



**CLOTHING & HOME**

# **Environmental & Chemical Policy**

## **MODULE 3**

**MINIMUM STANDARDS AND BEST  
PRACTICES FOR**

**TEXTILE WET PROCESSING**

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## INTRODUCTION

This module explains the Marks & Spencer minimum standards and best practices for dyehouses, printers, laundries, tanneries finishing facilities. 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 factory 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 factories 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.

Additional components such as zips, threads and interlinings must comply with the standards relating to chemicals on finished product and the principles of worker safety, environmental compliance and responsible chemical usage detailed in this document should be applied.

### 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 dyehouse 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 factory.

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, dyeing, finishing and process control 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
- All fibres, yarns and fabrics 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 dyeing, printing and finishing of textiles and 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.

# 1. WORKER SAFETY

Marks & Spencer take the issue of worker safety extremely seriously. It is vital that factory 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 factory 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°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.



- 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](http://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

### 1.1.3 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 <https://www.hse.gov.uk/toolbox/ppe.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 factory, with frequent, random fire drills carried out
Smoking must be banned in working areas of the factory
A segregated safe smoking area must be provided for workers

When processing textiles the potential for fire is high as most textile fibres are flammable, many chemicals are flammable and there are several sources of ignition in dyehouses. 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 factory 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 (e.g. singeing machines) 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 factory 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 factory 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](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 factory. Frequent, random fire drills (practices of evacuation) must be carried out to ensure workers are fully aware of the correct procedures during a fire.



**1.3 Personal Protective Equipment (PPE)**

Minimum Standards Requirement
Personal protective equipment (PPE) requirements must be signposted throughout the factory
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 factory, but a tidy factory 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 factory where chemicals are handled. Therefore workers must be provided with a segregated eating area, with suitable hand washing facilities.



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 dyeing department to assess the finishing department for housekeeping and safety problems. Extended to the whole factory 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:  
<https://www.nebosh.org.uk/qualifications/#Diplomas>

Independent certification is also available using standards such as ISO 45001:  
<https://www.iso.org/publication/PUB100427.html>

### 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 factory 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. To be world class, effective quality management systems have to be employed. Quality systems protect the reputation of the factory, 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 factory performance, costs, and environmental impacts on a continuous basis, exploring how the factory 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 factory. 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 factory 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 factory 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 Storage of greige and raw materials

Minimum Standards Requirement
All greige must be stored indoors
The store must be clean, dry and tidy
All greige must be labelled

The material storage is generally a very good indication of the level of care that is applied to all other processes in the factory. Poor housekeeping in storage areas presents a severe fire risk, causes problems in identifying stock and results in unnecessary quality problems. For example, poor storage causes fabric creases which are often very difficult to eradicate, and, in the case of elastane containing fabrics, are impossible to remove.

Storage areas must be clean, dry, tidy and indoors. Outdoor storage is not recommended because exposure to sunlight, water and general contamination has serious negative effects on final product quality. It is recommended that a constant temperature and humidity is maintained in storage areas if possible, to aid processing of the fabric. Storage halls which are conditioned are particularly useful for fabrics containing elastane.

Raw material stock should be stored on appropriate shelving or at the very least on pallets. It should never be stored directly on the floor. Fabric stored in horizontal rolls helps maintain the quality of the fabric.



The raw material storage area is the first point for a factory to instigate the use of batch controls and materials should be labelled to identify:

- Fibre type
- Yarn count (where applicable)
- Source / Supplier
- Yarn merge information
- Date of arrival into factory
- End product and end customer (where known)

Raw materials should be registered on arrival into the factory and an up to date inventory kept at all times. Location markers in the storage area complement the labelling system and help to manage the movement of stock in and out of the area.

## 2.4 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.



## 2.5 Machine Utilisation and Factory Planning

Production planning and scheduling can play a huge role in improving on time delivery and driving down costs. It can lead to better quality and efficiency due to improved work-flow organisation.

Planning production so that it can be processed in blocks and that machines are switched off when not in use can save massive amounts of water, energy and money. It also provides the opportunity for the spare capacity to be used to increase production volumes with minimal impacts on overhead costs. For example, the scheduling of colours more carefully to minimize the need for extensive cleaning between each batch reduces machine down time, saves water and energy, and reduces effluent loading. It can also lead to increased quality, as colour contamination is also less likely to occur. The ideal sequence is to run the same colour repeatedly on a particular machine. If that is not possible, it is best to group colours within families (red, yellow, blue, etc.) and then run the orders within each colour family from light to darker values and from bright to duller shades.

## 2.6 Chemicals

Minimum Standards Requirement
There must be a copy of the Marks & Spencer ECP standards on-site
The facility must have a chemical purchasing policy in place. All chemicals must be checked for compliance to the MRSL before purchase
The facility must maintain an inventory of all chemicals kept 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 factory chemicals, to ensure both worker safety and product quality.

A Chemical Inventory List must record all chemicals kept on site. This must include production, waste water treatment and commodity chemicals at a minimum. It should also extend to chemicals for sanitary, maintenance and laboratory use.

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.

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.



**Unlabelled chemical pose a risk to quality and safety**



**Bund stands reduce risks that arise from container leaks**

Information on safe chemical storage is available at: <https://www.safetystorage.ie/product/ibc-bunds/>

**MSDS's should be consulted for advice on safe storage.**

For more guidance, please refer to the ZDHC Chemical Management System framework and ZDHC CIL template. Both can be downloaded from the following page: <https://www.roadmapzero.com/process>

Chemical Inventory Template:

[https://uploads-ssl.webflow.com/5c4065f2d6b53e08a1b03de7/5db6ecbe4f6690633477de99\\_ZDHC\\_-\\_Textilbundnis\\_Chemical\\_Inventory\\_Collection\\_Template-with\\_guidance\\_.xlsx](https://uploads-ssl.webflow.com/5c4065f2d6b53e08a1b03de7/5db6ecbe4f6690633477de99_ZDHC_-_Textilbundnis_Chemical_Inventory_Collection_Template-with_guidance_.xlsx)

## 2.7 Incoming Water

Unreliable, inconsistent and/or contaminated incoming water will have a major impact on the ability of a factory 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. LABORATORY DYEING PROCESSES

#### Minimum Standards Requirement

The lab must have direct access to Marks & Spencer spectral data standards

The **CMC 2:1** equation must be used for calculating numerical colour differences

The most obvious task for the dye laboratory is to produce lab dyes that match colour standards for customer approval. To ensure the efficiency of this task, substrates should be prepared in the bulk dyehouse wherever possible since laboratory preparation is notoriously poor and inconsistent. Substrates should be conditioned and weighed on accurate balances. Allowances should be made for any weight loss that may occur in preparation. In addition to using bulk prepared substrates, the best 'lab to bulk' results are achieved by using dyes and chemicals from bulk stores, ideally changed every week to ensure consistency. Where bulk dyeing is done at a different liquor ratio, a lab dye check should be done to assess if the shade is affected.

There are other important jobs that the dye lab should do on a routine basis to improve the performance of the factory. For example, the dye lab should assess substrates for inconsistencies or fibre 'merge' changes and check the concentration of new batches of dyestuffs and chemicals.

#### 3.1 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 Instrumental Colour Measurement of Textiles document, available on Supplier Exchange.

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/>

### 3.2 Lab dyeing machines

The lab dyeing machines should be capable of reproducing bulk processes as closely as possible. Many lab machines allow for chemical dosing and these have been proven to be the best way to reliably reproduce bulk processes in the lab. Care has to be taken to ensure that the syringes deliver accurately measured quantities of chemicals.

Marks & Spencer recommend the use of computer controlled dyeing equipment. An example of a suitable lab dyeing machine is the Mathis IR heated dyeing machine.



**Mathis IR heated dyeing machine**

### 3.3 Washing off and Finishing

It is a common mistake to carry out very accurate dyeing but to then fail to wash off and finish the dyeing as per the bulk process. It is not uncommon for dyes to be affected by pH and application of chemical finishes, and failure to take this into account at lab dye stage can be the cause of bulk rejections. An unfinished lab dye and a finished lab dye should be sent to the dyehouse for reference when bulk is processed.

### 3.4 Lab Continuous Dyeing

The only satisfactory method for continuous dyeing in a laboratory is to use a mini-range. These can be supplied free of charge by the bulk machinery suppliers to imitate bulk conditions as closely as possible. For laboratory cold pad batch dyeing there are two methods; a standard method that is very close to bulk and a microwave method that creates a 'reference' dye.



**Mathis pad-steam mini range**



**Mathis lab mangle for cold pad batch**

### 3.5 Lab Dye approval and Colour Measurement

The best practice is to use modern, well maintained, calibrated colour measurement equipment to make decisions on whether colours match the standard. The information presented here applies to measurement and assessment of lab dyes **and** bulk. Instrumental colour measurement must be used for bulk batches as this data forms a critical part of the dyehouse quality management.

The use of spectrophotometers is now standard practice in the Marks & Spencer supply chain and they play a vital role in supporting the approval of colour. It is imperative that spectrophotometers are kept in good condition and they are regularly calibrated.

As many dyes can be affected by temperature and humidity, Marks & Spencer pioneered the use of conditioning cabinets to ensure that samples are fully conditioned before colour measurements are taken. These cabinets also have controlled lighting as some dyes change significantly when exposed to light.

Full details of Marks & Spencer tolerances, accreditation and submission procedures can be found in our C41 Instrumental Colour Measurement of Textiles document, available on Supplier Exchange.

### 3.6 1<sup>st</sup> Bulk Approval

Once a lab dye is approved the laboratory needs to provide the dyehouse with information to recreate the colour in bulk. This can be done using a paper system, or preferably using computerised recipe bulking systems that automatically transfer relevant data from the lab to the dyehouse.

The lab dye should be re-confirmed (at the correct liquor ratio as the first bulk) and all recipe, chemical and process information passed to the dyehouse.

It is important to provide the finished lab dye and master standard to ensure that the dyehouse management are aware of the final shade that is expected by end consumers. Failure to use the master standard in visual or numerical assessments in bulk processing is a major cause of fabric rejection by customers.

### 3.7 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.

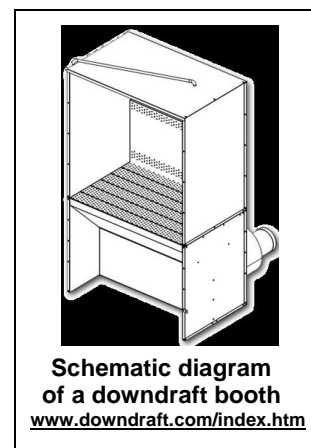
Each dyestuff should be stored in a clearly labelled closed container, and an individual scoop or spoon for each dyestuff must be used to minimise the risk of cross-contamination. It is best practice to transport these containers to the balance before the dye is removed, as carrying small quantities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



The importance of accurate weighing of dyes and chemicals cannot be over emphasised. The fundamental purpose of a dyehouse 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:

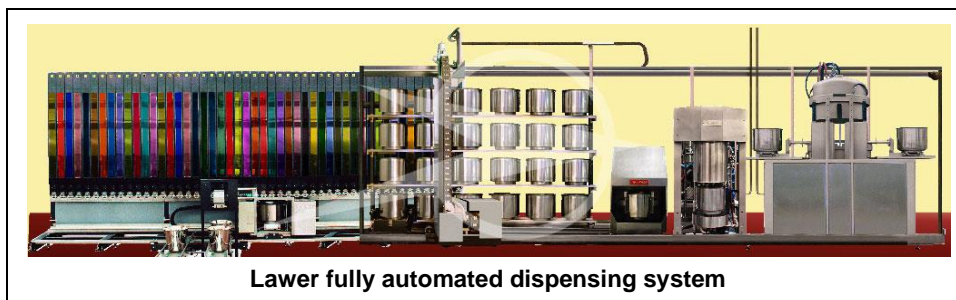
- Selected the correct dye or chemical
- Weighed/measured the correct amount



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.



Lower 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](http://uk.mt.com/gb/en/home/products/Industrial_Weighing_Solutions.html)

### 3.8 Preparation and Bleaching

Preparation refers to either bleaching or scouring of textile substrates in order to make them ready for dyeing or printing and serves two purposes:

- To remove natural impurities and processing aids (e.g. oils and sizes) that form a barrier to dyeing
- To create a uniform base colour for the dyer or printer to produce a uniform finished fabric

Many problems in dyeing or printing processes are caused by poor preparation so it is important to ensure that fibres are clean and consistent prior to the application of dye. The choice of preparation process depends on the colour of the base substrate, the desired colour of the final product and the type of substrate. After the preparation process, samples of fabric should be checked to ensure the process has been successful and retained for reference.

You should also consider the environmental impact of preparation processes by establishing the minimum temperature and chemical requirement for adequate preparation. Advanced chemical packages for preparation, bleaching and scouring are available where the overall environmental impact and costs of the process can be reduced. There are also a number of detergents derived from natural products which are more easily biodegraded.

#### 3.8.1 *Process control*

Process control can have a huge impact on process efficiency, leading to lower costs and increased capacity. The use of optimised continuous preparation on modern counter-flow machinery is recommended as it is the most effective, lowest cost and lowest impact method for fabric pre-treatment.

#### 3.8.2 *Bleaching*

Marks & Spencer have recommended the use of peroxide for bleaching in preference to chlorine for many years and this is now the most popular bleaching agent. The peroxide route requires alkali to activate the bleaching action and a stabiliser to ensure that the reaction is controlled. It is important to remove all traces of peroxide from the fibres after preparation; otherwise it can adversely affect the dyeing process. It is recommended that you check for residual peroxide before proceeding to dyeing which can be done very quickly with a drop of liquid indicator or with test strips.

#### 3.8.3 *Removal of processing aids*

Amylase enzymes have been used for many years to remove starch size from woven cotton, and recently enzymes have been developed to work in batchwise scouring and bleaching of cotton.

The Gentle Power Bleach system developed by Huntsman enables batchwise preparation of some cotton fabrics to be done at 60°C and can offer savings of up to 40% in energy. It is recommended that you assess whether enzymatic preparation can benefit your business.

Many synthetic fibres only need a simple detergent wash to remove processing aids. The best method is to scour synthetic fabrics before pre-setting as this ensures that oils are not set into the fibres during the pre-setting process. Pre-setting is preferable to post-setting for a number of reasons:

- It reduces the chances of permanent creasing being formed during dyeing processes
- It enables post-dyeing processes (e.g. drying) to be carried out at lower temperatures in order to minimise the negative effect of heat on colour fastness

## 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 Natural Dyes and ‘Green Chemistry’

‘Green chemistry’ is a phrase that is not well defined. It normally refers to a chemical that is either a plant extract or derived from a plant extract. It is worth keeping up to date with commercially available green chemistry and apply it where appropriate, however, it is important to carefully assess the ‘green’ credentials of these products.

There is a huge amount of interest in natural dyes and plant extracts. It is very important to test natural products before use as natural does not always mean low toxicity. The source of the natural raw material used to produce the chemical must be sustainable and from a waste source, usually agricultural or forestry waste.

It is also important to consider the performance and durability of finished products. Whether the dyestuff is natural or synthetic, it must achieve the required performance standards for colour fastness.

### 4.3 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 MRSL / RSL, UK REACH and EU REACH requirements. See [Module 1 – Restricted Substance List](#), and [Module 2 – REACH](#) for further details.

### 4.4 Exhaust Dyeing Methods

#### 4.4.1 Cotton

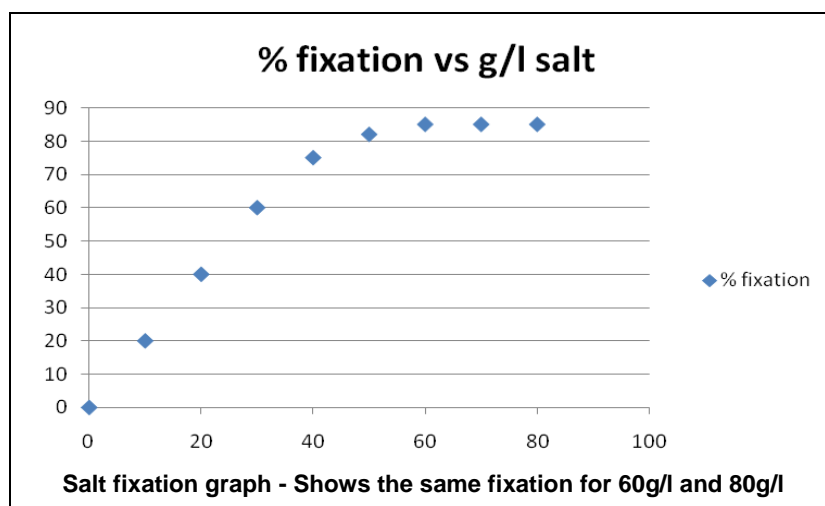
Cotton is the most commonly used fibre at Marks & Spencer. Cotton dyeing processes are often very long and use large amounts of water, chemicals and energy. Therefore they represent a major opportunity to reduce environmental impacts as well as reducing costs.

##### 4.4.1.1 *Reactive dyeing*

Almost all the cotton used by Marks & Spencer is dyed with reactive dyes. Reactive dyeing is a multi-stage process that needs to be carefully controlled to ensure consistency, and is sensitive to variations in liquor ratio, pH and salt concentration.

Salt concentrations are often increased to improve fixation, but the graph opposite demonstrates that increasing the use of salt does not always achieve this.

Salt is often viewed as being relatively harmless; however, it often passes straight through ETP into rivers and lakes and can cause huge environmental harm.



Reducing the amount of salt used in reactive dyeing should be a key activity of any dyehouse manager. This will not only reduce the environmental impact of the process, but will also reduce costs and make removal of unfixed dyes easier. Reduced salt could remove the requirement for the use of high temperature migration methods to achieve uniformity, which requires higher amounts of time and energy. Methods for minimising salt in reactive dyeing include:

- Use of low salt dyes (such as the Huntsman Novacron LS range) which are higher affinity dyes where level dyeing can be achieved with minimal amounts of salt
- Use of automatic dosing systems for increased accuracy and hence reduced salt usage
- Use of Specific Gravity checks to measure process consistency and control salt usage

Dye fixation also requires the addition of alkali, and the best way to add this is using 'dosing curves' which help to control uniformity and to maximise fixation, saving time and energy.

The reactive dyeing wash off process is a major opportunity to reduce energy and water use as well as saving time and increasing productivity. All wash off baths should be sampled to establish whether they are effective; baths with virtually no dye gives a good indication of where improvements can be made.

Fixing agents should not be used on pale shades, as they can affect the quality of the product. Marks & Spencer receive many consumer complaints that pale shades look dull very quickly because they will be 'over-dyed' in domestic washing machines. Wherever possible fabrics should be washed off thoroughly instead of using cationic fixing agents as these can have a seriously negative effect on light fastness.

Information on Huntsman Novacron Low Salt dye range is available at: <http://www.huntsman.com>

#### 4.4.1.2 *Sulphur Dyeing*

Sulphur dyeing processes can be optimised by using lower liquor ratios, parallel processes and some of the washing off techniques outlined in the reactive dyeing section. Sulphur dyeing is considered a relatively low impact dyeing process compared to reactive dyeing; however most sulphur dyes are given a subsequent laundry wash which uses a lot of energy, water and chemicals.

It is very important that appropriate sulphur dyes are selected and used in Marks and Spencer products, as many sulphur dyes fail the **M&S C10a Oxidative Bleaching** requirements. When creating a specific wash down look for sulphur dyes, it is imperative that the correct catonisation pre-treatment and dyes are chosen, as a wrong choice can result in appalling light fastness. It is recommended that you contact the dye manufacturer for specific advice.

#### 4.4.2 *Polyester dyeing*

Polyester dyeing is generally regarded as a relatively low impact dyeing method but there are opportunities for improvement by reducing liquor ratios, concurrent processing and reducing levels of re-dye. To get good RFT dyeing on polyester you need:

- High quality dyes
- Accurate weighing
- Consistent and appropriate pH
- Controlled temperature
- The use of anti-reductants to prevent dyes being affected in dyeing
- The use of high quality dispersing agents to maintain uniformity of dye application

The most important factor is dye selection. Although lower fastness dyes are easier to apply, only higher fastness dyes will meet the Marks & Spencer standards. For disperse dye, heat can adversely affect fastness and this negative effect can be magnified by the use of some softeners and performance finishes - in particular cationic finishes. Chemical suppliers should provide recommendations for softeners, finishes and application conditions to ensure good fastness.

Marks & Spencer recommend the use of pre-setting to minimise the need to use high temperatures in finishing, which affects the final fastness. This is particularly important when dyeing polyester/elastane blends, as elastane cannot be repeatedly dyed at high temperatures so it is important to focus on getting the dyeing 'right first time'.

Microfibres have inherently lower fastness than standard fibre and extreme care has to be exercised to avoid fastness failures. Medium and dark shades will require a reduction clearing process, using a high temperature process with caustic soda and hydros. There are now sugar based reducing agents that can be used in place of hydros and these have much lower impact on the environment, therefore these are recommended wherever possible. Very dark shades may require two sequential reduction clears to remove all surface dye and ensure good wash and rub fastness.



#### 4.4.3 *Wool Dyeing*

##### 4.4.3.1 *Acid Dyeing*

Minimum Standards Requirement
Dyeing of wool using chrome dyes is not allowed for Marks & Spencer

Acid dyeing of wool is relatively straightforward with the dyes almost always applied at 98°C from an acidic dyebath. The fastness is largely dependent on dye choice, but pH and time also affect results.

Marks & Spencer do not allow chrome dyeing of wool on their products, as after-chrome dyeing relies on the use of chromium salts. These chromium salts are harmful to workers and the environment, especially in the Chrome VI oxidation state.

##### 4.4.3.2 *Reactive dyeing*

Reactive dyeing of wool is an established technology and is becoming the best option to use in many cases. When compared with pre-metallised dyes, the wash fastness is superior, and although the light fastness is not quite as high, reactive dyes are generally metal-free and hence are better for the environment. There are a wide range of shades available and for dark shades reactive dyes are undoubtedly the best choice. Unlike cotton dyeing, no salt is required for reactive dyeing of wool.

##### 4.4.3.3 *Shrink-proofing of wool*

Marks & Spencer were the first major brand to use machine washable and tumble dryable wool and a large proportion of Marks & Spencer wool products are now machine washable and tumble dryable.

The most popular shrink-proofing processes involve the use of permonosulphuric acid (PMS) pre-treatment and the application of polymeric/resin finishes. Wherever possible Marks & Spencer recommend the avoidance of chlorine based shrink-proofing processes, as uncontrolled use of chlorine could lead to environmental damage. However, it is recognised that completely chlorine free processes are not always possible for some products.

#### 4.4.4 *Nylon*

Minimum Standards Requirement
Preliminary checks on nylon fibres to establish the exact nature of dye strike and colour yield should always be carried out

There are a wide variety of nylon types available which have a broad range of fibre property variation. Therefore preliminary checks on nylon fibres should always be made to establish the exact nature of dye strike and colour yield. Nylon contains numerous dye sites which have to be protected during pre-setting otherwise they can be 'burnt off' and deep shades with good fastness will not be achievable. This is particularly prevalent for bright shades, as most nylon is dyed using acid dyes and brighter colours tend to have lower fastness.

Nylon dyeing is a relatively simple process, but it is important that the process is carefully controlled to ensure dye uptake is as uniform as possible, as nylon can suffer from barre. A combination of high fastness dyes with well controlled processing is recommended. Nylon dyeing tends to require only a small amount of unfixed dye removal, however very deep blacks may require a very mild alkaline scour (pH 8) to help to remove unfixed dye.

To meet Marks & Spencer standards, it is common that after treatments are required to improve the wash fastness and cold water staining of nylon dyed products, even when high fastness dyes and good

processes are used. If after-fixing treatments such as Syntan and cationic are used, advice on the correct systems from the dye supplier should be sought.

It is preferable to use pre-setting over post-setting, as high temperatures (above 150°C) used in post-setting can significantly reduce the affect of many fixing agents and fastness can drop by over 1 point. This is also relevant to moulding and fusing, and great care must be taken to control process temperature.

Reactive dyeing of nylon is one of the few fundamentally innovative dyeing processes of the past decade; this method covalently bonds dyes to the dye sites and results in much better fastness. Reactive dyeing is less affected by heat than acid dyeing and should be used for fabrics that will be subjected to heat.

The leading range of reactive dyes is Eriofast from Huntsman (<http://www.huntsman.com>), who should be contacted for specific processing advice.

The chlorine fastness of acid dyed nylon is relatively poor and it requires the use of a special anti-chlorine fixative to make fabrics fit for purpose. This type of finish is known as 'Fadex', and it is important that new versions are used, as older versions were brown and resulted in a large change of shade when applied to pale bright shades. Disperse dyeing of nylon is also possible, however the only time it should be considered is for swimwear where the superior chlorine fastness of disperse dyes is beneficial as the wash fastness is usually very, very poor.

#### 4.4.5 *Silk*

The key to successful silk dyeing is the degumming of the silk fibre. This removes the seracin gum that coats silk fibres, and is required in order to get good dye penetration and fixation. Traditionally this was done using Marseilles soap but this has been replaced by the use of synthetic detergents. Detergents based on APEO (alkyl phenol ethoxylate) are illegal in many areas of the world and Marks & Spencer does not permit their use. Marks & Spencer regularly test its products for APEO. Any goods found to be containing these chemicals are rejected and returned to the manufacturer. Your silk suppliers must be directed to use an APEO-free degumming methods and testing for any residual APEO should be carried out.

Silk is a natural micro-fibre and therefore requires more dye to achieve a specific shade than normal fibres. Most silk is dyed with acid dyes and these can meet our fastness standards in most cases, however it can be difficult to achieve very high fastness in dark shades. In these cases reactive dyes should be used as they are capable of giving excellent wash fastness in a full range of shades. Like synthetic micro-fibres, it can be difficult to meet light fastness standards for silk and careful dye selection is required. It should also be noted that silk is a very delicate fibre and extreme care has to be taken with it processing to avoid abrasion marks.

#### 4.4.6 *Acrylic*

Acrylic dyeing is relatively simple and achieving the Marks & Spencer performance standards is not difficult. Basic dyes for acrylic have very high affinity and the major challenge faced by dyers is slowing down the dyeing to prevent un-level results. It is normal to use retarding agents such as glaubers salt to slow down the rate at which the dye fixes onto the fibre. One strange anomaly of acrylic is that it goes bright yellow when bleached using alkaline peroxide processes, so care has to be taken when dyeing blends with cotton.

### 4.5 Pigment dyeing

Pigment dyeing can present a large problem with achieving rub fastness, which is one of the biggest sources of consumer complaint faced by Marks & Spencer, often leading to expensive customer claims for damage and replacement of goods. Therefore, Marks & Spencer should be consulted immediately if there are any concerns in achieving the correct rub fastness performance.

The normal method for pigment dyeing is to apply a pigment with a binder system. Following application it is normal to carry out a wash-down laundry process to develop the casual look. It is advisable to apply a further layer of binder after this stage to reduce the chances of dye transfer. With a range of soft handle binders (usually acrylic or PU) now available, rub fastness can be maximised without having a detrimental effect on fabric handle.

A problem often encountered with pigments is off-shade wash down and this results from 'stacking' of the pigment particles in layers of colour. For example, in a brown recipe you may get the blue, red and yellow pigments applied in discrete layers and the wash-down can yield pink, orange or green colours depending on the order of stacking. Pigment suppliers need to be consulted to get the correct pigment combinations and application conditions to achieve homogenous colour application.

## 4.6 Best Practice for Exhaust Processing

Although there are a very wide range of processes for exhaust dyeing, there are a number of best practices that if applied throughout a dyehouse can improve product quality, reduce water, energy and chemical usage, improve productivity and lower costs.

### 4.6.1 *Dyeing Blends*

The subject of dyeing fibre blends is complex; however there is some general guidance to consider:

- Some blends are unnecessary and simply serve to increase the cost and difficulty of dyeing; as a dyer you should challenge the inclusion of these small quantities of non-functional fibres.
- Ensure the preparation method is compatible for all fibres and it does not damage any fibres.
- If a single dyebath application method will not meet the required performance standards then a sequential dyeing method should be considered.

### 4.6.2 *Liquor ratio control*

Controlling the liquor ratio is absolutely critical for controlling the dyeing processes and this means controlling the amount of water in the dye vessel which can be done in two ways:

1. Level indicators indicate how much water is in the machine. These will need to be calibrated on a regular basis to ensure good control of the liquor ratio.
2. Flow meters measure how much water is pumped into a dye vessel. Placing a flow meter on the drain will ensure that liquor ratios can be consistently measured, however the amount of water retained by the substrate after the machine has been drained must also be known for an accurate measurement.

### 4.6.3 *pH control*

In addition to controlling liquor ratio it is very important to control pH. Normally this is done off-line but there are now systems that can check this on-line within the dye vessel. If regularly checked and calibrated these systems can really help to improve process consistency.

#### 4.6.4 *Process efficiency improvement*

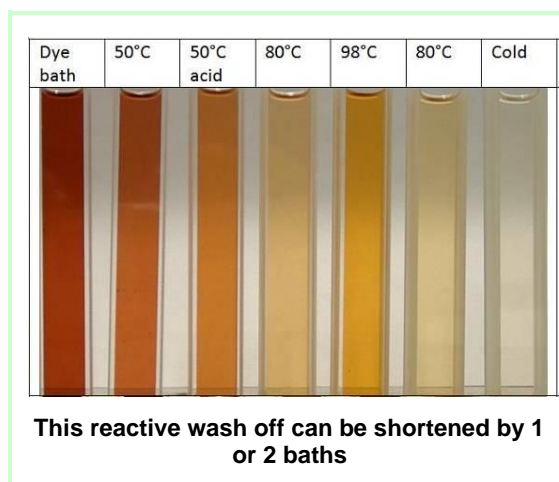
It is often possible to shorten a process step or even remove it completely to save time, energy and water. However this must never be done without detailed analysis to confirm it there are no detrimental effects to the finished product.

Replacing unnecessary sequential process steps with parallel processes can reduce time and improve productivity. For example, water for process baths can be heated and stored in hot water tanks prior to addition. This can save up to 2 hours on a long reactive dye process. However, this is not always advisable for fabrics that are prone to creasing due to temperature shocks.



Use the lowest practical temperatures to reduce the time taken for heating, and drain machines at the highest practical temperatures to reduce the time for cooling and use of cooling water. It is important to buy machines with appropriately sized heat exchangers. If they are too big, heating and cooling can be too fast and if they are too small heating and cooling can be too slow.

The design of liquor circulation systems and size of pumps needs to be carefully assessed to ensure machines are capable of level dyeing and efficient wash off. Some machines have the facility to simultaneously introduce fresh water and open the drains to speed up rinsing, but this is at the expense of greater water use. A similar option is 'over-flow rinsing'. Overflow rinsing can be fast but it is rarely efficient and uses a massive amount of water compared to sequential bath washing and is therefore not recommended. A 10 minute overflow rinse can use more water than four or five sequential wash-off baths.



The best rinsing option is combined cooling and rinsing. In this method small amounts of fresh water are introduced into the dye vessel and then a small amount of water is released down the drain. This discontinuous process gives the fresh water time to mix with the dye liquor so the washing effect is efficient, and the introduction of cold water is a quick way to cool machines resulting in a water and energy efficient process.

Renowned intelligent wash off systems can be found by:

Thises <http://www.thiestextilmaschinen.com/> and Sclavos <http://www.sclavos.eu/>

## 4.7 Continuous Dyeing

Continuous preparation, cold pad batch dyeing and continuous wash off can almost halve the amount of water and energy required for reactive dyeing of cotton compared to jet dyeing.

Although continuous and cold pad batch dyeing machines are designed to produce high volumes of dyed fabric you should not sacrifice performance for productivity. Running mangles at high speeds can lead to poor dye penetration resulting in dull shades, poor light fastness and poor rub fastness. Experience has shown that, with the same reactive dye recipe and fabric, light fastness results can vary by 1.5 points depending on the speed of processing and degree of penetration.



Large continuous dye range

An excellent review of continuous dye options is available for download from Benninger:  
<https://www.benningergroup.com/textile-finishing/overview>

The moisture content of the fabric is very important in continuous dyeing. Often fabric that has been prepared on continuous preparation machines is immediately wound onto beams or lapped into barrows and can remain hot for days and become over-dried. This leads to variable moisture content which inevitably leads to inconsistent uptake of dye liquor and shade variation through the batch. Fabric must be conditioned prior to dyeing to ensure consistent, uniform results and the best way to achieve this is to install a cooling can prior to the dye mangle. Moisture meters can be installed to check moisture levels of fabric before dyeing.

Mahlo (<http://www.mahlo.com/>) are recognised as leaders in moisture control (and many other control systems)

To aid dyeing and penetration, dye bath preparation for continuous dyeing should take place as close to the time of dyeing as possible, and for reactive dyeing alkali should be mixed with the dye at the last possible moment.

Unlike exhaust dyeing (Section 4.4), cold pad batch and continuous dyeing allow you to check the dye liquor before dyeing. If samples of bulk dye liquor are checked in the dye lab before production the chances of dyeing off-shade fabric are vastly reduced and RFT increased. Colour can be monitored on-line by installing automatic colour measurement immediately after the dye pad mangle.

Hunterlab are recognised for their expertise in continuous colour measurement  
<http://www.hunterlab.com/>

It is important that Pad mangles are checked on at least a weekly basis to ensure that dye application is uniform and that the mangle hardness is uniform and within tolerance.

Kuesters are recognised as being leaders in the field of pad mangles for dye application – both continuous and cold pad batch.

An excellent document on mangle set up and Cold Pad Batch best practice is available for download at <https://www.benningergroup.com/textile-finishing/overview>

## 4.8 Cold Pad Batch

Cold pad batch dyeing is a low water, energy and chemical usage process that does not require salt, (which means unfixed dye is much easier to remove). Cold pad batch dyeing reduces effluent loading,

especially useful where salt effluent is a problem. This type of dyeing is primarily used for dyeing woven fabrics but it can be used for dyeing weft knits.

The process is simple; dye is applied by the mangle and the fabric placed on a rotating beam where it is allowed to stand for up to a day to allow the dye to fix. The relaxation time is temperature dependent; too hot a temperature and there is a risk that dye will hydrolyse and for too cold a temperature fixation can be delayed.

Fabric wash off can be via continuous wash ranges which use less energy and water than batch processing, or if the fabric is placed on a perforated beam it can be washed by pumping water through the beam which can be very effective if set up by an expert.



**Cold Pad Batch –  
Note the small footprint**

A further benefit of cold pad batch dyeing is that the fabric surface is not abraded during dyeing, as can happen in other dyeing methods.

## 4.9 Denim

In denim dyeing, indigo dye is applied to the surface of yarns; colour is built up by sequential dips in indigo dyebaths. Indigo dyeing is relatively easy to control and systems exist to continuously monitor and correct the pH, reduction potential and indigo concentration. Using these systems with on-line monitoring of yarn colour can give much greater consistency, reducing process time and the need for shade sorting. The speed of dyeing is also an important control factor and slow speeds are recommended to give better penetration for dark denim. The prevalence of shade sorting is an admission that denim dyeing is not well controlled!



**Benninger indigo range**

Marks & Spencer recommend the use of pre-reduced Indigo dyes from DyStar, Blu Connection and Archroma. These can be applied via existing machinery but offer savings in water, energy and hydrosulphite usage.

Karl Mayer provide excellent denim dyeing information for download:  
<https://www.karlmayer.com/en/products/warp-preparation/indigo-dyeing-units/>

## 4.10 Dyeing Machines

This section identifies best practices specific to different types of dyeing machines. It should be noted at this point that many machines can be upgraded for a fraction of the cost of the purchase of a new machine and upgrading often has just as much benefit as investing in new equipment.

#### 4.10.1 *Jet dyeing*

Jet machines offer the dyer a flexible and reliable process for dyeing fabrics, however there are a number of factors to consider to ensure the correct processing of fabric:

- High lift machines should be avoided for stretch fabrics or those prone to distortion, such as knitted viscose. It is far better to use horizontal type machines that put lower stress on the fabric.
- The size of the jet should be matched to the thickness of the fabric rope to reduce fabric abrasion.
- Jet pressure must be controlled to avoid 'surfacing' on delicate fabrics or poor dye penetration when jet pressure is too low. Turning fabrics inside out can protect the face and reduce 'surfacing'.
- The jet pressure propels the fabric around the machine and it has to be adjusted to ensure the correct rope speed is met. If the rope moves too slowly un-level dyeing can result, and if it moves too quickly high rope tension can develop resulting in fabric shrinkage.
- Matching the speed of the winch reel and the fabric avoids tangling and fabric damage. The best way to match speeds is to calibrate the winch reel with a tachometer and then measure the speed of the fabric using coloured flags, or using automatic seam detection with magnets.

#### 4.10.2 *Beam Dyeing*

Beam dyeing machines normally have to be run full of water so it is advisable to avoid running small dyelots as this reduces the efficient use of water, energy and chemicals.

#### 4.10.3 *Jig Dyeing*

The main difficulty with jigs is selecting dye combinations that give uniformity of colour from the start to finish of the roll and advice should be sought from dye manufacturers. Jigs are also very inefficient in terms of washing and it is sometimes better to wash jig dyed fabrics on continuous wash ranges. Also some old jigs are heated by the injection of live steam rather than by the use of heat exchangers and this can cause contamination problems.

#### 4.10.4 *Winch Dyeing*

Marks & Spencer do not recommend the use of winches. The technology is old and requires very high amounts of water, energy and chemicals compared with modern machines.

#### 4.10.5 *Yarn Dyeing*

In **package dyeing** the most important factor is achieving uniformity of tension on the yarn packages during winding to ensure uniformity of liquor flow. Rather like beam dyeing it is not advisable to run package dyeing at less than full capacity, it is both inefficient and makes it very difficult to get consistent liquor ratios between batches.

**Hank dyeing** is used for delicate yarns and knitwear yarns that need to be bulked up. Hank dyeing tends to use longer liquor ratios than package dyeing so inherently uses more water.

#### 4.10.5 *Fibre Dyeing*

Fibre dyeing has good environmental implications because it is very rare for any batch to be rejected as the fibre is usually blended during spinning. Loose stock dyeing is usually a long liquor ratio process so it is worth considering the use of modified package dyeing machines to dye fibre in specially designed baskets at a lower liquor ratio.

#### 4.10.6 *Garment Dyeing*

Garment dyeing is good from two perspectives; environmental – as only the fabric used to make the garment is dyed, and it allows decisions on the colour to be made much closer to the time of selling.

For all dyeing processes it is important to check the dyeability of the substrate, but this is vital for garment dyeing. Fabrics of variable dyeability in the same batch will result in colour variation across the batch, or even within a single garment. The dyeability of threads, buttons and components must be checked before processing to ensure the final products looks aesthetically pleasing. It may be necessary to attach buttons after the dyeing process if colour matching is not possible.

Woven garments are normally dyed in front-loading garment dyeing machines. These are relatively aggressive but use less water, energy and chemicals than the gentler, long liquor ratio paddle machines that are used for most knitwear and delicate garments. The use of closed pocket machines or garment bags can help to protect delicate products, but care has to be taken to avoid poor penetration and unwanted tie-dye effects.

#### 4.10.7 *Machinery*

Minimum Standards Requirement
Machines must be maintained and serviced on a regular basis

Machine selection, maintenance and control systems are important factors in determining if a factory is capable of making products efficiently and to the required Marks & Spencer standards. The last two decades have seen some major changes in the fundamental design of dyeing, printing and finishing equipment so it important to keep machine knowledge up to date.

20 years ago most dyehouses were using liquor ratios of about 10:1, now many dyers operate at liquor ratios as low as 5:1 and some even go as low as 3:1 on air jets. Even greater advances have been made in continuous washing machines where design improvements reduced water use by 50%.

Irrespective of machine age, it is important that all machines are maintained and serviced on a regular basis to protect quality standards and productivity.



Factories with preventative maintenance programmes suffer fewer breakdowns and have more consistent production. Good preventative maintenance programmes check and calibrate key parts, audit critical parts such as electrical drives and pumps, and review machine safety.



#### 4.10.7.1 Control Systems

The performance and economy of a machine can be revolutionised by adding a new controller unit.

Manual controllers are very simple and require an operative to intervene in the process to set parameters such as temperature and time, but they do not record process data.

However, it is often the case that individual controllers are used by operatives to over-ride written programmes which results in poor quality dyeing, and very few controllers are used to interrogate the performance of the machine.

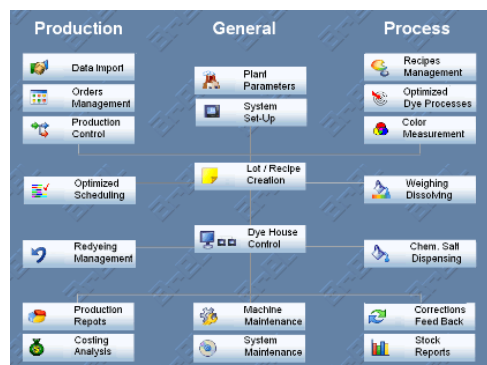


**Manual controller on tumbling equipment**

The recommended option is to use central controllers wherever possible. These can manage everything from automatic dispensing, automated transfer to the dyehouse and automated dosing of dyes and chemicals into the processing vessel, as well as automatic pH and specific gravity checks. They can also manage the running of pumps, pulleys and valves of the production equipment, and are the best way to ensure that the programmed process is carried out exactly as required.



**Sedomat machine controller (these can be integrated into central systems)**



**Arel central controller**

In addition to controlling processes and operations around the dyehouse, the real benefit of central controllers is they provide a huge amount of process data. This data can be used to check:

- Programme running time
- Temperature control and other process parameter such as pH etc.
- Liquor filling and draining rates
- Chemical dosing rate

Central controllers can allow machines to be run by management, leaving operatives free to carry out manual procedures such as loading and unloading vessels.

For more information about dyehouse controllers see <http://arel.com>

## 5. TEXTILE FINISHING PROCESSES

This section refers to the standards and best practices expected by Marks & Spencer for post-dyeing and post-printing processes. Fabric finishing encompasses these key elements:

- Hydro extraction and fabric drying
- Fabric Shrinkage and twist control
- Application of chemical finishes
- Application of physical finishes

### 5.1 Hydro extraction and fabric drying

This is the first process after dyeing and is used to remove excess water from the fabric or substrate. To remove as much water as possible by physical means through hydro-extraction can save large amounts of energy for the subsequent drying processes. The main types of hydro-extractors are:

- Spin-drying; the payback time for investing in a new, faster spin dryer can be very short.
- Mangles; It is very important to regularly maintain mangle rollers to ensure efficiency and quality. A badly maintained hard roller drying fabric to 70% owf (of weight of fabric) can cost \$10,000 per year more in energy than a well maintained soft roller drying fabric to 100% owf.
- Vacuum slots; very good at removing moisture (and lint) from fabrics that may be adversely affected by very heavy mangle pressures.

Drying of textiles substrates can account for up to half of the total energy consumption of a dyehouse or laundry. There are several ways to improve the energy efficiency of the drying process:

- Maximise the amount of water removed during hydro-extraction
- Maximise machine utilisation by avoiding drying machines running idle
- Avoid over-drying, as achieving 1 or 2% moisture regain is an unnecessary waste of energy.
- Assess the feasibility of heat recovery
- Consider replacing DC blowers with AC blowers which can save up to 15% of energy

Through the use of moisture meters, fabric can be dried to ambient moisture levels rather than to absolutely dry which can save up to 20% of energy.

**Yarn** is often dried using radio frequency (RF) driers. Although these use a massive amount of energy when in operation they have the benefit of being easy to switch on and off to enhance machine utilisation.

**Garments** are usually dried in tumble driers and rather like domestic tumble drying the focus should be on high spin speeds in spin drying and the use of modern, efficient machinery.



Mahlo <http://www.mahlo.com/> are recognised as leaders in moisture control (and many other control systems)

### 5.2 Fabric Shrinkage and Twist Control

Some fabrics are relatively unstable when they leave a dyeing machine and if washed would shrink and or twist leading to customer dissatisfaction. Some of the problems of variable shrinkage can be traced to

different greige sources, so it is important to segregate greige from different sources and treat them as different fabrics even if they have the same nominal specification. There are a number of processing methods which can reduce shrinkage and twisting of unstable fabric.

**Santex relax driers** are useful for weft knitted fabrics. It is recommended that a pin entry on these machines is used to control over-feed into the fabric and to hold open width fabric at a controlled width.

**Stenters** are used to carry out a multitude of tasks in a finishing department and can have several features including:

- Controlled over-feed to compress fabrics and reduce shrinkage
- Pyrometers – to measure the **actual** fabric temperature
- Moisture meters
- Pick/course counters
- Gravimetric fabric weight measurement
- Bow and skew control
- Auto-levellers on pad troughs to ensure uniformity of finish application
- Pad mangles to apply performance finishes
- Steam boxes to reduce ripples formed by over-feeding mechanism
- Cooling cans to cool and condition fabric
- Vacuum slots to remove lint / excess moisture
- Scrubbers to reduce air emissions
- Heat recovery

These features offer many benefits but Marks & Spencer particularly recommend course/pick counters to ensure fabric stability and pyrometers to ensure fabrics are subjected to the correct temperature for correct period of time, essential for pre and post setting. Marks & Spencer does not recommend stenters and other finishing equipment as devices for on-line final examination as there is not sufficient time to carry out a thorough examination of the fabric. Also there is no opportunity to test finished fabric; **testing should always be completed before examination.**

**Sanforisers and compactors** are used as the final process to apply the final compression to the fabric to ensure the required stability is achieved.

### 5.3 Application of chemical finishes

Almost all fabrics need the application of at least a softener to enable the fabrics to be sewn, and whilst the application of finishes is not as critical as the application of colour it is still important to ensure consistency of appearance and performance.

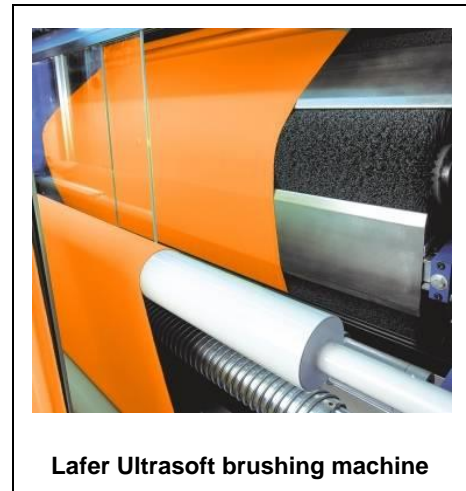
Most chemical finishes are applied by a mangle at the entry to a stenter. The same principle applies for using a mangle to squeeze out water in simple hydro extraction as it does for applying a finish. Harder rollers, operating under higher pressure results in fabric having less moisture present as it enters the stenter and it therefore requires less energy to dry the fabric. Well maintained mangles will apply chemicals in a more controlled and uniform manner. Consistent application can be improved through the use of auto-levellers to control the liquor levels and fabric immersion times.

Simple softeners, lubricants, fixatives and anti-static finishes are often considered relatively non-critical in terms of process control but SOP's are still required to ensure mistakes are not made. Performance finishes such as resins, flame retardants and water-repellents are far more critical and it is highly recommended that pyrometers are used to control these processes. For some fabrics that require long curing times (such as FR finishes) it is worth considering the purchase of a baker rather than using a stenter at slow speeds. Bakers hold large quantities of fabric so can still give a high throughput.

## 5.4 Physical Finishing

Brushing, sueding and emerising machines all use abrasive rollers to disrupt the fabric surface. The abrasive units become less effective over time and the levels of abrasion reduce. It is advisable to replace a third to a half of the abrasive units at each maintenance change for an improved fabric consistency. This is particularly important when producing long production runs of the same fabric.

As with all other processes, an SOP must be established and the use of reference visual and/or handle samples will help ensure the operators can deliver fabric to the correct level of finishing.



Lafer are a leader in brushing and sueding equipment <http://www.laferspa.com/>

## 6. PRINTING

### Minimum Standards Requirement

You must not use phthalates that are categorised as SVHC under Reach legislation. See **Module 2 – REACH** for more information

### 6.1 Fabric Printing

Printing is essentially a form of localised dyeing and much of the information discussed within section 4 is applicable to printing. Although less water and chemicals are used in printing compared to dyeing, machine utilisation is often much lower and energy use can be very high per kilogram of production. Therefore there are opportunities for improvement.

Fabric preparation is more critical for printing and must be very effective in removing all the oils, waxes and potential barriers to dyes. It is also important to remove loose fibres and lint from the fabric surface to avoid white spots. The use of vacuum slots after fabric preparation is recommended. Also many prints are done on white bases, and optical brighteners must be selected so they are not washed away by the print wash off process.

Automated weighing and dispensing of colour and chemicals is even more critical for printing than for dyeing; correcting fabric after dyeing is possible, but it is impossible to alter the shade of a print once it has been printed.

It is important from an environmental and cost point of view to optimise the quantities of paste produced; if only 20 kg of print paste is required do not prepare 50kg. Prepared print pastes can be checked by simple draw-downs or small, plain screen prints before bulk printing, and this is highly recommended to ensure the colours are correct.



Rotary screen printing with integral dryer



GSE paste preparation and dispensing

**Steaming** is a critical process for printing; if the steam is too dry the dyes won't penetrate or fix properly and if the steam is too wet prints can smudge.

Most screen printing machines have an integral dryer at the end of the print bed and it is likely that it will be switched on for most of the working day, but it is drying fabric for as little as a quarter of the day. Even though IR dryers require more energy to run them, they may offer a solution to this low efficiency problem, as they can be switched on and off very quickly and therefore be optimised to match production.

**Washing off** prints is more difficult than washing off dyes because of the presence of print paste thickeners and also because it is crucial that unfixed dye does not re-deposit on the (often white) base

fabric. Washing processes are best carried out on modern counter-flow wash ranges and you should contact your dye and chemical suppliers for specific advice on the best products to prevent back-staining.

When Rotary printing using Nickel screens, ensure that fabric is washed off properly. When printing pigment or discharge pigment designs using this method there is a risk of nickel contamination on the fabric.

Some best practice for printers include:

- After printing, any paste left in the cylinders should be removed using a specially designed squeegee before rinsing. This means not only can the excess paste be returned for reuse, but less water is used to clean the cylinders, with less effluent being generated.
- When printer stations are rinsed, recycling the water back through the system will reduce water usage. Some mills have saved up to 60% of their rinsing water through recycling.
- When bulk printing systems are used for sample printing, a relatively large amount of paste remains in the pumps and hoses, which has to be flushed out and disposed of. By using smaller manual paste applicators for printing samples, paste and water usage can be reduced.

## 6.2 Dye & Pigment Prints

Screen printing can be done using dyes or pigments. Superior results can be achieved using dyes because:

- There are no problems with rub fastness
- Finer designs are possible
- There are no binders to affect fabric handle
- Colours penetrate into the fabric structure so minimise 'grinning' of white fabric

Sometimes printing with dyes is the only way to meet Marks & Spencer performance and aesthetic requirements for softness.

## 6.3 Common Print Problems

Frequent problems with fabric prints include:

- Bulk fabric looks different to buying samples. Samples should be produced on bulk machines using bulk methods wherever possible.
- Poor fabric penetration / grinning of undyed fabric. Paste viscosity and squeegee/bar pressure must be adjusted to push paste into the fabric structure.
- Blurred prints due to low paste viscosity or wet steam.
- White/unprinted areas due to poor screen registration. These areas can be touched up by applying paste with a paint brush, re-steaming and re-washing.
- Poor fastness due to wrong dye selection but occasionally because of poor wash off.

## 6.4 Panel Printing

Panel printing is usually done on carousel machines using pre-packaged printing pastes (sometimes called printing inks). Prints are simply applied and dried/cured with no wash off process employed.

Responsible use of chemicals in panel printing is vital because panel prints are usually not washed before being put on sale, so consumers will be exposed to any chemicals used. Please refer to **Module 1 – Restricted Substances List** and **Module 2 – REACH** to learn more about the restrictions on chemicals for Marks & Spencer products. We recommend the use of water-based, PVC-free print pastes to ensure that you avoid problems with restricted substances and we recommend the use of formaldehyde-free discharge pastes.



Carousel machine for t-shirts

Magna Colours provide many of our suppliers with printing products that are free from restricted chemicals <http://www.magnacolours.com/>

## 7. LAUNDRY AND GARMENT DYEING

Minimum Standards Requirement
Continuity cards must be retained
The use of pumice is not permitted for any Marks & Spencer Childrenswear products.
Sand blasting is not to be used on any Marks & Spencer products

### 7.1 Washing

The levels of process control in laundries are often considerably worse than in dyehouses but there is no reason why this should be the case. There are many opportunities in a modern laundry to improve product quality and consistency, to reduce the environmental impact as well as reduce costs and improve productivity. A number of simple suggestions include:

- Use computer controlled machines.
- Use machines that control dosing of chemicals from side tanks into process baths.
- Use Standard Operating Procedures (SOPs) and standard liquor ratios for all processes.
- Use standard machine loadings to avoid inconsistent batch to batch colour and appearance.
- Ensure batch cards are used and all process data is noted.
- Ensure all dyes and chemicals are weighed or measured accurately.



Many harsh wash-downs have traditionally been achieved by the use of pumice stone but this may cause environmental problems. Also residual pumice left in the pockets of Childrenswear products is considered a choking hazard. As a result of this potential risk to children, Marks & Spencer have banned the use of pumice in any Childrenswear products. The use of abrasive balls in combination with cellulase enzymes is recommended as an alternative

### 7.2 Localised Abrasion and Embellishment

There are several processes that are carried out prior to laundry washing that add specific looks to garments. Many of these can expose workers to harmful chemicals and dust so it is important to:

- Provide engineering controls to minimise exposure
- Ensure workers are provided with adequate PPE
- Look to use alternative, lower impact technologies

Many abrasive processes and spraying techniques can now be done using automatic, computer controlled machines contained in special booths. These not only make processes safer, they also make them more consistent.

To ensure the safety and long term health of workers, sand blasting using crystalline silica is banned for all Marks & Spencer production, and alternatives such as hand scraping, enzyme treatment and laser techniques should be considered.



Potassium permanganate is often used for localised bleaching of denim. It is effective but particularly harmful to workers and if residues remain in the garments it can also be harmful to customers. Marks & Spencer is phasing out the use of PP Spray in production.

Several alternative, safer sprays are in use on M&S production and can be sourced from [Officina 39](#), [Nearchimica](#) and [CHT](#)

### 7.3 Environmental Impact Measurement

From AW20, Marks and Spencer has introduced mandatory Environmental Impact measurement for all Denim styles to measure the water usage and water, energy, chemical and worker impacts of denim washing. The EIM score is measured on the Jeanologia EIM platform. All laundries must subscribe to the platform and enter laundry processes for all styles. The data collected forms the basis of sustainable claims made about the M&S Sustainable Denim program.

Learn more about [Jeanologia and EIM](#)

## 8. QUALITY CONTROL

### 8.1 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. A copy of a typical Marks & Spencer master standard is shown below.

To ensure consistency of colour assessment, pre-finished and fully finished samples of bulk fabric 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.

**MSCC 19235 A**  
**RED**  
**21G 100% COTTON**

NB. Data below must be keyed in as Colour Standard.  
 Samples measured against this standard should be conditioned as overleaf and then folded minimum 4 thicknesses to prevent transmission of light.

COLOUR SPECIFICATION AT CORRECT CONDITION (See notes overleaf) SUM CHECK = 214.77

400	420	440	460	480	500	520	540
3.66	3.56	3.60	3.48	2.96	2.48	2.17	2.17
560	580	600	620	640	660	680	700
2.38	5.04	14.06	22.40	25.33	30.46	40.02	51.00

SUPPLIER - C V C STEVENSONS LTD. FPL DATE - 16/08/00

MARKS & SPENCER® COLOUR MANAGEMENT

**A Marks & Spencer data standard**

### 8.2 Testing

Minimum Standards Requirement
Finished fabrics and products must be tested in an accredited laboratory using M&S test methods
There must be a QC laboratory for basic testing
All test results must be retained

Finished fabrics and products must be tested in an accredited laboratory using Marks & Spencer test methods to demonstrate that the product meets the required specification and standards. A record of the test results must be kept in case there are any consumer complaints, product failures or legal investigations.

It is strongly recommend that products are tested throughout the production process to ensure that each stage of the production process is consistent. These test results can be analysed to identify patterns of failure and an action plan can be developed to improve processing consistencies.

Details of our laboratory accreditation programme, independent accredited laboratories and test methods can be found on the Marks & Spencer Supplier Exchange site

### 8.3 Examination

Minimum Standards Requirement
Products must be examined

Examination of fabric should only occur after testing, as products that fail tests will need to be rejected or reprocessed before they are inspected.

Examination should be carried out at a speed that is slow enough to enable examiners to highlight faults:

- Running at speeds too high for correct inspection will lead to more fabric being rejected by the customer.
- Examiners require frequent breaks to allow their eyes to rest, as overworked examiners often make mistakes and release poor fabric.

In general it is best to have the fabric examination tables with standard lighting and a back light.

It is recommended that swatches are taken from each fabric roll for assessment of colour.

Fault labelling is very helpful for garment makers and there are some automatic systems that create an electronic 'fault map' and produce cutting plans with minimal wastage.

The examination and testing departments are crucial to continuous improvement programmes, and record keeping and data analysis is very important.



Shelton inspection machine

For garment dyed and laundered garments samples should be examined and records kept to ensure continuity of colour and appearance. The colour continuity card in **Appendix B** can be modified to help record such information.

Automatic examination systems are available that use cameras and image analysers to detect faults. They must be trained to identify faults so are suitable for very long runs of the same fabric quality. Information and case studies can be found at <http://sheltonvision.co.uk/>

### 8.4 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 factory 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			