Thinking of you
Electrolux

Electrolux laundry System
Project Planning and Calculating Dimensions
September 2009

Project Planning
&
Calculating Dimensions

Content

Introduction

The intention of “Project Planning and Calculating Dimensions” (PPCD) is to provide support for everyone involved in a laundry project, all the way from sales to service. It is designed to assist people in their efforts to fulfil the aims of the company by including business policy, vision, strategy and quality assurance.

In the field of industrial laundry and textile handling processes, customers will meet personnel who are flexible and adaptable, who will provide competent and complete technical service throughout all phases of a project, i.e. sales, project planning, installation, training, start-up and maintenance. In order to ensure perfect functioning projects world wide, Electrolux Laundry Systems (ELS) offers solutions with of a consistently high quality.

“Project Planning and Calculating Dimensions” also promises a consistent level of competence for everyone involved. However, the document is primarily aimed at:

- Salesmen
- Project managers
- Installation managers
- Persons responsible for after-sales service.

The document is to be used when training personnel and will be used as part of all the various phases of the project. It will be used primarily at Electrolux Laundry Systems subsidiary companies and distributors, but also by the parent company.

After training, the document is intended as a reference guide in subsequent day-to-day work. It is therefore of utmost importance that each respective holder keeps the folder up-to-date by inserting any revised pages or new supplements that are received.

Central Marketing - located at the Head Office in Ringvägen 14, 341 80 Ljungby, Sweden, (+46-37266100 - Fax +46-37213390) - is responsible for the contents in “Project Planning & Calculating Dimensions” (PPCD), including the distribution of updates.
If you have any questions, please contact Product Category Management, Central Marketing.

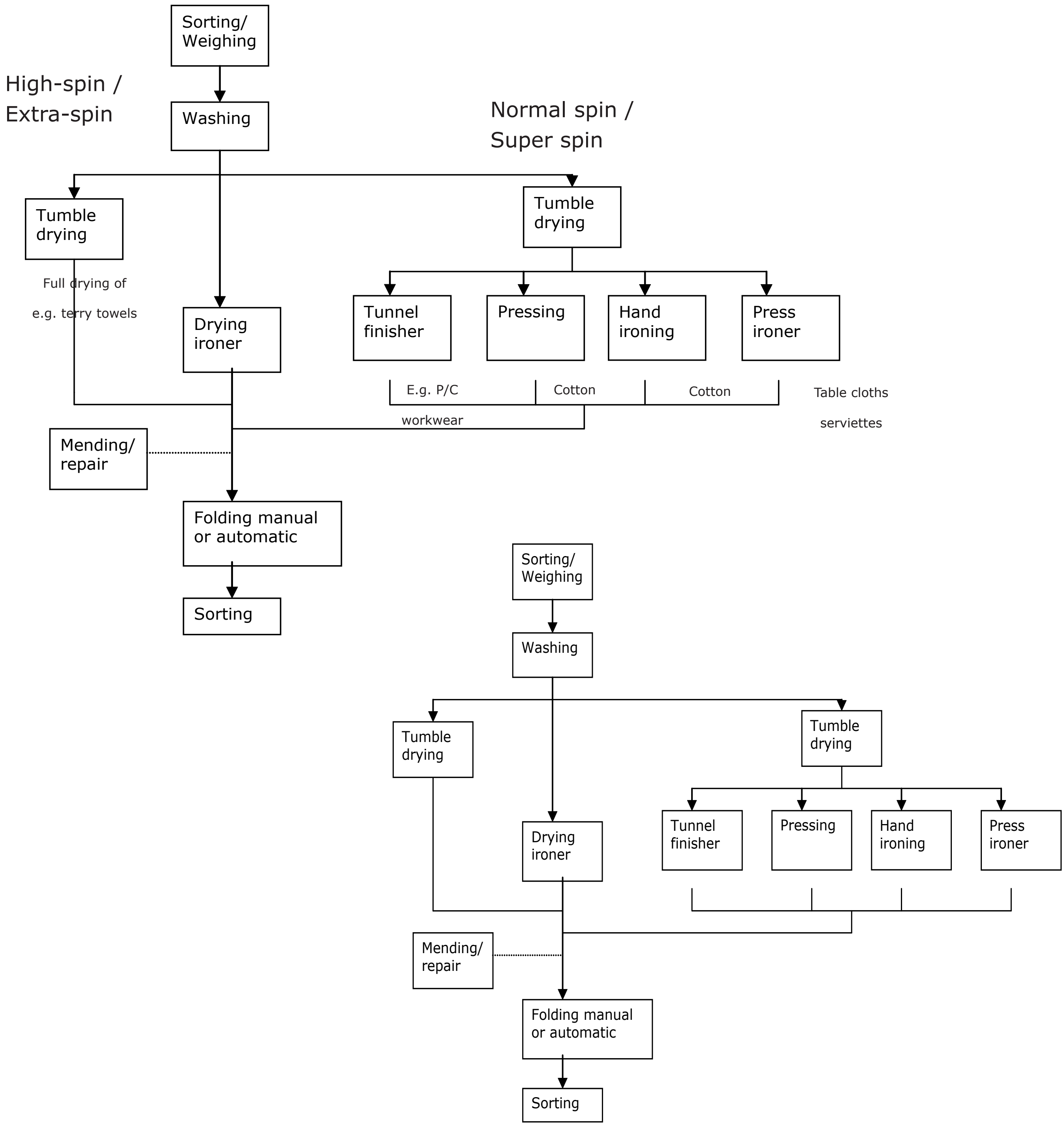
Washing Process in General

The washing process in a laundry comprises all aspects - from the collection of dirty laundry to the delivery of the finished goods.

The following activities are normally included in the process:

- Sorting and weighing
- Washing
- Dewatering/drying
- Ironing and pressing
- Mending
- Folding
- Storage prior to delivery

The figure below shows a simple production-flow diagram in a normal laundry.



Textile washing is basically a combination of mechanical and chemical processing, time and temperature (Sinner's Circle).

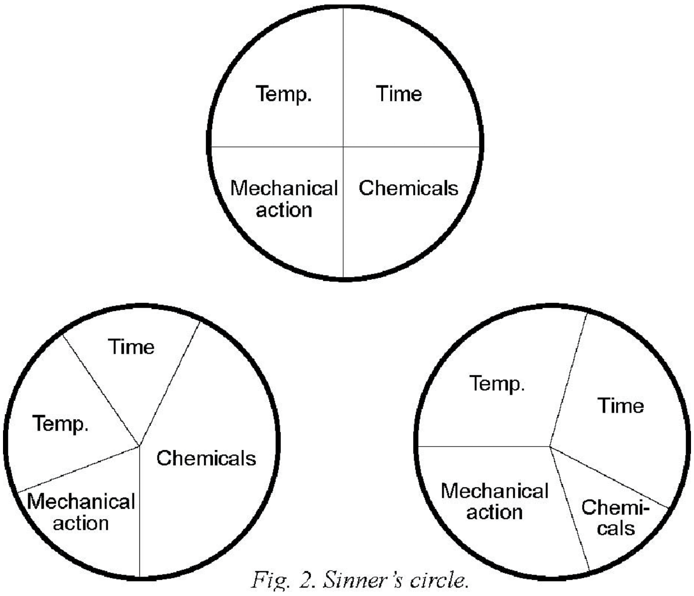


Fig. 2. Sinner's circle.

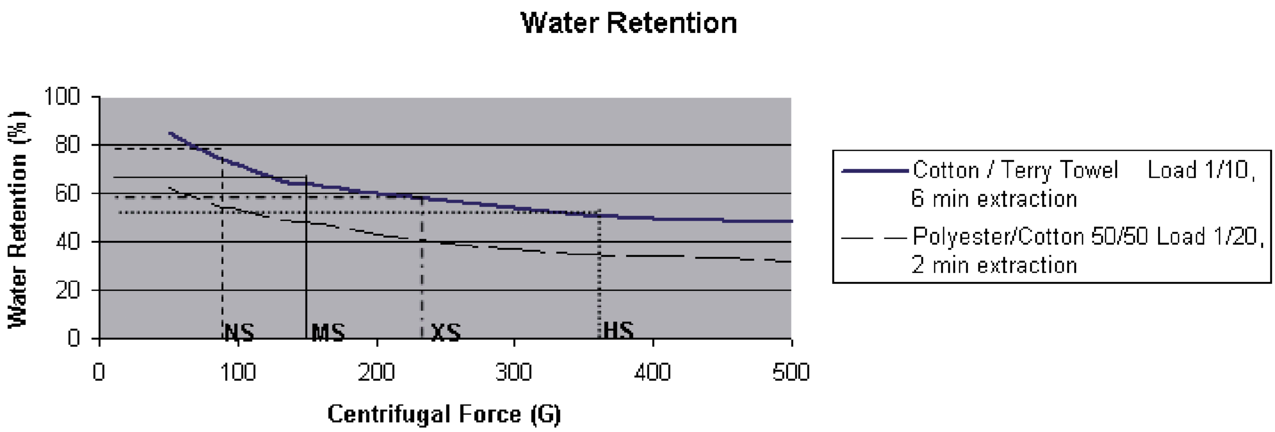
The Circle shows that the sum total of these factors corresponds to the energy required to wash a certain amount of a certain type of textile. These four factors are interdependent and if one factor is altered, the remaining factors must be altered correspondingly, in order to acquire a fixed result.

- The **mechanical action** is performed by the machine.
- The **chemical process** occurs using water combined with a washing detergent.
- The **time**, and **temperature** at which the process must be performed, is compiled in a washing programme that determines the characteristics and ulti mately the field of application the actual washing process is given.

The washing process is divided into different phases, e.g. pre-wash, main wash and rinsing. In order to obtain good results, it is important to acquire the correct balance between the mechanical and chemical process and the time and temperature in each phase.

During the washing process, the clothing absorbs water. The amount of water absorbed depends on the type of textile, e.g. cotton absorbs approximately twice its weight, whilst a mixture of cotton and polyester absorbs considerably less.

The dewatering process generally begins with hydro extraction (centrifuge). The residual moisture after hydro extraction in high-spin washing machines or separate hydro extractors varies for different types of washing:



The drying and the finishing process varies for different textiles, but basically the process can be divided as follows:

- Tumble drying
- Ironing
- Finishing

After the drying process, any mending and folding is done before delivery from the laundry.

Textiles

Textiles can be divided into two large main groups: material made of natural fibres and man-made fibres.

Natural fibres

Natural fibres breathe, i.e. they have the ability to carry away moisture from the skin.

Consequently they feel pleasant against the skin. Natural fibres are divided into plant fibres and animal fibres.

Amongst the plant fibres, **cotton** is by far the largest. Cotton is a high quality material with high wear resistance. It endures powerful processing and high temperatures. A suitable washing temperature for cotton is 60 - 95°C. Another plant fibre is **linen**, which is used when a stiff and lustrous surface is desired, e.g. for tablecloths, serviettes and table mats. Linen is not as wash-resistant as cotton and preferably should be washed in temperatures below 60°C.

An example of animal fibres is wool, where wool from sheep is the most common. The shape of the wool fibre is wrinkled and has good stretch properties. The material creases only slightly and also encapsulates air, the reason why woollen material is warm.

During washing, **wool** is sensitive to mechanical action and the recommended washing temperature is 40°C. Woollen garments marked contain pure wool and can be washed in a machine that uses a special wool-washing programme.

Silk is a material that requires the same care as wool (maximum 40°C washing temperature). The material normally should not undergo hydro extraction. Instead it should be drip-dried or alternatively, the rinsing water can be wrung out in a terry towel. In machines with special silk-programmes, e.g. Lagoon®, hydro extraction may be used.

Man-Made Fibres

Man-made fibres are divided into two sub-groups, synthetic fibres and regenerated fibres.

Synthetic fibres

are manufactured from the raw materials petroleum or coal by a chemical-technical process. Common synthetic fibres are polyester, acrylic and polyamide fibres (nylon). Synthetic materials are strong and have good crease resistance.
The disadvantages with synthetic material are that due to its limited water retention ability:

- it forms static electricity that causes the garment to “stick” to the body.
- it feels cold in cold weather and wet and sticky in hot weather.

By manufacturing synthetic materials that are more porous, the disadvantages of trapped moisture can be avoided.

The advantages of synthetic materials are that they are easy to wash and dry quickly, as they don’t retain water.

Regenerated fibres

Regenerated fibres can breathe in the same way as natural fibres and consequently feel pleasant against the skin. The most important and most commonly used regenerated fibre is viscose, which is produced from cellulose, e.g. from spruce or hardwood. **Viscose** is available in several different variations, from material requiring high washing temperatures and powerful processing (similar to cotton) to qualities that cannot withstand temperatures higher than 40°C. Viscose can stretch when wet. This is important to consider when hanging heavy garments that contain a lot of water.

Summary

Natural fibres and synthetic fibres have different qualities that have advantages and disadvantages when manufacturing garments. By combining various fibres, the best qualities in each respective fibre can be used.

For example, a pair of socks with a wool/synthetic blend will be:

- stronger than a pair of socks made only of wool
- warmer than a pair of socks made only of synthetics.

Furthermore, material with a blend of cotton/synthetic will provide:

- a more crease-resistant fabric than those made from cotton only.
- a fabric that only shrinks slightly compared to those made of cotton.

Water

The quality of the water is important to achieve good washing results. Water supplied through mains does not normally cause problems, except perhaps from the degree of hardness in the water.

During the washing process, water operates partly as a solvent for the soluble alts in the soiled fabric and partly as a transport medium for dispersed dirt.

Water has the following characteristics that must be taken into consideration when washing:

- High surface tension
- Varying degree of hardness depending on geographical locations
- Alkalinity after softening
- Metal content

The ideal water for washing, that causes no discomfort when washing and which achieves the best possible detergent economy, should contain the following values

Hardness	less than 4 - 5°dH
pH	7.0 - 7.5
Iron	less than 0.1 mg/l
Manganese	less than 0.05 mg/l

The following values are recommended for the water used in washer extractors, finishing equipment and steam boilers in order to achieve good results and a trouble free operation.

- Colour value to be below 30 (not critical)
- pH value to be between 7-8.5
- Alkalinity should to be above 60 and preferably to be above 100 mg HCO3/l
- Total hardness should not exceed 5° dH
- Iron, Manganese and Copper is harmful to washing and the limit value are as follows:
  - Fe < 0.2 mg/l
  - Mn < 0.05 mg/l
  - Cu < 0.05 mg/l

- Chloride content must be below 100 mg/l
- Conductivity should be between 5-150 uS (if the value is below 1, the water is aggressive and pitting can begin on the stainless steel and metal components)

If the quality of the water is unknown, a water analysis should be made on site. If necessary, a fully automatic water-softening unit should be installed to soften the water. *Please contact local water purification specialists.*

High Surface Tension

Clean water has a high surface tension that makes it difficult for the water to penetrate between the textile fibres and into the dirt on the material. By adding surfactants (an integral part of the washing detergent) to the water, the water surface tension is lowered and the water washing ability is consequently improved.

Hardness

Various substances in the earth are dissolved in natural water. The most important of these substances, where washing is concerned, are the water hardeners, i.e. calcium and magnesium salts. The content of salts and consequently the hardness of water varies considerably between different geographical areas depending on the type of soil.

The degree of hardness of water is defined in the unit °dH, German degree of hardness (water at 1°dH contains as much soluble calcium per litre as 10 mg quick lime, CaO).

- Soft water 0 - 6 °dH
- Medium hard water 7 - 13 °dH
- Hard water 14 - 45 °dH

The negative effect of hard water is that the hardeners combine with the surfactants in the washing detergents, which results in the detergents losing their cleansing efficiency.
The resulting compounds also tend to stick to the washing, causing it to lose its appearance (washing becomes greyish and colours dull). It may also cause a decreased softening effect and sometimes even a bad odour.

It is important to dose the washing detergent in proportion to hardness of the water. If the water is hard, the machines must be de-scaled at regular intervals (De-scaling agents are available from the Spare Parts Department of Electrolux Laundry Systems).

If the water is extremely hard, it is advisable to install an ion-exchange filter to soften the water and thus avoid problems with the washing results and with chalk deposits in the machine. Please contact local water purifying specialists.

The installation and operation of an ion-exchange filter is fairly costly. Costs must however be put in relation to savings in the form of considerably lower washing detergent costs and less wear and tear on the machines.

Alkalinity

A term that is used in conjunction with alkalinity is the pH value (potential Hydrogenous), which is a logarithmic index for the hydrogen ion concentration in an aqueous solution. The pH is measured on a scale from 0 - 14. At 20°C, distilled water has a pH value of 7, i.e. it is neutral. Values above pH 7 indicate alkalinity and values below pH 7 indicate acidity.

The term pH is derived from “p”, the mathematical symbol of the negative logarithm, and “H”, the chemical symbol of Hydrogen. Water that is softened in an ion-exchange filter normally shows an alkaline reaction, sometimes even causing yellow discolouring to appear on the laundry goods, especially after thermal treatment after washing.

This problem can be avoided in two ways:

- ”Acidify” the last rinsing water, i.e. add acetic acid and consequently neutralize the alkalinity. Please contact the washing agent supplier.

- Using hard water in the last rinse(s) is a commonly used method. However, tests show that rinsing in soft water gives the same result. There are two disadvantages in using hard water for rinsing. Extra detergent must be added in the following wash cycle to compensate for the deposits of the hard water in the textiles. In addition, hard water increases the wear and tear on the textiles. That is why Electrolux Laundry Systems does not provide hard water valves on its new range of washers.

Metals

The metals found in water which cause problems in the washing process, are iron and magnesium. High levels of these metals cause:

- Discolouration of textiles (precipitation)
- Damage to textile fibres.

By installing special filters, or filters in combination with softening-filters, these problems may be avoided.

Measures must be taken with discoloured washing prior to the next wash. This can be done using special rust-dissolving detergents, e.g. a solution containing 2% oxalic acid.

Washing, Rinsing & Bleaching Agents

In this chapter the configuration and the action of the washing, rinsing and bleaching agents is described very briefly.

Washing Detergents

Washing detergents are divided into alkaline, neutral or acidic, depending on their pH-value. Usage of the different types depends on the alkalinity or acidity of the washing detergent. Figure 3 shows a summary of the qualities of washing detergents in relation to their pH-value.

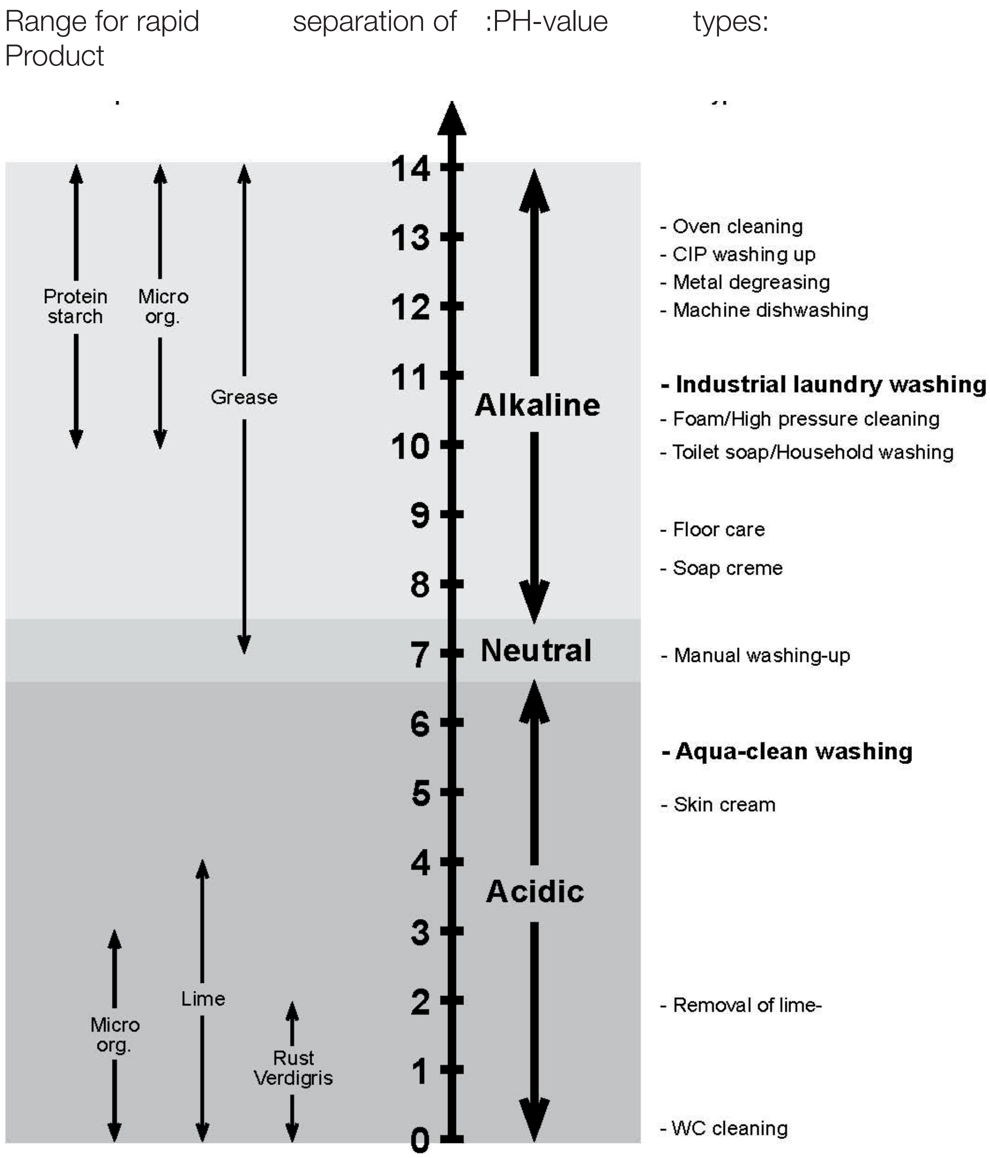


Fig 3 pH-value of washing detergents

The main components of washing detergents are surfactants and water softeners.

Surfactants (synthetic or soap) is the active washing substance in the detergent, that releases dirt from the material and consequently performs the actual washing.

Water softeners (complex bonding detergents) are used to modify the properties of water. The choice of a suitable softener is made when commissioning the actual project. Common water softeners are phosphates, zeolite and sodium carbonate.

- Phosphates: Complex bond of calcium and magnesium ions in the water. Phosphates also act as a pH-regulator (buffer). If the water contains too many $Ca2+$ and $Mg2+$ ions, these bonds to the washing detergent and the cleansing effect deteriorates. So-called lime soap may also be formed, causing the washing to become greyish. It may also cause coating in the machine.

- Zeolite bond calcium ions. The magnesium ions are too small and are not affected.

- Sodium carbonate precipitates calcium as carbonate. This may in due course cause lime coating in the machine.

Rule of thumb:
15 grams average per kg wash (contact local supplirer)

Rinsing Agents

The rinsing agent normally contains quaternary ammonia salts. Using rinsing agents in the final rinse, gives the following effects:

- softens the material.
- prevents the material from becoming statically charged.
- prevents bacterial growth through biocide effects.
- improves dewatering (the residual moisture can be reduced by 7 - 8% when rinsing agents are used).

Bleaching Agents

Bleaching agents in the washing process are used to restore the original colour of the goods in the event of discolouration. Under this heading, the qualities of the most common bleaching agents and the risks associated with their use are described.

Amongst the most common bleaching agents are sodium perborate, TAED, sodium hypochlorite, hydrogen peroxide and sodium chloride.

- **Sodium perborate** is found in powder washing detergents. The detergent is effective from 70°C and above.

- **TAED** (Tetra Acetyl Ethylene Diamine) activates perborate that becomes effective at 40°C and has good bleaching effect at 60°C.

- **Sodium hypochlorite** (chlorine) acts as a powerful oxidation detergent and may only be used on white goods. This bleaching detergent should not beused together with a washing detergent. Bleaching should normally occur in the first rinse. Sodium hypochlorite is effective in the temperature range 40 - max 60°C and a pH-value between 9.5 and 11.

Note!
At temperatures that are too high (above 50°C), combined with a high pH (above 10.5), the hypochlorite dissolves and hydrochloric acid is formed, causing decomposition of cotton fibres. Correct dosage is also important to prevent unnecessary decomposition of fibres.

- **Hydrogen peroxide** replaces hypochlorite and provides a bleaching detergent that is con siderably more environment friendly. It is effective at 60 - 80°C and has a pH-value of 10 - 12. In the presence of rust (Fe2+), hydrogen peroxide may damage fibres.

- **Sodium chloride** is a reducing bleaching detergent that is effective in the temperature range 80 - 95°C and at a pH-value 3.5 - 5.

Note!
Sodium chloride is very corrosive and may not be used in washing machines. When bleaching, a plastic or enamelled vessel should be used.

Programming Washing Machines

Programme Configuration

The table below is an overview showing **general** proposals for programme configuration. Local requirements and regulations should be followed as a general rule.

Textile type	Temperature	Type of goods	Hydro extraction time
Synthetics, polyamide,			
Polyacryl	< 40 °C	Normal wash	Short 1 – 1.5 minutes
Wool, sensitive items	< 40 °C	Gentle wash	Short 1 – 1.5 minutes
Linen	< 60 °C	Normal wash	Short 1 – 1.5 minutes
Cotton			
- coloureds	< 60 °C	Normal wash	Long 4 - 6 minutes
- whites	< 80 °C	Normal wash	Long 4 - 6 minutes
Polyester	< 80 °C	Normal wash	Short 1 - 2 minutes
	(cooling required above 60 °C)		

Degree of soiling	Time (main wash)	Temperature	Pre-wash	No. of rinses
Light	6 - 10 minutes	< 60 °C	no	3
Medium	8 - 12 minutes	< 60 °C	no	3
Heavy	10 - 14 minutes	< 60 °C	yes	3

Hygienic demand differs depending on guidelines in each country.

Germany 85 °C for 15 minutes or 90 °C in 10 minutes
(Bundesgesundheitsblatt BGA)

Great Britain 65 °C for 10 minutes or 71 °C in 3 minutes
(The Department of Health recommends in HSG)

Sweden 70 °C for 10 minutes
(HSS Hälso- och Sjukvård Standardiseringen)

Denmark 80 o C for 10 minutes
(Dansk Standard – DS2451-8)

France 65 o C for 20 minutes
(Pasteur institute)

Tips to Remember When Programming

- To achieve a better washing result (without a pre-wash), especially on protein-based soiling (egg, milk, blood, etc.), the main wash should begin with a cold period before heating begins.

- Normal action can for example be 12/3, 9/6, 12/8 or 14/6 (seonds).

- Gentle action can for example be 3/12, 5/12, or 5/15 seconds.

- Draining time should be 1 - 2 minutes depending on the size of the machine.

Normal action	
Rotation	Pause
12	3
9	6
12	8
14	6

Gentle action	
Rotation	Pause
3	12
5	12
5	15

- Low extraction should be 1 - 2 minutes prior to high extraction.

- Rinsing periods should be 2 - 3 minutes after the achieved level.

- Extraction is by far the cheapest method to get rid of water from the washing, much cheaper than any other way of removing water. It is important therefore to optimise extraction time in relation to the type of washing.

Please refer to the heading “Washing programmes” in the chapter “The washing process in general” and to documentation for relevant machine.

Wash Programmes

In this section, general information is provided to help understand wash programmes. It also includes a list of examples showing a number of prepared programmes suitable for the sales concepts “Hotel/Industry” and “Hospital/Institution”. Information on rules and tips when programming, is provided in the section “Programming” under the heading “Commissioning” under this tab.

Lightly and normally soiled washing generally only requires one main wash, 3 rinses and one final extraction to achieve satisfactory washing results. Severely soiled washing normally requires a pre-wash and an extra rinse.

The temperature, 40, 60 or 90°C, is selected, depending on the kind of textile, type of washing and when the risk for contamination is present. Special programmes are often required for washing functional garments, e.g. fire garments, operating room (OP) textiles or garments used in the food industry. When choosing a programme, the laundry production must also be taken into consideration.

In the service manual for each respective washing machine, the fixed programmes built into the machine are described. The table below shows a list of thirteen programme examples that provide a good range of the needs for the sales concepts "Hotel/Industry" and "Hospital/Institution". Thereafter, each respective programme is described.

Programme	Description	Hotel/Industry	Hospital/Institution
1	Coloured, cotton, lightly soiled 60°C	☐	
2	White goods, cotton, lightly soiled 85°C	☐	☐
3	Kitchen goods, tablecloths, work-wear, cotton		
	Lightly soiled (60 to 85) °C	☐	☐
4	Kitchen goods, tablecloths, work-wear, cotton		
	lightly soiled (85) °C	☐	☐
5	Work-wear P/C, lightly soiled 60°C	☐	☐
6	Work-wear, tablecloths P/C, normally soiled (60) °C	☐	☐
7	White goods, work-wear, tablecloths P/C		
	severely soiled (60 to 85) °C	☐	☐
8	Entrance carpets, mops C, 85°C	☐	☐
9	Entrance carpets, synthetics, 40°C	☐	
10	White goods, cotton (60 to 85) °C		☐
11	Coloured goods, cotton, (40 to 60) °C		☐
12	Delicate goods, blankets, cardigans, 40°C		☐
13	Delicate goods, synthetics, 40°C	☐	

Wash Programme Manager software has been developed by Electrolux Laundry Systems (ELS) to help train everyone to do an optimised wash programme (contact the Logistics Department at ELS).

Wash programmes for the various controls (Compass, Clarus, etc.) are described in the Operating Manuals available on our website: www.laundrysystems.electrolux.com

Planning Projects

It is of utmost importance that each project that is started in an organisation, is accurately specified. The purpose of this is to clearly define areas of responsibility and commitment within the project, to the customer and to any subcontractors.

Under the heading “Project specification”, there is a proposed form. The purpose of the form is to facilitate project specification and to prevent any important issue not being fully clarified between the various parties working on the project.

The form should be filled in completely and any questions should be clarified before calculating, planning and dimensioning the project.

Project Specification

The figures in brackets in the various fields of the form, refer to explanations under the heading “Instructions for project specification”. The form is available as an answer sheet, see appendix 3.

Office Use Only	
Ref No.	

PROJECT REQUEST FORM

PRESENTATION	
Date Proposal Required:	Presentation to comprise : (tick as appropriate)
Company:	Projects
Adress:	☐ Detailed Quotation
Postal Code: (Country?)	☐ Proposed Layout Drawing
Attention of (Name):	☐ Sales Literature
Positon:	Laundry Equipment Only
Telephone number:	☐ Detailed Reports on Potential Savings
Is the presentation to be sent directly to the Customer?	☐ Summary of How Savings are Achieved
	☐ Breakdown of How Machine Was Selected

PROPOSED SITE	
Name of site:	
Adress: Postal code:	
Site Contact Name:	Telephone Number:

COPIES TO BE SENT TO
External:
Internal:

ADDITIONAL INFORMATION:
Margin Required : Group Product List Less % 3rd Party %GM
Budget:

Further Information:
Competitors:
What Floor is the Laundry on:
Approximate Date of Delivery:

REQUESTED BY
Name:
Date:

Instructions for Project Specification

The figures in the form refer to the following instructions, which contain examples and explanations of the heading in each box.

1. State who is the ultimate customer.

2. In some cases, the project has a separate designation (e.g. different projects for the same customer).

3. Date when this project specification is drawn up.
   If the project can be classified into any of Electrolux Laundry Systems sales concepts, please specify here, e.g. OPL, Lagoon, AHL, Coin-op laundry, etc.

4. Name and telephone number of the person who is responsible for the project for the final customer.

5. The Project Manager at Electrolux Laundry Systems subsidiary company or distributors.

6. In cases where areas of responsibility are shared within the project, state name, area of responsibility and telephone number for these people.

7. Give a short description of the premises.

   Premise profile:
   type of building (professional building – only employees are allowed in the premises OR semi-professional building – public is also welcome on the premises (a few local regulations interfere with the laundry layout and security devices, due to public visitors).

   Type, number of floors, lift, etc.? Are the premises to be built or do they already exist? Does building construction affect the choice and location of the equipment?

   Access to the laundry area to transport the machines: doors sizes, corridor, stairs, height etc. Do we need to disassemble parts of the machine? Photos if possible are always good for access problems and routes into area.

8. Is there a drawing describing the layout of the building?
   - If YES, specify the drawing number.
   - If NO, who is responsible?

9. Specification of the goods for which the project is to be dimensioned (specify the amounts of different goods to enable accurate calculation of the dimensions of the pressing iron, tumble dryer, etc.).
   - Four main categories are well known:
     - large flat or apartment
     - small flat
     - wet laundry to be tumble-dried
     - all other laundry

   - List of goods:
     - large flat: bed sheets all sizes, large table clothes, etc.
     - small flat: pillow cases, napkins, aprons, hospital gowns, etc.
     - laundry to be tumble-dried: terry towels, etc.
     - all other laundry: clothing, delicate items, etc.

10. This information is necessary to calculate the relationship between the number of staff required and the number of machines required. This is normally specified in kg/day, although other units may obviously also be used.

11. Specify how the goods are to be transported into, within and out of the plant. Specify if the goods are to be sorted, ironed, pressed, etc.

12. Is there a production-flow layout available?
    - If YES, specify drawing number.
    - If NO, who is responsible?

13. Specify the staff capacity available or the staff capacity that the customer has planned to establish for this project.

14. What is the operating time for the dimensions of the project to be calculated (number of hours/day, two shifts, three shifts, etc.).

15. To enable machine configuration in the dimensioning phase of the project, specify avaiable data for:
    - Energy (electricity, gas, steam, thermal fluid)
        - if gas (nature: natural, LPG, other)
        - if steam (steam vessel capacity, pressure, etc.)
    - Water (cold soft, cold hard, hot hard, etc.)
    - Available water treatment system for used water. (Check local environmental legislation: for water temperature, pH, etc.)
    - Compressed air
    - Floor condition
    - Drainage
    - Ventilation
    - Air inlets and outlets
    - Available liquid or powder chemical installation

16. In cases where the Project Manager engages subcontractors for different parts of the project, the commitments of each subcontractor must be clearly defined, and a contact person specified.

17. The Project Manager must draw up a timetable for each project. Specify the registration number here. It is also appropriate to specify the planned starting date and the expected date when the plant is to be handed over.

18. Should recommendations for spare parts be specified? Is delivery of spare parts included in the project? Specify the registration number of relevant documents. Include in project quotations for after sales service, warranty labour cost, etc.

19. This is a very important item that must define clearly and distinctly the delivery limits, commitments and responsibility to the customer which are related to the project. If there are other guidance documents relating to the project, apart from the project specification, then they must be registered and listed here under the heading: “Comments”.

Calculating Dimensions

Directions, tips and simple rules of thumb that may be useful when calculating the machine configuration of the project are covered in this chapter.
The calculation of dimensions in a project includes the following:

- Machine configuration with general rules and concepts that apply when choosing a machine.
- Designing the layout.
- Vibration and noise.
- Guidelines for design of the foundation.
- Ventilation.
- Tips and rules of thumb when calculating electricity, water, steam, gas and compressed air.
- Drawings for installation details.
- Which additional items should be packed (examples for different machine options).
- What documentation should be delivered with the project.

Note!

For hospitals, nursing homes, old peoples' homes and also for hygienic process in food industry.

Since a large amount of contaminated laundry is normally found in a hospital, this will inevitably affect the dimensions and choice of equipment.

Example:

- Local legislation and regulations determine the time and the temperature needed for the destruction of any bacteria in the contaminated goods. These factors affect the cycle length of the washing process and consequently the choice of equipment.

- Electromechanical and pre-programmed microprocessor-controlled programmes do not always comply with legislation and regulations concerning the washing of contaminated laundry. For this reason machines with programmable microprocessor-controlled programmes are the only solution in these specific cases.

- Hygiene, legislated or not, is also a reason to consider through-feed machines (Barrier washers range), that ensure strict hygiene between the soiled and clean areas. Since 2003 the EN 14065 standard is applicable to all European countries.

EN 14065 title

TEXTILE - LAUNDRY PROCESSED TEXTILE - BIO CONTAMINATION CONTROL SYSTEM.

Note!

Are customers (in European countries) concerned by the scope of EN 14065 standard?

Do customers need to respect the RABC* method or other quality systems with means for traceability?
Do customers need the CMIS** system connected to a computer? (For traceability).

* Risk Analysis Bio-contamination Control
** Certus Management Information System

Product Configuration

Configuration is influenced by the customer segment (Horeca, Healthcare, self-service, etc.), the type of textile, the conditions at each respective laundry, all of which will influence the choice of product design (N: normal-spin, S: super spin, H: high-spin, X: extra-spin).

The cost efficiency of each concept is dependent on the relationship between capital, labor and operation costs. This can vary in different countries and in different parts of the world.
Machine configuration section is divided into the following sub-sections:

- Product design
- Examples when calculating washing capacity (hotels and hospitals respectively).
- Proposal of appropriate machine configuration and layout at different washing capacities, for hotels, industry and hospitals.

Model	Normal	Super	Extra	High
G-force	**100**	**200**	**300**	**300-425**
Textiles				
Terry towelling	-	-	-	OK
Cotton	-	-	(OK)	OK
Poly/Cotton	OK	OK	OK	OK
Polyester	OK	OK	OK	OK
Segments				
Horeca/Health care – large	-	-	OK	OK
Horeca/Health care – small	(OK)	OK	OK	OK
Commercial laundries	-	-	OK	OK
Self-service laundries	OK	OK	-	OK

Calculating Washing Capacity at Hotels

Cotton	Filling factor 1:10
Electrical heating	Washing capacity up to 100 kg/h
Steam heating	Washing capacity from 100 kg/h

Kg per bed factor for	**3 stars**	**4 stars**	**5 stars**	**Finish Category**
• bed linen	1.50	2.00	2.50	FW (Flat Work Iroer)
• bathroom towels	0.75	1.00	1.50	TD (Tumble Dry)
• catering linen	0.25	0.50	0.50	FW (Flat Work Ironer)
• staff garments	0.25	0.25	0.25	P (Press/Hand Iron)
• various	0.25	0.25	0.25	TD (Tumble Dry)
Total kg per bed factor (K)	**3.00**	**4.00**	**5.00**	

Finishing categories as a percentage of total washing capacity

Flatwork Ironer FW		60%
Tumble dry fully		40%
Pre-dry before FW and P	20% (only with N/S spin washers)	
Tumble Dry total	TD	60%
Press/hand iron	**P**	**10%**

Variable Parameters

B=	Number of beds	
F=	Frequency of linen exchange per week	
	Every day	= 7.00
	Every other day	= 3.50
	Every third day	= 2.30
	Once a week	= 1.00
K=	Kg per bed factor	
O=	Occupancy rate of beds	
H=	Working hours per week	
Q=	Total amount (kg) of washing per hour	

Formula for calculating capacity

$$Q = \frac{B \times F \times K \times O}{H} \text{ kg/h}$$

Example 1: 100 bed - 3 stars hotel

B= 100 beds
F= Every second day = 3.50
K= 3 kg per bed
O= 80% = 0.8

$$Q = \frac{100 \times 3.5 \times 3 \times 0.8}{40} \text{ kg/h} = 21 \text{ kg/h}$$

Example 2: 300 bed - 4 stars hotel

B= 300 beds
F= Every day = 7.00
K= 4 kg per bed
O= 100% = 1.0
H= 6 days x 8 hours = 48 hours

$$Q = \frac{300 \times 7.0 \times 4 \times 1.0}{48} \text{ kg/h} = 175 \text{ kg/h}$$

If the information is inadequate, a rough estimate for a 5-stars hotel with 300 beds can be calculated as follows: **5 kg linen/bed and day plus 25 kg/hour and laundry staff.**

Calculating Washing Capacity at Hospitals & Institutions

Cotton Filling factor 1:10

Steam heating washing capacity from 100 kg/h

Kg per bed factor for	Institution	Public H	Private H	Finish category
• bed linen	1.50	1.50	2.00	FW (Flat Work)
• bathroom towels	0.75	0.75	1.00	TD (Tumble Dry)
• operation linen		0.50	0.50	FW (Flat Work)
• catering linen	0.25	0.25	0.50	FW (Flat Work)
• staff garments	0.50	0.50	0.75	P Press/Hand Iron)
• patient garments	0.50	0.50	0.75	P (Press/Hand Iron)
• various	0.25	0.25	0.25	TD Tumble Dry)
Total kg per bed factor (K)	**4.00**	**4.50**	**6.00**	

Finishing categories as a percentage of total washing capacity

Washing - regular		90%
Washing - infected		10%
Flatwork	FW	60%
Tumble dry fully		40%
Pre dry before FW and P		20% (only with N/M spin washers)
Tumble dry total	TD	60%
Press/hand iron	P	10

Variable parameters

B=	Number of beds	
F=	Frequency of linen exchange per week	
	Every day	= 7.00
	Every other day	= 3.50
	Every third day	= 2.30
	Once a week	= 1.00
K=	Kg per bed factor	
O=	Occupancy rate of beds	
H=	Working hours per week	
Q=	Total amount (kg) of washing per hour	

Furmula for calculating capacity

$$Q = \frac{B \times F \times K \times O}{H} \text{ kg/h}$$

Example 1: 200 bed - public hospital

B= 200 beds
F= Every day = 7.00
K= 4.5 kg per bed
O= 80% = 0.8
H= 5 days x 8 hours = 40 hours

$$Q = \frac{200 \times 7.0 \times 4.5 \times 0.8}{40} \text{ kg/h} = 126 \text{ kg/h}$$

Example 2: 250 bed - private hospital

B= 250 beds
F= Every day = 7.00
K= 5 kg per bed
O= 100% = 1.0
H= 6 days x 8 hours = 80 hours

$$Q = \frac{250 \times 7.0 \times 5.0 \times 1.0}{48} \text{ kg/h} = 182 \text{ kg/h}$$

If the information is inadequate, a rough estimate for hospitals and/or institutions with 300 beds, can be calculated as follows: **5 kg linen/bed and day plus 25 kg/hour and laundry staff.**

Product Selection Design On Which the Choice of Equipment is Based

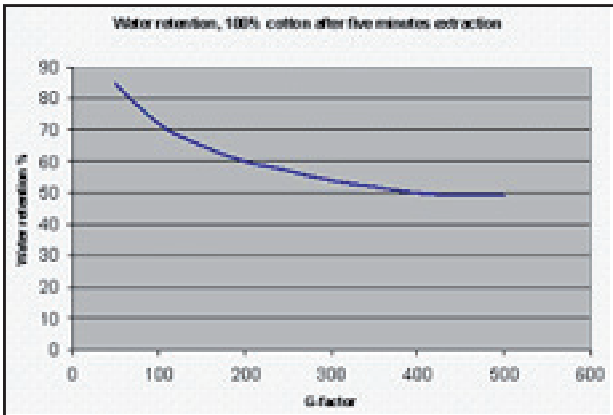
General Comments:

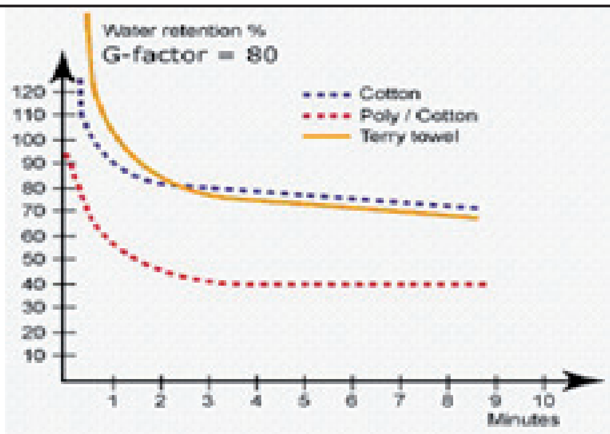
The cost efficiency of each concept depends on the relationship between capital, labour and operating costs. This varies in different parts of the world.

Normal & Super Spin Washers

The G-force of our Normal & Super spin washer extractors are 100-200 G. If cotton is processed the water retention of the textiles after washing is approximately 80 - 65%. In order to decrease the moisture content to below 50% and to reduce time and utility consumption in the drying process, separate hydro extractors are always recommended.

If polyester-cotton material is processed instead of cotton, the selection of N & M models is appropriate, since the water retention of polyester-cotton is considerably lower. Consequently a separate hydro extractor will only be required to process the terry-towelling material before tumble-drying





+ Low machine investment

– Labour intensive (more manual handling)
  Terry towelling washing > extraction > drying
  Flat work, etc. washing > extraction > pre-drying > ironing or pressing

– Energy consumption
– The washer extractor must be permanently fixed to the floor on a special
  foundation.

High-Spin & Extra-Spin Washers

The G-force of high-spin & extra-spin washer extractors is 220-425 G. If cotton is processed, the water retention of the textiles after washing and extraction is approximately 50 - 60%. Terry towels are fully dried in the tumble dryers and flatwork can go directly to the ironer from high-spin washers. Cotton from extra-spin machine needs to be pre-dried before ironing.

Polyester-cotton can go directly to the ironer. after either a high-spin or extra-spin washer extractor.

+ Less labor intensive compared with N & S models
  Terry towelling washing > extraction > drying
  Flat work, etc. washing > extraction > ironing (high-spin)
  washing & extraction > pre-drying > ironing (extraspin-cotton)
+ Increased output per man-hour compared to the normal-spin concept
+ No special foundations required for washer extractors
– Higher machine investment

How to calculate residual moisture:

$$\frac{\text{Weight of wet linen (kg) - Weight of dry linen (kg)}}{\text{Weight of the dry linen (kg)}} \times 100 = \text{Residual moisture in \%}$$

Equipment Selection Principle:

Washer Extractors

Hotel:
Normally 100% of the laundry is to be washed.

On average, cycle time is calculated at one hour including loading and unloading.

The average filling ratio of a washer is 1:10 (1 kg of dry linen for 10 liters inner drum capacity).

It means that a W4240H washer will have 24 kg/hour wash capacity.

This means that if a wash capacity of 72 kg/hour is required, then washer extractors with a total capacity of 72 kg are also required (example: 3 x 24 kg capacity).

It is always preferable to have more than one machine. Two machines with relatively low capacity are therefore better than one machine with high capacity.

- In the event of breakdown all capacity is not lost
- Small batches are avoided which saves water, detergent etc.
- Reduced time to accumulate full loads of similar linen

Different types of washer extractors may be selected, as explained above.

Healthcare:
The average cycle time is calculated at one hour and a half (1 ½ hours), including loading and unloading. This means that a WSB4250H barrier washer will have 16 kg/hour wash capacity (33% less capacity).

If a wash capacity of 72 kg/hour is required, then washer extractors with a total capacity around 100 kg (72 kg/h + 33%) will also be required. (Example: 4 x 24 kg + 1 x 13 kg capacity).

In health care sectors a certain percentage of linen will be ”contaminated” (average of 10%). Using barrier washers for the processing of hygienic linen is recommended. Barrier washers are normally installed in an isolated room with a separate entrance for dirty linen, in order to avoid cross contamination

Hydro Extractors

Why use a hydro extractor? The answer: to remove the maximum amount of water before the drying or ironing process. It is all about the percentage of residual moisture content.

Hydro extractors should always be installed as a complement to Normal- spin washer extractors, if linen of terry toweling or cotton to be dried or ironed is

processed, as described in the concept normal-spin. With an extraction speed of 1450 rpm, hydro extractors ensure a high de-watering capacity, saving time, reducing energy consumption and increasing efficiency.

The average cycle time, including loading and unloading, is 10 minutes.

A hydro extractor must only run 5 loads per hour in order to prevent the motor from overheating. The capacity is normally 20% of the total washer extractor capacity, as the hydro extractor should only run 5 loads per hour. This means that for 72 kg of wash capacity approximately 15 kg extracting capacity is needed (15 kg x 5 loads/h = 75 kg/h).

If all the linen processed in the laundry is a poly-cotton mixture, no hydro extractor is required, as poly-cotton mixture holds less water (approximately 45% residual moisture after washing in normal-spin machines).

There are two types of hydro extractors; one with a suspended drum, and one with a rigidly mounted drum, which is suitable for marine installations.

In a hydro extractor with a suspended drum, rubber straps will absorb all vibrations.
The anchor-point of the hydro extractor does not require stability, and therefore this type is suitable for installations where a low noise level is important.

Due to vibrations from the ship or offshore installations, the construction of the hydro extractor with a rigidly mounted drum needs to absorb the vibrations from the extraction, and then transfer them to the anchor point.

Designed for maximum user safety, the hydro extractor features a monitoring system that ensures that the lid is securely locked until the drum has come to a complete stop. The cycle stops automatically if the load becomes unevenly distributed in the drum.

The cabinet has a tough construction and is manufactured in high-quality stainless steel to ensure a long lifetime.

Use Phenolphthalein on the linen in order to check if the rinsing result is sufficient. If detergent remains are found in the linen, problems will occur in the ironing process.

If the Phenolphthalein becomes pink when it is applied to the linen then, pH value is above 8.2.
If it remains transparent then, pH value is below 8.2.

On all Chest Ironers the pH value must be below 7 for problem free operation.

It is advisable to use an acetic acid in the last rinse in order to bring the pH value under 7.

Tumble Dryers

If possible, select tumble dryers with the same capacity as the largest washer extractor, to avoid dividing loads.

As a rule of thumb, calculate 1 tumble dryer for every 2 washer extractors of similar capacity, as the dryer can take 2 loads per hour if the linen comes from a high-spin machine or a hydro extractor (with approximately 50 % residual moisture content).

However, to avoid bottlenecks, calculate on average 1.5 full drying loads per hour or 3 pre-drying loads per hour.

If nothing else is specified regarding requested drying capacity, assume the following approach:

If using normal- or medium-spin washers, then 60% of the total washing capacity will be pre-dried before ironing or finishing.

If using high-spin or extra-spin washers, then 40% of the total washing capacity will be dried.

To calculate the dimensions of a tumble dryer, the filling ratio is 1:25 (ISO standard) or 1:20 to match other dryers on the market. This means that a tumble dryer with a 900 litre volume will have a capacity of 900:25 = 36 kg if using the loading factor 1:25. If using the loading factor 1:20 the capacity will be 900:20 = 45 kg. All laundry equipment capacities are given in dry linen.

The average drying cycle can be estimated at:
- 30 minutes if the moisture content is below or equal to 50 % (cotton / polycotton mixture)
- 40 minutes for heavy terry towels (400 g/m²) if the moisture content is approximately 55 % (cotton)
- 50 minutes if the moisture content is 70 - 80 % (normal-spin bascally)

Ironers

Ironers are normally a major portion of the total investment in the laundry. They should be selected with adequate capacity to cope with the calculated Flat Work (FW), in order to avoid bottlenecks.

Always match the largest flat linen with the cylinder working width in order to get maximum utilisation of the heated cylinder and thereby maximum ironing output and efficiency.

If there are no details of requested ironing capacity, assume 60 % of total washing capacity for both hotels and hospitals.

Capacity Calculations for Ironers

In the initial stages an ironer would normally be selected according to the water evaporation capacity in litre/hour (from the product datasheet), which has to be changed to kg/hour output capacity. As a guideline this can be calculated as follows:

$$\frac{\text{Evaporation potential in litre/hour x 80 \% usage (aver-}}{\text{Residual moisture content in linen}} = \text{approximately kg/hour capacity}$$

Example of IC44832, gas heating

(59 liter/hour x 80 % usage) / (50% residual moisture) = approximately 95 kg “dry weight”/hour.

As the aforementioned is a very general way of estimating a suitable ironer, it is recommended that a detailed calculation is made of the number of relevant items to be be processed in given time period, to ensure that the ironer has adequate capacity.

For example: we have made a calculation of a number of sheets that can be processed in one hour on an IC44832, using gas heating.

How many sheets can be processed in an IC44832 with gas heating?
Standard cotton sheets, dimension: 240 x 310 cm, at 175 gr/m2 = weight of 1.30 kg.

Specification IC44832 with gas:

- Maximum water evaporation per hour: 59 litres
- Length of cylinder: 320 cm

Calculation:

- Dimension of sheet: 310 cm x 240 cm
- Weight of sheet: 1302 grams
- Water retention in pecent: 50 %
- Water retention in gram: 651 grams
- Percentage of cylinder used: 3.10 m (sheet) / 3.20 m (cylinder) = 97 % usage
- Water evaporation l/hour: 59 liters x 97 % = 57.23 litres
- Water evaporation gr/minute: (57.23 liter x 1000 grams) / 60 minute = 953.83 grams/minute
- Maximum ironing speed if have to be fully dried: (953.83 grams/minute / 651 grams) x 2,40 m = 3.52 m/minute

Capacity per hour with a feeding gap of 40 cm between the sheets:

$$\frac{(3.52 \text{ m/minute x } 60 \text{ minutes})}{(2.40+0.40 \text{ m})} = 75 \text{ sheets/hour}$$

The previous calculation can be automatically done by using Iron-calc software (available from Central Marketing).

Calculations can be summed-up in the following output table indicating the maximum number of sheets that can be processed in our different ironers:

The calculations are based on the following conditions:

- Electric, gas and steam heated ironers
- Sheets made of 100% cotton: 145 grams/m2
- 50 % residual moisture
- Maximum operator efficiency (20 cm between sheets when feeding)

Sheet/ironer	IC43316	IC43320	IC44819	IC44821	IC44825	IC44828	IC44832
160x310 cm	53	43*	55*	“40*	27*	27*	112
180x310 cm	-	48	62	55*	34*	27*	100*
240x310 cm	-	-	-	-	62	55*	80
310x310 cm	-	-	-	-	-	-	62

Electric heated ironers
* Bad use of the cylinder working width

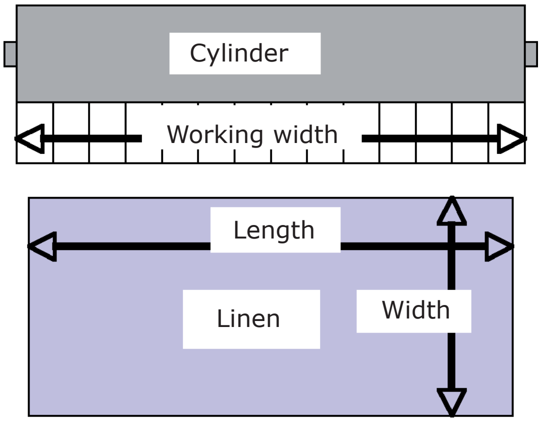
Sheet/ironer	IC43316	IC43320	IC44819	IC44821	IC44825	IC44828	IC44832
160x310 cm	46	38*	62	48*	32*	32*	130
180x310 cm	-	42	70	62’	40	32*	118
240x310 cm	-	-	-	-	70	62*	91
310x310 cm	-	-	-	-	-	-	70

Gas heated ironers
* Bad use of the cylinder working width

Sheet/ironer	IC44819 FFS	IC44825 FFS	IC44832 FFS
180x310 cm	85	85*	140
240x310 cm	-	85	105
310x310 cm	-	-	85*

Steam heated ironers – 10 bar pressure
* Bad use of the cylinder working width

As apparent from the previous table, the maximum efficiency of the ironer is always achieved when the width of the linen matches the length of the cylinder



Gas or steam heated ironers will generally have an output that is higher than the electric heated ironers.

Ironer Equipped with LF (Length Folding) Option:

If length folding is added, the output may also increase due to increased operator efficiency. Further the final folded sheets will be more uniform.

Ironer Equipped with FLF (Feeding & Length Folding) Option:

If feeding and length folding is added it can mean considerable reductions in staffing. Compared with a basic model where two operators feed and two fold, an FLF ironer requires only one operator for all functions. Only the cross folding has to be done manually.

Ironers equipped with FFS option:

If feeding, length folding and stacking are added, there are additional benefits for savings on labour costs, and increased production.

In Europe or countries with similar salary levels, the estimated payback time on an investment in an ironer with FFS option which requires only 1 operator (compared to a basic ironer requiring 3-4 operators) is only about 2 years, as a result of savings on salaries.
It must be emphasized however that the previous examples should only be used as a guideline as the examples used are based on theoretical calculations.

Finishing Equipment:

Different presses and ironing tables for different types of garments and parts of garments are available e.g. shirts, coats, sleeves, collars, etc. The capacity requirements for the number of items per hour should be estimated before selecting the equipment.

- For each ironing table with a sleeve arm, calculate 15 shirts/coats or 10 trousers per hour.
- For each combination of 1 utility press and 1 ironing table, calculate 25 shirts/coats or 15 trousers per hour.

As there are so many different types of finishing equipment on the market, it would be impossible to give average guidelines on various combinations and their hourly output.

Recommendations for finishing equipment must therefore be given on a case-by-case basis, depending on number of items per hour, the material and the required finish.

Other Auxiliary Equipment

Scales: (Weighing Equipment)

- Scales should be available in the sorting room of a laundry with a capacity which can cope with the number of kg/hour of goods, so that correct load sizes can be calculated for the washer extractors.
- For a number of high-spin washers an integrated weighing system (IWS) is available as an option. IWS helps to put the correct load weight and to optimise dosing of detergent and water intake.

Soiled Linen Trolleys:

- For transport from sorting area to washer extractors.
- If possible, select trolleys to match the load size of the washer extractors.
- Normally twice as many trolleys as washer extractors are needed.

Wet Linen Trolleys:

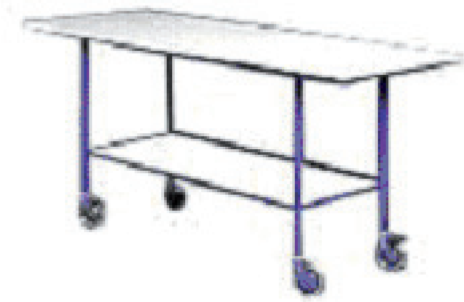
- For transport from washer to hydro extractor to dryer to ironers or presses.
- Normally one trolley is needed per washer extractor.

Shelf Trolleys & Garment Racks:

- For transport from dryer to clean linen store. 1 shelf trolley can stock approximately 150 bath towels or 300 hand towels.
- For transport from ironer to clean linen store. 1 shelf trolley can stock approximately 150 sheets or 400 pillowcases.
- For transport from presses and ironing boards to clean linen store.
- 1 shelf trolley can take approximately 100 shirts or 1 rack can take approximately 40 coats or equivalent garments

Tables:

Tables are needed for:
- Sorting of soiled linen
- Folding after fully drying
- Folding after ironing
- Folding after pressing and hand ironing
- Mending



Storage Shelving:

In an On Premises Laundry (OPL), normally only 3 sets of linen are required, in comparison to 4-5 sets if the laundry is sent out to an external contractor.

- 1 set in the room
- 1 set in the store
- 1 set in the laundry room

A clean linen store is required to take approximately 2 sets of linen to cover peak storage. Calculate on average: kg of wash/hour x hours per day.

This will give a general figure for the required storage capacity in kg of linen.

- A rack with four shelves, each 100 x 50 cm, can hold approximately 100 kg of folded linen.

Sewing Machines:

Recommended for mending in larger laundries. These should be placed on a worktable in a mending room or a clean linen room.

Marking Machines:

Recommended for temporary marking of guest garments and permanent marking of staff garments.

Laundry Bags:

Recommended to separate linen categories according to: colour, fabric, finishing, contamination (for processing in special barrier washers), etc., in order to facilitate efficient processing.

Colour coding bag saves time in the sorting phase of the laundry process.

It considerably increases operator efficiency in the sorting phase.

- 1 operator can handle 120 to 200 kg per hour, if pre-sorting takes place.
- 1 operator can handle 80 to 100 kg per hour, without pre- sorting

General Equipment Selection Tables:

On the following pages we have outlined the possible equipment selection for complete laundries, based on the general principles for equipment selection and giving two product selection designs: normal-, super-, high-, and extra-spin washers.

The tables should only be considered as a guideline, as specific requirements of the individual customers may call for specific equipment not accounted for in these general tables. When in doubt contact Central Marketing for assistance.

In order to keep the table simple, we have drawn them up using equipment generally needed for hotels. For hospitals, the following should be kept in mind and alternative products selected where appropriate:

- Hospitals may have contaminated linen that requires separate processing, i.e. operation linen, a special machine should be designated for this linen. This could be either a normal washer extractor or a barrier washer extractor. The capacity would normally be 10 % of the total washing requirement.

- As hospitals normally have a larger percentage of textiles to be pressed or hand-ironed, (20 % on average compared with 10 % for hotels) additional pressing and hand ironing equipment should be selected. We recommend adding the following to hospital laundries processing more than 100 kg/ hour, aside from what is proposed for hotels.

- Finishing cabinet - to dry and finish hospital gowns & uniforms if polyester-cottonor
- Steam air finisher - to prepare hospital gowns & uniforms before pressing if cotton.
- Laundry press - to cope with the extra presswork if cotton.

Proposed Machine Configuration

Main Laundry 20 - 60 kg/h

A = normal-spin, B = high-spin

Washing capacity	20kg/h		40kg/h		60kg/h	
	A	B	A	B	A	B
Machine Model	**Quantity**					
Sorting						
Table	1	1	1	1	1	1
Trolley	4	4	4	4	6	6
Washing						
W4105N/S	2					
W4250N/S			2			
W4330N/S					2	
W4105H		2				
W4240H				2		3
Trolley	2	2	2	2	2	2
Extracting						
C240	1					
C260			1			
C290R					1	
Drying						
T4190	1	1				
T4250			1	1		
T4350					1	1
T4290					1	1
Table	1	1	1	1	1	1
Store trolley	1	1	1	1	1	1
Ironer						
IB42314 (pre-dried linen)	1	1	1	1		
IC43316 or IC43320			1	1	1	1
Table	1	1	1	1	1	1
Store trolley	1	1	1	1	2	2
Finishing						
Ironer table	1	1	1	1	1	1
Table	1	1	1	1	1	1
Store trolley			1	1	1	1
Mending						
Sewing machine					1	1
Table					1	1
Miscellaneous						
Shelves	2	2	2	2	3	3
Table	1	1	1	1	1	1
Store trolley	1	1	1	1	1	1

If pre-dried

100 % washed

60 % ironed (flat linen covering 100% of the cylinder width)

40 % tumble-dried (garment and/or terry toweling)

Main Laundry 80 - 100 kg/h

A = normal-spin, B = high-spin

Washing capacity	**80 kg/h**		**100 kg/h**	
	A	B	A	B
Machine model	**Quantity**			
Sorting				
Table	1	1	1	1
Trolley	6	6	6	6
Washing				
W4250N/S	2			
W4330N/S	1		3	
W4240H		2		1
Trolley	3	3	3	3
Extracting				
C290R	1		1	
Drying				
T4350	1	1	1	1
Table	1	1	1	1
Store trolley	1	1	1	1
Ironer				
IC44825	1	1	1	1
Table	1	1	1	1
Store trolley	1	1	1	1
Finishing				
Ironer table				
Table				
Store trolley				

100 % washed

60 % ironed (flat linen covering 100% of the cylinder width)

40 % tumble-dried (garment and/or terry toweling)

Main Laundry 120 - 160 kg/h

A= normal-spin, B = high-spin

Washing capacity	120 kg/h		140 kg/h		160 kg/h	
	A	B	A	B	A	B
Machine model	**Quantity**					
Sorting						
Table	1	1	1	1	1	1
Trolley	6	6	8	8	8	8
Scales			1	1	1	1
Washing						
W4250N/S	1		1			
W4330N/S	3		4		5	
W4240H		2		1		
W4400H		2		3		
W4850H						1
Trolley	3	4	4	4	5	4
Extracting						
C240	1					
C260			2			
C290R	1				2	
Drying						
T4250	1	1				
T4350	1	1				
T4290			2	2		
T4650					1	1
Table	1	1	1	1	1	1
Store trolley	1	1	1	1	1	1
Ironer						
IC44832		1		1		1
IC46432 FFS	1		1		1	
Table	1	1	1	1	1	1
Store trolley	2	2	2	2	2	2
Finishing						
Ironer table	1	1	1	1	1	1
Press			1	1	2	2
Table	1	1	1	1	1	1
Store trolley	1	1	1	1	1	1
Mending						
Sewing machine	1	1	1	1	1	1
Table	1	1	1	1	1	1
Miscellaneous						
Shelves	6	6	7	7	8	8
Table	1	1	1	1	1	1
Store trolley	1	1	2	2	2	2
Compressor (local)			1	1	1	1

100 % washed

60 % ironed (flat linen covering 100% of the cylinder width)

40 % tumble-dried (garment and/or terry toweling)

Main Laundry 180 - 200 kg/h

B = high-spin

Washing capacity	180 kg/h	200 kg/h
	B	B
Machine model	**Quantity**	
Sorting		
Table	1	1
Trolley	8	10
Scale	1	1
Washing		
W4250H	1	2
W4400H	2	2
W4850H	1	1
Trolley	4	5
Drying		
T4900	1	
Table	1	1
Store trolley	1	1
Ironer		
IC44832	1	1
Table	1	1
Store trolley	2	2
Finishing		
Press	2	2
Ironer table	1	1
Table	1	1
Store trolley	1	1
Mending		
Sewing machine	1	1
Table	1	1
Miscellaneous		
Shelves	10	10
Table	1	1
Store trolley	2	2
Compressor (local)	1	1

100 % washed

60 % ironed (flat linen covering 100% of the cylinder width)

40 % tumble-dried (garment and/ or terry toweling)

Proposed Machine Configuration, Healthcare Laundry

Barrier Laundry 20 - 60 kg/h

B = high-spin

Washing capacity	20 kg/h		40 kg/h		60 kg/h	
		B		B		B
Machine model	**Quantity**					
Sorting						
Table		1		1		1
Trolley		4		4		6
Washing						
WB4130H		2				
WSB42500		1		2		
WSB43500						2
Trolley		2		2		3
Drying						
T4190		1				
T4250				1		
T4450						1
T4290						1
Table		1		1		1
Store trolley		1		1		1
Ironer						
IB42314 (pre-dried linen)		1		1		
IC43316 or IC43320				1		
Table		1		1		1
Store trolley		1		1		2
Finishing						
Ironer table		1		1		1
Table		1		1		1
Store trolley				1		1
Mending						
Sewing machine						1
Table						1
Miscellaneous						
Shelves		2		2		3
Table		1		1		1
Store trolley		1		1		1

If pre-dried

100 % washed

60 % ironed (flat linen covering 100% of the cylinder width)

40 % tumble-dried (garment and/ or terry toweling)

Barrier Laundry 80 - 100 kg/h

B = high-spin

Washing capacity	**80 kg/h**		**100 kg/h**	
		B		B
Machine model	**Quantity**			
Sorting				
Table		1		1
Trolley		6		6
Washing				
WSB4250		1		
WSB4350				1
WSB4650H or WPB4700H		1		1
Trolley		3		3
Drying				
T4250				2
T4350		1		
T4530				1
Table		1		1
Store trolley		1		1
Ironer				
IC4825		1		1
Table		1		1
Store trolley		1		2
Finishing				
Ironer table		1		1
Table		1		1
Store trolley		1		1
Mending				
Sewing machine		1		1
Table		1		1
Miscellaneous				
Shelves		4		5
Table		1		1
Store trolley		1		1

100 % washed

60 % ironed (flat linen covering 100% of the cylinder width)

40 % tumble-dried (garment and/or terry toweling)

Barrier Laundry 120 - 160 kg/h

B = high-spin

Washing capacity	120 kg/h		140 kg/h		160 kg/h	
		B	A	B		B
Machine model	**Quantity**					
Sorting						
Table		1		1		1
Trolley		6		8		8
Washing						
WSB4250H		1				
WSB4350H		1				
WPB4700H		1		2		
WPB4900H						2
Trolley		4		4		4
Drying						
T4250		2				
T4450						2
T4530		1				
T4290						1
Table		1		1		1
Store trolley		1		1		1
Ironer						
IC44832		1		1		1
Table		1		1		1
Store trolley		2		2		2
Finishing						
Ironer table		1		1		1
Press				1		2
Table		1		1		1
Store trolley		1		1		1
Mending						
Sewing machine		1		1		1
Table		1		1		1
Miscellaneous						
Shelves		6		7		8
Table		1		1		1
Store trolley		1		2		2
Compressor (local)				1		1

100 % washed

60 % ironed (flat linen covering 100% of the cylinder width)

40 % tumble-dried (garment and/ or terry toweling)

Barrier Laundry 180 - 200 kg/h

B = high-spin

Washing capacity	180 kg/h	200 kg/h
	B	B
Machine model	**Quantity**	
Sorting		
Table	1	1
Trolley	8	10
Scale	1	1
Washing		
WSB4500H		
WPB4700H	1	
WPB41100H	1	2
Trolley	4	5
Drying		
T4650	1	
T4900	1	
T41200		1
Table	1	1
Store trolley	1	1
Ironer		
IC44832	1	1
Table	1	1
Store trolley	2	2
Finishing		
Press	2	2
Ironer table	1	1
Table	1	1
Store trolley	1	1
Mending		
Sewing machine	1	1
Table	1	1
Miscellaneous		
Shelves	10	10
Table	1	1
Store trolley	2	2
Compressor (local)	1	1

100 % washed

60 % ironed (flat linen covering 100% of the cylinder width)

40 % tumble-dried (garment and/ or terry toweling)

Proposed Machine Configuration, Hotel “Dry Cleaning” and “Guest Laundry”

Dry Cleaning approximately 5% of Q (total laundry requirement for main laundry)

Quantity Machine model	Up to 100 kg/h	120-200 kg/h
	Number of pieces	
Table 2000 mm	1	1
Marking *	1	1
Trolley	3	4
Spotting table	1	1
Dry clean	1	1
Press		1
Ironer table	1	1
Steam finisher	1	1
Garment rack	2	3
Packing stand	1	1

** Dry Cleaning and Guest Laundry have one marking machine in common.*

Guest Laundry approximately 10% of Q (total laundry requirement for main laundry)

Quantity Machine model	Up to 60 kg/h	80-120 kg/h	140-200 kg/h
	Quantity		
Table 2000 mm	1	1	1
Marking *	1	1	1
Trolley	2	4	4
W465H	1	2	
W4105H			2
T4190	1	1	
T4250			1
Ironer table	1		
Ironer table		1	2
Shirt packing table		1	1
Packing stand	1	1	1
Table 2000	1	1	1

** Dry Cleaning and Guest Laundry have one marking machine in common.*

In the previous calculations, the capacity and the equipment tables are strictly to be used for general equipment proposals in the event that a customer does not have detailed information and specific requirements. If possible, a detailed analysis of both the required capacity and processing should always be made and an appropriate equipment proposal should be presented on this basis. We have included, as a supplement, an example of a how a detailed calculation could be presented.

The Layout

An efficient laundry does not only consist of efficient equipment. Special consideration must also be taken to ergonomics and work-flow within the laundry. To facilitate the calculation of work-flow, a drawing that shows a plan of the layout of the building must be available for each project. This drawing must display any essential factors that cannot be altered, e.g. power-supply, supporting walls, doors and drainage. When planning, these factors must be taken into consideration.

Examples of factors that could be altered or that may allow you to offer several alternatives, are:
- How are the soiled goods transported to the laundry, and how should the clean goods be delivered?
- Where should the goods be sorted and into which categories?
- Which programmes are suitable for that particular type of washing and should hydro extraction be used or not?
- What finishing is to be used, and to what extent?
- Should the goods be fully dried?
- Which types of ironers and presses should be used?
- How many people should work in the laundry and what should their aims be to reach an efficient production flow?

When these questions have been answered, and when consideration has been taken of fixed factors and to ideas based on past experience, a proposal for the location of the equipment in the laundry can be presented. See the examples in the following figure.

Technical data and dimensions of the proposed equipment are available in the product data sheets available on Electrolux Laundry Systems website www.laundrysystrms.electrolux.com . Always use the updated version from the website.

Laundry Layout

Layouts are drawn according to the dimensions of premises available. Even if premises do not offer the best ergonomics, the layout must always keep the following principals:
Straight forward laundry/linen flow - No cross linen

Standard laundry layout

Barrier laundry layout

Functional separation between clean and dirty laundry.

Electrical Connections

All necessary information about electrical connection is available in the installation manual and product data sheet (PDS).

Installation must always be carried out according to local regulations.

Vibration and Sound Level

Vibration

The vibration that occurs in a building is a combination of the equipment and the building structure. As a supplier of equipment, we rarely have adequate information regarding the technical qualities of the building. However, we are intimately aware of the qualities and behaviour of the equipment.

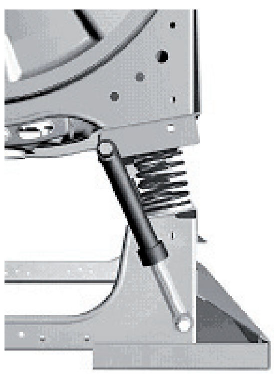
Vibration in the equipment depends on the following factors:
- extraction rotation speed (frequency).
- the dynamic force against the foundation (because of uneven loading of the linen during extraction).
- the mass and rigidity of the foundation.

For each machine, Electrolux Laundry Systems presents the value of the floor load and the frequency of the machine. This information is found in the product data sheet for each respective machine.

		W475N	W4330N
Frequency of the dynamic force	Hz	9.3	7.5
Maximum floor load at extraction	kN	1.1+ 2.8	3.8 + 6.0

Note that rigid mounted machines like normal-spin, medium-spin and extra-spin machines gives a much higher additional dynamic load than soft-mounted machines (high-spin). The dynamic force goes directly into the floor on rigid mounted machines whereas soft mounted machines (high-spin) always have suspension springs and shock absorbers between the drum and the floor to absorb the force.

For further information please read the Installation Manual (instead of Order complete installation instructions.)

Soft mounted	Rigid/Solid mounted
	

Sound Levels

Sound problems associated with a laundry project can be divided into two types: airborne sound and structural-noise.

- **airborne sound** is the sound generated in the machine which is heard in the premises. The sound is carried through walls, doors or air ducts if poorly insulated. Airborne sound level is described in all product data sheets.
- **structural-noise** is the sound that passes through the building framework because of the anchoring of the machine, causing noise in adjacent areas.

The sound climate in an adjacent area is a balance between airborne and structural-noise. To give some idea of this balance, an information document has been drawn up, in which the airborne sound of the machine provides a basis for denoting a limit for permitted structural-noise over a frequency range. The machine is situated in a defined environment and building structure.

Recommendations regarding certain building-related measures are available in the information document. Using this document, one can form an opinion regarding the expected sound climate in buildings that have other structures. For a more accurate analysis **always contact a specialist in acoustics.**

The table below shows general values of airborne sound for washers, hydro extractors, tumble dryers and ironers:

Type of machine:	Airborne sound level in dB(A)
Washer extractor	70
Hydro extractor	60
Tumble dryer	70
Ironer	62

For exact figures please check in the product data sheet.

Sound level is measured according to the following illustration.

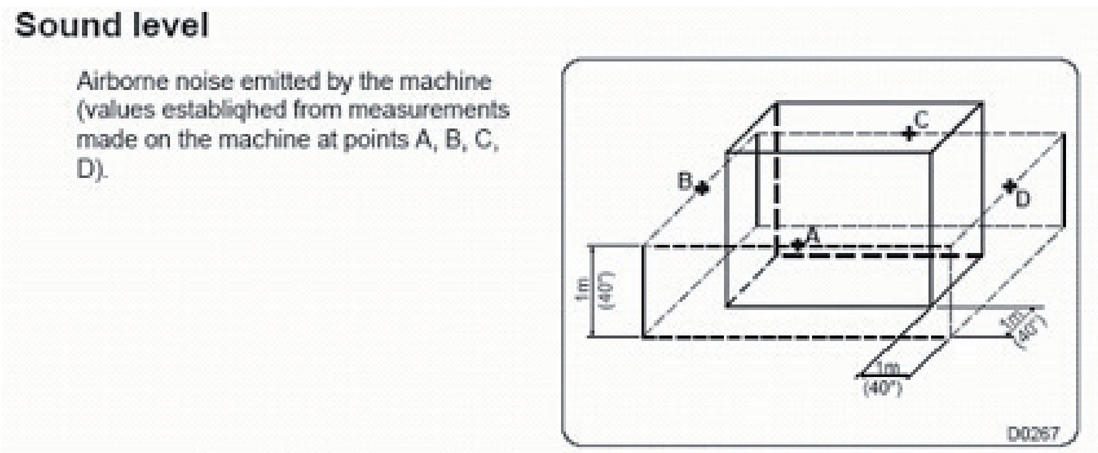


Figure 4. Example from product data sheet.

Foundation

The larger machines are normally placed directly on the floor, while the smaller and mid-sized machines are normally fitted on a foundation. The foundation serves the following purposes:

- Adjusts the working height of the machine
- Fixes the machine to the floor
- Muffles structural-noise from the machine

The most common reason for using a foundation is to adapt the working height of a machine to auxiliary equipment, e.g. trolleys and filling facilities, to provide good ergonomics, i.e. to facilitate operation. The foundation also prevents spilt water from coming into contact with the machine.

Foundations can be divided as follows:
- Fixed height plinths
- Adjustable height plinths
- Structural-noise isolating plinths

> *Note!*
> *Avoid placing a machine foundation in the middle of the floor.*
> *Try to place it beside or close to a supporting wall.*

Instructions for floating foundations

The purpose of floating foundations is to isolate the structural-noise of the washing machines from the building. This is achieved by moulding a foundation and placing it on rubber insulators.

Calculating the dimensions of these foundations depends on the type and number of machines to be placed on the foundations.
It is of utmost importance to keep to the specified foundation measurements. Under no circumstances should the size of the foundation be reduced.
If it should become necessary to deviate from the specified measurements for the installation, the Service Department at Electrolux Laundry Systems must always be contacted.

With regard to the moulding of the foundation, please follow these instructions:
- Place the moulding form on the exact spot intended for the foundation.
- Place plastic foil or waxed paper at the bottom of the form.
- Carefully level the upper side of the form.
- The foundation must be built with chequered reinforcement close to the lower and upper surface (diameter 8, c/c 250 mm).
- The floor bolts must protrude 40 mm above the upper surface of the foundation and must be fixed to the concrete reinforcement.
- Ensure the foundation does not change position when removing the form.
- Lift up one short end of the foundation at a time. Clean the floor and the lower side of the foundation, i.e. where the insulators are to be fitted.
- Coat the rubber insulators on both sides with Glue 3M EC 226, EC22 16B/A or equivalent, and position them.
- Place an insulator in each corner of the smaller foundation and also two in the middle of the larger foundation. (See the drawings on the following pages.)

Description of rubber insulator: 100 x 200 x 8 (FL335: 100 x 100 x 8), laminated structure on both sides.

Rubber insulators NOVIBRA - double plate 100 x 200 mm (FL335, 100 x 100 mm) from Trelleborg's Gummifabrik or equivalent from other supplier and with spring rigidity = 8000 N/mm/plate (FL335 4000 N/mm/plate 100 x 100).

Ventilation

Ventilation in a laundry is normally divided into two systems; one general ventilation system and one evacuation system for tumble dryers and ironers. The machines normally use air from the premises. This must be taken into consideration when calculating the dimensions for ventilation on the premises. A general rule of thumb is that the area of the air supply duct must be five times the area of the evacuation duct.

The fresh air input must at a minimum be equivalent to the volume of evacuation air.
In order to prevent drafts in the room, the best solution is to place the air inlet behind the machine.

WARNING:
Do not forget to allow for the fact that grills often block half the total area of the fresh air opening. It is recommended that a separate smooth-walled evacuation duct is connected to each machine, providing the least possible resistance to air.

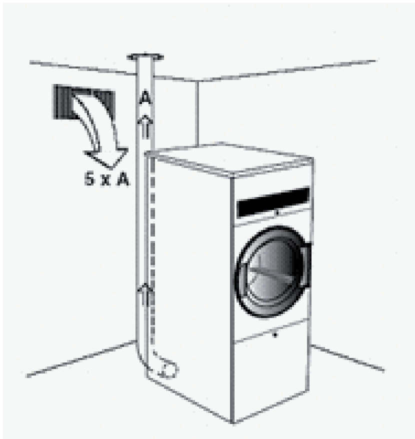


Figure 5. Relationship between intake and evacuation air.

General Ventilation

General ventilation follows building standards in each individual country. This document will not discuss this system further as all dimensioning and installation calculations should be performed by a local ventilation engineer.

A useful rule of thumb: when a tumble dryer is fully loaded with wet linen and in full drying operation, the wet exhaust air should have a temperature of about 50 ° C. If the temperature is much higher, there is insufficient airflow. If there is poor air flow through the dryer, it could be caused by one or more of the following:

- The fan is running in the wrong direction (switch two phases)
- Restrictions of air into the room
- Restrictions of air internally in the dryer, lint screen clogged up or other factors that restrict the air flow
- Defect felt gasket internally in the dryer causes air to by-pass
- Restrictions to outlet air in the outlet ducting

Ventilation, heat radiated from machines during operation.
This data is required for calculating dimensions for air conditioning and for the dimensions for general ventilation in the laundry.

Radiated heat from washing machines in a Normal 90°C programme is estimated using the following formula:
Heat radiated in the room, in W = Drum volume of washing machine in litres x 2

For tumble dryers, approximately 15 % of the applied heat energy is radiated into the room.
For all other machines, finishing equipment, presses, etc. where there is no water drain or air exhaust duct is 100% of the applied heating energy radiated into the room.

Evacuation System

To prevent damage caused by damp in a building or on the facade of the building, it is important to evacuate the warm and damp air correctly.

- The diameter of the evacuation duct must be at least the same diameter as the evacuation connection of the machine.
- The pressure-drop in the evacuation pipe must never exceed the specified value in each respective product sheet.
- The protective net on the evacuation duct outlet must be easily detachable. It must also be easy to clean.

Evacuation through the outer wall

Normally the evacuation duct passes through the outer wall. It should slant downwards to avoid wind, rain or snow increasing the pressure-drop in the duct.

To avoid damage caused by damp on the outer facade, the duct should pass 200 - 500 mm beyond the outer surface of the wall.

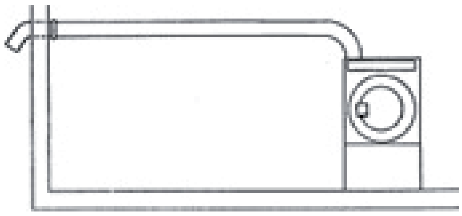


Figure 6. Normal evacuation from tumble dryer.

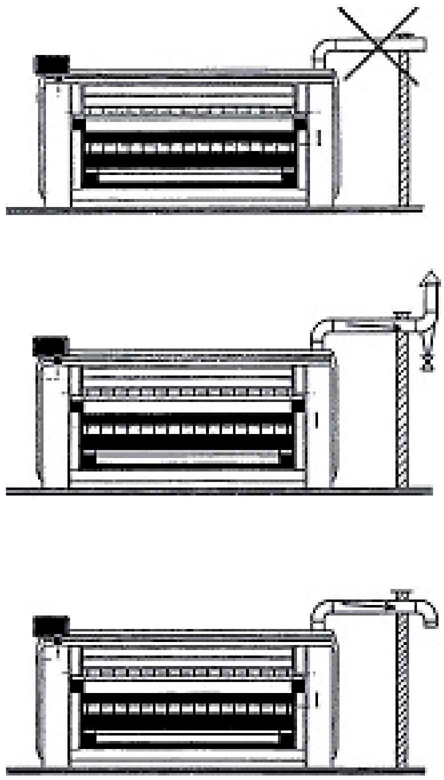


Figure 7. Evacuation from ironer.

Do not place the exhaust duct close to windows, balconies or close to the pavement. The reason is that the exhaust air may give off odours e.g. from the rinsing detergent. During winter, the warm and damp air may condense into white vapour. Lint from the tumble dryer exhaust may also be collected on the outside. This could easily be interpreted as a nuisance.

If it is not possible to avoid the aforementioned factors, alternative exhaust through the outer wall must be made, e.g. below ground to a drain situated approximately 10 m from the outer wall. Alternatively, the duct can pass through the wall above ground and then go directly into the ground, i.e. avoid the risk of damaging the wall with dampness if the duct passes under ground.

Consider the need for insulating the exhaust duct if it runs through cold areas and the intake duct if it runs through warm areas. The duct should slope downwards against the exhaust outlet.

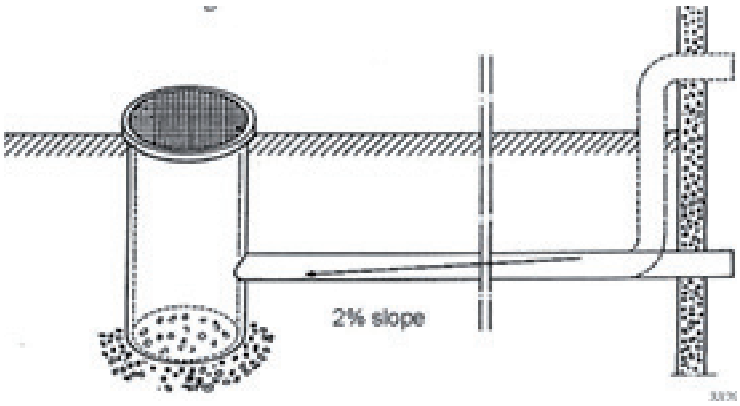


Fig. 8. Exhaust to drain.

Another method to avoid steam and the risk of frost on the façade is to fit a hood over the exhaust duct outlet. When the damp air from the machine meets the plate, the moisture will condense and drip onto the ground. If a hood is placed over the exhaust duct outlet, make sure that the pressure drop in the ducting does not exceed the maximum pressure drop for the product. In general it is better to use a 180 bending duct than to place a hood at the end.

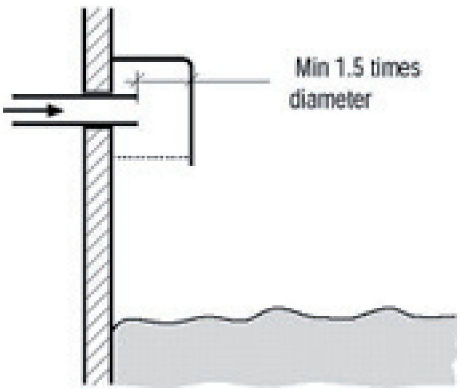


Fig. 9. Condensation trap on outer wall.

Pressure drop in the exhaust duct

An important factor in the exhaust system is the pressure drop in the exhaust duct. This is crucial for the functioning of the machine, as the fan has a defined capacity regarding pressure drop. The following parameters should be considered when calculating the dimensions of the exhaust duct:

- Air flow/unit of time
- Duct dimension
- Duct material
- Type and number of direction changes (elbows)

Example:
A tumble dryer T4190 installed according to the figure below:

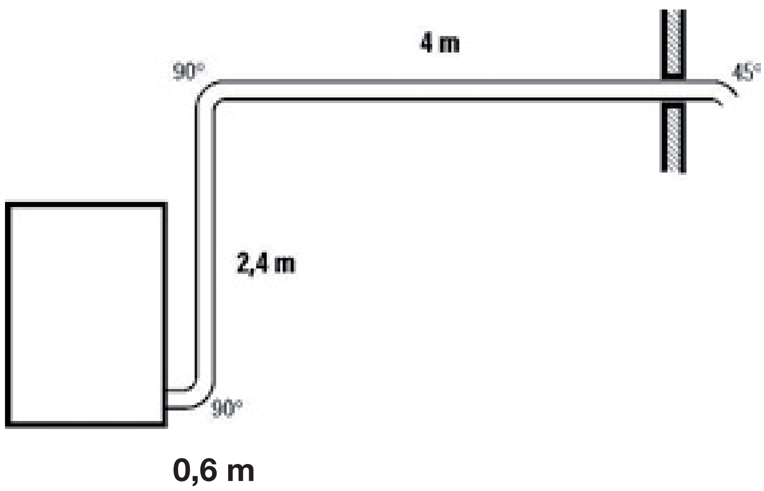


Fig 10. Installation example – tumble dryer.

The product data sheet or the table shows that T4190 evacuates 290 m3 air per hour and should normally be connected to a 125 mm diameter exhaust duct.

- Look at the diagram for steel pipes and read the pressure drop for both straight ducts and elbows.

> ***Note!***
> *If the machine concerned is installed with an air supply duct this must be calculated in the same manner as the evacuation duct.*

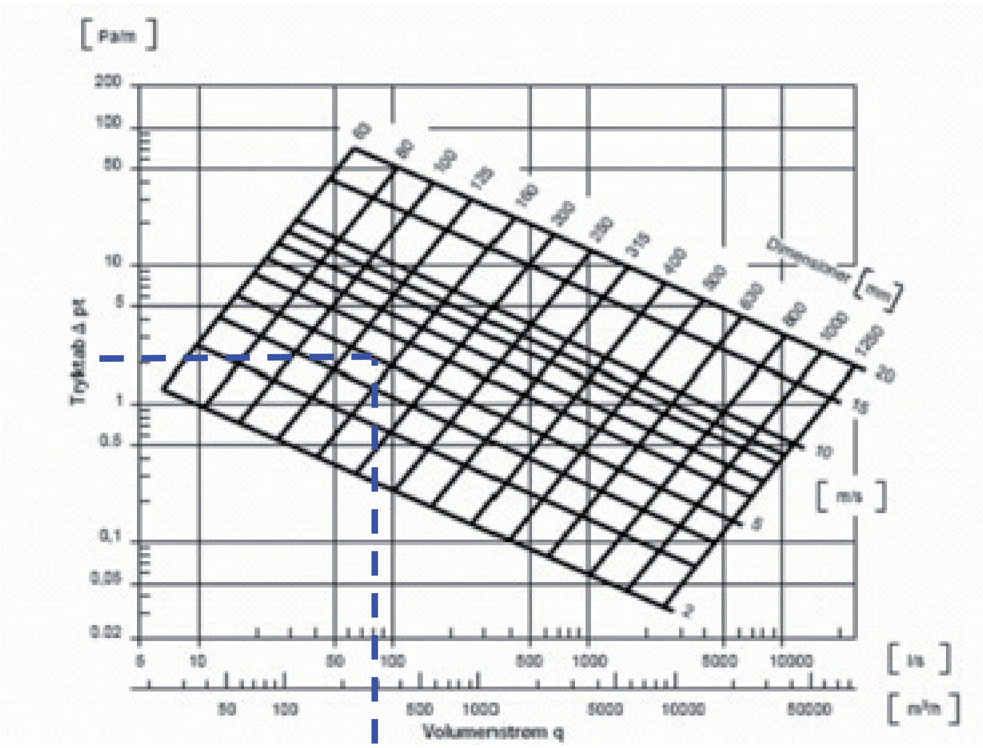


Fig. 11. Example; graph showing drop of pressure for steel pipes, straight duct.

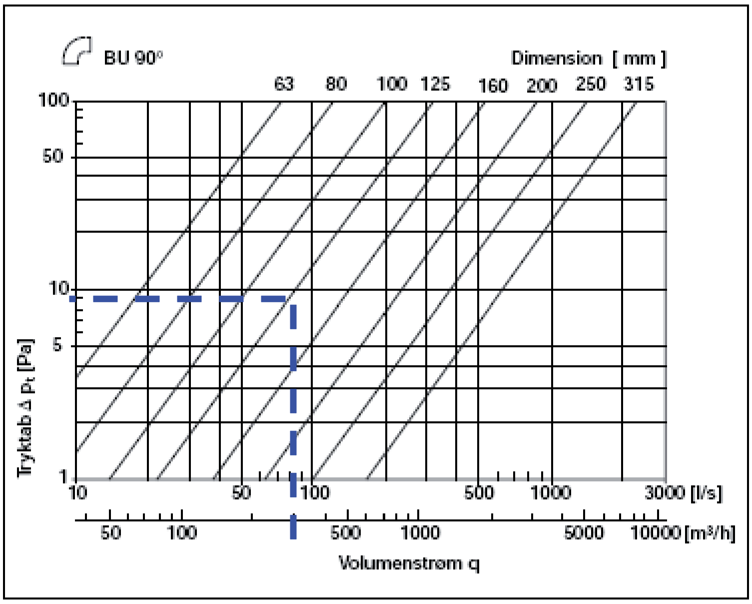


Fig. 12. Example; graph showing drop of pressure for elbows made of steel pipe.

The following values for the drop of pressure in the evacuation pipe are obtained at 220 m3/h in pipe of 100 mm:

Straight duct	4 Pa/m
90° Elbow	8 Pa/elbow (approximately 2 m straight duct)
45° Elbow	5 Pa/elbow (approximately 1 m straight duct)

The total drop of pressure in the evacuation pipe is (4 x (0.6 + 2.4 + 4) + 2 x 8 + 5 = 49 Pa. The product leaflet shows that the maximum drop of pressure allowed in the evacuation pipe is 250 Pa. This installation is therefore at the limit, and a more accurate examination should be conducted by a ventilation company. Is it possible to modify the installation so as to reduce the pressure-drop?

When several machines are connected to a common evacuation duct, the diameter must be increased in relation to the number of machines installed. The reason is that the machines must have as little as possible variation in pressure drops for the different operation modes. Correspondingly, the intake duct must increase in size comparable to the number of machines. Air stream operated dampers could possibly be needed in complicated installations.

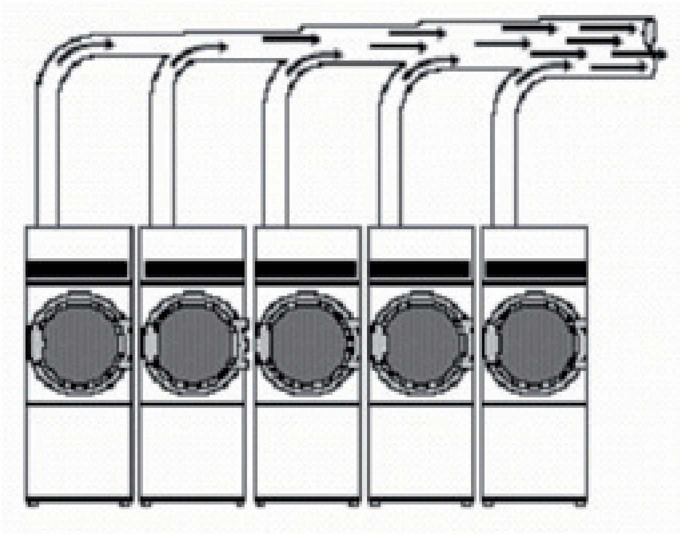


Figure 13. Schematic view of several machines connected to the same evacuation duct.

The following table shows examples of the relationship between the exhaust duct diameters, the area of the intake duct and the number of machines installed.

Please contact the installation company regarding the calculation of the exact diameter/area for each respective pipe.

Exhaust duct diameter (mm) and quantity of dryers:

	1	2	3	4	5	6	7	8	9	10
Ø 100	100	160	200	250						
Ø 125	125	160	200	250						
Ø 200	200	280	315	355	400	450	475	500	535	560
Ø 315	315	450	560	630	710	800	800	900		

Area required for intake duct (m2):

	1	2	3	4	5	6	7	8	9	10
Ø 100	0,04	0,08	0,12	0,16						
Ø 125	0,04	0,08	0,12	0,16						
Ø 200	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	1,5
Ø 315	0,4	0,8	1,2	1,6	2,0	2,4	2,8	3,2		

Example of the relationship between the exhaust duct diameter and the area of the intake duct and the number of tumble dryers.

Heat Exchanger

Instead of supplying the tumble dryer with air from the premises, a heat exchanger can supply air from the outside. This will eliminate any ventilation problems. Exhaust from the heat exchanger is calculated in the same manner as for tumble dryers and ironers.

The evacuated air in the heat exchanger creates a certain amount of condensation. Moreover, a heat exchanger conserves energy better. The energy saving effect of the heat exchanger decreases as the outdoor temperature increases.

Note

The heat exchanger serves no purpose if the outdoor temperature is above 25^{o}C.

”It is very important that the total pressure drop is taken into account” (see "Worth knowing about tumble dryers”).

Condenser

Instead of supplying the tumble dryer with an exhaust duct, a condensing unit can be mounted. A condensing unit is required for installations where normal dryer exhaust connections to the outside are not possible.

The condensing unit is connected to the dryer air exhaust and air inlet connections. The warm moist exhaust air passes through the condensing unit where moisture, lint and dust are removed before the air is re-circulated as inlet air.

The condensing unit is available for smaller tumble dryers. (See product data sheet at www.laundrysystems.electrolux.com)

Electricity

Although each machine in any given installation must be individually provided with fuses, it is unlikely that all machines will use full power at the same time. This implies that, for washing machines that only use full power during the initial heating phase, the total power requirement can be reduced, depending on how many machines are installed. Tumble dryers, ironers and pressing equipment however, use full power during the whole process. For this reason reduction is not possible.

In an installation with several washing machines, the size of the fuses required by the two largest machines is always added. Thereafter, a reducing factor according to the following table can be used:

Total number of machines in the installation	1-2	3-4	5-6	7-8	9-12	>13
Reducing factor	1.0	0.6	0.5	0.45	0.4	0.35

The PC 5 (Power Control up to 5 machines) can be connected in cases where power supply to the installation is limited. This can be programmed to monitor and control the power connection for up to 5 machines, so that the available power is not exceeded. Each PC 5-unit can control the heating or extraction on machines with Clarus Control.

PC5 is an electronic device for managing the global power input required for the use of up to 5 washer-extractors with Clarus Control. It acts like a traffic light, allowing the machines to heat and/or extract sequentially (configurable); if one machine is heating, the rest continue to wash but do not demand power to heat. Once the heating machine achieves programmed temperature the next one in line is allowed to heat, using the full power supply. None of the machines are left out, since the PC5 takes care of each in turn. As a result, the total heating power input for an installation can be reduced to the power of a single machine. The same applies for extraction, if configured.

NB: PC5, in its present form, will not work with ironers and dryers, which means that the benefits of using the PC5 when sharing a boiler for steam are somewhat restricted (i.e. to the needed steam for all Clarus washers minus the needed steam for one Clarus washer). The PC5, should ELS decide to do it, however could work with dryers and ironers if one potential-free contact to postpone the heating were used and any time-out error codes were shut off.

Rule of thumb:

The following values can be used as a general estimate of total electricity consumption for a complete laundry process with wash, drying, finishing:

- 0.15 kWh per kg dry linen (if hot water or steam is used)
- 2.50 kWh per kg dry linen (if electric heating is used)

Water

General rules when calculating the dimensions of the supply pipe.

• Velocity of water in the pipe must be below 2 m/s.

• Flow and pressure required by the machine is obtained from the tables under the head ing "Technical data", summary or from the product sheet for each respective machine.

• The Drop in pressure in each pipe circuit comprises:
  - Drop in pressure as a result of friction losses in the pipe.
  - Drop in pressure as a result of individual resistances, e.g. valves, pipe, elbows etc.
  - Drop in pressure in individual resistances is taken into consideration by conversion to the equivalent pipe length.
  - Dynamic pressure to force the water forward at a certain velocity.

The supply pipe must be able to deliver to the pipe circuit, the amount of water that a consumer requires, at a pressure that corresponds to the pressure needed by the consumer, plus the pressure losses in the pipe circuit.

Example: Pipe dimension and drop in pressure in a machine

Prerequisites

The pipe circuit between the supply pipe and the washing machine must comprise:

• 1.5 m connecting hose (longer for tilting machines)
• Check valve
• Stop valve
• A 90 pipe elbow
• Pipe between the stop valve and the supply pipe, 5 m galvanized steel pipe.

Step 1: Determine the pipe diameter:

Use a nomogram for galvanized steel pipes (figure 14) to decide the drop in pressure due to friction.

• According to technical data, W375H requires a flow of 27 l/min = 0.45 l/sec. (300 kPa at the machine connection)
• Draw a line through 0.45 l/sec and water velocity 2 m/s (dotted line).
• Read the diagram, 17.5 mm, and choose the closest standard diameter = 20 mm or 3/4".

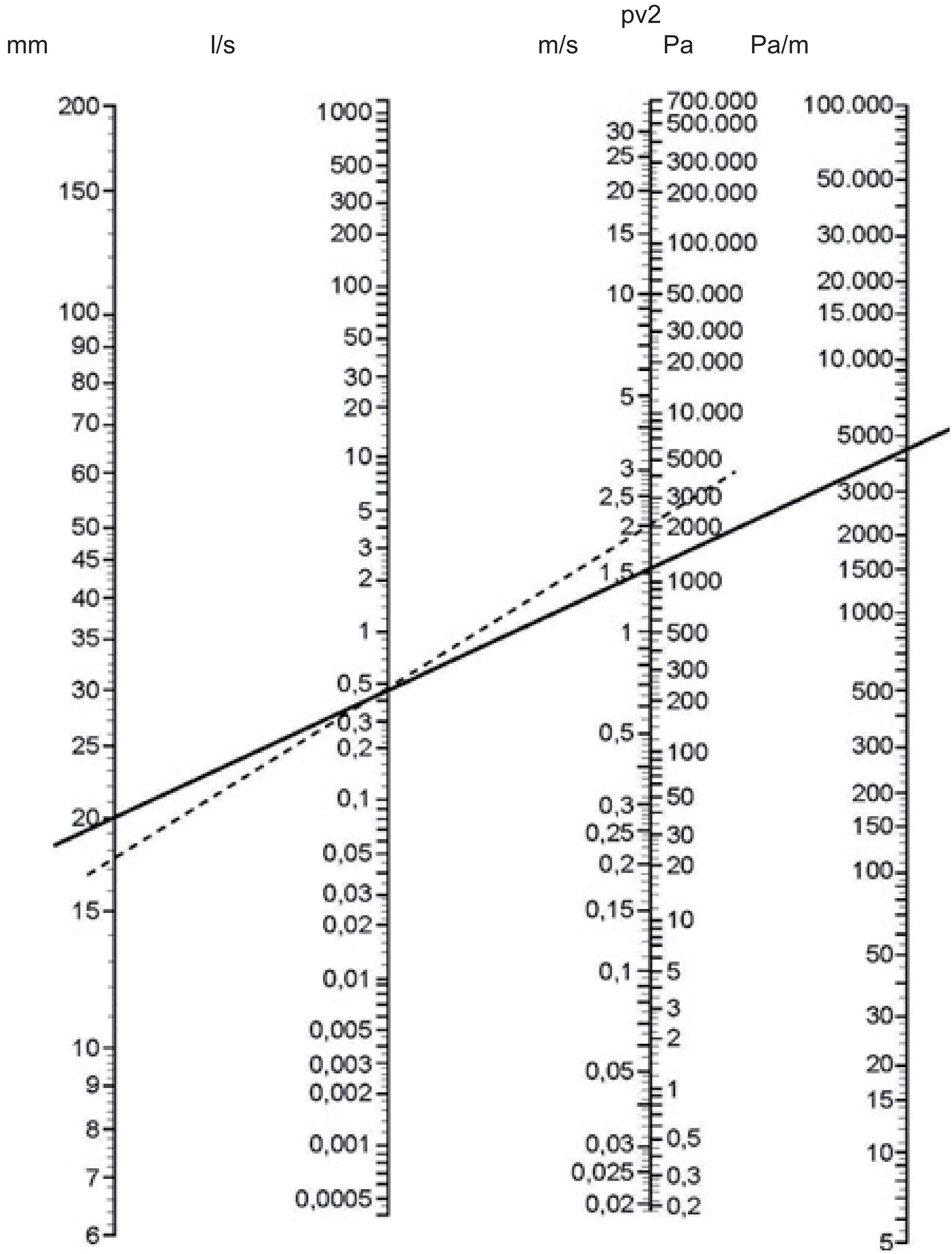


Figure 14. Pressure drop in galvanised steel pipes with deposits.

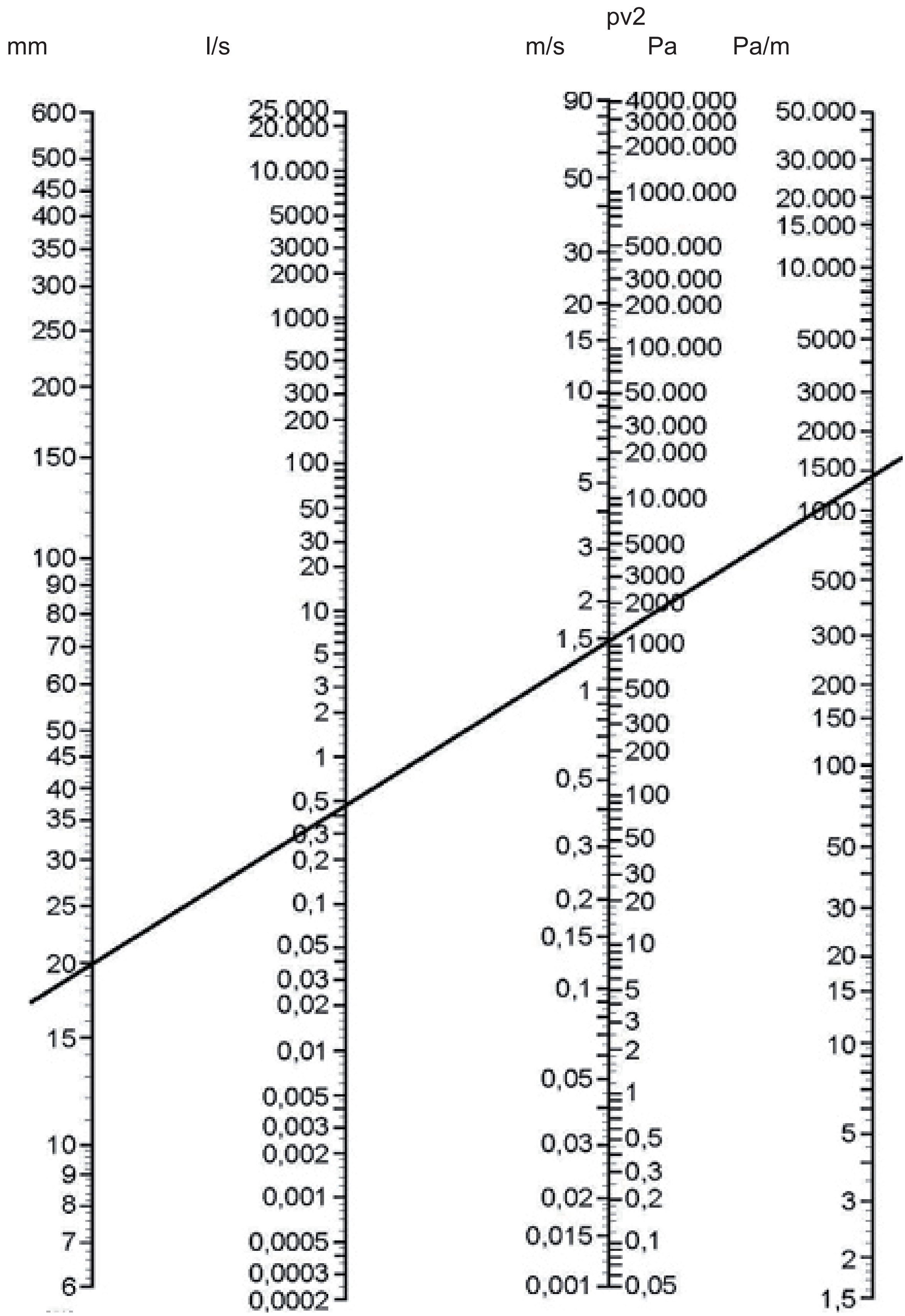


Figure 15. Pressure drop in plastic pipes.

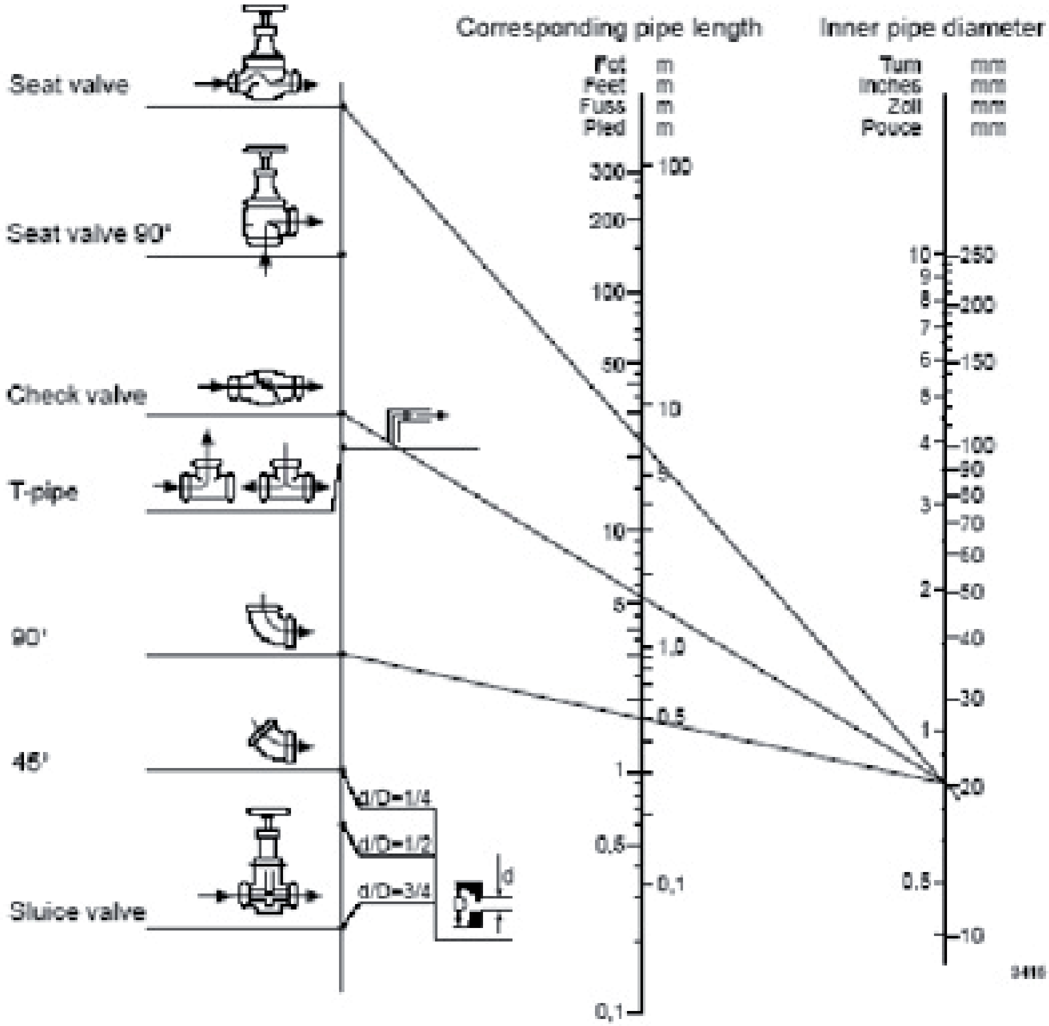


Figure 16. Pressure drop in valves and pipe elbows.

Step 2: Determine drops of pressure

- Use the nomograms for drop of pressure due to friction in plastic pipes (figure 15), drop of pressure in valves and pipe elbows (figure 16) and drop of pressure in galvanised steel pipes (figure 14).
  Draw a line in each respective monogram. i.e. for plastic pipes and galva nised steel pipes, draw an unbroken line through the inner diameter 20 mm and flow 0.45 l/sec., then read the pressure losses and the dynamic drop of pressure. Plastic pipe = 1450 Pa/m; Steel pipe = 4500 Pa/m; Dy namic drop of pressure 1200 Pa

- Draw a line in the monogram for drop of pressure in valves and pipe el bows to show each specific resistance. Then read the equivalent pipe length for each respective component. Check valve = 1.5 m, Stop valve = 7 m, 90 pipe elbow = 0.5 m. In total each separate resistance should correspond to the pressure losses in 9 meters of steel pipe.

- Read the dynamic drop of pressure forcing the water forward (the mono gram for steel pipes). Drop of pressure = 1200 Pa.

Step 3 Determine pressure and flow requirement in the supply pipe when connecting the laundry pipe:

• Pressure requirement at the washing machine:	300 kPa
• Drop in pressure in the plastic hose (1.5 m x 1450 kPa/m):	2.175 kPa
• Drop in pressure in galvanised steel pipe (5 m x 4.5 kPa/m):	22.5 kPa
• Drop of pressure in separate resistances (9 m x 4.5 kPa/m):	40.5 kPa
• Dynamic pressure:	1.2 kPa
Total	**366.375 kPa**

To provide W475H with water in this installation, the supply pipe that is connected to the laundry pipe must hold pressure of approximately 365 kPa at a flow of 27 l/min (0.45 l/sec).

Water Consumption

Rule of thumb:
As a general estimate of total water consumption for a complete laundry the following values can be used:

Type of washing machine	**Liter/kg dry goods**
Top-loaded machines and older household machines	50 - 70
Modern household machines	30 - 40
Machines with drum volume 70 - 220 l	20 - 30
Machines with drum volume 350 - 800 l	15 - 25
Tunnel washers / continuous batch washers	7 – 9

Smaller machines have a greater consumption of water per kilogram laundry, while larger machines have a smaller consumption. By recycling some water such as the last rinse, water consumption can be reduced further.

In an installation with several washing machines, the peak water demand is estimated by first adding the consumption of the two largest machines and then by using a reduction factor in accordance with the table below:

Number of machines in the installation	1 - 2	3	4	5	6	7	8	9 -
Reduction factor	17.0	0.7	0.55	0.45	0.4	0.35	0.32	0.30

Example: Instantaneous water requirement in an installation with several machines

Calculating the instantaneous water requirement for an installation with one unit W4240H, two units W4105H and two units W465H.

According to data, the instantaneous water flow reached in a machine at pressure 300 kPa is:

W4240H = 60 l/min

W4105H = 27 l/min

W465H = 27 l/min

First machine (W4240H) – reduction factor 1.0 gives 1.0 x 60 = 60 l/min

Second machine (W4105H) – reduction factor 1.0 gives 1.0 x 27 = 27 l/min

Third machine (W4105H) – reduction factor 0.7 gives 0.7 x 27 = 19 l/min

Fourth machine (W465H) – reduction factor 0.55 gives 0.55 x 27 = 15 l/min

Fifth machine (W465H) – reduction factor 0.45 gives 0.45 x 27 = 12 l/min

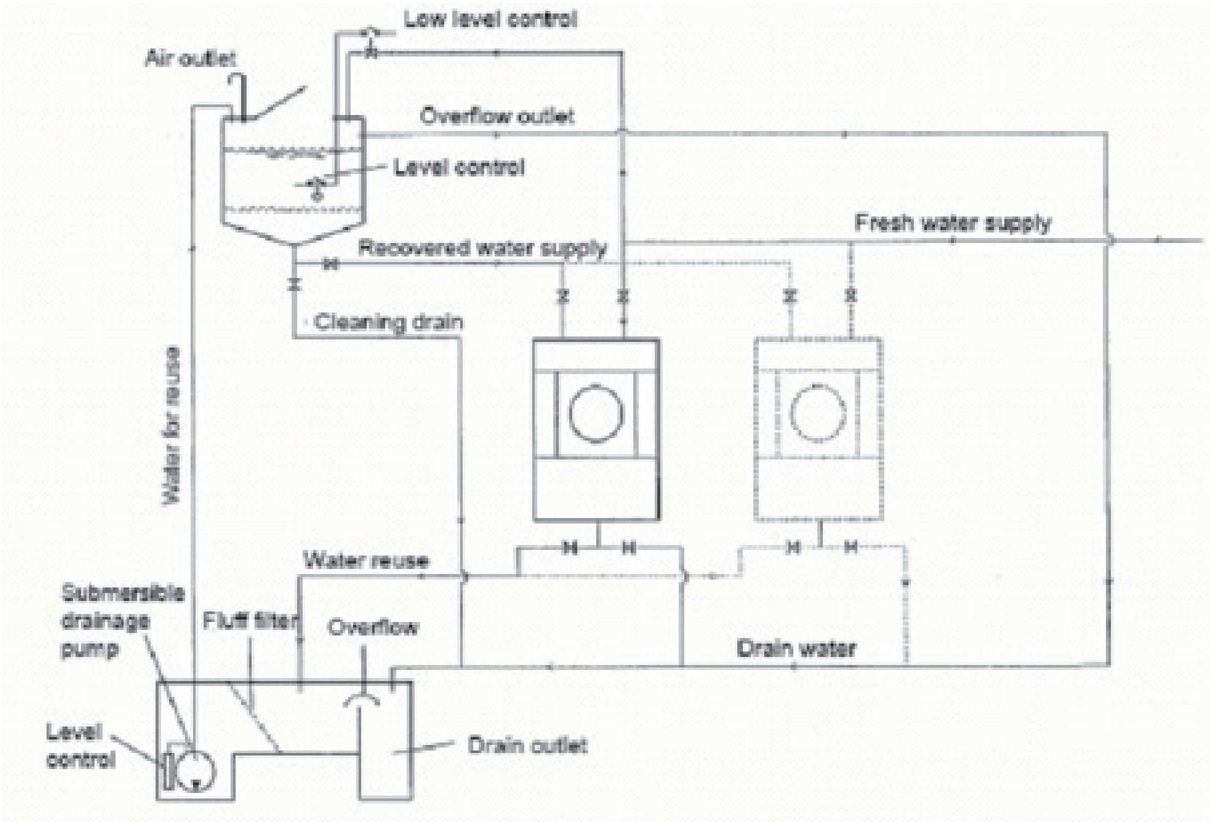
The supply pipe must be able to deliver a total of 133 l/min.

To determine the necessary pressure in the supply pipe, the drop in pressure for each part of the circuit must be added together. To calculate the drops in pressure, see the example under the heading General rules for calculating the dimensions of the supply pipe.

Water Recovery

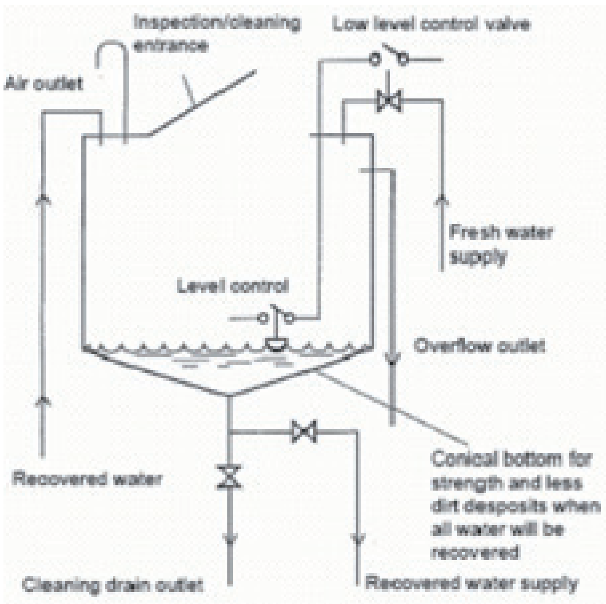
All programmable machines are prepared for water recovery. The following page shows an example of a recovery system). Please contact Electrolux Laundry Systems' Technical Support Department for additional information.

Water recovery system

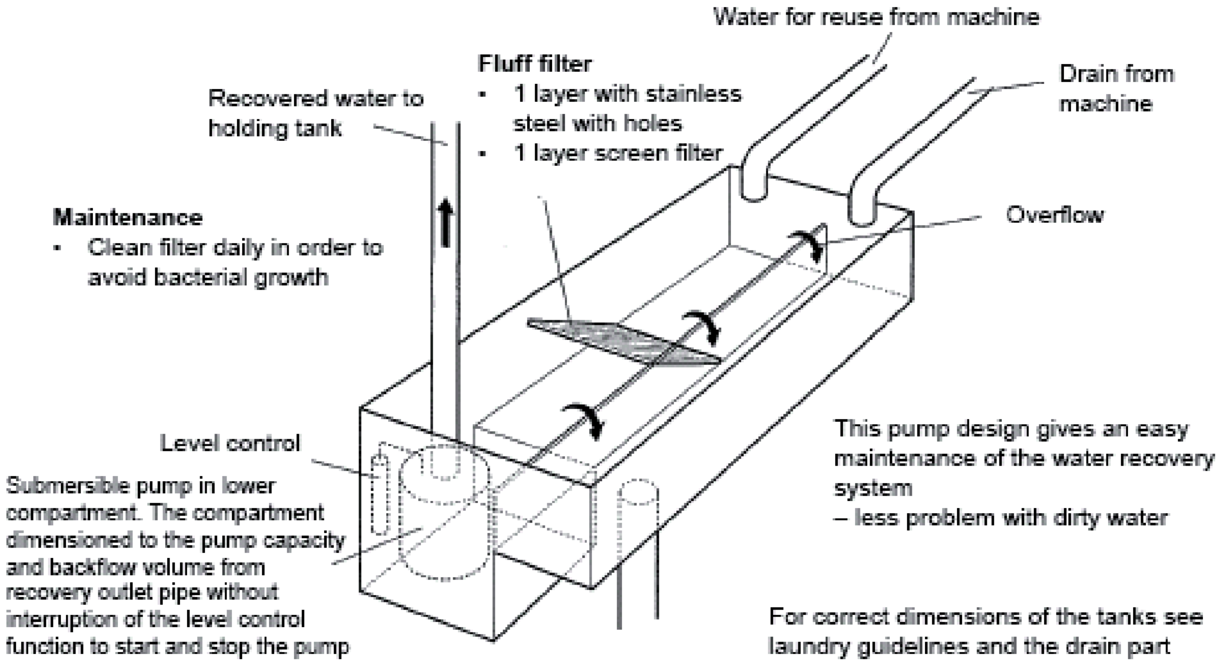


Water recovery tank

- It is important to use only the second and third rinse, where softener or other additives have not been used.
- Do not reuse coloured rinse water.
- The water in the recovery tank should be changed daily.
- For recovery stops longer than one day, empty the recovery tank through cleaning drain outlet.
- Ensure regular maintenance to avoid bacterial growth.

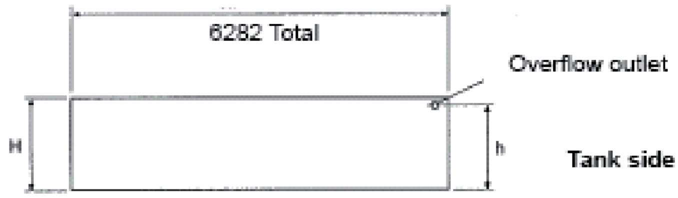


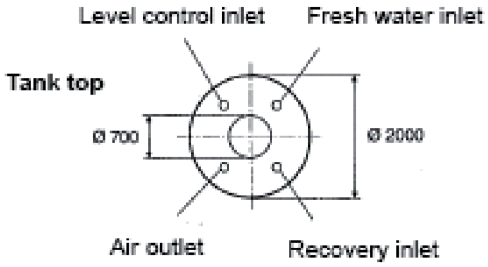
Feeding tank with overflow to drain pump and filter

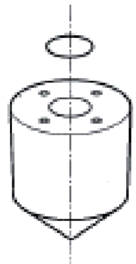


Water recovery tank

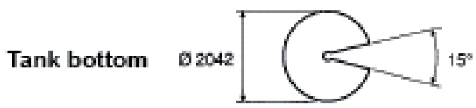
Stainless steel 2 mm thickness



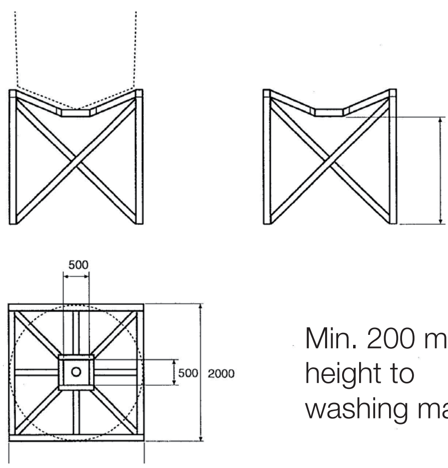




H	h	Litres
740	640	2000
1060	960	3000
1380	1280	4000
1700	1600	5000
2010	1910	6000



Support frame for water recovery tank



Min. 200 mm + height to washing machine

Steam

General

(see the following website, **www.spiraxarco.com**, for more information)

When heat is added to water, the temperature rises towards boiling point of 100°C. Even if the heat supply persists, water is unable to absorb more heat. Instead, the water successively alters to a gaseous form. This gas is called water vapor or simply steam.

When water is boiled in a saucepan, the temperature of both the water and the steam produced is 100°C. If a lid is placed on the saucepan, and if heat is still being added, the lid will rise due to the pressure energy that is formed as the steam is compressed. If the lid is prevented from being lifted, the pressure of the steam in the saucepan will increase and consequently causes the amount of steam to increase in the saucepan. The steam pressure against the water surface in the saucepan causes the boiling point to increase, e.g. at 1 bar water boils at 100°C, while the boiling point at 7 bar is 164.2C. Since steam temperature is the same as the temperature of boiling water, the steam temperature will also rise when the pressure rises.

Steam contains pressure and heat energy that therefore makes it suitable for heating and as a driving force for turbines, etc.

- Heat energy in steam is available in the form of:
  - Fluid heat, i.e. the heat energy that is transmitted to water in the flue gas of a boiler.
  - Heat-generating steam, i.e. the heat energy that has been added so that water can vaporise without increasing the temperature and the pressure energy.

- Steam pressure can either be specified as gauge pressure (above atmospheric pressure) or as absolute pressure (above absolute 0).
  - Gauge pressure is the amount by which the pressure exceeds the atmospheric pressure, i.e. the reading starts at 0.
  - Absolute pressure is the sum of the gauge pressure and the atmospheric pressure, i.e., the ready starts at around 1 bar (1.013 bar at sea level).

In steam technology and laundry application, gauge pressure is used in most cases.

The volume of steam is to a great extent affected by pressure. For example, 1 kg of steam at 0 bar (absolute) has a volume of 1.7 m3, while the same amount at 7 bar (absolute) is only 0.27 m3.

A clear picture of the different parameters of steam in relation to one another is shown in a summary referred to as the steam table. An extract from this table, under the heading Steam table, is presented next (i.e., 50 -1500 kPa gauge pressure).

Water Treatment

In a steam system, everything apart from clean water molecules is regarded as contamination.

Water is distilled in the boiler, i.e. the water leaving the boiler in the form of steam is much cleaner than the remaining water. As time passes, the amount of contamination in the boiler increases, visible as sludge and boiler scale. Contamination must be removed at regular intervals so that the boiler does not lose efficiency or sustains damage.

The biggest problem is the hardening salts that are formed that cause boiler scaling. The degree of hardness in the water (°dH) is a measurement of the content of these salts.

The time between cleaning and the life-time of the boiler is therefore extremely dependent on the quality of the water. Generally, most steam installations should be provided with softening filters to reduce the content of hardeners.

Water treatment costs money. However, a reduced service life of a boiler and a steam system is also expensive. It is important therefore to find a level for water treatment that is suitable for each specific installation.

Required values recommended for the water used in steam boilers, for a trouble free operation are:

- Colour value to be below 30. Not so critical.
- pH value to be between 7-8.5
- Alkalinity should to be above 60 and preferred to be above 100 mg HCO3/l
- Total hardness should not exceed 5º dH
- Iron, Manganese and Copper is harmful from the washing prospective and the limit value as follows:
  - Fe < 0.2 mg/l
  - Mn < 0.05 mg/l
  - Cu < 0.05 mg/l
- Chloride content must be below 100 mg/l
- Conductivity should be between 5-150 uS (if the value is below 1, the water is aggressive and pitting can start on the stainless steel and metal components).

Estimating Necessary Steam Boiler Power

For machines, consumer of steam, such as ironers, tumble dryers, and finishing equip¬ment; the consumption of steam is assumed to be even and constant throughout the operating period. These are classified as ‘indirect’ steam consumers. Their requirements are therefore added together to estimate the total requirement of steam.

Washer extractors on the other hand, are classified as ‘direct’ steam consumers. Here, the total steam requirement will require the notions of average consumption (per hour) and peak consumption.

An estimate of requirements depends a great deal on the temperature of the water supply. For indirect consumers of steam, the condensate can be recycled at 100°C or higher as a supply to the steam boiler. The following formula can be used to **convert the power in kW to kg steam** at a steam pressure of 6 bar:

Kg steam from the boiler = Boiler power in kW x 1.4 (at 20°C supply water)

-”- x 1.5 (at 60°C supply water)

-”- x 1.6 (at 100°C supply water)

Necessary boiler **power in kW = Volume of water (litres)** for each heating (washing) x 0.6 (for heating from 10-80°C in ten minutes at 6 bar steam pressure).

For Washing Machines

As a rough estimate, the consumption of steam is about 0.6 kg per kg of dry linen to washing.

For calculation of the peak flow for washing machines during the short time for heating, we assume that the machine consumes steam for approximately 6 minutes per hour.

Peak consumption in Kg of steam per hour = kg steam per washing cycle x 10.

The following applies for several washing machines in an installation. The machines are assumed to use steam for about eight minutes per washing cycle, or about six minutes per hour. Add together the power requirements of the two largest machines. Then use the reduction factor in the following table for the remaining machines in the same way as for calculating the total fuse rate for electrically heated machines.

Number of machines in the installation	1-2	3-4	5-6	7-8	9–12	>13
Reduction factor	1.0	0.6	0.5	0.45	0.4	0.35

How steam pressure affects the water evaporation capacity of our Electrolux Laundry Systems ironers

The lower line shows the steam pressure the lower the capacity.

In fact the ironer capacity is directly related to the ironing/steam temperature which itself has a direct relationship to the steam pressure.

The following table shows the influence of steam pressure on the ironing temperature and the water evaporation capacity of the IC44832.

Steam pressure in bar	Water evaporation capacity l/h
9	93
8	89
7	84
6	78
5	72
4	65

The maximum water evaporation capacity of the IC44832 at 9 bars steam pressure is 93 l/h as indicated on the product datasheet of all ironers.

Rule of thumb:

- To estimate the temperature obtained at a certain steam pressure, the following formula maay be used:

Temperature °C = $\sqrt{4}$ Actual gauge pressure + 1 (in bar*) x 100

* 1 bar = 100 kPa

What To Observe in an Installation

Dry saturated steam contains a large amount of energy in a small volume. To protect this energy, the two major enemies of steam (air and condensate) must be discharged from the supply pipe that leads to the respective consuming machine.
Some basic rules applicable in the installation of steam systems are described below, see figure 17:

A Steam connections to consuming machines should be made on the upper part of the main pipe.

The reason is that pure steam will thus be provided at the connection, because condensate is heavier than steam and will therefore remain in the

lower part of the pipe.

B Place vent valves at the very end of all steam pipes.
This reduces the start-up time of the steam system and ensures that air does

not block heat emitting surfaces.

C Place condensate drains at the very end of all steam pipes. This reduces system start-up time and reduces the risk of water hammering that otherwise may damage valves, pipes and steam consumers.

D Avoid low points in the system because condensate will otherwise collect in such pockets and therefore may cause water hammering.

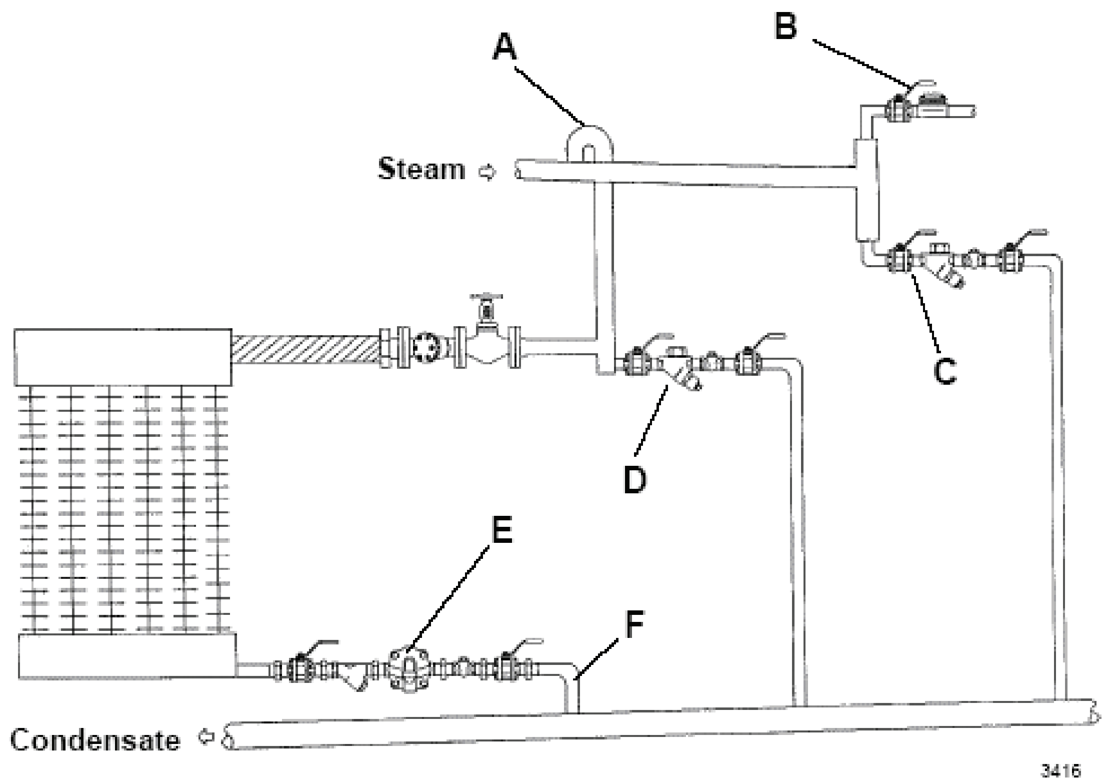


Figure 17: What to observe in steam installations.

E Use steam traps to ensure that condensate can be drained from the machines without causing steam leakage.

Ensure that:

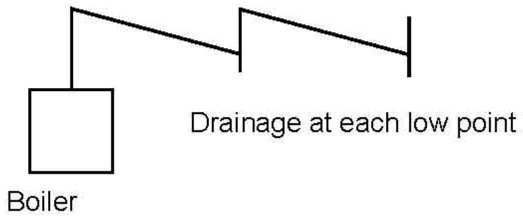
- The correct type of steam trap is chosen
- That the steam trap is correctly dimensioned
- That the steam trap is placed on the same level or below the drainage point for the machines in question.

F A loud noise is often heard if condensates at two different temperatures are mixed. This sound is caused by ”flash steam” bubbles exploding and eroding material from the condensate pipe.

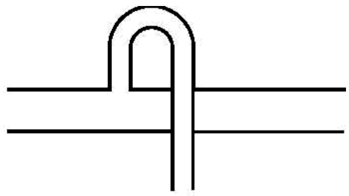
To reduce the risk of this problem arising, condensate pipes must always be connected to the upper part of the pipe.

Examples for a steam installation

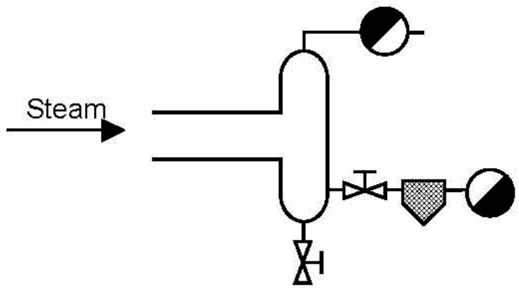
Slope the steam pipe forward approximately 3 - 5 mm/m



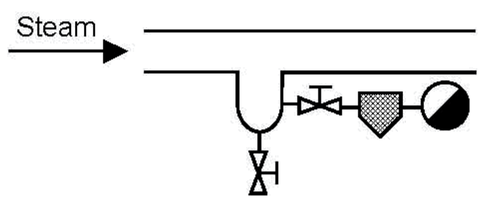
Steam tapping at top part of pipe



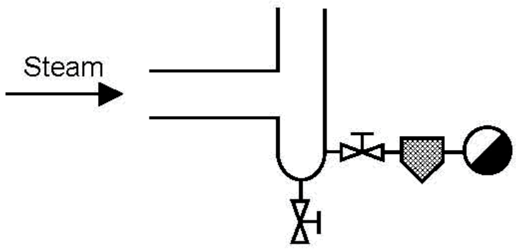
Dead end of steam pipe



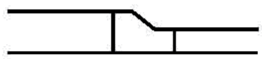
Steam pipe drainage



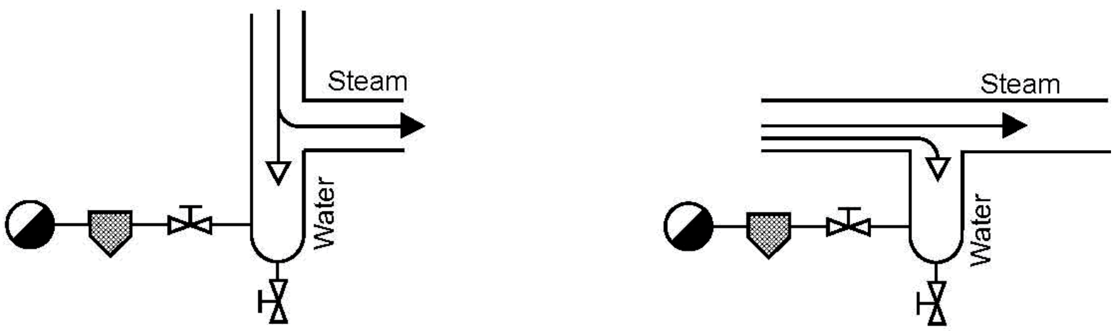
Steam pipe drainage



Use eccentric cones



Drain the steam pipe prior to machine or regulating valve



Rule of Thumb for Dimensioning the Boiler

The correction factor for boiler power (kg/h) at different temperatures of condenser return is as follows:

Boiler power in kW according to boiler data sheet x conversion factor below		
20°C condenser return	-	Factor 1.4
60°C condenser return	-	Factor 1.5
100°C condenser return	-	Factor 1.6

Example:

A 36 kW boiler with 60° C condenser return gives: 36 x 1.5 = 54 kg/h

Steam Consuming Equipment:

Small laundries with maximum total steam consumption up to about 125 kg/h
Values acquired by experience

Form finisher	8 kW
Press	8 kW
Ironing station	4 kW
Dry cleaning machine	24 kW
Washing machine	6 kW per litre water at main washing level and 85°C
	washing programme. Machine connected to cold water
	supply at 15°C.
Tumble dryer	20 kW per ca 10 kg goods
Ironer	20 kW per ca 10 kg goods

Dimensioning of Steam Boiler:

For quick reference of total consumption (including washing, drying, ironing and pressing): calculate hourly washing capacity in the laundry x 3 kg steam/kg dry linen.

> Example: 200 kg/hour wash capacity x 3 kg = 700 kg/hour boiler. However always calculate exact hourly consumption of all equipment and add 20 % safety margin to verify the quick reference.

Gas

There are four different types of gas on the market today; propane, butane, natural gas and town-gas. Natural gas and propane are the most frequently used. The energy content in natural gas may vary considerably. This also applies for propane and butane as these are derived from natural gas.

Gas can be fluid or in gaseous form simultaneously and there is always a balance between gas and fluid. At each temperature, gas has a certain pressure, referred to as vapour pressure that is expressed in kp/cm2, kPa, etc.

If the gas bottle is to produce gas and not fluid, the supply from the bottle must be at a temperature that gives a vapour pressure that is at least equal to atmospheric pressure.

When butane is used in low ambient temperatures, problems may arise in lighting the gas burner. Butane normally has a connecting pressure of 3 - 5 kPa. At temperatures below 10°C there may be problems with the safety valve, if the pressure is too low for it to open. In countries with low morning temperatures, it can happen that a gas burner will not light until the temperature has risen to a sufficiently high level.

Butane should not be used at temperatures that are constantly below 15°C. Propane may be used down to -40°C. Natural gas and town-gas is supplied via pipelines and is not as sensitive to the ambient temperature.

The purity of butane and propane varies from country to country and sometimes even within countries. This may cause problems when calculating the dimensions of the gas nozzles.

When ordering gas items or equipment, it is very important to determine the following:

- Type of gas
- Gas pressure available at the machine
- Energy values per m3 of gas or kg of gas
- Weight of the gas

Contact the gas supplier for data concerning the gas in question.

Note !

Installation of, or work on gas plants may only be performed by adequately certified and qualified personnel.

Compressed air

Most laundries have equipment that requires compressed air.

To determine the size of an appropriate compressor, the requirement for each and every machine which consumers must be added together as if they were in operation at the same time. Thereafter, choose a standard compressor that can supply 20% more than the calculated requirement.

To avoid problems and to reduce equipment maintenance, the compressor should be equipped with an air filter and air dryer.

A manual stop valve must be fitted on the supply pipe of each machine.

Under NO circumstances should compressed air be used for ironers.

Drain

In old installations, it is common that the drain hoses of washing machines ended just above the grid of the floor drain. This often causes some of the waste water to run out on the floor causing an unpleasant working environment and perhaps unnecessary damage due to dampness.

When new equipment is installed or when old equipment is renovated, similar solutions should be avoided. This chapter gives advice and tips concerning various solutions for draining off waste water from washing machines.

An effective drainage system requires a close relationship between:

- size of the floor drain
- diameter of the drain pipes
- slope of the drain pipes
- drainage capacity of the washing machines.

Drainage Capacity

The following table shows the drainage capacity of different washing machines:

Machines	Drainage capacity
From W455H to W4300 H, X, S & W4600X	2.7
From W4400H to W4100H	6.7
WB4130H	2.7
From WSB4250H to WSB4650H	4
From WPB4700H to WPB41100H	6.7

Drainage from One Machine

Use a high-capacity floor drain that is deep and has a large inlet and outlet valve. Make a hole in the grid and position the end of the drain hose a few centimetres into the hole. If the drain is lower than the surface of the floor, it is sufficient to position the hose just above the grid.

If a small floor drain is used, or one with an under-dimensioned and long drain pipe, or if the drain pipe does not slope enough, fluff collecting-boxes can be used. These boxes separate the fluff and the waste water and also function as a buffer before the drain, making it easier for the drain to accept the waste water. Figure 18 shows an example of an installation with a fluff collecting-box. Fluff collecting-boxes are available in different sizes.

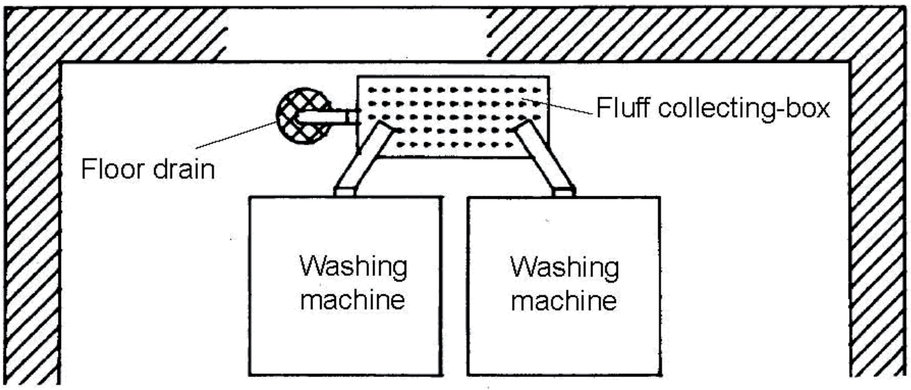


Fig. 18. Example of an installation with a fluff collecting-box.

Drainage from two or more machines

The first choice should be a high-capacity floor drain for each washing machine.

If there is only one floor drain available it is advisable to arrange a suitable channel in or above the floor. The channel should be made of non-corrosive material and it must slope adequately towards the drain. To avoid condensation in the premises, the channel should be covered with stainless sheets. Calculate the dimension of the channel in accordance with the total drainage capacity of the installation concerned.

Where there is only a single drain into which a large amount of water is to flow, a common collecting-pipe made of PVC can be used. From the drain muff on each machine, connect a drain hose to a branch pipe on the collecting-pipe. To avoid rigid fitting, rubber hoses should be fitted from the machines. By fitting a reducer on the end of the collecting-pipe to a smaller floor drain, the entire pipe will function as a buffer when the machines are being emptied. The collecting-pipe can be fixed to the floor, on the wall or fitted in a concrete bed. Figure 19 shows an example of an installation with a collecting-pipe.

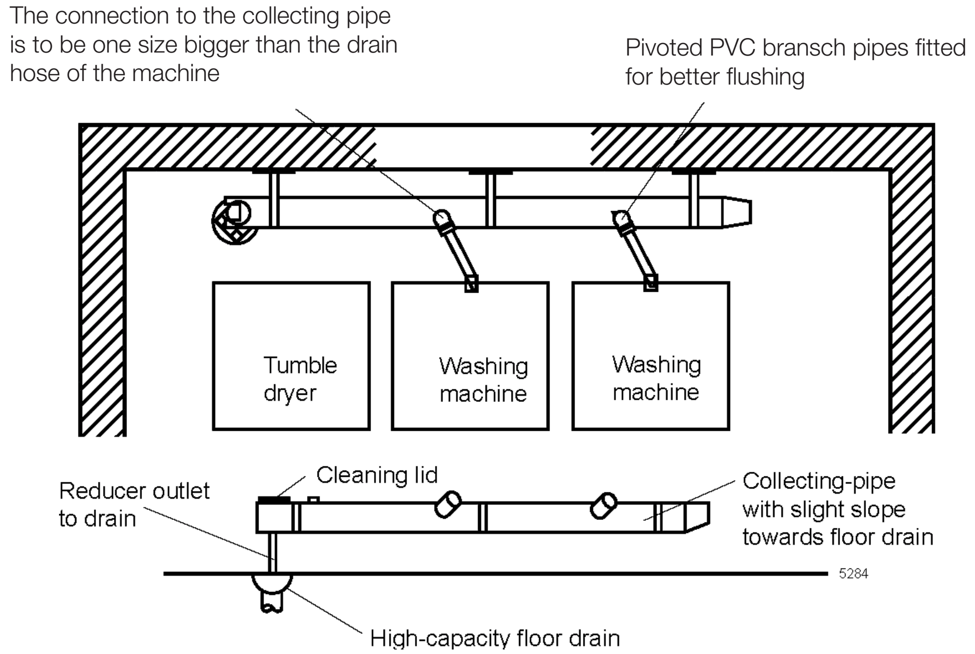


Fig. 19. Example of an installation with collecting-pipe.

In an installation with several washing machines, the total drainage capacity is estimated by first adding the capacity of the two largest machines and then by multiplying with a reduction factor according to the table below:

Number of machines in the installation	1-2	3-4	5-6	7-8	9-10
Reduction factor	1.00	0.85	0.75	0.60	0.50

Select the sewer pipe size that matches the design trough capacity. If the trough capacity falls between two sewer pipe sizes, select the larger.

mm Ø:	75	100	125	150	200	250	300
l/min	380	760	1 325	2 082	3 785	6 815	10 600

Documentation

Electrolux Laundry Systems will provide documentation for each product, in accordance with the following.

Included with each machine
- Installation manual
- Operating manual
- Electric circuit diagram and list of components.

In addition, a spare parts list and service manual are both available from the Service Department of Electrolux Laundry Systems. All technical documentation is available on the website www.laundrysystems.electrolux.com

The International System (SI) of Units

It is the custom in Electrolux Laundry Systems documentation to use the SI-system. In diagrams and tables we sometimes specify Units of measurement according to other Systems in addition to the SI-system. Conversion tables for some of the units used in our line of business are shown below.

Some base units		
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	Ampere	A
Temperature	kelvin	K

Some derived units			
Frequency	hertz	Hz	1 Hz = 1/s
Force	newton	N	1 N = 1 m/s²
Pressure (Stress)	pascal	Pa	1 Pa = 1 N/m²
Energy (Work)	joule	J	1 J = 1 N/m
Power	watt	W	1 W = 1 J/s
Electric voltage	volt	V	1 V =1 W/A

Some additional units			
Time	minute	min	1 min = 60 s
	hour	h	1 h = 3600 s (60min)
Plane angle	degree	°	1° = 1/360 of a circle
Volume	litre	l	1 l = 1 dm³

Some multiple precifixes				
Unit factor	Prefix name	Name	Example	
10^{12}	tera	T	1 terrajoule	1 TJ
10^{9}	giga	G	1 gigawatt	1 GW
10^{6}	mega	M	1 megavolt	1 MV
10^{3}	kilo	k	1 kilometre	1 km
10^{2}	hecto	h	1 hectogram	1 hg
10^{1}	deca	da	1 decalumen	1 dal
10^{-1}	deci	d	1 decimeter	1 dm
10^{-2}	centi	c	1 centimeter	1 cm
10^{-3}	milli	m	1 miligram	1 mg
10^{-6}	micro	µ	1 micrometer	1 um
10^{-9}	nano	n	1 nanohenry	1 nH
10^{-12}	pico	p	1 picofarad	1 pF

Some conversion factors

Lenght (l)

m	in (inch)	ft (foot)	yd (yard)	mile
1	39,370	3,280	1,093	0,621 x 10^{-3}
25,400 x 10^{-3}	1	83,333 x 10^{-3}	27,777 x 10^{-3}	15,783 x 10^{-6}
0,305	12	1	0,333	0,189 x 10^{-3}
0,914	36	3	1	0,568 x 10^{-3}
1,609 x 10^{3}	63,360 x 10^{3}	5,280 x 10^{3}	1,7609 x 10^{3}	1

Area (A)

m^2	in^2	ft^2	yd^2
1	1,550 x 10^{3}	10,764	1,196
0,645 x 10^{-3}	1	6,944 x 10^{-3}	0,772 x 10^{-3}
92,903 x 10^{-3}	144	1	0,111
0,836	1,296 x 10^{3}	9	1

Volume (V)

m^3	in^3	l (litre)	gallon (UK)	ft^3	yd^3
1	61,024 x 10^{3}	1,000 x 10^{3}	0,220 x 10^{3}	35,315	1,308
16,387 x 10^{-6}	1	16,378 x 10^{-3}	3,605 x 10^{-3}	0,579 x 10^{-3}	21,434 x 10^{-6}
1,000 x 10^{-3}	61,024	1	0,220	35,315 x 10^{-3}	1,308 x 10^{-3}
4,546 x 10^{-3}	277	4,546	1	0,161	5,946 x 10^{-3}
28,317 x 10^{-3}	1,728 x 10^{3}	28,317	6,229	1	37,037 x 10^{-3}
0,765	46,656 x 10^{3}	0,765 x 10^{3}	0,168 x 10^{3}	27	1

Velocity (v)

m/s	km/h	ft/s	mile/h
1	3,6	3,281	2,237
0,278	1	0,911	0,621
0,305	1,097	1	0,682
0,447	1,609	1,467	1

Mass (m)

kg	oz (ounce)	lb (pound)
1	35,274	2,205
28,350 x 10^{-3}	1	62,500 x 10^{-3}
0,454	16	1

Force (F)

N	lbf (pound-force)	kp (kilopound)
1	0,225	0,102
4,448	1	0,454
9,807	2,205	1

Volume rate of flow (q)

m^{3}/s	lt^{3}/h	m^{2}/h	l/s
1	0,127 10^{6}	3,600 x 10^{3}	1,000 x 10^{3}
7,866 x 10^{-6}	1	28,317 x 10^{-3}	7,866 x 10^{-3}
0,278 x 10^{-3}	35,315	1	0,278
1,000 x 10^{-3}	0,127 x 10^{3}	3,6	1

Density (p)

kg/m^{3}	lb/ft^{3}	g/cm^{3}	lb/in^{3}
1	62,428 x 10^{-3}	1,000 x 10^{-3}	36,127 x 10^{-6}
16,018	1	16,018 x 10^{-3}	0,579 x 10^{-3}
1,000 x 10^{3}	62,428	1	36,127 x 10^{-3}
27,680 x 10^{3}	1,728 x 10^{-}	27,680	1

Moment of force (M)

Nm	lbt x in	lbt x ft	kpm
1	8,851	0,738	0,102
0,133	1	83,333 x 10^{-3}	11,521 x 10^{-3}
1,356	12	1	0,138
9,807	86,796	7,233	1

Pressure (p)

Pa = N/m^{2}	mm vp (ca)	mm Hg (ca)	lbt/in^{2} = psi	kp/cm^{2} = at	bar
1	0,102	7,501 x 10^{-3}	0,145 x 10^{-3}	10,197 x 10^{-6}	10,000 x 10^{-6}
9,807	1	73,559 x 10^{-3}	1,422 x 10^{-3}	0,100 x 10^{-3}	98,066 x 10^{-6}
0,133 x 10^{3}	13,595	1	19,337 x 10^{-3}	1,360 x 10^{-3}	1,333 x 10^{-3}
6,895 x 10^{3}	0,703 x 10^{3}	51,715	1	70,307 x 10^{-3}	68,948 x 10^{-3}
98,066 x 10^{3}	10,000 x 10^{3}	0,736 x 10^{3}	14,233	1	0,981
0,100 x 10^{6}	10,197 x 10^{3}	0,750 x 10^{3}	14,504	1,020	1

Installation

Acceptance inspection

Before installation begins, an acceptance inspection and an examination of the premises must be conducted. This is to ensure adherence to the project specifications.

1. Ensure that the condition of the machines and/or equipment delivered is satisfactory and has not been damaged during delivery.

> *Note*
>
> *Any damage upon delivery must immediately be settled with the forwarding agent before the machine is incorporated into the installation.*

2. Ensure that the obligations of each party at the point of delivery correspond to what has been agreed into the contract.

3. Check that ventilation has been properly installed and that the intake and evacuation air follows the requirements of the installation instructions for each separate machine.

Installation

- Check the performance of the installation against the project specifications.
- Conduct a functional inspection where each respective machine is tested in accor dance with the accompanying installation instructions.

Commissioning

Starting up

The person on the project who is responsible for commissioning, will start up the entire installation together with permanent working staff.

- Programme the machines according to the customer's processing requirements.
- Start up the installation and ensure that it functions according to pre-set requirements.

Training

During commissioning, working staff will be trained in:

- Handling (operators).
- Daily supervision (operators).
- Preventive maintenance (maintenance personnel).
- Trouble-shooting and repair (maintenance- and service personnel).
- Documentation pertaining to the installation and how to look up items in the documentation, (operators, maintenance and service personnel).

Completion and Handover

Once the project has been completed and you, as owner of the project are satisfied, it is time for handover to the customer. Handover may be informal or may form part of contractual agreements that need to be more formal. You might consider including the following in your handover procedure.

If you are under contractual obligations ensure you have adhered to the entire 'Scope of Contract', this may include documentation, etc.

- Walk around the site and confirm customer satisfaction.
- Raise any issues or concerns you had during the project and how you rectified any problems.
- Carry out a snagging detail of any issues the customer has and make sure you set a time duration for resolving these issues.
- Handover operating and maintenance (O&M) manuals, training literature and any documentation that you feel will benefit the customer.
- Make sure training has been carried out for all staff. Any need of further training by the customer should be scheduled accordingly.

This list is not exhaustive and should really complement what you have been doing during the course of the project schedule.

Remember to take minutes of any meetings held on site, at customer's premises or over the telephone, this will help to resolve any issues that may have arisen during the project.

Contract Completion

The completion of the contract (such as fixed-price or lump-sum, cost reimbursable, unit price contracts). Closeout includes resolving all outstanding issues and items, such as inspections or invoices.

Approval/Hand Over

When the installation is operating and functioning according to the agreement, the installation will be formally handed over. When the hand over comes into effect, a document will be drawn up, confirming that the buyer takes over the installation and that the warranty is valid from that day.

Adjustment points are obviously to be included in the report. However, if the installation is in satisfactory operating condition and if the buyer is able to use the installation, minor points should not be a reason for delaying the handing over.

If the equipment is delivered excluding installation, the delivery terms ”Ex Works” applies, i.e. the warranty, in this case is valid from invoice date.

Warranty

Electrolux Laundry Systems’ factories cover epidemics faults and problems related to user safety. Electrolux Laundry Systems’ sales companies assume warranty coverage based on local regulations.