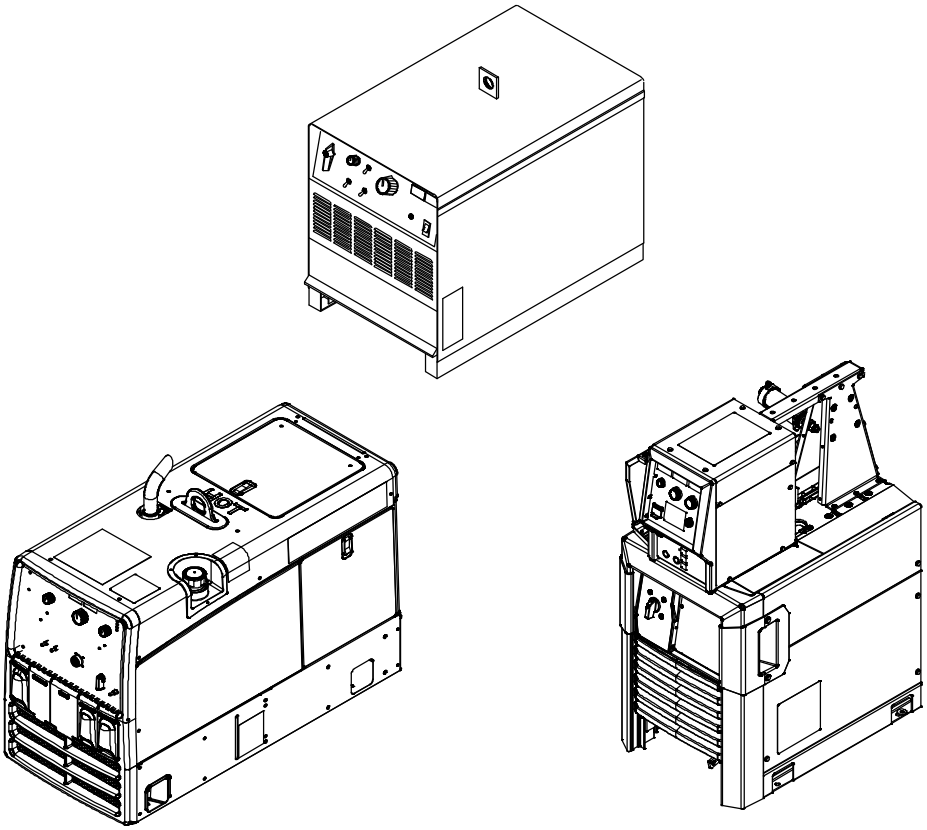
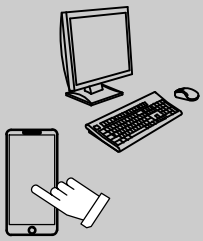
275053C 2016–12

Calibration/Validation Guidance For Miller Welding Equipment





For product information, Owner's Manual translations, and more, visit

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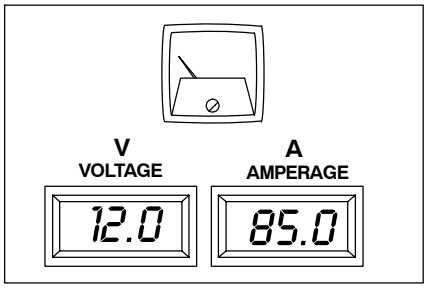
SECTION 1 – INTRODUCTION

⚠ Read and follow all labels and the Owner's Manual carefully before installing, operating, or servicing units. Only qualified persons should install, operate, maintain, or repair units, or perform calibration, validation, or certification activities.

☞ *The product Technical Manual may provide additional information on calibration procedures.*



The transition from analog meters to digital displays brought a new level of accuracy to weld parameter control and indication on Miller welding equipment. This evolution in technology also prompted changes in procedures for weld meter testing and calibration. In February of 2002, Miller released a document entitled *Welding Equipment Meter Calibration*. This was a collection of articles from Miller's *Techline* newsletters that provided definitions, guidelines, and resources to help service technicians support their customers' calibration needs.

Much has changed since that time. Developments in technology, products and regulatory standards have required the technical staff at Miller to revisit the topic of weld meter calibration. The result is the document you are now reading. It replaces the 2002 document and its purpose is to provide information aligned with current technology and industry standards. It defines the terminology of welding variables, test procedures and requirements. It also discusses documentation related to equipment manufacturing and servicing. The intention is to help machine owners and technicians understand the service requirements of welding equipment and indication devices, and to understand the related service options.

SECTION 2 – INDUSTRY STANDARDS

The regulations that pertain to welding power equipment design and calibration come from multiple sources. The International Electrotechnical Commission (IEC) is the international standards and conformity assessment body for all fields of electrotechnology. Safety and performance requirements for the manufacture of welding equipment are defined in IEC 60974–1: 2008 – Arc Welding Equipment Part 1: Welding Power Sources. This international standard has been adopted by the American National Standards Institute (ANSI) with modifications as ANSI/IEC 60974–1: 2008 – American National Standard for Arc Welding Equipment, to apply to equipment manufactured in the United States.

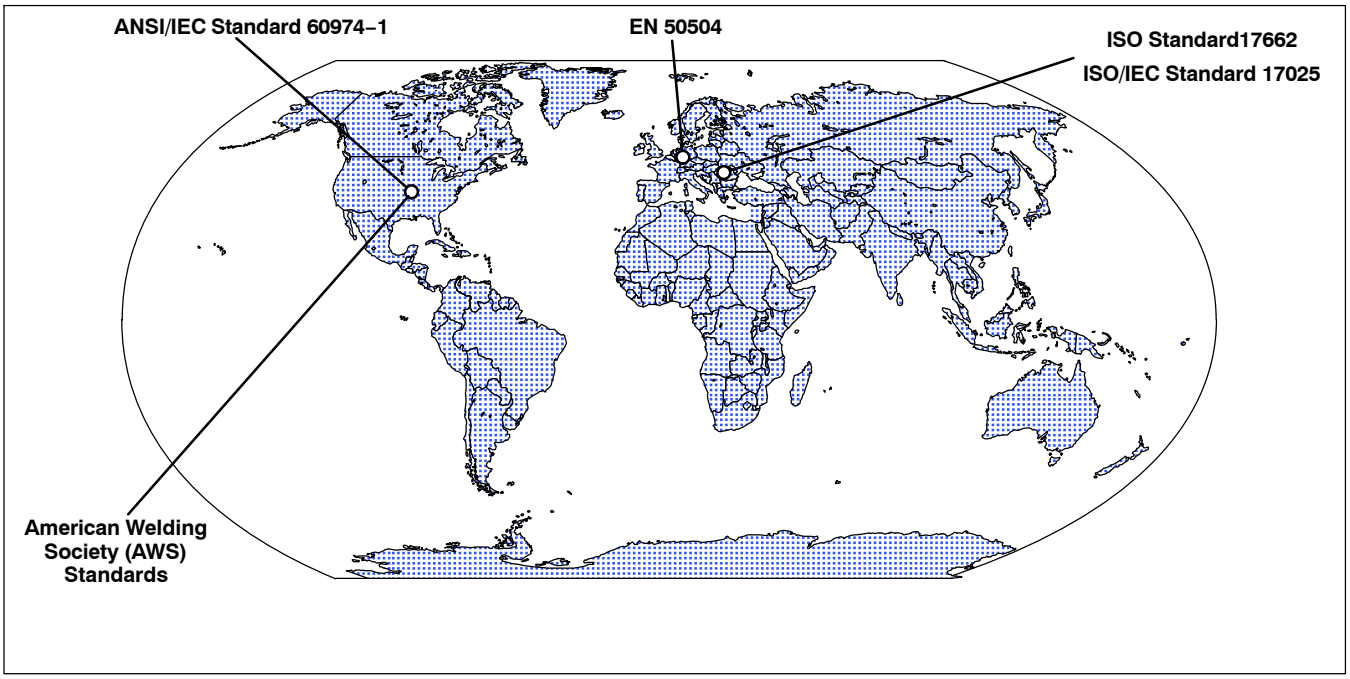


Figure 2-1. Sources Of Different Standards That Regulate Calibration Activities

Standards for calibration of welding equipment after entry into service are also defined by various agencies. The International Standards Organization (ISO) provides discussion, definitions and guidance toward compliance in document ISO 17662:2016 Welding – Calibration, Verification and Validation of Equipment Used for Welding, Including Ancillary Activities. ISO 17662:2016 refers to another document, EN 50504:2008 – Validation of Arc Welding Equipment, for related tolerances during equipment tests for recertification. (EN 50504 was drafted and approved as an international

standard by CENELEC, the European Committee for Electrotechnical Standardization.) With some exceptions, these two standards are recognized around the world as the primary references for calibration requirements, test procedures, and tolerances. There is also an international standard that defines requirements for laboratories that perform testing and calibration. This information is found in ISO/IEC 17025. The American Welding Society (AWS) has issued its own operational standards that apply to welding equipment used in construction and manufacturing in the United States.

An Internet search will yield the numbers and titles of many documents that pertain to welding equipment calibration. The task of finding and understanding the governing standard by country can be confusing. Some standards refer to other standards that originated from sources that seem unrelated, such as the ANSI adaptation of IEC 60974−1 described above. Many similar cross−references exist in the regulatory information. The challenge is to determine which requirements apply to a given piece of equipment or a specific area of industry within a certain country. These interpretations must be made by an employer's quality control officer or by the machine owner. For assistance, Miller recommends consultation with the agencies mentioned previously. See Section 5 for regulatory agency contact information.

2-1. Definitions

An understanding of the following terminology is necessary in order to determine what actions are required and when. All definitions are given in context with welding power sources/accessories and their related control and indication systems.

A **Standard** is a document that defines technical and/or procedural requirements to be met by welding equipment or by the owner of the welding equipment. Standards may originate in the United States, from countries other than the United States, or be hybrids that incorporate standards from multiple sources. Miller welding equipment is distributed worldwide. Governing standards may vary from country to country. Standards fall into one of two categories: Manufacturing Standards and Operational Standards.

Manufacturing Standards define welding equipment requirements and operational parameters which must be met by the equipment manufacturers. These standards define the tolerance for accuracy of variable settings (control markings) versus actual output values, and tolerance of variable indicating and recording devices (data storage systems, meters and displays) vs actual output values.

Operational Standards define requirements that apply to welding equipment after entry into service. These standards include requirements for maintaining the accuracy of weld control and indicating/recording devices.

Variables

Parameters that can be varied by use of controls on the welding equipment or are known to vary during the process of welding. The primary variables are voltage, amperage, arc length, and wire speed.

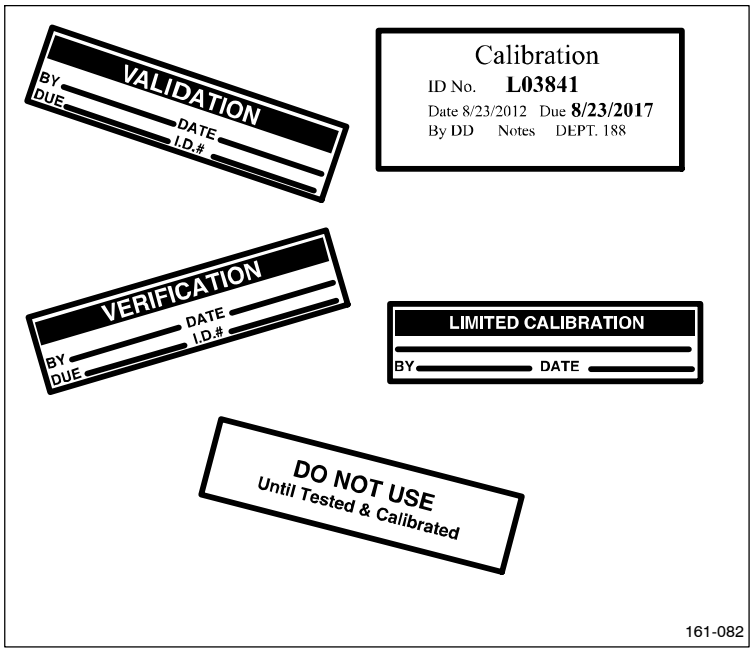


Figure 2-2. Examples Of Labels Used For Calibration And Validation Activities

Calibration

ISO 17662: 2016 defines calibration as a "set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or reference material, and the corresponding values realized by standards."

In practice, calibration is the process of comparing indicated weld outputs (typically voltage and amperage) from a piece of welding equipment to indications of a certified test instrument. The comparison is made to determine whether the equipment meter indications are within the accuracy tolerances defined in the governing standard. If so, the test yields a "Pass" result. If not, a "Fail" result is recorded. Simply stated, the calibration test answers the question, "Does the meter correctly indicate the actual output?"

Validation

ISO 17662: 2016 defines validation as "confirmation through the provision of objective evidence that the requirements for a specific intended use (e.g. client specification) or application (e.g. product standard) have been fulfilled." In prac-

tice, validation is the process of taking measurements to determine if the output of the welding equipment with controls marked by graduated scales is within the accuracy tolerances of the governing standard. A graduated scale is a range of settings between reference points. The points might be specific values of volts or amps but they might also be identified with markings that represent 0 to 100%. Again, the comparison is made to measurements taken with a certified instrument. This measurement can also be referred to as verification of conformity. The validation test answers the question, “Does the control setting give an output that corresponds to the set point marking of the control?”

Verification

Per ISO 17662:2016, verification is defined as confirmation through the provision of objective evidence that specified requirements have been fulfilled. (Verification is also interpreted as a confirmation that an available process achieved an expected level of success.)

Conformity Or Conformance

This term is defined as the condition of satisfying design and performance requirements as specified in a manufacturing standard.

Certificate Of Conformity

A Certificate of Conformity is issued by Miller Electric Mfg. Co. to declare and establish the initial validation of the welding equipment. Certificates of conformance are serial number specific to represent the condition of a Miller product as delivered from the factory.

Recertification

This term is defined as the process of performing calibration or validation of equipment after entry into service and providing documentation of the work performed and results observed.

Standard Grade

In general, this term refers to welding power sources and accessories used for manual welding operations.

Precision Grade

In general, this term refers to welding power sources and accessories used in fully automated welding operations.

SECTION 3 – VALIDATION OR CALIBRATION?

The introduction to EN 50504:2008 discusses the terms “Calibration” and “Validation”. While these two words have different meanings, they are often thought to be the same thing. There is a common belief among many welders and technicians that the process of calibration involves some physical adjustment of electrical components to bring indication accuracy back within specified limits. The introduction to EN50504:2008 supports this notion by stating “The operation of calibration can be applied only to determining and adjusting the errors of a measuring instrument.” However, the definition of calibration provided under Clause 3.1 of that same document refers only to “operation to determine the magnitude of errors”. While it does not state that adjustment is a required part of the calibration process, adjustment to correct indication errors may be possible on some indication circuits.

The difference between Calibration and Validation can be simply explained as follows: Calibration is performed on equipment fitted with meters, whether digital or analog, to verify that the indications are within the required tolerances. Validation is performed on equipment with output controls that are marked with graduated scales, to demonstrate that the resultant outputs are within tolerance per the set points of the controls.

Some welding equipment in the Miller product family allows for adjustment of the metering circuits. These procedures, when available as a design feature of the welding equipment, are described in the technical manual for that specific product. Analog meters on some equipment, including engine–driven models, can be adjusted to indicate “Zero” when no signal is present but this is not a calibration. The appropriate technical manual must be consulted for instructions on the procedure to be performed.

When the welding equipment does not pass the calibration or validation tests, further evaluation by a qualified technician will be needed to determine the source of the error. In most cases, one or more faulty components will be the cause. Replacement of those components will be required to restore operation within acceptable limits.

3-1. When Is Validation Or Calibration Required?

The answer to this question may vary by area of industry and governing standard but, in general, equipment must be recertified annually. In addition, governing standards typically require validation when there are indications that the equipment is not working properly, when there is visible damage, if the equipment has been overloaded or subjected to severe stress, or when the equipment has been rebuilt or repaired. The governing standard must be consulted for specific guidance.

3-2. What Are The Tolerances For Meter Indications On Miller Equipment?

Weld parameter indicating devices (commonly referred to as “weld meters”) on current production, standard grade Miller welding equipment are designed to meet the accuracy requirements of ANSI/IEC 60974−1 Clause 16.3 and, by reference, EN 50504.These values are indicated in Table 3-1. Note that the control setting validation tolerances are presented in the upper section of the table. The meter calibration tolerances are listed in the lower section.

Table 3-1. Validation Accuracies For Standard Grade Welding Power Sources

Quantity	Accuracy
Current And Voltage	±10% Of The True Value, between 100% And 25% Of The Maximum Setting
	±2.5% Of The Maximum Setting, Below 25% Of The Maximum Setting
Analog Meters	Class 2.5 (Reference Clause 3.5)
Digital Meters	
Current	±2.5% Of The Maximum Rated Welding Current
Voltage	±2.5% Of No-Load Voltage Or According To Manufacturer’s Specification

Table 3-1 presents validation accuracies as shown in EN 50504:2008, with reference to IEC 60974-1. Per Clause 3.5, by reference, Class 2.5 analog meters have a tolerance of ± 2.5% of full scale deflection.

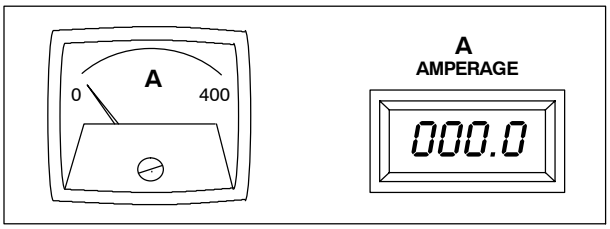


Figure 3-1. Analog And Digital Meter Calibration

For calibration of the analog meter shown in Figure 3-1, the tolerance would be 10 amps. The meter has a full scale deflection of 400 amps, so the tolerance is ± 2.5% of 400 = ±10 amps.

Digital meters on some Miller equipment can indicate up to a value of 999, so the tolerance is based on the max rated output of the unit under test. For example, the maximum rated output of an XMT 304 is 400 amps, so the tolerance for calibration would be ± 2.5% of 400 = ±10 amps.

3-3. How Is A Wire Feeder Calibrated?

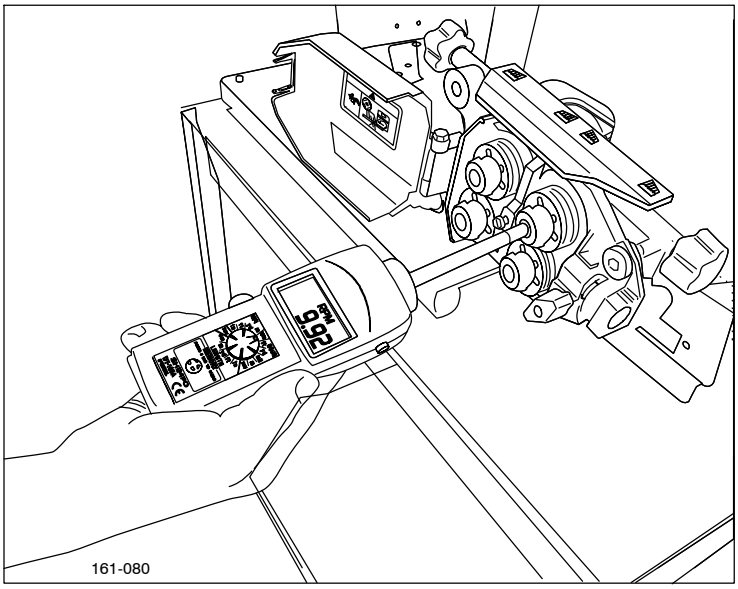


Figure 3-2. Validating Wire Feed Speed

Meter displays on Miller wire feeders must be calibrated. Accuracy of the wire feed speed must be validated. By design, the tolerance of wire feed speed and indication on Miller equipment is plus or minus 10% vs. control setting / display value. Note that the accuracy of indication might vary out of this tolerance as the drive motor heats up.

Validation is performed with a stopwatch and a tape measure, or a stopwatch, RPM counter and math formula across a range of speed settings. For validation, the measured RPM of the drive roll is multiplied by the nominal circumference of the drive roll. (An easy way to determine the circumference of a drive roll is to multiply the diameter of the drive roll by 3.14.) The wire feed speed (measured RPM x drive roll circumference) will be the length of wire that will be fed in sixty seconds at that given RPM. This value is then compared to the display value. On a properly adjusted wire feeder where no slippage occurs, this value will accurately represent the actual length of wire that would be fed at that speed. Again, note that results will vary between a cold and warm motor.

3-4. How Are Meters Adjusted On The Miller Load Bank?

The Owner's Manual for the Miller load bank includes meter adjustment instructions. Potentiometers on the meter control circuit board allow a limited range of adjustment. Validation with certified instruments must be performed before adjustments are made. Annual validation is not mandatory unless the load bank is used to validate other equipment. The governing standard must be consulted to determine whether the Miller load bank meets the requirements for use as a certified test instrument.

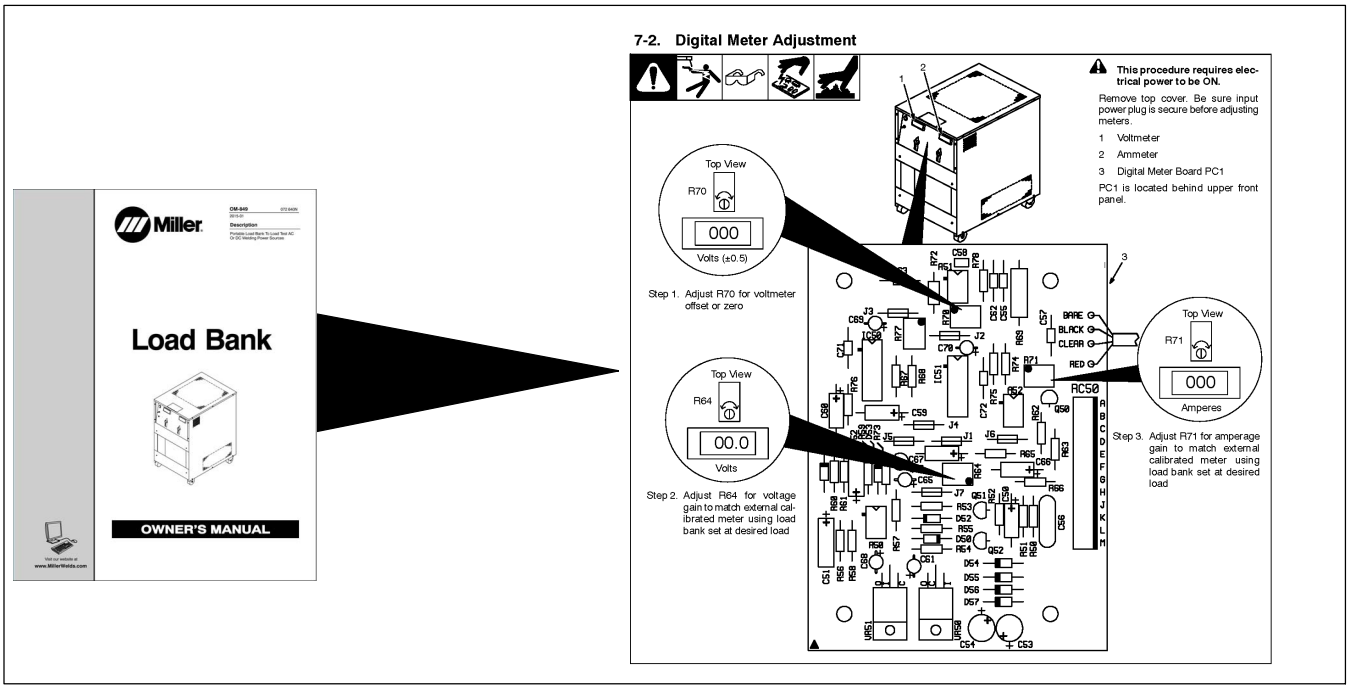
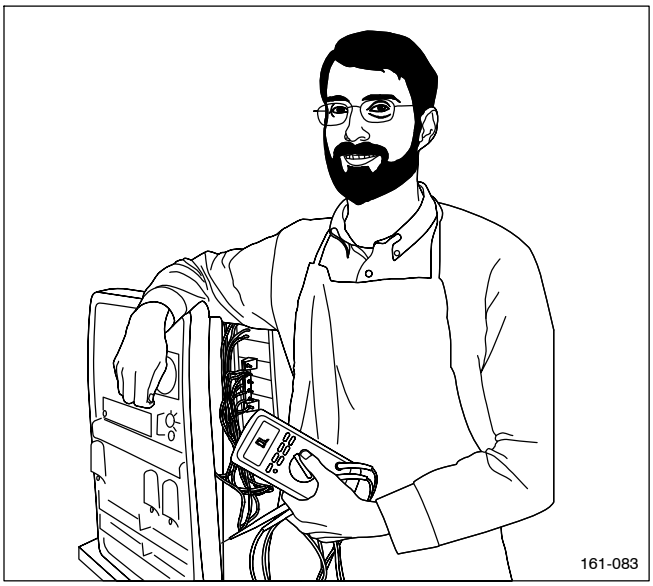


Figure 3-3. Digital Meter Adjustment Procedure From Miller Load Bank Owner's Manual

3-5. Certification Of Induction Heating Equipment

Induction heating equipment, such as Miller's ProHeat 35 system, as used for preheating and post-weld heat treatment "can" require validation per clause 15 of ISO 17662:2016. The standard states that thermocouples themselves are "reasonably stable and accurate" but the supporting "electrical instruments" and "the entire set–up shall be validated." Instructions for certifying the temperature indication and recording components of the ProHeat 35 system are provided in the ProHeat 35 Owner's Manual which can be downloaded from www.millerwelds.com. Submit the product serial number to obtain the correct manual.

3-6. Who Should Perform Validation And Calibration?



Individuals with knowledge of industry standards and validation technology, and possessing the necessary equipment, might have the ability to perform measurements with the intention of validating their welding equipment. It is possible, however, that an inspector will not accept the validation as being legitimate.

ISO/IEC Standard 17025 defines general requirements for the competence of testing and calibration laboratories. Requirements for issuing certificates of the work performed are also called out. Miller recommends for equipment owners to have validations performed by accredited service facilities or instrumentation laboratories that are in compliance with these requirements.

SECTION 4 – SUMMARY

⚠ Read and follow all labels and the Owner's Manual carefully before installing, operating, or servicing units. Only qualified persons should install, operate, maintain, or repair units, or perform calibration, validation, and certification activities.

For help in locating service support, please contact Miller Customer Support at 866–931–9733.

It is the responsibility of the equipment owner to determine which standard applies to a given work location or welding process and to interpret the related requirements for welding equipment certification. Miller will only provide guidance with regard to service and repair procedures for its products.

When needed, certification services must be provided by a qualified service facility or instrumentation laboratory to be selected by the machine owner.

Certificates of Conformity for welding equipment manufactured by Miller are available on request. Certificates of Conformity are specific to machines by serial number. These certificates establish the initial validation for control settings and weld variable indicating/recording devices installed by Miller at the time of production.

Information on testing, troubleshooting and repair is provided in the Technical Manuals for Miller products. The appropriate technical manual (check effective serial number) must be consulted for information on individual equipment design and service procedures.

Calibration is the process of comparing meter indications on a piece of welding equipment under load to indications of a certified instrument to determine if the meter indications are within tolerance. Physical adjustment of electrical components is not required in order for the process to meet the definition of calibration. The calibration test answers the question, "Does the meter correctly indicate the actual output?"

Validation is the process of comparing the output of the welding equipment to measurements with a certified instrument to determine whether the accuracy of control markings is within required tolerances. The validation test answers the question, "Does the control setting give an output that corresponds to the set point marking of the control?"

A Certificate of Conformity is a serial-number specific document that establishes the initial validation of a Miller product as delivered from the factory.

Recertification is the process of performing calibration or validation of equipment after entry into service and providing documentation of the work provided and results observed. This service must be provided by a third party other than Miller Electric Mfg. Co.

Electrical testing and repair of equipment built by Miller Electric Mfg. Co. should only be performed by a qualified person who has received instruction in electrical theory and safe work practices. This person must be properly trained and equipped in accordance with applicable standards.

Miller products meet the accuracy standards for control settings, and indication and recording functions as delivered from the factory. A statement of Miller's validation practices during the manufacturing process is available upon request.

SECTION 5 – REFERENCE RESOURCES

For assistance in locating or interpreting standards, contact the agencies listed below:

ANSI – American National Standards Institute, website: https://ansi.org

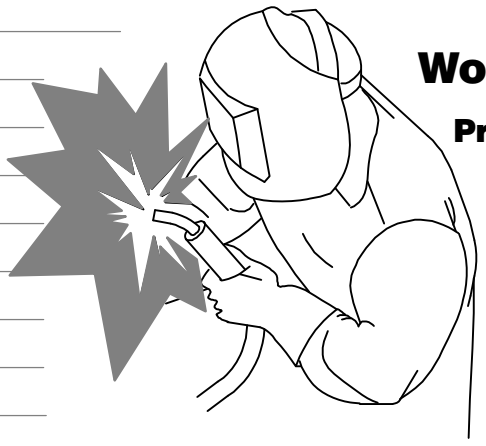
AWS – American Welding Society, website: www.aws.org

IEC – International Electrotechnical Commission, website: http://www.iec.ch/

ISO – International Standards Organization, website: www.iso.org

CENELEC – European Committee for Electrotechnical Standardization, website: https://www.cenelec.eu/

Notes



Work like a Pro!

Pros weld and cut safely. Read the safety rules at the beginning of this manual.

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