

# PROTHERM



 **United**  
PROCESS CONTROLS

**SENSORS, PROCESS CONTROLS  
& AUTOMATION SOLUTIONS**



# ATMOSPHERE PROBES, ANALYZERS & TESTING EQUIPMENT

## CARBON / OXYGEN PROBES

Highly accurate rugged probes for use in a variety of heat treating applications such as carburizing, carbonitriding, nitrocarburizing, hardening, annealing and endothermic generators.

**CS87™ / CCS2000™** - Our most rugged oxygen probe with mechanical cleaning for the toughest environments and superior thermal shock resistance.

**CARBONSEER™** - Rugged design, ideal for use in high carbon applications with focused burn off feature.

**ACCUCARB®** - High accuracy oxygen sensor used in low and medium carbon applications, or generators where frequent burn off is not required.

**ACCUCARB® LTA** - Same performance-wise as original AccuCarb® but features a special electrode design for low temperature applications. Safe and reliable for volatile atmospheres.

**QUICKSILVER™** - Economical rugged sensor with superior thermal shock resistance. Installs in seconds.

**NITROCARB™** - Vacuum-tight oxygen sensor for nitrocarburizing.



## HYDROGEN ANALYZER



The **H2Smart™**, complete with an integrated sampling system, is designed to measure hydrogen content with high accuracy in nitriding and nitrocarburizing atmospheres and to calculate the parameters necessary for process control:  $p_{H_2}$ ,  $p_{NH_3}$ ,  $p_{O_2}$ ,  $p_{CO}$ ,  $p_{CO_2}$ ,  $K_N$ ,  $K_C$ ,  $K_O$  and % dissociation.

## PORTABLE INFRARED GAS ANALYZER



The **FurnaceDoctor®-Pro** provides accurate infrared measurement of  $CO$ ,  $CO_2$ , and  $CH_4$  and computes the % carbon, Dew-point and expected carbon probe millivolts.

**CQI-9 COMPLIANT**

## DIRECT READING DEW POINT ANALYZER



The easy-to-use **The FurnaceDoctor®-DPT Dewpoint Analyzer** can provide oxygen probe operation verifications. Includes equivalent % carbon calculation.

**CQI-9 COMPLIANT**

## CONTROLLERS & PROGRAMMERS

From simple single loop carbon controller to sophisticated programmers with multiple loops and process modelling capability. These support all types of furnaces such as batch, continuous and pusher and all types of processes such as nitriding, nitrocarburizing, carburizing, carbonitriding, plasma and vacuum. Standard connectivity allows for integration with SCADA systems.

**PROTHERM 20** - 1/4 DIN single-loop process controller. Controls carbon potential, dewpoint, temperature, and oxygen concentration.

**PROTHERM 455** - 1/2 DIN multi-loop embedded programmer with a color touch-screen interface, and built-in chart recorder function. Calculates variables such as % carbon, dew point, or millivolts, and percent oxygen. Stores up to 200 19-step recipes. Direct drop-in replacement for Marathon Monitors' CarbPro, DualPro, MultiPro, and Carb PC. Works with internal and/or external I/O's.

**FOR CQI-9, AMS 2750, & AMS 2759/10-12 COMPLIANCE**

**PROTHERM 470** - 1/2 DIN multi-loop embedded programmer with a color display and turn-and-push knob navigation. Up to 32 programmable PIDs included, plus built-in calculators for real-time carbon and/or nitrogen diffusion, and hardness profile, a mathematical model for calculating atmospheric parameters, and integrated web server for browser-based remote access. Works with internal and/or external I/O's.

**FOR CQI-9, AMS 2750 & AMS 2759/10-12 COMPLIANCE**

**PROTHERM 500/600/700** - Universal configurable programmers that monitor, control and record processes running in a single furnace or simultaneously in multiple chambers. Up to 32 programmable PIDs included, plus built-in calculators for real-time carbon and/or nitrogen diffusion, and hardness profile, a mathematical model for calculating atmospheric parameters, and integrated web server for browser-based remote access.

**FOR CQI-9, AMS 2750 & AMS 2759/10-12 COMPLIANCE**



TOUCH SCREEN

TOUCH SCREEN

### CARBON / TEMPERATURE TRANSMITTER WITH PROBE MAINTENANCE

**Carbon Sender** - Provides a cost-effective solution for carbon potential and temperature transmission to your PLC or SCADA system either via 4-20mA signal or Modbus RTU.



Carbon Sender

### CHART RECORDER

The **KD7** is a 1/2 DIN paperless chart recorder with a 5.7" color touchscreen interface and Ethernet communication.



KD7 TOUCH SCREEN

# PLUG & PLAY PROCESS CONTROL SOLUTIONS FOR RETROFITS & NEW FURNACES



## Carburizing / Carbonitriding Control Solution for Batch Furnaces

Supplied with a PROTHERM 455, 500, 600 or 700 universal programmable controller. Optional online carbon and nitrogen diffusion and  $\beta$ -control modules available for even more precise control.

**Compliance: AMS 2750, CQI-9, NFPA 86-C, NADCAP\***



## Nitriding / Nitrocarburizing Control Solution

Supplied with a PROTHERM 500, 600 or 700 universal programmable controller, H2Smart™ hydrogen analyzer & optional NitroCarb™ probe for nitrocarburizing.

Precise atmosphere control:  $K_N$ ,  $K_C$ ,  $K_O$  or % dissociation.

**Compliance: AMS 2750, CQI-9, NFPA 86-C, NADCAP\*, AMS 2759/10, AMS 2759/12 (FNC)**



## Vacuum Control Solution

Supplied with a PROTHERM 500, 600 or 700 universal programmable controller and optional multiple load thermocouple inputs for soak guarantees. Interfaces to popular vacuum gauges.

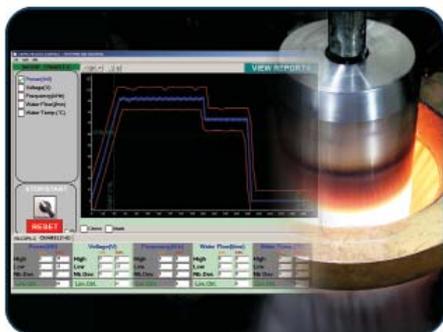
**Compliance: AMS 2750, CQI-9, NFPA 86-C, NADCAP\***



## Annealing / Bright Annealing Control Solution

Supplied with a PROTHERM 455, 500, 600 or 700 universal programmable controller and either an AccuCarb LTA probe or FurnaceDoctor FX analyzer. Add-on modules available for process atmosphere analysis, process atmosphere control, and flow control.

**Compliance: AMS 2750, CQI-9, NFPA 86-C, NADCAP\***



## Induction Solution

Supplied with PROTHERM 9800 Induction, a monitoring and alarm package. Protherm 9800 Induction monitors current, voltage, and frequency to the coil in real-time, enabling to determine whether or not uniform heating, proper flux density and depth are achieved.

**Compliance: CQI-9**

\* depending on the options chosen

## HT-TOOLS PRO SIMULATION SOFTWARE FOR CARBURIZING, CARBONITRIDING, NITRIDING, & NITROCARBURIZING PROCESSES

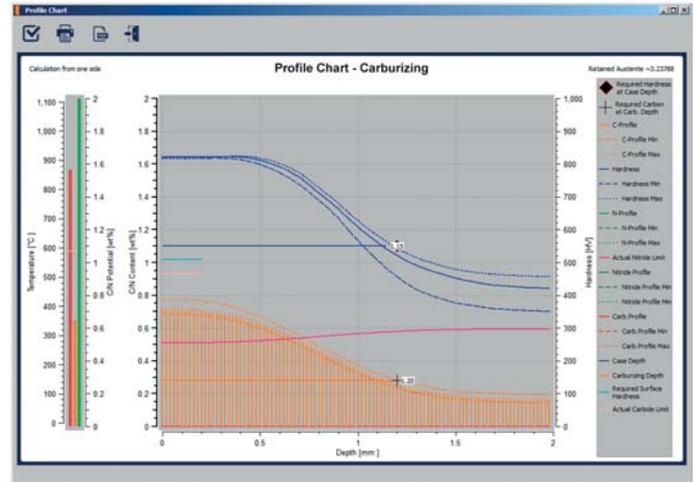
**HT-Tools Pro** is a powerful simulation tool for designing and optimizing recipes for carburizing including low-pressure carburizing, carbonitriding, as well as nitriding and nitrocarburizing processes. It can significantly reduce the lead time for process development, replacing time-consuming evaluations and trials.

The software determines the most efficient recipe for a given application based on its specifications, which include part characteristics such as steel composition and, where applicable, design geometry as well as quench conditions, or quenched and tempered conditions for nitriding/nitrocarburizing processes. HT-Tools Pro analyzes the data entered and models the carbon and/or nitrogen content and hardness profiles. For nitriding and nitrocarburizing, the software produces models in accordance to AMS 2759/10A and 2759/12A recommendation.

HT-Tools Pro includes a materials database that can be populated with steels of various chemical compositions. Depending on the alloying elements in the steel, HT-Tools Pro calculates alloying factors and solubility limits versus carbide and nitride precipitation. Additionally, a recipe database makes it possible to store and analyze multiple recipes. The simulation of different alternatives by changing parameters allows the user to quickly evaluate a recipe so that optimal results are achieved.

### HT-Tools Pro calculates

- Compound layer thickness and composition
- Diffusion (precipitation) layer
- Total diffusion depth; Effective case depth
- Nucleation
- Hardness profile with tolerances
- Carbon percentages; Surface carbon/nitrogen content
- Alloy factor; Carbide limit; Nitride limit; Soot limit
- Recommended process setpoints including Kc and KN



## CREATING/MODIFYING RECIPES

Recipes are created and modified by setting the:

- temperature in heating, holding and cooling stages;
- furnace atmosphere in carburizing/carbonitriding - specifying the carbon and/or nitrogen potentials, soot limit, carbide limit, and surface carbon content; and
- furnace atmosphere in nitriding/nitrocarburizing - specifying the nitriding and/or carburizing potentials and nitrogen dilution.

## FEATURES

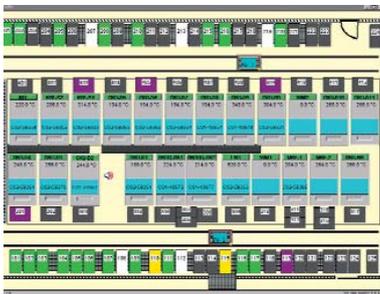
- Calculation of the expected hardness distribution - carbon and/or nitrogen profiles for the required case depth
- Progression of process curves with zoom options
- Profile curves of the expected carbon and/or nitrogen and hardness distribution with zoom options
- Database of recipes with automatic calculation of limits versus soot formation and carbide/nitride precipitation
- Materials database that can be populated with the chemical composition of various steels
- Possibility of accounting for a part's geometrical characteristics

## BENEFITS

- Short recipe optimization time
- Faster sampling-to-production time
- Possibility of in-flight parameter modifications reduces the need for expensive testing
- Recipes can be transferred to any PROTHERM controller via the PROTHERM 9800 production management software.

## INTEGRATION OF HEAT TREATING OPERATIONS

The **Protherm 9800** delivers everything to optimize the performance and efficiency of a heat treatment plant operating with a wide a variety of furnaces as well as automatic handling machinery. By combining process control, equipment integration, and automation capabilities, the Protherm 9800 provides a comprehensive approach to plant wide supervisory control and management.



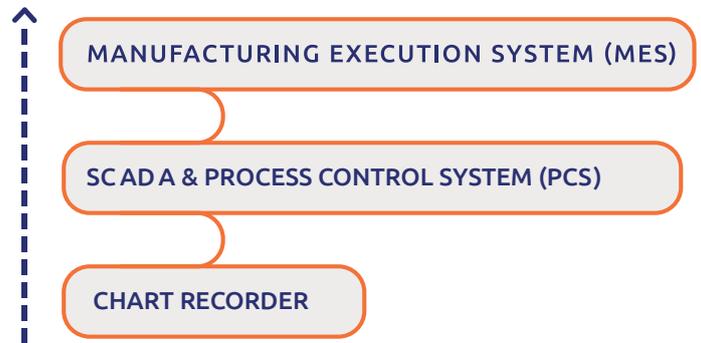
Overview screen of fully automated lights-out production cell



## SCALABLE SYSTEM

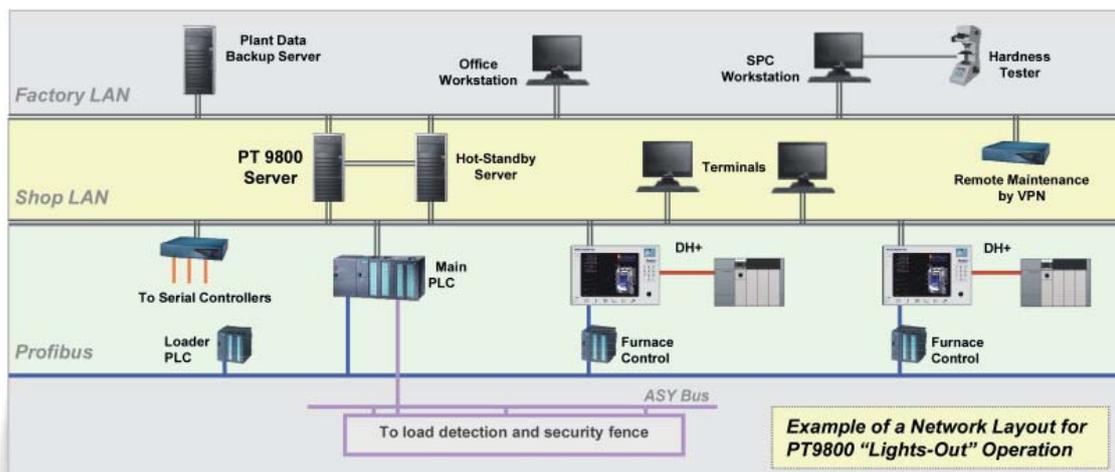
Protherm 9800 is a modular system consisting of basic modules for data acquisition and load reporting, and extended with a set of modules for recipe management, alarm and event logging.

A fully complemented system includes plant utilization calculations, maintenance tracking along with SMS and email alarm messaging, real-time carbon and nitrogen diffusion calculations, modeling as well as load planning and interface to Manufacturing Execution Systems such as SAP. Protherm 9800 can also be configured to allow complete "lights out" plant automation.



## FEATURES

- Scalable set of functions
- Module for fully automated production system/cell (lights-out).
- Easily implementable interface to existing planning and production systems.
- Possibility of simulating heat treating processes



## VARIABLE AREA METERS FOR PRECISE & RELIABLE CONTROL OF ATMOSPHERE GASES & LIQUIDS

**FLO-METER™** - "The Heat Treater's Favorite" provides precise visual indication of rates of flow of air, liquids and industrial gases. All of Waukee's **FLO-METER™**'s are calibrated in our ISO/IEC 17025:2005 certified lab and traceable to NIST (National Institute of Standards and Technology).

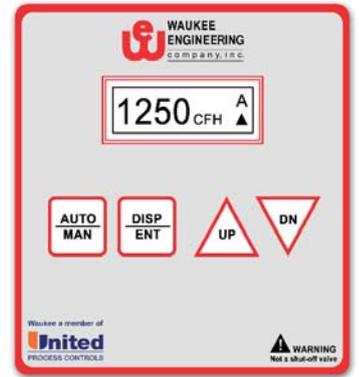
**FLO-ALARM™** - includes our basic **FLO-METER™** with or without a manual flow control valve. The **FLO-ALARM™** provides either a high or low flow alarm.

**FLO-TRONIC Plus™** - includes a basic **FLO-METER™** with or without a manual flow control valve. The **FLO-TRONIC Plus™** provides visual flow rate indication as well as an analog output signal proportional to the flow rate. Waukee's new magnetic sensor technology is immune to problems associated with dirty oil. Ideal for customers who need to data log flow rates for compliance to NADCAP, AMS2750D, or CQI 9.

**SAV Plus™ Control Valve** - includes a standard Waukee **FLO-METER™** scaled to your requirements and an electronic control valve that modulates flow based on a signal from your control system delivered via 4-20mA or digital communications such as Modbus TCP. The **SAV Plus™** features a bright, easy to read LCD display, and user friendly key board for configuration and manual operation. Ideal for precise control of industrial gases or liquids used in heat treat processes. Built-in web server for remote access to **SAV Plus™** settings and alarm logs.

**VALVE-TRONIC Plus™** - Complete electronic control valve and meter. Includes a Waukee **FLO-METER™** scaled to your requirements, and an electronic control valve that modulates flow based on a signal from your control system delivered via 4-20mA or digital communications such as Modbus TCP. The **VALVE-TRONIC Plus™** features a bright, easy to read LCD display, and user friendly key board for manual operation. Ideal for precise volumetric flow control of industrial gases used in heat treat processes. Other features include totalization, and alarms.

All flow data may be accessed over digital communications for easy integration into your control or SCADA system. Waukee's new magnetic sensor technology is immune to problems associated with dirty oil. These meters are best for customers who need to control and data log flow rates for compliance to NADCAP, AMS2750D, or CQI 9. A built-in web server provides remote access to the **SAV Plus™** and **Valve-Tronic Plus™** settings and alarm logs.



FLO-TRONIC Plus™

SAV Plus™

VALVE-TRONIC Plus™

**Integrated Visual Flow Indicator**

## DIFFERENTIAL PRESSURE METERS FOR PRECISE & RELIABLE CONTROL OF ATMOSPHERE GASES & LIQUIDS

### FurnaceMeter™ Touch Product Line



The FurnaceMeter™ Touch and VersaMeter™ Touch are precision flow measurement instruments designed specifically to meet the rugged requirements of industrial heat-treatment applications. The meters utilize precision, field-proven and certifiable differential pressure flow measurement technology. The advanced calibration and display modules on the electronic versions include integrated flow rate alarm and flow consumption totalizing functions. The meters meet NFPA86 guidelines for safe application in the thermal processing industry. In addition, every meter is calibrated to NIST transfer standard and ships complete with a 10-point calibration certificate. The meters can also be field calibrated to meet CQI-9, ISO, NADCAP, and QS quality audit systems.

### Integrated Flow Controller & Motorized Valve

The electronic FurnaceMeter™ Touch and VersaMeter™ Touch integrated flow controllers can be fitted with a motorized flow control valve designed to provide a complete solution for flow control applications. The desired flow rate setpoint can be programmed locally using the touchscreen or remotely using 4-20mA signal or ethernet TCP/IP communications.

### VersaMeter™ Touch Product Line



## FEATURES & BENEFITS

- Flow measurement can be checked anytime
- Touchscreen interface
- Paperless chart recording of flow
- Precision flow measurement and control
- NIST traceable 10-point calibration with every meter
- Manual or electronic flow control valve
- Integrated flow alarms and flow switch (optional)
- Integrated flow totalizer
- Direct visual indication of flow (meets NFPA86)
- Ethernet TCP/IP communications
- 4-20mA flow feedback and set point signals
- No fragile sight glass tubes or float assemblies to wear out
- No oil or float assemblies to clean or maintain
- Fast and accurate response to flow changes
- Flow Sensor can be calibrated in-situ and without disassembly
- Not susceptible to soot or particulates in the gas stream as long as particles can fit through orifice
- Retrofit or simplify existing piping
- USB port for transferring data

## CUSTOM PANEL ASSEMBLIES



Complete Flow Control Panel

### Flow Panels

Turnkey flow control panels are designed to provide installation ready assemblies for any process control application. These panels include all process flow control components pre-piped and wired to a NEMA enclosure to reduce installation time. All assemblies include detailed dimension drawings, component documentation, and calibration records.

Our design engineers utilize the latest 3D modeling software to ensure proper fitting and system operation prior to production, while our assembly technicians use best piping and wiring practices to provide a reliable and fully tested system ready for installation.

## ACTIVE PLC™



ACTIVEHMI™

### Industrial Process Control Solution

The ActivePLC™ provides a single, universal process control platform that can be standardized on many different applications, machines and projects, reducing development time, training, and spare part requirements. This industrial standard programmable logic controller runs on the ActivePLC™ process control platform with its universal PLC program that is ready to run “out of the box” without PLC programming required. The platform provides a completely flexible and uniform system to define and setup inputs, outputs, alarms, timers, advanced math functions, logic operations, PID loops, recipe operation, analog signal scaling, and even thermocouple type selection and calibration on an industry standard controller. Configuration of the ActivePLC™ is accomplished via the ActiveHMI™ touchscreen. Settings and logic can be backed up locally and replicated to any other ActivePLC™ hardware regardless of manufacturer.

### APPLICATIONS

- Complete furnace control system (multi-zone temperature and atmosphere)
- Nitriding Furnace Control (%DA or Kn)
- Annealing Furnace Control
- Gas Generators (Endo/Exo/DA)
- Batch Type and Continuous Applications & many others

### FEATURES

- Customizable HMI
- Data Logging and Paperless Chart Recorder
- Recipe Control
- Alarm Log
- Calibratable Temperature Inputs
- Advanced Math and Logic Capabilities & many others

## NITROGEN + METHANOL CONTROL SYSTEMS



SmartMeth™ Panel

The SmartMeth™ control system is a fully automated nitrogen methanol mixing system for heat treating furnace atmosphere production. The SmartMeth™ utilizes the latest in precision differential pressure flow measurement and touch screen controller design. This first of its kind system with built-in flow rate calculation automatically sets the nitrogen and methanol flow rates based on a desired %CO furnace concentration.

### FEATURES & BENEFITS

- Automatic flow set point calculation - calculates the required nitrogen and methanol flow rates to maintain a desired %CO at the required volume
- Customizable recipe software
- Optional integrated carbon and temperature control
- Automatic atmosphere recovery provides additional synthetic gas flow on demand, when introducing a new load into the furnace
- Integrated paperless chart recorder stores furnace temperature, %carbon, and synthetic gas flow furnace details
- Completely assembled and tested to NFPA 86 safety guidelines

## ENDO/EXO MIXING SYSTEMS



EndoInjector™

The EndoInjector™ is a precision gas mixing and control system for endothermic gas generators. The system incorporates a patented fuel injection design that utilizes electronic flow measurement and precise ratio control to consistently provide the ideal gas mixture for high quality endothermic gas generation. The fuel injection design automatically delivers gas mixture on demand, providing only as much endothermic gas as your furnaces require. This design feature makes it possible to significantly reduce operating costs and eliminate gas waste. Designed to easily replace existing carburetor/pump designs, the EndoInjector™ typically pays for itself in less than one year.

### FEATURES & BENEFITS

- Large turndown capability
- Reduce operating costs
- Touch-Screen control interface
- Minimize generator setup / startup time
- Eliminate gas waste
- No lubrication required
- Precision dew point control
- Eliminate sooting of catalyst due to mistuned carburetors



EndoInjector™ Generator Overview

## TURNKEY GAS GENERATORS



MicroGen™

The advanced EndoFlex™ and The MicroGen™ endothermic gas generators combine the patented EndoInjector™ fuel injection generator control system with the high-efficiency ReactionCore™ technology to lower operation and maintenance costs associated with producing high quality endothermic gas for your heat treatment furnaces. Both generators are equipped with the latest sensors to monitor dew point, unreacted methane, and energy consumption. The touchscreen interface provides easy access to review generator operations, and the integrated paperless chart recorder tracks generator performance to meet production auditing requirements.

### ReactionCore™ Technology

ReactionCore™ technology is a proprietary generator design that replaces a single large retort with several smaller centrifugally-cast retorts to significantly increase the surface area, improve the heating efficiency of the reaction chamber, and reduce the heating energy required for the production of endothermic gas. In addition, the smaller retort design significantly reduces the cost of replacement when necessary.



Dissociated Ammonia Generator

## FEATURES & BENEFITS

- Lower operating costs and emissions waste from 20-80% of generator capacity
- Automatic endothermic gas pressure control eliminates regulator adjustments
- Multi-retort design reduces cost, allowing for quick replacement of components
- Separate methane sensors provide data for scheduling retort burnout
- Filter change indicator improves system efficiency and operation time
- Built-in software for ease of scheduling, maintenance, and paperless data logging



EndoFlex™

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