1. INTRODUCTION

This procedure is used to calibrate the control functions of X–HW 200, Hot Wire Power Supply System. This procedure applies to all AMET Hot Wire Power Supply Systems.

2. RESPONSIBILITIES

Performer	Responsibility
Technician	After assuring the prerequisites have been met, performs Initial Setup using step 4.1. Performs the following calibrations and linearity checks: ▪ Frequency control using step 4.2 ▪ Voltage control using step 4.3 ▪ Voltage feedback using step 4.4 ▪ Current feedback using steps 4.5 ▪ External voltage reference using step 4.6 ▪ External voltage feedback using step 4.7 ▪ External current feedback using step 4.8. Performs post calibration restoration of the Hot Wire Power Supply to return it to normal operational mode using step 4.9. If calibration or linearity check fails, initiate troubleshooting with the assistance of AMET Technical Support.

3. PREREQUISITS

The following tools and equipment are required by this procedure:

3.1. Two Digital Volt Meters (4-½-digit). The calibration of these meters must be verified and current
3.2. Calibrated DC Power Supply, 0 – 10 VDC
3.3. Current Shunt (1,000 amps @ 100 millivolts)
3.4. Load bank that will handle 200 amps at 3.6 KW
3.5. RC filter constructed per Figure 1, *RC Filter Schematic and Connection* (See section 4.1.5.)

4. INSTRUCTIONS

4.1. Initial Setup

4.1.1. Remove all power from the Hot Wire Power Supply by disconnecting the main power connector on the back of the Hot Wire Power Supply.

4.1.2. Connect the current shunt in series with the Work lead from the Hot Wire Power Supply.

4.1.3. Connect the voltmeter across the current shunt and set the meter to the correct setting in order to read the voltage drop that the shunt will produce (2.0 to 20.0 mV AC).

4.1.4. Connect the load bank to the output of the Hot Wire Power Supply. (The output of the supply is an AC signal so the polarity does not matter.) Make sure that the load bank leads are connected properly and turn on the load bank.

NOTE
When measuring the power supply output voltage, use an RC filter circuit to eliminate erroneous readings caused by the switching noise of the power supply.

4.1.5. Connect the RC filter and voltmeter across the output leads of the Hot Wire Power Supply as shown in Figure 1. The meter will be parallel to the load bank. Set the meter to AC Volts on the 20 VAC range or Auto Range.

Figure 1, RC Filter Schematic and Connection

Resistor = 10k Ω, ½ W, 20%, carbon. Capacitor = 0.1 µf, 50v.

NOTE
Perform steps 4.1.6 through 4.1.9 ONLY if performing a frequency calibration. Otherwise continue with step 4.1.10.

4.1.6. Remove the Hot Wire Power Supply cover by removing the appropriate screws.
4.1.7. Remove the front cover of the Allen Bradley 1336 Plus II, Adjustable Frequency AC Drive by removing the locking screw on the bottom of the front panel of the drive.
4.1.8. Remove the blank Human Interface Module (HIM) blank panel located in the upper right quadrant of the Allen Bradley Drive enclosure.
4.1.9. Install the Allen Bradley HIM with the appropriate program. The HIM can be supplied by Allen Bradley but the program must be loaded to the HIM by technical personnel at AMET Inc.
4.1.10. Press and Hold the **Adjustment** Knob on the front of the Hot Wire Power Supply Control Panel while you connect the input power to the Hot Wire Power Supply. Hold the **Adjustment** Knob in until "Calibration 1.1" appears on the LCD display.
4.1.11. Using the **Adjustment** Knob scroll to "PID Control" and select it by pressing the **Adjustment** Knob. Scroll to "Cntl Loop" and change the value to "OFF" by pressing the **Adjustment** Knob.
4.1.12. Scroll to and select "Save & Exit."

4.2. Frequency Control Calibration

Note

The Frequency Control has been calibrated at the factory. This function does not need to be recalibrated in the field. If you would like to verify the frequency calibration in the field then you will need to attach an oscilloscope across the output of the Hot Wire Power Supply and verify that the commanded frequency is accurate.

4.2.1. Select "Frequency Cntl" from the menu by scrolling through the menu using the **Adjustment** Knob and then pressing the **Adjustment** Knob to select the correct item.
4.2.2. Scroll to and select "Voltage SetPt" on the menu and enter 2.0 Volts in the value field.
4.2.3. Scroll to and enter 51 into the "Frequency" value field.
4.2.4. Press the **Contactor** Button on the front of the Hot Wire Supply. This will command a 2.0 volt output at 51 hertz from the power supply.
4.2.5. Monitor the frequency display on the front of the HIM attached to the Allen Bradley Drive enclosure. If the display reads 51 hertz then continue with step 4.2.7. If the display does not read 51 hertz then continue with step 4.2.6.
4.2.6. Adjust the "Course Offset" and "Fine Offset" until the frequency displayed on the front of the HIM reads 51 hertz.
4.2.7. Scroll to and enter 299 in to the "Frequency" value field.

4.2.8. Monitor the frequency display on the front of the HIM that is attached to the Allen Bradley Drive. If the display reads 299 hertz then continue with step 4.2.10. If the display does not read 299 hertz then continue with step 4.2.9.

4.2.9. Adjust the "Course Gain" and "Fine Gain" until the frequency displayed on the front of the HIM reads 299 hertz.

4.2.10. Repeat steps 4.2.3 to 4.2.10 until no adjustments are needed.

4.2.11. Check the calibration of the Hot Wire Power Supply frequency control in 50 hertz increments starting at 50 hertz and ending at 300 hertz to confirm that the control is linear. Record the values in Section 5. RECORDS, Table 1, *Frequency Control Linearity Check.*

4.2.12. Press the **Contactor** Button on the front of the Hot Wire Supply to disable the output of the Hot Wire Power Supply.

4.2.13. Remove power from the Hot Wire Power Supply by disconnecting the main power connector on the back of the Hot Wire Power Supply.

CAUTION

The Allen-Bradley Drive may remain energized for as long as one minute after removing power from the Hot Wire Power Supply. Be certain the Allen-Bradley Drive control panel LEDs are extinguished before proceeding.

4.2.14. Remove the HIM from the front of the Allen Bradley Drive and re-install the blank HIM panel.

4.2.15. Re-install the front cover of the Allen Bradley Drive and make sure that the locking screw is tight.

4.2.16. Re-install the Hot Wire Power Supply cover and make sure that all mounting screws are installed properly.

4.2.17. Press and Hold the **Adjustment** Knob on the front of the Hot Wire Power Supply Control Panel while you connect the input power to the Hot Wire Power Supply. Hold the **Adjustment** Knob in until "Calibration 1.1" appears on the LCD display.

4.2.18. If no other calibrations are to be completed, proceed to step 4.9. Otherwise, continue with the next calibration section.

4.3. Voltage Control Calibration Procedure

4.3.1. Select "Voltage Cntl" from the menu by scrolling through the menu using the **Adjustment** Knob and then pressing the **Adjustment** Knob to select the correct item.

4.3.2. Connect the RC filter and voltmeter across the output leads of the Hot Wire Power Supply as shown in Figure 1. The meter will be parallel to the load bank. Set the meter to AC Volts on the 20 VAC range or Auto Range.

4.3.3. Enter 2.0 Volts into the "Voltage SetPt" value field.

4.3.4. Enter 60 into the "Frequency" value field. By setting this value to 60 hertz will allow the volt meter to make the most accurate measure of the voltage.
4.3.5. Press the **Contactor** Button on the front of the Hot Wire Supply. This will command a 2.0 volt output from the power supply.
4.3.6. Check the digital volt meter connected in parallel to the load bank, to verify the actual output of the Hot Wire Power Supply.
4.3.7. If the Output of the Hot Wire Power Supply is incorrect then adjust the "Course Offset" and "Fine Offset" until the output reads 2.0 volts.
4.3.8. Enter 14.0 volts into the "Voltage SetPt" value field.
4.3.9. Check the digital volt meter, which is connected in parallel to the load bank, to verify the actual output of the Hot Wire Power Supply.
4.3.10. If the Output of the Hot Wire Power Supply is incorrect then adjust the "Course Gain" and "Fine Gain" until the output reads 14.0 volts.
4.3.11. Repeat steps 4.3.3 through 4.3.9 until no adjustments are necessary.
4.3.12. Check the output voltage of the Hot Wire Power Supply in 2 volt increments starting at 2.0 volts and ending at 14.0 volts to confirm that the output is linear. Record the values in Section 5. RECORDS, Table 2, *Voltage Control Linearity Check*.
4.3.13. Press the **Contactor** Button on the front of the Hot Wire Supply to disable the output of the Hot Wire Power Supply.
4.3.14. Scroll down and select the "Save and Exit" option at the bottom of the "Voltage Control" menu by using the **Adjustment** Knob on the front of the Hot Wire Power Supply.
4.3.15. If no other calibrations are to be completed, proceed to step 4.9. Otherwise, continue with the next calibration section.

4.4. Voltage Feedback Calibration

4.4.1. Select "Voltage Fdbk" from the menu by scrolling through the menu using the **Adjustment** Knob and then pressing the **Adjustment** Knob to select this option.
4.4.2. Enter 2.0 Volts into the "Voltage SetPt" value field.
4.4.3. Press the **Contactor** Button on the front of the Hot Wire Power Supply. This will command a 2.0 volt output from the power supply.
4.4.4. Check the "Volts" readout on the LCD Display on the front of the Hot Wire Power Supply to verify that it reads 2.0 volts.
4.4.5. If the readout on the LCD Display is incorrect then adjust the "Course Offset" and "Fine Offset" until the display reads 2 volts.
4.4.6. Enter 14.0 volts into the "Voltage SetPt" value field.
4.4.7. Check the "Volts" readout on the LCD Display on the front of the Hot Wire Power Supply to verify that it reads 14.0 volts.
4.4.8. If the readout on the LCD Display is incorrect then adjust the "Course Gain" and "Fine Gain" until the display reads 14 volts.

4.4.9. Repeat steps 4.4.2 through 4.4.8 until no adjustment is necessary.
4.4.10. Check the calibration of the Hot Wire Power Supply voltage feedback in 2 volt increments starting at 2.0 volts and ending at 14.0 volts to confirm that the feedback is linear. Record the values in Section 5. RECORDS, Table 3, *Voltage Feedback Linearity Check*.
4.4.11. Press the **Contactor** Button on the front of the Hot Wire Supply to disable the output of the Hot Wire Power Supply.
4.4.12. Scroll down and select the "Save and Exit" option at the bottom of the "Voltage Fdbk" Menu by using the **Adjustment** Knob on the front of the Hot Wire Power Supply.
4.4.13. If no other calibrations are to be completed, proceed to step 4.9. Otherwise, continue with the next calibration section.

4.5. Current Feedback Calibration

4.5.1. Select "Current Fdbk" from the menu by scrolling through the menu using the **Adjustment** Knob and then pressing the Adjustment Knob to select this option.
4.5.2. Enter 2.0 Volts into the "Voltage SetPt" value field.
4.5.3. Press the **Contactor** Button on the front of the Hot Wire Supply and monitor the actual current output of the Hot Wire Power Supply using the current shunt that was connected to the output of the Hot Wire Supply.
4.5.4. Adjust the "Voltage SetPt" until the actual measured current on the shunt is approximately 20 amps (2.0 mV).
4.5.5. Check the "Current" readout on the LCD Display on the front of the Hot Wire Power Supply to verify that it reads 20 amps.
4.5.6. If the readout on the LCD Display is incorrect then adjust the "Course Offset" and "Fine Offset" until the display reads 20 amps.[1]
4.5.7. Increase the "Voltage SetPt" until the actual measured current on the shunt is approximately 195 amps (19.5 mV).
4.5.8. If the readout on the LCD Display is incorrect then adjust the "Course Gain" and "Fine Gain" until the display reads 195 amps.[1]
4.5.9. Repeat steps 4.5.2 through 4.5.8 until no adjustment is necessary.
4.5.10. Check the calibration of the Hot Wire Power Supply current feedback in 25 amp increments starting at 20 amps and ending at 195 amps to confirm that the feedback is linear. Record the values in Section 5. RECORDS, Table 4, *Current Feedback Linearity Check*.
4.5.11. Press the **Contactor** Button on the front of the Hot Wire Supply to disable the output of the Hot Wire Power Supply.
4.5.12. Scroll down and select the "Save and Exit" option at the bottom of the "Current Fdbk" Menu by using the **Adjustment** Knob on the front of the Hot Wire Power Supply.

[1] Refer to Appendix A, *Current Shunt Ampere to Millivolt Conversion Chart* for the correct millivolt reading.

4.5.13. If no other calibrations are to be completed, proceed to step 4.9. Otherwise, continue with the next calibration section.

4.6. External Voltage Reference Calibration

> **Note**
> This calibration procedure is only used for Hot Wire Power Supplies that will be connected to an AMET ADVENT System.

4.6.1. Select "External Ref" from the menu by scrolling through the menu using the **Adjustment** Knob and then pressing the Adjustment Knob to select this option.
4.6.2. Connect a 0-10 VDC variable power supply to pins D and E on the 16-pin Amphenol connector on the back of the Hot Wire Power Supply (D=Common; E=Positive).
4.6.3. Make sure that the 0-10 VDC variable power supply is turned off and check the "Voltage" readout on the LCD Display on the front of the Hot Wire Power Supply to verify that it reads 0.0 volts.
4.6.4. If the readout on the LCD Display is incorrect then adjust the "Course Offset" and "Fine Offset" until the display reads 0.0 volts.
4.6.5. Turn the 0-10 VDC variable power supply on and adjust to 10.0 volts.
4.6.6. Check the "Voltage" readout on the LCD Display on the front of the Hot Wire Power Supply to verify that it reads 20.0 volts. (There is a 2:1 ratio for this calibration procedure.)
4.6.7. If the readout on the LCD Display is incorrect then adjust the "Course Gain" and "Fine Gain" until the display reads 20.0 volts.
4.6.8. Repeat steps 4.6.3 to 4.6.7 until no adjustment is needed.
4.6.9. Check the calibration of the Hot Wire Power Supply External Voltage Reference in 1 volt increments starting at 0.0 volts and ending at 10.0 volts to confirm that the feedback is linear. Record the values in Section 5. RECORDS, Table 5, *Voltage Feedback Linearity Check*.
4.6.10. Scroll down and select the "Save and Exit" option at the bottom of the "External Ref" Menu by using the **Adjustment** Knob on the front of the Hot Wire Power Supply.
4.6.11. If no other calibrations are to be completed, proceed to step 4.9. Otherwise, continue with the next calibration section.

4.7. Remote Voltage Feedback Calibration

> **Note**:
> This calibration procedure is only used for Hot Wire Power Supplies that will be connected to an AMET ADVENT System.

4.7.1. Select "Remote VFdbk" from the menu by scrolling through the menu using the **Adjustment** Knob and then pressing the Adjustment Knob to select this option.
4.7.2. Connect a calibrated volt meter to pins H and J on the 16-pin Amphenol connector on the back of the Hot Wire Power Supply (J=Common; H=Positive).
4.7.3. Enter 1.0 Volt into the "Voltage SetPt" value field.
4.7.4. Press the **Contactor** Button on the front of the Hot Wire Supply.
4.7.5. Check the volt meter readout (connected to pins "J" and "H") to verify it reads 0.5 volts. (There is a 2:1 ratio for this calibration procedure.)
4.7.6. If the readout on the voltmeter is incorrect then adjust the "Course Offset" and "Fine Offset" until the voltmeter reads 0.5 volts.
4.7.7. Enter 14.0 Volts into the "Voltage SetPt" value field.
4.7.8. Check the volt meter readout to verify that it reads 7.0 volts.
4.7.9. If the readout on the voltmeter is incorrect then adjust the "Course Gain" and "Fine Gain" until the voltmeter reads 7.0 volts.
4.7.10. Repeat steps 4.7.3 to 4.7.9 until no adjustment is needed.
4.7.11. Check the calibration of the Hot Wire Power Supply External Voltage Feedback in 2 volt increments starting at 2.0 volts and ending at 14.0 volts to confirm that the feedback is linear. Record the values in Section 5. RECORDS, Table 6, *Voltage Feedback Linearity Check*.
4.7.12. Press the **Contactor** Button on the front of the Hot Wire Supply to disable the output of the Hot Wire Power Supply.
4.7.13. Scroll down and select the "Save and Exit" option at the bottom of the "Remote VFdbk" menu by using the **Adjustment** Knob on the front of the Hot Wire Power Supply.
4.7.14. If no other calibrations are to be completed, proceed to step 4.9. Otherwise, continue with the next calibration section.

4.8. Remote Current Feedback Calibration

Note
This calibration procedure is only used for Hot Wire Power Supplies that will be connected to an AMET ADVENT System.

4.8.1. Select "Remote CFdbk" from the menu by scrolling through the menu using the **Adjustment** Knob and then pressing the Adjustment Knob to select this option.
4.8.2. Connect a calibrated volt meter to pins F and G on the 16-pin Amphenol connector on the back of the Hot Wire Power Supply (G=Common; F=Positive).
4.8.3. Enter 2 Volts into the "Voltage SetPt" value field.
4.8.4. Press the **Contactor** Button on the front of the Hot Wire Supply and monitor the actual current output of the Hot Wire Power Supply using the voltmeter connected to the current shunt on the output of the Hot Wire Supply.
4.8.5. Adjust the "Voltage SetPt" until the actual measured current on the shunt is approximately 20 amps (2.0 mV).
4.8.6. Check the volt meter readout to verify that it reads 1 volt. (There is a 20 amps per volt ratio for this calibration procedure.)
4.8.7. If the readout on the voltmeter is incorrect then adjust the "Course Offset" and "Fine Offset" until the voltmeter reads 1.0 volts.
4.8.8. Increase the "Voltage SetPt" until the actual measured current on the shunt is approximately 200 amps (20.0 mV current shunt voltage).
4.8.9. Check the volt meter readout to verify that it reads 10.0 volts.
4.8.10. If the readout on the voltmeter is incorrect then adjust the "Course Gain" and "Fine Gain" until the voltmeter reads 10.0 volts.
4.8.11. Repeat steps 4.8.3 to 4.8.10 until no adjustments are needed.
4.8.12. Check the calibration of the Hot Wire Power Supply External Current Feedback in 20 amp increments starting at 20 amps and ending at 200 amps to confirm that the feedback is linear. Record the values in Section 5. RECORDS, Table 7, *Voltage Feedback Linearity Check*.
4.8.13. Press the **Contactor** Button on the front of the Hot Wire Supply to disable the output of the Hot Wire Power Supply.
4.8.14. Scroll down and select the "Save and Exit" option at the bottom of the "Remote CFdbk" menu by using the **Adjustment** Knob on the front of the Hot Wire Power Supply.
4.8.15. If no other calibrations are to be completed, proceed to step 4.9. Otherwise, continue with the next calibration section.

4.9. Post Calibration Restoration

4.9.1. Once the Hot Wire Power Supply Calibration is complete you will need to perform the following tasks for the Power Supply to operate properly:

4.9.2. Using the **Adjustment** Knob select "PID Control". You will then need to highlight "PID LOOP" and change to the "ON" option.

4.9.3. Cycle power to the Hot Wire Power Supply. This will place the Hot Wire Power Supply back into the correct operation mode.

4.9.4. Attach a copy of the completed calibration to the unit.

5. RECORDS

Technician	Date
Hot Wire Power Supply Serial Number	Current Shunt Serial Number
Digital Voltmeter Serial Number	Digital Voltmeter Serial Number
DC Power Supply	

Table 1
Step 4.2.11 – Frequency Control Linearity Check

Frequency Control Setting (Hz)	Frequency Control Indicated (Hz)	Expected Value (Hz)
50		
100		
150		
200		
250		
300		

Table 2
Step 4.3.12 - Voltage Control Linearity Check

Voltage Control Setting (Volts)	Voltage Control Indicated (Volts)	Expected Value (Volts)
2.0		
4.0		
6.0		
8.0		
10.0		
12.0		
14.0		

Table 3
Step 4.4.10 - Voltage Feedback Linearity Check

Voltage Feedback Setting (Volts)	Voltage Feedback Indicated (Volts)	Expected Value (Volts)
2.0		
4.0		
6.0		
8.0		
10.0		
12.0		
14.0		

Table 4
Step 4.5.10 - Current Feedback Linearity Check

Current Feedback Setting (Amps)	Corresponding Shunt Millivolts	Current Feedback Indicated (Amps)	Expected Value (Amps)
20.0	2.00		18.0 – 22.0
45.0	4.50		43.0 – 47.0
70.0	7.00		68.0 – 72.0
95.0	9.50		93.0 – 97.0
120.0	12.00		118.0 – 122.0
145.0	14.50		143.0 – 147.0
170.0	17.00		168.0 – 172.0
195.0	19.50		193.0 – 197.0

Table 5
Step 4.6.9 - External Voltage Reference Linearity Check

Reference Voltage Setting (Volts)	Indicated Voltage (Volts)	Expected Value (Volts)
0.0		0.0
1.0		2.0
2.0		4.0
3.0		6.0
4.0		8.0
5.0		10.0
6.0		12.0
7.0		14.0
8.0		16.0
9.0		18.0
10.0		20.0

Table 6
Step 4.7.11 - Remote Voltage Feedback Linearity Check

Voltage Set Point Value (Volts)	Voltmeter Reading, Pin H to J (Volts)	Expected Value
2.0		1.0
4.0		2.0
6.0		3.0
8.0		4.0
10.0		5.0
12.0		6.0
14.0		7.0

Table 7
Step 4.8.12 – Remote Current Feedback Linearity Check

Input Set Point Values		**Output Values**	
Shunt Current Setting (Amps)	Corresponding Shunt Millivolts	Voltmeter Reading Pin F to G (Volts)	Expected Value (Volts)
20.0	2.00		1.0
40.0	4.00		2.0
60.0	6.00		3.0
80.0	8.00		4.0
100.0	10.00		5.0
120.0	12.00		6.0
140.0	14.00		7.0
160.0	16.00		8.0
180.0	18.00		9.0
200.0	20.00		10.0

6. DEFINITIONS

None

7. REFERENCES

7.1. *X–HW 200 Hot Wire Power Supply Manual*, SM-[TBD] – DRAFT

8. APPENDIXES

8.1. Appendix A, *Current Shunt Ampere to Millivolt Conversion Chart*
8.2. Appendix B, *X–HW 200 Hot Wire Power Supply Calibration Tables*

Appendix A

Current Shunt Ampere to Millivolt Conversion Chart
(1,000 Ampere, 100 mV DC Shunt)