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ECP

MINIMUM STANDARDS

MINIMUM STANDARDS AND BEST PRACTICES

FOR

TANNERIES

MODULE CONTENT

1 INTRODUCTION

This module explains the Marks & Spencer minimum standards and best practices for tanneries. As legislation and best practice are continually evolving it is vital to ensure that the latest versions of the standards are being used and are consulted frequently.

Minimum standards

The minimum standards highlighted in this document **must** be met in order for a tannery to supply Marks & Spencer. Non compliance to the minimum standards can result in orders being cancelled and a supplier being de-listed from the Marks & Spencer supply base. Marks & Spencer will not place orders with companies who fail to declare full details of production routes. It is also important to note that the minimum standards are **minimum** standards: we expect tanneries to aim to exceed these standards and aspire to being world class suppliers.

The Marks & Spencer approach for managing standards is one of ensuring ongoing compliance and improvement. Meeting the minimum standards is easy to achieve and, with very few exceptions, issues of non-compliance can be rectified very quickly with minimal cost, provided there is a genuine desire to solve the problem.

In the event of failures, a Corrective Action Plan (CAP) will need to be developed and implemented over an agreed time period to ensure factories have an opportunity to meet the Marks & Spencer requirements. However, if the CAP is not completed to the satisfaction of Marks & Spencer, the result may be the cancellation of orders and the supplier being de-listed.

General Best Practices

As well as the minimum standards this module also identifies best practice guidelines for each section. This best practice has been developed over many years, with input from many sources including machinery builders, chemical and dyestuff companies, consultants and tannery managers themselves. As factories can have very different designs, machinery types and processes, the best practice in this module is a guide rather than a formal instruction, and should be treated as such when being considered for implementation within your tannery.

In general, the best practice for factories has been developed from the same principle approaches to process management. Below is some general guidance on a number of aspects of preparation tanning that can improve quality, reduce consumption of water, energy and chemicals and help improve productivity.

- All raw materials (dyes, chemicals, substrates, hides etc) should be checked for conformance and consistency
- Substrates and hides should be accurately weighed before processing
- All dyes AND chemicals must be accurately measured or weighed
- Selection of chemicals and dyes should consider toxicity, COD/BOD and other potential hazards
- There must be clear, written procedures Standard Operating Procedures (SOP) for ALL processes
- In-house testing and access to accredited testing facilities is essential
- All finished batches must be examined prior to dispatch

Environmental Compliance

Poorly managed tanning of leather can have a significantly negative effect on the environment. The impact on water quality, water availability, air quality, soil contamination and even noise has an effect on the workers, management, the local community and even the world at large. Therefore, Marks & Spencer has strict requirements regarding the protection of the environment, and expects its suppliers to adhere to, and aspire to exceed these requirements. **Module 4 – Environmental Management** contains more information regarding Environmental Management and should be read in conjunction with this module.

Minimum Standards Requirement
All leather used for Marks & Spencer products must be compliant with the Marks & Spencer Leather Sourcing Policy

All finishing tanneries must comply with Marks & Spencer minimum standards and particular attention must be paid to effluent treatment. There is a relatively high proportion of solid waste produced during leather processing and this waste must be disposed of in accordance with local regulations.

But, as with textiles processing, there are some simple best practice guidelines that will help a tannery achieve the standards required by Marks & Spencer:

- Safe, well controlled machinery
- Accurate weighing, dispensing and dosing of chemicals
- Consistent water and raw materials
- Standard operating procedures
- Robust quality systems
- Continuous improvement programmes to improve quality and reduce consumption

Training and best practice information is available from the BLC leather technology centre **http://www.blcleathertech.com/** and we recommend you seek specialist advice to improve your factory and optimise your processes.

Information is also available from an EU document highlighting best available techniques in the tanning of hides and skins that can be downloaded from

http://old.vpvb.gov.lv/ippc/bat/bat_ES1/

Please refer to M&S ECP Module 7 Chromium Vi Management :A Practical Guide **https://supplierexchange.marksandspencer.com**

1. WORKER SAFETY

Marks & Spencer take the issue of worker safety extremely seriously. It is vital that finishing tannery managers focus not only on producing quality products that meet the Marks & Spencer specifications, but they do so in a way that does not put their workers at risk.

Arguably the most important factor in workplace safety is a documented **safety policy or manual**. The policy must ensure the correct equipment and training has been provided for the workers and that clear rules are in place for taking disciplinary action against workers who continually disobey safety rules.

Marks & Spencer expects senior tanneries management to take responsibility for managing worker safety and the promotion of the factory safety manual and Personal Protective Equipment (PPE). Formal safety training should be given to workers. It should cover their specific tasks as well as the general safety principles.

1.1 Machine Safety

Minimum Standards Requirement
There must be safety interlocks on high temperature and pressurised machines
Machines must be electrically safe
Moving machine parts must be adequately guarded
Personal Protective Equipment (PPE) requirements must be clearly signed
Machines must undergo regular services and maintenance

1.1.1 *Pressurised Machinery*

Pressurised equipment, such as dyeing machinery that operates above 80^{o}C, can cause serious injury if pressure is released in an uncontrolled manner. In some countries there is legislation that requires pressurised equipment to have safety interlock fitted. Marks & Spencer insist that interlocks are employed on all such pieces of machinery.

1.1.2 *Electrical safety*

Electrical safety practices not only ensure the safety of the workforce, but also help to prolong the life of electrical systems, and can ensure quality and efficiency of processes.

Common electrical problems include:

- Bare wires and poor insulation.
- Short circuits caused by wear & tear and poor servicing. Dirt and debris can bridge live wires leading to a serious fire risk, so it is important equipment is kept clean at all times.
- Control panel doors left open due to overheating exposes electronics, which could electrocute workers or cause a fire hazard. Therefore regular machine maintenance is imperative.

Old fashioned, exposed electrical circuitry are a serious risk

- All electrical work must be done by certified professionals.
- Water sources near machinery lead to high risks of electrocution. It is imperative that water is kept away from electrical sources.

The use of circuit breakers, which shut off the current when any short circuit is detected are strongly recommended.

A control panel door left open to prevent over-heating

Excellent information on electrical safety is available at **www.hse.gov.uk/electricity/index.htm**

1.1.3 *Machinery with moving parts*

It is vital that moving parts on all machinery are guarded wherever possible. Examples of safety risks and solutions are:

- In-running nips can crush fingers and hands and these should always be guarded.
- Hydro extractors without lids can cause loss of limbs. Lids must be present on all hydro extractors, and lids with an interlock switch to ensure the machine cannot be operated with the lid open are recommended.
- Cogs, pulleys and other moving parts can trap fingers, limbs and clothing and should always be guarded.
- Use of guards, interlock switches and 'dead man's handles' to ensure the machines cannot be operated when moving parts are exposed are recommended by Marks & Spencer.

In-running nip: The red line shows a safety trip device to stop fingers being trapped

Hydro extractor with no lid: Poses an unacceptable risk to worker safety

Unguarded cogs on a continuous wash range: Pose an unacceptable risk

1.1.4 *Hazard Signs, training and PPE*

Regular maintenance and servicing of machines can save lives and reduce the likelihood of injury as well as increase machine productivity and reliability. In addition to ensuring machines are electrically and mechanically safe, all potential hazards must be clearly signed and workers given adequate training to ensure the risk of injury is minimised. Also, all workers must be trained in the use of Personal Protective Equipment (PPE) and be supplied with the necessary PPE for their roles. Systems and procedures must be in place to ensure all workers use the necessary PPE at all times.

Information and links to useful documentation can be found at **www.hse.gov.uk/equipment/info.htm**

1.2 Fire Safety

	Minimum Standards Requirement
	Local and national laws for fire prevention must be complied with, and evidence of valid local authority fire certificates in applicable regions must be available
	Electrical equipment must be regularly serviced
	Combustible materials must be stored safely
	There must be adequate and appropriate fire fighting equipment
	Fire fighting equipment must be serviced and certificated
	Fire fighting equipment must be clearly signed and easily accessible
	Fire alarm points must be clearly signed and accessible
	Fire exits & escape routes must be clearly signposted, unobstructed and unlocked
	There must be a fire assembly point a safe distance from the tannery, with frequent, random fire drills carried out
	Smoking must be banned in working areas of the tannery
	A segregated safe smoking area must be provided for workers

When processing textiles and hides the potential for fire is high as most substrates are flammable, many chemicals are flammable and there are several sources of ignition in factories. Marks & Spencer expects all of its suppliers to comply with the local and national laws for fire prevention and have valid **fire certificates** in those regions where they are issued by the local authorities.

There are three aspects of fire safety for a tannery to consider: **Prevention**, **Fire fighting** and **Escape**.

1.2.1 *Prevention*

In order for a fire to start the following are required: fuel, oxygen (air) and a source of ignition. Preventing the risk of fire can be achieved by reducing the likelihood of these three components mixing. Therefore, factories and mills should be regularly assessed for fire risk to identify sources of ignition and location of fuels.

For Example:

- keep electrical equipment clean and serviced to avoid these becoming the source of ignition
- Ensure good housekeeping practices to keep potential fuels (textiles, chemicals, papers, etc) stored safely and away from sources of ignition
- Risk assess all processes that use a naked flame to ensure the risk of fire is minimised

The results of a fire in a knitting department

1.2.2 *Fire Fighting*

Most fire can be extinguished very quickly if the appropriate equipment and basic training is available. A fire assessment should be carried out for each area of the tannery to ensure the correct type and amount of fire fighting equipment is present. For example, hand held extinguishers will not be sufficient for a cotton store fire. Equally water extinguishers would be inappropriate for electrical fires.

All fire fighting equipment must be well maintained and serviced regularly. All fire fighting equipment must be clearly signposted and access to it must remain unobstructed at all times. Marking an exclusion zone around fire fighting equipment is a useful way to ensure access is not blocked.

We encourage the appointment of a dedicated fire officer role within the senior management team to ensure fire safety is continually assessed, and fire safety should always form part of inter-departmental audits.

Marks & Spencer require all suppliers to have a total ban on smoking in all working areas of the tannery with a segregated area for smokers provided away from fire risks.

Information on different extinguisher types is available at:
http://www.fireriskuk.com/fire_extinguishers.htm

1.2.3 *Escape*

The majority of deaths in factory fires are a result of inadequate, blocked or locked fire escapes. Management must provide adequate fire escapes for workers and these must be clearly signposted, with all fire escape doors kept unlocked at all times.

Marks & Spencer require compliance with these minimum standards at all times. The possession of a valid fire certificate will not excuse blocked fire exits.

Fire doors with crash bars are recommended, as they are locked from the outside but can be opened from within to provide security and fire safety.

It is important that a fire assembly point is established which is a safe distance from the tannery. Frequent, random fire drills (practices of evacuation) must be carried out to ensure workers are fully aware of the correct procedures during a fire.

Fire exit with crash bar

1.3 Personal Protective Equipment (PPE)

	Minimum Standards Requirement
	Personal protective equipment (PPE) requirements must be signposted throughout the tannery
	Appropriate PPE must be provided and worn

Wherever possible, the need for PPE should be removed by automating or using engineered safety features on machinery (such as interlock switches) to protect the workers. However, where risk still exists, PPE policies must be created and enforced.

Workers must be provided with personal protective equipment (PPE) for any hazardous or dangerous operations. Full training and instruction on when and how the PPE should be used must also be provided. There is often reluctance amongst workers to wear PPE, however, systems and procedures must be in place to encourage workers to use PPE when and where required. PPE includes, but is not limited to:

- Boots or closed shoes - must be worn in areas where chemicals are handled
- Gloves and goggles - must be worn when handling chemicals
- Respirators - must be worn if hazardous fumes are present
- Dust masks - must be worn in dusty atmospheres
- Ear protectors - must be worn if workers spend prolonged periods of time in noisy areas

1.4 General Safety

Minimum Standards Requirement
Workers must be provided with changing facilities
Eating and drinking must be prohibited where chemicals are handled
There must be a segregated eating area provided for workers
Housekeeping must be at a level that does not pose a safety risk
Walls, floors and roofs of the building must be safe and in good condition
Drops from upper floors must be protected by barriers

Poor housekeeping leads directly to safety problems, as well as leading to poor quality. There is no cost in tidying a tannery, but a tidy tannery will result in improvements in safety, quality and efficiency. Providing workers with a clean, tidy working environment is also a very clear signal that the management care for and value them.

There is a high risk for chemical ingestion when workers eat and drink in areas of the tannery where chemicals are handled. Therefore workers must be provided with a segregated eating area, with suitable hand washing facilities.

Factory with excellent levels of tidiness

Frequent inter-departmental audits are a very good tool for keeping a factory tidy as well as safe. For example, simply ask a small number of representatives from the production department to assess the finishing department for housekeeping and safety problems. Extended to the whole tannery this approach will quickly build a team of safety representatives who are actively improving safety and productivity.

We encourage the appointment of a professionally qualified safety officer who has the authority to stop any processes or activities that are considered to be unsafe irrespective of the impact this may have on

productivity. Marks & Spencer recommend the use of independent safety certification as a way to minimise any potential safety issues.

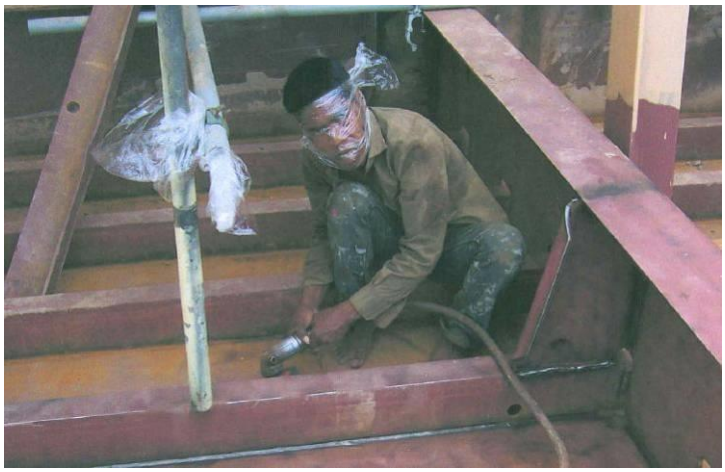
There are many organisations around the world that provide safety certification and training. One example is NEBOSH, who have an international diploma:
http://www.nebosh.org.uk/qualifications/diploma/default.asp

Independent certification is also available using standards such as OHSAS 18001:
http://www.ohsas-18001-occupational-health-and-safety.com/

1.5 Engineers and Contractors

	Minimum Standards Requirement
	External contractors must work to all the existing factory safety standards and requirements
	Tools must be used safely by external contractors
	Access equipment (e.g. Ladders and scaffolding) must be appropriate and used safely by external contractors

Marks & Spencer require all safety standards to be applied to everyone on the tannery site, including any external contractors, engineers and visitors. It is extremely important that any external visitors to the site are briefed on health & safety, and use tools and equipment safely, and use PPE.



External engineer using dangerously inappropriate protection equipment

2. QUALITY SYSTEMS

Minimum Standards Requirement
There must be written Standard Operating Procedures (SOPs) for all processes
Batch cards must accompany every production batch

Marks & Spencer expects its suppliers to aspire to be world class, and to be world class, effective quality management systems have to be employed. Quality systems protect the reputation of the tannery, and they invariably deliver process optimisation that leads directly to improved productivity and cost savings.

Continuous quality improvement is a philosophy that Marks & Spencer expects from its suppliers, as this defines the culture of an organisation that is constantly trying to improve product quality, consistency and levels of efficiency. It requires the measurement of tannery performance, costs, and environmental impacts on a continual basis, exploring how the tannery can be improved.

Marks & Spencer have identified some basic principles that play a major role in ensuring compliance to standards. To produce products safely and consistently you must have consistent raw materials and consistent processes. To confirm that processes are done consistently you need quality control systems and detailed records on each batch of production. This allows areas of good and bad practice to be identified which can be used for continuous improvement.

2.1 Standard Operating Procedures (SOPs)

Standard Operating Procedures describe how individual processes are carried out and ensure consistency within the tannery. Consistency of processing is key to delivering quality goods batch after batch. If correctly implemented, SOPs will improve quality, increase productivity, reduce waste and save costs. All tannery processes, however simple, should have a written SOP that provides step by step details of what needs to be done in order to carry out a task such as:

- The equipment used
- Temperature, humidity and lighting requirements
- Timings
- Chemicals used

2.2 Batch Cards

Batch Cards track the flow of goods throughout the entire process from goods inwards to final product shipment. Good batch cards identify individual process requirements and record the parameters used in each process and even the operator responsible for carrying out the process. Batch cards reinforce with the operatives what is expected of them and ensures they carry the process out as consistently as possible and noting any variations.

The key to a good batch card system is the concept of the internal tannery customer. Batches only pass to the next stage, or customer, if the batch meets their requirements. If it does not, the batch is not accepted until the issue is resolved. This creates ownership of quality throughout a process rather than leaving it to final Quality Control (QC) to make decisions.

Appendix A shows two examples of batch cards; a general material flow card and a jet dyeing card.

2.3 Work in Progress

Managing the levels of Work in Progress (WIP) is obviously crucial in terms of cash flow and efficiency. But excessive WIP can lead to quality problems, delivery issues and even health and safety risks. For example, the storage of excessive WIP may block fire escapes or impair access to fire extinguishers.

A tidy working environment where raw materials are brought in just in time (JIT) for processing, and finished products are dispatched immediately after processing is more efficient. Excessive stock and WIP stock ties up cash, so reducing WIP releases cash. A key performance indicator for WIP is how many days it takes to receive raw material, process into goods, and ship to the customer.

2.4 Chemicals

	Minimum Standards Requirement
	There must be a copy of the Marks & Spencer ECP standards on-site
	There must be a Material Safety Data Sheet (MSDS) for all chemicals, filed in the proximity of the chemical
	All stored dyes and chemicals must be labelled
	All chemical hazards must be clearly signed (orange labels)
	All chemicals must be stored according to MSDS advice
	Incompatible chemicals must be stored separately
	Bulk quantities of hazardous chemicals must be stored in a manner that avoids the risk of a spillage
	There must be no SVHC's present in any chemicals that are used for M&S production

It is very important that appropriate storage and systems are in place for tannery chemicals, to ensure both worker safety and product quality.

Unlabelled chemicals pose safety risks, and could lead to a mistake in production which will compromise the quality of the product. Therefore all stored chemicals must be labelled with their correct name and any specific hazards and requirement to wear personal protective equipment clearly identified. Flammable chemicals (e.g. solvents) must be segregated and stored separately, preferably in a locked, secure area.

An authentic Material Safety Data Sheet (MSDS) for each chemical must be available in the local language and kept in close proximity to the chemical for ease of access.

Bulk quantities of hazardous chemicals must be stored appropriately to avoid the risk of a spillage. The recommended approach is to enclose containers with bunds or bund trays that are capable of holding the entire amount of chemicals in the container.

Unlabelled chemical pose a risk to quality and safety

All chemicals must be stored to minimise the risk of dangerous reaction with other chemicals. For example acids and alkalis must be segregated and oxidising and reducing agents should be separated. Storage advice on the MSDS must be followed at all times.

It is also extremely important that there are no Substances of Very High Concern (SVHCs) present in any of the chemicals used for Marks & Spencer production. Please see **Module 2 - REACH** for more detail on REACH, and to see the list of SVHCs.

Bund stands reduce risks that arise from container leaks

Information on safe chemical storage is available at: **http://www.safetystorage.ie/ibcbunds.htm**

MSDSs should be consulted for advice on safe storage

2.5 Incoming Water

Unreliable, inconsistent and/or contaminated incoming water will have a major impact on the ability of a tannery to deliver quality goods on time and in a cost effective way.

Wet processing factories need a consistent supply of soft water or the ability to soften water on-site. Hard water is a problem because it reduces the solubility of dyes and chemicals and causes precipitation of solids. Wash off processes are less effective with hard water and can lead to poor wash and rub fastness.

The salts in hard water can also act as a buffer and make it difficult to achieve the extremes of pH required for several dyeing and finishing processes. For example, achieving the high pH required to fix reactive dyes or low pH for the full curing of cross linking resins. The latter can lead to formaldehyde levels above permitted safety levels and hence consumer safety issues.

One of the biggest problems with hard water is its variability which leads to inconsistency in processing. To ensure production is as consistent as possible, water quality should be monitored on-line and off-line and records retained as part of quality management systems.

3. RAW LEATHER & TANNING

Minimum Standards Requirement
only raw hides that are a by-product of the meat industry, are comply with the Marks & Spencer Animal Welfare Policy and the Leather risk assessment tool can be used for Marks & Spencer production

3.1 Tanning

3.1.1 *Raw Hides*

Compliance with the Marks & Spencer Leather Sourcing policy is mandatory and only raw hides that are a by-product of the meat industry, are comply with the Marks & Spencer Animal Welfare Policy and the Leather risk assessment tool can be used for Marks & Spencer production.

Salt is used on the hides to avoid attack by micro-organisms and decomposition during storage. It is recommended that every effort is made to minimise use of salt and discharge of salt to the environment and there should be no uncontrolled dumping of the salt off site.

A cow hide

Liming drum in typical tannery

Best Available Techniques at this stage of the process are:

To process fresh hides as far as they are available and thereby avoid the use of salt

Exceptions:

- When long transport time is necessary (max 8 - 12 hours for fresh, un-chilled hides; 5 - 8 days if a cooling chain of 2 °C is maintained)
- Sheepskins, calf skins

To use biocides with the lowest environmental and toxicological impact. Reputable suppliers of biocides often work with processors (often at no charge) to determine the correct type and amount of biocide to apply.

3.1.2 *Soaking*

Hides and skins are soaked in alkaline liquors to re-hydrate them for processing. Paddles (right) and drums are both used but the use of paddles is more common for hides and skins that are very dry or for hides and skins with long hair or wool. Some tanneries feel the need to use biocides to prevent decomposition of the hides, but their use must be minimised. Dip slides (agar coated plates) are cheap and readily available and can be used to assess bacterial contamination.

Best Available Techniques at this stage of the process are:

To process fresh hides as far as they are available and thereby avoid the use of salt
To use biocides with the lowest environmental and toxicological impact.

3.1.3 *Fleshing*

Sending waste material from the fleshing process (residual fat and muscle tissue) to landfill should be a last resort. Many organisations have been able to find economic outlets for this material, for example, it could be recycled for use in gelatin production or other low grade food uses where possible. Fats can be rendered for conversion to tallow or bio-fuel. If disposal is the only option this should be in compliance with local legislation.

3.1.4 *Liming or Hair Removal*

The function of liming and unhairing is to remove hair, interfibrillary components and epidermis and to open up the fibre structure. Hair removal is performed by chemical and mechanical means. The keratinous material (hair, hair roots, epidermis) and fat are eliminated from the pelts mainly with sulphides (NaHS or Na_2S) and lime. Alternatives to inorganic sulphides include organic compounds such as mercaptans or sodium thioglycolate in combination with strong alkali and amino compounds.

Best Available Techniques at this stage of the process are:

To reduce the organic content (BOD & COD), Suspended Solids, Nitrogen and Sulphide in the waste water by the use of hair-saving techniques
To reduce sulphide consumption by the use of alternatives such as organic sulphur compounds or enzymes

Hair-save processing has been developed for processing bovine hides. This involves manipulating the conditions of alkalinity and reducing the agent in such a way that the hair comes out of the follicle without being pulped and without destroying the hair shaft. A recirculation system with a screen is used to separate the intact hair. This waste should be used as new raw material elsewhere, rather than being discharged to the effluent. This brings about a reduction in levels of solids and BOD. Hair causes a very

high organic load, which results in a high production of sludge. Several commercial hair-save processes are on the market. Although these processes are not suitable for all types of raw hides and leather products, high quality leathers are already being produced

Enzymes and amines can be added to facilitate the unhairing and reduce the consumption of sulphides. Mechanical removal can then be performed easily. Combinations of enzymes with sulphides are used to make the hair removal more efficient. The hair has to be removed continuously to prevent it from dissolving in the float.

Sulphides can also be reduced by means of recycling. Suspended and dissolved solids are a problem for the recycling of the floats. Large size solids can be filtered out (hair-save systems, separation of solids > 1mm) by screening, centrifugation and/or sedimentation. After filtration the unhairing liquors must be analysed, and their chemical concentration has to be corrected before re-circulating into the process. Alkali-stable enzymes can be added at the end of the unhairing process to clarify the liquors (preventing them from becoming glutinous, soupy), though care has to be taken that the enzyme activity is stopped before the liquor is recycled. Recycling requires laboratory analysis and process control.

Liming drum in typical tannery

3.1.5 *De-liming*

The aim of deliming is to remove residual lime from the pelts and to take the pelts to the optimum condition for bating. This involves a gradual lowering of the pH (by means of washing and addition of deliming chemicals), an increase in temperature and the removal of residual chemicals and degraded skin component. Ammonia free de-liming processes are recommended. In some locations regulations governing emissions of ammonia to the atmosphere, or levels of ammonia in the workplace, effectively make ammonia free deliming a necessity.

Best Available Techniques at this stage of the process are:

To reduce the nitrogen content in the waste water by making a complete or partial substitution of ammonium salts with CO_2 and/or weak organic acids.

Carbon dioxide deliming is generally regarded as a practicable, cleaner technology that can considerably reduce the environmental impact of this operation. A complete substitution of ammonium deliming agents is possible for bovine hides, but the process can be very slow with thicker hides. If sufficient deliming cannot be achieved using CO_2 alone, auxiliary agents other than ammonium salts, e.g. organic acids, can be used.

Boric acid, magnesium lactate, organic acids such as lactic acid, formic acid and acetic acids, or esters of organic acids can be used to substitute ammonium agents. The advantage of substituting ammonium salts is that ammonia levels in the waste water are reduced. Selection must be made bearing in mind waste water discharge consent limits, for example, some water authorities restrict the amount of borates permitted in the effluent, in these locations the use of boric acid would not be permitted.

3.1.6 *Bating*

Bating is a partial degradation of non-collagenic protein achieved by enzymes to improve grain of hide and the subsequent run and stretch of leather. In this process the rest of the unwanted hair roots and scud can be removed. This is an enzymatic process that loosens the skin to make the leather more

supple. In common with any enzyme process it requires close control of pH and temperature to ensure consistency of processing.

3.1.7 *Tanning*

Tanning is a process where collagen in the skin is cross-linked to turn the skin into leather. In the tanning process the collagen fibre is stabilised by the tanning agents such that the hide is no longer susceptible to putrefaction or rotting. In this process the collagen fibres are stabilised by the cross-linking action of the tanning agents. Furthermore their dimension stability, resistance to mechanical action and heat increase.

There are different ways to carry out the tanning process and the most common is chrome tanning. As effluent consents for chrome are very tightly controlled it is recommended that chrome baths are re-used. The chrome concentration of the tanning bath should be monitored at the start and finish of the process, and the chrome content of the tanned leather should also be checked. The presence of highly toxic Chromium VI salts should be regularly checked.

Chrome-free tanning is an established technology and should be considered by all tanneries. The most popular chrome-free process uses aldehydes and produces white tanned leather – called wet white. Much of the automotive industry has moved to chrome-free tanning so it is already proven in large quantities for a very demanding end use. Vegetable tanning, using natural plant extracts is also possible.

Best Available Techniques at this stage of the process are:

To reduce the salt concentration by using low volume floats.

To increase the efficiency of the chrome tanning process through careful control of pH, float, temperature, time and drum speed, all in combination with an appropriate treatment of the discharged float containing chromium.

To use high exhaustion tanning methods provided the necessary leather qualities can be obtained.

To use chromium recovery through the precipitation of process water containing chromium.

To maximise the exhaustion of vegetable tanning liquor.

Please refer to M&S ECP Module 7 Chromium Vi Management :A Practical Guide **https://supplierexchange.marksandspencer.com**

The chrome uptake in the hides depends on many factors. Helpful measures can therefore be taken in previous process steps. For example, a thorough liming produces more groups where the chrome complex can be bound. Splitting after liming facilitates chrome penetration and reduces chemical input. The next step is to ensure high efficiency in the process. The ‘classic’ chrome tanning carried out in long floats is characterised by poor exhaustion; 30 – 50 % of the chrome applied being lost with the waste water [tan/tm/17/Frendrup]. BLC reports that an average of 40 % of the chrome input may be discharged.

To improve the exhaustion of conventional tanning systems the following actions are relevant:

- The chrome input must be optimised during conventional chrome tanning to reduce the possible waste.
- Processing parameters, e.g. float length, pH and temperature, must be optimised to increase chrome uptake.
- Short floats reduce the chrome input, combining a low chrome input with a high chrome concentration.
- Allow enough time for penetration and reaction of the chrome with the substrate.

Without introducing any new chemicals or technologies, tanners can significantly improve the chrome uptake (compared to about 60 % in normal operation)]:

- 80 % chrome uptake can be achieved by altering the physical parameters (temperature rise from 20 ºC to 50 ºC, pH from 3.5 to 4.5) of the tanning operation.
- up to 90 % chrome uptake by altering both physical and chemical parameters (float levels, chrome offers).

To improve control of the process parameters, (automatic) process regulation equipment has to be installed. The obvious advantages are a reduction in the consumption of tanning agents; waste water; waste treatment and effluents. High-exhaustion chrome tanning recipes exist, often making use of proprietary products. There are two types of high-exhaustion systems:

- The tanning agents are modified so that a low basicity tanning powder penetrates first into the cross section. Then a high basicity chrome powder is added and the temperature is increased.
- There are special chrome agents (aromatic dicarbon acids, e.g. of adipin or phthalic acid, aldehyde carbon acids, e.g glyoxylic acid), which enhance the number of links available for the binding of chrome in the collagen structure.

The technique can be applied to both existing and new plants but may require the installation of pH and temperature control equipment. Furthermore, provisions need to be made to control the increase in temperature of the bath. Some leather products cannot be made with a high exhaustion process.

The effect of chrome recycling on chrome discharges depends on the efficiency of the existing tanning processes, but on average 50 % of the exhausted tanning float can be recycled. There are two options for the recycling of exhausted tanning liquors:

- Recycle the tanning liquors to pickle process
- Recycle the tanning liquors to tanning process (and the pickle liquors to the pickling).

For both options a holding tank and a screening of the solutions are required.

Process control and monitoring are necessary for calculating and adjusting bath strength (salt content, pH, etc.) and for checking impurities. Some changes to the tanning process might be necessary, such as reducing the amount of masking agents and salts added.

3.1.8 *Recycle the tanning liquors to pickle*

If tanning is executed in the pickle float, the exhausted tanning bath can only partly be recycled into the next batch of pickle liquor. For recycling into the pickling float the liquor is passed through a nylon screen and, after 24 hours, passed to a tank where it is mixed with the pickle acid. The hides are drummed in brine solution, then the pickle/chrome liquor is added. After the standard pickling time, the fresh chrome input is added.

3.1.9 *Recycle the tanning liquors to tanning process*

If the liquors are recycled to tannage, hides are taken out of the drums at the end of the process, allowing about 60 % of the float to be recovered. In the tanning operation, fresh chrome powder is added to the drained pickled pelts (which carry about 20 % residual float) and then the recycled liquor is added.

Chrome can be recovered from the exhaust liquors (tanning liquors, samming water) from the conventional chrome tanning process; chromium from high-exhausting chromium salts is not recycled due to the low concentration. The chromium-containing liquors are collected in a collection tank, after which the chromium is precipitated by addition of an alkali. The precipitated chromium is separated from the supernatant, after which the chromium sludge is dissolved in concentrated sulphuric acid (for 1kg of Cr_2O_3 as precipitate about 1.9 kg H_2SO_4 is required). The supernatant is generally discharged to the effluent.

The precipitate should be re-dissolved as soon as possible, as it gets less soluble with time. Any alkali will precipitate chrome, but the stronger the alkali, the faster the rate of coagulation. Therefore, the following precipitation options can be selected:

- Sodium hydroxide or sodium carbonate (as strong alkali) will lead to a fast precipitation and voluminous sludge.
- Fast precipitation with additional agents like polyelectrolytes to facilitate coagulation has the advantage that only simple de-watering is necessary.
- Slow precipitation, e.g. magnesium oxide (as a powder, pH 8), gives a denser sludge, which allows for decanting. For 1.0 kg Cr_2O_3 in the spent liquors, 0.25 – 0.4 kg MgO, is needed depending on the basicity and masking. Another advantage of the use of MgO is that any excess addition will not cause pH to rise beyond 10, so that any sludge redissolving at higher pH levels is avoided.

Impurities and process chemicals may build up and therefore an increased level of process control is needed, and impurities may need to be destroyed after dissolving the chromium sludge. Chromium recovered in this way resembles the quality of fresh chromium, and therefore this system of chromium precipitation tends to be favoured over direct chromium recycling.

3.1.10 *De-watering*

After tanning, the leathers are drained, rinsed and either horsed up to age, or unloaded in boxes and subsequently sammed to reduce the moisture content prior to further mechanical action, such as splitting and shaving. The setting out operation can be carried out to stretch out the leather. Machines are available which combine the samming and setting action. After samming and setting, hides and skins can be sorted into different grades after which they are processed further or sold on the market. Water removed from chrome tanned leather will contain chrome and this must be collected, re-used or disposed of carefully.

3.2 POST TANNING & DYEING

3.2.1 *Post-tanning*

The post tanning operations modify tanned hides by treating them with a potentially wide range of chemicals that modify the leather in terms of feel, colour, softness etc in preparation for a surface coating. There are several stages which follow one after another without the need for the leather to be removed from the process vessel. The normal sequence of operations is: neutralisation, retanning, dyeing, fatliquoring.

Neutralisation is the process by which the tanned hides are brought to a pH suitable for the process of retanning, dyeing and fatliquoring.

The retanning process can be carried out with the following objectives:

- to improve the feel and handle of the leathers
- to fill the looser and softer parts of the leather in order to produce leathers of more uniform physical properties and with more economical cutting value to the customer
- to assist in the production of corrected grain leathers
- to improve the resistance to alkali and perspiration
- to improve the wetting back property of the hides which will help the dyeing process.

A wide variety of chemicals can be used for the retannage of leather. They can generally be divided into the following categories: vegetable tanning extracts, syntans, aldehydes, mineral tanning agents and resins.

The dyeing process is carried out to produce level colours over the whole surface of each hide and skin and exact matching between hides in a commercial pack. Leather is usually dyed with acid dyes (Basic and reactive dyes are less commonly used) using a drum dyeing machines and the same controls that are used in the exhaust dyeing of textiles (section **Error! Reference source not found.**) should be put in lace to maintain quality, reduce the environmental impact of the process and improve productivity.

Leathers must be lubricated to achieve product-specific characteristics and to re-establish the fat content lost in the previous procedures. The oils used may be of animal or vegetable origin, or might be synthetics based on mineral oils. Stuffing is an old technique used mainly for heavier vegetable-tanned leather. The sammed leather is treated in a drum with a mixture of molten fat.

The retanned, dyed, and fatliquored leather is usually washed before being piled on a 'horse' to age (let the fat migrate from the surface to the inside of the pelt).

Best Available Techniques at this stage of the process are:

To reduce COD by optimising the process in terms of float length, temperature (use of high temperature), duration and quantities of retanning agents, fatliquors and auxilliaries applied.

3.2.2 *Drying*

The objective of drying is to dry the leather whilst optimising the quality and area yield. There is a wide range of drying techniques and some may be used in combination. Each technique has a specific influence on the characteristics of the leather. Drying techniques include samming, setting, centrifuging, hang drying, vacuum drying, toggle drying and paste drying. Generally samming and setting are used to reduce the moisture content mechanically before another drying technique is used to dry the leather further.

Over-drying must be avoided as this can make the leather harsh as well as wasting energy. After drying, the leather may be referred to as crust. Crust is a tradable intermediate produc

3.3 Recipe Prediction & Formulation

Minimum Standards Requirement
Instrumental colour measurement and intelligent computerised systems must be used for recipe prediction and formulation

Marks & Spencer were one of the pioneers of instrumental colour measurement and spectral data standards. We expect all our suppliers to be using instrumental colour measurement and intelligent computerised recipe prediction systems. Once a recipe has been developed it is recommended that automated dispensing equipment is used to prepare the laboratory recipes to ensure accurately weighed dyestuffs are used for the lab dyes. See section 5.7 for more information on weighing dyes and chemicals. More details on colour measurement can be found in the Marks & Spencer **C41 document.**

Stock solutions for the dispenser should be made at least every day. Some dyers even make fresh solutions every 12 hours to reduce the chance of dye hydrolysis or settling/aggregation. Dispensers work on a g/l basis and it is important to remember that liquid dyes should be made up to the final volume and **not added to** the final volume, otherwise small but significant errors can occur. For example, to make a 1g/litre stock solution, 1g of liquid dye should be added to 999 ml of water and not to 1 litre.

There are many colour management system choices including Smartmatch by Datacolor **http://www.datacolor.com** and Robolab from Intertrad **http://www.intertradgroup.com/**

3.4 Weighing Dyes and Chemicals

Minimum Standards Requirement
Dye stores must be clean, dry and tidy
All dyes & chemicals must be labelled
Scales and balances must be clean, dry, serviced and calibrated
All chemicals must be accurately weighed or measured by volume (not estimated)

Marks & Spencer require as a minimum that dye and chemical stores are clean, dry and tidy and that workers are provided with appropriate PPE.

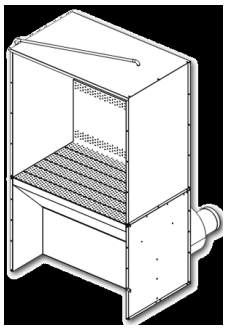
Each dyestuff should be stored in a clearly labelled closed container, and an individual scoop or spoon for each dyestuff must be used to minimise the risk of cross-contamination. It is best practice to transport these containers to the balance before the dye is removed, as carrying small quantities of dye over large distances results in inaccuracy.

Marks & Spencer also recommend the use of trained, dedicated staff to carry out weighing of all dyes and chemicals. It has been proven that accuracy is greater for workers whose sole responsibility is to weigh and dispense dyes compared to machine operatives weighing their own dyes and chemicals.

Marks & Spencer recommend that manual or check-weighing is carried out in a down-draught booth for the safety of workers. These are simple booths where an extraction unit draws air to the floor pulling potentially irritating dust away from the operative. Down draft booths are not a substitute for PPE but they do reduce the risk of exposure to dust.

The image opposite shows a downdraft booth schematic - note the extraction unit at the bottom of the booth. It is important to switch the extraction fan on before the scales are tared (or zeroed) to ensure accurate and consistent weighing.

Up-draft booths are not recommended as these tend to pull dust past the operatives' faces and make the process more hazardous.



Schematic diagram of a downdraft booth
www.downdraft.com/index.htm

The importance of accurate weighing of dyes and chemicals cannot be over emphasised. The fundamental purpose of a tannery is to produce consistent products and this can only be achieved by consistently applying accurately measured amounts of colour to an accurately weighed substrate. Lack of attention to weighing of chemicals, and dyes in particular, will result in inconsistent colour continuity, high cost of rejection and unnecessary environmental impacts.

There are three basic options for weighing dyes and chemicals: **Manual**, **Check-weigh** and **Automatic**. Whichever option is used, the scales must be professionally calibrated and certified regularly.

Manual weighing can achieve good results if carefully done, however, Marks & Spencer recommend a check weigh system as a minimum requirement to deliver consistent weighing of dyes. Workers in manual dye and chemical stores should sign their name against each item that they weigh or dispense to confirm they have:

- Selected the correct dye or chemical
- Weighed/measured the correct amount

Checkweigh with bar-code reader

Check-weigh systems are better than manual systems as the system automatically confirms the correct weight of dye or chemical to the operative. With basic check-weigh systems there is still a chance that the wrong dye or chemical can be selected so it is recommended that a check-weigh system with a bar code reader is used as this confirms the correct chemical is always weighed.

Check-weigh systems cost in the order of £10 -15,000. Fully automated dye dispensers can cost over £500,000 but they are the ultimate in accuracy and convenience. Automatic dispensers can be linked so dyes are dissolved automatically and transferred to dyeing vessels without intervention by an operative.

Lawer fully automated dispensing system

Although the weighing of chemicals is slightly less critical than the weighing of dyes care should still be taken. Common problems include:

- Mistakes regarding the specific gravity of the liquids. The common assumption that 1 litre weighs 1kg is not always the case.
- Viscous liquids are often weighed accurately but transferring the liquid to the machine leads to inaccuracies as pouring is difficult.
- The majority of basic chemicals are clear liquids or white powders, and therefore if labelling in the chemical stores is poor the selection of the wrong product can occur.

Adequate chemical storage & labelling

Mettler are one of the leaders in industrial weighing:
http://uk.mt.com/gb/en/home/products/Industrial_Weighing_Solutions.html

4. DYEING

The subject of dyeing is huge and we do not intend to cover every aspect of dyeing in this document. However, the aim of this module is to provide best practice information to improve quality and consistency and to increase the levels of right first time (RFT). Marks & Spencer recommend the following key principles:

- Use the best quality dyestuffs
- Use the best quality chemicals
- Weigh and measure all dyes and chemicals accurately
- Aim for consistent batch to batch weights when loading machines
- Aim for consistent liquor ratios from batch to batch
- Set and record key process data on batch cards and recipe sheets
- Analyse process performance to improve quality and reduce unnecessary steps and excessive chemical use
- Regularly seek advice and demand process reviews from your dye and chemical suppliers

4.1 Dye Selection

Minimum Standards Requirement
The strength of incoming dyestuff deliveries should be regularly checked
Health and safety data for all dyes and chemicals must be assessed

Low quality dyes produce low quality results. To meet the Marks & Spencer performance standards high performance dyestuffs are recommended. It is important that technical data for dyestuffs are fully assessed to ensure they will meet the required standards.

The consistency of dyes is also important to ensure consistent quality performance. The major international dye suppliers have tighter strength tolerances (+/- 2%) than many of the smaller suppliers who can only manage +/-5%. Irrespective of the dyestuff supplier the strength of incoming deliveries of dyes should be regularly checked.

Health & safety data for all dyes must be assessed to ensure they are compliant with the Marks & Spencer RSL and REACH requirements. See **Module 1 – Restricted Substance List**, and **Module 2 – REACH** for further details.

4.2 Chemical Selection

Cheap chemicals are often very inconsistent, resulting in inconsistent dyeing. The cost of processing chemicals as a percentage of finished product costs is tiny and it is a false economy to save small amounts of money on chemical purchases that can then lead to huge costs of reprocessing.

Health and safety data for all chemicals must be assessed to ensure they are compliant with the Marks & Spencer RSL and REACH requirements. See **Module 1 – Restricted Substance List**, and **Module 2 – REACH** for further details.

5. QUALITY CONTROL

5.1 Colour continuity

Minimum Standards Requirement
Colour continuities must be retained

Colour continuity is a system used to manage shade consistency of bulk batches relative to the approved standard. Good colour continuity is based on the use of continuity cards which help ensure 'drift' from the original standards does not occur for repeat batches. Continuity cards must always have the approved customer colour attached.

To ensure consistency of colour assessment, pre-finished and fully finished samples of bulk production must be mounted in the same direction as the standard and other batches with the face being visible. Assessment of colour continuity is then made with reference to the master standard and along with the previous batches. Details on Marks & Spencer method for colour assessment can be found with the C41 documentation. An example of a Colour Continuity Card can be found in Appendix B, please note the batch number on the continuity card linking it to the process history data.

5.2 Quarantine

Minimum Standards Requirement
There must be a quarantine area for non-conforming products

Quarantine areas are where non-conforming products are separated from conforming products. These areas should be clearly marked, and even segregated from the rest of the tannery to ensure poor quality, non-conforming products are not shipped to the customer. A system of positive release from the quarantine should be established to ensure products are not moved from the area unless there are specific instructions to do so. Quarantine areas should also be established at key points throughout the process with particular importance at the final inspection stage.

APPENDIX A: BATCH CARDS

General material flow card

Batch Card						
	Batch Number:					
	Quality:					
	Colour:					
	Customer:					
	Process Route	Received in good condition (signed)	Date Completed	Comments	Process completed satisfactorily (signed)	
	Sew					
	Bleach					
	Dye					
	Hydro					
	Relax Dry					
	Pad Soften Dry					
	Compact					
	Test					
	Exam					

Jet dyeing card

Batch Card							
	Batch Number:						
	Quality:						
	Colour:						
	Customer:						
	Process:						
	Machine Number:						
	Batch size:						
	Liquor Ratio:						
	Programme:						
	Rope length:						
	Cycle time:						
	Preparation Recipe						
	Chem 1	x g/l					
	Chem 2	x g/l					
	Dye Recipe						
	Dye 1	y%					
	Dye 2	z%					
	Chem 4	x g/l					
	Chem 5	x g/l					
	Process Route	Standard Value	Measured Value	Comments	Process completed (signed)	Time	
	Fill						
	Load						
	Add prep chems						
	Add salt						
	Check specific gravity						
	Add dyes						
	Add alkali						
	pH check						
	Take sample						
	Unload						

APPENDIX B: COLOUR CONTINUITY CARD

Quality		Colour	
		Pre-Finish	Fully Finished
Date		Always mount fabric the same way □□	Always mount fabric the same way □□
Batch Number			
DE (to master standard)			
Pass/Fail			
Approved (sign)			
Date		Always mount fabric the same way □□	Always mount fabric the same way □□
Batch Number			
DE (to master standard)			
Pass/Fail			
Approved (sign)			
Date		Always mount fabric the same way □□	Always mount fabric the same way □□
Batch Number			
DE (to master standard)			
Pass/Fail			
Approved (sign)			
Date		Always mount fabric the same way □□	Always mount fabric the same way □□
Batch Number			
DE (to master standard)			
Pass/Fail			