

# **Stump Socks—**

## **Their Manufacture, Use and Care**

By LEE J. FAWVER, C.P.O. and TED W. SMITH, C.O.

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In the manufacturing and fitting of the thousands of prosthetic appliances, which are supplied to amputees each year, a better knowledge and understanding of the contribution of stump socks to the comfort of the individuals we serve will assist the prosthetist to more capably care for those who are in need of our services.

The existing and continuing need for suitable stump socks by wearers of prosthetic appliances represents to our profession a considerable volume of business and a need that should be capably filled. It is the desire of the writers of this article to bring out information that will give to the field a better knowledge of the manufacture, use and care of stump socks, by here giving a background of stump sock manufacturing together with notes on what we have learned through years of experience in the proper fitting and care of these important aids to amputee comfort.

It is necessary in most cases where individuals wear an artificial arm or limb to have some means of padding and positioning their stump legs or arms in the appliances which they wear. Stump socks have been developed as the best means of doing this and are worn over the stump in sufficient weight and number to meet their needs. They are carefully knitted of high quality yarns to shapes and sizes which will properly fit the contours of the stump legs or arms.

### **Materials Available**

Available to the manufacturers are two vegetable fibers, cotton and linen, and two animal fibers, wool and silk, together with synthetic or man-made fibers, particularly those that have been developed in recent years. Of these available fibers those used to date in the manufacture of stump socks have been wool and cotton and a mixture or blend of these two. However, the volume of stump socks made from 100 percent cotton yarn or from a mixture of cotton and wool is very limited. About 90 percent of the stump socks produced by The Knit-Rite Company are made from 100 percent virgin wool yarn in five-ply weight.

This would indicate that, as a matter of consumer education and selection, limb wearers have found that 100 percent wool stump socks have given them the optimum of comfort that can be obtained.

Wool has been the noblest of all fibers down through the ages, and probably will remain so for many years to come. Fine wool is not over-abundant and the factor of scarcity adds to its value. Science has never been able to produce a substitute that will acceptably replace this fiber.

## How Good Wools Grow

Sheep raising was one of man's earliest occupations and was first found in Central Asia. Probably the most significant crossbreeding in history was produced by the North African and the Torrentine sheep of the Romans which was carried on in Spain to produce the Merino strain, which is considered our finest wool today. During early times Spain was most reluctant to let these sheep leave her own soil, but down through the years this strain was smuggled out and crossbred with other flocks until we now have over two hundred main breeds in the world today differing in weight, height, and in structure and also texture of their fleeces. Of this number we have about eighteen important breeds in the United States.

Wool fibers are unusual in appearance. Under a microscope they are revealed as having a shaft or center construction known as the medulla. Immediately covering this center construction is the cortex which is an interlacing layer after layer of compound cells which adhere closely. Wool is often characterized as being alive and it is because these cells bend, swell, shrink and stretch under normal conditions from changes in atmospheric pressure that this is considered true. Covering the cortex is the outer coating or epidermis resembling scales of a fish or bark of a tree with the scales ranging from 1,000 to 4,000 per inch, which gives the fiber its cohesive quality. So it is with this unique structure that the fibers are able to be stretched thirty percent beyond their length and when released return to their original tension.

### Characteristics of Wool

The striking characteristics of wool fibers are great elasticity, high absorbency, ability to hold much moisture without feeling damp, and a high degree of resistance to acids that are a basis of perspiration. When a fiber is elastic the yarn is springy and the resultant fabric will be resilient. Because one of the basic necessities of a stump sock is its padding effect for the protection of the stump, this high resiliency of wool fibers makes it superior to any other fibers.

As wool is the most absorbent of all fibers with a natural moisture content of between twelve and sixteen percent, it will absorb moisture quickly and will hold a large amount. This makes an ideal fiber for stump socks as wool, even when containing a high degree of body moisture, will not have the tendency to wrinkle and stick to the body as will other fibers. While wool is quickly destroyed by strong alkalies, it does have a high degree of resistance to the acids of excessive perspiration from the stump resulting from the wearing of a prosthetic appliance.

In an effort to obtain the maximum of useful characteristics in wool fibers for the specific use of stump socks, through the years we have found that a blend or mixture of domestic and foreign wool fleeces is far superior. From this blend we obtain a higher degree of elasticity, resiliency, and softness of texture, strength, moisture absorption, and greater resistance to shrinkage.

### Processing the Wool

A lengthy article alone could be written on the story of wool fibers from the sheep to the spun yarn that is used in the knitting of stump socks. In this article we will only attempt to touch on a few of the facts which we

believe will be of particular interest to our readers. Each clip or fleece from a single sheep is sorted or graded into several different qualities of wool fibers. Wool sorting or grading is a trade learned only by long practical experience and is highly skilled. The wool sorter does the work by observing and handling the wool and his experience enables him to instinctively assign each to its proper grade.

The quality most generally used in the manufacture of stump socks is termed or classified as 64's, which is the U. S. domestic designation of a wool grade. The 64's quality is one of the finest obtainable from a sorting of the fleece. These fine quality virgin wool fibers are spun into a worsted yarn of a suitable count or size for knitting into stump socks. This particular type of spinning is done by the French system. This is a dry method using no oil and differs from the Bradford system in which oil is used. The French system results in a softer worsted yarn and makes up into a much more satisfactory stump sock, with better resiliency and cushion. In the size or yarn count that is used in the knitting of stump socks the average size of stump socks will contain approximately 2,500 yards of virgin wool yarn.

It now becomes our responsibility to take this fine virgin wool yarn which we obtain from our spinner and use it as the raw material which we have to work with in the knitting and manufacturing of stump socks. Although knitting construction is not so widely used for general fabrics as weaving it possesses qualities that make it preferable for certain garments—particularly stump socks. The advantage of stretchability which knitting possesses is an important consideration where fit and comfort are concerned, as is so necessary in stump socks. The insulative air pockets contained in knitted products give a higher resiliency and cushioning effect and greater moisture absorption. The knitting is done on flat bed power machines using a plain knit stitch which is sometimes known as the flat knit or jersey stitch. This type of stitch can be identified by wales or vertical ribs on the outside of the sock and by courses of horizontal stitches on the inside. With this type of stitch more stretch is obtained in width than in length, permitting the sock to better conform to the stump contours.

### **Hand Finishing Operations**

In addition to the knitting there are other necessary manufacturing processes before the product is completed and ready for the limb wearer. As the stump sock comes off the knitting machine it is necessary for the toe to be hand finished. After this hand operation the stump socks in our terminology are processed. This is more than a washing operation as it is necessary for the socks not only to be cleaned but to be fulled. In fulling, water and chemicals are used at a proper temperature to make the wool fibers interlock and to produce a desired shrinkage or stitch relaxation, resulting from the stretching of the yarn in the knitting operation. This processing also gives the stump sock additional thickness and a firmer, softer texture which is the prime requirement of amputees. In drying, the socks are properly sized and then properly fleeced. They are then ready for inspection and packaging.

Another responsibility that the manufacturers have is to supply stump socks in a range of sizes which will give a suitable selection to meet the requirements of different individual needs, including those of varying sites of amputations. All stump socks are fashioned by being knit to the various

sizes which are to be supplied. They are carefully sized and inspected in order that a consistent standard will be constantly maintained.

### Basic Measurements

The three basic measurements necessary for the determination of a size of stump socks are the length, the top, and the end or toe circumference, which is approximately two inches from the end of the sock. However, it is customary to list the top and toe measurements as flat measurements, which are one-half of the circumference.

Five standard widths and lengths of from ten inches to thirty-two inches graduated each two inches has been established, from which it has been our experience that the majority of amputees of lower extremities can make a selection of their required size. For amputees of the upper extremity, a selection of two standard widths in lengths of five inches to twenty inches inclusive gives a selection of size which will take care of most of the requirements of this group. The majority of the volume of stump socks produced are in these two groups of sizes. In addition, the demand for leg socks is principally for five ply weight wool and for arm socks it is four ply weight wool. Within these two groups of sizes and weights, the five widths of leg socks in five ply weight white wool, and the two widths of arm socks in four ply weight white wool, is represented the majority of our demand. They are termed our standard sizes and weights and under normal conditions are carried in stock for immediate shipment. Consequently, they can be ordered by size number 0, 1, 2, etc., and length measurement only.

### Special Cases

However, there are amputees who for proper fitting will require stump socks of special size, weight, and under certain conditions stump socks made of material other than white wool yarn. It is necessary for the prosthetist to know the length, the top measurement, and the toe measurement required. These are termed special stump socks and have to be manufactured to order. In the case of amputees with stump legs that have bulbous ends, where a stump sock of an uneven taper is required, these can be made to order.

It is desirable to have a paper pattern the exact size and shape the stump sock is to be made. If this not readily obtainable, a profile drawing of the stump may be made with circumference and measurements noted on the drawing at intervals of approximately three inches. Especial care should be given to measurement at the site of bulbous irregularities in the contour of the stump. Length of finished stump socks should also be stated. These requirements for patterns or profile drawings will also apply to individuals with deformities that are fitted with prosthetic appliances. Stump socks of uneven taper that are made for these two groups are termed irregular shapes. As additional operations are required to make this type of stump sock, it is customary to make an extra charge for this work.

As we have stated above, the five ply weight and four ply weight white wool in the case of leg socks and arm socks respectively represent the majority of the volume of stump socks produced and are termed our standard weights. However, there are individuals who need other weights and/or materials for various reasons. The materials generally available for other selections are Dark Gray Wool, Pearl Gray Wool, fifty percent wool and

fifty percent cotton, one hundred percent cotton, and Silkoline (mercerized cotton). Any of these materials, including white wool yarn, can be made up into stump socks of three ply, four ply, five ply, or six ply weights, which gives a selection of stump sock weight whenever such a need is indicated. Stump socks of these materials and weights have to be made to order.

### **Exactness Is Necessary**

In addition to the proper kind and weight of stump socks, carefully made by the manufacturer, there is another consideration that an amputee must have before he can be assured of having the utmost in stump sock comfort. All prosthetists have experienced that a correctly fitted stump sock will add to the comfort of wearing a well fitted prosthesis and by the same token an improperly fitted stump sock will detract from the comfort of wearing the best fitting prosthesis and can cause a considerable amount of stump difficulty. For the optimum of comfort the individual amputee must have a stump sock that is not too tight nor too loose; one that in the case of below knee amputees will permit proper functional use of the knee, and one of correct length.

The correct manner of wearing a stump sock will contribute materially to the comfort of the individual. For example, The Knit-Rite Company and the W. E. Isle Company have found by experience that if a stump sock is worn outside in, that is with the vertical ribs or wales next to the stump leg, considerable stump irritation can be eliminated, particularly in hot weather.

The horizontal rows or stitches inside of the stump sock can cause irritation due to the piston action of the stump leg in the socket of the artificial limb. This irritation is practically eliminated when the vertical ribs or wales are worn next to the stump leg. It is the general custom to wear the fleeced or napped side of the sock next to the stump leg. The only possible advantage in wearing a sock in this manner would be that the fleece or nap of the inside of the sock would pick up the moisture more quickly from the stump leg. However, a limb wearer will find that it is also true that when the stump sock is worn with the rib or outside next to his stump leg, the moisture of perspiration will evaporate more readily from the stump sock. This is a definite advantage as the wool of the stump sock will pick up moisture more quickly than it can be evaporated.

### **Prosthetist Is Responsible**

The only qualified source that the amputee has for this information is his prosthetist. Consequently, it is the professional responsibility of the certified prosthetist to exercise every care on his part to see that each individual amputee is fitted satisfactorily with the proper kind and weight of stump socks to meet his individual needs.

The importance of being careful in the washing of wool stump socks can never be stressed too strongly. More stump socks are probably ruined through improper washing than from any other one cause. The wearer should understand that more care should be exercised in the washing and storage of wool stump socks than with any other item of clothing. The amputee will be well compensated in the long wearing comfort that he will obtain from his stump socks if they are properly washed and cared for.

## Washing the Socks

Wool stump socks should be washed and rinsed in water that is lukewarm, with a temperature of 100 to 110 degrees. By all means the stump socks should never be rinsed in cold water. Any change in water temperature will affect wool adversely. The selection of soap is very important. A soap must be used that will dissolve in water of this low temperature, as well as a kind that contains the least possible amount of alkali. As Ivory soap has a high degree of purity and will dissolve in water of a low temperature it can be recommended very highly for washing stump socks.

Where individuals have a preference in the use of detergents or synthetic soaps they must be careful to ascertain that the particular brand they use is made from coconut oil base. The other bases from which detergents are manufactured are petroleum, alcohol, and alkali. Any of these will harmfully affect the fine wool of stump socks. Excessive rinsing and any soaking is not recommended, and in most cases a small amount of soap left in stump socks will act as a lubricant and actually improve the quality of the stump socks. Soapsuds should be squeezed into the stump socks and they should never be rubbed. In washing, avoid lifting the socks out of the water as much as possible. The weight of the water in the sock will distort and stretch the sock if it is lifted out of the water constantly. Excessive wringing and twisting should be avoided as this will felt the socks. To hasten drying one of the best methods is to roll the stump sock in a towel and remove as much of the excess water as possible. Stump socks should be dried at a moderate temperature and never against direct heat or in sunlight. Direct heat dries out the fibers and causes them to become brittle and harsh. Drying outside in cold weather will also have this effect.

## The Daily Change

It is our recommendation that every limb wearer should have a sufficient supply of stump socks to permit him to wear a clean stump sock daily, and to allow for the stump socks to be stored several days after washing and before wearing. They should be worn in rotation, as this gives an interval of several days during which the sock is not used, permitting the wool to have an opportunity to rest. This restores the resiliency and elasticity of the fibers.

It is the hope of The Knit-Rite Company that we will have available to us a blend of synthetic fibers and wool that will make up into an improved stump sock; one that will not require such extreme care in washing and which will stand up better under the conditions of stump sock use. Experimentations have been carried out in the past several years in the use of various synthetic yarns, such as Nylon, Fibre V or Dacron, Orlon, etc., together with blends of these synthetics with wool yarns.

While much is to be expected of these synthetic yarns in the immediate future for various uses, so far, the results of our experiments convinces us that at present there is nothing that will surpass or even equal the quality of 100 percent wool stump socks. We are continuing with our experiments with these new yarns, as well as with wool, in the hope that we may sometime be able to obtain a yarn which will make up into an even better stump sock.

A stump sock is a highly specialized item which affects the welfare and comfort of thousands of individuals. The high quality product which we have today is the result of years of study and effort on the part of the manufacturers.