Starling Associates, Inc.

Starling Associates specializes in natural gas measurement software, including natural gas and hydrocarbon properties software, natural gas flow meter software, natural gas dew point software, and natural gas thermodynamic properties software. Starling Associates software is used in gas metering, efm verification, gas accounting verification, meter sizing, gas volume calculations, and gas pipeline calculations. Measurement accuracy has been advanced by computer use, and Starling Associates software is the standard. We can help you implement the newest industry standard in gas flow measurement: the 1992 American Gas Association Transmission Measurement Committee Report No. 8. At Starling Associates, we can aid you with your process design and fluid phase behavior modeling. We know that others check their software against the Starling Associates software as the test for accuracy, making Starling Associates the de facto software standard. Starling Associates assures our customers of ACCURACY without COMPROMISE.

Visit our website: www.starlingassoc.com for current pricing.

Each SAI software product has been developed to meet a range of customer needs. For example, natural gas properties calculation modules are used in all products in the SAI Natural Gas Measurement Suite, but each product in the suite has been designed to meet a different range of customer needs. Most SAI products have been developed at the request or suggestion of an industry group or a highly respected individual in the industry.

GasProps2008.DLL

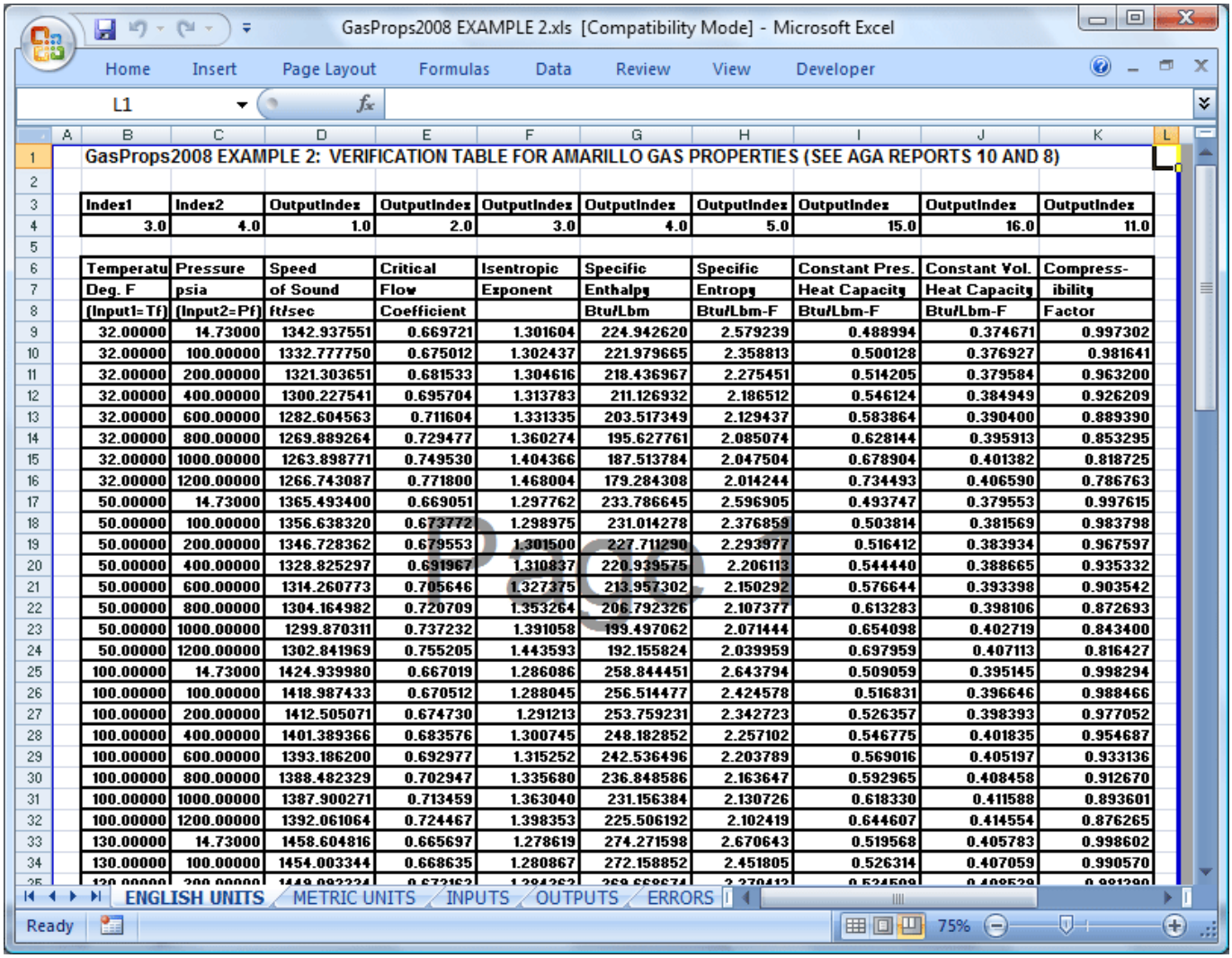
GasProps2008 accurately calculates 23 natural gas properties using equations in the gas industry standards AGA Report No. 8 and AGA Report No. 10. The research project to develop these equations was led by Ken Starling, the founder of Starling Associates, Inc. The GasProps2008 software is accessed in a Microsoft Excel spreadsheet format enabling you to calculate natural gas speed of sound, critical flow coefficient, Joule-Thomson coefficient, density, compressibility factor, enthalpy, entropy, heat capacity, isentropic exponent and other thermodynamic properties.

HOW GasProps2008 CAN HELP YOU SOLVE PROBLEMS

- Sonic Prover Calculations - the calculated speed of sound times the cross-sectional area at the minimum diameter of a sonic prover is the volume flow rate
- Ultrasonic Meter Speed of Sound Validation - check the calculations of the speed of sound used by the ultrasonic meter to calculate flow rate
- Flow Computer Properties Validation - check the gas properties calculations of an electronic flow meter
- Joule-Thomson Temperature Drop Calculations – calculate temperature drops across valves and pressure regulators to assess the potential for liquid water and hydrates
- Compressor Design Calculations - calculate natural gas compressor power requirements, number of compressor stages, intercooler duties and discharge temperatures
- Compressor Troubleshooting Calculations - compare actual operating conditions versus design conditions to determine deterioration in efficiency, increased power requirements, increased internal recycle, and if discharge temperature exceeds lubricant maximum
- Heat Exchanger Design Calculations - calculate natural gas heat exchanger duties and temperature profiles (GasProps2008 also can be used for air properties, and so for air coolers, and also for combustion gas, and so for heaters using combustion gas)
- Heat Exchanger Operation and Troubleshooting Calculations - monitor heat exchanger efficiency, determine changes in heat transfer coefficient and fouling factor, detect leaks

WHY GasProps2008 WAS DEVELOPED

The suggestion to provide gas properties calculations in a spreadsheet format was made in 2002 by Jim Witte of El Paso Corporation to Ali Quraishi of the American Gas Association around the time that AGA Report No. 10 was in final draft. Starting with the source code developed by Warren Peterson of Transcanada Pipelines, Ken Starling, SAI founder, developed the GasProps software. Because of Jim Witte's desire to have the Joule-Thomson coefficient included, a JT algorithm was developed for GasProps.



GasProps2008 window

GOFXL2008.DLL

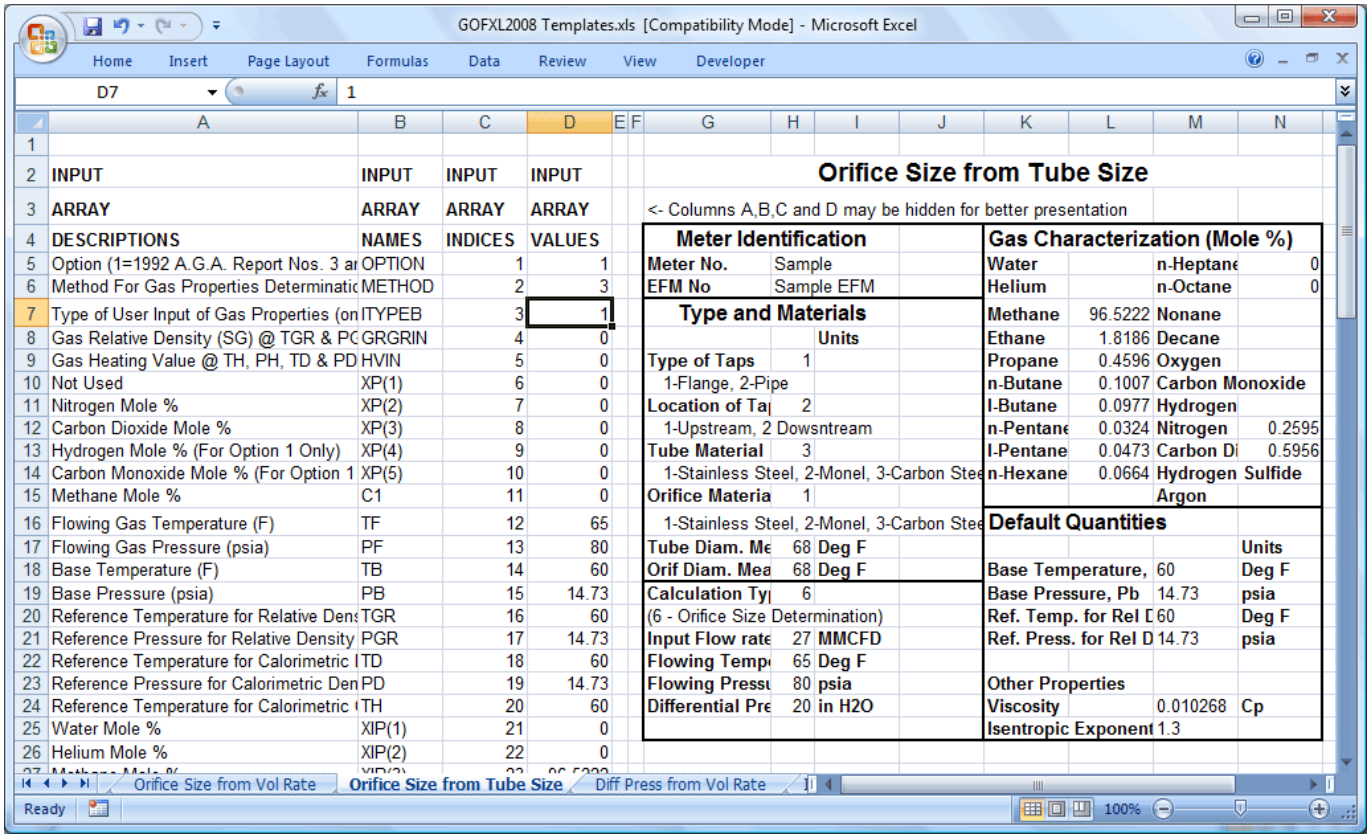
GOFXL2008 is the most popular product in the SAI Natural Gas Measurement Suite among customers who need or prefer to utilize spreadsheets in their work. GOFXL2008 can be used for orifice meters and linear meters, including turbine meters, ultrasonic meters and positive displacement meters. GOFXL2008 has proven valuable in the engineering design environment, the field environment and the office environment. In each application, customized GOFXL2008 spreadsheet forms can be used if desired to achieve uniform style and format within the company.

HOW GOFXL2008 CAN HELP YOU SOLVE PROBLEMS

- Meter Installation Design - compare the effects of changing meter tube diameter and orifice diameter on the ranges of flow rate for acceptable limits of differential pressure without orifice plate deformation
- Volume Calculator - calculate natural gas volumes or other variables associated with gas measurement
- Meter Changes – calculate the effects of field measurement calibration and equipment changes
- Facilities Management - use by field technicians in the inspection and management of natural gas measurement facilities
- Flow Computer Validation – check the calculations of an electronic flow meter over a period of recorded clock time
- API 21.1 Validation - check the integrity of the time averaging of variables such as average differential pressure used to obtain the gas volume integrated over the time period (e.g., 3600 seconds) according to API 21.1, the standard for electronic measurement
- SCADA Data Transfer Verification – check the integrity of data transfers in SCADA systems which must use different protocols to obtain data from different manufacturers' flow computers
- Accounting Calculations - volume checking and recalculation in the accounting office environment

WHY GOFXL2008 WAS DEVELOPED

The suggestion to provide gas measurement calculations in a spreadsheet format was made in 1992 by John Stuart of Pacific Gas and Electric in a meeting with Ken Starling, SAI founder. John, who was very active in gas measurement professional groups, had volunteered to review an MS DOS program for orifice metering developed by SAI using the 1992 revisions of the AGA 8/API 14.2 properties standard and the API 14.3/AGA 3/ANSI 2530-92/GPA 8185-92 orifice metering standard. John felt that a spreadsheet format would be especially useful when a large number of calculations need to be performed and/or compared. The SAI product GOFXL2008, which performs orifice and linear meter calculations in Microsoft Excel spreadsheets, was designed to meet the needs expressed by John Stuart and subsequently by other gas measurement experts.



GOFXL2008 window

GOFW2008

GOFW2008 is a computer notebook designed to assist field technicians with the management of natural gas measurement facilities, including meter inspections, calibrations and orifice plate, pressure transducer or other equipment change outs. GOFW2008 can be used for orifice meters and linear meters, including turbine meters, ultrasonic meters and positive displacement meters. Calculations can be made in either US or metric units. Although the GOFW2008 user interface is oriented to field use, GOFW2008 is just as valuable in the office environment.

HOW GOFW2008 CAN HELP YOU SOLVE PROBLEMS

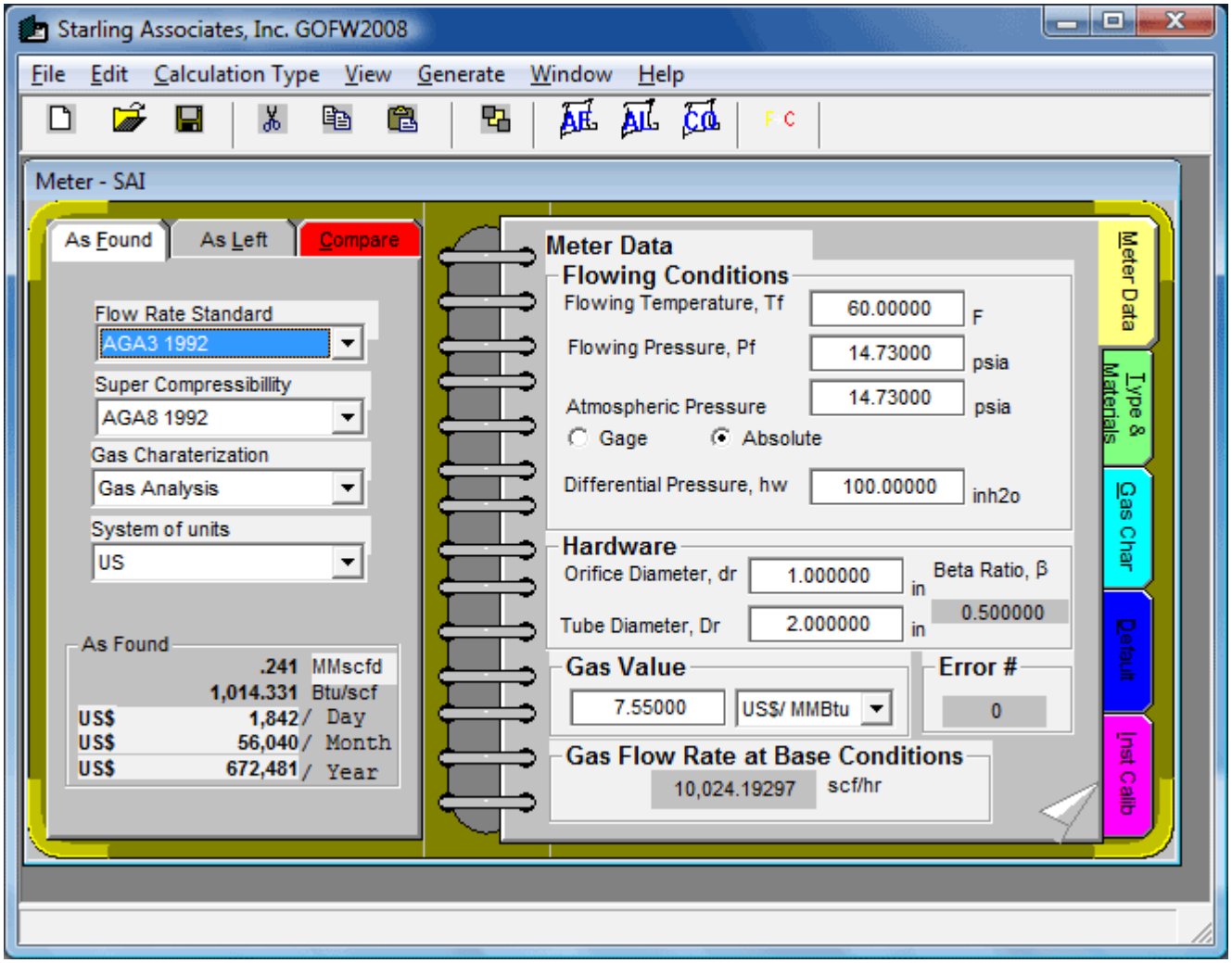
GOFW2008 makes quantitative calculations of the effects of meter changes showing "As Found", "As Left" and "Comparison" for volume, energy, monetary value and other pertinent quantities. All of this information can be automatically recorded in a "Crystal Reports" file for record-keeping purposes as well as transmission to the office environment. In addition, the original data files created in the field can be saved on the laptop and uploaded to desktop office computers which use the GOFW2008 software.

- Field Meter Test - Record gas meter inspections
- Meter Changes - Record field measurement calibration and equipment changes
- Volume Calculator - Calculate natural gas volumes or other variables associated with gas measurement
- Gas Quality Calculator - From lab analysis data calculate associated variables such as heating value in BTU/scf and gas gravity (also calculate comparisons for different input data)
- Lost Revenue Calculator - Calculate gas revenue loss associated with meter changes and changes in input data, such as lab analysis data
- Report Generator – Automatically generate reports showing "As Found", "As Left" and "Comparison" for volume, energy, monetary value, etc.
- Units Converter – Convert all units from US to metric or metric to US units

WHY GOFW2008 WAS DEVELOPED

In 1996, Union Oil Company of California requested that SAI develop a product using the Microsoft Windows operating system which could be used by Unocal field technicians to manage natural gas measurement facilities, with an emphasis on knowing the differences between the As Found and As Left meter conditions and the effect on calculated quantities such as volume, energy, and monetary value.

In the period 1996-2000, a team led by Juan Luongo, then SAI President, developed CO$TFLOW, a predecessor of GOFW2008. Unocal personnel involved included Myron Goforth and Steve Baldwin, gas plant and metering specialists with extensive field experience. Prior to the purchase of Unocal by Chevron, CO$TFLOW was used extensively in Unocal gas measurement short courses organized by the John Campbell Co. and taught by Ken Starling, SAI founder, at Unocal locations in both the US and Thailand.



GOFW2008 window

PRDewPointV1

HOW PRDEWPOINTV1 CAN HELP YOU SOLVE PROBLEMS

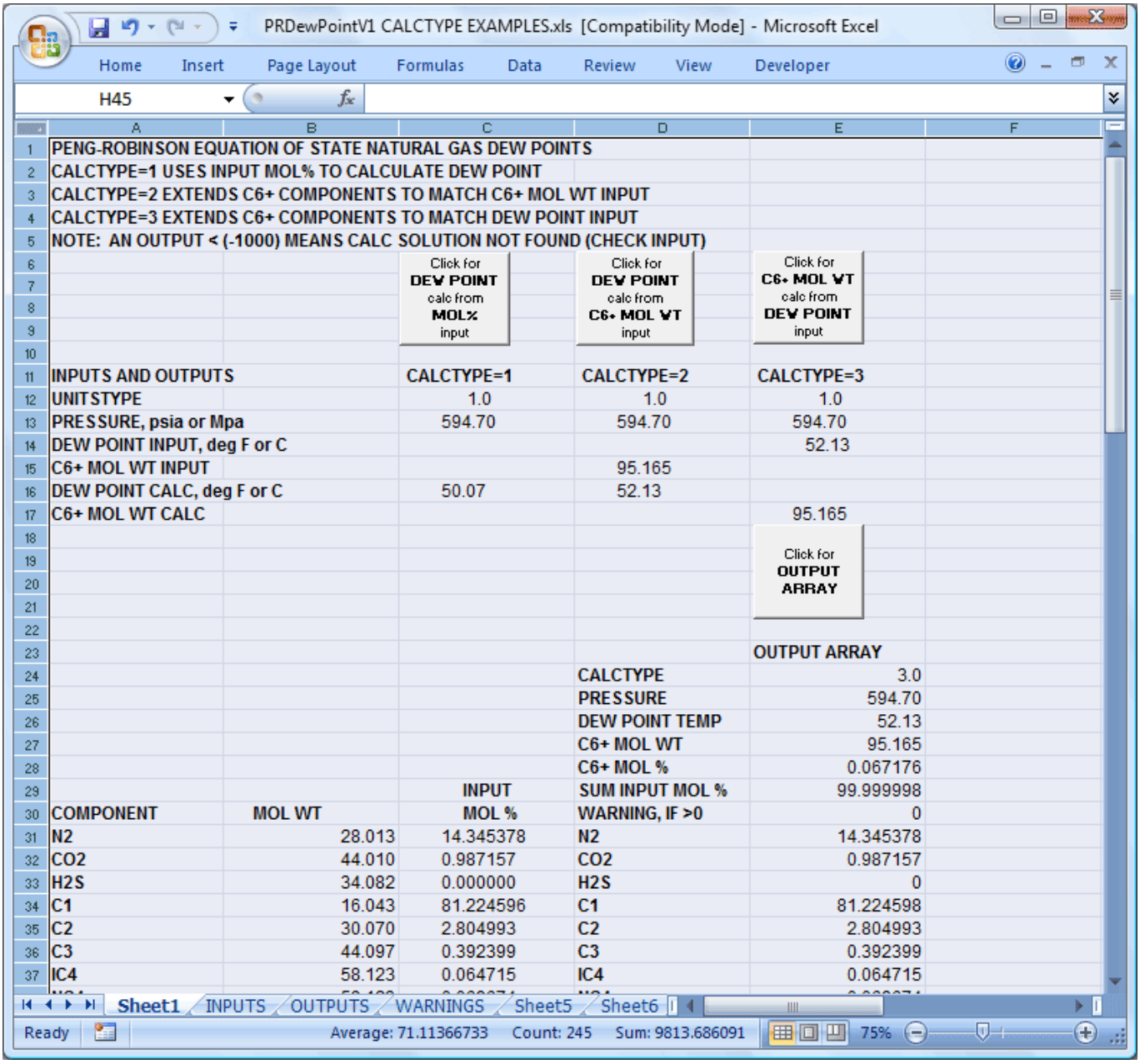
- *Calculate HCDP for Detailed Gas Analysis* --- Input composition and pressure, output HCDP (Hydrocarbon Dew Point)
- *Calculate HCDP for Gas Analysis with Lumped Hexanes Plus* --- Input composition, Hexanes Plus molecular weight and pressure, output HCDP (Hydrocarbon Dew Point) and Hexanes Plus estimated composition
- *Match Measured HCDP* --- Input Measured HCDP, composition (including Hexanes Plus mole percent) and pressure, output Hexanes Plus estimated composition which matches Measured HCDP (Hydrocarbon Dew Point)
- *Calculate HCDP using Hexanes Plus estimated composition at any pressure* --- Input estimated composition and pressure, output HCDP (Hydrocarbon Dew Point)

WHY PRDEWPOINTV1 WAS DEVELOPED

In 2000, prior to initiation of the API 14.1 program of experimental measurements of natural gas dew points at Southwest Research Institute, SAI founder Ken Starling served as a consultant in development of the research plan, a role he had previously played in 1985, prior to the dew point and liquid drop out measurements sponsored by Gasunie Research in the Netherlands.

Following the progress of both of these research projects disclosed the need for a reliable method for accurate calculations of dew points for natural gases in operating gas pipelines. The commonly used three step method of sampling, analysis and calculation can encounter undetected errors at each step. Sampling is difficult, accurate analysis is difficult and the resultant calculations of dew point and/or condensed liquid are uncertain.

The method developed and used in PrDewPointV1 is to combine the direct measurement of dew point and the gas analysis so that the hexanes plus portion of the gas analysis is adjusted to match the measured dew point. This adjustment of the portion of the gas analysis which has the largest uncertainty yields calculation results in the region of the dew point which have much lower uncertainty than the commonly used three step method. This method was first presented in the paper “Peng-Robinson Equation of State Natural Gas Dew Points,” by Kenneth E. Starling, AGA Operations Conference, Orlando, 2003.



PRDewPoint window

GOFLIBC

HOW GOFLIBC SOURCE CODE CAN HELP YOU SOLVE NATURAL GAS MEASUREMENT AND METER CALCULATIONS

GOFLIBC closely resembles the ancillary FORTRAN subroutines in which the standards were initially programmed, but now with GOFLIBC you can also perform the same calculations with a C compiler. GOFLIBC has been compiled with Microsoft C compiler version 7.0 and Borland C++ version 3.1. We have made an effort to remain as close to ANSI C as possible for portability among different C compilers and therefore we don't foresee any major changes going from different C compilers.

The GOFLIBC computer code calculates natural gas properties and orifice gas flowrates for flange and pipe taps and generates density, compressibility and supercompressibility tables. Measurement units include SI, US, IP and metric. Instrument calibration corrections are allowed and warnings and errors can be generated. The technical documentation for this code appears in the 1992 versions of AGA Reports No.3 and No. 8. Revisions in the 1994 Errata for AGA Report No. 3 and the 1994 reprinting of AGA Report No. 8 are included.

GOFLIBC-COMPANY allows use of the functions included in GOFLIBC within your company* to customize the gas flow rate calculations to your needs and create in-house applications.

GOFLIBC-PLUS allows production of firmware and/or stand-alone executable software to be sold by the licensee company*.

GOFLIBC-ENTERPRISE allows use of the functions included in GOFLIBC within your parent company and its affiliates and subsidiaries to customize the gas flow rate calculations to your needs and create in-house applications.

GOFLIBC-ENTERPRISE-PLUS allows production of firmware and/or stand-alone executable software to be sold by the licensee parent company, its affiliates and subsidiaries.

*A company is a single, legal entity.

GOFLIB32

HOW GOFLIB32 CAN HELP YOU SOLVE PROBLEMS

Calculations Available:

- *Volumetric Flow Rate*
- *Mass Flow Rate*
- *Differential Pressure*
- *Orifice Plate Sizing*

GOFLIB32 Outputs:

- *VB6 template that shows how to connect to DLL. Appropriate call forms, subroutines, definitions and DLL protocol*
- *One Input Structure to pass all Input Quantities*
- *One Output Structure to pass all Output Quantities*
- *Error and warning messages for out of range input quantities and computational errors*

WHY GOFLIB32 WAS DEVELOPED

During the late 1980s and early 1990s SAI provided meter calculation libraries to a number of companies developing custom in-house software. These companies included Unocal, American Pipeline and Software Performance. This experience suggested the need for a dynamic link library implementing A.G.A. Report No. 3 (1992) and A.G.A. Report No. 8 (1994 printing) calculations. GOFLIB32.DLL was then developed and has been used in numerous applications, including field and office calculations by El Paso Corporation and others and in control and monitoring systems by Alstom Power and others.

SAI ANNOUNCES THE **SAI MeterCheck** SERIES

Starling Associates Inc. is pleased to announce the introduction of feature-based license fee natural gas metering software, the **SAI MeterCheck** series. The **SAI MeterCheck** license fee structure allows SAI to offer low fees for the basic features, with moderate fees for products with added features, as shown below. Each product also has the features of all lower fee products. Most importantly, each product conforms to the SAI motto, **Accuracy without Compromise**.

SAI MeterCheck

- Orifice Plate Change Out Selection – Feature automatically calculates volumes for different orifice diameters to select best diameter for orifice plate change out
- Differential Pressure Calculation – Feature automatically calculates differential pressure required for an input volume rate of flow

SAI MeterCheck&Calibration

- Meter Calibration and Changes – Use this feature to calculate the effects of all field measurement calibration and equipment changes (all calibration factors are included)

Although **GOFXL2008** is not a member of the **SAI MeterCheck** series, the individual value of each of the many features of **GOFXL2008** helped convince us of the value of the **SAI MeterCheck** series. **GOFXL2008** has proven valuable in the engineering design environment, the field environment and the office environment.

GOFXL2008 is capable of large scale calculations, such as multiple meter recalculations and time-averaging for simulation of electronic flow meters. **GOFXL2008** calculations can even be integrated with other software calculations in the same Excel spreadsheet. The SAI website www.starlingassoc.com has detailed information on the many features of **GOFXL2008**.