

# Smartprocess™ Heater



*Get maximum value from your heaters using Emerson's Smart Process™ Heater solution*

- Extend run-lengths by balancing pass outlet temperatures to prevent hot spots and excess coking
- Reduce energy cost by minimizing excess air and optimizing fuel usage
- Lower stack emissions by promoting complete combustion and maintaining optimal excess air
- Improve outlet temperature control by automatically compensating for changes in fuel composition, charge rate, and feed temperature
- Increase heater capacity while operating safely, efficiently, and dependably



## Introduction

Fired heaters are a primary source of heat input to many refining and petrochemical processes. The goal of these heaters is to raise the temperature of a given process stream up to a target for use in reactors, distillation columns and oil fractionators. In many sites, fired heaters use a fuel stream that is a blend of process unit off-gases and purchased natural gas, which has potential for a high degree of variability depending on which process units are venting to the fuel system. As a result, furnaces using this gas can often see big swings in the energy content of the fuel when one of the process units is upset or trips offline. Not only does this disturbance affect the ability of the furnace to maintain a constant outlet temperature, but it also changes the amount of air required to properly burn the fuel, and thus, the excess air required for combustion. In order to prevent operating in a hazardous low-oxygen environment during upsets, operators tend to run with a higher excess air safety margin during normal operation, thus lowering the overall operating efficiency. Given that the fuel bill for a small refinery is several million dollars per year, the opportunity for significant savings can be substantial.

Emerson's SmartProcess Heater delivers energy savings and more stable operation of fired process heaters. SmartProcess Heater combines advanced control with patent-pending combustion control technology to optimize operation of multi-pass process heaters. Emerson's unique combustion controls maintain safe operation while continuously operating closer to maximum efficiency.

## Benefits

SmartProcess Heater technology has been used in numerous process heaters worldwide. Benefits which have been achieved include:

- Improved outlet temperature stability and operating closer to maximum temperature limits leads to higher distillate yields
- Improved combustion efficiency of 1-3% by operating with lower excess air
- Longer run lengths as a result of fewer hot-spots and upsets
- Additional capacity of 3-8% by consistently operating closer to actual equipment constraints

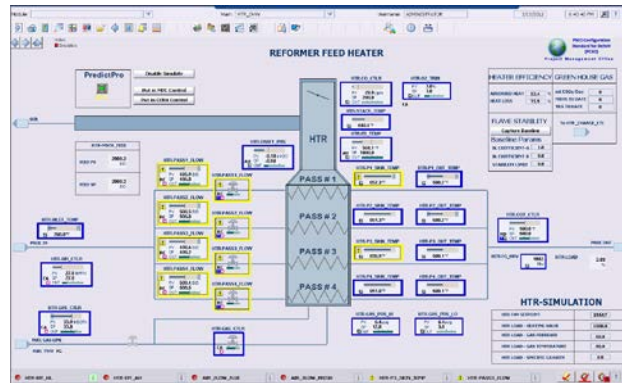
## Product Description

The SmartProcess Heater solution provides advanced combustion controls in the regulatory control layer designed to provide safe, efficient operation under all operating conditions. In addition, model predictive control technology is used to further optimize performance in a layered approach. Each of these functions can be implemented independent of each other and is further described below.

## Advanced Regulatory Control Scheme

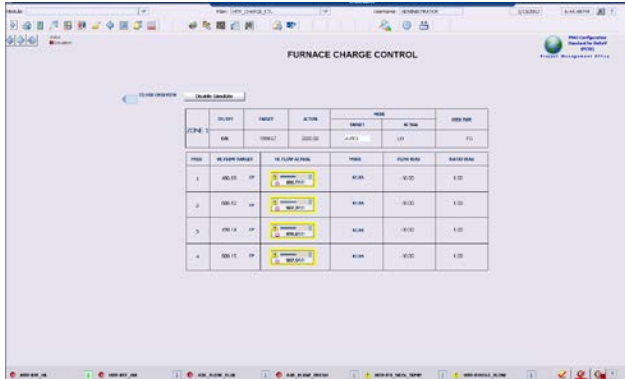
The primary function of the advanced regulatory control strategy is to provide robust control of the heater outlet temperature while maintaining sufficient air for proper combustion of the fuel. The combined coil outlet temperature controller is used to set a master fuel demand in terms of heat (Btu) released. An air-to-fuel cross limiting strategy is used to ensure that air demand leads the fuel demand on increasing load and lags the fuel demand on decreasing load. A relative Btu trim controller is used to trim fuel demand based on any detected changes in fuel BTU content. Fuel flow is then adjusted for changes in Btu to provide consistent heat release in the furnace.

Emerson's patent-pending combustion solution utilizes a "consumed air" model to adjust for changes in fuel Btu. This model calculates the heat release of the fuel based on the amount of O<sub>2</sub> that is consumed in the combustion process. The consumed air model requires a measurement of the airflow to the furnace as well as the stack O<sub>2</sub> content. Alternatively, fuel Btu indication can also be obtained from a specific gravity meter or other on-line Btu analyzers. (e.g. Wobbe meter). An O<sub>2</sub> trim controller is used to trim the air demand based on the desired percent stack O<sub>2</sub>. A CO override controller relaxes the O<sub>2</sub> target when CO levels in the stack gas increase. A draft pressure override controller may also override the air damper demand to prevent operating in an unsafe region.



SmartProcess Heater main overview graphic

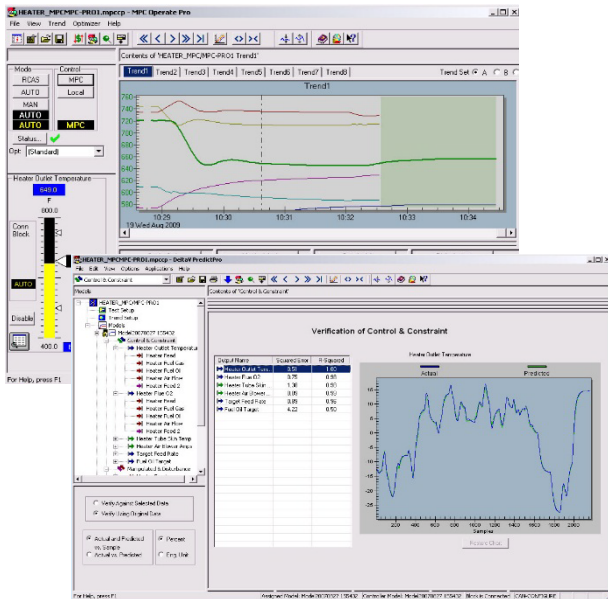
The regulatory controls also provide a master charge controller which adjusts the individual pass flows to obtain the desired charge rate. The charge controls allow the operator to specify a bias for one or more passes and provides bumpless transfer from regulatory control to advanced control and back.



Heater Charge Control Graphic

### Advanced Process Control Features

Optimization of heater performance involves minimizing energy consumed, balancing passes to eliminate hot-spots, compensating for process upsets, and operating within all equipment constraints, thereby reducing the operating cost and increasing the life of the heater. The embedded Advanced Process Control (APC) in DeltaV provides a convenient means to stabilize operations, optimize the setpoints, and control against limiting constraints. SmartProcess Heater significantly reduces the effort to implement optimized control on a fired heater. Using pre-engineered solutions, the implementation is a matter of configuring the solution templates for a particular heater.



Embedded DeltaV PredictPro tools use dynamic process models to predict future behavior

Model Predictive Control (MPC) is a technique that improves control of multi-variable process units, such as fired heaters. MPC uses dynamic models of the process, and a record of its past behavior, to predict how the process will behave in the future. These predictions are then used to determine an optimum sequence of control actions that ensure all process control objectives are achieved simultaneously. The process models are obtained from unit testing and are adjusted online using plant measurements to ensure future predictions and actions are always consistent with desired process operation.

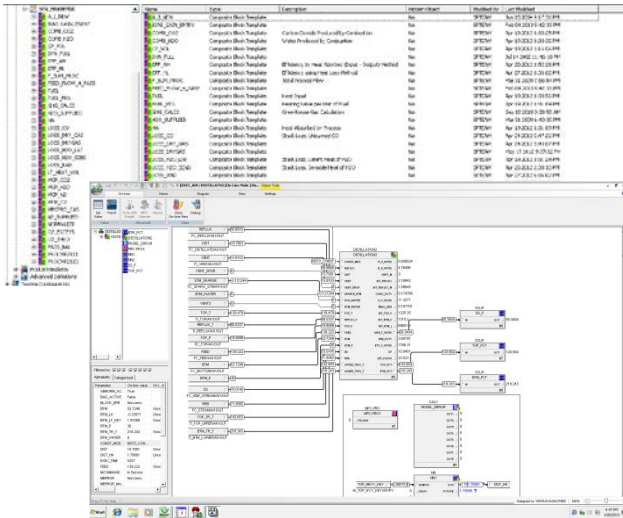
The Advanced Process Control objectives of the SmartProcess Heater are to:

- Control the total feed flow to target by manipulating the individual pass flows
- Control coil outlet temperature to the desired target by manipulating the fuel demand
- Adjusting pass flows to balance the individual pass outlet temperatures to eliminate overheating any particular pass more than others.
- Control heater for changes in charge rate, fuel composition and inlet temperature
- Control heater against constraints such as tube skin temperature limit, firebox temperature limit, air flow and fuel limits

### Package Details

SmartProcess Heater is delivered with the necessary libraries and an example configuration. The libraries include custom composite templates which include key heater calculations while the example configuration includes the advanced regulatory control functions described above. The standard DeltaV APC tools required by the application are provided as part of the licensed software.

SmartProcess Heater may be installed in either a project environment or for simulation and demonstration. The installation files are grouped so that for projects, only the APC modules, composite libraries and standard graphical components are installed. For simulation and demonstration installations the example regulatory control and simulation modules with their libraries and dynamos are also installed. SmartProcess Heater is delivered on a CD or via a file download. The installation media contains the executable file, which installs SmartProcess Heater and extracts the relevant files to the specified locations in the local machine's "DeltaV\DVData" folder.



Standard Deltav libraries make configuration easy

### SmartProcess Fired Heater Annual Support

Through the Global Service Center, Emerson provides one-number call-in support for DeltaV and all of the Emerson-supplied equipment and software. Annual Support includes guaranteed access to new versions, enhancements and updated documentation along with unlimited telephone and remote support of the application. With an Application Support agreement, you can rest assured that expert help is only a phone call away and your SmartProcess Fired Heater will remain current with future system upgrades.

## Ordering Information

Description	Model Number
SmartProcess Fired Heater Base license for One Heater; Includes 1 Base License, 8 DeltaV PredictPro Output (MV) licenses, SmartProcess Fired Heater Library, Installation Guide and Configuration Guidelines.	VF1050B1H1
SmartProcess Fired Heater Extension License – Extension License for additional Heater(s). Includes 8 DeltaV PredictPro Output (MV) licenses for each quantity ordered.	VF1050E1
Annual Application Support for SmartProcess Fired Heater Base	VF1050S1
Annual Application Support for SmartProcess Fired Heater Extension	VF1050S2

## Related Products

- **MicroMotion Density, Specific Gravity and Mass Flow Sensors.** Measure heating value variability and mass flow measurement for heater fuels
- **Rosemount Analytical Stack Gas Analyzers.** Maintain the optimum ratio between the fuel sent to the burner and the oxygen required to burn available fuel by measuring stack O<sub>2</sub>.
- **Fisher Control Valves and Regulators.** Control fuel gas and air supply accurately and consistently
- **Rosemount Temperature Sensors.** Accurately measure temperature in tubeskins, firebox and inlet and outlet coils

## Prerequisites

DeltaV v11.3 or higher

### Emerson Process Management

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Europe, Middle East : 41.41.768.6111

North America, Latin America :

+1 800.833.8314 or

+1 512.832.3774

[www.EmersonProcess.com/Smartprocess](http://www.EmersonProcess.com/Smartprocess)

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