A STUDY OF RECOMMENDED PROCEDURES FOR THE CARE AND MAINTENANCE OF FOOTBALL EQUIPMENT AND THE DEVELOPMENT OF A HANDBOOK OF INSTRUCTIONS

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A STUDY OF RECOMMENDED PROCEDURES FOR THE CARE AND
MAINTENANCE OF FOOTBALL EQUIPMENT AND THE
DEVELOPMENT OF A HANDBOOK
OF INSTRUCTIONS

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## VIII. A Handbook of Instructions for the Care and Maintenance of Football Equipment

### INTRODUCTION

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CHAPTER I

INTRODUCTION

Selection of Problem

Source. -- Football is one of the most popular sports in the United States. "It is played in more than 600 colleges and in about 3,000 high schools. As many as 70,000 people often go to see big college games." The popularity of this game has come about in the last twenty years, and because of this increase in popularity more and better equipment has been designed for the protection of the players and to enhance the attractiveness and efficiency of the teams. Aspects of protection are mainly for the prevention of injuries that may occur while participating in the game. As a result, high schools and colleges are spending large sums of money annually on football equipment. This equipment is expensive and receives much severe punishment while in use. Having been football equipment manager for three years at North Texas State College, the writer realizes that football equipment is expensive and is frequently abused; therefore this problem was chosen because of a sincere personal interest in the care and maintenance of football equipment.

\(^1\text{World Book Encyclopedia, 1947 Edition, VI, 2675.}\)
equipment and because of a realization that expert knowledge is needed to care for football equipment.

**Justification of the problem.** -- The care of football equipment includes all phases of handling from the time it is unpacked in the equipment room until it is destroyed. Football equipment warrants proper care and maintenance in order to prolong its useful life. Kenneth L. Meyer verifies this statement by saying:

> The longevity of athletic equipment is greatly affected by the care it receives. For example, two coaches were arguing the merits of a popular sweat sock. One condemned it; the other praised it. In going a bit further into the problem, it was found that the coach condemning the sock had been working on a limited budget. The shoes that the boys wore lacked insoles. They changed socks once a week, and then the "cruddy" socks were boiled for 30 minutes. The other coach, praising the socks, had his boys change every other practice, had smooth insoles in the shoes, laundered the socks in the school laundry. The constant factor in both cases was the sock. The variables were several but all added up to -- CARE. It is a larger item than most coaches care to admit. It is time consuming and bothersome. In the majority of cases, it is passed on to untrained and unconcerned student managers.  

The writer is fully aware of the wastes due to improper care of football equipment and has taken into consideration the many phases of the problem in this attempt to furnish information that will aid the coaches, managers, players, cleaners, and launderers who have anything to do with the care and maintenance of football equipment.

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Limitations and Scope of Study

Nature of the problem. -- The problem of this study was to determine the best methods in relation to caring for materials that compose football equipment by studying the recommendations suggested by those who manufacture the materials; and also to report the results on information received as to how to care for and maintain the materials commonly found in football equipment. Further, the problem was to write a handbook of instructions for the care and maintenance of football equipment.

Purposes of the problem. -- The purposes of the study were as follows:

1. To arrive at the best possible methods of caring for football equipment.

2. To provide athletic directors, coaches, and equipment managers with essential information that will aid in the care and maintenance of football equipment.

3. To satisfy a personal interest in how better to care for and maintain football equipment.

4. To write a handbook of instructions for the care and maintenance of football equipment.

Sources and Treatment of Data

Materials that are commonly found in football equipment were selected as listed:
1. Cotton  
2. Wool  
3. Rayon  
4. Nylon  
5. Rubber  
6. Leather  
7. Fiber  
8. Plastics  
9. Metal

The source materials for the study were both documentary and human. The documentary sources of data for the study were bulletins, circulars, and books relating to how to care for and maintain materials that are used in football equipment. The human sources of data were experts in the field of textile fabrics, rubber, leather, plastics, and fiber materials and the actual experience of the writer who has had certain responsibilities in connection with the care and maintenance of football equipment at North Texas State College. Letters were written to firms which manufacture materials commonly found in football equipment, and, as a guide to the research, the following questions were asked:

1. What causes the materials to deteriorate?
2. How would you prevent the deterioration?
3. How would you prevent fading of the fabrics?
4. How would you prevent shrinkage of fabrics?
5. What is the proper way to launder and clean the various textile fabrics?
6. How would you clean and care for the following materials: rubber, leather, plastics, fiber, metal?

An analysis of the recommended procedures for the care
and maintenance of materials commonly found in football equipment was made, together with recommendations as to proper procedures in the care and maintenance of materials. Finally, a handbook of instructions was written to aid athletic directors, coaches, and equipment managers in the care and maintenance of football equipment.

Definition of Terms

The term "handbook" is used to indicate a manual of concise information to be used as a guide.

Related Studies in the Field

Only a few studies in the field of the care and maintenance of football equipment have been made, one of which is noted here with a brief mention of its similarity and differences to this study. Kenneth L. Meyer made a study entitled Purchase, Care, and Repair of Athletic Equipment, in which he analyzed the purchase, care, and repair of athletic equipment, together with its administration, but he did not go into detail as to the specific care and maintenance of football equipment.

Organization and Presentation of the Study

This study is divided into eight parts. Chapter I is the introductory chapter, giving the reason for selecting the problem, the justification of the problem, the nature and purpose of the study, the sources and treatment of data,
the definition of terms, related studies in the field, and an outline of the procedure. The succeeding seven chapters have to do with recommended procedures for the proper care and maintenance of various types of materials incorporated in the manufacture of football equipment, as follows:

Chapter II. Textile Fabrics.
Chapter III. Leather Materials.
Chapter IV. Rubber Materials.
Chapter V. Fiber Materials.
Chapter VI. Plastic Materials.
Chapter VII. Metal Materials.

Finally, the concluding section of the study, Chapter VII, represents the writer's effort to develop a concise and usable handbook of instructions for the proper care and maintenance of football equipment, based upon recommended practices presented in earlier chapters.
CHAPTER II

AN ANALYSIS OF RECOMMENDED PROCEDURES FOR THE CARE AND MAINTENANCE OF TEXTILE FABRICS

Woolen Materials

Wool is an essential component of much of the equipment worn by football players. It is particularly suited for such usage because of the great strength of its fibers, which enables it to outwear any other fabric, even under the severest possible conditions of wear.

Proper care adds to the length of its useful life. It adds greatly to appearance. No other fabric responds so readily and completely as do wool textiles to proper hanging and correct folding, to brushing, to drycleaning, and to laundering under prescribed conditions which prevent them from shrinking.¹

In order to know how to care for woolen materials found in football equipment in the proper manner it is necessary to become familiar with the common causes of deterioration of this fabric, such as perspiration, dirt, wear and tear, and damage produced by the presence of moths. Milton Harris of the Harris Research Laboratories gives the

¹Your Woolens, Their Wear and Care, booklet issued by Botany Mills, Passaic, New Jersey, 1948, p. 3.
following information on the deterioration of woolen materials:

Some of the most common causes for the deterioration of woolen materials are attacks by moths, carpet beetles, and similar insects; shrinkage; prolonged exposure to sunlight; damage by alkalies; abrasion, i. e., simply "wearing out."\(^2\)

J. N. Dalton, a research chemist in the field of woolen textiles, has pointed out similar causes for the impairment of woolen goods when he stated: "The principal causes of wool fabric deterioration are due to the attacks of insect pests, bacteria and strong sunlight, and various forces such as wear."\(^3\)

When knowledge is at hand as to the causes of deterioration in the woolen materials included in football equipment, the next step is to learn ways and means of reducing and minimizing, or even of completely preventing, such deterioration. This is necessary because the best care which it is possible to give woolen goods is that of preventing or reducing deterioration. Of course, because of the rough usage which it often undergoes, woolen material in football equipment cannot escape wear and tear. The usefulness of such equipment, however, can be prolonged by the

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\(^3\)Personal letter from J. N. Dalton, Director of Chemical Department, Pacific Mills, Worsted Division, Lawrence, Massachusetts, December 28, 1948.
careful repairing of any damage as soon as possible after the damage occurs. Also, it is necessary to clean or launder all woolen materials soon after they become soiled. If woolen goods are permitted to remain in a soiled condition for considerable periods of time, they will become more susceptible to attacks by moths or other destructive insects which thrive in soiled fabrics, and particularly in woolens.

Wool fabrics will not normally show deterioration beyond ordinary wear and tear if they are properly protected against the action of moths and if they are dry cleaned when necessary by careful and reputable dry cleaning establishments.4

Harris offers the following discussion relating to the deterioration of woolen materials:

Damage by insect pests can be prevented by the use of mothproofing agents. Shrinkage, of the type caused by felting or matting of the wool, can be minimized by dry cleaning or employment of careful washing procedures; in addition, a number of processes have recently been developed for rendering wool resistant to felting shrinkage. All of these processes must be applied at some stage of the manufacturing process. As their use becomes more widespread it should be possible to specify shrink-resistant materials in purchase orders. Deterioration by prolonged exposure to sunlight can be minimized by storage of garments in the dark when they are not in use.5

Chemical research specialists in the United States Army have conducted extensive experimental work for the purpose of discovering ways of preventing or reducing the

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5 Harris, op. cit.
deterioration of woolen materials. These chemists recommend that woolen goods should be dry cleaned as soon as they become soiled; and, if they are to be stored, they should be thoroughly cleaned before they are placed in storage. While in storage for any length of time, they should be protected against damage by insects by adequate treatment with naphthalene or paradichlorobenzine.

Insect deterioration may be prevented by treatment of the wool materials with chemical repellents against moths and carpet beetles. Deterioration by bacteria, strong sunlight and wear is dependent upon how much the wool material is subjected to these agents.6

Woolen materials are subject to shrinkage in washing and cleaning unless these processes are carried out with extreme care. Woolens that have not been treated with a shrink-resistant process at the time of manufacture should not be washed, but dry cleaned. Even with woolens which have been treated to resist shrinkage during laundering, care should be taken that the temperature of the water in which they are washed never rises above 100° Fahrenheit. Mild soaps should be employed in whipping up a good cleansing lather. Woolens should be washed in plenty of water, since washing in an insufficient quantity of water often produces shrinkage even of fabrics which have been made shrink-resistant at the time of manufacture. The laundering

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6Delton, op. cit.
process should never be prolonged more than five minutes, which means that the washing must be done briskly. When the washing has been completed, the woolen goods should be thoroughly rinsed in at least three waters. As in the case of the wash water, the rinse water must not be allowed to attain a temperature above 100° Fahrenheit. Although there are various chemical processes now in use to prevent shrinkage in washing, as yet there are no shrink-proof woolen fabrics. "Careful washing procedures include use of mild soap and lukewarm water and a minimum of agitation." 7

All woolen materials will fade if they are submitted to prolonged exposure to sunlight. Although chemists have been working on the problem for many years, no one has yet succeeded in developing dyes that are perfectly "fast."

Preventing woolen goods from fading has been a problem that has never been solved as yet -- as some garments will crack when worn by certain parties and other parties can wear the same garment and this will not occur. It is usually caused by perspiration and sometimes poor dye, even though we purchase the best dyes obtainable from the leading manufacturers in America. 8

Dalton gives the following information concerning the fading of woolen materials:

There is nothing that will prevent partial fading of wool if exposed long enough to strong sunlight. Dyestuffs for wool are usually selected to

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7 Harris, op. cit.

dye the material fast enough to sunlight to give sufficient satisfaction for the life of a garment, that is, while it is wearing out or replaced for style purposes.\textsuperscript{9}

To prevent the running of colors in woolen materials, one should be careful to purchase only those materials whose colors are "fast." "Fading can best be prevented by specifying fast dyestuffs of the chrome or vat types."\textsuperscript{10} Helfrich, however, offers a reminder that no woolen material is completely resistant to fading:

If wool fabrics have been dyed with proper care, they should show all reasonable resistance to fading. However, even though the finest dyes are used, certain colors such as purple and various blues are more susceptible to fading than other colors.\textsuperscript{11}

As has already been indicated, there are two accepted methods for cleaning woolen materials, namely, washing and dry cleaning.

Washing is the best method of cleaning wool materials from the standpoint of removing soil and perspiration. However, care must be used to prevent shrinkage, if the wool has not been given a shrink-resistant process.\textsuperscript{12}

For those who wish to wash woolen materials found in football equipment, Botany Mills offers these suggestions:

Daily care alone is not sufficient for woolens. They must be washed, cleaned, pressed or periodically blocked. How often this should be done depends on the fabric and garment, its color and the frequency with which it is worn.

\textsuperscript{9}Dalton, \textit{op. cit.} \hfill \textsuperscript{10}Harris, \textit{op. cit.}

\textsuperscript{11}Helfrich, \textit{op. cit.} \hfill \textsuperscript{12}Harris, \textit{op. cit.}
Washable woolens will launder well if you follow a few simple rules.

Examine all garments for stains and remove them. Rips and torn places should be repaired before washing to prevent enlargement of the holes.

Wash in lukewarm water and do not soak wool for any longer than it takes the fabric to become saturated with the suds. Soaking weakens the fiber.

Water for both washing and rinsing should be lukewarm, around 90 to 100 degrees, never more. The water should feel cool to the hand. Hot water or any abrupt changes in water temperature, such as lukewarm wash water and a cold rinse, will cause the wool fiber to felt and the fabric to shrink.

Use plenty of neutral soap in the water before the garment is put in. Strong caustic soaps harden the wool fiber. Keep a heavy suds on the wash water. Two or three times the usual amount of soap may be necessary to get wool garments clean. Soap in combination with the alkali in water forms a curd which remains in the garment unless there are plenty of suds to wash it out. Use a second heavy suds if it is necessary to remove all the soil.

When it is at all practicable, suds should be squeezed through a wool garment by hand, because pounding and rubbing will cause wool fibers to entangle and mat and injure the fabric. Work under water, so that the weight of water in the garment will not distort it. If it is necessary to use a washing machine, the material should not be crowded, nor should it be agitated violently for long periods.

Rinse thoroughly in several waters to remove all soap. Soap left in wool tends to coarsen it and to disolor the texture by affecting the dye.

Squeezing water out of a wool garment by hand is the best method, but when a wringer is necessary for heavier pieces, set it loosely so the fabric won't mat.

Dry away from heat. Never hang wool garments near heated radiators nor in the hot sun because heat dries out the wool fiber, causing it to become brittle and break.13

Further suggestions are given by Stevens as follows:

13Your Woolens, Their Wear and Care, booklet issued by Botany Mills, Passaic, New Jersey, 1948.
Woolens are very hard to clean and great care must be taken in cleaning them. Using water by inexperienced users is very dangerous. If the water is the least bit too hot, shrinkage results. The temperature should not exceed 100°F. Soaps containing destructive chemicals should not be used as they destroy the fibers. For this reason it seems advisable to send all woolens to cleaners specializing in this work.\textsuperscript{14}

When woolen materials are washed, it is best to use a soapless cleanser because it is neutral and has a good emulsifying action on oily soil particles and will leave the nap fluffy.

Wool cannot be washed in alkali-free soap solutions unless the wool has been treated by some process such as chlorination or resin, which will prevent felting of the materials. If the wool is not treated with some shrink-resistant process, then the safest method of cleaning is to give it the so-called dry-cleaning where solvents other than water are used.\textsuperscript{15}

It has been found that dry-cleaning is the most economical method of cleaning woolen materials. It is also the preferable method from the standpoint of efficiency, since the process of dry-cleaning does not produce shrinkage and the fibers of the woolen materials are not in any way harmed. It is not advisable for an inexperienced person to use the dry-cleaning agents because of the fire hazards involved, together with the danger of using the cleaning fluids too often. Fresh cleaning fluids should be used for each cleaning job, since unclean liquids used

\textsuperscript{15}Dalton, op. cit.
as cleaning agents will soil the material and sometimes will leave spots in the fabric. It is recommended that dry-cleaning be done commercially by those who specialize in such services.

In summarization of the recommended procedures for the care and maintenance of woolen materials found in football equipment, the data previously presented have revealed the following findings:

Common causes for the deterioration of woolen fabrics are as follows:

1. Perspiration.
2. Dirt.
3. Wear and tear.
4. Damage due to moths.

To prevent the deterioration of woolen fabrics the following procedures are recommended:

1. Launder or clean woolen materials soon after they have come in contact with perspiration.
2. Launder and clean woolen materials as soon as they have been exposed to dirt and soil.
3. Woolen materials can be protected from moths by keeping the fabric clean and treating with moth-repellents, like naphthalene or paradichlorobenzine.
4. Repair any wear and tear immediately after it occurs to prevent any further damage.
In preventing shrinkage of wool it is recommended that the following be done:

1. Buy woolen materials that have been treated with a shrink-resistant process.

2. Dry-clean if possible and launder only when absolutely necessary. In laundering the following procedures are suggested:
   
   a. Water temperature should not exceed 100° Fahrenheit.
   
   b. Use mild soaps.
   
   c. Use plenty of water.
   
   d. Wash for only about five minutes.
   
   e. Rinse woolen materials thoroughly in water, of which the temperature is not to exceed 100° Fahrenheit.

To prevent fading of woolen materials it is suggested that the following be done:

1. Buy woolen materials that have been dyed properly, preferably vat-dyed.

2. Avoid prolonged exposure to sunlight.

3. Launder and clean properly.

In planning to launder woolen materials, the following procedures are recommended:

1. Wash in lukewarm water.

2. Avoid soaking of woolen materials.

3. Avoid any abrupt changes in water temperature.
4. Use plenty of neutral soap.

5. Squeeze suds through woolen materials. If washing machine is used, the material should not be crowded.

6. Rinse thoroughly in several waters to remove all soap.

7. Dry away from heat.

8. Avoid drying in direct sunlight.

If dry-cleaning is used in cleaning woolen materials, it is suggested that fresh cleaning fluids be used at all times. If the school is not properly equipped for cleaning in this manner, woolen materials should be sent to a reliable commercial dry-cleaning agent.

Cotton Materials

Cotton is the most frequently used of all fabrics in football equipment, and is sold under a variety of names such as satin and airplane cloth. Since cotton is an important material in football equipment, it is best to know just what causes the material to deteriorate in order to care for it properly. Cotton fabric is subjected to abrasion or wear just as any other fabric used in football equipment, and it will mildew when stored in a damp condition or if it is allowed to stay damp. It will deteriorate due to prolonged exposure to sunlight, and perspiration will cause a weakening of the fibers. Application of strong bleaches tends to deteriorate cotton material also. A. G. Bonhuys
gives the following causes for the deterioration of cotton fabrics:

Abrasion, the corrosive action of perspiration during prolonged contact with the fabrics, prolonged exposure to direct sunlight over a considerable period of time, and the deleterious action of mildew upon storing of the uniform in damp, warm, crumpled condition in a dark place.\(^\text{16}\)

Repeated laundering will cause cotton to deteriorate, as is stated by C. Norris Robold in his causes for the deterioration of cotton materials:

Abrasion, due to wear and laundering, exposure to strong oxidizing agents, exposure to moisture and perspiration, and mildew caused by fabrics remaining damp under humid conditions in a dark location, such as a locker.\(^\text{17}\)

J. D. Dean points out that the causes for deterioration of cotton materials are as follows:

Mechanical stresses and abrasion resulting from rough usage; the chief causes of degradation or tendering in garment fabrics are usually repeated laundering, perspiration, biological attack (mildew), during storage of cellulosic materials, and perhaps the photochemical action of sunlight.\(^\text{18}\)

K. S. Campbell makes a brief statement as to the deterioration of cotton materials: "Deterioration of cotton


\(^\text{18}\)Personal letter from J. D. Dean, Cotton Chemical Finishing Division, Southern Regional Research Laboratory, United States Department of Agriculture, New Orleans, Louisiana, December 30, 1948.
material may result from abrasion or wear, exposure to sunlight, excessive heat, and the action of certain chemicals (e.g., overbleaching in cleaning)."  

It has been found that dampness will affect cotton and will cause it to deteriorate. In this connection, R. L. Anthony states that dampness is an important factor in the deterioration of cotton fabrics: "The most general difficulty probably comes from dampness which would mean that a garment when put away should be perfectly dry."  

Cotton materials will deteriorate quickly when they come in contact with the agents that produce deterioration; therefore, it is best to act quickly in preventing the deterioration.

Preventing abrasion due to wear and tear is an impossibility in the case of football equipment, but it can be held to a minimum. "There is no way to prevent loss of strength due to wear as this is a natural condition that occurs in all fabrics."  

Mildew is a formidable enemy to cotton material because it will weaken it and cause it to deteriorate rapidly. To

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19 Personal letter from K. S. Campbell, Professor, Textile Chemistry and Dying Department, North Carolina State College of Agriculture and Engineering, University of North Carolina School of Textiles, Raleigh, N. C., February 1, 1949.


21 Robold, op. cit.
prevent deterioration of cotton due to mildew the cause, which is dampness, should be removed.

The first step in preventing mildew is to remove the cause of dampness. Then thoroughly air out the room or articles affected. Otherwise, a layer of moist air settles around articles, and mold spores -- always present in the air -- have ideal conditions for growth.\textsuperscript{22}

Knowing that molds cause mildew in a dark, warm, damp place, it is advisable to quote C. Norris Robold on how to prevent mildew of cotton fabrics:

Garments, after wear, should be washed as quickly as possible since football clothes are usually badly soiled and will contain large quantities of perspiration and moisture. If they cannot be washed immediately, they at least should be left out in the open where they can dry out rather than be thrown in a dark locker and allowed to lie there damp. This condition is very conducive to mildew which will rapidly destroy the cellulose fiber.\textsuperscript{23}

A. G. Bonhuys states the following on the deterioration due to mildew:

Deterioration due to mildew may be prevented by airing and drying the uniforms after use and by frequent washing in warm water with a good soap followed by thorough rinsing in warm, soft water baths and promptly drying on a clothes line in the open air, preferably with sunlight, or in heated dryers.\textsuperscript{24}

Knowing that prolonged exposure to sunlight weakens cotton fabrics, Bonhuys gives this information on preventing

\textsuperscript{22}\textit{Preventing and Removing Mildew}, Bulletin A1572, United States Department of Agriculture, June, 1948, p. 2.

\textsuperscript{23}Robold, \textit{op. cit.}

\textsuperscript{24}Bonhuys, \textit{op. cit.}
deterioration due to sunlight: "Garments should not be permitted to habitually hang out in the sun for most of the season."\textsuperscript{25}

Any cotton material in football equipment will come in contact with perspiration, which greatly weakens cotton fabrics. The only way to prevent perspiration from deteriorating cotton is to remove it as soon as possible. "The proper cleaning and drying of goods after use would therefore appear to be a detail to which attention might most profitably be directed."\textsuperscript{26}

Strong bleaches have a strikingly bad effect on cotton materials. Robold makes this clear in his statement on the effect of strong bleaches on cotton fabrics:

> It is common practice to use chlorine bleaching agents, either in the wash water or as a special operation. Many people suppose that such bleaching agents remove soil but all the bleaching agent does is to destroy any organic coloring matter that might be present in the garment and improve the white. Soil removal is largely a matter of mechanical action such as takes place in a laundry wash wheel or a home washer. The soap acts as an emulsifying agent for the soil particles and thus helps in their removal. Chlorine bleaching agents are strong oxidizing agents and tend to weaken the cellulose fiber of the material, especially when used in a high concentration. If and when used, the quantity employed should be well within the limits recommended by the manufacturer of the product.\textsuperscript{27}

There is little that can be done to prevent shrinkage

\textsuperscript{25}Bonhuys, \textit{op. cit.} \hfill \textsuperscript{26}Dean, \textit{op. cit.}

\textsuperscript{27}Robold, \textit{op. cit.}
of cotton materials, although shrinkage can be kept to a minimum provided proper care is practiced.

There is little you can do to prevent shrinkage of cotton materials. Manufacturers reduce shrinkage by giving goods a mechanical pre-shrinkage treatment known as Sanforizing. Some fabrics have their shrinkage stabilized by the addition of shrink-setting resins.\textsuperscript{28}

Robold gives his ideas on the shrinkage of knitted goods:

In the case of knitted goods, most manufacturers handle such fabrics in a relaxed condition so that the garment is not stretched or pulled so that it will subsequently shrink. Any trouble encountered by you as regards shrinkage could probably only be overcome by drying garments on a form which would only allow it to shrink to the dimensions of such a form.\textsuperscript{29}

To assure oneself that shrinkage of cotton material depends upon the construction and the finishing treatment given it during the manufacturing process, it is wise to accept Bonhuys' statement:

Shrinkage of material constructed from cellulose fibers depends upon the construction of the fiber and the finishing treatment to which it has been subjected. A garment manufactured from a pre-shrunk material will rarely shrink excessively upon laundering or when becoming wet. We are aware of nothing that can be done to the garment to overcome this condition.\textsuperscript{30}

In the preventing of shrinkage, R. L. Anthony suggests that the following be done:

There is no way to prevent complete shrinkage of cotton material. The best protection apparently

\textsuperscript{28}\textit{Abid.} \hspace{1cm} \textsuperscript{29}\textit{Abid.} \hspace{1cm} \textsuperscript{30}\textit{Bonhuys, op. cit.}
is through Sanforization which holds the residual shrinkage down to a maximum of one per cent.\textsuperscript{31}

To keep shrinkage to a minimum, K. S. Campbell makes the following suggestion: "Shrinkage of cotton garments may be avoided by making them from Sanforized material."\textsuperscript{32}

Since Sanforization will prevent shrinkage to a certain extent, it is wise to find out what has been done to prevent fading of cotton materials.

Just as in other fabrics, fading is prevalent in cotton materials. Research has accomplished much in preventing fading of cotton materials but as yet there has been no fade-proof dye put on the market.

There is no such thing as a completely fast color when applied to the fabric. All reputable manufacturers use the best colors they can buy and the chief protection against fading is to be sure when purchase is made there be a fasemeter test on the guarantee of the maker.\textsuperscript{33}

The prevention of fading in cotton material depends upon the quality of dye used, although even with the best dyes cotton materials will fade more or less.

Fading of the color depends on the fabric and generally not on the basic fiber used. If the garment has not been properly dyed with fast dyes, fading is likely upon exposure to light or when the garments become wet and we know of nothing to prevent it, except perhaps to avoid unnecessary exposure to perspiration and sunlight and to have the garments dry cleaned and not laundered.\textsuperscript{34}

\textsuperscript{31}Anthony, op. cit. \hfill \textsuperscript{32}Campbell, op. cit.
\textsuperscript{33}Anthony, op. cit. \hfill \textsuperscript{34}Bonhuys, op. cit.
To stress the point that there is no fade-proof dye, it would be wise to point out what Robold has to say about fading of cotton fabrics:

There is no such thing as a dye that does not fade. Prolonged exposure to sunlight, action of bleaching agents, excessively severe laundering, or all combined, causes dyes to lose strength or change caste. Cotton goods dyed with what are known as "Vat" colors have the greatest resistance to fading. So-called commercial dyes are usually much less resistant to laundering and the action of bleaching agents, though some of them are quite good to light fading. However, the majority will not stand prolonged exposure to sunlight. Since a garment encounters all three of the mentioned conditions, it is wise to use goods dyed with "Vat" colors for maximum resistance.\(^{35}\)

To be on the safe side, as nearly as is possible, it is recommended that when purchasing cotton material, it should be "vat-dyed" so as to be assured that there will not be any "running" of colors.

Cotton material that has been Sanforized and "vat-dyed" can be laundered provided proper care is taken. Cotton material is not as hard to launder as other fabrics, but if not laundered properly, it will soon deteriorate. The use of warm or hot water with a good grade of soap is advisable. Bonhuys advises the following cautions concerning the laundering of cotton materials:

Laundering, if desirable, is best accomplished by the use of warm or hot soft water with a good grade of neutral soap. After washing, the garment

\(^{35}\)Robold, op. cit.
should be rinsed repeatedly in warm or cold soft water to remove all soap or other detergent material. 36

In laundering cotton material it is best to avoid excessive amounts of bleaching agents which may cause cotton fabrics to deteriorate.

The best procedure for laundering cotton material is to avoid excessively high temperatures, excessive quantities of bleaching materials, use a neutral soap, and be sure the garment is laundered in a laundering machine which will not give it too violent mechanical action. 37

Kenneth L. Meyer states the following facts relating to the laundering of cotton fabrics:

Some more facts to be cognizant of in the laundering process are supplies. Use only a good grade of soap. By "good" is meant a soap well-balanced in alkali, fats, and other basic ingredients such as abrasives, extra cleansers, etc. The fat-alkali proportion is the basis of strength in a soap. Alkali is cheaper than other ingredients; therefore, the cost may be for a load of alkali and not a balanced soap. Soaps having excessive soda content are hard on hands and equally deteriorating to the majority of fabrics. Acids have little place in the laundering process as they will not remove dirt. The common cry about commercial laundries using powerful acids that injure fabrics is not true. There would be no point in their use.

Don't use too much soap. The fabrics should be washed by soapy water and not frothy suds. Add soda to soap solution as deemed necessary. It reduces costs and aids in dissolving stains. If soap powders are used, give them plenty of time to dissolve before adding more. Use a water softener, it will aid the quality of the wash. See the dealer for a suggested softener. If using bluing, get a good grade that dissolves thoroughly and has little iron.

36 Bonhuys, op. cit. 37 Robold, op. cit.
content. Poor grade bluing will streak, and the iron will settle if clothes are not well rinsed.\textsuperscript{38}

Further suggestions are made by Meyer regarding the washing of white cotton goods:

Soak before washing. A little dissolved soda may be added if the soaking period is short and the materials exceedingly dirty. The washing process then becomes mechanical and chemical. The machine agitates the dirt, and the soap aids in dissolving and freeing it. Use extremely hot water and if necessary, boil. The rinse should be thorough with first hot water and then cold. Whenever a garment is moved from one tub to another it should have the excessive water extracted. Extractors and dryers are excellent.\textsuperscript{39}

Before laundering cotton materials, all stains should be removed. Study a staining chart or consult the local laundry or cleaner for advice.

In the preceding discussion of recommended procedures for the care and maintenance of cotton materials, it has been found that the common causes for the deterioration of cotton fabrics are the following:

1. Abrasion due to wear.
2. Mildew caused by mold.
3. Prolonged exposure to sunlight.
4. Perspiration.
5. Application of strong bleaches.

The procedures recommended for preventing deterioration are as follows:

\textsuperscript{38}Meyer, op. cit., p. 90. \textsuperscript{39}Ibid., p. 92.
1. Repair abrasion due to wear.

2. Keep cotton materials dry.

3. Avoid storing cotton material in a dark, damp place.

4. Avoid keeping cotton materials in prolonged sunlight.

5. Launder cotton materials soon after they have come in contact with perspiration.

6. Avoid the use of strong bleaches and acids.

To avoid loss due to shrinkage it is recommended that cotton materials be purchased from noted and reliable manufacturers who specialize in pre-shrunk materials.

Fading is a problem that has not been satisfactorily solved; therefore, it is recommended that cotton materials be bought from manufacturers who practice "vat-dying." This will not absolutely prevent fading, but it will be minimized.

Recommended procedures for laundering cotton materials are as follows:

1. Remove all stains.

2. Soak white cotton material to loosen dirt.

3. Cover cotton material with soft lukewarm and soapy water.

4. Use separate containers for very dirty and slightly soiled articles.
5. Use a good grade of soap that is well-balanced in alkali, fats, and other basic ingredients.

6. Wash cotton materials in plenty of soapsuds as hot as the hand can stand.

7. If water becomes dirty, drain it off and replace it with clean, hot suds.

8. Rinse thoroughly in plenty of hot, clear, soft water, to be sure all soap is removed from fabric. Soap left in cotton materials will yellow and weaken the fibers.

9. Extract water from materials before moving from tub to tub.

10. Dry thoroughly before being stored or put to use.

Rayon Materials

Rayon is a synthetic fiber made from a cellulose base. It has become a competitive fabric with wool, silk, cotton, and linen, and can be made into attractive football equipment. It can be dyed with fast and even colors of a quality equal to those of other fabrics.

It can combine with any other fabric; it can be warm or cool; lustrous or dull in sheen; expensive or low in cost; in other words, rayon is our most versatile fiber, and has been accorded a place among the major fibers.\(^{40}\)

Among the various items of football equipment, rayon is used principally in football pants and jerseys. It is sometimes used in wool socks to minimize shrinkage.

\(^{40}\)M. S. Woolman and E. B. McGowan, Textiles, p. 206.
To know how to care for rayon material found in football equipment, it is necessary to know the common causes of deterioration of this fabric. The most common cause of deterioration of rayon materials found in football equipment is wear due to abrasion. Other causes of deterioration of this fabric are perspiration, mildew, and breaking down of the fabric due to excessive heat.

Rayon is subject to attack by micro-organisms of the fungus and mold types. Prolonged wetting and drying cycles tend to have a deteriorating action. Amounts of heat normally applied to such fibers as cotton and linen, will fuse, and if excessive, melt it to a hard glossy bead.\(^4\)

S. W. Brainard, Manager of Rayon Technical Service, lists the common causes for the deterioration of rayon:

Wear due to abrasion; loss in strength due to repeated laundering; slow attack by the action of gases, liquids, and solids in presence of air and sunlight (usually associated with long-time use); action of mildew organisms; breakdown due to high temperature, for example, in ironing; action of perspiration on cellulosic materials.\(^4\)

Knowing the causes of deterioration in rayon materials found in football equipment, the next important step is to know how to prevent such deterioration. It is a problem to avoid wear and tear of rayon materials used in football equipment; in fact, it is an impossibility. However, the

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life of rayon can be prolonged provided all damage due to wear and tear is repaired before the equipment is used again.

Certain coatings are available on the market, which, if applied to fabrics, will present a harder surface and thus lengthen the life of the fabric, by reducing the effects of abrasion, flexing and stress.\textsuperscript{43}

Molds cause mildew and will grow on anything from which they can derive enough food.

Though always present in the air, these molds need moisture and certain temperatures in order to grow. Molds commonly develop in muggy summer weather, especially if the house is closed. They flourish wherever it is damp, warm, poorly aired, poorly lighted -- in cellars and in clothing closets.\textsuperscript{44}

To safeguard rayon materials from mildew caused by mold, it is advisable always to keep the materials in a dry place. If they cannot be laundered or cleaned immediately after use, the fabrics, if damp, should be dried. In storing rayon materials found in football equipment it is advisable to store them in a place where dampness is not present. The storage place should be cool at all times and should be well ventilated with plenty of light. When buying football equipment made from rayon materials, it is advisable to make sure the materials have been treated to prevent mildew as

\textsuperscript{43} Tenney, op. cit.

\textsuperscript{44} Bureau of Human Nutrition and Home Economics, United States Department of Agriculture, Preventing and Removing Mildew, Bulletin A1572, 1948, p. 1.
a result of mold.

All football players perspire, and perspiration, if allowed to stay in rayon materials, will cause the fibers to weaken. To prevent deterioration due to perspiration it is recommended that the material be laundered or cleaned immediately after use. This will stop all action of the perspiration.

To prevent deterioration due to heat it is suggested that rayon materials be pressed with low-temperature irons and presses. "Ironing temperatures should not be excessive."\(^{45}\)

The problem of shrinkage is common in most fabrics. Much experimental work has been done and is being done to discover causes of shrinkage in rayon and to find ways to control it. Generally speaking, shrinkage is more prevalent in fabrics that have been improperly processed.

There are several known factors that are large contributors to rayon shrinkage:

1. The characteristic of regenerated cellulose to take up water with simultaneous swelling is an important factor in the shrinkage of rayon. The rayon fiber, after being thoroughly wet and hydro-extracted, may still retain as high as 100% of its own weight in moisture. The swelling which occurs when the fiber is in this wet state, while only 1% to 2% in length, may be as high as 60% in cross-sectional area (thickness). When any rayon fabric which has not been previously relaxed is wet out, the fabric draws up in length and width, due to the displacement caused by the cross-sectional swelling of the fibers that make up yarns.

a. When this same fabric is allowed to dry relaxed, it will be noticed that further shrinkage takes place. This shrinkage which takes place

\(^{45}\)Brainard, op. cit.
between the wet and dry state seems to be caused by
the release of strains in the individual fiber re-
sulting from tensions applied to the yarn or fabric
during processing.

b. Another thing that the progressive
shrinkage which occurs in rayon fabric may be due to
is the fact that individual fibers in the fabric,
obstructed because of twist, fabric construction,
etc., in their attempts to release strains, are con-
tinually shifting and moving during wetting and dry-
ing cycles. All of the strains in all fibers are
never completely released.

2. The tendency of rayons to stretch when wet,
and to retain this stretched condition if dried un-
der tension, is another cause of rayon shrinkage.
A fabric that has been dried under tension will, if
subsequently wet out and dried relaxed, show consid-
erable shrinkage for the reasons stated under num-
ber 1 above.\footnote{46}

To insure a low residual shrinkage, manufacturers of
rayon materials use three general methods: the use of
"resins," the "constititizing" process, and the "Glyoxol"
process. For example, the best-known method of shrinkage
control is the application of synthetic resins of the thermo-
setting type. "This process impregnates the fibers with
materials which become insoluble on curing, and lessens
their inherent tendency to absorb water and swell."\footnote{47}

Fading of rayon material is still a problem that has
not been solved completely, but improvements have been made.
Fading will occur if rayon is exposed to light for long
periods of time, but bleaching of colors will not happen

\footnote{46}{H. F. Creegan, "Facts about Shrinkage Control Pro-
cesses of Rayon Fabrics" (mimeographed), an address at the
Philadelphia Section Meeting of the American Association of
Textile Chemists and Colorists, September 27, 1946.}

\footnote{47}{Ibid., p. 3.}
provided the rayon has been dyed with a fast color. "Vat dyes, as a class, usually give sufficient degree of fastness to satisfy all requirements."^48

Improper washing will cause rayon to fade and colors to "run" together no matter how "fast" the dye may be. "The proper choice of dyestuffs and dyeing procedures will result in satisfactorily fast colors."^49

Rayon can either be wet-washed or dry-cleaned, depending upon the type of garment.

Ashton M. Tenney makes the following suggestions concerning the cleaning and laundering of rayon:

Rayon may be washed using standard procedures, providing high temperatures and/or strong alkali soaps are avoided in the washing. Common dry-cleaning methods will be found satisfactory, again providing that the solvent used in the process is not a solvent for cellulose acetate. Such solvents as carbon tetrachloride or naphtha are not solvents for cellulose acetate.^50

Special care must be taken in the laundering of rayons.

The American Institute of Laundering offers suggestions as follows:

Minimize mechanical action by using as short a formula as is consistent with adequate cleaning; maximum temperature should not exceed 100°F.; neutral soap or a synthetic detergent should be used to protect colors; finishing may be accomplished by hand ironing, steam pressing, form finishing, reduced temperature and pressure of pressing, or by pressing after pre-conditioning. Because

^48Breinerd, op. cit.  
^49Ibid.  
^50Tenney, op. cit.
of the danger of the fusing of cellulose-acetate which may be present, care must be exercised in finishing all rayons, and pressing temperatures should be maintained preferably below 300° °F.51

Frank D. Meade offers these suggestions for laundering rayon materials used in football equipment:

Rayon fabrics can be washed with pure soap and water. The top colleges and schools send their garments to be cleaned to concerns like the Ivory System in Peabody, Massachusetts, which have such facilities for picking up, cleaning, and returning athletic garments. In their plant they have forms on which the garments are put after they are cleaned and allowed to dry to their true shape. Rayon, as you know, is malleable when it is damp; therefore, if you keep a record of the length of the garments before they are washed, they can always be brought to the exact measurements, if they are distorted in the washing, by stretching the garments, then iron it while it is damp and this will set the garment to its correct size.

This also can be done on a Hoffman Presser, by letting the steam penetrate the rayon fabrics and then by manipulating the garment to the correct size. The distortion of rayon garments is easily caused by having them washed in a washing machine that has a tumbler, as every fall in the machine causes a wet felting action, the same as you would get on the distortion of woolens improperly washed.52

Fortunately, rayon can be cleaned rather easily, so the American Institute of Laundering suggests a washing formula when a plant is equipped with a small-diameter cylinder machine:

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52Personal letter from Frank D. Meade, Manager, Special Fabric Department, William Skinner and Sons, New York City, January 27, 1949.
First bath -- Add warm water at 90° to 100° F. until a five-inch level is reached. Add dissolved high-titer neutral soap or dry low-titer neutral soap to obtain a running suds. Drain the machine at the end of five minutes.

Second bath -- Repeat.

Note: Bedly soiled pieces may require an additional suds with neutral soap. In many cases, two suds will prove sufficient.

Third bath -- Add ten inches of water at a temperature not exceeding 100° F. and run for three minutes after proper level has been reached. Drain. If the water used contains two or three grains of hardness per gallon, the first rinse may be run at a five-inch level.

Fourth bath -- Rinse for three minutes at a ten-inch level.

Fifth bath -- Repeat.

Note: If heavy loads are being handled, use another three-minute, high, warm rinse.

Sixth bath -- Add five inches of water at 90° F. and sour to correct pH. Drain at the end of five minutes.

Every operator who handles rayon should be cautioned to treat such pieces with special care. The operator should
recognize the fact that since rayon can be washed successfully under home conditions, there is no reason why it cannot be laundered in a commercial laundry. Every care should be taken to avoid tearing the wet pieces by careless "pulling" or extracting. 53

In summarization of the recommended procedures for the care and maintenance of rayon materials, it has been found that the common causes for the deterioration of rayon are as follows:

1. Perspiration.
2. Mildew as a result of mold.
3. Excessive heat.
4. Abrasion due to wear and tear.
5. Sunlight.

To prevent deterioration it is suggested that the following be done:

1. Repair all abrasions due to wear and tear.
2. Perspiration should be removed as soon as it has come in contact with rayon material, either by laundering or by dry-cleaning.
3. Mildew caused by molds can be prevented in rayon materials if they are stored in a dry place where dampness is not present. This storage place should be cool and ventilated with plenty of indirect sunlight. By no means

53 American Institute of Laundering, op. cit., p. 4.
should rayon materials be allowed to lie around for several
days in a soiled or damp condition.

4. To prevent deterioration due to excessive heat, it
is suggested that the rayon materials be pressed and ironed
at low temperatures.

5. Rayon should not be exposed to sunlight over long
periods of time.

To prevent shrinkage of rayon materials, the following
practices should be employed:

1. Buy rayon materials that have been processed either
by the "resin," "constitizing," or the "Glyoxal" method.

2. Avoid sudden changes of temperature in washing
water.

To prevent fading of rayon materials it is suggested
that the following be done:

1. Keep rayon from being exposed to direct sunlight
for long periods of time.

2. Buy materials that have a reliable dye, preferably
vat-dye.

3. Launder rayon materials properly.

In laundering or cleaning rayon materials, it is best
to:

1. Select a reliable laundry or cleaner that special-
izes in the cleaning of rayons.

2. Launder in low water temperature and avoid strong
alkali soaps. Water temperature should not exceed 100° F.
3. Never wash in washing machine for over five minutes.

4. Rinse out thoroughly, being sure that all soap is rinsed out.

5. Dry on forms if possible to assure required shape and size.

6. Pressing temperatures should be maintained below 300°F.

Nylon Materials

Nylon is a new material on the market. It was put into commercial production in 1939. "Unusual strength and elasticity are claimed. It is a synthetic fiber developed from coal, water, and air and seems to be coming into its own as an athletic fabric."\(^{5}\) It is most frequently used in football pants because of its elasticity and strength. It makes an attractive football garment and at the same time is not hard to clean and care for.

Like other fabrics, nylon does deteriorate but it does not have as many causes for deterioration as do other fabrics. The common causes for the deterioration of nylon in football equipment are as follows: wear and tear, exposure to sunlight, and commercial bleaches.

Aside from ordinary wear and tear, which usually has less effect on nylon fabric than on similar fabrics of other fibers, deterioration in nylon can be

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\(^{5}\)Meyer, op. cit., p. 29.
due to a variety of reasons. Long-continued exposure to strong sunlight weakens all fibers commonly used for apparel purposes, including nylon. Certain chemicals, strong mineral acids and strong bleaches cause deterioration in nylon as in other fabrics; however, nylon generally stands up well under normal laundering procedures. Exposure to excessive heat can also injure the fabric; the correct pressing temperature for nylon is about the same as for rayon.55

Moths cannot live on nylon alone. However, the moth larvae, if trapped in nylon, will eat their way out.

Nylon is resistant to mildew caused by molds or other micro-organisms. "Molds can be induced to grow upon nylon yarn by applying suitable food materials, but such growth causes little if any loss in strength of the yarn."56

Although nylon does not deteriorate easily, it is wise to limit the deterioration that is caused by the ever-present wear and tear found in football equipment. From the standpoint of economy, all wear and tear should be repaired as soon as it has occurred in order to prevent further deterioration. Nylon that is not in actual use should be stored in a dark place to prevent the weakening of the fabric due to excessive light. As bleaches will weaken nylon, it is advisable not to use them.


The natural whiteness of nylon is not improved by bleaching. Chlorine or common household bleaches have a tendency to discolor the fabric. Peroxide bleaches do not discolor, but if a strong hot solution is used, the fabric may be weakened.\textsuperscript{57}

J. Salmon gives the following information on the prevention of deterioration of nylon fabrics:

Most nylon fabrics can take a lot of wear and tear, and this quality suits them particularly for athletic equipment. However, in general the rougher the treatment, the shorter the life of the fabric. Nylon fabrics should not be left in strong direct sunlight when they are not in actual use. They should be ironed at the correct temperature and should not be brought in contact with strong mineral acids or bleaches. All of these precautions would apply equally well to almost any other fabric.\textsuperscript{58}

Just as has been found with other textile fabrics, nylon is subject to shrinkage. A type of heat-setting procedure is used in the manufacture of the product and the degree of shrinkage is regulated by the heat-setting process used. "The degree of shrinkage depends on the heat-setting procedure to which the fabric was subjected in the course of manufacture."\textsuperscript{59} When buying nylon material it is advisable to buy materials that have been manufactured by a reliable concern so as to be assured of a material adequately treated to prevent minimum shrinkage.

The fading of nylon may be determined largely by the types of dyes used and by the process by which they are

\textsuperscript{57}E. I. du Pont de Nemours and Company, \textit{Washing Nylon Fabrics}.

\textsuperscript{58}Salmon, op. cit.

\textsuperscript{59}Ibid.
applied. However, no nylon fabric is absolutely safe from fading, as long periods of time will produce fading in nylon fabrics even when the best dyes have been used. Fading results from too long exposure to direct sunlight. When buying nylon fabrics it is desirable to procure the fabrics that have been dyed with acetate dyestuffs. "Acetate dyestuffs are usually preferred for nylon because of their better uniformity of dyeing compared with other types." 60

Concerning the fading of nylon materials, J. Salmon states with finality, "The fading of nylon fabrics depends on the dyestuffs applied." 61

Nylon material can be laundered easily, but certain precautions should be taken. It should be laundered in lukewarm water with a mild soap added.

All nylon fabrics may be washed if the finishing materials and dyes will withstand laundering. If in doubt, test an inconspicuous part of the item such as a hem for color fastness. Use warm sudsy water. Rinse thoroughly and hang on smooth line or rod away from contact with hot radiators or pipes. Strong bleaches should also be avoided. As with other fabrics made from other yarns, color fastness may be affected by exposure to direct sunlight. Because of its smoothness, dirt does not readily adhere to nylon. 62

Nylon has a resistance to dry-cleaning fluids, and

61 Salmon, op. cit.
therefore it is not injured by the fluids. "If there is any question as to the washability of a particular fabric because of dyes used, construction, or the type of stain, it is suggested that the garment be sent to a reliable dry-cleaner."63 It is further suggested that information can be obtained from manufacturers regarding the cleaning and laundering of a particular article made of nylon.

Nylon itself may be cleaned with standard cleaning fluids which are satisfactory for other fibers. When in doubt about cleaning because of finishes or dyes, test a small inconspicuous spot or send the article to a reliable commercial cleaning establishment.64

It has been found in the analysis of the recommended procedures for the care and maintenance of nylon that the causes for deterioration are as follows:

1. Wear and tear.
2. Exposure to sunlight.
3. Commercial bleaches.
4. Excessive heat.

To prevent deterioration it is suggested that the following procedures be employed:

1. Wear and tear caused by rough usage of nylon in football equipment should be repaired as soon as the damage

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63Du Pont Company, Washing Nylon Fabrics.

64Du Pont Company, About du Pont Nylon.
is done. This will prevent further wear and tear and will prolong the life of the fabric.

2. Well-sodded football fields will help to prevent wear and tear on nylon materials.

3. Nylon should not be left in direct sunlight when not in actual use.

4. Avoid the use of excessive heat in pressing or ironing nylon.

5. Avoid the use of bleaches on nylon materials.

6. Always assure oneself that when storing nylon materials, there are no moths trapped in the folds of the materials.

To avoid the problem of shrinkage of nylon materials it is best to purchase nylon articles from a reliable company which has applied the proper heat-setting method to the materials during the process of manufacture.

To prevent the fading of nylon:

1. Keep from being exposed to direct sunlight when not in use.

2. Buy nylon articles that have been dyed with acetate dyestuffs.

To clean or launder nylon materials it is suggested that the following be observed:

1. Use standard cleaning fluids if the cleaning is done within the school plant.
2. Never use dirty cleaning fluid, as it will soil the material.

3. If necessary to send equipment to a cleaner, be sure that it goes only to a reliable concern.


5. Pressing temperatures should be maintained below 300° Fahrenheit.
CHAPTER III

AN ANALYSIS OF RECOMMENDED PROCEDURES FOR THE CARE
AND MAINTENANCE OF LEATHER MATERIALS

Leather is made from animal skins and hides which are so changed by the tanning process that they no longer undergo decomposition. Although leather does not decompose after tannage, it will deteriorate if not properly cared for. The most common causes for the deterioration of leather found in football equipment are lime, perspiration, dirt, water, mildew, and dryness. As Kenneth L. Meyer states: "Dirt, water, lime, and other foreign agents get a crack at leather."¹ It is a problem to prevent agents of deterioration with the exception of mildew, from getting on football equipment, because all such equipment while in use is exposed to such agents.

Lime, dirt, and perspiration will cause thread to rot in leather parts; therefore, they must be removed before they begin their destructive work. These agents will also cause the leather to deteriorate. To prevent this deterioration it is suggested that water be used to remove the lime,

dirt, and perspiration. If dirt is caked upon the leather, it should be removed with a dull scraper or with a stiff brush. Avoid the use of wire brushes.

In cleaning leather it is desirable that the article become no wetter than necessary to remove the adherent dirt. For this purpose any mild soap will do. It should be applied as a lather and the dirt removed with a dry, clean cloth.²

If leather becomes wet, it should be dried out to prevent the deterioration of the leather and the rotting of the threads. This can be done by careful drying, which will be discussed later in this chapter.

Mildew of leather is usually the result of dampness on the leather itself or of keeping the leather in a place where the humidity is high.

Leathers kept in a warm place are almost certain to mildew. Mildew probably will not seriously harm the leather unless it is allowed to remain too long, but it may change the color. The simplest way to prevent mildewing is to keep the leather in a well ventilated, dry, light place. When first detected, the mildew should be washed off with soap and warm water, or, simply wiped off with a moist cloth and the leather will dry.³

The natural oils and greases of leather are its life. If these escape, the leather will become dry and hard and will crack. To prevent the escaping of these greases, C. H.

²Fred O'Flaherty, Prolonging the Life of Leather, Tanners' Research Laboratory, University of Cincinnati, November, 1938, p. 1.

³United States Department of Agriculture, Leather Shoes, Selection and Care, Farmers' Bulletin No. 1523, April, 1933, p. 21.
Ellis offers this suggestion:

A waxed surface is the most ideal method of retaining oils and greases in leather, particularly where they would be subjected to dry heat or to wet conditions, such as perspiration.4

The proper care and cleaning of leather will add to its life and will prevent unnecessary deterioration. "One of the soundest advices which can be offered is -- keep leather clean,"5 as has already been stated by O'Flaherty: "Cleaning will add to the useful life of leather."6 Leather should be cleaned as needed so that it will be useful for a long period of time.

From time to time leather should be cleaned thoroughly with a good grade of soap, preferably glycerine-content saddle-soap; there are several good grades of highly refined oils on the market to restore natural conditions in the leather.7

John Kraft makes this suggestion for the cleaning of leather:

Should leather require cleaning, saddle soap, applied with a moist cloth, is an excellent application. The dirt is easily loosened by the leather and requires only a brisk rubbing with an additional clean cloth.8

All leathers in football equipment are subjected to dampness, and special care must be taken in caring for such

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5O'Flaherty, op. cit., p. 1. 6Ibid.

7Ellis, op. cit.

8John Kraft, "Make Your Equipment Last," Scholastic Coach, XIV (February, 1945), 18.
leather. "Leathers are subjected to dampness through perspiration and inclement weather. Drying out and cracking of the leather can be prevented by the use of a leather preservative." Leather that becomes wet should be dried thoroughly at a normal room temperature. "Baking and other means of artificial drying must be avoided. A good leather preservative worked into the pores will do much to maintain its serviceability and tone."10

A. G. Spalding offers this suggestion in the care of leather that has become wet: "If leather becomes wet, wipe and let dry at normal room temperature without excessive heat. Do not place close to radiator."11 The Wilson Sporting Goods Company makes the following remarks on leather that has become wet:

Any wet leather article should be dried thoroughly at room temperature away from heat. High drying temperatures heat the moisture and create a cooking process within the leather. The resultant drying out destroys the pliability of the leather and causes surface cracks.12

Other suggestions for the cleaning and care of leather are as follows:

Keep leather clean so that the pores are not clogged. Leather which does not "breaths" causes excessive perspiration. Never allow leather to

9Ibid.
10Ibid.
11A. G. Spalding and Brothers, The Bell of Big Games, a circular, p. 2.
become wet any more than is absolutely necessary, and never dry leather near a stove or other source of heat. Wipe off and dry at room temperature. Keep leather well lubricated. As long as the fibers are properly lubricated, they will slide on one another without producing excessive friction. If leather is not properly lubricated, it becomes stiff and the fibers gradually grind themselves to pieces whenever the leather is flexed. Nowadays it is possible to fortify leather with specially treated preservatives that revive, soften and preserve the item and at the same time render it water repellant and mildew-proof. They leave no sticky or oily residue to dull the surface or catch dirt or dust. During the spring and summer months all leather equipment that is to be stored away should be treated with a dressing.\textsuperscript{13}

Leather articles should be kept in a well-ventilated place that is cool and dry and that has plenty of light. "The simplest way to prevent mildew is to keep leather in a well-ventilated, dry, and light place."\textsuperscript{14} The Special Services Division of the Army Service Forces cares for and maintains leather in this manner:

In order to prevent green mold rot, leather articles should be kept in a cool, dry, light place. When wet, leather articles should be dried immediately but the action should not be forced. The article should be dried at normal room temperature without the use of artificial heat. If it happens that repeated wetting and drying are encountered, there will be a tendency for a harshness to develop but this can be overcome by applying Neatsfoot oil or light paraffin (mineral) oil to the leather surface. Mersolite-P is an excellent commercial leather dressing.

Leather that has become soiled should be cleaned with saddle soap only. Never use any other type of

\textsuperscript{13}"Care of Equipment for the Duration," \textit{Scholastic Coach}, CII (December, 1942), 14.

\textsuperscript{14}United States Department of Agriculture, \textit{on. cit.}, p. 21.
soap or dry cleaning fluid. The saddle soap should be applied with a moist cloth by rubbing the cloth over the soap to work up a cream on the cloth. The soiled leather should then be rubbed with the cloth until a lather has been worked up and the dirt is loosened. The dirty leather should then be wiped off with a clean cloth and the leather briskly rubbed with a clean cloth. Remember that heat and forced drying will destroy leather.\(^{15}\)

In summarization of recommended procedures for the care and maintenance of leather goods, it has been found that the causes for the deterioration of leather found in football equipment are due to:

1. Wear and tear.
2. Lime.
3. Dirt.
5. Mildew.
6. Dryness.

To prevent leather from deteriorating, it is suggested that the following be observed as procedures:

1. Repair any wear and tear that may occur.
2. Clean leather as soon as it becomes soiled and use a reliable leather preparation.
3. Keep leather in a cool, dry, well-ventilated place.

To clean and care for leather the following procedures are recommended:

\(^{15}\) Pamphlet issued by Special Services Division, Army Service Forces, Washington, D. C., p. 3.
1. Clean dirt, lime, and perspiration from leather with water.

2. While still damp, apply saddle soap as a suds.

3. Use highly refined oils that are on the market to restore natural oil conditions into the leather.

4. Dry wet leather at normal room temperatures and avoid excessive heat which will crack the leather.

5. Store and keep leather articles in a cool, dry, well-ventilated, and lighted place.

In the succeeding chapter attention will be directed toward recommended practices in the care and maintenance of football equipment constructed of rubber.
CHAPTER IV

AN ANALYSIS OF RECOMMENDED PROCEDURES FOR THE
CARE AND MAINTENANCE OF RUBBER MATERIALS

Rubber is an essential component of much of the equipment worn by football players. It is valuable for two purposes, namely, protection and its resistance to moisture. Rubber being an important item in football equipment, and an expensive one, it would be important to know the causes which are commonly responsible for its deterioration, which have been listed as sunlight, excessive heat, various oils, oxidation, acids, dirt, perspiration, and strain. Several authorities give the following information on the causes for the deterioration of rubber: "Deterioration of rubber is caused by several things: sunlight, oxidation, acids and oils."¹ A chemist employed by a rubber company wrote: "The main causes for deterioration of rubber in regard to football equipment are the natural oils that are absorbed into rubber parts, excessive heat, storage in hot places, and sunlight."²


A district executive of a rubber company wrote that "the common causes of deterioration of rubber can be summed up as follows, assuming it is a natural rubber: oils and greases and long exposure to direct sunlight."\(^3\) Similar factors have been reported as follows: "Common causes for the deterioration of rubber are: strong light; exposure to direct sunlight after use is very bad for rubber; heat; oxygen; oils and hydrocarbons; copper; manganese; perspiration and permanent stretch."\(^4\) Outstanding enemies of rubber have been defined as follows: "In regards to the causes for the deterioration of rubber, it has been found that the greatest enemies of rubber are heat, sunlight, and oils or greases."\(^5\) An official of the Goodrich Rubber Company has said that "the causes for deterioration of rubber are exposure to the effects of oxygen, heat, oils and greases."\(^6\)

After one has learned the important causes for the deterioration of rubber, it is important to know how to

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\(^3\) Personal letter from Moll M. Barton, Southwest District Manager, W. J. Voit Rubber Corporation, Los Angeles, California, December 28, 1948.

\(^4\) Personal letter from Frank Hall, Converse Rubber Company, Malden, Massachusetts, January 17, 1949.


prevent them. To prevent rubber from deterioration due to sunlight, it is suggested that it be put in a cool, dark place. William J. O’Brien offers these suggestions in preventing deterioration due to sunlight:

Obviously one would keep rubber goods out of direct sunlight as much as possible and store such goods in a cool, dry place because occasionally if stored in a damp place rubber will be attacked by mold and bacteria which will cause it to deteriorate. The safest procedure is to store the rubber article when not in use in a closed cardboard container and place this container in a cool dry place.7

Obviously, an important factor in preventing deterioration of rubber due to various oils is to keep it away from such. As it is impossible to avoid getting body oils on some rubber found in football equipment, it should be cleaned often to take off the oils. To clean the oils off is a procedure that will be discussed in relation to the cleaning and care of rubber. Frank Hall makes this statement about the deterioration of rubber due to various oils: "Keep away from contact with oils."8 As it has been stated, oils and greases affect rubber and cause it to deteriorate; therefore, rubber should not be stored where greases and oils will attack it. B. T. Johnson has found that "one of the greatest enemies of rubber is oils and greases. Any petroleum

8Hall, op. cit.
product will affect rubber; therefore, it should be kept free of oils and greases."^9

Oxygen will cause rubber to deteriorate and this is a problem that has not been solved completely. Oxidation can be prevented to a certain extent by exercising special care in storing and using rubber, which cannot, however, be shut off completely from oxygen. H. L. Ebert points out that deterioration due to oxidation is almost an impossible problem to solve:

It, of course, is not possible to keep oxygen away from rubber parts. It is possible, however, to store it in a place where it is not exposed to elevated temperatures and direct sunlight. We have found that an airy room where there is some change of air is better than one in which the rubber is confined without a change of air. This is true even though oxidation is the thing we want to guard against.\(^10\)

On the market are protective paints and waxes which will protect rubber from exposure to oxidation in the air and in any sunlight which might come in contact with the rubber. The protective paints are waxes in a wetter solution.

Keeping dirt and perspiration from rubber found in football equipment is an impossibility, but it can be cleaned to remove these agents. How to remove dirt and perspiration

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^9 Johnson, op. cit.

will be brought out in the discussion of care and cleaning of rubber materials.

The cleaning of rubber will aid in the prevention of deterioration, especially if done immediately after soiling has occurred. The safest way to clean rubber is with water, or with soap and water. The soap should be mild and one that will not harm the rubber. It is suggested that "the best way to clean rubber is through the use of a mild soap such as Lux flakes and warm water."\(^1\)

O'Brien states that in the case of oil or grease contamination of rubber, it would be permissible to use acetone:

If oil or grease has contaminated the rubber this can be removed through the use of acetone. It is by no means advisable to clean rubber with gasoline or kerosene or to boil rubber articles in strong soap and water solutions. Excessive heat and the choice of the wrong solvent will do more damage than the original dirt or grease on the rubber article.\(^2\)

Winkley gives this information on the cleaning of rubber:

After use rubber should be cleaned in one of the following two ways: either wash in lukewarm water with a mild soap such as Ivory or Swan, not Fels Naphtha or the like. After this washing it should be rinsed. If a mild soap is not handy it is possible to flush the surface of the rubber with lukewarm water and achieve practically the same results. The advantage of using a soap is that it saponifies the oils that have been absorbed by the

\(^{11}\) O'Brien, op. cit.

\(^{12}\) Ibid.
rubber by way of perspiration. After washing and flushing, the rubber should be hung up to dry in a normal manner; in other words, it should not be force-dried by means of heat as this hastens the deterioration of rubber.\textsuperscript{13}

Experimentation has proved that "the best method for cleaning all rubber articles is to wash them thoroughly with a neutral soap and then see that they are rinsed with clear water."\textsuperscript{14} After cleaning rubber with soap and water, it is suggested that the rubber be rinsed thoroughly to remove all traces of soap.

The care of rubber is simple and is in no way a hard task for anyone provided a few simple rules are followed. As previously stated, rubber should be clean before being stored. It should be kept away from heat and sunlight as well as from oils and greases. Also, it must be stored in a place where moisture will not come in contact with it.

When football equipment is stored from one season to another, these parts that contain rubber should be stored with a piece of newspaper between each component. This allows any moisture present to be absorbed by the paper and not form mold or bacteria on the rubber parts. It is also poor practice to store equipment in a place that is going to get too hot or where sunlight could reach it through the window, for the ultra-violet light in the sun's rays accelerates deterioration of the rubber.\textsuperscript{15}

\textsuperscript{13}Winkley, \textit{op. cit.}

\textsuperscript{14}Personal letter from H. W. Martin, Manager of Footwear, Hood Rubber Company, Watertown, Massachusetts, February 10, 1949.

\textsuperscript{15}Winkley, \textit{op. cit.}
Another method that is very practical in caring for rubber is brought out by William J. O'Brien:

The safest procedure is to store the rubber article when not in use in a closed cardboard container and place this container in a cool, dry place. It is advisable to dust the rubber article with a small amount of talcum powder and then store the rubber article.\textsuperscript{16}

Frank Hall has this statement to make on the care of rubber:

For the rubber goods, store in a dark cool place out of contact with oil and with least stress on the rubber. It is sometimes found advantageous to wipe on to rubber a thin film of glycerin and wipe off all that will come off readily.\textsuperscript{17}

In summarization of recommended procedures for the care and maintenance of rubber articles, it has been found that the causes for deterioration of rubber are as follows:

1. Sunlight.
2. Excessive heat.
3. Various oils or greases.
4. Oxidation.
5. Dirt.
6. Perspiration.
7. Strain.

To remove the causes of the deterioration of rubber, it is suggested that the following be done:

\textsuperscript{16}O'Brien, \textit{op. cit.}

\textsuperscript{17}Hall, \textit{op. cit.}
1. Keep in a cool dark place where there is a change of air.

2. Clean thoroughly as needed.

3. Keep away from various oils or greases.

4. Store or keep rubber in such position as to cause no strain on it.

In cleaning rubber, the following procedures are suggested:

1. Clean with a mild soap and lukewarm water.

2. Rinse thoroughly after using soap and water.

3. Dry at normal room temperatures.

To care for rubber, it is recommended that the following be done:

1. Clean thoroughly after each use.

2. Store in a cool place, in a cardboard container.

3. Dust with powder before storing.

4. Avoid the folding and creasing of rubber articles.

5. Rubber that is not stored in a cardboard container may be stored with newspapers between it to absorb any moisture that may be present.

In the following chapter the care and maintenance of football equipment constructed of fiber will be discussed.
CHAPTER V

AN ANALYSIS OF RECOMMENDED PROCEDURES FOR THE

CARE AND MAINTENANCE OF FIBER MATERIALS

Fiber materials are used on the protective pads that
football players wear. Fiber is a strong material that
offers protection and withstands excessive abuse.

Just as any other materials that make up football
equipment, fiber materials have a tendency to deteriorate
if not cared for properly. The causes for the deterioration,
however, are few, namely: dampness, heat, and fungus at-
tack. "Dampness, moisture or wet and extreme heat cause
fiber to deteriorate."

On the other hand, F. L. Gerhauser points out that

Fiber is not affected by oils, greases, gasoline, or the ordinary commercial solvents. Fiber, unless subjected to the action of acids, does not
deteriorate, but actually improves with age. However, it does have an affinity for moisture and if exposed to a damp atmosphere or immersed in water, it will tend to absorb the moisture and swell
and soften. When the excess moisture is evaporated, it will shrink to approximately its original thickness, but will also tend to warp.

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As has been stated, fiber materials will not deteriorate under conditions other than dampness, excessive heat, and fungus attack. To realize more clearly the causes for the deterioration of fiber materials, it is well to state H. T. Lundquist's idea on the deterioration of fiber:

We usually think of fiber as a material that does not deteriorate. Fiber is made of cotton rag paper and is a practically pure cellulose. If kept under normal humidity and temperature conditions, it will last well-nigh indefinitely. There are, of course, limitations. If fiber is buried in the ground it will decay the same as would any other cellulose material, and if fiber is dried out excessively, it will become brittle. At the temperature of 200° F. fiber will dry out and become brittle but will not deteriorate to such an extent that it will not regain its strength when brought back to normal moisture content.

Fiber might be heated to 300° F. for a short period of time without any measurable change, but if kept at this temperature for a long period of time, the fiber will lose some of its strength permanently. When used for athletic goods guards, fiber is not exposed to conditions that might cause rot, nor is the fiber exposed to temperatures that will do any damage. Fiber, being very strong and yet somewhat flexible, has been found to be the best material available for athletic goods guards. Fiber will take up moisture, but athletic goods guards are always given a protective coat of varnish and ordinary changes in humidity or even immersion in water for a short period of time will not affect the guard.3

Although fiber material used in football equipment does not deteriorate readily, it does need protective and preventative measures against deterioration. Fiber material that has become wet should be allowed to dry out at normal

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temperatures and should not be force-dried. For preventing fiber from absorbing moisture, it is suggested that a coat of shellac or varnish be applied.

Deterioration is therefore best prevented by keeping the fiber dry and away from sweat or use on rainy days. Since this is often an impossibility, the fiber can be coated with a water resistant lacquer which will slow down moisture penetration. Keep below 120° F.⁴

As one can see, fiber materials will absorb moisture and therefore they should be kept in a dry place. When they become wet, they should be cared for immediately: "Keep in a dry place -- dry it as soon as possible after it becomes wet."⁵ It has also been found that fiber materials will deteriorate in excessive heat if they remain in this condition over a long period of time.

Fiber should not be subjected in storage to either extreme, such as extremely dry or extremely damp conditions. Fiber adjusts its moisture content to correspond with the atmospheric humidity to which it is exposed.⁶

To prevent fungus from getting on fiber materials, the material should be allowed to dry as soon as it becomes damp or wet. It should be stored in a place where the humidity is not too high. No fiber material should be allowed to stay damp over long periods of time.

⁴Varnum, op. cit.

⁵Personal letter from M. E. Armstrong, Advertising Department, Continental-Diamond Fiber Company, Newark, New Jersey, December 31, 1948.

Fiber material used in football equipment has a protective varnish or lacquer. This protective finish will permit cleaning with water or a damp cloth. A mild soap and water can also be used. "Carbon tetrachloride is most commonly used for cleaning fiber."7 After using water on the fiber, it is best to allow the material to dry in a normal position so that it will not get out of shape.

Special precautions should be taken when caring for fiber materials. As has already been stated, fiber material should be stored at normal temperatures. It should be allowed to dry at normal temperatures when it has gotten wet and should be allowed to dry so that there is no stress or strain on the material. Fiber material that has become damp and is therefore out of shape should be reshaped while wet. The material should be waxed or varnished occasionally for protective purposes.

J. M. Farnum makes this statement about the care of fiber materials:

Fiber needs no care except to keep moisture away from it and avoid extreme heat. Don't put it on a radiator or in an oven or a room over 120°F. It will become brittle and lose some of its toughness. So far as we know extreme cold does not affect fiber. The main things are to avoid exposure to moisture and yet keep in the fiber its natural content of 4 to 6% moisture. This is necessary for its toughness. Fiber is quite sensitive to humidity changes; that is why we advise keeping away from heat. Once the normal moisture content has

7Gerhauser, op. cit.
gone below 4% it is difficult for the fiber to regain it.\textsuperscript{8}

Farnum states that "fiber needs no care except to keep away from heat and moisture,"\textsuperscript{9} but it is advisable to clean and put protective coatings on the material. "After being dried, the fiber should be treated with shellac, varnish, wax, or some protective coating. A protective coating helps to prevent scuffing and disintegration of the fiber."\textsuperscript{10}

In this chapter concerning recommended procedures for the care and maintenance of fiber, it has been found that causes for the deterioration of fiber materials are as follows:

1. Moisture.
2. Excessive heat.
3. Fungus attack.

To remove the causes for the deterioration of fiber material, it is suggested that the fiber should be kept away from excessive heat, and when it becomes wet, that it should be dried at a normal temperature, always avoiding force-drying.

To clean fiber either use water or mild soap and water. Carbon tetrachloride may also be used.

In caring for fiber it should be cleaned and a protective coating of shellac, varnish, or wax applied. Keep in

\textsuperscript{8}Farnum, \textit{op. cit.}

\textsuperscript{9}\textit{Ibid.}

\textsuperscript{10}Meyer, \textit{op. cit.}, p. 106.
a dry place and dry as soon as it becomes wet. Reshape while wet any article that has become out of shape.

Suggestions for caring for and maintaining football equipment made of plastic will be presented in the following chapter.
CHAPTER VI

AN ANALYSIS OF RECOMMENDED PROCEDURES FOR THE
CARE AND MAINTENANCE OF PLASTIC MATERIALS

Plastic is a new material that is now coming into widespread use in football equipment. It is still in its experimental stage in so far as its utilization in football equipment is concerned, and little is known as yet as to the causes for its deterioration or about how to care for it properly. However, as a result of the writer's correspondence with certain noted manufacturers of plastic materials, he notes that they seem to believe that the common causes for deterioration in plastics are excessive heat and sunlight, cracking produced by excessively rough usage, and breaking or scratching as a result of real abuse.

Plastics are used predominantly for the manufacture of headgears which, when made of this material, constitute a comparatively new phase of football equipment. Just as does the leather headgear, the plastic headgear deteriorates under certain conditions and needs special care.

Causes for the deterioration of plastic materials are as follows: cracking due to rough usage, excessive sunlight and heat, and the showing of marks due to real abuse. There
may be other causes for the deterioration of plastic materials, but these are the most common found in football equipment. "Exposure to the ultraviolet light from the sun causes deterioration of plastics."

To prevent the deterioration of plastic materials used in football equipment, it is suggested that it not be exposed to direct sunlight for long periods of time and that one never allow plastic material to be thrown around to cause it to crack. It is impossible to prevent plastics from getting marks and abrasions due to abuse, but such impairments can be brought to a minimum by putting on a protective coating of clear wax.

Cleaning plastic material is rather easy and simple in that lukewarm water and soap is all that is needed. "We suggest the use of lukewarm water -- Dreft solution. For removal of grease spots we would suggest the use of isopropyl alcohol." Edward G. Smith makes the following comment on the cleaning of plastics: "The simplest method of maintaining plastic equipment would be to give it a good scrubbing with soap and water." To give assurance that plastics should be cleaned with soap and water, the Tenite Company says: "Plastics are cleaned merely by the application

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1 Personal letter from Richard H. Erlewine, Vice-president, General Plastics Corporation, Marion, Ind., January 27, 1949.

2 Ibid.

of soap and water.  

In general, it is simple to care for plastics used in football equipment. It should be washed with soap and water when it becomes soiled. Should not be put in a position that will cause it to warp or get out of shape. A wax finish will aid to protect the surface of plastic material, and it should not be subjected to extreme heat. The use of wax will preserve the finish of plastic material.  

Richard H. Erlewine offers this statement on the care of plastic materials: "For a protective coating after cleaning we would suggest a clear wax be used -- Glasswax is good."  

In this discussion of recommended procedures for the care and maintenance of plastics, it has been found that the common causes for the deterioration of plastic materials are as follows:  

1. Cracking under rough usage.  
2. Excessive heat.  
3. Marks due to abuse.  

With the exception of damage due to excessive heat, it is almost impossible to prevent the causes for the deterioration of plastics, as previously mentioned. Never store plastic or leave it in the presence of excessive heat.  

To clean plastics it is suggested that lukewarm water and a mild soap be used. If any grease is on the plastic,  

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4 Ibid.  
5 Smith, op. cit.  
6 Erlewine, op. cit.
it can be removed in the application of isopropyl alcohol.

To care for plastic it is recommended that the following be done:

1. Clean with soap and water.

2. Always place plastics in a position so that it will not warp or get out of shape.

3. Avoid throwing or tossing plastic articles such as headgears, as this may cause cracking.

4. Avoid exposing plastic materials to extreme heat.

5. Use of a commercial wax will protect the surface of plastic materials.

In the succeeding chapter is presented a discussion of recommended procedures for the care and maintenance of metal parts found in football equipment.
CHAPTER VII

AN ANALYSIS OF RECOMMENDED PROCEDURES FOR THE
CARE AND MAINTENANCE OF METAL MATERIALS

Metal is an important part of football equipment. It is used in the form of buckles, zippers, eyelets, steel plates, brads, and snaps. On shoulder pads metal buckles are used to adjust the elastic straps and brads are used to hold the different parts of the pad together. Metal buckles can also be found on hip pads, pants, knee pads, and belts.

Steel plates are used in the construction of the football shoe. The plate is between the inner and outer sole of the shoe and is used for cleat-post attachment. The plate also serves as a protection against any cleats that might push up into the shoe.

Metal deteriorates like any other material used in the construction of football equipment, although only one agent is especially detrimental to metal. The one thing that causes metal to deteriorate under ordinary conditions of usage is carbon dioxide in the air and in water. When carbon dioxide comes in contact with metal, oxidation begins, which can usually be detected by the formation of a brownish-red substance that forms on the surface of the
metal. This brownish-red substance is commonly known as rust. The rust will flake off, thus exposing more of the metals' surface to air and moisture, and then more oxidation will take place.

To prevent the deterioration of metals, the causes for such impairment must be removed. First of all, football equipment is exposed to dampness and moisture during the time it is in use. This cannot be prevented, but after the equipment has been used, the metal parts can be washed and dried and a protective coating of some sort can be applied to prevent the oxidation that is caused by carbon dioxide present in air and moisture. "Keeping iron and steel dry and brightly polished is the best preventive against rust. Coating the surface with paraffin prevents rust."¹ There are other ways to prevent rust from forming on metals. One suggestion is to "dip iron or steel articles in a mixture of carbolic acid and olive-oil, rubbing the surface with a rag. Others rub the metal with a mercurial ointment, leaving a thin layer of mercury over the surface."² This practice in the prevention of rust may prove expensive; therefore, it is suggested that such preventive measures be employed as those listed in the Farmers' Bulletin

Number 1180: "Keep iron and steel dry and brightly polished. If such articles are to be stored, coating the surface with paraffin or other fat that contains no salt or wrapping them in newspaper prevents rust."\(^3\)

If rust has already formed on metal, this will have to be removed in order to prevent further rusting. Different methods can be used in removing rust from metal, all of which will prove satisfactory. The Farmers' Bulletin suggests the following in removing rust:

> A scourer, such as bathbrick, applied with a moistened cork or cloth, usually removes rust and discoloration. If this treatment is not effective, kerosene should be poured on the spot and allowed to stand for a few minutes before the scourer is applied. After rust is removed, all traces of the kerosene should be washed off with hot soapy water and the metal dried thoroughly.\(^4\)

Another way to remove rust is by "the use of flour of emery or any other polishing powder, provided the rust has not been forming for too long a time. A thick coat of rust requires the use of an emery wheel, a grindstone, or a file for its removal."\(^5\) A practical way to remove rust is suggested in the *Encyclopedia Americana*:

> To remove rust the usual way is to rub the object with a piece of oiled rag or emery paper. More rapid and more satisfactory results are secured by using very pure petroleum and wiping with a hempen or woolen rag.\(^6\)

\(^3\)Farmers' Bulletin, No. 1180. \(^4\)Ibid.


In summarization of recommended procedures for the care and maintenance of metal, it has been found that the one cause for the deterioration of metal is the presence of carbon dioxide in the air and in water. Carbon dioxide will cause metal to oxidize and this process can be detected by the presence of rust.

To prevent metal from rusting, it is suggested that the metal be kept dry and well-polished. A protective coating of paraffin or pure petroleum can be used.

Rust can be removed from metal in several ways. The method to be employed depends upon how thick the rust has become before an attempt is made to remove it. Thin rust can be eliminated from metal with soap and water, an oiled rag, or emery paper. Rust that has become thick will have to be removed with an emery wheel, a grindstone, or a file. After rust has been removed, the surface should be thoroughly washed and dried. A protective coating of oil or of paraffin should then be applied.

In the succeeding chapter the writer presents a handbook of instructions for the most effective methods of caring for and maintaining football equipment, with special emphasis upon items of equipment constructed from fabrics (cotton, wool, rayon, nylon, and plastic), leather, rubber, fiber, and metal. In the preparation of this handbook attention has been devoted to recommended procedures outlined in earlier portions of this thesis.
CHAPTER VIII

A HANDBOOK OF INSTRUCTIONS FOR THE CARE AND
MAINTENANCE OF FOOTBALL EQUIPMENT

Introduction

Football equipment is one of the more expensive items found in athletic sports. Large sums of money are spent annually for this item by high school and college athletic departments throughout the nation. This equipment plays an important part in making football teams attractive in appearance and in protecting the individuals who play the game. The value of an efficient system for the purchase and issuing of equipment is lost if proper care is not given to the equipment during and after the football season. This observation applies to the repair of equipment during the season as well as to proper storage procedures after the season is concluded. To maintain attractiveness and maximum protection it is necessary that football equipment receive proper care in all stages of its use.

Football being an outdoor sport, the equipment is generally exposed to all weather conditions. If inclement weather conditions prevail, rapid deterioration of football equipment will offer a real and a constant problem if it
is not cared for promptly and properly in order to prevent damage.

The responsibility of handling football equipment is sometimes placed in the hands of individuals who do not know how to care for and maintain it properly in order to prolong its useful life. The writer has felt the need for general and specific information for the proper care and maintenance of football equipment; therefore, this handbook was written to provide information that will aid athletic directors, coaches, and equipment managers in the care and maintenance of the materials that make up football equipment.

The purposes of this handbook may be outlined as follows:

1. To arrive at the best possible methods of caring for football equipment.

2. To provide athletic directors, coaches, and equipment managers with essential information that will aid in the care and maintenance of football equipment.

3. To satisfy a personal interest in how better to care for and maintain football equipment.

This handbook is organized into two sections. The first part relates to the care and maintenance of the principal materials that go into football equipment, including wool, cotton, rayon, nylon, leather, rubber, fiber,
plastic, and metal. The second division of the handbook deals with specialized care, maintenance, and storage of the principal types of football equipment, including leather helmets, plastic helmets, shoulder pads, hip pads, football shoes, uniforms made of various materials, footballs, football socks, athletic supporters, T-shirts and towels, thigh pads and shin guards.
PART I

CARE AND MAINTENANCE OF THE PRINCIPAL MATERIALS THAT GO INTO FOOTBALL EQUIPMENT

The principal materials commonly found in football equipment are as follows: wool, cotton, rayon, nylon, leather, rubber, fiber, plastic, and metal. Equipment managers and others who are responsible for the care and maintenance of football equipment should know the causes for the deterioration of the materials and how to remove these causes through proper knowledge and practice of care and maintenance.

Woolen Materials

The principal causes for the deterioration of woolen materials used in football equipment are wear and tear, perspiration, dirt, and damage due to moth attack.

It is almost impossible to prevent wear and tear of woolen materials employed in football equipment because of the hard usage it encounters. But further damage can be prevented if proper repairing is done. Repair immediately after use any woolen material that has been damaged due to wear and tear.

Woolen material that is used in football equipment will
always come into contact with dirt and perspiration. Dirt and perspiration, if left in the woolen material, will weaken the fibers and also attract moths. It is advisable to clean or to have woolen materials cleaned immediately after they have been used. Never have the material in a soiled condition over long periods of time.

There is no justification for allowing moths to attack woolen materials. To prevent the attack of moths on the material, it is advisable to clean the material as it becomes soiled, place in a cedar chest that is air-tight, and treat with a moth repellent such as naphthalene or paradichlorobenzine. If this practice is followed, there will be no danger of moth attack.

Shrinkage and fading are prevalent in all woolen materials. To minimize the danger of shrinkage and fading, it is advisable to buy woolen material that has been treated with a shrink-resistant and fade-resistant process and to launder or clean properly. It is also recommended that one buy woolen material that is Sanforized-shrunken and vat-dyed. To care for woolen materials properly and to prevent shrinkage or fading, it is advisable to use the following method for laundering:

1. Wash in lukewarm water.
2. Avoid soaking of woolen materials.
3. Use plenty of soap and water.
4. Avoid any abrupt changes in water temperatures.
5. Squeeze suds through woolen materials. If a washing machine is used, the material should not be crowded.

6. Rinse thoroughly in several waters to remove all soap.

7. Dry away from heat.

8. Avoid drying in direct sunlight, as this fades woolen materials.

If dry-cleaning is used to clean woolen materials, it is advisable to use fresh cleaning fluids at all times. Dirty cleaning fluids will soil the material. If the school is not properly equipped for dry-cleaning, it is recommended that the material be sent to a reliable dry-cleaning agent.

Cotton Materials

The common causes for the deterioration of cotton materials found in football equipment are abrasion due to wear and tear, mildew as a result of mold, prolonged exposure to sunlight, perspiration, and the application of strong bleaches.

Wear and tear of cotton material are common in football equipment. It is an impossibility to prevent this wear and tear, but further damage can be prevented if proper repair is made. Repair all damage due to wear and tear soon after it occurs.

Mildew as a result of mold has a tendency to attack
cotton material, especially if this material has been exposed to dampness over a period of time. Cotton material that is damp with water or perspiration should be laundered immediately, if possible. If laundering cannot be done soon after use, the material should be placed in such position as to facilitate drying. As a further preventive of mildew because of mold, keep the materials in a cool, well-lighted, and dry place.

Prolonged exposure to direct sunlight will weaken the fibers of cotton material; therefore, avoid exposing to direct sunlight for long periods of time.

Perspiration, if allowed to remain in cotton material, will weaken the small fibers. To prevent this process of weakening, it is advisable to launder the material soon after it has been used.

Strong bleaches will not only weaken the fiber of cotton material but also will destroy the fiber. The purpose of bleaches is to remove organic matter and not soils that may be present in fabrics. If cotton material is soiled, remove the soil by washing and avoid trying to bleach it out.

To avoid shrinkage in cotton material, it is advisable to buy those materials that have been pre-shrunk and to use proper laundering methods.

To minimize the fading of cotton material, it is recommended that those materials that have been vat-dyed be bought,
and, to serve as a further preventive of fading, avoid expos-
posing the material to direct sunlight over long periods of
time.

Laundering of cotton materials is a simple operation
but certain practices should be performed:
1. Remove all stains.
2. Soak white cotton material to loosen dirt.
3. Cover cotton material with soft, lukewarm, and
soapy water.
4. Use separate container for very dirty and slightly
soiled articles.
5. Use a good grade of soap.
6. Wash cotton material in plenty of soap suds as hot
as the hands can bear.
7. If water becomes dirty, drain it off and replace
with clean hot suds.
8. Rinse thoroughly in plenty of hot, clear, and soft
water, to be sure all soap is removed.
9. Extract water from material before moving from tub
to tub.
10. Dry thoroughly before using or storing.

Rayon Materials

Phases of deterioration most commonly found in rayon
football equipment are perspiration, mildew as a result of
mold, excessive heat, abrasion due to wear and tear, and
direct sunlight.

Abrasion due to wear and tear should be repaired as soon as possible to prevent further damage.

Perspiration that has come in contact with rayon material should be removed either by laundering or by dry-cleaning.

Mildew on rayon material is usually caused by allowing the material to remain in a damp condition. Always keep rayon material in a well-ventilated, cool, and dry place accessible to plenty of indirect sunlight. Under no conditions should the material be allowed to lie around for several days in a soiled or damp condition.

Excessive heat tends to destroy rayon fibers; therefore, pressing or ironing should be done at low temperatures, preferably below 300° Fahrenheit. Sunlight has the same effect on rayon materials as excessive heat does. Avoid exposure to direct sunlight over a long period of time.

Shrinkage of rayon material can be prevented by buying a material that has been processed by the "resin," "con- sticizing," or "Glyoxol" method; also, avoid sudden changes of temperature in washing waters.

To minimize fading of rayon material in football equipment, it is necessary to buy a material that has been vat-dyed by a reliable concern. Also, caution should be taken in laundering the materials and in avoiding exposure to direct sunlight.
To launder rayon materials, the following practices are recommended:

1. Launder in low water temperature and avoid strong alkali soaps. Water temperature should not exceed 100° Fahrenheit.

2. Wash in a washing machine for no more than five minutes.

3. Rinse thoroughly, being sure that all soap is rinsed out.

4. Dry on forms if possible to assure the resumption of proper shapes.

5. Press on iron at temperature below 300° Fahrenheit.

6. Rayon material can be dry-cleaned and if this is to be done, care should be exercised in selecting a reliable cleaning concern.

Nylon Materials

Nylon, being a durable fabric, is not affected by as many agents of deterioration as are other textile fabrics found in football equipment. The common causes for the deterioration of nylon are exposure to sunlight, excessive heat, commercial bleaches, and wear and tear. Damage done by wear and tear should always be repaired to prevent further damage to the material. Commercial bleaches tend to discolor nylon material, and for this reason their use should be avoided.
When ironing or pressing nylon, the temperature should be maintained below 300° Fahrenheit to avoid damage to the fibers due to excessive heat. Long exposure to strong sunlight will weaken nylon fibers in the same manner as does excessive heat; therefore, the material should not be exposed to sunlight over long periods of time.

Moths will not attack nylon material, but if the larvae are trapped between folds of nylon, they will eat their way out in order to escape. Always inspect the material to make sure no larvae are in evidence.

The degree of shrinkage of nylon depends upon the type of heat-setting procedure used by the manufacturer. To be sure of minimum shrinkage of nylon material, it is advisable to purchase nylon garments from reliable manufacturers who use the correct heat-setting processes.

Fading is prevalent in all nylon fabrics. In minimizing the danger of fading, it is suggested that the nylon material be kept from direct sunlight when not in use, and that only nylon articles that have been dyed with acetate dyestuffs be purchased.

Nylon material can be either dry-cleaned or laundered. When dry-cleaning nylon, use standard cleaning fluids, avoiding the use of any that may be dirty. If the school is not equipped to dry-clean nylon, it is advisable to send the materials to a reliable commercial concern. Nylon material is easily laundered by using lukewarm water with a neutral
soap. Rinse thoroughly and allow to dry at normal temperatures. Avoid force-drying of nylon materials. Pressing temperatures should be maintained below 300°F Fahrenheit.

Leather Materials

Leather used in football equipment is exposed to a number of agents of deterioration, namely, wear and tear, lime, dirt, water, mildew, and dryness. From the standpoint of economy, any wear and tear that occur in leather should be repaired immediately. Lime, dirt, and water will produce dryness in leather; therefore, these causes of dryness should be removed by cleaning the leather with any reliable leather-cleaning preparation that is available on the market.

Mildew that is formed on leather is caused by the leather being in a damp condition and left in a dark, warm place. The formation of mildew can be minimized by keeping leather dry and in a cool, dry, well-ventilated and light place.

To clean and care for leather properly, the following procedures are suggested:

1. Clean dirt, lime, and perspiration from the leather with water.

2. While leather is still damp, apply saddle soap as a suds.

3. Use highly refined leather oils to restore natural
oil conditions into the leather.

4. Dry wet leather at normal room temperature and avoid excessive heat which will crack the leather by drying it to excess.

5. Store and keep leather articles in a cool, dry, well-ventilated, and well-lighted place.

Rubber Materials

The causes for deterioration of rubber found in football equipment are as follows: sunlight, excessive heat, various oils and greases, oxidation, dirt, perspiration, and stain. The causes for the deterioration of rubber may be minimized by keeping rubber articles in a cool dark place where there is a change of air. Rubber should be cleaned thoroughly as needed and kept away from the various oils and greases. When storing, keep rubber in such position that there is no strain upon it.

Care should be taken to clean rubber properly and it should be cleaned as often as it is needed. The following practices are recommended in the cleaning of rubber:

1. Clean with a mild soap and lukewarm water.
2. Rinse thoroughly after using the soap and water.
3. Dry at normal temperatures.

In caring for rubber, one should be sure that it is properly cleaned after each use. Avoid storing rubber material in a place that is hot with direct sunlight and which
has no change of air. This will tend to bring about oxidation and this process will soon destroy the life and usefulness of the rubber. Always keep rubber in a cool, dark, and dry place where there is a change of air. Rubber can be stored in a cardboard container or with newspapers between separate articles to absorb any moisture that may be present. Avoid folding or creasing of rubber articles.

Fiber Materials

Common causes for the deterioration of fiber materials found in football equipment are three in number. They are moisture, excessive heat, and fungus. To remove the causes of deterioration, it is advisable to keep fiber dry and to prevent it from coming into contact with excessive heat. It is sometimes impossible to keep dry the fiber material that is found in football equipment because of perspiration and rainy weather. When it does become wet, fiber should be dried as soon as possible and at normal temperatures.

Fiber material can be cleaned either by the use of water or with a mild soap and water. Carbon tetrachloride can also be used in the cleaning of fiber materials.

In caring for fiber material, it should be cleaned as described above, and then a protective coating of shellac, varnish, or wax may be applied. Any article made of fiber which has been allowed to get out of shape because of moisture should be re-shaped while wet.
Plastic Materials

Plastic material is now being used extensively in the manufacture of football helmets. Common causes for its deterioration are cracking due to rough usage, excessive heat, and scratches and marks as a result of abuse. With the exception of damage due to excessive heat, it is almost impossible to prevent the causes of deterioration as previously mentioned. Never store plastic or leave it in the presence of excessive heat.

To care for plastic material found in football equipment, the following steps should be taken:

1. In cleaning plastic material, use soapy lukewarm water. If grease or oil is present, this can be removed with isopropyl alcohol.

2. Always place plastic in a position so that it will not warp or get out of shape.

3. Avoid throwing or tossing plastic, as this may cause the material to crack.

4. The use of a commercial wax will protect the surface of plastic material.

Metal Materials

The common cause for the deterioration of metal found in football equipment is rust. Rust is formed on metal as a result of the presence of carbon dioxide in the air and in water. To prevent the rust from forming on metal,
it is suggested that all metal be kept dry; and if it should become wet, which often happens in the case of football equipment, it should be dried and polished. A protective coating of paraffin or pure petroleum can then be applied.

Practices for the removal of rust depend upon how thick the coating of rust has become. A thick coating of rust can be removed with an emery wheel, a grindstone, or a file. Thin coatings of rust can be removed by soap and water. After the rust has been removed, the surface should then be thoroughly washed and dried. A protective coating of oil or paraffin should be applied after the metal surface is completely dried.
PART II

SPECIALIZED CARE, MAINTENANCE, AND STORAGE OF THE PRINCIPAL TYPES OF FOOTBALL EQUIPMENT

Leather Helmets

After use, leather helmets need to be cleaned and cared for properly in order to prolong their useful life. The helmets should be cleaned to remove all dirt that may be on the leather. This can be done by using a damp cloth to remove the dirt or mud.

When the cleaning has been completed, check the helmets to determine whether any straps have been pulled loose. Check also for broken stitching on the crown of the headgear. Examine all chin-strap attachments for damage or for broken attachments. Leather helmets are made of heavy leather and fiber; therefore, to repair them properly, it is advisable to send them to an athletic repair service where machines are available to do the heavy work required. If this is done, added life will be given to the helmets.

Leather helmets should be painted several times during the football season, and especially is this necessary before storing. Several methods can be used to apply paint to helmets such as spraying with a paint spray, with a fly-spray
gun, or painting with a soft-bristle brush. Select a paint that is especially made for leather. All leather paints are pliable in order to flex with the leather without cracking. This paint can be purchased from sporting-goods companies throughout the nation. Before painting helmets, clean the surface thoroughly and allow to dry. Place newspaper inside the helmet to absorb any paint that may drain into the vent holes of the crown. A base of white shellac should first be applied to the helmets to prevent the leather from absorbing the paint. When thoroughly dry, apply one coat of leather paint to the helmet and allow to dry before handling again.

A thin coat of leather preparation can be applied to the leather lining to prevent cracking as a result of dryness. Be careful not to saturate the lining with this leather preparation. This will cause the lining to become sticky and messy and will be uncomfortable to the person wearing the helmet. The leather preparation that soaks through the leather will come in contact with the foam rubber that is used in the helmet and will cause it to deteriorate. A very light coat of leather preparation is all that is needed to preserve the leather lining.

Any leather helmet that has become wet should be dried at normal temperatures and should not be dried in a position that will cause the helmet to become warped and out of shape.
The recommended procedure for drying helmets is to use wire helmet forms or suspend the helmet by placing a rod through the ear holes.

Helmets that are to be stored should be cleaned and painted. The methods used in storing are as follows: Use of wire forms, by placing a rod through ear holes, or by setting helmets on the back pieces and resting on the ear pieces. The helmets should be stored in a cool, dry, light, and well-ventilated place to prevent mildew as a result of mold. Helmets that are suspended by the ear pieces should be covered so that dust and dirt do not fall into the helmet. Care should be taken not to permit helmets to be stuffed into boxes; to be thrown or tossed around; to be used as benches; or to be force-dried when wet.

Plastic Helmets

Plastic helmets can be cleaned with soapy water and then rinsed off thoroughly to remove all traces of soap. If grease or oil is present, it can be removed with isopropyl alcohol.

Check the helmet for cracks in the molding and suspension straps that may have become broken or torn.

A protective coating of a commercial wax should be applied to protect the surface of the crown.

Avoid throwing or tossing the plastic helmet, using it as a bench, or placing it in a position that will cause
it to become out of shape.

The same methods recommended for storing leather helmets should be practiced in the storing of the plastic helmet.

Shoulder Pads

Shoulder pads require special care and maintenance. While in use, shoulder pads should be checked every day for broken elastic straps, eyelets that have been pulled out, cracked fiber, broken stitches, torn leather connectors, broken laces, and torn fabric covering that will expose the padding of the shoulder pad. Any needed repair should be done as soon as possible to prevent further damage. If the fabric covering has become damaged because of wear and tear or if the fiber has become cracked, it is advisable to send the pad to an athletic reconditioner who is experienced and has the proper equipment needed to replace the damaged fiber and fabric. The reconditioner can also replace any padding in the shoulder pads that has been damaged. Other repair work can be done by local shoe repairmen or by a saddle shop.

All shoulder pads will get wet because of both perspiration and rainy weather during workouts and games. Between workouts the pads should be placed in a position to allow drying at normal room temperatures and in a normal position to prevent warping. Special hangers should be
provided for each player so that shoulder pads can be placed on them. Never hang shoulder pads by the elastic straps or on nails that might become rusty.

To clean shoulder pads, wash with a mild soap and water and rinse thoroughly by squeezing fresh water through the padding. Allow to dry at normal temperature and in a normal position. The fiber parts can then be shellacked, varnished, or waxed to form a protective covering that prevents penetration of moisture and scuffing. A light coat of leather preparation should be applied to all leather parts to prevent drying and cracking.

In storing shoulder pads, avoid stacking one on top of the other. This will cause each pad to become out of shape. A special hanger should be provided for hanging each pad separately. The pads should be stored in a well-ventilated, cool, dry, and light place.

**Hip Pads**

With the exception of the methods used in storing, hip pads receive the same care as that of shoulder pads. They should be cleaned when necessary and in the same manner as shoulder pads. Some hip pads have leather reinforcements instead of fiber; therefore, the leather should be cleaned and dried at normal temperatures. After drying, a leather preparation made of highly refined oils should be applied.

To store hip pads, lay the pad with the padded side up
end stack in groups of five. Large stacks of hip pads will cause too much pressure on the bottom pads and warping of the fiber or leather reinforcements will result. Storage of hip pads should be in a cool, dry, well-lighted, and adequately ventilated place.

**Football Shoes**

Football shoes receive severe abuse while being used, and special care should be given to them. Football shoes, while in use, are exposed to such agents of deterioration as dirt, lime, mud, water, and perspiration. It is impossible to prevent these agents of deterioration from getting on the shoe; but they should be removed as soon as possible. All football shoes should be cleaned and cared for daily. Dirt, mud, and lime can be removed with a scraper, a stiff brush, or water. Care should be taken when using a scraper not to cut or tear the leather. Special care must be taken to remove dirt and lime from the welt of the shoe in order to prevent rotting of the stitching found in the welt.

Any time a shoe has become wet, saddle soap, in a suds, should be applied to the shoe while it is still wet. Then the shoe should be dried slowly at normal room temperatures. Avoid force-drying of football shoes. After the shoe has been dried thoroughly, apply a leather preparation of highly refined oils to restore the natural oil conditions of the leather. Avoid bathing the shoe in the leather preparation,
but apply smoothly and evenly.

Wear and tear are always found in football shoes, and are manifested in such ways as tearing of the leather, stitches break and wear, eyelets pull out, steel plates between soles break, and cleat posts break off and wear. Any shoe that has a tear in the leather upper or that has loose soles or eyelets pulled out can be repaired at the local shoe shop, but any other damage done should be sent to an athletic reconditioner, who may need to rebuild the shoe. Repair all football shoes as soon as they have been damaged in any way. This will prevent further damage to the shoes.

Cleats on the football shoe should be kept at an even height to prevent the shoe from running over to the sides. Change cleats before they wear down and expose the metal posts.

Change cleats when necessary by removing the cleat from the shoe with a pair of pliers or with a special cleat wrench that can be purchased at most sporting-goods supply stores. If the cleat post is dirty or rusty, it should be cleaned with a wire brush and then a thin coat of oil should be applied before putting on a new cleat. If this is done, the danger of cleat posts turning in the shoe will be minimized. Avoid tightening the cleat down too tight because there is the danger of breaking the cleat and stripping the
threads on the cleat posts. Avoid cross-threading of the cleats.

Proper fitting of the shoes to the football player is an important item in the care of football shoes. The player's foot should be measured to decide what size shoe is needed. A shoe that is too tight on the foot or too large usually wears out more rapidly than one that fits correctly.

Before storing shoes it is necessary that they be cleaned and cared for properly. They should be stored according to sizes and should not be stacked one on top of the other. Stacking shoes will break down the spur, causing the shoe to get out of shape. Always keep shoes paired by tying the laces of each pair. The storage place should be cool, dry, well-lighted, and thoroughly ventilated. Never set football shoes on the floor because of the dampness.

Any mildew found on shoes should be removed with a dry cloth. Then apply a leather preparation and store in a cool, dry, well-lighted, and thoroughly ventilated place. Mildew thrives in a dark, damp, and warm place. Shoes that have been stored should be checked monthly to see whether more cleaning and oiling are necessary.

Uniforms

All football uniforms are designed for hard wear and at the same time to make the teams attractive in appearance. Just as is true of other football equipment, the uniform is
subjected to hard use and abuse. The fabrics commonly used in football uniforms are subjected to the following agents of deterioration: wear and tear, perspiration, dirt, damage by moths, mildew, prolonged exposure to sunlight, excessive heat, and commercial bleaches. All of these agents are found in the following fabrics commonly used in football pants and jerseys: wool, cotton, rayon, and nylon. Regardless of the type of fabric used in the manufacture of the football uniforms, it should be repaired as soon as any wear and tear appears. This should be done before laundering or cleaning. Avoid leaving the uniforms dirty and wet over long periods of time. If laundering or cleaning cannot be done immediately after use, it is best to hang the uniforms so that they will dry. Never pile dirty and wet uniforms. This will promote the growth of mildew as a result of mold, especially on cotton and rayon fabrics.

Proper fit is an important item in the care and maintenance of football uniforms. If jerseys or pants fit too tightly, the material may tear or rip at the seams. Measurements should be taken to decide the exact size of jerseys and pants needed. Kenneth Meyer suggests the following procedure for ascertaining the correct sizes for uniforms:

A good procedure to follow in measuring for uniforms is to measure the waist with a tape and add six sizes to obtain the jersey size. For example, a boy with a 30-inch waist should wear a size 36 jersey. Modify this in case of football uniforms and add ten sizes. This is necessary
due to the use of shoulder pads. Add specifications necessary; for example, "long" if a longer leg than the standard length is desired.¹

**Woolen materials.** -- Wool jerseys and pants should be cared for in the same manner as any other woolen material. They can either be dry-cleaned or laundered after each use. The safest method of cleaning woolen pants and jerseys is to dry-clean them. If these woolen articles are either dry-cleaned or laundered, it is advisable to record both the inseam and outseam measurements for each garment. This will aid in stretching the garments back to the original size if shrinkage results. Proper methods of laundering and cleaning of woolen pants and jerseys should be used as described on pp. 78-79.

Caution should be observed in buying wool jerseys and pants to be sure that the material has been treated with a shrink-resistant process, preferably Sanforization. This, together with proper laundering or cleaning, will aid in the prevention of shrinkage.

To prevent fading of wool pants and jerseys, it is advisable to buy materials that have been vat-dyed. Avoid long exposure to direct sunlight. Proper laundering or dry-cleaning will also help in the prevention of fading.

To aid in the care and storage of woolen pants and jerseys, it is advisable to fold each garment neatly. Then

the garment should be placed in a cedar chest or box that is air-tight. When placing the garments in the chest, it is recommended that naphthalene or paradichlorobenzene be placed between each two garments and around them to prevent moths from damaging the woolen materials. The chest should be put in a place that is dry, cool, and well-ventilated. Monthly inspections should be made to determine whether more moth repellent is needed.

**Cotton materials.** -- Cotton jerseys are usually used for workout jerseys. They are more serviceable and are much cheaper to buy than jerseys made of wool, rayon, or nylon. Cotton pants are usually made of a cotton material called gaberdine or whipcord. Gaberdine and whipcord materials are almost alike with one exception. Whipcord is a coarse-grained fabric whereas gaberdine is a small fine-grained fabric.

Cotton jerseys as well as cotton gaberdine and whipcord pants should receive the same care as that recommended for all cotton materials (see pp. 79-81).

If any stains such as grass stains are found on the garments, it is advisable to study a staining chart in order to know the proper method of removing the stain. This should be done before laundering begins. Fading and shrinkage are prevalent in cotton garments provided they have not been made of a vat-dyed material or of a material that has been pre-shrunk. To make sure of long-lasting colors and a
longer life of cotton jerseys and gabardine and whipcord pants, proper laundering should be practiced (see pp. 80-81).

In storing jerseys and pants made of cotton, care must be taken to store in a cool, dry, light, and well-ventilated place. Fold all garments neatly before storing.

Rayon materials. -- Rayon jerseys and pants are used mostly for gym uniforms in football. Rayon makes an attractive garment and at the same time provides a very durable uniform. Although rayon is a durable fabric, the rayon jerseys and pants are still exposed to agents that will cause deterioration if not cared for properly. As has been discussed in the section on the general care of uniforms, rayon materials are subjected to such agents of deterioration as perspiration, excessive heat, and direct sunlight, which weaken the fabric; to mildew as a result of mold that will destroy the rayon fibers; and to abrasion resulting from wear and tear. Any wear and tear of rayon jerseys and pants should be repaired before laundering to prevent further damage. Rayon jerseys or pants should be laundered soon after use if they have become soiled by dirt, mud, water, lime, and perspiration. Never pile rayon garments while wet and leave for long periods of time. If garments cannot be cleaned or laundered soon after use, they should be hung to allow drying. To launder or clean rayon jerseys and
pants, care must be taken in order to prevent shrinkage or fading and to prolong their life (see pp. 82-83). Proper laundering or cleaning alone will not prevent fading or shrinkage of rayon jerseys and pants. When purchasing rayon jerseys and pants, it is advisable to procure those that are made of rayon materials that have been treated with the "resin," "comcticizing," or "glyoxol" method. Sudden changes of water should be avoided to prevent shrinkage. To minimize fading of rayon jerseys and pants, it is advisable to buy those jerseys and pants from rayon materials that have been vat-dyed. This is the best-known type of dye on the market. Exposing rayon pants or jerseys to direct sunlight for long periods of time will produce fading.

The ironing or pressing temperature for rayon jerseys or pants should not exceed 300° Fahrenheit. Any temperature above that will destroy the synthetic fibers of which rayon is made.

To be sure of longer wear from rayon jerseys and pants, it is recommended that proper fits be made. Measure each football player to decide the exact size of jerseys and pants needed.

Before storing rayon jerseys and pants, be sure they are clean and thoroughly dry. Fold each garment neatly and place in a large box or boxes in order to protect the
material from dust and dirt. Store in a cool, dry, well-ventilated, and lighted place.

**Nylon materials.** -- Nylon materials possess unusual strength and will produce an attractive uniform that appeals to everyone. Because of nylon's resistance to moths and mildew, the nylon jersey and pants used in football are not subjected to as many agents of deterioration as those made of other fabrics used in football uniforms. The common causes of deterioration of nylon football jerseys and pants are wear and tear, excessive heat, and sunlight. As in all other types of football jerseys and pants, nylon jerseys and pants should be repaired as soon as they show any evidence of wear and tear. Exposure to excessive heat and sunlight should be avoided. The pressing temperatures of nylon jerseys and pants should not exceed 300° Fahrenheit, and care should be taken to avoid exposure to direct sunlight over long periods of time.

In buying nylon jerseys or pants, careful selection should be made to be sure that the garment is made of nylon that has received the proper heat-setting process during the stages of manufacture. To be sure of procuring the proper heat-setting process, buy the jerseys and pants from a reliable manufacturer. Fading can be prevented by purchasing nylon jerseys and pants made of material that has been dyed with acetate dyestuffs.
Nylon jerseys and pants can either be dry-cleaned or laundered. Proper laundering and cleaning as well as proper selection will prevent shrinkage or fading and will add to the life of the garment. (For proper laundering of nylon jerseys and pants, see pp. 84-85.)

Proper fit of nylon football jerseys and pants will assure one of a longer life to the garment. Get correct sizes and fill them.

Before storing nylon football jerseys and pants, they should be thoroughly cleaned. Fold neatly and store in a cool, dry, well-lighted, and ventilated place. Moths cannot live on nylon, but if the larvae are trapped between the folds of jerseys and pants, they will damage the garment in order to escape.

**Two-way-stretch football pants.** -- Two-way-stretch football pants are half-knit and may have a rayon, nylon, or cotton front. The knit back is made of worsted woolen fibers that are combed parallel and twisted hard. The knit back tends to stretch two ways, causing the pants to fit smugly. This produces a comfortable fitting to the football players, who have to run and get in the various positions in the game.

To obtain a maximum wear from the two-way-stretch pants, proper care is required. It is very important that the knit back be repaired as soon as a snag or tear has occurred. If
the pants get wet from perspiration or water, they should be laundered or dried immediately. Two-way-stretch pants should not be dry-cleaned. They should be washed in lukewarm soapy water. The pants may be washed in a washing machine for about five minutes. Scrub the front with a grass brush. Rinse out in several waters that are of the same temperature in order to prevent shrinkage. Dry slowly at normal temperatures and avoid pressing. Each time the two-way-stretch pants are sent to the cleaners, it would be advisable to remind them that the pants are not to be pressed.

For the purpose of preventing shrinkage of two-way-stretch pants, it is recommended that only those be bought which have been pre-shrunk by the process of Sanforization and that proper laundering instructions be followed carefully. Fading can also be prevented by buying pants that have been vat-dyed and by avoiding exposure to direct sunlight for long periods of time. To aid further in the prevention of fading, follow proper laundering instructions.

It is important that two-way-stretch pants fit properly to avoid tearing at the seams and putting a strain on the knit backs. Take measurements to decide the proper pants size for each individual player.

In storing two-way-stretch pants it is important that they be clean and thoroughly dry. Store in a cedar chest or box and put moth repellant such as naphthalene or paradichlorobenzine between each two pants and in the box around them.
During the period of storage, monthly inspections should be made to determine whether more moth repellent is necessary. Store these garments in a cool, dry, well-lighted, and ventilated place.

**Footballs**

Footballs should be cleaned as soon as they get any dirt, mud, or lime on them. They should be cleaned with saddle soap in a suds and, when thoroughly dry, a very light coat of any commercial leather preparation may be applied.

Footballs should be inflated to the correct pressure recommended by the manufacturer. If the ball is inflated beyond the recommended pressure, there will be extra strain on the seams of the ball and tearing at the seams will occur. To inflate balls properly, use a pressure gauge. The needle that is inserted into the valve should be moistened before being inserted. Avoid deflating balls after each workout, as this will cause damage to the delicate valve.

Footballs should be cleaned and dried thoroughly before storing. Just enough air should be let out of the ball to relieve the tension on the seams and leather. Wire cages made of mesh-wire should be used to store footballs, and each ball should have a separate stall.

**Football Socks**

Football socks are usually made from one hundred per cent wool or forty per cent cotton and sixty per cent wool.
Some have forty-five per cent cotton, forty per cent rayon, and fifteen per cent wool. Although football socks have a variety of fibers, it is advisable to care for them as woolen material. It has been stated that the recommended procedure for cleaning woolen material is dry-cleaning and laundering. Socks become wet with perspiration and are often soiled with dirt and mud; therefore, they will have to be laundered. If possible, it would be better to launder football socks every day. This will eliminate any extra wear that will be caused by perspiration and dirt. The recommended procedures for washing football socks are as follows:

1. Water temperature should not exceed 100° Fahrenheit.
2. Use mild soaps.
3. Use plenty of water.
4. Wash for only about five minutes.
5. Rinse thoroughly in water temperatures not to exceed 100° Fahrenheit.

Do not force-dry football socks because it will produce shrinkage. Dry at normal temperatures.

To care for football socks properly, be sure of a correct fit. Socks too large or too small will wear out much faster than those that fit properly. Keep the socks clean and be sure that all football shoes have good insoles in order to prolong the life of the socks.

Any sock that has wool in it should be stored with a
moth repellant such as naphthalene or paradichlorobenzine to prevent moths from attacking and causing damage. Store in a cool, dry, well-lighted, and ventilated place.

Athletic Supporters

The better type of athletic supporters are made of an elastic material. To get better service from these supporters, it is suggested that proper fit be made to eliminate strain on the material. Supporters should be laundered in soapy lukewarm water and then dried at normal temperature. Any excessive heat will destroy the small rubber fibers in the elastic material. The supporters should not be allowed to become too dirty before being laundered, as perspiration and dirt will damage both the rubber and the fiber material.

Any strap that has come loose on a supporter can be sewed back. This can be done with a sewing machine.

Store supporters in a cool, dark, and well-ventilated place.

T-shirts and Towels

T-shirts and towels can be cared for as cotton material. T-shirts should be properly repaired as soon as a seam rips or a snag occurs. Launder T-shirts and towels soon after they have become soiled, and if it is impossible to give them immediate laundering, they should be hung out to dry.
Piling T-shirts and towels to be left over a period of time may produce mildew as a result of mold.

To launder T-shirts and towels, it is advisable to use the following methods:

1. Remove all stains.
2. Soak to loosen dirt.
3. Cover with soft, lukewarm, and soapy water.
4. Use separate containers for those that are very dirty.
5. Use a good grade of soap.
6. Wash in plenty of soap suds as hot as the hands can bear.
7. If water becomes dirty, drain it off and replace with clean hot suds.
8. Rinse thoroughly in plenty of hot, clear, and soft water to be sure all soap is removed from the fabrics.
9. Extract water and dry thoroughly.

Fold T-shirts and towels neatly before storing and store in a cool, dry, light, and well-ventilated place.

Thigh Pads and Shin Guards

Thigh pads and shin guards are subjected to perspiration and dirt. They can be cleaned with warm soapy water and then thoroughly rinsed and dried at normal temperature. Avoid putting any pressure on either thigh pads or shin guards that have become wet. Pressure on the wet pads will
cause them to warp out of shape. Never force-dry the pads.

Store the pads when thoroughly dry by placing one on top of the other with paper between to protect the foam rubber that is usually found on the inside of the pad. Store in a cool, dry, well-ventilated, and lighted place.
APPENDIX

SAMPLES OF LETTERS

Ira T. DePoo
Box 5143, T. C.
Denton, Texas

Erwin Cotton Mills Company
Mill No. 3
Goodeemee, North Carolina

Dear Sir:

As a graduate student at North Texas State College, I plan to write a thesis entitled "A Study of Recommended Procedures for the Care and Maintenance of Football Equipment and the Development of a Handbook of Instructions." In order to write the thesis, I will need to know the answers to the following questions on cotton material:

1. What causes cotton material to deteriorate?
2. How would you prevent deterioration of cotton material?
3. How would you prevent shrinkage of cotton material?
4. How would you prevent fading of cotton material?
5. What is the best method of laundering cotton material?

I would appreciate any material or information you could send me pertaining to the five questions asked.

Yours truly,

Ira T. DePoo
Hodgman Rubber Company  
Framingham, Massachusetts

Dear Sir:

As a graduate student at North Texas State College, I plan to write a thesis entitled "A Study of Recommended Procedures for the Care and Maintenance of Football Equipment and the Development of a Handbook of Instructions." In order to write the thesis I will need to know the answers to the following questions on rubber:

1. What causes rubber to deteriorate?
2. How would you prevent the deterioration of rubber?
3. What is the best way to clean rubber?
4. How would you properly care for rubber?

I would appreciate any material or information you could send me pertaining to the four questions asked.

Yours truly,

Ira T. DeFoor
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Reports

