

True Energy™

Instantaneous Energy Values for the Weld

Technology



▶▶ WHAT IS IT?

True Energy™ is a proprietary Lincoln Electric technology that uses the digital control system embedded in each Power Wave® arc welding power source to measure and calculate the instantaneous amount of energy put into a weld. Customers can then use this value, in conjunction with the length of the weld, to get the Heat Input.

Heat input calculations are used extensively in the welding industry, and the accurate calculation of these values is of utmost importance.

True Energy™ addresses some of the issues related to accurately measuring heat input, particularly as it relates to advanced welding processes such as GMAW-P. This value is displayed on the user interface of the Power Wave® package and can also be stored through Lincoln Electric's Production Monitoring™ 2 software.

HOW DOES TRUE ENERGY™ WORK?

True Energy™ uses the instantaneous values of the welding output, sampled at a rate of 10kHz (10,000 times per second), to calculate the total amount of power (W or KW) produced during the entire weld. This value is then multiplied by the duration of the weld, to calculate the True Energy™ (J or kJ) for the weld. Using the True Energy™ value and the length of the weld, one can easily calculate the heat input for the weld.

How does this differ from previous methods of calculating heat input? The traditional method of calculating heat input involves measuring the average voltage and average current. While this method produces relatively consistent results with high energy processes, such as traditional spray arc, the results become less consistent and accurate with short arc and pulse modes due to the rapidly changing output of the machine.



Power Wave® 455M/STT®
Superior Arc Performance.
Revolutionary Communication.



Short Arc		
Power Calculation Types	Power (kW)	% Diff. compared to True Energy™ Results
Traditional 'Average' Power Measurement	2.96	10.0%
True Power Measurement - Third Party Measurement Tool (Fluke® 345 Power Quality Clamp Meter)	2.66	-1.16%
Power Measurement from True Energy™	2.69	

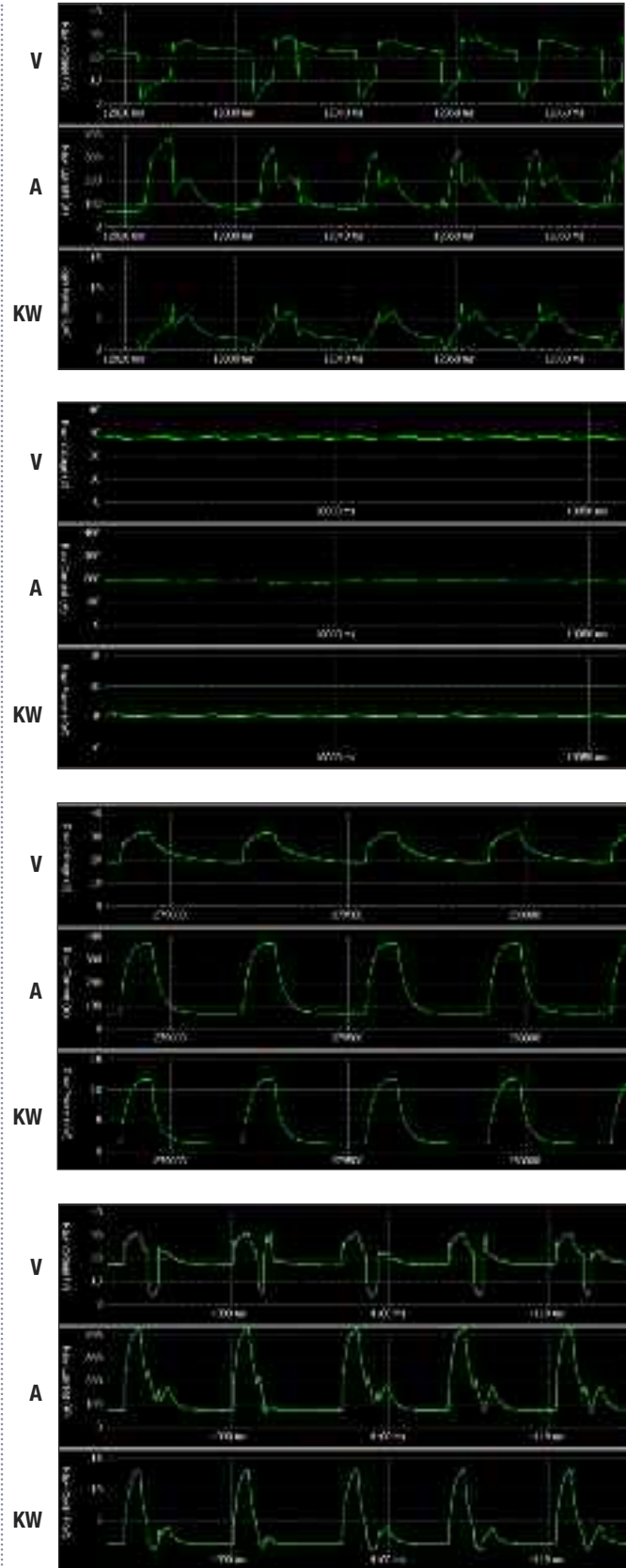
Axial Spray		
Power Calculation Types	Power (kW)	% Diff. compared to True Energy™ Results
Traditional 'Average' Power Measurement	5.25	-0.38%
True Power Measurement - Third Party Measurement Tool (Fluke® 345 Power Quality Clamp Meter)	5.12	-2.85%
Power Measurement from True Energy™	5.27	

Pulse		
Power Calculation Types	Power (kW)	% Diff. compared to True Energy™ Results
Traditional 'Average' Power Measurement	3.5	-13.58%
True Power Measurement - Third Party Measurement Tool (Fluke® 345 Power Quality Clamp Meter)	3.98	-1.73%
Power Measurement from True Energy™	4.05	

RapidArc®		
Power Calculation Types	Power (kW)	% Diff. compared to True Energy™ Results
Traditional 'Average' Power Measurement	2.89	-13.5%
True Power Measurement - Third Party Measurement Tool (Fluke® 345 Power Quality Clamp Meter)	3.26	-2.40%
Power Measurement from True Energy™	3.34	

Test Conditions - February 2009 - Multiple Tests - Score shown is an average of results.
Welding Procedures - All welding tests conducted with .035" solid wire at 350 ipm.

Note the close relationship between the Fluke® 345 Power Quality Clamp Meter and the True Energy™ power scores. In contrast, note the significant difference between the traditional 'average' versus the True Energy™ and Fluke® third party validation tool.



► USING TRUE ENERGY



True Energy™ is currently available for all “M Series” Power Wave® Pulsed MIG machines. The Power Wave® AC/DC 1000® will add True Energy™ capability in 2009. Some units may need to have their software updated to enable this feature via the update website, www.powerwavesoftware.com. The True Energy™ value and the duration of the weld will continually increment while the welding arc is present, and will be displayed after the weld. The values will be reset when the next arc is started.

Lincoln Electric’s Production Monitoring™ 2 software has the ability to record the True Energy™ values for each weld along with all the other welding information such as voltage, amperage, and wire feed speed. Using the True Energy™ value and the length of the weld, one can calculate Heat Input. Compare the Traditional Heat Input Calculation to the Lincoln True Energy™ Heat Input Calculation:

Traditional Heat Input Calculation

$$\text{Heat Input} = \frac{V_{\text{AVG}} * A_{\text{AVG}} * 60}{\text{Travel Speed}} = \frac{\text{(J or kJ)}}{\text{(in. or mm)}}$$

True Energy™ Heat Input Calculation

$$\text{Heat Input} = \frac{\text{True Energy™ Value}}{\text{Distance Traveled}} = \frac{\text{(J or kJ)}}{\text{(in. or mm)}}$$

It is important to understand that while the Heat Input calculated using the True Energy™ method may be different from that obtained from traditional methods, it does not imply that either of these values are incorrect; just different. If welding parameters have been developed around a Heat Input using the traditional methods, and the actual welds have passed the necessary mechanical tests, it simply means that the value at which it passed may actually be different. This difference can be compared to calibration on a scale, where the same item may reflect a different weight on two different scales if their calibration is different.

What is important is that if this weight is approved, then provided the same scale is used for ongoing verification, the results can be trusted. Much like the scale analogy, if the same calculation methods are used for verification that were used for qualification, one would expect the same mechanical results for the same Heat Input results. Using the True Energy™ value, however, will give you a more accurate indication of the actual Heat Input, based on its data capturing and calculation methods.

The True Energy™ heat input is accurate based on the welding parameters output by the machine. Various factors can influence the data’s accuracy such as circuit resistance and arc efficiency in the welding circuit. Independent verification of the results is still recommended. Lincoln Electric does include a computer based method for testing welding circuit resistance and inductance, which can be used to verify that the values present during welding are similar to those during qualification. This testing system is part of the free Diagnostics software package for all Power Wave® units.



True Energy™ results can be displayed on a Power Feed™ series wire feeder.

POWER WAVE® C300

The Power Wave® C300 is a portable multi-process power source with high-end functionality. Ideal for welding a wide variety of materials including aluminum, stainless, and nickel materials – where arc performance is critical. The Power Wave® C300 is well suited for production welding, construction, aerospace, automotive repair, general fabrication and training facilities.



POWER WAVE® S350

The multi-process Power Wave® S350 is packed with Lincoln performance technology on both the input and output side. It delivers extremely fast arc response, includes over 65 standard welding waveforms for optimized performance on almost any application and efficiently converts input power to reduce operational costs – all in a compact, rugged case.



WHAT IS NEXTWELD®?

Through our commitment to extensive research and investments in product development, Lincoln Electric has established an industry benchmark for applying technology to improve the quality, lower the cost and enhance the performance of arc welding processes. Advancements in power electronics, digital communications and Waveform Control Technology® are the foundation for many of the improvements.

NEXTWELD® brings you a series of Process, Technology, Application and Success Story documents. NEXTWELD® explains how technologies, products, processes and applications are linked together to answer the important questions that all businesses face:

- *How can we work faster, smarter, more efficiently?*
- *How can we get equipment and people to perform in ways they've never had to before?*
- *How do we stay competitive?*

Ask your Lincoln Electric representative how to improve the flexibility, efficiency and quality of your welding operations to reduce your cost of fabrication.

Power Wave® Models Equipped with True Energy™ Capability

- Power Wave® 355M
- Power Wave® F355i
- Power Wave® 455M
- Power Wave® 455M/STT®
- Power Wave® 655R
- Power Wave® i400
- Power Wave® C300
- Power Wave® S350
- Power Wave® AC/DC 1000® SD

CUSTOMER ASSISTANCE POLICY

The business of The Lincoln Electric Company is manufacturing and selling high quality welding equipment, consumables, and cutting equipment. Our challenge is to meet the needs of our customers and to exceed their expectations. On occasion, purchasers may ask Lincoln Electric for information or advice about their use of our products. Our employees respond to inquiries to the best of their ability based on information provided to them by the customers and the knowledge they may have concerning the application. Our employees, however, are not in a position to verify the information provided or to evaluate the engineering requirements for the particular weldment. Accordingly, Lincoln Electric does not warrant or guarantee or assume any liability with respect to such information or advice. Moreover, the provision of such information or advice does not create, expand, or alter any warranty on our products. Any express or implied warranty that might arise from the information or advice, including any implied warranty of merchantability or any warranty of fitness for any customers' particular purpose is specifically disclaimed.

Lincoln Electric is a responsive manufacturer, but the selection and use of specific products sold by Lincoln Electric is solely within the control of, and remains the sole responsibility of the customer. Many variables beyond the control of Lincoln Electric affect the results obtained in applying these types of fabrication methods and service requirements.

Subject to Change – This information is accurate to the best of our knowledge at the time of printing. Please refer to www.lincolnelectric.com for any updated information.



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