Honeywell

Product Information Note

Experion STEAMPROP Standard Function Block: Simple Real-time Thermodynamics

The Experion IAPWS-IF97 (ASME) Water and Steam Thermodynamic Properties Function Block calculates important and widely used physical properties, such as specific volume, density, enthalpy and entropy, accurately and in real time.

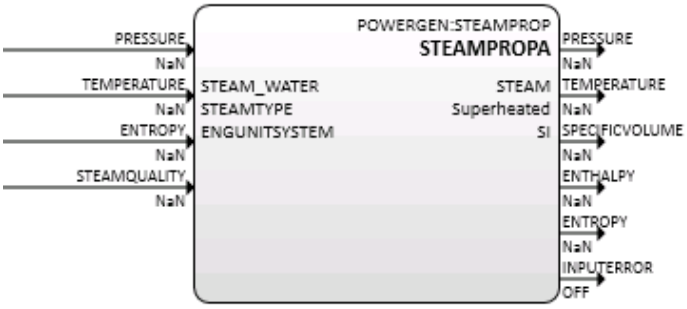

Figure 1. The STEAMPROP function block

An essential tool

Leveraging the robustness and execution capabilities of the C300 controller or ACE node, STEAMPROP provides users with calculations in real time according to the IAPWS-IFC 97 (ASME) International Standard. It enables them to implement highly accurate water and steam flow compensation, energy balancing and monitoring, and advanced energy control.

The function block is an essential tool for calculations of boiler, turbine, pump or heat exchanger efficiency and energy performance indicators (EPIs) in real time. A cornerstone of state-of–the-art energy management, it helps drive energy efficiency and improve business results.

STEAMPROP provides the engineer and manager a deeper energy insight. This new C300/ACE Function Block simplifies compliance with energy and environmental standards EN 14001 and ISO 50001 and enables sites to optimize energy consumption and reduce their environmental impact.

From IFC-67 to IAPWS-IF97

The International Association for the Properties of Water and Steam (IAPWS) released its first standard, IFC-67, covering the various properties over the range of 273.15 - 1073.15 K and 0 - 100 MPa, almost 50 years ago. This would become the basis for the ASME standard. Providing a set of equations and formulas for industrial and scientific water and steam property calculations, it nevertheless required iterative calculations for certain frequently-used combinations, such as enthalpy as a function of the pressure and entropy, or saturated temperature as a function of the pressure.

Accumulated experimental data, increased computing power and new techniques saw a new international standard released in 1997, IAPWS-IF97 (ASME). This formed the basis of the Experion function block. As Figure 2 shows, 5 regions (including the saturation line) are identified, and for each region a set of equations as well as boundaries are determined and provided.

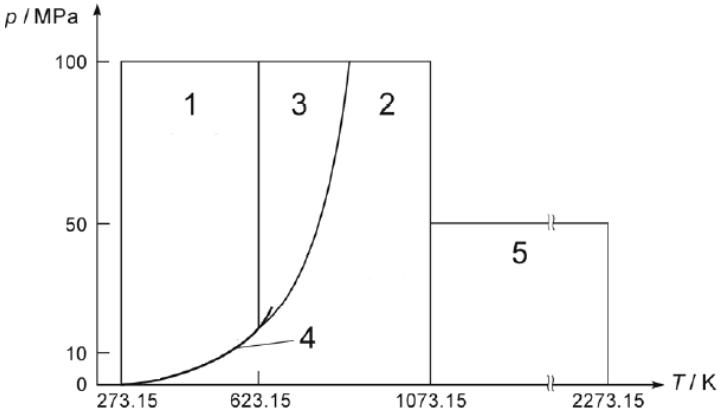

Figure 2. Regions and ranges of the water/steam properties

IAPWS-IF97 includes an extended range – from 1073.15 - 2273.15 K and 0 – 50 MPa (region 5) – and offers high accuracy and faster computation than its predecessor.

For common combinations an additional set of equations avoids the need for iterative calculations. This makes calculations faster, and also deterministic, enabling them to run directly in a secure and robust control environment such as the Experion C300/ACE controller.

STEAMPROP and Experion

From Experion R431 the standard STEAMPROP function block is available in the C300/ACE PowerGen Standard Library of Control Builder (Figure 3). It can be used as any other function blocks to develop Control Modules and strategies in the C300/ACE by just graphically connecting input and output pins.

The user configures or selects from a set of standard input and output engineering units: British, Metric or SI (Figure 4).

Input connections (below) can be configured as pressure, temperature, steam quality or dryness or entropy (from a second STEAMPROP function block, for example). Based on the selected region or phase (water, steam, saturation or 2 phase – wet steam) the function block automatically checks whether inputs are in range and their values are consistent with the selected region. Once validated and calculated, the various properties are available and updated at the time of the execution. If validation fails the outputs are set to NaN, ensuring value status propagation of the signal for other applications (such as a PHD historian) or control strategies.

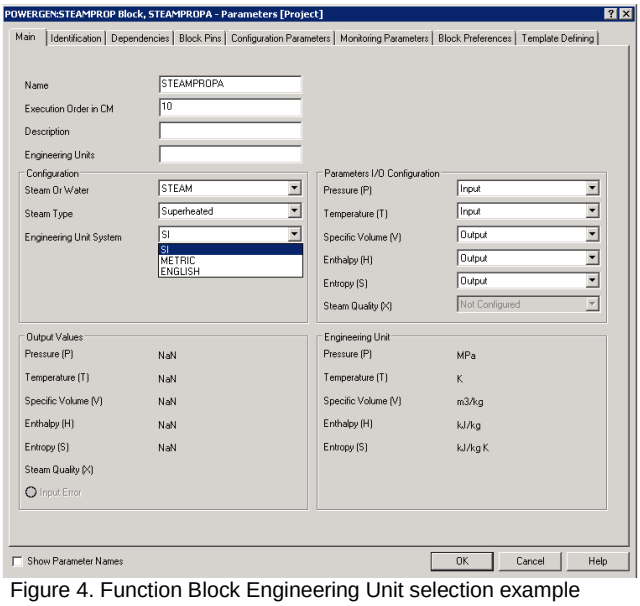

Figure 4. Function Block Engineering Unit selection example

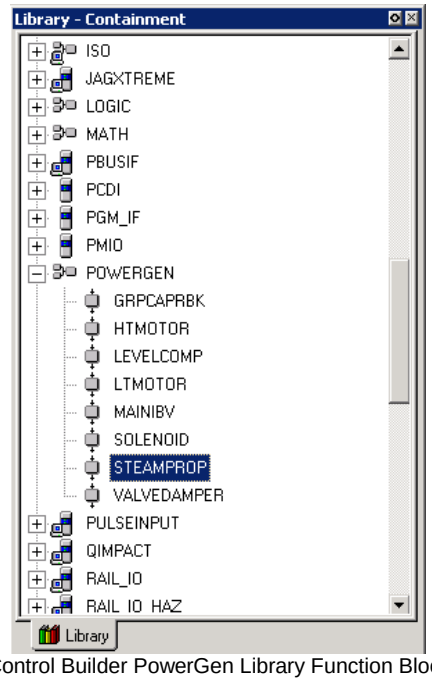

Figure 3. Control Builder PowerGen Library Function Block pane

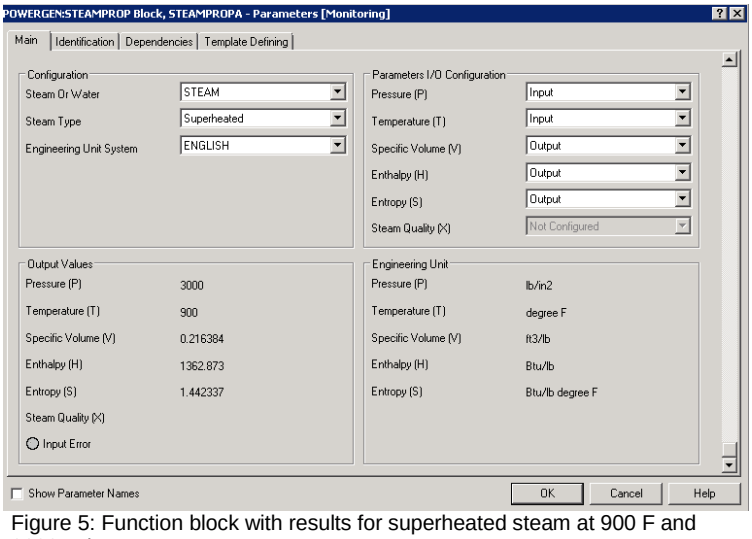

Figure 5: Function block with results for superheated steam at 900 F and 3000 psia

The standard detail display (Figure 6) that comes with the function block provides all key information, including pressure, temperature, steam quality, entropy, enthalpy, specific volume and specific density. An Input error flag indicates thermodynamic inconsistency in input data, which is available for further processing in the Control Module for data validation.

Furthermore, two standard Mollier diagrams (T – S or H - S) are provided with two tabs visualizing the location of the operating point in the water steam phase diagram, which allows zooming and blanking.

STEAMPROP applications and usage

With the STEAMPROP function block available in the C300 control environment, control modules can be created easily via standard Experion functionality to calculate and monitor the health and efficiency of individual units or a complete steam complex. Applications are available at control or performance engineers' fingertips without having to rely on third-party applications .

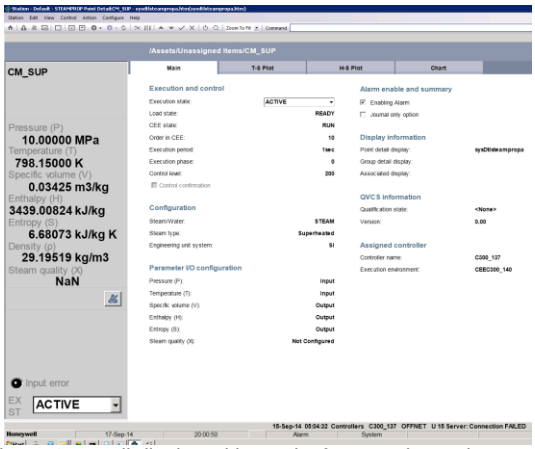

Figure 6. Detail display with results for superheated steam 525 deg C

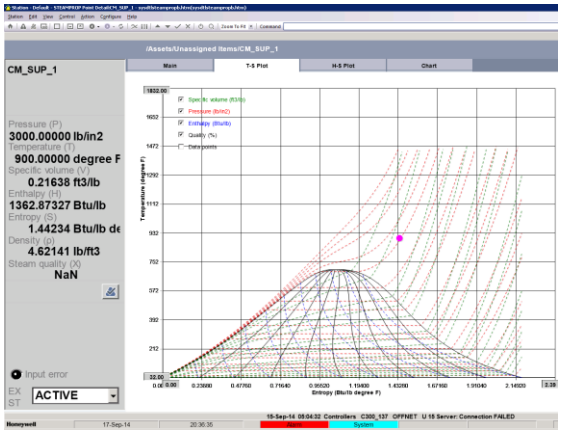

Figure 7. T-S for superheated steam 900 F and 3000 psia

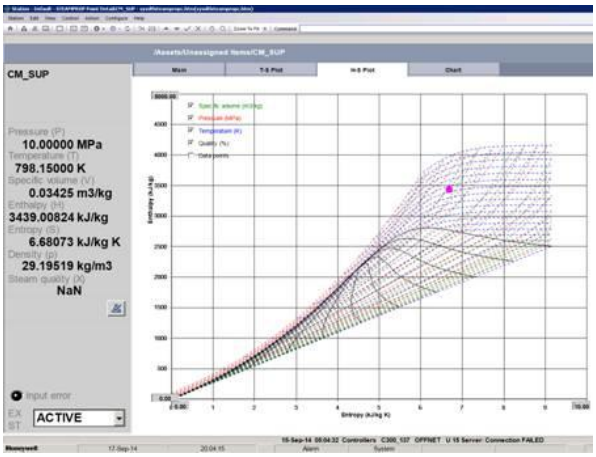

Figure 8. Detail display with H-S diagram for super heated steam 525 deg.C and 10 MPa

STEAMPROP is suitable for a wide range of applications and calculations:

- Unit characterization (ie. {energy versus fuel} or {energy versus electrical MW}) for further use in global power house economic optimization or economic load allocation
- Energy balances around steam headers (providing loss or rate of change indications)
- Energy balances around steam/water heaters (for fouling indications)
- Boiler input/output efficiency calculations
- Turbine isentropic expansion efficiency calculations
- Outlet/inlet/injection water flow calculation for pressure reducing and de-superheating stations
- Enthalpy control for super critical power generation units
- Injection water control for condensing steam turbine bypass stations
- Water pump efficiency monitoring
- Steam turbine-driven compressors/pump efficiency calculation
- Accurate water and steam flow compensation (including for metering purposes)
- Various other applications requiring accurate thermodynamic property values for water and steam.

Real time thermodynamics has never been so easy.

For More Information
Learn more about Honeywell solutions, visit our website www.honeywellprocess.com or contact your Honeywell account manager.

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