WHITE PAPER

# Cast Line Heaters

## The Benefits of This Space Saving Electric Heater

### Introduction

Cast line heaters, or cast-in heaters, offer an alternative to the more common inline process heaters that have directly immersed heating elements housed in a vessel. Cast heaters are best utilised where space saving and temperature sensitivity are of paramount importance. As an effective solution for heating low flow liquids or gases, they can replace the need for a pressure vessel and operate at significantly higher pressures than their counterpart due to their superior, but simple design.

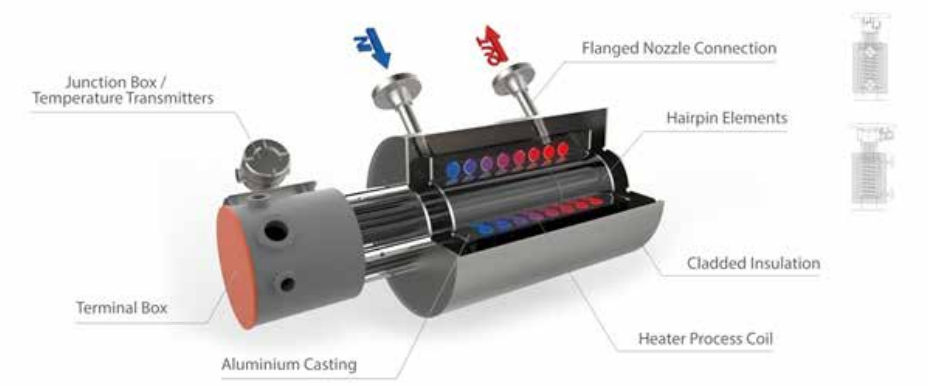
### Design

The main components of this heater design are its process coil and the electric heating elements manufactured from 80/20 Ni/Cr resistance wire, with compacted high purity magnesium oxide, sheathed in corrosion/erosion resistant materials. These are housed within marine-grade aluminium casting which acts as the medium to transfer the heat directly from the heating elements to the process that is passing through the coil. The coil material can be selected from an array of materials dependent on the process temperature and corrosion resistance requirements.

### Operational Benefits of Cast Heaters

Unlike process heaters, cast heaters do not restrict the flow and therefore offer almost zero pressure drop, as the process continues to flow through unrestricted pipework, rather than a baffled heater housed within a vessel. It is possible to quickly and safely pre-heat a cast line heater with little or no flow running, which can allow faster start up times. In addition, cast heaters allow for more precise process control for low-flow or zero-flow conditions compared to conventional heaters and other so called compact enveloped resistor technologies, leading to a steady temperature output.

One benefit that cast heaters have over other inline heaters is that there is no direct contact between process and heating elements. This eradicates ‘hot spots’ and allows for elements to run at higher temperatures when required. Both the control sensor and safety-trip sensor are housed within the aluminium casting, and should low/zero-flow conditions arise, these sensors control and de-energise before the process reaches any critical temperature. This also leads to there being a heavily reduced chance of the heater tripping, which is particularly advantageous for unmanned on and offshore applications. As the elements and heating coil are embedded in the aluminium casting, vibration caused by process flow is also eliminated. Cast heaters are also particularly reliable and ideal for high performing reciprocating applications where a failure in the heater’s performance will directly impact the entire system.




## Sizing and Cost Benefits

Cast heaters have a smaller footprint than inline heaters making them an ideal space saver, which can be of key importance to offshore platforms, compact skids and pumping stations. The heater's associated thyristor control system is also more compact. Cast heaters can be secured on the wall or floor, vertically or horizontally mounted, giving flexibility to its position and use of space.

Being physically smaller in size, not only are the initial purchase costs considerably lower for an electric cast heater, but without the need for frequent and complex maintenance activities and the associated downtimes or expensive performance monitoring, operating costs are lowered too. Electric heating, in general, boasts a simpler means of operation with faster setup times.

## Certification

EXHEAT's range of cast heaters are extensively certified to IECEx, ATEX, CSA and other standards, enabling the company to supply electrical heating equipment globally for use in potentially explosive atmospheres.

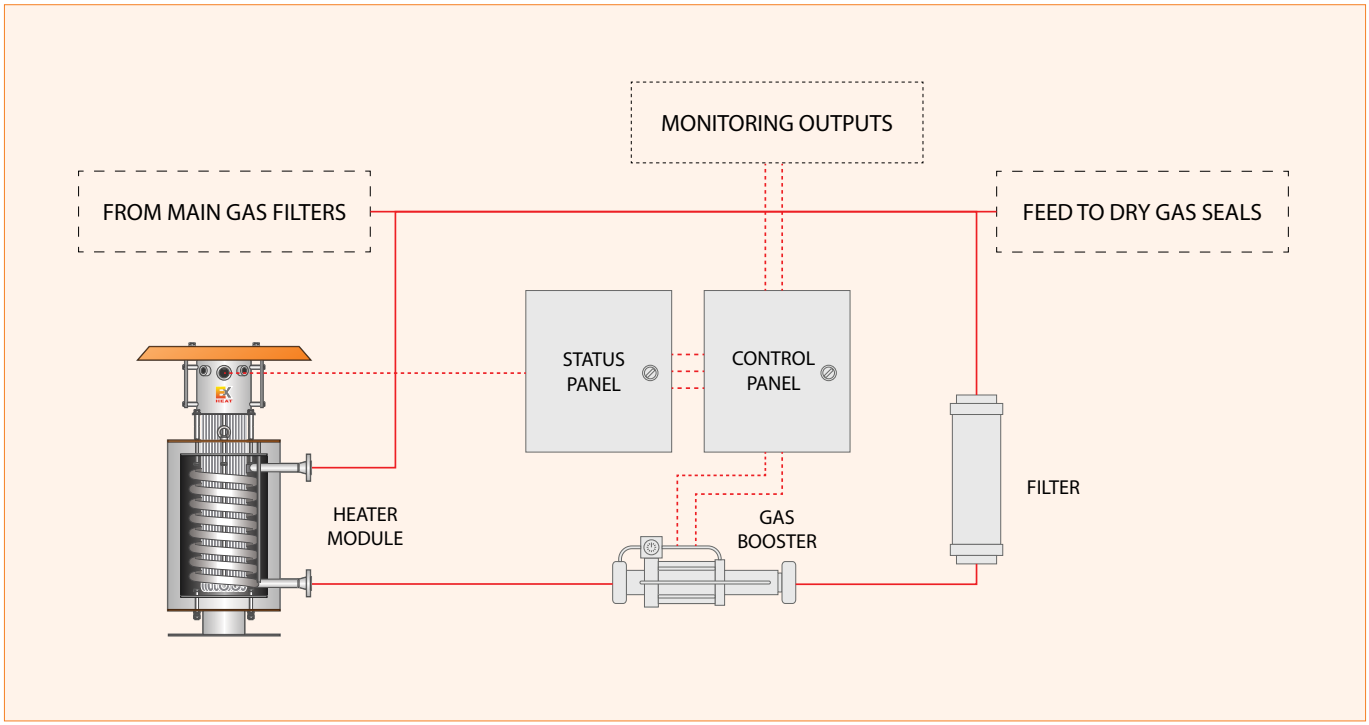
## Typical Applications

### Heating Medium

A heating medium is typically in a closed loop and is used to transfer heat indirectly to another process fluid normally via a downstream heat exchanger. EXHEAT's electric cast heaters can reliably heat a heating medium for these applications. Alternatively, the cast heaters are often selected to heat the process directly and completely replace the heating medium circuit. This is done because EXHEAT's cast heaters are excellent at providing a steady and easily controlled heating rate. The aluminium block helps maintain a uniform heating pattern along the length of the coil and avoids any hot-spots.

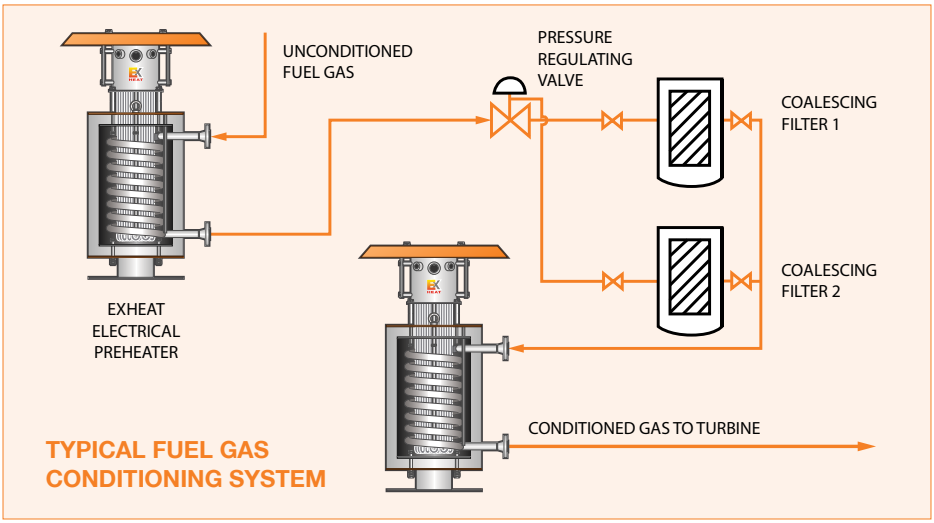
### Seal Gas

Dry gas seals are used in process gas centrifugal compressors. It is necessary to have shaft sealing to prevent the process gas from escaping to the atmosphere. Dry gas seals can be applied to accomplish the required shaft sealing - and although available in a variety of configurations - a tandem style seal is typically applied within a process gas service. Tandem seals consist of a primary seal and a secondary seal. During normal operation, the primary seal absorbs the total pressure drop to a vent system and the secondary seal acts as a back-up should the primary seal fail. Dry seals are basically mechanical face seals, consisting of a mating (rotating) ring and a primary (stationary) ring. During operation, grooves in the mating ring generate a fluid-dynamic force causing the primary ring to separate from the mating ring and create a running gap between the two rings. A sealing gas is injected into the seal, providing the working fluid for the running gap and the seal between the atmosphere or flare system and the compressor internal process gas.



## Fuel Gas

Fuel gas is commonly used in the power generating industry as an energy source for turbines. Before the fuel gas is burned in the turbines, it needs to be treated to ensure the removal of solid, liquid, and gas contaminants. A fuel gas conditioning system commonly consists of the following components: a pre-heater, a pressure regulation valve, two high efficiency coalescing filter elements, and a superheater. The pre-heater is used to prevent the formation of hydrate due to a pressure and temperature drop across the pressure regulator. The pressure regulating valve is then used to maintain a constant gas pressure to the turbine in the event that the gas supply pressure exceeds an acceptable level. A coalescing filter is then used to remove the solids and liquids. The system will commonly include two such filters so that one can be replaced without shutting down the fuel gas conditioning system. Thereafter, a superheater is used to ensure that superheated gas enters the turbine at the correct temperature.

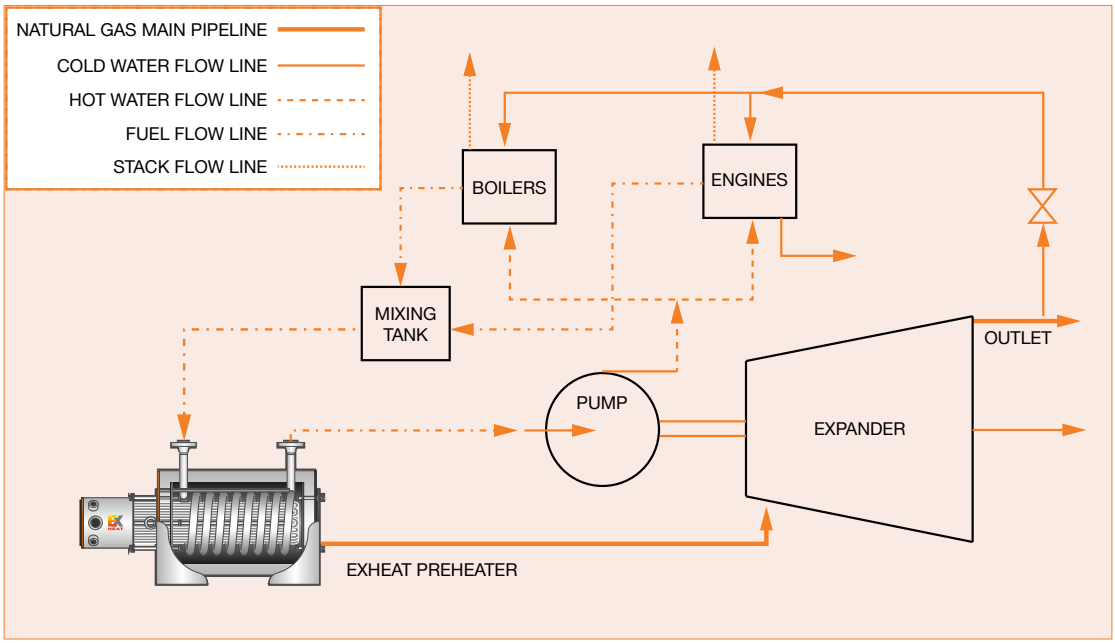



TYPICAL FUEL GAS CONDITIONING SYSTEM

## Oil Processing

'Heavy crude oil' or 'extra heavy crude oil' is any type of crude oil which does not flow easily. It is referred to as 'heavy', because its density or its specific gravity is higher than of light crude oil. Heavy crude oil has been defined as any liquid petroleum with an API gravity less than 20°, meaning that its specific gravity is greater than 0.933 (g/ml). Production, transportation and refining of heavy crude oil presents special challenges compared to light crude oil. Physical properties that distinguish heavy crudes from lighter ones include higher viscosity and specific gravity, as well as heavier molecular composition. Generally a diluent is added at regular distances in a pipeline that carries heavy crude to facilitate its flow. However, it is possible to reduce viscosity in order to improve flow of heavy oils using an electric line heater or outflow heater if the oil is in a pipeline or within a storage tank.

Electric cast heaters are commonly used to reduce the viscosity of crude oils in order to make them more free flowing. Cast line heaters provide a clean, efficient and controllable solution for process heat provision, in comparison with other systems such as heat exchangers or fired heating systems.




**Natural Gas**

Natural gas is transmitted through long distance pipe lines under high pressure. However, this pressure is not suitable for local gas distribution networks supplying customers for use in domestic and industrial gas appliances. Usually, a pressure reduction valve (PRV) (ie a throttle valve, also known as Joule-Thomson valve), is used at pressure reduction stations (PRS) to reduce natural gas pressure before supply to a local gas distribution network. This pressure reduction in a PRS by a throttle valve results in reduction of both pressure and temperature of natural gas. For example, natural gas throttled from 25BarG and 10°C to 3BarG would be cooled by about 6.5°C (ie will be at about 3.5°C) after pressure reduction. It is a normal practice to have provision for heating natural gas at PRS - preferably before throttling - so that its temperature is maintained at an acceptable level after throttling, to avoid operational and material integrity problems in local gas distribution network that might be caused by low gas temperatures. It is estimated that 22kJ of heat would be required per kg of natural gas to preheat it to 16.5°C before throttling, which will leave the gas at 3BarG and 10°C after throttling.

**Other applications**

In addition to the above product applications, cast heaters can be used for a wide variety of process fluids and operations - including hydrocarbon liquids, air, carbon dioxide, nitrogen, instrument air, solvents, paint and pasteurisation.

## Standard Cast Heaters

Besides the size and costs savings, cast heaters can have advanced delivery times when opting for a model that is covered by the standard range. EXHEAT's standard cast heater range, in general, can accommodate design pressures up to 330BarG and temperatures to 350°C. They consist of a process coil, up to 12 active Alloy 800 sheathed heating elements, offering a maximum duty of 40.2kW in a single unit, and can be certified to meet the requirements of ATEX Directive (2014/34/EU), IECEx, CSA, CU TR (EAC) and ASME Code Stamp. A cast heater containing these specifications will allow for faster delivery times and lower costs. For higher duties, cast heaters can be used in series or parallel, and when opting for a custom process coil, design pressures up to 690BarG can be achieved.

## Conclusion

Cast line heaters are a favourable alternative to inline process heaters in areas where space saving and product temperature sensitivity are of utmost importance. A cast heater's aluminium casting has excellent heat transfer properties and the heater's baffle plate-free design results in there not being any flow restrictions. Fast start-up times, precise process control, no vibration, smaller footprints and lower maintenance costs are some of this heater's key benefits. When opting for a standardised product, there is also the advantage of decreased delivery times. Whether selecting a custom engineered or standard product, cast heaters provide an effective heating solution for constant flow liquids or gases, eliminating the requirement for a costly pressure vessel in high pressure applications.