Acoustic Measurement Plan

Date: 5/27/21 Report No: 2021-32

Factory Test Location: [ ] 21 Great Hollow Dr. [**X**] 71 Heater Rd.

Product Model No: SmartSYNC cartridges

Product Description / Part Numbers: 428925 - Cartridge: SmartSYNC or Adapter 45 A Mechanized Cutting, 428930 - Cartridge: SmartSYNC or Adapter 65 A Mechanized Cutting, 428934 - Cartridge: SmartSYNC or Adapter 85 A Mechanized Cutting and 428936 - Cartridge: SmartSYNC or Adapter 105 A Mechanized Cutting

The system to be measured shall be operated within the parameters recorded in the conditions section of this report and measured for acoustic sound pressure levels to determine reference sound pressure data to report in the instruction manual and/or for internal use per the direction of the project team.

Document any data printouts, engineering notes, photo's, etc., on a separate page and attach to the report.

This measurement plan is primarily based on the Hypertherm ES1380 Instruction for Sound Pressure Level Measurement.

The measurement site shall be free from all equipment, personnel, or objects not directly involved with the measurement as far as practical. A sketch of the measurement site showing equipment, personnel and objects and the position of the microphone relative to the plasma arc shall be provided with the data sheet.

CAUTION: Heat and spatter associated with the arc process may damage the measuring equipment. It is recommended that the microphone be protected by a calibrated windscreen (foam cover over microphone) and the equipment be covered.

Testing Performed by: Todd Doody (Printed) Todd Doody (Signature) Date: 5/27/21

Testing Witness by: _____ (Printed) _____ (Signature) Date: _____

Testing Approved by: Greg Corban (Printed) (Signature) Date: 5/27/21

Acoustic Measurement Procedure and Data

Reference Document: ES1380

1. Complete the test condition section and set-up the equipment accordingly.

2. Set up the sound pressure meter parameters as described in ES1380.

3. Perform a confidence check of the measuring instrument using the external calibration device provided (see ES1380 for instructions). Record the calibration level and calibration factor below:

Calibration Level:	**94.1**	Calibration Factor:	**1.9**

4. For mechanized/machine/robotic torches, position the sound pressure meter at 1 meter (39.4 inches) from the plasma arc, and on a horizontal plane 340 mm (13 1/4" inches) above the plasma arc. For manual/handheld torches, position the sound pressure meter at 0.5 meter (19.7 inches) from the plasma arc, and on a horizontal plane 340 mm (13 1/4" inches) above the plasma arc. All distances will be referenced to the approximate midpoint of the plasma arc.

5. Measure the sound pressure with all equipment operating, but with plasma arc off. This may require relocation or shutting down of some equipment outside the test site. The purpose of this measurement is to determine the noise generated by the equipment which is essential to the arc process and which cannot be readily placed in a position remote to the test site. Measurement time is 1 minute. Record the measurement and attach the printout to this report, mark the printout as sound pressure measurement with no arc (see ES1380 for record storage and printout instructions).

6. Measure the sound pressure with the equipment operating under the conditions described in the test condition section. Measurement time is 1 minute. Start the sound pressure meter first then start the operating condition. Record the measurement and attach the printout to this report. Mark the printout as sound pressure measurement in operating condition and note the microphone position (see ES1380 for record storage and printout instructions).

7. Reposition the sound pressure meter 90^{o} from the original measurement position where possible. Repeat item 6.

8. Reposition the sound pressure meter 270^{o} from the original measurement position where possible. Repeat item 6.

9. For mechanized/machine/robotic torches, where the operator station is known to be closer than 1 meter, take additional measurements at locations that best simulate actual operator positions at 1.2 meters (47.2 inches) from the ground for seated operators and at 1.5 meters (59.0 inches) from the ground for standing operators. Repeat item 6.

10. Where feasible continue to repeat measurements, in any direction from the plasma arc, until no hazard exits; thereby determining the safe zone without noise protection.

    10a. At 2 meters. Repeat item 6 to determine if hazard exits.
    10b. At 3 meters. Repeat item 6 to determine if hazard exits.
    10c. At 5 meters. Repeat item 6 to determine if hazard exits.

11. Following the measurements perform a confidence check. Record the calibration level and calibration factor below:

Calibration Level:	**94.1**	Calibration Factor:	**1.9**

Test Condition: 45A

Torch Part Number:	**059599**	Power Source Model Name:	**PMX105 SYNC 200-600V CSA POWER SUPPLY**	Power Source Part Number:	**059641**
Maximum Current :	**105A**	Minimum Current :	**30A**	Arc Voltage at Maximum Amps:	**160VDC rated**
Work Piece Material:	**Mild steel**	Work Piece Thickness:	**¼"**	Arc Voltage at Minimum Amps:	**NA**
Operating Condition:	☐ Piercing ☐ Gouging ☒ Cutting ☐ Bevel Cutting ☐ Marking				
Table Parameters:	☐ Dry ☒ Wet Water Level (above/below work piece) inches:				**6" above**
Plasma Gas:	**Air**	Shield Gas:	**Air**	Cut Flow Pres.(psi) (Plasma/Shield):	**65**
Cartridge P/N:	428925				
Cut Speed IPM:	**12**	Torch Height:	**1/8"**	Cut Coupon:	**Strip cut**
Other Parameters:	**Measured arc volts at 45A was 154VDC**				

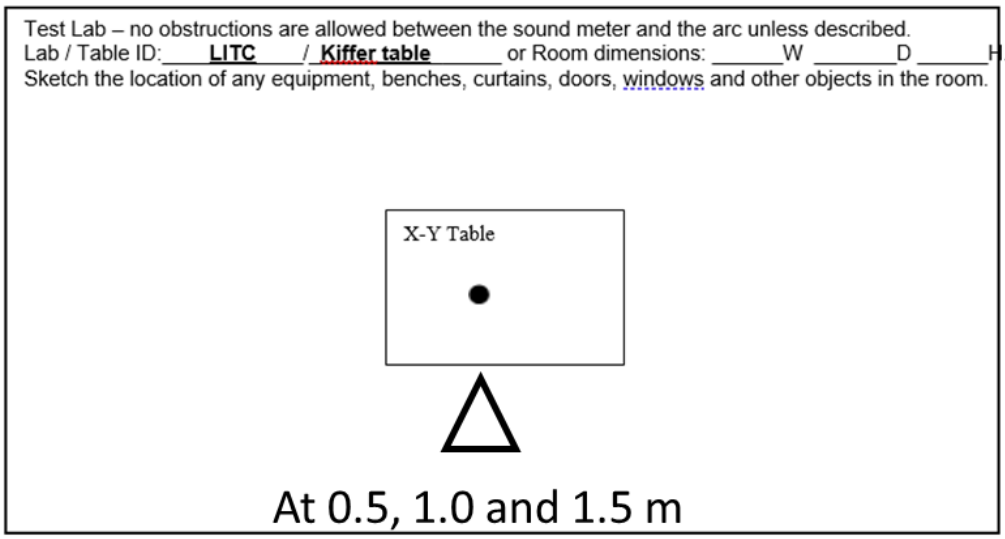
***Same setup for all acoustic measurements**

Sketch Keys

● Arc location at start

▷ Sound Meter

Identify all sound meter positions where measurements were performed and mark each location with the step used as described in the procedure and show the ID in summary table below.



Summary of Measurements 45A

Sound Meter Position ID:	**0.5 m ambient**	**0.5 m 45A cutting**	**1.0 m 45A cutting**	**1.5 m 45A cutting**
Max Peak dB:	**97.2**	**112.7**	**102.4**	**100.8**
LAV5 dB:	**72.5**	**97.3**	**89.3**	**86.8**

Test Condition: 65A

Torch Part Number:	**059599**	Power Source Model Name:	**PMX105 SYNC 200-600V CSA POWER SUPPLY**	Power Source Part Number:	**059641**
Maximum Current :	**105A**	Minimum Current :	**30A**	Arc Voltage at Maximum Amps:	**160VDC rated**
Work Piece Material:	**Mild steel**	Work Piece Thickness:	**½"**	Arc Voltage at Minimum Amps:	**NA**
Operating Condition:	☐ Piercing	☐ Gouging	☒ Cutting	☐ Bevel Cutting	☐ Marking
Table Parameters:	☐ Dry ☒ Wet	Water Level (above/below work piece) inches:			**6" above**
Plasma Gas:	**Air**	Shield Gas:	**Air**	Cut Flow Pres.(psi) (Plasma/Shield):	**68**
Cartridge P/N:	428930				
Cut Speed IPM:	**12**	Torch Height:	**1/8"**	Cut Coupon:	**Strip cut**
Other Parameters:	**Measured arc volts at 65A was 153VDC**				

Summary of Measurements 65A

Sound Meter Position ID:	**0.5 m 65A cutting**	**1.0 m 65A cutting**	**1.5 m 65A cutting**
Max Peak dB:	**115.9**	**106.6**	**104.0**
LAV5 dB:	**101.4**	**93.8**	**91.4**

Test Condition: 85A

Torch Part Number:	**059599**	Power Source Model Name:	**PMX105 SYNC 200-600V CSA POWER SUPPLY**	Power Source Part Number:	**059641**
Maximum Current :	**105A**	Minimum Current :	**30A**	Arc Voltage at Maximum Amps:	**160VDC rated**
Work Piece Material:	**Mild steel**	Work Piece Thickness:	**½"**	Arc Voltage at Minimum Amps:	**NA**
Operating Condition:	☐ Piercing ☐ Gouging ☒ Cutting ☐ Bevel Cutting ☐ Marking				
Table Parameters:	☐ Dry ☒ Wet Water Level (above/below work piece) inches:				**6" above**
Plasma Gas:	**Air**	Shield Gas:	**Air**	Cut Flow Pres.(psi) (Plasma/Shield):	**67**
Cartridge P/N:	428934				
Cut Speed IPM:	**12**	Torch Height:	**1/8"**	Cut Coupon:	**Strip cut**
Other Parameters:	**Measured arc volts at 85A was 154VDC**				

Summary of Measurements 85A

Sound Meter Position ID:	**0.5 m 85A cutting**	**1.0 m 85A cutting**	**1.5 m 85A cutting**
Max Peak dB:	**116.4**	**109.2**	**106.6**
LAV5 dB:	**101.4**	**95.9**	**92.8**

Test Condition: 105A

Torch Part Number:	**059599**	Power Source Model Name:	**PMX105 SYNC 200-600V CSA POWER SUPPLY**	Power Source Part Number:	**059641**
Maximum Current :	**105A**	Minimum Current :	**30A**	Arc Voltage at Maximum Amps:	**160VDC rated**
Work Piece Material:	**Mild steel**	Work Piece Thickness:	**½"**	Arc Voltage at Minimum Amps:	**NA**
Operating Condition:	☐ Piercing	☐ Gouging	☒ Cutting	☐ Bevel Cutting	☐ Marking
Table Parameters:	☐ Dry ☒ Wet	Water Level (above/below work piece) inches:			**6" above**
Plasma Gas:	**Air**	Shield Gas:	**Air**	Cut Flow Pres.(psi) (Plasma/Shield):	**72**
Cartridge P/N:	428936				
Cut Speed IPM:	**12**	Torch Height:	**1/8"**	Cut Coupon:	**Strip cut**
Other Parameters:	**Measured arc volts at 105A was 167VDC**				

Summary of Measurements 105A

Sound Meter Position ID:	**0.5 m 105A cutting**	**1.0 m 105A cutting**	**1.5 m 105A cutting**
Max Peak dB:	**117.1**	**111.2**	**109.7**
LAV5 dB:	**103.7**	**97.5**	**94.9**

Comments: One of each amperage mechanized cutting cartridges used. Cut mode has higher output pressure settings which results in higher noise. Used a 105CSA, serial number 105-B1-21, for all cartridges as it can cut at each amperage. See following attachments for test setup and raw data.

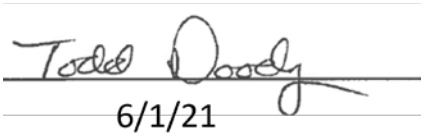
Test Technician: Todd Doody Date: 5/27/2021

Equipment Used:

Asset# 00447, Bruel & Kjaer Type 2236 Sound Meter – Calibrated on 8/13/20 and due calibration on 8/31/21
Asset# 00448, Bruel & Kjaer Type 4231 Acoustical Calibrator - Calibrated on 8/24/20 and due calibration on 8/31/21
Asset# 02555, Fluke 286 Multimeter - Calibrated on 7/30/20 and due calibration on 7/31/21

Test setup

Raw test data



Bruel & Kjaer
SLM Type 2236

SETTINGS:

S 60-140 dB
RMS: A Peak: C
Ambient at 0.5 meters
----
27 May 2021 09:18:17
Elapsed Time 0000:01:01
Pauses 0
Overload 0.0 %

MaxP 97.2 dB
MaxL 73.3 dB
MinL 72.0 dB

Lav5 72.5 dB
SEL N.A. dB
LEPd (Te= 0h01) N.A. dB

L10 72.5 dB
L50 72.5 dB
L90 72.0 dB

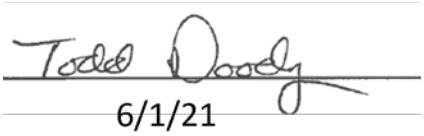
Bruel & Kjaer
SLM Type 2236

SETTINGS:

S 60-140 dB
RMS: A Peak: C
45A cartridge at 0.5 meters
----
27 May 2021 09:21:20
Elapsed Time 0000:01:03
Pauses 0
Overload 0.0 %

MaxP 112.7 dB
MaxL 100.9 dB
MinL 95.4 dB

Lav5 97.3 dB
SEL N.A. dB
LEPd (Te= 0h01) N.A. dB



L10 99.5 dB
L50 96.5 dB
L90 95.5 dB

Bruel & Kjaer
SLM Type 2236

SETTINGS:

S 60-140 dB
RMS: A Peak: C
45A cartridge at 1.0 meter
----
27 May 2021 09:23:37
Elapsed Time 0000:01:02
Pauses 0
Overload 0.0 %

MaxP 102.4 dB
MaxL 92.1 dB
MinL 87.5 dB

Lav5 89.3 dB
SEL N.A. dB
LEPd (Te= 0h01) N.A. dB

L10 90.5 dB
L50 89.0 dB
L90 88.0 dB

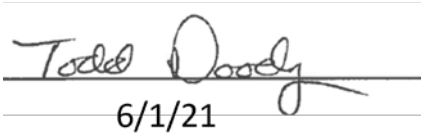
Bruel & Kjaer
SLM Type 2236

SETTINGS:

S 60-140 dB
RMS: A Peak: C
45A cartridge at 1.5 meters
----
27 May 2021 09:25:29
Elapsed Time 0000:01:01
Pauses 0
Overload 0.0 %

MaxP 100.8 dB
MaxL 89.3 dB
MinL 85.9 dB

Lav5 86.8 dB
SEL N.A. dB
LEPd (Te= 0h01) N.A. dB



L10 88.0 dB
L50 86.5 dB
L90 86.0 dB

Bruel & Kjaer
SLM Type 2236

SETTINGS:

S 60-140 dB
RMS: A Peak: C
65A cartridge at 0.5 meters
----
27 May 2021 09:33:15
Elapsed Time 0000:01:01
Pauses 0
Overload 0.0 %

MaxP 115.9 dB
MaxL 105.6 dB
MinL 99.7 dB

Lav5 101.4 dB
SEL N.A. dB
LEPd (Te= 0h01) N.A. dB

L10 103.0 dB
L50 100.5 dB
L90 100.0 dB

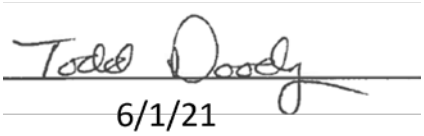
Bruel & Kjaer
SLM Type 2236

SETTINGS:

S 60-140 dB
RMS: A Peak: C
65A cartridge at 1.0 meter
----
27 May 2021 09:35:12
Elapsed Time 0000:01:01
Pauses 0
Overload 0.0 %

MaxP 106.6 dB
MaxL 96.6 dB
MinL 92.5 dB

Lav5 93.8 dB
SEL N.A. dB



LEPd (Te= 0h01) N.A. dB

L10 95.0 dB
L50 93.0 dB
L90 92.5 dB

Bruel & Kjaer
SLM Type 2236

SETTINGS:

S 60-140 dB
RMS: A Peak: C
65A cartridge at 1.5 meters
----
27 May 2021 09:37:24
Elapsed Time 0000:01:01
Pauses 0
Overload 0.0 %

MaxP 104.0 dB
MaxL 93.5 dB
MinL 90.5 dB

Lav5 91.4 dB
SEL N.A. dB
LEPd (Te= 0h01) N.A. dB

L10 92.0 dB
L50 91.0 dB
L90 90.5 dB

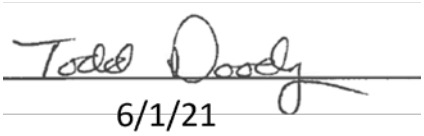
Bruel & Kjaer
SLM Type 2236

SETTINGS:

S 60-140 dB
RMS: A Peak: C
85A cartridge at 0.5 meters
----
27 May 2021 09:41:15
Elapsed Time 0000:01:01
Pauses 0
Overload 0.0 %

MaxP 116.4 dB
MaxL 105.1 dB
MinL 99.6 dB

Lav5 101.4 dB



SEL N.A. dB
LEPd (Te= 0h01) N.A. dB

L10 103.0 dB
L50 101.0 dB
L90 100.0 dB

Bruel & Kjaer
SLM Type 2236

SETTINGS:

S 60-140 dB
RMS: A Peak: C
85A cartridge at 1.0 meter
----
27 May 2021 09:46:13
Elapsed Time 0000:01:01
Pauses 0
Overload 0.0 %

MaxP 109.2 dB
MaxL 99.4 dB
MinL 94.5 dB

Lav5 95.9 dB
SEL N.A. dB
LEPd (Te= 0h01) N.A. dB

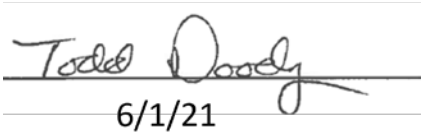
L10 97.5 dB
L50 95.5 dB
L90 95.0 dB

Bruel & Kjaer
SLM Type 2236

SETTINGS:

S 60-140 dB
RMS: A Peak: C
85A cartridge at 1.5 meters
----
27 May 2021 10:25:30
Elapsed Time 0000:01:01
Pauses 0
Overload 0.0 %

MaxP 106.6 dB
MaxL 94.9 dB
MinL 85.1 dB



Lav5 92.8 dB
SEL N.A. dB
LEPd (Te= 0h01) N.A. dB

L10 93.5 dB
L50 92.5 dB
L90 92.0 dB

Bruel & Kjaer
SLM Type 2236

SETTINGS:

S 60-140 dB
RMS: A Peak: C
105A cartridge at 0.5 meters
----
27 May 2021 10:28:27
Elapsed Time 0000:01:01
Pauses 0
Overload 0.0 %

MaxP 117.1 dB
MaxL 107.2 dB
MinL 101.5 dB

Lav5 103.7 dB
SEL N.A. dB
LEPd (Te= 0h01) N.A. dB

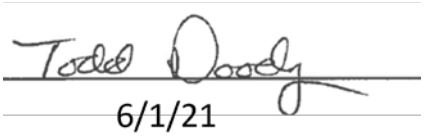
L10 105.0 dB
L50 103.0 dB
L90 102.0 dB

Bruel & Kjaer
SLM Type 2236

SETTINGS:

S 60-140 dB
RMS: A Peak: C
105A cartridge at 1.0 meter
----
27 May 2021 10:30:47
Elapsed Time 0000:01:02
Pauses 0
Overload 0.0 %

MaxP 111.2 dB
MaxL 100.5 dB
MinL 69.9 dB



Lav5 97.5 dB
SEL N.A. dB
LEPd (Te= 0h01) N.A. dB

L10 98.0 dB
L50 97.0 dB
L90 96.5 dB

Bruel & Kjaer
SLM Type 2236

SETTINGS:

S 60-140 dB
RMS: A Peak: C
105A cartridge at 1.5 meters
----
27 May 2021 10:33:00
Elapsed Time 0000:01:01
Pauses 0
Overload 0.0 %

MaxP 109.7 dB
MaxL 97.7 dB
MinL 72.6 dB

Lav5 94.9 dB
SEL N.A. dB
LEPd (Te= 0h01) N.A. dB

L10 95.5 dB
L50 94.5 dB
L90 94.0 dB