Gas Information Sheet 51

Type B appliance energy efficiency information for licensed persons

Overview

One of the key objectives of Energy Safe Victoria is to promote the awareness of energy efficiency of gas installations and appliances. The intent of this technical information sheet is to help identify where there may be opportunities for licensed persons to influence the efficiency of Type B appliances through decisions made during specification, installation and commissioning, as well as through ongoing maintenance.

Note: When specifying, installing or optimising Type B gas appliances and processes, consider seeking expert advice to ensure the most energy efficient outcome is achieved.

Energy efficient product specification

Careful product selection (where options are available) is the first step to achieving an efficient solution. Energy efficient products include:

1. A heating plant that is sized to match heat load and temperature requirements to ensure it can operate in its most efficient band. This may be a consideration at the time of appliance replacement (see Example 1).
2. Modulating burners that allow heating production to closely meet process demand; this reduces appliance standby times and reduces heat losses that occur at these times. Heat losses can be reduced by a significant margin when compared to on/off appliances, or to a lesser extent, multi-stage appliances. The use of electronic commutator (EC)/variable speed burner motors also reduces electric motor energy when the burner is modulating.
3. Fully modulating burners, which more closely track a heat load compared to on/off or partially modulating burners, reduce periods of standby, which can lead to heat losses by up to 4%.
4. Economisers to recover heat from flue gases, and reuse that heat for preheating combustion air or process fluids.
5. Catalytic/flameless infra-red ovens, which can reduce fuel demand by up to 80% and paint drying time by up to 50%. Consider these ovens as an alternative to traditional gas-fired spray booths or bake ovens.
6. Condensing boilers, which operate at higher efficiencies when cooler supply water is available. The condensing effect only begins as supply water temperatures fall below 50°C, and efficiency improves as the temperature of the entering water reduces further.

Boiler thermal efficiency

Typical thermal efficiency for properly maintained boilers is as follows:

- Condensing boilers = up to 98% (when condensing).
- Forced draught boilers = 85-90%.
- Induced draught boilers = 80-83%.
- Atmospheric boilers = 70%.

Example 1

Project:	Boiler plant upgrade
Annual heat requirement:	10,000 GJ
Natural gas unit cost:	$9/GJ
Upgrade scope:	From atmospheric boiler plant (2x 1000kW boilers at 65% efficiency) to forced draft boiler plant (90% efficiency)
Benefit to operational cost =	$38,000/annum
Capital cost =	$250,000
Simple payback =	6.5 years
Reduction in greenhouse gas emissions = **10,000 GJ**	230 tonnes CO2-equivalent/annum

Reduction of heat losses

Heat losses are inherent in heat production and reticulation systems and reduce their operating efficiency. Heat losses can be reduced through a number of strategies:

1. Insulating of processes, including:
    - Hot water pipes. Losses from well-maintained pipework are estimated to be 1.5% of the system capacity in a commercial office building.
    - Steam pipes. Uninsulated steam pipes incur a relatively large heat loss, which increases the amount of condensate in the steam, and thus reduces the heat transfer efficiency. An uninsulated 100 m run of 50 mm pipe, carrying steam of 10 bar, could condensate approximately 180 kg/h of steam through heat losses with ambient temperature of 15°C.
    - Spray booths.
    - Vats.
    - Kilns.
    - Building fabric.
2. Isolating lag boilers, when on standby, from the water flow by using automatically actuated valves. Heat losses from standby boilers are typically 5-10% of the system heat per hour.
3. Minimising temperatures in heating processes, where possible, to reduce radiant losses. The potential for reducing temperatures will be dependent on the process the system is serving
4. Applying time clocks to circulation pumps (in some cases) i.e. such as DHW reticulation in a commercial building, to reduce heat losses from pipes when heat supply is not required.
5. Recovering hot condensate, where possible, from steam distribution and process equipment and then feeding the condensate to the feedwater tank. This saves energy and chemical treatment costs and reduces fresh water demand. A 60°C rise in temperature of the feedwater can save around 1% of the gas input.
6. Removing leaks in steam traps, joints and valves. A significant steam wastage can occur due to leaks. A 3 mm diameter hole can discharge as much as 30 kg/h of steam at 10 bar (gauge). Some

leaks are visible, which are straightforward to fix, but some are invisible such as leaks through faulty steam traps – that requires a visual inspection run by maintenance personnel.

7. Installing pressure reducing valves (PRV). As most steam end users will operate at a lower pressure than the main steam supply pressure PRVs will provide pressure reduction. Calibrating the PRVs is important, not only to maintain correct operating pressure, but also to improve the dryness of the steam in the process.

Type B appliance maintenance

Regular maintenance is essential for the efficient operation of a Type B appliance. The maintenance regime includes:

1. Tuning the gas burner – to achieve an optimum air/fuel mixture can improve heating efficiency by up to 2% (see Example 2). High combustion efficiency is shown through the appliance exhaust gas temperature and the oxygen level in the exhaust gases.
2. Boiler blow down – is essential to maintain the total dissolved solids (TDS) level in the boiler drum. An optimal TDS level control can save energy, water and chemical treatment costs.
3. Boiler water condition – exhaust gas temperature indicates how efficiently the energy from the combustion of gas inside the combustion chamber is used in the boiler. If the exhaust gas temperature rises over a period of time it indicates that there is scale formation on the water side of the heat exchanger surfaces and that the boiler water treatment is not effective.
4. Regularly checking the steam traps – it is essential to identify steam losses. Steam in a condensate recovery tank is an indicator of steam trap failure.

Example 2

Project:	Initiate regular burning tuning
Average heat load:	500 kW
Natural gas unit cost:	$9/GJ
Upgrade scope:	Tuning air/fuel ration (assumed 2% efficiency benefit)
Benefit to operational cost =	$2,800/annum
Tuning cost =	$2,000
Simple payback =	1 year
Reduction in greenhouse gas emissions =	17 tonnes CO2-equivalent/annum

Optimisation for improved appliance/process efficiency

There is significant scope for optimisation of gas systems through commissioning to increase system efficiency. Methods include:

1. Reduction of process temperatures. This improves system efficiency by reducing heat losses.
2. Reduction of entering water temperatures, for condensing boilers, to 50°C. This enables increased efficiency. This might be achieved through reducing supply temperatures, reducing flow rates in the reticulation system to enable greater temperature drop, or applying a temperature reset to reduce

supply temperatures when heating demand is low (suitable for commercial building heating systems).

3. Reduction of generated steam pressure to match the specifications of the site equipment.
4. Optimised boiler/steam generator staging. When the heating demand exceeds the capacity of one boiler, stage up and modulate boilers in parallel. Boilers generally run at higher efficiency at higher capacity, therefore it is best to stage up late (bring second boiler on when first boiler is close to its maximum capacity).
5. Minimise cycling of burner operation. Relatively high frequency cycling causing undershoot and overshoot of process temperature set points can lead to heat losses, i.e. up to 4% in boilers (see Example 3). Frequent cycling causes frequent purging of the combustion chamber and thus a significant amount of heat is moved away from the chamber by the cold air.

Example 3

Project:	Reduction of burner cycling
Average heat load:	500 kW
Natural gas unit cost:	$9/GJ
Upgrade scope:	Optimised burner modulation (assumed 4% efficiency benefit)
Benefit to operational cost =	$5,700/annum
Tuning cost =	$2,000
Simple payback =	1 year
Reduction in greenhouse gas emissions =	33 tonnes CO2-equvalent/annum

Who we are

At Energy Safe Victoria we work to keep Victoria energy safe.

We regulate the energy industry and sector to ensure generation, supply and usage uphold safety standards, and engage with the community to raise awareness of energy safety risks.

In everything we do, we strive to deliver on our purpose to keep Victoria energy safe. Always.

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