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Technical Meeting on the Selection
of Woodworking Machinery

Vienna, 19-23 November 1973

QUALITY CONTROL PROCEDURES AND EQUIPMENT FOR THE SECONDARY WOODWORKING INDUSTRIES[1/]

by

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Institutul de Cercetari
si Projectari Pentru
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SUMMARY

The paper deals with the problem of quality control in the furniture and joinery industries of developing countries. Testing methods for furniture and joinery products are presented on the basis of standards elaborated in developed countries. It is proved by practice that quality and standard are becoming increasingly interdependent notions. The structure of standards, as far as their concept is concerned, is dynamically changing; standards containing quality requirements and test methods are increasing in number.

In general we estimate the quality of products by the sum total of its most essential characteristics which determine its degree of suitability for an envisaged concrete purpose. The measurement of characteristics of a product presupposes availability of specifications and the existence of testing procedures and equipment.

The importance of measuring techniques used at the factory level in the secondary woodworking industry has soared as a result of the transition to the quality control system.

In order to ensure uniformity and correctness of measurements throughout all stages of production, a range of suitable measuring and testing equipment is recommended.

Specifications and sketches of testing equipment are included in this paper.

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dans l'industrie du bois
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RESUME

CONTROLE DE LA QUALITE DANS LES INDUSTRIES DU BOIS : METHODES ET EQUIPEMENT[1/]

par
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L'auteur traite du problème du contrôle de la qualité dans les industries du meuble et de la menuiserie des pays en voie de développement. Il présente des méthodes d'essais applicables aux produits de ces industries et conformes aux normes élaborées dans les pays avancés. L'expérience prouve que qualité et normes sont des notions de plus en plus interdépendantes. La structure des normes évolue rapidement et elles comportent de plus en plus souvent des spécifications relatives au contrôle de la qualité et aux méthodes d'essais.

On définit en général la qualité d'un produit comme l'ensemble de ses caractéristiques principales qui déterminent son degré d'adaptation à l'utilisation envisagée. L'évaluation des caractéristiques d'un produit suppose l'existence de spécifications ainsi que de méthodes et d'équipement d'essai.

1/ Les opinions exprimées dans le présent document sont celles des auteurs et ne reflètent pas nécessairement les vues du Secrétariat de l'ONUDI.

In the analysis of some of the basic quality problems in developing countries some recommendations are made with a view to improve conditions for production of furniture for export.

In this connexion it is recommended that centres for the development of production be created in developing countries.

L'importance des techniques de mesure utilisées au niveau de l'entreprise dans les industries du bois s'est considérablement accrue du fait de la généralisation du contrôle de la qualité.

L'auteur décrit un certain nombre d'appareils de mesures et d'essais dont il recommande l'utilisation en vue d'assurer l'uniformité et la correction des mesures à toutes les phases du processus de production.

Le document contient des spécifications et des dessins d'équipement d'essais.

L'auteur analyse certains des principaux problèmes qui se posent dans les pays en voie de développement dans le domaine du contrôle de la qualité et recommande des mesures propres à améliorer la production de meubles pour l'exportation.

Il recommande notamment que des centres pour le développement de la production soient créés dans les pays en voie de développement.

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INTRODUCTION

One of the features of the scientific-technical revolution that the world is at present experiencing is the fact that the demands on the quality of products are steadily rising. What was good yesterday is no longer good today, and what is regarded as the peak in the world today is going to be overcome tomorrow. There are efforts appearing simultaneously with this development to discover all kinds of factors influencing the quality of products and to master them.

The development of quality control has been regarded from various points of view and divided into stages, mostly according to organizational arrangements of quality control of individual enterprises.

It was presumed for many years that the most important stage is production itself; this was in accordance with general overestimation of the importance of production: what really happens at this stage is that raw materials are changed into final products. It took a rather long time to discover that the point in question in the final stage of production is a mere reproduction and that the imagination of a designer is just the factor that primarily decides whether the product is going to fulfil its required function. Simultaneously with these requirements, the importance of process inspection with respect to the final product has been recognized. The responsibility of the manufacturer for the whole life of the product was also discovered, as well as the responsibility of the manufacturer to secure servicing, repairs, manufacturing of spare parts, distribution and consultant services.

Another discovery appeared later, namely the fact that the quality of products is not only a technical matter, but that there exists a close relationship between achieving technical perfection and costs spent on the same.

The quality of design and the quality of service are evaluated by the customer and since quality, like value, cannot be determined objectively, it must be judged according to the standards of the customer.

Another aspect of quality that the customer considers is the quality of the product when used over a long period of time.

A business must consider many factors in determining the level of quality of its products.

Competitive price standards will influence the choice of quality level. A lower quality than that offered by a competitor at the same price will mean that fewer customers will buy the product and some of these will be disappointed. Conversely, a quality too high above competitors' levels may mean that too much emphasis is placed on quality with the result that profit margins are not as large as they could be.

As with any other product parameter, money is required to improve quality or to maintain a high standard.

The quality standards are often expressed in terms of standards developed by the industries themselves, by technical organizations or by government agencies.

Standards are actually the backbone of mass production methods since they allow interchangeability between manufacturers.

I WHAT IS QUALITY AND WHAT CONSTITUTES CONTROL

In general we estimate the quality of products by the sum total of its most essential characteristics which determine its degree of suitability for an envisaged concrete purpose. In addition, scientific and technical activity is simultaneously an important guide as to its economic effectiveness.

In any large modern business, a systematic approach to any function is required to assure maximum operational effectiveness. This is as true for quality as it is for accounting, drafting, or production contro. The quality programme should extend into every contributing function of the business and should integrate the quality of efforts of each function into measurable administrative entities. Thus a quality system may be defined as a network of administrative procedures designed to deliver a quality product to the customer.

Within this framework, the rcle of the quality control organization is to provide and coordinate a system which ensures that the operation will produce an optimum quality product at minimum product cost. The actual responsibilities of the quality control organization are to define plan, coordinate and measure the quality efforts of the business, as well as to perform those activities normally associated with the quality control function.

The quality control axioms reflect the direction that the quality control programme must take:

- Quality must be designed and built into the product
- Quality cannot be inspected into the product

The organizational level and the structure of the organization for quality control depend on many factors, such as type of product, size of operation, type of business and management philosophy and thus no single organization can be described as typical. However, all quality control organizations should have well defined responsibilities and authority and should have the organizational freedom to identify and evaluate quality problems and to initiate, recommend and provide solutions.

Whatever the level at which the quality control function reports, and whatever form it takes, one of the crucial criteria for a successful quality programme is management endorsement.

The basic job of modern quality control equipment is no longer merely to inspect or test in the form of simply accepting or rejecting parts; it is also to provide rapid, accurate useable information about product and process quality. This information may still be used in part as the basis for acceptance or rejection, but its other major use if for rapid manual, mechanized or fully automatic feedback for process control and for true control of product quality - in some operations often for the first time.

Testing and inspection mechanization that is designed in terms of this quality information concept is often much lower in total cost, if savings are included, than is the equipment designed without this concept in mind.

It is proved by practice that quality and standards are becoming more and more interdependent notions.

The most important tendencies in standardization are:

- The structure of standards, as far as their concept is concerned, is dynamically changing: standards containing quality requirements and test methods are increasing in number.

- The level of quality requirements stipulated in standards keeps rising.
- Standardization involves more and more consumer goods.
- Quality improvement increasingly necessitates that quality requirement regarding materials and final products should be stated in standards with close connection to each other, in a complex way.
- Quality requirements presented in standards have an ever growing role in the exchange of goods, in technical and trade agreement.

Many features of quality do not permit measurement by instrument or by test. Yet it is faults that are detected by human sensing that cause so many quality problems. For all decorative materials, furnishing fabrics and finishes, the appearance and freedom from flaws constitute an important quality requirement.

Attempts to organize such judgements usually include the setting of standards for definition of acceptability.

A simple count of occurences of defective items in samples provides a useful measure of quality to enable control decisions. In some situations where difficulties of preserving or identifying standards exist, we use ranking or grading methods as a means of quantifying and regularizing subjective judgement of quality.

Today countries are interested in quality on a far larger scale. This can be regarded as a result of a connexion of the balance of trade and export on the one hand, and the fact that the most decisive condition for successful export is the quality of products on the other hand.

There are two motivations on the whole leading to quality: either granting of benefits to producers manufacturing quality products, or sanctions on those manufacturing products of inferior quality. One of them consists of both direct and indirect support, this being a set of measures in connexion with prices, taxes and grants; the other one can usually be solved by way of higher taxes, dues, payments, as well as enforced reductions or even prohibition of sale of respective products.

At present these kinds of motivation are quite common in all countries with highly developed industries.

It is necessary to point out that these incentives for products of good quality cannot be regarded as the only factor influencing the same. This often depends on the activities of all authorities of a government.

The knowledge of additional factors will require the formation of a "complex quality control" system on a level above the enterprise level and the expansion of the authority of various organs of the state power that are in charge of quality control.

In developing countries the development of state control of quality can be regarded as uniform. According to specific conditions of the development of economy and with respect to the mentality of the working people, stress is being laid to a greater or smaller extent on some of the quality control elements.

II TESTING METHODS FOR FURNITURE AND JOINERY PRODUCTION

A prototype or, in the case of an existing design, a sample truly representative of the production model for which claim of compliance with the standards is made, shall be subjected by or on behalf of the manufacturer to the test specified in the standard and shall meet the performance requirements laid down therein.

All subsequent production shall be subjected to such supervision and inspection procedure as to provide assurance, to the greatest degree possible, that the quality and performance of each article is at least equal to that of the prototype or sample as regards the requirements of the standard.

On the factory level, the programme of quality control is indicated hereunder.

There are certain points in the manufacturing process where inspection is frequently performed. These points of inspection vary widely from plant to plant but generally will include some combination of the following:

- Incoming materials: lumber, veneer, glue, finishing materials, sandpaper, hardware.
- Solid parts and veneered panels after machining and sanding.
- Assemblies before finishing.
- After filler.
- After sealer, or first coat of varnish or lacquer.
- Before packing (final inspection).

A. Control of Quality of Incoming Materials

It is a general practice to scale and inspect for footage and grade all incoming shipments of lumber. This inspection is generally carried out in accordance with the applicable specifications. It is recommended to use a sampling plan for inspecting only periodic shipments from known suppliers whose quality record warrants such a risk. Past data on each shipment of lumber from each supplier are on record. These data are in the form of value, as determined by the receiving factory's inspection, compared with the invoice price.

There are no international quality standards for sawn timber intended for furniture raw material as there are for sawn softwood timber for building purposes.

The individual furniture manufacturers make up their own grading standards which define the quality of wood required for each particular member of a produot.

In a 4-grade classification the uses of the different grades can be specified as follows:

Grade I	Parts always exposed (table, drawer front, chair legs)
Grade II	Temporarily exposed parts (drawer sides and back)
Grade III	Unexposed parts (binding components) Parts to be painted
Grade IV	Blindwood (parts to be veneered)

The standard requirements of solid wood for use in high quality furniture are indicated in Annex 1, page 29.

Practices regarding the testing of incoming shipments of glue and finishing materials vary widely. In the case of glues, the types of testing vary from the old crude "knife" test of peeling off glued veneer to elaborate testing prooedures involving plywood shear and block shear-strength tests, durability tests, mixed-glue viscosity tests, pH tests, etc. Standard tests for these quality characteristic of resin glues have been developed.

The amount of routine testing of glues that should be done in a plant can be determined only by that plant's needs. The obvious fallacy in not testing is that, should defective glue by used, considerable loss to the consumer may result before the deficiency is noted.

In the case of finished surfaces, a test producedure will, for example, determine the resistance to:

- liquids
- grease
- heat
- scratches
- impact.

B. Control of Quality in Wood-machining Operations

The dimensional control and surface quality control oan generally be made more effective in most operations if certain basic concepts are understood and if proper organization for quality is instituted.

The prevalent belief among woodworking personnel that close tolerances are applied only in the metal trades and cannot be applied to woodworking is a most serious deterrent to obtaining effective dimensional control. Much of this is a carry-over from the craft type of manufacturing, where extensive hand-fitting was considered normal and necessary.

Facts indicate, however, that relatively close dimensional control can be obtained with modern, well-maintained woodworking equipment.

If tolerance is to be considered in wood-machining operations, knowledge of the basic accuracy and precision of the equipment to be used is necessary. This can best be determined by calculation of the standard deviation of measurements taken on successive pieces produced by the equipment.

Dimensional variation from equipment such as moulders, tenoners, ripsaws, and planers - assuring they are first-class pieces of equipment and are well maintained - will be generally found to stem from two sources:

- Machine variation: the dimensional variation reflected in successive parts coming from the machine in the same set-up.

- Set-up variation: the differences from set-up to set-up in the departure of the average part dimension for a set-up from the nominal or specified dimension. These differences reveal not only the ability of the set-up man to obtain from the machine the dimension he wishes but also the quality of gauging equipment available to him, and accuracy of the adjusting mechanisms on the machine.

C. Control of Tools and Gauges

The quality of a product depends, to a large extent, upon the accuracy and reliability of the tools, gauges and test equipment used in the manufacturing, inspecting and testing operations. Tools and gauges provide the physical means of attaining volume production and at the same time the fabrication, inspection and testing of parts, components and assemblies to the required degree of uniformity.

To assure that tools are capable of producing uniform parts and that gauges will control the dimensional and functional characteristics of the product within prescribed tolerances, it is necessary that they be initially inspected and proved relative to specification requirements. New, modified or re-worked tools and gauges must be inspected and evaluated with reference to the tool or gauge drawing as well as to the engineering drawing for the part prior to release for service.

An effective tool and gauge control system cannot exist without precision control over the basic standards and measuring and calibrating instruments that are used to determine the accuracy of tools, gauges and test equipment.

Precision gauge blocks, masters, setting gauges, length measuring rods and similar items form the basis of control over dimensional inspection equipment; standard cells, dead-weight tests, manometers and similar items form the basis of control over functional testing equipment. Without accurate reference standards, inspections and calibrations of tools, gauges and test equipment are of little value.

D. Testing Methods and Acceptance Criteria for Furniture

Specifications for strength and stability of furniture have been elaborated. They are intended to provide assurance to non-technical buyers with regard to matters such as quality, durability and reliability, which such a buyer cannot assess by inspection.

1. Methods of test and acceptance criteria for strength of all types of domestic and contract furniture for seating (e.g. chairs, stools, settees, etc.)

The above and a swivelling test for all swivelling chairs are elaborated. The illustrations in figures 1-16 give a diagramatic representation of the various test procedures. For the purpose of these methods of test the following definitions apply:

Numerical rating:

1. Light and delicate furniture, i.e. obviously fine chairs, etc., intended only for careful functional use.
2. Furniture for normal domestic use.
3. Furniture for heavy domestic use and careful contract use.
4. Furniture for normal contract use, i.e. where rough treatment and careless handling occur.
5. Furniture for severe contract use.

Functional loadings:

Test loadings applied to an article of furniture to cause stresses to simulate those caused by the use of an article as a support for the body when sitting.

Non-functional loadings:

Test loadings applied to an article of furniture to simulate stresses which may be applied to it when it is used other than as a support for the body. This category of loadings is thus intended to cater for such foreseeen abuse of any article of furniture as may occur mainly during handling and transport, or for example when a chair supports more than one person or a person using the chair in an unconventional way.

Static loading:

The steady and gradual application, up to the maximum which the article may be required to withstand, of a test loading repeated a sufficient number of times to make sure of the static strength of the article.

Fatigue loading:

The often-repeated - but also steadily and gradually applied - subjection of the article to the repeated application of the level of loading which is likely to occur most frequently.

Each article to be tested shall be submitted in turn to each of the 12 tests included in Table 1, Annex 2, page 30, with the appropriate force and number of applications. The test loads may be applied by any suitable means, but for a number of the impact tests a simplified description is given so that the effects of the test may be tried out in any factory.

Before any wooden article is subjected to the strength tests, the moisture content of the timber must be checked with an electric moisture meter to verify that the moisture content of the timber parts is not higher than 12%. If it is too high, the article will have to be allowed to dry out gently in a warm ventilated room until the moisture content is below 12%. The moisture content at the time of testing should be recorded.

Immediately before commencing testing, the operator should thoroughly inspect each article and any apparent defect should be noted. If any defect noted is such that would cause the rejection of the article, testing should not be carried out and the article should be deemed to have failed to comply with the requirements of this standard.

The test for the strength of upright chairs and stools should be carried out in accordance with the details shown in Table 1. All applicable tests should be used in turn for each article to be tested, except when the seat and back fatigue load tests are combined. The order in which the tests are performed should be reported.

Immediately after the completion of any test, the article should again be thoroughly inspected. Any apparent defects should be noted and a determination made of any changes that have taken place since the initial inspection.

Each article tested should comply with the requirements for each of the tests specified in Table 1, and as a result of the tests should not show:

- any fracture of any member, joint or component;
- any fracture or extensive cracking through the thickness of any part of a structural shell;
- any loosening, shown to be permanent by means of hand pressure applied to the suitable members, or joints intended to be rigid;
- any loosening of the underframe or base inserts moulded into a structural shell relative to the shell surface, shown to be permanent by means of hand pressure applied to the underframe or base;
- any free movement in the back, arms, legs or components of the article greater than that noted in the initial inspection;
- any deformation of any part of the article which will adversely affect its function or any cracks which will spoil its appearance.

2. Methods of test and acceptance criteria for easy chairs and settees.

See Table 1 (tests 13-25) pages 32, 33.

Immediately before commencing testing, the operator should thoroughly inspect each article, removing in the case of upholstered articles, as much of the cover on the bottom, etc. as is necessary to facilitate thorough inspection of joints, etc. Any apparent defect should be noted. If any defect is noted of such a kind that it would cause the rejection of the article, the test should not be proceeded with and the article should be deemed to have failed to comply with the requirements of this standard.

Before proceeding with testing the article should be classified, for the purpose of tests, as having a soft, medium or hard seat, as follows:

Soft:	Seat having suspension with coiled springs, rubber webbing or serpentine springing.
Medium:	Seat having a thick cushion on a rigid plastic shell, plywood base or other similar firm surface.
Hard:	Seat having rigid plastic shell or surface, plywood seat or similar hard surface, without thick cushioning.

The test for strength of easy chairs and settees is to be carried out in accordance with the details shown in Table 1. All applicable tests should be used in turn for each article tested, except when the seat and back fatigue load tests are combined. The order in which the tests are performed should be reported.

Immediately after the completion of the tests, the article should again be thoroughly inspected with as much as possible of the covers removed from the outside of the back, bottom and arms. Any apparent defects should be noted and an estimate made of any changes that have taken place since the initial inspection.

Each article tested should comply with the requirements for each test specified in Table 1 and the tests should not show:

- any fracture of any member, joint or component;
- any fracture or extensive cracking through the thickness of any part of a structural shell;
- any loosening, shown to be permanent by means of hand pressure applied to the suitable members of joints intended to be rigid;
- any loosening of the underframe or base inserts moulded into a structural shell surface, shown to be permanent by means of hand pressure applied to the underframe or base;
- any free movement in the back, arms, legs or components of the article greater than that noted in the initial inspection;
- any deformation of any part of the article which will adversely affect its function or any cracks which will spoil its appearance.

3. Methods of test and acceptance criteria for beds

Testing embraces tests of the strength of bedsprings and the durability of mattresses, the load capacity of the bed and the strength of legs and end-boards.

Bedspring and mattress are tested in combination. Testing embraces determining resilience, impact testing and fatigue testing in the following order:

- Fatigue testing 100 cycles
  Recovery (bed unloaded) 15 minutes
  Determining resilience
- Impact testing 10 impacts
  Fatigue testing 5,000 cycles
  Recovery 3 hours
  Determining resilience

The latter phase is repeated, but with fatigue testing an additional 45,000 cycles; subsequently an additional 50,000 cycles and after this, a further 100,000 cycles (total 200,000 cycles).

Impact testing is carried out with the test body having a diameter of 340mm and weighing 50kg (fig. 17, page 39).

Determining resilience is carried out with the aid of test body having a diameter of 100mm and weighing 5kg and which is allowed to rest for a period of 2 minutes at each of the 4 points on the bed where fatigue testing is carried out (fig. 18, page 39).

The body is allowed to fall from a height of 800mm above the surface of the mattress.

The fatigue test is carried out with 2 test bodies (fig. 19 page 39). These are in turn lifted and allowed to fall 40 times per minute from a position where the underside of the 2 parts barely touches the upper surface of the mattress.

After this test, the legs and ends of the bed are submitted to forces as shown in figures 20 and 21 (page 40).

Examination is made after 1,000, 2,000, 5,000 and 10,000 cycles.

4. Methods of test and acceptance criteria for tables

A steel plate weighing 70kg is placed in the centre of the table top and pressure is applied with the aid of compressed air cylinders or the like in 4 directions (fig. 22 page 40).

Pressure is applied in turn in direction a, b, c, d. The amount of force is 150 N (15kg), which shall act for 1 minute against the table top with the centre of pressure 50mm from one side.

On round tables, the pressure is applied in directions c and d against a block mounted on the table top.

The furniture is tested for 5 cycles (1 cycle consisting of pressure being applied in 4 directions) and the movement of the furniture from one outer position to the other is noted after the fifth cycle, both in a longitudinal and a transverse direction. This movement is noted as a rigidity value.

Testing is subsequently continued, but at a rate of 1 cycle per 2 seconds. After 100, 500, 2,400 and 12,500 cycles, a note is again made of the movement of the furniture. If damage occurs or if stability deteriorates to such an extent that the useability of the table is affected, testing is discontinued.

5. Methods of test and acceptance criteria for storage furniture

All storage surfaces (shelves, drawers) in the furniture are loaded with steel plates. If the depth of the shelf/drawer is less than 300mm, it is loaded with a weight of 1kg per 100mm length (length of front edge). If the depth is greater than 300mm, it is loaded with a weight of 2kg per 100mm length.

Pressure is applied against the sides of the furniture 50mm from the front edge and as high up as possible, although not more than 1500mm from the floor (fig. 23 page 41). The force is 150 N (15kgf) which shall act for 1 minute. Drawers and doors should be closed during the test.

Determining the durability of drawers

Drawers are opened and closed with the aid of a compressed air piston. A drawer is pulled out so that one fifth of its length remains in the cabinet. Opening is carried out horizontally but when the drawer has been pulled out the front edge is allowed to drop as far as the construction permits. During the test the drawer is loaded with a carriage (fig. 26, page 42).
Wheels are fitted to this carriage, which is 20mm shorter than the internal dimensions of the drawer. Its weight should correspond to 0.3 kgf per d3 drawer volume, but not more than 7.5kg.

A drawer is opened and closed at a speed of 0.5m per second. A rest period of 4 seconds is allowed each time the drawer is closed.

The drawer is examined after 5,000, 10,000, 20,000 and 40,000 cycles and a note is made of any damage occurring.

E. Testing Methods for Joinery Products

1. Methods of test for measuring the resistance to water penetration of windows and gasket glazing systems

These have been elaborated for the purpose of giving an indication of the performance of windows in practice.

Determining the resistance to water penetration of windows is made under static pressure, and of gasket glazing systems under dynamic pressure.

Much of the test apparatus and procedure is common to all 3 tests, but where it is particular to one or two of them only, the letters A, B or C are inserted after the relevant clause number to indicate requirements for air infiltration, water penetration and gasket glazing system tests respectively.

Immediately before commencing testing, the operator should thoroughly inspect each article. Any apparent defect should be noted.

The specimen should be stiff enough to withstand the test pressures without deflecting to an extent likely to impair jointing or to impose bending stresses on the test specimens. If necessary, the surface of the surrounding frame should be treated to protect it from deterioration caused by its getting wet.

The specimen should be fixed and sealed flush into the frame, the weather side facing the inside of the box.

Any part of the specimen which is designed to open, such as an opening casement for light, or sliding window, should be opened and closed 5 times before commencing the test.

a. Method of measuring air infiltration of windows (Test A only)

All opening joints of the specimen shall be sealed with an impermeable self-adhesive tape, for example a self-adhesive PVC tape. This seal may be made on either face of the specimen, but preferably on the weather face.

The door of the pressure chamber should be closed and the air pressure within the chamber increased in steps of 5mm water gauge to 100mm water gauge. The rate of any air leakage should be recorded at each step, as the pressure is increased to the maximum and again as the pressure is decreased. The greater of the two leakages at each pressure step should be taken. These are the "blank" readings.

The sealing shall be removed from the opening joints of the specimen. The pressure within the chamber shall be increased again in steps of 5mm water gauge, to a pressure of 100mm water gauge and the rate of air leakage shall be recorded at each step, as the pressure is increased to the maximum and again as the pressure is decreased. The greater of the two leakages at each pressure step shall be taken. The respective "blank" readings shall be subtracted from these readings to give corrected results.

For each specimen tested, the report shall include the volume of air flow through the specimen expressed as cubic meters of air per hour passing through each meter of opening joint and as cubic meters of air per hour passing through each square meter of opening light. These shall be plotted against rising pressure.

This information may be tabulated as follows:

Test Specimen	Pressure	Blank Reading (a)	Specimen Unsealed (b)	Corrected Rate of Leakage (b-a)	m^3/m of joint/hour	m^3/m^2/of opening light/ hour
	mm	m^3/h	m^3/h	m^3/h		

b. Method of measuring resistance to water penetration of windows (Test B only)

The water spray system shall be designed to present a continuous uniform horizontal band of approximately equi-sized water droplets across the width of the test area. This band should be about 50mm in depth, with its centre line level with the centre of the highest horizontal bar of the specimen.

The water spray shall emanate from a series of holes drilled by a 0.65mm drill at intervals of 20mm along the rectangular aluminium tube, with external dimensions of about 30mm x 30mm. The black light u/v lamp should be switched on.

The water shall be turned on and the flow adjusted to the specified rate. With the access door open, light from the strobosoope, operating at about 1,500 cycles per minute, shall be directed into the head of the specimen in order to observe the position of the droplet band. Any necessary fine adjustments in the flow rate shall be made so that the centre of the droplet band falls into the specimen in the position described in Chap.III,C. (page 24).

The clock shall be started and the access door closed. The test shall be continued for 15 minutes, making careful observation of the position of any leaks that occur, the black light u/v being used to assist in the detection of leaks.

The air supply shall be switched on and the air pressure within the chamber adjusted to 5mm water gauge. The test shall be continued for a further 5 minutes. The procedure shall be repeated, increasing the air pressure in steps of 5mm every 5 minutes until gross leakage of the specimen occurs, or a pressure of 150mm is reached. It may be found necessary to make slight increases in the flow rate of the water as air pressure increases, to maintain the position of the water band. The pressures at which initial leakage and gross leakage occur and the positions of the penetration shall be recorded.

For each specimen tested, the test report shall include the following details:

- Point of initial leakage
  - pressure at which it occured
  - position(s) of leakage through the specimen

- Point of gross leakage
  - pressure at which it occured
  - position(s) of leakage through the specimen

This information may be tabulated as follows:

Test Specimen	Point of initial leakage		Point of gross leakage	
	Pressure	Position(s)	Pressure	Position(s)
	mm		mm	

c. Method of measuring resistance to water penetration of gasket glazing systems (Test C only)

A specimen shall be prepared as described above, glazed with the gasket glazing system to be tested and with all opening joints of the window sealed with an impermeable self-adhesive tape. The black light u/v shall be switched on.

The water shall be turned on and the flow adjusted to the specified rate. With the access door open, light from the stroboscope operating at about 1,500 cycles per minute shall be directed onto the head of the specimen in order to observe the position of the droplet band.

The clock shall be started and the access door closed.

The pressure within the chamber shall be increased in steps of 15mm up to 150mm water gauge.

At each step, the pressure within the chamber shall be brought back to atmospheric pressure within 1 second by operating the pressure release valve, and shall be held for 5 seconds. The valve shall be closed and the pressure re-applied within 3 seconds and maintained for a further 5 seconds. This operation shall be repeated so as to complete 20 cycles at each pressure step. The black light u/v lamp shall be used to detect initial and gross leakage through the gasket glazing system.

The pressures at which initial leakage and gross leakage occur and the positions of the penetration shall be recorded.

d. Resistance to physical and mechanical stresses of doors

The moisture content of the tested specimen shall be 10% - 12%.

Control of planeness is made using a straight edge and feeler gauge. The concavity must be not more than 5mm.

Control of planeness on a length of 200mm is made using a dial indicator. The deformation must be not more than 0.10mm.

2. Testing for Variations in Relative Humidity

This is made according to the following conditions:

7 days	25°C	85% R.H.
7 days	25°C	40% R.H.
7 days	25°C	85% R.H.
14 days	25°C	40% R.H.

At the end of each period of testing the door is checked and damages recorded.

3. Impact test

This is made by spherical object with 63mm diameter and a total weight of 400g. The object is dropped from a height of 600mm.

4. Longitudinal bending test

The deflection after the 24 hours loading with 50 CN must be as follows:

Load	Dimensions of doors, mm.	Deflection after 24 hours, mm.	Deformation after 24 hours from end of test, mm.
	2200 x 900	40	
	2100 x 900	40	
	2100 x 800	35	
	2100 x 700	30	5
	2100 x 600	25	

III RANGE OF TESTING EQUIPMENT USED IN FURNITURE AND JOINERY INDUSTRIES AND ITS SUITABILITY FOR USE IN DEVELOPING COUNTRIES

A. Gauges and Templates used in Production

The furniture is made (by hand) and in series production.

Advantages of high accuracy in furniture production are as follows:

- Parts of produots belonging to different series are interchangeable.
- A sliding fit between parts is possible without manual fitting in assembly.
- Joints are strong and easy to assemble.
- Manufacture in large series is possible.

To achieve high aocuraoy in large series of produotion, the following measures must be taken:

- The machines are regularly servioed according to working instructions.
- Dimensioned working drawings are used.
- Gauges and templates are used to control the dimensions during machining.
- Jigs are used in machining and assembly.

In the purpose to control aocuracy and to assure interohangeability of different parts or produots, gauges and templates must be used. In annex 4 (page 43) a few models of gauges and templates are presented, aooording to measuring limits.

B. Testing Equipment used in the Furniture Industry

A prototype or a sample truly representative of the production model shall be subjected to the test specified in the standard.

Generally, the testing equipment imitates natural conditions in which furniture and joinery products are used.

Some of the equipment has a very simple form, based on the principle of testing with different weights, etc., but on the other hand the more complex and more automated apparatus for testing is indicated only for large production series. Some indications about purpose, description and specifications of the tested equipment follow.

a.. Equipment for testing chairs

Fig.	Purpose of equipment	Description	Specifications
27 page 47	Testing for dining-type chairs	A testing apparatus capable of applying known diagonal forces to the chair frame, bending forces to the chair back, and repeated impact forces to the seat of the chair. In fig 27 is shown a simple apparatus, constructed mainly from wood, and capable of carying out all parts of the Performance Test.	1. Upright 2. Top rail 3. Centre rail 4. Packing 5. Moving beam 6. Plunger 7. Link arm 8. Hinge block 9. Pad arm 10. Pad 11. Weight box side 12. Pad arms. 13. Block 14. Pad 15. Bottom rail 16. Brace 17. Leg support rail 18. Upright 19. Leg support brace 20. Baseboard
28 page 48	Testing chairs - static tests -	It is used in the purpose of making static tests for different types of chairs. In the picture can be noted: 1 - stand 2,3 - frame carriers 4 - tranverse 5 - air cylindor with D=150 mm 6 - guides 7 - devices for measuring 8 - panel	- overall dimensions, mm ..... 1800 x 1200 x 1550 - distance between frames, mm.... 1100 - number of air cylinder..... 1 - weight, kg..... 450 - working pressure, kg/cm^2..... 3.5-6 - frequency of operation per min. 20 - maximum pressure of air cylinder, kgf..... 600 - precision of measurement - deformation, mm..... 0,01 - forces, kgf..... 1

29 page 49	Testing chairs -dynamic test-	It is used for the purpose of making dynamic tests of chairs, including tipping and rocking. In the picture can be noted: 1 - chair under test 2 - static load 3 - chain 4 - wheel 5 - weights 6 - lifting mechanism	- method of testing: 1. extension of seat 2. extension of back - number of tested chairs..... 2 - static load mass,kg..... 7o - method of loading...with weights of 12 kg. - frequency of operation cycles per min..... 2o - Imput power, kw..... o,8 - Size of base of machine,mm .....135o x 185o - Height, mm.....2loo
30 page 50	Testing chairs -dynamic test-	It is used for the purpose of making dynamic tests of chairs and to determine their strength and durability. Following tests are possible: 1 - test of seat under vertical impact. 2 - test of seat under static load. 3 - test of joints of seat and back. 4 - test of joints of legs and back. 5 - test of joints of arms.	- overall dimensions,mm.... 14oo x 88o x 193o - distance between pressure plates and table,mm....4oo-6oo - distance between thrust pivots system,mm..... 45o-56o - distance between pivots and table, mm..... 53o-77o - input power, kw..... 1.1

b. Equipment for testing beds

31 page 51	Testing bedstead ends	A testing apparatus for carrying out the endurance test of bedstead ends. The apparatus, which is suitable for testing beds from 2 ft. 6 in to 4 ft. 6 in wide, consists of two upright members (1), wich are fixed to the floor or baseboard, each with two blocks (2) and a brace (3)	1. Posts 2. Base block 3. Brace 4. Beam rail 5. Beam block 6. Lever (on post) 7. Lever (on beam) 8. Pad 9. Pad arm 10. Pulling block 11, 12. Leg stop 13. Static load beam 14. Cage 15, 16. Baseboard 17. Plates 18. Rollers 19. Pulleys 20. Plate 21. Bushes 22. Ball castor 23. Flexible cord 24. Spring balance
32 page 52	Testing beds and tables	It is used for the purpose of making static and dynamic tests of beds and tables. The following parts of beds are tested: -vertical load of side wall of beds -horizontal load of bed legs. -horizontal load of backs -impact test of side wall of beds.	- overall dimensions, mm. - length..... 3040 - width..... 3100 - height..... 2350 - Number of special devices for fixing legs..... 4 - Precision of measurement: - horizontal displacement of the board, mm..... 0,01 - resistance under static board, kgf..... 1

Testing beds 33 page 53	It is used for the purpose of making static tests on different types of beds. In the picture can be noted: 1 - horizontal support 2-3 - vertical supports 4 - cross-piece in fixed position 5 - mobile cross-piece 6 - mobile air cylinder 7 - fixed air cylinder	- overall dimensions, mm..... 1700 x 2600 x 2500 - precision of measurement: - deformation, mm..... 1 - force, kgf..... 1 - pressure of air, kg/cm^2..... 3.5-6 - frequency of operation per min..... 20 - maximum of pressure: - air cylinder with 50 mm dia.,kgf... 100 - air cylinder with 125 mm dia.,kgf.. 600 - number of air cylinders ..... 3 - lifting of air cylinders, mm..... 100

c. Equipment for testing tables

Testing table 34 page 54	A testing apparatus for applying the horizontal force, and measuring the movement of the table top.	1. Post 2. Brace 3. Bearer 4. Pulley board 5. Pulley block 6. Platform 7. Platform support 8. Pulling block 9. 10. Leg stop 11. 12. Cage 13. Baseboard 14. Plates 15. Rollers 16. Pulley 17. Flexible cord

Testing tables 35 page 55	It is used for making a cyclic test and to determine the strength and durability of tables. In the picture can be noted: 1. horizontal support 2-3. vertical supports 4. transverse 5-6. air cylinders 7. device for two fixed legs of table 8. device for two unfixed legs of table. 9. device for deformation measurement.	- precision of measurement: - deformation, mm..... - force, kgf..... - pressure in air cylinder, kg/cm^2..... - frequency of operation per min..... - force, kgf..... - maximum size of table, mm.... 1450 x 950 x 800 - minimum size of table, mm....500 x 450 x 500 - distance between air cylinders, mm. 400-1500	1 1 3.5-6 20 10-60
Testing table -cyclic test- 36 page 56	It is used for making a cyclic test and to determine deformation of table under tests. The equipment has 3 principal parts: - double frame - upper transverse - device for measurement On the upper transverse there are guides and two brackets used for loading the board of the table. Deflection of the board is determined by reading a deformation directly on the device for measurement.	- overall dimensions, mm - length..... - width..... - height..... - weight for cyclic loading of table..Kgf.....	2200 1500 1500 10

d. Equipment for testing storage furniture

37 page 57	Endurance test for cabinet furniture	A testing apparatus for measuring the flexibility of the article and for carring out the stimulated reversed racking	1. Rocking lever 2. Pivot stand 3. Jack block 4. Jack dial 5. Jack bracket arm 6. Leg support 7, 8, Metal plates 9. 10. Counterweight
38 page 58	Testing storage furniture	It is used for the purpose of controlling rigidity of framework, strength, and rigidity of doors and strength and rigidity of legs. Equipment has a horizontal frame and two vertical supports, jointed in the upper part with a transverse. Two transverses with a carriage move on the horisontal frame. The position of the lower transverses changes according to the dimensions of the tested furniture.	Overall dimensions, mm: - length..... 1500 - width..... 2200 - height..... 2600 Dimensions of storage furniture, mm: - depth..... 200-800 - width..... 500-1600 - height..... 500-2000

	Testing storage furniture	It is used for the purpose of making tests of storage furniture and furniture frames. The piece of furniture is fixed in the carriage and loaded by cable, with weights on right and left hand alternately. It is also possible to test tables with this equipment. In the period of testing the state of the joints and the general state of the furniture are controlled.	- power of carriage, kw..... 0.6 - number of lifting per min..... 16 - height of loading, mm..... 0-320 - inside width of frame, mm..... 3500 - inside height of frame, mm..... 3000 - platform of carriage, mm..... 1000 x 2700
39 page 59			

	Testing storage furniture	It is used for the purpose of determining strength and deformation of storage furniture. In the picture can be noted: 1 - frame 2 - platform 3 - air cylinders 4 - bracket 5 - distributing valve	- Overall dimension, mm - length..... 3160 - width..... 1540 - height..... 2330 - frequency in operation of air cylinder per min..... 16 - dimensions of storage furniture, mm..... - depth..... 200-300 - width..... 500-1400 - height..... 500-2200
40 page 60			

e. Equipment for testing upholstered furniture

Testing upholstered seat, loading arm position 41 page 61	A testing apparatus for carrying out the performance test on seats. The framework of the apparatus may be constructed from 1 inch nominal inside diameter steel tube, using fittings and joints.	1. Upright 2. Top rail 4. Brace 5. 6. Pivot rail 7. Support rail 8. Lever 9. Steel bearing plate	10. Beam 11. Guide box rail 12. Guide box guides 13. Guide box roller 14. Rail 15. Block 16. Pad 17. Packing
Testing easy chairs and sofas 42 page 62	It is used for the purpose of testing upholstered parts of furniture, such as: - seat of armchairs - back of armchairs - sofas Two vertical supports with guides are fixed on the rigid plate. A horizontal slide with two devices is established on the guides. The distance between devices varies from 220 to 1600 mm. Number of liftings is counted by two cycle counters.	- Overall dimensions, mm: - length..... 1420 - width..... 2620 - height..... 1500 - Consumption of compressed air, m^3/hour.. 2,5 - Regulation of device lifting, mm..... 2-250	

43 page 63	**Testing upholstered furniture -dynamic test-**	It is used for the purpose of making a dynamic test of upholstered furniture, under vertical impact. In the picture can be noted: 1 - frame 2 - drive block 3 - excentric shaft 4 - cam mechanism 5 - pile driver 6 - support	- overall dimensions,mm 2050 x 1100 x 1200 - height of falling,mm...50;100;150 - weight of pile driver,kp.... 70-80 - strength of blow (impact),kgf. ..... 260-400 - number of impacts per min... 8-10 - imput power, kw..... 1 - speed, rpm..... 1000 - number of cams 3
44 page 64	**Testing mattresses**	It is used for the purpose of making performance tests of different types of mattresses. In the picture can be noted: 1 - framework 2 - console 3 - platform 4 - drive block 5 - testing shaft 6 - shifting fork 7 - lifting platform 8 - support	- overall dimensions, mm 2250 x 1900 x 1850 - dimensions of mattresses or upholstered part of divans,mm 2000 x (600-1400)x 300 - lifting possibility, mm..... 300 - dimensions of testing shaft,mm - width..... 300 - thickness..... 200 - weight of testing shaft, mm. 100-125 - run, mm..... 1000 - pressure, kg/cm^2..... 15

C. Testing Equipment used in the Joinery Industry

The overall dimensions of the equipment should be selected to suit the components under test. Equipment as in figs. 45, 46 and 47 (pages 65,66,67), Annex 10, is indicated for testing a wide range of windows.

1. Pressure Chamber

The test chamber shall be an air-tight box capable of withstanding the test pressures. One of its vertical faces shall be left open so that the test specimen can be inserted with a frame if necessary. The maximum pressure during the test shall not exceed that safely permissible for the structure of the pressure box and specimen assembly. It should be borne in mind that glazing may blow out at high pressures.

A door shall be fitted to the side of the chamber to provide access. One or more observation windows shall also be provided to enable the weather face of the specimen under test to be viewed.

The chamber shall be fitted with a pressure release valve capable of reducing the pressure to atmospheric level within a period of 1 second with the air supply system turned off.

2. Air Supply System

Air shall be passed into the box to maintain the specified pressures. Provision shall be made to measure the air pressure differentials between the inside and the outside of the box to an accuracy of $\pm$ 0.5mm water gauge.

(Test A only) Provision shall be made to measure the rate at which air is entering the box to an accuracy of $\pm$ 2%.

(Test C only) The system shall be capable of restoring the pressure within the box from atmospheric to any specified test pressure within a period of 3 seconds.

3. Water Spray System (Tests B and C only)

The water spray system shall be designed to present a continuous uniform horizontal band of approximately equal-sized water droplets across the width of the test area. This band shall be about 50mm in depth with its centre line level with the centre of the highest horizontal bar of the specimen.

The water spray shall emanate from a series of holes drilled by a 0-65mm drill at intervals of 20mm along the centre line of the length of one of the faces of a square or rectangular aluminium tube, with external dimensions of about 30mm x 30mm and a wall thickness of approximately 2.5mm.

The ends of the tube shall be plugged. The water shall be fed into the spray assembly through a hole in the centre of the tube unless the tube is longer than 2m, when two entries at quarter points shall be incorporated. The spray tube shall be mounted on a rigid support which ensures that the water jets are directed upwards, at an angle of 60° to the horizontal and with the line of holes 325mm horizontally distant from, and 145mm below, the centre of the highest horizontal bar of the specimen. Without altering the angle of presentation of the water spray, the position of the spray tube shall be capable of adjustment so that its relationship to all specimens is constant. To assist in the correct alignment of the tube, two pointer rods shall be attached at right angles to the tube support and offered up to the vertical face of the specimen under test. (See fig. 47 page 67).

The spray system shall be supplied with water at the rate of 50 ml per hole, per minute, to an accuracy of ± 2% over the whole system. The water shall be collected from the bottom of the box and recirculated. A valve and a variable area flowmeter shall be inserted into the circuit, so that the rate of flow of the water can be measured and controlled. A fine filter shall be included in the line to prevent particles from blocking the spray jets.

4. Specification of Water (Tests B and C only)

The water used in the test chamber shall be maintained at 20 ± 1°C.

It shall contain 0.2 g/litre to 0.25 g/litre of fluorescein sodium (technical grade) to enable leakages to be detected by a black light ultra-violet lamp.

It shall contain an appropriate non-ionic and non-foaming wetting agent so that the surface tension of the water when tested at 25°C is within the limits 45 ± 2 dyn/cm.

The surface tension of the water shall be checked by means of a suitable apparatus. If the surface tension falls outside the prescribed limits, either more wetting agent shall be added or the whole of the test water shall be discarded and replaced.

5. Ancillary Equipment

Stop clock or watch

(Tests B and C only) Black light ultra-violet lamp (125 watts)
Stroboscope
Suitable apparatus for measuring surface tension

D. Considerations about Progression to more Complex and more Automated Equipment for Quality Control

The basic job of modern quality oontrol equipment is no longer merely to inspect or test in the form of simply accepting or rejecting parts;it is also to provide rapid, accurate and useable information about product and process quality. This information may still be used, in part, as the basis for acceptance or rejection. However, its major use is for rapid manual, mechanized or fully automatic feedbaok for prooess oontrol and for true control of product quality.

Testing and inspection mechanization that is designed in terms of this quality information conoept is often much lower in total oost, if savings are included, than is the equipment designed without this concept in mind.

It is found most useful in a suitable period of time to make an analysis of eaoh major test and inspection activity in the oompany.

An example of the technique used in such analysis is shown in the Test Automation Planning Sheet in Annex 11 (page 68).

In the left hand vertioal oolumn the 10 basic meohanization and automation levels - from hand operations at the bottom and measured as zero, to fully automated antioipation, decision and correotion, measured 100, are listed. Across the top of the ohart, horizontally. the basic elements of testing, from test set-up at the left to test tear-down at the right, are listed.

This chart is named TAG - for Test Automatio Growth.

Instructions for completion are as follows:

1. Classify all test operation into basic elements, such as shown on TAG chart.
2. Analyse each element, mark automation level on the TAG chart. Connect points.
3. Obtain element time (either manual or total) and write in as percent of total.
4. Obtain test cost for each element (or group) and record (use labour or total test cost).
5. For each element, analyse possible mechanization methods. Consider all improvement potentials and savings. Estimate equipment costs.
6. Determine the highest justified automation level for each test operation element. Mark levels on chart; connect points.
7. Use the work planning section to plan sequence and work schedule for mechanization or automation of test elements.
8. Indicate operation element, initiation date, work detail schedules with completion dates, and show equipment cost (design material, labour, etc.) and actual net savings expected (use appropriate base - yearly or per unit).
9. Indicate at bottom completion date and total costs and savings.

E. Definitions of Quality Cost Elements

In defining general categories of quality costs, the most popular concept attributes the costs to prevention, appraisal or failure.

The cost of prevention would be defined as those costs incurred to minimize later defects or failures and costs for training, inspection, planning, etc.

Costs of appraisal would include costs incurred in performing appraisal functions such as inspections, tests, calibrations and sorting.

The costs of failure would be defined as costs incurred for scrap, rework, customer returns, etc. as a result of nonconformance.

The best industry estimates of the percentages of each category: failure - 70%; appraisal: 25%; prevention: 5% or less.

The cost elements of appraisal are defined in Annex 12 (page 69); the definition should be considered as a guide.

In order to perform an evaluation, cost of labour and material, inspected time, equipment utilization, cost of rejects, cost expected if failure is found at a later operation, cost effect of schedules, and lot size and quantities should be known. Costs of planning, appraisal and potential failure should be calculated to determine the optimum situation.

F. Some Basic Quality Problems in Developing Countries

The development of the secondary wood processing industries in the developing countries, irrespective of whether they have forest resources or not, implies the transformation of production technology from craft to industrial process.

The furniture industry in many developing countries is still at the craft level, with machines representing less than 30% of the manufacturing processes. Consequently, furniture products cannot be considered as standard industrial production.

With this in mind, as well as the quality of furniture exhibited in foreign markets and produced under the most developed techniques, the idea of introducing mechanized production arises due to the fact that there must be a noticeable increase in the production capacity accompanied by an improvement in the quality to compete with the products sold on foreign markets.

This requires the introduction of industrial methods based on modern production planning, process and quality control and industrial costing techniques.

Investment alone will not ensure a speedy development of the furniture industry, since the plants will have difficulty in obtaining technical know-how and skilled workers to operate the equipment.

In order to achieve the rapid development of an export-oriented industry, governments of developing countries should consider establishing a centre for the development of the furniture industry. Such centres would serve as focal points for the country's secondary wood processing industries and help the dissemination of technical know-how in these subjects through organizing courses, compiling and distributing technical documentation, as well as providing common service facilities to existing plants. The centre should aim to take all measures to develop the country's furniture industry. In order to achieve this, it must be active in design, advise on production methods, advise the authorities on the elaboration of standards for furniture and also serve as a clearing house for technical information.

A standards and testing department will form part of this centre and will have the role of testing the quality parameters of furniture and its various inputs and will advise the government authorities on the elaboration of standards for furniture, joinery and their components, including inputs such as textile materials, glues, paints and other surface finishes, etc.

It is an acknowledged fact that export marketing of consumer and durable goods is facilitated by the establishment of "quality labels", for which this department would be the responsible authority.

This department would assist in the establishment of quality control policies and would train inspectors of the various plants in their application.

The same type of centre will be needed by the countries with vast forest resources, in which the present prejudices against wood are associated with poor manufacturing, inaccurate sawing, poor seasoning and preservation practices and the lack of uniform grading and inspection standards for wooden components.

Selection of quality control equipment will be influenced by the size of factory and range of models produced.

For example, the use of gauges and templates is not economical for small production series for export or when a big number of models are produced.

In these factories portable laboratory equipment will be used for quality control. Annex 13 (page 71) lists the items needed. To these must be added:

For controlling humidity:
- portable moisture meter

For measuring wood materials:
- metal tape rule, 2000 or 3000 mm length
- calipers 150 mm max. useful length

For determining viscosity of glues and lacquers:
- Ford cup no. 4

For controlling quality of surfaces:

- Unfinished surfaces: Profilograph TSP-4
- Finished surfaces: Glossmeter type Bruno-Lange

For determining the alternative inclination of teeth of different saws:
- Setting gauge

When integration with other woodworking plants is assured, it should be possible to organize a laboratory on the factory level.

In this case, for the first period is indicated to use equipment for testing chairs and other products. It is better to make some of the testing equipment locally, starting with the simple varieties.

Only the national centre for the development of the furniture industry will need to be provided with imported testing equipment.

IV RECOMMENDATIONS

To improve conditions for the production of furniture for export in developing countries, it is recommended:

- To determine the need, level and structure of quality control according to type of product, size of operation, etc.
- New equipment must be purchased for the production of furniture, including woodworking machines for elements of solid wood and panels, hot presses, lacquering and polishing machines, etc.
- To organize a central maintenance and repair shop so as to facilitate the repair and maintenance of woodworking machines, thereby ensuring the necessary accuracy for the production of high quality furniture.

It is recommended that the organizations for standardization in developing countries elaborate standards for furniture production, such as:

- Tolerances
- Limit gauges
- Methods of testing furniture
- Methods of testing joinery products

It is recommended that quality control units be set up in the factories with measuring and controlling equipment.

It is recommended that equipment for testing furniture and joinery products be obtained. Top priority should be given to that needed to test chairs, according to the product specifications in developing countries.

Problems hindering the rapid development of the furniture and joinery industries, especially for export, could be fully overcome if centres for the development of this sector were to be created in developing countries.

It is better, if possible, to manufacture testing equipment locally, starting from the simple varieties.

Imported testing equipment is indicated only for use by the proposed centre. This is because the centre will be a responsible authority for the establishment of quality labels and will assist in the establishment of quality control policies and will train inspectors of the various plants in their applications.

Judging by the experience of other developing countries, such a centre would be a focal point for the development of an export-oriented industry.

ANNEX 1.

STANDARD REQUIREMENTS OF SOLID WOOD

The standard requirements of solid wood for use in high quality furniture are:

Woods - All materials shall be of good quality

Softwoods - All softwoods used shall be sound, free from fungi - or insect - infections.
Softwoods shall be without barky edges, resin galls, checks, shakes, or "dead", i.e. black or loose knots.
Occasional sound knots may be tolerated, provided that they will not tend to weaken the total stability of furniture or parts as in special constructive joints of furniture.
Sound knots, however, shall not be more than one - fourth of the width of the material, and never with a diameter of more than 20 mm.

Hardwoods - All hardwoods used shall be sound, free from defects from fungi - or insect - infections.
There shall be no checks, shakes or other defects, just as knots will generally not be tolerated.
In hardwoods with specific formation of heartwood, such as oak, teak, mahogany, rosewood, etc., there shall be no sapwood.
In the case of French, Italian or other European walnut, sapwood may be used.

Table 1:

Number of applications and test forces

(1 newton = 0.225 lbf approximately)

Test number	Test description	Performance rating				
		1	2	3	4	5
	UPRIGHT CHAIRS AND STOOLS, SEAT, BACK AND ARM TEST					
	Seats					
1	Static load test	-	10 x 780 N	10 x 1000 N	10 x 1250 N	10 x 1870 N
2	Fatigue load test	12500 x 950 N	25000 x 950 N	50000 x 950 N	100 000 x 950 N	200 000 x 950 N
3	Impact test	-	10 x 25 kg through 75 mm	10 x 25 kg through 105 mm	10 x 25 kg through 135 mm	10 x 25 kg through 190 mm
	Back					
4	Static load test	-	10 x 410 N	10 x 560 N	10 x 760 N	10 x 1200 N
5	Fatigue load test	12500 x 330 N	25 000 x 330 N	50 000 x 330 N	100 000 x 330 N	200 000 x 330 N
6	Impact test	-	10 x 6.5 kg at 0.75 m/s	10 x 6.5 kg at 1.5 m/s	10 x 6.5 kg at 3.0 m/s	10 x 6.5 kg at 4.5 m/s
	Arms					
7	Static loading sideways	10 x 200 N	10 x 300 N	10 x 400 N	10 x 600 N	10 x 900 N
8	Impact sideways	-	10 x 6.5 kg at	10 x 6.5 kg at	10 x 6.5 kg at	10 x 6.5 kg at

9	Static loading downwards	1o x 54o N	1o x 71o N	1o x 1ooo N	1o x 125o N	1o x 1875 N
	UPRIGHT CHAIRS AND STOOLS, DROPPING TESTS, LEG TESTS FOR SWIVEL ACTIONS					
	Drop test					
10 a	Upright chairs and stools					
	Rear foot	1o through 15o mm	1o through 3oo mm	1o through 45o mm	1o through 6oo mm	1o through 9oo mm.
	Front foot	1o through 15o mm	1o through 3oo mm	1o through 45o mm	1o through 6oo mm	1o through 9oo mm
10 b	Chairs with castors or swivelling glides					
	Rear foot	-	1o through 15o mm	1o through 2oo mm	1o through 3oo mm	1o through 45o mm
	Front foot	-	1o through 15o mm	1o through 2oo mm	1o through 3oo mm	1o through 45o mm
11	Legs					
11 a	Front legs forwards	1o x 31o N	1o x 39o N	1o x 49o N	1o x 62o N	1o x 94o N
11 b	Front leg sideways	1o x 25o N	1o x 31o N	1o x 39o N	1o x 49o N	1o x 75o N
12	Chair swivelling tests					
	1000 N downwards force and rotate ± 45 degrees	12 5oo times	25 ooo times	5o ooo times	1oo ooo times	2oo ooo times

EASY CHAIRS, SETTEES, ETC., SEAT, BACK AND ARM TESTS

	Seat			
13	Static load test	1o x 78o N	1o x 1ooo N	1o x 125o N
14	Fatigue load test	25 ooo x 1ooo N	5o ooo x 1ooo N	1oo ooo x 1ooo N
15	Impact test	1o x 25 kg through 9o mm	1o x 25 kg through 2oo mm	1o x 25 kg through 3oo mm
	Back			
16	Static load test	1o x 62o N	1o x 78o N	1o x 1ooo N
17	Fatigue load test	25 ooo x 4oo N	5o ooo x 4oo N	1oo ooo x 4oo N
18	Impact test	1o x 6.5 kg at o.75 m/s (and repeat on one wing)	1o x 6.5 kg at 1.5 m/s (and repeat on one wing)	1o x 6.5 kg at 3.o m/s (and repeat on one wing)
	Arms			
19	Static loading sideways	1o x 3oo N	1o x 42o N	1o x 6oo N
2o	Impact sideways	1o x 6.5 kg at	1o x 6.5 kg at	1o x 6.5 kg at
21	Static loading downwards	1o x 71o N	1o x 1ooo N	1o x 125o N

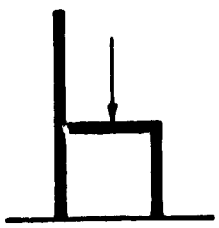
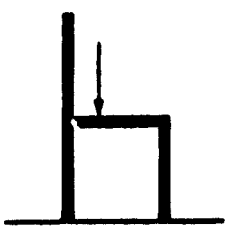
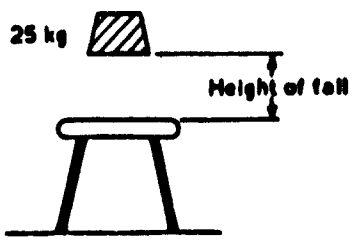
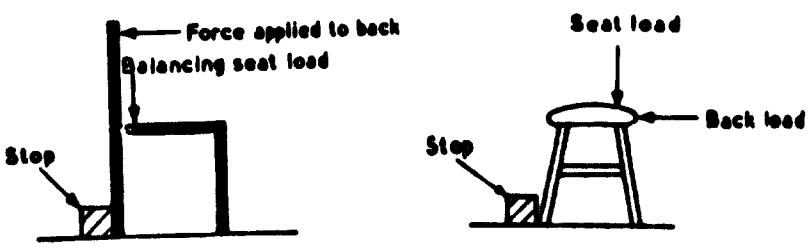
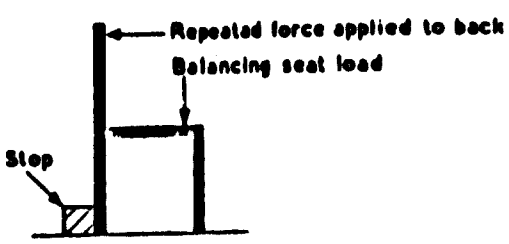
./.

EASY CHAIRS, SETTEES, ETC. DROPPING TESTS, DIAGONAL TEST ON BASE OF FRAME AND TEST FOR SWIVEL ACTIONS

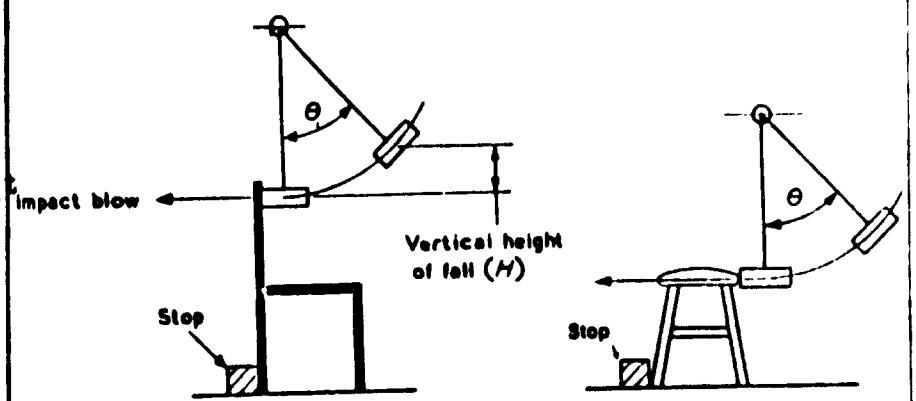
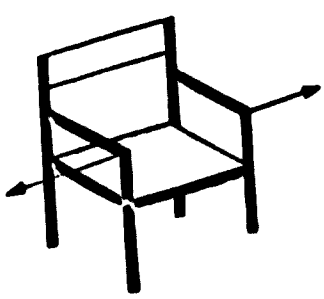
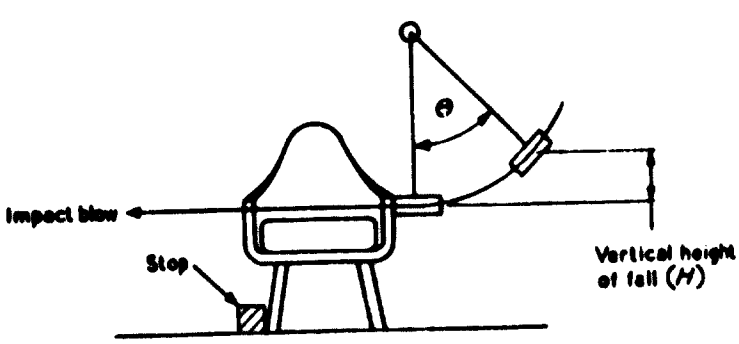
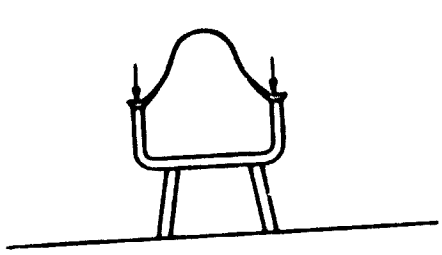
22	Drop test for chairs and stools	-	lo through 75 mm	lo through loo mm	lo through 15o mm	-
	Rear foot		lo through 75 mm	lo through loo mm	lo through 15o mm	
	Front foot		lo through 75 mm	lo through loo mm	lo through 15o mm	
23	Drop test for settees					
	One end	-	lo through 75 mm	lo through loo mm	lo through 15o mm	-
24	Diagonal test on base	-	lo x 25o N	lo x 375 N	lo x 5oo N	-
25	Chair swivelling test looo N downward force and rotate ± 45°	-	25 ooo times	5o ooo times	loo ooo times	-

Annex 3

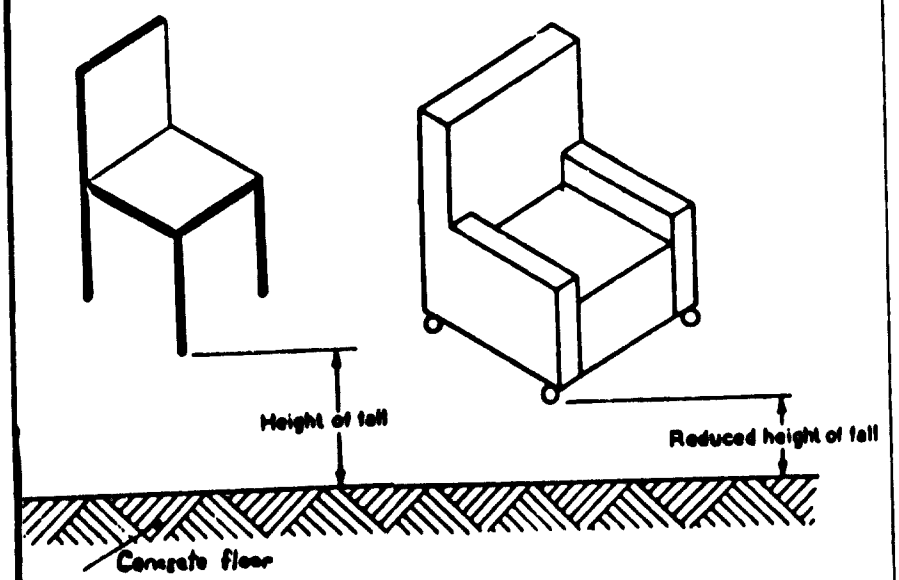
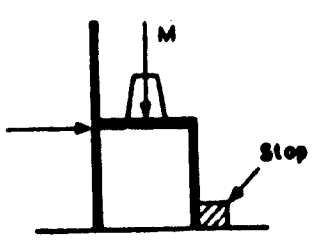
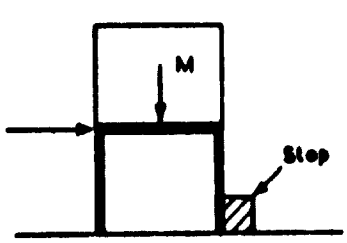
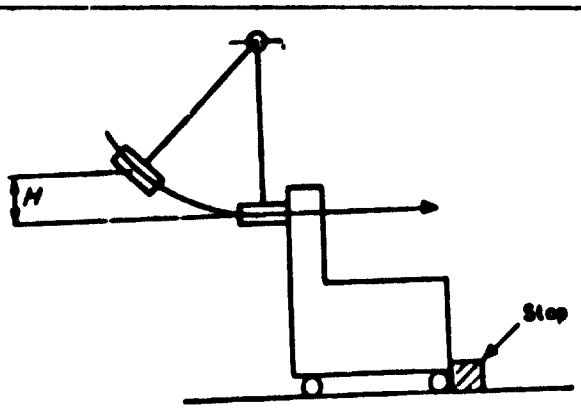
STRENGTH TESTS FOR UPRIGHT CHAIRS AND STOOLS.

Fig.	Test number	Diagram of testing
1	1 & 13 Seat static load test.	
2	2 & 14 Seat fatigue test	
3	3 & 15 Seat impact test	
4	4 & 16 Back static load test	
5	5 & 17 Back fatigue load test	

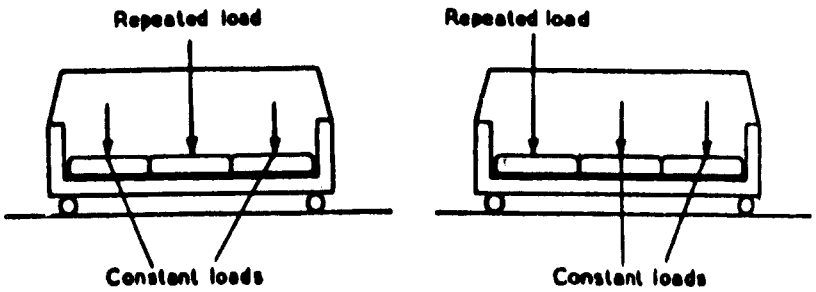
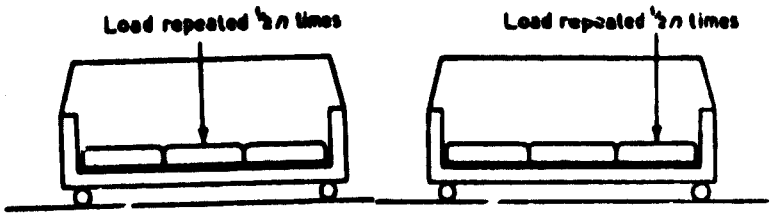
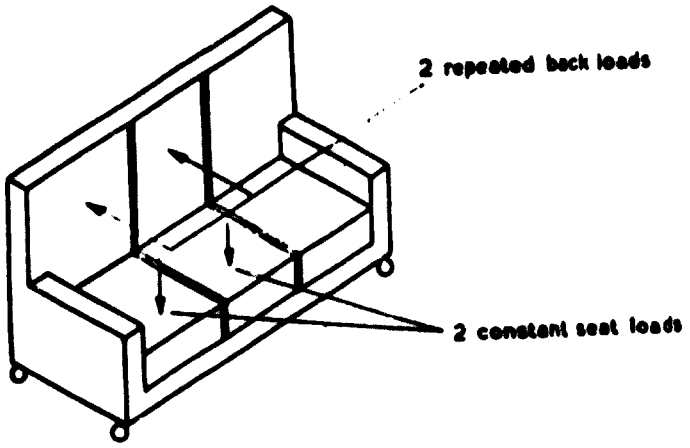
STRENGTH TESTS FOR UPRIGHT CHAIRS AND STOOLS.

Fig	Test number	Diagram of testing
6	6 **Back impact test**	
7	7 & 19 **Arm sideways static load test**	
8	8 & 20 **Arm sideways impact test**	
9	9 & 21 **Arms downwards static load test**	

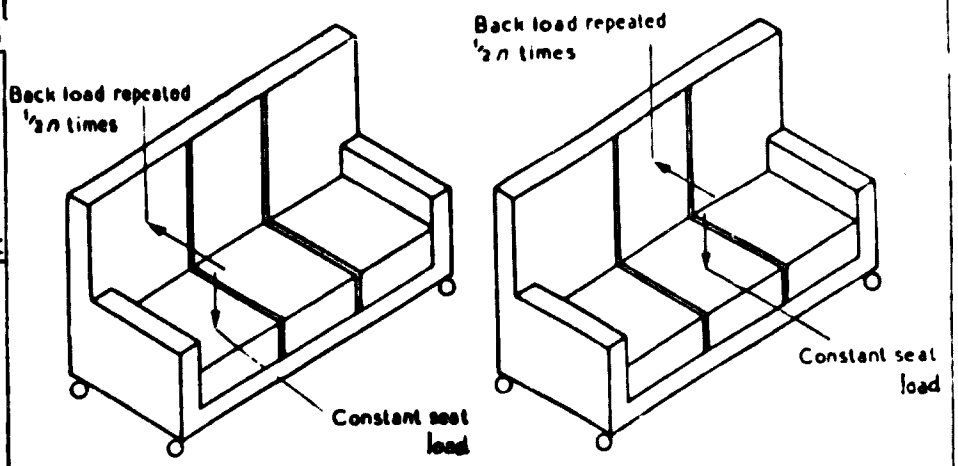
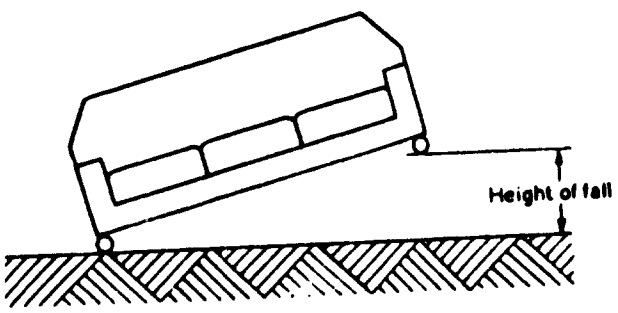
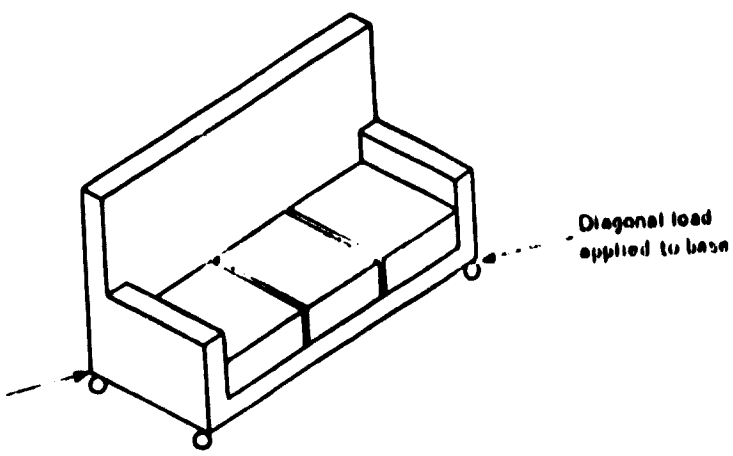
STRENGTH TESTS FOR UPRIGHT CHAIRS AND STOOLS.

Fig.	Test number	Diagram of testing
10	10 & 22 Chair drop test	
11	11 a Forwards front leg test	
12	12 b Sideways front leg test	
13	23 Back impact test for easy chairs and settees	

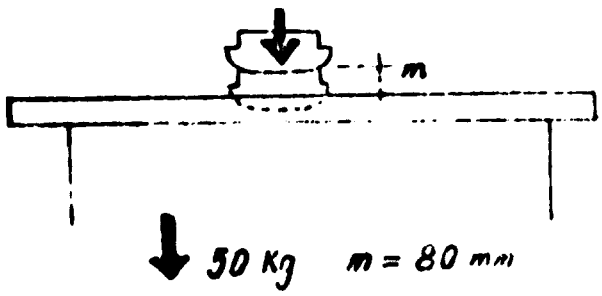
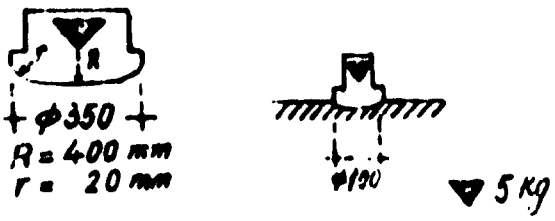
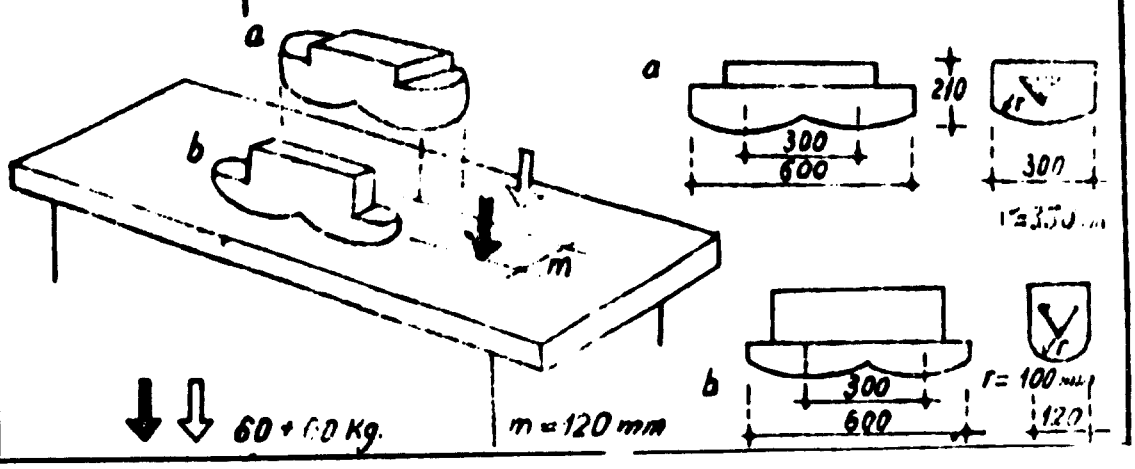
STRENGTH TESTS FOR EASY CHAIRS AND SETTEES

Fig.	Test number	Diagram of testing
14a	TESTS OF SETTEES Seat static load test	 Central position seat static loading End position seat static loading
14b	Seat fatigue test	 Central position seat loading End position seat loading n-Specified number of applications of seat fatigue load.
14c	Back static loadings.	 Double back loading

STRENGTH TESTS FOR EASY CHAIRS AND SETTEES

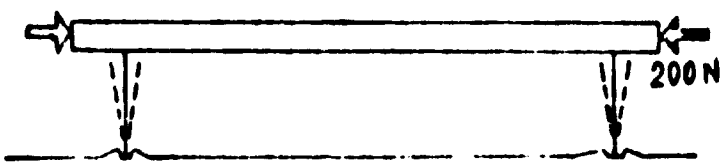
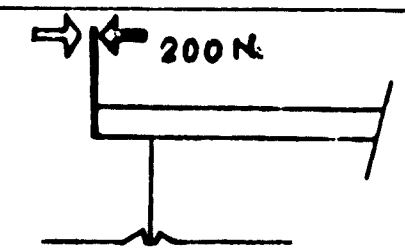
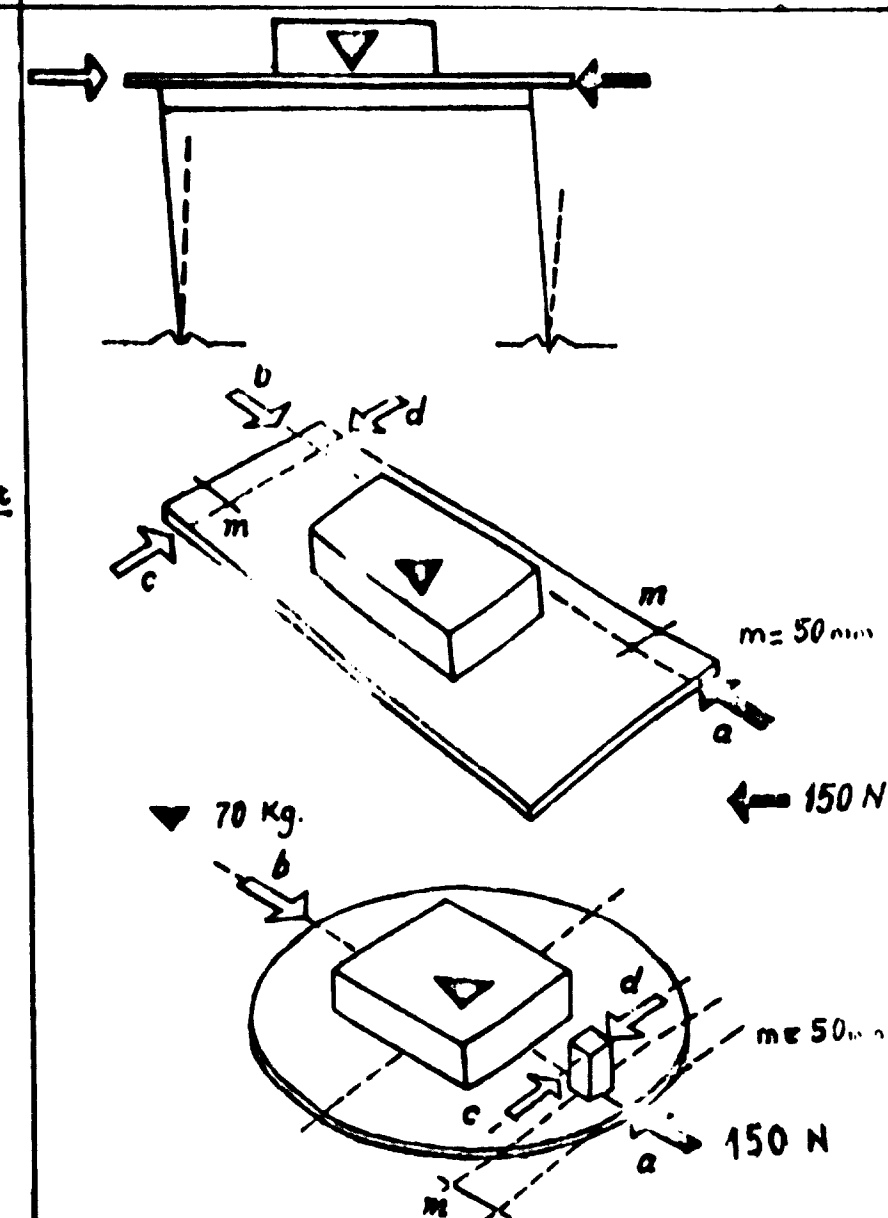
Fig.	Test number	Diagram of testing
14d	TESTS OF SETTEES Back fatigue test	 End position back fatigue loading Central position back fatigue loading
15	22 Drop test for settees	
16	Diagonal base test	

STRENGTH TESTS OF BEDS .

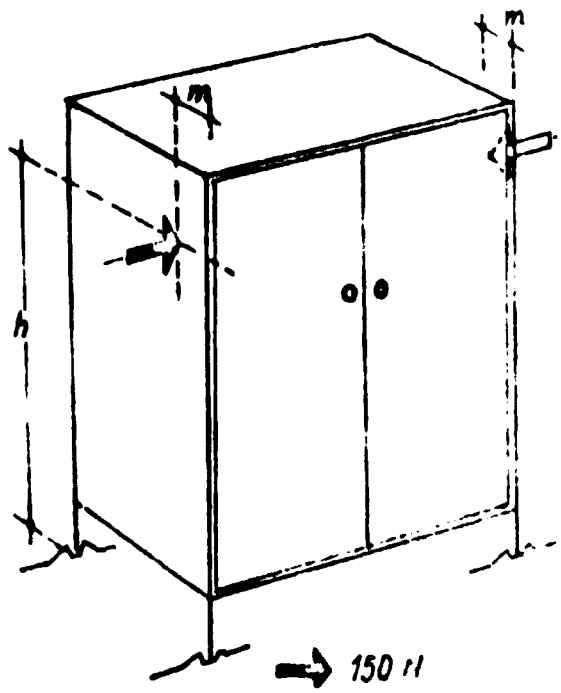
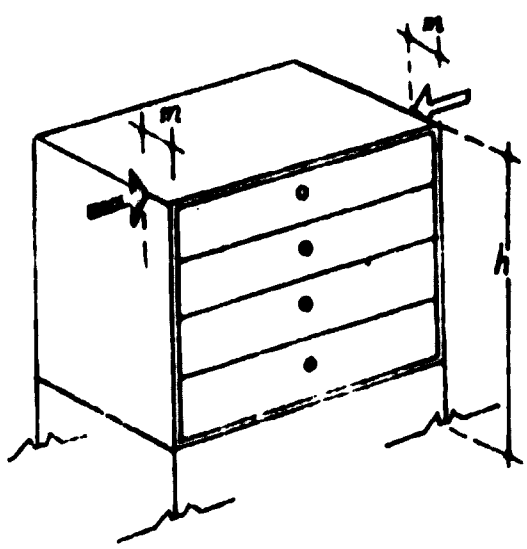
Fig.	Test	Diagram of testing
17	Impact testing	
18	Fatigue testing (characteristics of bodies)	
19	Fatigue testing of mattress.	

STRENGTH OF BEDS

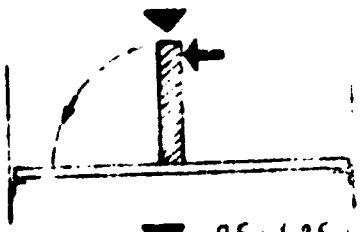
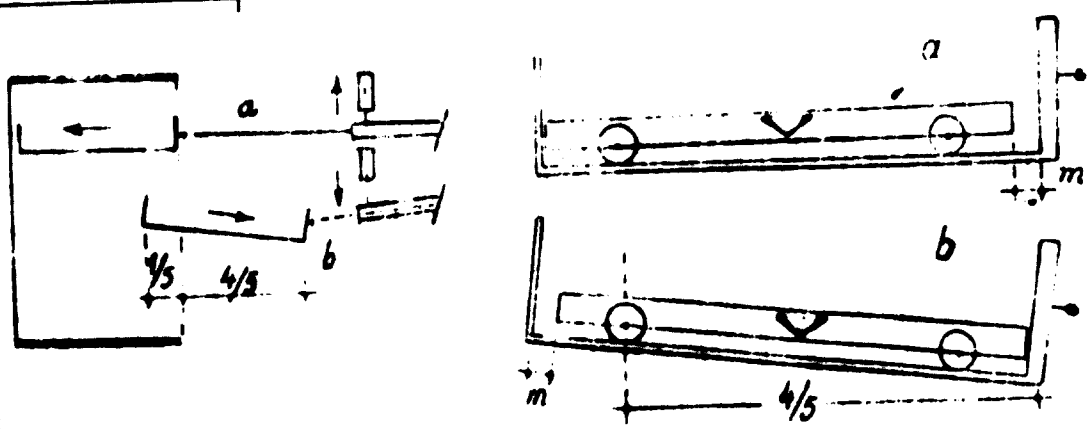
STRENGTH TESTS OF TABLES

Fig.	Test	Diagram of testing
20	Test of legs	
21	Test of ends	
22	Cyclic test of tables	

STRENGTH TESTS OF STORAGE FURNITURE.

Fig.	Test	Diagram of testing
23	Cyclic test of storage furniture	  m = 50 mm h max = 1500 mm

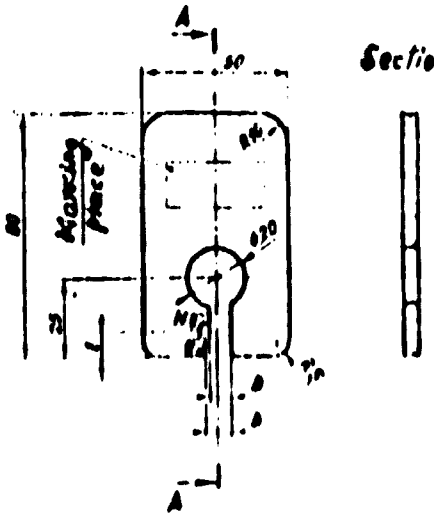
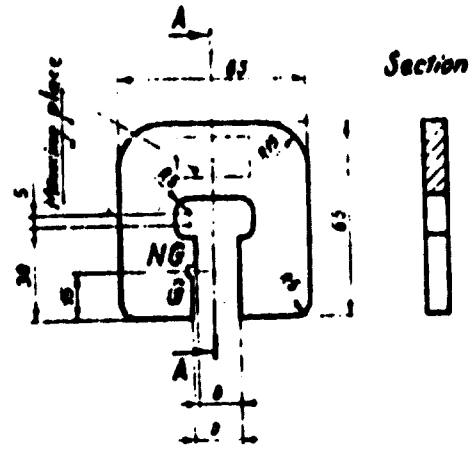
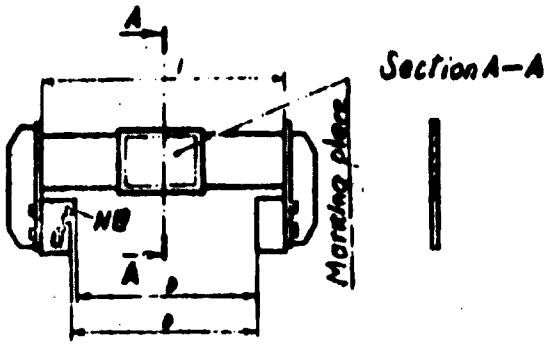
STRENGTH TESTS OF STORAGE FURNITURE.

Fig.	Test	Diagram of testing
24	Impact test of shelves	 ▼ 0.5 ; 1.25 ; 2.[illegible] Kg
25	Load test of shelves	
26	Cyclic test of drawers	 ▼ 0.3 Kg/dm², max 7.5 Kg m = 20 mm

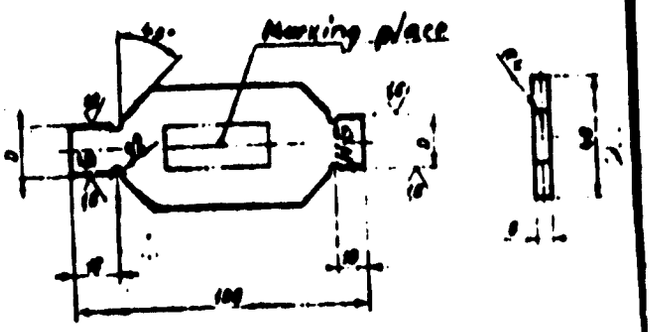
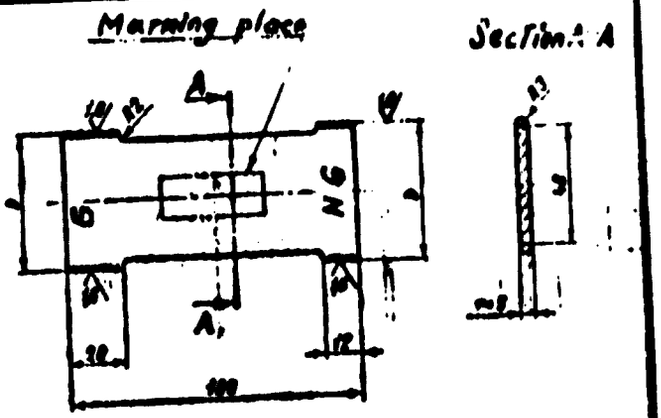
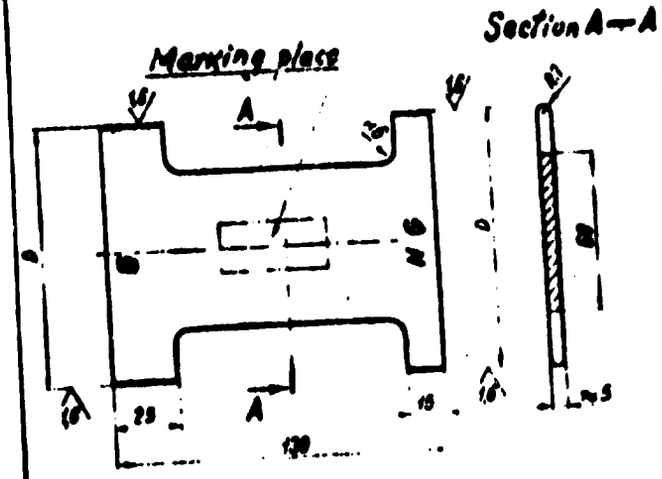
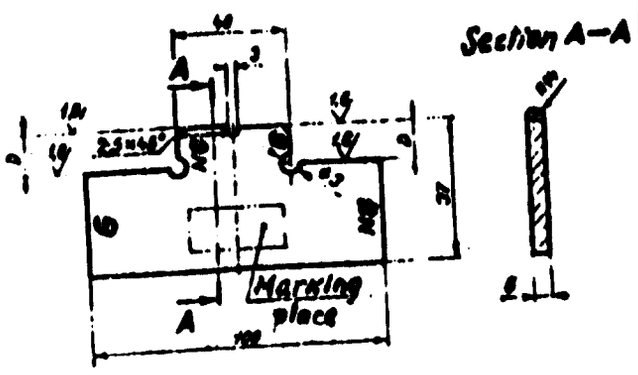
Annex 4.

GAUGES AND TEMPLATES

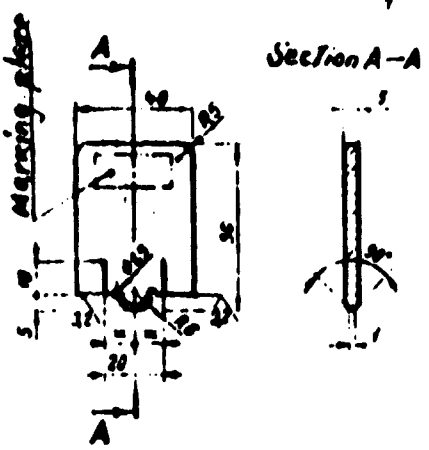
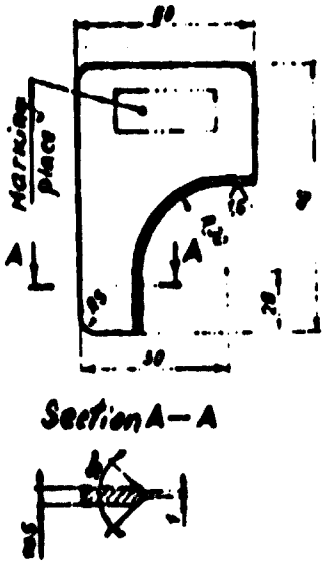
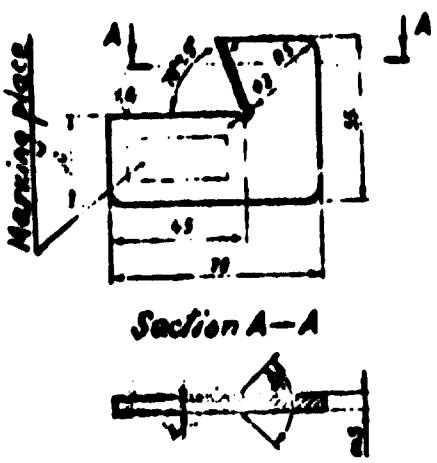
1. EXTERNAL GAUGES GO-NO GO

TYPE	SKETCH OF GAUGE Dimensions in mm.	MEASURING LIMITS, mm
0	1	2
Type A		3 – 15 at 2 mm intervals
Type B		16 – 30 at 2 mm intervals
		31 – 50 at 2 mm intervals
		51 – 100 at 2 mm intervals
		101 – 150 at 3 mm intervals
		151 – 250 at 3 mm intervals
Type C		250 – 1000 at 5 mm intervals
		1001 – 2000 at 5 mm intervals
		2001 – 3150 at 5 mm intervals

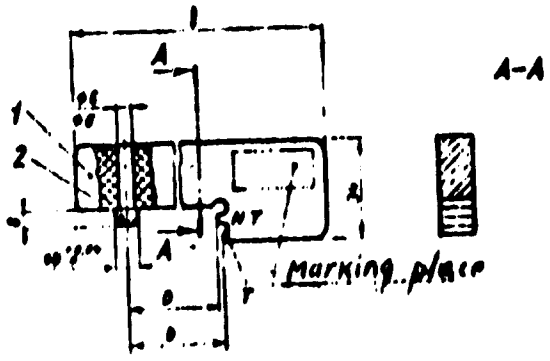
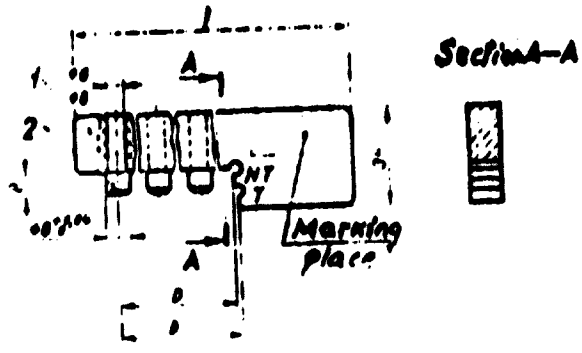
2. INTERNAL GAUGES GO - NO GO

Type A		3 - 15 at 2 mm intervals
Type B		16 - 150 at 2 mm intervals
Type C		16 - 100 at 2 mm intervals 101 - 250 at 3 mm intervals
Type D		16 - 100 at 2 mm intervals

3. CONTOUR TEMPLATE

0	1	2
Type A		3 - 15 at 2 mm intervals
Type B		16 - 30 at 2 mm intervals
		31 - 50 at 2 mm intervals
Type C		50 - 100 at 2 mm intervals

4. INTERNAL (HOLE) GAUGES.

Type A	 SIMPLE	3 - 1250 at 2 mm intervals
Type B	 MULTIPLE	3 - 1250 at 2 mm intervals

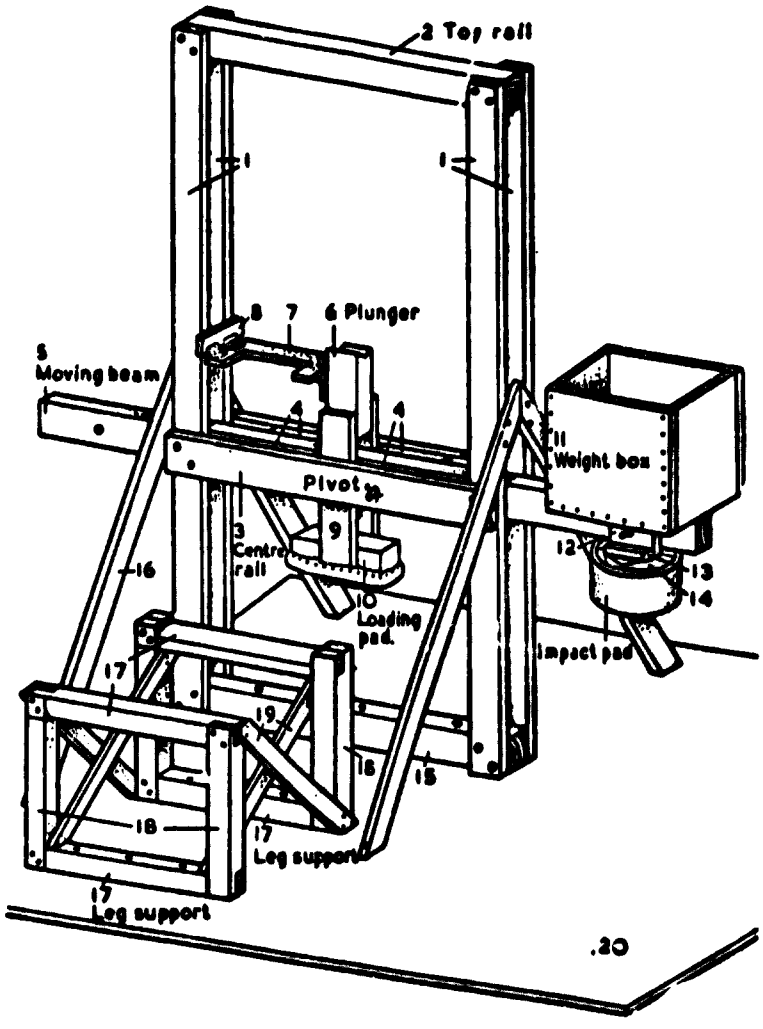
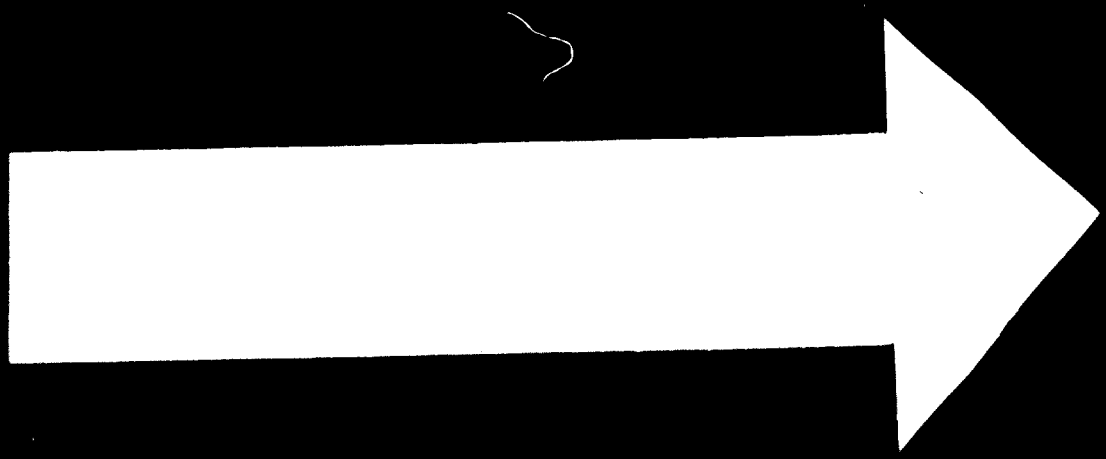


FIG. 27

APPARATUS FOR TESTING DINING-TYPE CHAIRS. (See page 15 for legend)



2. 9. 74

2 OF 2

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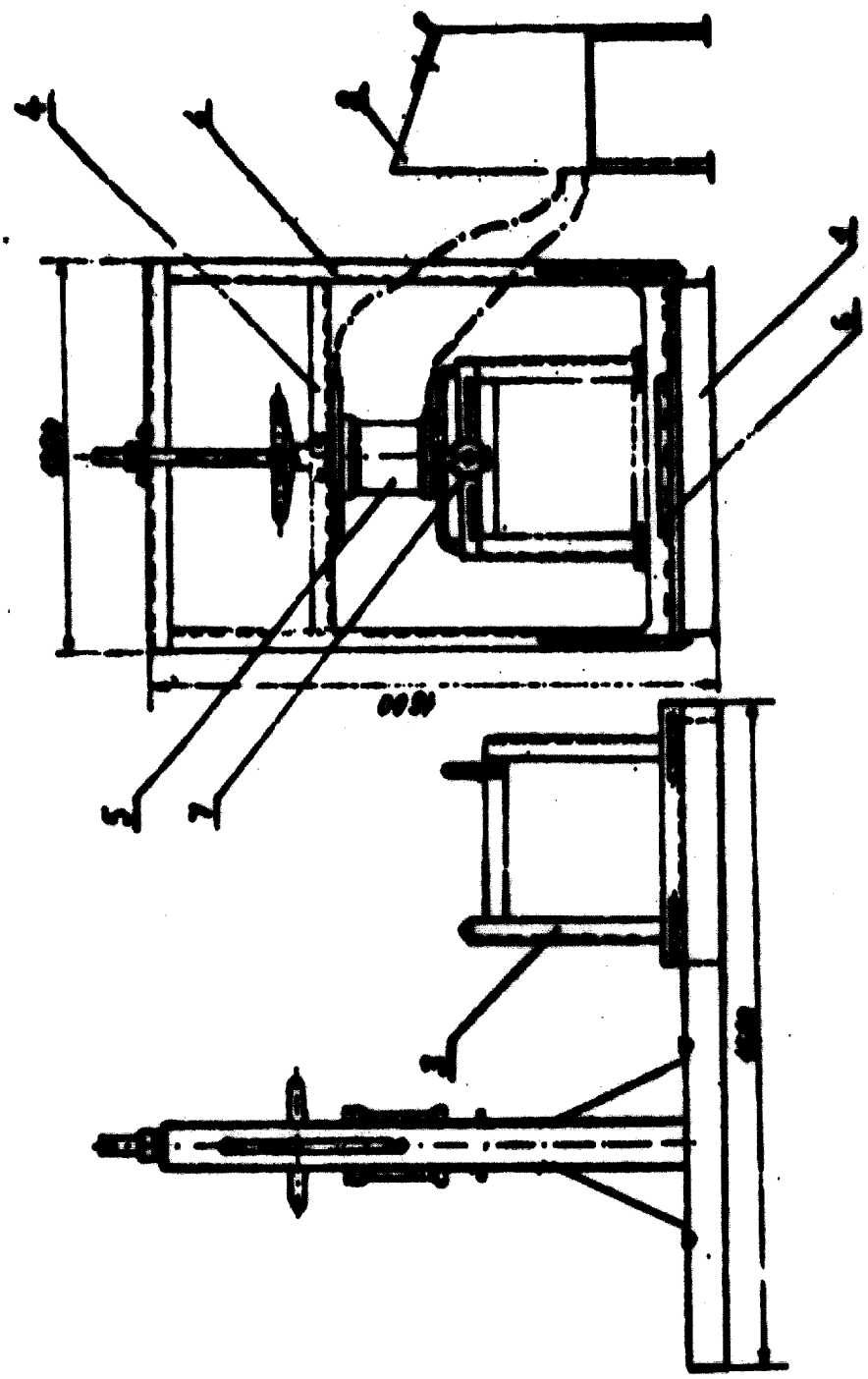
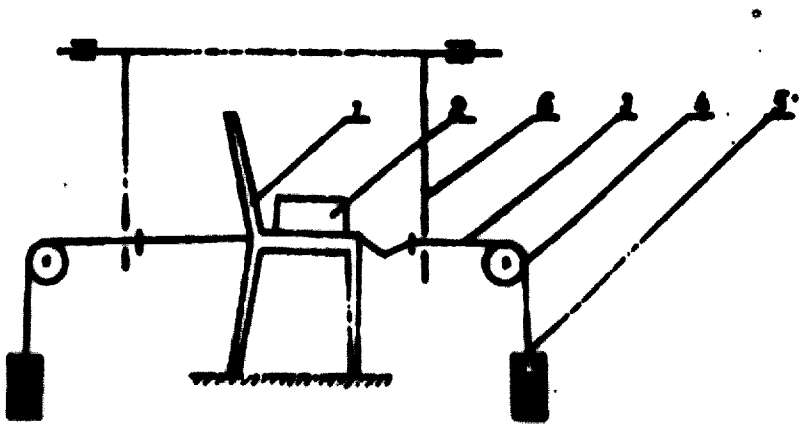


FIG.28

EQUIPMENT FOR MAKING STATIC TESTS ON GRATES (See page 15 for legend)



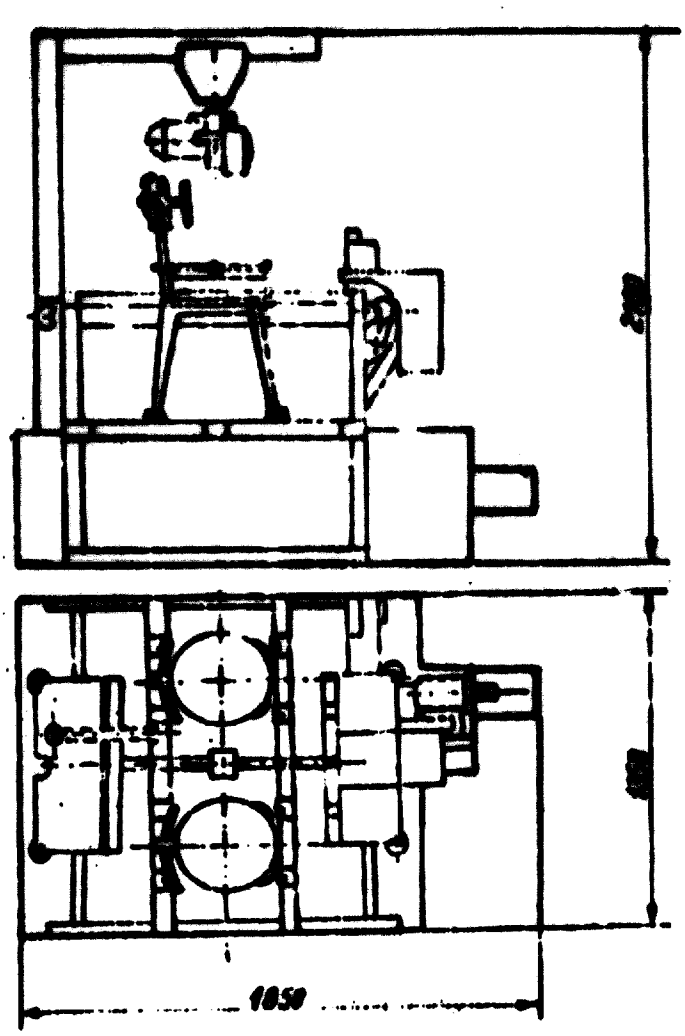
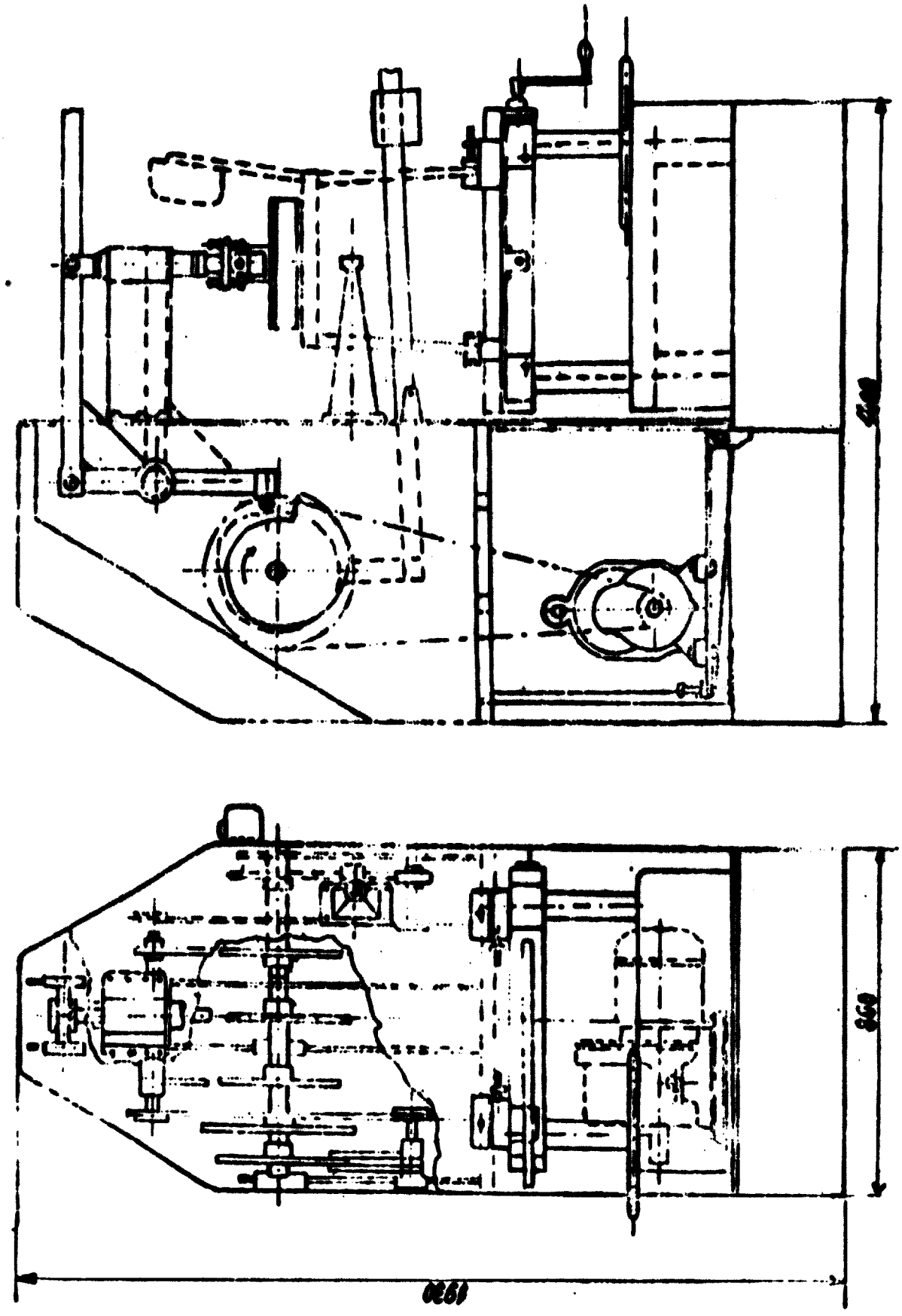


FIG. 29
EQUIPMENT FOR MAKING DYNAMIC TESTS ON CHAIRS (TIPPING AND ROCKING)

(See page 16 for legend)

FIG. 30

EQUIPMENT FOR MAKING DYNAMIC TESTS ON CHAIRS (STRENGTH AND DURABILITY)
(See page 16 for legend)



Annex 6

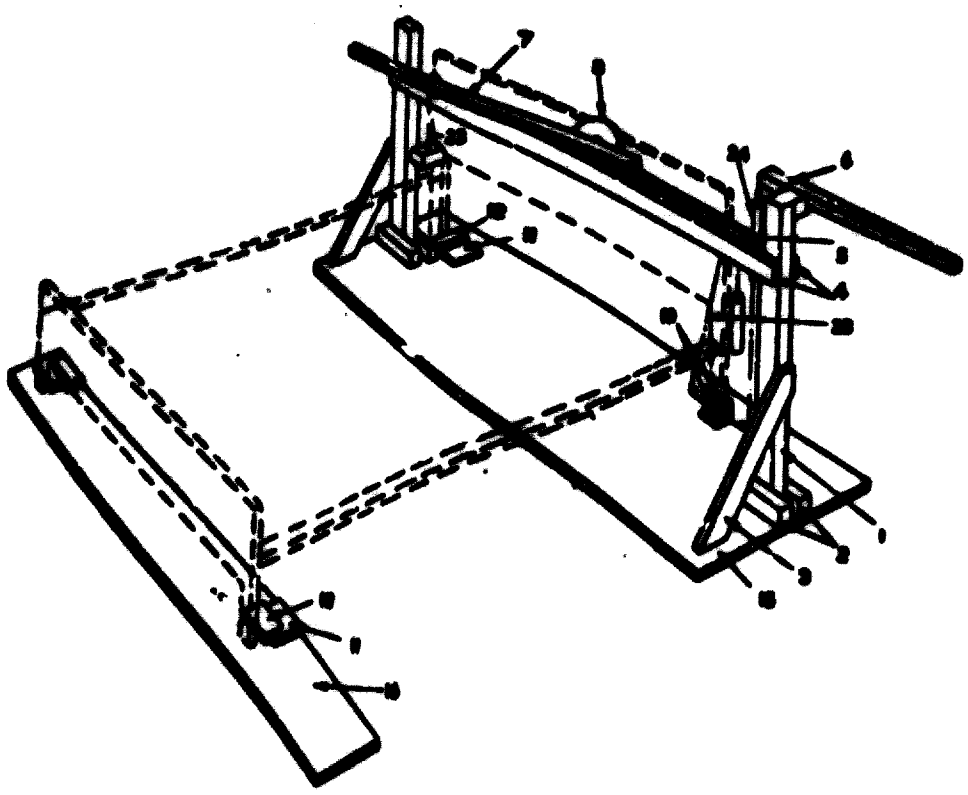


FIG.31

EQUIPMENT FOR TESTING BEDSTEAD ENDS (See page 17 for legend)

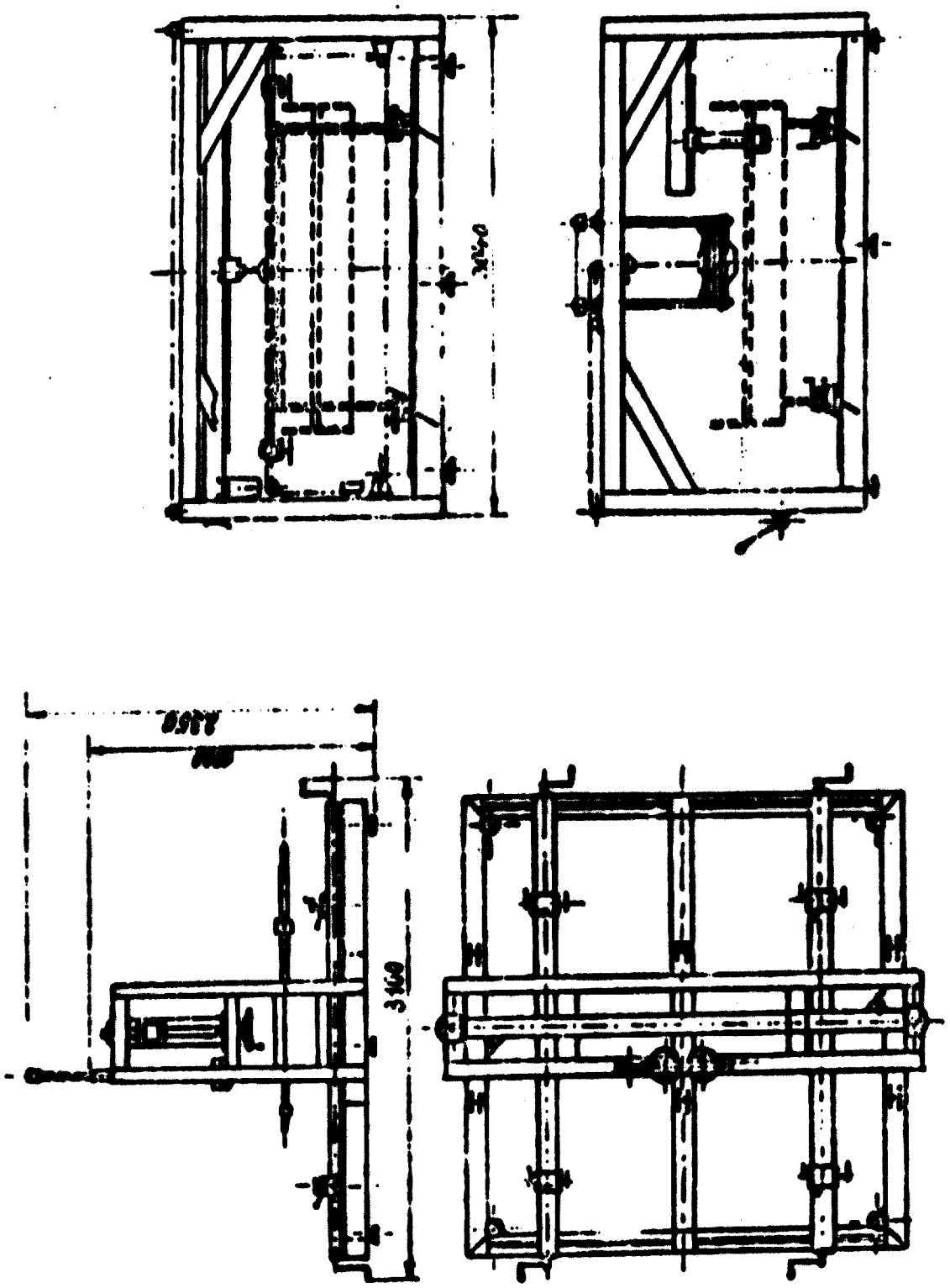


FIG. 32 EQUIPMENT FOR TESTING BEDS AND TABLES (STATIC AND DYNAMIC TESTS) (See page 17 for legend)

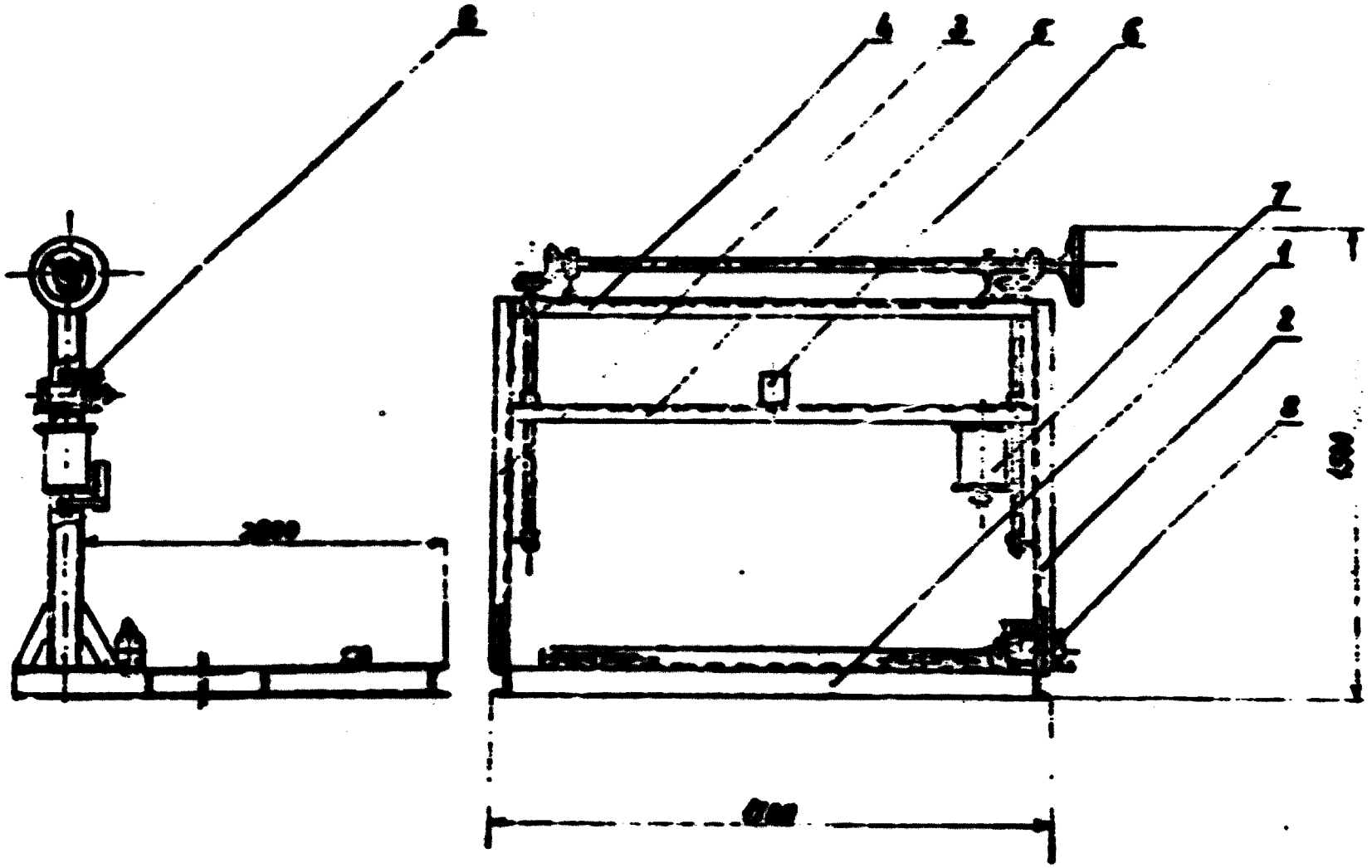


FIG.33
EQUIPMENT FOR MAKING STATIC TESTS ON BEAMS (See page 18 for legend)

Annex 7

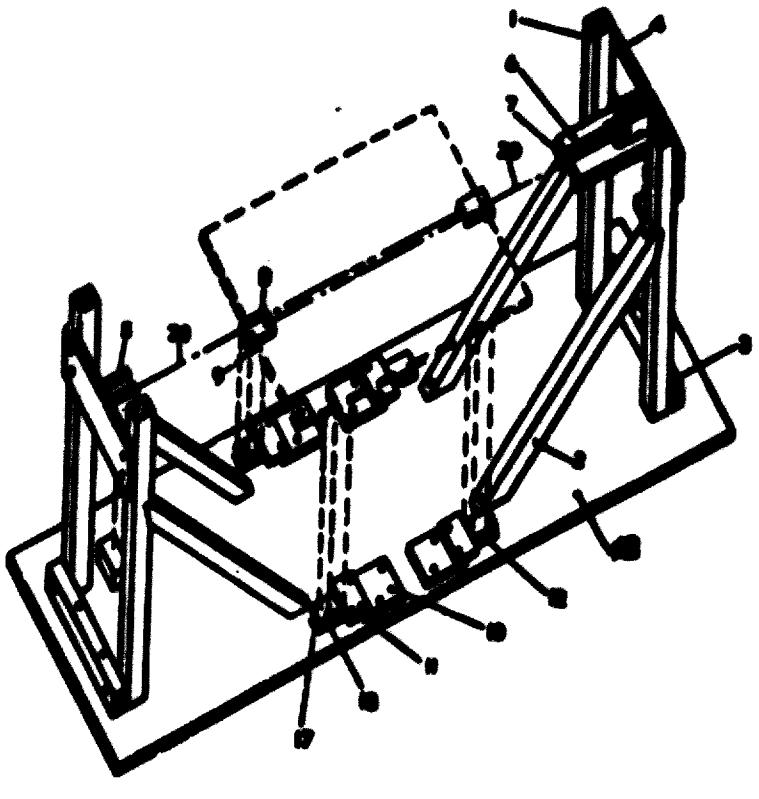


FIG. 34

EQUIPMENT FOR TESTING TABLES (See page 18 for legend)

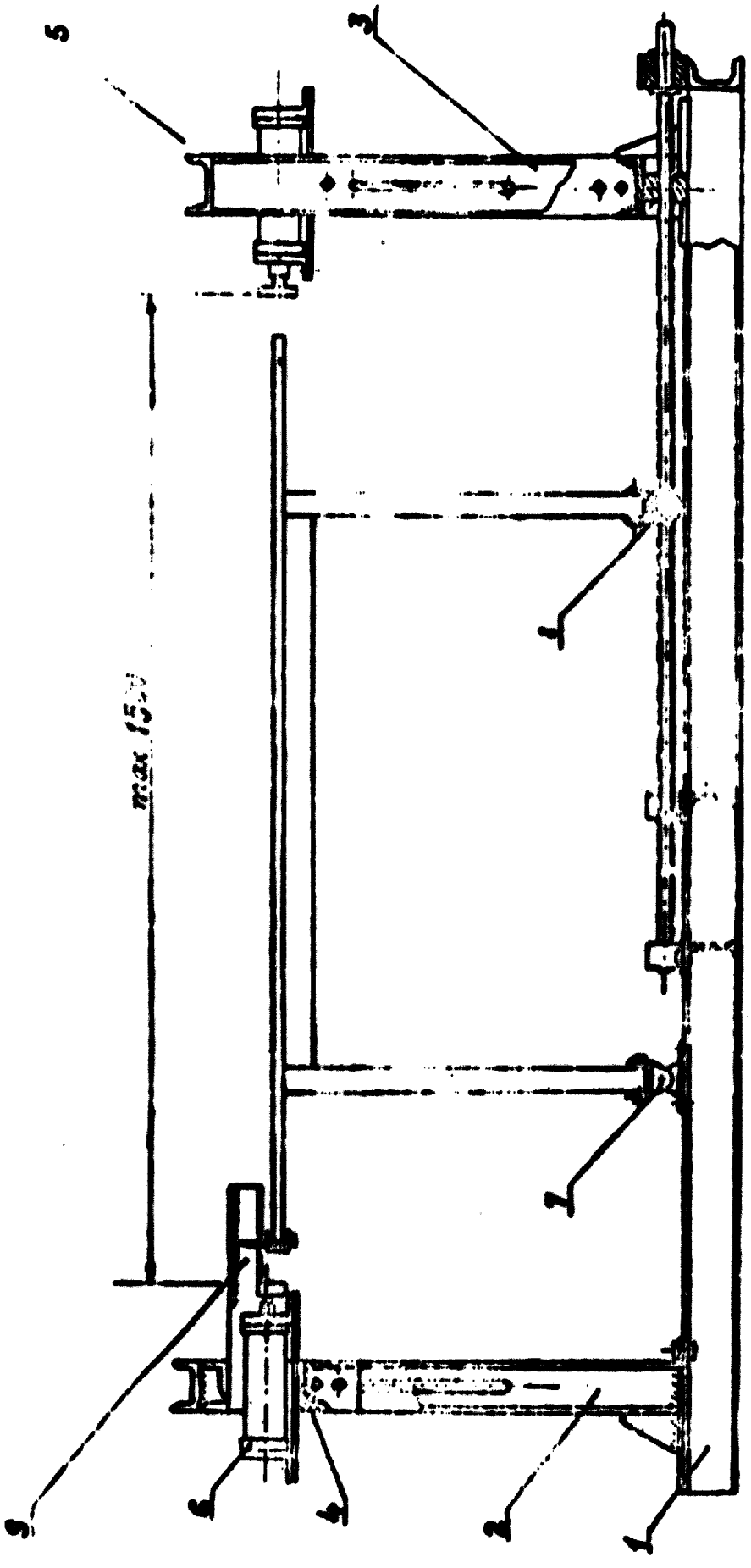


FIG. 35
EQUIPMENT FOR TESTING TABLES (CYCLIC, STRENGTH AND DURABILITY TESTS)
(See page 19 for legend)

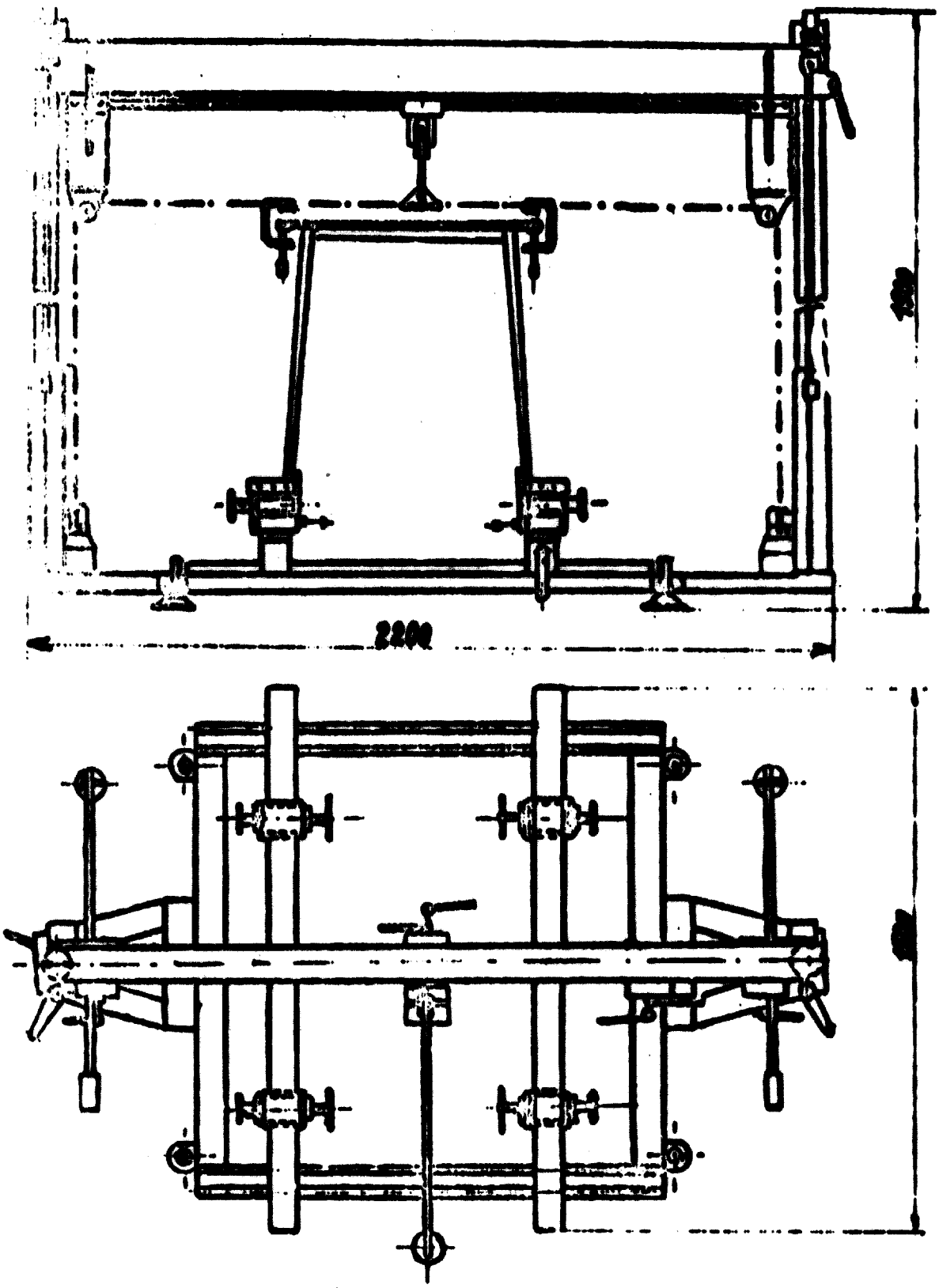


FIG. 36

EQUIPMENT FOR TESTING TABLES (CYCLIC AND DEFORMATION TESTS)

(See page 19 for legend)

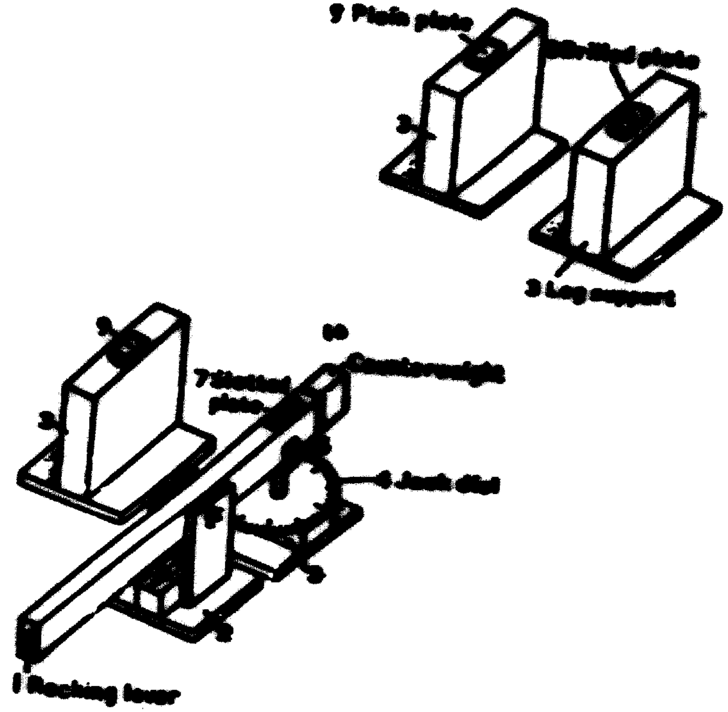


FIG. 37 ENDURANCE TEST EQUIPMENT FOR CABINET FURNITURE
(See page 20 for legend)

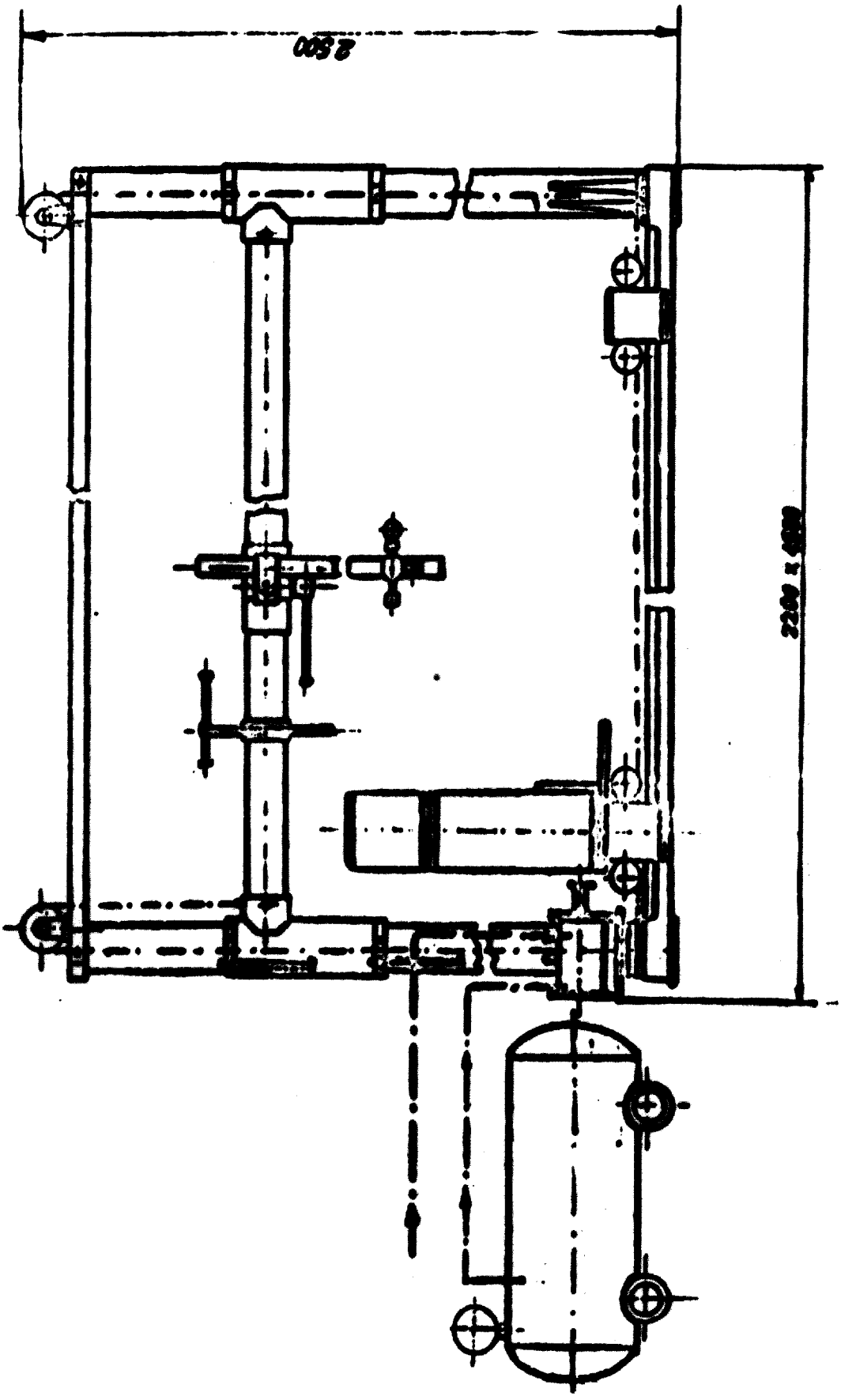


FIG. 36 EQUIPMENT FOR TESTING STRENGTH AND RIGIDITY OF STORAGE FURNITURE (See page 20 for legend)

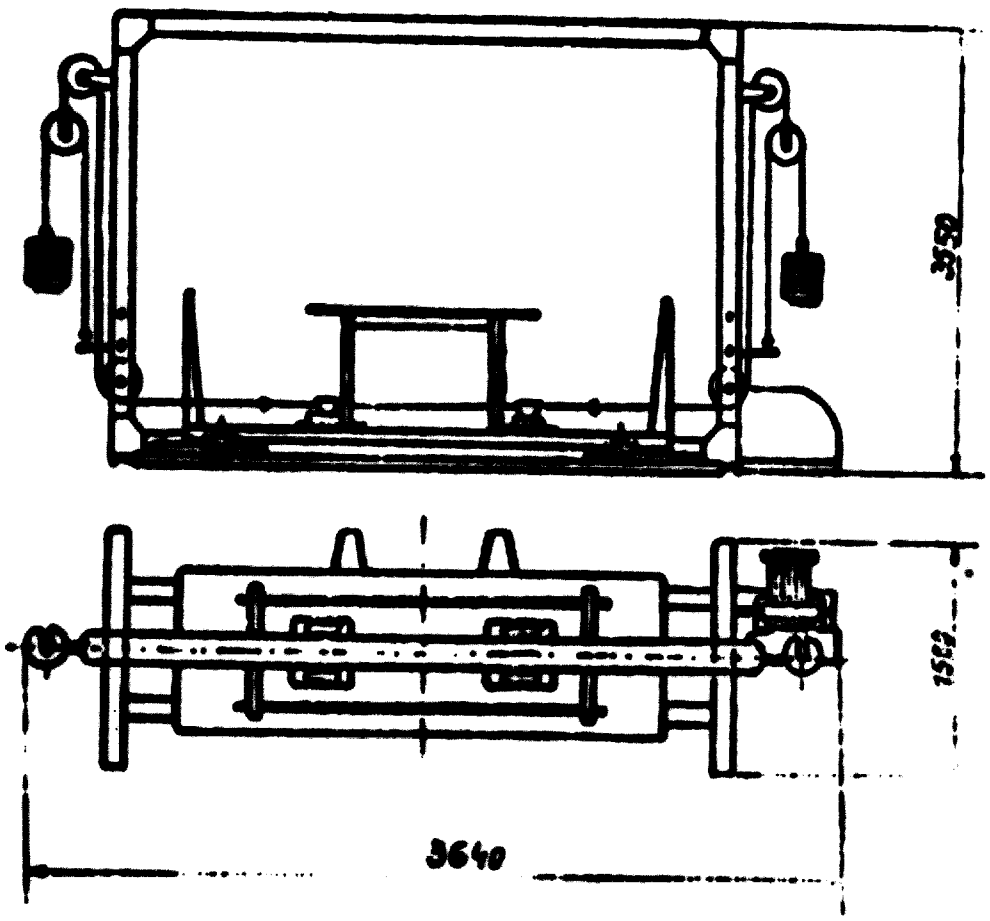


FIG. 39

TESTING EQUIPMENT FOR STORAGE FURNITURE

(See page 21 for legend)

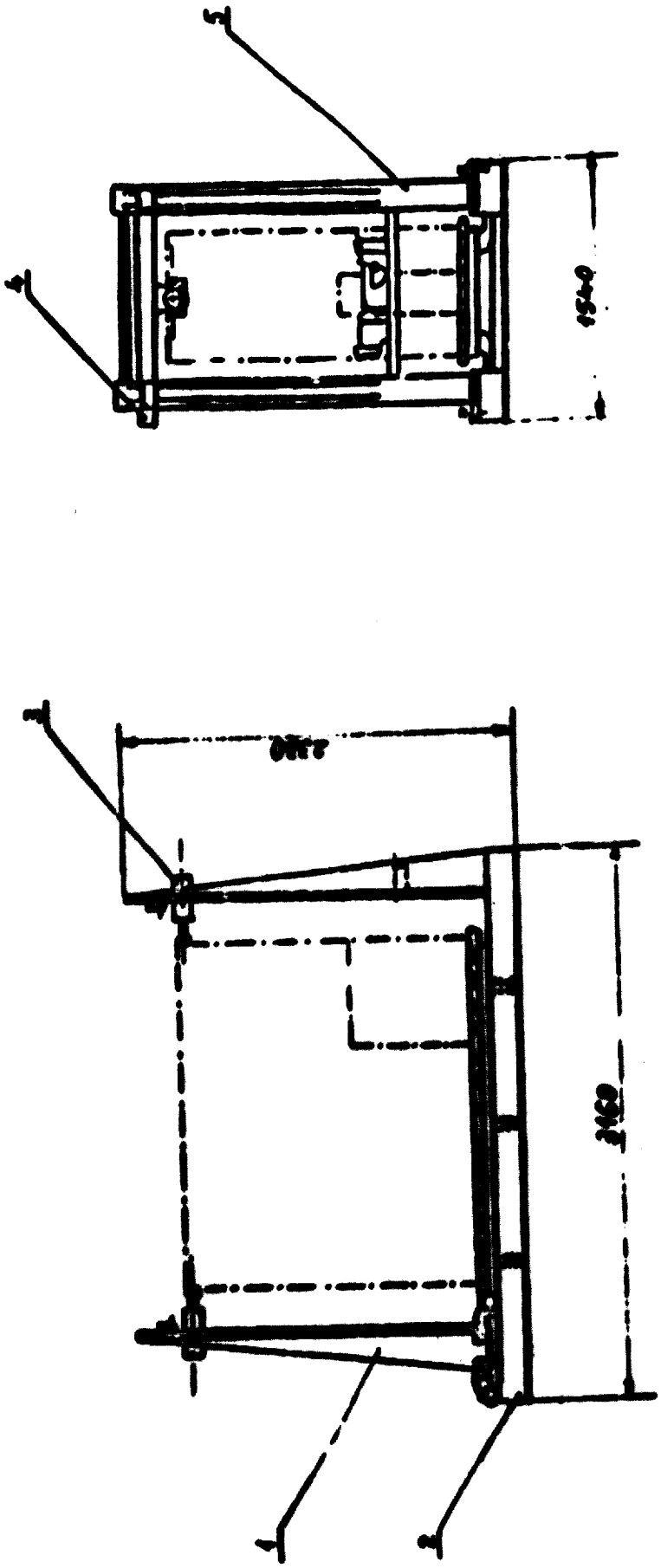


FIG. 40

Annex 9

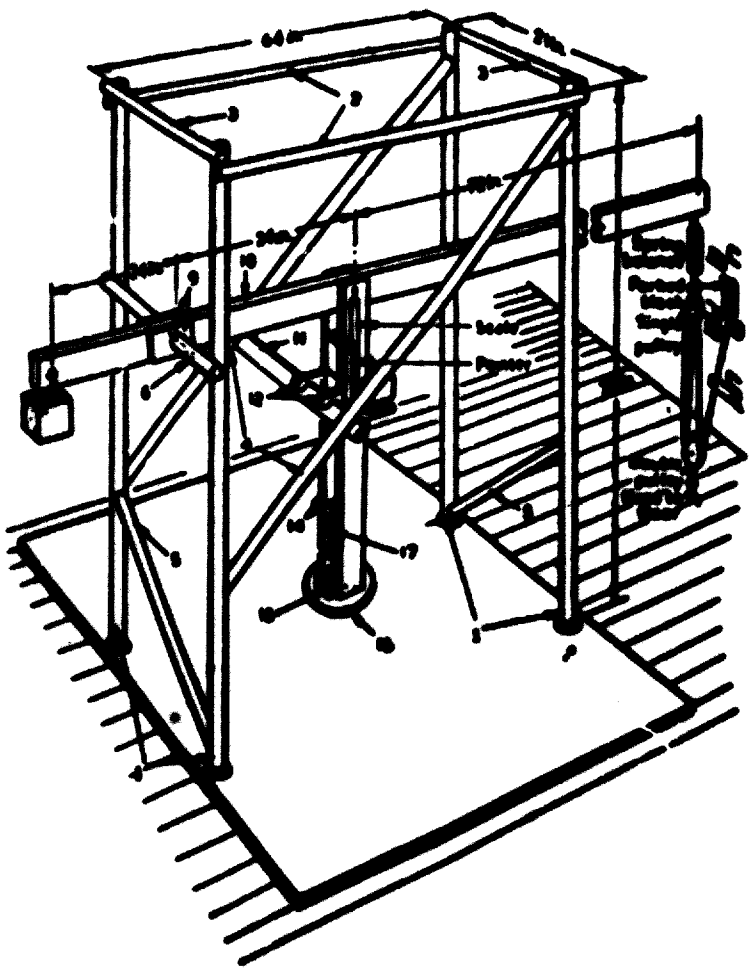


FIG. 41

EQUIPMENT FOR TESTING UPHOLSTERED FURNITURE SEATS

(See page 22 for legend)

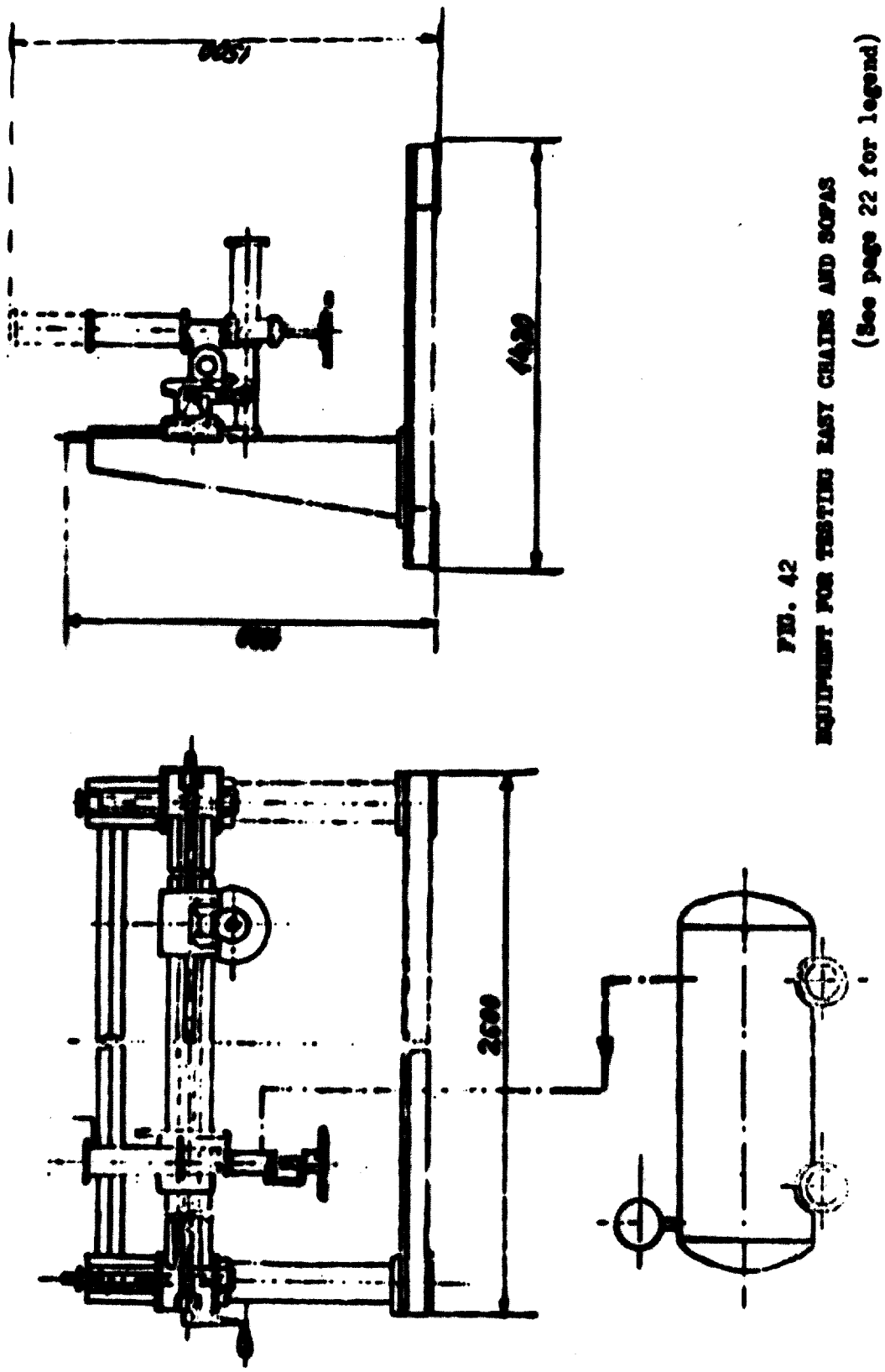


FIG. 42
EQUIPMENT FOR TESTING CAST CHAINS AND SCRAP
(See page 22 for legend)

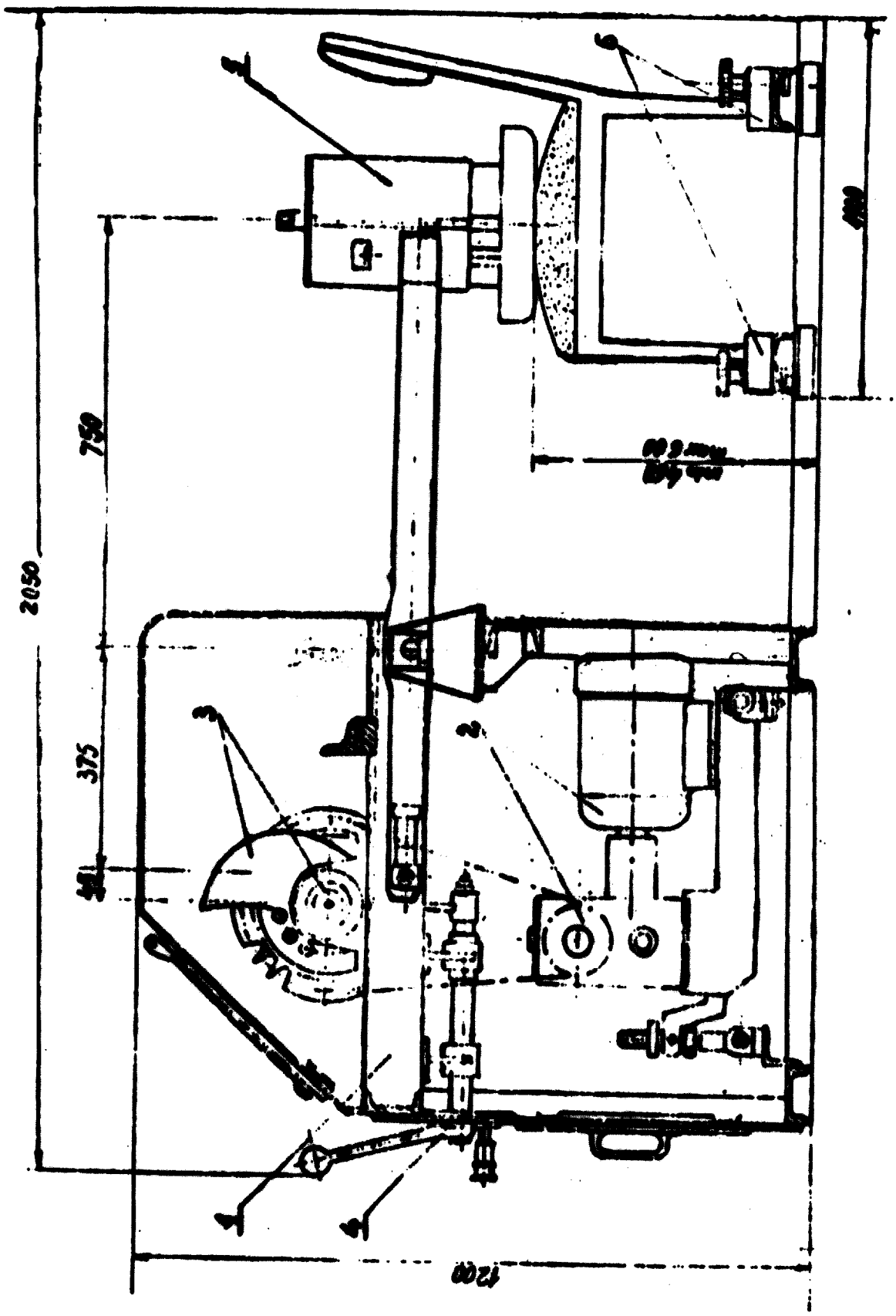


FIG. 43

EQUIPMENT FOR HYDRAULIC SERVICES OF UPHOLSTERED FURNITURE (See page 23 for legend)

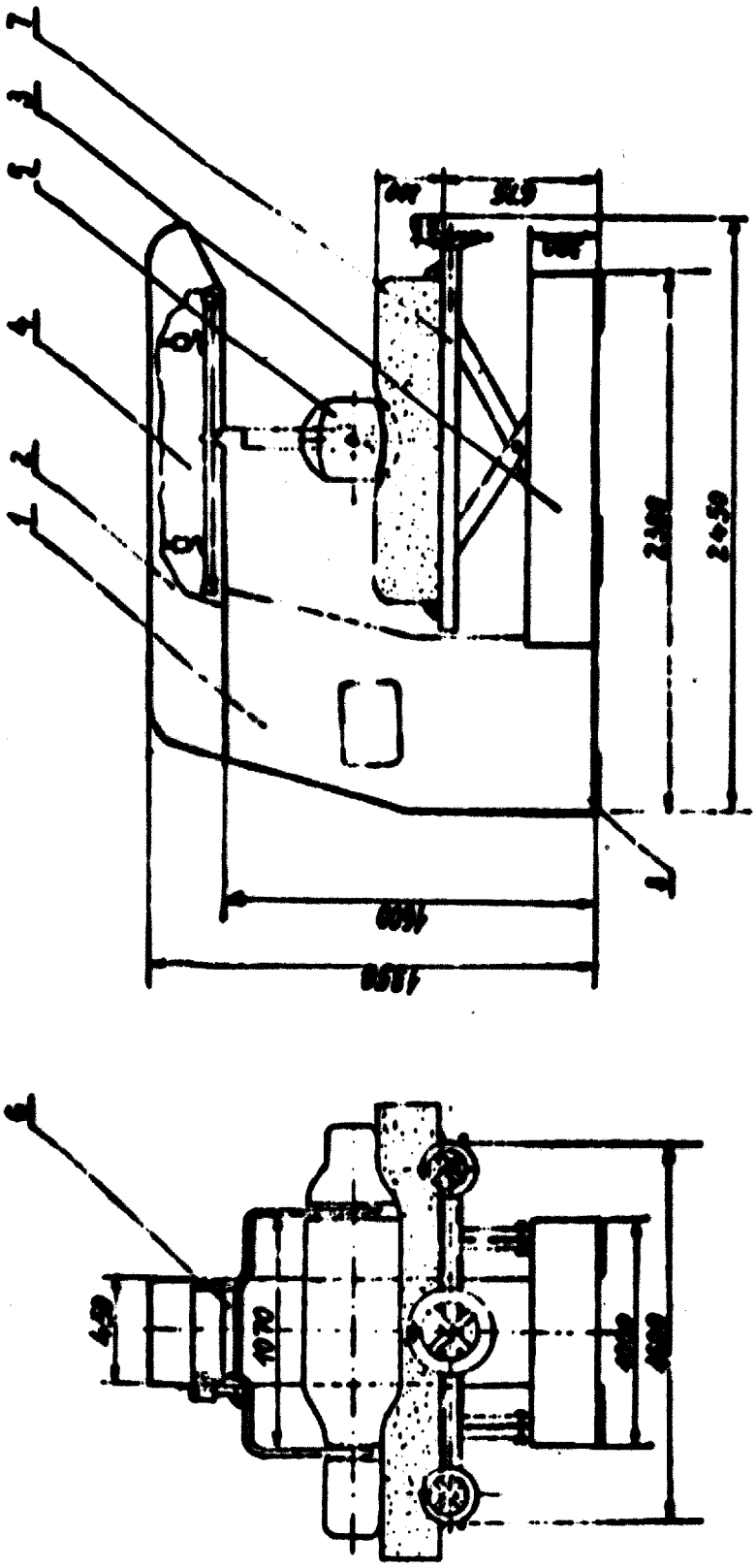


FIG. 44
BATTERIES TESTING EQUIPMENT
(See page 23 for legend)

Annex 10

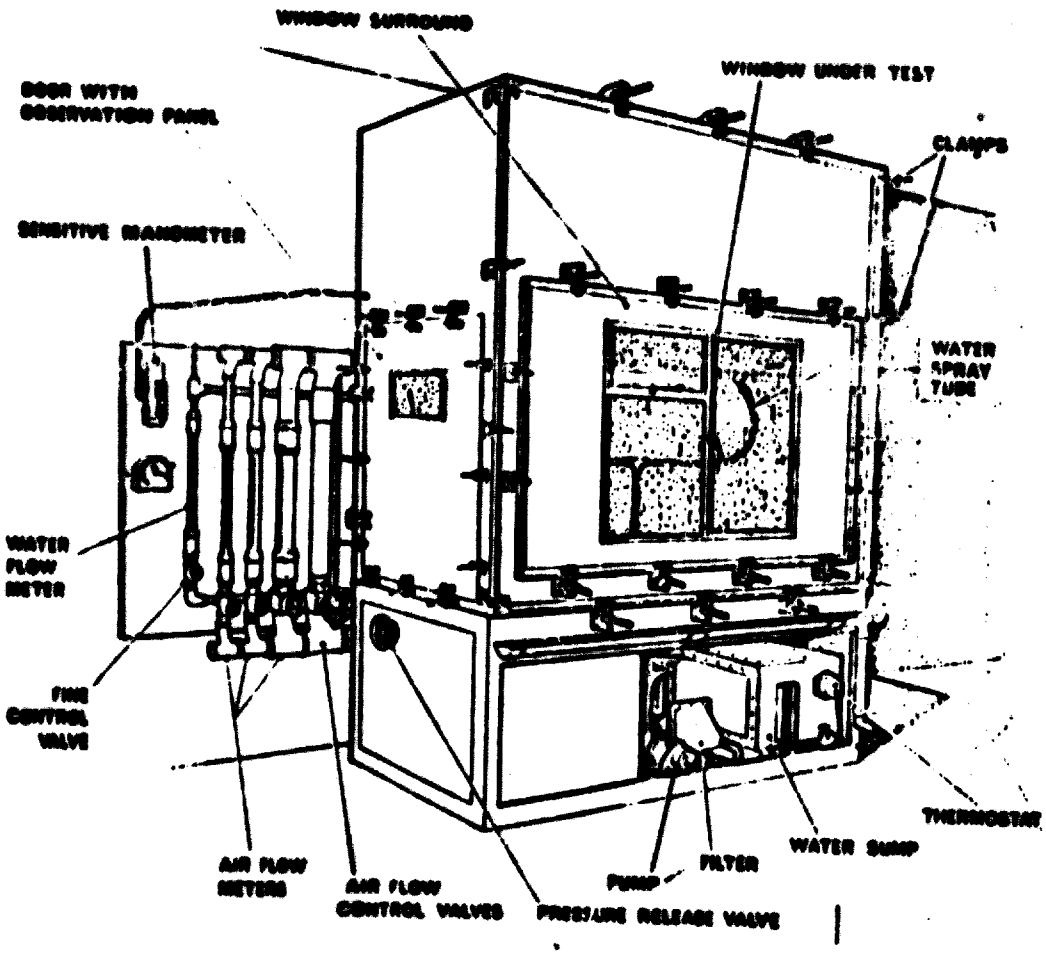


FIG. 45

PRESSURE CHAMBER FOR TESTING JOINERY PRODUCTS

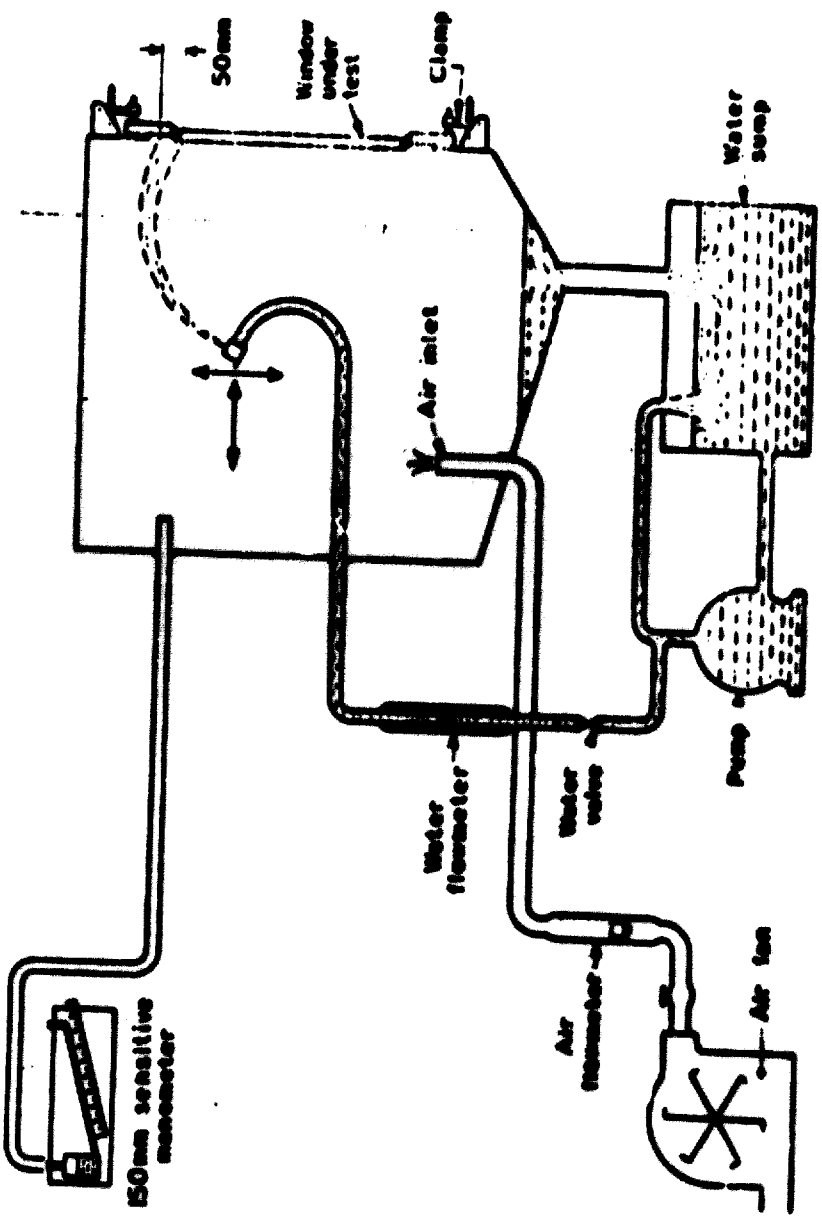

50mm
Window under test
Clamp
Water sump
Air inlet
Water flowmeter
Water valve
Pump
Air flowmeter
Air fan
50mm sensitive manometer

FIG. 40

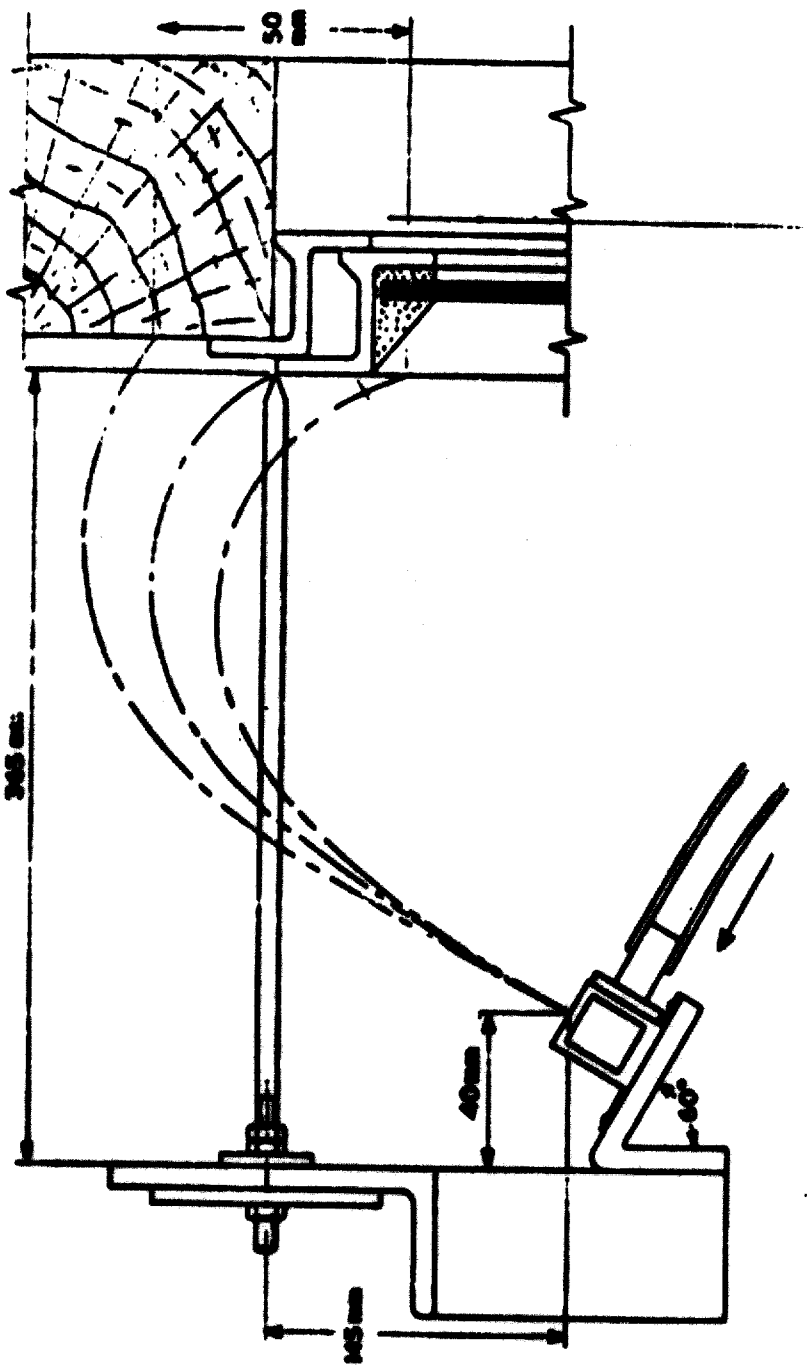
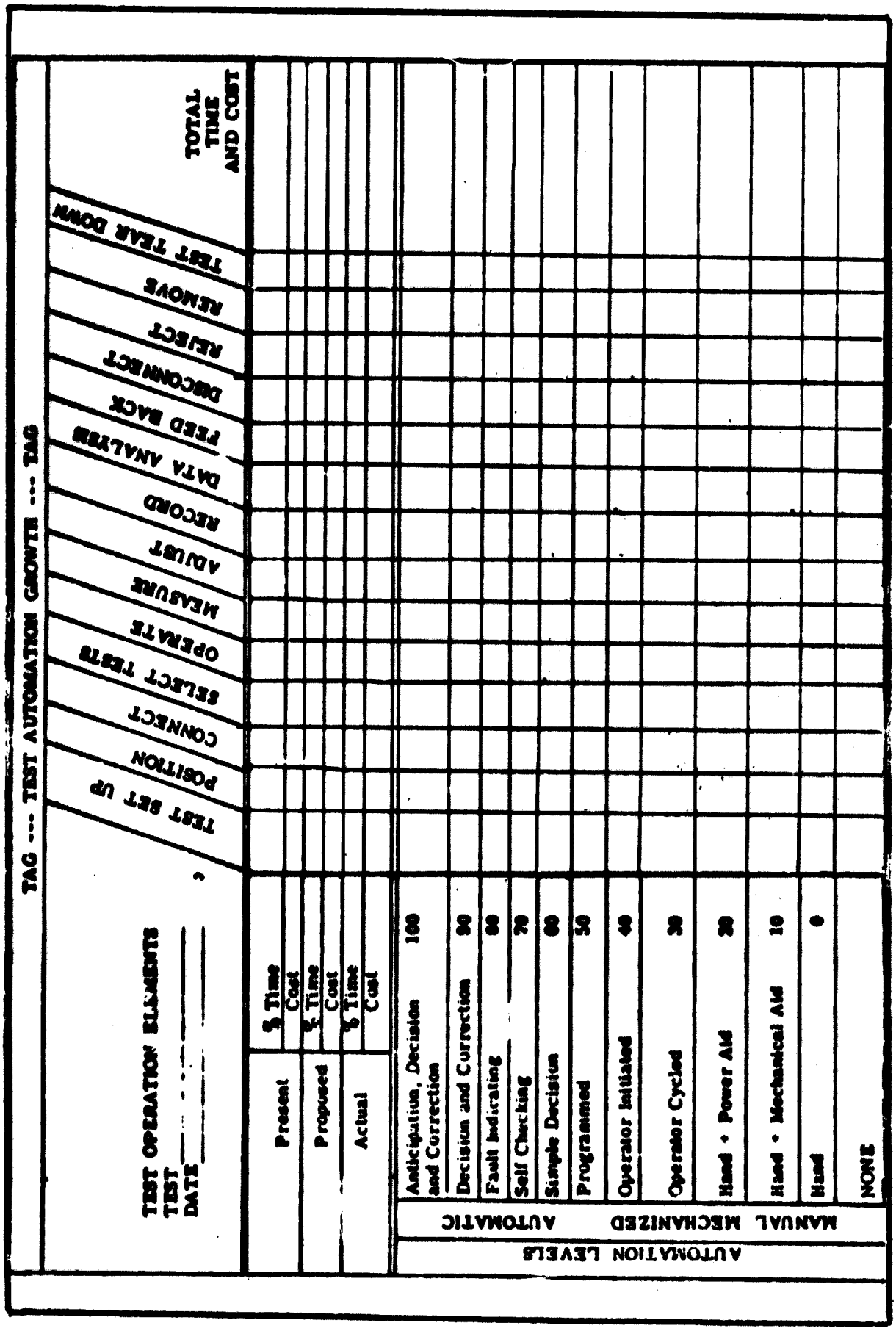


FIG. 47

Annex 11.


TAG --- TEST AUTOMATION GROWTH --- TAG
TEST OPERATION ELEMENTS
TEST
DATE
TEST SET UP
POSITION
CONNECT
SELECT TESTS
OPERATE
MEASURE
ADJUST
RECORD
DATA ANALYSIS
FEED BACK
DISCONNECT
REJECT
REMOVE
TEST TEAR DOWN
TOTAL TIME AND COST
Present
Proposed
Actual
% Time
Cost
AUTOMATION LEVELS
AUTOMATIC
MANUAL MECHANIZED
Anticipation, Decision and Correction 100
Decision and Correction 90
Fault Indicating 80
Self Checking 70
Simple Decision 60
Programmed 50
Operator Initiated 40
Operator Cycled 30
Hand • Power Aid 20
Hand • Mechanical Aid 10
Hand 0
NONE

Annex 12.

Definitions of quality cost elements

Receiving inspection. Inspection costs associated with inspection and test of purchased materials.

- Inspection and test. All inspection and test costs incurred for purposes of appraising and controlling the product.

- Calibration and maintenance. All costs of the calibration and maintenance of inspection or test equipment used for appraisal purposes.

- Evaluation tests. Costs incurred in running evaluation tests such as life tests and environmental tests. This includes costs of any material or product consumed or rendered unusable as a result of the test.

- Screening labour. Costs of any effort expended in screening the product for quality characteristics by any function.

- Quality audits. Costs of any quality audits for either product or procedural determinations.

- Final inspection. Any final inspection costs where this type of function occurs. Also costs of packaging, preservation, packing and shipping inspections.

- Vendor services. Costs of such vendor services as evaluations tests laboratory tests, and equipment repairs.

- Operator inspections. Costs of all process control activities performed to quality - supplied instructions by other than quality personnel.

- Process controls. Costs of all process control activities performed by other than quality personnel in accordance with instructions given by the latter.

- Process control engineering. The cost of that part of the quality engineering effort expended on appraisal functions.
  This includes first - piece inspections, troubleshooting, clarification of standards, product evaluation, etc.
- Equipment. Depreciation charged for equipment usage.
- Materials. Costs of any materials expended as part of the appraisal functions.
  This includes cost of products or samples destroyed through tests, utility costs, and costs of operating supplies.
- Quality reports. All labour and data processing charges associated with generating quality reports on appraisal efforts.

Annex 13.

The Portable Laboratory

1. Dial indicators with accuracy of 0.01 mm.
2. Measuring stand for dial indicators.
3. Tachometer with watch chronometer.
4. Quadry 4-way measurement caliper with accuracy of 0.05 mm.
5. Vernier slide caliper with range of 600 mm.
6. Feeler gauges
7. Universal level protractor
8. Block thickness gauge
9. Frame type spirit level
10. Flat steel rules
11. Inspection straightedge 400 mm.
12. Inspection straightedge 1250 mm.
13. Try square with bubble level
14. Rule meter 3000 mm. with bubble level and multiple possibilities for use for exterior, interior measurement, etc.

Annex: 14.

List of standards with quality requirements and condition of testing [1]

NF D 60 311	- Meubles massifs et plaqués - Caractéristiques minimales d'exécution.
NF D 60 701	- Meubles de bureau en bois - Caractéristiques minimales d'exécution.
AS S_1 - 1965	- Household Furniture (Minimum Requirements for Materials, Construction, Workmanship and Finish)
AS S_3 1 - 1961	- Contents and Dimensions of Innerspring Mattresses for Domestic use (Minimum Requirement).
AS S_3 2 - 1966	- Bases and Divans (Minimum Requirements)
RAL 430 D_2	- Quality requirements for office furniture.
DIN 68 360	- Timber for joinery, quality requirements.
DIN 68 705 (sheet 2)	- Plywood for general purposes; general requirements.
DIN 68 750	- Fibre building boards, soft and hard boards, quality requirements.
DIN 68 761 (sheet 3)	- Particle boards, quality requirements.
MSZ 8976-62	- Quality requirements and quality specifications for varnished and half-varnished domestic furniture.
MSZ 8977-68	- Furniture upholstery. Quality requirements.

1/ See page 76 for country identification

JUS/D.E_2.185	- Kitchen furniture. Methods of testing.
JUS /D.E_2 180	- Kitchen furniture. Characteristics of material and quality requirements.
NF D 60 501	- Méthodes d'essais des sièges individuels
NF D 60 511	- Sièges individuels en bois d'usage courant - Construction et essais.
NF D 60 512	- Sièges de repos garnis - Construction et essais.
Pr D 60 515	- Ameublement - Sièges transformables en lits - Construction et essais.
NF D 60 551	- Plan de travail des meubles de cuisine et éléments pour installations de cuisines. Caractéristiques-Essais.
NF D 64-501	- Lateles à ressort à usage domestique - Caracteristiques - Essais.
NF D 66-501	- Meubles de cuisine et éléments pour installations de cuisine - Caractéristiques générales de construction - Essais.
MSZ 8976 - 62	- Quality requirements, test and quality specifications for varnished and half-varnished domestic furniture.
MSZ 8977-68	- Furniture upholstery. Quality requirements. Test and qualification.
MSZ 12514-67	- Construction test and qualification of colour finished and unpainted furniture
MSZ 12294/1-68	- Surface treatment of wooden furniture parts: testing and qualification
NEN 2563	- Stiffness and strength of tables.
NEN 2565	- Resistance of wooden table-tops and other wooden flat parts to hot pans etc.
NEN 2566	- Resistance of wooden table-tops and other wooden flat parts to water.

NEN 2567	- Resistance of wooden table-tops and other wooden flat parts to alcohol.
NEN 2568	- Stability of tables (tilting)
PN-62/F-06002	- Domestic furniture. Specifications and methods of tests.
PN-66/F-06004	- Domestic furniture. Upholstered elements Specifications and methods of tests.
PN-64/F-06008	- Furniture for nurseries. Specifications and methods of tests.
PN-64/F-06009	- Furniture for nursery schools. Specifications and methods of test.
PN-64/F-06011	- Furniture for mess halls. Specifications and methods of tests.
PN-65/F-06012	- Furniture for reading rooms. Specifications and methods of tests.
PN-67/F-06014	- Domestic kitchen furniture. Specifications and methods of tests.
STAS 7182/1-70	- Furniture. Resistance to physical and mechanical stresses. Specifications.
STAS 7182/2-69	- Cabinet furniture. Resistance to physical and mechanical stresses.
STAS 7182/3-70	- Furniture. Tables for dining and working purposes. Resistance to physical and mechanical stresses.
STAS 7182/4-70	- Furniture. Chairs, easy chairs and settees. Resistance to physical and mechanical stresses.
STAS 7182/71	- Furniture for resting and sleeping. Resistance to physical and mechanical tests.
STAS 6335-71	- Furniture. Upholstery. Testing of resistance to mechanical stresses.

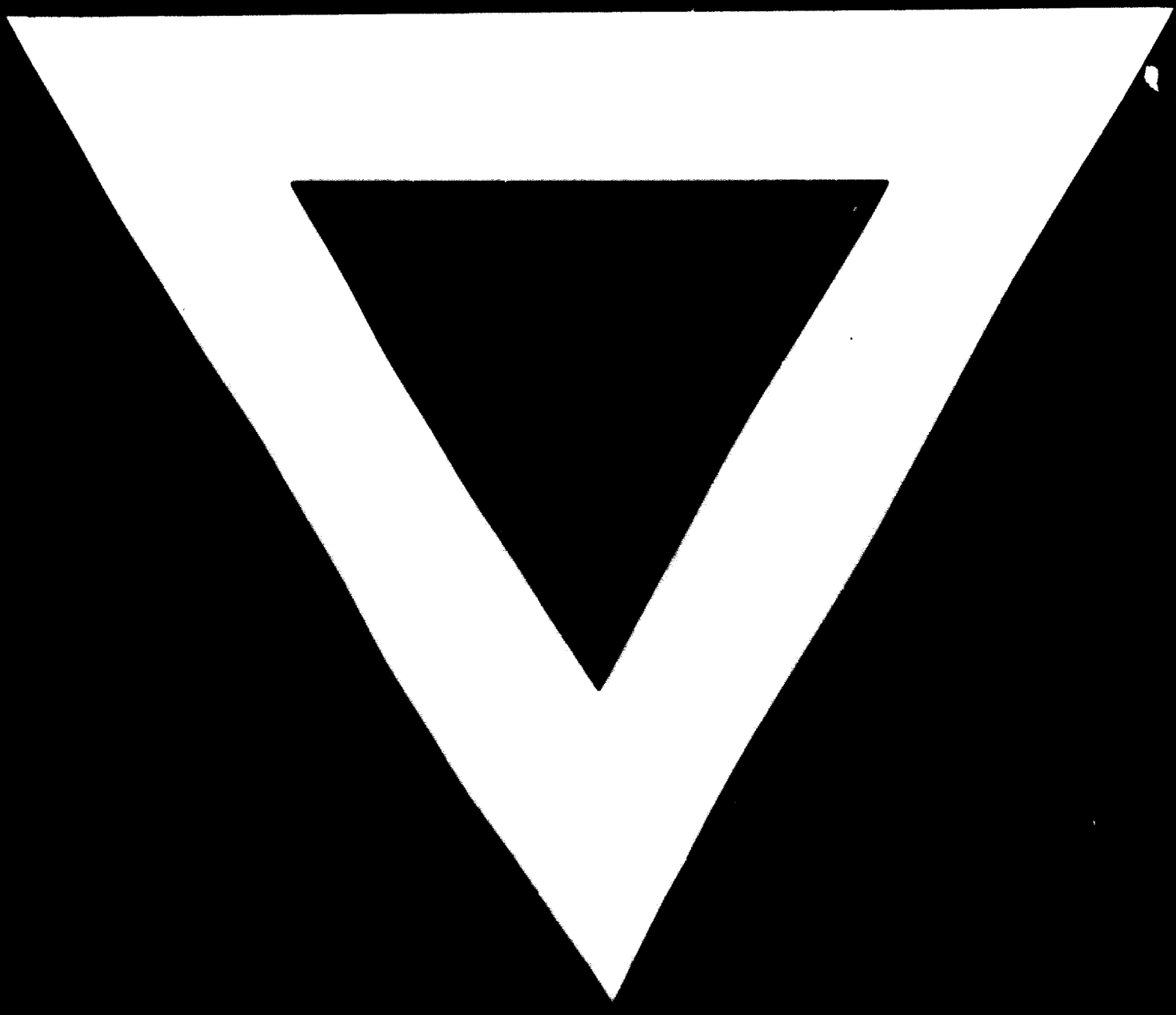
BS 1960-Part 1-5: 1953	- Domestic furniture constructed mainly of wood.
BS 4875: Part.1: 1972	- Specification for strength and stability of domestic and contract furniture - Part 1 - Seating.
SIS 1841-63	- Paints. Estimation of resistance to fats of organic finishes.
SIS 18-41-79	- Paints. Estimation of heat resistance of organic finishes.
SIS 24-58-20	- Plastic laminated decorative sheets. Quality and testing.
SIS 70-50-03	- Furniture surface. Resistance to liquids.
SIS 70-50-10	- Chairs - Test Methods.
SIS 83-91-10	- Furniture and fittings for housing. Determination of resistance of surfaces to blows.
SIS 83-91-11	- Furniture and fittings for housing. Test methods for drawers.
SIS 83-94-01	- Tables. Determination of rigidity
SIS 83-94-02	- Tables. Determination of stability.
SIS 83-94-03	- Tables. Determination of strength
SIS 83-95-01	- Determination of durability of armchairs and sofas.
SIS 83-95-02	- Stools and benches. Determination of strength.
SIS 83-95-04	- Chairs. Determination of stability.
SIS 83-95-05	- Arm-chairs. Determination of stability.
SIS 83-95-06	- Children's dining stools. Determination of strength.

SIS 83-95-07	- Childrens dining stools. Determination of stability.
SIS 83-96-21	- Furniture. Determination of durability of beds.
SIS 83-97-01	- Childrens cots. Test methods.
SIS 83-97-01	- Storage units. Determination of rigidity.
SIS 83-97-02	- Storage units. Determination of strength.
STAS 9317-72	- Joinery for non-industrial and industrial buildings. Endurance tests of wooden doors and windows at physical and mechanical stresses.
GOST 475-70	- Wooden windows and doors. Specifications.
BS 4315: Part 1; 1968	- Methods of test for resistance to air and water penetration. Part 1: Windows and gasket glazing systems.

LEGEND

Symbol/Country		Name/Address
NF	France	Association Française de Normalisation 92080 Paris - La Défense
AS	Australia	Standards Association of Australia 80-86 Arthur Street, North Sydney, N.S.W. 2060
RAL) DIN)	Federal Republic of Germany	Deutscher Normenausschuss, 4-7 Burggrafenstrasse 1 Berlin 30
MSZ	Hungary	Magyar Szabványügyi Hivatal, Postafiok 24 1450 Budapest 9
JUS	Yugoslavia	Jugoslovenski savod sa Standardisaciju Cara Uroša ul. 54, Post pregr. 933 11001 Beograd
NEN	Netherlands	Nederlands Normalisatie-Institut Polakweg 5, Rijswijk (ZH)-2106
PN	Poland	Polski Komitet Normalisacji i Miar Ul. Electoralna 2, Warszawa 51
STAS	Romania	Institutul Român de Standardizare Casuta Postala 10, Bucarest 1
BS	United Kingdom	British Standards Institution 2 Park Street, London W1A 2BS
SIS	Sweden	Sveriges Standardiseringskommission Box 3295, S-103 66 Stockholm 3

Symbol/Country		Name/Address
DS	Denmark	Dansk Standardiseringsraad Aurehøjvej 12, DK-2900 Hellerup
GOST	U.S.S.R.	Gosudarstvennyj Komitet Standartov Soveta Ministrov S.S.S.R. Leninsky Prospekt 9b, Moskva M-49



2. 9. 74