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FURNITURE UPHOLSTERING FOR DEVELOPING COUNTRIES 1/

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C O N T E N T S

FURNITURE UPHOLSTERING FOR DEVELOPING COUNTRIES

1. INTRODUCTION

Despite the rapid technological changes which have occurred in the furniture industry during the past two decades, probably the section of the industry least affected is that of upholstery. Even with the use of modern sophisticated methods of production and the development of new materials and fabrics, the upholsterer in many respects still plies his trade much as did many previous generations of craftsmen. It is true that the hammer, scissors, and web-stretcher have been replaced by the stapling gun shears and resilient webbing, but the production of a well-made item of upholstery is still dependant to a considerable extent on the individual skill and judgement of the craftsman.

For developing countries, the inevitable improvement in living standards and consequent increased demand for furniture of all kinds, ensures for upholstery and those engaged in its production, a promising future. It is, and will remain, much more labour intensive than other sectors of the furniture industry, and this should undoubtedly recommend its careful nurturing to those charged with worthwhile home-based industrial development. Furthermore, its establishment on either a workshop or factory basis requires a comparatively low initial capital investment in either production facilities or training, and its close relationship with the clothing industry allows it to derive immediate and lasting benefit from the latter.

2. THE UPHOLSTERY FRAME

2.1 Design

Since the upholstery frame is an integral part of the finished article of furniture, it cannot be regarded in isolation from it, nor from the other elements such as the padding and covering fabrics which go to make up the whole. Indeed the successful production of any piece of upholstery, particularly from the points of view of shape, contour uniformity, good tailoring and, most important of all, comfort, is derived in large measure from the careful design of the skeleton, or inner frame.

The design of the frame will therefore take into consideration the overall styling of the piece, the upholstery materials to be used, the degree of comfort aimed at, as well as its functional use as a support for the human body sitting down on it, and rising from it.

If the frame is show-wood then there are further considerations such as the timber species to be used, and the type of finish required. The widespread use of foam in its various forms has added a further dimension and permitted the design and manufacture of shells and shaped components hitherto unobtainable from wood.

2.2 Production

It is not part of the function of the upholsterer to 'correct' the faults in shape or structure of the inner frame by means of padding or other such practices. This merely adds to the cost of production without adding to the value, and usually results in an article which is sub-standard. All such "faults" can and should be eliminated at the production and assembly stages of the frame. Whether the frame is show-wood or an inner box-like structure, its production should be equally precise, and have the same attention to detail paid to it whether it be in the machining of the various components to be jointed, or the contouring or "arrising" of elements which will come into direct contact with fabrics and other materials easily damaged.

Considerations such as ease of production as well as economy of materials will always apply, but in addition, the good upholstery frame will always anticipate the needs of the upholsterer by incorporating appropriate fixing points for springs, webbing, connectors and castors. In large manufacturing units, techniques have been evolved for the production of a rationalised and highly integrated type of unit production, where the various elements such as arms, seats, backs, and cushions are completed to the upholstery stage before final assembly. However, this is not possible with traditional or reproduction type seating and in the smaller factory or workshop an integral type frame even for modern designs is usually manufactured.

It is a truism that the upholstery of any type of seating, is only as good the frame so that careful attention given to the latter at all stages from design to final assembly, will pay handsome dividends in the satisfactory production of the completed piece.

3. UPHOLSTERY PRODUCTION

The major elements of upholstery production may be summarised as follows:

1. Selection of appropriate frame.
2. Cover selection and inspection.
3. Cover marking and cutting out.

4. Sewing (including quilting and zip insertion).
5. Cushion filling and buttoning.
6. Upholstering of frame (including springing up and profoaming) Final Assembly.

3.1 <u>Selection of appropriate frame</u>

This has been dealt with at length in the previous chapter. It is sufficient to emphasise here that when the frame reaches the upholsterer it is ready for upholstery and can be "sprung up" and pre-foamed without further delay.

3.2 <u>Cover selection and inspection</u>

The materials available for upholstery covering are many. Traditionally, there were the wool and cotton fibres which lasted for many hundreds of years. Then there were the rayons and finally a multiplicity of the latest synthetic fibres including nylons, polyesters, acrylics and polyolifins. These may come as a combination of any or all of the latter.

In deciding therefore on a suitable material for covering purposes, it is necessary to seek one with the following characteristics:

(a) <u>Resistance to abrasion</u>. For example nylon yarn is more resistant to abrasion than wool or cotton, and in general it can be said that this applies in every comparison between natural and synthetic materials.

(b) <u>Resistance to soiling</u>. Lighter materials will show soiling more readily than darker shades, but the fibres used in the manufacture of the cloth have a considerable bearing on this problem. In general, an all wool cloth will show less soiling than a similar all rayon cloth.

(c) <u>Suitability for sewing</u>. In materials where the yarns are heavy, and there are relatively few threads per inch, the threads can fray out easily from the edge. Furthermore a ½" seam allowance is considerably less by the time the machinist has turned the piece inside out. If the seam is located on a part of the chair which is subjected to considerable wear, fraying can be even more marked and will eventually cause the seam to part.

(d) <u>Avoidance of slippage</u>. This occurs when the weft slides over the warp and any seams parallel to the weft can readily slip open when strained, causing seam breakdown.

Since most upholstery covers are made from woven materials, there is at the same time a growing use for both warp and weft knitted fabrics which have a bonded foam backing. Great care however must be taken in sewing, as it tends to damage the threads in the cloth, and ladders or splits across the courses can occur. This fault is best dealt with by using the finest needles practicable, having regard to the possibility of excessive needle breakage.

Some rule of thumb checks which can assist in assessing the suitability or otherwise of a fabric for upholstery include:

1. If the fabric splits when stretched between finger and thumb.
2. If it is possible to slide the weft threads over the warp so that bruising occurs, then there is every likelihood of slippage.
3. Make a slight cut in the fabric and if subsequently it can be easily torn, then it will not be suitable.
4. Fold a white handkerchief over the index finger and rub the cloth with a steady pressure over an area of about 4" for about 25 rubs. If little or no colour rubs off, then it is likely to be suitable.

In the case of coated materials, there are supported and unsupported PVC materials and PV coated fabrics. The performance of unsupported PVC is related to thickness, but with coated fabrics it depends to a considerable extent on how solid the top layer is. Maximum resistance to scuffing and knocking is achieved by choosing a coating with a thick solid layer. It is also advisable particularly in deep buttoning, to use the better quality backing and thus avoid bursting through of the button. There are very many varieties of Polyurethane (PU) coated fabrics which it is difficult to assess through the normal test of feel and appearance. It should therefore be accurately tested for resistance to flex cracking, scuffing or scratching and should be capable of being easily cleaned.

3.3 Cover Marking and Cutting Out

Good cover marking and subsequent economical cutting-out of the material is achieved by careful planning and accurate marking of patterns, avoidance of using light patterned materials and the use of specialist cutting and marking equipment. Economical use of the material begins, of course, at the design stage when, among other things, the designer takes into consideration the width and texture of the material intended for use.

Marking Out

a. Standard Chalks

For small-scale upholstery, the simplest and most common method is that of using standard chalks. These are readily available in a variety of colours and shapes. They are sometimes difficult to remove.

b. Wax Chalks

These produce marks which will not rub off, but can be removed later by ironing or steaming.

c. Vanishing Chalks

These are used for delicate fabrics and will disappear within a matter of days.

Pattern Boards

The type of board really depends on frequency of usage, but in any case they should not easily wear out. Suitable materials include plastic laminate, plywood and hardboard. These pattern boards should be given a coat of lacquer for protection and carefully stored in a special locker under the cutting bench for further use.

Cutting Out

The smaller upholsterer is unlikely to be concerned with multiple lay cutting, and will concentrate on single lay cutting by hand or powered shears. It will, however, still be to his advantage to consider and plan carefully for all his cutting requirements. These begin with a good cutting table, built to the correct dimensions, which is adequately lighted. He must equip himself with the proper tools and these include a clearly marked and easily read measuring rule and a good shears whether hand or power operated.

Powered Shears

These can be electrically or pneumatically operated and are most suitable for single lay-cutting particularly of heavy duty upholstory. The blades can be 4, 6, 8 or 10 sided and are fitted with automatic sharpeners.

Round Knife Cutters

These are somewhat similar to the powered shears having flat base plates and blades from 4" to 10" high, but they are stronger and therefore more suited to multiple lay-cutting. They also have automatic sharpeners and since the total cutting edge is quite long and the action a shearing one, the cutting edge of the blade remains sharp over a prolonged period. A difficulty arises in dealing with tight radii as there is a tendency to slant the cut on sharp bends.

4. SEWING

The best way to ensure good sewing performance is to select the machine best suited to the job. The most widely applied stitch type is the lock-stitch which uses a needle thread and a bobbin thread. A loop of the needle thread passes through the material and is interlaced with the bobbin thread. The needle thread is pulled back so that the interlacing comes mid-way between the surfaces of the fabric being sewn.

Two basic types of sewing machine mechanisms are used to achieve this stitch formation:

a. Oscillating shuttle
b. Rotary hook.

Lockstitch machines are available as single needle models and two-needle models. Machine frame construction is in three basic forms:

a. Flat bed
b. Cylinder bed
c. Post bed.

4.1 Feed Systems

Applied to the basic lockstitch machine are many different feed systems and the correct choice of feed is most important. The basic system is that the fabric is fed forward by a bottom feed with the presser foot held against the feed surface by spring pressure. The feeding action only takes place when the needle is clear of the fabric, the feed "dropping" beneath the throat plate at completion of its feeding action. An adequate feeding system for most sewing operations using light to medium weight fabrics with good dimensional stability, the method has the disadvantage of allowing fabric movement against the stationary presser foot with the tendency to produce differential rates of feed between bottom and top layers of fabric.

Compound Feed

Using the same basic "drop" feed system, compound feed has the added advantage of being so designed that the needle on passing through the fabric moves forward with the feed motion. This helps to ensure that the two, or more, layers of fabric are fed forward uniformly, the needle acting as an additional feed. This type of feed is a minimum requirement when sewing fabrics that exaggerate the over feeding of the bottom ply, and is the basic feed requirement for upholstery work. Piping feet are available for this type of machine. With the introduction of the open cam replacing the piped seam, the two needle lockstitch, compound feed, post bed machine has found an application in the trade. The post allows for easy access to the open seam, and for the cover to fall away from the operator, two operation advantages which would not be obtained by using a two needle flat-bed machine. A reinforcing tape can be fed to the bottom of the seam if required and is desirable on a fabric with dimensional instability.

4.2 <u>Needle types and applications</u>

Perhaps the most important part of every sewing machine is the correctly made needle. Each machine has its own needle designation and it is vitally important that the correct needle for the machine is used.

There are two general classifications of needle point styles:

1. <u>Cloth Points</u> : Points with a round cross section
2. <u>Leather Points</u>: Sub-divided into various styles of points designed for stitching leather and other materials for which a round pointed needle would be unsuitable.

Generally the upholstery trade uses cloth point needles and most sewing problems encountered can readily be overcome from a choice of one or two point styles.

<u>Needle Sizes</u>

In selecting a needle size to use for a particular operation, the blade must be heavy enough to provide the strength necessary to penetrate the fabric being stitched without forming too large a perforation and without damaging the fabric. The needle must also be heavy enough to prevent its being deflected by the texture of the fabric. The eye of the needle must be suited to the thickness of the thread to be used. The thread must pass easily through the eye so that during the actual stitch formation, the thread can be drawn freely through the eye and grooves of the needle without chafing. The eye must not be so large in relation to thread thickness that the needle thread loop cannot be correctly formed.

For most upholstery sewing jobs, needle sizes 20, 21, 22 are used with size 21 being the most common. On open seam work using a post bed machine, it is better to use as small a needle size as possible - in practice this is a size 18 or 19. The major sewing machine manufacturers supply a technical service for needle application and their assistance should be sought in solving specific sewing problems.

5. SEWING THREADS

When sewing lounge upholstery materials such as polyurethane or expanded vinyl coated fabrics, it is not enough simply for a thread to be strong, it must be very much more besides if it is not to let down an otherwise good quality article.

Seam break-down has not been uncommon where cotton or linen threads have been used and this is not surprising when it is realised that these natural fibre threads have a maximum extension of about 9 per cent. Modern synthetic threads, on the other hand, have far greater stretch and it is for this reason more than any other that core-spun threads are to be recommended.

These consist of a continuous filament synthetic core, usually of polyester, around which is spun a cotton cover. The synthetic core gives the thread a high strength and extensibility which is characteristic of the fibre, while the cotton gives good sewing properties. Because synthetic threads are so much stronger than the natural ones, it means that finer sizes can be used whilst maintaining or even increasing the level of strength.

Finer threads mean that longer lengths can be wound onto a package with consequently less down-time for changing cones. Using finer threads allows the use of finer needles with reduced risks of excessive perforation in the case of PU or vinyl materials and laddering in the case of knitted fabrics. While you cannot lower the needle size past a certain limit because of the nature of the material being sewn and the number of thicknesses in some seams, the very heavy needles used for upholstery in the past are too severe for modern materials.

Synthetic threads have good resistance to both flexing and abrasion and will stand up to wear and tear as well as the fabric itself. Apart from this, both nylon and polyester have excellent resistance to the rotting effects of mildew and bacteria which can pose a problem in tropical countries or where conditions are damp. Considering upholstery which is washable, whether it is removeable zip covers, or mattresses for hospital use which are washed and sterilised at high temperatures, it is evident that the thread used must be stable and unaffected by washing conditions. Synthetic fabrics need threads which will match their washing characteristics so that there will be no distortion due to seam shrinkage and no seam failure due to the thread being degraded by washing agents.

One sewing problem often encountered with unsupported vinyl fabrics is differential feeding in sewing. This arises because the bottom ply of the material is fed forward positively by the feed dogs on the machine, while the top ply is held back by the presser foot. The result of this is a puckered seam with one ply of fabric left shorter than the other. Ideally fabrics of this type which are prone to differential feeding should be sewn on a machine which has the unison feed, where the feeder, needle and presser foot move forward together. Common practice where these machines are not available, is to spray the upper surface of the top ply with silicone or oil, or alternatively, to smear a little oil along the seam line prior to sewing. A similar feeding problem can occur with pile fabrics; if two pile faces are in contact, one seems to "walk" over the other as the fabric is fed forward and this can only be solved by using a compound feed.

6. FLEXIBLE FOAMS

Since Latex Foam first made inroads into the market previously held by cotton batting, feathers, hair and springs etc., flexible foam, latterly polyurethanes have advanced in many aspects of both product quality and manufacturing techniques.

6.1 Latex Foam

Latex Foam is still an extremely good cushioning material, and its special characteristics of resilience continue to make it a popular though more expensive medium for upholstery.

6.2 Polyurethane Foams

Polyether types of urethane foam, which were introduced in the mid 50's did have better cushioning characteristics with regard to resiliency and began to replace Latex, but at the lower end of the market. As confidence grew in the new materials, it led to a fairly rapid expansion of the product which, at this stage, was being produced in slabstock form only. The furniture industry is still supplied mainly with foam which is of the slabstock variety which is subsequently fabricated into the desired shapes. It was, however, a logical development that flexible polyurethane foam should be moulded. One of the more recent developments was that of High Resistance Foam or cold cure as it is sometimes called. It was first produced in moulded form and has since been produced in slabstock form. In its moulded form it is possible to "cold" mould units and although this may be an advantage to small manufacturers, the main advantage of the material is the significant improvement in its load bearing properties and resiliency.

When choosing a foam or combination of foams for any furniture application, it is important to consider both the physical properties, and the load deflection characteristics.

7. [illegible]

7.1 Density

This is the weight of a given volume of foam and is expressed in either pounds per cubic feet or kilograms per cubic metre. The density is not necessarily related to hardness and can be varied independently. It is generally considered that density is that property which has the greatest single effect on the fatigue properties of the foam. Care should be taken when stating density of a moulded unit to ensure that the density quoted is either overall density or core density.

7.2 Indentation Hardness

This can be considered as one aspect of the load bearing properties and is measured by preconditioning a unit and then indenting it by 40 per cent or 50 per cent of its thickness and after 30 seconds recording the corresponding force. The hardness value is mainly governed by the application of the foam. The deflection of a cushion should not be such that bottoming occurs and where softer cushions are used the depth of foam should be increased to compensate.

7.3 Tensile Strength and Elongation

The tensile strength is determined by extending a test piece of foam until it ruptures. The force to rupture is expressed in lbs/ins^2 or KN/m^2.

The elongation is the percentage increase in length of a given section of the specimen after the test piece has been extended and is measured at breaking point.

7.4 Compression Set

This is measured by subjecting a test piece to pre-set conditions of heat, time and a constant deflection. The compression set is the lack of recovery of height of the test piece and is expressed as a percentage of the original height. The maximum allowed in BS 3379 is 10 per cent. Strictly speaking this test is related to the measure of a cure of the foam.

7.5 Fatigue

The measurement of fatigue is usually an attempt to simulate the results that would be achieved by a cushion in actual service.

The cushion is subject to a constant load pounding test for a given number of cycles, on completion of which, both the loss in hardness and height are measured. These are usually expressed as a percentage of the original.

Having [illegible] design requirements, it is important [illegible] that the performance is upheld in service and the [illegible] guide.

7.6 Load Deflection Characteristics

Basically the cushion in seat chairs is there to "soften" the seating and to accommodate movements of the user without the loss of comfort. It is important therefore to understand how a foam deflects under loads and also how it recovers on reduction or removal of such loads.

Since the days when foam was used mainly for simple reversible cushions, new fabricating and moulding techniques have been developed which have opened up many new applications which allow the foam to perform functions previously done by the frame. The frame can become a much simpler design, the foam giving the external contours on one side and simple flat location on the other side.

Having established the basic shape, the seating characteristics required, and the quality of foam to be used, the choice of manufacture must then be established.

This may be governed by the requirements of the foam unit favouring one process or it could be an economic choice.

7.7 Fabricated Units

It is quite possible that because of the additional design requirements now imposed on the foam units, and requirements of support and comfort, the fabricated unit will consist of a combination of varying hardness density foams, but it is difficult to produce units of a highly sculptural nature. These can, however, be produced by the more highly sophisticated types of profile cutting machines but because of cutting time and foam wastage this process tends to be expensive.

7.8 Moulded Units

It was not until wider acceptance and use of high resilient slab stock was established that moulded high resilience foam has become economical, moulded units whether produced on a high volume production track or in large static fibre-glass moulds offer immense freedom to designers as well as consistency of shape in production. Tooling costs are expensive but costly errors can be obviated by careful prototyping. It is possible to mould-in various types of inserts either to facilitate assembly (i.e. wooden inserts) or to alter the deflection characteristics (i.e. foam inserts).

Full [illegible] produced in these types of moulds [illegible] around some type of simple frame which may [illegible] a suspension unit. This type of unit [illegible] considerable design freedom and can be an economical [illegible] production.

8. UPHOLSTERY TECHNIQUES

8.1 Possible Sequence of Operations

8.1.1 Selecting Frame, Padding and Covering Arms

a. Select and carry frame from stock pile to workplace.
b. Fit webbing to both arms of chair.
c. Fit strawboard in position on both arms of chair.
d. Fit cotton felt in position on both arms.
e. Locate and secure polyether sheet to both arms.
f. Position and fit polyether strip to the front of each arm in turn; cut to final shape.
g. Fit tissue to top front of each arm of chair.
h. Locate and secure outer cover over padding on each arm of chair; tension and cut to final shape.
i. Staple production identification ticket to front seat rail.

8.1.2 Springing and Stuffing Back

a. Fit spring clips to top and bottom rails of back frame.
b. Locate springs in clips on back frame.
c. Hammer down spring ends, and staple open end of clips.
d. Shape springs.
e. Lash string across the back springs.
f. Locate and secure hessian across the back.
g. Fit cotton pads to inside back.
h. Fit polyether sheet to inside back and staple down.

8.1.3 Covering Inside Back

a. Fit inside back cover.
b. Staple the inside back cover to the top rail.
c. Staple inside back cover to the right and left-hand wings.
d. Trim inside back seat cover.

8.1.4 Fixing Buttons

a. Fit buttons to inside back cover using needle and thread.
b. Secure buttons to inside back cover.
c. Trim inside back buttons.

8.1.5 <u>Making Seat and Seat Front</u>

a. Fit spring clips to front and back rails of seat frames.

b. Fit springs to seat spring clips.

c. Hammer down spring ends and staple open end of clips.

d. Fit polyether sheet to seat.

e. Locate and fit platform cloth to seat. Staple to front of frame.

f. Fit front border cover. Staple reverse of border cover to front of frame.

g. Fit polyether sheet to front of seat.

h. Nail ply strip to front seat rail.

i. Fit strawboard to seat front.

j. Tension down front cover.

k. Finish platform cloth.

8.1.6 <u>Finishing off Outside Covers</u>

a. Finish front border cover.

b. Finish front of right arm cover.

c. Finish front of left arm cover.

d. Finish back of right arm cover.

e. Finish back of left arm cover.

f. Locate and fit outside back cover.

g. Fit strawboard strip to the outside back.

h. Tension and staple outside back cover along bottom back rail.

8.1.7 <u>Finishing off Back</u>

a. Trim back outside cover to size at edges.

b. Apply tack strips to back of wing upright.

c. Trim and finish loose ends.

8.1.8 <u>Fixing Bottom and Castors</u>

a. Fit hessian bottom cover to base.

b. Fit castor sockets to base.

c. Fit castors into sockets.

d. Staple production ticket on chair.

e. Mark base with production or group number.

f. Despatch.

8.2 <u>Operating the Staple Gun</u>

8.2.1 <u>Connecting to Air Supply</u>

a. Pick up staple gun; select, correct and safe holding position fingers clear of trigger, guide body assembly pointing to the bench work surface.

b. [illegible] position.

c. With [illegible] on the frog and [illegible] the main supply bracket retaining the staple gun in safe position.

d. Connect [illegible] tighten.

8.2.2 <u>Loading, Setting and Firing the Staple Gun</u>

a. Pick up clip of staples.

b. Withdraw magazine spring.

c. Load magazine with clip of staples.

d. Replace retaining spring to lock position.

e. Take up work piece.

f. Position staple gun to piece.

g. Return isolation switch to "on" position.

h. Fire staple gun.

i. Hold gun in SAFE position. Examine fired staple.

8.2.3 <u>Removing Jammed Staples</u>

a. Select isolation switch to "off" position.

b. Staple gun to safe position, fingers clear of trigger, guide body assembly pointing to the bench work surface.

c. Lift hinge retaining plate on guide body assembly.

d. Examine staple eject channel; retain staple gun in safe position.

e. Locating defective staple, pick up clearing bar and remove reject staple.

f. Return hinge retaining plate to work position.

g. Select "on" position for isolation switch.

h. Position gun to operate position.

i. Operate (test fire), examine ejected staple, holding gun in SAFE position.

j. Re-position staple gun.

k. Operate.

8.2.4 <u>Securing Material</u>

a. Position fillings correctly on material; Half length.

b. Position top covering correctly; Half length.

c. Staple material to line location and judge staple spacing; of piece.

d. Examine fixing of staples and depth of staple bedding.

8.2.5 <u>Tailoring and Shape Covering</u>

a. Assemble materials.

b. Position fillings correctly on material full length.

c. Position top covering correctly full length.

d. Staple material to fix position and judge staple spacing.

e. Staple material around the radius at end of piece, tailoring and profile tensioning.

f. Examine fixing of staples and [illegible] of staple bedding to acceptable standards.

g. Materials to be positioned on the underside of the piece; correct tension and free of creases.

h. Staple to underside.

i. Continue to end of piece tailoring and profile tensioning.

9. UPHOLSTERY OF MOULDED SHELLS

Certain aspects of upholstering are avoided by utilising the bulk of the moulded shell to conform closely to the final required shape. For outside arms and backs a thin sheet of foam under the cover or preferably with a cotton scrim between them, can be considered adequate for most applications. The foam can be moulded in together with the shell in the case of polyurethane, or attached separately, by staples or adhesives, in the case of polystyrene. Inside arms can be finished in a similar fashion but the seat and back require thicker layers of resilient materials. Some low back chairs have used comparatively thin sheet foam in the backs either with or without quilting or buttoning. Unless provision is made to incorporate fixing points in the shell, quilting and buttoning can only be carried out between the cover, foam and a backing sheet; subsequently the composite panel is fixed to the shell or sewn up to the outside and inside panels. The sewn-up cover is drawn over the foam covered shell and fastened to the base of the shell on the inside and drawn under the shell on the outside where it is held either by a draw string or stapled to plywood inserts included in the shell.

The seat is normally fabricated separately and is fixed to the shell so that it hides the fixing of the inside cover to the base of the shell. Alternatively the inside and outside of the shell can be thinly padded and covered, with separate cushions for the seat and back incorporated.

In the earlier designs in expanded polystyrene the base of the seat was made up with foam and attached to moulded plywood. Captive screws fixed to this were pushed through the shell to protrude through the bottom and were in turn used for attaching the legs. There are variations using plywood above and below the seat as well as the use of thin steel plate. With polyurethane it is comparatively easy to mould a metal plate inside the seat part of the moulding to which either a swivel base or legs can be attached. In this case the made-up seat cushion is simply attached to the shell by screws or adhesive, so that it covers the joints of the cover along the inside arms and back.

It should be stressed that there is considerable scope for development in these fields and that upholstery aids, such as fixing points, must be considered at the design stage since small alterations in the mould can significantly reduce the time spent in the subsequent upholstery.

10. PERFORMANCE TESTING

A list of documents of British origin containing methods of test applicable to upholstered furniture and upholstery materials.

1. Graded performance tests for furniture for seating (easy chairs and settees): FIRA.
2. Graded performance tests for furniture for seating (upright chairs and stools): FIRA.
3. Method of test for ignitability and self extinguishing characteristics of plastics and rubber cellular materials: BSI: BS4735: 1971.
4. Methods of test for flexible cellular materials. Indentation hardness tests: BSI: BS4443 Part 2: 1972.
5. The performance testing and behaviour in service of flexible polyether foam. Constant load indentation pounding test: FIRA: FIRA Technical Report No. [illegible]: [illegible].
6. The performance testing and behaviour in service of flexible polyether foam. Dynamic indentation recorder: FIRA: FIRA Technical Report No. [illegible]: 1966.
7. Latex foam rubber components for furniture: BSI: BS3129: 1959.
8. Latex foam rubber components for transport seating: BSI: BS3157: 1960.
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