SQUIRE ENERGY

GAS PRESSURE BOOSTING - A GUIDE

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General Information on Gas Pressure Boosting

Most issues with gas pressure boosting are experienced on standard `low pressure` (LP) systems operating at 21mbarg notional pressure, often less than this pressure in urban locations where there are numerous demands and limited available capacity in the gas network. The sudden start-up of `non-typical` plant e.g. burners, boosters, compressors, CHP / CCHP etc. can rob the appliance of the required inlet gas pressure causing the under-pressure cut-off switches (lowest allowable setting = 10mbarg) to shut off before pressure recovers from the meter / inlet gas service pipe. Often this is a control issue and slowing down the response of the booster / appliance take off of gas may solve the issue – allowing the gas network, upstream pipework offtake, meter and downstream pipework to respond to change of loads in good time.

This issue is exacerbated if a Rotary Positive Displacement (RPD) type gas meter (required for `larger` peak hour gas demands or for gas demands which can take a second or two to fully respond) and the governor on the meter takes a second or so to open fully.

If boosters / compressors are used, we recommend the following considerations:

- Boosters / compressors should not be considered as a solution to overcome incorrectly (undersized) downstream installation pipework.

- The proposal to install a booster / compressor (or `non-standard` or `non-typical` plant e.g. CHP / CCHP) must be notified to Squire Energy at the pre-quotation design stage to ensure that correct network analysis is undertaken.

- The proposal to install a booster / compressor (or `non-standard plant e.g. CHP / CCHP) must be notified to Squire Energy at the pre-quotation design stage to ensure that a correctly designed and sized new gas connection, offtake (upstream) inlet and primary meter works are proposed, approved by the Gas Transporter (GT – owner / operator of the gas network) and subsequently carried out by us.

- It is not possible to retro-fit a booster / compressor (or to install `non-standard` or `non-typical` equipment) post-connection if the system has not been designed to accommodate this.

- Retro-fitting a booster / compressor post-construction could render the entire installation as `unfit for purpose` and potentially unsafe.

- The GT can opt to disconnect the gas supply if they deem it to have been incorrectly designed or to have a detrimental effect on their network due to the presence of boosters / compressors (or other such `non-standard` or `non-typical` plant) that was not notified to them at the design stage.

- Boosters/compressors supplied by the various approved manufacturers have a "soft start" or programmable ramp-up ability – (typically c. 6 second ramp). Whilst the appliance/burner may take 100 or so seconds to ramp-up it's the booster sudden start that can cause issues – before the appliance takes gas.

- The downstream (outlet) installation pipe from the primary gas meter to the booster / compressor to appliance/s must be `sensibly` (correctly) sized – e.g. min. of at least one pipe dia. increase from that specified as the design minimum.

- The under-pressure cut-off switch for the booster is fitted with a damper/local reservoir (there are proprietary fittings available) to slow down the sensing of lowering inlet pressure.

- The under-pressure cut-off switch for booster should be located sensibly (e.g. not in the throat of the booster suction pipe).

- If the downstream installation pipes between meter and booster / compressor and appliances is relatively short (little volumetric capacity), a pressure accumulator may be installed to increase capacity to smooth out pressure transients.

- Boosters / compressors may not be installed in the same room / space as the primary gas meter. Further guidance is available from The Institution of Gas Engineers and Managers (IGEM).

- For additional information, please reference Squire Energy' Gas Pressures – Common Queries / FAQ's – A Guide.

If you Decide that a Booster is to be used: When the Incoming Gas Pressure Requires a Booster to Meet Your Plant Requirements

When you decide that a gas booster is required there are a number of key issues that must be taken into account to ensure a safe and compliant installation one that will be reliable and has efficient performance.

Should you decide that a gas booster (or any similar plant, `non-standard` or `non-typical` Plant and equipment or the plant is usage will fall outside of the normal heating pattern) is proposed or is going to be required you should provide all relevant information to us at the pre-quotation / pre-design (by Squire Energy) stage. See Note*, below.

Ensuring that heating plant operates efficiently is clearly very important for any organisation that is seeking to minimise energy costs and environmental impact. In the case of gas-fired heating plant there are a number of factors that need to be taken into account when designing for maximum efficiency – not least of these being the potential requirement to boost gas pressure to the burner.

All gas-fired burners have a requirement for a minimum gas pressure to ensure correct operation. In some instances the incoming gas pressure already available from the GT's gas network and available through the primary gas meter may be sufficient but in other cases it may fall short of the minimum working pressure stated by the appliance manufacturer and you may therefore need to consider the installation of a gas booster. Where a gas booster is required, careful selection is essential.

***Note:**

The decision as to whether or not to install a booster etc. is yours together with the specification and installation of any downstream (outlet) installation. Squire Energy cannot advise on this matter, but can provide general information to help enable you to reach your own conclusion. We do not supply such equipment nor do we recommend any particular manufacturer or supplier.

However, should you decide to install a booster or any other such similar or `non-standard` or `non-typical` plant or know that the utilisation gas plant usage will fall outside of the normal heating pattern then these details must be forwarded to Squire Energy when any request is made for a quotation for any new gas connection, primary gas meter works etc. As part of the gas industry design process and safe control of operations and to ensure we carry out our responsibilities as a safe and prudent operator we must prepare a proposed design (for any new offtake etc.) and submit this to the GT for their assessment and prior approval.

The assessment and evaluation of requirements for any new offtake and new gas connection would be based upon the information that we have received from you. Should it subsequently be found that incorrect or incomplete information was provided by you or any agent or 3rd party working on your behalf which was then

relied upon by us in good faith and provided to the relevant approving party for their review then this would result in any design by Squire Energy, review and approval by the GT and any installation work that may be carried out by us or any 3rd party working on our behalf being incorrect.

Should a new connection be carried out based upon incorrect or incomplete information or if gas pressure boosting plant and equipment is installed that wasn't advised prior to the design and assessment works, then in such circumstances the GT may take the appropriate action under their license to operate and to ensure that the gas network is protected and kept safe this may include the disconnection of any offtake from the gas supply network. Any costs to rectify such matters would be the customer's responsibility. It is therefore essential that any and all information as supplied by you to Squire Energy is complete and correct.

Gas Booster Selection

For gas booster selection you should contact the appropriate equipment manufacturer / supplier for their assistance and guidance. Please refer to Acknowledgements below, for a summary (not complete list) of suppliers. Additional information on boosters is also available from IGEM.

Gas booster selection involves calculating the gas volume flow rate and the gas pressure lift (or elevated pressure) required for operation of the burner. The gas flow rate is calculated by dividing the burner firing rate by the calorific value* (CV) of gas. The pressure lift is calculated by subtracting the gas mains supply pressure from the minimum pressure required at the burner.

**Note:*

Calorific Value (CV) is a measure of heating power and is dependent upon the composition of the gas. The CV of natural gas, which is dry, gross and measured at standard conditions of temperature (15oC) and pressure (1013.25 mbar) is usually quoted in Megajoules per cubic metre (MJ/m3). Natural gas passing through the National Grid pipeline system in the UK is measured at over 100 locations and has a CV range of 37.5 MJ/m3 - 43.0 MJ/m3. Average CV is calculated monthly by the GT and allows for any periodic or regional variations in the quality of natural gas. The average CV for any particular month would appear on the invoice you receive from your gas supplier i.e. the company from whom you purchase gas used.

In situations where a number of burners are being supplied by a single gas booster, selection involves calculating the total gas flow of all the appliances and the maximum gas supply pressure required by any single appliance.

It is also very important to note that all downstream (outlet) installation pipework (also taking in to account any bends, fittings, valves etc.) should be designed and sized as normal, irrespective of whether a booster is being used, aiming for just a 1.0 mbar pressure drop between the outlet of the primary gas meter and the appliance. Installing a gas booster is not a way to enable the use of smaller gas pipework and the use of a gas booster will not overcome any existing issues with incorrect or undersized pipework.

When installing the gas booster it is necessary for the customer to provide Squire Energy with a 'ramp profile' (or `ramp rate`) so that we can ensure the design (and subsequent undertaking of construction works) of any connection and pipework upstream of the meter is correct and to also ensure that any network analysis, undertaken by the GT, required to ascertain the availability and capacity in the gas distribution network, is correct. The ramp profile is not governed by the booster but by the burner/boiler or other appliances that are consuming (or utilising) the gas.

Gas Booster Installation

For gas booster installation you should contact the appropriate equipment manufacturer / supplier for their assistance and guidance.

Additional installation requirements for gas boosters are also detailed by IGEM in their recommendation and standards, publication IGE/UP/2 current ed. 'Installation Pipework on Industrial and Commercial Premises'. Boosters must be installed in compliance with IGE/UP/2.

Early in the design/selection process it is very important to identify the most appropriate location for the gas booster(s). The chosen area should be well-ventilated, dry, clean and easily accessible for both installation and maintenance purposes. Also, to minimise the length of high/elevated-pressure pipework required within the building, the booster(s) should ideally be as close to the burner(s) as is practically possible. Usually this will be somewhere in the boiler or plant room.

In terms of pipework runs, the maximum recommended volume of boosted pipework is usually no more than 25% of the total run between the primary gas meter and the appliance burner. If it is necessary to have a higher volume of boosted pipework than the recommended maximum, then the installation of a non-return valve (NRV) on the booster outlet is recommended. As good engineering practice, we would recommend the customer installs a NRV on all installations where a booster is fitted.

Where parallel or duty/standby booster systems are in use, NRV's must be fitted to prevent gas re-circulating around the non-operative booster. When NRV's are used, the pressure drop across NRV must also be taken into account when selecting the booster and sizing the downstream (outlet) gas installation pipework.

Ideally, in accordance with IGEM IGE/UP/2 a gas booster should not be located in the governor or gas meter room. However, if this is unavoidable, subject to customers risk assessment and space availability, the booster must be positioned so that it does not compromise access to the governor or metering plant. Any electrical equipment used in this location must be suitable for a Zone 2 area with group II A gases.

Similarly, locating the gas booster in an air compressor plant room is not recommended, but if this cannot be avoided then, again, subject to customers risk assessment and space availability, access to the air compressor plant should not be compromised.

Also, the air inlet to the compressor must be connected to ductwork that terminates outside the plant room. In the event of gas leakage, this will avoid the compressor drawing in gas.

Wherever the gas booster is located, anti-vibration mountings and flexible gas inlet and outlet connections are required to minimise noise transmission and pipework stresses. This is the sole purpose of the flexible connections - they must not be used to correct any misalignment of the installation pipework or uneven floor. The booster should be firmly positioned on a flat, level floor.
If connecting the booster requires changes to pipework dia. then these should be smooth and as close to the gas booster as possible.

We would also recommend that whenever the booster is located near to the primary gas meter that suitable design is considered to determine the oversizing and selection of an appropriate length / section of downstream (outlet) installation pipework between the outlet connection on the primary gas meter to the inlet of the booster. This `oversized` section of pipework acts as a reservoir, `dampening` the possible adverse effect of the booster lift on the upstream network and primary gas meter and control components.

All such installations must be in accordance with the Gas Safety (Installation and Use) Regulations.

Controlling the Gas Booster

Gas boosters can be configured to either run continuously or to use automatic/thermostatic controlled operation.

The key benefits of continuous running are avoidance of frequent pressure fluctuations and also reducing wear and tear on the booster motor, bearings and drive belt through stop/start operation. The disadvantages of continuous running are increased noise and energy consumption – both of which are avoided by using automatic/thermostatic operation. Ref. BS 8487:2007 (the Design and Construction of Gas Boosters used in Association with Combustion Equipment - Specification) points specifiers and installers towards automatic booster operation but this is not absolutely necessary.

Boosters must have a low inlet pressure cut-out or cut-off device that shuts down the booster in the event that the gas supply pressure falls below a set level (e.g. min. 10 mbar - subject to booster manufacturer). This device protects the incoming gas supply from being compromised by the operation of the booster. Often the booster start surge (start-up) can lead to activation of this low pressure device, resulting in nuisance tripping out of the booster.

`Tripping out` can usually be overcome by using a booster motor with a variable speed drive/soft start or by installing an anti-surge reservoir (see gas booster installation above) upstream of the booster. The anti-surge reservoir works by acting as a 'damper' between the inlet pipework and the inlet gas pressure switch. This 'damping' effect is created by fitting a restrictor in the connection between the inlet pipework and the reservoir.

This prevents detection by the inlet pressure switch of momentary surges and changes in the inlet pressure as the booster starts and stops. Care must still be taken in sizing the restrictor to ensure that any permanent reduction in the inlet pressure is detected by the gas pressure switch within the mandatory 3 second period. Variable speed drives are useful when the booster serves multiple appliances. If one boiler switches off, then the downstream gas pressure will increase and this is detected by the pressure transducer which relays this to the inverter.

In turn, the inverter reduces the motor speed on the booster to achieve stable downstream pressure. Variable speed drives may also deliver energy savings, as well as reducing booster start surge issues and wear and tear stresses. Generally, the booster is interlocked to the appliances it is supplying so that failure of the booster leads to appliance shutdown. Dual-fuel burners should be interlocked with the fuel selection so the booster only operates for gas firing.

Given all of the factors that can influence the correct performance of a gas booster there are clear benefits to seeking specialist input when getting involved with this highly complex area. Squire Energy is not a manufacturer or supplier of specialist booster plant and we recommend that the customer and their installer seek out such specialist expert services as required.

Acknowledgements

We are fortunate at Squire Energy to have a team comprised of managers, operatives and professional engineers all of whom offer a wealth of experience, competence and knowledge gained from training, `real-life` situations and from working in the gas and construction industry for many years in the upstream,

downstream and gas metering areas as specifiers, designers, installers and problem solvers. We have unashamedly tapped in to this resource to help compile this guide.

However, we appreciate and duly acknowledge the invaluable assistance, recommendations and guidance which we have referred to, in particular to the recognised gas industry working practices and recommendations published by:

- The Institution of Gas Engineers and Managers IGEM

as well as to the specialist and expert advice from various booster manufacturers and suppliers and our acknowledgement, recognition, thanks and grateful appreciation goes to:

- Dunphy Combustion Ltd
- Nu-way Enertech Limited
- Riello Limited / Riello Burners UK
- Secomak Limited

and as stated above, we recommend that the customer and their installer always seek out such independent specialist expert advice from these or similar parties above, who are experts in this field.

Disclaimer

This Gas Pressure Boosting – A Guide is guidance note/advisory information and is intended for general guidance purposes only. This is not offered as any instruction or as a full or exhaustive list and is intended for general guidance purposes only. This document is not intended as a replacement for any legislation, legislative guidance, ACoPs or manufacturers instruction or interpretation of any and all such information. Reference should be made to the appropriate Institution of Gas Engineers and Managers published

recommendations; British Standards; UK/EU legislation; ACoPs; appropriate and other industry guidelines; recognised good working practice and recommendations where made, policies and procedures of the appropriate Gas Transporter, Meter Asset Manager, Approved Meter Installer, plant or equipment supplier or manufacturer or any other relevant 3rd party.

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