

REPAIR SERVICE INSTRUCTIONS — CALIBRATION

2206-20 Fork Meter for HVAC/R

Environmental Condition

Perform all calibration at an ambient temperature of $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ / $73.4^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$ and relative humidity of 80% - allow the fork meter to sit at this temperature for a minimum of 30 minutes before proceeding.



REPAIR SERVICE INSTRUCTIONS

Calibration



MILWAUKEE ELECTRIC TOOL CORPORATION
13135 WEST LISBON ROAD • BROOKFIELD, WISCONSIN 53005-2550 • USA

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TABLE OF CONTENTS	Page
Introduction	1
Precautions and Safety Information	1
Symbols	1
Safety	2
Specifications	3
General Specification	3
Voltage Specification	4
Current Specification	4
Resistance Specification	5
Continuity Specification	5
Capacitance Specification	6
Temperature Specification	6
Physical and environment characteristics	8
Certification and compliance	8
Required Equipment	9
Basic Maintenance	10
Opening the Meter Case	10
Replacing the Battery	10
Performance Tests	11
Testing the Display	11
Testing the Voltage Function	12
Testing the Resistance Function	12
Testing the Current Function	13
Testing the uA Function	13
Testing the Capacitance Function	13
Testing the Temperature Function	14
Calibration	15

Introduction

WARNING

To avoid shock or injury, do not perform the verification tests or calibration procedures described in the manual unless you are qualified to do so.

The information provided in this document is for the use of qualified personnel only.

CAUTION

The 2206-20 contain parts that can be damaged by static discharge.

Follow the standard practices for handling static sensitive devices.

Precautions and Safety Information

Use the Meter only as described in the Operator's Manual. If you do not do so, the protection provided by the Meter may be impaired. Read the "Safety Information" page before servicing this product.

In this manual, a  **WARNING** identifies conditions and actions that pose hazard (s) to the user; a

CAUTION identifies conditions and actions that may damage the Meter or the test instruments.

The Symbols

The symbols used on the Meter and in this manual are explained in Table 1.

Table A. The Symbols

	Risk of electric shock
	See instruction card
	DC measurement
	Equipment protected by double or reinforced insulation
	Battery
	Earth
	AC measurement
	Conforms to EU directives
	Application around and removal from hazardous live conductors is permitted.
	Do not discard this product or throw away.

SAFETY

Review the following safety precautions to avoid injury and prevent damage to this product or products connected to it. To avoid potential hazards, use the product only as specified.

⚠ WARNING: These statements identify conditions or practices that could result in personal injury or loss of life.

CAUTION: These statements identify conditions or practices that could result in damage to the equipment or other property.

Specific precautions

To reduce the risk of injury, user must read and understand operator's manual.

Do not operate without covers. To avoid personal injury, do not apply any voltage or current to the product without covers in place.

Electric overload. Never apply a voltage to a connector on the product that is outside the range specified for that connector.

Avoid electric shock. To avoid injury or loss of life, do not connect or disconnect probes or test leads from the meter while they are connected to a voltage source.

Do not operate in wet/damp conditions. To avoid electric shock, do not operate this product in wet or damp conditions.

SPECIFICATIONS

All specifications are warranted unless noted typical and apply to the 2206-20.

Stated accuracies are at 23°C±5°C at than 80% relative humidity and without the battery indicator displayed.

General specifications

Characteristics	Description
Display count	4000 counts
Numeric update rate	3 times / sec
Polarity display	Automatic
Overrange display	Display "OL" when the reading exceeds range by 10%
Low voltage indicator	 is indicated
Automatic power-off time	20 minutes
Power source	1.5V * 2 IEC LR6 or AA size
Maximum input voltage	600V CAT IV between V and COM 1000V CAT III between V and COM
Maximum floating voltage	600V CAT IV between any terminal and earth ground 1000V CAT III between any terminal and earth ground
V connector	V~, V=, Ω,  , 
Temperature Coefficient	0.1×(Spec. Accuracy) / °C, <18°C or >28°C
Battery Life	56 hours typical (Alkaline)

Measurement Characteristics

Accuracy is $\pm(\% \text{ reading} + \text{number of digits})$ at $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$, less than 80% R.H.

Temperature coefficient: $0.1 * (\text{Specified accuracy})/^{\circ}\text{C}$, $<18^{\circ}\text{C}$, $>28^{\circ}\text{C}$

(1) DC Voltage

Range	Resolution	Accuracy
400.0V	0.1V	$\pm(1\% \text{ reading} + 2 \text{ digits})$
1000V	1V	

Input Impedance: $1\text{M}\Omega$

Response Time: $< 1.5 \text{ sec.}$

Overload Protection: AC/DC 1200V for 10 second.

(2) AC Voltage

Range	Resolution	Accuracy (Sine Wave)
400.0V	0.1V	$\pm(1.5\% \text{ reading} + 5 \text{ digits})$
1000V	1V	

Input Impedance: $1\text{M}\Omega$ // less than 100pF

Frequency Response: 45 ~ 500Hz (Sine Wave)

AC Conversion Type: RMS sensing, RMS indication

Additional Accuracy by Crest Factor (C.F.): Add 6.0% for C.F. 1.0 ~ 2.0.

Add 7.0% for C.F. 2.0 ~ 2.5.

Add 9.0% for C.F. 2.5 ~ 3.0.

Max. Crest Factor: 2.0 for 4000 ~ 3000 digits

3.0 for 3000 ~ 0 digits

Response Time: $< 2 \text{ sec.}$ when the LCD reading is bigger than 1000 digits in each range.

Overload Protection: AC/DC 1200V for 10 second.

(3) DC μA

Range	Resolution	Accuracy
400.0 μA	0.1 μA	$\pm(1\% \text{ reading} + 2 \text{ digits})$
1000 μA	1 μA	

Response Time: $< 1.2 \text{ sec.}$

Overload Protection: AC/DC 1200V for 10 second. AC/DC 200mA for 10 second.

(4) AC Current

Range	Resolution	Accuracy
200.0A	0. 1A	$\pm(3\% \text{ reading} + 3 \text{ digits})$

Frequency Response: 45 ~ 60Hz (Sine Wave)

AC Conversion Type: AC coupled average sensing, RMS indication

Additional Accuracy by Crest Factor (C.F.): Same as ACV.

Max. Crest Factor: Same as ACV.

Adjacent Conductor Influence: < 0.08A/A

Response Time of AC Input: < 2 sec. when the LCD reading is bigger than 1000 digits in each range.

Overload Protection: AC 400A for 10 second.

(5) Resistance

Range	Resolution	Accuracy
400.0 Ω	0.1 Ω	$\pm(1\% \text{ reading} + 5 \text{ digits})$
4.000k Ω	0.001k Ω	$\pm(1\% \text{ reading} + 2 \text{ digits})$
40.00k Ω	0.01k Ω	
400.0k Ω	0.1k Ω	
4.000M Ω	0.001M Ω	
40.00M Ω *	0.01M Ω	$\pm(2\% \text{ reading} + 5 \text{ digits})$

* There is a little rolling less then ± 50 digits when measuring > 10.00 M Ω .

Open Circuit Voltage: Approx. 0.4V

Response Time: < 1.5 sec.

Overload Protection: AC/DC 600V for 10 second.

(6) Continuity

Range	Resolution	Accuracy
400.0 Ω	0.1 Ω	$\pm(1\% \text{ reading} + 5 \text{ digits})$

Open Circuit Voltage: Approx. 0.4V

Continuity: Built-in buzzer sounds when measured resistance is less than 30 Ω and sounds off when measured resistance is more than 200 Ω , Between 30 Ω to 200 Ω the buzzer maybe sound or off either.

Continuity Indicator: 2.7KHz Tone Buzzer

Response Time of Buzzer: < 500 μ sec.

Response Time of LCD reading: < 1.5 sec.

Overload Protection: AC/DC 600V for 10 second.

(7) Capacitance

Range	Resolution	Accuracy
100.0 μ F	0.01 μ F	$\pm(1.9\%$ reading + 2 digits)
1000 μ F	1 μ F	

Response Time when measuring 1000 μ F: < 2.5 sec.

Overload Protection: AC/DC 600V for 10 second.

(8) Temperature

Range	Resolution	Accuracy
-40.0°C ~ 400.0°C	0.1°C	$\pm(1\%$ reading + 2°C)
-40.0°F ~ 752.0°F	0.1°F	$\pm(1\%$ reading + 3°F)

Max. Sensitivity: 600V rms

Response Time: < 3.5 sec.

Overload Protection: AC/DC 1200V for 10 second.

(9) Volt Sense

Volt Sense Light should be on at 50V @ 1 inch (2.54 cm).

(10) Thermocouple

K Type Class II Thermocouple with standard dual banana jack.

Measurement Range: -40.0°C ~ 260.0°C (-40.0°F ~ 500.0°F)

Accuracy: $\pm 2.5^\circ\text{C}$

(11) Over-range Indication

Display "OL" when the reading exceeds 10% of the full scale except the full scale is 10000 counts.

(12) Rotary Switch

In order to prevent a "0" reading, the contacts about the input signal must be made properly before the contact of the function selection.

(13) Auto Power Off

The meter automatically turns the power off after powering up and no operation for 20 $\pm$ 5 minutes.

Press any key or rotate the rotary to power up.

(14) Measuring Rate: 3 times/sec.

(15) Battery: Alkaline 1.5V Battery * 2

(16) Low Battery Voltage: 2.3V ± 0.1V

(17) Battery life (ALKALINE):

Approx. 56 hours with backlight on.

Approx. 542 hours with backlight off.

(18) Overvoltage Category

IEC 61010-1 1000V CAT. III

(19) Operating Temperature

-10°C ~ 30°C, ≤ 80%RH

30°C ~ 40°C, ≤ 75%RH

40°C ~ 50°C, ≤ 45%RH

(20) Storage Temperature

-40°C ~ +60°C, 0 ~ 80%RH (No batteries)

Physical and Environmental Characteristics

Characteristics	Description
Dimensions (H×W×D)	200mm×64mm×43mm
Weight (with battery)	0.3Kg
Environmental characteristics	Description
Temperature operating	-10 to +50°C
Non-Operating	-40 to +60°C
Humidity (operating)	<80% R.H.
Altitude Operating	2,000M (6560 ft.)
Non-Operating	12,300M (40354 ft.)
Vibration & shock Operating	MIL-PRF-28800F for Class 2 Instrument
Indoor Use	

Certifications and compliances

Safety	Designed to IEC61010-1, UL61010-1 and CSA specifications
Input rating	Category IV 600V.
	Category III 1000V.
Over voltage category	CAT IV : The source of the Low-Voltage installation.
	CAT III : Distribution level mains, fixed installation.
	CAT II : Local level mains, appliances, portable equipment
	CAT I : Signal level, special equipment or parts of equipment, telecommunication, electronics.
Pollution Degree 2	Do not operate in environments where conductive Pollutants may be present.

Required Equipment

Required equipment is listed in Table B. If the recommended models are not available, equipment with equivalent specifications may be used.

Repairs or servicing should be performed only by qualified personnel.

Table B. Required Equipment

Equipment	Required Characteristics	Recommended Model
Calibrator	AC Voltage Range: 0 ~ 750V AC Accuracy: $\pm 0.07\%$ (Basic) Frequency Range: 40 ~ 1kHz Accuracy: $\pm 2\%$ DC Voltage Range: 0 ~ 1000V DC Accuracy: $\pm 0.006\%$ (Basic) Current Range: 0 ~ 600A Accuracy: AC (40Hz to 60Hz): $\pm 0.08\%$ (Basic) DC: $\pm 0.02\%$ (Basic) Resistance Range: 1Ω ~ $100M\Omega$ Accuracy: $\pm 0.03\%$ (Basic) Temperature Range: -50°C ~ 500°C (K type) Accuracy: $\pm 0.05\%$ (Basic) Capacitance Range: $0.1\mu\text{F}$ ~ $1100\mu\text{F}$ Accuracy: $\pm 0.10\%$ (Basic)	Fluke 5500 or Wavetek 9100 Calibrator or equipment

Basic Maintenance

⚠ WARNING

To avoid shock, disconnect test leads from any voltage source than remove from meter before opening the case or replacing the battery.

Opening the Meter Case

CAUTION

To avoid unintentional shock circuit, always place the uncovered Meter assembly on a protective surface. When the case of the Meter is open, circuit connections are exposed.

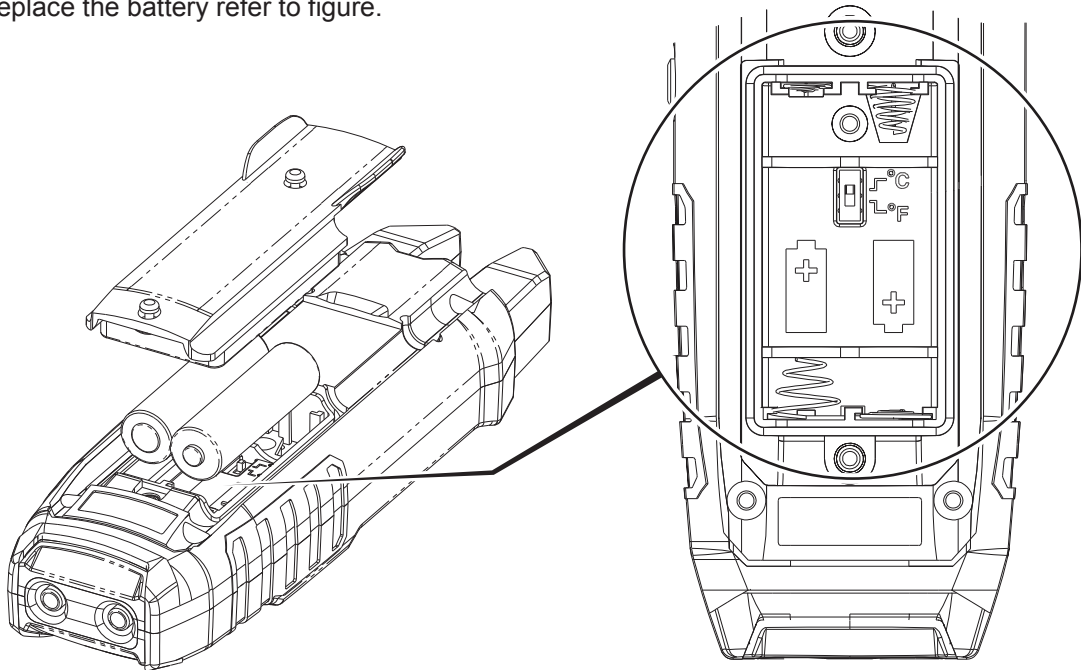
To open the Meter case, do the following:

1. Disconnect test leads from any voltage source than remove from meter before opening the case.
2. Remove the battery door by using a flat-blade screwdriver to turn the battery door screws counter-clockwise.
3. The case bottom is secured to the case top by two screws. Using a Phillips-head screwdriver, remove the two screws.

Replacing the Battery

The meter is powered by 2 AA 1.5V batteries.

To replace the battery refer to figure.



Performance Tests

The following performance tests verify the complete operability of the Meter and check the accuracy of each Meter function against the Meter's specifications.

Accuracy specifications are valid for a period of one year after calibration, when measured at an operating temperature of 18°C to 28°C and a maximum of 80% relative humidity.

To perform the following tests, it is not necessary to open the case, no adjustments are necessary, merely make the required connections, apply the designated inputs, determine if the reading on the Meter display falls within the acceptable range indicated.

If the Meter fails any of these tests, it needs calibration adjustment or repair.

Testing the Display

Press "HOLD" key while turning the Meter on from the "OFF" position to hold the display in the Display Test Mode. Compare the display with the example in Figure 2. Turn off the meter to escape the test mode.

LCD Graphics 2206-20

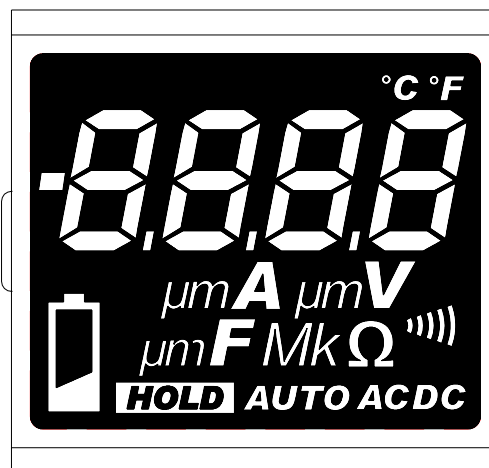


Figure 2 Display Test

Testing the Voltage Function

To verify accuracy in the AC and DC voltage ranges, do the following:

1. Turn on the meter.
2. Connect the Calibrator to the **VΩ** and **COM** inputs on the Meter.
3. Set the Calibrator for the voltage and frequency from step 1 to 6 in Table 1.
4. Compare the reading on the Meter display with the display reading shown in Table 1.
5. If the display reading falls outside of the range shown in Table 1, the Meter does not meet specification.

Table 1 Voltage Test:

Step	Input	Frequency	Reading
1	10.0V AC	50Hz	9.6 ~ 10.4
2	10.0V AC	500Hz	9.5 ~ 10.5
3	600V AC	50Hz	594.3 ~ 605.7
4	600V AC	500Hz	590.7 ~ 609.3
5	100V DC		99.5 ~ 100.5
6	600V DC		598.0 ~ 602.0

Testing the Resistance Function

To verify the accuracy of the resistance function, do the following:

1. Connect the calibrator to **VΩ** and **COM** on the Meter.
3. Apply the inputs for step 1-6 in Table 2.
4. Compare the Meter display readings to the display readings in Table 2.
5. If the display reading falls outside of the range shown in Table 2, the Meter does not meet specification.

Table 2 Resistance Test:

Step	Source	Reading
1	360.0Ω	354.1 ~ 365.9
2	3.600kΩ	3.562 ~ 3.638
3	36.00kΩ	35.62 ~ 36.38
4	360.0kΩ	356.2 ~ 363.8
5	3.600MΩ	3.562 ~ 3.638
6	36.00 MΩ	35.23 ~ 36.77

Continuity check: Internal sounds activates if the resistance of the circuit under test is less the 30Ω.

Testing the Current Function

To verify the accuracy of AC current measurement functions, do the following:

1. Using jaw of the meter around the suitable wire or conductor.
3. Apply the inputs for steps 1-2 in Table 3.
4. For each input, compare the readings on the Meter display to the reading in Table 3.
5. If the display reading falls outside of the range shown in the Table 3, the meter does not meet specification.

Table 3 Current Test:

Step	Source	Frequency	Reading
1	90.0A AC	60Hz	87.0 ~ 93.0
2	180.0A AC	60Hz	174.3 ~ 185.7

Testing the uA Function

To verify the accuracy of the uA function, do the following:

1. Connect the calibrator to **VΩ** and **COM** on the Meter.
3. Apply the inputs for step 1-2 in Table 4.
4. Compare the Meter display readings to the display readings in Table 4.
5. If the display reading falls outside of the range shown in Table 4, the Meter does not meet specification.

Table 4 uA Test:

Step	Source	Reading
1	300.uA	296.8 ~ 303.2
2	1000uA	988 ~ 1012

Testing the Capacitance Function

The Meter measures capacitance by charging the capacitor with a known Direct current, measuring the resultant voltage, and calculating the capacitance. If the same capacitance is measured on an impedance bridge, a different reading may result. This variance is likely to be Greater at higher frequencies.

To verify the accuracy of the capacitance measuring function, do the following:

1. Apply the Capacitor to the **VΩHz** and **COM** inputs on the Meter. For steps 1-4 in Table 5.
2. Turn the rotary switch to $\text{—}|\text{—}$.
3. Compare the reading on the Meter display to the reading in Table 5.
4. If the display reading falls outside of the range shown in Table 5, the Meter does not meet specification.

Table 5 Capacitance Test:

Step	Source	Reading
1	3.6uF	3.3uF to 3.9uF
2	80.0uF	78.3uF to 81.7uF
3	320uF	312uF to 328uF
4	1000uF	979uF to 1021uF

Testing the Temperature Function

To verify the accuracy of the temperature function, do the following:

1. Connect the Calibrator to **VΩHz** and **COM** on the Meter.
2. Wait for at least 30 minutes.
2. Turn the rotary switch to Temperature.
3. Apply the inputs for step 1-11 in Table 6.
4. Compare the Meter display readings to the display readings in Table 6.
5. If the display reading falls outside of the range shown in Table 6, the Meter does not meet specification.

Table 6 Temperature Test:

Step	Input	Mode	Reading
1	0.0 degree	Celsius	-2.0 to 2.0
2	-10.0 degree	Celsius	-12.1 to -7.9
3	-40.0 degree	Celsius	-42.4 to -37.6
4	100.0 degree	Celsius	97.0 to 103.0
5	400.0 degree	Celsius	394.0 to 406.0
6	0.0 degree	Fahrenheit	-3.0 to 3.0
7	-10.0 degree	Fahrenheit	-6.9 to -13.1
8	-40.0 degree	Fahrenheit	-36.6 to -43.4
9	32.0 degree	Fahrenheit	28.7 to 35.3
10	400.0 degree	Fahrenheit	393.0 to 407.0
11	750.0 degree	Fahrenheit	739.5 to 760.5

Calibration Procedure

Recalibrate the meter:

It is recommended that the meter may be calibrated once year. Use the following procedure to calibrate the Fork tester.

Environmental Condition

Perform calibration at an ambient temperature and relative humidity ($23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and R.H. $\leq 80\%$). Allow the instrument to sit at this temperature for at least thirty minutes.

Calibration Procedure

⚠ WARNING

To avoid shock, disconnect test leads from any voltage source than remove from meter before opening the case or replacing the battery.

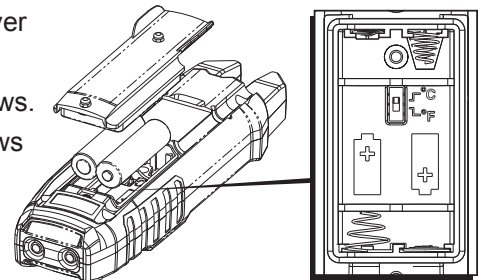
Opening the Meter Case

CAUTION

To avoid unintentional shock circuit, always place the uncovered Meter assembly on a protective surface. When the case of the Meter is open, circuit connections are exposed.

(A) To open the Meter case, do the following:

1. Disconnect test leads from any voltage source than remove from meter before opening the case.
2. Remove the battery door by using a flat-blade screwdriver to turn the battery door screws counter-clockwise.
3. The case bottom is secured to the case top by two screws. Using a Phillips-head screwdriver, remove the two screws
4. Supply 3V DC to the meter.



(B) DCV Calibration (VR105)

1. Rotate the rotary switch to DCV Function.
2. Connect the output of a DCV calibrator to V and COM input terminals of the meter.
3. Output DCV 300.0V from the calibrator.
4. Adjust VR105 until the display shows $300.0\text{V} \pm 0.1\text{V}$.
5. Turn off the output of the calibrator and disconnect the meter from the calibrator.

(C) ACV Calibration (VR104)

1. Rotate the rotary switch to ACV Function.
2. Connect the output of an ACV calibrator to V and COM input terminals of the meter.
3. Output ACV 300.0V @ 60Hz from the calibrator.
4. Adjust VR104 until the display shows $300.0\text{V} \pm 0.1\text{V}$.
5. Turn off the output of the calibrator and disconnect the meter from the calibrator.

(D) DC μ A (400.0 μ A Range) Calibration (VR103)

1. Rotate the rotary switch to the resistance function.
2. Connect the output of a DC μ A calibrator to V and COM input terminals of the meter.
3. Output DC 300.0 μ A from the calibrator.
4. Adjust VR103 until the display shows $300.0\mu\text{A} \pm 0.1\mu\text{A}$.
5. Turn off the output of the calibrator and disconnect the meter from the calibrator.