

*(Version: 2024)*

**Leather:**  
**AN OVERVIEW OF MANUFACTURE**  
**(Part 4)**  
**Application of the finish**

**Authors: Paul Evans and Richard P. Daniels**

**Recommended by:**



**INTERNATIONAL UNION OF LEATHER  
TECHNOLOGISTS AND CHEMISTS SOCIETIES**



**UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION**

## Leather: AN OVERVIEW OF MANUFACTURE

### **Content and Structure:**

**This section includes a summary of hides and skins as raw materials.**

**Part 1: The removal of unwanted materials and extension of the structure.**

**Part 2: The introduction of new materials and extension of the structure.**

**Part 3: The removal of water and reconfiguration to a flat form.**

**Part 4: Application of the finish.**

**Part 5: Different types of bovine leathers.**

**Part 6: Small skins: hair sheep and goat: grain leathers.**

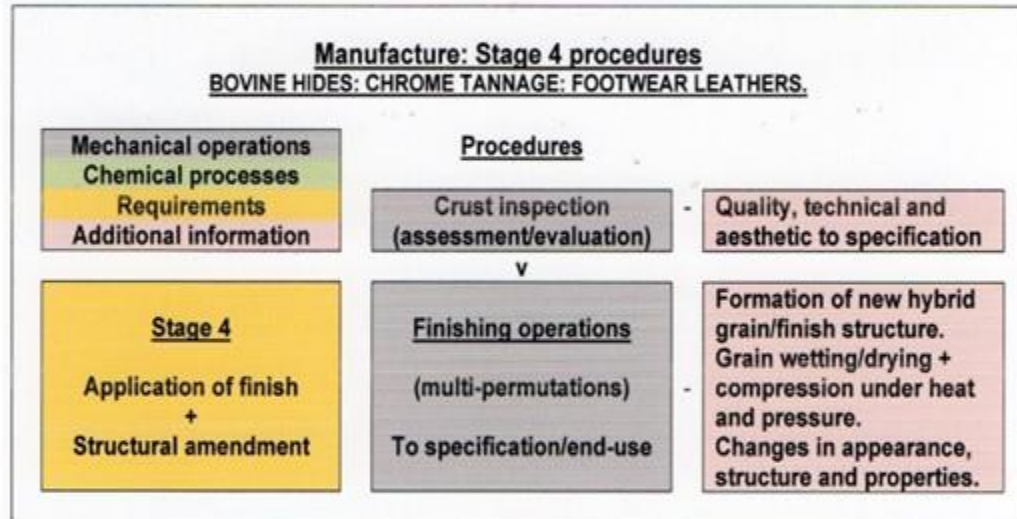
**Part 7: Small skins: wool bearing sheep: double face, shearling and rugs.**

**Part 8: Discussion.**

### **Annex.**

*All rights reserved. This publication is for dissemination and study free of any associated charges. It should only be transmitted or used in its entire form. The rights of Richard Daniels to be identified as author of this work are asserted in accordance with the Copyright, Design and Patents Act 1988.*

## Stage 4 procedures



- Procedures set down in Stages 1, 2 and 3 provide leathers with properties to specification at the pre-finished state.
- Within finishing operations, these leathers are tailored to suit both leather customer and end-user.
- The mix of physical and chemical properties developed within the leathers before finishing, and the finishes applied, need to work in synergy to achieve best results.

## FINISHING PROCEDURES

**Surface coatings are developed on the grain surface for protection, precise colour, and visual enhancement.**

**Within these operations, the final leather appearance and aesthetic characteristics are developed.**

**This involves the application of liquid finishes - binders, colour to specification and various auxiliary products - and the development of protective films.**

**Many different effects are possible to meet fashion and end-user demands.  
Finishes are mainly developed using precision machines.  
Both heat and pressure are required to complete these operations.  
These operations also influence the final physical properties of the leather.**

*This can involve:*



**Chemical coating applications:**

- **Spray machine.**
- **Roller coating machines.**
- **Sometimes by hand.**

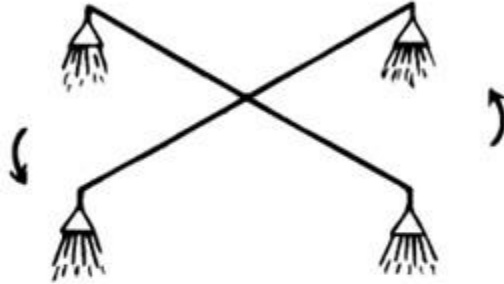
**Physical (machine) operations:**

- **Drying, cooling and conditioning.**
- **Smoothing/embossing and consolidation - roller/ram pressing.**
- **Texture and handle – milling and staking.**



## Spray operations

Movement of the spray gun assembly.



Spray finishing in sealed cabinets.



- Very light finishing may use spray applications alone.
- The spraying assembly comprises either 4, 8, 12 or 16 spray guns carried on rotating arms, or 2 or 4 guns on a single arm.
- The leather is generally fed into an enclosed spray cabinet supported on a stringed feed conveyor.
- Several applications can be used to provide sufficient cover of the grain surface to a precise shade and thickness.

**Careful presentation of leather.**



**Area scanned to avoid over-spray.**

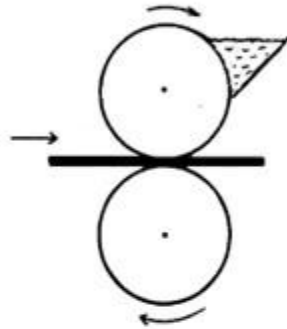


- **Area scanning under micro-processor control ensures that spraying only occurs when leather is positioned under the spray area.**
- **This minimises overspray and waste.**
- **The feed systems and machine controls can ensure reproducibility of a given process.**



## Roller coat operations

The reverse roller coater action.



Presentation to the support roller.



- Roller coating operates on the principle of transferring the wet finish from a stainless steel engraved roller onto the leather surface.
- The leather is presented to the support roller by a feed-belt or table.
- The transfer of finish is precisely determined by the depth of engraving, the setting of a doctor blade and direction of rotation of the application (*top*) roller.

**Through-feed of wet coated leather.**



**Grain patterning using special rollers.**



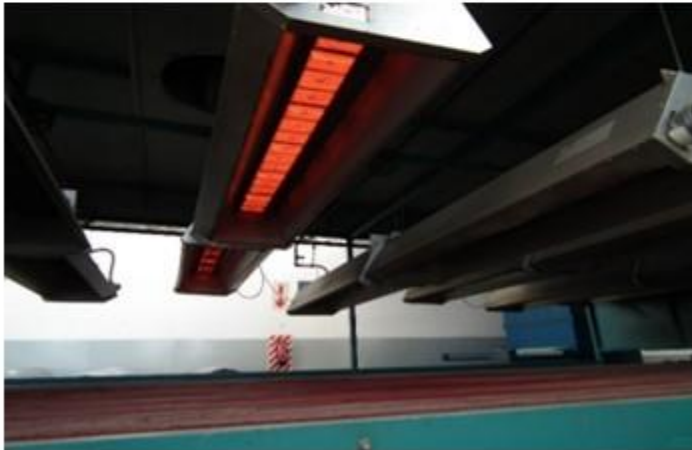
- **Once the wet application has dried a film is created on the leather surface.**
- **There may be several of these applications, with intermediate drying, with spray coats often applied as final top coats.**
- **Special surface effects such as shading, tipping and clouding can be developed by forward roll coating.**

## Drying operations

**Spray cabinet coupled with drying unit.**



**Radiant heat - both electric and gas.**



- After wet finish applications, the leathers are conveyed by machine linkages into drying units.
- The finish is dried using forced air circulation at controlled temperatures within these cabinets.
- Steam radiators are used for air heating, but direct radiant drying is also employed.



**Water removal in drying cabinets:  
essential part of film formation.**



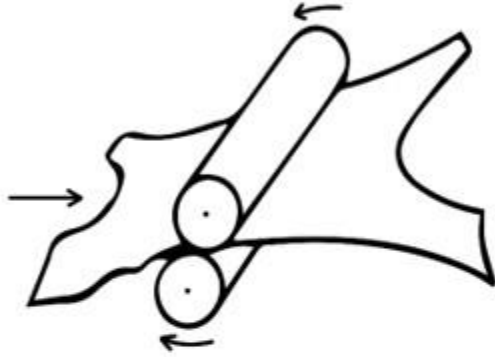
**Finish films created to specification.**



- **Polyurethane, acrylic and butadiene polymer binders are used within finish blends to provide different physical properties to the finished leather.**
- **On water removal in drying, these selected polymers coalesce to create a continuous and protective film.**
- **These are important steps in developing the properties of a finish to meet different end needs.**

## Roller press or ironing

Roll press action.



Presentation to the roller press.



- Hot roll pressing or ironing may be used for these operations.
- The finish film - being thermoplastic - softens and flows forming a smooth flat surface on the grain of the leather.
- Through-feed rolling systems are mainly used.



**Example of a highly polished roller.**



**The support cage rotates for fast exchange of pre-heated rollers.**



- **The rollers may be smooth and polished, or have textures engraved into the surface.**
- **Different rollers create detailed grain effects.**
- **Several rollers may be carried on a single machine.**
- **Before use they can be pre-heated as required to enable a rapid change of rollers.**

## Ram or platen press

The ram press action.



Considerable pressure is possible.



- Platen pressing employs a heated plate fitted in a ram press as an alternative technique to roll pressing.
- Smooth and engraved plates are interchangeable, and a huge range of patterns can be printed or embossed into the leather grain.
- This is a versatile operation, and very high pressures can be employed.
- Often used for smaller volume production.

**Other considerations:**

**Production runs may be large or small, and customer needs are subject to fast change.**

**The layout of the finishing plant and its management by necessity is highly flexible.**

**There are many different combinations of finish applications and operations.**

**Some insight into these issues and the technology involved follow.**

## Finishing by hand

Both heavy and delicate applications are possible by hand finishing.



Considerable care is required for uniformity of covering and colour.



- Small volume speciality batches and samples are often finished individually.
- Heavier coatings may be applied by hand using application pads.
- These can be followed by hand spray finishing.
- Very light finishes may be developed by spraying alone.



## Linkages and rationalisation

**Roller coater and conveyor – rail mounted.**



**Auto-stack at end of spray units.**



- **Roller coating, spraying and tunnel drying are through-feed systems.**
- **These suit rationalisation for normal volume manufacture.**
- **Machines mounted on rails may be introduced into production lines as required.**
- **Units can also be linked by movable conveyors.**
- **Leathers may be handled at take-off by stacking devices.**



## Milling and vibration staking

Milling drums - used within finishing.



Vibration staking – and too.



- In addition to applications after 1<sup>st</sup> time drying, both milling and vibration staking operations (*also stretching machinery*), can be used within finishing.
- Milling is used for tumbling soft leathers for further softening.
- It is also a means to enhance some grain effects.
- Vibration staking is employed too for relaxation and flattening after milling, and lighter softening needs.

**Bovine full grain tumbled with water repellent spray finish only.**



- **Various grain effects can be developed by milling within finishing.**
- **The grain enhancement is dependent upon the mechanical action, time, temperature and RH required in tumbling.**
- **However, the most subtle grain appearance and surface texture relies on the finishing techniques.**

## Review:

**Finishing operations are the final stage in creating the final leather appearance and properties.**

**This involves the application of liquid finishes - binders, colour to specification and various auxiliary products - to the grain layer and the development of protective films.**

**Both heat and pressure are required in these operations, to complete the final physical properties of the leather.**

**The operations can be highly mechanised, but small lots employ hand operations and specialised techniques.**

**Flexibility is required to meet fast changing customer demands.**

## FINISHING REQUIREMENTS

**There are many different finish requirements in terms of colour, texture and tactile effects.**

**The amount of cover and visual effects required are considerable, and subject to changing customer and fashion demands.**

**The products available are sophisticated and provide different physical properties.**

**The physical properties of the pre-finished leather are amended within finishing operations.**

## Variations within finishing

There are six major variations within finishing.

These comprise of two different grain structures, and three different categories of finish, as set down in *Panel 2*:

<i>Panel 2</i>		<i>"Overview" ©P. Evans</i>	
<u>Finish variations</u>			
<u>Structure</u>	<u>Category</u>		
Full grain	Aniline	Semi-aniline	Pigmented
Corrected Grain	Aniline	Semi-aniline	Pigmented



## Full grain leathers

The natural beauty of full grain leathers.



- Where the leather surface is good quality, the finish may be applied directly to the grain layer.
- These leathers are known as full grain leathers.
- They are often finished by a light spray application.
- It is important that the grain characteristics remain visible and are enhanced.

**Full grain leather: unfinished**

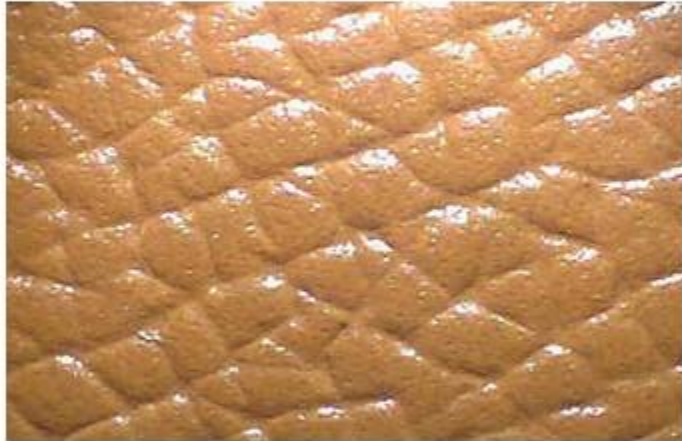


**Full grain leather: light aniline finish.**



- **Aniline finishing develops and enhances the beauty of the natural grain surface.**
- **The finish also provides protection and maintains appearance during use.**

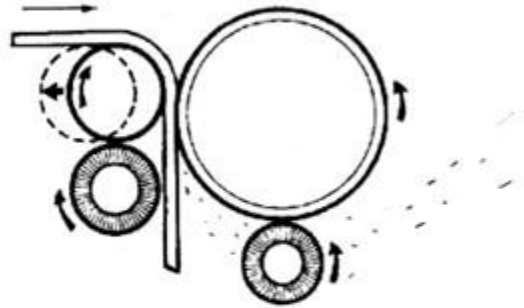
**Full grain leather: pigmented finish.**



- **Pigmented finishes can be used to cover fine surface defects.**
- **In this example the leather has also been embossed.**

## Corrected grain leathers

Action of the buffing machine.



Corrected grain leather after buffing and de-dusting.



- Leathers with small surface defects may be buffed.
- This operation is carried out by feeding the grain to a rotating cylinder covered with emery/sand paper.
- This removes small grain irregularities and forms a more uniform surface.
- Dust created is removed from the grain by air blast.
- These are known as corrected grain leather.



**After buffing, a new grain surface needs to be made.**

**Requires application of an emulsion of soft acrylic resin to the buffed surface.**

**Known as impregnation, these resins fill and support the new surface as a secure base for further finishing.**

**After drying + light re-buffing, this uniform surface enables heavy finish applications.**

**Applications mainly by roller coaters - occasionally spray or curtain coating equipment.**



## Categories of different finishes

### *Aniline finishes:*

**Some leathers have simple finishing techniques. They rely heavily on accuracy of dyeing and specialised properties developed in pre-finishing procedures.**

**Aniline finishes consist of a transparent film containing dyestuffs to adjust the shade to pattern. Here, the grain detail must be clear through the finish to retain the natural grain appearance. Pigments cannot be used in these finishes.**

### ***Semi-aniline finishes:***

**Some leathers are not entirely suited for aniline finishes, although they can be of high quality. In this instance, a small quantity of pigments of ultra-fine particle size are added to the finish formulation. These partially cover or mask minor blemishes and leave the skin with a natural appearance.**

### ***Pigmented finishes:***

**These finishes are used for leathers with a lower quality grain surface and corrected grain leathers. The film formed mainly consists of pigments and binders to provide good cover. These finishes can provide a high level of protection.**

**Within these six variations there are speciality leathers.**

## ***Waxy and Oiled effects:***

**Both high gloss and matt appearances.**



- **Development of handle and finish characteristic begins at time of dyeing and retannage.**
- **Finishing is based on blends of oils, waxes or greases to give a specified feel and appearance to the leather.**

## ***Nubuck leathers:***

Fine buffed grain for nubuck leathers.



- **Buffed lightly (*snuffed*) on the grain.**
- **These leathers do not have any finish applied.**
- **The end appearance and uniformity is dependent upon the quality of dyeing and buffing.**
- **There may be a light spray with special dye solutions to match a colour pattern and treatment with water repellent agents.**

## ***Suede leathers:***

Uniform colour and surface fibre length (*nap*) for quality suede.



- **Buffed heavily on the flesh side and unprotected by finish applications.**
- **The end appearance and uniformity is governed by uniformity of dyeing and the buffing operations.**
- **The surface fibre length is a key feature of these leathers.**
- **There may be treatment with water repellent agents.**



## ***Flesh splits:***

**Suede split with two-way rub effect.**



### **Splits have many uses:**

- They can be heavily buffed to create a smooth and uniform surface before finishing.
- They can then be heavy plated for fibre compression and surface consolidation before finishing.
- Alternatively, they may have been previously processed for suede leather.
- The retannage and buffing techniques determine the fibre length and surface effects including “two-way rub”.

## Review:

**There are many different types of finishing.**

**Applications can be minimal, or provide heavy cover and protection.**

**In general, after suitable preparation, water-based finishes are applied to the grain by roller coater or spraying machine.**

**The first application penetrates the grain layer, the binders selected being relatively soft for good adhesion.**

**Once dried, this hybrid grain/binder structure carries the subsequent finish applications.**

**There are usually several subsequent applications of finish.**

**Each application may carry progressively harder properties so that the top coat provides good wear resistance.**

**The amount of cover and visual effects required are considerable and fast changing.**

**The products available are sophisticated and provide different physical properties.**

**Plating under conditions of heat and pressure may occur between finish coats. The plates/cylinders used may be smooth or embossed, so that patterns can be created within the leather for numerous effects and grain textures.**

**This is generally followed by spraying a top finish to improve wear resistance.**

**Specialised top sprays of waxes or silicones may be used to enhance the feel, handle or tactile characteristics of the grain surface.**



**Most finishing blends and techniques employed are complex and developed to suit precise marketing requirements.**

**The finish must be able to stretch with the leather and be compatible with the demands of the client in further manufacture, and in end consumer use.**

**The properties of the final finish have to meet precise specifications in terms of colour and brightness of finish, aesthetic characteristics and physical properties.**

**Each end use carries its own demands. Official standards and limits are defined, but many customers set their own specifications.**

**These are based on properties expected when using leather in the production of an item, but clients often have additional needs. In addition, customer expectations change as do wider marketing demands.**

**Leather is increasingly being used in multi-fabric construction too. Over and above materials compatibility, colour-fastness and non-migration of plasticisers and oils are needed when combined with other fabrics.**

**Finishing requirements are subject to rapid change.**

**It should also be taken into account that specific properties have been developed in the crust leathers.**

**In finishing, water within the finish causes a wetting of the grain surface and causes grain swelling.**

**Heat is subsequently used to remove water from the wet finish application and the grain layer.**

**Further, heat and pressure is used to both flatten the grain surface and to soften and smooth the finish film.**

**But these operations cause fibre compression.**

**This causes a firming of the leather and changes both aesthetic and physical properties.**

**Flexibility and grain strength will change, as well as general softness and tensile strength, and even water resistance.**



- Major leather properties are defined at the pre-finished state.
- These are modified within finishing operations.
- Finishing provides beauty and protection to leather at the end of leather making.
- Technology has to address these sometimes conflicting values.
- This is the art of finishing in leather making.



*Continues as:*

**Leather:**  
**AN OVERVIEW OF MANUFACTURE**  
**(Part 5)**  
**Different types of bovine leather**

**Author: Richard P. Daniels**

**Recommended by:**



**INTERNATIONAL UNION OF LEATHER  
TECHNOLOGISTS AND CHEMISTS SOCIETIES**



**UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION**