Series 1550	Btu Monitor Reading Confirmation	Technical Brief

SITUATION:
Btu Monitors are frequently used to allocate energy usage among various tenants for a centralized system. For this reason confirmation of sensory and system accuracy can be a requirement.

SOLUTION:
Confirmation involves system design review, inspections of hardware installation, device programming review, and finally comparison to secondary standards.

PROCEDURE:
Verification of Btu reading accuracy involves five issues.

1. Location and installation of Hardware
2. Accuracy of the Flow Reading
3. Accuracy of the Supply Temperature Reading
4. Accuracy of the Return Temperature Reading
5. Accuracy of the Signal Conversion and Math computations in Series 1550.

1. As with any device, optimum performance is only achieved with careful planning and attention to detail. In the case of a Btu meter, it is important that the flow sensor "see" all of the flow associated with Source/ Load to be monitored; and, that the temperature sensor locations are such that the distribution system heat losses are included (or excluded) as the designers have intended. Care should be taken not to locate any of the sensors in local thermal mixing loops. For example, in some air handler systems, supply water is first delivered to a three-way mixing valve. Usually working in conjunction with a small pump, this valve modulates to maintain uniform flow and temperature through the air handler loop, in order to temper the incoming supply water temperature. The flow in this line would not represent the true volume of supply water consumed, and would have very low ΔT. As a result, sensor location in this area should be avoided.

Although the supply water temperature sensor can usually be located physically near the main supply line, the return temperature sensor should not be located physically close to the main return line. Such close proximity has the potential of corrupting the readings due to mixing of flows. For best accuracy, the T1 sensor should be in same supply (or return) line as the flow sensor. This is due to software features in the 1550, which compensate for the changes in the specific gravity of the water with respect to temperature. This is important since Btu measurements are based on mass and not volume.

Proper installation of the flow sensor is critical to system performance.
Considerations include
• 10 diameters of straight unobstructed pipe ahead of the flow sensor and five beyond.
• Alignment with flow direction
• Insertion depth per instructions in the sensor operators manual.

2. Accuracy of Flow Readings is dependant on the entry of proper "K" and "Offset" values for type flow sensor used and pipe size in which it has been installed.
• Confirm the "K" and "Offset" using the tables in the flow sensor manual.
• Confirm the actual values entered into the Series 1550 in "MAIN sensor"
(See the Programming Flow Chart in the 1550 Operators Manual).

Once the "K" and "Offset" have been confirmed, the displayed readings should be comparison to a secondary standard as confirmation. Press the "^" button unit the display shows Flow Rate, and compare the reading to a selected reference. The technician has many options depending on the degree of precision required.
• Pump curves (not precise, but a good "ball park" estimator)
• Differential pressure across system components such as air handlers, heat exchangers, or other devices with known properties.
(Along with pitot-tubes, this is the method used by most "system balancing" contractors)
• Delta T measured across known heat/cooling loads and sources.
(If the Btu rating is known this can be another rough indicator)
• When a high degree of confidence is required, a strap-on ultra-sonic flow meter can be installed temporarily for this purpose. However, please note, these are tricky devices with very subtle installation variables. Reliable readings require skilled handling by professional technicians.

3. Supply water temperature readings are probably the easiest to verify. The Series 1550 can display the actual supply and return temperatures. Simply go to "TEMP Readings" and press "Enter" to display T1 will be displayed on the top line of the LCD, and T2 on the bottom. If the flows in the supply lines are normal, one would expect any sensor monitoring this line and all branches from it to be very close in reading (Usually

within a couple degrees or so, with the most extreme variance in the less used or most distant branches). As a result, in a typical system there are literally dozens of reading devices that can be compared. In addition to reading the displayed values, the actual resistance across the thermistors can also be measured. This requires that the thermistors be disconnected from the Series 1550, and must be done with caution using a high quality DVM Meter. This is because of self-heating effects of the thermistor element itself, as a result of the test current applied by the measuring device. When taking any of these readings it must be remembered that these are dynamic systems where all variables are continuously changing. If comparisons are to be made, then stable operation must be assured at least for the time between readings being compared.

4. Return Temperature Readings are not as easy to confirm. This is because each branch returns at a different temperature depending on the flow rate and energy load. As a result, only a comparison to a secondary measurement can be used. There are many ways to do this. Some devices are surface contact or infrared technologies. Others are immersion type, using insertion or thermowell technologies. Surface measurements must be used with caution. Especially with large pipe sizes, lines with limited insulation, or lines with low flow rates. The heat losses from any exposed surface the might be available for measurement can be substantial, and enough to affect the measurement. Also, obviously, the greater the ΔT between the pipe and the environment the greater the effect.

5. The Series 1550 is a precise microprocessor based device. It incorporates highly developed math algorithms, 12 Bit D/A converters, and Single Precision Floating Point math formats which have a precision of about 7 digits when converted in standard base ten formats. As a result the errors associated with the monitor itself can in most cases be ignored.

Manually computing Energy Rates and Totals, with all of the variables and nuances of the 1550's programming included, would be a laborious and tedious task. However, if the inspector wishes to compute a close approximation of energy rate in order to double check the over all system performance, the following equation can be helpful.

Btu/Hr = GPM *Delta T * 500.4

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