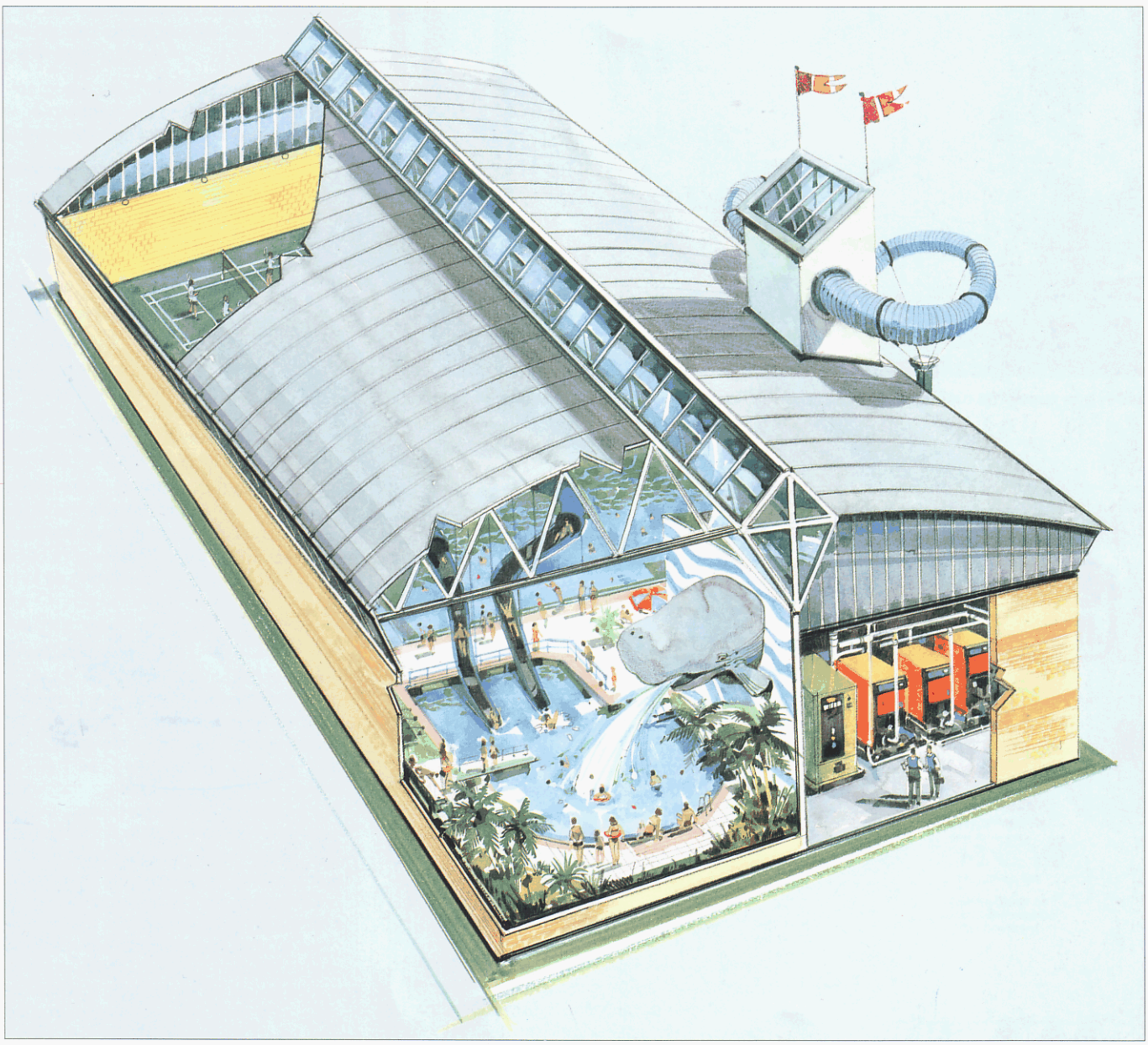
Guide 137

Energy efficiency in sports and recreation buildings: effective plant maintenance

A Guide for Sports Centre Managers and Maintenance Staff



"It pays to ensure that maximum performance is being obtained from existing plant"

BEST PRACTICE PROGRAMME

Energy Efficiency Office
DEPARTMENT OF THE ENVIRONMENT

Introduction

Sports and recreation centres that operate an effective plant maintenance programme can avoid wasting many thousands of pounds a year on their fuel bills. They can also minimise the risk of expensive breakdowns and related safety problems.

The main aim of this Guide is to help sports and recreation centre managers appreciate more fully the effects of plant maintenance on energy efficiency, and what can be done to achieve cost-effective improvements.

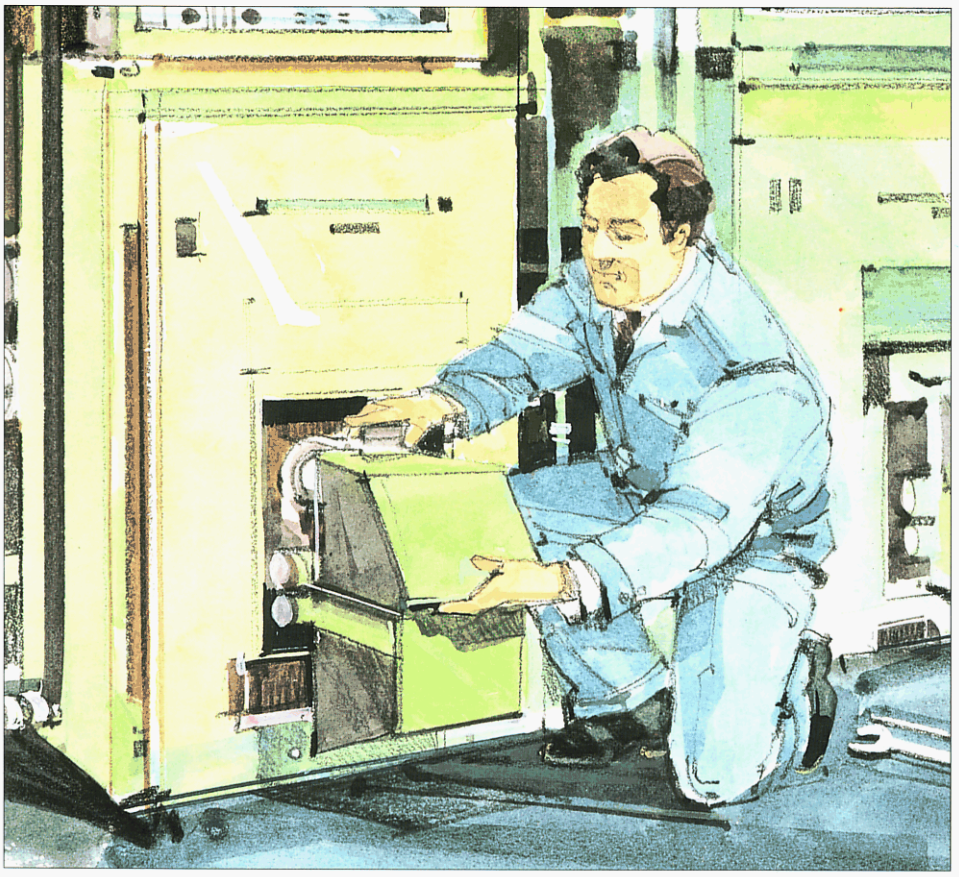
Explanations are given of how the plant works, and of the maintenance tasks (other than simple housekeeping) that are required to keep it in peak running order.

For the purposes of this Guide, each type of plant is grouped according to the service it provides, under the following headings:

- heat supply
- heat recovery
- heat distribution
- mechanical ventilation
- controls
- pool water filtration
- other services.

This information should help managers decide how much of the maintenance work can be sensibly undertaken in-house, and what should be entrusted to a specialist contractor.

Effective plant maintenance can also help managers make decisions on the need for replacement plant. If maximum performance is obtained from existing plant, then replacement may not be necessary.



Frequent checks and adjustments to boilers are required to maintain efficiency and reliability

Commissioning

It is essential that all plant, services and equipment are properly commissioned, and operate in accordance with their design documentation and specifications. Detailed records of all testing and commissioning data should be included in the full operational and maintenance documentation, which must be available when any installation (new or refurbished) is taken over by operators. It is important that the performance of the installation and the relevant set points of controls and equipment are checked regularly to verify that they do not vary from required values and that any changes to these values are clearly recorded.

Caution

No-one should maintain plant unless they are competent to do so. Many jobs are simple and straightforward, but others require operators that have completed an appropriate training course. Any jobs that are beyond the capability of in-house staff should be handled by specialist contractors.

Essential tools

Staff involved in plant maintenance must have easy access to the manufacturers' manuals and plant layout drawings; and a maintenance log book is essential. The log should provide a complete record of all inspections made, and actions taken. Also required is a maintenance plan or checklist clearly stating what needs to be done, when it should be done, and who is responsible for doing it.

Necessary practical tools will include a digital thermometer and a flue gas analyser.

A digital thermometer should be chosen with a quoted accuracy of 0.3°C or better. These cost about £100. (Be warned that many digital thermometers are only accurate to 1°C, even if they display finer divisions.)

Flue gas analysers are devices that allow the efficiency of a boiler to be determined by measuring the percentage excess air and the flue gas temperature. They allow early detection of a drop in boiler efficiency; and the beneficial effect of planned boiler maintenance to be directly confirmed by centre staff.

The cost of an analyser is about £700 or more. Smaller centres might consider sharing an analyser, especially if they are managed under the same compulsory competitive tender (CCT) contract.

SPORTS COUNCIL

ISRM
The Institute of Sport & Recreation Management

ILAM
Institute of Leisure & AmenityManagement

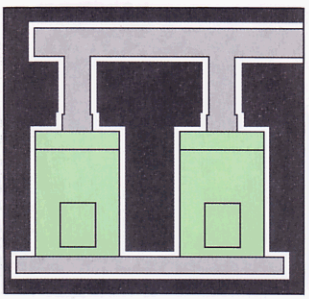
This Guide has been developed with, and is endorsed by, the above organisations.

Detailed advice on understanding and maintaining plant in sports centres

The aim of the detailed advice below is to give sports centre managers and maintenance staff a greater understanding of the plant that is under their care. Understanding the plant makes it much easier to assess what work a centre can do, and what needs to be put out to contract maintenance. It also helps managers in their negotiations with external contractors, and in checking that the scope and frequency of maintenance activity is appropriate for their needs.

Reading through the list of jobs will aid decision-making on which of the tasks the sports centre can incorporate into their routine. Larger centres will be able to handle all of them: smaller ones will need external help.

Heat supply: boiler plant



Combustion boilers convert part of the energy in the fuel they burn into useful heat: the rest is discharged as waste heat into the atmosphere. The fuel combustion efficiency can easily be measured using a flue gas analysis test, and the results provide the best single indicator of whether fuel is being burnt correctly. This test should be done monthly, even though it is also part of an annual service.

Factors affecting combustion efficiency include adjustment and cleanliness of the burners, oil temperatures, and how well the fuel is mixed with the air. The fuel-to-air ratio is of paramount importance. If there is too little air, the fuel will not burn completely, and poisonous carbon monoxide gas will be produced. On the other hand, if there is too much air, energy will be wasted in having to heat it.

In practice, not all air flowing up through the boiler will come into contact with the fuel vapour or gas. To ensure that there is enough air to burn all the fuel completely it is always necessary to allow a proportion of 'excess' air into the boiler.

Whether the boiler is burning at a high or low rate, the proportion of excess air should be set to the manufacturers specified level. This will be the minimum that still allows all the fuel to be burnt completely. This is generally about 6% for gas-fired boilers and 15% for oil-fired boilers. In natural draught boilers where the fuel-to-air ratio is essentially fixed by the boiler design, ensure that the path for combustion air is clear of obstructions. (See 'Grilles' later.)

Caution
A specialist should be called in when a flue gas analysis indicates that the fuel-to-air ratio needs adjusting unless there is someone adequately trained on site.

For non-gas-fired boilers, a smoky exhaust normally indicates poor combustion through lack of air. This causes unnecessary pollution. It also means that fuel is being wasted, and heat exchange surfaces will become sooted over and much less efficient (soot is as good an insulator as asbestos).

Note that the absence of smoke from the flue of a gas-fired boiler is no indication of good combustion. Flue gas analysers should be used.

Flue gas analysis

A flue gas analysis test should form part of the annual service and act as a reference point for measurements made through the year by the sports centre staff. The test requires a sample pipe connected to a flue gas analyser to be introduced into the flue and measurements of oxygen and temperature taken. Flues will usually already have a hole drilled for this purpose with a small cover plate attached.

Burners

The burners of oil-fired, or dual-fuel, boiler plant should be inspected by qualified personnel every three months to ensure that the components are in good working order and that the optimum fuel-to-air ratio for efficient combustion is being maintained. Gas burners require the same attention every six months.

Dual-fuel (gas or oil) rotary cup burners require special attention: their filters should be cleaned at least once a week.

Flue gas temperature

In the boiler itself, there is a gradual accumulation of soot and scale which hinders heat transfer from the combustion process through the boiler's heat exchanger to the water or air. This is more noticeable with oil-fired rather than gas-fired boilers. The result is an increase in fuel consumption. This is indicated by a rise in flue gas temperature.

If a boiler does not have a temperature sensor permanently fitted in the flue, and a flue gas analyser is not available, it is worth considering having a sensor installed. This will help to identify when the boiler needs servicing; a 15°C rise in temperature is an indication that the efficiency of the boiler has fallen by 1%.

Note that the temperature should not be read until the boiler has been burning fuel continuously for 10 minutes and the temperature stabilised. The manufacturer's data will say what the flue gas temperature should be after a service.

Annual servicing

Specialist boiler servicing should be performed at least annually, and certainly before the main heating season.

Gas-fired boilers

- Gas burners: clean and examine for wear
- Burner gas pressure: check
- Gas lines: check for leaks
- Gas boosters, governors and valves: check for correct operation
- Heat exchanger: brush and vacuum clean

Oil-fired boilers

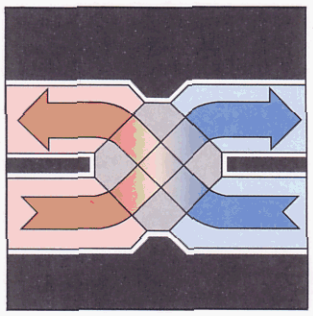
- Oil burners: check nozzles, cups, and clean
- Oil strainers: clean or replace if dirty
- Oil heaters: ensure oil kept at right temperature. Check tank insulation
- Oil pipe lines: look for leaks
- Oil pumps: check for correct operation
- Heat exchanger: brush and vacuum clean. Check for air leaks in the boiler and flues, check associated plant (fan, fan belts, pumps, water treatment plant, control system, thermostats, etc)

The annual servicing of boilers is required for safety reasons, but more frequent checks and adjustment are required to maintain good efficiency and reliability. Good records of fuel use, boiler efficiency and flue gas temperature enable trends to be determined.

A large proportion of a sports centre's costs are for fuel. Increases in boiler efficiency release significant amounts of money.

IMPACT
Consider a centre with a heating bill of £50 000 per year using a boiler with an average efficiency of 70%. If the efficiency drops by 3% to 67% the annual bill will rise by a factor of 70/67 wasting about £2200 per year of fuel.

Heat recovery



Run-around coils

Run-around coils allow heat in outgoing air to be recovered and transferred to incoming air via an intermediate fluid (usually water and glycol). The fluid is continually pumped from one heat exchanger to the other and back again. Taking into account the energy used by the pump, they can save up to 20% of the heating fuel.

Every 12 months, before each winter:

- check the pump for leaks, bearing wear and flow rate
- check the system for leaks
- check the proportion of glycol is adequate for the likely temperature overnight in cold weather
- clean the heat exchangers and inspect the condensate drains.

It is very important that the proportion of glycol in the system is adequate. (Failure to observe this has led to successive leaks and systems being abandoned.) Systems which have header tanks connected may allow automatic topping up of any loss of working fluid - but this is done with water. These are particularly risky designs as a leak will mean the system may freeze and rupture the heat exchanger.

In systems with automatic top-up, check that the amount of glycol is adequate, once a week in cold weather, by withdrawing a sample of fluid and testing with a hydrometer

Rotary heat exchangers

Rotary heat exchangers, or thermal wheels, are honeycomb meshes that alternately pass through the outgoing warm air stream (where they absorb heat) and then through the incoming cool air (where they release heat). In this way they save considerable energy.

Where the wheel is easily visible, a daily check should be made to confirm that it is rotating at the manufacturer's recommended rate.

Every six months check that:

- the wheel is rotating at the correct speed
- the bearings are lubricated
- the seals are in good condition
- there are no signs of corrosion
- the honeycomb is washed.

Some honeycombs have a chemical coating that is hygroscopic and enhances heat recovery. Follow the manufacturer's cleaning instructions. Even if access to the heat exchangers is difficult, it is very important to inspect them because if they stop rotating and become blocked the result will be much reduced ventilation. This could lead to condensation in the building's structure and have serious consequences.

Plate heat exchangers

Plate heat exchangers consist of glass, metal or plastic plates arranged in a stack with the exhaust air and incoming air flowing in the adjacent channels. Heat transfers from the outgoing air through the plates to the incoming air. If grease and grime are allowed to build up on the plates this will lead to a substantial reduction in their effectiveness.

Every month, if good access is available, but certainly twice a year, the heat exchanger should be opened up and the plates washed down with water and mild detergent. A high pressure hose can be used, but precautions should be taken to prevent water running into adjacent ductwork or filters.

If the plates are made of metal, chlorinated air can attack them. Inspect for signs of corrosion at least once a year. Periodically, but particularly in the autumn, any summer:winter by-pass damper should be checked to see that it is in the heat recovery position – otherwise no heat will be recovered.

IMPACT

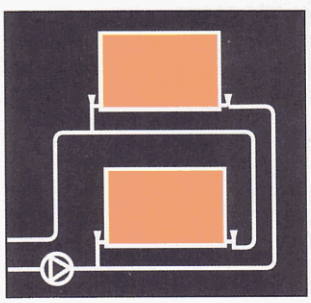
Consider a cross-flow heat exchanger installed in a pool hall, which normally reduces the fuel bill by 30%. If this has become dirty with oil aerosol and dust, the heat transfer rate may fall by 50%.

For a centre with a space heating bill of £50 000 per year, of which half is used in the heating of the pool hall (using mechanical ventilation) , the dirty heat exchanger will lead to a wasting of about £5400 per year of fuel. This assumes that all the heat is used to combat ventilation heat loss.

Rotary heat exchangers require routine inspection

Ensure that all pipework including insulation, valves and flanges are checked regularly

Heat distribution



Pipework

Considerable heat may be wasted from uninsulated heating pipework. Their surface temperature may be as high as 80°C. Make sure that all pipework including valves and flanges are adequately insulated and regularly checked for:

- leaking pipe joints
- soggy and damaged insulation
- insulation that has not been put back after repair work.

The circulating water in pipework contains dissolved air. This often separates out and becomes trapped in radiators, reducing their heat output; releasing the air restores output.

Radiators

Radiators give out most of their heat by directly heating the air next to them. It is therefore important to ensure that air is free to circulate around the radiator.

Each month:

- check that paper, etc has not been stuffed behind the radiators
- release air trapped in radiators
- check pipe joints for signs of leaks.

Fan convectors

Fan convectors pass air over a heat exchanger heated by hot water. They allow a more rapid input of heat into a space than do radiators, but they require greater maintenance. In particular, it is necessary to filter the air flowing through them, and these filters need frequent cleaning.

Each month:

- remove the filters and check for damage
- clean or replace them if necessary
- release air from vent points
- inspect the heat exchanger and, if dirty, clean with an industrial vacuum cleaner, drawing air through in the opposite direction to the normal flow.

At least every 12 months, fan convectors should receive more substantial maintenance including: lubrication of bearings, checks for corrosion and proper operation of controls.

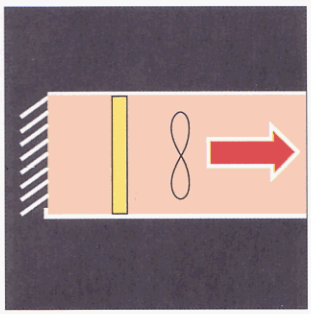
Failure to clean the filters will greatly reduce the fan convector's heating capability. This may lead to a decision to raise the boiler flow temperature or switch the heating system on earlier, which in both cases would lead to increased fuel consumption.

IMPACT

Consider a hall which has space heating provided by hot water distributed through pipes in a false ceiling. The false ceiling is insulated and the void ventilated to outside. Consider if, following a leak, the pipe insulation was removed to allow it to dry out, but was never replaced.

For 20 m of exposed 50 mm pipe, and typical operating conditions, the annual fuel cost of the unreplaced insulation is £600 per year (£30/metre per year). This assumes the typical operating condition is a surface to air temperature difference of 60°C wet heat supplied by a boiler operating 17 hours per day at 70% efficiency using gas at 1p per kWh.

Mechanical ventilation



Grilles

Grilles provide protection from the ingress of larger objects which might damage the system. If they become blocked there may be an increase in fan energy used. Insect screens are particularly liable to become blocked.

- Every six months, and especially at leaf fall, examine all external grilles, bird and insect screens and louvres.
- Every year examine all internal grilles.
- Clean grilles and louvres if dirty.
- Check screens for integrity and replace if holed, otherwise brush or wash clean as appropriate.
- Regularly place hands near to grilles to become familiar with the normal flow of air through them; investigate if this changes.

Filters

Air is filtered before it enters ductwork to reduce the build-up of dust both within ducts and in the building itself.

Contamination by dust:

- reduces the effectiveness of air handling systems and can lead to increased energy consumption
- reduces the effectiveness of heat recovery or heat exchange equipment
- reduces the reliability of sensors
- increases cleaning costs and brings forward the need for redecorating.

There are many different types of air filter, but whatever the type they will eventually become clogged with dust and debris. As this happens, the resistance to air flow increases. This is revealed by an increase in the pressure drop across the filter.

The pressure drop can be used together with manufacturer's information to indicate whether an air filter needs to be changed (if disposable) or washed out. The frequency of filter changing or washing depends on the environment.

- Filters should be checked at least every six months.
- Grease filters used in kitchens may need to be cleaned daily or weekly. Failure to clean grease filters can lead to deposits in ductwork, thus increasing the hazard of a flash over fire in a main duct.

Fans

Fans provide the air movement that ensures adequate ventilation. Fans and the motors that drive them need attention to correct:

- bearing wear and loss of lubrication
- fan belt wear leading to slippage
- looseness in mountings caused by vibration.

Poor maintenance will reduce air handling capacity and increase energy consumption.

Fans should be checked at least every three months. Ensure that:

- fan belts are correctly tensioned and aligned with respect to the motor (only a slight bow should be present on the slack side when in operation)
- bearings are lubricated as recommended by the manufacturer
- fan mountings are secure and the fan assembly is clean.

Increased noise from a fan will suggest that attention is required. A thorough inspection should be carried out every six or twelve months. This should check the electrical integrity of the motor (replacing worn brushes) and test for bearing wear.

Ductwork

Check annually that:

- ductwork is internally clean and free of leaks, especially at duct junctions
- insulation is sound
- flexible connections between ducts and fans or other plant are not taut or split. If dust is found, this may indicate leaks or loose panels elsewhere, or failure of filters – the cause should be investigated.

If ducts have to be cleaned it is essential to either remove or protect any sensors.

Dampers

Dampers and louvres are used to control:

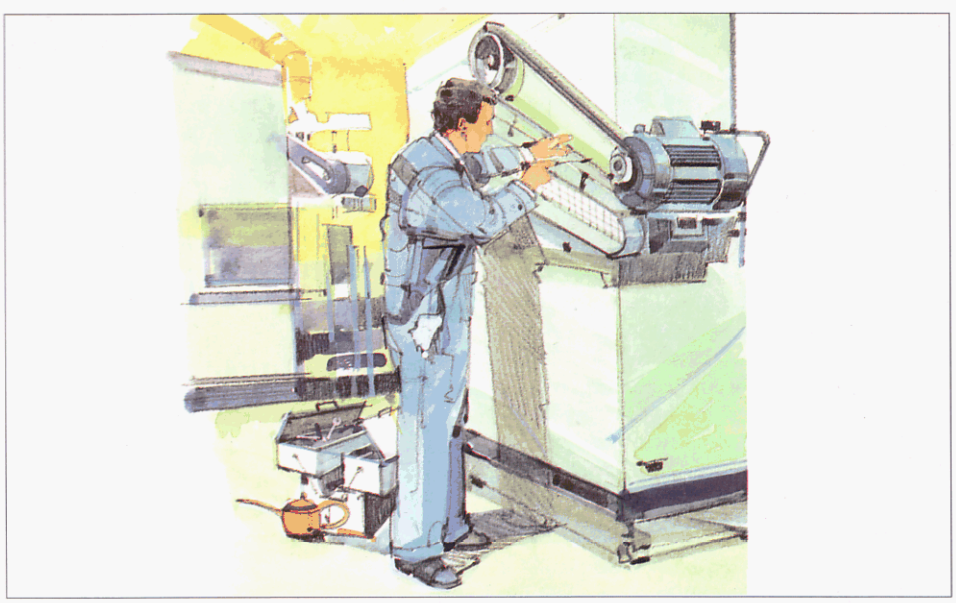
- whether air is routed through one duct or another
- the proportion of fresh to recirculated air, and thus the fuel needed for heating it
- the emergency cut-off of air movement in the event of fire.

During commissioning, they are adjusted to balance the flow of air away from duct junctions to different parts of the building. Poorly maintained dampers and louvres, or their control, can be responsible for large volumes of warm air being exhausted to the outside unnecessarily. This will have a large impact on energy use.

It is important to check every three months that:

- control dampers are not stuck; they are free to open and close; and the limits on movement have not been adjusted
- the linkages for dampers activated by motor, have not become loose or disconnected
- dampers are clean.

Fire dampers should be checked only by trained personnel. Electrically-triggered fire dampers may need manually resetting after a full fire test.



Quarterly checks of fans can ensure efficient operation

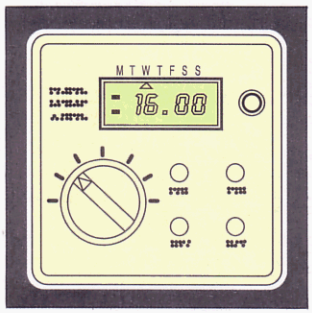
IMPACT

Consider a swimming pool hall whose mechanical ventilation system is designed to vary the amount of fresh air introduced according to need. This saves at least 10% on pool air heating.

When less fresh air is needed, some systems work by recirculating internal air with the incoming fresh air supply. This maintains the flow in the ductwork and gives good air distribution.

Suppose that a manager wishes to cease recirculating internal air and decides simply to disconnect the control rods that activate recirculation. This will, at times, lead to a ventilation rate higher than required. The average ventilation rate for the hall is likely to be at least 10% higher. For a centre with a space heating bill of £50 000 per year, where half is used in the heating of the pool hall, the increased fuel use will be at least £2500 per year. Different controls or recommissioning are better alternatives.

Controls



Temperature sensors

Heating a sports centre just 1°C above the recommended temperatures will increase heating fuel use by about 10%.

- As well as using a digital thermometer for checking the space temperatures daily, it is important that thermostats and sensors should be cleaned and checked against an independent measurement every 12 months. They should be recalibrated if necessary.

Thermostats that work using a bi-metallic strip are often in error by several degrees centigrade. Sensors lose their calibration in time. If they are connected to a Building Energy Management System (BEMS), it may be necessary to contact the BEMS supervisor in order to compare readings. (The centre's digital thermometer should itself be checked against a reference every 12 months.)

Pressure sensors

A warning of the need to change or clean an air filter is often given by measuring the pressure drop across it. The pressure drop increases as the pores of the filter become clogged with debris.

- Operators should be aware of the pressure drop at which the manufacturer of the filter recommends action needs to be taken.

One type of pressure sensor that needs attention is a manometer which works using a U-tube partly filled with a liquid. (The ends of the tube are connected across the pressure difference and this results in the liquid levels being different in each arm of the tube.) It is possible, for instance, if an air filter has become excessively clogged, for the working liquid of a manometer to be ejected from the U-tube. Check for liquid loss. Where a pressure sensor is relied upon to activate an alarm (perhaps via a BEMS), it is essential that the operation of this switch is checked at least every 12 months.

Humidity sensors

Humidity is controlled to avoid problems associated with condensation on the structure of the building – these problems can lead to the total collapse of ceilings above swimming pools. A relative humidity of 55-65% in pool halls is recommended.

- Humidity sensors commonly drift in time and give unreliable readings. They should be recalibrated annually.

Mechanical ventilation of pool halls may be automatically controlled by a humidity sensor. If this sensor has gone wrong, large volumes of air may be heated and extracted quite unnecessarily. Because of this potential to waste large amounts of energy, it is worthwhile considering replacing them every two years unless recalibration results show that they are still reliable.

Timeswitches

Timeswitches allow clear on/off control of plant. If conditions permit, pool hall extract fans can be turned off overnight by timeswitch if a pool cover is normally used. They can thus considerably reduce energy use.

- At least every 12 months, the dials of mechanical timeswitches should be manually rotated and the correct switching of the plant checked. This is sensibly done when the clocks are adjusted at Greenwich Mean Time and British Summer Time time shifts.

A record of the on/off settings should be kept next to timers so that they can easily be checked and reset, where applicable, after a battery change. When batteries are changed the contacts should be checked for corrosion and cleaned.

Optimisers (optimum start and stop)

It takes less time to warm a building up in mild weather than in cold weather. Optimisers take advantage of this by adjusting the start-time of heating according to the weather and leaving it as late as possible. Optimisers may also determine when to switch off the heating, before the end of occupancy, by allowing for the rate of cooling of the building in relation to external temperature. Considerable fuel is saved in this way.

The optimiser relies on receiving proper measurements of internal and external temperature. It is therefore necessary to:

- know where these sensors are; check that they are not near sources of heat; and ensure that they and the optimiser are checked thoroughly every 12 months
- make a simple check by noting the start (and stop) times, (which are often displayed on an optimiser) for cool days and warm days. The boilers should be automatically switched on at a later time and switched off earlier on the warmer days.

Boiler sequencers

Where there is more than one boiler, a sequencer controls which boiler is on at any one time. This increases the number to match the demand for heat. The boiler which comes on first should always be the same one – the lead boiler – otherwise more fuel will be used. This is because, when a boiler has just switched off, it loses (and wastes) heat by natural draught up its flue and because there are losses from the case of the boiler. Confining these losses to one boiler, whenever possible, minimises them.

In some installations, the lead boiler may be of a particularly efficient type (eg a condensing boiler). It is then especially important to ensure that the sequencer always chooses this as the lead boiler.

- Hours-run meters, if fitted, can be used to confirm that the lead boiler is used for more hours than the second boiler, and so on. (The hours run should be recorded each month.) This simple check can be used to confirm that annual contract servicing has left the sequencer working properly. It is normal to even out the wear on a set of boilers by rotating the sequence, or firing order, every three to six months.

Weather compensators

In central heating systems, fuel can be saved if the water's flow temperature is reduced. This limits the maximum heat output of the system in warmer weather. Some systems take other weather variables into account.

- The correct operation of a compensator should be checked annually by a specialist.

On both warm and cool days, centre staff can confirm that the compensator is working properly by using a digital thermometer in the boiler room to measure the flow temperature to radiators. The flow temperature should be cooler on warmer days. (Do not measure the temperature during the period of early morning heating; controls such as weather compensators are often automatically switched off at such times to allow the building to heat up quickly.)

Building Energy Management System

Many sports centres are connected to remote Building Energy Management System (BEMS). These permit experienced engineers to supervise and maintain many buildings from one place and often to alert centres to problems before they are aware of them.

BEMS should be maintained annually by a specialist who is familiar with the software and hardware. Centre staff – particularly if they have opted to run a BEMS themselves – should periodically check that the temperatures and plant activity, as displayed by the BEMS match the reality. A well maintained BEMS can save a substantial amount of energy and money.

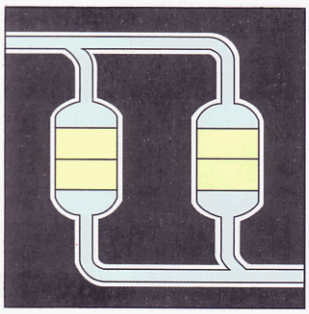
- A digital thermometer can be placed next to the sensors used by the BEMS and compared with the BEMS readings. If the BEMS says that the boilers are off, check that they are off.

It has been found that most of the energy savings associated with the installation of a BEMS on an existing building come from the re-commissioning of the plant – not from the BEMS. This shows that there is considerable scope to save energy by getting the existing plant working properly.

IMPACT

Consider a centre with a space heating bill of £50 000 per year of which half is used to heat a pool hall and 20% (£10 000) is used to heat a sports hall. If the control of temperature in the sports hall has gone awry, and is operating at 20°C rather than 16°C, fuel consumption will increase by almost 50%. The penalty for poor control of temperature in the sports hall alone is thus 50% of £10 000, or £5000 per year.

Pool water filtration



Pressure sand filters

Sand filters remove particulate and biological matter from pool water. Water clarity is important both for aesthetic and safety reasons. If filtration is not adequate, the pool will never be satisfactory.

- Every 12 months, immediately after back-washing, the filter should be opened up and the sand bed inspected.

The pressure drop across the filter, when clean water is flowing through, should be noted and compared with previous records and manufacturer's instructions. An increased pressure drop indicates clogging of the filter.

Turnover time should be known from a flow meter and the volume of the pool. It is good practice to have flow meters fitted. A well maintained flow meter enables optimum filtration and disinfection to be achieved. It is poor practice to rely on rated pumping capacity as there is no way of being alerted to a reduced flow rate, perhaps due to a partial blockage of a pipe which can lead to very long turnover times.

Back-washing

Back-washing should be carried out as recommended, but bear in mind that excessive back-washing is wasteful in energy and water. The time for back-washing should be determined from the increased pressure drop across the filter as it becomes dirty - thus linking it to bathing load. The manufacturer's instructions should be followed, but back-washing should be carried out at least once per week or when the pressure difference across the filter increases by 30 kPa (4 psi) above that when the filter was clean.

The minimum period for back-washing is set by the filter manufacturer's instructions, but back-washing should be continued, if necessary, until the back-wash water observed through the sight glass is seen to run clear.

It is essential to fluidise the sand bed during back-washing, and this requires the appropriate reverse flow rate. Many filter designs incorporate the induction of compressed air to enhance the cleaning process. Some filters are fitted with observation windows which allow the operator to see when fluidisation is taking place.

Avoid back-washing on or immediately after days when the water temperature is raised for special activities such as mother-and-baby classes or disabled people's sessions.

Recording hours run each month will confirm that boiler sequencers are operating correctly

Getting the balance right between excessive and insufficient back-washing can provide considerable energy savings.

Fresh water dilution

Fresh water dilution can be effected through the replacement of water used in back-washing, but back-washing may not be sufficient to keep the concentration of unwanted pollutants at an acceptably low level. Some forms of combined chlorine and total-dissolved-solids can only be reduced through dilution. As well as making the bathing water and the air in the pool hall more pleasant and healthy, proper dilution can help to protect the fabric of the pool. Diluting up to 30 litres of fresh water per bather per day is the recommended amount, which clearly has practical implications.

Pool pumps

Pool pumps have to be powerful in order to be able to attain adequate turnover times - usually up to three hours - and transfer many hundreds of litres a minute. They use a considerable quantity of electricity. (One 7.5 kW pump will cost about £3500/year to run continuously.)

It is good practice to install three half capacity pumps instead of one full capacity pump. This allows pump capacity to be reduced at times when it is appropriate to do so without detriment to water quality. Such a system also provides a standby pump and gives ideal flexibility.

A strainer box should be fitted to the suction side of the pool pump in order to remove large particles, and protect the pump impeller. Strainers should be thoroughly cleaned each time back-washing takes place. More regular cleaning as indicated by flow rates and visual inspection may be necessary in some cases.

IMPACT

Consider a swimming pool using a 2.5 m diameter pressure sand filter, with mechanical scouring. The filter is back-washed every other day with water taken from the pool. Back-washing at 3000 litres/minute continues for five minutes. A volume of 15 m^3 is thus discarded. If the replacement fresh water enters at 9°C and is heated (at 70% efficiency) to 29°C, 500 kWh will be used. Using gas at 2p/kWh and water at £1/m^3 each back-washing costs £10 + £15 = £25; back-washing costs £4600/year.

It is desirable to back-wash according to need – not just a regular timetable. If in this example back-washing is really needed every fourth, rather than second day – £2300/year could be saved (£900 on fuel, £1400 on water). Notice also that if back-washing time were unnecessarily extended to ten minutes, costs would rise by £4600/year.

Operators should be familiar with the normal sound that the pump makes and be alert to any change in this which may signal a problem. A noise change will occur if:

- air is sucked into the pump (eg if glands lose their seal)
- cavitation occurs (eg because of a blockage in the supply pipe)
- an impeller fails.

In all cases, the throughput of water will be reduced and may lead to unacceptably long turnover times. A flow meter which records both current and cumulative flow is very useful in checking turnover times. If the hourly throughput of water decreases, this may indicate a pump problem or a blockage in the main pipework.

It is worth recording flow rates.

- The pump should receive regular, thorough servicing every three months.
- The pump's strainer should be cleaned, at least, at each back-washing.

If a pump begins to fail, and an additional pump is switched on to run at the same time, it is important to get the broken pump repaired quickly. This avoids the high cost of running the extra pump.

- Furry white deposits on flanges can indicate the onset of leaks.

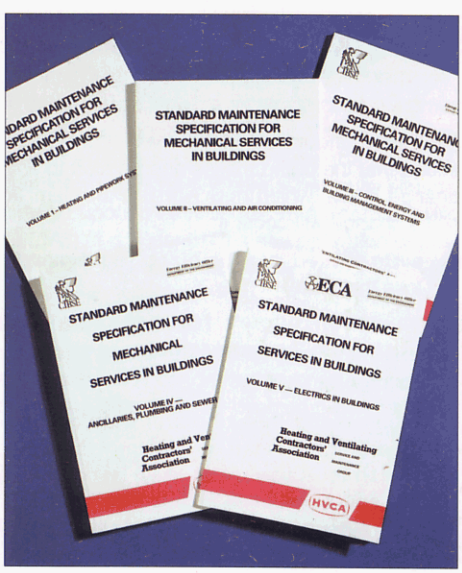
Other services

De-humidification equipment will require specialist maintenance, but you should check that the humidity sensors controlling the plant are properly calibrated and set. It is expensive and wasteful to maintain an unnecessarily dry atmosphere.

Some sports centres allow in substantial daylight and have light sensors that automatically reduce or turn off electric lighting when it is bright outside. These sensors need checking because they may drift or become dirty, resulting in lights being on even in bright weather.

Hot water for showers, etc should not be stored below 55°C, otherwise harmful bacteria may not be killed. The accuracy of the temperature sensor for hot water storage should be checked annually. The actual temperature of stored water should be checked more frequently.

This Guide cannot cover all types of plant in a sports centre. Detailed maintenance requirements should be determined by consulting equipment manuals and external advisors. To summarise some of the advice given here, a simple maintenance plan is shown opposite.



HVCA Manuals

Check that pool filters are clean. Inadequate filtration can lead to the need to empty and refill the pool

TASKS	WEEKLY	MONTHLY	SIX-MONTHLY	YEARLY
Boilers: measure boiler efficiency or flue gas temperature		★		
Boilers: specialist boiler service.				★
Run-around coils: check for leaks, check flow rate, clean heat exchangers				★
Run-around coils: check for adequate glycol concentration in cold weather	★			
Pipework: check for leaks, soggy insulation. Check also after repair work				★
Radiators: release trapped air, check for leaks, remove paper, debris, etc		★		
Ventilation air filters: clean or replace at least every six months		★	★	
Ventilation fans: check fan belts for tension, alignment. Check noise		★	★	
Sensors: recalibrate and check all timers, sensors, etc				★
Pool water sand filter: open filter and inspect sand bed. Clean inlet strainer				★
Pool water pump: specialist service				★

Useful sources of information:

- Standard maintenance specification for mechanical services in buildings, volume 1; heating and pipework systems. London, HVCA, 1990. £50.00
- Standard maintenance specification for mechanical services in buildings, volume 2; ventilating and air conditioning. London, HVCA, 1991. £75.00
- Standard maintenance specification for mechanical services in buildings, volume 3; control, energy and building management systems. London, HVCA, 1992. £65.00
- Standard maintenance specification for mechanical services in buildings, volume 4; ancillaries, plumbing and sewerage. London, HVCA, 1992. £75.00
- Standard maintenance specification for mechanical services in buildings, volume 5; electrics in buildings. London, HVCA, 1992. £65.00
- 'Practical Leisure Centre Management', Vol II, The Institute of Sport & Recreation Management, Melton Mowbray, Leicester.

ENERGY EFFICIENCY IN SPORTS AND RECREATION

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