# HOW TO SELECT A LOW VOLUME (L.V ) BOILER

## FREQUENTLY ASKED QUESTIONS OR COMMENTS ON BOILERS

Dear Potential Customer:
Low Volume Operator Exempt boilers have been marketed in Ontario to eliminate the requirement for Operating Engineers in specific applications. This can be accomplished if the following conditions are met.
Operating water content in **each** boiler does not exceed **75 imperial gallons**, and the total operating water content of **all** boilers in the plant, does not exceed **250 imperial gallons**.

To achieve these conditions manufacturers of boilers have had to design special boilers to perform under these conditions, which are now classified by **TSSA** as "***Low Volume Boilers".***

In meeting the Low Volume conditions, manufacturers have **had to compromise** on fundamental design features of traditional boilers. **Some of these changes are as follows.**

1. Reduction of Heating Surface area
2. Reduction of Steam drum space
3. Increasing heat transfer area, by adding baffling to transfer heat. On many designs this has resulted in higher electrical blower motor consumption
4. Reduction of number of gas passes. This normally has results in lower combustion efficiencies
5. Increase in normal conventional boiler blow down rates to achieve good quality steam
6. Compacting boiler tube design, not allowing for ease of tube replacement.
7. Designing burners with set flame control to overcome potential tube stress from inadequate internal water circulation.
8. Higher burner Purge Loss using Step Fired Burner concepts, versus Full Burner Modulation as found in conventional boilers
9. Poor control of Water Treatment Chemicals in the boiler. Some Low Volume Boilers designs do not have a good location for obtaining a representative water sample, to control proper chemical control.
10. Compromise of Steam Quality resulting in many issues including Efficiency Loss.

The above points are some of the issues that will be addressed **in this report to follow**

## COMMENTS ON THE ABOVE ISSUES

### ❖ Heating Surface Area

**This is one of the most important reviews to determine boiler life expectancy / performance**

- **Higher** the **square feet / BHP,** the better the boiler will be. Boilers having higher heating surface area provides, lower heat release making boiler tubes have a **longer life expectancy**, and also capable to withstand more abuse, without failure from fouling due to scale.

Less heating stress can be expected with a **larger** heating surface. Also, better quality of steam is achieved. Some manufacturers try to sell smaller heating surface as an advantage to the boiler making steam faster from cold start. This is a false consideration and should be dismissed in thermal equipment selection, when considering the type of boiler to purchase.
Another condition that is pushed is small foot print. Smaller foot print boilers usually have **smaller** heating surface. This condition should not be accepted, when purchasing boilers.
In the case of some L.V **Design Boiler** the following Heating Surface applies. We recommend that you take the time to review competitor's products and fill in the comparison data prior to purchase.

| **Some Low Vol. Design Boilers** | | **Competitor Boiler** |
|---|---|---|
| 100 BHP = **314 sq feet** | 100 BHP = | sq feet |
| 150 BHP = **486 sq feet** | 150 BHP = | sq feet |
| 175 BHP = **596 sq feet** | 175 BHP = | sq feet |
| 200 BHP = **596 sq feet** | 200 BHP = | sq feet |
| 250 BHP = **753 sq feet** | 250 BHP = | sq feet |
| 300 BHP = **753 sq feet** | 300 BHP = | sq feet |

**Pick the boiler with the Higher Heating Surface . (Fill in the above and compare)**

## ❖ Steam Drum Space

**Larger Steam Drum Space** provides the following **advantages**

- Less potential for Wet Steam
- Less potential of low water conditions causing the boiler to shutdown.
- Less thermal shock on the boiler tubes resulting from low water conditions
- Reduces Purge Loss. ( This is an Energy Loss)

**Some Low Volume design** have a **larger steam drum** than most of the Low Volume boilers on the market. **Pick the boiler with the biggest Steam Drum**

## ❖ Higher Electrical Consumption:

**Smaller Boiler Blower Motor HP,** reduces Electrical consumption, and therefore lowers operating cost.
On some L.V Design Boilers the blower motor HP ratings are as follows

| **Some Low Vol. Design Boiler** | | **Competitor Boiler** |
|---|---|---|
| 100 BHP = **3 HP** | 100 BHP = | **HP** |
| 150 BHP = **5 HP** | 150 BHP = | **HP** |
| 200 BHP = **7.5 HP** | 200 BHP = | **HP** |
| 250 BHP = **5 HP** | 250 BHP = | **HP** |
| 300 BHP = **7.5 HP** | 300 BHP = | **HP** |

**Fill in & Compare**

**Pick the boiler with lowest Blower Motor HP and save on daily operating energy cost.**

## ❖ Number of Gas Passes

The Higher the number of Gas Passes on a boiler, the greater the heat transfer recovery.
Therefore, **Higher efficiencies** are generally expected with boilers having **more gas passes**.

| **Some L. V Design Boiler** | **Competitor Boiler** |
|---|---|
| **Some L. V boilers = 5 Gas Passes** | **Gas Passes** |

**Fill in & Compare**

**Note:** Some manufacturers use an economizer to recover heat loss, due to not having a high gas pass number. Economizers are an additional cost and have potential problems such as low life expectancy, if inadequate Water Treatment control is not maintained at all times.

**Pick the boiler with the Highest Gas Pass without the use of an economizer.**

## ❖ Claims Of 85% Fuel to Steam Efficiency

Most boilers have the ability to achieve 85% efficiency, based on a Feed water temperature of **68F** and at **"0"** Operating pressure. **However**, this is not a good evaluation to prove high equipment efficiency"

Why? **No boiler operates under these conditions.**

**Review the manufacturer's literature or ask them how they arrived at their efficiencies.**
Request the data they use to arrive at their efficiency. **Example:**
Feed Water Temperature: ____ F
Operating Pressure ____ Psig

**Ask the manufacturer to supply Efficiency based on the following**
Feed Water Temperature 180 F or at your Feed Water Temperature
Operating Pressure you will be running at ____Psig

**Suddenly claims of 85% Efficiency will no longer be valid.**

Make the manufacturer responsible for **any false claims**, in the event of a purchase of equipment does not match the claimed manufacturer efficiency. **Pick the boiler which gives a True Higher Efficiency**

## ❖ Fuel to Steam Efficiency will be determined by the following.

- No of Gas passes the boiler has. (Highest number of passes is better.)
- Heating Surface area of the boiler. (Highest area is better.)
- Steam Quality. (The lower the water moisture in steam is better.)
- Purge Losses. (The lower number of boiler stops and starts the better.) Purchase boilers with the highest Turndown ratio.
- Type of Burner and the type of Modulation. (Look for High turndown modulation.)
- The Oxygen % Value the Burner can safely operate at. (Lowest % is better.)
- Radiation Loss. (Lowest value is best)

## ❖ BOILER SURFACE BLOWDOWN POINT

Some Low Volume boiler designs do not have a **true water separation point,** to remove boiler water solids effectively. As boiler water solids are highest in the location **2" below the water** and steam separation, this is the ideal location for removal. On Low volume boilers that do not have the ability to remove these solids effectively, these boilers have to over compensation on blow down, to achieve the same results.

**Over compensation on blow down will result in the following losses**

- Higher Btu going to blow down drain, from extra blow down – Fuel Loss
- Extra water going to blow down – Water Loss
- Extra chemicals going to blow down – Chemical loss

As these losses will vary based on make up, steam consumption and water make up quality, each application loss has to be calculated. In general, end users of boilers having **poor** blow down control **(no true water separation point),** can expect anywhere from **1 - 2% higher** annual **extra** fuel cost plus the additional chemical and water costs. This is calculated into thousands of dollars / year

**Some L. V boilers design,** follow the standard solid removal approximately **2" below water separation. Many Low Volume Boilers do not.**

**Pick the boiler which has a True blowdown separation point.**

## ❖ Tube Replacement

One of the most significant costs after fuel, to operate a boiler is **maintenance expenses**.
As boilers normally last for many years and only require tube replacement, depending on water treatment conditions and heat release / stress factors, owners should consider in their purchase evaluation, the cost of tube repairs and replacement.

On some L.V boilers **all the tubes** can be replaced **without welding**. All tubes are ferruled requiring **no** welding procedures.

**Pick the Boiler were the least welding is required to install tubes.**

## ❖ Burner Turndown Control:

**Higher the Turndown the better the Steam Control and the Higher the Efficiency expected.**

| **Some L.V Boiler** | | **_____ Competitor Boiler Turndown** |
|---|---|---|
| **4:1** | **Standard Turndown** | **_____ Standard Turndown** |
| **8:1** | **Optional Turndown** | **_____ Optional Turndown** |

**Pick the boiler with the Highest Turndown ratio. (Fill in & Compare)**

## ❖ Circulating Pump Design Boilers

Some boiler designs require an additional circulating pump. These designs have the following problems.

- Another Pump and maintenance to maintain. **(Higher operating cost)**
- Higher electrical usage. **(Higher operating cost)**

**Some L.V boiler** design have **no circulating pump**. These design uses **natural** circulation where two large **external** down comer tubes are part of the design.

**Pick the boiler which does not have a circulating pump. (Cheaper to Operate)**

## ❖ Purge Loss

**Reduce Purge loss by picking the boiler with the Highest Turndown ratio.**

Purge loss is the loss expected when a boiler shuts off and restarts sending the heat in the boiler up the stack. This heat loss is not recovered.

Purge Losses from **ASME guidelines** are as follows

**2** Purge Times / hour boiler shutdown = **2% efficiency Loss**
**5** Purge Times / Hour boiler shutdown = **8% efficiency Loss**
**10** Purge Times / Hour boiler shutdown = **30% efficiency Loss**

***EXAMPLE: If the boiler is 100 BHP***
*The boiler having **2:1 turndown** will shutdown when the load **is below 50 BHP***
*A similar boiler with a **4:1 turndown** will shut off when the boiler load **is below 25 BHP***
*And a boiler with a **8:1 turndown** will shut off when the load **is below 12.5 BHP***

**Some L.V boilers** the turndown is standard at **4:1** and higher ratios of **(8:1)** are available.

**Pick the boiler with the Highest Turndown ratio.**

## ❖ Water Treatment Chemical Control:

**Some L.V designs have less Water Treatment problems, for the following reasons.**

- Excellent Steam quality due to steam drum design
- Good location of water solid separation for removal.

Water Treatment chemical control is a major consideration to be reviewed in a boiler selection. The impact of poor chemical control will result in higher fuel, water and chemical cost.

**Pick the boiler that offers design that reflects in good chemical control capabilities.**

## ❖ Steam Quality:

Good quality steam is one of the factors normally neglected, when reviewing boiler purchase. It is one of the most **important** issues, as **poor steam quality** results in the following.

A. Lower steam temperatures at the process. Longer process time.
B. Higher blow down rates as boiler feed water is contaminated with high solids in condensate
C. Potential for heat stress on tubes, due to low water conditions.
D. Fouling of heat exchanger with boiler water solids and contaminants
E. Fouling of steam pipes.
F. Fouling of steam traps resulting in high energy losses, and higher trap maintenance.
G. System efficiency loss, resulting in higher fuel usage.

Some L.V Boilers have been tested in the field and provides **excellent steam quality** under most load conditions. Do not rely on the manufacturer claims, test it for yourself, or have it done by an independent source, such as your Water Treatment Specialist.

**Always pick the boiler giving the Best Quality Steam.**

## ❖ Low NOx on Boilers:

Boilers operating in Ontario must have NOx values **below 49.6 ppm on Natural Gas,** if the input fuel on Natural Gas exceeds **10,000,000 btu / hour (245 BHP Boiler).** These regulations also apply to **# 2 Oil,** where the limits are **72.3 ppm NOx.** The stipulation on # 2 Oil meeting these limits only come into effect, should the burner operating on # 2 Oil **exceed 500 hours / year**. Therefore, if # 2 Oil is a stand by fuel, then NOx limits do not necessary come into effect for Oil firing. These regulations are from the Ministry of Environment **"Ontario Policy Guidelines A – 9"**

**Some L.V boilers** can achieve NOx below these limits using a special burner cone **without** the need to implementing **FGR (Flue Gas Circulation). Most competitors have to** use FGR Technology to accomplish this, and need to **increase** their blower motor size. Also, as FGR will **reduce** boiler output, competitors have to increase fuel inputs causing many other potential problems such as

1. Higher electrical cost from the larger blower motor
2. Lower Boiler outputs as much as 10%

**Pick the boiler that does not require FGR Technology**

## ❖ Guarded Plant Package

All Low volume boilers sold in Ontario must have a Guarded Plant Package. These packages are supplied by all Low Volume Boiler manufacturers **as standard on their boilers.**

## ❖ Modems:

Some manufacturers provide a modem, attached to the boilers, to relay information back to the manufacturer. This concept is unique and has advantages and disadvantages.
Having an independent modem monitor, could reduce your in house liabilities. This is available using other equipment rather than the boiler supplier network.

## ❖ Parts and Service

**All** Service on some **L.V boilers** can be done by **any** qualified boiler Service Company.
**All** Parts on some **L.V boilers** can be purchased from **any** local boiler supplier.
This reduces after market operating cost of the boiler.

**Pick the boiler that does not require the Manufacturer to Service the boiler or to purchase parts.**