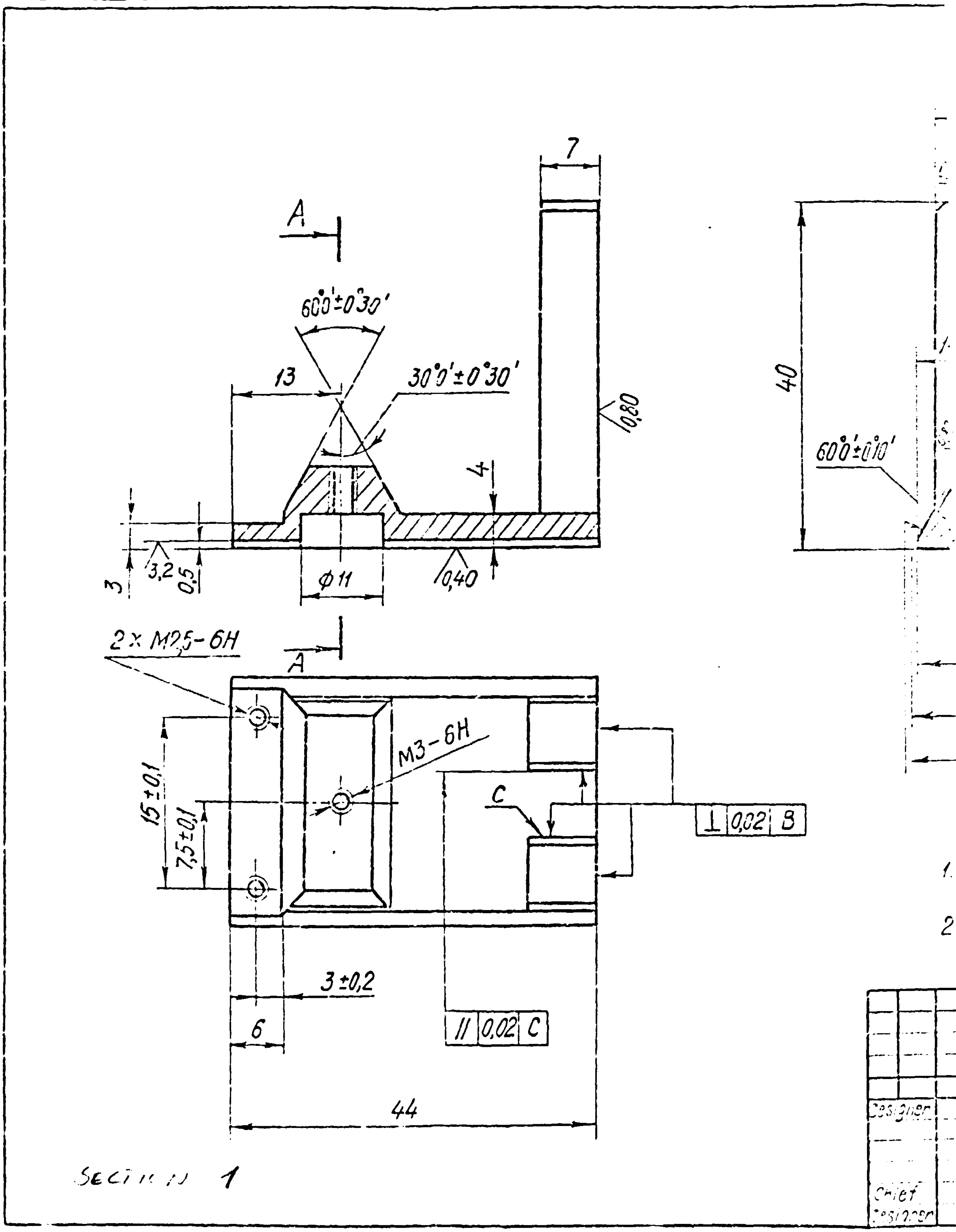
320.174			
Union		Mass	Scale
			2:1
	Sheet	Sheets 1	
Aluminium alloy AL-Cu 4 Mg Mn Fe Si	LITMO		



320.175		
Tube	Mass	Scale
		1:1
	Sheet	Sheets 1
Rubber	LITMO	
Designer		
Chief Designer		

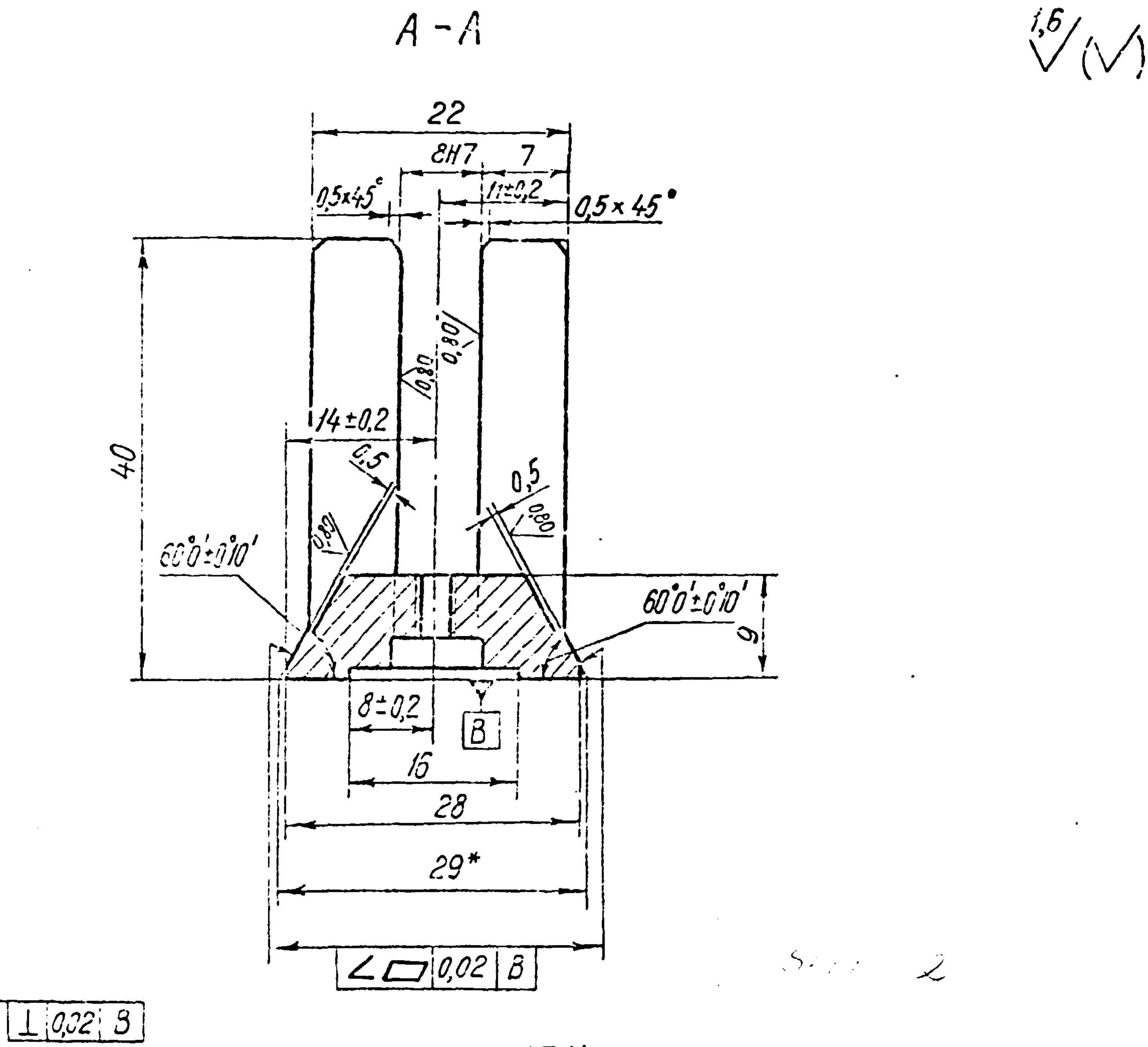


320.177			
Pipe		Mass	Scale
			1:1
		Sheet	Sheets 1
Rubber		LITMO	



7
A
60°0'±0°30'
13
30°0'±0°30'
0,80
4
3,2
0,5
3
φ11
0,40
2 x M2,5-6H
A
M3-6H
15±0,1
7,5±0,1
C
⊥ 0,02 B
3±0,2
6
// 0,02 C
44
40
60°0'±0°10'
Designer
Chief Designer

SECTION 1



1. $H14, h14, \pm \frac{IT14}{2}$

2. Coating Fe/Cr 12 mat finish

320.178

Guide

Steel 50

Designer

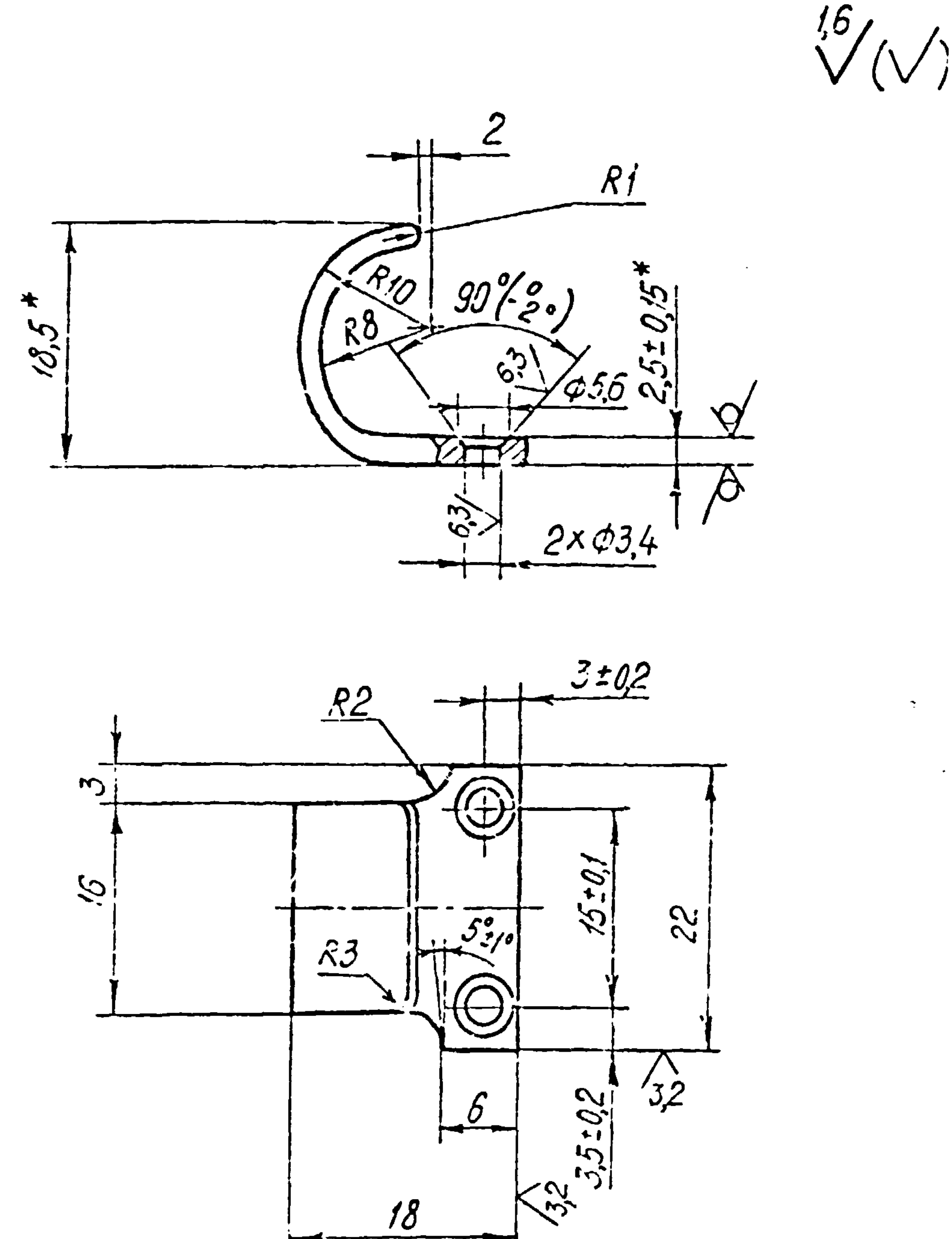
Chief Designer

Mass | Scale 2:1

Sheet | Sheets 1

LITMO

Form A 3

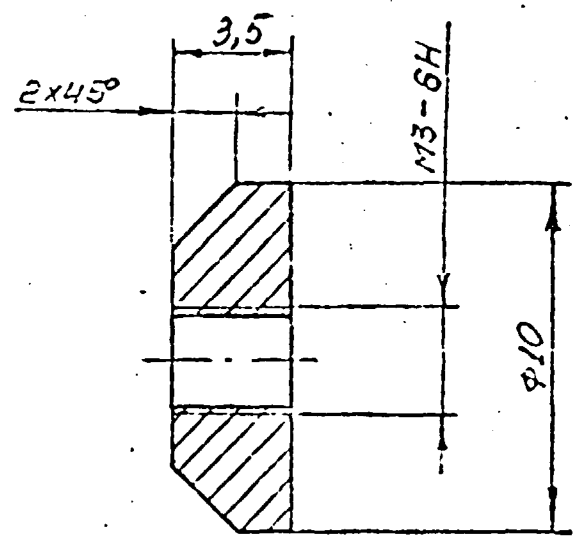


1. The dimensions for information.
2. H14, h14, $\pm \frac{IT14}{2}$
3. Coating: Fe/NiCr12

320. 179			
Hook		Mass	Scale
			2:1
		Sheet	Sheets 1
Steel 10kn		LITMO	

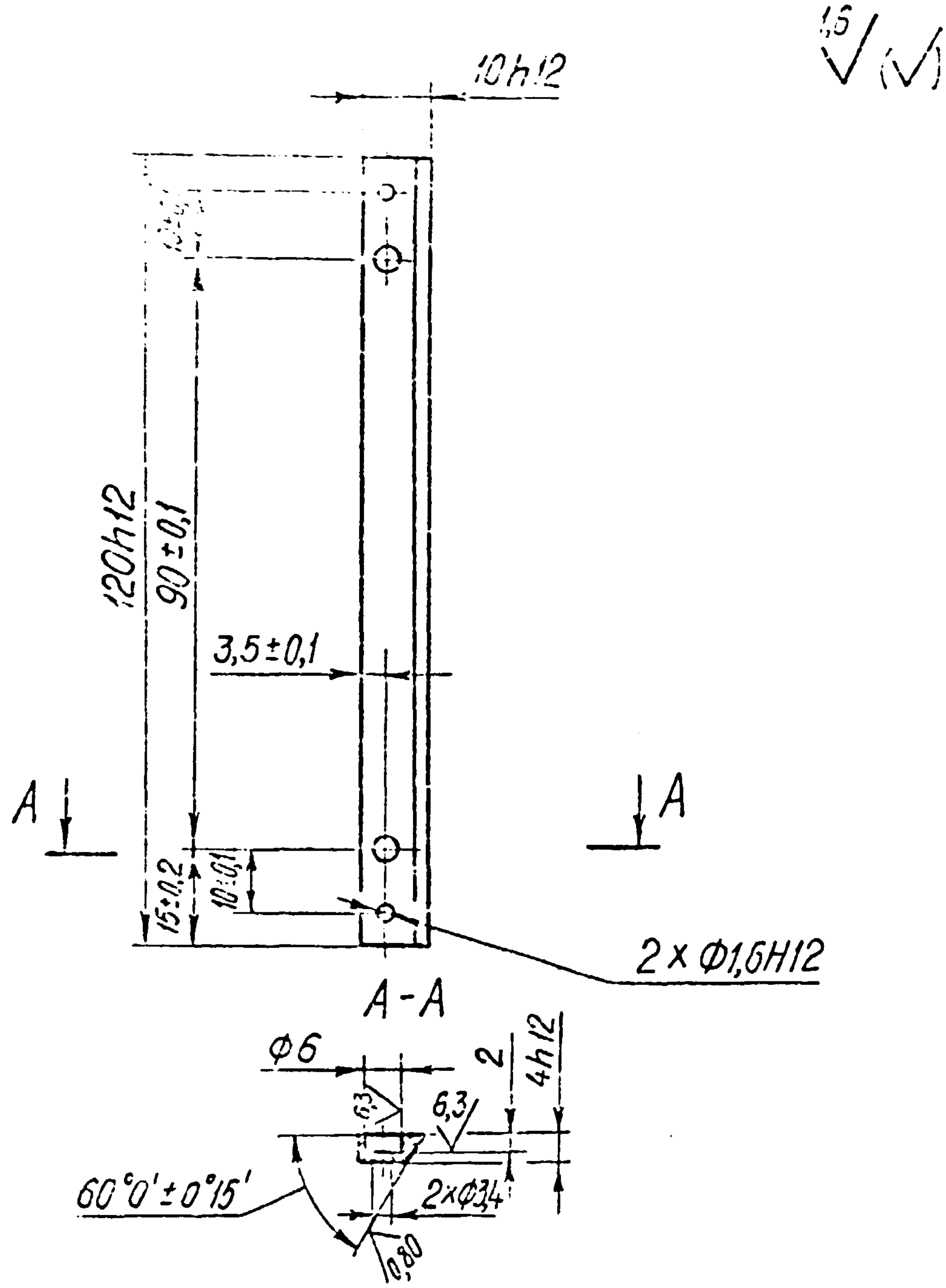
Form A4

3,2



1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating: Chemical oxidation

	320.181	
	Pivot	Mass: – / Scale: 5:1
Design		Sheet / Sheets 1
Chief design	Brass CuZn40	LITMO



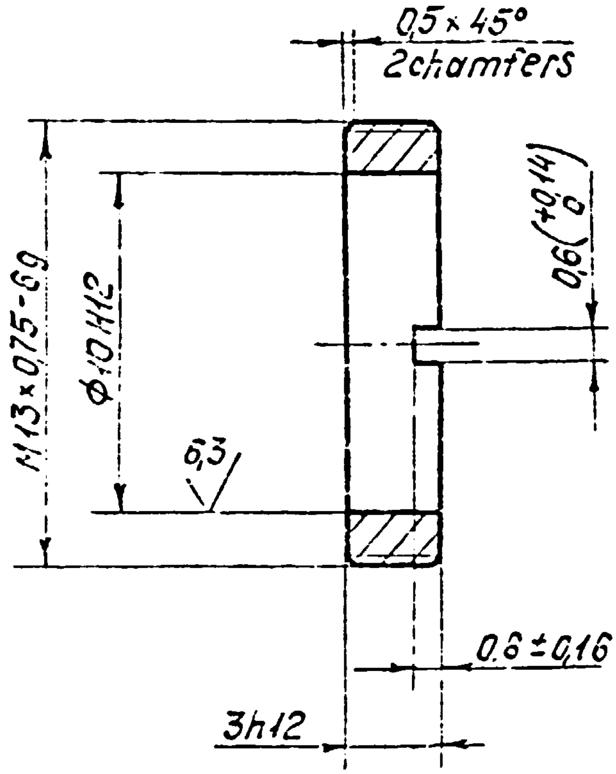
1. H14, h14, $\pm \frac{IT14}{2}$
2. Coating: Fe/Cr 12

320.182	
Plate	Mass: — / Scale: 1:1
	Sheet / Sheets 1
Steel 20	LITMO

Designer

Form A4

3,2 √(√)

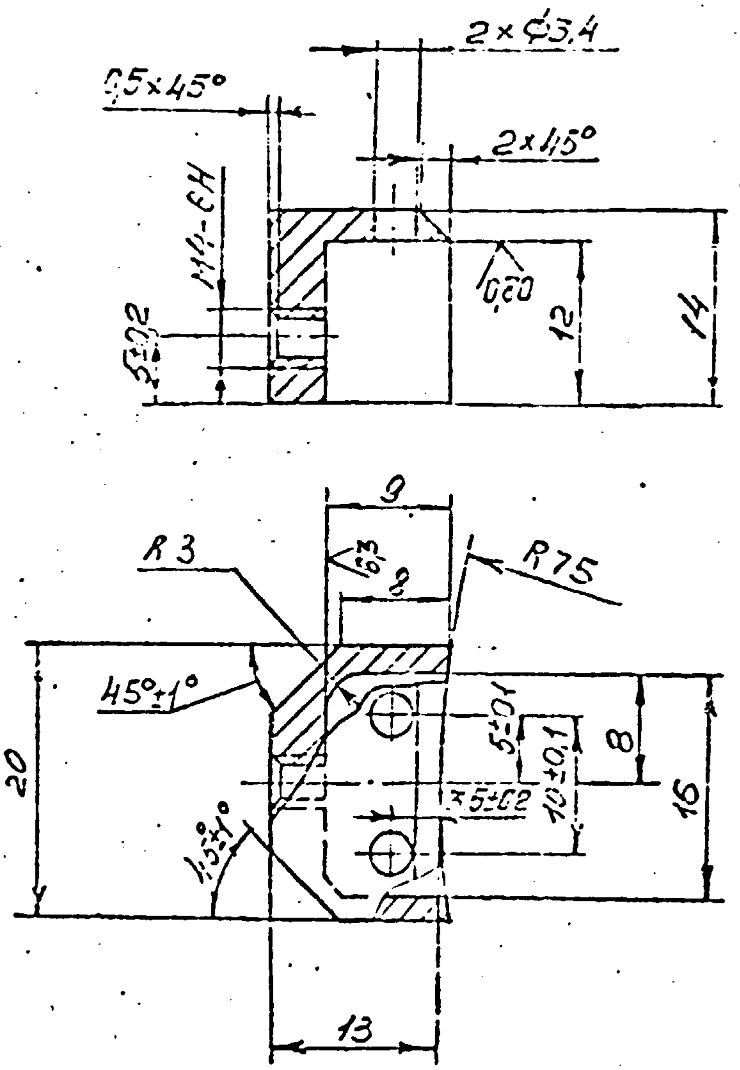


1. H14; $\pm\frac{IT14}{2}$

2. Coating: Anodic oxidation

320.089		
Ring	Mass	Scale
		5:1
	Sheet	Sheets 1
Aluminium alloy Cu-Mg Mn Fe Si	LITMO	

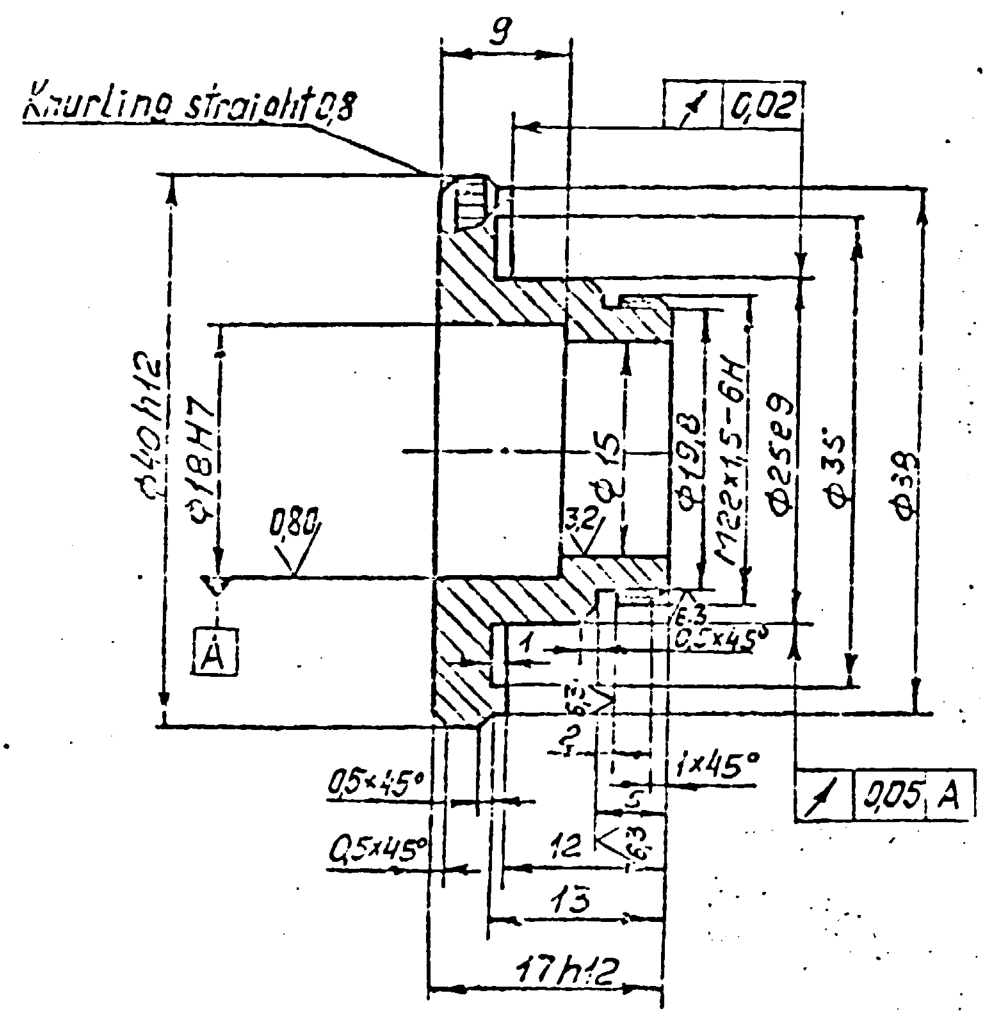
$\sqrt[1.6]{}\,(\checkmark)$



1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating Fe/Ni Cr6 mat finish

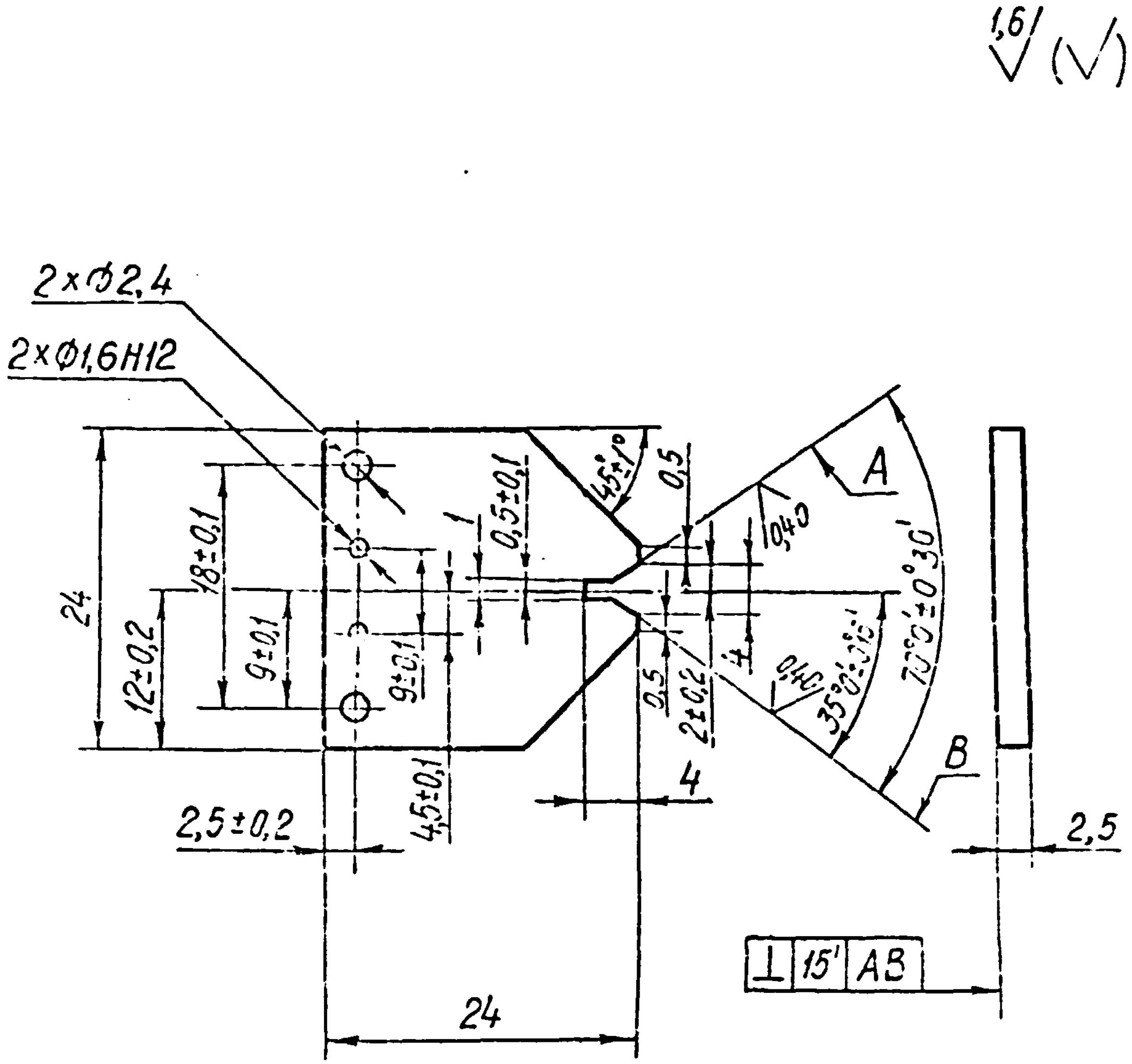
	320.183		
Design	Angle piece	Mass	Scale
			2:1
		Sheet	Sheets 1
Chief design	Steel 20	LITMO	

$\overset{1,6}{\surd}(\surd)$



1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating Fe/NiCr 9 mat finish

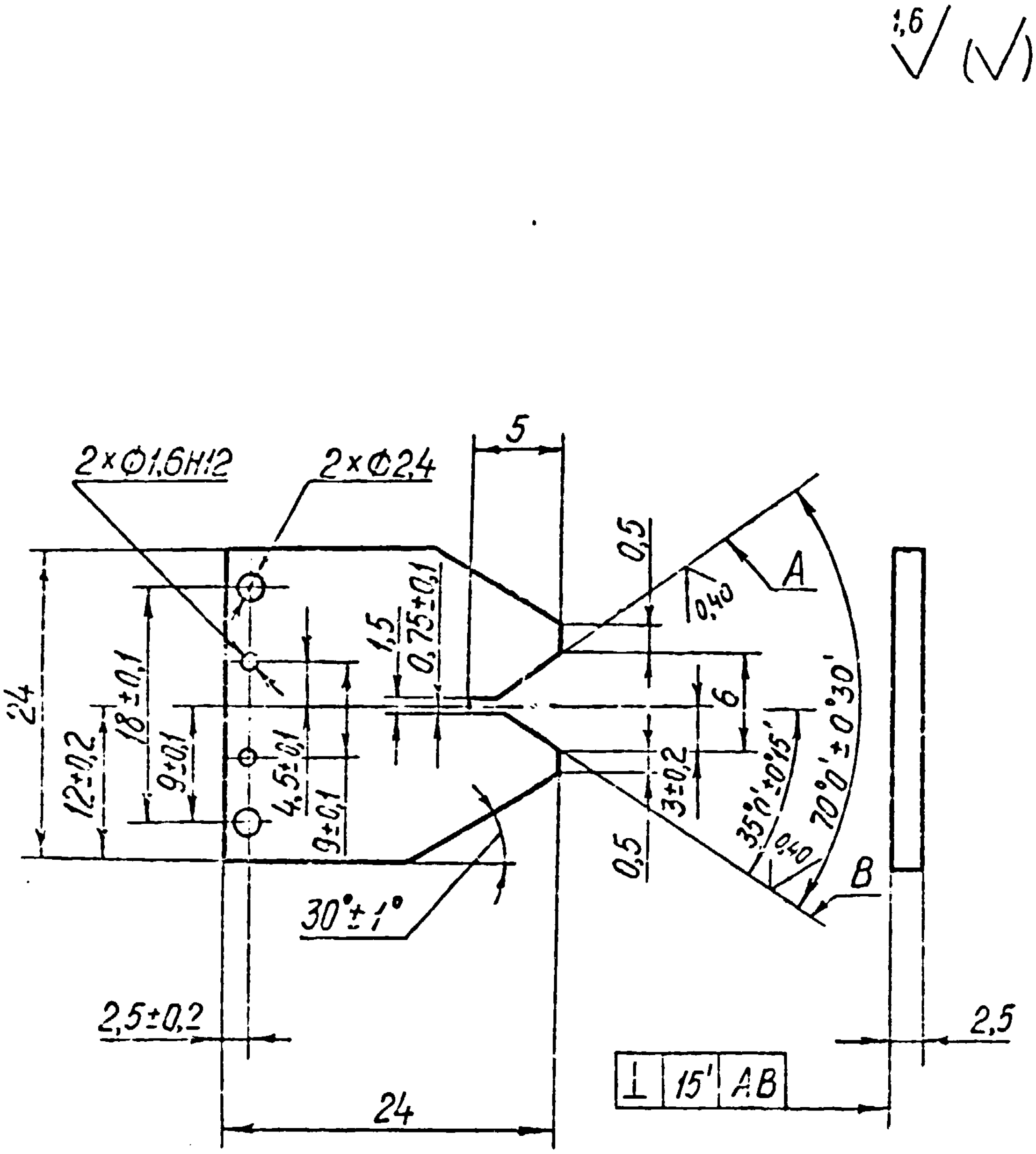
320.191		
Bushing	Mass	Scale
		2:1
	Sheet	Sheets 1
Steel 20	LITMO	



1. Carburize in depth 0,8 ... 1,2 mm.
   Harden 59 ... 63 HRCэ
2. H14, h14, $\pm \frac{IT14}{2}$
3. Coating: Chemical oxidation cromatizing

	320. 201	
Designer	Knife - edge	Mass / Scale: 2:1
		Sheet / Sheets 1
Chief / Des.gen.	Steel 20	LITMO

Form A4



1. Carburize in depth 0,8 ... 1,2 mm
Harden 59 ... 63 HRC э
2. H14, h14, $\pm \frac{IT14}{2}$
3. Coating: Chemical oxidation chromatizing

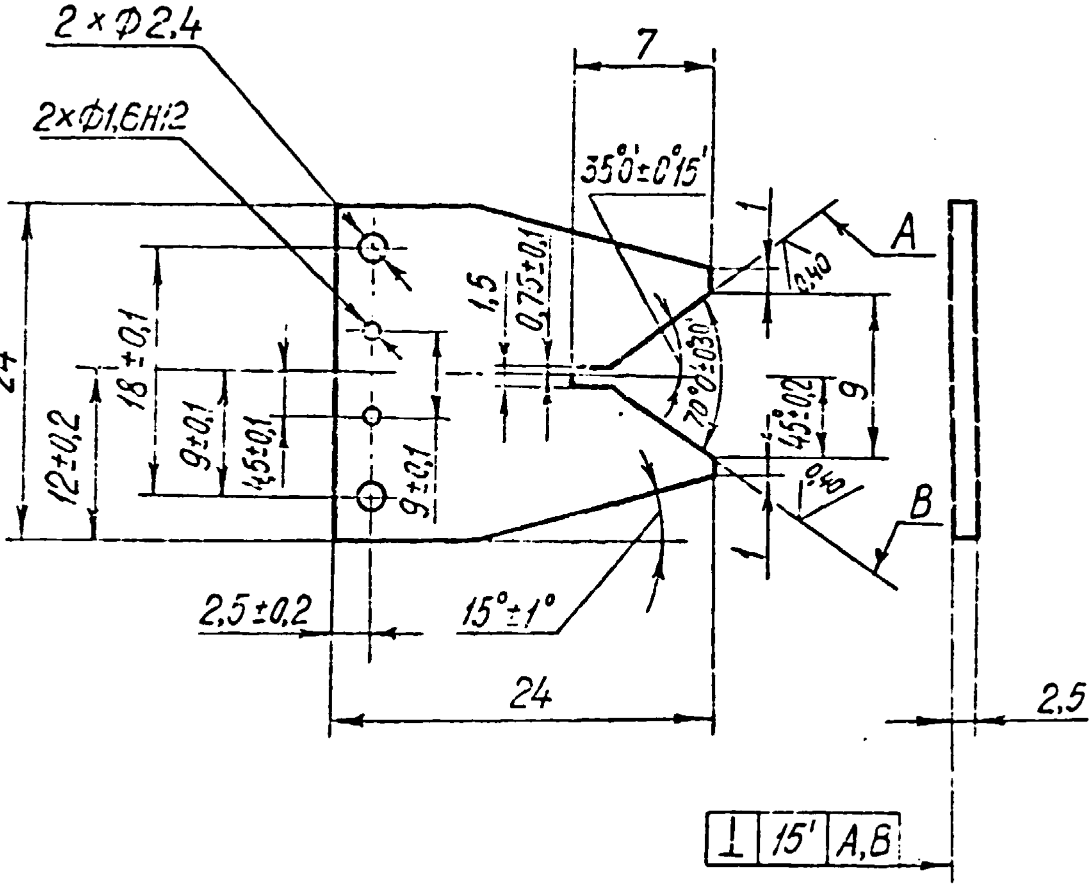
320. 202				
Knife - edge			Mass	Scale
				2:1
	Sheet		Sheets 1	
Steel 20	LITMO			

Design

Check

Form A4

1,6 √ (√)



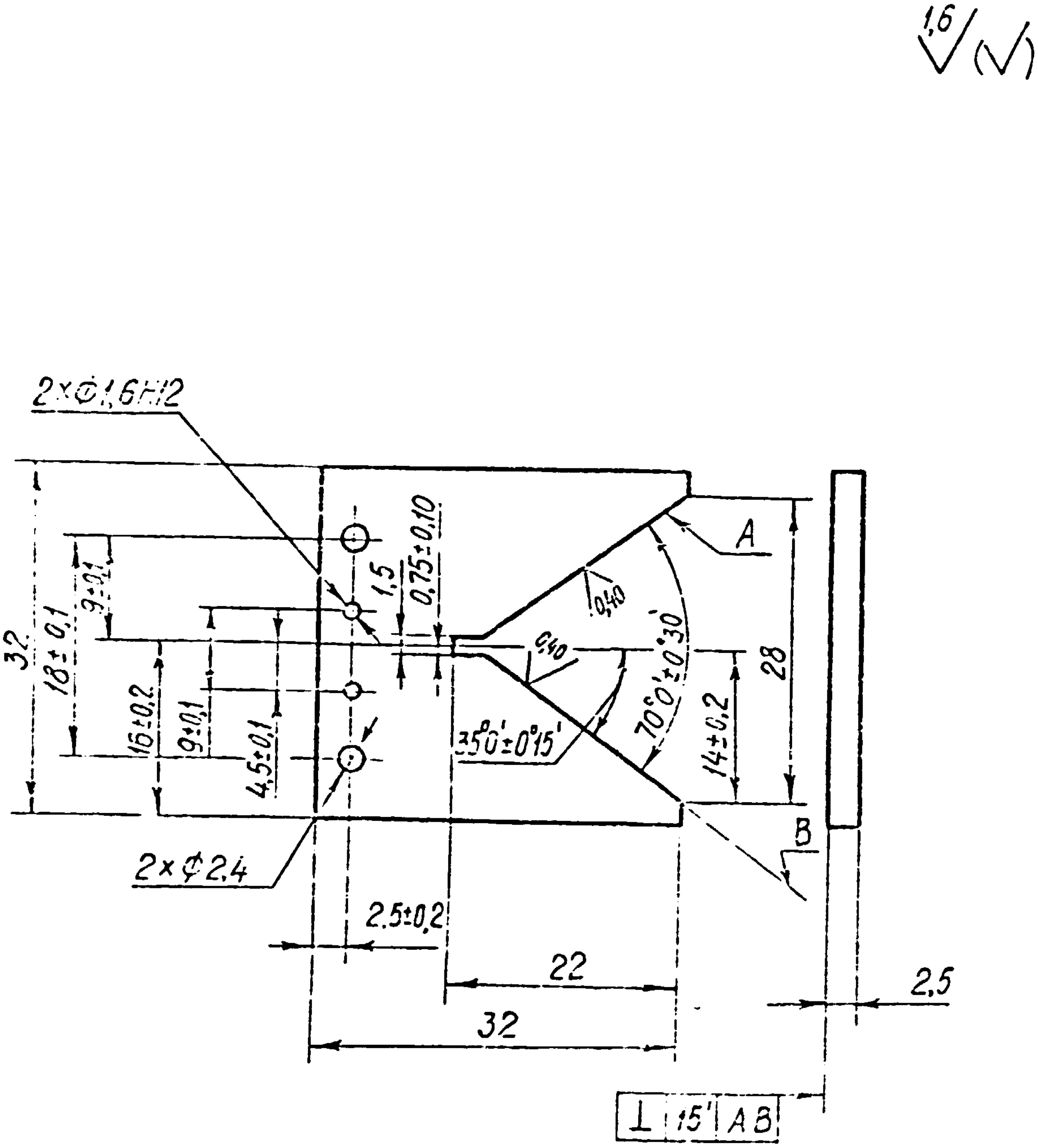
1. Carburize in depth 0,8 ... 1,2mm
 Harden 59 ... 63 HRCэ
2. H 14, h 14, $\pm \frac{IT\,14}{2}$
3. Coating: Chemical oxidation chromatizing

320.203		
Knife - edge	Mass	Scale
		2:1
	Sheet	Sheets 1
Steel 20	LITMO	

Designer

Chief designer

Form A4

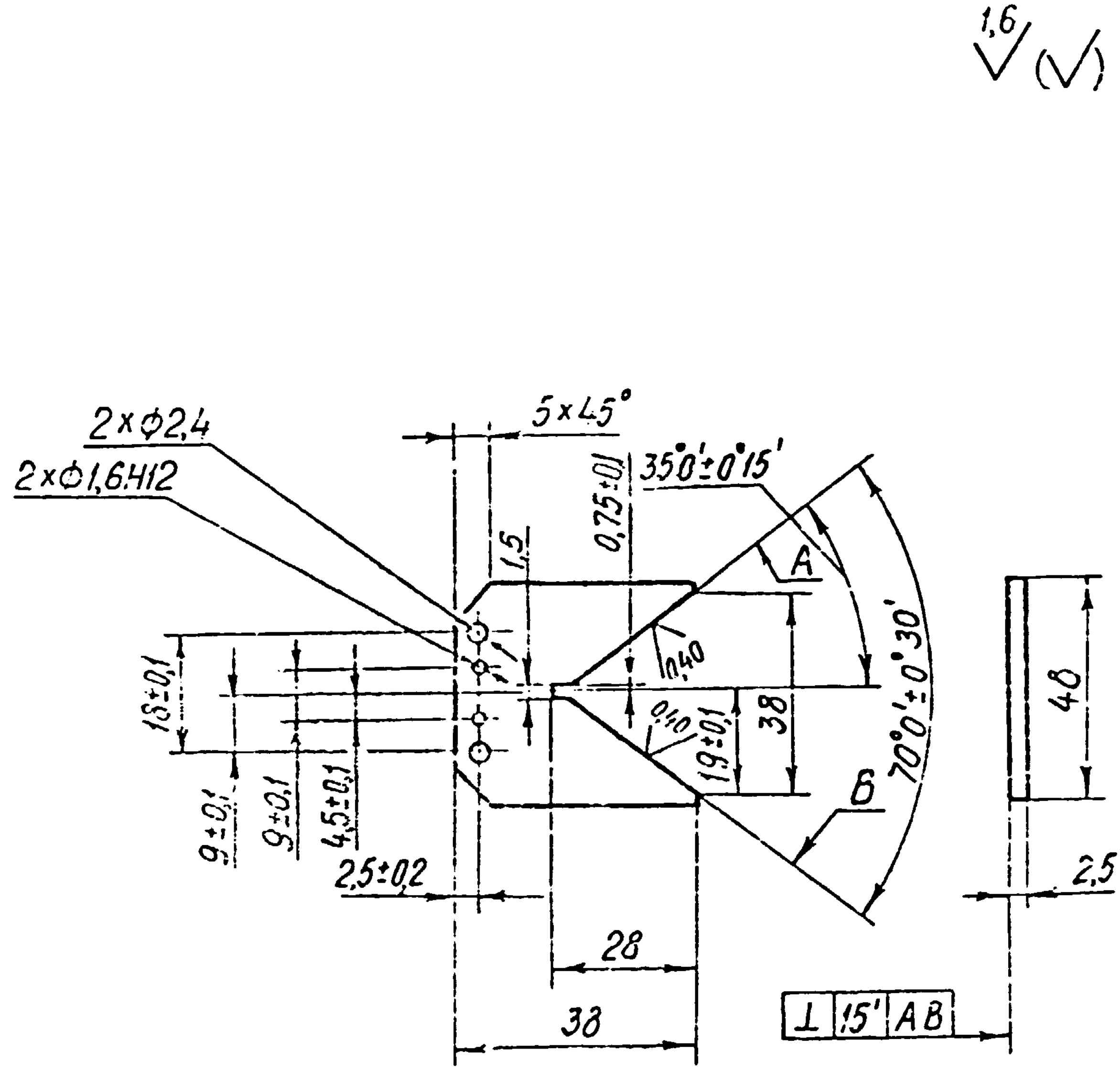


1. Carburize in depth 0,8...1,2 mm
   harden 58...63 HRCэ
2. H14, h14, ± $\frac{IT14}{2}$
3. Coating Chemical oxidation chromatizing

320. 204			
Knife - edge		Mass	Scale
			2:1
		Sheet	Sheets 1
Steel 20	LITMO		

Designer

Form A4



1. Carburize in depth 0,8...1,2 mm
   Harden 59...63 HRC э
2. H14, h14, $\pm \frac{IT14}{2}$
3. Coating: Chemical oxidation chromatizing

320. 205

Knife - edge

Mass | Scale
1:1

Sheet | Sheets 1

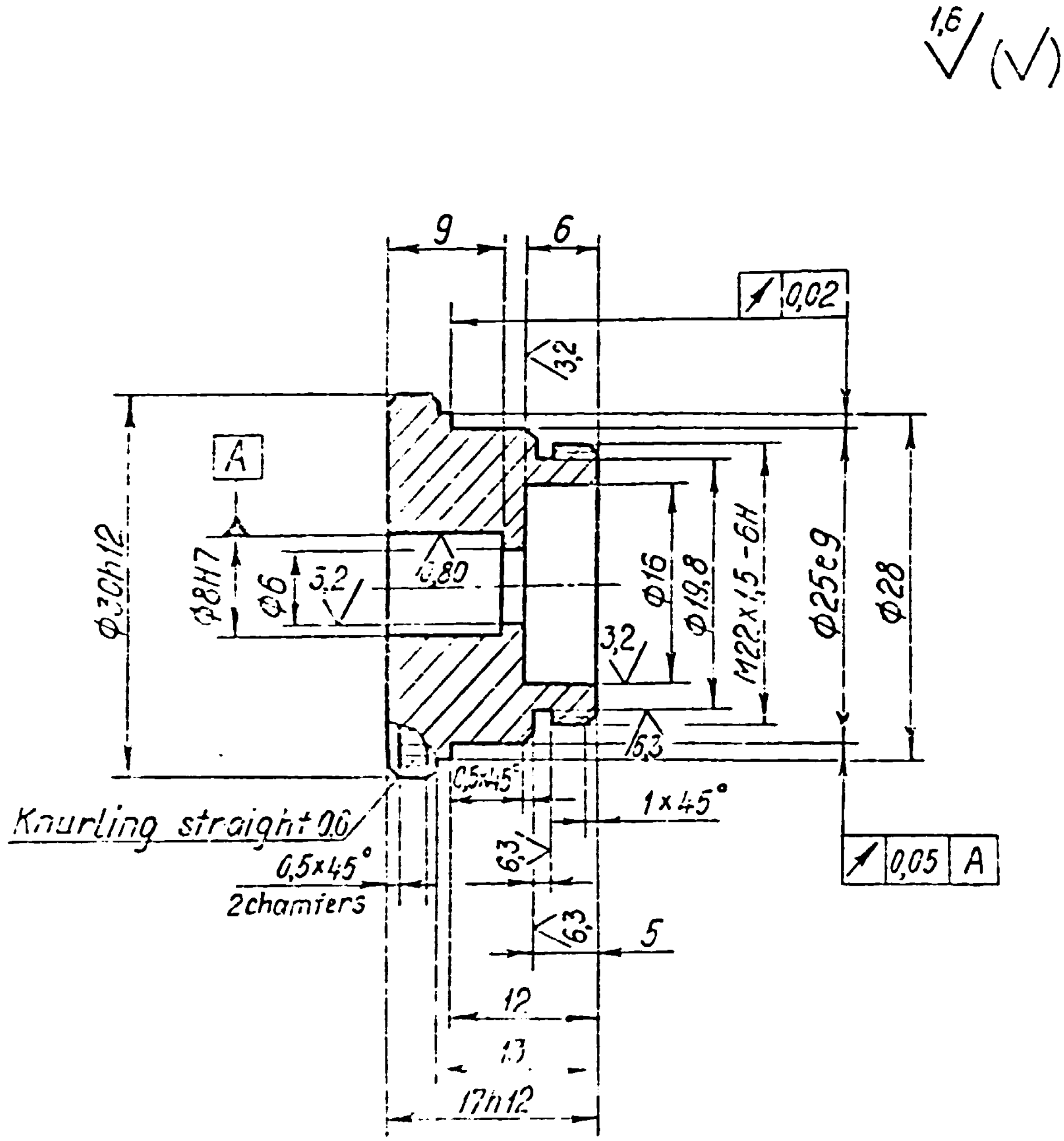
Designer

Steel 20

LITMO

Chief Designer

Form 54

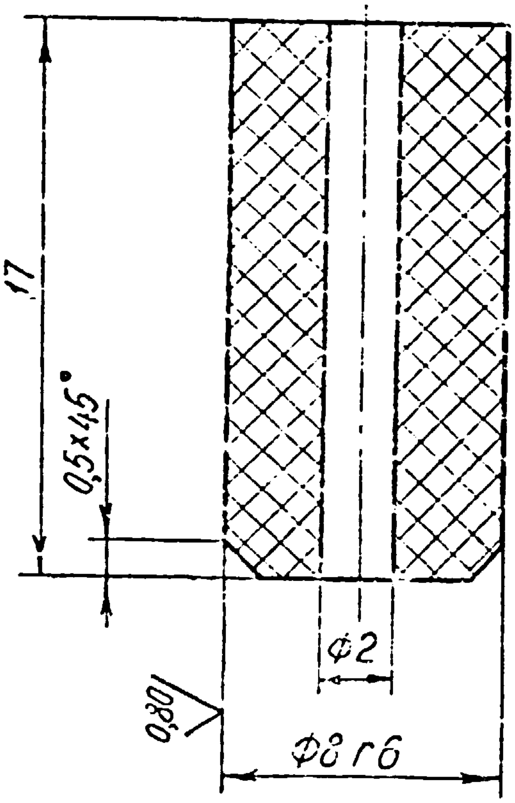


1. $H14, h14, \pm \frac{IT\,14}{2}$
2. Coating Fe/Ni Cr 9 mat finish

320. 221			
Bushing		Mass	Scale
			2:1
		Sheet	Sheets 1
Steel 20		LITMO	

Form A4

$\sqrt{1,6}\,(\sqrt{\ })$

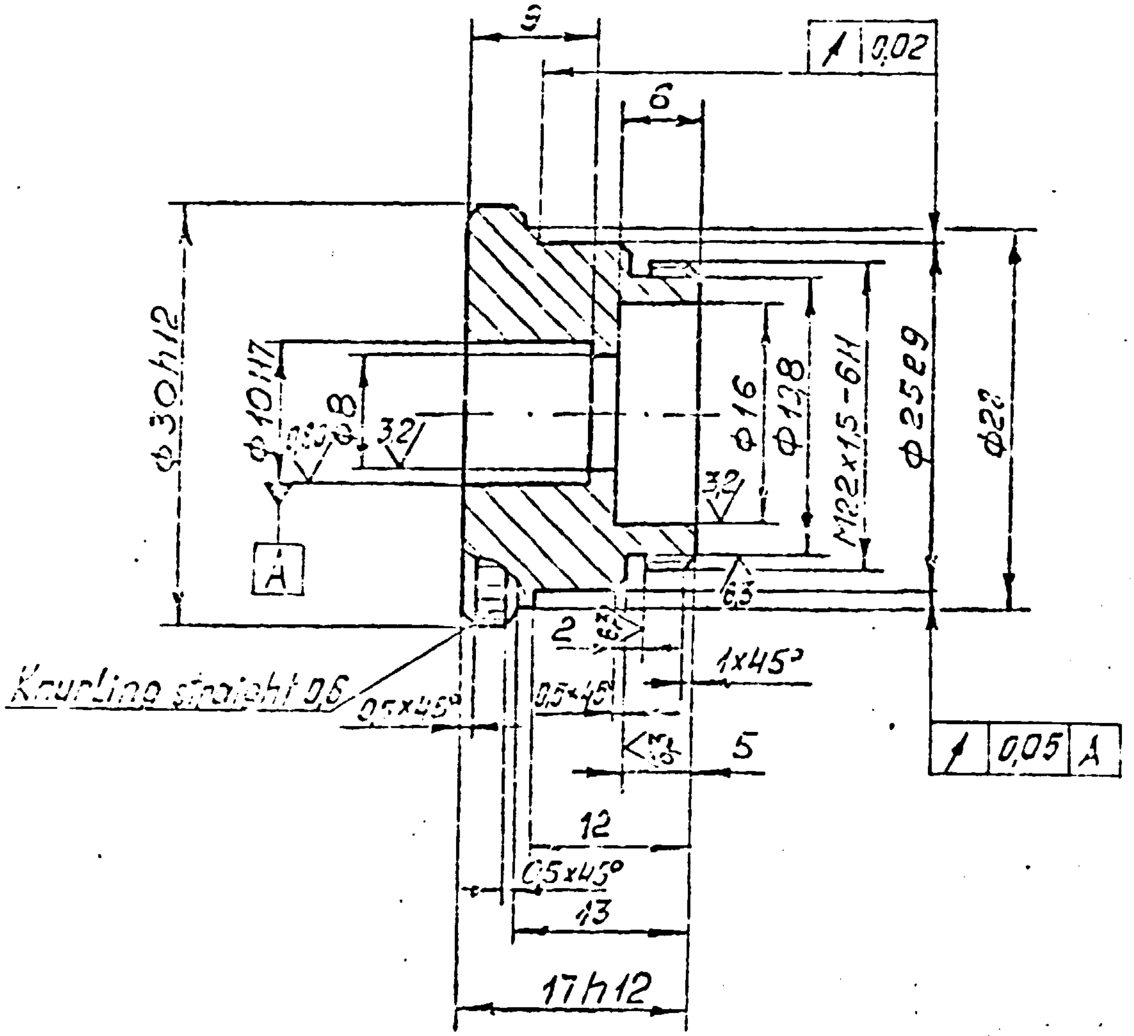


H14, h14, $\pm \frac{IT14}{2}$

	320.222	
Designer	Ring	Mass / Scale 5:1
		Sheet / Sheets 1
Chief Designer	Fluoroplast	LITMO

Form A4

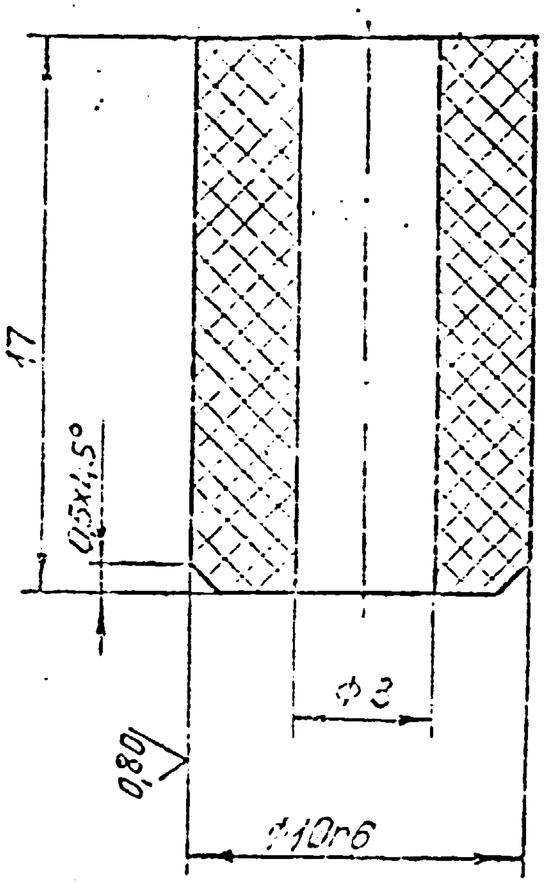
$\sqrt{1{,}6}\,(\sqrt{\ })$



1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating: Fe/Ni Cr 9 mat finish

320.223			
Bushing		Mass	Scale
			2:1
	Sheet		Sheets 1
Steel 20	LITMO		

1,6 √ (√)

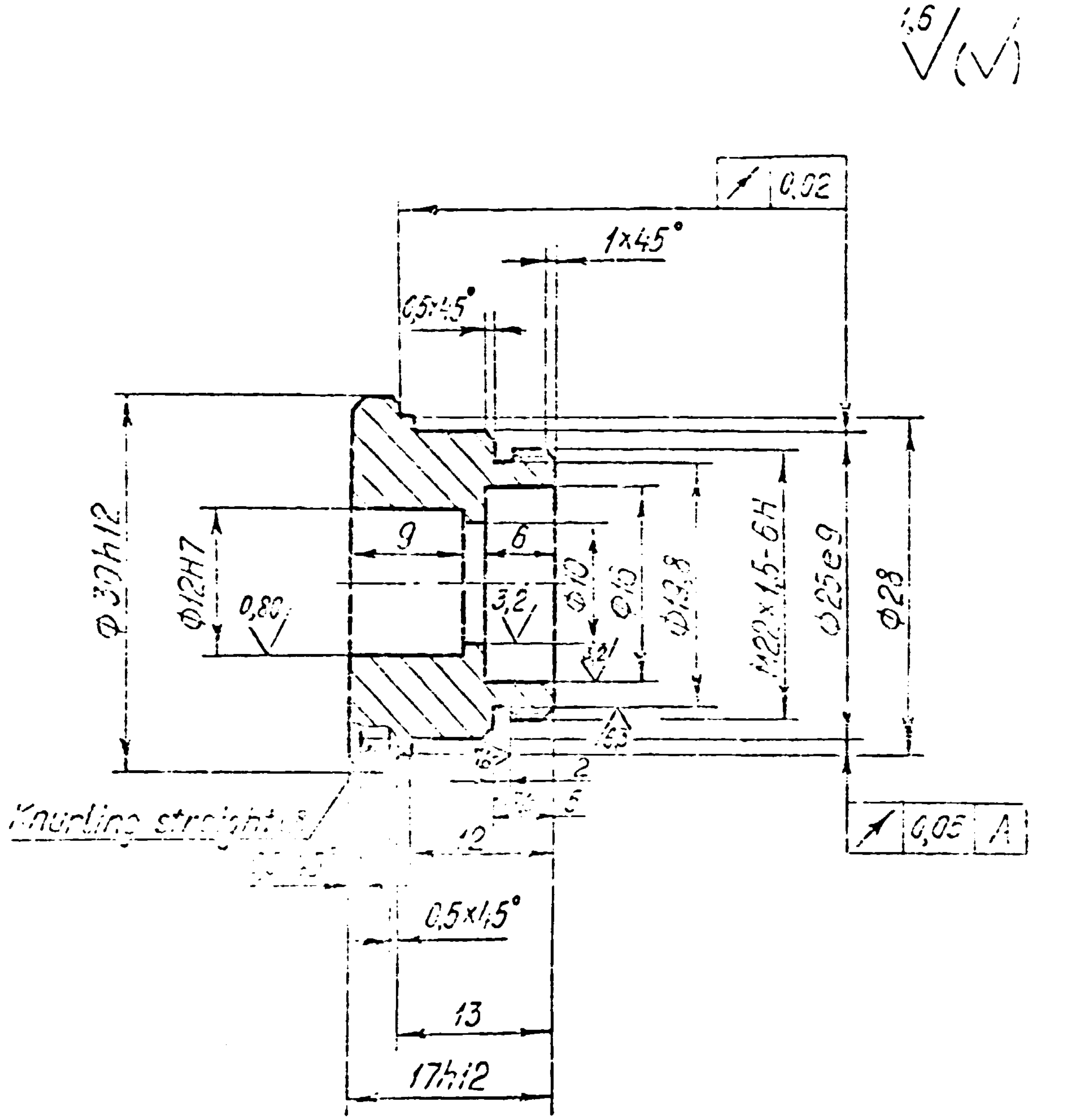


H14; h14; $\pm \frac{IT14}{2}$

320.224		
Ring	Mass	Scale
		5:1
Fluoroplast	Sheet	Sheets 1
	LITMO	

Design

Check

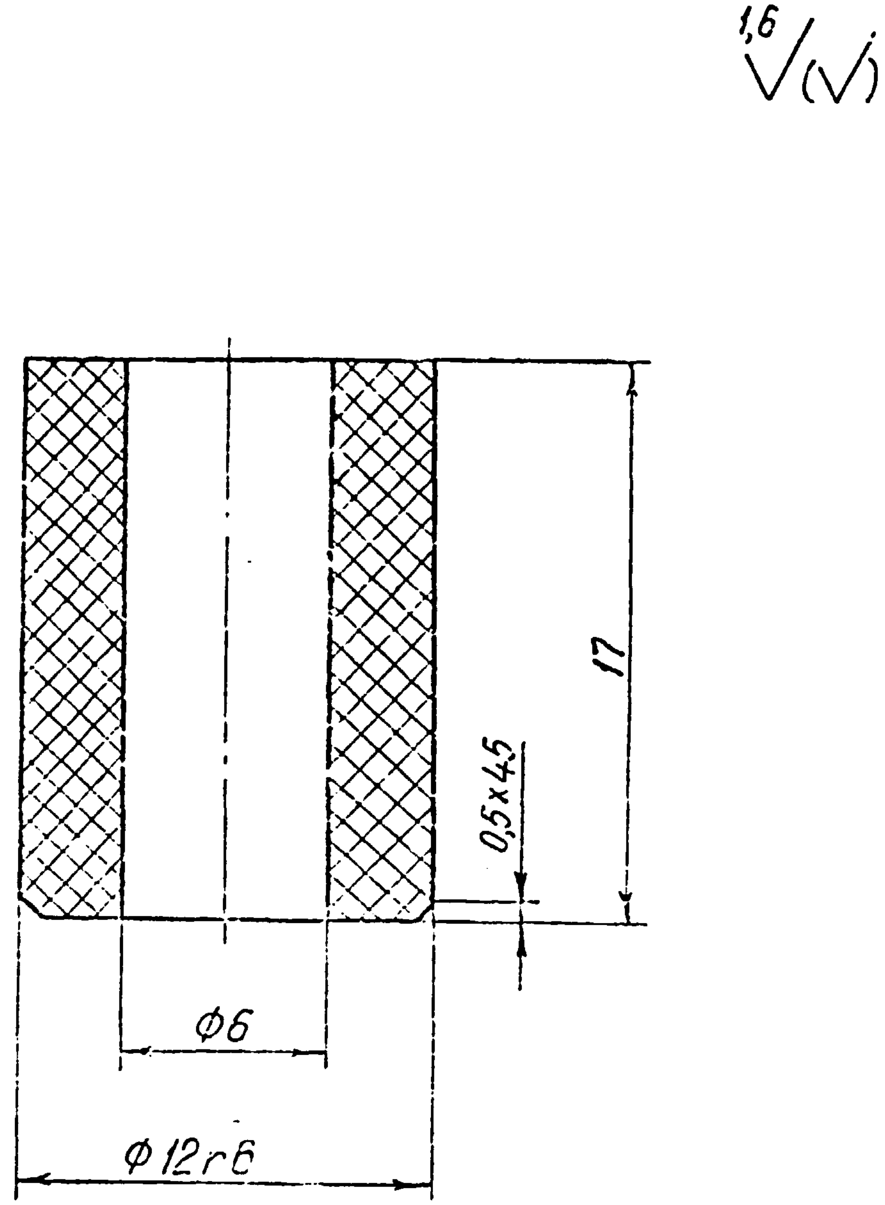


1. $H14, h14, \pm \frac{IT14}{2}$

2. Coating Fe/NiCr9mat finish

	320. 225	
	Bushing	Mass / Scale 2:1
		Sheet / Sheets 1
	Steel 20	LITMO

Form A4

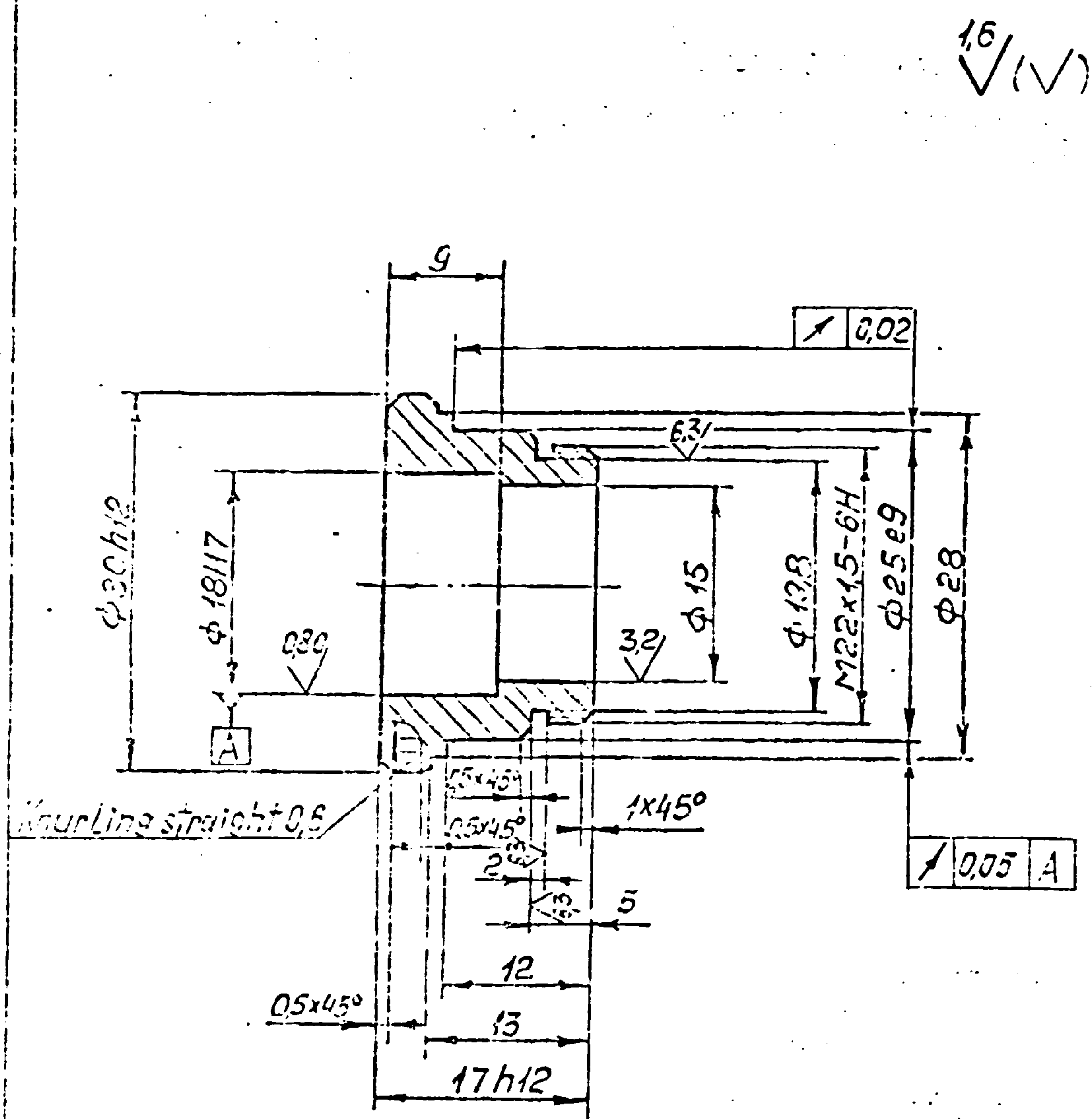


	320. 226
Ring	Mass / Scale 5:1
	Sheet / Sheets
Fluoroplast	LITMO

Designer

Chief Designer

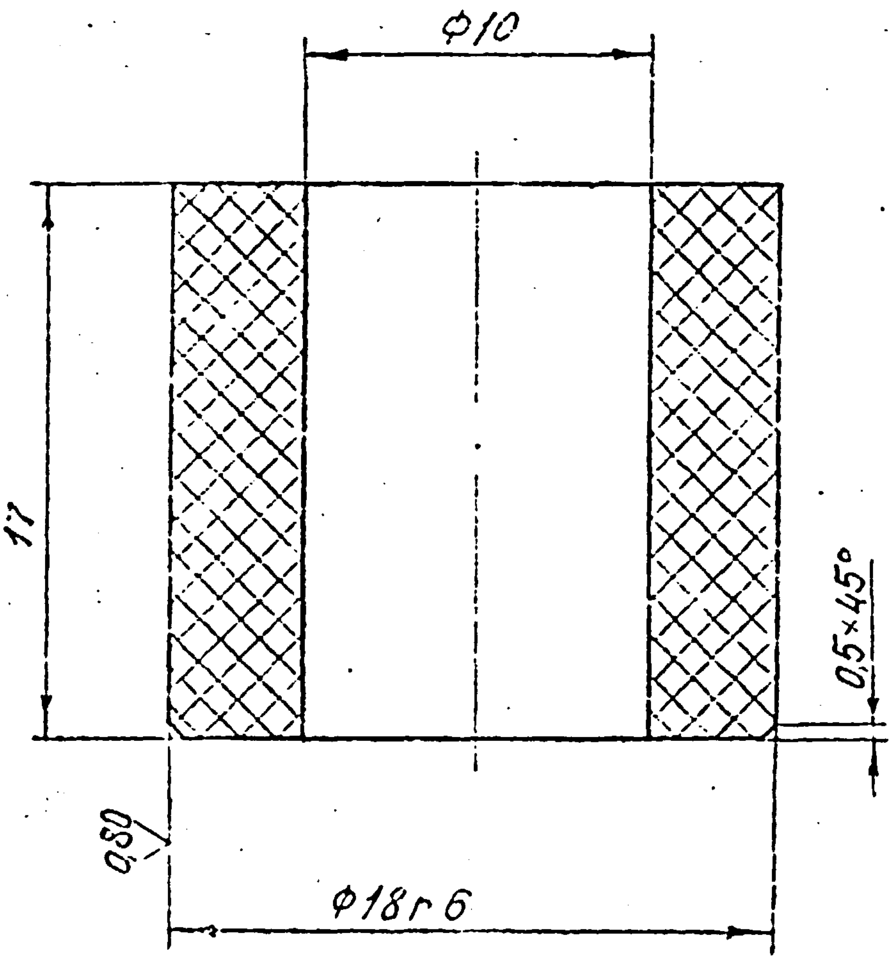
Form A4



1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating Fe/Ni Cr9 mat finish

320.227			
Bushing		Mass	Scale
			2:1
		Sheet	Sheets 1
Steel 20	LITMO		

$\sqrt[1,6]{}\,(\sqrt{})$

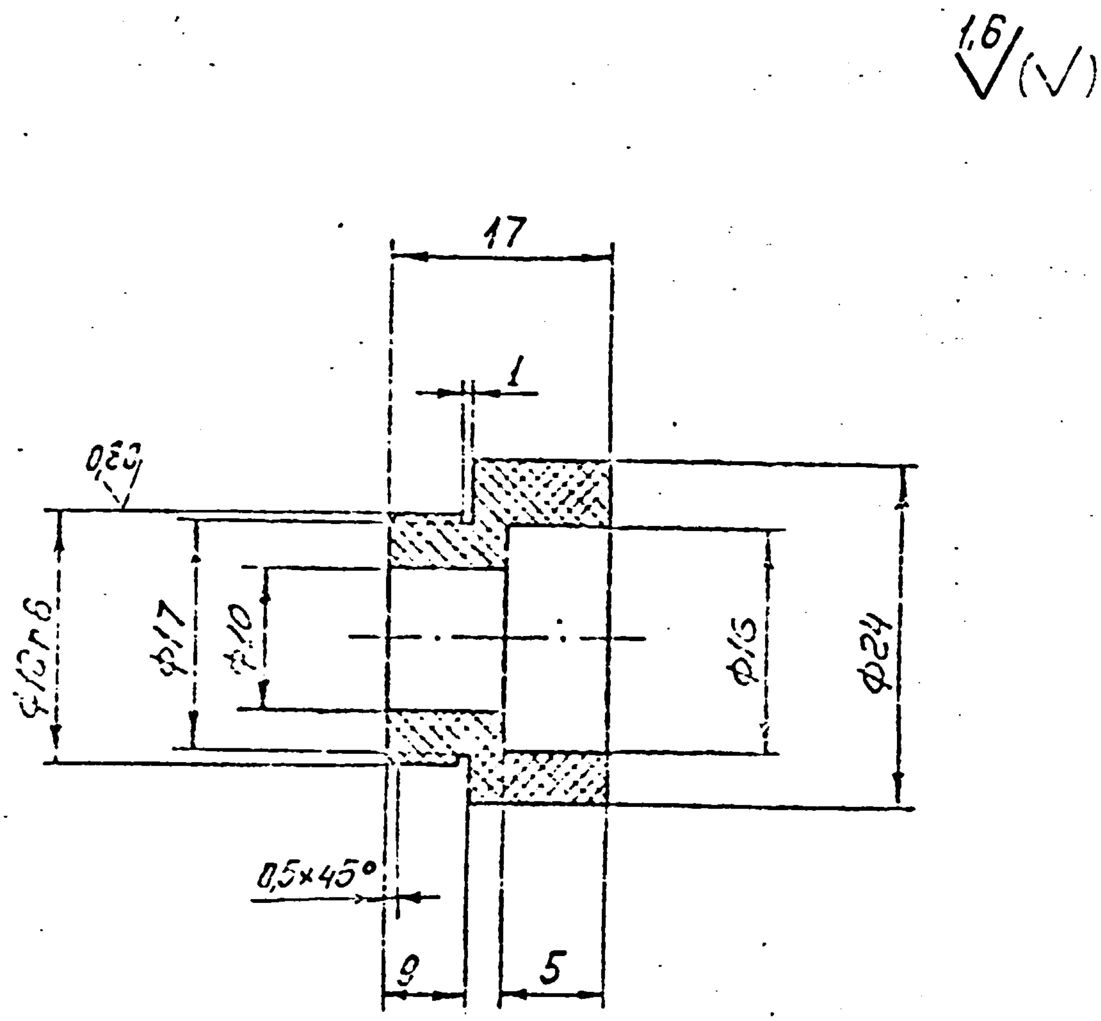


$H14;\ h14;\ \pm\frac{IT14}{2}$

320.228		
Ring	Mass	Scale
		5:1
	Sheet	Sheets 1
Fluoroplast	LITMO	

Designer

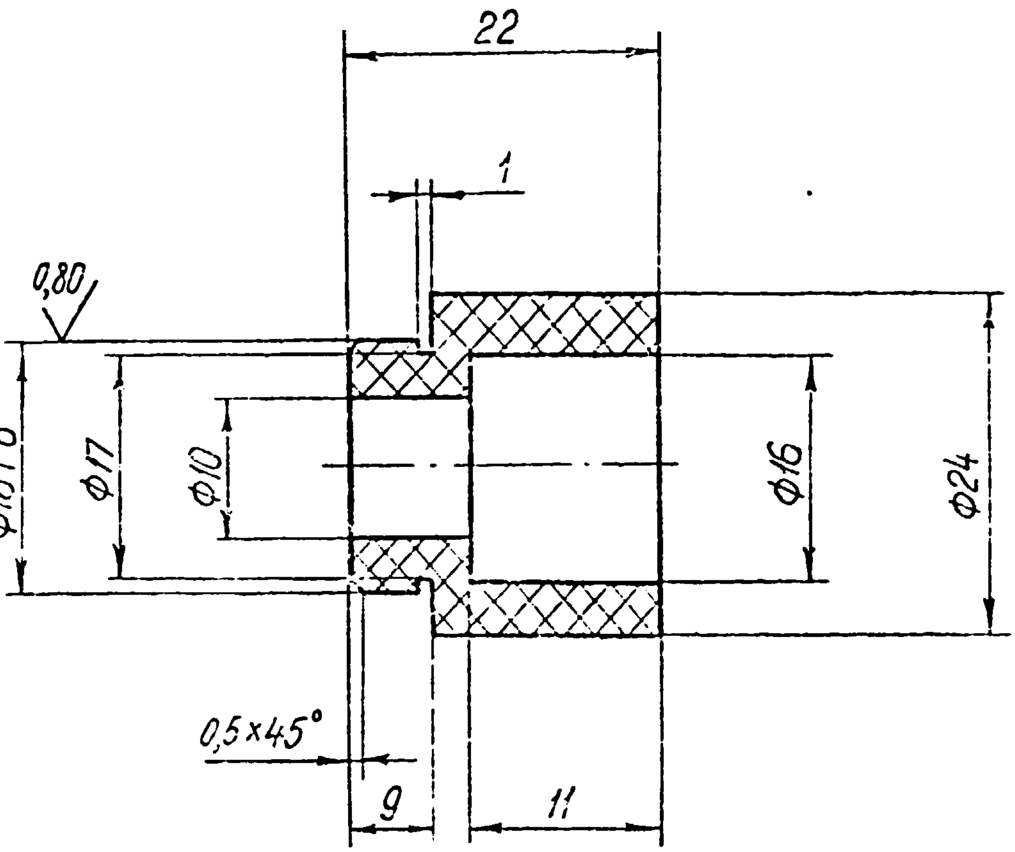
Chief Designer



H14; h14; $\pm \frac{IT14}{2}$

320.229			
Ring		Mass	Scale
			2:1
		Sheet	Sheets
Fluoroplast	LITMO		

$\sqrt{1,6}\ (\sqrt{\ })$



$H14, h14, \pm\frac{IT14}{2}$

320. 231

Ring

Mass | Scale

2:1

Sheet | Sheets 1

Designer

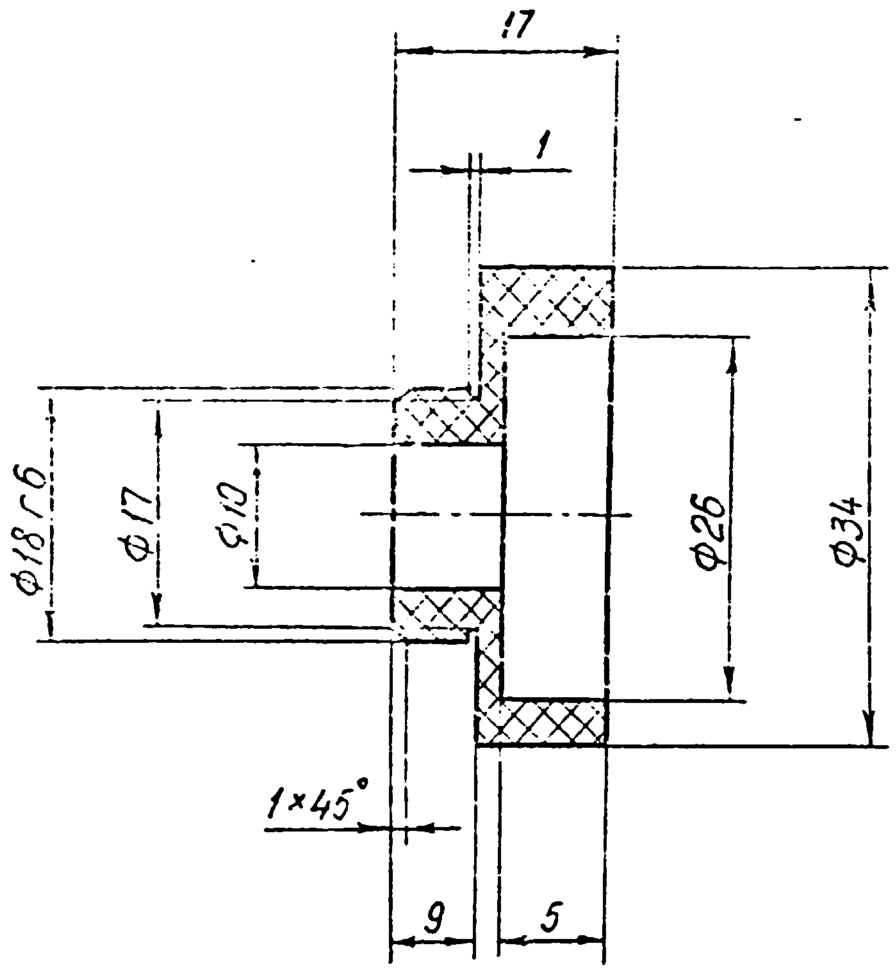
Chief Designer

Fluoroplast

LITMO

Form A4

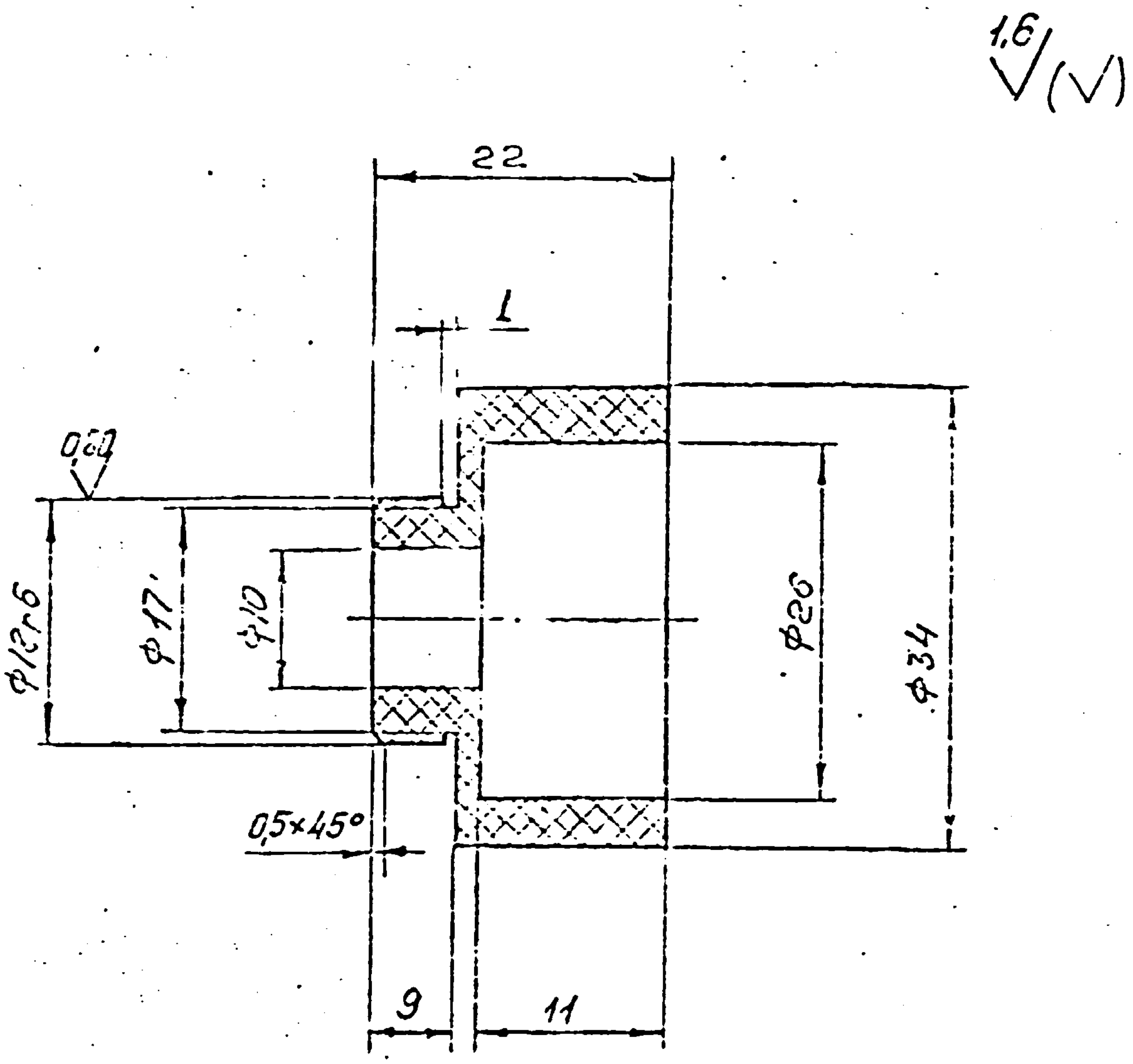
1,6 √(√)



$H14, h14, \pm \frac{IT14}{2}$

320.232			
Ring		Mass	Scale
			2:1
	Sheet	Sheets 1	
Fluoroplast	LITMO		

Form A4



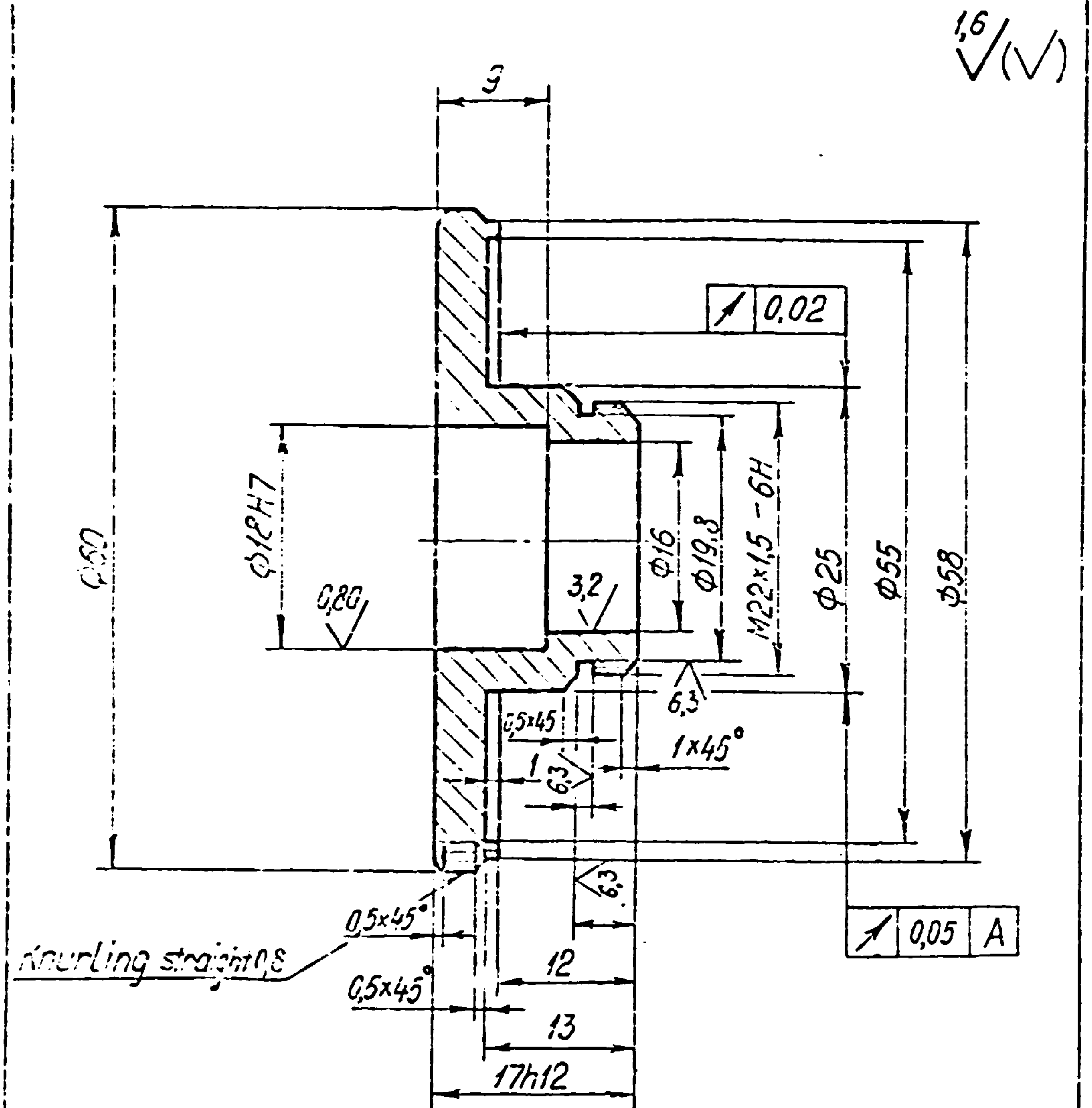
H14; h14; $\pm\frac{IT14}{2}$

320.233		
Ring	Mass	Scale
		2:1
	Sheet	Sheets 1
Fluoroplast	LITMO	

Designer

Check

Designer



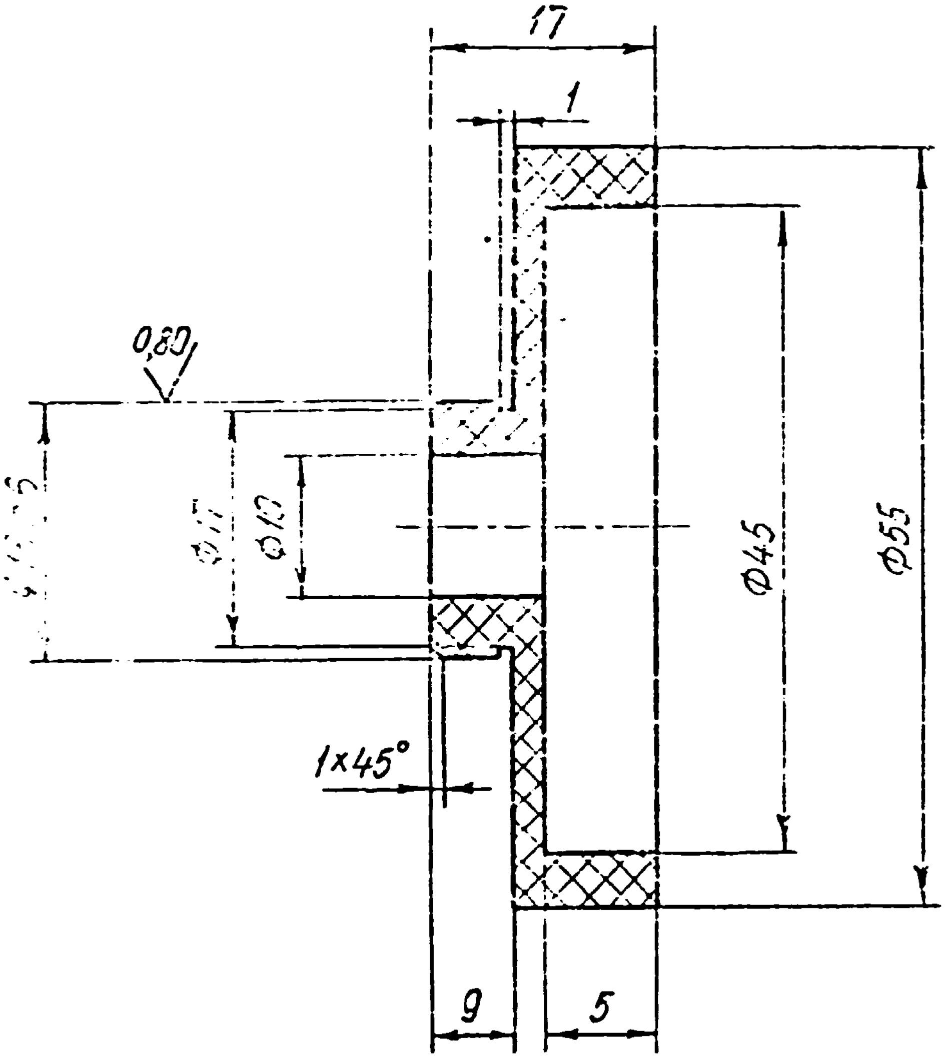
1. H14, h14, $\pm \frac{IT14}{2}$

2. Coating: Fe/Ni Cr9 mat finish

320.234		
Bushing	Mass	Scale
		2:1
	Sheet	Sheets 1
Steel 20	LITMO	

Form A4

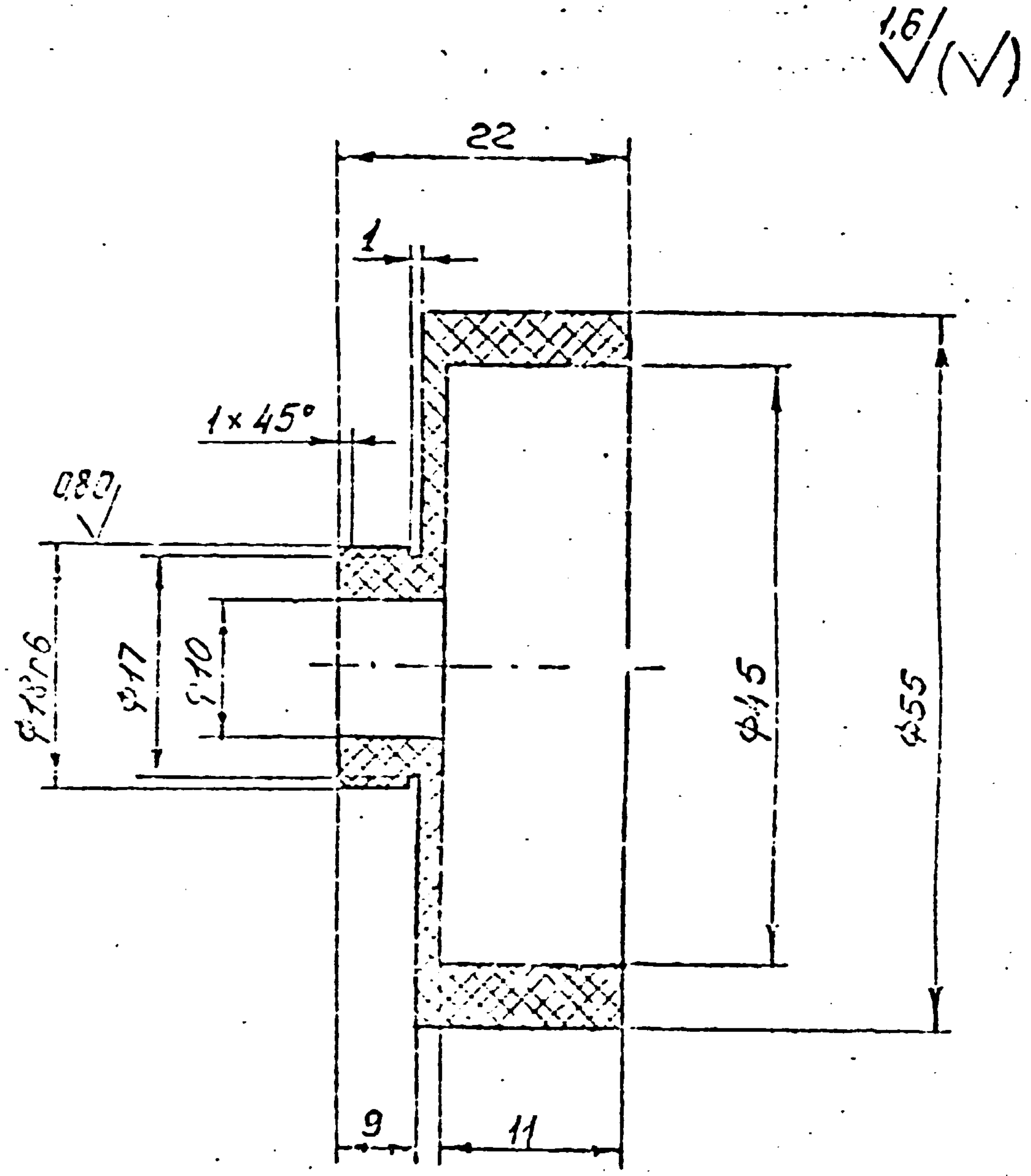
1,6 (√)



H14, h14, $\pm\frac{IT14}{2}$

320. 235		
Ring	Mass	Scale
		2:1
	Sheet	Sheets 1
Fluoroplast	LITMO	

Form A4



H14; h14; $\pm\frac{IT14}{2}$

320.236		
Ring	Mass	Scale
		2:1
	Sheet	Sheets 1
Fluoroplast	LITMO	

19353

(7 of 7)

Leningrad Institute of Precision Mechanics and Optics

F I N A L   R E P O R T

(project DP/SYR/86/011)
contract No 89/44

Annex 4.2

Technical Documentation on Equipment for Assembling and Adjusting of the Microscope

330.000 Testing device
350.000 Mounting jig
360.000 Centring tube
370.000 Auto-collimated tube
380.000 Templet
390.000 Templet

KNOW-HOW PACKAGE
Adapters, Tools
Wrenches
Thread bushings
Nozzles

[illegible] DEVICE

Technical description and
service manual

Technical description and service manual of testing device

1. Purpose

The testing device is intended to test the parfocal distance and residual decentring of objectives.

2. Technical data

Length of the microscope tube with
a rotation chuck, mm................................ 160
Scale factor of fine feed knob scale,mm 0,002
Scale factor of the eyepiece graticule, mm 0,1
Blacklash of the fine focusing
mechanism no more than, mm 0,004
Eyepiece magnification, factor...................... 10

3. Design of the device

The testing device is a microscope with a built-in illumination system, a rigid tube, rotational stage and mechanisms of fine and coarse focusing. The microscope is equipped with two renewable rotation threaded chucks to screw-in standard and test objectives (OB 4/5" x 1/36"), and with a gauge-standard to measure parfocal distance.

The testing device comprises:

1) Eyepiece with a graticule
2) Set of objects (lined specimen, centring plate).
3) Standard objectives

4. Device operation technique

4.1. Parfocal distance checking.

Checking is done as follows. Screw the rotation chuck (bushing) 330010 into the tube. Screw the standard objective in parfocal distance into the rotation chuck 330010, put the lined specimen on the microscope stage. Focus the microscope to a sharp object image by moving the stage with coarse and, if necessary, fine feed knobs, the fine feed knob being near the middle position of the travel range. Set gauge-standard in parfocal distance (330019) and take the reading from fine feed knob scale. This reading is taken as zero. Substitute the standard objective by the test one. Bring the microscope stage to the stop with a coarse feed knob viewing through the eyepiece. Focus the objective to a sharp image of the object by turning the fine feed knob and take the reading "n" from the knob scale. Determine the parfocal distance of the objective from

$$H_T = H_{ST} \pm N\, 0.002$$

where H_T - parfocal distance of the test objective, mm
H_{ST} - parfocal distance of the standard objective taken from the certificate, mm
n - number of divisions of the fine feed knob scale

Draw a conclusion concerning the suitability of the objective.

4.2. Objective centring checking.

Objective centring checking is done as follows: screw in the rotation chuck 330010 into the microscope tube and standard objective into the chuck. Place the specimen (centring plate) on the microscope stage. Focus the microscope to a sharp object image. Bring the object cross-hairs centre to that of the eyepiece graticule cross-hairs by moving the object. Make sure that the object cross-hairs centre remains stable when the chuck is rotating. Substitute the standard objective for test one and watch the value of the object cross-hairs centre image displacement and also the value of the cross-hairs image beating when the chuck is rotating. Knowing the scale factor of the eyepiece graticule and the allowable value of the given magnification objective decentring, draw a conclusion on the objective suitability.

Comment: When an inter-decentring of objectives is determined which make up the set one uses a rotation chuck with screws (330020).

In this case objective centring is done as follows:

Screw the rotation chuck 330020 into the tube and the objective of the least magnification in the set into the chuck, mount the centring plate on the microscope stage and focus the microscope to a sharp object image. Coincide the cross-hairs centre object image with the cross-hairs centre of the eyepiece graticule moving centring plate and strive for these centres to be without offset when chuck with objective under the test is rotated inter-travelling the object and the objective in the chuck with the screws 330012.

Mount successively the objectives of other magnifications starting with the lowest one in the given set and watch the value of offsetting the cross-hairs centre of the centring plate. Knowing the scale factor of the eyepiece graticule in each case, draw a conclusion whether it is allowable to include the test objectives into the set.

Format	Zone	Ref. No.	Designation	Name	Quantity	Comment
				Specification		
			330.000Ass	Assembling drawing		
				Assembling units		
		1	330.010	Chuck		1piece. It is allowable to replace by the chuck 2
		2	330.020	Chuck		1piece. It is allowable to replace by the chuck 1
				Pieces		
		6	330.015	Tube	1	
		7	330.016	Spacer	1	
		8	330.017	Screw	1	
		9	330.018	Nut	1	
		10	330.019	Support	1	
		11	330.021	Adapter	1	

330.000		
Testing device	Sheet 1	Sheets 3
Designer / Chief designer	LITMO	

Form A4

Format	Zone	Ref N	Designation	Name	Quantity	Comment
				Standard units		
		15		Bolt M5-6g×16.58.05 ГОСТ 7798-70	1	
		17		Screw B.M4-6g×14.58.05 ГОСТ 1491-80	6	
		18		Screw A.M2-6g×4.58.05 ГОСТ 17473-80	5	
		20		Washer 6.01.05 ГОСТ 10450-78	1	
		21		Pin 3 u8 × 16 ОСТ3-2234-80	2	
		22		Pin 3 u8 × 18 ОСТ3-2234-80	2	

330.000

Sheet 2

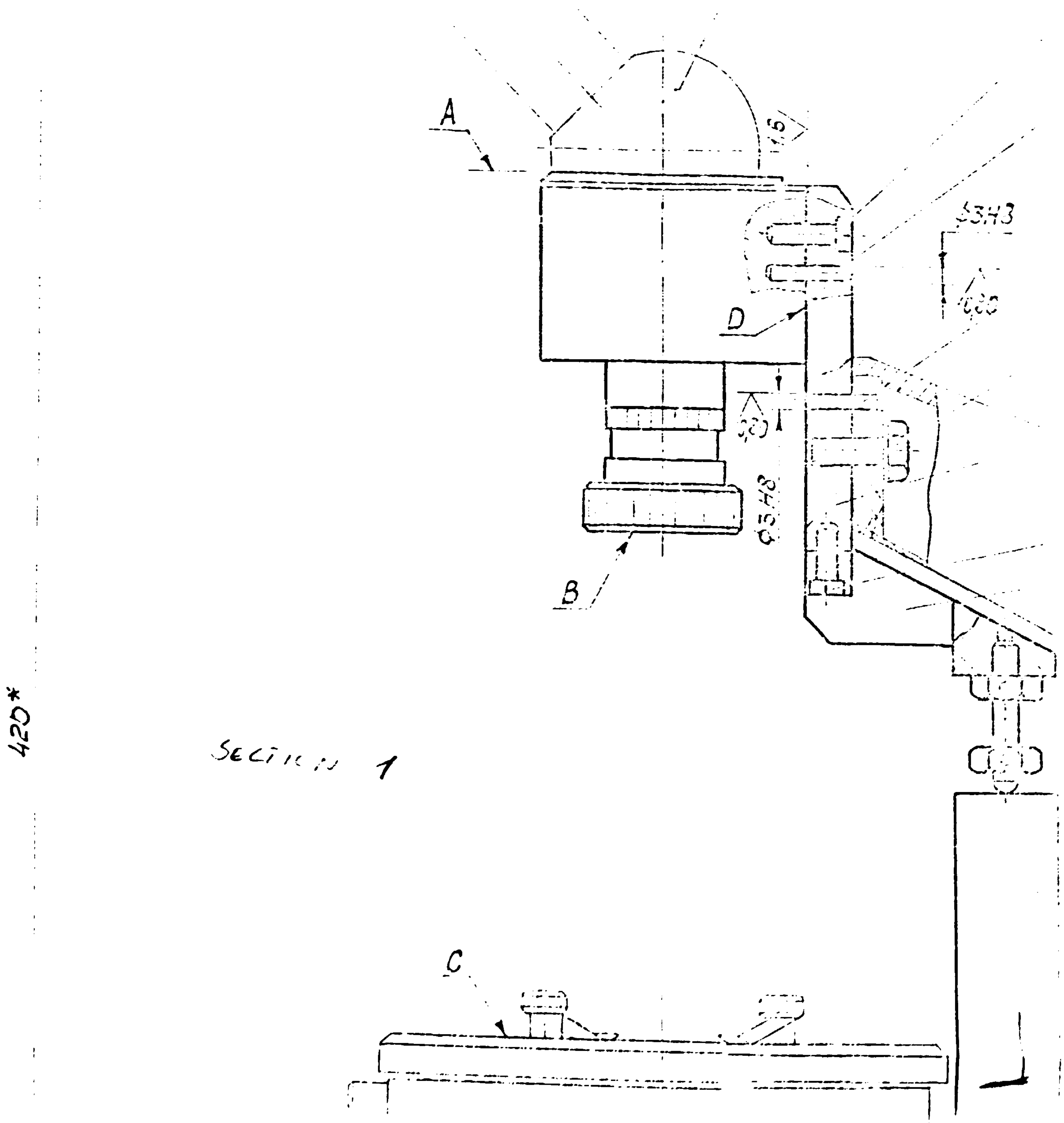
Form A4

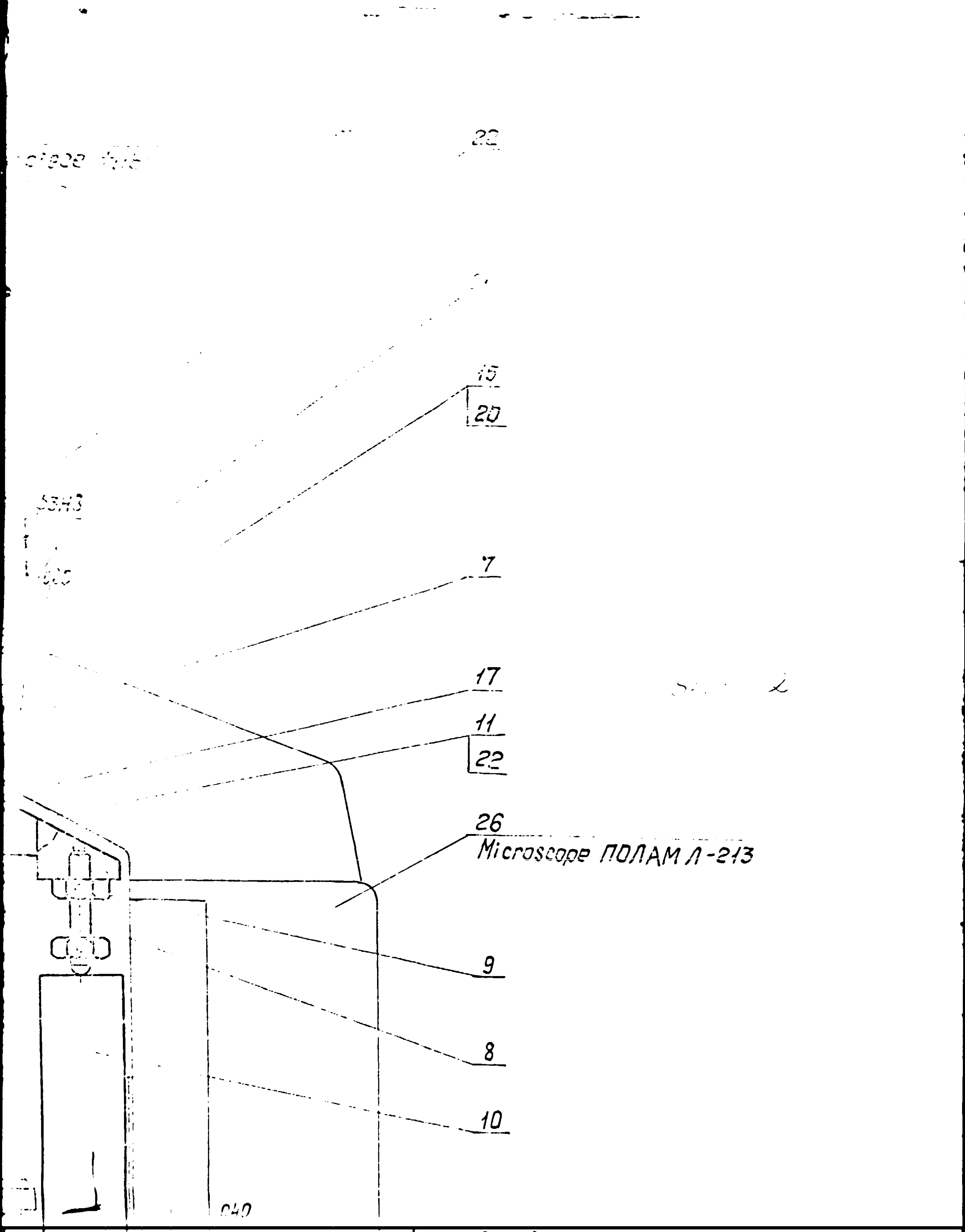
Form	Zone	Ref.No	Designation	Name	Quantity	Comment
				<u>Other products</u>		
		25		Eyepiece 10 × with graticule	1	
		26		Microscope ПОЛАМ Л-213	1	
		27		Monoeyepiece tube (from microscope БИОЛАМ)	1	

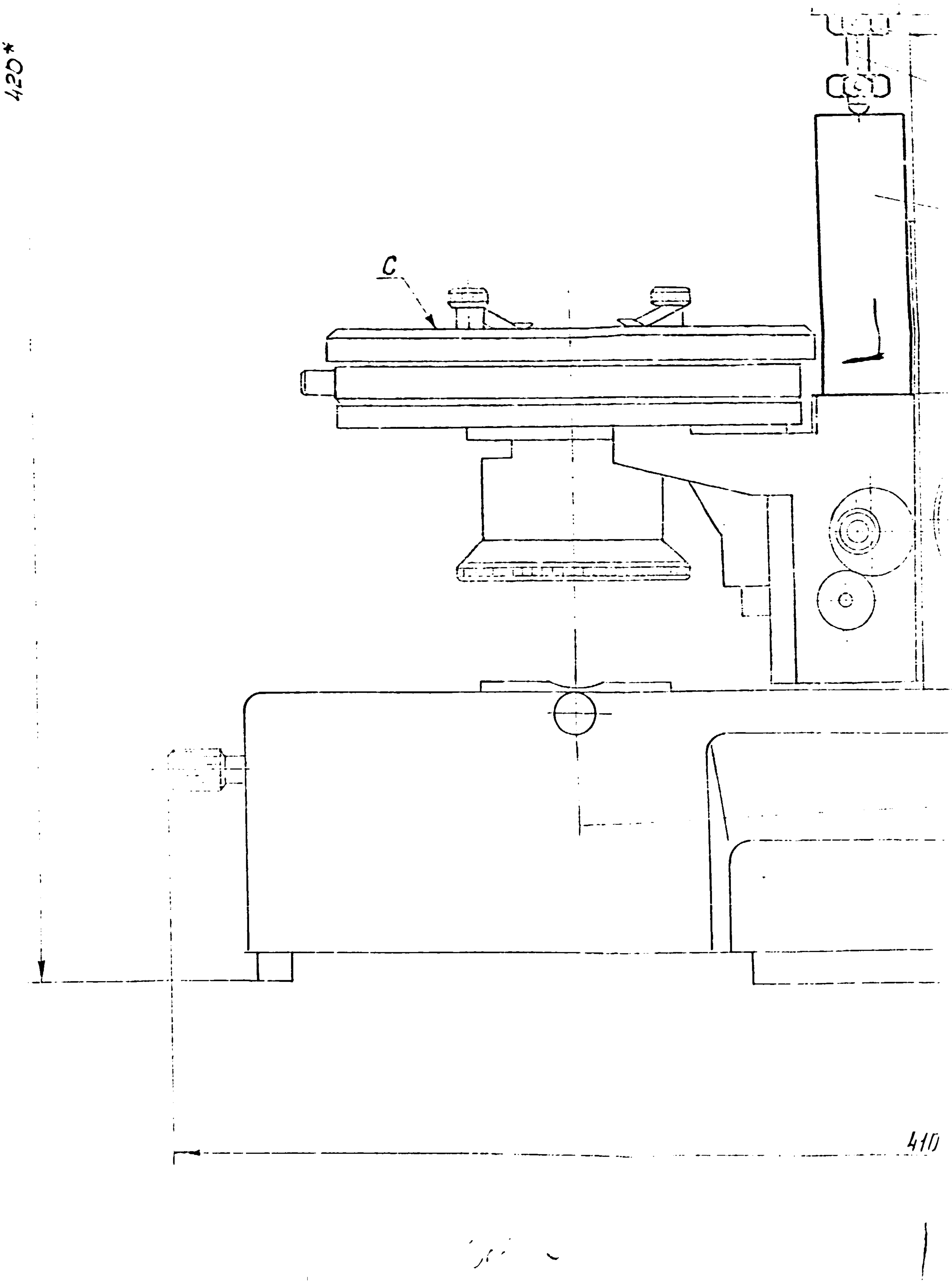
330.000

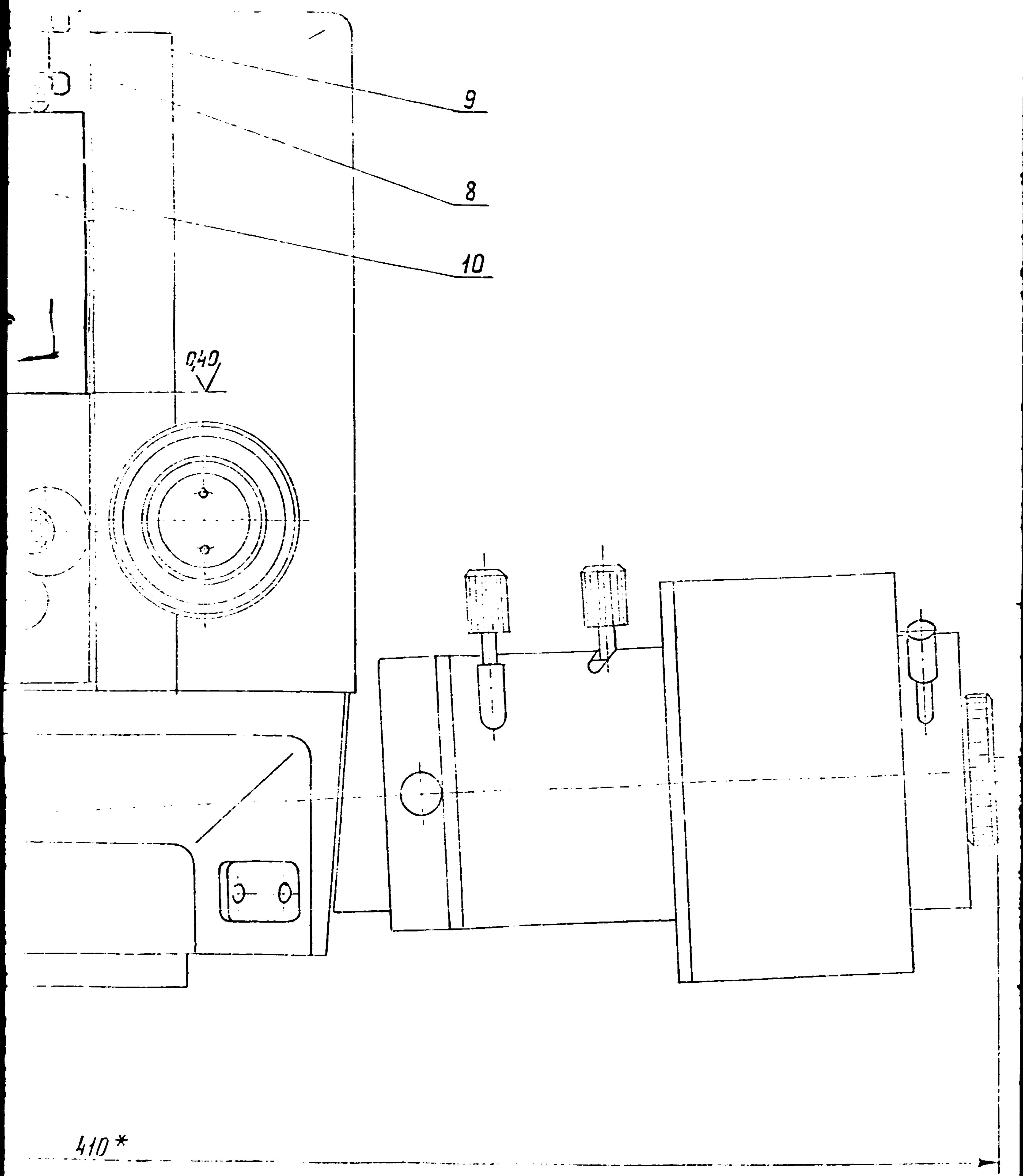
Sheet 3

27
Monoeyepiece




22
15
20
7
17
11
22
26
Microscope ПОЛАМ Л-213
9
8
10


420*
C
410



SECT 4

SECT E

1. * The dimensions for information
2. Departure from parallelism of the object plane C of the stage relative to the plane A of the tube and to the plane B of the chuck is no more than 0°2'
3. Departure from normal of the instrument sight axis relative to the plane C is no more than 0°2'
   The requirements are provided by moving the stage with matching screws, by finishing the surface D of the spacer and by mounting it on the bolt followed by securing with pins.

330.000 Ass

Mass | Scale

Testing device

1:1

Designer

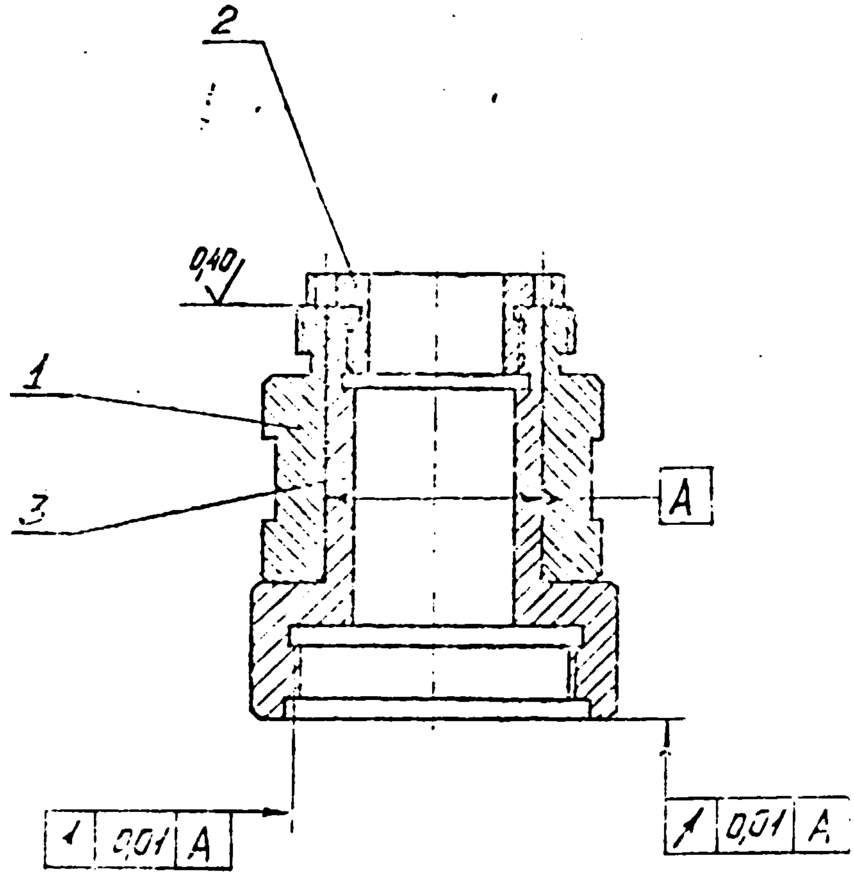
Sheet | Sheets 1

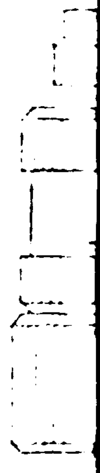
LITMO

Designation	Name
	Specification
330. 010 Ass	Assembling drawing
	Pieces
330. 001	Bushing
330. 002	Nut
330. 003	Case

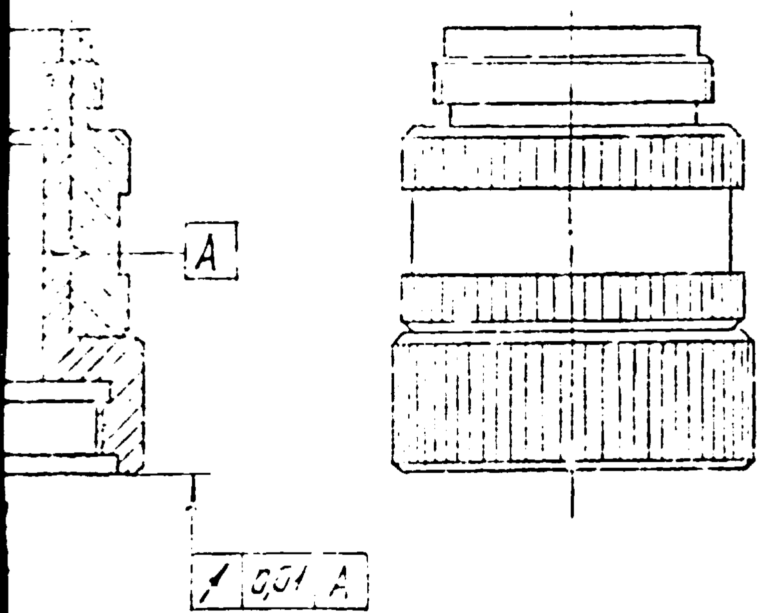
330. 010

Chuck





SECTION 1



1. Fit in the surfaces of the pieces 1,3 to reach the smooth rotation without any backlash.
2. Lubricate the contact surfaces with oil.

330. 010 Ass		
Chuck	Mass / Scale: 2:1	
Designer	Sheet / Sheets	
Chief Designer	LITMO	

			Designation	Name	Quantity	Comment
				Specification		
			330. 020 Ass	Assembling drawing		
				Pieces		
		1	330. 007	Bushing	1	
		2	330. 008	Case	1	
		3	330. 009	Nut	1	
		4	330. 011	Ring	1	
		5	330. 012	Screw	4	

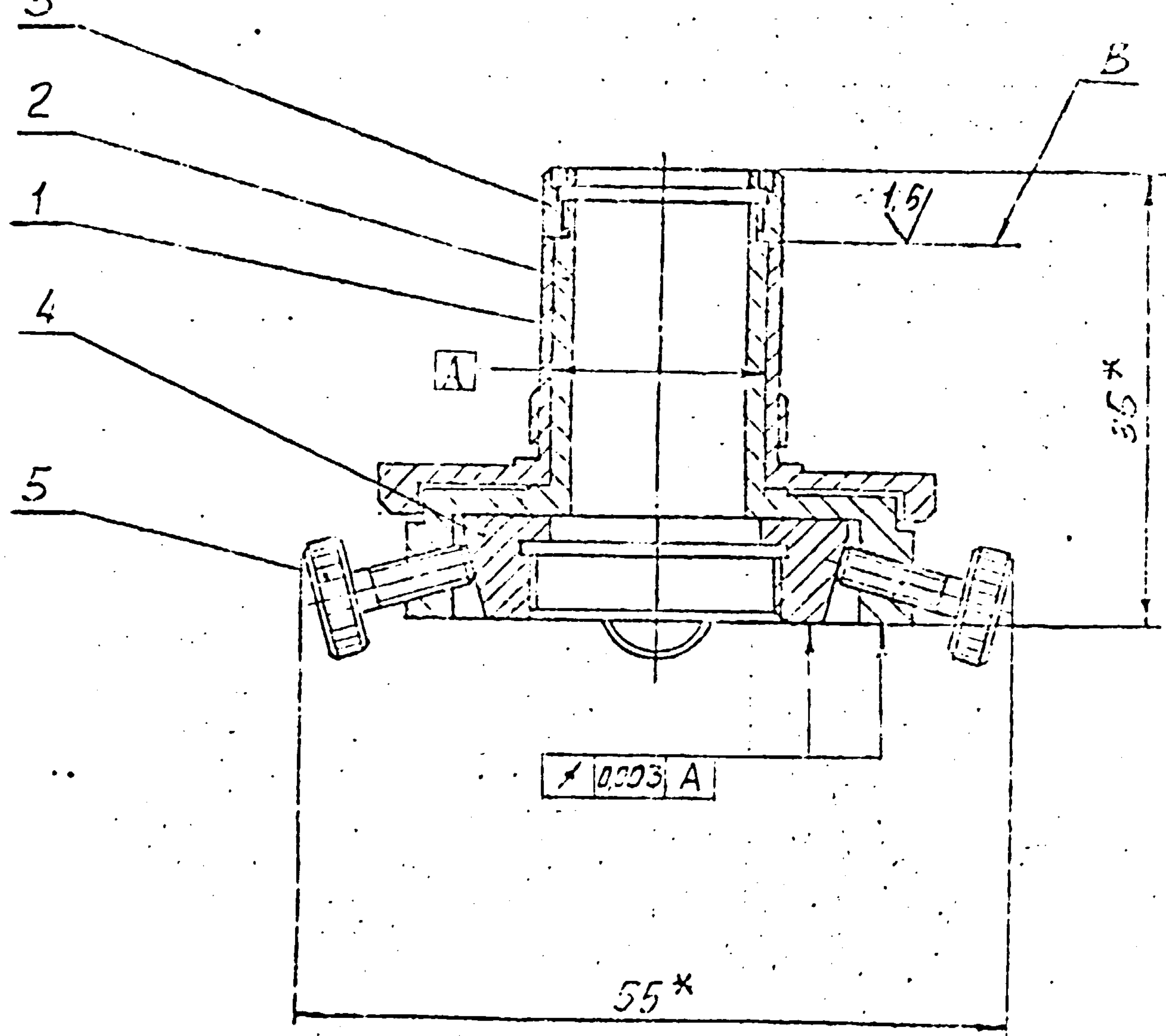
330. 020

Chuck

Sheet	Sheets
	1

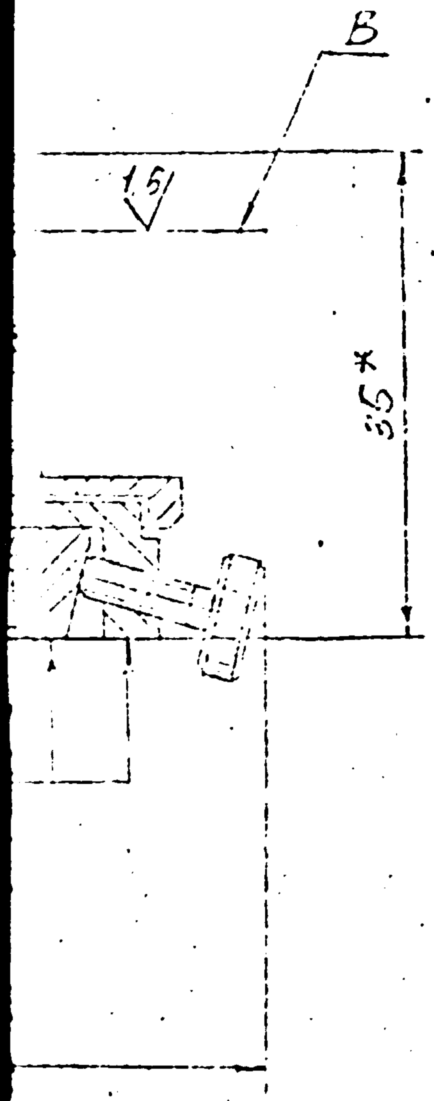
LITMO

Form A4



1.*The
2. Fin
Б
The
3. Zu

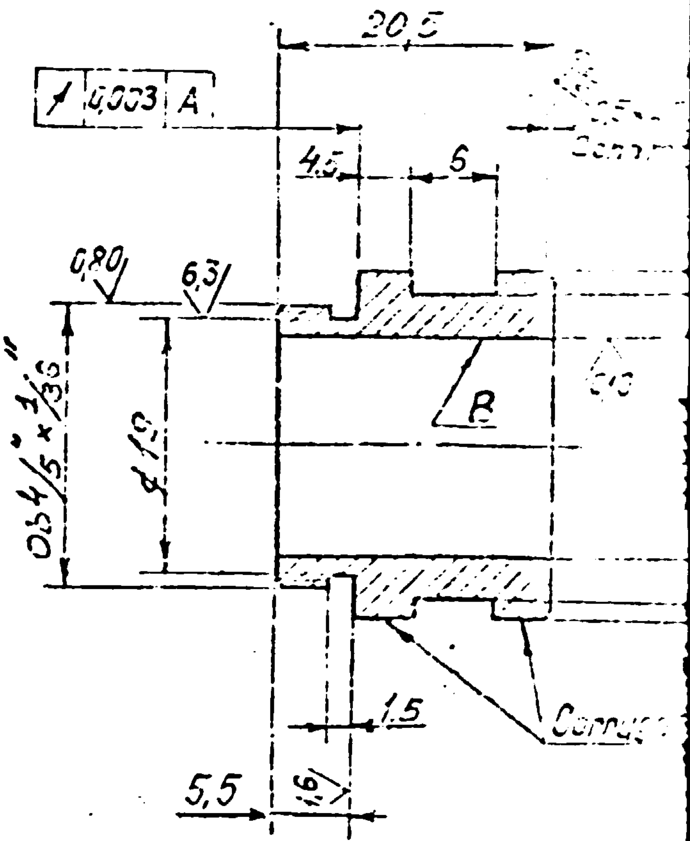
Section 1



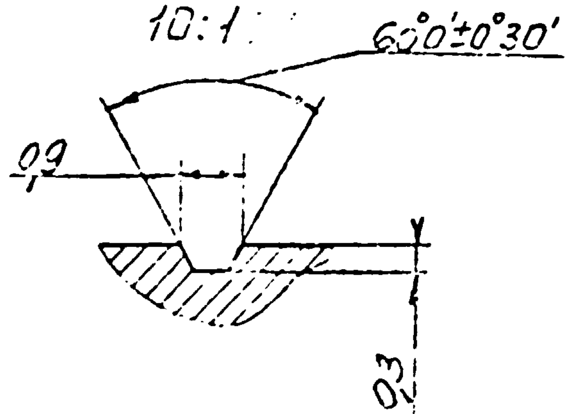
*

1. The dimensions for information
2. Finish simultaneously the surfaces A and the ends B of the pieces 1,2 to reach smooth quiet rotation. The run-out must be no more than 0,01mm
3. Zubricate the contact surfaces with oil.

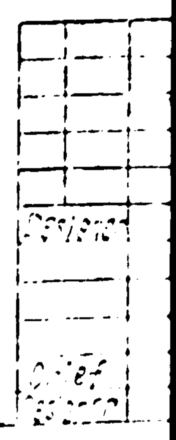
	330. 020 Ass	
Designer	Chuck	Mass: / Scale: 2:1
		Sheet / Sheets 1
Chief Designer		LITMO



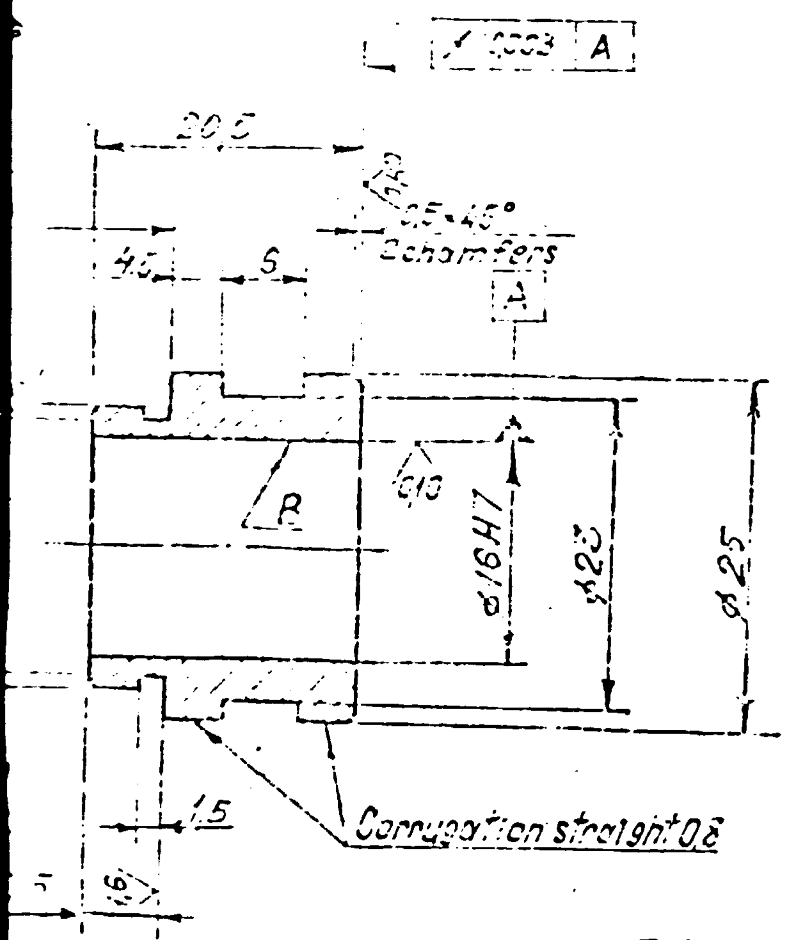
Spiral shape
10:1



1. H14
2. Cut
sur



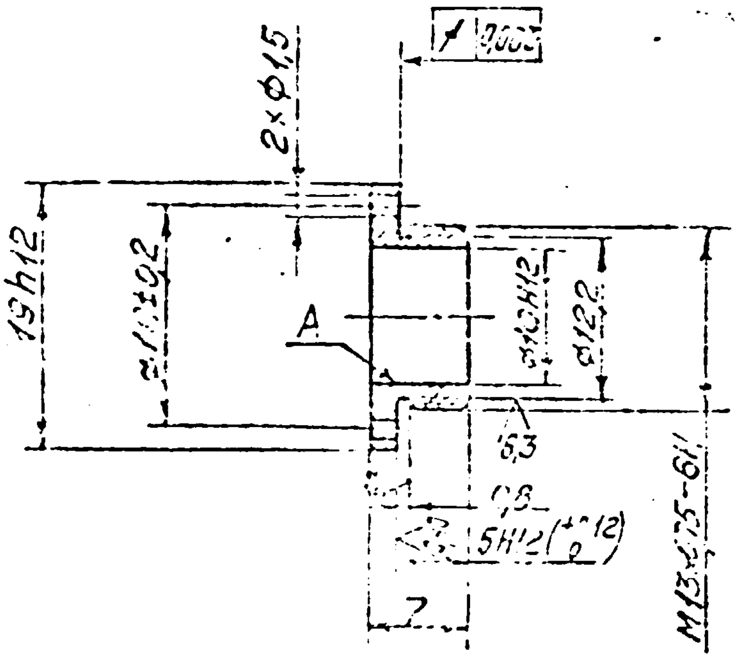
SECTION 1



1. H14; h14; $\frac{IT14}{2}$
2. Cut left and right spirals with indicated shape on the surface „B". Spiral pitch is 10mm.

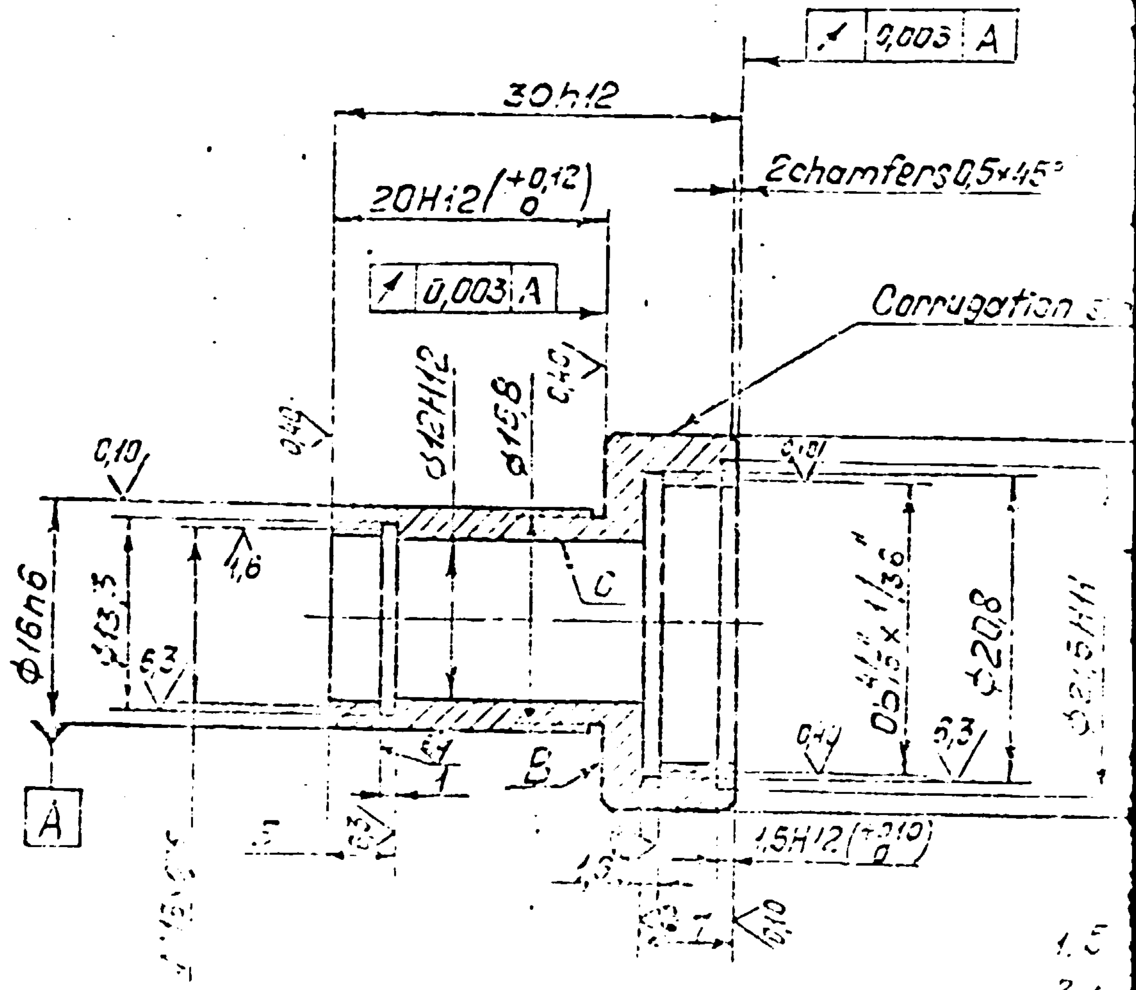
	330.001
Designer	Bushing
Chief Designer	Bronze CuSi3Mn1
Sheet / Sheets 1	LITMO
Scale	2:1

$\sqrt{}^{1,6}$ (√)



1. 45,5...47,5 $HRC_э$
2. H14; h14; $\pm \frac{IT14}{2}$
3. Coating: Chemical oxidation
   Coat the surface A with black enamel

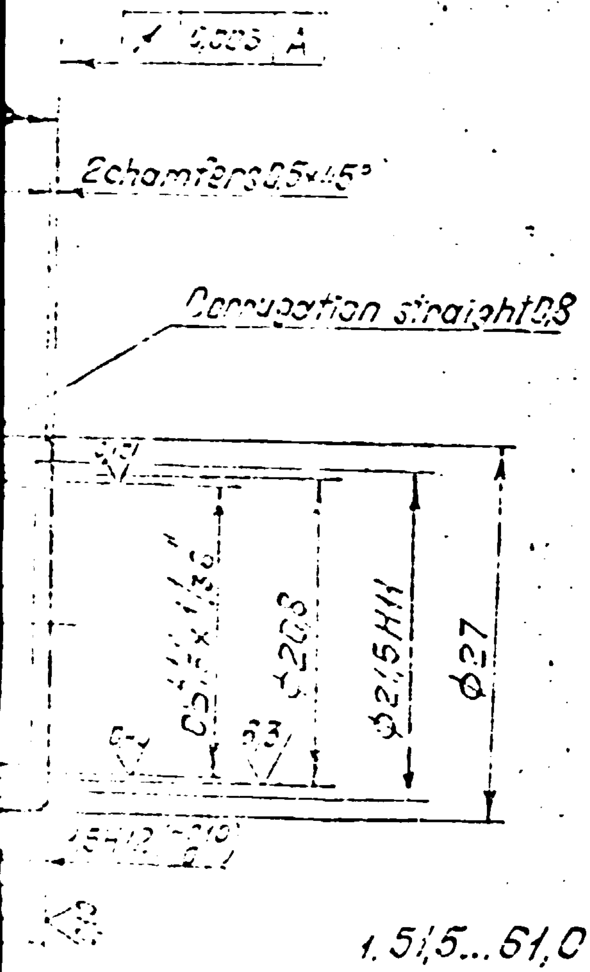
330.002		
Nut	Mass	Scale
		2:1
	Sheet	Sheets 1
Steel 50	LITMO	



0,003 A
30h12
2chamfers 0,5×45°
20H12 (+0,12 0)
Corrugation
Φ12H12
Φ15,8
Φ16h6
Φ13,5
C
B
A
Φ20,8
1,5H12 (+0,10 0)

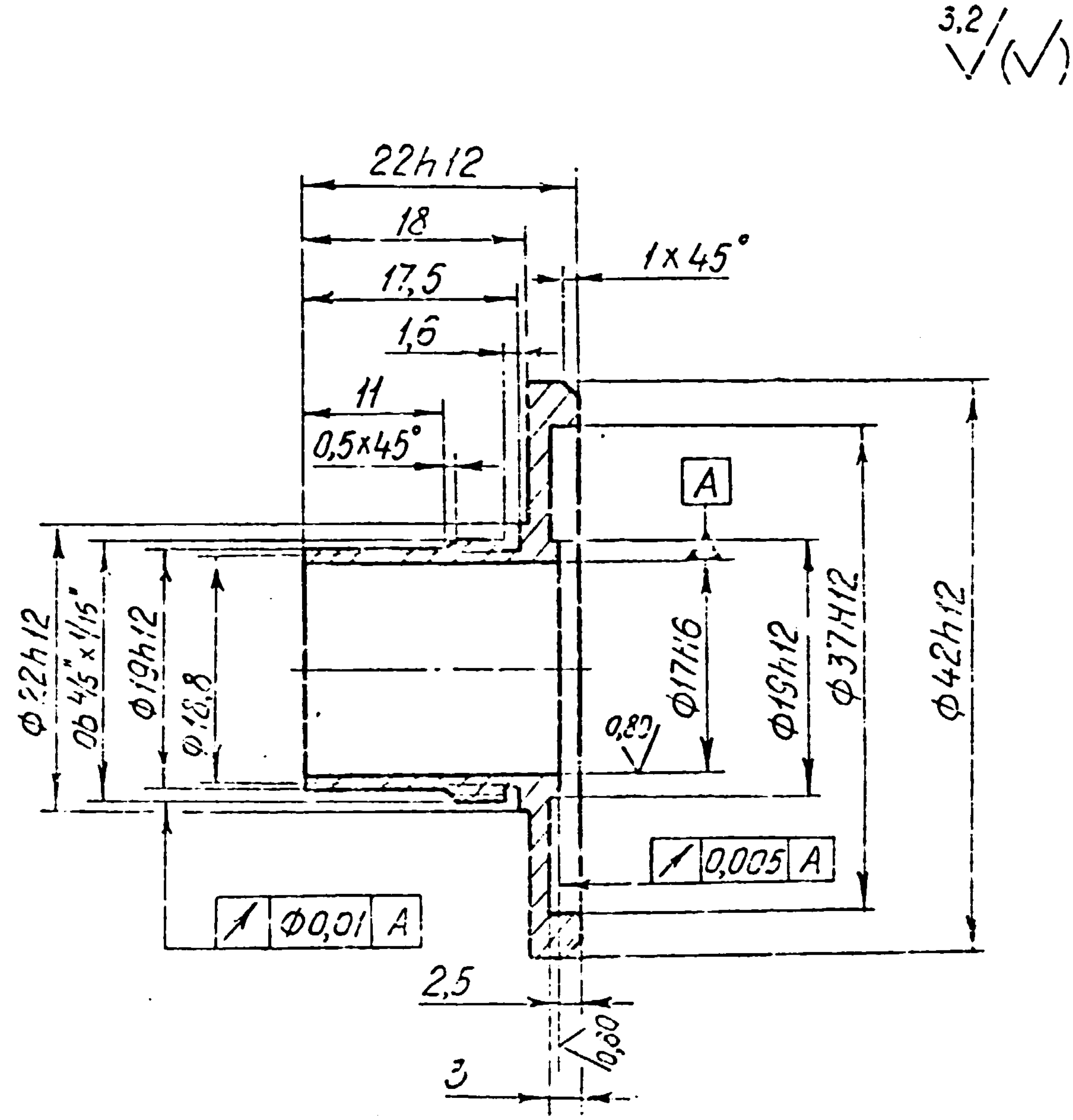
SECTION 1

$\sqrt{^{1,6}}\ (\sqrt{})$



1. 51,5...61,0 $HRC_э$
2. H14; h14; $\pm \frac{IT14}{2}$
3. Fit in the piece surfaces A and B with the piece 330.001 and the piece 330.002.
4. Coating: Coat the surface C with black enamel.

Designer	330.003	
Chief designer	Case	Mass: — Scale: 2:1
		Sheet — Sheets 1
	Steel ХВГ	LITMO

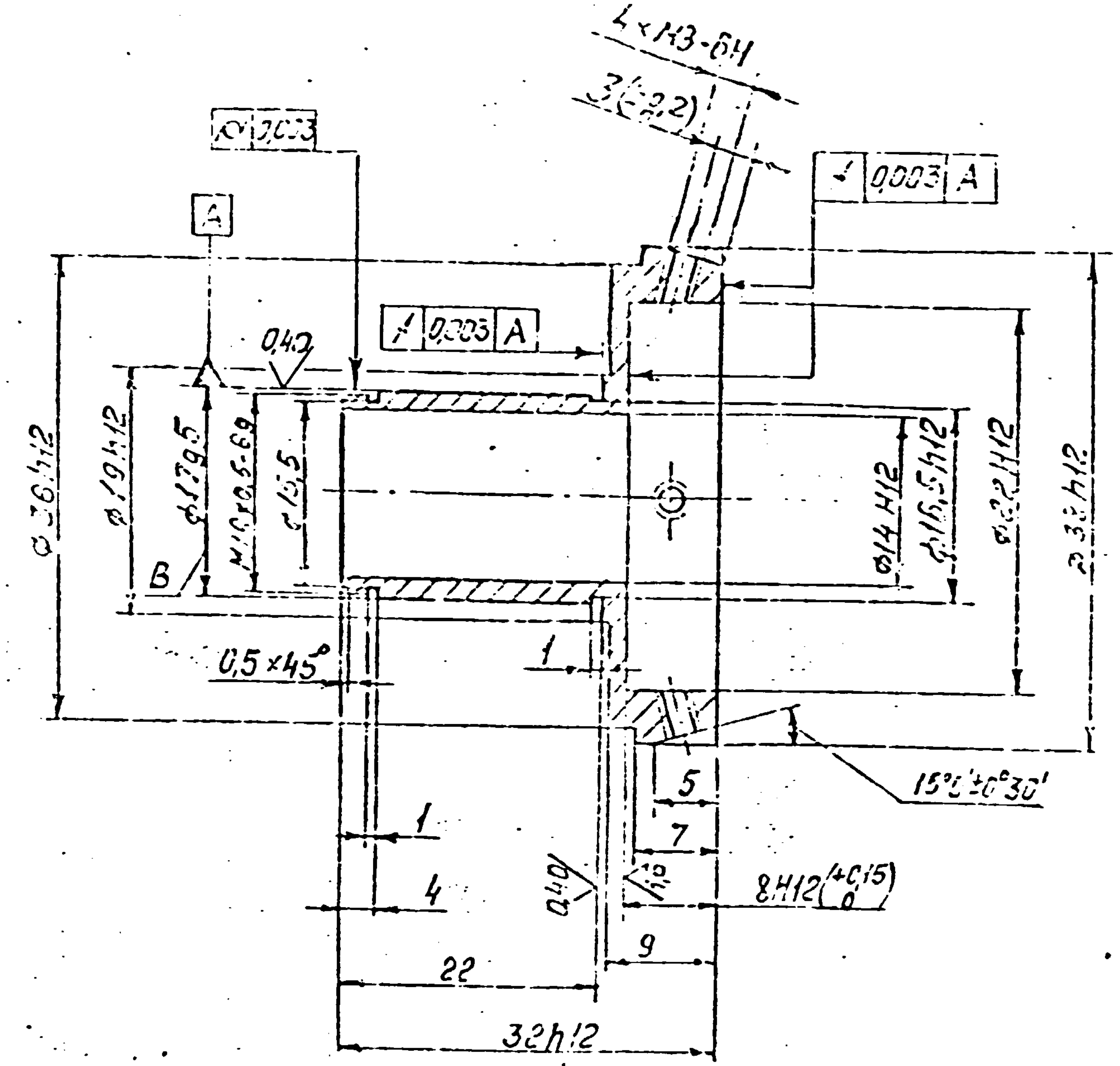


1. H14, h14, $\pm \frac{IT14}{2}$

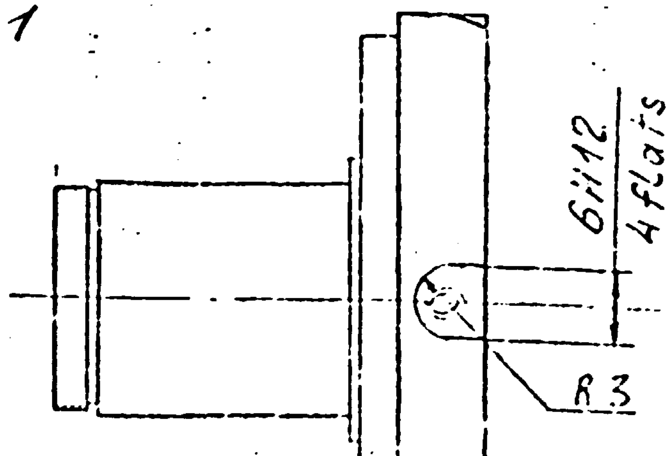
2. Coating: Chemical oxidation chromatizing

	330. 007	
Designer	Bushing	Mass / Scale 2:1
		Sheet / Sheets 1
Chief Designer	Bronze CuSi 3 Mn 1	LITMO

Form A4


4×M3-6H
0,003 A
A
0,42
Ø36h12
Ø19h12
B
0,5×45°
1
4
22
32h12
9
7
5
8H12(+0,15 0)
15°0'±0°30'
Ø14H12
Ø16,5H12
Ø22H12

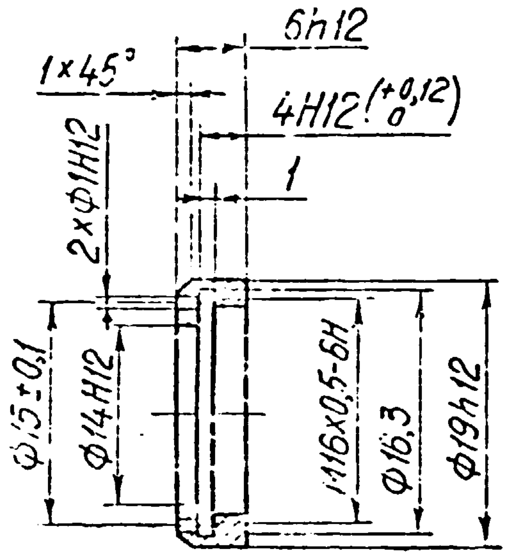
SECTION 1


6H12
4 flats
R 3

1. 49,5 ... 51,5 $HRC_э$ - surface A
2. H14; h14; $\pm \frac{IT14}{2}$
3. Fit in the diameter B to the piece 330.007, the clearance must be no more than 0,003 mm
4. Coating: Chemical oxidation chromatizing

	330.008	
Designer	Case	Mass / Scale 2:1
Chief designer	Steel X3Г	LITMO

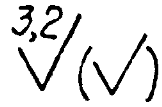
3,2

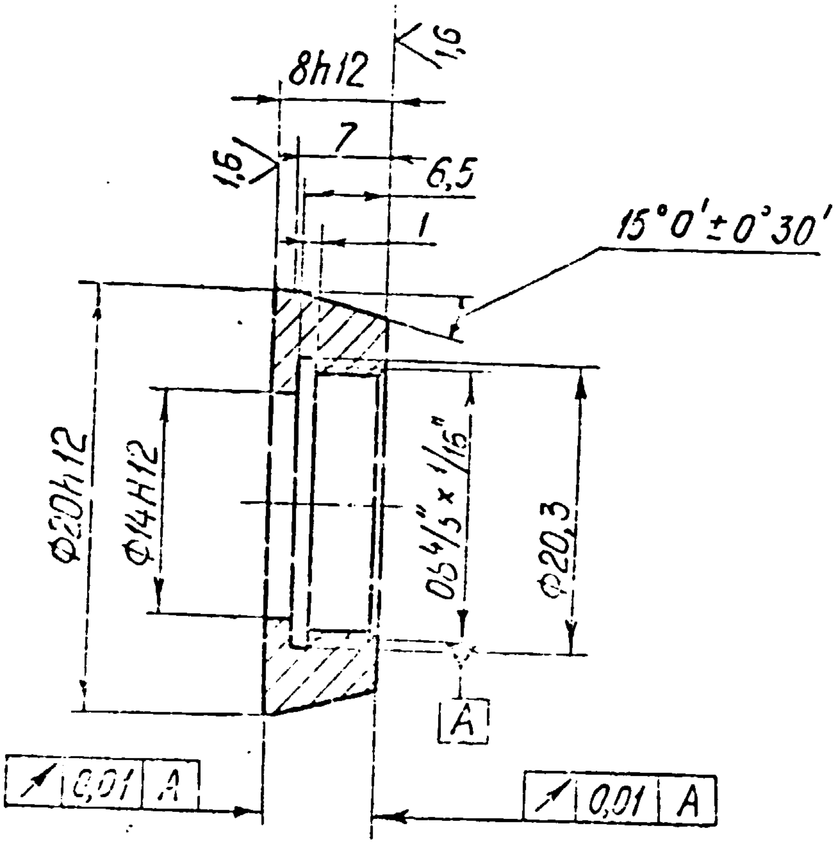


1. H14, h14, $\pm \frac{IT14}{2}$
2. Coating: Chemical oxidation chromatizing impregnation by oil

330.009			
Nut		Mass	Scale
			2:1
		Sheet	Sheets 1
Steel 50	LITMO		

Form A4





1. H14, h14, $\pm \frac{IT14}{2}$
2. Coating: Chemical oxidation chromatizing

330.011

Ring

Mass | Scale 2:1

Sheet | Sheets 1

Designer

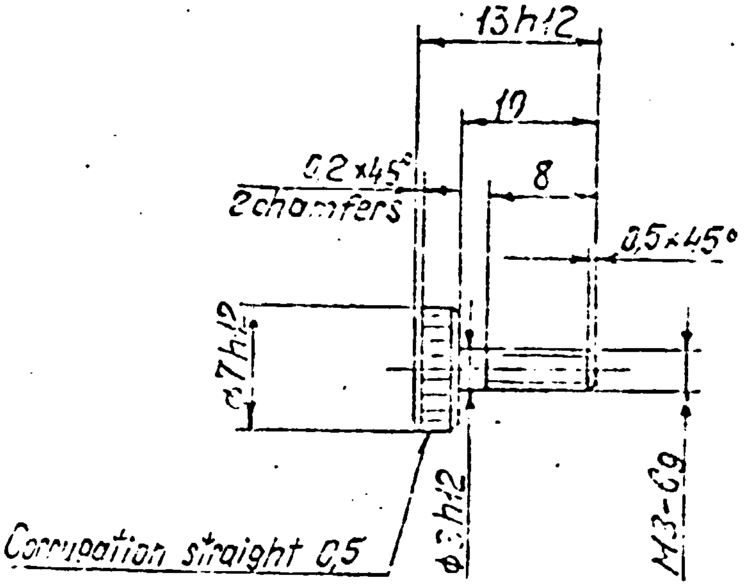
Chief designer

Brass Cu Zn 40

LITMO

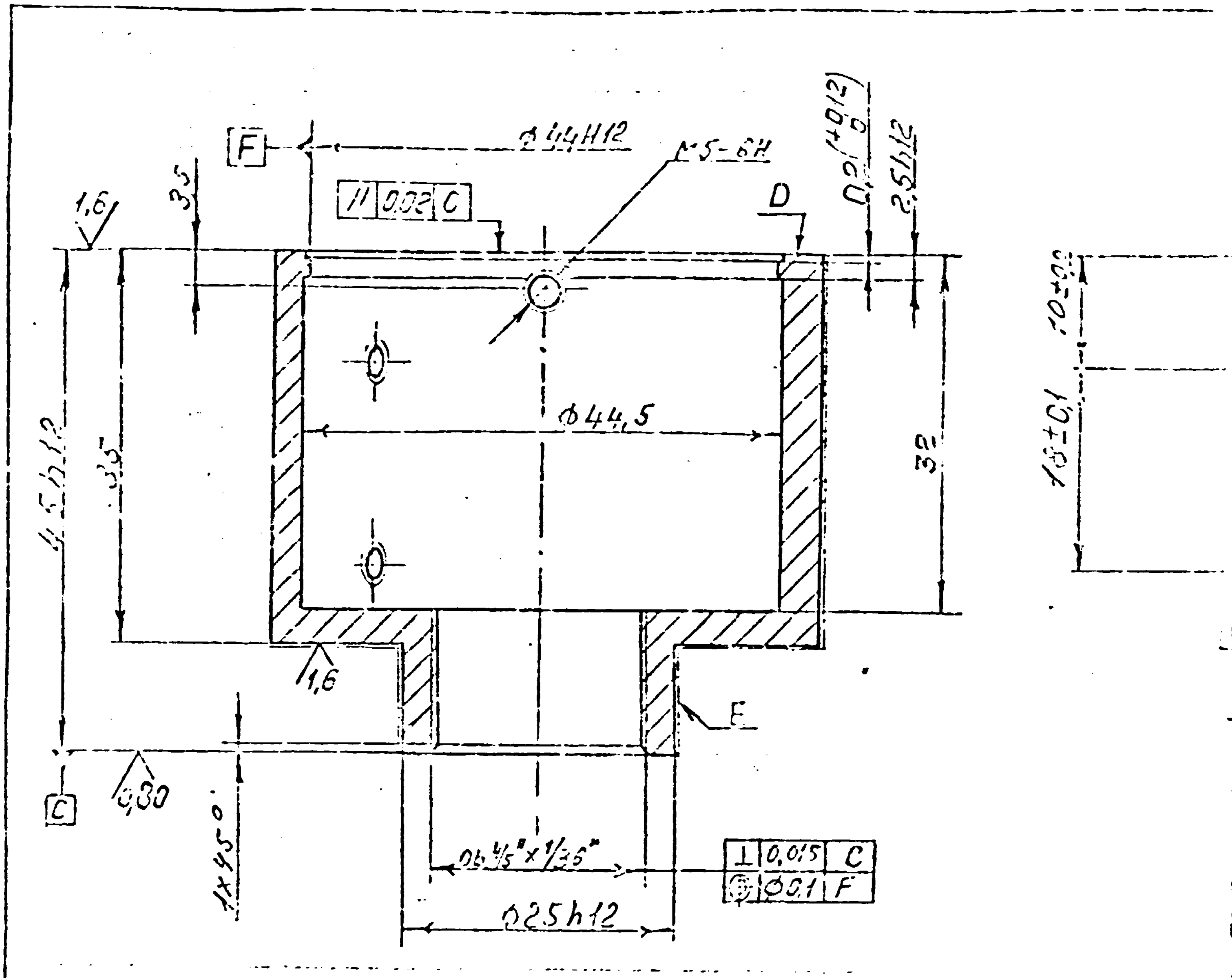
Form A4

3,2

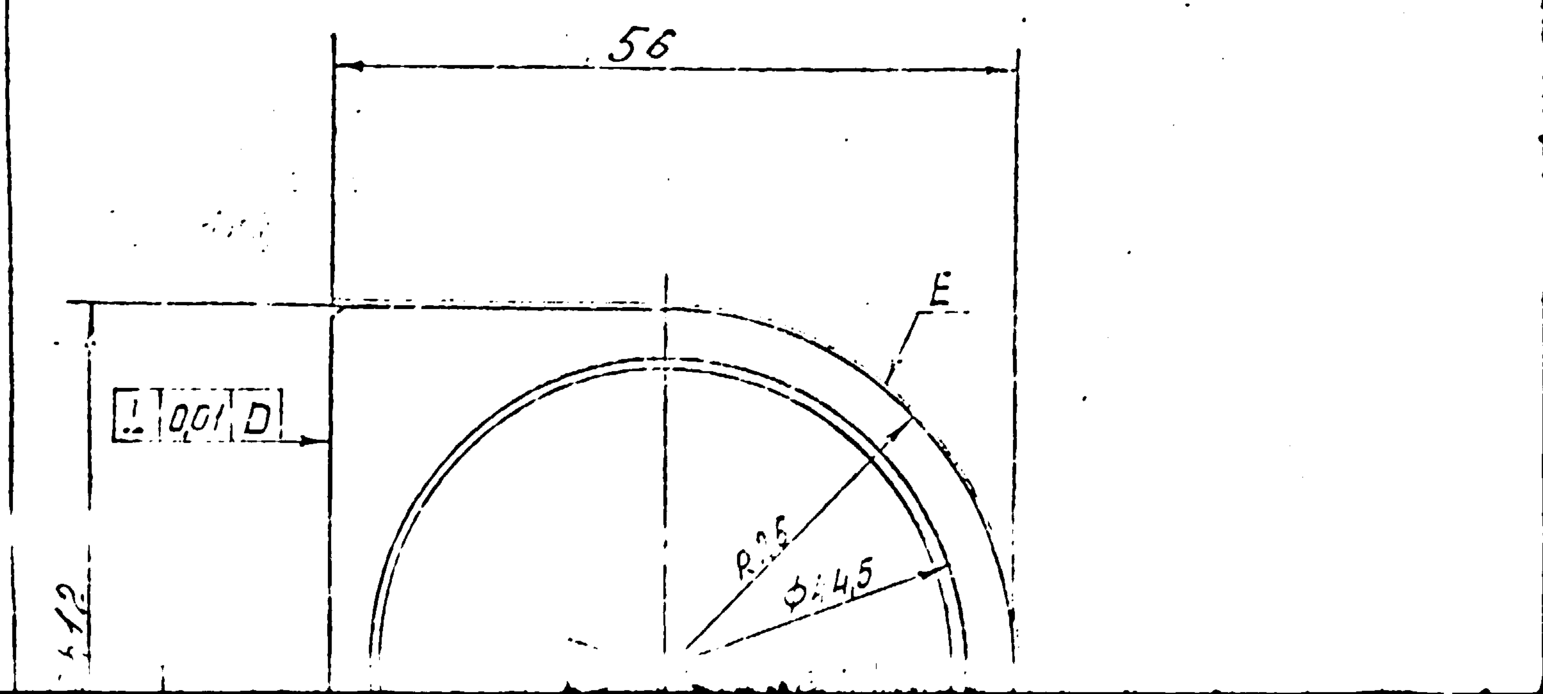


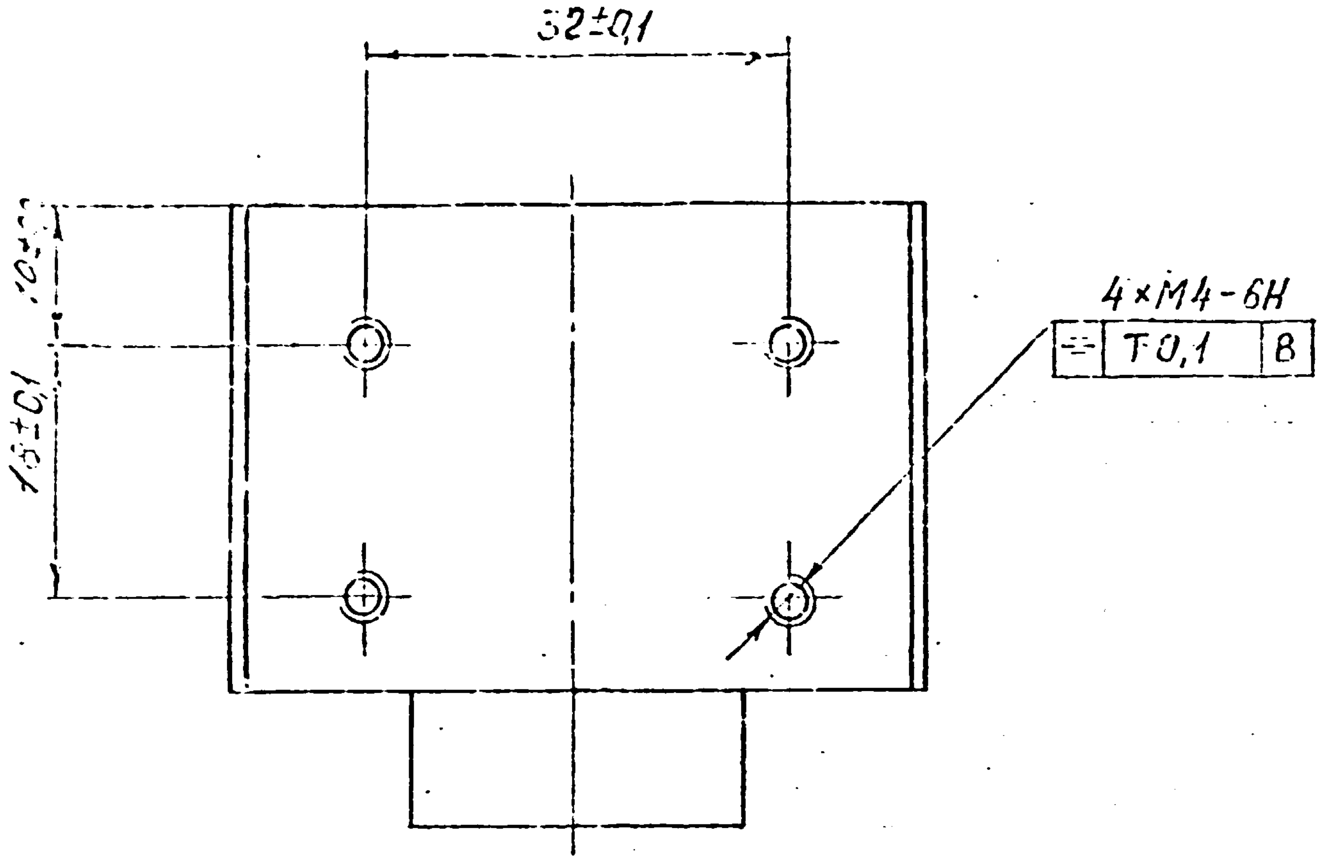
1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating: Chemical oxidation chromatizing impregnation by oil

	330.012		
	Screw	Mass	Scale
Designer			2:1
		Sheet	Sheets 1
	Steel 20		

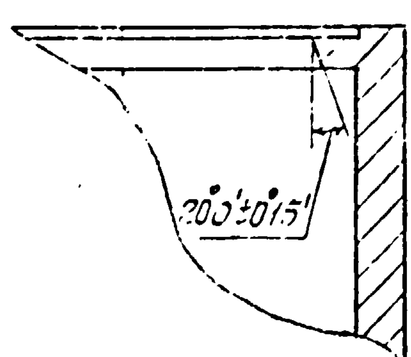

F
Φ44H12
M5-6H
// 0,02 C
D
1,6
3,5
35
Φ44,5
32
2,5h12
18±0,1
10±0,2
45h12
1,6
E
C
0,80
1×45°
⊥ 0,015 C
Φ25h12

SECTION 1

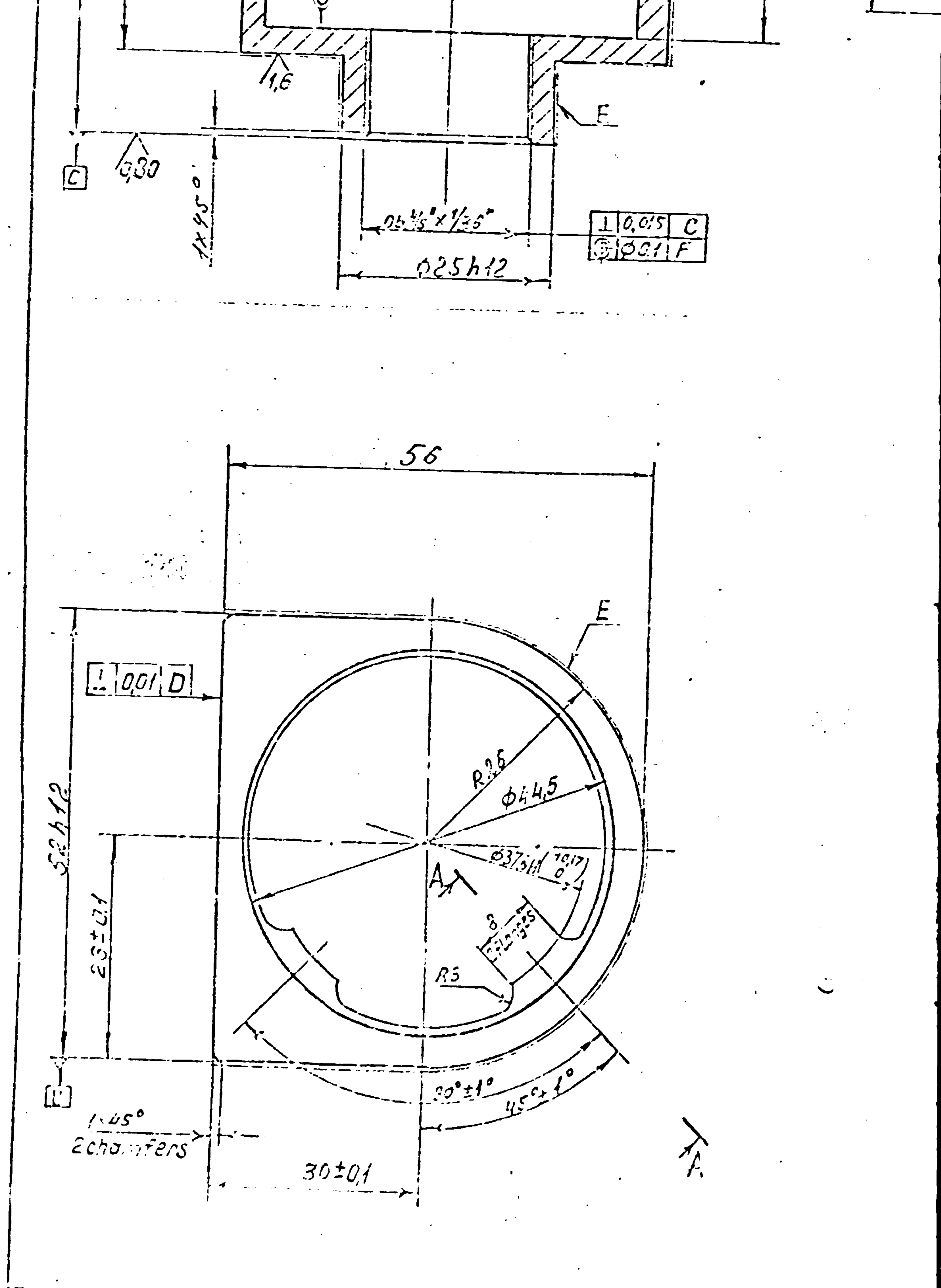

56
E
⊥ 0,01 D
R36
Φ44,5



A-A



1. H14; h14; ±
2. Coating: C



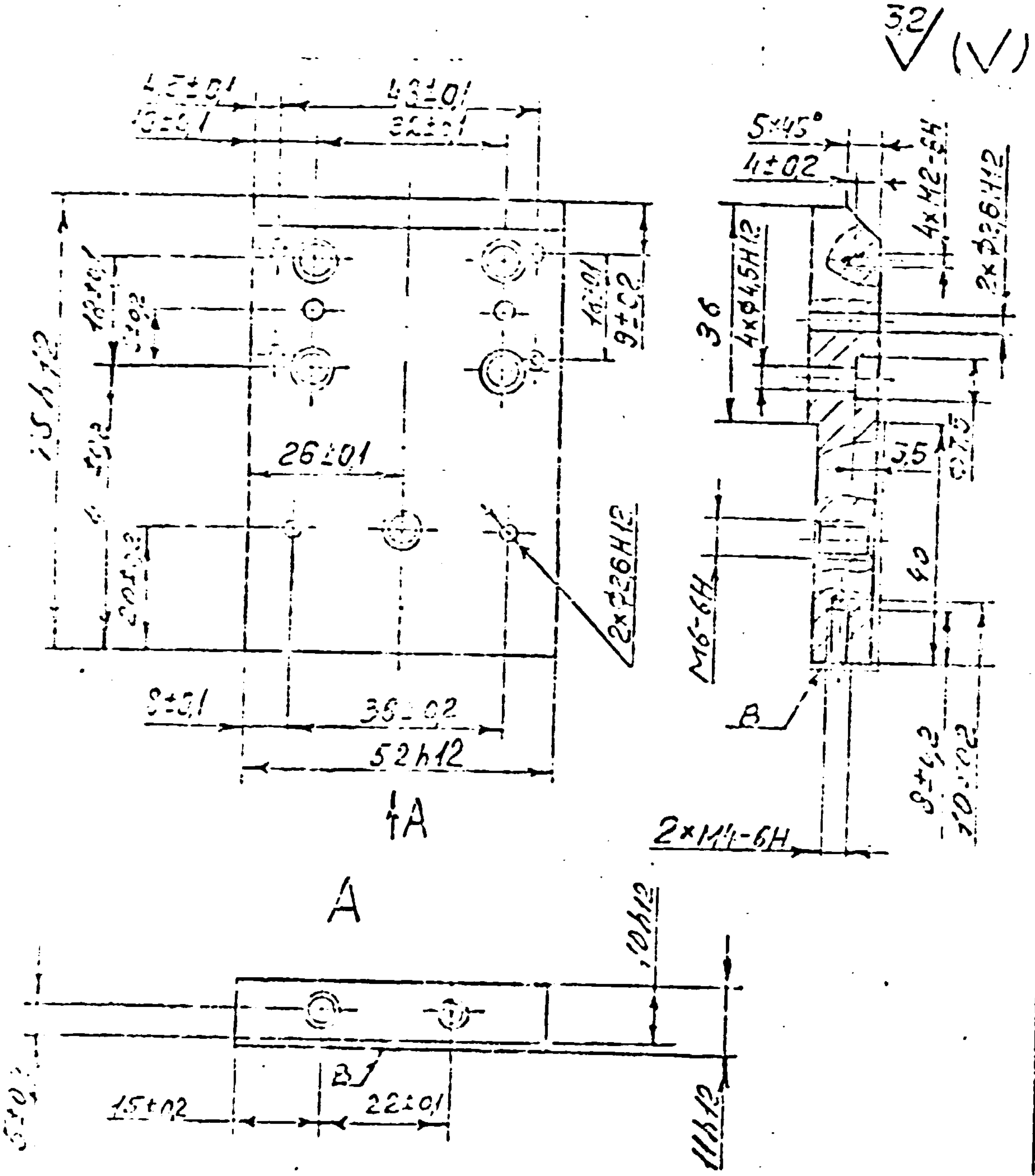
1,6
E
C
0,30
1×45°
Ø25h12
⊥ 0,015 C
Ø0,1 F
56
E
⊥ 0,01 D
R26
Ø44,5
Ø37
A
R3
52h12
23±0,1
D
30°±1°
45°±1°
1×45°
2 chamfers
30±0,1
A

SECT 4

1. H14; h14; $\pm \frac{IT14}{2}$

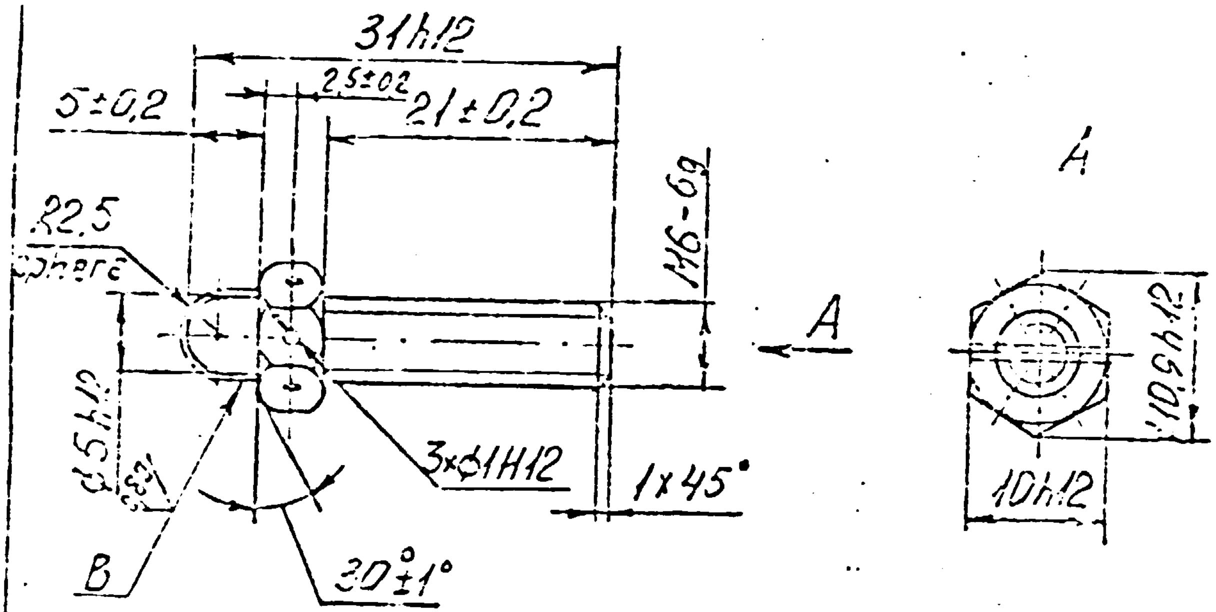
2. Coating: Chemical oxidation except for the surfaces C and D. Coat the surface E with grey enamel.

Designer	330.015		
	Tube	Mass	Scale
			2:1
		Sheet	Sheets 1
	Brass CuZn40	LITMO	



1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating: Chemical oxidation
Coat the outside surfaces with grey enamel except for the surface B

... 330.016		
Spacer	Mass	Scale
		1:1
	Sheet	Sheets 1
Steel 20	LITMO	



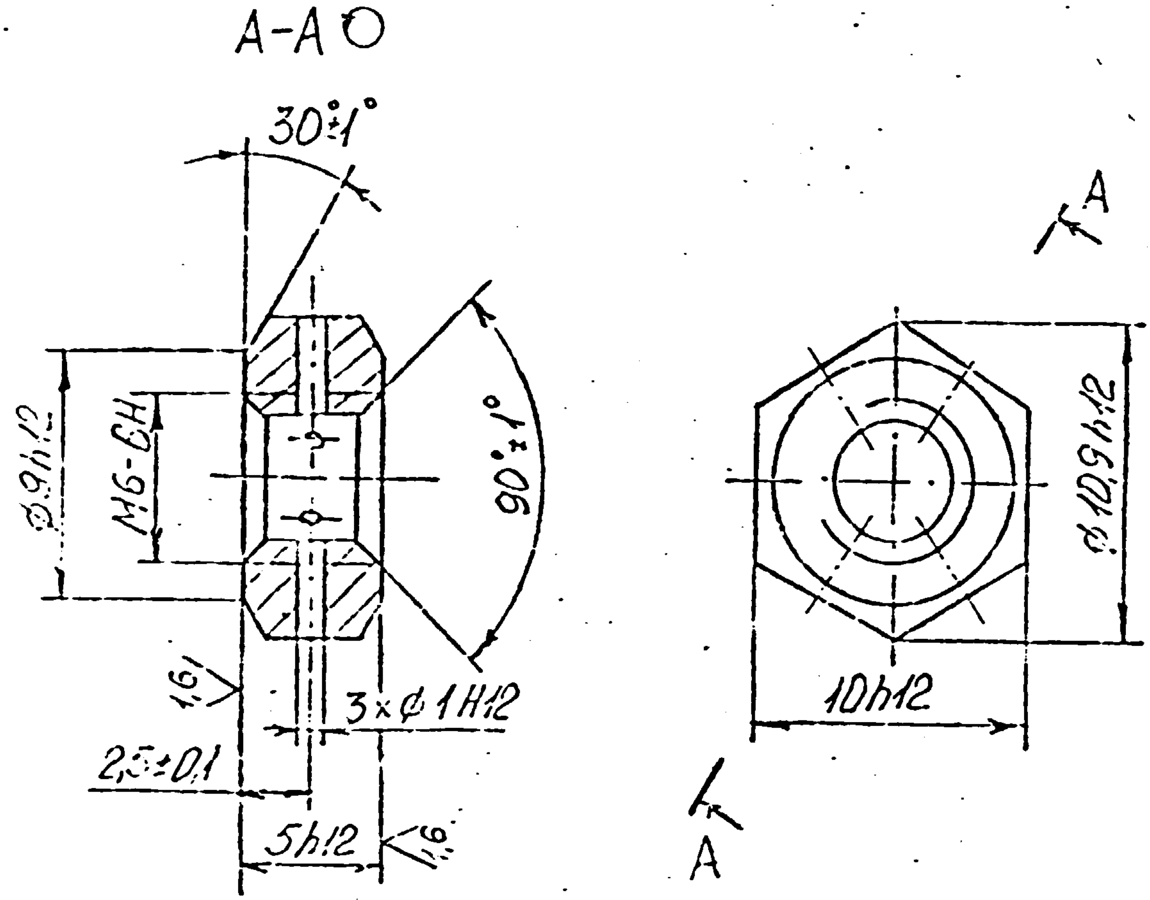
1. Surface B - 39,5...43,5 HRCэ
2. Coating: Chemical oxidation

330.017		
Screw	Mass	Scale
		2:1
	Sheet	Sheets 1
Steel 50	LITMO	

Designer

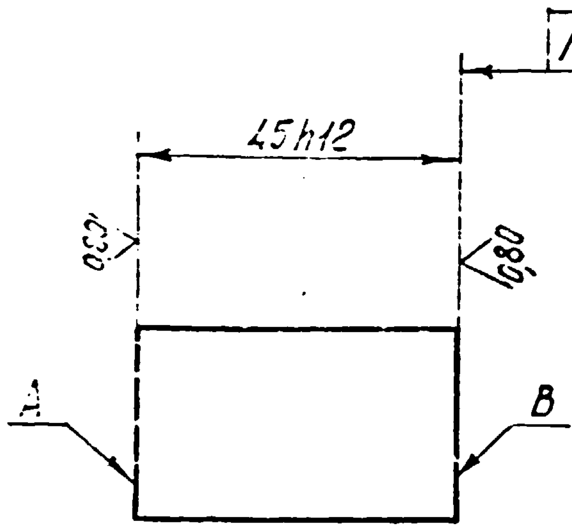
Chief Designer

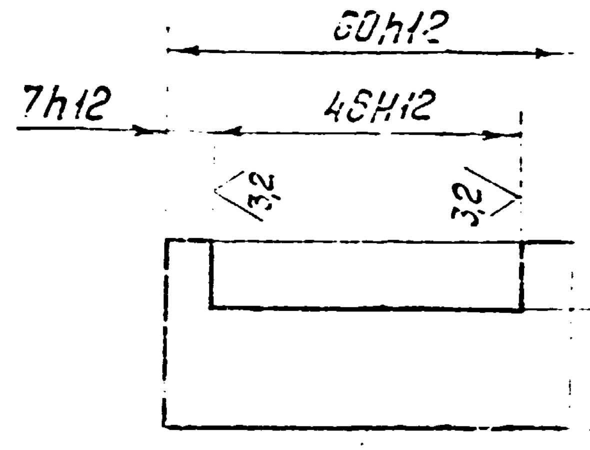
3.2 V(V)



Coating: Chemical oxidation

Designer	330.018	
Chief Designer	Nut	Mass / Scale 5:1
		Sheet / Sheets 1
	Brass CuZn40	LITMO





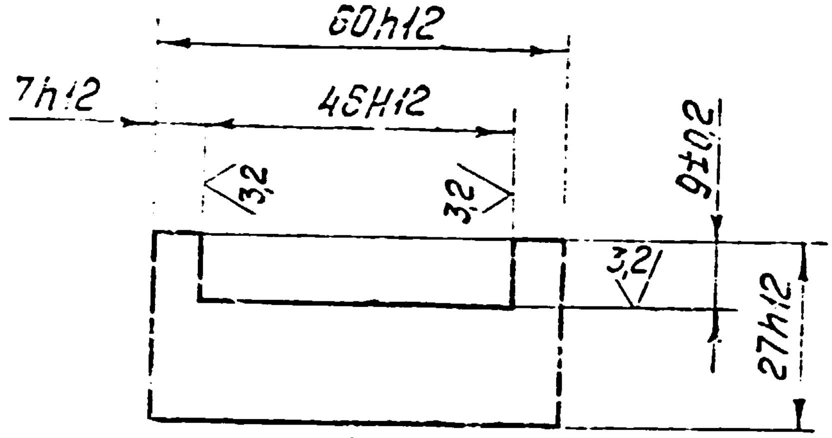
1. Carburize in de
2. Coating: Chemica
impregn

SECTION 1

Designer

Chief Designer

1,6 (√)

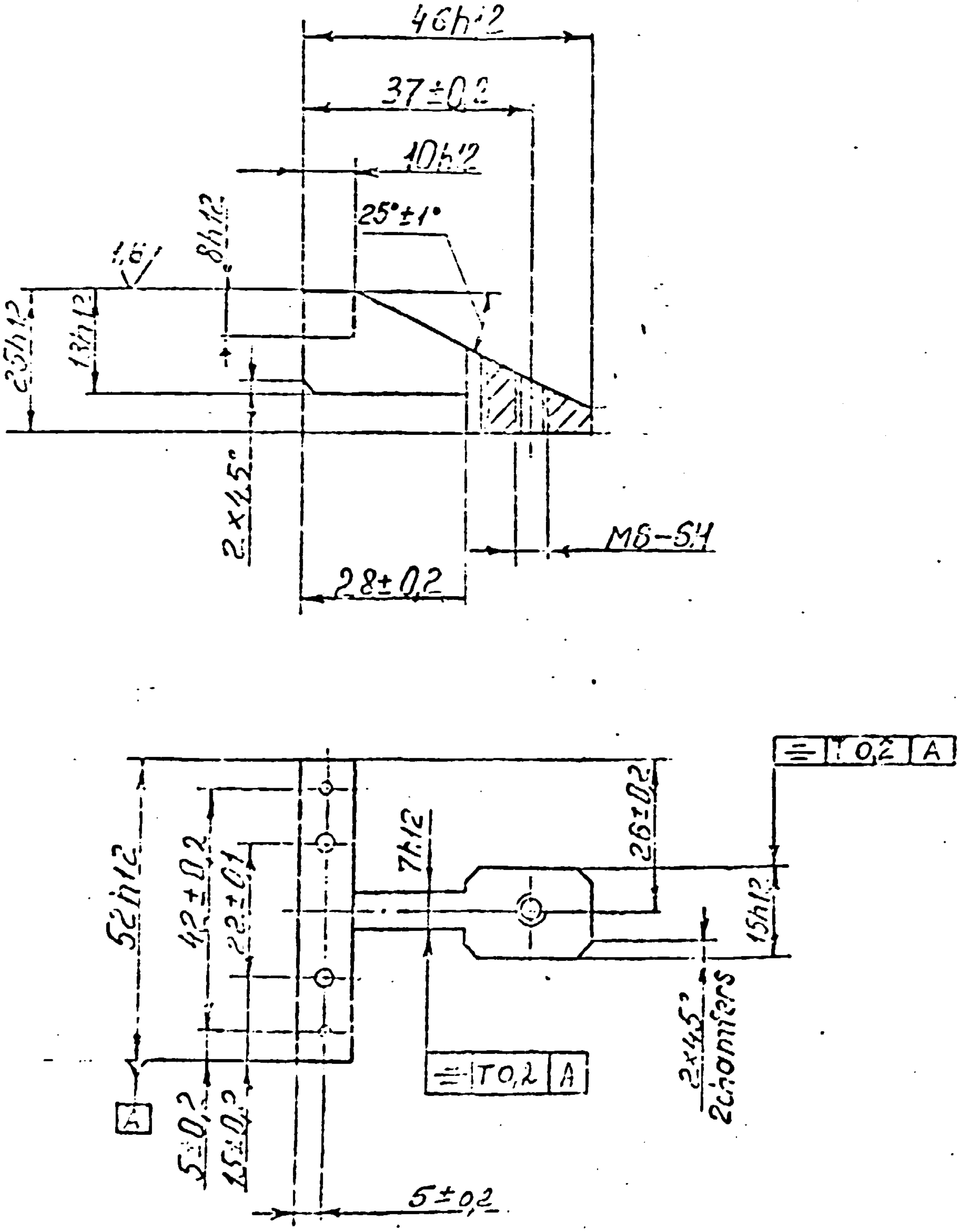


1. Carburize in depth 0,8...1mm. 51,5...53,0 HRC$_э$
2. Coating: Chemical oxidation chromatizing impregnation by oil.

330.019			
Support		Mass	Scale
			1:1
		Sheet	Sheets 1
Steel 20	LITMO		

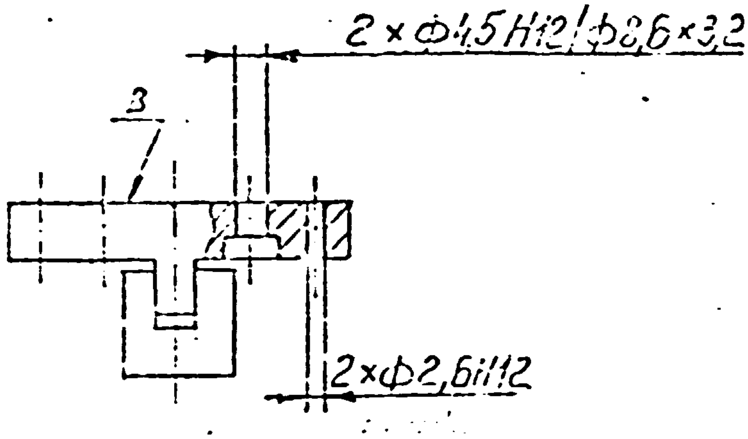
Designer

Chief Designer


46h12
37±0,2
10h12
25°±1°
8h12
25h12
13h12
2×45°
M6-5H
28±0,2
= T0,2 A
52h12
42±0,2
22±0,1
7h12
26±0,2
15h12
= T0,2 A
2×45°
2chamfers
A
5±0,2
15±0,2
5±0,2

SECTION 1

3,2 √ (√)



⌯ | 0,2 | A

1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating: Chemical oxidation
   Coat the outside surface with black enam[...]
   except for the surface B.

Designed	330.021	
	Adapter	Mass / Scale 1:1 / Sheet / Sheets
Chief designer	Steel 20	LITMO

[illegible]
[illegible] ng [illegible]

[illegible]

[illegible]
[illegible]
[illegible]

[illegible]
[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

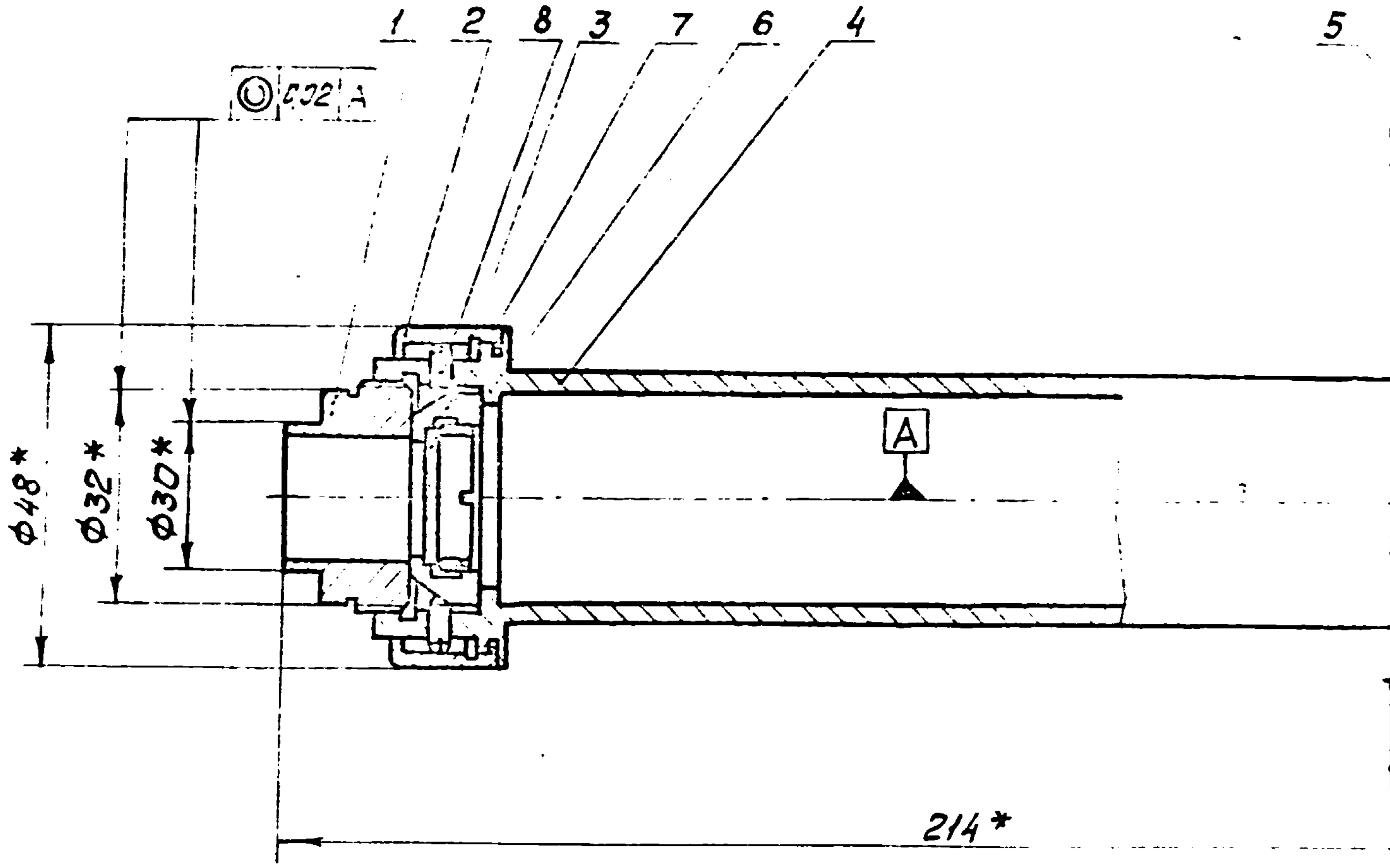
[illegible]

[illegible]

[illegible]

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				<u>Specification</u>		
A3			360. 000 Ass	Assembling drawing		
				<u>Pieces</u>		
A4		1	360. 001	Nozzle	1	
A4		2	360. 002	Cap	1	
A4		3	360. 003	Mount	1	
A2		4	360. 004	Tube	1	
A4		5	360. 005	Diaphragm	1	
A4		6	360. 006	Threaded ring	1	
A4		7	360. 007	Graticule	1	
				<u>Standard units</u>		
		8		Screw B.M3-6g×5. 14H.05 ГОСТ 1476-84	4	

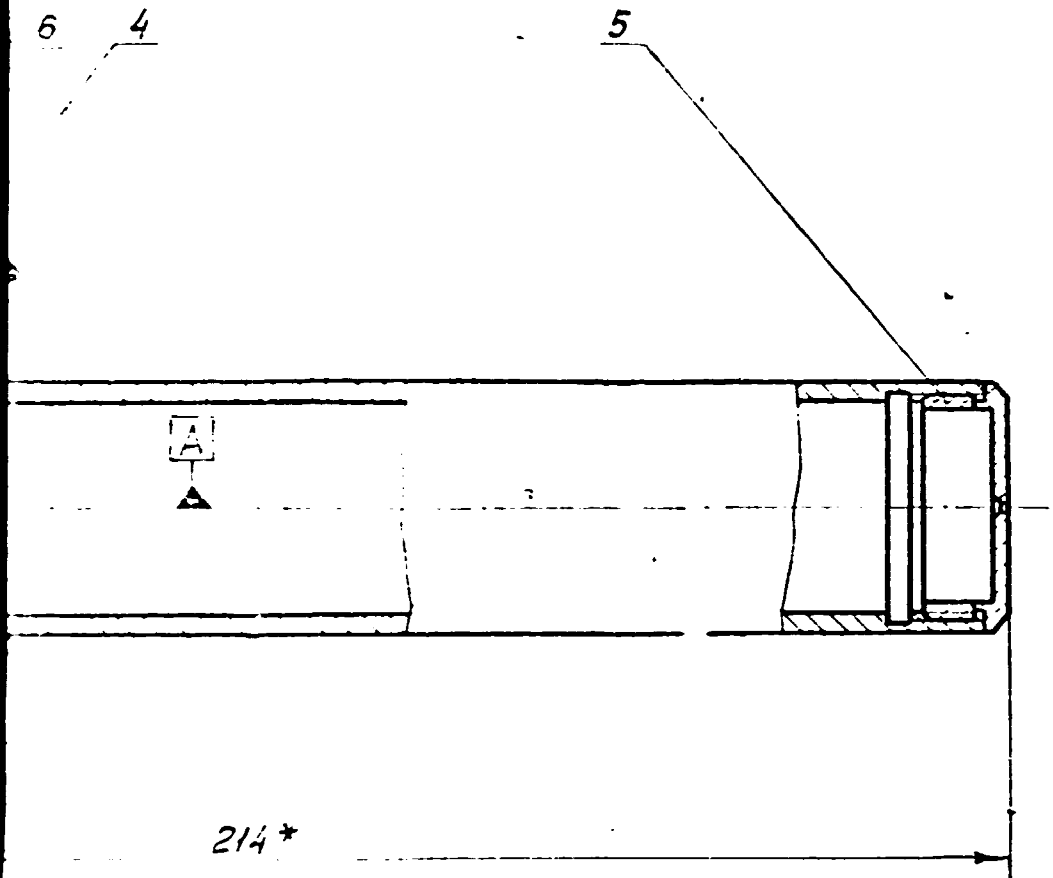
	360. 000		
Designer	Centring tube	Sheet	Sheets
Chief Designer			1
		LITMO	



* The dimensi[illegible]

SECTION 1

Designer			
Chief Designer			



* The dimensions for information

360.000 Ass

Centring tube

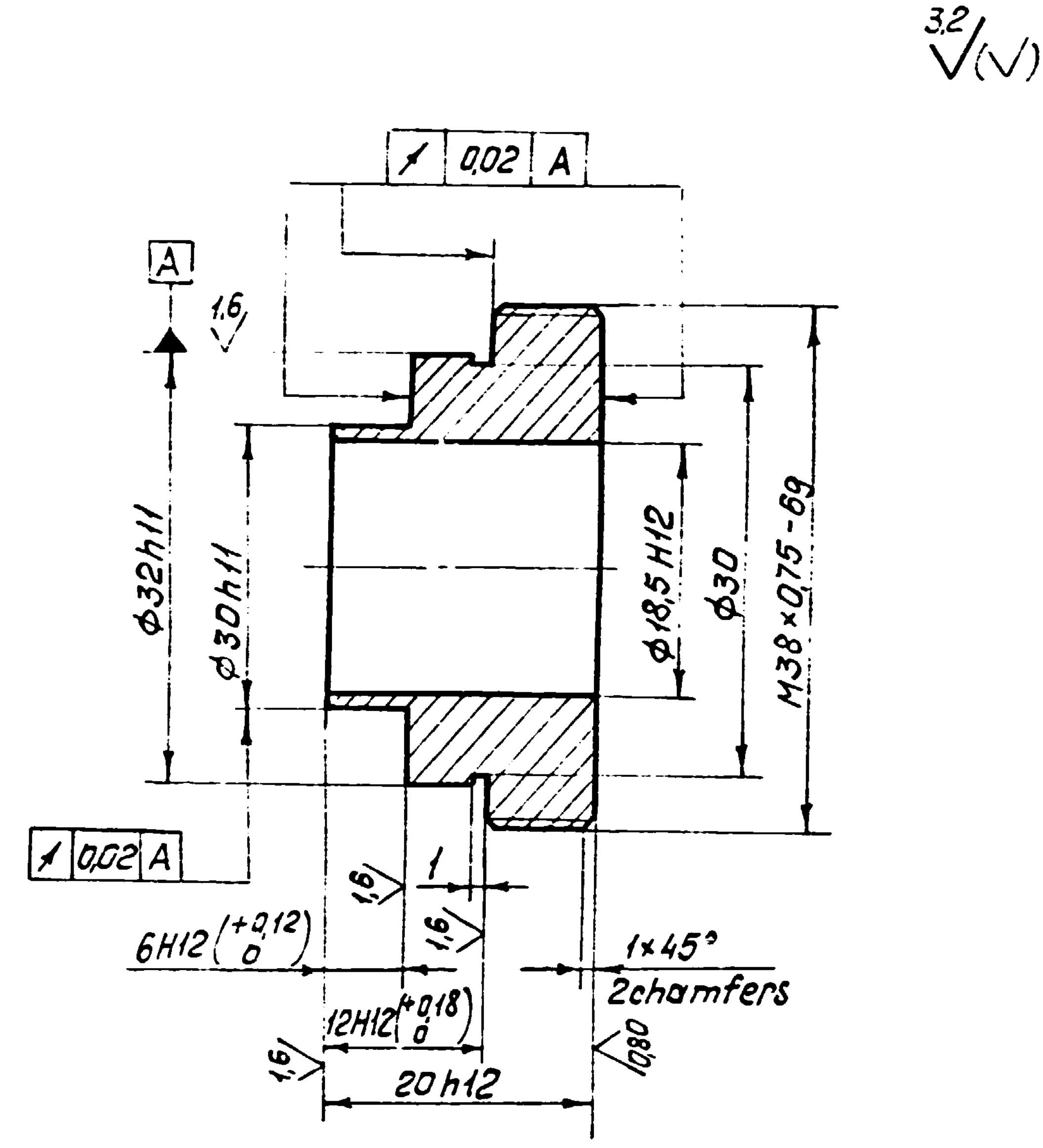
Mass | Scale

1:1

LITMO

Designer

Chief Designer

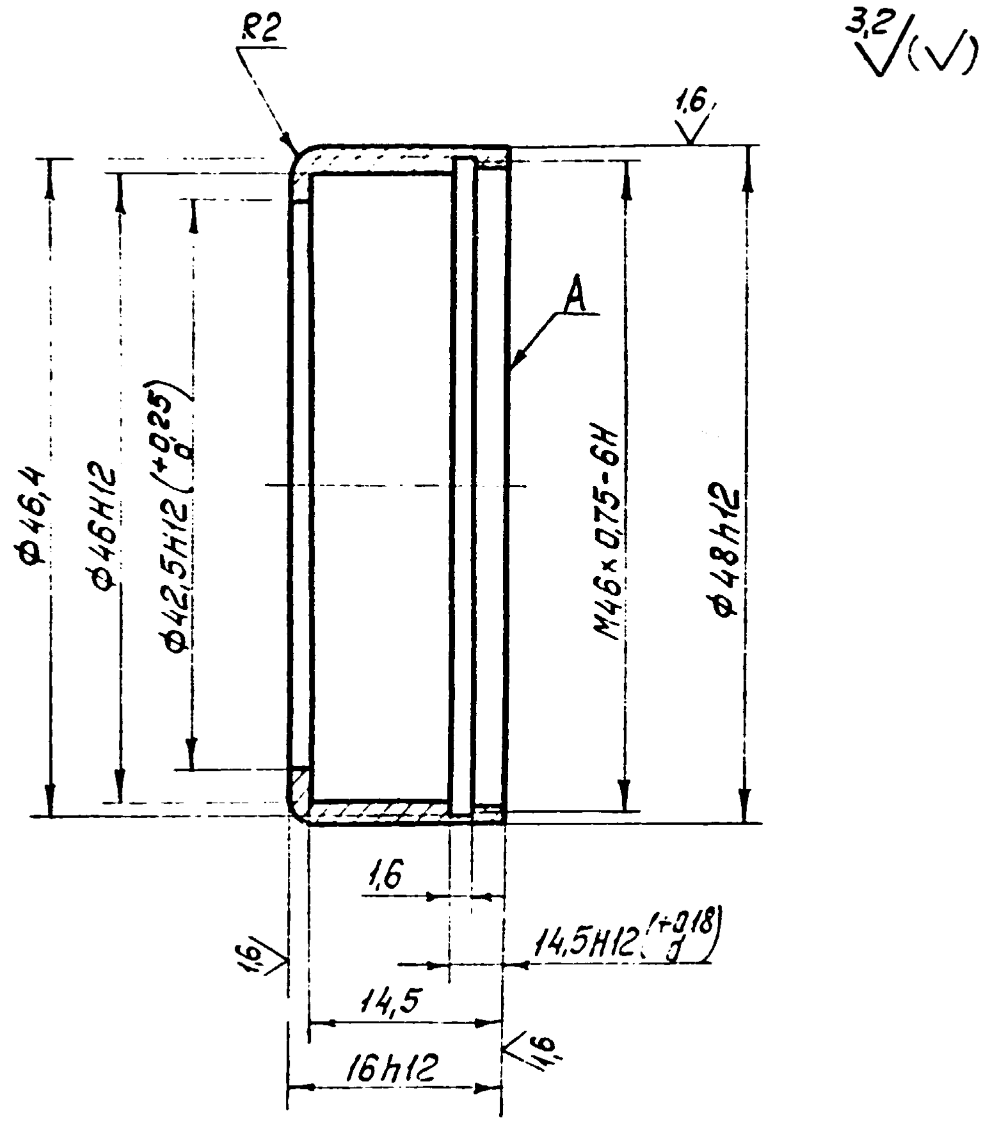


1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating Chemical oxidation

360.001			
Nozzle		Mass	Scale
			2:1
		Sheet	Sheets 1
Steel 20		LITMO	

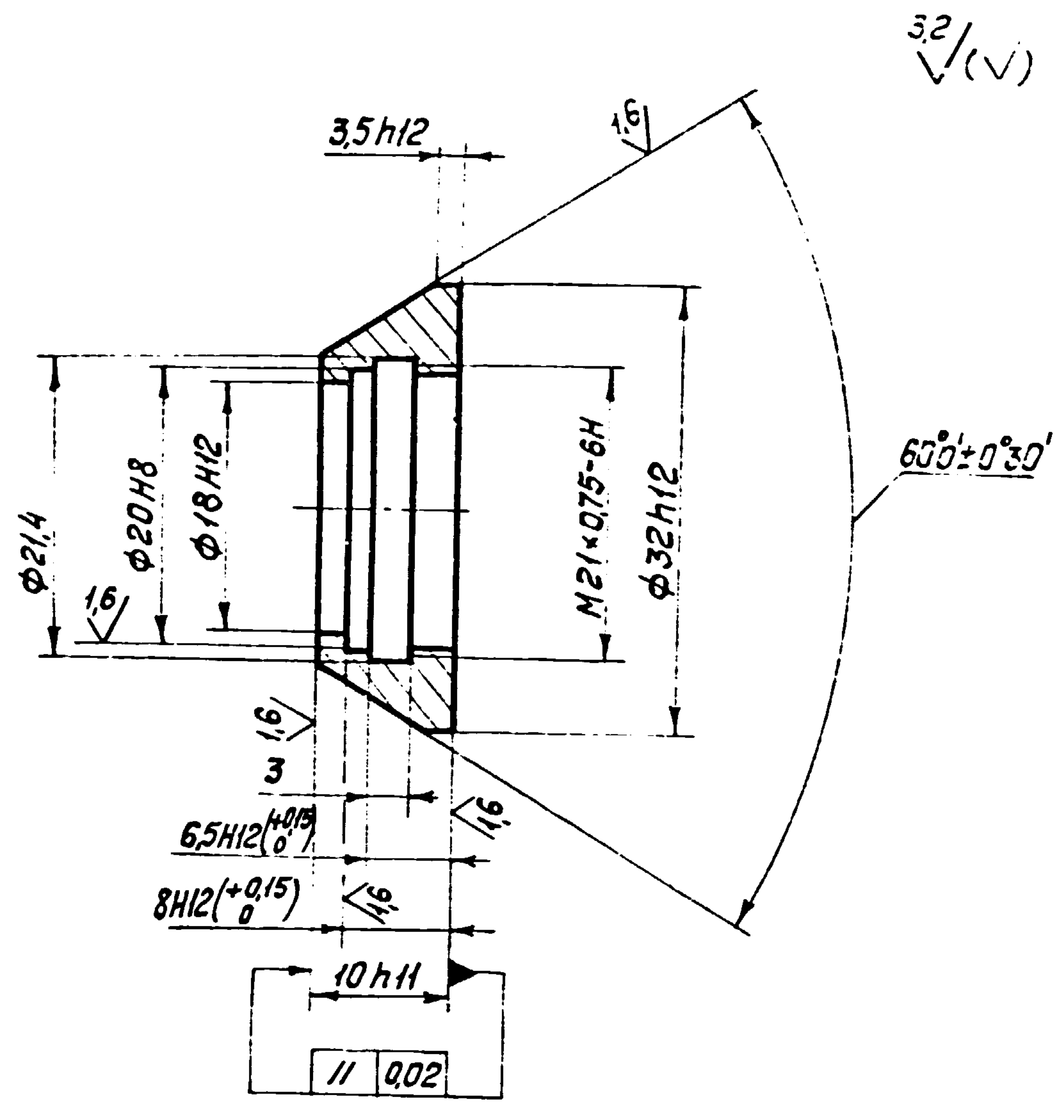
Designer

Chief Designer



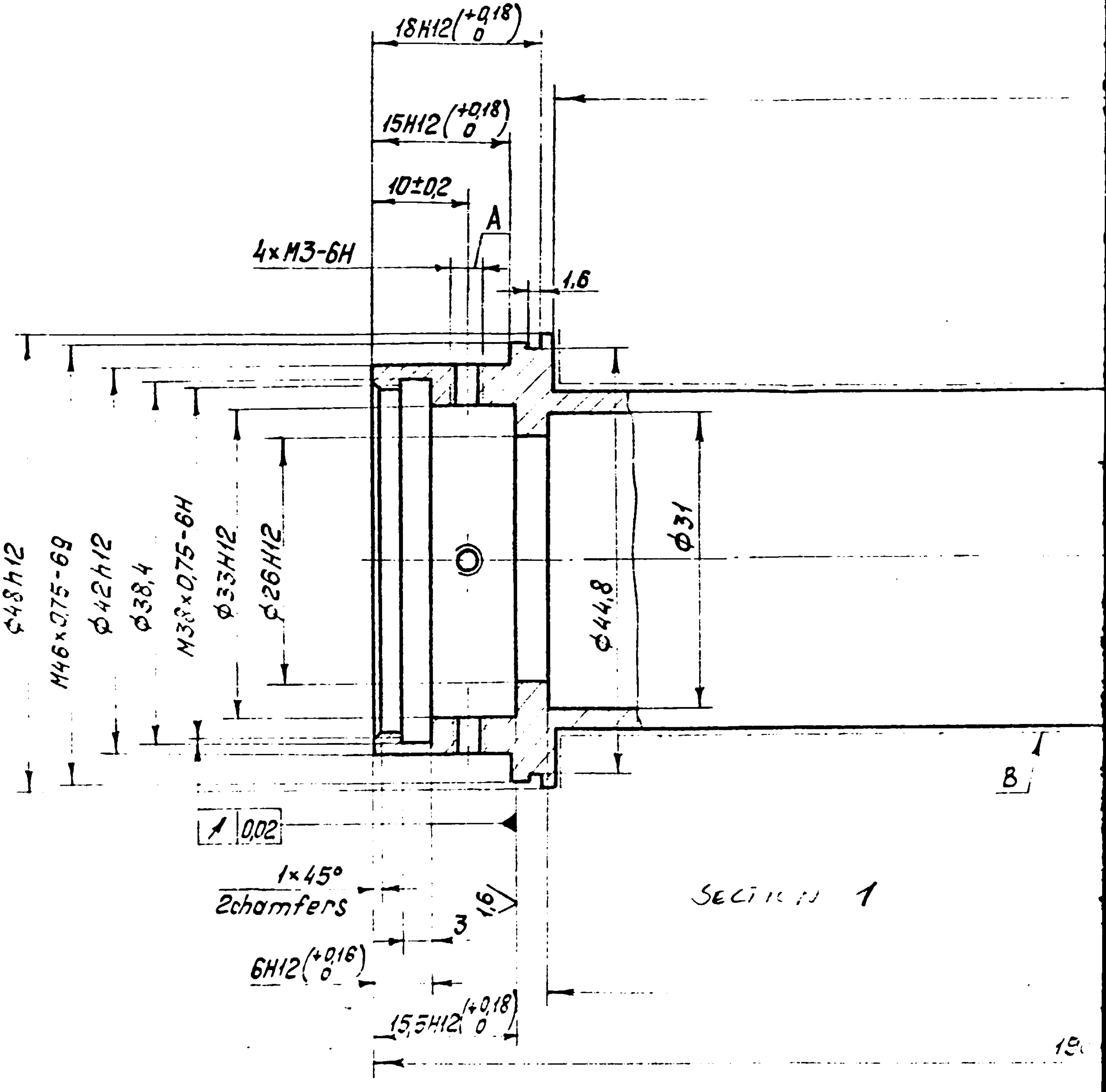
1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating Chemical oxidation.
   Coat outside surfaces with grey enamel except for the surface A

360.002		
Cap	Mass	Scale
		2:1
	Sheet	Sheets 1
Steel 20	LITMO	
Designer		
Chief Designer		

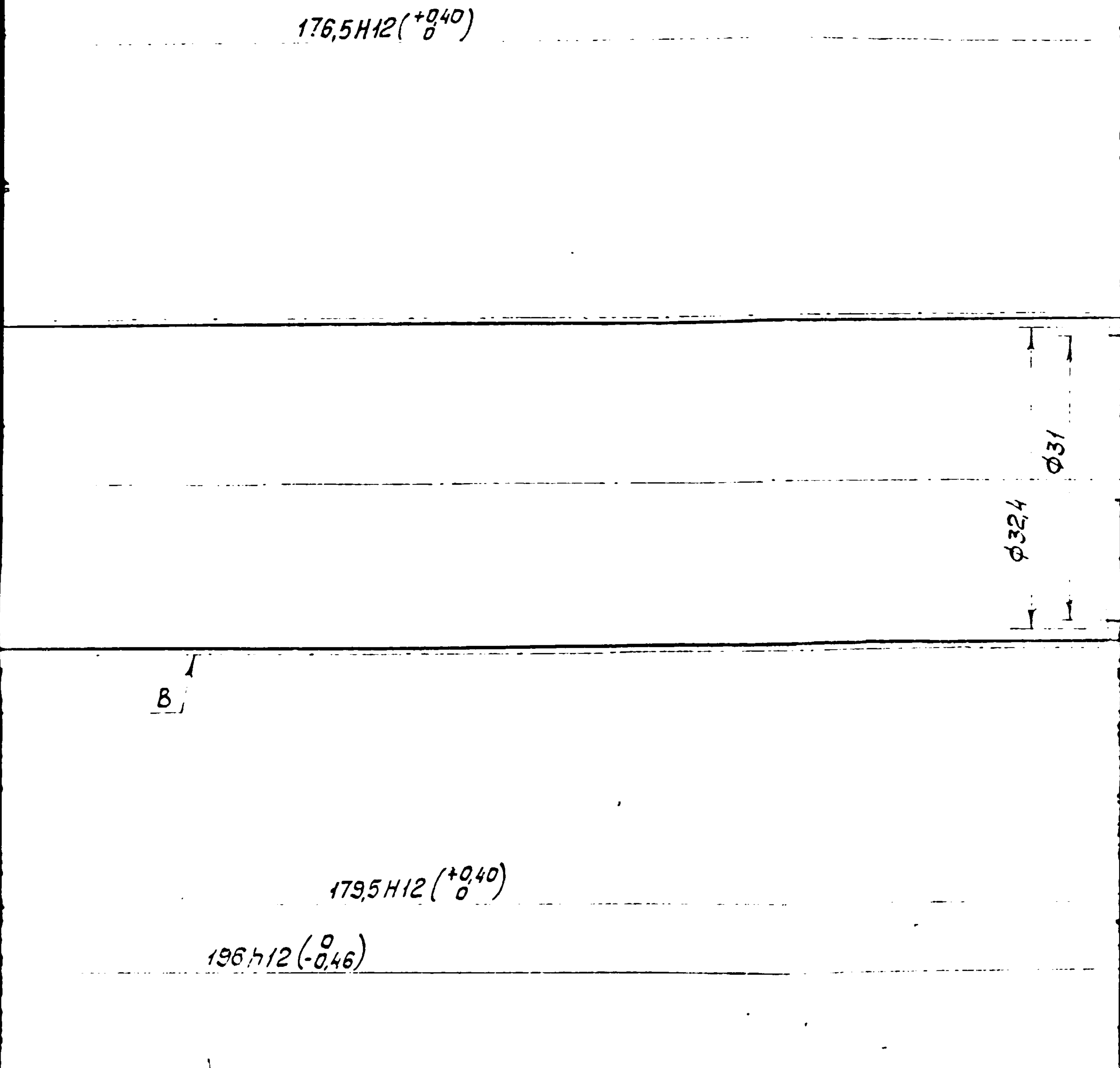


1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating Chemical oxidation

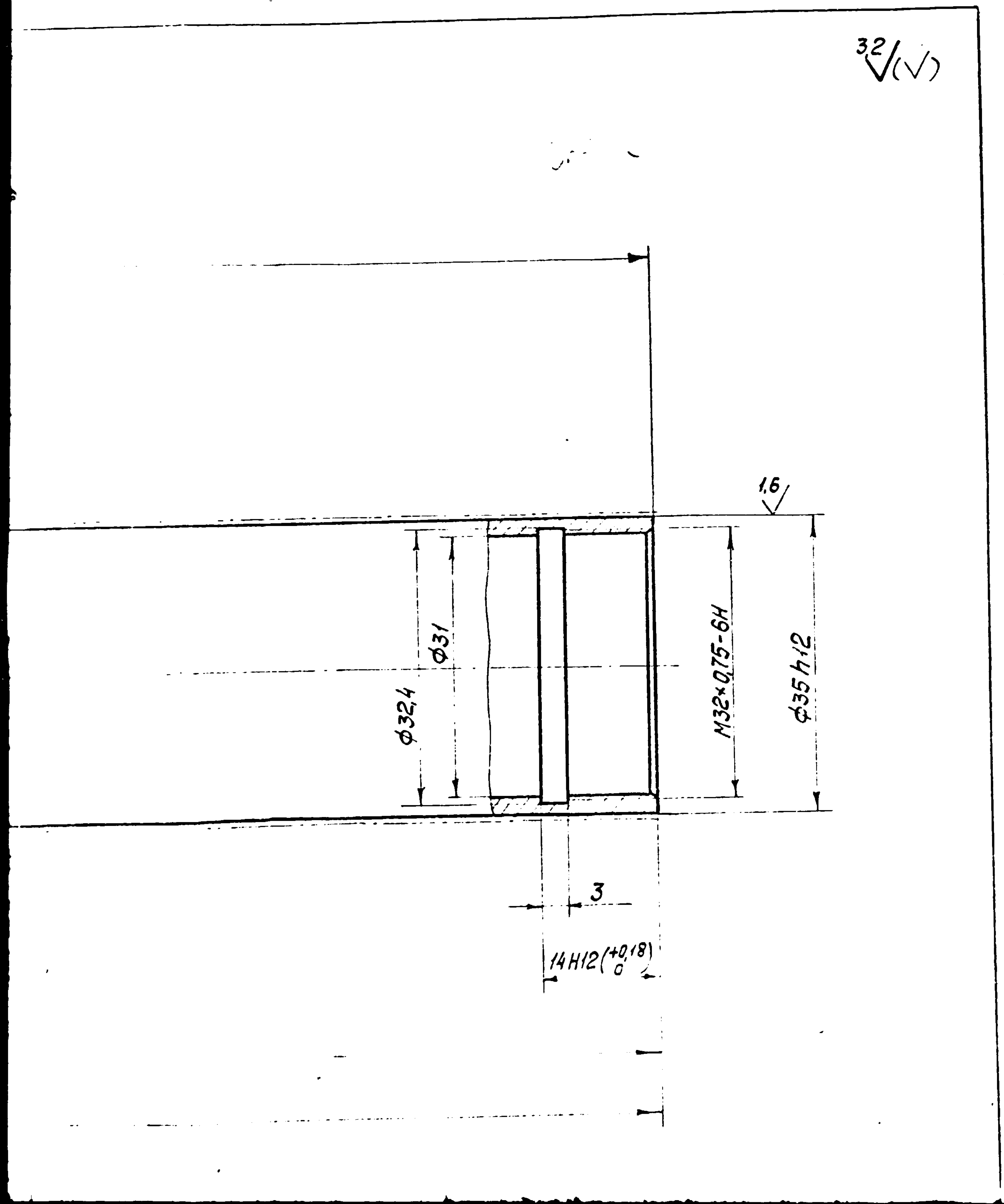
	360.003		
	Mount	Mass	Scale
Designer			2:1
		Sheet	Sheets 1
Chief Designer	Steel 20	LITMO	



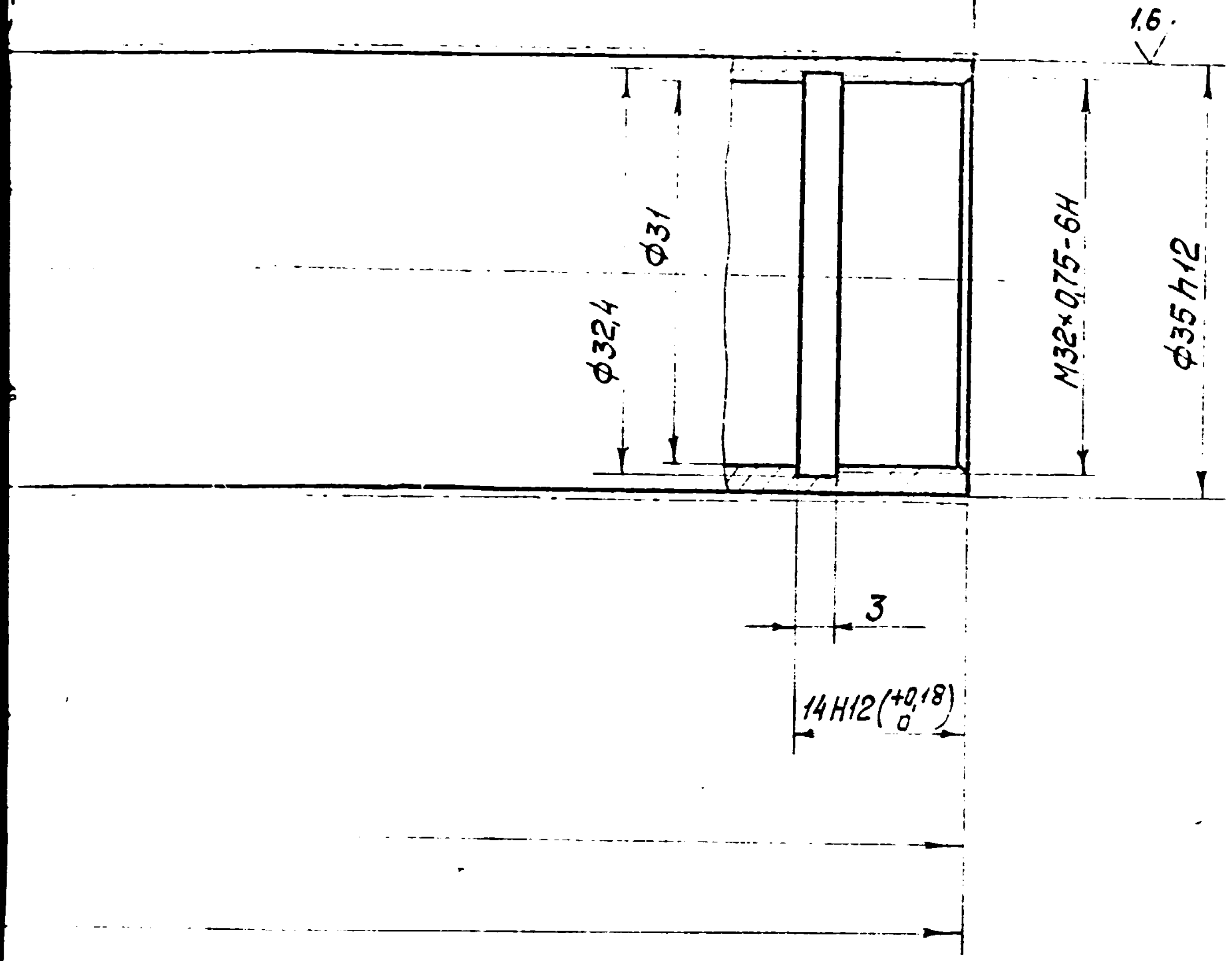
18H12(+0,18 0)
15H12(+0,18 0)
10±0,2
A
4×M3-6H
1,6
⌀48h12
M46×0,75-6g
⌀42h12
⌀38,4
M38×0,75-6H
⌀33H12
⌀26H12
⌀44,8
⌀31
B
0,02
1×45°
2chamfers
3
1,6
6H12(+0,16 0)
15,5H12(+0,18 0)



1. H14; h14; $\pm \frac{IT14}{2}$
2. Central angle li
   of two any holes
3. Coating Chemica
   Cnat the



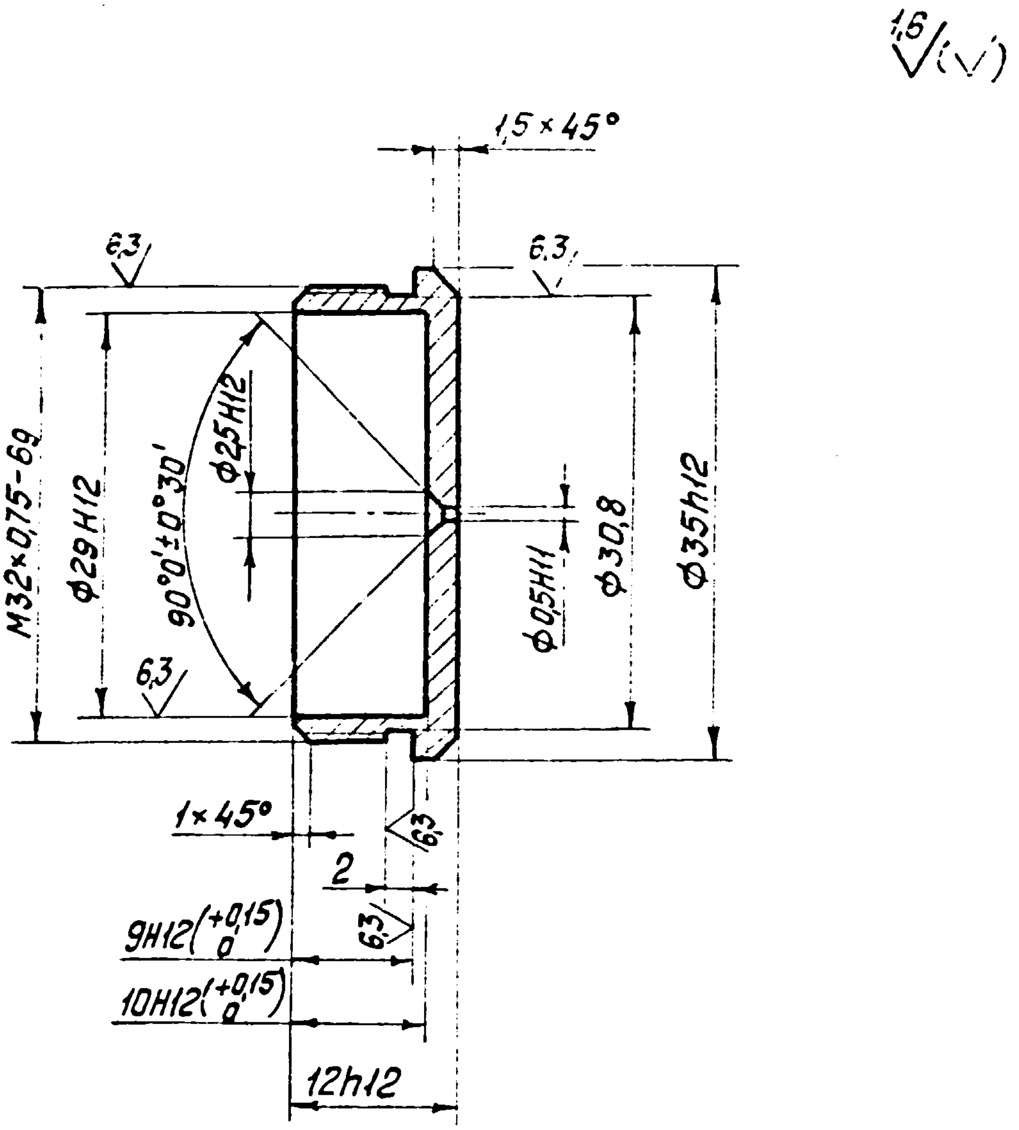
3,2
1,6
Ø31
Ø32,4
M32×0,75-6H
Ø35 h12
3
14H12 (+0,18 / 0)



SECT 4

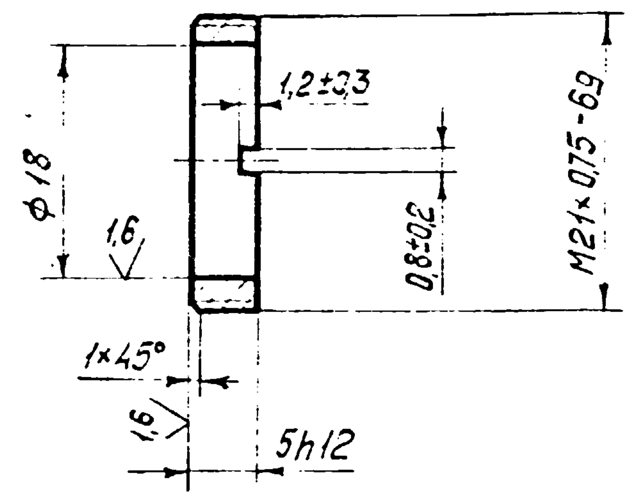
1. H14; h14; $\pm \frac{IT14}{2}$
2. Central angle limiting deviations between the axes of two any holes A-$\pm 0°20'$
3. Coating Chemical oxidation
   Coat the surface B with grey enamel

	360.004		
Designer	Tube	Mass	Scale
			2:1
		Sheet	Sheets 1
Chief Designer	Steel 20	LITMO	



1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating Anodic oxidation black

	360. 005	
Designer	Diaphragm	Mass: — / Scale: 2:1
		Sheet / Sheets 1
Chief Designer	Aluminium alloy Al-Cu 4 Mg Mn Fe Si	LITMO

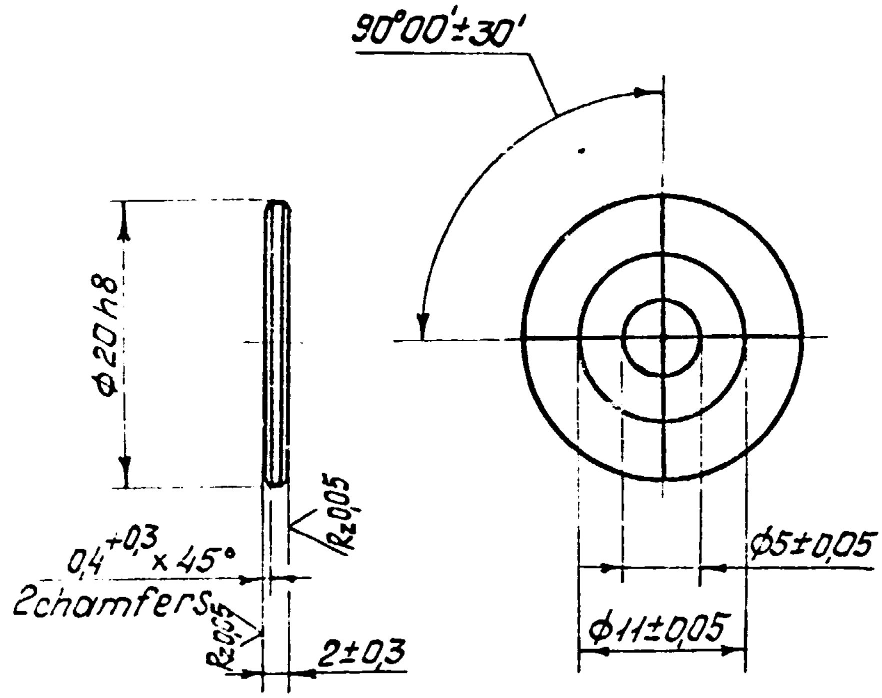


1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating Chemical oxidation impregnation by oil.

	360.006	
Designer	Threaded ring	Mass / Scale 2:1
Chief Designer	Steel 20	LITMO

$\sqrt{1{,}6}\ (\sqrt{\ })$

Δn_E	—
$\Delta(n_{F'}-n_{C'})$	—
Homogeneity	H1
Birefringence	N
μ	—
Veins	P2
Inclusions	B1
N	10
ΔN	2
Surf. qual.	0,02*
Wedge angle	10
O_ϕ	18



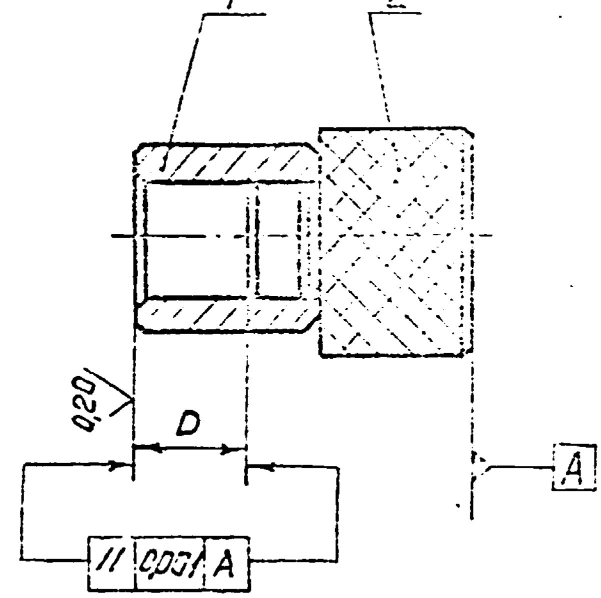
1. Line thicknesses (0,2±0,05)mm
2. Lines are made by photomethod
3. *Permitted total area of scratches, pits (mm^2)

360. 007		
Graticule	Mass	Scale
		2:1
	Sheet	Sheets 1
Glass BK7	LITMO	
Designer		
Chief Designer		

Form	Zone	Ref №	Designation	Name	Quant.	Comment
				<u>Specification</u>		
A4			380.000 Ass	Assembling drawing		
A4			380.000 Tabl.	Table		
				<u>Pieces</u>		
A4		1	380.001	Ring	1	
A4		2	380.002	Stopper	1	

380.000		
Templet	Sheet	Sheets: 1
	LITMO	

Chief Designer



1. Gauge the dimension and the tolerance after assembly.
2. The D dimension values are in the table 380.000 Tabl.

380.000 Ass		
Templet	Mass	Scale
		2:1
	Sheet	Sheets 1
	LITMO	

Ref No.	Designation	Dimension value, mm		
		D	φ C	F
1	200.010	$3 \pm 0{,}002$	$15(^{\ 0}_{-0{,}043})$	3
2	200.020	$8{,}63 \pm 0{,}002$	$15(^{\ 0}_{-0{,}043})$	10,63
3	200.[illegible]30	$2 \pm 0{,}002$	$15(^{\ 0}_{-0{,}043})$	7
4	200.030	$1 \pm 0{,}002$	$15(^{\ 0}_{-0{,}043})$	[illegible]
5	210.020	$4{,}6 \pm 0{,}002$	$15(^{\ 0}_{-0{,}043})$	[illegible]
6	210.030, 230.040	$5{,}5 \pm 0{,}002$	$15(^{\ 0}_{-0{,}043})$	[illegible]
7	210.040	$2{,}8 \pm 0{,}002$	$15(^{\ 0}_{-0{,}043})$	[illegible]
8	210.050	$5{,}45 \pm 0{,}002$	$15(^{\ 0}_{-0{,}043})$	10,45
9	220.040	$5{,}1 \pm 0{,}002$	$13(^{\ 0}_{-0{,}043})$	[illegible]
10	220.050	$4{,}7 \pm 0{,}002$	$12{,}8(^{\ 0}_{-0{,}043})$	9,7
11	220.060	$5 \pm 0{,}002$	$13(^{\ 0}_{-0{,}043})$	10
12	220.070	$6{,}43 \pm 0{,}002$	$13(^{\ 0}_{-0{,}043})$	11,45
13	230.050	$6{,}7 \pm 0{,}002$	$14{,}8(^{\ 0}_{-0{,}043})$	11,7
14	230.060	$5{,}3 \pm 0{,}002$	$15(^{\ 0}_{-0{,}043})$	[illegible]
15	230.070	$4 \pm 0{,}002$	$15(^{\ 0}_{-0{,}043})$	[illegible]
16	230.080	$9{,}71 \pm 0{,}002$	$15(^{\ 0}_{-0{,}043})$	[illegible]

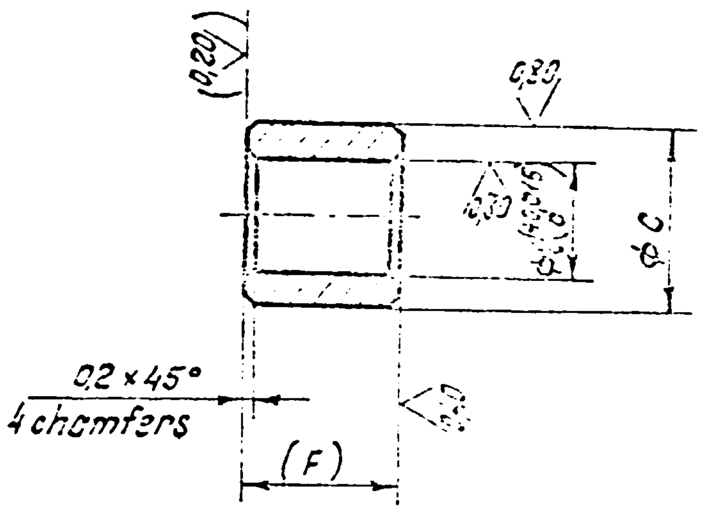
380.000 Tabl.

Designer

Chief Designer

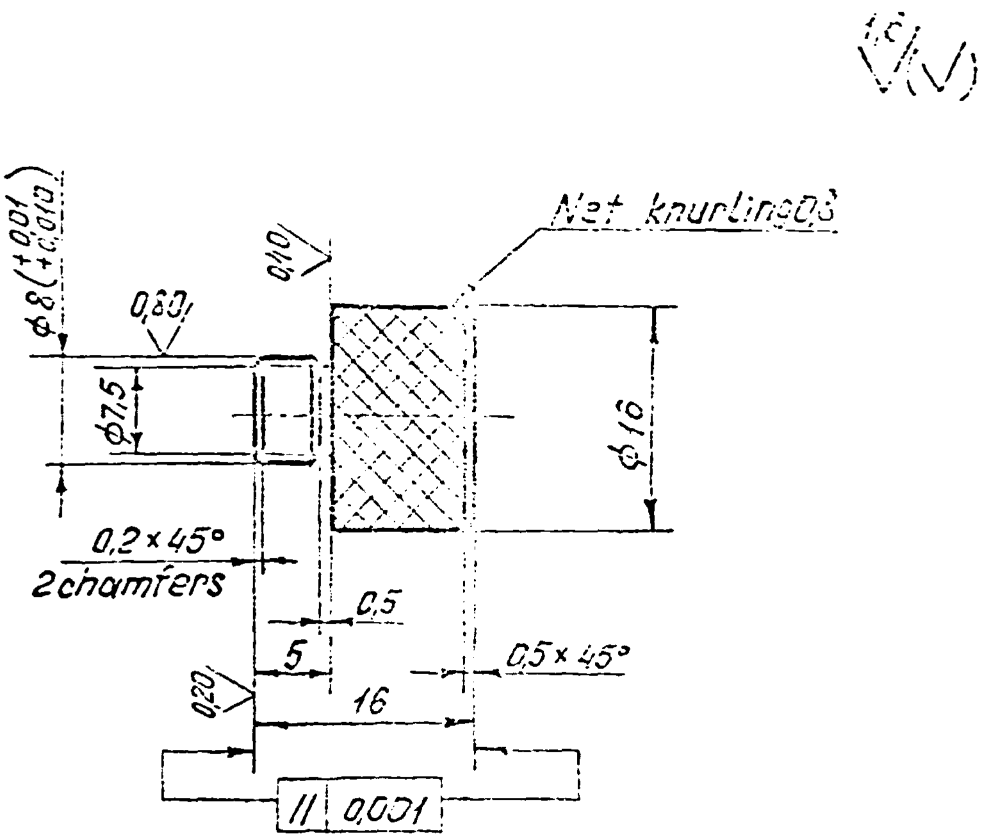
Templet Table

LITHO



1. H14; h14; $\pm \frac{IT14}{2}$
2. The bracket dimension and the bracket roughness must be produced after assembly
3. The F, C dimension values are in the table 380.000 Tabl.

	380.001	
Designer	Ring	Mass / Scale: 2:1
		Sheet / Sheets
Chief Designer	Steel 50	LITMO



1. $H14;\ h14;\ \pm\frac{IT14}{2}$
2. The dimension values are in the table 380.000 Tabl.

380.002		
Stopper	Mass	Scale
		2:1
	Sheet	Sheets 1
Steel 20	LITMO	

Designer

Chief Designer

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				<u>Specification</u>		
A3			370.000 Ass	Assembling drawing		
A2			370. 000 L3	Optical sheme		
				<u>Assembling units</u>		
A4		1	370.010	Auto-collimated eyepiece	1	
A4		2	370.020	Objective	1	
				<u>Pieces</u>		
A2		3	370.001	Tube	1	
A4		4	370.002	Ring	1	
A4		5	370.003	Mount	1	
A4		6	370.004	Nut	1	
A4		7	370.005	Nozzle	1	

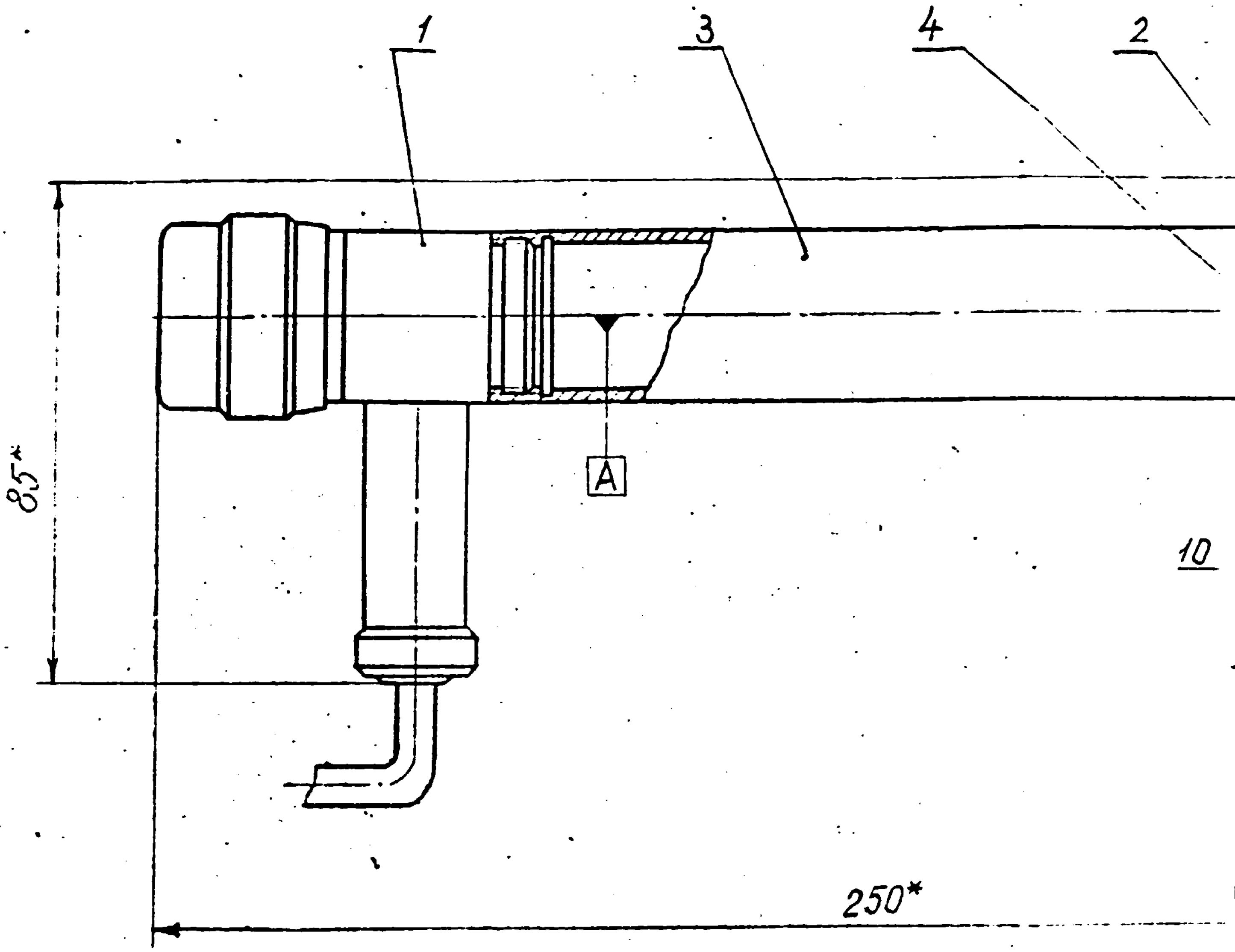
370.000

Designer	Auto-collimated tube	Sheet 1	Sheets 2
Chief Designer		LITMO	

Form	Zone	Ref No	Designation	Name	Quantity	Comment
				Standard units		
		8		ScrewB.M2-6gx4.14H.05		
				ГОСТ 1476-84	1	
		9		ScrewB.M3-6gx4.14H.05		
				ГОСТ 1476-84	1	
		10		ScrewB.M6-6gx8.14H.05		
				ГОСТ 1479-84	4	
				Sets		
				Set of accessory units		
				Pieces		
A4		14	370.006	Nozzle	1	
A4		15	370.007	Nozzle	1	

370.000

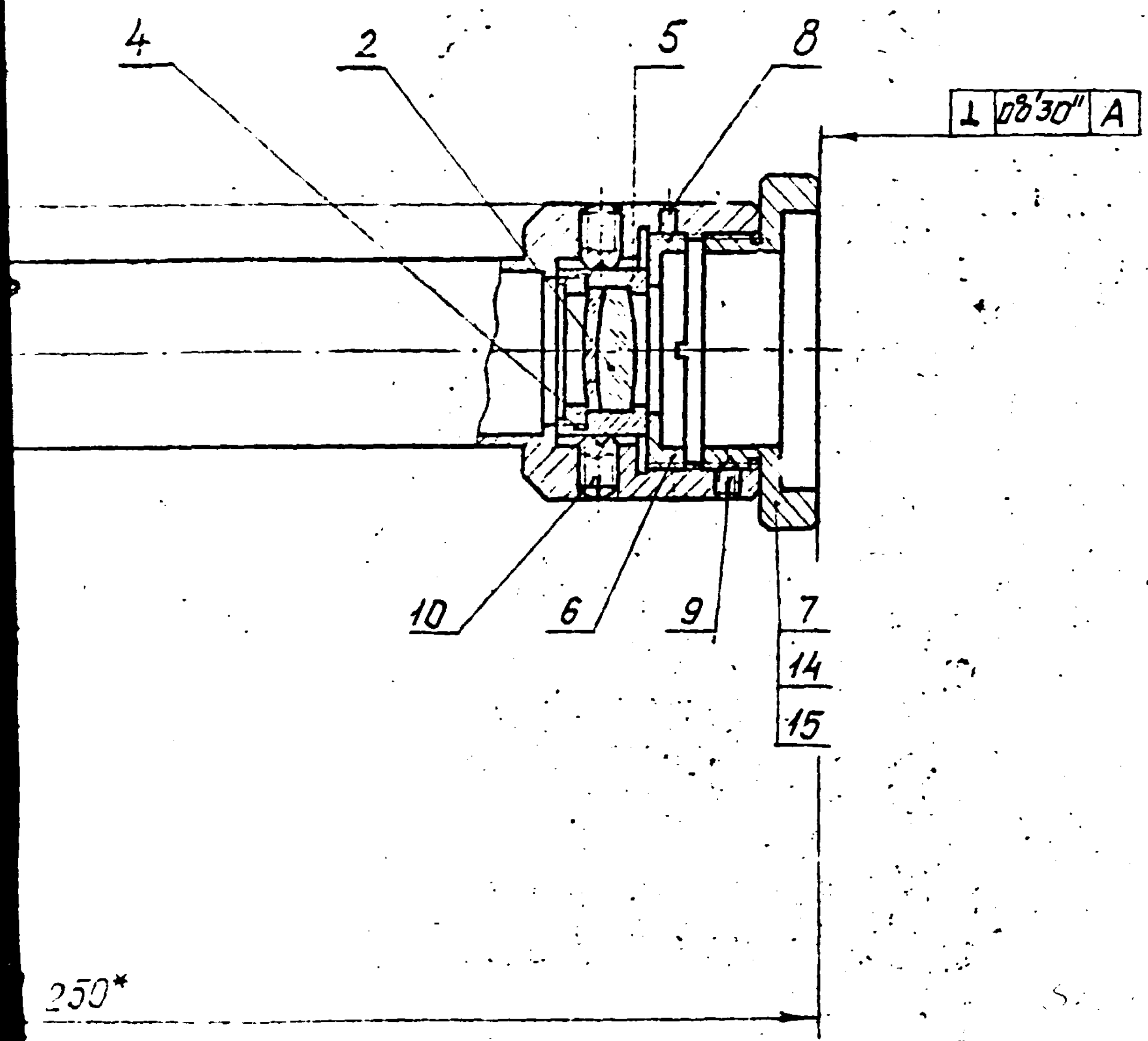
Sheet 2



1.* Th...
2. Sec...
af...

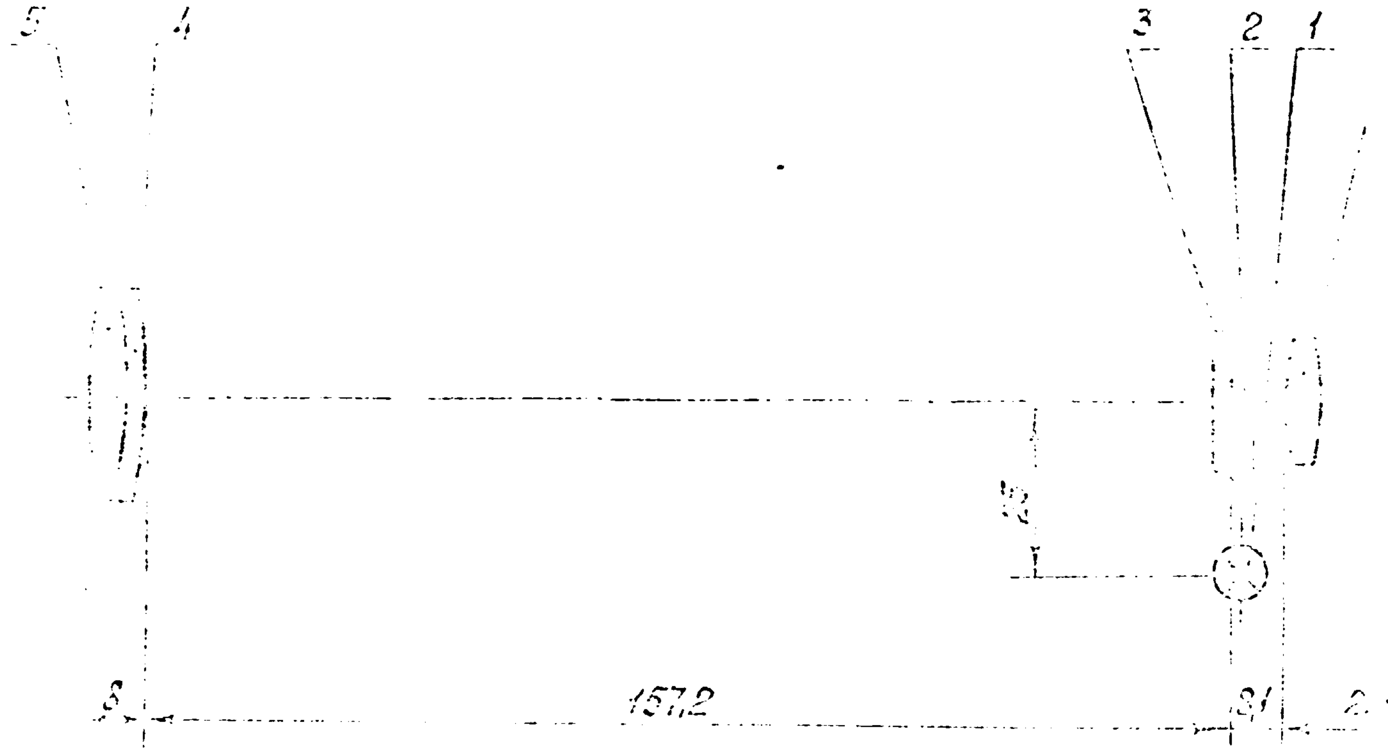
Designer		
Chief Designer		

SECTION 1



1.* The dimensions for informations
2. Secure the screws p.10 with black enamel after the adjustment

	370.000 Ass		
Designer	Autn-collimated tube	Mass	Scale
			1:1
		Sheet	Sheets 1
Chief Designer		LITMO	



SECTION 1

mm Table 1

[illegible]	Name	f'	S_F	$S'_{F'}$
[illegible]	Objective	[illegible]	-157,0	155,5
[illegible]	Eyepiece	[illegible]	-8,1	8,5

mm Table 2

[illegible]	Ø1	Sag Ø1	Ø2	Sag Ø2	Thickness
[illegible]	—	—		—	3
[illegible]	18	0,35	18	[illegible]	2
[illegible]	17	[illegible]	17	[illegible]	2
[illegible]	17		[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

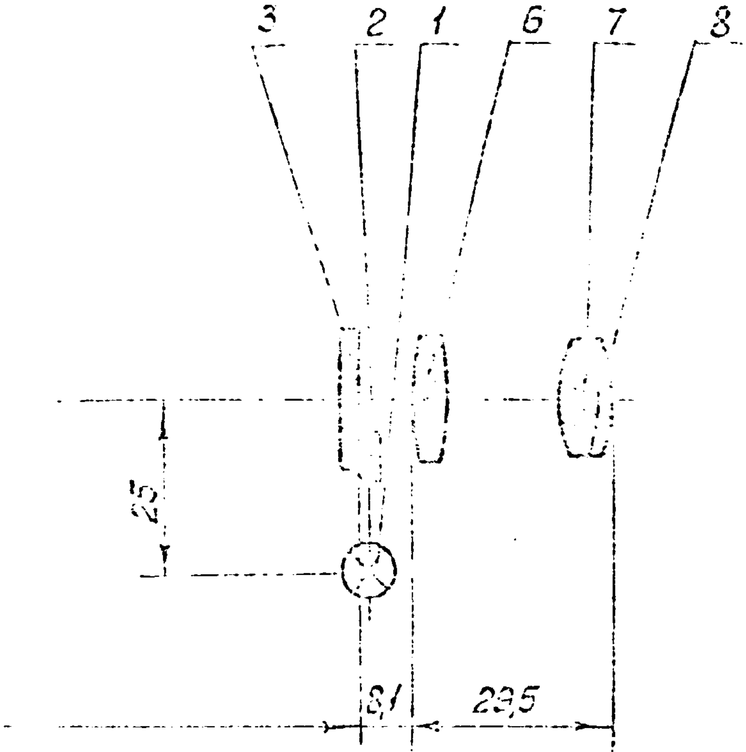


Table 1

[illegible]	S'F
[illegible]	[illegible]
[illegible]	[illegible]

Table 2

		Designati
	1	
	2	370.015
	3	370.016
	4	370.005
	5	370.003
	6	370.1[illegible]
	7	370.[illegible]
	8	[illegible]

Table 3

[illegible]	Pos.	Designation	Name	[illegible]	Comment
	1		Lamp	1	
	2	370.015	Prism	1	
	3	370.016	Graticule	1	
	4	370.035	Lens	1	
	5	370.036	Lens	1	
	6	370.026	Lens	1	
	7	370.02[illegible]	Lens	1	
	8	370.02[illegible]	Lens	1	

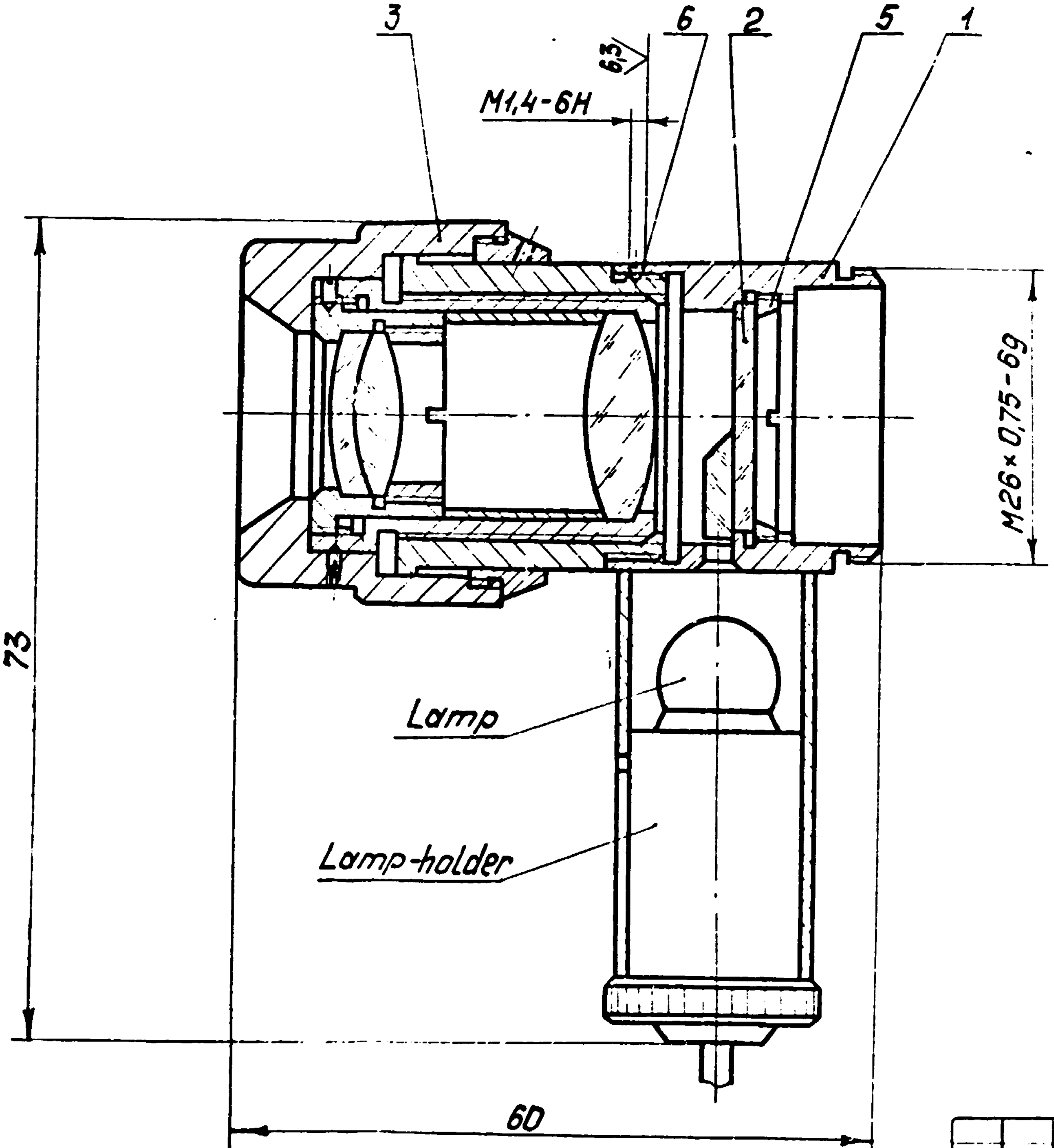
Form	Zone	Ref No	Designation	Name	Quant.	Comment
				<u>Specification</u>		
A4			370.010 Ass	Assembling drawing		
				<u>Assembling units</u>		
A4		1	370.030	Graticule mount with illuminator housing	1	
A4		2	370.040	Graticule with prism	1	
A4		3	370.050	Eyepiece $10^{\times}$	1	
				<u>Pieces</u>		
A4		5	370.011	Ring	1	

370.010			
Designer / Chief Designer	Auto-collimated eyepiece	Sheet 1	Sheets 2
		LITMO	

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				Standard units		
		6		Screw B.M1,6-6g×2.14H.046 ГОСТ 1476-84	1	

370.010

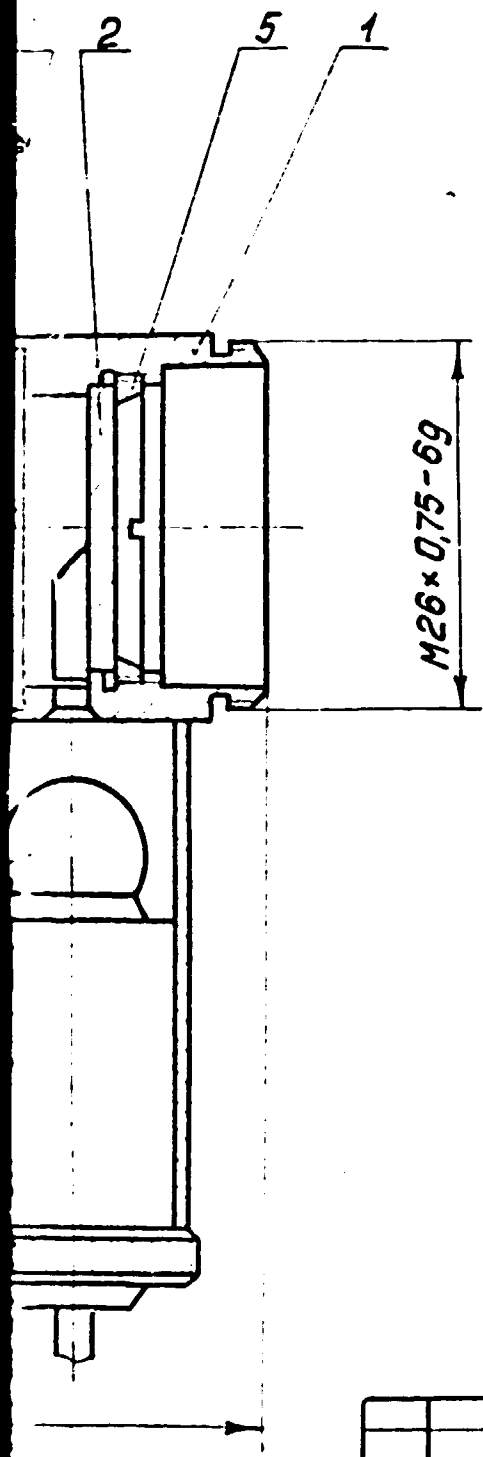
Sheet 2



Section 1

Designer

Chief Designer



The dimensions for information

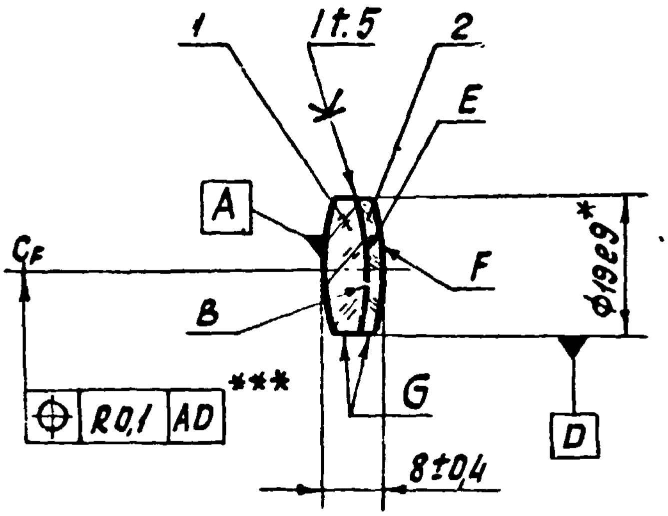
370.010		
Auto-collimated eyepiece	Mass	Scale
		2:1
Designer	Sheet	Sheets 1
Chief Designer	LITMO	

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				Specification		
A4			370020 ASS	Assembling drawing		
				Pieces		
A4		1	370.035	Lens	1	
A4		2	370.036	Lens	1	

	370.020			
Designer	Objective		Sheet	Sheets
				1
Chief Designer		LITMO		

N	2
ΔN	0,25
Surf. qual	0,02**

f'	159,4
S_F	-157,0
$S'_{F'}$	156,4
D_{ϕ}	17

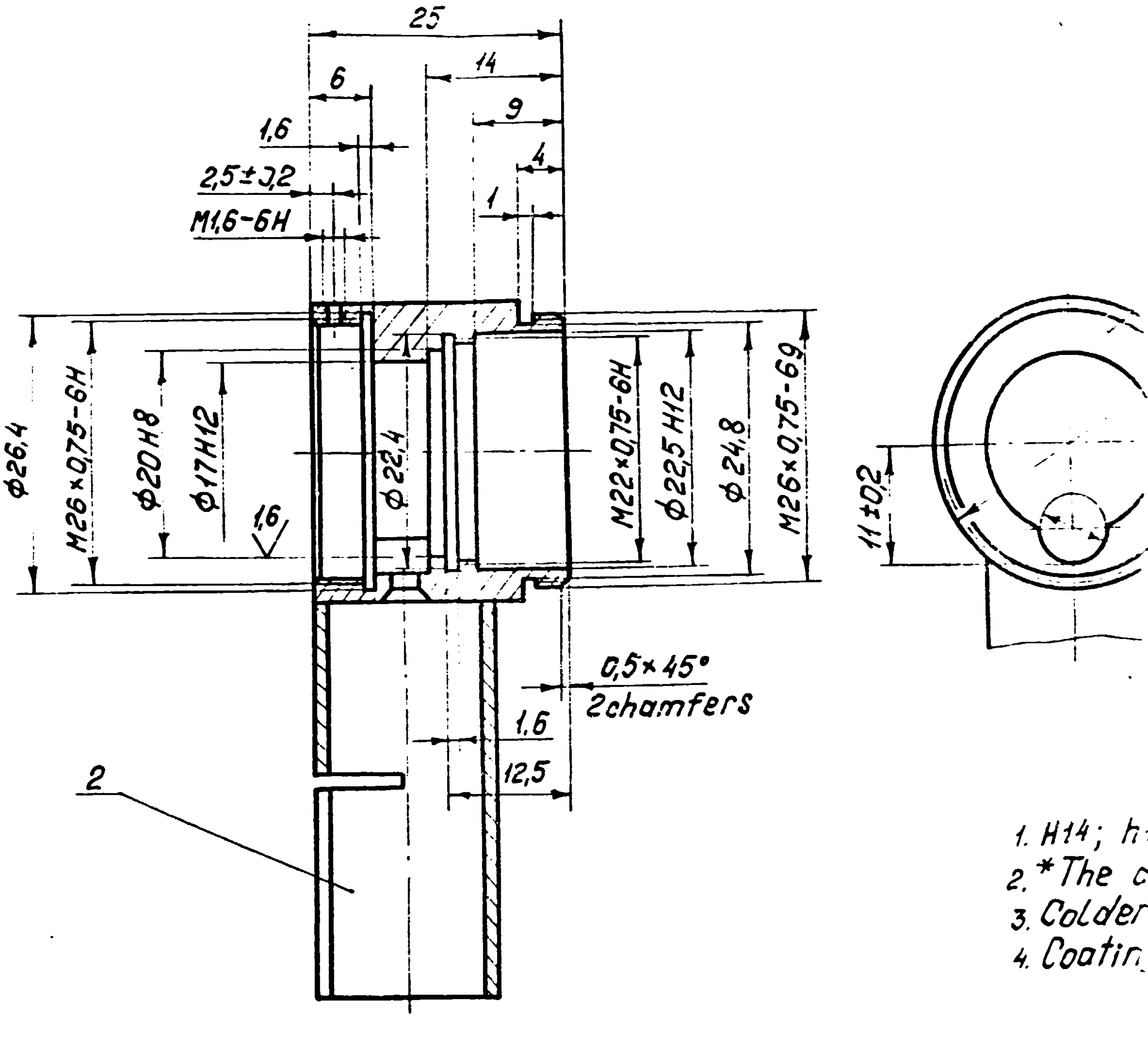


1. *The dimensions for information
2. ** Permitted total area of scratches, pits (mm²)
3. *** Shift in focal plane of light beam passing throught the lens must be no more than 0,05 mm
4. Coat the surface G with black enamel
5. Balsam

370.020 Ass			
Objective		Mass	Scale
			1:1
		Sheet	Sheets 1
Designer			
Chief Designer		LITMO	

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				Specification		
A3			370.030 Ass	Assembling drawing		
				Pieces		
A4		1	370.012	Graticule mount	1	
A4		2	370.013	Illuminator housing	1	

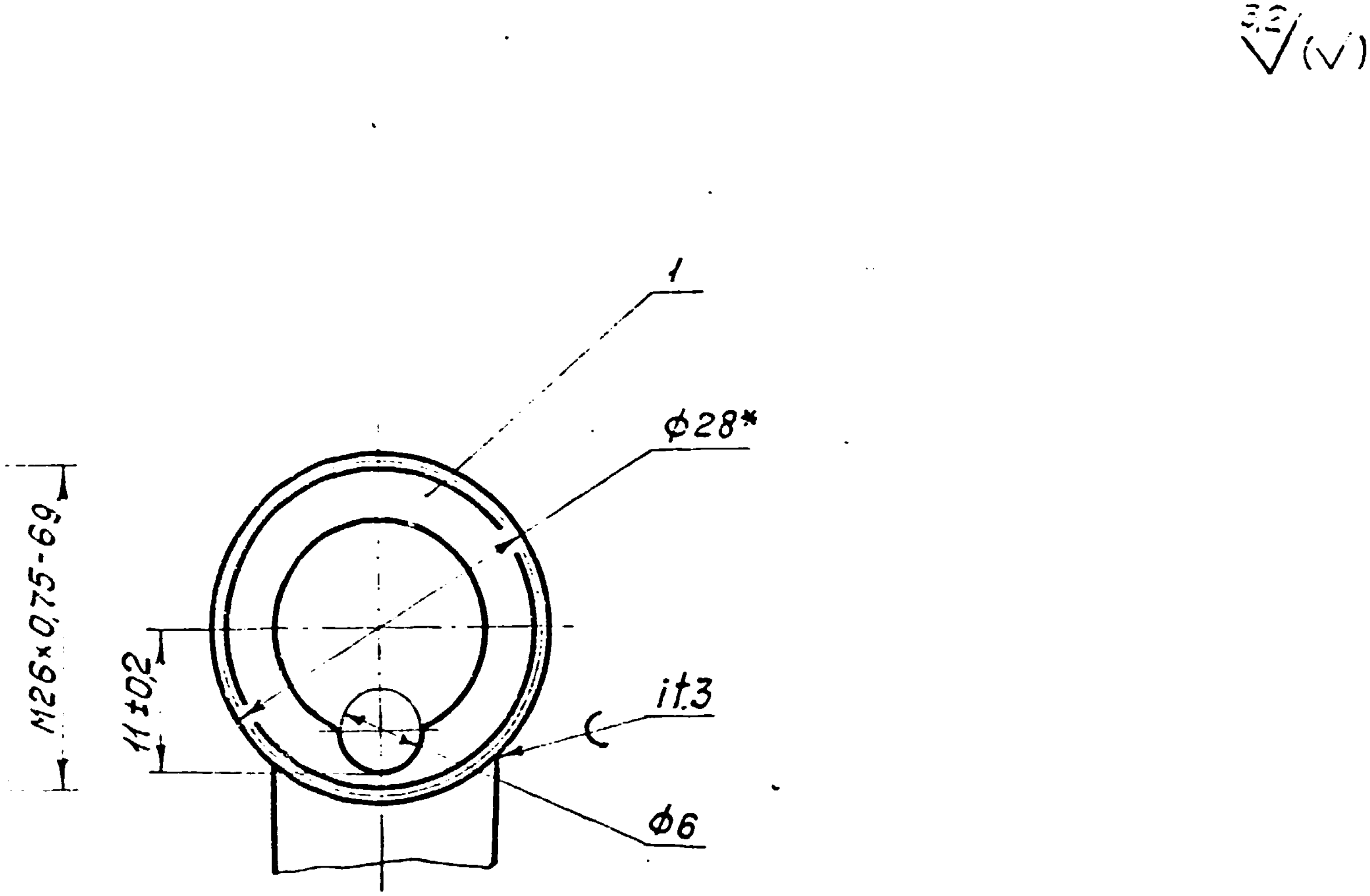
	370.030		
Designer	Graticule mount with illuminator housing	Sheet	Sheets 1
Chief Designer		LITMO	



1. H14; h…
2. *The c…
3. Colder…
4. Coatin…

SECTION 1

Designer		
Chief Designer		

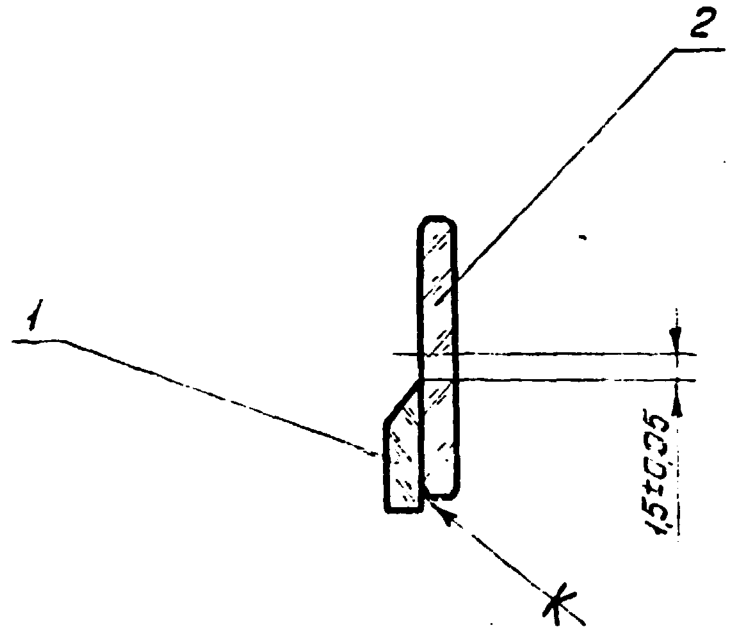


1. H14; h14; $\pm\frac{IT14}{2}$
2. *The dimension for information
3. Colder Cu60 Zn39 Pb1 Si0,3
4. Coating Chemical oxidation
   Coat outside surfaces with grey enamel.

					370.030 Ass
Designer				Graticule mount with illuminator housing	Mass: — / Scale: 2:1 / Sheet — / Sheets 1
Chief Designer					LITMO

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				<u>Specification</u>		
A4			370.040 ASS	Assembling drawing		
				<u>Pieces</u>		
A3		1	370.015	Prism	1	
A2		2	370.016	Graticule	1	

	370.040	
Designer	Graticule with prism	Sheet: / Sheets: 1
Chief Designer		LITMO



Balsam

370.040 Ass			
Graticule with prism	Mass	Scale	
		2:1	
	Sheet	Sheets 1	
	LITMO		

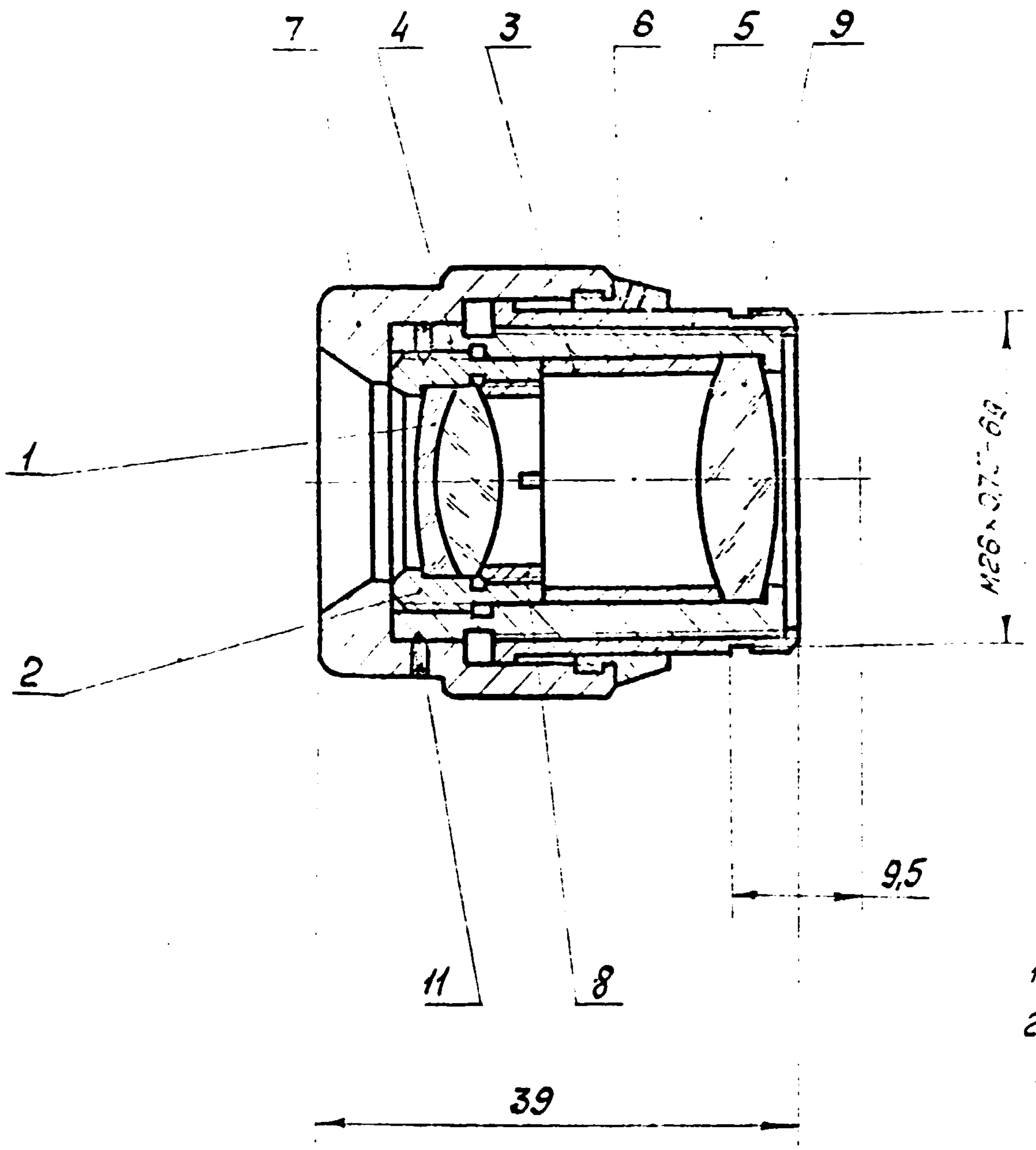
Designer

Chief Designer

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				Specification		
A3			370.050 Ass	Assembling drawing		
A3			370.050 L3	Optical sheme		
				Assembling units		
A4		1	370.070	Lens	1	
				Pieces		
A4		2	370.018	Mount	1	
A4		3	370.019	Bushing	1	
A3		4	370.021	Eyepiece mount	1	
A3		5	370.022	Case	1	
A4		6	370.023	Ring	1	
A3		7	370.024	Eyeguard	1	
A4		8	370.025	Ring	1	
A3		9	370.026	Lens	1	
				Standard units		
		11		Screw B M2-6g×3.14 H.046 ГОСТ 1476-84	4	

370.050

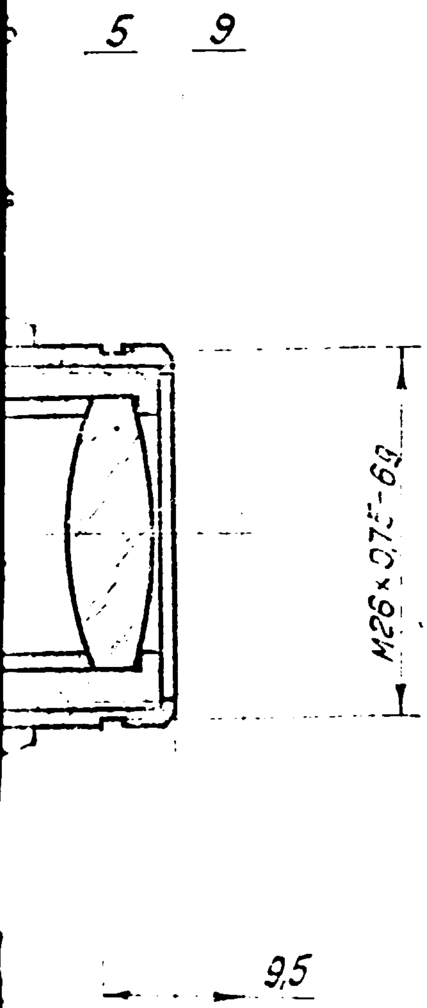
Designer	Eyepiece 10×	Sheet	Sheets
			1
Chief Designer		LITMO	



1. The dimensio
2. Fit in the thr
smooth movem

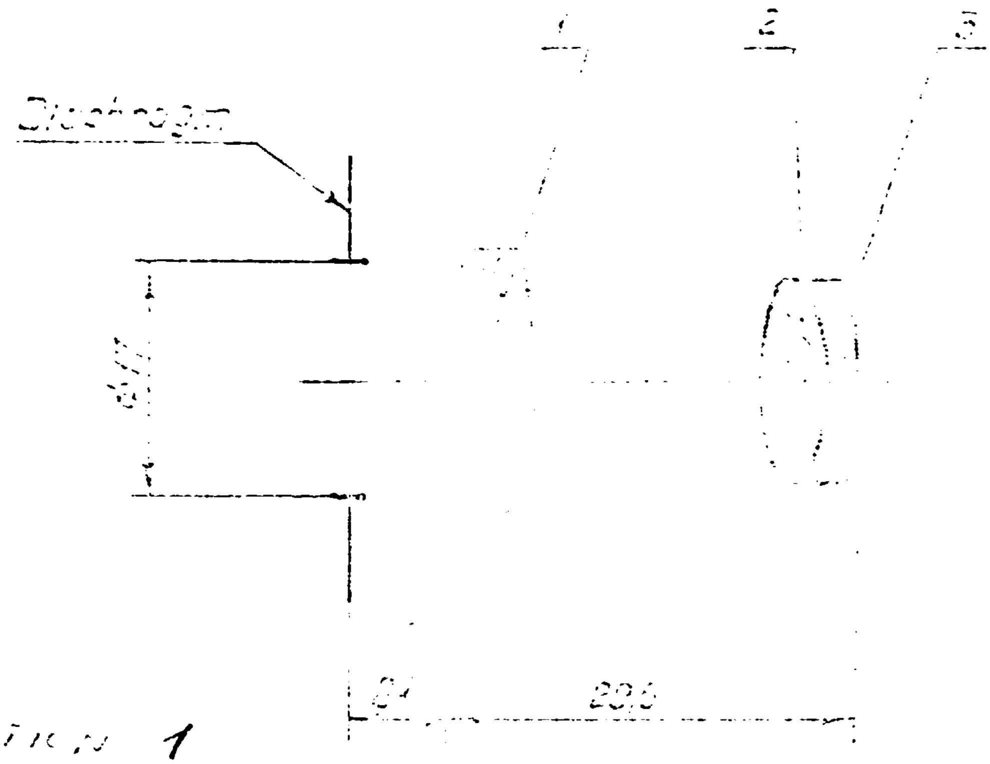
SECTION 1

Designer			
Chief Designer			



1. The dimensions for information
2. Fit in the thread of the pieces 4 and 5 to produce smooth movement

370.050 Ass			
Eyepiece		Mass	Scale
			2:1
	Sheet	Sheets	
	LITMO		
Designer			
Chief Designer			



SECTION 1

mm Table 1

Pos.	Name	f'	Sf	S'f'
1,2,3	Eyepiece	24,3	-0,1	[illegible]

mm Table 2

Pos.	$O_{\phi 1}$	Sag $O_{\phi 1}$	$O_{\phi 2}$	Sag $O_{\phi 2}$	Thickness
1	17	0,55	[illegible]	1,13	3
2	14	1,41	[illegible]	[illegible]	5,5
3	14	1,95	[illegible]	7,25	1,5

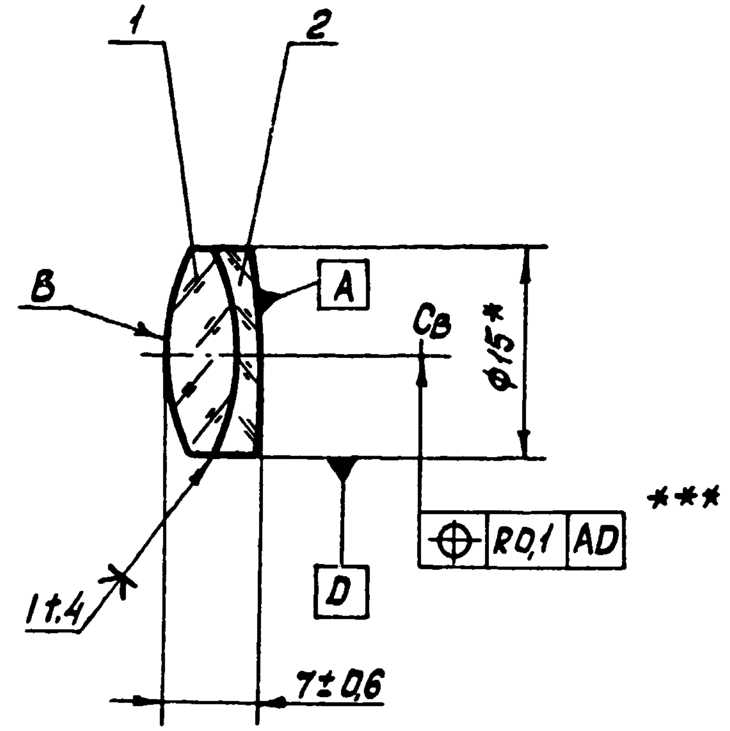
Magnification [illegible]
Field [illegible]
Focal length [illegible]
Exit pupil [illegible]

Sheet 2

[illegible]	[illegible]	Designation	Name
	1	3[illegible]0.026	Lens
	[illegible]	370.028	Lens
	[illegible]	370.029	Lens

Form	Zone	Ref No	Designation	Name	Quant.	Comment
				Specification		
A4			370.070 Ass	Assembling drawing		
				Pieces		
A3		1	370.028	Lens	1	
A3		2	370.029	Lens	1	

	370.070		
Designer	Lens	Sheet	Sheets
			1
Chief Designer		LITMO	



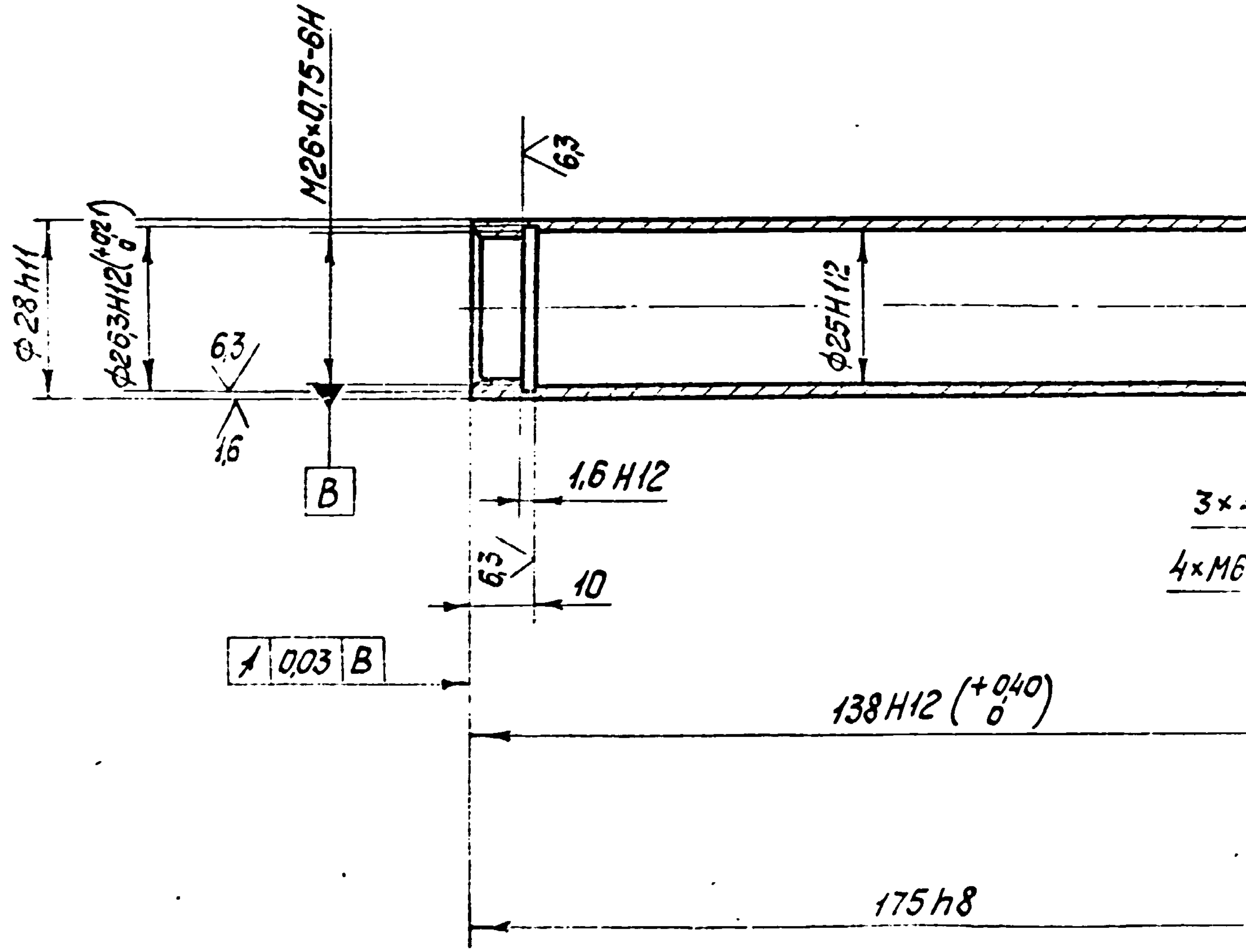
$N_{A,B}$	5
$\Delta N_{A,B}$	0,5
Surf. qual.	0,02**

f'	32,5
S_F	-28,5
$S'_{F'}$	32,5
D_{ϕ}	14

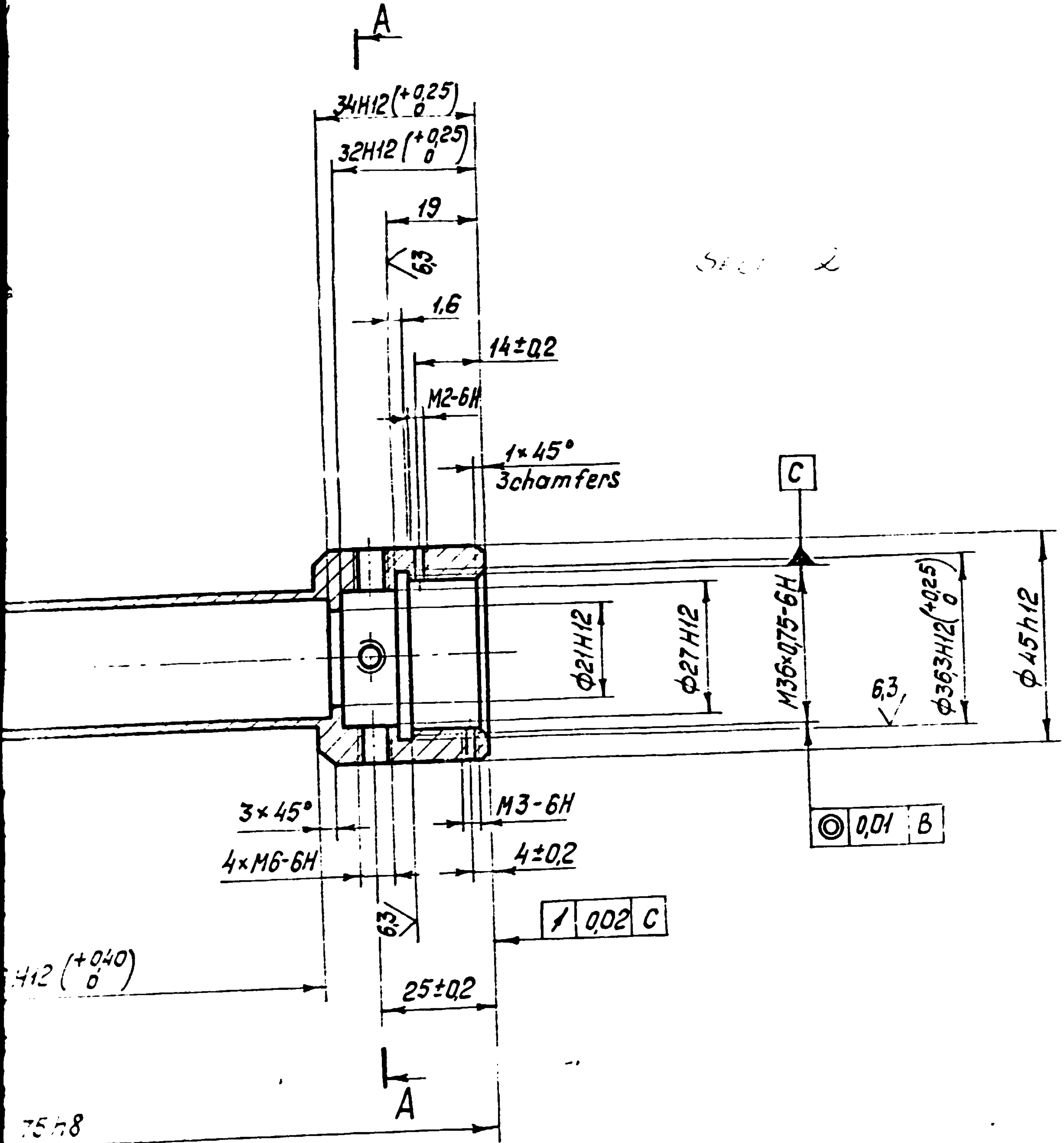
1.* The dimension for information
2.** Permitted total area of scratches, pits (mm)
3.*** Shift in focal plane of light beam passing throught the lens must be no more than 0,1mm
4. Balsam

370.070 Ass			
Lens		Mass	Scale
			2:1
Designer		Sheet	Sheets 1
Chief Designer		LITMO	

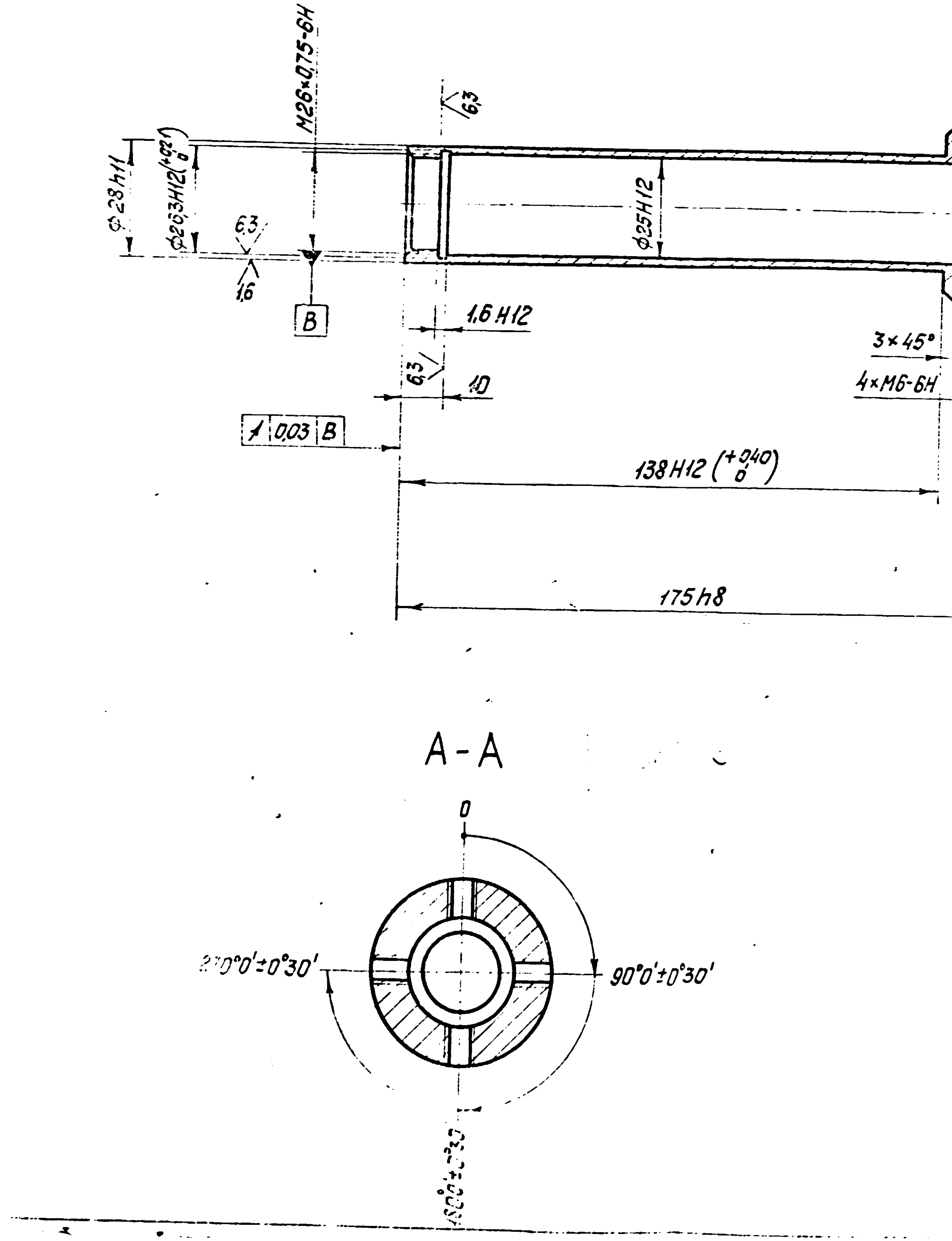
SECTION 1

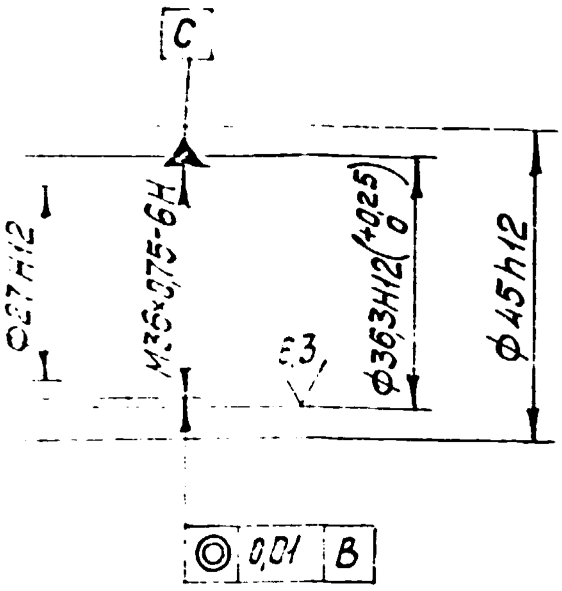

M26×0,75-6H
6,3
Φ28h11
Φ26,3H12(+0,21 / 0)
6,3
1,6
Φ25H12
B
1,6 H12
3×
4×M6
6,3
10
0,03 B
138 H12 (+0,40 / 0)
175h8

A-A



1. H14 ; h14;
2. Coating

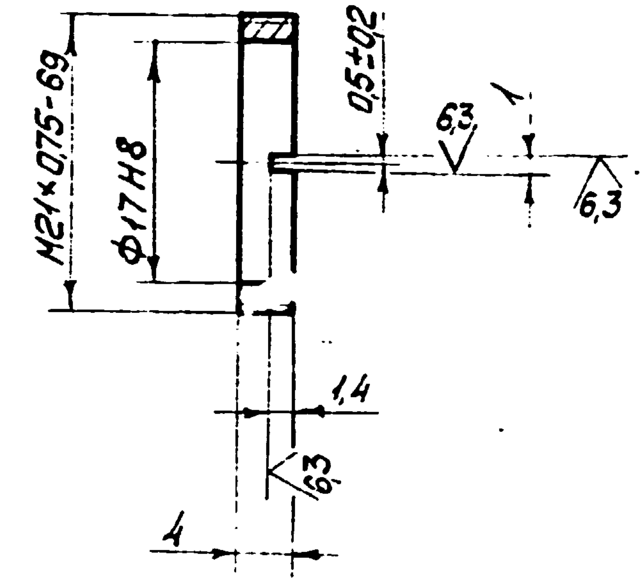

M26×0,75-6H
6,3
Φ28h11
Φ26,3H12(+0,21 0)
6,3
1,6
B
Φ25H12
1,6H12
6,3
10
3×45°
4×M6-6H
0,03 B
138H12 (+0,40 0)
175h8
A-A
0
270°0'±0°30'
90°0'±0°30'



SECT 4

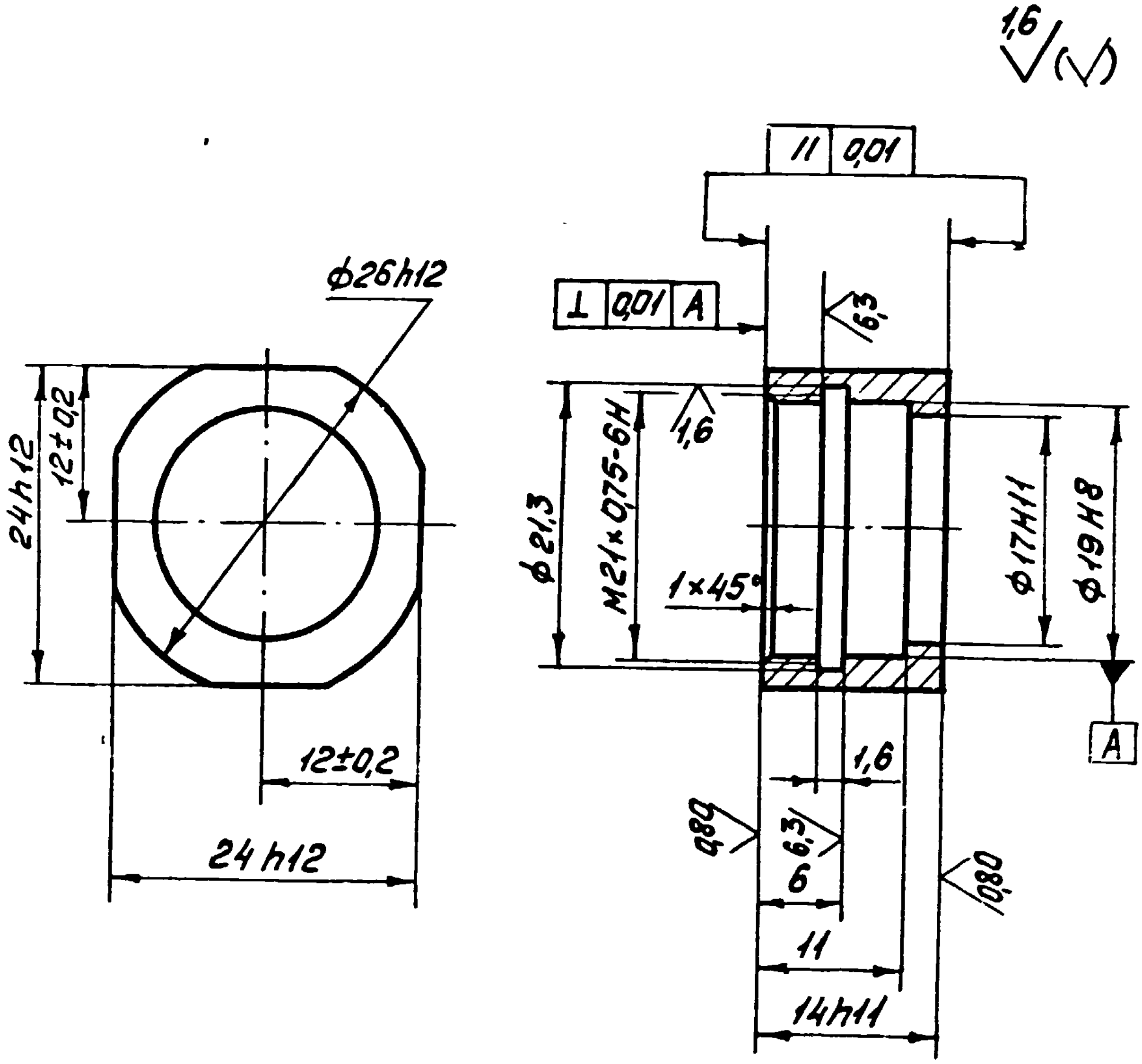
1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating Anodic oxidation black

	370.001	
	Tube	Mass / Scale: 1:1
Designer		Sheet / Sheets 1
Chief Designer	Aluminium alloy AL-Cu 4 Mg Mn Fe Si	LITMO



1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating Anodic oxidation black

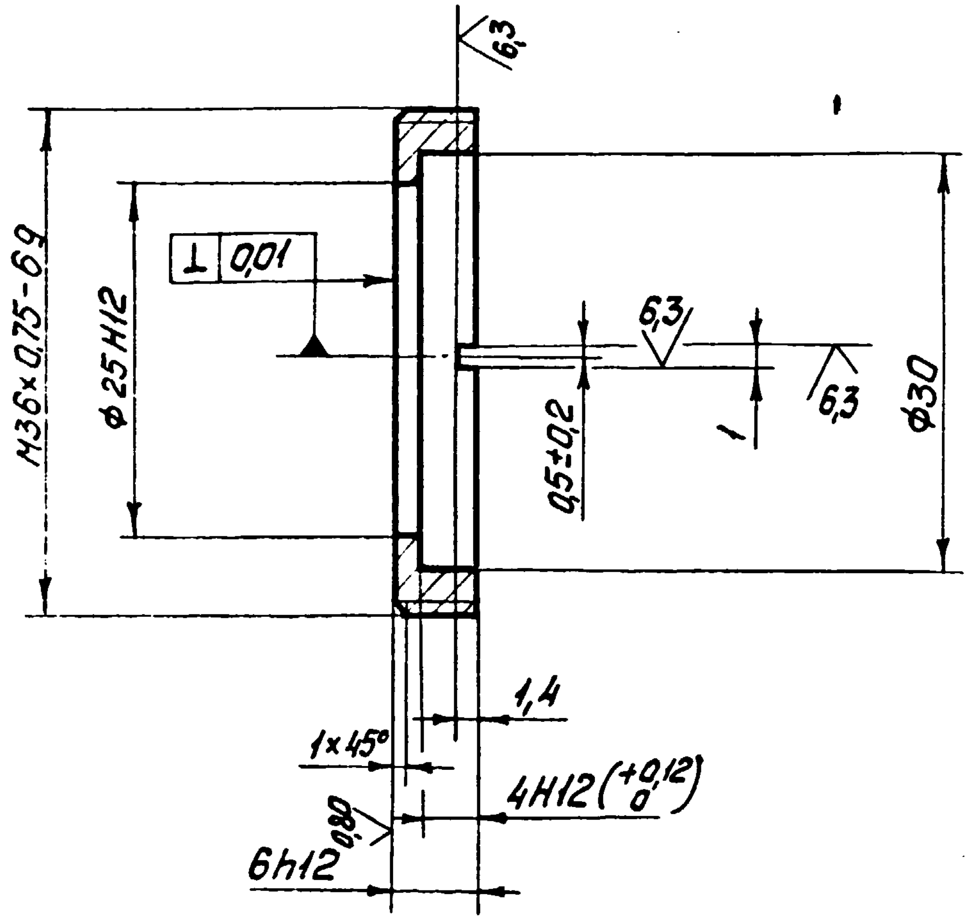
	370.002		
	Ring	Mass	Scale
Designer			2:1
		Sheet	Sheets 1
Chief Designer	Aluminium alloy AL-Cu4 MgMnFeSi	LITMO	



1. $H14;\ h14;\ \pm\frac{IT14}{2}$
2. Coating Chemical oxidation

	370.003			
Designer	Mount		Mass	Scale
				2:1
		Sheet	Sheets 1	
Chief Designer	Brass CuZn 40	LITMO		

1,6 (√)



1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating Chemical oxidation impregnation by oil

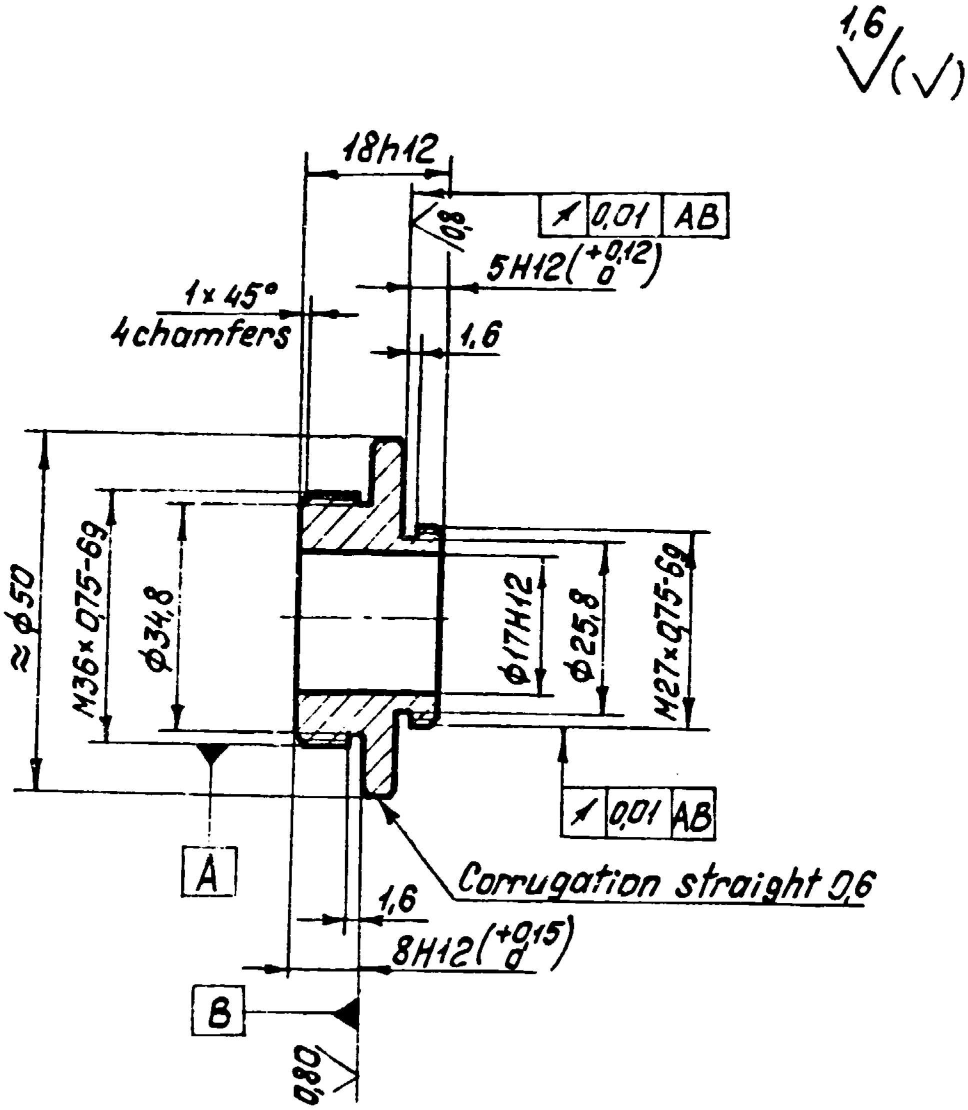
370.004		
Nut	Mass	Scale
		2:1
	Sheet	Sheets 1
Designer		
Chief Designer		
Steel 20	LITMO	

$H14;\ h14;\ \pm\frac{IT14}{2}$

370.005

Nozzle

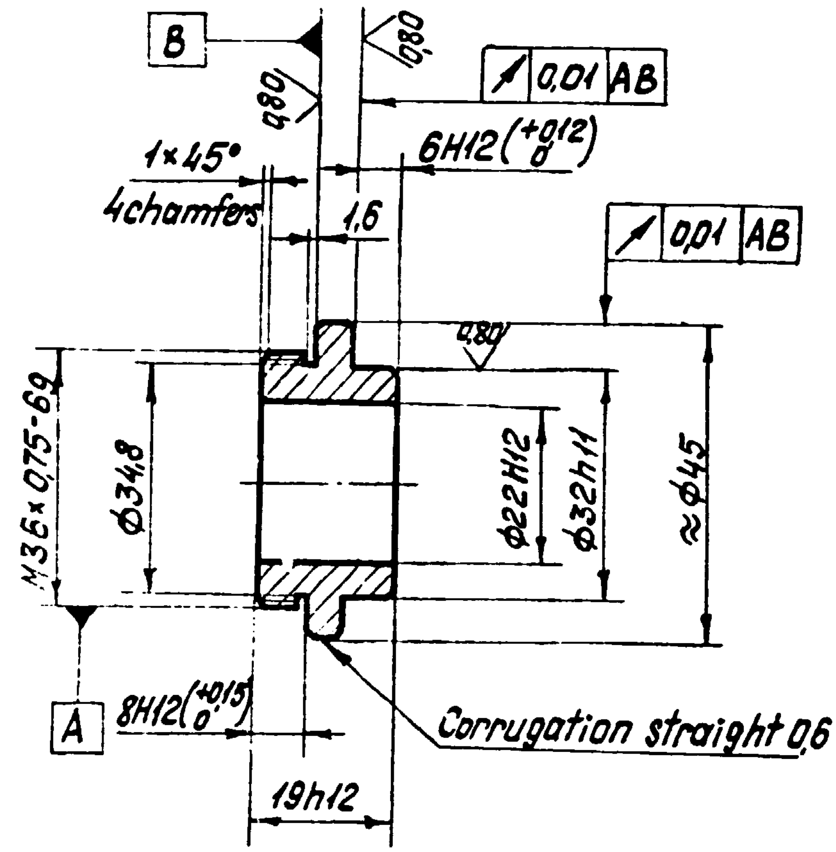
Steel 50



H14; h14; $\pm\frac{IT14}{2}$

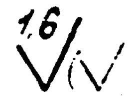
370.006			
Nozzle		Mass	Scale
			1:1
		Sheet	Sheets 1
Designer	Steel 50	LITMO	
Chief Designer			

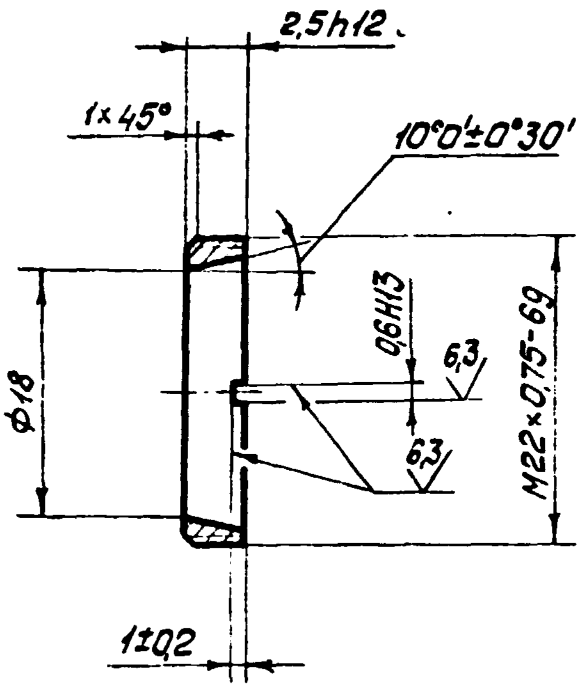
1,6 (√)



H14; h14; $\pm\frac{IT14}{2}$

370.007		
Nozzle	Mass	Scale
		1:1
	Sheet	Sheets 1
Steel 50	LITMO	
Designer		
Chief Designer		





1. H14; $\pm \frac{IT14}{2}$

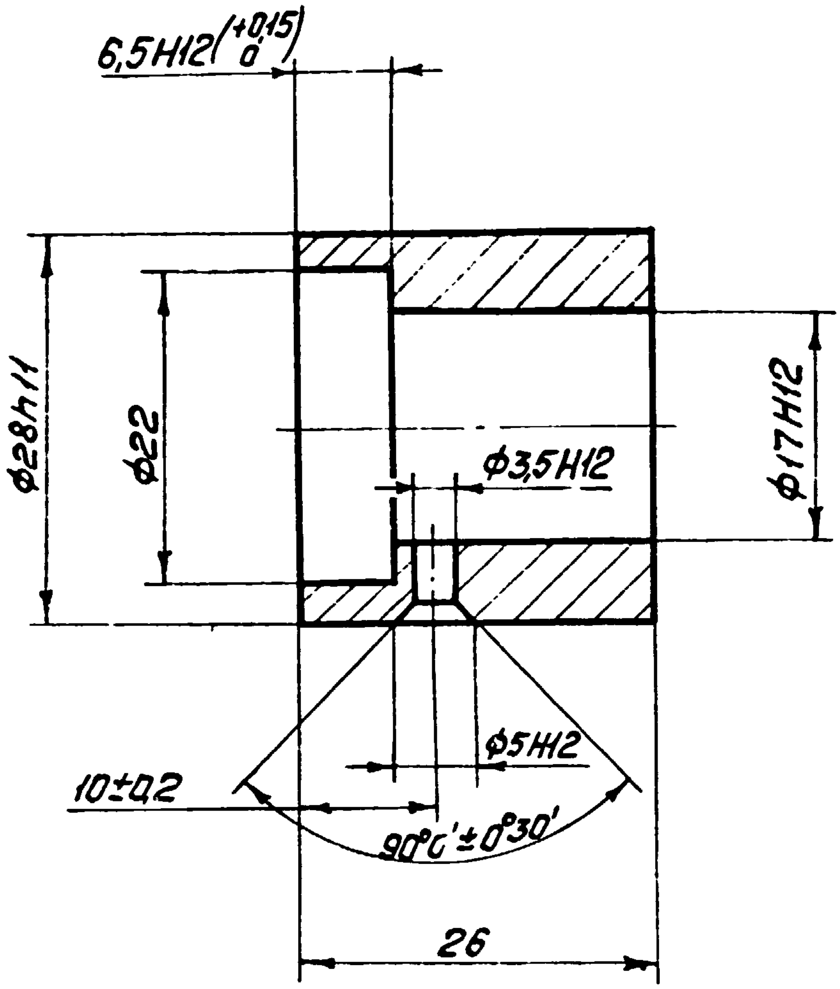
2. Coating Chemical oxidation

370.011			
Ring		Mass	Scale
			2:1
		Sheet	Sheets 1
Aluminium alloy Al-Cu4 Mg Mn Fe Si	LITMO		

Designer

Chief Designer

3,2



$H14;\ h14;\ \pm\ \frac{IT14}{2}$

370.012

Graticule mount

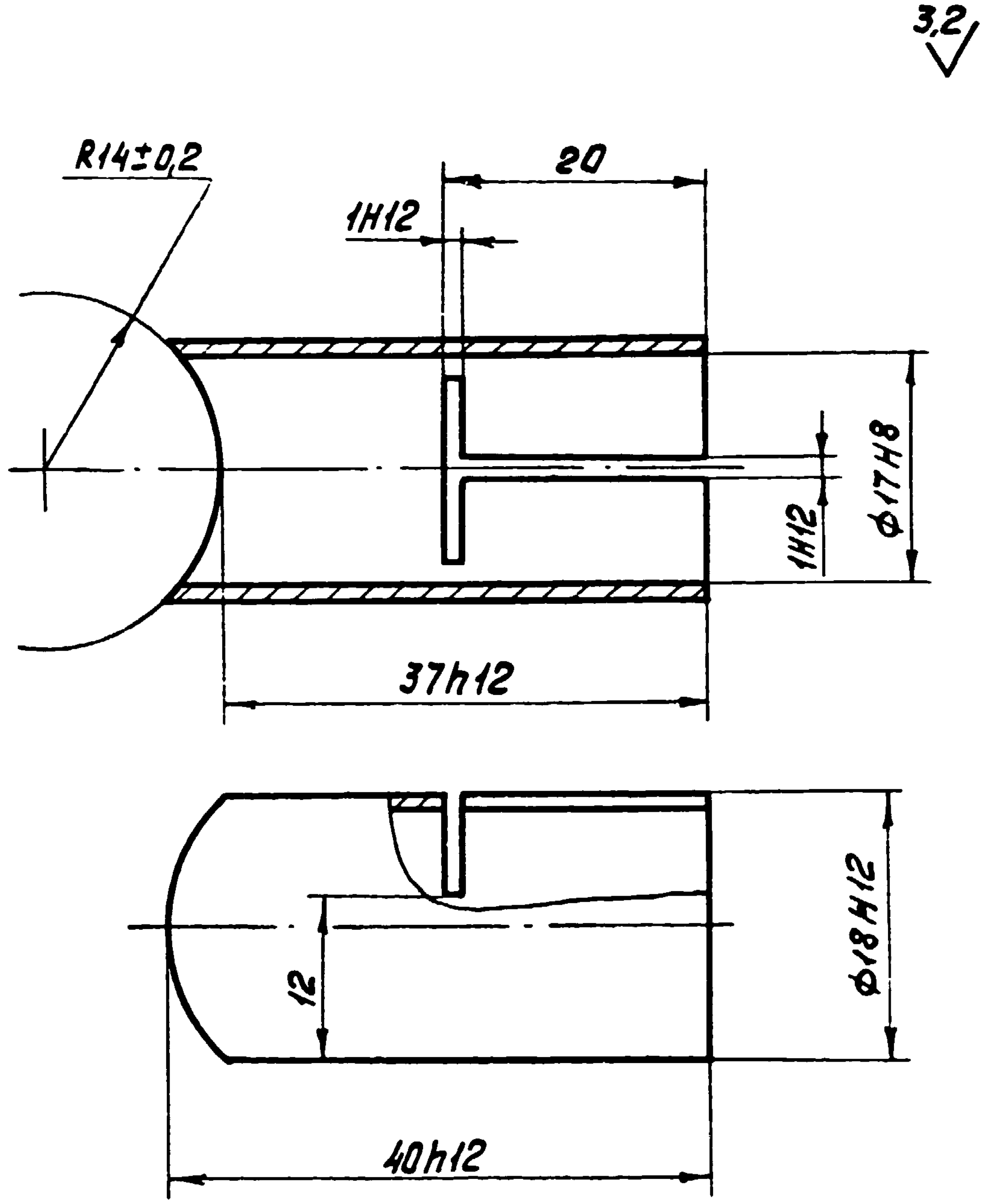
	Mass	Scale
		2:1
Sheet	Sheets 1	

Designer

Chief Designer

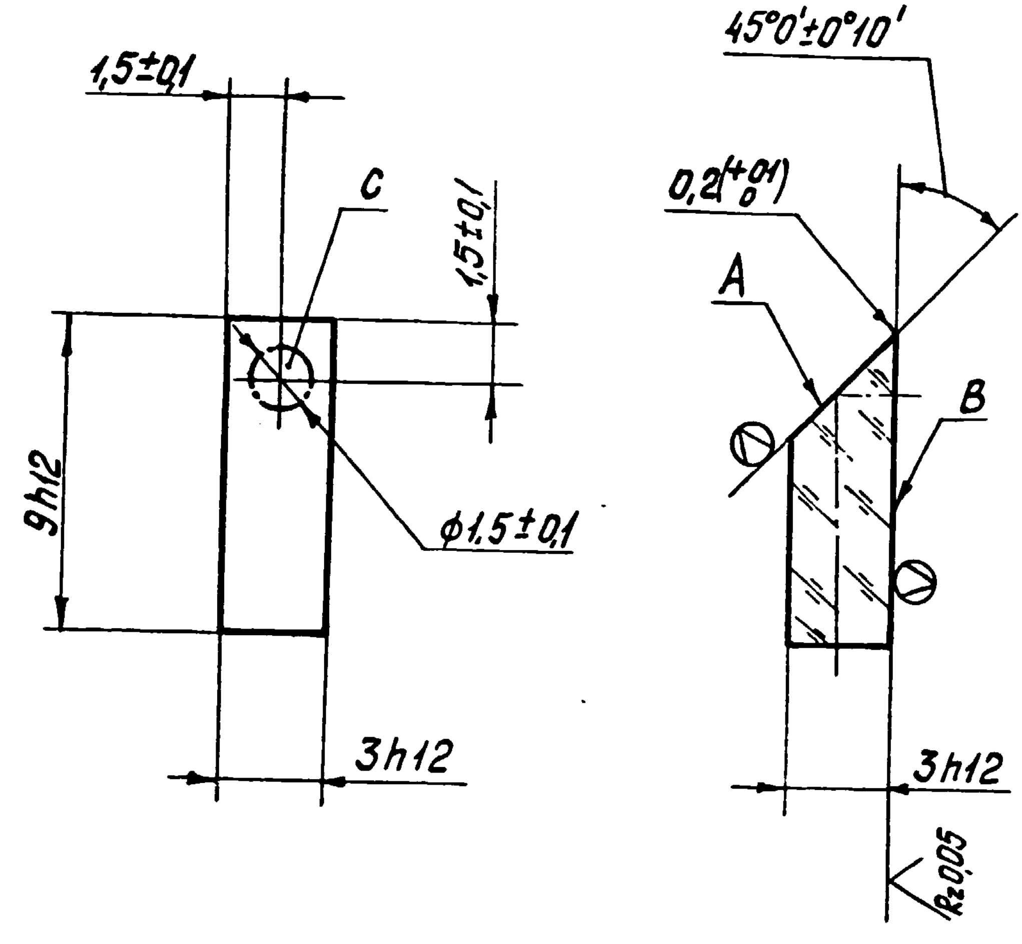
Steel 20

LITMO



H14; h14; $\pm \frac{IT14}{2}$

	370.013		
	Illuminator housing	Mass	Scale
Designer			2:1
		Sheet	Sheets 1
Chief Designer	Steel 20	LITMO	



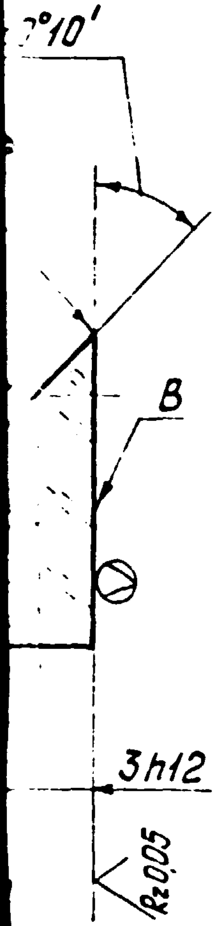
1. * Perm
the
2. Surf
that
20mm
be no
aper
3. Angle
4. Edge
5. Coati

Designer		
Chief Designer		

SECTION 1

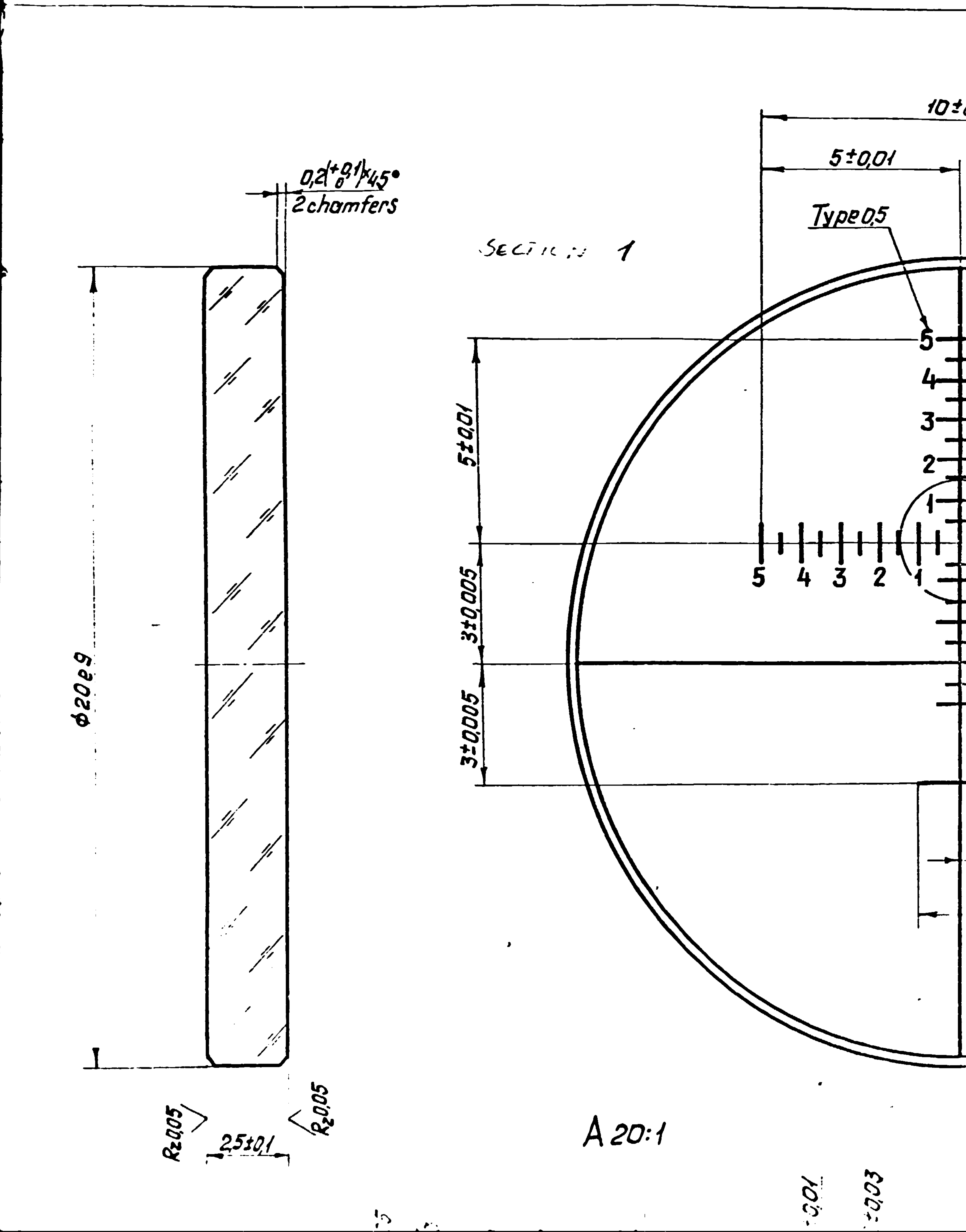
1,6 √(√)

Δn_e	3N
$\Delta(n_{F'}-n_{C'})$	—
Homogeneity	H1
Birefringence	N
μ_A	—
Veins	P2
Inclusions	B0
N_A	2
ΔN_A	0,2
N_B	5
ΔN_B	0,5
Wedge angle	10′
Surf. qual.	0,02

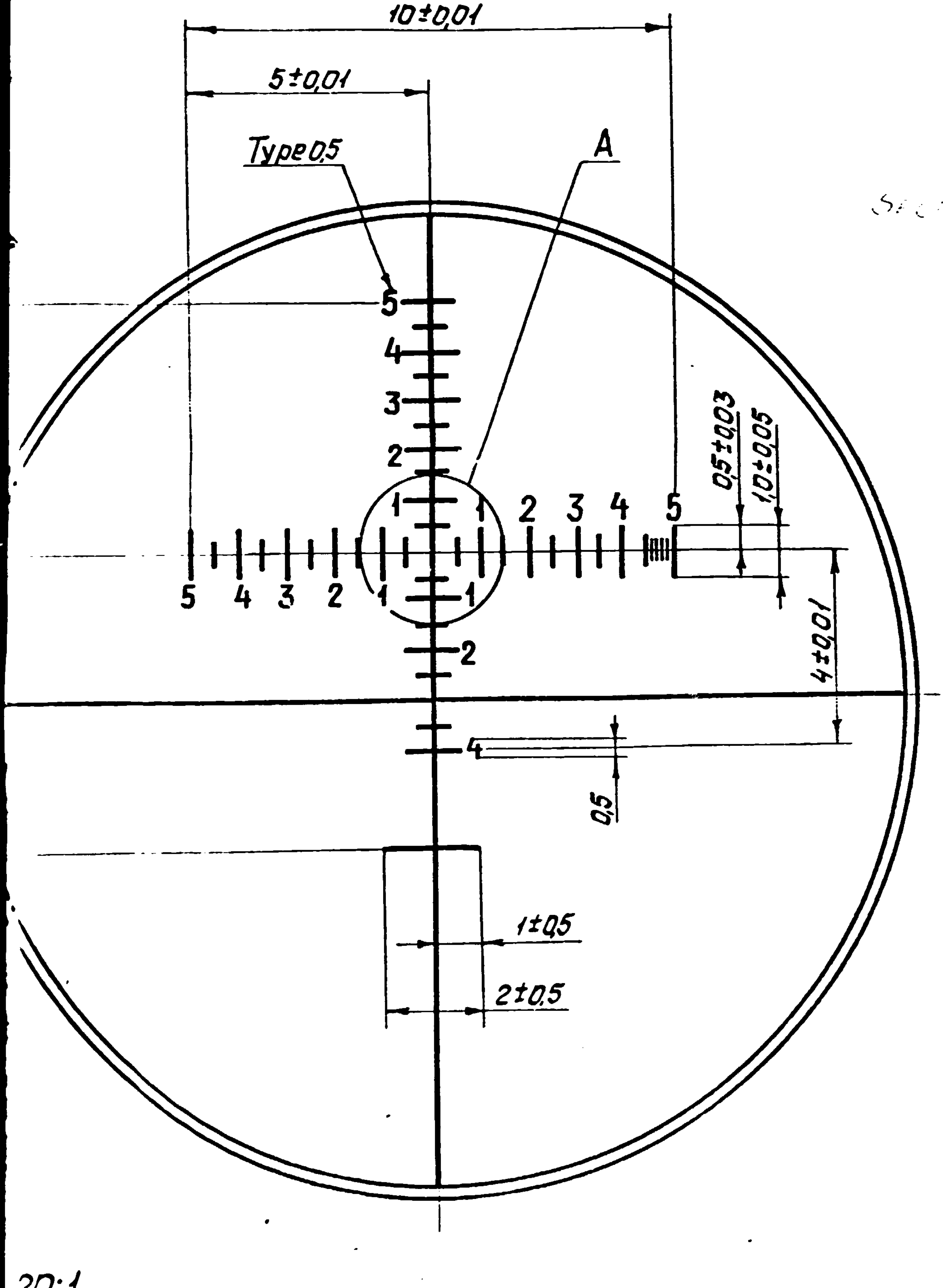


1. *Permitted total area of scratches, pits (mm²), except for the zone C
2. Surface quality of the zone C must be 0-20 that means that focal lenght of the following sustem (eyepiece) is 20mm and scratch thicknesses point diameters must be no more than 0,001mm across the area with 1/3 clear aperture diameter
3. Angle chamfers $0{,}3^{+0{,}3} \times 45°$
4. Edge chamfers $0{,}1^{+0{,}2} \times 45°$
5. Coating for surfaces A,B: aluminized, except for the zone C

	370.015		
	Prism	Mass	Scale
Designer			5:1
		Sheet	Sheets 1
Chief Designer	Glass BK7	LITMO	



0,2(+0,1 / 0)×45°
2 chamfers
Φ20e9
Rz0,05
2,5±0,1
Rz0,05
SECTION 1
10±
5±0,01
Type 0,5
5
4
3
2
1
5 4 3 2 1
5±0,01
3±0,005
3±0,005
A 20:1



20:1

1±0,01

2±0,03

1. Line t

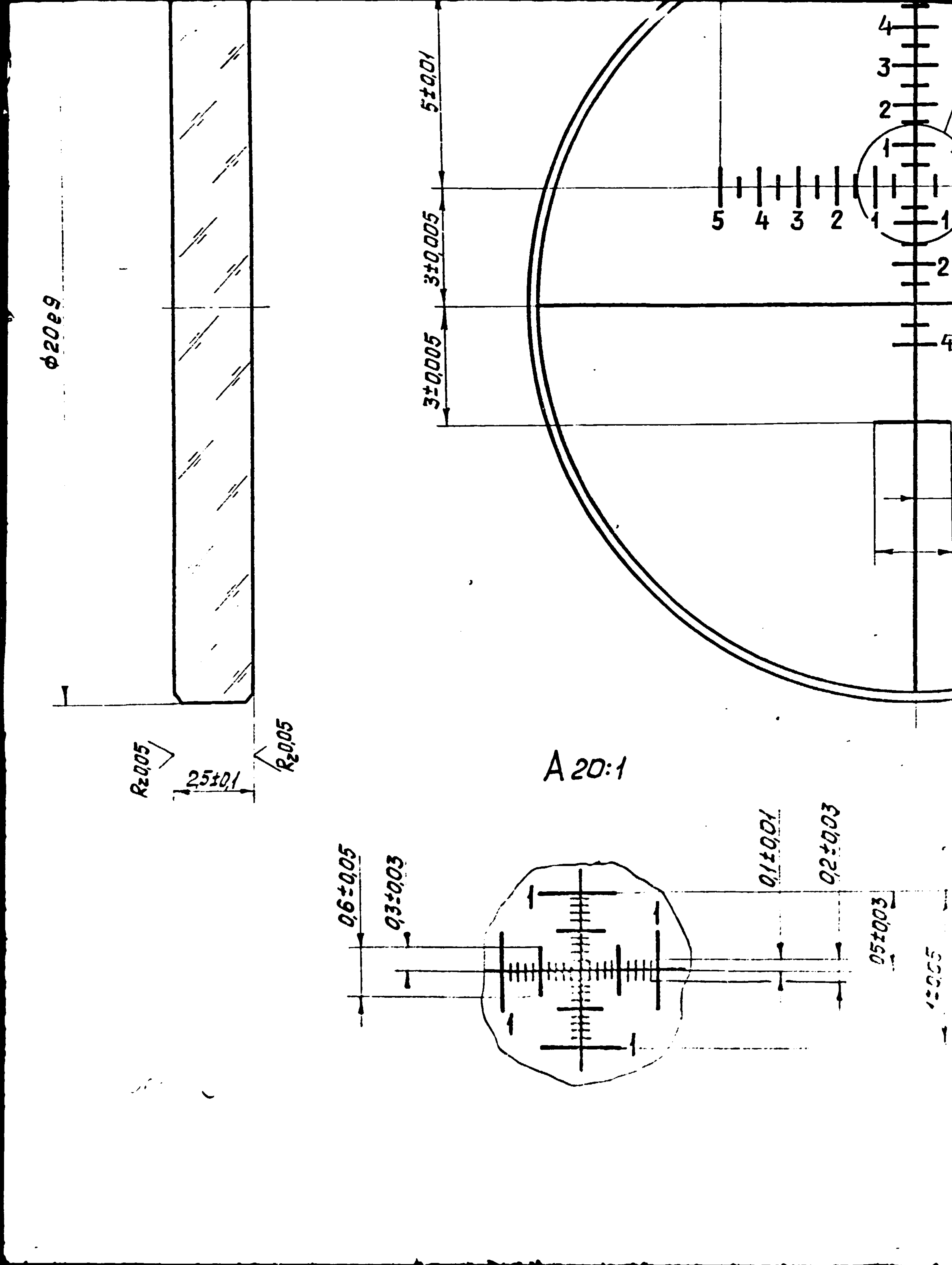
2. Scale

3. * 0-20

(eyepi

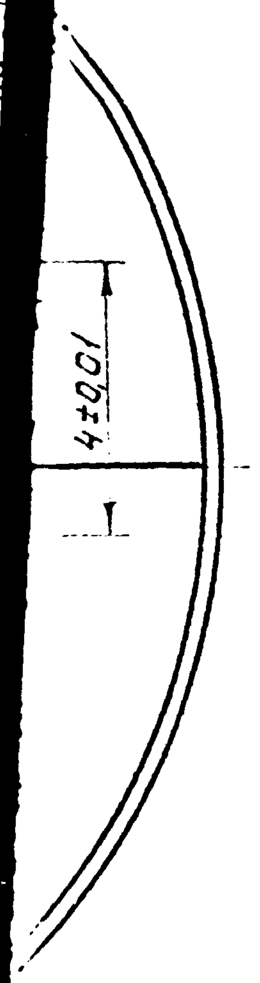
diamet

area



Φ20e9
Rz0,05
2,5±0,1
Rz0,05
5±0,01
3±0,005
3±0,005
A 20:1
0,6±0,05
0,3±0,03
0,1±0,01
0,2±0,03
0,5±0,03

1,6 (√)

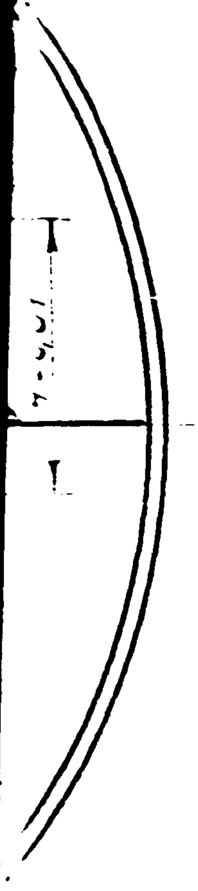


SECT 4

Δn_e	3N
$\Delta(n_{F'}-n_{C'})$	—
Homogeneity	H1
Birefringence	N
μ_A	—
Veins	P1
Inclusions	B0
N	5
ΔN	0,5
Surf. qual.	0-20*

O_ϕ	18

1. Line thicknesses are 0,02 ± 0,005 mm
2. Scale factor is 0,1 ± 0,005 mm
3. *0-20 means that focal lenght of the following sustem (eyepiece) is 20 mm and scratch thicknesses, point diameters must be no more than 0,001 mm across the area with 1/3 clear aperture diameter

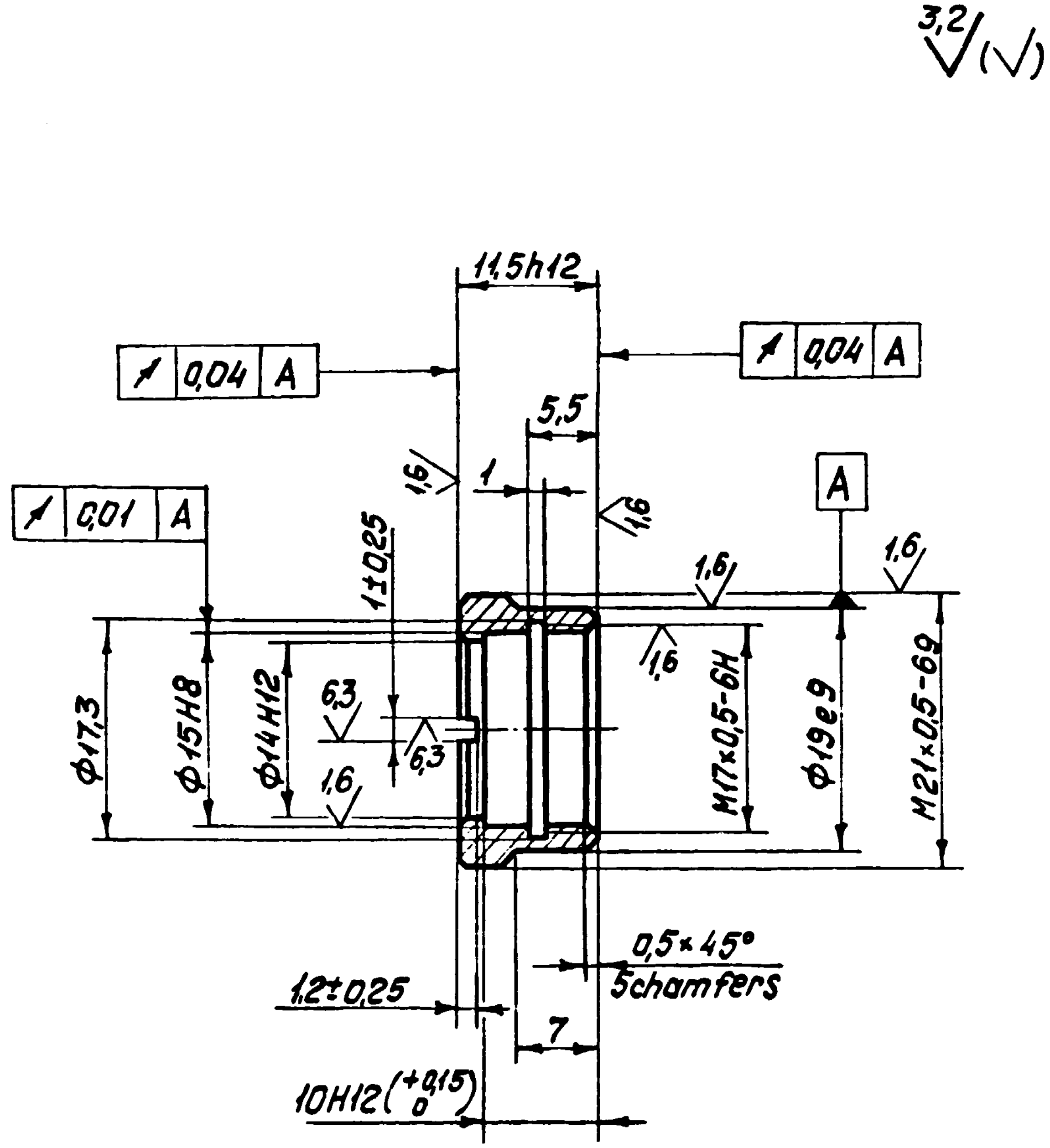


N	5
ΔN	0,5
Surf. qual.	0-20*

D_{Φ}	18

1. Line thicknesses are 0,02 ± 0,005 mm
2. Scale factor is 0,1 ± 0,005 mm
3. *0-20 means that focal lenght of the following sustem (eyepiece) is 20 mm and scratch thicknesses, point diameters must be no more than 0,001 mm across the area with 1/3 clear aperture diameter

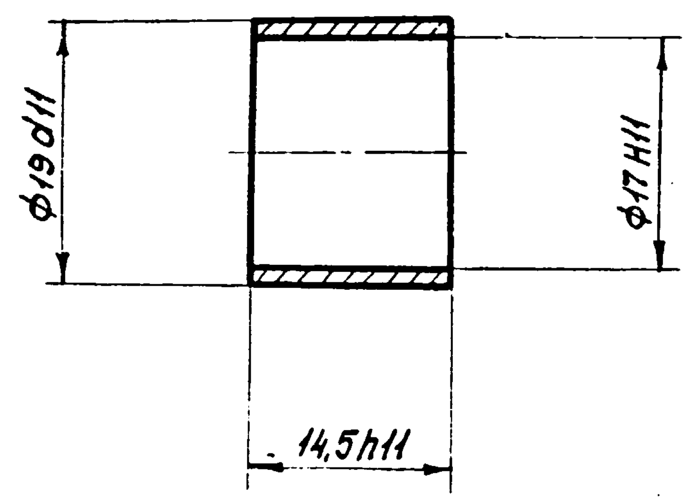
370.016		
Graticule	Mass	Scale
		10:1
	Sheet	Sheets 1
Glass BK7	LITMO	



1. H14; h14; ± $\frac{IT14}{2}$
2. Coating Chemical oxidation

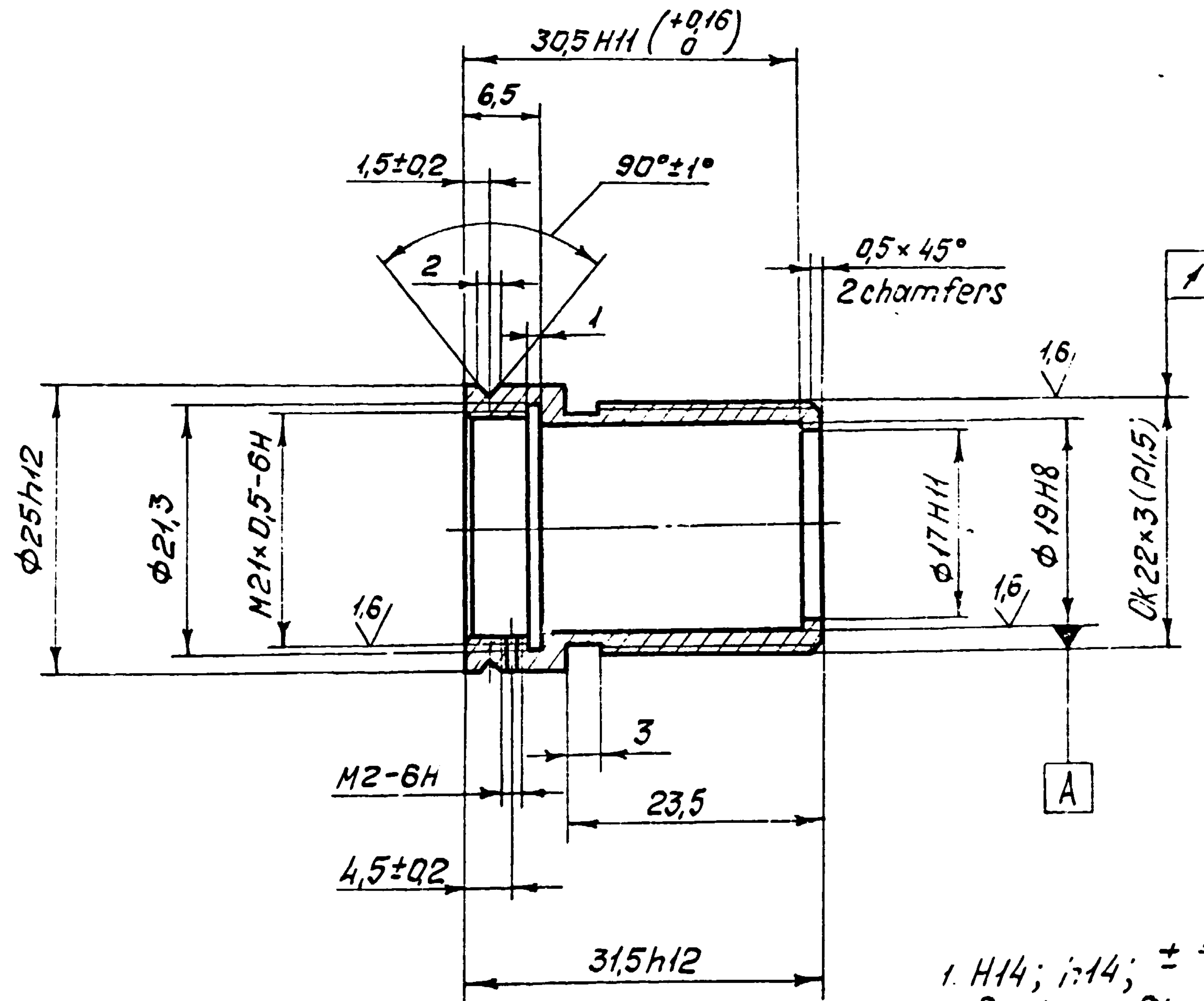
370.018		
Mount	Mass	Scale
		1:1
	Sheet	Sheets 1
Brass CuZn40	LITMO	
Designer		
Chief Designer		

3,2



Coating Chemical oxidction

	370.019	
Designer	Bushing	Mass	Scale 1:1
		Sheet	Sheets 1
Chief Designer	Brass Cu Zn 40	LITMO

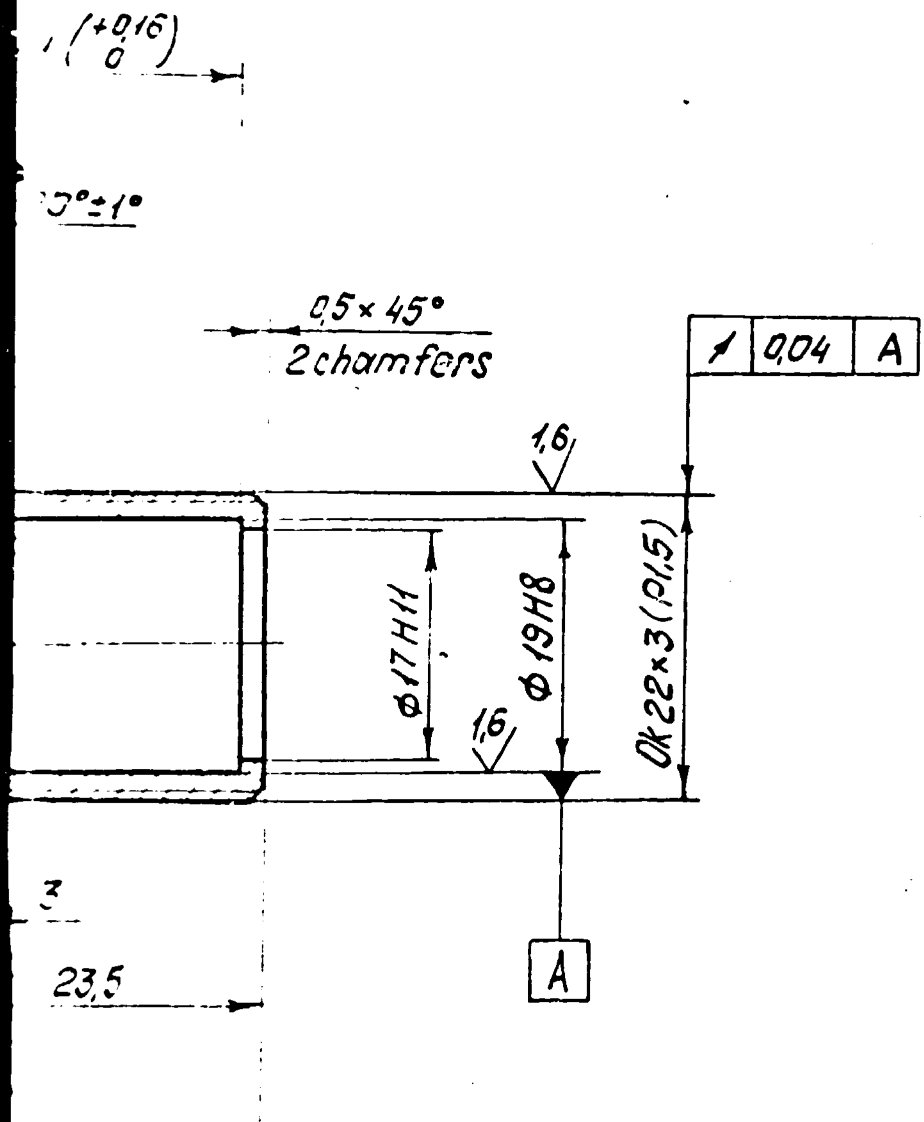


1. H14; h14; ± ...
2. Coating Che...

Designer				
Chief Designer				

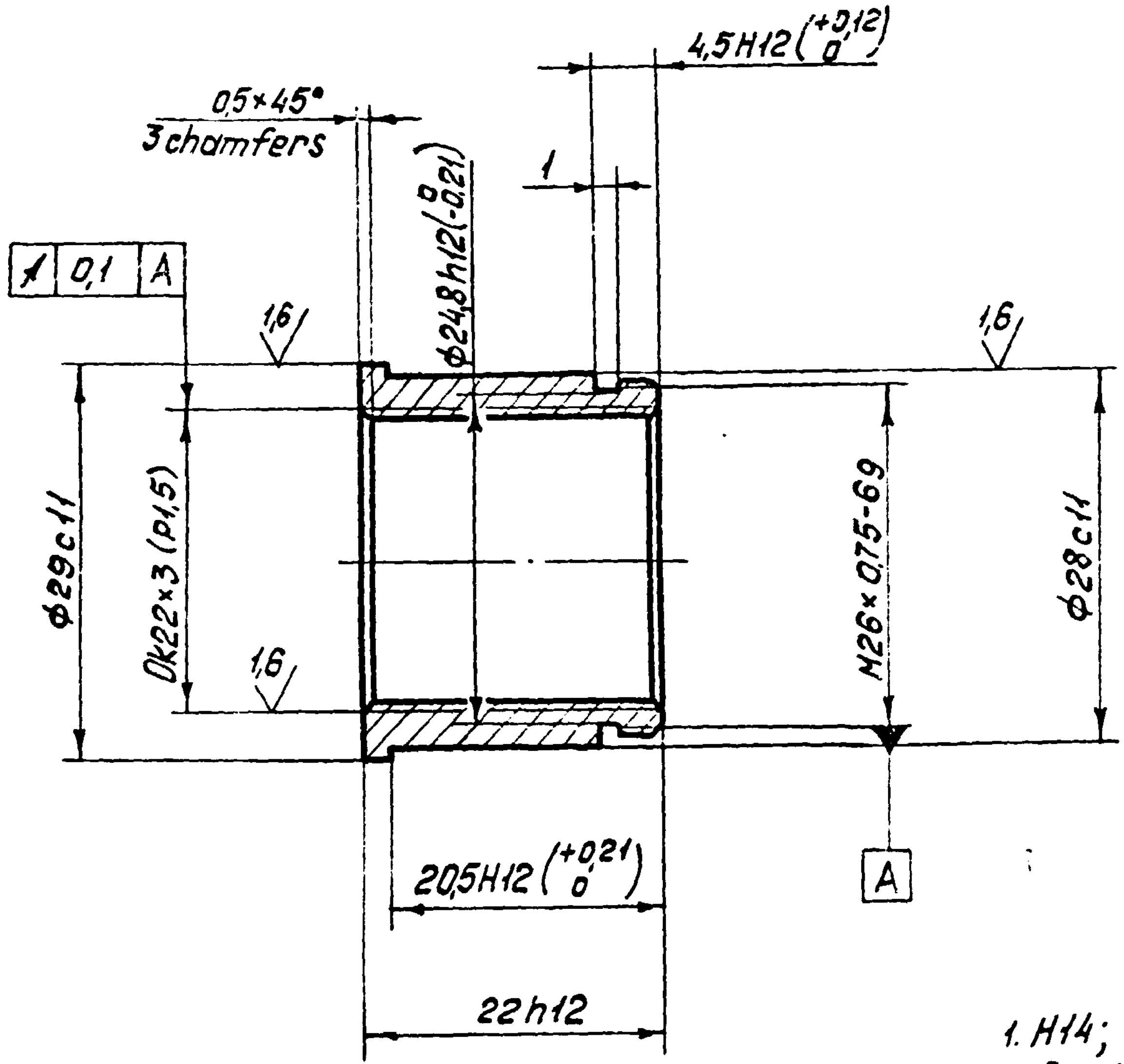
Section 1

3,2 (√)



1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating Chemical oxidation

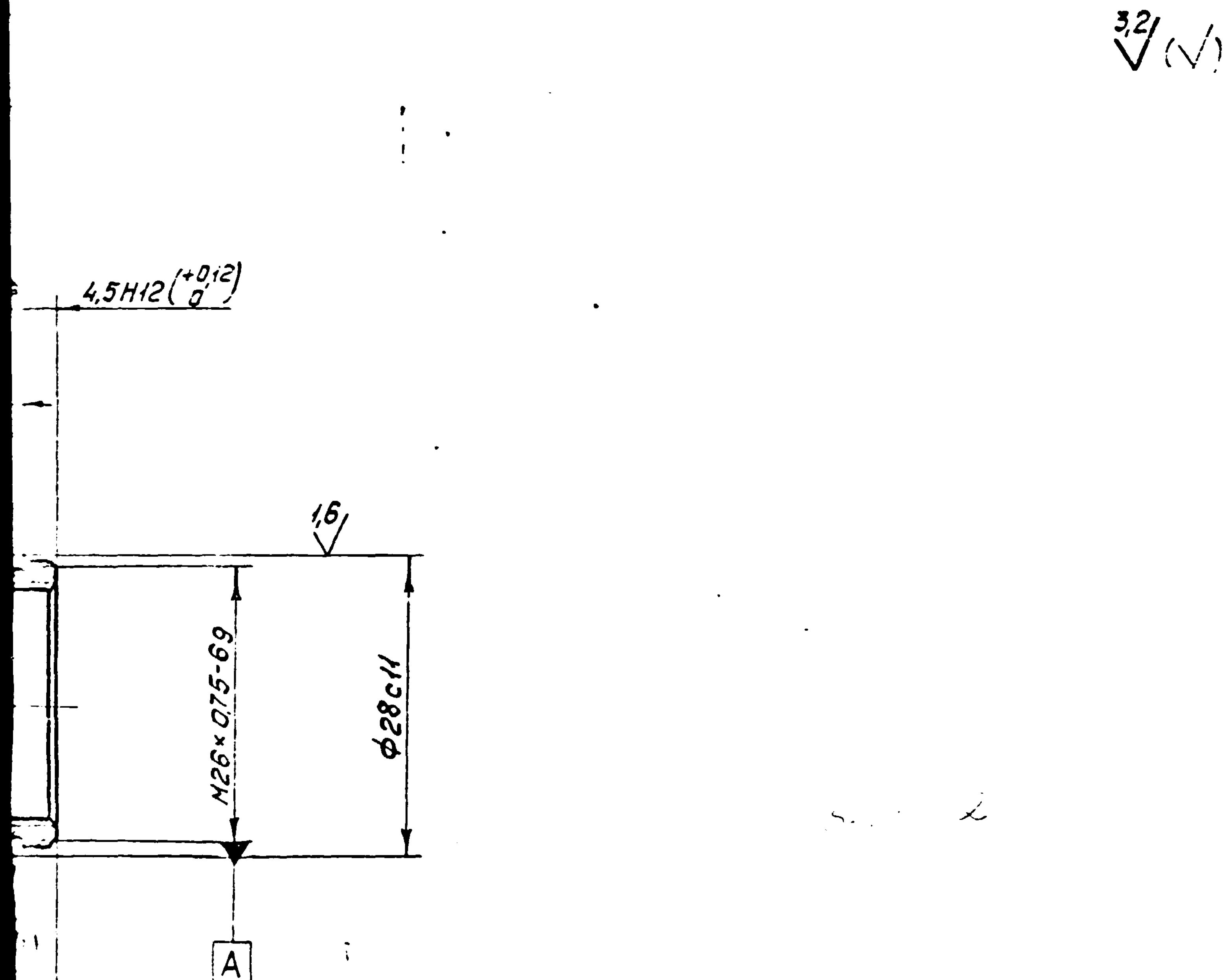
	370.021		
Designer	Eyepiece mount	Mass	Scale
			1:1
		Sheet	Sheets 1
Chief Designer	Brass CuZn 40	LITMO	



1. H14; h14; ±
2. Coating C

SECTION 1

Designer		
Chief Designer		



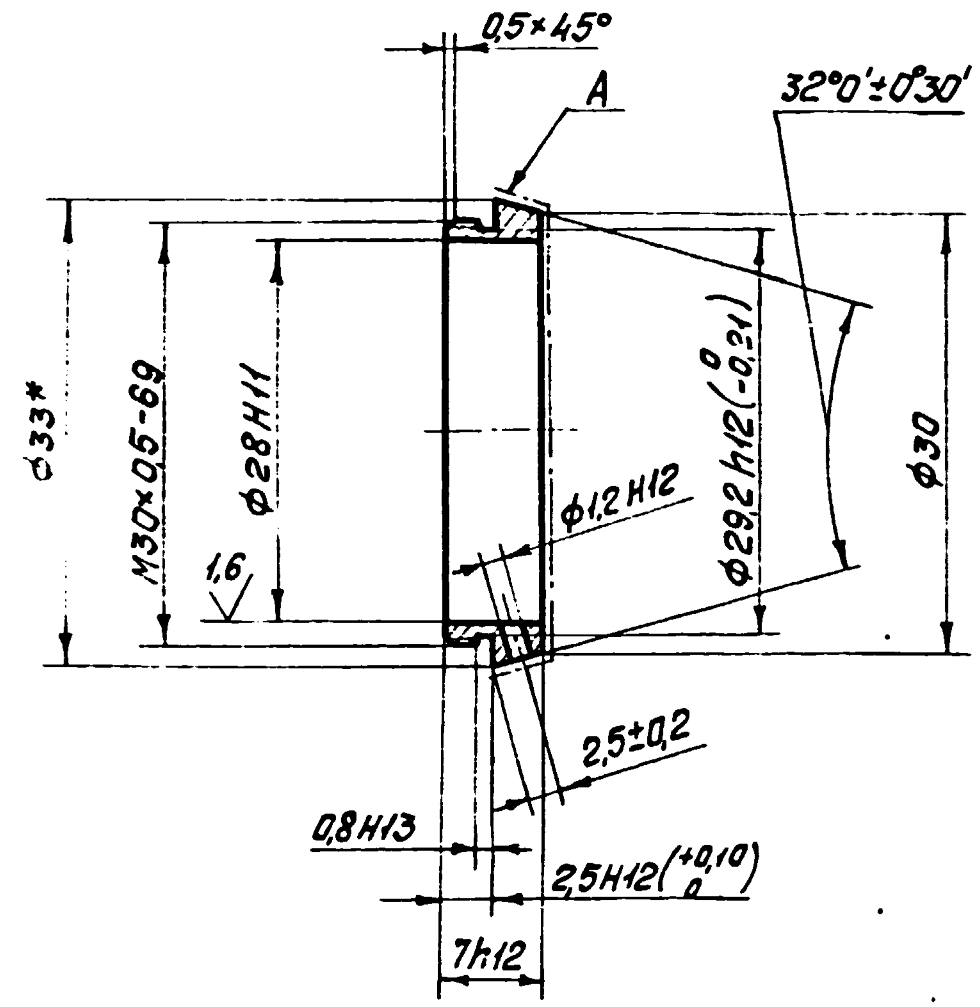
1. H14; h14; $\pm \frac{IT14}{2}$
2. Coating Chemical oxidation

370.022		
Case	Mass	Scale
		2:1
	Sheet	Sheets 1
Brass CuZn40	LITMO	

Designer

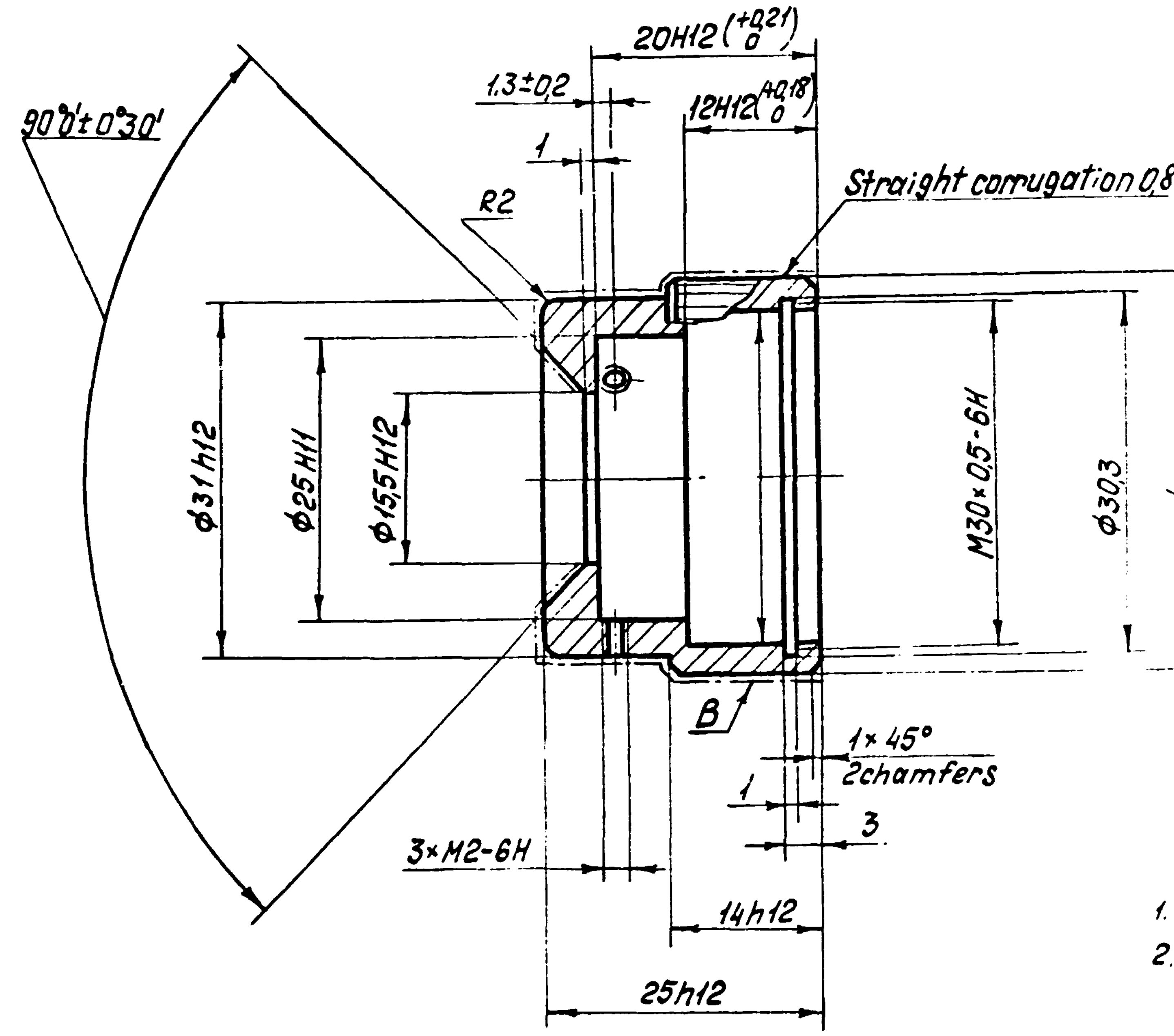
Chief Designer

3,2 √(√)

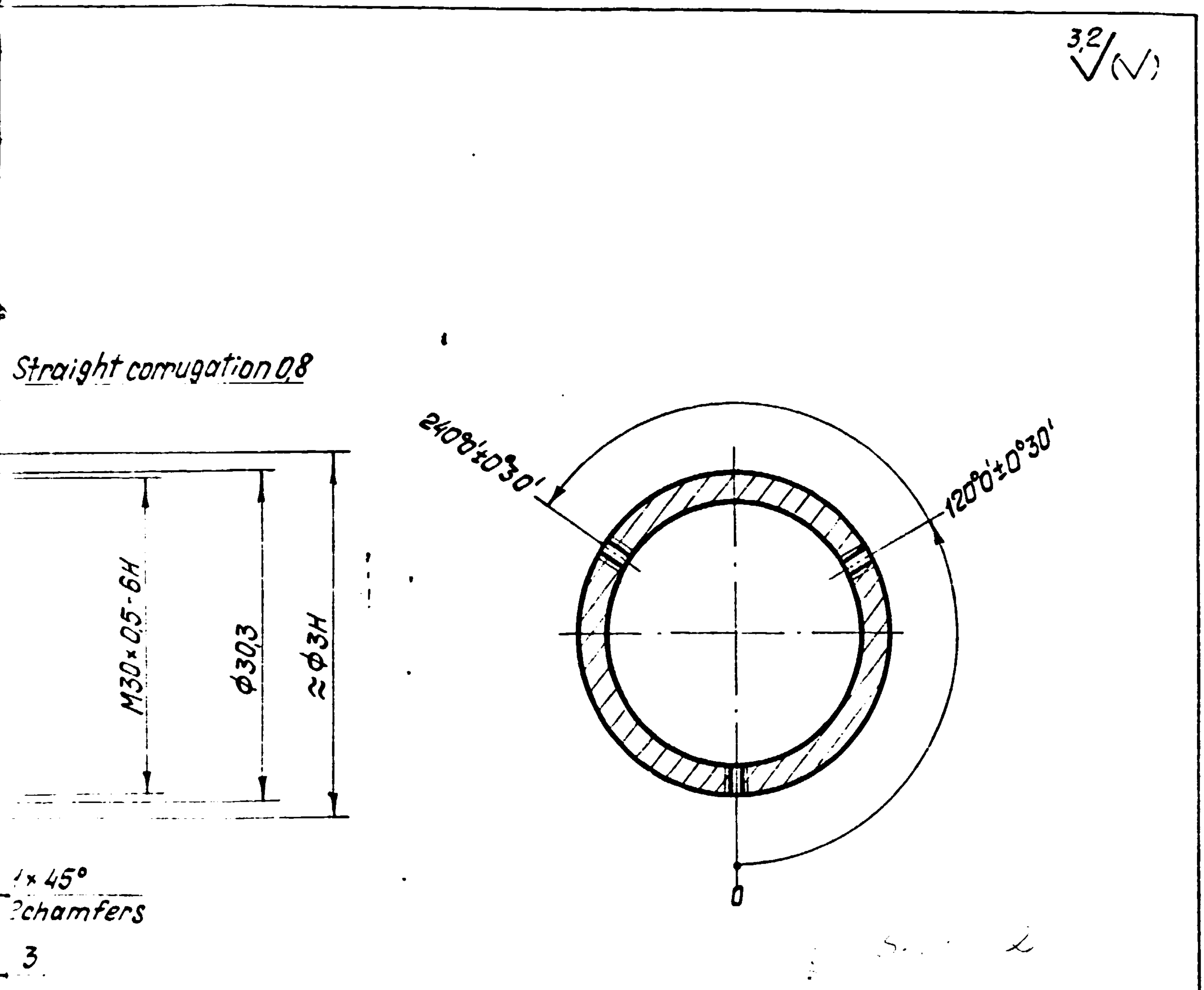


1. *The dimension for information
2. $\pm \frac{IT14}{2}$
3. Coating Chemical oxidation
   Coat the surface A with grey enamel

370. 023		
Ring	Mass	Scale
		2:1
	Sheet	Sheets 1
Brass CuZn40	LITMO	
Designer		
Chief Designer		

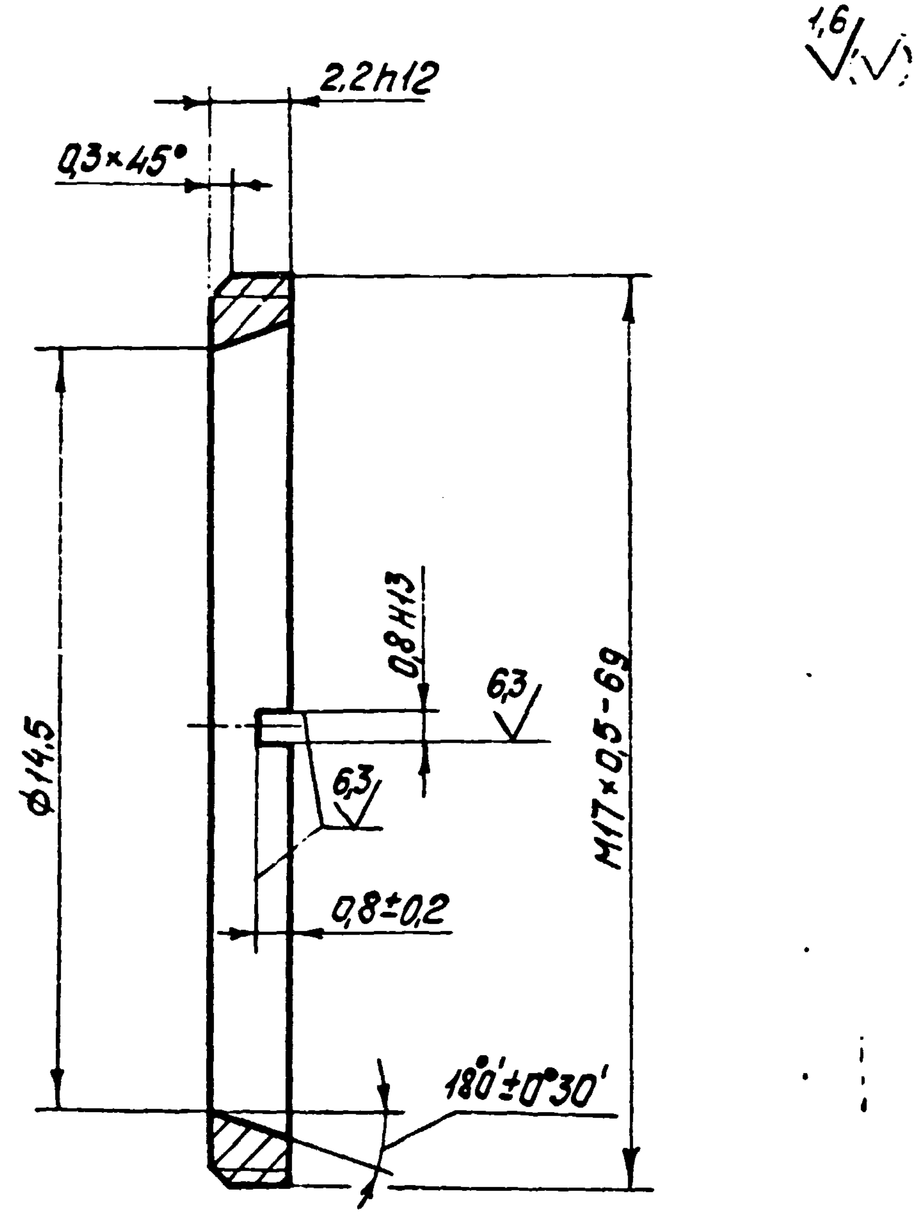

20H12 (+0.21 / 0)
1.3±0.2
12H12 (+0.18 / 0)
90°0' ± 0°30'
1
R2
Straight corrugation 0.8
Ø31 h12
Ø25 H11
Ø15.5 H12
M30×0.5-6H
Ø30.3
B
1× 45°
2chamfers
1
3
3×M2-6H
14h12
25h12

SECTION 1



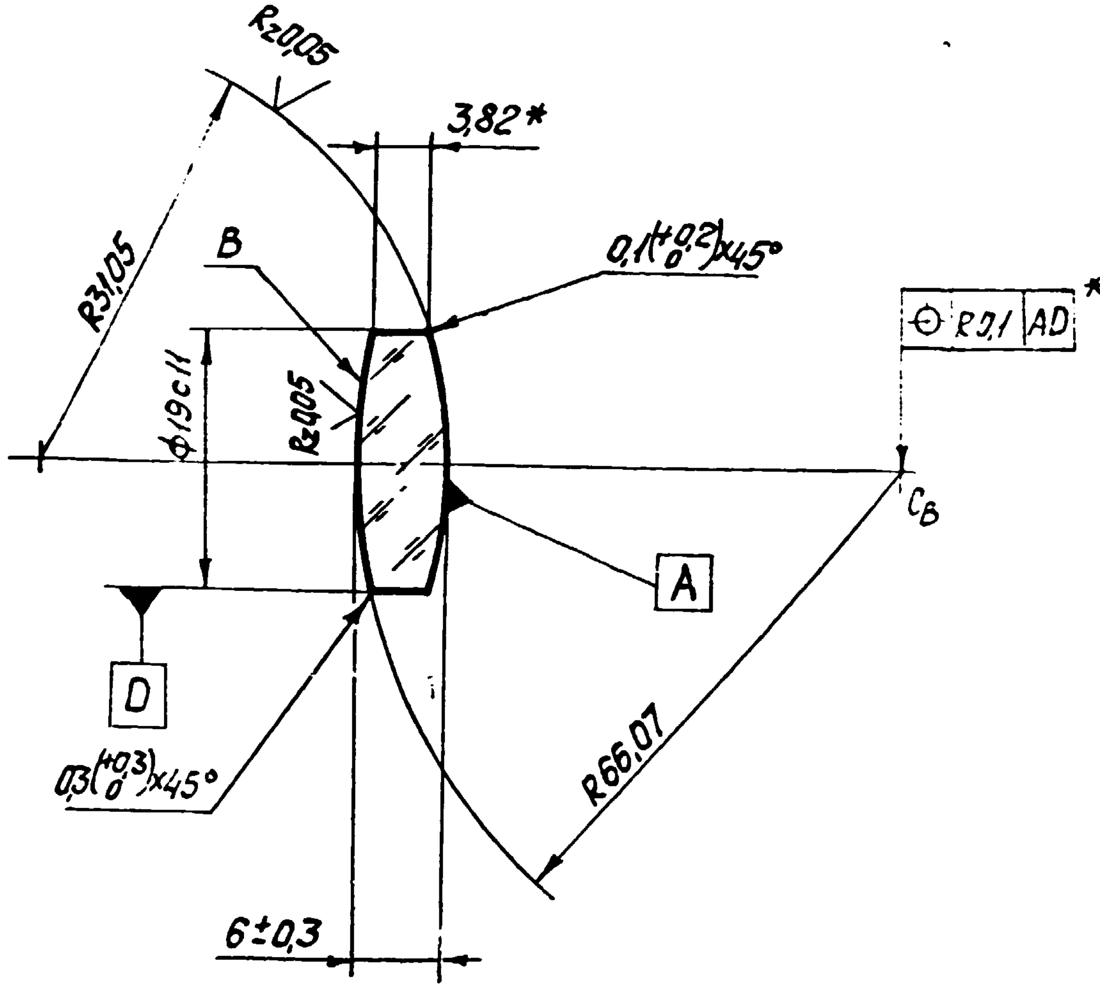
1. H14; h14; $\pm\frac{IT14}{2}$
2. Coating Chemical oxidation
   Coat the surface B with grey enamel

Designer	370.024	
	Eyeguard	Mass / Scale 2:1
		Sheet / Sheets 1
Chief Designer	Steel 20	LITMO



1. $H14; \pm \frac{IT14}{2}$
2. Coating Chemical oxidation

370.025		
Ring	Mass	Scale
		10:1
	Sheet	Sheets 1
Designer		
Chief Designer		
Aluminium alloy AL-Cu4 Mg Mn Fe Si	LITMO	



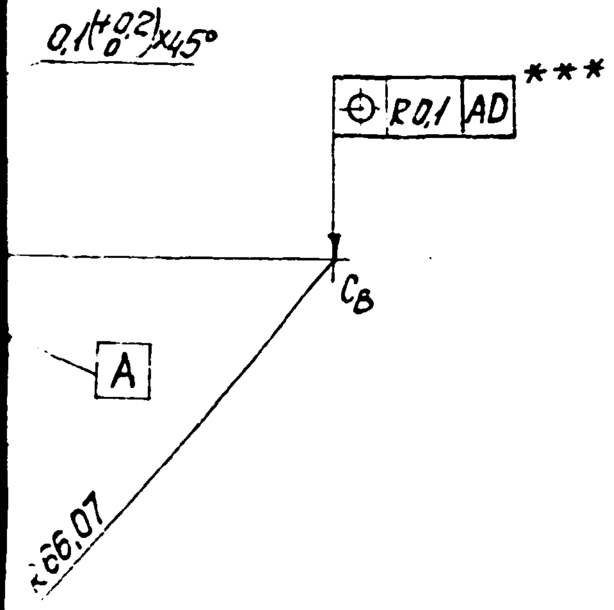
1. * The di
2. ** Permi
3. *** Wed

Designer

Chief Designer

SECTION 1

$\overset{2,5}{\sqrt{}}(\sqrt{})$

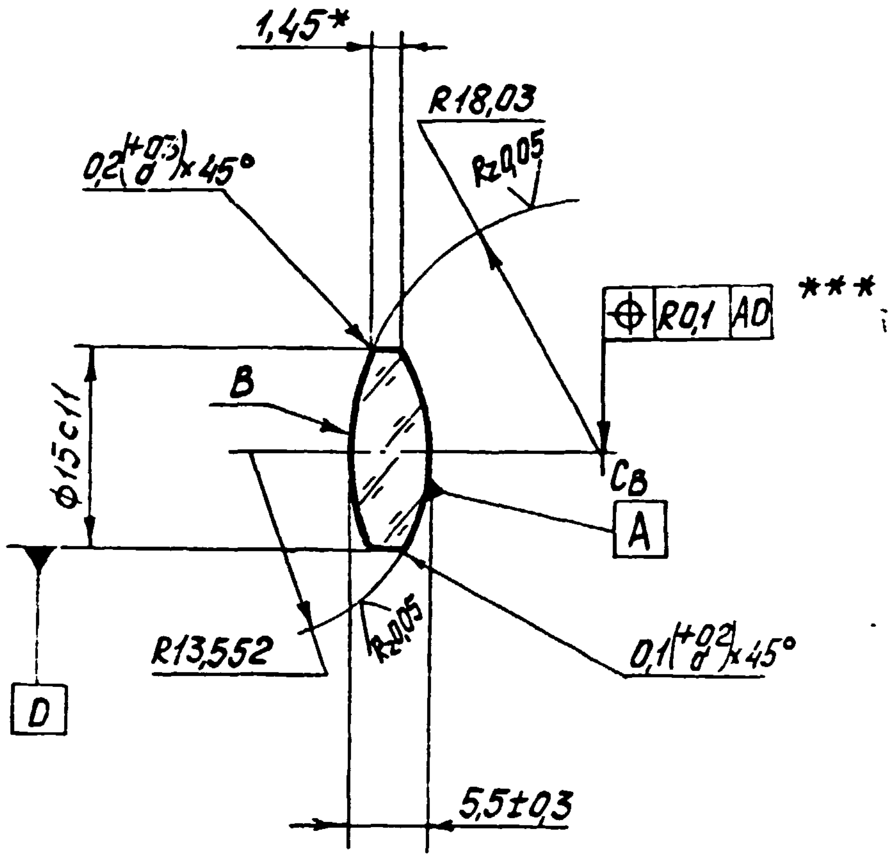


Δn_e	3N
$\Delta(n_{F'}-n_{C'})$	—
Homogeneity	H1
Birefringence	P
μ_A	—
Veins	P2
Inclusions	B0
N_A	5
N_B	5
ΔN_A	0,5
ΔN_B	0,5
Surf. qual	0,006**
ΔR_A	±0,01%
ΔR_B	±0,03%

f'	41,8
S_F	-40,5
$S'_{F'}$	39,0
$O_{\phi A,B}$	17

1. * The dimension for information
2. ** Permitted tutal area of scratches, pits (mm^2)
3. *** Wedge angle 10′

	370.026		
	Lens	Mass	Scale
Designer			2:1
		Sheet	Sheets 1
Chief Designer	Glass BK 7	LITMO	

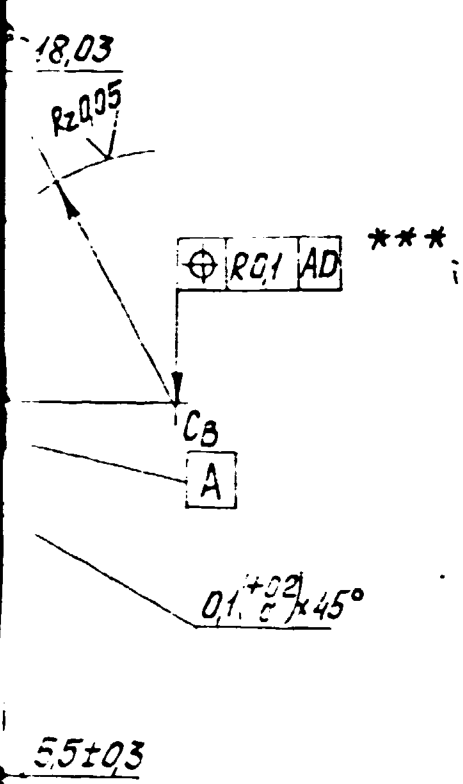


1.* The dimension for
2.**Permitted total a
3.*** Angle wedge 15'

SECTION 1

Designer

Chief Designer



$\sqrt[1,6]{}(\surd)$

Δn_e	N
$\Delta(n_{F'}-n_{C'})$	—
Homogeneity	H2
Birefringence	N
μ_A	—
Veins	P2
Inclusions	32
N_A	5
N_B	5
ΔN_A	0,5
ΔN_B	0,5
Surf qual.	0,1**
ΔR_A	±0,05%
ΔR_B	±0,04%

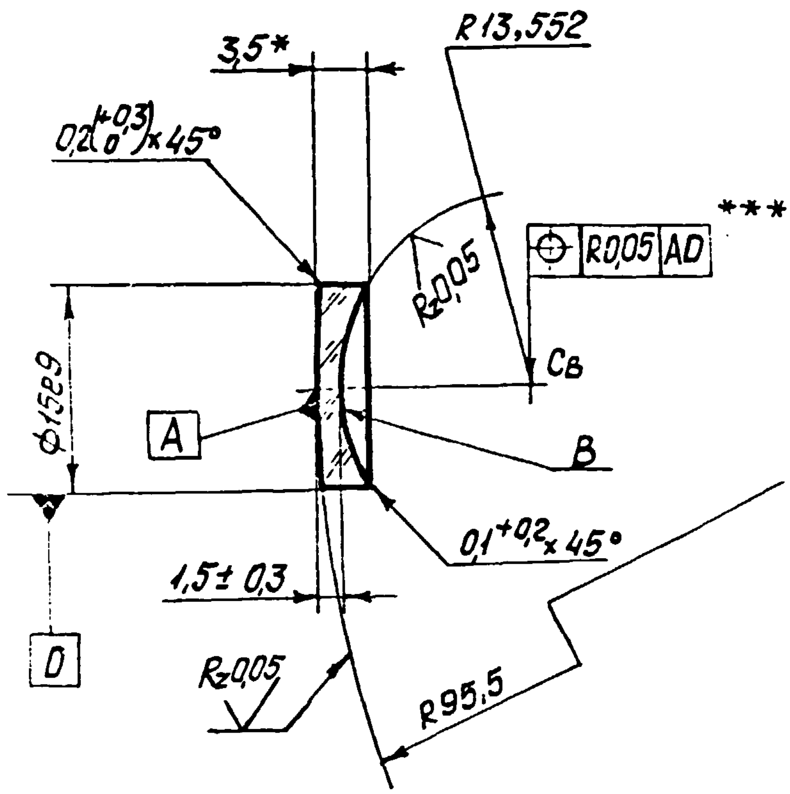
f'	15,3
S_F	-13,1
$S'_{F'}$	13,6
$D\phi_{A,B}$	14

1. * The dimension for information
2. ** Permitted total area of scratches, pits (mm²)
3. *** Angle wedge 15′

370. 028			
Lens		Mass	Scale
			2:1
		Sheet	Sheets 1
Glass BAK2		LITMO	

Designer

Chief Designer



1. * The dimension for in
2. ** Permitted total are
3. *** Angle wedge 15'

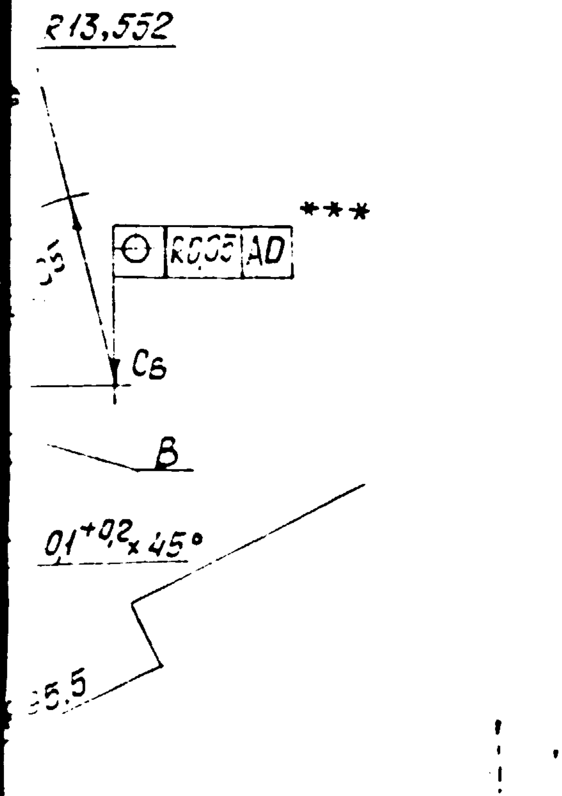
SECTION 1

Designer					
Chief Designer					G

1,6/(√)

Δn_e	N
$\Delta(n_{F'}-n_{C'})$	—
Homogeneity	H2
Birefringence	N
μ_A	—
Veins	P2
Inclusions	B1
N_A	5
N_B	5
ΔN_A	0,5
ΔN_B	0,5
Surf. qual.	0,02**
ΔR_A	±0,03%
ΔR_B	±0,05%

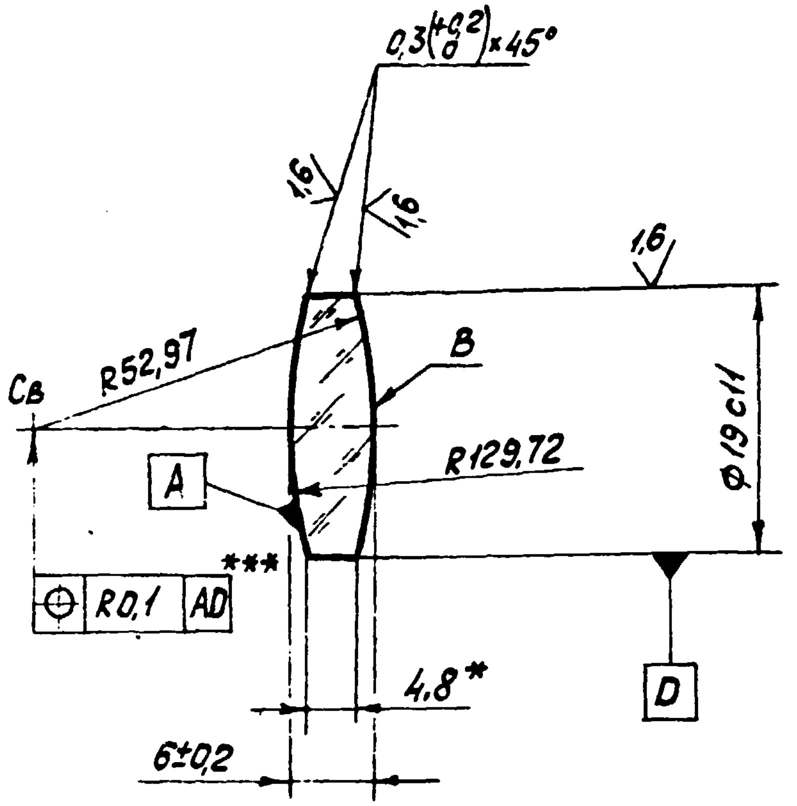
f'	−25,8
S_F	26,9
$S'_{F'}$	−25,7
$O_{\phi A,B}$	14



1.* The dimension for information
2.** Permitted total area of scratches, pits (mm²)
3.*** Angle wedge 15'

370.029			
Lens		Mass	Scale
			2:1
Designer		Sheet	Sheets 1
Chief Designer	Glass F4	LITMO	

Rz 0,05 (√)

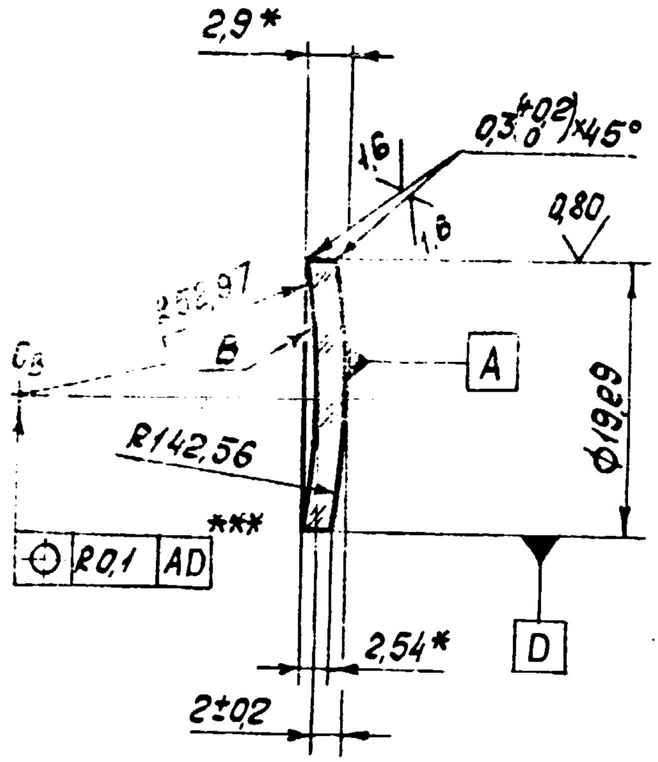


Δn_e	4N
$\Delta(n_{F'}-n_{C'})$	—
Homogeneity	H1
Birefringence	N
μ_A	—
Veins	P2
Inclusions	B2
N_A	2
N_B	3
$\Delta N_{A,B}$	0,25
Surf. qual.	0,02**
$\Delta R_{A,B}$	±0,03%
f'	73,7
S_F	-70,8
$S'_{F'}$	72,5
O_ϕ	17

1. *The dimension for information
2. ** Permitted total area of scratches, pits (mm²)
3. *** Wedge angle 6'

370.035			
Lens		Mass	Scale
			2:1
		Sheet	Sheets 1
Designer	Glass BK7	LITMO	
Chief Designer			

$R_z 0{,}05$ (✓)



Δn_e	4N
$\Delta(n_{F'} - n_{C'})$	--
Homogeneity	H1
Birefringence	N
μ_A	—
Veins	P2
Inclusions	B2
N_A	2
N_B	3
$N_{A,B}$	0,25
Surf. qual.	0,02**
ΔR	±0,03%
f'	-136,2
S_F	135,5
$S'_{F'}$	-138,2
O_Φ	17

1. *The dimension for information
2. **Permitted total area of scratches, pits (mm)
3. *** Wedge angle 6'

370.036

Lens

Mass	Scale
	2:1

Sheet | Sheets 1

Designer

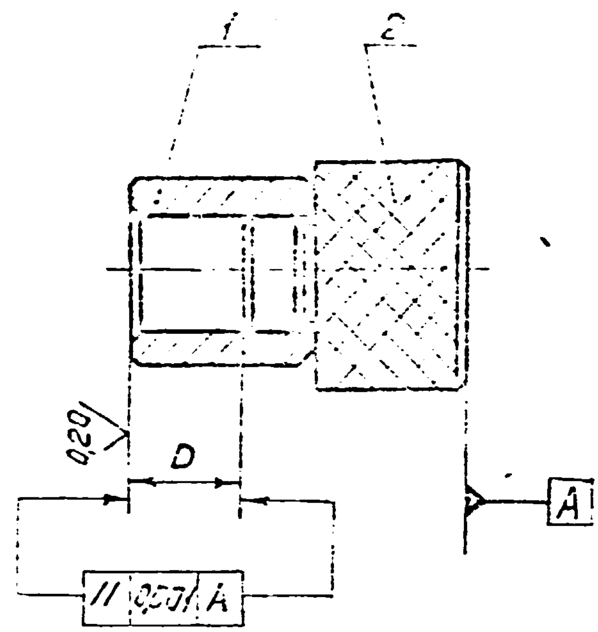
Chief Designer

Glass F1

LITMO

Pos.	Designation	Name	Quant.	Comm.
		Specification		
	380.000 Ass	Assembling drawing		
	380.000 Tabl.	Table		
		Pieces		
1	380.001	Ring	1	
2	380.002	Stopper	1	

380.000		
Templet	Sheet / Sheets: 1	LITMO



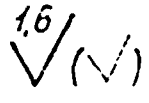
1. Gauge the dimension and the tolerance after assembly.
2. The D dimension values are in the table 380.000 Tabl.

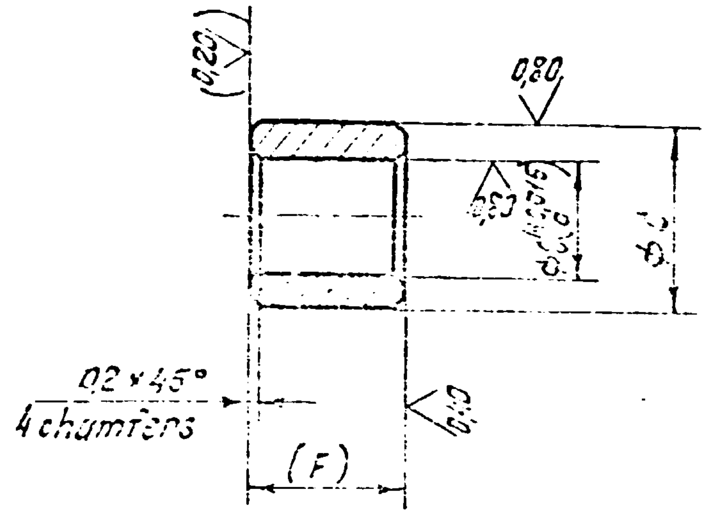
380.000 Ass		
Templet	Mass	Scale
		2:1
	Sheet	Sheets 1
	LITMO	

	Designation	Dimension value, mm		
		D	⌀C	F
1	200.010	$3 \pm 0{,}002$	$15(^{0}_{-0{,}043})$	8
2	200.020	$8{,}63 \pm 0{,}002$	$15(^{0}_{-0{,}043})$	13,63
[illegible]	200.030	$2 \pm 0{,}002$	$15(^{0}_{-0{,}043})$	7
[illegible]	[illegible]	$1 \pm 0{,}002$	$15(^{0}_{-0{,}043})$	6
[illegible]	210.020	$4{,}6 \pm 0{,}002$	$15(^{0}_{-0{,}043})$	9,6
[illegible]	[illegible], [illegible]040	$5{,}5 \pm 0{,}002$	$15(^{0}_{-0{,}043})$	10,5
[illegible]	[illegible]	$2{,}5 \pm 0{,}002$	$15(^{0}_{-0{,}043})$	7,5
[illegible]	210.050	$5{,}45 \pm 0{,}002$	$15(^{0}_{-0{,}043})$	10,45
[illegible]	[illegible]	$5{,}1 \pm 0{,}002$	$13(^{0}_{-0{,}043})$	10,1
[illegible]	[illegible]	$4{,}7 \pm 0{,}002$	$12{,}8(^{0}_{-0{,}043})$	9,7
[illegible]	[illegible]	$5 \pm 0{,}002$	$13(^{0}_{-0{,}043})$	10
[illegible]	[illegible]	$6{,}43 \pm 0{,}002$	$13(^{0}_{-0{,}043})$	11,43
[illegible]	[illegible]	$6{,}7 \pm 0{,}002$	$14{,}8(^{0}_{-0{,}043})$	11,7
[illegible]	[illegible]	$5{,}3 \pm 0{,}002$	$15(^{0}_{-0{,}043})$	10,3
[illegible]	[illegible]	$4 \pm 0{,}002$	$15(^{0}_{-0{,}043})$	9
[illegible]	200.000	$9{,}71 \pm 0{,}002$	$15(^{0}_{-0{,}043})$	14,71

380.000 Tabl.

Templet Table	Sheet	Sheets
		1
	LITMO	

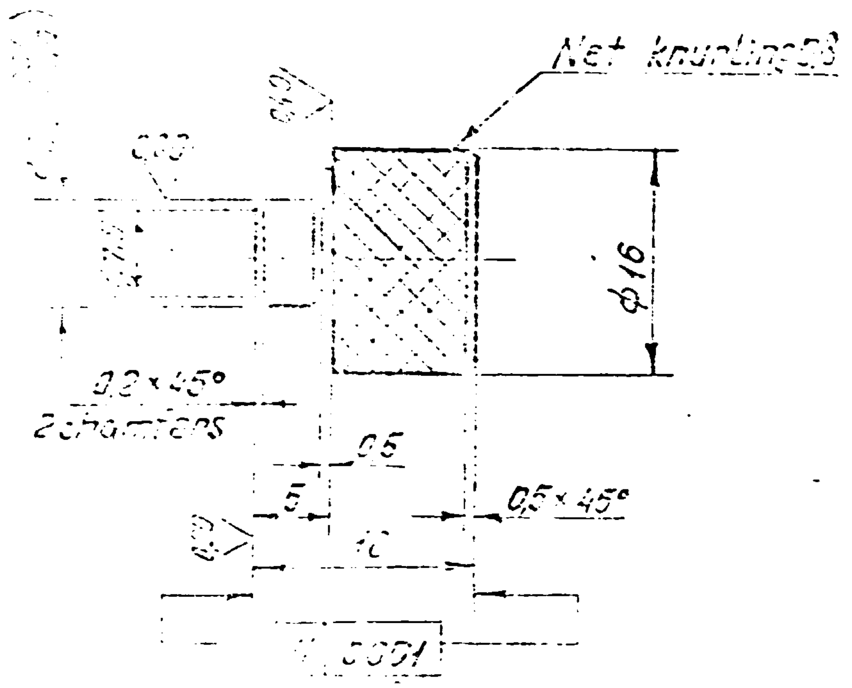




1. H14; h14; $\pm \frac{IT14}{2}$
2. The bracket dimension and the bracket roughness must be produced after assembly
3. The F, C dimension values are in the table 380. 00L Tabl.

380.001		
Ring	Mass	Scale
		2:1
	Sheet	Sheets
Steel 50	LITMO	

Design...
Chief...



H14; h14; $\pm \frac{IT14}{2}$

The dimension values are in the table

Steel 20

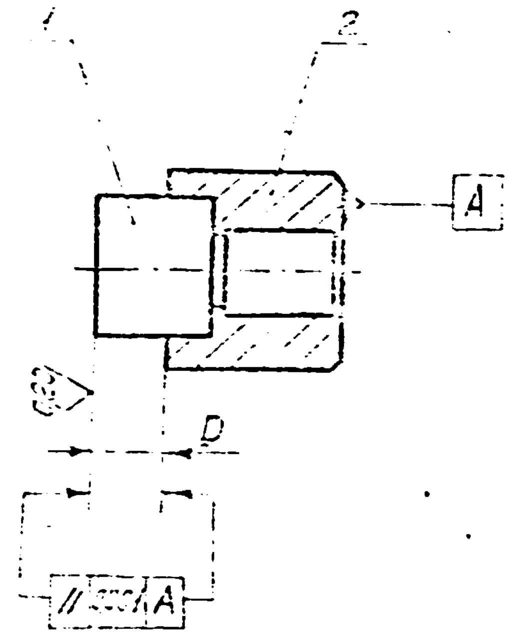
Designation	Name	Quant	Comment
	Specification		
390.000 Ass	Assembling drawing		
390.000 Tabl.	Table		
	Pieces		
390.001	Stopper	1	
390.002	Ring	1	

390.000

Templet

Sheet | Sheets
1

LITMO



1 Gauge the dimension D and the tolerance after assembly

2 The D dimension values are in the table 390.000 Tabl.

390.000 Ass		
Templet	Mass	Scale
		2:1
	Sheet	Sheets 1
	LITMO	

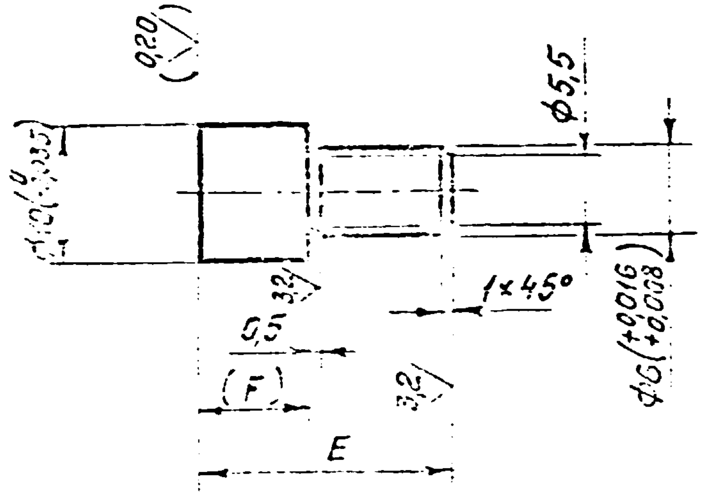
№	Designation	Dimension value, mm			
		D	⌀C	F	E
1	200.010	1,7±0,002	$15(^{0}_{-0,043})$	5,7	14
2	200.020	0,33±0,002	$15(^{0}_{-0,043})$	4,33	13
3	210.020	6,2±0,002	$15(^{0}_{-0,043})$	10,2	19
4	210.040	4,77±0,002	$15(^{0}_{-0,043})$	8,77	17
5	210.030	4,4±0,002	$15(^{0}_{-0,043})$	8,4	17
6	220.040	5±0,002	$13(^{0}_{-0,043})$	9	18
7	220.050	5±0,002	$12,8(^{0}_{-0,043})$	9	18
8	220.060	4,4±0,002	$13(^{0}_{-0,043})$	8,4	18
9	230.040	4±0,002	$15(^{0}_{-0,043})$	8	17
10	230.050	5,45±0,002	$14,8(^{0}_{-0,043})$	9,45	18
11	230.060	6,4±0,002	$15(^{0}_{-0,043})$	10,4	13
12	230.070	5,1±0,002	$15(^{0}_{-0,043})$	9,1	18

390.000 Tabl.

Templet
Table

Sheet	Sheets

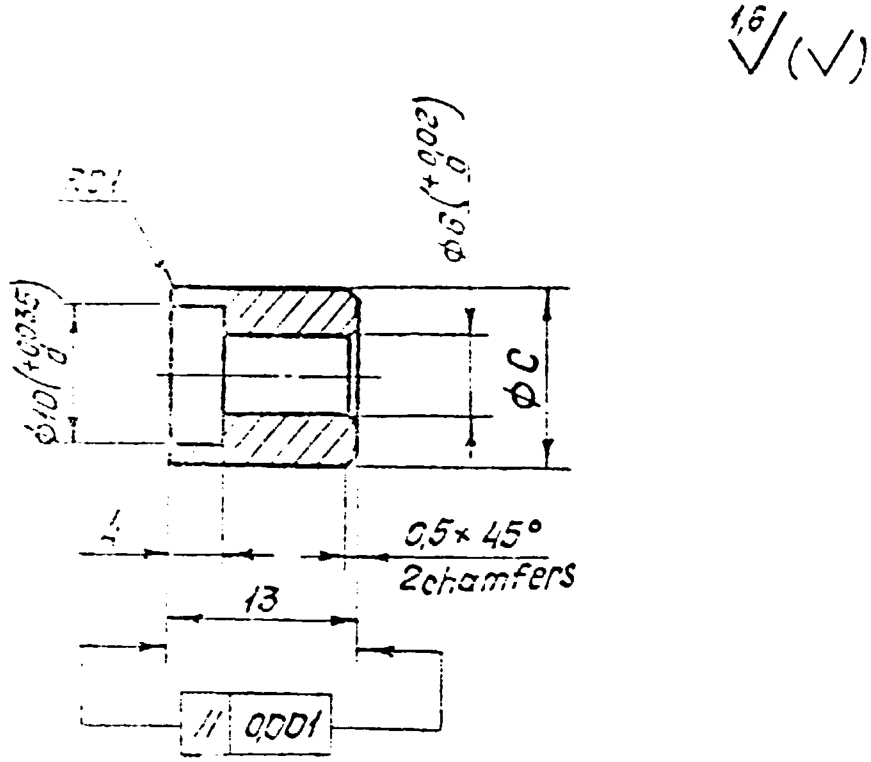
LITMO



1. H14; h14; $\pm\frac{IT14}{2}$
2. The bracket dimension and the bracket roughness must be produced after assembly
3. The F,E dimension values are in the table 390.003 Tabl.

390.001			
Stopper	Mass	Scale	
		2:1	
	Sheet	Sheets 1	
Steel У8А	LITMO		

Chief



1. H14; h14; $\pm \frac{IT14}{2}$
2. The C dimension values are in the table 390.000 Tabl.

390.002

Ring

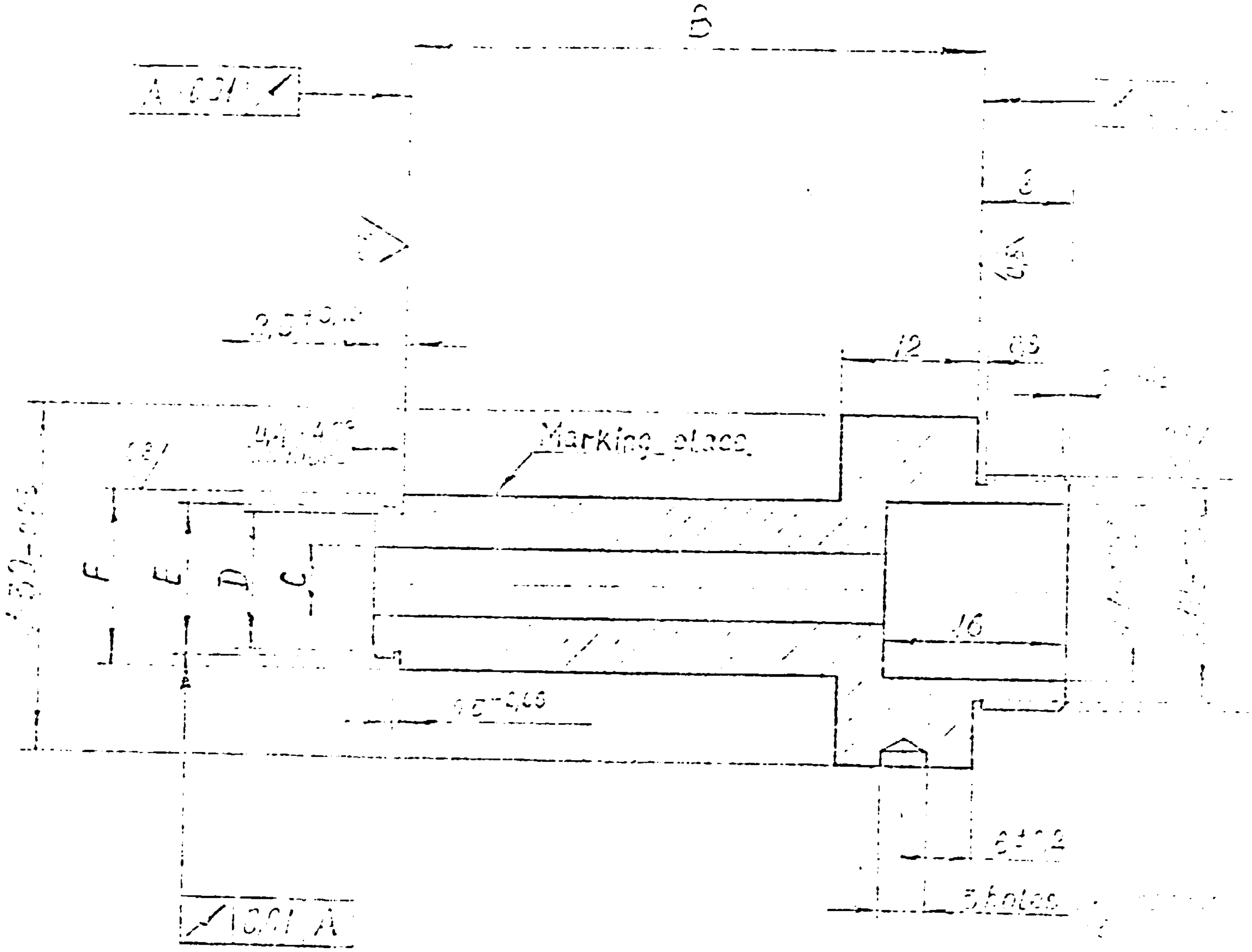
Mass | Scale

2:1

Sheet

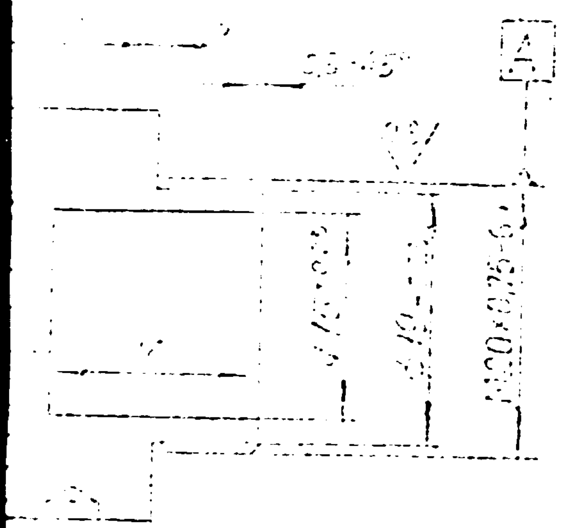
Steel Y8A

LIT[illegible]



1. H14; h14; $\pm \frac{IT}{2}$
2. HRC 35...40
3. Steel 20

SECTION 1



Table

№ ass.	B	C	D	E	F
2[illegible]0.040	13-[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
220.040	[illegible]	[illegible]	[illegible]4,6	[illegible]	[illegible]
2[illegible]0.040	15,92[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
230.050	14,00[illegible]	[illegible]	[illegible]22,5	[illegible]	[illegible]
230.060	18,28[illegible]	[illegible]	[illegible]22,5	[illegible]	[illegible]

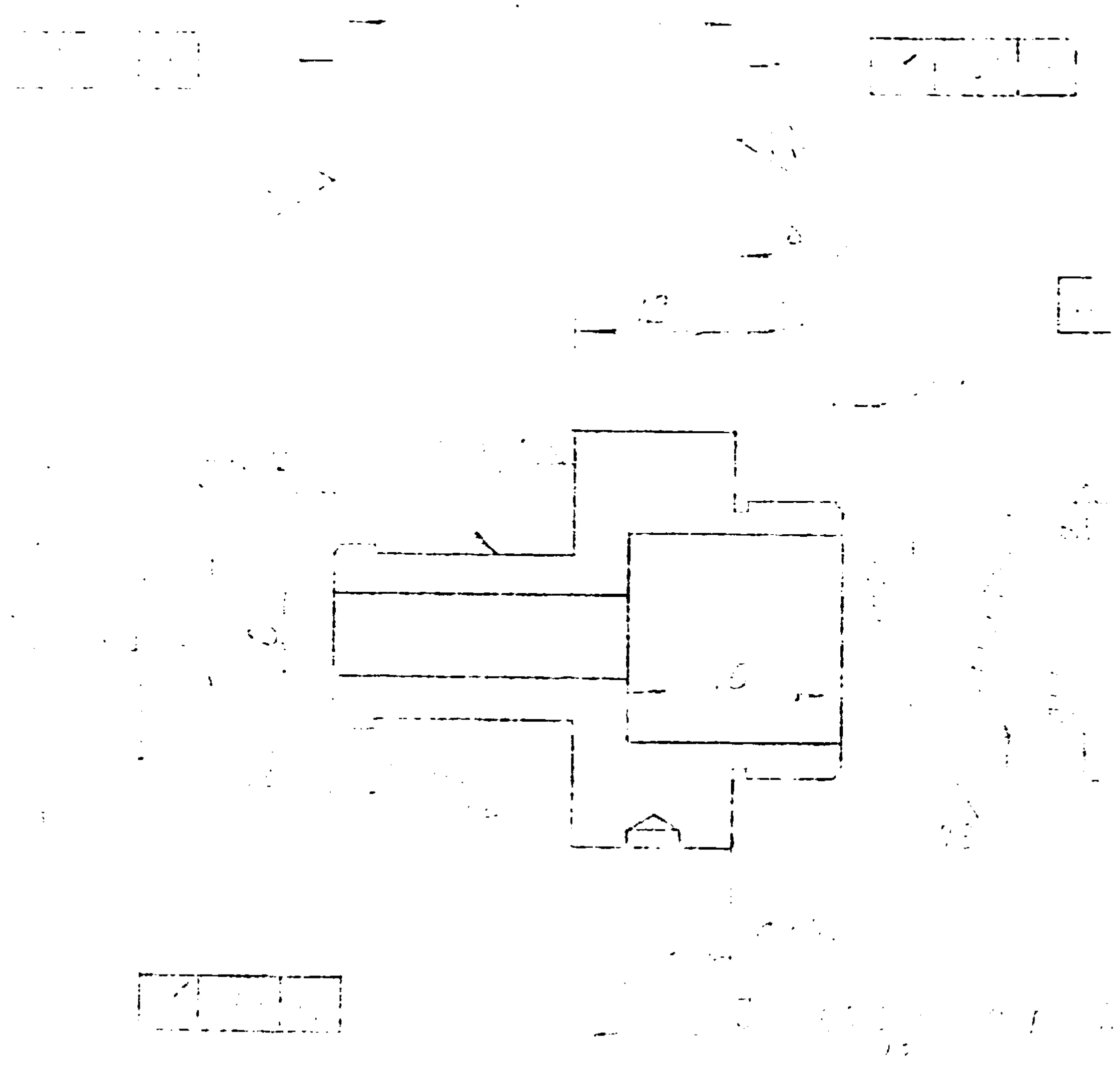
KNOW-HOW PACKAGE

Adapters for [illegible]
gap depth 22mm

Project [illegible]
CONTRACT № 3[illegible]44

1:2[illegible]

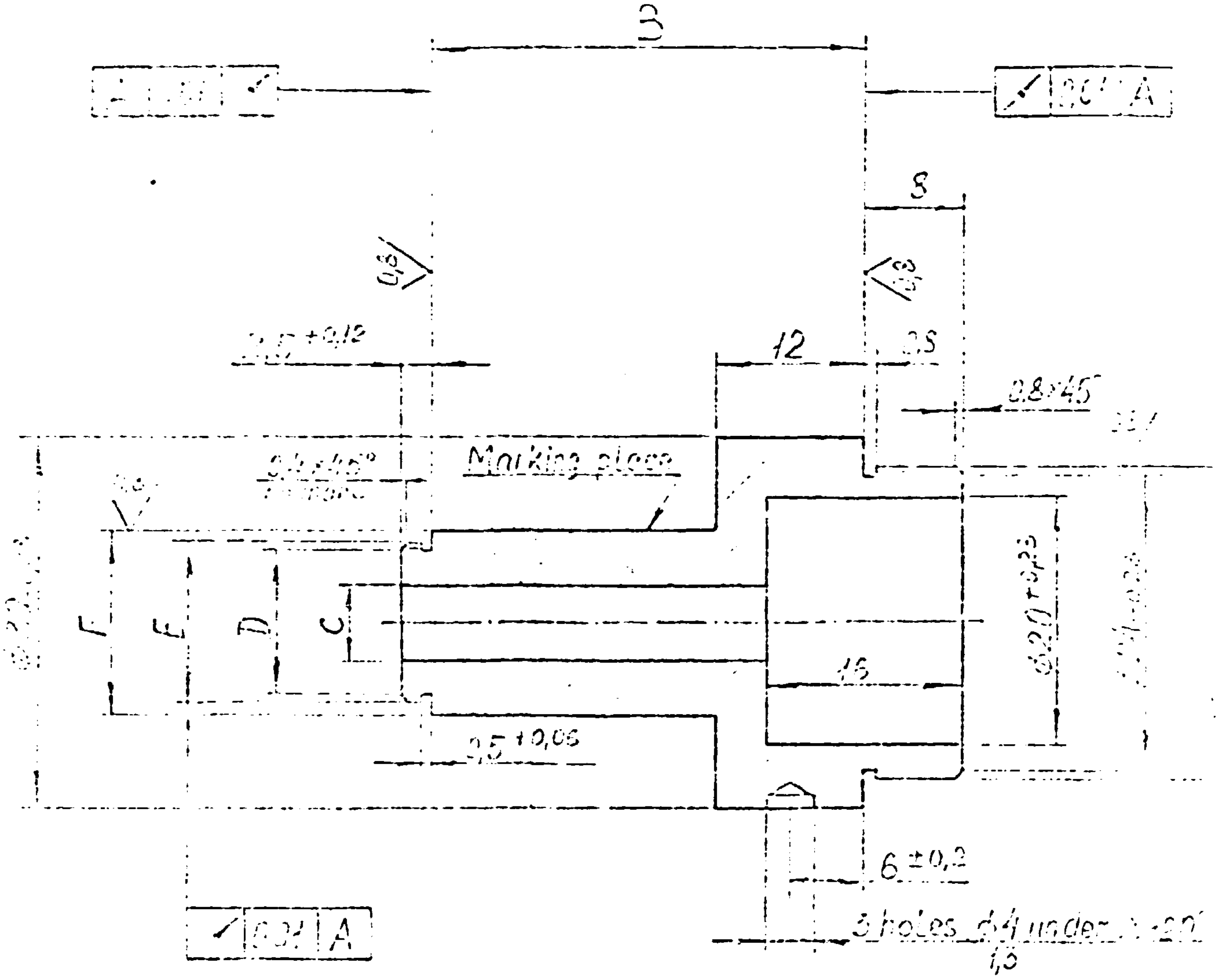
LITMO



SECTION 1

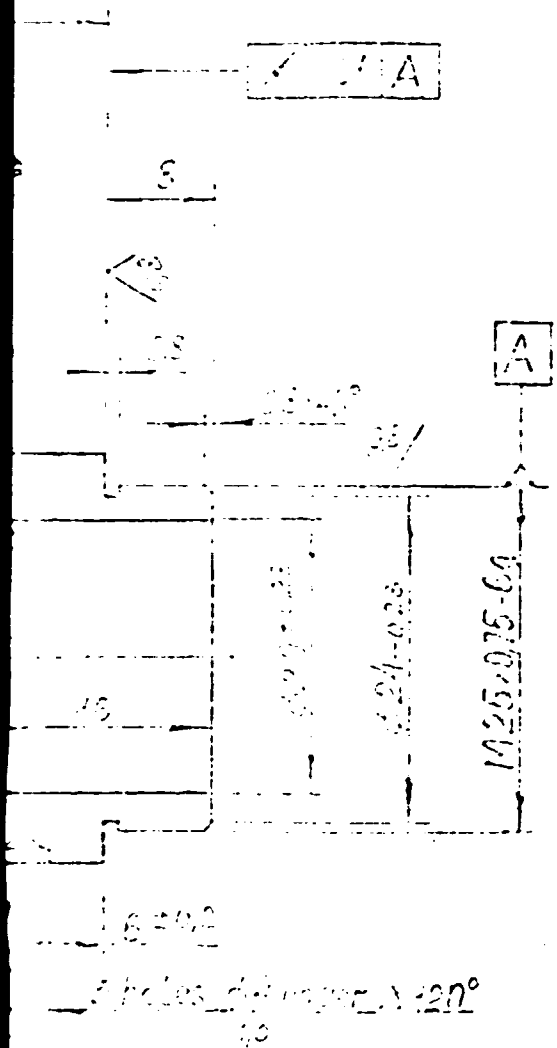
Table

N…	B	C	D	E
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	30	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]



1. H14, h14, ± IT14/2
2. HRC 35 ... 40
3. Steel 20

SECTION 1



Table

№ ass.	B	C	D	E	F
200.030	[illegible]	[illegible]	[illegible]2,6	M18×0,5-6g	[illegible]
210.020	[illegible]	[illegible]	d12,6	M18×0,5-6g	[illegible]
210.030	[illegible]	[illegible]	d12,6	M18×0,5-6g	[illegible]
210.040	[illegible]	[illegible]	[illegible]	M18×0,5-6g	[illegible]
220.040	[illegible]	[illegible]	[illegible]10,6	M11×0,5-6g	[illegible]
230.040	[illegible]	[illegible]	d12,6	M18×0,5-6g	[illegible]
230.050	[illegible]	[illegible]	d12,6	M18×0,5-6g	[illegible]
230.060	42,28 [illegible]	[illegible]	d12,6	M18×0,5-6g	[illegible]

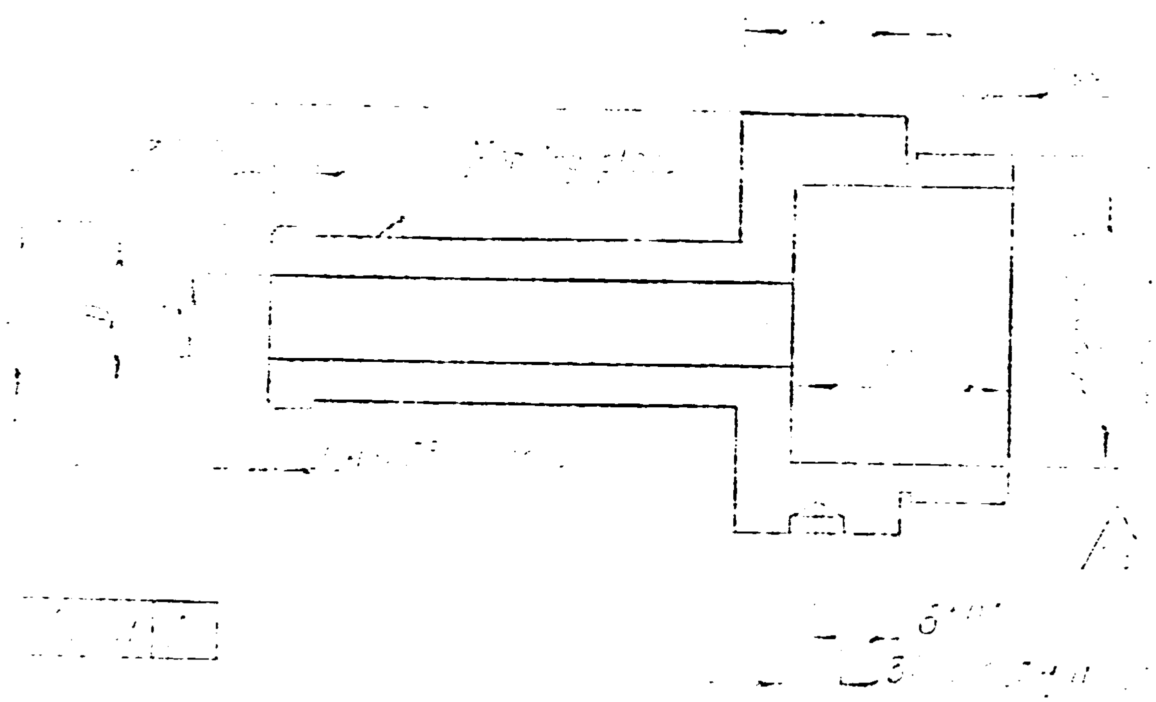
KNOW-HOW PACKAGE

Adaptors for assemblies gap depth 5.5mm

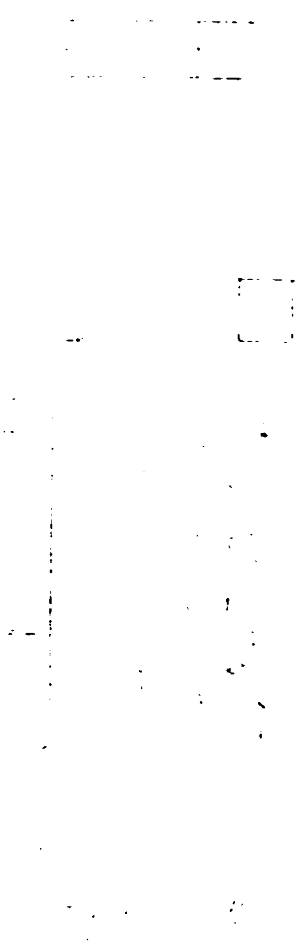
Scale 2:1

Project [illegible]
CONTRACT [illegible]

LITMO



SECTION 1



Tab.

[illegible]	B	C	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] 0??	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] 0?0	[illegible]	[illegible]	[illegible]	[illegible]
200 0?0	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

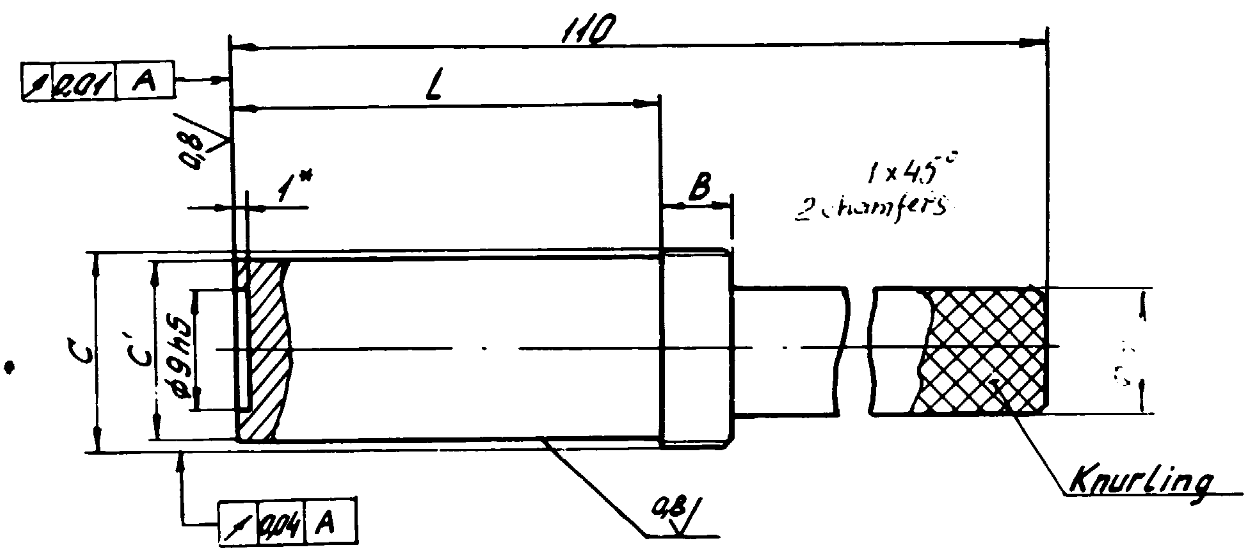
S… 2

[illegible]-HO… …KAGE

…mm

…/Rn

…0 44



for objective	L	B	C	C'
40×0,65 (220.000)	31	5	M14×0,5 6g	13h6
100×1,25 (230.000)	33	3	M16×0,5 6g	15h6

1. * The dimensions for information
2. H14; h14; $\pm \frac{IT14}{2}$
3. Harden HRC, 48...52

Know-how package

Fitting in thread bushing „A" for objective

Designer

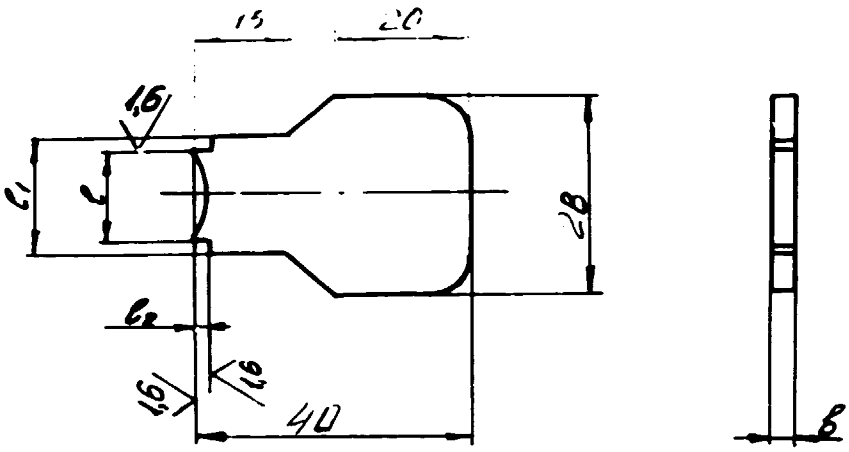
Mass | Scale 1:2

Sheet | Sheets 1

Project DP/SYR/086/011

ITMO

3,2 (√)



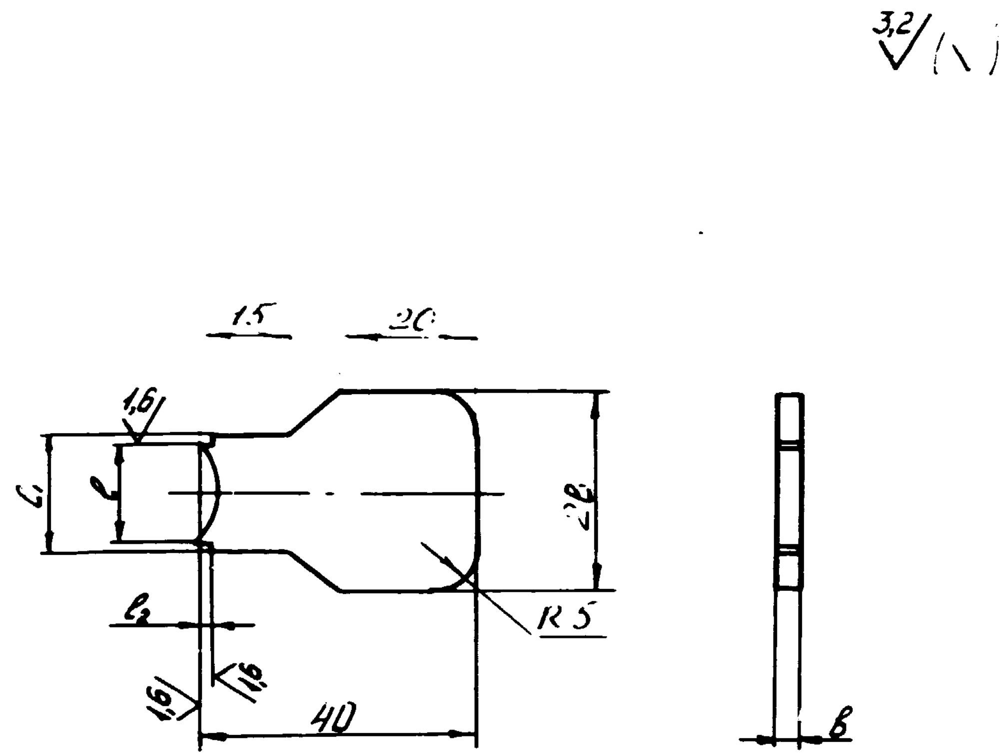
1. H14; h14; $\pm\frac{IT14}{2}$

Objective 200.000 for bushing 210.012 $\ell=13$ $\ell_1=15$ $B=1{,}4$ $\ell_2=2$
—"— 210.000 —"— 210.012 $\ell=13$ $\ell_1=15$ $B=1{,}4$ $\ell_2=2$

Project DP/SYR/086/011 contract N89,
Know-how package

Wrench for
bushing 210.012

Designer	Mass	Sc
		1:
Sheet	Sheets	



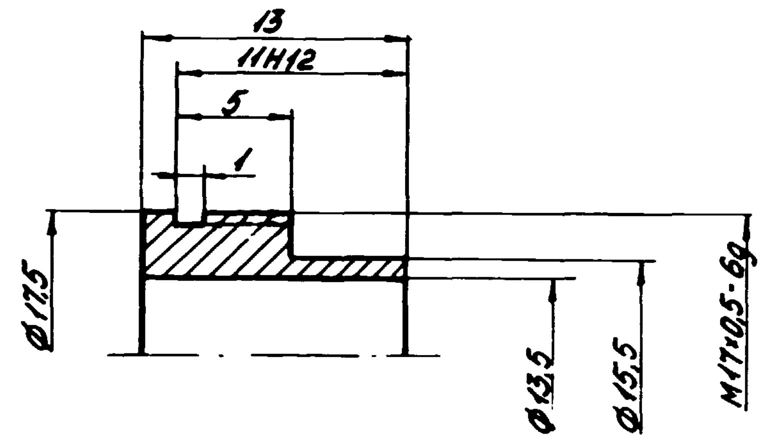
1. H14; h14; $\pm \frac{IT14}{2}$

Objective 220.000 for IrIS 220.019 ℓ=15,5 ℓ_1=16 ℓ=1,4 ℓ_2=2

—"— 230.000 for IrIS 230.021 ℓ=15,5 ℓ_1=16 ℓ=1,4 ℓ_2=2

Project DP/SYR/086/011 contract N89/44 Know-how package					
Designer	Wrench for bushing 220.019 and 230.021		Mass	Scale	
				1:1	
		Sheet	Sheets 1		

1,6



H14; h14; $\pm\frac{IT14}{2}$

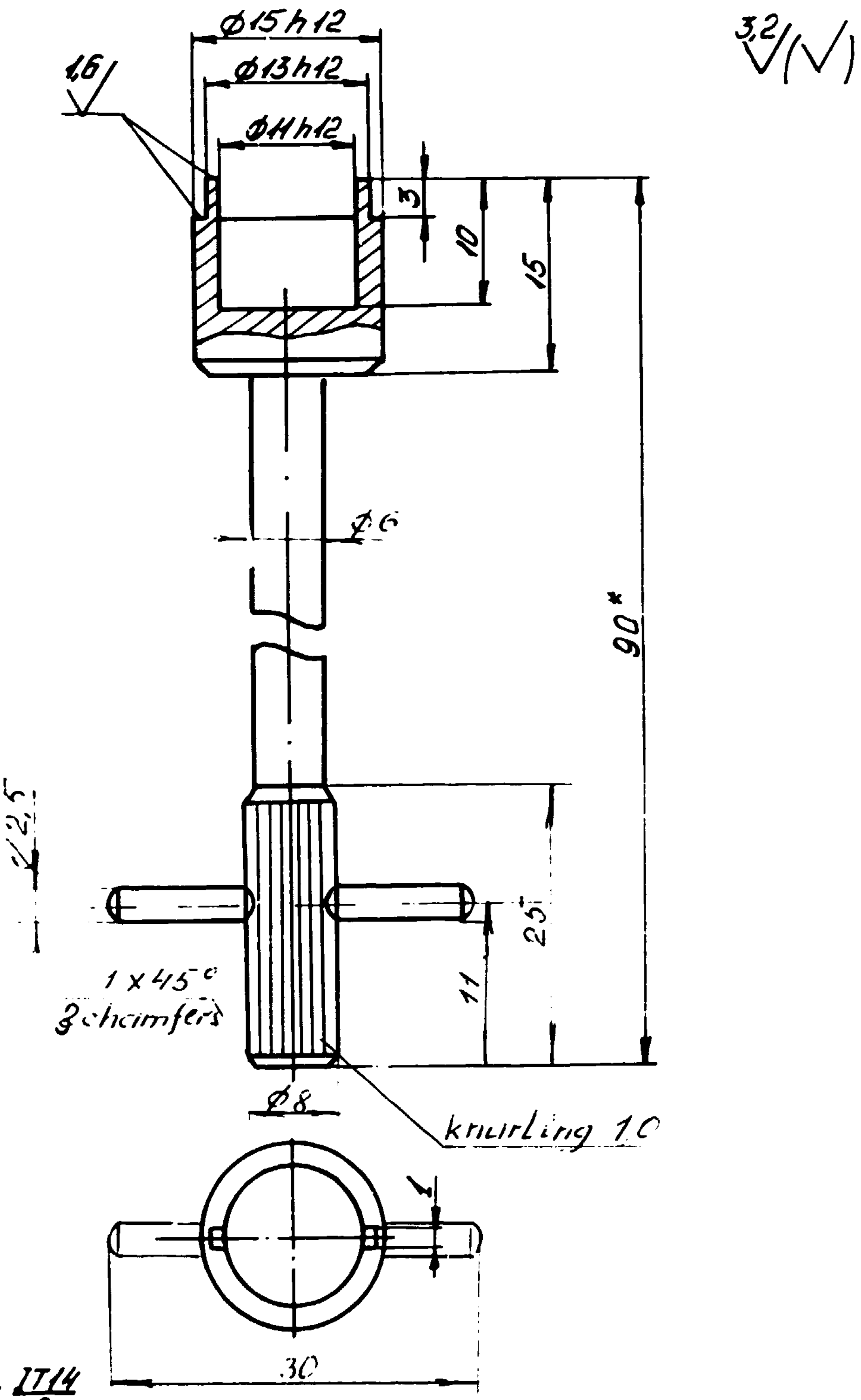
Know-how package

Thread bushing „B" for objective 40×65 (220.000)

Project DP/SYR/086/011

	Mass	Scale	
		3:1	
Sheet		Sheets	
11TMO			

[illegible]esigner

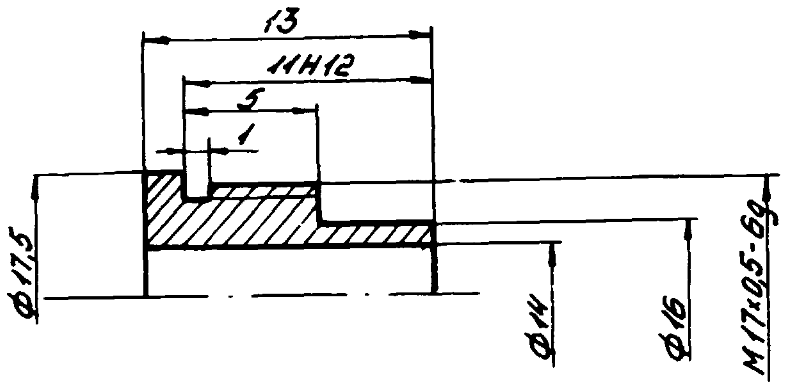


1. $H14;\ h14;\ \pm\frac{IT14}{2}$

2. *The dimension for information

					Project DP/SYR/086/011 contract N 89/44 KNOW-HOW PACKAGE
					Wrench for objective rings 220.018 230.019
Designer					Mass: — / Scale: 2:1
					Sheet / Sheets 1

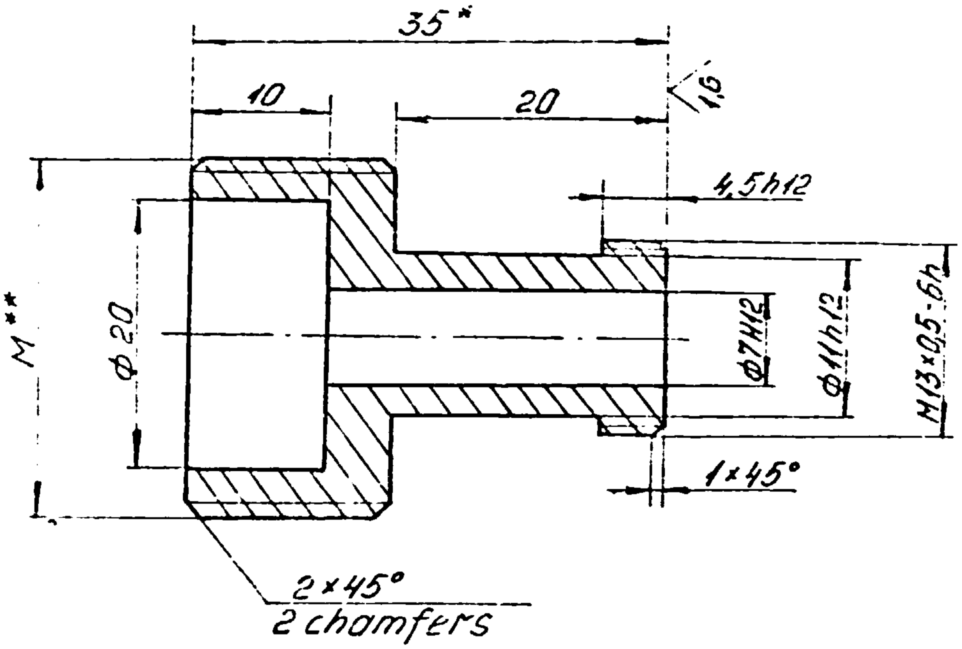
1,6



H14; h14; $\pm\frac{IT14}{2}$

Know-how package				
Thread bushing „B" for objective 100×1,25 (230.000)			Mass	Sca
Designer				3:1
			Sheet	Sheets

For 200010, 200020, 210050, 230070, 250030



1. H14, h14, $\pm \frac{IT14}{2}$

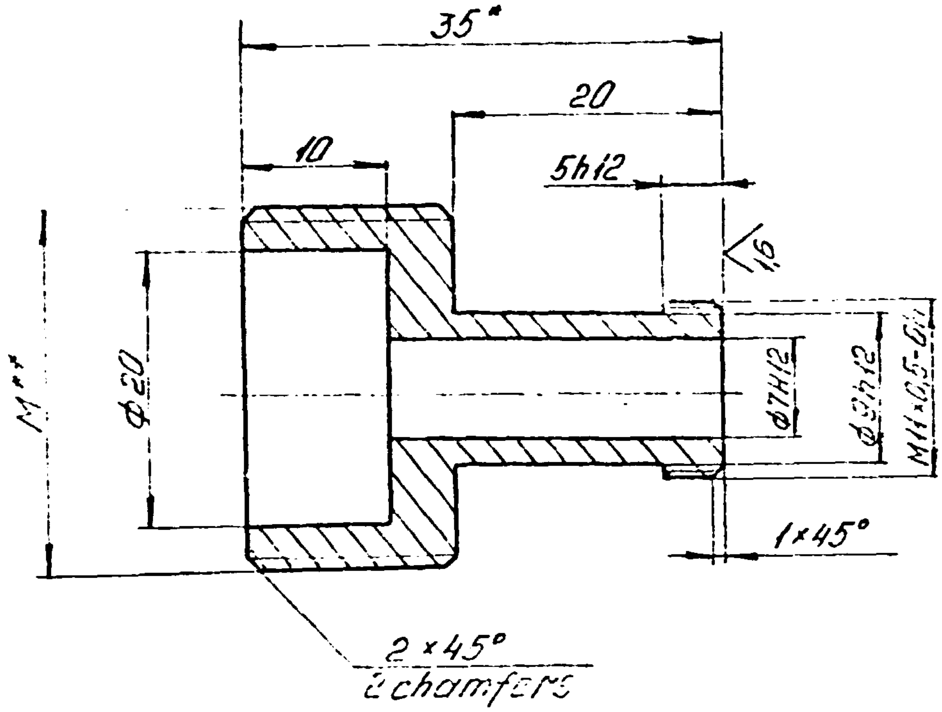
2. * The dimension for information

3. ** The dimension according to the machine spindle

Designer	Thread chuck	Mass / Scale	2:1
		Sheet / Sheets	
Chief designer	Steel 20	LITMO	

Format A4

For 220 050, 220 060, 220 070 $\sqrt[3{,}2]{}$ ($\checkmark$)



1. H14, h14, $\pm\frac{IT14}{2}$

2. * The dimension for information

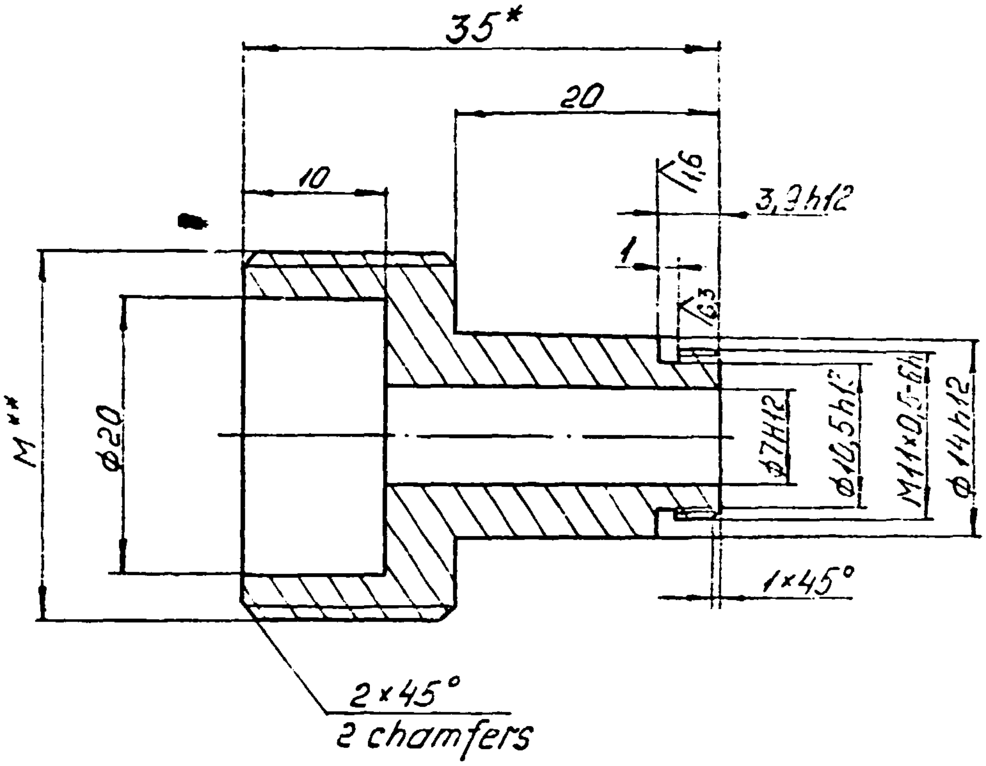
3. ** The dimension according to the machine spindle

Thread chuck		Mass	Scale
			2:1
	Sheet	Sheets	
Chief Designer	Steel 20	LITMO	

Form A4

For 220040

3,2 √(√)



1. H14, h14, $\pm\frac{IT14}{2}$

2. *The dimension for information

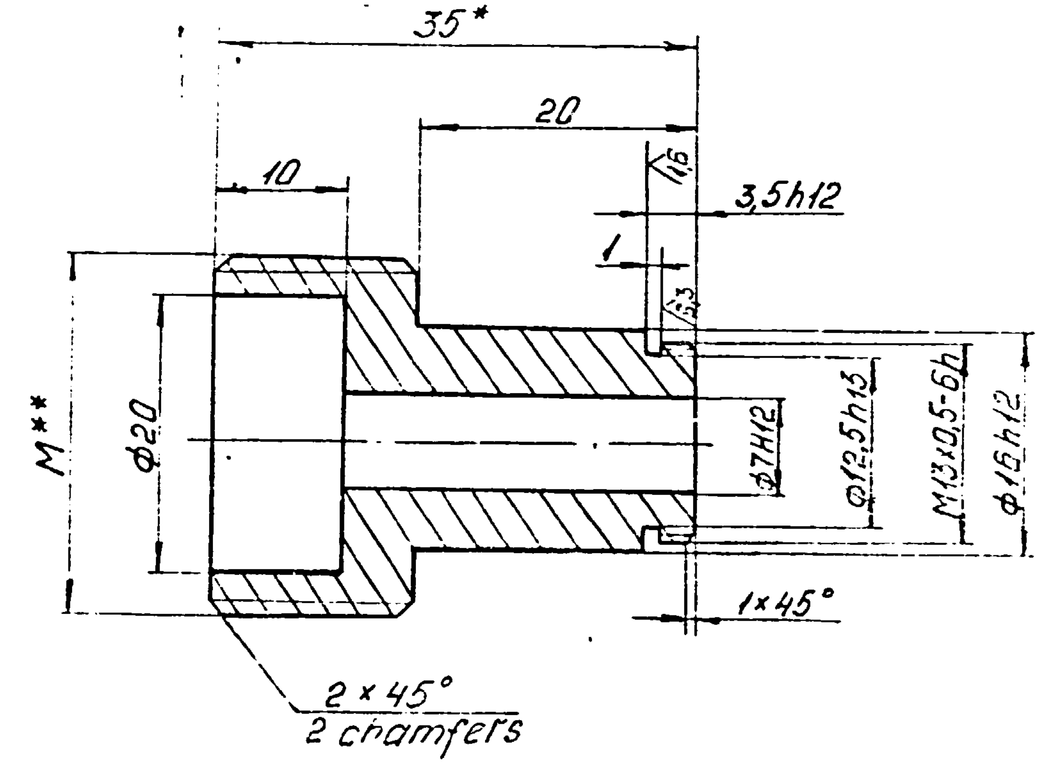
3. **The dimension according to the machine spindle

Designer	Thread chuck	Mass	Scale
			2:1
		Sheet	Sheets 1
Chief Designer	Steel 20	LITMO	

Form. A4

For 200030, 210020, 210030, 210040,
230040, 230050, 230060

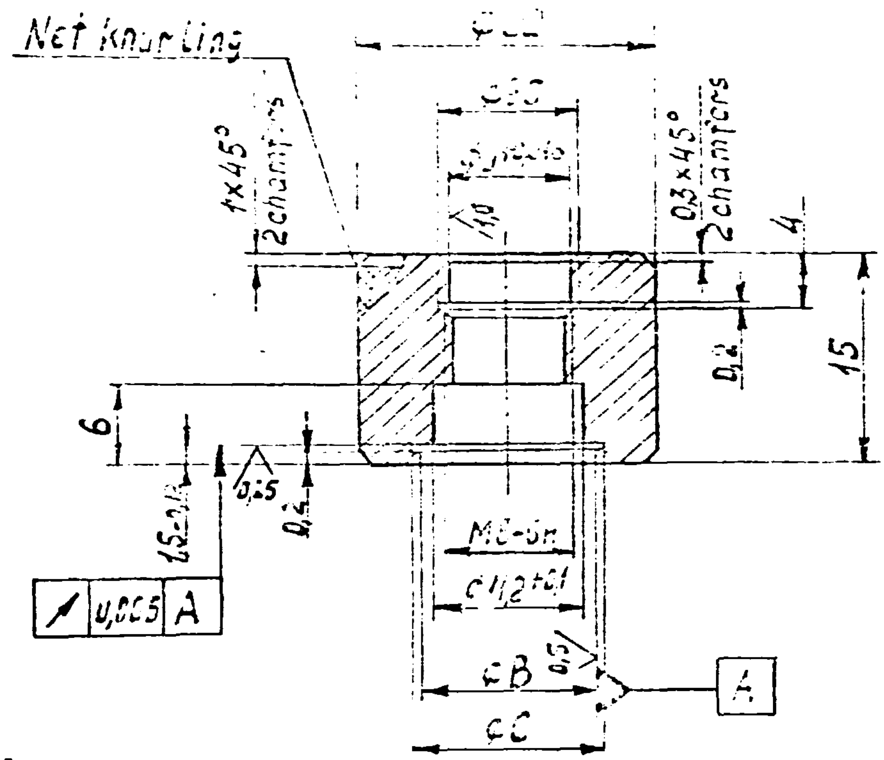
$\sqrt{3{,}2}\ (\sqrt{\ })$



1. H14, h14, $\pm \frac{IT14}{2}$
2. *The dimension for information
3. **The dimension according to the machine spindle

Designer	Thread chuck	Mass / Scale 2:1
		Sheet / Sheets 1
Chief Designer	Steel 20	LITMO

Form. A4



	For the assemblies		
	220040 220060 220070	220050	220040 [illegible] 220060 220070
⌀B	$13^{+0,035}$	$12,8^{+0,035}$	$13,5^{+0,035}$
⌀C	14	14	14,5

1. H14; h14; $\pm \frac{IT14}{2}$

Designer	Nozzle for indicator	Mass / Scale 2:1 / Sheet / Sheets 1
Chief Designer	Steel 50	LITMO