LTC

IRONER HANDBOOK

A guide to the efficient operation of

STEAM HEATED IRONERS

Published by Laundry Technology Centre

Acknowledgements

In preparing this handbook the authors, Richard Neale and Howard Neal, would like to acknowledge the help and advice they have received from manufacturers and users of ironing equipment throughout the laundering and textile rental industry.

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INTRODUCTION

This handbook has been designed to provide a useful source of basic information for the laundry supervisor and the laundry engineer. It covers all aspects of ironing and explains how attention to simple details can help maintain trouble free operation and minimise operating costs.

The information given is designed to help in achieving high output with excellent quality. Once the basic technology is understood then attaining these is a matter of routine. Once the ironer is properly tuned then maintaining its performance simply requires systematic management.

There is a troubleshooting section towards the end of the handbook which covers most day to day faults and which should prove an invaluable reference.

A Glossary is provided to help readers new to the laundry industry to understand some of the special terms used.

An Index is given at the back to help the user quickly find the information required.

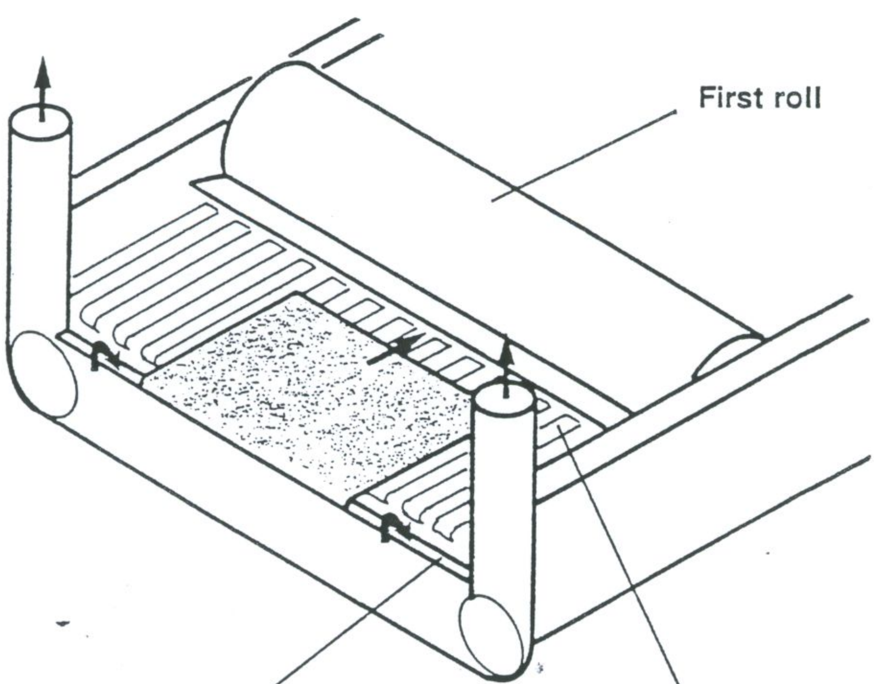


Diagram 1:
Typical ironer arrangement showing a hand feeding aid

1. WHAT THE IRONER LINE IS DESIGNED TO DO

The ironer line is designed to produce:

(a) work which is crease free and wrinkle free
(b) work with straight edges and square corners
(c) work which is dry
(d) work with an attractive sheen to the top surface - particularly table linen
(e) work which is correctly folded
(f) maximum output of correctly finished flatwork with minimum energy costs.

An ironer line consists of three main sections - feeding, ironing and folding. Each stage needs to be tuned and probably re-tuned daily to maintain peak performance and this requires skill, knowledge of the basic principles of ironing and experience of troubleshooting.

1.1 Feeding

The feeder is designed:

- to present the front edge of the article to be ironed so that it is parallel to the front roll.

- to apply sufficient back and side tension to ensure that the tail of the article is pulled out flat as it enters the ironer.

- to present the next article immediately after the previous one with the minimum amount of uncovered bed between them.

Feeding may either be manual or by automatic feeding machine. The principles of matching up the feeding and folding machines to the ironer itself are described in section 7 of this handbook.

1.2 Ironing

The article being ironed is drawn over the heated steel bed of the ironer by a padded roller. On most ironers the moisture evaporated is vacuumed through the clothing into the hollow roll and carried away by the suction exhaust applied to the end of each roll.

Fabric tapes are fitted to guide the work through the ironer but it is the mechanical drive on the rolls which actually transports the linen through the system.

The rolls and the beds are aligned and there is a system to maintain even pressure on the work.

1.3 Folding

The folder is designed:

- to put the correct sequence of folds into each article.

- to make the folds neatly and consistently, meeting edge to edge and fold to fold so that the finished work stacks and packs tidily.

2. MAIN FEATURES OF THE IRONER

2.1 Bed

The curved **bed** of the ironer is the main surface which transfers heat to the linen being finished. The surface in contact with the linen is highly polished to give rapid heat transfer. The bed is hollow and is heated by steam which condenses on the inside. An ironer usually has from one to four beds.

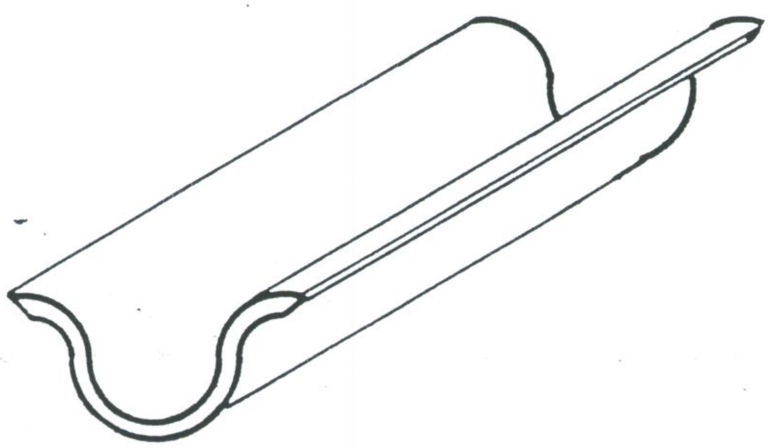


Diagram 2: Ironer bed

2.2. **Gap or gap piece**

Between each of the rolls on an ironer is usually an exposed **gap** where a great deal of heat transfer takes place.

The gap may be formed either

a) from the trailing lip of one bed and the feeding lip of the next

or b) by means of a separate **gap piece** which is a small additional steam heated chest.

The linen is lightly stretched as it passes over the gap piece and this part of the ironer makes a large contribution to the drying performance of the ironer.

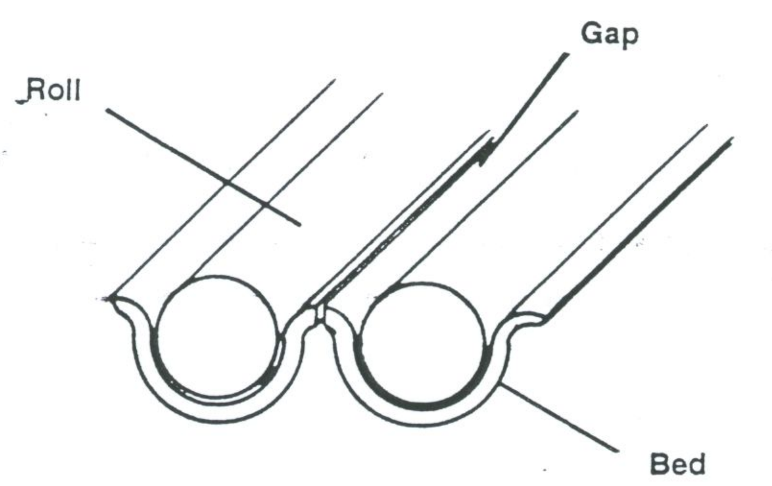


Diagram 3:
Ironer bed and roll arrangement showing the 'gap'

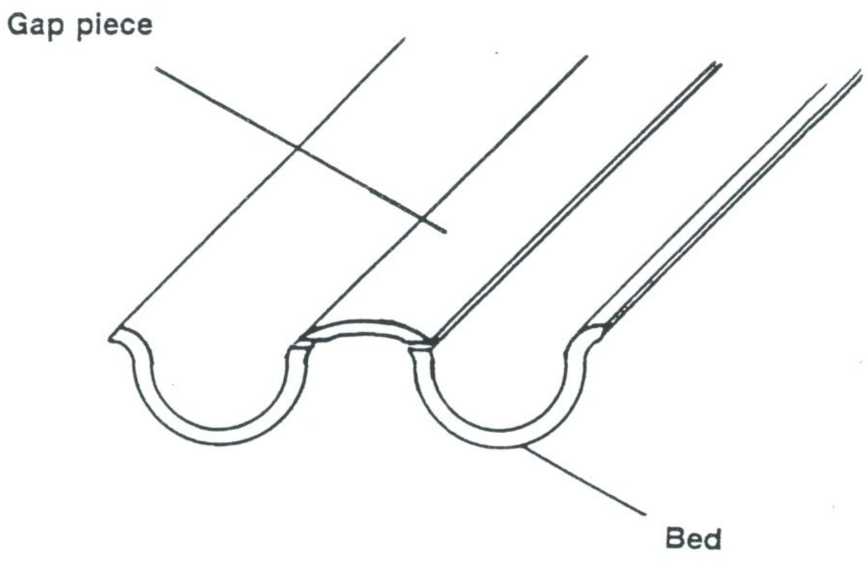


Diagram 4:
Ironer bed with separate gap piece

2.3 **Wax**

A coating of wax needs to be applied over the beds and gaps periodically during the day in order to clean and lubricate the heat transfer surface. This helps to prevent puckering of the work being ironed and it also reduces the load on the drive motor. Wax is applied by running through the ironer a special **waxing cloth** which has an abrasive underside to scour and clean the bed.

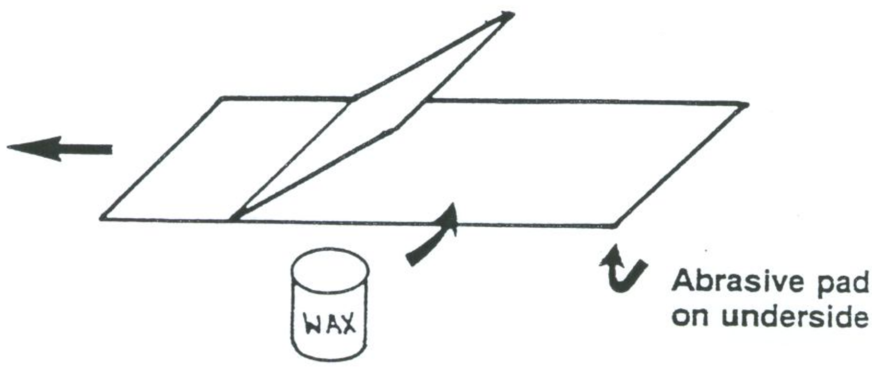


Diagram 5: Waxing cloth

2.4 Roll

The ironer roll is a rigid cylinder usually covered first with a layer of springs and then with resilient padding or clothing. The roll is usually hollow with perforations so that suction can be applied to remove water vapour from the clothing and linen. This vapour is drawn away into the vacuum exhaust system via the roll end.

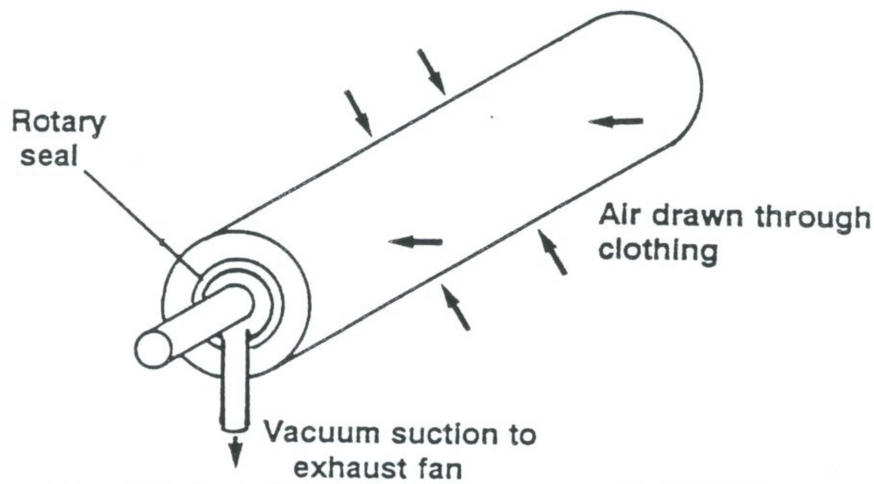


Diagram 6:

Typical vacuum exhaust from clothed roll

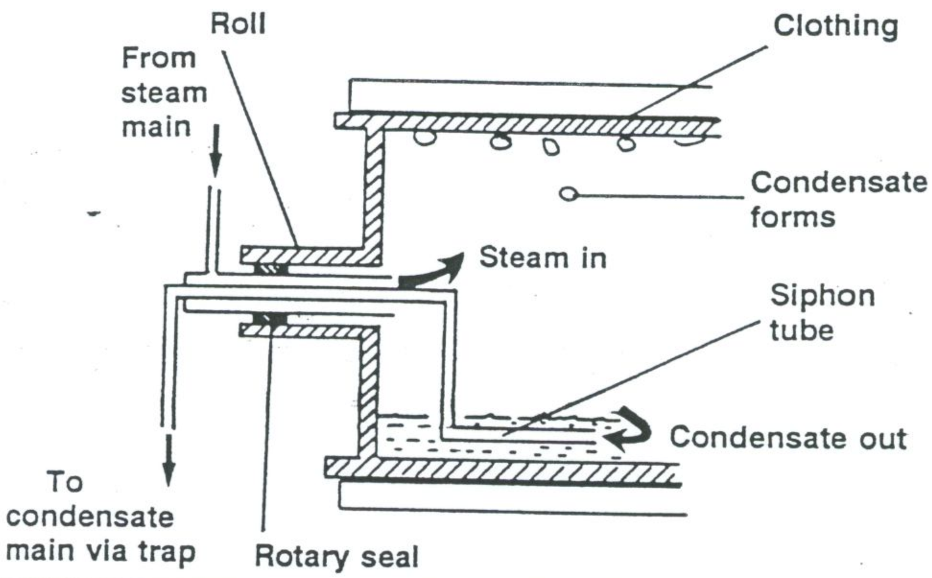


Diagram 7:

Steam supply and condensate removal for heated roll

2.5 **Roll/bed pressure**

The ironer rolls can be lifted (or sometimes the beds lowered) so that an even **pressure** can be exerted between the rolls and the beds. This is essential to make sure the linen dries evenly. Also uneven roll/bed pressure causes clothing to 'corkscrew' and wear unevenly. When not in use the system allows the rolls to be lifted or the beds lowered to prevent scorching of the clothing and unnecessary drag on the drive motors. The ironer may well use less electricity when it is processing work than when it is idling with the rolls in contact with the beds.

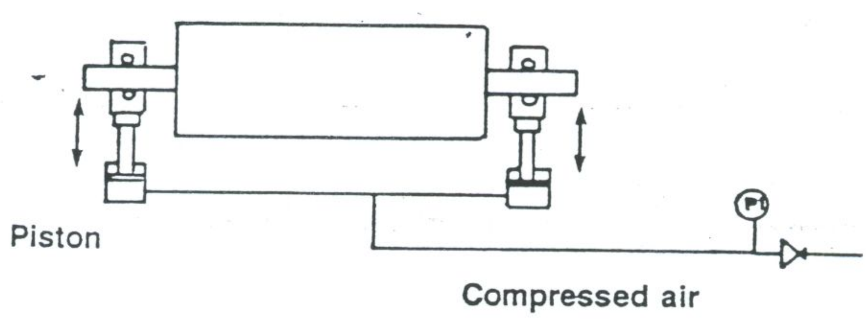


Diagram 8:
Roll raising and lowering arrangement for ironer with fixed bed

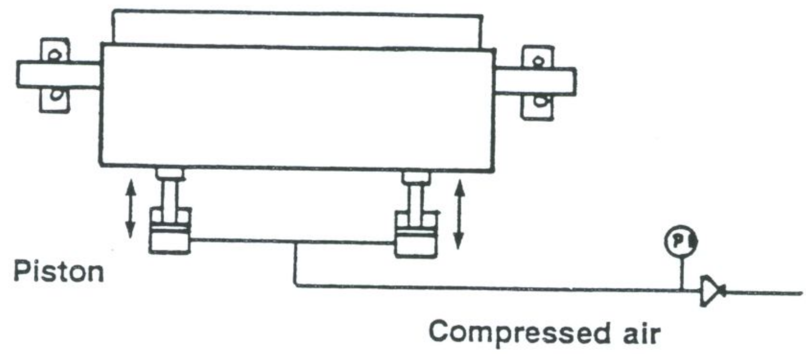


Diagram 9:
Bed raising and lowering arrangement for ironer with fixed rolls

2.6 Drive

The **drive system** is designed to turn the rolls so that work is drawn through the unit over the curved surface of each bed in turn. The surface of each roll usually moves at a slightly higher speed than the previous one so that the linen is continually stretched a little. This helps to flatten it and improve the heat transfer in the gaps.

The progressive increase in surface speed can be achieved by making each roll slightly larger in diameter than the previous one. When the same number of revolutions per minute are applied to each roll, the correct variation in surface speed is then maintained throughout the speed range of the ironer.

It is also possible to achieve a variation in surface speed by small differences in revolutions per minute from roll to roll. This method means that all rolls can be the same diameter.

The speed differential is usually designed to stretch linen by 50mm in every ten revolutions of the roll.

2.7 Clothing

Each roll is covered with resilient **clothing**, usually felt, designed to give an even flow of water vapour from the damp work being dried. This water vapour is drawn into the air flow created by the suction/exhaust fans which create a partial vacuum inside the perforated rolls.

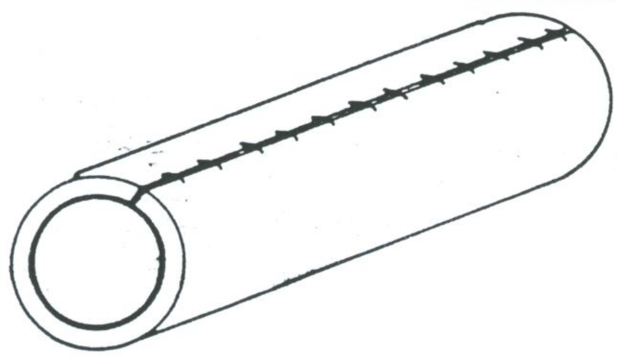


Diagram 10:

Clothing consisting of a single layer, shrunk on and stitched

The clothing may consist of one or more layers of fabric or felt, designed to give the correct resilience and permeability. The clothing resilience takes up any variations in the thickness of the work being ironed.

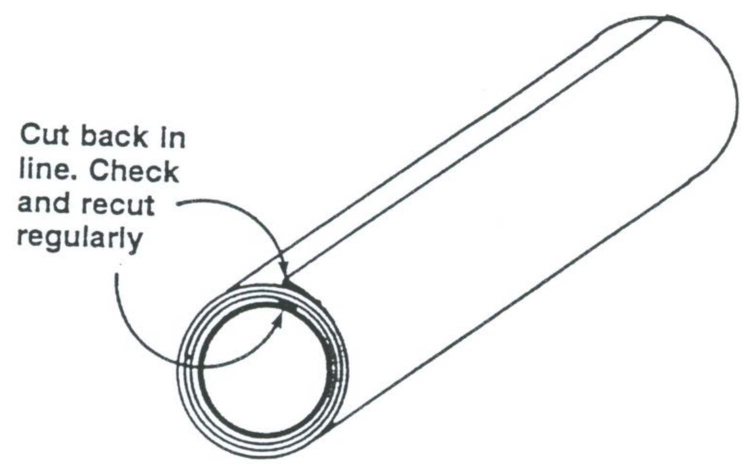


Diagram 11:

Clothing wound on to form multiple layers

Every ironer design relies on precise control of the clothing construction. As soon as the clothing becomes hard and compacted the ironer will cease to work efficiently or at high output. Consequently clothing must be renewed at regular intervals.

On most ironers the felt clothing is supported on a single layer of underclothing - a coarse fabric which evens out the spring surface.

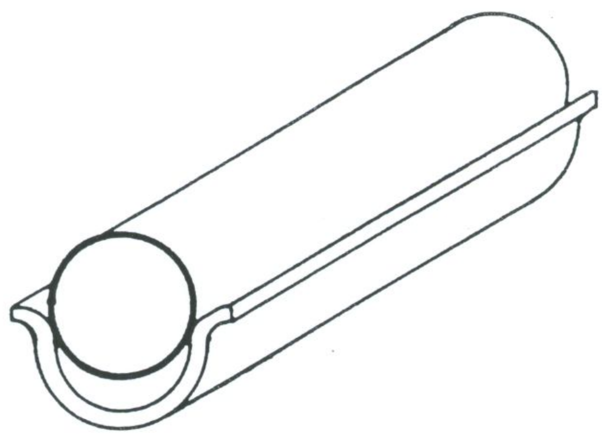


Diagram 12:
Bridging caused by roll diameter too large for bed

When the roll is clothed or re-clothed a careful check is made that it is exactly the right diameter to match the curve in the bed. If the diameter is too big, the roll will not fit into the bed - a fault called **bridging**. If the roll is too small, then it will fall straight to the bottom of the bed - a fault called **bottoming**. With bridging and bottoming the area of bed to roll contact becomes very small and ironer performance falls off accordingly.

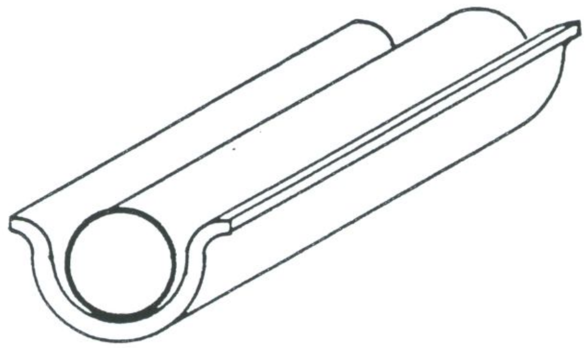


Diagram 13:
Bottoming caused by roll diameter too small

The diameter of a clothed roll is checked using an accurate flexible measuring tape and a new ironer is usually supplied with special metal tapes for this purpose. It is important to use the correct tape for the roll to which it relates if each roll has a different diameter. The roll number is frequently printed on the relevant tape.

2.8 Springs

There is usually a layer of spring supports fitted on the outside metal surface of the roll itself, to create an air gap between the clothing and the roll surface. This is designed to give even air flow through the clothing, so that all parts of the item being ironed, dry at the same rate with no damp patches.

The springs also increase the efficiency of the ironer by ensuring good roll to bed contact. They take up any small changes in the outer diameter of the clothed surface as the clothing wears, so that there is always an even pressure on the work being ironed to produce the best heat transfer from the steam heated surface of the bed.

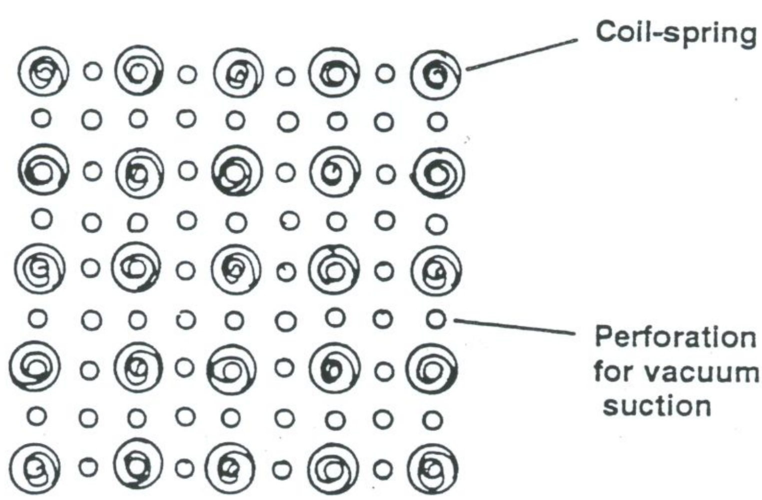


Diagram 14:
Coil spring support pattern on surface of unclothed roll

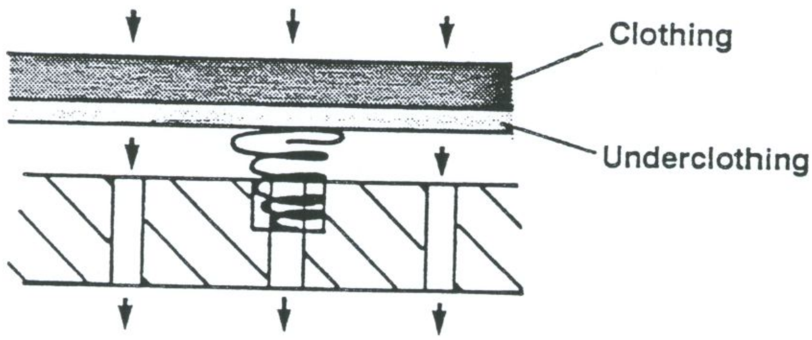


Diagram 15:
Coil spring screwed into roll structure

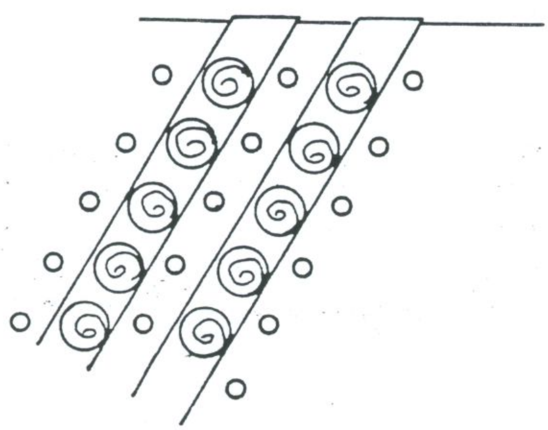


Diagram 16:
Re-springing of roll using new springs on tape carrier

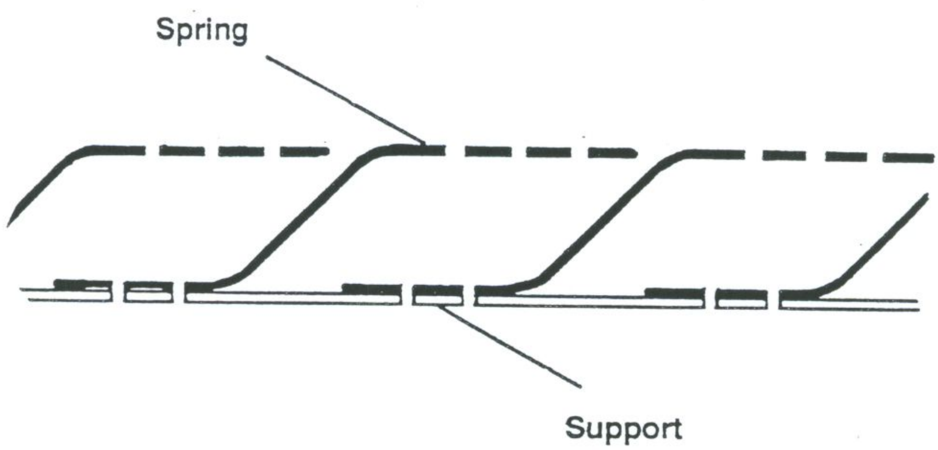


Diagram 17:
Typical leaf spring arrangement (in cross section)

2.9 Controls

The ironer is fitted with start and stop controls which must meet rigid safety requirements. In particular, the trip or **finger guard** at the front of the machine must stop the rolls instantly - this is the operator's protection against a finger or a limb being drawn into the ironer itself.

The ironer is also fitted with a speed controller, usually calibrated in metres per minute, to enable the desired speeds for the various classifications of work to be selected very quickly. It is important to keep the accuracy of the speed controller well adjusted during planned maintenance to avoid the waste associated with operating too fast or too slow.

Many ironers are also fitted with a steam pressure gauge, which shows the actual pressure of steam reaching the ironer beds themselves. This is frequently very different to the pressure of the boiler and section 4 of this handbook deals with the general problems of steam quality. It is the steam pressure which fixes bed temperature (see charts) and which has such a strong influence on ironer output. Some ironers also show bed temperature on the control panel.

Gauge pressure (psi)	Bed temperature (°C)
60	153
70	157
80	162
90	166
100	170
110	173
120	176
130	180
140	182
150	185

Chart showing maximum bed temperature (°C) vs steam pressure (psi)

Gauge pressure (bar)	Bed temperature (°C)
4.0	151
4.5	155
5.0	158
5.5	162
6.0	165
6.5	167
7.0	170
7.5	173
8.0	175
8.5	177
9.0	179
9.5	182
10.0	184

Chart showing maximum bed temperature (°C) vs steam pressure (bar)

There is usually an indicator showing the amount of electric current absorbed by the ironer. This is a good way of warning against excessive load on the drive motor, perhaps caused by too high a bed to roll pressure, or perhaps from some other fault. It should be checked regularly by the ironer operating team.

Some control panels also indicate when steam traps are leaking so as to avoid the possibility of unnecessary steam wastage.

2.10 Steam

The ironer is usually connected to the steam main in such a way as to avoid carry over of water droplets. The pipe connection must be of a sufficient size to allow the necessary flow rate of steam without much pressure loss. Many steam pipes are heavily furred up on the inside and this will cause a progressive reduction in performance. Steam quality is considered in more detail in Section 4.

2.11 Condensate

The ironer is connected to the condensate main so that the liquid condensate, formed by the condensing steam, can be removed through steam traps fitted to each bed and taken quickly and safely away to the boiler feed tank.

2.12 Electricity supply

The ironer usually requires a standard three phase electrical supply. The ironer motor is usually wired to provide a soft start, to cope with the considerable initial load when starting the rolls turning from rest, sometimes via an air-operated or electrically controlled clutch. The circuitry generally provides **fuses** to protect the wiring from excessive currents in the event of a fault. There is also an **overload protection** to protect the motor which operates by sensing either the motor current or the motor temperature.

When replacing fuses it is important first to locate and rectify the fault which caused the failure and then to use exactly the right type of fuse as specified by the manufacturer to maintain the correct response.

When replacing the overload protector it is important to adjust it carefully to the correct setting of overload protection, again as specified in the manufacturer's manual for the ironer.

2.13 **Compressed air supply**

Depending on the type or ironer, feeder and folder there will be a compressed air supply to the unit. This may be used for operating pistons or valves; it may also be needed for air jets which position the limp fabric during manipulation by the folder.

It is essential that the compressed air is not only at the correct pressure and available in sufficient quantity - its quality must also be correctly controlled. It should have passed through a **cooler** after the compressor to condense out most of the moisture from it. This will greatly increase the lives of the seals to the pistons at the ironer line - it will also reduce the risk of them sticking and causing mal-operation.

A compressed air supply requires correct **lubrication** via an in-line oiler before use in a piston, so that the moving surfaces are correctly lubricated and wear is greatly reduced. There is little point in oiling air to be used in air jets at the folder - oil is the last thing that is required on the finished linen.

3. THE KEY TO QUALITY IRONING - A GOOD WASH PROCESS

A great many ironer problems arise because of the wash process used for the linen. Unless these problems are remedied at source, no amount of adjustment at the ironer will help matters. In this section the important points to look for are summarised and the problems they cause are identified.

3.1 Water hardness

If the water supplied to the laundry contains dissolved minerals it is said to be **'hard'**. This is because most minerals contain some calcium or magnesium compounds and these interfere with the wash process by reacting with the detergent to form a grey scum. The scum itself can get redeposited on to the work being washed and in addition the detergency power will have been wasted so that soil removal will be poor. Soil and scum redeposited back on to the fabric will cause **greying**. (One of the functions of the detergent is to suspend soiling in the wash liquor so that it is flushed away down the drain at the end of the stage). White work which comes off the end of the calender looking grey, with soiling and staining still present, has probably been caused either by the use of hard water or by inadequate detergent.

Hard water is made soft by passing it through a **water softener**, usually of the ion-exchange type. This swaps the calcium and magnesium ions in the raw water for sodium ions which do not cause this problem. From time to time the water softener must be recharged with sodium ions by treating it with strong salt solution. It is when recharging is overdue that hard water tends to be passed forward and greying develops.

The only way to reverse greying is to rewash several times, preferably on a more vigorous process at high temperature. Even then some stains will be much more difficult to remove because they will have been firmly **set** by the heat of the ironer.

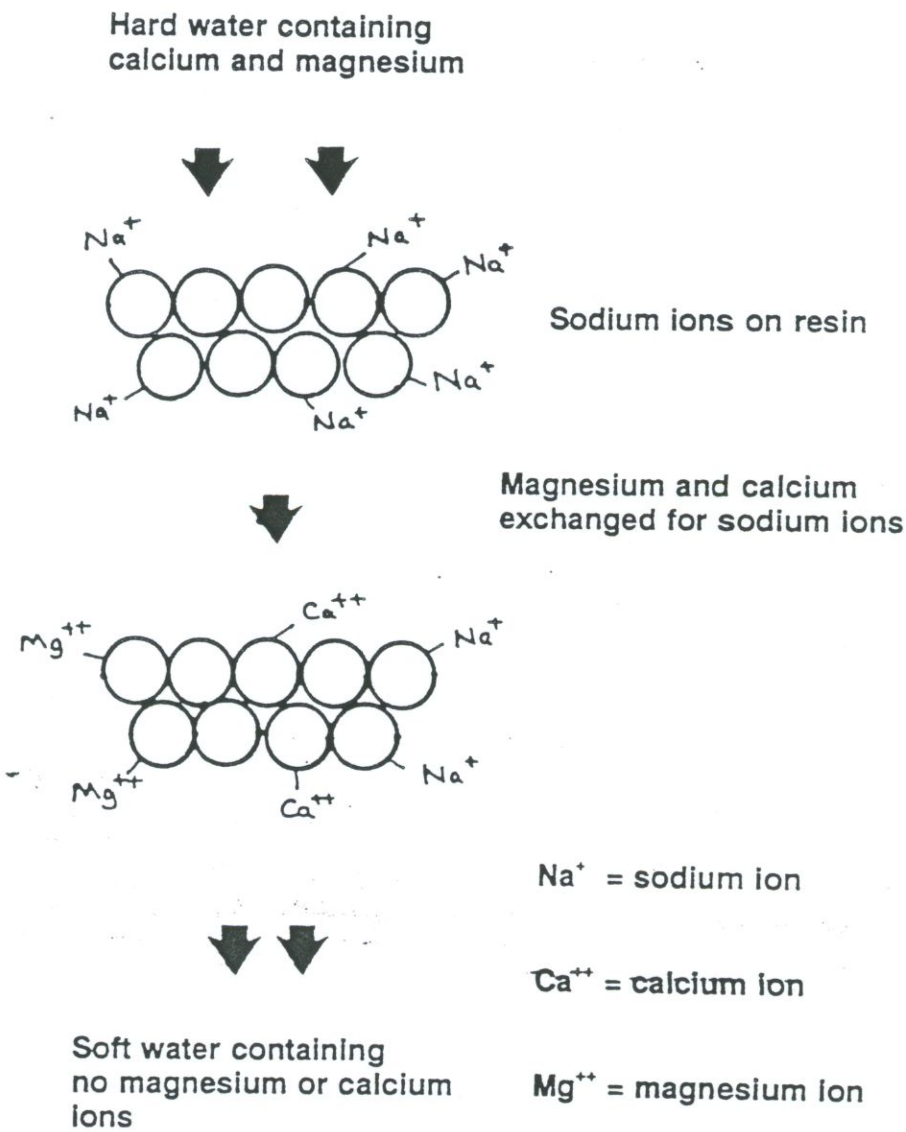


Diagram 18:
Water softening using ion-exchange resin

3.2 Water alkalinity

If the incoming raw water containing dissolved minerals is passed through a water softener, then only the calcium and magnesium ions are removed. Other parts of the dissolved minerals remain in the water and are carried forward with the wet work to the ironer. Although these impurities don't interfere with the wash process the heat of the ironer turns them a yellow colour so that all the sheets come forward from the folder with an overall yellow discolouration. This is called **galling**.

The impurities in water which cause galling are generally referred to as **alkalis**, and although they will usually occur in a very hard water supply, they are rarely at a level to cause this problem in a well run laundry. Most galling in laundering is because of poor rinsing, see section 3.6.

3.3 Iron in the incoming water

Most raw water contains a little dissolved **iron** which is converted into iron oxide (rust), either during the wash process or at the ironer. This produces dots or lines of orange brown rust marking, which again spoil the overall appearance and lead to customer complaint. Iron needs to be controlled to a very low level in the incoming raw water if this problem is to be avoided. Iron can be removed by aerating the water, which converts it to particles of rust and then filtering these out on a very fine carbon filter. There are also other ways of solving the problem.

Iron can be picked up from water and steam pipework within the laundry, or possibly from damage within the washing machine itself and this will also produce this fault in the form of small localised specks of discoloration.

3.4 Wash process

A well designed wash process involves **detergent** to help emulsify oils, greases and fats, **temperature** to swell the cotton fibres to help release the dirt trapped there and **mechanical action** to free the soiling so that it can be carried away into the wash liquor. The detergent must also be capable of keeping the soiling suspended in the wash liquor, to prevent it redepositing on to the fabric causing greying. Too little detergent, too short a process, too low a wash temperature and incorrect wash dips will all lead to greying with poor stain and soil removal. These are not ironer faults, even though they are first seen at this stage and the solution is not to use more bleach - they must be solved by redesign of the wash process itself.

3.5 Bleaching

Bleaching should be used to de-colour bleachable stains such as those caused by vegetable dyes (red wine, blackcurrant juice and so on). It is not a substitute for a poor wash process and will not prevent greying.

There are two types of bleaching system in present use. Peroxy bleaches (hydrogen peroxide, sodium percarbonate, sodium perborate) are used during the hot wash - hydrogen peroxide for example probably works best at around 65°C. Sodium hypochlorite ('chlorine bleach') must be used below 50°C and is normally added during the first rinse.

All common laundry bleaches cause damage to cotton fabric, especially if used incorrectly. If chlorine bleach is used above 50°C it will rapidly rot cotton. If it is not rinsed out thoroughly, then weakening of the fabric will occur when the linen is dried on the ironer. This will reduce the life of rental linen, which will start to tear easily, possibly at the feeder. The problem can be avoided by minimising the use of chlorine bleach, by checking the rinse efficiency regularly and, as a last resort, by the addition of an **anti-chlor** to the final rinse.

3.6 Rinsing

After washing, work must be rinsed to remove the soiling and the detergent. Modern detergents also contain a lot of alkali so that if rinsing is inadequate galling will occur and the sheets will turn yellow, however good the water quality.

In a well designed wash process the rinsing should reduce the alkalinity of the final rinse liquor to within 0.04 g/litre of the alkalinity of the incoming raw water. Although it is possible to make a chemical addition to compensate for high alkalinity of the raw water to avoid galling, this should never be used to compensate for inadequate rinsing.

Raising the temperature of the rinse water will improve the efficiency of the final extraction. For example raising the rinse temperature from 15°C to 60°C could reduce the final moisture content from 56% down to 52%. If this work is fed directly to the ironer then a higher throughput may be achieved because the work is already warm and because there is less moisture to be evaporated.

It is generally far more energy efficient to remove moisture by hydro-extraction than by evaporation. If hydro-extraction is improved by raising rinse water temperature this is only more energy efficient if the hot rinse was either achieved using recovered heat or the warm, used rinse liquor is to be re-used for a hot wash.

3.7 Souring

If the raw water has an alkalinity above 0.2 g/litre then it may be necessary to neutralise this at the final rinse stage. This is done by the addition of acetic acid, a process usually referred to as **souring**.

3.8 Starching

Most top quality restaurants require white cotton flatwork to be correctly starched. This should be done in a final starch rinse using a low dip. It is essential to purchase a good quality starch that will work its way well into the cotton fabric to give the necessary stiffness. Rice starches tend to be preferred to potato based ones but modern synthetic starches are often better still.

However, there is no point in purchasing a good starch unless adequate **time** is given to the starching stage so that it builds well into the fabric. The stage must be held at the correct **temperature** for this to occur (normally about 50°C). Otherwise the starch will simply sit on the surface of the fabric and most of it will come off and produce a build up at the front line of the first bed of the ironer, defeating the object of the exercise and making ironer operation more difficult as well.

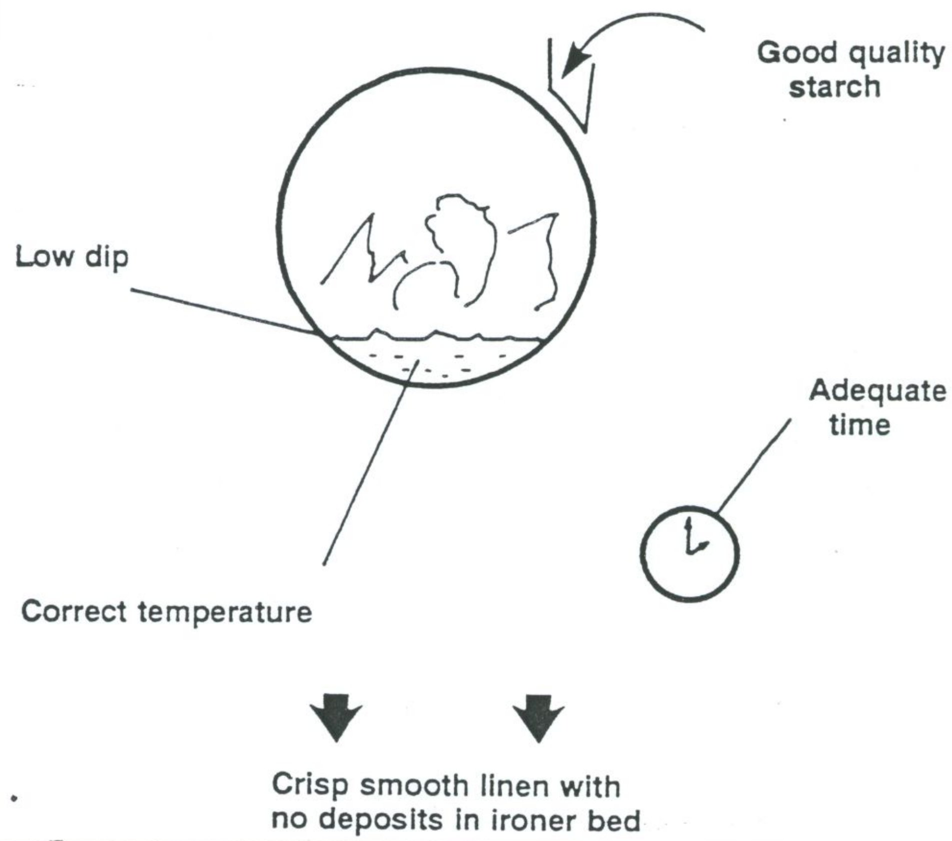


Diagram 19:
Requirements for high quality starching

3.9 Conditioning

Sheets from a washer extractor can be fed directly to an ironer without tumble drying. This avoids double handling and it also avoids unnecessary expense. Drying in a tumbler is usually three times more expensive in energy terms than drying on an ironer.

However, many operators still condition sheets because the tumbling action opens the fabric out and removal of some moisture means the ironer can be operated more quickly. Needless to say there is no point in this if the sheets cannot be fed more quickly (edge to edge).

From a continuous batch washer (CBW) the sheets are always tumbled to break the 'cheese' or 'cake' that is formed by the press stage, but it is not really necessary to have the heat on to the tumbler while this is being done. There is certainly no point if plenty of ironer capacity is available, or if feeding is already at the maximum rate possible.

If the CBW is programmed to turn off the steam to a tumble drier when processing sheets then it is important to maintain a small bleed of steam via a pilot valve to avoid **water hammer**. (Water hammer is the shock produced when the pressure released by an opening valve allows a slug of liquid to accelerate and hit, for example, a tumble drier heater battery causing both noise and damage.)

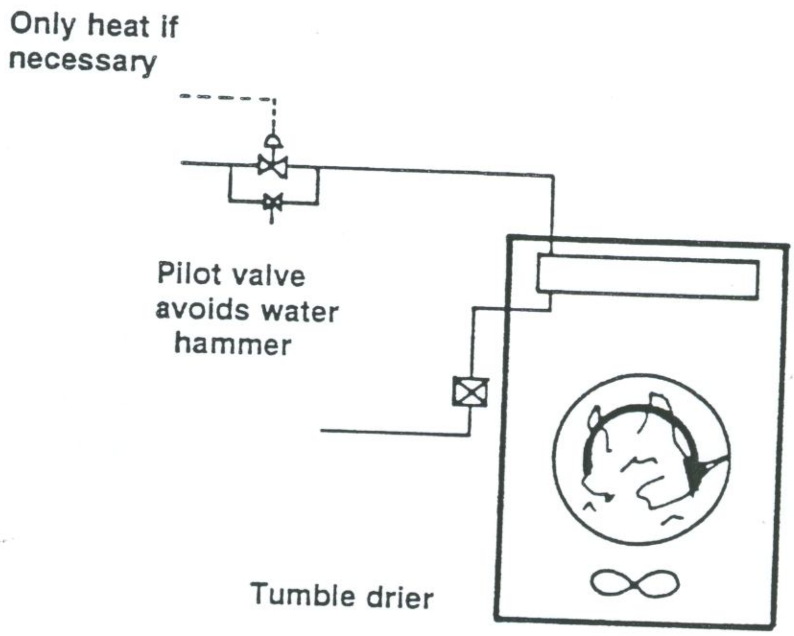


Diagram 20: Conditioning of linen

4. STEAM SUPPLY AND CONDENSATE REMOVAL

Steam quality and condensate removal are two of the most important features of an installation and if an ironer can only achieve two thirds of its design throughput it is quite likely that there are serious faults with these services.

4.1 Steam pressure

An ironer will only operate properly if it is supplied with steam at a constant pressure. The higher the steam pressure the higher its temperature and so the greater the throughput which should be possible. There will be a maximum operating pressure for the ironer beds and at a given moisture content this will give the greatest throughput for cotton sheets. Other fabrics are considered in section 7. The relation between steam pressure and bed temperature is shown in the charts in section 2.

If the steam pressure varies because of the intermittent demands of other equipment in the laundry, then the performance of the ironer will vary, so that whenever the pressure falls linen will come off damp. This can be a major problem for rental customers and many plants always operate the ironer below its maximum speed to compensate. It is far better practice to remove the source of fluctuations so that the ironer operates properly.

The most common cause of loss of steam pressure in a laundry is failure to control the large surges in demand produced by the washer extractors. A 100 kg washer extractor may well call for steam at the rate of 1000 kg per hour, although only for a few minutes. If two washer extractors call simultaneously, the steam pressure will usually drop and ironer performance will suffer in the way described.

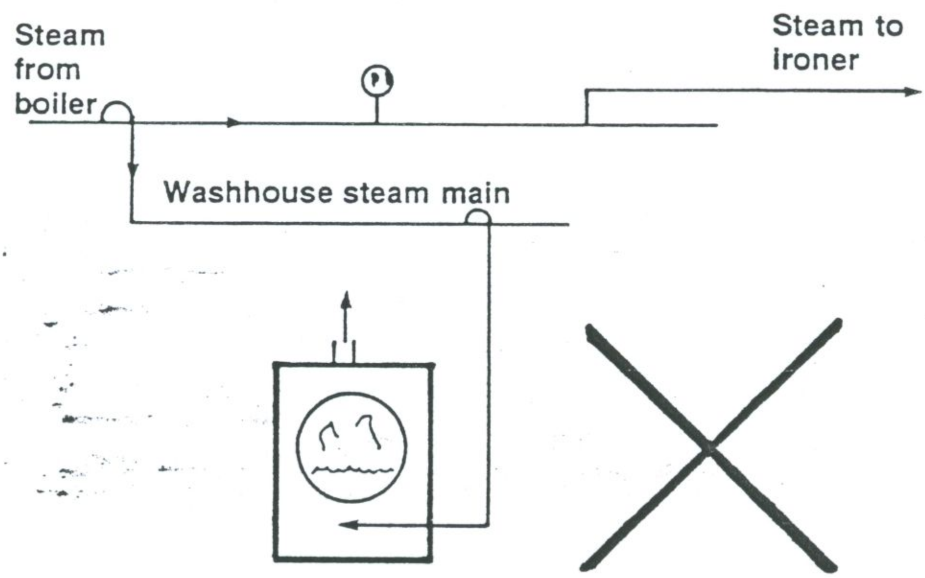
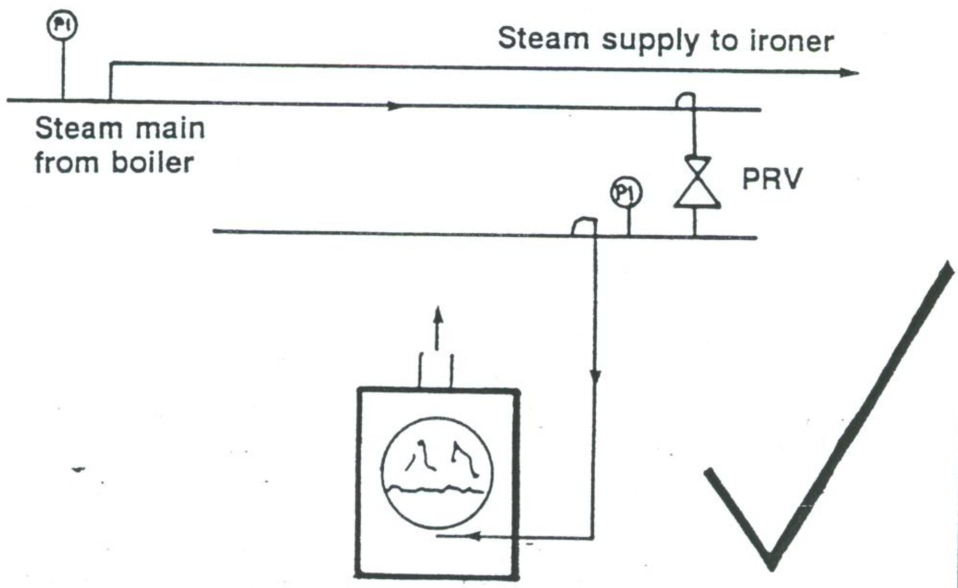


Diagram 21:
Incorrect piping arrangement for washer extractors

One way of reducing this problem is to fit a steam pressure reducing valve in the supply to the washhouse steam main. This will not only reduce steam pressure fluctuations at the ironer, it will also improve the efficiency of use of the steam directly injected into the washing machines, with lower vent losses.



PRV - pressure reducing valve
PI - pressure indicator

Diagram 22:
Correct steam piping arrangements
for washer extractors

4.2 Steam flow rate

In a poorly engineered laundry surges in steam demand frequently result in **priming** of the boiler, so that a froth of water and steam is carried into the steam main regularly. This causes a build up on the inside of the steam pipe and eventually restricts the flow rate to the ironer. Even if the pipe was correctly sized in the first place, the internal diameter becomes reduced, so there is considerable pressure loss between the boiler and the ironer beds.

This fault can be detected by reading the steam gauge on the ironer itself and comparing it with that on the top of the boiler. They should differ by only 0.1 - 1.0 bar (1-15 psi), the lower the difference the better. If the steam flow to the ironer is restricted, then it will warm up slowly, bed temperatures will always be lower than they should be and output could reduce to only 50 or 60% of design. It is good practice always to position the ironer as close as possible to the boiler.

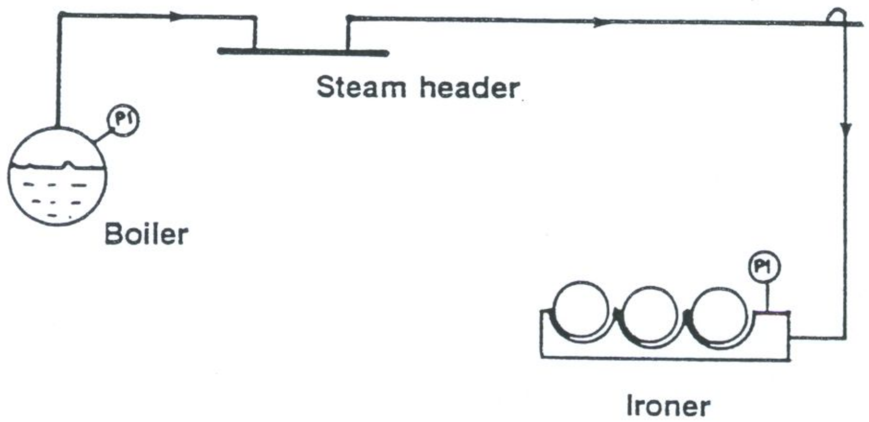


Diagram 23: Steam supply to ironer

4.3 Steam wetness and carry over

Many laundry boilers work so hard that there are always water droplets in the steam, regardless of whether the washer extractors are calling for steam or not. The amount of water droplets carried from the water surface in the boiler is determined by the boiler design (some are much better than others) and by the rate at which it is working.

If there are any uninsulated flanges or valves or lengths of steam pipe between the boiler and ironer, then the heat lost produces additional condensation in the steam main and these droplets too may pass forward to the ironer. Even a well insulated steam system will lose some heat and allow traces of condensation to form, so a correctly designed supply pipe will slope gradually down in the direction of flow and be fitted with regular drain points to remove this condensate. Eccentric reducers avoid hold up of liquid condensate in the steam line when the pipe diameter changes.

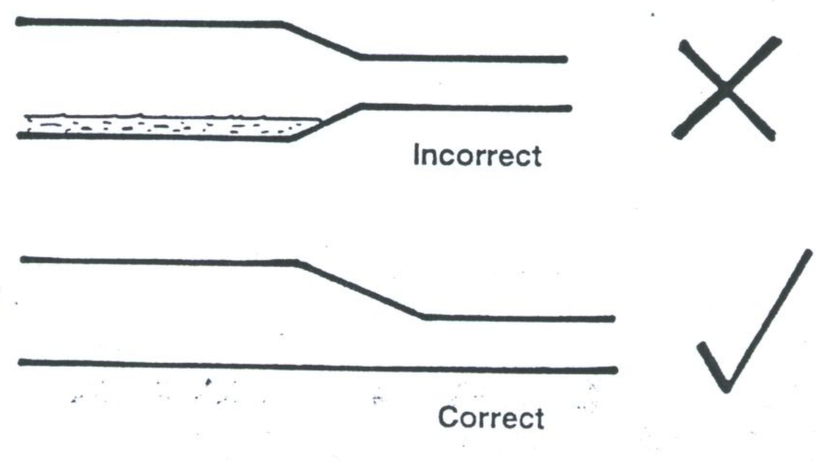


Diagram 24:
Horizontal steam main reduction arrangement to avoid build up of liquid condensate in steam line

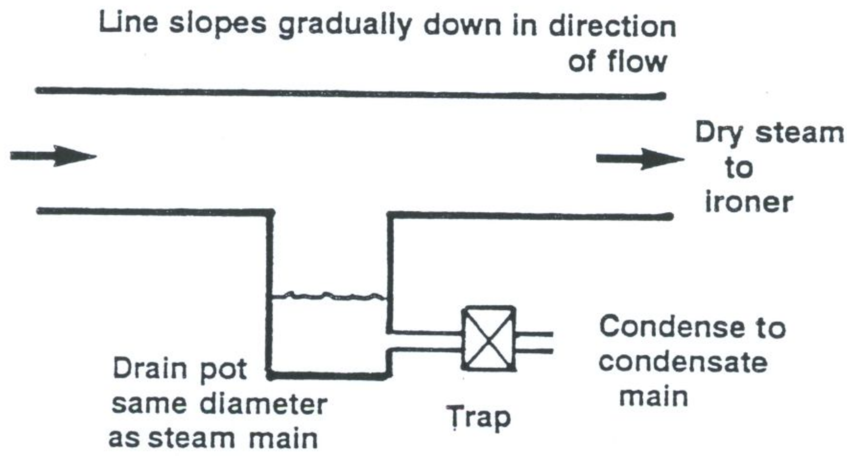


Diagram 25:
Correct arrangement for line drain in steam line

Steam containing water droplets is referred to as **wet steam** and the greater the amount of wetness the poorer the ironer performance. This is because the water droplets tend to coat the heating surfaces and provide an additional layer of insulation to slow down heat transfer as the rest of the steam condenses. It is quite easy to lose 5% or more of ironer capacity from this simple cause.

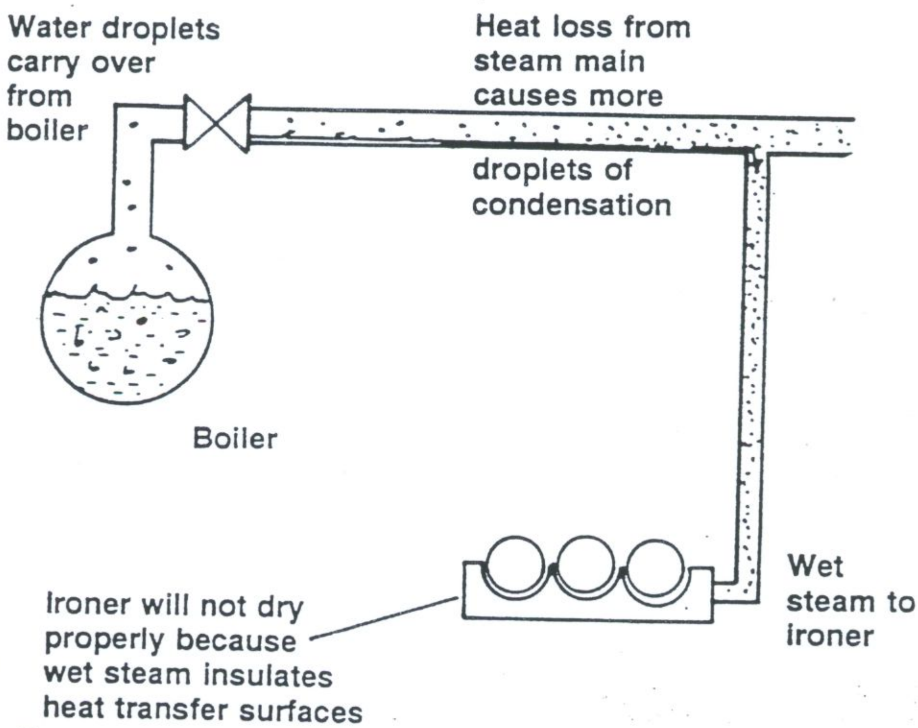


Diagram 26: Generation of wet steam to ironer

Carry over of water droplets can be corrected at the boiler by the insertion of a water separator in the main steam line, or by putting a small water separator in the individual line to the ironer. A well designed steam service also has meticulous insulation on all metal surfaces in contact with steam. Insulation is generally self financing within twelve months based on the energy savings alone.

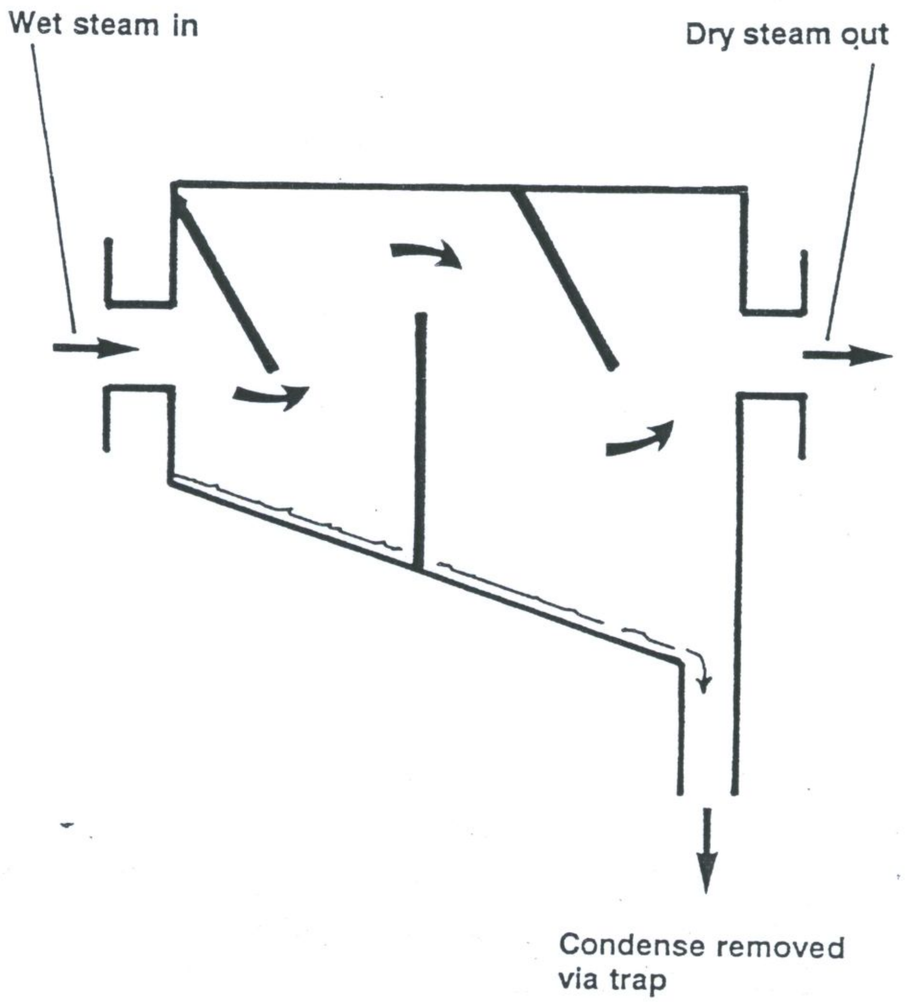


Diagram 27:

Typical design of horizontal steam/condense separator to produce dry steam at the ironer

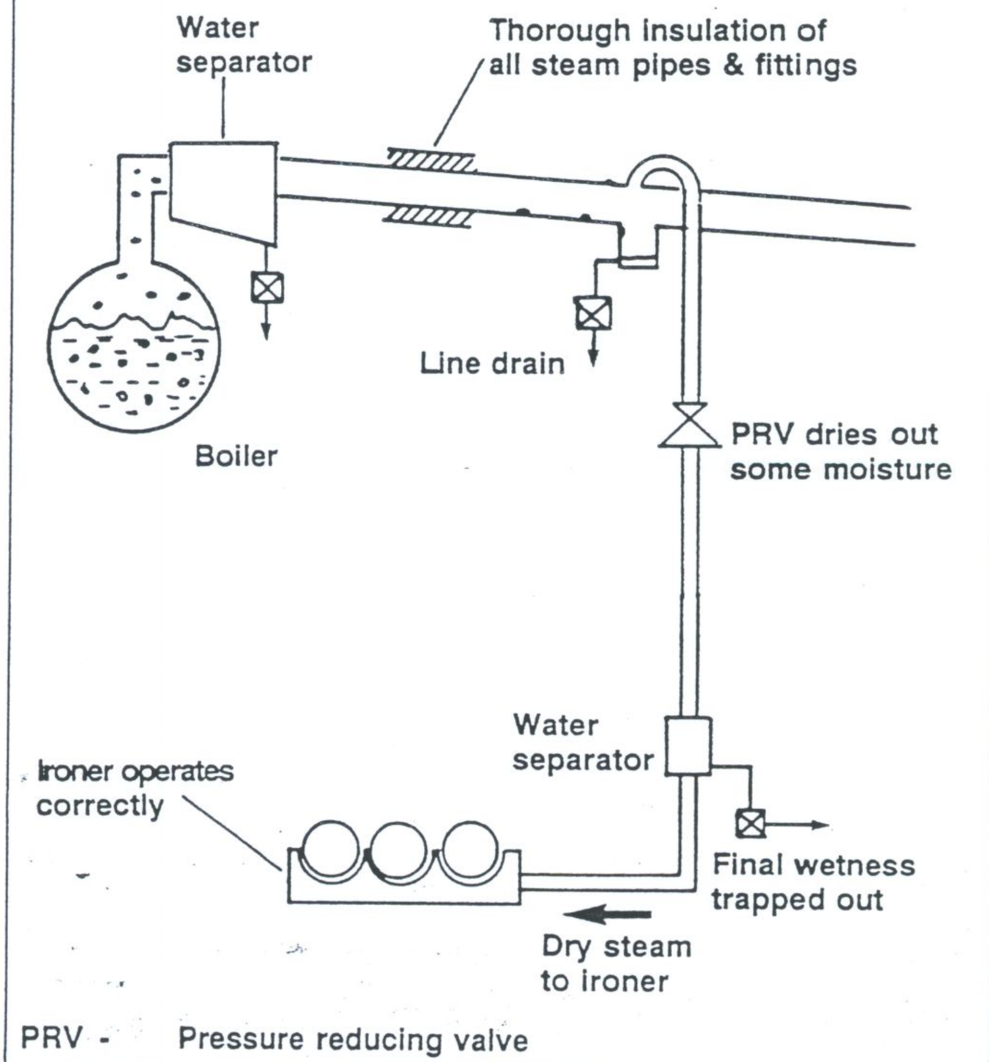


Diagram 28:
Different ways of achieving dry steam to the ironer

4.4 Non-condensables in steam

Steam is rarely just pure water vapour - it normally contains air and carbon dioxide. Water pumped into the boiler from the boiler feed tank contains dissolved air which goes out with the steam. Carbon dioxide is formed in the boiler by breakdown of carbonates from the mineral salts in the raw water which were mentioned earlier.

Air will not condense and if it is not removed from the ironer beds then it forms an insulating blanket and heat transfer from the steam is greatly reduced. Air is normally removed from the horns of the ironer beds with special air vents that discharge into the condensate main or into the floor drain. These may operate thermostatically or in the same way as a thermodynamic steam trap.

If air is not removed efficiently from the beds, either because the air vents are not working or because they have not been fitted, then bed temperatures will fall, cold spots will develop and damp work will be produced.

Some of the modern ironer designs have steam-ways in the beds, manufactured from a series of narrow passages that ensure that any air present is purged through the traps when steam is introduced. Hence this type of bed construction does not need air vents at the horns.

Care must be taken if it is found to be necessary to change or repair the steam trap on this design of ironer as it is important that thermodynamic traps are not fitted. At full working pressure they tend to react to air as they would react to steam and close. This action will seriously impair the efficiency of the ironer and the ability of the trap to remove the condensate from the bed.

4.5 Condensate removal

For an ironer to work efficiently the condensate needs to flow quickly down the inner face of the ironer bed so that the heat transfer surface is cleared for more steam to condense. The condensate is encouraged to flow off the base of the curved surface and collect in the bottom of the bed where it flows out through steam traps into the condensate main. If the steam traps are blocked then the bed will flood and heat transfer will cease.

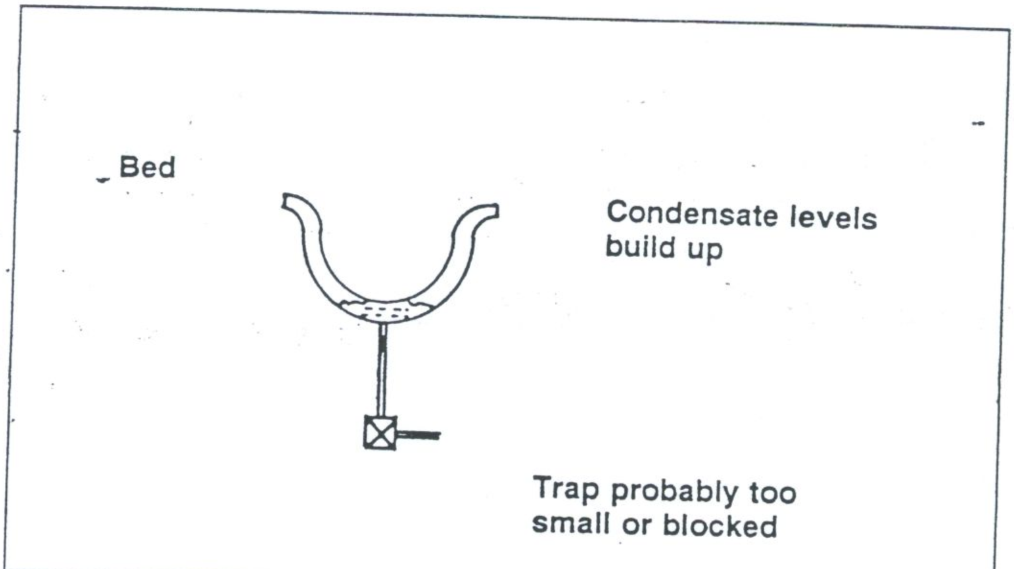


Diagram 29:
Flooded bed causes slow warm up and poor drying

If there is only a short height between the base of the bed and trap there is always a tendency for condensate to back up through the connecting pipe and if the trap gets blocked or partially blocked, flooding of the bed will occur.

Air must also be vented through the trap and the best trap designs for ironers have adequate provision for this. Just as air locks form in domestic central heating pipes so **steam locking** is possible in the pipe between the bed and the steam trap. This can only be avoided by careful trap selection and some systems avoid insulation of this section of condensate pipe to avoid the steam locking problem.

Carbon dioxide present in the steam tends to dissolve in liquid condensate to form **carbonic acid** which is quite corrosive and produces erosive corrosion of pipe bends, traps and other fittings. This erosive corrosion gives the appearance of the metal of the fitting having been 'gouged out' and leads to rapid failure and leakages. It can be avoided by injecting a suitable neutralising additive into the steam but this is not normally practised in laundries because of the risk of contaminating the work in the laundry process itself.

There is always some **back pressure** on the condensate main because as soon as the condensate enters the main it separates into flash steam and boiling water. Although it is not normally a problem, if the back pressure is allowed to rise to a high level (for instance because of leaking steam traps on adjacent equipment) then condensate removal will be slowed up and ironer performance will be made much worse, for all the reasons stated earlier.