Washing machine

A **washing machine** (**laundry machine**, **clothes washer**, or **washer**) is a machine designed to wash laundry, such as clothing, towels and sheets. The term is mostly applied only to machines that use water as the primary cleaning solution, as opposed to dry cleaning (which uses alternative cleaning fluids, and is performed by specialist businesses) or even ultrasonic cleaners.

A typical modern front-loading washing machine

History

Laundering by hand involves beating and scrubbing cloth. It is hard work even with manufactured aids like washboards and soap to help.

Clothes washer technology developed as a way to reduce the drudgery of this scrubbing and rubbing process by providing an open basin or sealed container with paddles or fingers to automatically agitate the clothing. The earliest machines were hand-operated. As electricity was not commonly available until at least 1930, some early machines were operated by a low-speed single-cylinder hit and miss gasoline engine. By the mid-1850s steam-driven commercial laundry machinery was on sale in the USA and Great Britain.[1] Technological advances in machinery for commercial and institutional laundries proceeded faster than domestic washer design for several decades, especially in the UK. In the US there was more emphasis on developing machines for washing at home, as well as machines for the commercial laundry services which were widely used in the late 19th and early 20th centuries.[2]

Because water often had to be carried, heated on a fire for washing, then poured into the tub, the warm soapy water was precious and would be reused over and over, first to wash the least soiled clothing, then to wash progressively dirtier laundry. While the earliest machines were constructed from wood, later machines made of metal permitted a fire to burn below the washtub, to keep the water warm throughout the day's washing.

Removal of soap and water from the clothing after washing was originally a separate process. After rinsing, the soaking wet clothing would be formed into a roll and twisted by hand to extract water. To help reduce this labour, the wringer/mangle was developed, which uses two rollers under spring tension to squeeze water out of clothing and household linen. Each item would be fed through the wringer separately. The first wringers were hand-operated, but were eventually included as a powered attachment above the washer tub. The wringer would be swung over the wash tub so that extracted wash water would fall back into the tub to be reused for the next wash load.

The modern process of water removal by spinning did not come into use until electric motors were developed. Spinning requires a constant high-speed power source, and was originally done in a separate device known as an extractor. A load of washed clothing would be transferred from the wash tub to the extractor basket, and the water spun out.[3] These early extractors were often dangerous to use since unevenly distributed loads would cause the machine to shake violently. Many efforts have been made to counteract the shaking of unstable loads, first by mounting the spinning basket on a free-floating shock-absorbing frame to absorb minor imbalances, and a bump switch to detect severe movement and stop the machine so that the load can be manually redistributed. Many modern machines are equipped with a sealed ring of liquid that works to counteract any imbalances.

What is now referred to as an automatic washer was at one time referred to as a washer/extractor, which combines the features of these two devices into a single machine, plus the ability to fill and drain water by itself. It is possible to take this a step further, to also merge the automatic washing machine and clothes dryer into a single device, but

this is generally uncommon because the drying process tends to use much more energy than using two separate devices; a combined washer/dryer not only must dry the clothing, but also need to dry out the wash chamber itself.

Milestones

19th-century Metropolitan washing machine

The first English patent under the category of Washing and Wringing Machines was issued in 1691.[4] A drawing of an early washing machine appeared in the January 1752 issue of "The Gentlemen's Magazine," a British publication. In Germany, Jacob Christian Schäffer's washing machine design was published in 1767.[5] In 1782 Henry Sidgier was issued a British patent for a rotating drum washer, and in the 1790s Edward Beetham sold numerous "patent washing mills" in England.[6] In 1862, a patented "compound rotary washing machine, with rollers for wringing or mangling" was shown at the 1862 London Exhibition, done by Richard Lansdale of Pendleton, Manchester.[7]

A vintage German model

The first United States Patent titled "Clothes Washing" was granted to Nathaniel Briggs of New Hampshire in 1797. Because of the Patent Office Fire of 1836, no description of the device exists, and it is not known what kind of washing device Briggs invented. A device that combined a washing machine with a wringer mechanism did not appear until 1843, when John E. Turnbull of Saint John, New Brunswick patented a "Clothes Washer With Wringer Rolls."[8]

Electric washing machines were advertised and discussed in newspapers as early as 1904.[9] Alva J. Fisher has been incorrectly credited with the invention of the electric washer. The US patent office shows at least one patent issued before Mr. Fisher's US patent number 966677 (e.g. Woodrow's US patent number 921195). The "inventor" of the electric washing machine remains unknown.

US electric washing machine sales reached 913,000 units in 1928. However, high unemployment rates in the Depression years hit sales; by 1932 the number of units shipped was down to about 600,000.

The first laundromat opened in Fort Worth, Texas in 1934.[10] It was run by Andrew Clein. Patrons used coin-in-the-slot facilities to rent washing machines. The term laundromat can be found in newspapers as early as 1884 and they were widespread during the depression. It is almost impossible to determine who had the first laundromat. England established public wash rooms for laundry along with bath houses throughout the 19th century.[11]

Washer design improved during the 1930s. The mechanism was now enclosed within a cabinet, and more attention was paid to electrical safety. Spin dryers were introduced to replace the dangerous power wringers of the day.

Early automatic washing machines were usually connected to the water supply via temporary slip-on connectors to the sink taps. Later, permanent connections to both the hot and cold water supplies became the norm. Most modern front-loading European machines now only have a cold water connection (i.e. cold fill) and rely completely on electric heaters to raise the water temperature.

By 1940, 60% of the 25,000,000 wired homes in the United States had an electric washing machine. Many of these machines featured a power wringer, although built-in spin dryers were not uncommon.

Bendix introduced the first automatic washing machine in 1937,[12] having applied for a patent in the same year.[13] In appearance and mechanical detail, this first machine is not unlike the front loading automatic washers produced today. Although it included many of the today's basic features, the machine lacked any drum suspension and therefore had to be anchored to the floor to prevent "walking".

1910 advertisement

Many of these early automatic machines had coin-in-the-slot facilities and were installed in the basement laundry rooms of apartment houses. After the attack on Pearl Harbor, US domestic washer production had to be suspended for the duration of World War II. However, many US appliance manufacturers were given permission to undertake the research and development of washers during the war years. Many took the opportunity to develop automatic machines, realizing that these represented the future for the industry.

An improved front loading automatic model, the Bendix Deluxe (which retailed at $249.50), was introduced in 1947.[14]

General Electric also introduced its first top loading automatic model in 1947. This machine had many of the features that are incorporated into modern machines.

A large number of US manufacturers introduced competing automatic machines (mainly of the top loading type) in the late 1940s/early 1950s. Several manufacturers even produced semi-automatic machines, where the user had to intervene at one or two points in the wash cycle. A common semi-automatic type (available from Hoover in the UK until at least the 70's) included 2 tubs: one with an agitator or impeller for washing and/or rinsing; another, smaller, tub for water extraction or centrifugal rinsing.

One early form of automatic washing machine manufactured by Hoover used cartridges to program different wash cycles. This system, called the *Keymatic*, used plastic cartridges with key-like slots and ridges around the edges. The cartridge was inserted into a slot on the machine and a mechanical reader operated the machine accordingly. The system did not commercially succeed because it offered no real advantage over the more conventional program dial, and the cartridges were prone to getting lost. In hindsight it can be seen as a marketing gimmick rather than offering any really useful functionality.

Since their introduction in the late 1930s/mid 1940s, automatic washing machines have relied on mechanical timers to sequence the washing and extraction process. Mechanical timers consist of a series of cams on a common shaft. At the appropriate time in the wash cycle, each cam actuates a switch to engage/disengage a particular part of the machinery (e.g. drain pump motor). The timer shaft is driven by a small electric motor via a reduction gearbox.

On the early mechanical timers the motor ran at a constant speed throughout the wash cycle, although it was possible for the user to truncate parts of the program by manually advancing the control dial. However, by the 1950s demand for greater flexibility in the wash cycle led to the introduction of electronic timers to supplement the mechanical timer. These electronic timers enable greater variation in such functions as the wash time. With this arrangement, the electric timer motor is periodically switched off to permit the clothing to soak, and is only re-energised just prior to a micro-switch being engaged/disengaged.

Despite the high cost of automatic washers, manufacturers had difficulty in meeting the demand. Although there were material shortages during the Korean War, by 1953 automatic washing machine sales in the US exceeded those of wringer-type electric machines.

In the UK and in most of Europe, electric washing machines did not become popular until the 1950s. This was largely because of the economic impact of World War II on the consumer market which did not properly recover until the late 1950s. The early electric washers were single tub, wringer-type machines, automatic washing machines being extremely expensive. During the 1960s, twin tub machines briefly became very popular, helped by the low price of the Rolls Razor washers. Automatic washing machines did not become dominant in the UK until well into

the 1970s and by then were almost exclusively of the front-loader design.

In early automatic washing machines, any changes in impeller/drum speed were achieved by mechanical means or by a rheostat on the motor power supply. However, since the 1970s electronic control of motor speed has become a common feature on the more expensive models.

A 1950s model

Early front loading machines, especially those manufactured in Mediterranean countries (e.g. Italy), had low spin speeds (e.g. 800 rpm or less). Nowadays, a spin speed of 1200 rpm is common and a peak spin speed as high as 1600 rpm is available on many machines. Now models in Europe have speeds of 1800 rpm and a few European washing machines have a spin speed of 2000 rpm. However, because they were not susceptible to gravitational forces, some early top loading machines had spin speeds in excess of 1000 rpm, although some were as low as 360 rpm. Most US top-loading washers have spin speeds less than 1000 rpm.

In the early 1990s, upmarket machines incorporated microcontrollers for the timing process. These proved reliable, so many cheaper machines now incorporate microcontrollers, rather than mechanical timers. Washing machines are a classic application for fuzzy logic. Miele, from West Germany, was the top of the line front load washer, and was introduced in Kananaskis, Alberta by Glenn Isbister starting a revolution in Laundry in Canada.

In 1994, Staber Industries released the System 2000 washing machine, which is the only top loading, horizontal-axis washer to be manufactured in the United States. The hexagonal tub spins like a front loading machine, only using about third of the water as conventional top-loaders. This factor has led to an Energy Star rating for its high efficiency.

In 2001, Whirlpool Corporation introduced the Calypso, the first vertical-axis high efficiency washing machine to be top-loading. A washplate in the bottom of the tub nutated to bounce, shake, and toss the laundry around. As this happened, water containing detergent was sprayed on to the laundry. The machine proved to be good at cleaning but gained a bad reputation due to frequent breakdowns and destruction of laundry and the washer was recalled with a class-action lawsuit and pulled off the market.

In the early first decade of the 21st century, the British inventor James Dyson launched the ContraRotator, a type of washing machine with two cylinders rotating in opposite directions; which, it is claimed, reduces the wash time and produces cleaner results; however, this machine is no longer in production.

In 2007, Sanyo introduced the first drum type washing machine with ‘Air Wash’ function.[15] This washing machine uses only 50L of water in the recycle mode.

In 2008, the University of Leeds created a concept washing machine that uses only a cup (less than 300ml) of water to carry out a full wash. The machine leaves clothes virtually dry, and uses less than 2 per cent of the water and energy otherwise used by a conventional machine, but requires 20 kg of re-usable plastic chips in each load. As such, it could save billions of litres of water each year.[16]

Features available in most modern consumer washing machines:

- Predefined programs for different laundry types
- Variable temperatures including cold wash
- Rotation speed settings
- Delayed execution: a timer to delay the start of the laundry cycle

Additionally some of the modern machines feature:

- Child lock
- Time remaining indication
- Steam

Top versus front loading

Modern washing machines are available in two configurations: top loading and front loading.

Market share

Market	Top Loading Washer	Front Loading Washer
European Market Share	10%**	90%
US Market Share	65%	35%

Top-loading

The top-loading design or V-axis clothes washer, most popular in Australia, New Zealand, Canada, the United States and Latin America, places the clothes in a vertically-mounted perforated basket that is contained within a water-retaining tub, with a propeller-like agitator in the center of the bottom of the basket. Clothes are loaded through the top of the machine, which is covered with a hinged door. During the wash cycle, the outer tub is filled with water sufficient to suspend the clothing freely in the basket, and the movement of the agitator pulls the clothing downward in the center towards the agitator paddles. The clothing then moves outward and up the sides of the basket to repeat the process. Top-loaders are not well-suited to cleaning large objects such as pillows or sleeping bags due to the tendency for them to just float on the surface of the water without circulating, and the aggressive agitator action can damage delicate fabrics.

In most top-loading washers, if the motor spins in one direction, the gearbox drives the agitator; if the motor spins the other way, the gearbox locks the agitator and spins the basket and agitator together. Similarly if the pump motor rotates one way it recirculates the sudsy water; in the other direction it pumps water from the machine during the spin cycle. Because they usually incorporate a gearbox, clutch, crank, etc., top-loading washers are mechanically more complex than front loading machines but are generally lower maintenance since there is no need for a door seal (described below). However, the electro-mechanical components in conventional top-load washers have largely reached maturity.

The top-loader's spin cycle between washing and rinsing allows an extremely simple fabric softener dispenser, which operates passively through centrifugal force and gravity. The same objective must be accomplished by a solenoid-operated valve on a front loader. Another advantage to the top loading design is the reliance on gravity to contain the water, rather than potentially trouble-prone or short-lived front door seals.

Front-loading

Arctic BE1200A+ is a front loading budget model sold in 2008 with 6 kg load, LCD indicator, 1200 RPM

The front-loading design or H-axis clothes washer, most popular in Europe and the Middle East, mounts the inner basket and outer tub horizontally, and loading is through a door at the front of the machine. The door often but not always contains a window. Agitation is supplied by the back-and-forth rotation of the cylinder and by gravity. The clothes are lifted up by paddles on the inside wall of the drum and then dropped. This motion flexes the weave of the fabric and forces water and detergent solution through the clothes load. Because the wash action does not require the clothing be freely suspended in water, only enough water is needed to moisten the fabric. Because less water is required, front-loaders typically use less soap, and the aggressive dropping and folding action of the tumbling can easily produce large amounts of foam.

Front-loaders control water usage through the surface tension of water, and the capillary wicking action this creates in the fabric weave. A front-loader washer always fills to the same low water level, but a large pile of dry clothing standing in water will soak up the moisture, causing the water level to drop. The washer then refills to maintain the original water level. Because it takes time for this water absorption to occur with a motionless pile of fabric, nearly all front-loaders begin the washing process by slowly tumbling the clothing under the stream of water entering and filling the drum, to rapidly saturate the clothes with water.

Front-loading washers are mechanically simple compared to top-loaders, with the main motor normally being connected to the drum via a grooved pulley belt and large pulley wheel, without the need for a gearbox, clutch or crank. But front-load washers suffer from their own technical problems, due to the drum lying sideways. For example, a top loading washer keeps water inside the tub merely through the force of gravity pulling down on the water, while a front-loader must tightly seal the door shut with a gasket to prevent water dripping onto the floor during the wash cycle. This access door is locked shut during the entire wash cycle, since opening the door with the machine in use could result in water gushing out onto the floor. For front-loaders without viewing windows on the door, it is possible to accidentally pinch fabric between the door and the drum, resulting in tearing and damage to the pinched clothing during tumbling and spinning.

Nearly all front-loader washers for the consumer market must also use a folded flexible bellows assembly around the door opening, to keep clothing contained inside the basket during the tumbling wash cycle. If this bellows assembly were not used, small articles of clothing such as socks could slip out of the wash basket near the door, and fall down the narrow slot between the outer tub and basket, plugging the drain and possibly jamming rotation of the inner basket. Retrieving lost items from between the outer tub and inner basket can require complete disassembly of the front of the washer and pulling out the entire inner wash basket. Commercial and industrial front-loaders used by businesses (described below) usually do not use the bellows, and instead require all small objects to be placed in a mesh bag to prevent loss near the basket opening.

This bellows assembly around the door is the source of problems for the consumer front-loader. The bellows has a large number of flexible folds to permit the tub to move separately from the door during the high speed extraction cycle. On many machines, these folds can collect lint, dirt, and moisture, resulting in mold and mildew growth and a foul odor. Some front-loading washer operating instructions say the bellows should be wiped down monthly with a strong bleach solution, while others offer a special *freshening* cycle where the machine is run empty with a strong

dosing of bleach. In the past, suggested remedies have included adding vinegar to the laundry detergent, running an empty cycle with bleach every few weeks, wiping the door gasket with a diluted bleach solution every other week, and leaving the front-loading washer door ajar between loads.

Further comparisons

Top-loading washers do not suffer from continued maintenance problems and need no regular *freshening*. During the spin cycle, a top-loading tub is free to move about inside the cabinet of the machine, using only a lip around the top of the inner basket and outer tub to keep the spinning water and clothing from spraying out over the edge.

There are many variations of these two general themes. Top-loading machines in Asia use impellers instead of agitators. Impellers are similar to agitators except that they do not have the center post extending up in the middle of the wash tub basket. There is also a variant of the horizontal axis design that is loaded from the top, through a small door in the circumference of the drum. These machines usually have a shorter cylinder and are therefore smaller, but offer the efficiency of a front-loader while eliminating the problems of the flexible bellows. This kind of washing machine is sold and popular in Europe, especially in small households, because it offers the same drum system as front-loaders, just with a smaller footprint.

Many front loading machines have electrical heating elements to heat the wash bath to near boiling. Chemical action is supplied by the detergent and other laundry chemicals. Front loaders use special detergents that are designed to release different chemical ingredients at different temperatures. This is so that different type of stains and soils will be cleaned from the clothes as the wash water is heated up by the electrical heater. Front loaders also need to use low sudsing detergents because the tumbling action of the drum folds air into the clothes load that can cause over-sudsing. Due to the concentration of water and detergent, though, the sudsing issue of front-loaders can also be controlled by simply using less detergent without lessening cleaning action.

Tests comparing front loading and top loading machines have shown that, in general, front-loaders wash clothes more thoroughly, cause less wear, and use less water and energy than top-loaders. As a result of using less water, they require less detergent to be used, or conversely, they can use the same amount of detergent with less water, which increases detergent concentration and increases the amount of chemical action. They also allow a dryer to be more easily mounted directly above the washer.

- Water leakage: Top loading machines are less prone to leakage. Front loading machines require a seal on the front door, and similarly the front door must be latched during operation to prevent opening, lest large amounts of water spill out. This seal may leak or require replacement. Many current front-loaders, though, can be stopped and added to or removed from, by way of keeping the water level in the horizontal tub below the door level.
- Energy usage: Front loaders use less energy, water and detergent and clean more effectively than the best top loaders.[17] "High Efficiency" washers use 20% to 60% of the detergent, water & energy of "standard" washers. They usually take somewhat longer (20-110 min.) to wash a load, but are computer controlled with additional sensors, to adapt the wash cycle to the needs of each load. As this technology improves, the human interface will also improve.
- Water usage: Front loaders generally use less water than top-loading residential clothes washers. Estimates are front loaders use anywhere from about one third (About.com [18]) to one half (Consumer Energy Center [19]) as much as top loaders.
- Compactness: Front loading machines may be installed underneath counters. A front loading washing machine, in a fully-fitted kitchen, may even be disguised as an ordinary base cabinet/unit. They may also be convenient in homes with limited floor area, since the dryer may be installed directly above the washer.
- Spin-dry effectiveness: Front loaders also offer much higher spin drying speeds of up to 2000 RPM, although those marketed to consumers tend to be in the 1100 or 1200 RPM range, but still considerably higher than the 650 RPMs that are typically found in top loaders. This makes it possible to dry clothes very quickly by hanging them on washing lines or airing racks or can substantially reduce the length of time required in a tumble dryer.

- Noise: Front loaders tend to operate more quietly than top loaders, because the door seal helps contain noise and because there is less of a tendency to imbalance.
- Accessibility and Ergonomics: Front loaders are more convenient for little people and those with paraplegia, as the controls are front-mounted and the horizontal drum eliminates the need for standing and/or climbing. For people who are sufficiently tall and can stand, top-loaders may be easier to load and unload, since reaching into the tub does not require stooping. However, this issue can be mitigated due to the offering of risers (usually with storage drawers underneath) to raise the front loader door opening closer to the user's level.

Wash cycles

Rinsing

Washing machines perform several rinses after the main wash to remove most of the detergent. Modern washing machines use less water due to environmental concerns; however, this has led to the problem of poor rinsing on many washing machines on the market,[20] which can be a problem to people who are sensitive to detergents. The Allergy UK website suggests re-running the rinse cycle again.[21]

Maintenance wash

Most, if not all consumer washing machines, now use a plastic outer shell [22] instead of stainless steel to contain the water. Washing machine manufacturers are now advising users, due to the plastic's adhesion properties with laundry detergent and mold, to perform a regular maintenance wash which cleans the inside of the washing machine. A maintenance wash is performed without any laundry on the hottest wash programme,[23] using either one of the following: white vinegar, a detergent with bleaching properties (it is not advisable to put actual bleach inside the washing machine !) or a proprietary washing machine cleaner. The purpose of a maintenance wash is to remove any mold, bacteria, old detergent residue and gunge. If using white vinegar, it is important to allow the washing machine to fill for about 30 seconds before adding the vinegar, as the first bit of water goes into the sump.[24]

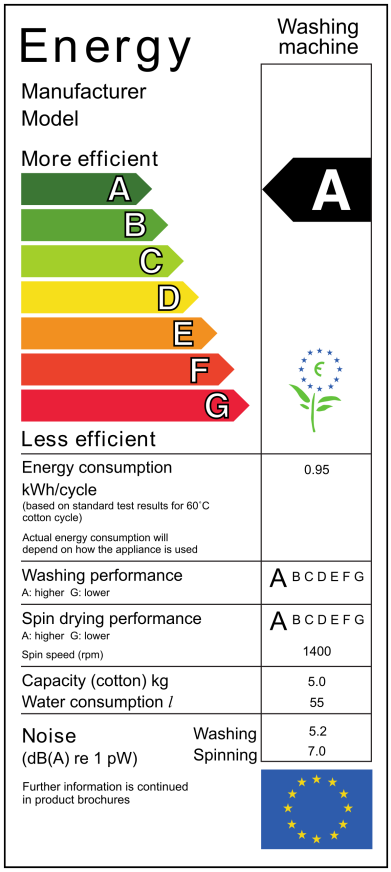
Standards

Europe

Capacity and cost are the main considerations when purchasing a washing machine. If intended for use by a small family, a capacity of under 5 kg should be sufficient (thus saving energy and running costs).

Washing machines display an EU Energy Label with grades for energy efficiency, washing performance and spin efficiency. Grades run from A to G (best to worst), providing a simple method for judging running costs and performance. For example a "Triple A" (AAA) rated machine indicates lowest energy consumption, best wash and best water extraction (i.e. spin) performance. This has had the desired effect of driving customers toward more efficient washing machines and away from less efficient ones.

One important factor that is missing from the energy labelling scheme is the washing machine's rinsing performance, which can adversely affect allergy sufferers and people who are sensitive to laundry detergents and chemicals. It is advisable to check an independent consumer report on how well a washing machine can rinse before purchasing, as newer washing machines use a lot less water than older ones.[20]



The EU requires washing machines carry an efficiency label

United States

Top-loading and front-loading clothes washers are covered by a single Federal Standard regulating energy consumption. The Federal Standard effective up until January 1, 2011 includes no restriction on water consumption. Therefore, washer manufacturers face no legal restriction on how much unheated rinse water may be used, in washers manufactured before that date.[25]

Many US-market clothes washers are more energy-efficient and water-efficient than required by the mandatory Federal Standard, or even the more stringent Energy Star standard.[26] Manufacturers may be motivated to exceed legally-mandated standards by a program of direct-to-manufacturer tax credits.[27] Excessive energy conservation in the laundering process may lead to less-than-satisfactory cleaning,[28] and excessive water conservation may lead to poor rinsing.[20]

Commercial use

Commercial washing machines in a self-service laundromat

A commercial washing machine is intended for more frequent and long-term usage than a consumer washing machine. Because function is more important than style, most commercial washers have a sharp-edged square appearance, often with stainless steel exteriors to minimize rust and corrosion in a constantly moist environment. They are built with large easy-to-open service covers, and the washer mechanisms are internally laid out in a manner that does not require access to the underside of the unit for service. Often commercial washers are installed in long rows with a wide access passageway behind all the machines to allow maintenance without moving the heavy machine.

Many commercial washers are built for use by the general public, and are installed in publicly accessible laundromats or laundrettes, operated by money accepting devices or card readers. The features of a commercial laundromat washer are more limited than a consumer washer, offering just two or three basic wash types plus an option to choose wash cycle temperatures. The common front-loading commercial washing machine also differs from consumer models in its expulsion of wash and rinse water. While the consumer models pump used water out allowing the waste line to be located above the washer, front loading, commercial machines generally use gravity to expel used water. A drain in the rear, at the bottom of the machine opens at the appointed time during the cycle and water flows out. This creates the need for a trough behind machines which leads to a filter and drain. the trough is usually part of a cement platform built for the purpose of raising the machines and can be seen behind washers at most laundromats.

Commercial washers for business (still often referred to as a *washer/extractor*) can include extra features that are never seen in the consumer market. Many commercial washers offer an option for automatic chemical injection of five or more different chemical types, so that the operator does not have to deal with constantly measuring out soap products and fabric softeners for each load. Instead a precise metering system draws the detergents and wash additives directly from large liquid-chemical storage barrels and injects them as needed into the various wash and rinse cycles.

Some computer-controlled commercial washers offer the operator complete control over the various wash and rinse cycles, allowing the operator to program custom washing cycles.

One special type of continuous-processing washer is known as the tunnel washer which does not have separate, distinct wash or rinse cycles, but combines them all in sequence inside a single long large-diameter rotating tube.

An industrial clothes washer can be used to batch process up to 800 pounds (140 kg) of textiles at once, and can be used for extremely machine-abusive washing tasks such as stone washing or fabric bleaching and dyeing.

An industrial washer can be mounted on heavy shock absorbers and attached to a concrete floor so that it can extract water from even the most severely out-of-balance and heavy wash loads. It may be mounted on hydraulic cylinders, permitting the entire washer to be lifted and tilted so that fabrics can be automatically dumped from the wash drum onto a conveyor belt once the cycle is complete.

A 1980s Belgian 180kg load industrial washer in a Hotel in Brussels

A 1980s Belgian 90kg load industrial washer

Social impact

The historically laborious process of washing clothes has at times been labelled "woman's work" and women from all classes tried to find ways to get relief from doing laundry.

In 2009, *L'Osservatore Romano* published an article entitled "The Washing Machine and the Liberation of Women" that was controversially meant to demonstrate that the washing machine had done more for the liberation of woman than the contraceptive pill and abortion rights, which are often associated to Women's Day.[29] The article shocked Italian feminists and provoked criticism from Opposition MP Paola Concia.[30] A study from Université de Montréal also presented a similar point of view to that of *L'Osservatore*.[31]

Manufacturers and brands

- Alliance Laundry (Speed Queen)
- Amica: including the brand names Hansa and Premiere
- Antonio Merloni under the brand names Ardo, Asko, Philco and Servis
- Arçelik: including the brand names Altus, Arctic, Beko and Blomberg
- Bendix
- Bira
- Bosch: including the brand names Balay, Constructa, Neff, Profilo and Siemens
- Candy: including the brand names Hoover and Zerowatt
- Continental Girbau
- Dexter Laundry
- Dyson (no longer produced)
- Electrolux: including the brand names AEG, Arthur Martin, Atlas, Faure, Frigidaire, John Lewis, Rex, Tricity Bendix, Zanussi and Zoppas
- Fagor: including the brand names Brandt, De Dietrich, Ocean, Samet, Sangiorgio, Sauter, Thomson and Vedette
- Fisher & Paykel
- GE: including (in the United States) the brand name Hotpoint
- Godrej (India)

- Gorenje
- Haier
- Hitachi
- IFB
- Indesit: including the brand names Ariston, Creda, Hotpoint and Scholtès
- Ipso
- LG
- Mabe: including the brand names Centrales, Dako, Easy and Moffat
- Miele
- Mueller Eletrodomésticos
- Matura (German) (From the same family as Zanussi)
- Pellerin Milnor
- Panasonic
- Privileg (German) (From the same family as Zanussi)
- Samsung
- Schulthess: including the brand name Merker
- Smeg
- Staber
- Thor
- V-Zug: including the brand names Gehrig and Sibir
- Vestel
- Videocon (India)
- Washex
- Whirlpool: including the brand names Admiral, Amana, Bauknecht, Inglis, Kenmore, Laden, Maytag, Magic Chef, Estate, Kirkland, Roper & Philips
- Zanussi

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External links

- Preservation and also exhibition of vintage washing machines (http://www.automaticwasher.org)
- History of Washing Machines (http://www.sciencetech.technomuses.ca/english/collection/washing_machines.cfm)
- How Washing Machines Work (http://www.howstuffworks.com/washer.htm) Article by HowStuffWorks.com
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- Open Source Washing Machine Project (http://www.oswash.org/)

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