above ground drainage system
A system of pipework used to remove (foul) black water or rainwater to the drainage system.

above ground sanitary pipework system
A system of pipework conveying the discharge from sanitary appliances.
See Types of sanitary pipework system

ABS
This stands for acrylonitrile butadiene styrene, which is a thermoplastic material used for waste discharge pipework. It has a dull matt surface and will burn if lit.

absolute pressure
The total pressure or force exerted on a surface. The more usual pressure measured by most gauges is called gauge pressure and reflects an adjusted pressure that measures zero at the Earth's surface. Since atmospheric pressure at the earth's surface is approximately 1 bar, the absolute pressure is 1 bar higher than gauge pressure at the same location.

So, gauge pressure + atmospheric pressure = absolute pressure

abutment flashing
A weatherproofing material used to seal the join between a roof and a brick wall, such as a garage joining the external brick wall of a house or a chimney passing through a roof.

Example of an abutment flashing
access point
A position in a sanitary or drainage pipework system at which access can be gained via an inspection chamber to undertake maintenance. Access points should be sited at places in a system where blockage is likely to occur, such as bends, branch junctions, changes in gradient. For the purposes of system design, the top of a stack vent and the removal of a trap can be regarded as access points.

acetylene gas
A gas used in oxyacetylene welding and lead welding. It is produced when calcium carbide is brought into contact with water. It is a relatively unstable gas and is dissolved in acetone to increase its stability and reduce the risk of explosion; it is therefore often known as dissolved acetylene. Acetylene gas is pressurised in order that it may be stored in cylinders. Cylinders are colour coded a maroon (red) colour in order that they may be easily recognised. The threads to the cylinder are left hand connection. See Welding equipment.

acid
An acid (often represented by the generic formula AH) is typically a water-soluble, sour-tasting chemical compound. In common usage an acid is any substance that, when dissolved in water, gives a solution with a pH value less than 7. Examples of acids in plumbing include active fluxes for pipe-cleaning purposes and drain-cleaning solutions. A further example of a mild acid is when rainwater falls through the atmosphere; it collects small amounts of gases such as carbon dioxide, leading to a weak mixture known as carbonic acid; the acid content of rainwater may further increase when it travels through material such as peat, further increasing its carbon dioxide content. Water with an acid content is said to be soft water, and in certain conditions can cause the corrosion of metals in plumbing and heating systems.

acrylic
A glassy, tough thermoplastic material that is vacuum formed by a process of sucking softened acrylic into cast and mould shapes that form the surface of fibreglass baths, shower trays, etc. It is hard-wearing plastic that is tough and relatively resistant to scratching.
active flux
See Flux

adhesion
This occurs when substances stick together, for example the surface molecules of water in a container are attracted to each other by cohesion and to the sides of the vessel by adhesion, and the water forms a thin, slightly curved skin, called a meniscus. Adhesion leads to capillary action.

adjustable spanner
See Spanners

adventitious ventilation
Natural ventilation is the air that enters a room through the gaps between floorboards and around doors and windows. Adventitious ventilation is taken into account when determining the amount of natural ventilation air required for correct combustion at flueless or open-flued combustion appliances.

aerated burner
A gas burner in which the gas is mixed with air before emission and ignition.

air admittance valve
A valve that allows air to enter the discharge pipework system but not to escape, in order to limit pressure fluctuations in the system. They can be used as an alternative to a stack vent in a limited number of properties connected to the drainage system. They must not, however, adversely affect the amount of air needed for the below ground drainage system to work correctly. Air admittance valves can also be used on branch discharge pipework as a means of preventing trap seal loss with pipework systems that do not meet the requirements laid down in Building Regulations or British Standards Institution requirements. They should be placed in a position where air is

▶ Air admittance valve, showing the internal features
readily available at their inlet, and they are prone to freezing, so they should only be used on the inside of a building.

▲ Location of an air admittance valve in a primary ventilated stack system

**air brick**
A purpose-designed brick with fixed ventilation openings to allow air to pass through, ensuring there is proper combustion of *open-flued* combustion appliances and adequate *ventilation*, which prevents rot in suspended timber ground floors.

**air change**
The rate at which the air in a room is completely changed by either *natural ventilation* or *mechanical ventilation*. The rate of air change in a room is dependent on the rate of ventilation to and from the room, that is, cracks/gaps in building components, size of natural air vents, extent that windows are opened and the speed and capacity of any extractor fans in the room. The rate of air change in a room needs to be considered when designing a central-heating system. A higher air change will lead to a higher heat load required in the room as there will be a requirement to heat a greater volume of air in the room every hour.

**air gap**
The vertical distance between an appliance outlet, such as a tap or warning pipe, and the highest level that the water can reach in the appliance, which is often known as the *spill-over level*. An air gap is commonly used as a *backflow prevention device* to prevent *back siphonage* and possible water *contamination* occurring in water fittings such as taps.

**air lock**
The trapping of air in a pipe or fitting, resulting in a reduction or a complete stoppage of the flow of water. Air locks are associated with low-pressure systems, for example water supplied from a *storage cistern* or *gravity circulation* in primary pipework to *hot-water storage vessels*. An air lock is usually formed as a result of bad installation practice, whereby pipework is not laid with the correct fall, allowing air to escape from the system during filling.
air-pressure switch
A safety cut-off device used in fan-flued boilers. If the fan is not operating, the air-pressure switch stops the ignition process from taking place and the boiler fails to safety condition and does not light.

air separator
This device, which is used in open-vented fully-pumped central-heating systems, allows the cold feed and vent pipe to be joined closely together in a desirable pipework configuration, causing turbulence, which removes air, reduces noise and reduces the risk of corrosion.

air tap (air valve)
This is a high point, usually in a central-heating system, where air can be bled from the system by manual means, as in the case of a radiator.

air tap key
A purpose-made device used with an air tap for letting out air from components such as radiators.
**air test**

A pressure test applied to plumbing systems to check for leakage. For gas systems, see **tightness testing**. Air tests are not recommended for use on **hot-water**, **cold-water** and **central-heating systems** components, as false readings may often be encountered owing to the fact that air is easily compressed. The test may be used with these system types in areas of the building where leakage could lead to substantial damage to expensive components such as computer suites.

Air tests are commonly carried out on **above ground sanitary pipework** systems and **below ground drainage systems** to check for leakage. With **sanitary pipework** systems the test is carried out as follows:

- Seal the system using hollow **drain plugs**. Fix a **test nipple** in the one to be used for the test. An inflatable bag can be used at the base of the stack as an alternative to a hollow drain plug if it is difficult to site.
- Fill the **traps** with water and cover the test plugs with water to make sure they are airtight.
- The **manometer**, rubber hose and hand pump are connected to the drain plug. Air is pumped into the system until a water head of 38 mm is reached on the manometer; the system is left for a test period of three minutes, during which time there should be no loss of pressure.
- Where a pressure drop is identified the system may be checked with **leak detection fluid** to identify the source of leakage.

With **below ground drainage systems** the test procedure is similar:

- Any **gully** traps are filled with water and pipe ends are plugged.
- Air is pumped into the system until a water head of 100 mm is reached on the manometer; the system is left for a test period of five minutes.
- During the test period there should not be a greater pressure drop than 25 mm on the gauge.

**air vent**

A grille which allows the free passage of air at all times, in particular for supplying air to combustion appliances for correct combustion and/or cooling.
purposes. Approved air vents cannot be adjusted or closed. When sited in an exterior or cavity wall the inner and outer grilles are connected by a liner which prevents blockage in the cavity. Air vents should be stable and resistant to corrosion. When used with combustion appliances there must be a minimum free area of aperture through the grille to meet the air supply requirements.

alignment test
This is a test carried out on drainage systems to determine whether a drain is properly aligned. There are two tests undertaken:

• Mirror test. A mirror is placed at both ends of a drain and a light shone down the drain, if the drain is in proper alignment then a perfect circle should be shown in one of the mirrors; if an ellipse is shown then this will indicate the extent to which the drain is out of alignment.

• Ball test. A ball slightly less in diameter than the drain is rolled down the pipe; if no obstruction is present the ball should roll freely down the pipe from one end to the other.

alkaline
Any substance that in solution gives a pH of greater than 7, as in the case of lye (potassium hydroxide or sodium hydroxide), baking soda (sodium bicarbonate), and lime (calcium oxide or calcium hydroxide). If rainwater which contains dissolved carbon dioxide travels through soils containing limestone or chalk, those alkalis are taken into suspension resulting in hard water, which has a pH greater than 7. Alkali waters may result in ‘furring’ taking place inside plumbing components but do not tend to be as corrosive as water containing acids.

allen keys
L-shaped tools with hexagonal heads of varying diameters designed to fit into socketed screws, allowing loosening and tightening of the screw.

alloy
A metal compound made by combining two or more metals. For example:

• brass is a combination of copper and zinc used for fixings
• bronze is a combination of copper and tin used for decorative purposes and for corrosion-resistant pumps
solder is a combination of lead and tin or tin and copper used for electrical connections and as a jointing material.

gunmetal is a combination of copper, tin and zinc used for corrosion-resistant underground fittings.

alternating current (a.c.)
The electrical current supplied to domestic properties, a.c. flows in forwards and backwards cycles (positive to negative). In the UK, domestic alternating current is usually single phase and supplied at 230 volts and a frequency of 50 Hertz (cycles per second).

ambient air temperature
The air temperature surrounding a body.

ammeter
A device used to measure current flow (electrical current) in amperes.

ampere
A measure of electric current. 1 A of current represents one coulomb of electrical charge moving past a specific point in one second.

angle branch
A junction in a main run of pipework where the branch joins the main run of pipe at an angle of less than 90°. An angle branch is sometimes called a splay or Y branch.

angle welded joint
The lead welding of two sheets of lead lying at different angles.

annealing
This process reduces the brittleness of metal by gentle heating and cooling, sometimes referred to as ‘softening’ the metal. Different metals and alloys require different temperatures for annealing.

annular space
The space between pipes or surfaces in close proximity, as in flue systems where there is space between the two pipe walls in a twin-wall pipe or there is space between a flue liner and its surrounding chimney.

anode
A positively charged electrode in an electrical circuit. During electrolytic action (corrosion) the anode is destroyed by the cathode. The rate of corrosion is dependent on the position of the metals in the electrochemical series.

anthracite
A ‘hard coal’, bright and shiny, smokeless, and generally found deeper in the earth than bituminous coal. It produces no smoke when burnt but may be difficult to light initially.
anti-capillarity groove
A groove cut into building materials preventing capillary action taking place, which may result in water entering the building. An anti-capillarity groove may be used where a lead drip is used to joint two pieces of sheet metal. The groove prevents water rising under the top piece of lead (overcloak) and prevents entry into the building.

anti-gravity valve
A type of non-return valve that is used in central-heating systems to prevent unwanted gravity circulation taking place in pumped circuits when the circuit is turned off. Essentially, with certain pipe layouts it is possible for gravity circulation to take place in the circuit when the motorised valve is closed or the pump is turned off. The anti-gravity valve is a special type of non-return valve that operates under low circulating pressure, so that when circulation ceases in the circuit, gravity circulation in the pipe in which the anti-gravity valve is sited cannot take place.

anti-legionella valve
A special valve connected to the inlet of an expansion vessel to ensure that fresh water circulates within it as water is drawn through the system. The valve is designed to minimise the possibility of bacteriological growth on the surface of the diaphragm which may lead to the growth of legionella bacteria.

anti-siphon traps
See Resealing trap

anti-vac traps
See Resealing trap
**anti-vacuum valve**
A valve that is designed to open to atmosphere when negative pressure occurs in a section of pipeline (suction pressure). The valve can be used as a backflow prevention device to guard against back siphonage in a pipeline and prevent system contents under suction pressure from being drawn back into water supply pipework. The anti-vacuum valve can also be used on certain types of resealing trap to permit air to enter the trap during operation and prevent the contents of the trap from being siphoned back into the waste discharge pipework, that is, it can be used to guard against trap seal loss.

**anti-vibration mountings**
These are special mountings sited under components, such as pumps, that are used to minimise the transmission of noise and the effects of vibration from the pump to the surface on which it is mounted. Anti-vibration mountings are usually manufactured from a rubber-based matter which acts as a good absorber.

**APHC**
This is the Association of Plumbing and Heating Contractors, which is the employers’ trade association for the plumbing and heating industry in England and Wales. APHC represents the interests of its members to key organisations such as government and provides a range of essential services in support of running an effective plumbing business.

**appliance compartment**
A non-habitable space or enclosure designed to house combustion appliances.

**appliance shut-off valve**
A service valve fitted on or next to an appliance that is used for the purposes of isolating the appliance, usually for service or maintenance activities.

**apron flashing**
A type of cover flashing which lays over a roof structure at the point where it meets an abutment in order to weatherproof the building at that point. See **Lead flashing**

**arc welding**
This is a group of welding processes that use a welding power supply to create an electric arc between an electrode and the base material to melt metals at the welding point. They can use either direct (d.c.) or alternating (a.c.) current, and consumable or non-consumable electrodes.

Special eye protection must be worn during the arc welding process to ensure that the eyes are not damaged.
artesian wells
An artesian well is formed by boring through an impervious layer of rock to a lower porous zone containing water. The well is designed so that the mouth is below the water table, forcing the water from the porous layer up and out.

artificial reservoirs
These are formed by damming a river in a low-lying area causing the land to flood, so that the water is preserved for domestic and industrial use.

asbestos
This is a mineral, extracted from rock to form a fibrous material used in products such as cement, fire-resistant boards, floor and ceiling tiles, insulation and roofing. Asbestos causes very serious health problems if the fibres are inhaled; it is not therefore widely used and great care must be taken when working with it in existing properties or removing it from site. Those who work with asbestos are required under health and safety legislation to be properly trained, informed and supervised in the work that they undertake.

asbestos cement
A mix of cement and asbestos used to form building components such as cold-water storage tanks, flue pipes and roof coverings. Asbestos cement is not now used owing to its asbestos content. Although not as dangerous as asbestos insulating materials, care should be taken when working with or removing asbestos cement-based materials; so all operatives must have received proper information, instruction and training on how to work safely with the material.

ascending spray bidet
A type of bidet which has an ascending spray below the spill-over level of the appliance, which presents a high risk of potential contamination to the water supply through backflow. Ascending spray bidets are not suitable for connection
to supply pipes; care should also be taken when connecting ascending spray bidets to systems fed from storage; in most cases the hot and cold supplies must come from independent dedicated distributing pipes rather than common pipework feeding more than one appliance.

atmospheric burner
See Natural draught burner

atmospheric corrosion
Corrosion caused by elements and compounds in the air, for example the combination of oxygen and water vapour in the air can attack steel and iron causing rusting. Carbon dioxide, sulphur dioxide and sulphur trioxide are present in the air, especially in industrial areas, and can corrode iron, steel and zinc. In coastal areas, sea salt, which is very corrosive, dissolves into the local atmosphere and attacks iron-based (ferrous) metal. Copper, aluminium and lead do not corrode as easily; they also form a patina or protective barrier on the outer layer, for example copper sulphate.

atmospheric pressure
The pressure caused by the weight of the Earth's atmosphere, which varies at different heights above sea level, for example the pressure at sea level is 101.3 kN/m² or approximately 1 bar. It is important to take atmospheric pressure into account to avoid creating negative pressure or vacuums in some pipework systems which can lead to problems. Atmospheric pressure is the force that allows siphonage to occur to good effect in some plumbing components.

atmosphere-sensing device (ASD)
A safety control, fitted to appliances such as water heaters and gas fires, to detect oxygen depletion. It is also known as a vitiation-sensing device or as an oxygen-depletion device (ODD). The device has a specially designed pilot which lifts away, cooling the thermocouple. The thermoelectric device then closes, shutting off the gas supply. Atmosphere-sensing
devices are fitted to flueless space or water heaters, or open-flued appliances, such as gas fires, or back-boiler units. In a faulted condition a flueless or open-flued appliance may produce carbon monoxide as part of the products of combustion; this would eventually result in the oxygen supply to the appliance becoming depleted, in which case the appliance would fail use owing to the operation of the atmosphere-sensing device.

atom
An atom is the smallest part of a chemical element, with a nucleus at the centre containing neutrons (electrically neutral) and proton (positively charged) particles. Negatively charged electrons orbit the nucleus. Atoms contain equal numbers of protons and electrons. Electrons can move out of orbit and on to another atom. The movement of electrons creates electricity.

atomising burner
See Pressure jet burner

autogenous welding
A welding process to join two pieces of the same metal using heat without the addition of filler metal.

automatic air vent
A device that is primarily installed on a central-heating system at a high point so that when air gets trapped in the system, the vent automatically removes the air. They usually work on the principle of a float inside the valve rising to close off the vent when there is no air present or falling open to release air if there is an air build up in the vent.

automatic bypass valve
A mechanical device used in systems with motorised valves or thermostatic radiator valves (TRVs), to ensure a minimum water-flow rate through the boiler if the zone valves or TRVs close and the circulating pressure developed by the pump goes over a pre-set limit. The automatic bypass valve minimises noise in the system and ensures premature failure of the pump and boiler heat exchanger does not occur.
**automatic changeover valve**

This is used on *liquefied petroleum* gas installations fed by gas bottles to automatically change the supply from an empty gas bottle to a full gas bottle without affecting the gas supply to the property.

**automatic flow cut-off device**

A device which controls the flow of water into a *cistern* supplying *urinals*. The automatic flow cut-off device could be in the form of a *solenoid* valve operated by a *time switch* or *infrared sensor* controlling the flow of water into the cistern; or by means of an *hydraulically operated valve* that senses the use of other sanitary appliances in the toilet/washing area.

**automatic flushing cistern**

This automatically flushes the contents of the *cistern* feeding a *urinal* at fixed intervals. The time period between flushes is based on the rate of water flow into the cistern. *Water Regulations* lay down the maximum amount of water to be flushed over specific time periods. To ensure that the urinal cistern does not operate when the building is not occupied, an *automatic flow cut-off device* is fitted to the installation to isolate the supply to the cistern when flushing is not required. The operation of the automatic siphon is as follows:

- As the cistern fills, the air inside the dome of the siphon is compressed.
- The increased pressure forces water out of the u-tube which reduces pressure in the dome.
- The pressure reduction in the dome causes siphonic action to take place, flushing the cistern.
- When the cistern has emptied, the water in the upper well is siphoned into the lower well and the process starts again.

![Automatic flushing cistern](image)
automatic valve
A device on a gas-fired instantaneous water heater which turns the gas on when a tap is opened and turns the gas off when the tap is closed. Automatic valves usually work on the principle of differential pressure, using a venturi.

Key to diagrams:
A – automatic valve/diaphragm housing
B – rubber diaphragm
C – bearing plate
D – venturi
E – low–pressure side
F – gland for push rod
G – gas valve
H – gas–valve spring
J – burner
K – flame supervision (bi–metal strip)
L – pilot feed

Operation of an automatic valve

auto-pneumatic pressure vessel
This device is normally used to supply water under pressure to the upper floors of high-rise buildings. The cylinder contains a cushion of air under pressure that is in contact with the water that is to be pressurised; this cushion of air forces water to high level and, as the water is drawn off, the air expands and its pressure falls.
At a pre-determined low level a float switch cuts in the pump; the pump will then supply water to the system which will meet the demand and gradually increase the air pressure in the cylinder until at a pre-determined height the high-level switch cuts off the pump. From time to time the air in the vessel will need to be topped-up; this is achieved by an air compressor feeding air into the vessel.

A variation on this system design is to use a high-pressure expansion vessel with internal diaphragm set to a fixed charge pressure. High- and low-pressure switches are incorporated into the design to operate the pump. So on filling, the water in the system compresses the air in the vessel to a point at which the setting on the high-pressure switch is reached which cuts off the pump supplying the system. On water being drawn off, the expansion vessel is capable of supplying a fixed volume of water into the system that has been stored in the vessel by virtue of compression of the air space; on reaching the pressure setting of the low-pressure switch the pump is activated slowly, charging the system to the pressure set on the high-pressure switch, and so on. See Boosted cold-water system.

![Auto-pneumatic pressure vessel](#)