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COVANTA
Powering Today. Protecting Tomorrow.

August 31, 2023

Ms. Julia DeGagne
Air Toxics Project Manager
Oregon Department of Environmental Quality
700 NE Multnomah Street, Suite 600
Portland, OR 97232
julia.degagne@deq.oregon.gov

RE: Covanta Marion, Inc. – Revised Cleaner Air Oregon Emissions Inventory Submittal

Dear Julia DeGagne:

Covanta Marion, Inc. (Covanta) is pleased to submit the revised Cleaner Air Oregon (CAO) Emission Inventory for its Brooks, Oregon facility in response to the Oregon Department of Environmental Quality (DEQ) request dated July 28, 2023. With this letter, Covanta is submitting the enclosed revised CAO Emissions Inventory Form and associated documents to comply with the requirement to submit an emissions inventory pursuant to Oregon Administrative Rule (OAR) 340-245-0030.

The enclosed inventory form and supporting documentation was prepared using best engineering estimates, process knowledge, source test data, and/or published emission factors for toxic air contaminants (TAC) listed in OAR 340-247-8010, Table 1. Covanta reserves the right to update the enclosed documentation upon obtaining updated and/or additional emissions or facility operating data.

RESPONSE TO SPECIFIC COMMENTS FROM OREGON DEQ

Per the request of Oregon DEQ in the letter dated July 28, 2023, Covanta has included the following revisions to its Emission Inventory submittal:

1. Revised welding emissions workbook to include the following:
    a. Designation of the following Toxic Emission Units (TEUs) in the emission calculations and AQ520 Form:
        i. WELD-OUTDOOR: Outdoor welding
        ii. WELD-BOILER: Inside-boiler welding
        iii. WELD-MAINTENANCE: Maintenance shop welding
        iv. WELD-BB: Boiler building welding (outside the boiler)
    b. Emission factor calculations to include all TACs present in the welding material safety data sheets (SDS);

c. Revised previously used default welding emission factors as listed in the San Diego County Air Pollution Control District (SDAPCD) database to be reflective of the TAC composition as listed in the SDS, where appropriate;[1]
d. Updated emission control efficiencies to the following values:
    i. Ninety-nine percent for baghouse that controls welding emissions generated within the boiler;
    ii. Thirty-five percent for the ROBOVENT MERV 15 filter that controls welding emissions generated in the maintenance shop (manufacturer specifications for the MERV 15 filter has also been included with this submittal in Attachment 1);
    iii. Zero percent for welding emissions generated within the boiler building.
e. Annual requested potential to emit (PTE) usage and maximum daily usage for each welding material and associated usage location (i.e., boiler building, maintenance shop, inside the boiler building and outside the boiler building). Annual usage is equivalent to the most representative recent years' purchasing data, while daily usages were determined based on the following:
    i. For emissions generated within the boiler, 30 days of plant outage, as emissions generated within the boiler would only occur during plant outages;
    ii. For emissions generated from all other welding activities, 200 days, as emissions generated will potentially occur 10 hours a day, 4 days a week for 50 weeks throughout the year. It should be noted that these welding activities occur on an as-needed basis.
f. Usages and emissions from the following materials:
    i. ER80S-B2;
    ii. 90SB-3;
    iii. MG289 (this is the product used and its SDS is included; it is used in welding and not in soldering nor in brazing);
    iv. Lincoln Electric Techrod 112;
    v. Radnor Carbon Arc electrodes;
    vi. Note that usages and associated emissions from Lincoln Electric Fleetweld 35 and ESAB Stoody 77 are not included because Covanta does not have recent purchase records for these materials and has no plans to use these materials.
g. A Level 1 Risk Assessment for emissions from welding operations, demonstrating that risk is below the Aggregate TEU Risk Action Level (RAL) for each exposure type and averaging period and justifying that welding activities shall be classified as an Exempt TEU. This Level 1 Risk Assessment is provided electronically in the Attachment 1. Supplemental Welding Data 2023-0901.xlsx workbook.

2. Maximum projected annual usage of maintenance materials and associated TAC compositions, justifying that all maintenance materials are below the chemical thresholds as listed in the Oregon DEQ document, "Cleaner Air Oregon Exempt TEU Reporting", justifying that usages and associated emissions are an Exempt TEU. To determine projected annual usage, Covanta reviewed purchasing records from 2020, 2021 and 2022. For each material containing TACs, the maximum purchase value across the three years was multiplied by a safety factor of 2, however Covanta anticipates minimal fluctuations in usages of these materials year over year. It should be noted that even with a safety factor of 10, material usages and associated TAC emissions would still be below chemical thresholds as listed in the Oregon DEQ document, "Cleaner Air Oregon Exempt TEU Reporting".

[1] Per meeting with Julia DeGagne on August 15, 2023, if the default welding emission factor is listed in units of lbs/lbs of welding material and does not specify a weight percent used to arrive at the emission factor, then the default factor shall not be adjusted to account for TAC composition as listed in the SDS.

3. Inclusion of a safety factor of 100 for potential xylene (mixture) (CASRN 1330-20-7) for TEUs MWC-1 and MWC-2, for consistency with other reported TACs.
4. Removal of 1,2,4-trichlorobenzene emission factor of 0.00808 pounds per hour to avoid double counting of emissions from TEUs MWC-1 and MWC-2.
5. Removal of 21 line items in the AQ520 for pollutants that are not listed TACs in OAR 340-247-8010 Table 1.
6. Addition of Exempt TEU IDs to Tab 2 in the AQ520 Form, for the following activities:
    a. Lime storage
    b. Carbon storage
    c. Cooling towers
    d. Brazing
    e. Ammonia storage
    f. Welding operations (as justified in the provided documentation for this submittal)

Enclosed Documentation

Enclosed with this cover letter is the revised CAO AQ520 form (Attachment 4) detailing actual and potential emissions from all significant TEUs.

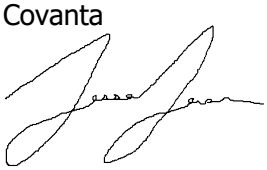
Additionally, Covanta has provided the following documentation to support the presented emission rates and the additional information requested by Oregon DEQ:

- Supplemental information for welding usage data and associated emissions, and Level 1 Risk Assessment (Attachment 1)
- Supplemental information for routine chemical usage data (Attachment 2)
- Revised supporting emission calculations in Excel format (Attachment 3)

We look forward to continuing to work with you and your team as we advance toward development of a HRA for Covanta after EI is approved. Please let me know if you have any questions.

Sincerely,

Covanta



Jesse Jensen
Area Manager 1 - West

Cc: Michael Eisele, Oregon DEQ
Brian Kent, Covanta Marion Inc.
Terry Coble, Covanta Marion Inc.
Joseph Walsh, Covanta Marion Inc.
Jeffrey Hahn, Covanta Consultant
Jesse Gonzalez, Trinity Consultants
Josh Haar, Trinity Consultants

Attachments

Attachment 1

Supplemental Information for Welding Usage Data

File is being provided electronically as "Attachment 1. Supplemental Welding Data 2023-0901.xlsx". Please note that the Level 1 Risk Assessment which justifies welding activities as Exempt TEUs is included with this attachment.

VENTBOSS® by RoboVent®

SPEC GUIDE

EFFECTIVE 07/01/2015

VENTBOSS®

TABLE OF CONTENTS

VENTBOSS®

PRODUCT/APPLICATION MATRIX

- ● Suited for application
- Ⓒ Collector ducted to hood above robot cell
- Ⓓ Collector integrated with ductwork to hoods or fume arms. Spark arrestance option recommended.
- Ⓛ Light duty / smaller applications.
- Ⓞ Option available.
- Ⓡ Recommended solution. Minimal install. Rapid implementation.
- Ⓣ Collector ducted to cutting table. Spark arrestance option recommended.

FULLY WELDED STEEL CONSTRUCTION

	MODEL	PAGE NUMBER	MANUAL WELDING	ROBOTIC WELDING	WELD SCHOOL/ TRAINING	GRINDING	GENERAL/AMBIENT AIR CLEANING	PLASMA CUTTING TABLE	PORTABLE UNIT	WELD TABLE W/EXTRACTION
PORTABLES	S110	5	●		●				●	
	S111	5	●		●				●	
	S112	6	●		●				●	
	S120	7	●		●				●	
	S121	8	●		●				●	
	S122	9	●		●	●			●	●
	S123	7	●		●				●	
	S124	8	●		●				●	
	S130	10	Ⓛ						●	
WORK STATIONS	S210	11	●		●	●			Ⓞ	●
	S211	12	●		●	●			Ⓞ	●
	S212	13	●		●	●			Ⓞ	●
	S220	14	●		Ⓡ	●				●
SPACE SAVER UNITS	S310	15	●	Ⓛ	●					
	S311	15	●	Ⓛ	●					
	S312	16	●	Ⓛ	●					
	S313	16	●	Ⓛ	●					
	S314	17	●	Ⓛ	●					
	S315	18	●	Ⓛ	●					
	S316	18	●	Ⓛ	●					
	S317	19	●	Ⓛ	●					
	S318	19	●	Ⓛ	●					
	S319	20	●	Ⓛ	●					
	S320	21	●		●					
	S321	22	●		●					
	S350	23	●	Ⓛ	●	●		Ⓣ		
COLLECTORS	S410	24	Ⓓ	Ⓒ	Ⓓ	Ⓓ		Ⓣ		
	S411	25	Ⓓ	Ⓒ	Ⓓ	Ⓓ		Ⓣ		
	S412	26	Ⓓ	Ⓒ	Ⓓ	Ⓓ		Ⓣ		
	S413	27	Ⓓ	Ⓒ	Ⓓ	Ⓓ		Ⓣ		
	S414	28	Ⓓ	Ⓒ	Ⓓ	Ⓓ		Ⓣ		
	S415	29	Ⓓ	Ⓒ	Ⓓ	Ⓓ				
	S610	29	Ⓡ		●		Ⓡ			
	S620	30	●		●					
HI-VAC	S710	31	●		●				●	
	S720	32	●	Ⓡ	●					
	S730	33	●	●	●					
	S740	34	●	●	●					

MODEL
S110/S111

1 25 Maximum filter life will be achieved with this product when one welder is welding up to 25 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 750 CFM @ 4.5 in.W.G.

Motor: 0.75 HP, Direct Drive

Voltage: Single phase, 110V, 50/60Hz

Full Load Amps: 13.8

Blower: Reverse inclined high performance blower wheel

Sound Level: 67 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 36" x 20" x 39"

Weight: 445 lbs.

Filter Cartridge: (1) VB-18D16-13

Filter Media Area: 203 sq.ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: Filter manual blow-out port

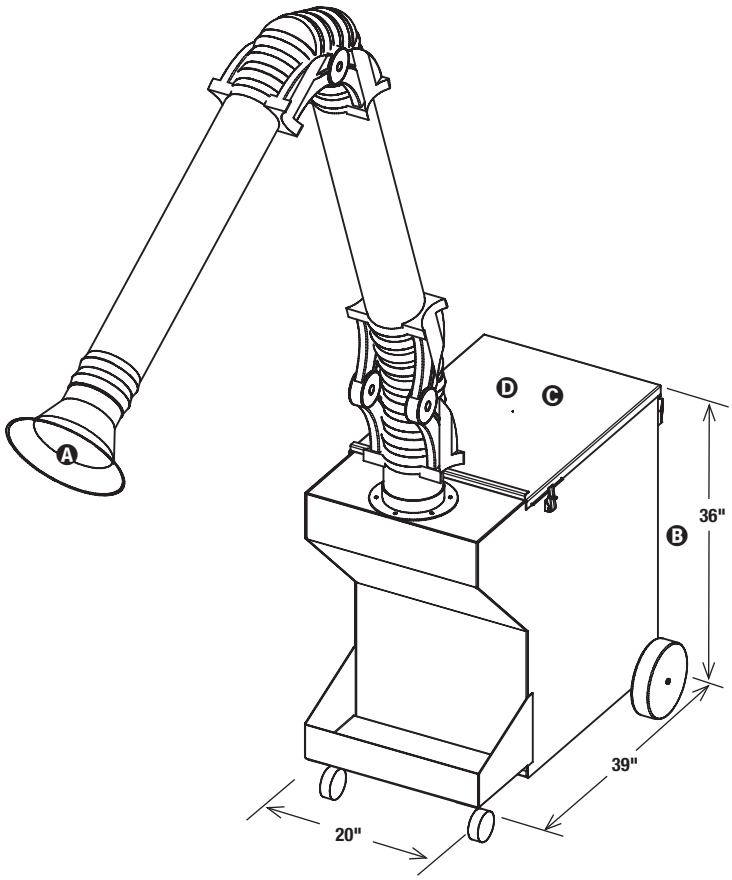
Dust Containment: Vacuum / sweep out filter plenum

Spark Arrestance: (1) Metal Mesh Screen MM-16202

Configurations:
- **S110:** (1) 6" Diameter, 10' long Steel FumeArm
- **S111:** (1) 6" Diameter, 14' long Steel FumeArm

Options:
- 6" FumeArm Light Kit — VB-HD-6LK
- Weld Arc Sensor & Timer Module — VB-LST-2
- Weld Current Sensor & Timer Module — VB-CST-2 (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Filter & Frame : HP-S110 (required for attachment)
- HEPA Replacement Filter: HP-S110-HF (Note: HEPA filter reduces airflow by approximately 10%)

Warranty:
Visit **ventboss.com/terms** for full warranty details.



Ⓐ Inlet Area
Ⓑ Clean Air Exhaust (on back of unit)
Ⓒ Filter Access Door
Ⓓ Motor/Blower Access

MODEL
S112

1 25

Maximum filter life will be achieved with this product when one welder is welding up to 25 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 750 CFM @ 4.5 in.W.G.

Motor: 0.75 HP, Direct Drive

Voltage: Single phase, 110V, 50/60Hz

Full Load Amps: 13.8

Blower: Reverse inclined high performance blower wheel

Sound Level: 67 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 36" x 20" x 39"

Weight: 420 lbs.

Filter Cartridge: (1) VB-18D16-13

Filter Media Area: 203 sq.ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: Filter manual blow-out port

Dust Containment: Vacuum / sweep out filter plenum

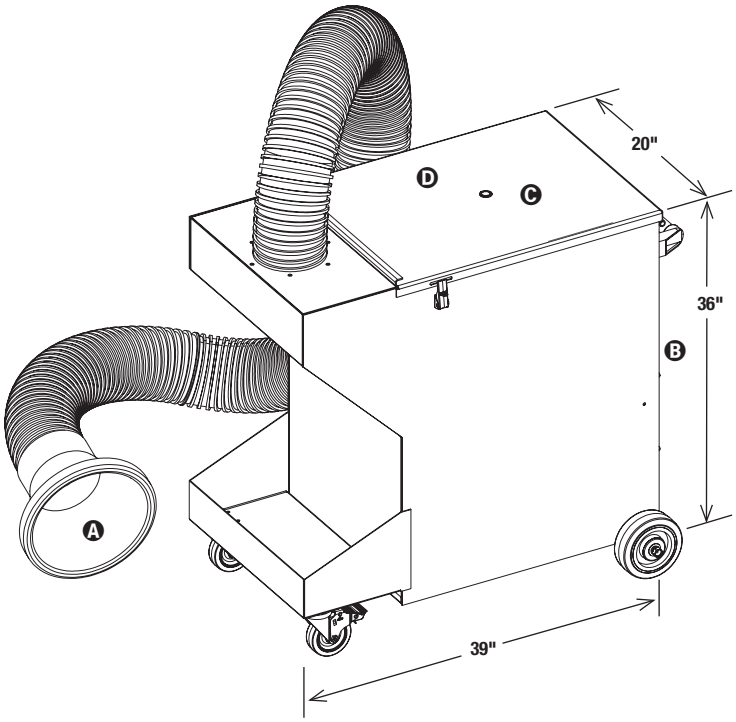
Spark Arrestance: (1) Metal Mesh Screen MM-16202

Configuration: (1) 6" Diameter, 12' long FlexHose and Hood with Magnetic Base

Options:

- 6" FumeArm Light Kit — VB-HD-6LK
- Weld Arc Sensor & Timer Module — VB-LST-2
- Weld Current Sensor & Timer Module — VB-CST-2 (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Filter & Frame : HP-S110 (required for attachment)
- HEPA Replacement Filter: HP-S110-HF (Note: HEPA filter reduces airflow by approximately 10%)

Warranty:
Visit **ventboss.com/terms** for full warranty details.



Ⓐ Inlet Area
Ⓑ Clean Air Exhaust (on back of unit)
Ⓒ Filter Access Door
Ⓓ Motor/Blower Access

MODEL
S120/S123

1 50

Maximum filter life will be achieved with this product when one welder is welding up to 50 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 1200 CFM @ 4.5 in.W.G.

Motor: 1.5 HP, Direct Drive

Voltage: Single phase, 110V, 60Hz

Full Load Amps: 20.0

Blower: Reverse inclined high performance blower wheel

Sound Level: 70 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 53" x 23" x 31"

Weight: 440 lbs.

Filter Cartridge: (1) VB-14D26-13-SF

Filter Media Area: 256 sq.ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 1/4"NPT compressed air connection

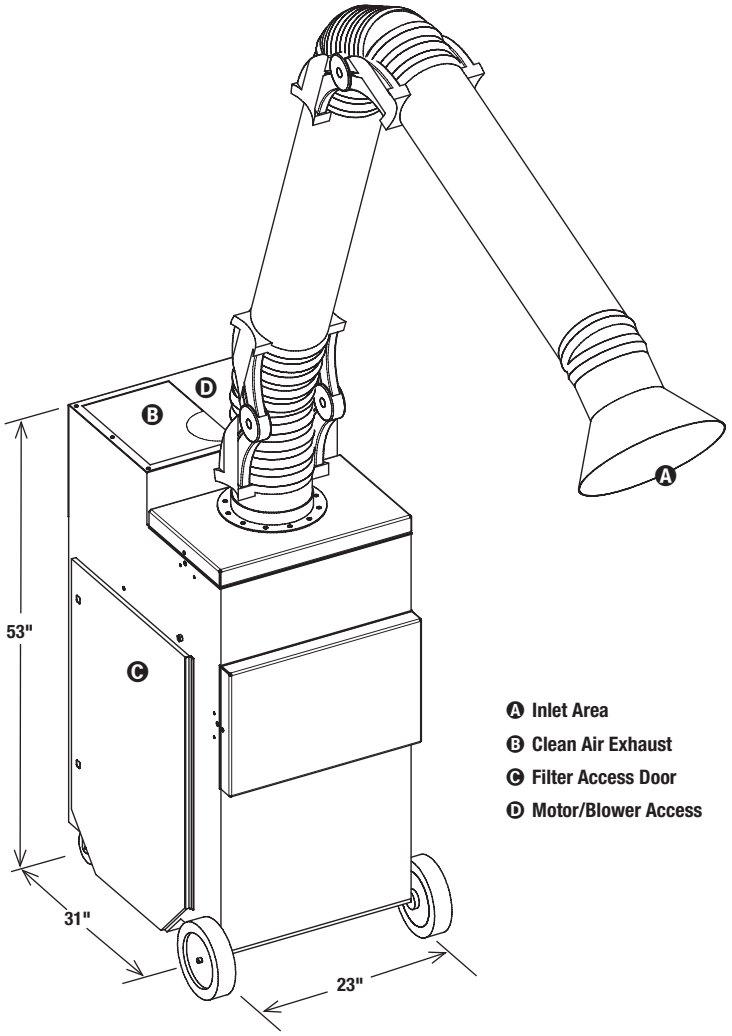
Dust Containment: Lift-out Dust Tray

Spark Arrestance: (1) Metal Mesh Screen MM-20242

Configurations:
- **S120:** (1) 8" Diameter, 10' long FumeArm
- **S123:** (1) 8" Diameter, 14' long FumeArm

Options:
- 8" FumeArm Light Kit — VB-HD-8LK
- Weld Arc Sensor & Timer Module — VB-LST-2
- Weld Current Sensor & Timer Module — VB-CST-2 (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Filter & Frame : HP-S120 (required for attachment)
- HEPA Replacement Filter: HP-S120-HF (Note: HEPA filter reduces airflow by approximately 10%)

Warranty:
Visit **ventboss.com/terms** for full warranty details.



A Inlet Area
B Clean Air Exhaust
C Filter Access Door
D Motor/Blower Access

MODEL
S121/S124

2 50

Maximum filter life will be achieved with this product when one or two welders are welding up to 50 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 1200 CFM @ 4.5 in.W.G.

Motor: 1.5 HP, Direct Drive

Voltage: Single phase, 110V, 60Hz

Full Load Amps: 20.0

Blower: Reverse inclined high performance blower wheel

Sound Level: 70 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 53" x 23" x 31"

Weight: 440 lbs.

Filter Cartridge: (1) VB-14D26-13-SF

Filter Media Area: 256 sq.ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 1/4"NPT compressed air connection

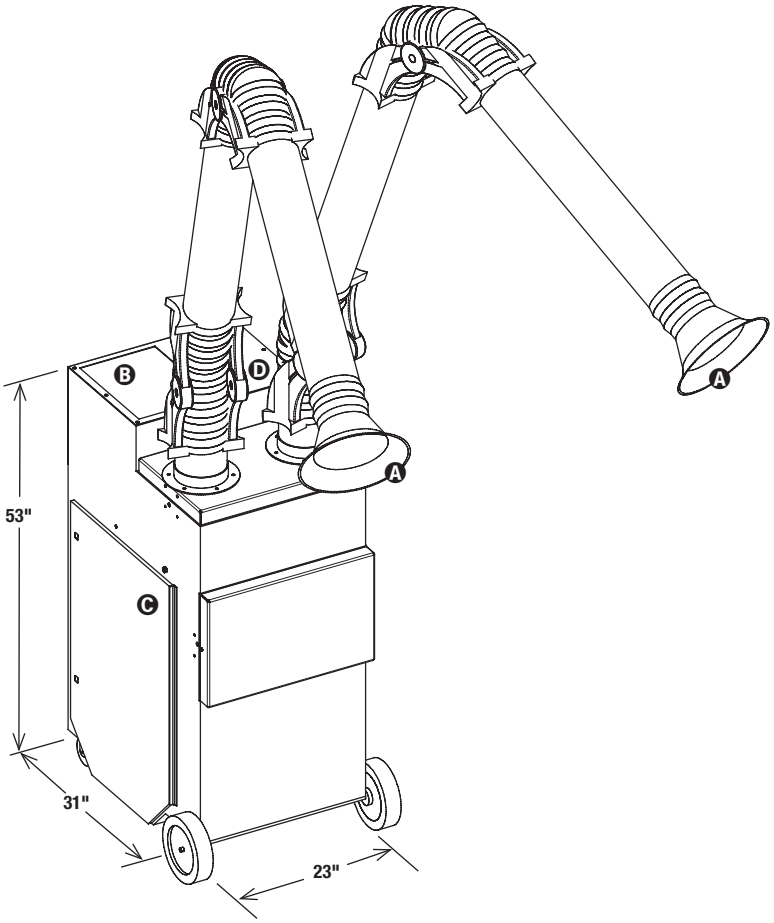
Dust Containment: Lift-out Dust Tray

Spark Arrestance: (1) Metal Mesh Screen MM-20242

Configurations:
- **S121:** (2) 6" Diameter, 10' long FumeArm
- **S124:** (2) 6" Diameter, 14' long FumeArm

Options:
- 6" FumeArm Light Kit — VB-HD-6LK
- Weld Arc Sensor & Timer Module — VB-LST-2
- Weld Current Sensor & Timer Module — VB-CST-2 (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Filter & Frame : HP-S120 (required for attachment)
- HEPA Replacement Filter: HP-S120-HF (Note: HEPA filter reduces airflow by approximately 10%)

Warranty:
Visit **ventboss.com/terms** for full warranty details.



Ⓐ Inlet Area

Ⓑ Clean Air Exhaust

Ⓒ Filter Access Door

Ⓓ Motor/Blower Access

MODEL
S122

1 50

Maximum filter life will be achieved with this product when one welder is welding up to 50 pounds of weld wire per week or grinding small weldments

FULLY WELDED STEEL CONSTRUCTION

Capacity: 1200 CFM @ 4.5 in.W.G.

Motor: 1.5 HP, Direct Drive

Voltage: Single phase, 110V, 60Hz

Full Load Amps: 20.0

Blower: Reverse inclined high performance blower wheel

Sound Level: 70 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 53" x 23" x 31"

Weight: 440 lbs.

Filter Cartridge: (1) VB-14D26-13-SF

Filter Media Area: 256 sq.ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 1/4"NPT compressed air connection

Dust Containment: Lift-out Dust Tray

Spark Arrestance: (1) Metal Mesh Screen MM-20242

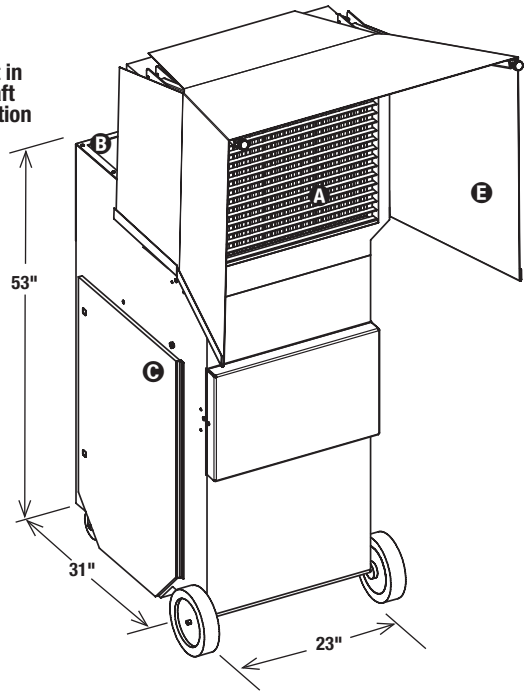
Configuration: (1) FlexDraft Attachment (Backdraft or Downdraft)

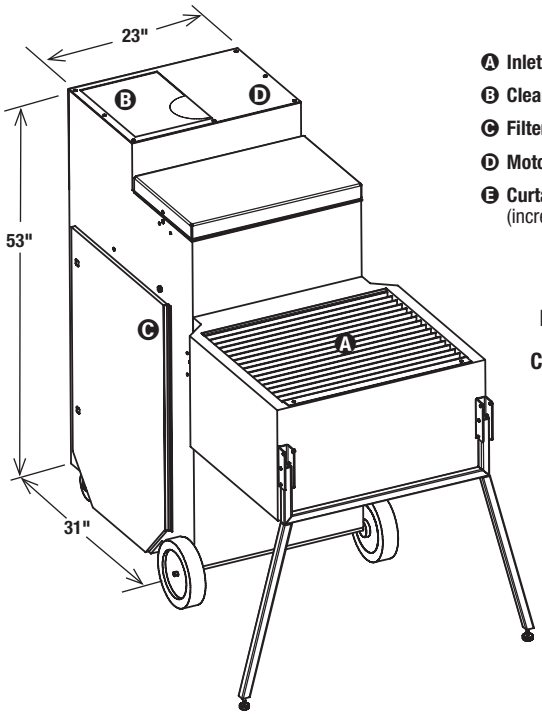
Options:

- Weld Arc Sensor & Timer Module — VB-LST-2
- Weld Current Sensor & Timer Module — VB-CST-2 (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Filter & Frame : HP-S120 (required for attachment)
- HEPA Replacement Filter: HP-S120-HF (Note: HEPA filter reduces airflow by approximately 10%)

Warranty:
Visit **ventboss.com/terms** for full warranty details.

FlexDraft in Backdraft Configuration





FlexDraft in Downdraft Configuration

Ⓐ Inlet Area
Ⓑ Clean Air Exhaust
Ⓒ Filter Access Door
Ⓓ Motor/Blower Access
Ⓔ Curtain Sides
(increase smoke capture area)

MODEL
S130

1 10 Maximum filter life will be achieved with this product when one welder is welding up to 10 pounds of weld wire per week

FULLY WELDED STEEL CONSTRUCTION

Capacity: 150 CFM Max, 110 in.W.G. Max

Motor: 2.3 HP (1700 Watts), Direct Drive, 1500+ hr. Duty

Voltage: Single phase, 120V, 50/60Hz

Full Load Amps: 15.1

Blower: Single Stage Tapered 8.4" dia. Tangential Discharge Blower

Sound Level: 75 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 18" x 16" x 14"

Weight: 50 lbs.

Filter Cartridge: (1) VB-10D12-13

Filter Media Area: 37 sq.ft.

Filter Type: Nanofiber MERV13

Dust Containment: Vacuum / sweep out filter plenum

Spark Arrestance: (1) Metal Mesh Screen MM-12121

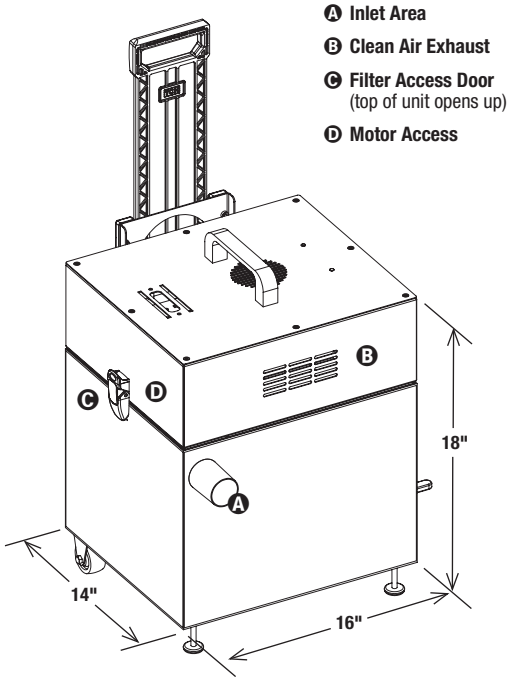
Configuration: (1) 2" Flex Hose, 15'

Filter Cleaning: Ball-Valve Activated Pulse Cleaning, 1/4" NPT Compressed Air Connection

Options:

- Weld Current Sensor & Timer Module — VB-CST-2
- Intake Attachment Options:
  - Flared Cone 7" H x 10" W — FC-VB
  - Slotted Hood 15" L — ST-VB
  - 2" Pipe with magnetic base — GNT-VB
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service

Warranty:
Visit **ventboss.com/terms** for full warranty details.



MODEL
S210

1 25

Maximum filter life will be achieved with this product when one welder is welding up to 25 pounds of weld wire per week or grinding small weldments

FULLY WELDED STEEL CONSTRUCTION

Capacity: 1280 CFM @ 4 in.W.G.

Motor: 0.75 HP, Direct Drive

Voltage: Single phase, 110V, 60Hz

Full Load Amps: 13.8

Blower: Reverse inclined high performance blower wheel

Sound Level: 67 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 52" x 37" x 29"

Weight: 420 lbs.

Filter Cartridge: (1) VB-22D14-13-C

Filter Media Area: 217 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 3/4"NPT compressed air connection

Dust Containment: Vacuum / sweep out filter plenum

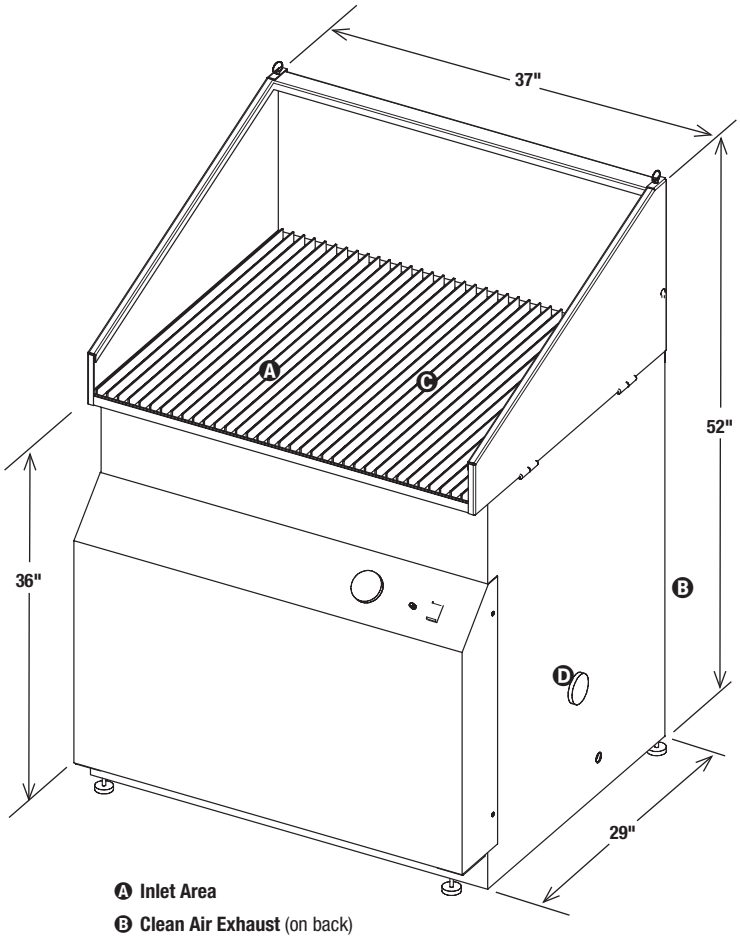
Spark Arrestance:
Triple Layer, (1) FB-24242, (2) MM-24242

Configuration: Table Size: 36 x 36in, 1 x 1/8 Bar Grating, 300lb. Load capacity

Options:

- Caster Wheel Kit — WK-S200
- Weld Current Sensor & Timer Module — VB-CST-2 (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Replacement Filter: HP-S211-HF (Note: HEPA filter reduces airflow by approximately 10%)

Warranty:
Visit **ventboss.com/terms** for full warranty details.



A Inlet Area
B Clean Air Exhaust (on back)
C Filter & Spark Arrestance Access
D Particulate Clean-Out

MODEL
S211

2 50

Maximum filter life will be achieved with this product when one or two welders are welding up to 50 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 2560 CFM @ 4 in.W.G.

Motor: 1.5 HP, Direct Drive

Voltage: Single Phase, 110V 60Hz

Full Load Amps: 20.0 (110V)

Blower: Reverse inclined high performance blower wheel

Sound Level: 72 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 52" x 61" x 29"

Weight: 700 lbs.

Filter Cartridge: (2) VB-18D12-13-C

Filter Media Area: 304 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 3/4"NPT compressed air connection

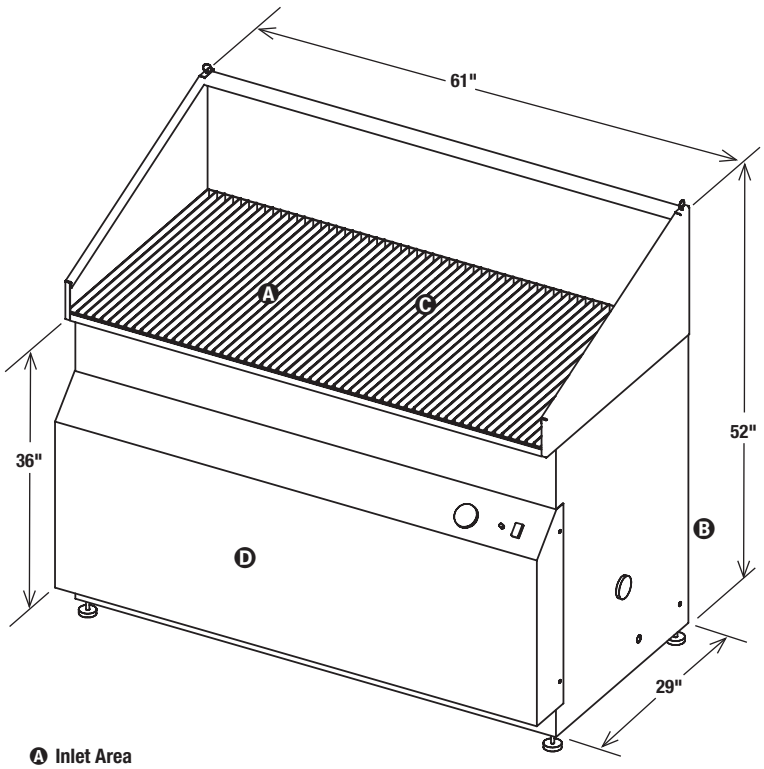
Dust Containment: Vacuum / sweep out filter plenum

Spark Arrestance:
Triple Layer, (2) FB-24242, (4) MM-24242

Configuration: Table Size: 60 x 36in, 1 x 1/8 Bar Grating, 630lb. Load capacity

Options:
- Caster Wheel Kit — WK-S200
- Weld Current Sensor & Timer Module — VB-CST-2 (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



Ⓐ Inlet Area

Ⓑ Clean Air Exhaust (on back)

Ⓒ Filter & Spark Arrestance Access

Ⓓ Particulate Clean-Out

MODEL
S212

2 50

Maximum filter life will be achieved with this product when one or two welders are welding up to 50 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 2560 CFM @ 4 in.W.G.

Motor: 1.5 HP, Direct Drive

Voltage: Single Phase, 110V 60Hz

Full Load Amps: 20.0 (110V)

Blower: Reverse inclined high performance blower wheel

Sound Level: 72 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 52" x 61" x 29"

Weight: 700 lbs.

Filter Cartridge: (2) VB-18D12-13-C

Filter Media Area: 304 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 3/4"NPT compressed air connection

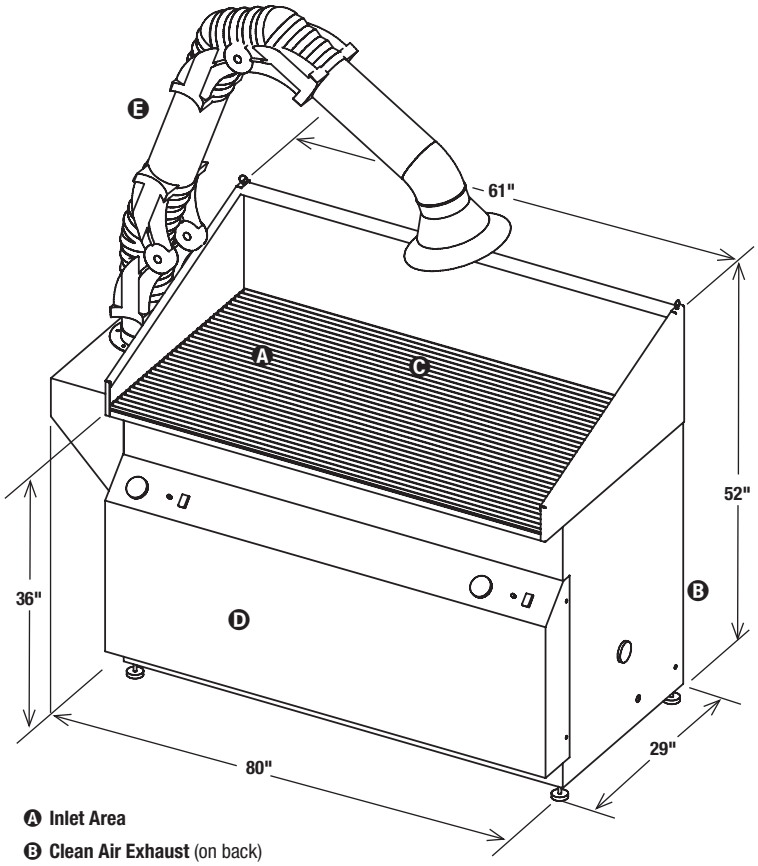
Dust Containment: Vacuum / sweep out filter plenum

Spark Arrestance:
Triple Layer, (2) FB-24242, (4) MM-24242

Configuration: Table Size: 60 x 36in, 1 x 1/8 Bar Grating: 6" dia. x 7' long fume arm; 630lb. Load capacity

Options:
- Caster Wheel Kit — WK-S200
- Weld Current Sensor & Timer Module — VB-CST-2 (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



Ⓐ Inlet Area
Ⓑ Clean Air Exhaust (on back)
Ⓒ Filter & Spark Arrestance Access
Ⓓ Particulate Clean-Out
Ⓔ Fume Arm

MODEL
S220

1 25

Maximum filter life will be achieved with this product when one welder is welding up to 25 pounds of weld wire per week, great for educational facilities as they can sit back to back and side to side

FULLY WELDED STEEL CONSTRUCTION

Capacity: 2000 CFM @ 3.5 in.W.G.

Motor: 2 HP, Direct Drive

Voltage: 3 Phase, 480V, 60Hz

Full Load Amps: 3.4

Blower: Reverse inclined high performance blower wheel

Sound Level: 72 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 89" x 48" x 68"

Weight: 700 lbs.

Filter Cartridge: (1) VB-22D12-13-C

Filter Media Area: 217 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 3/4"NPT compressed air connection

Dust Containment: Vacuum / sweep out filter plenum

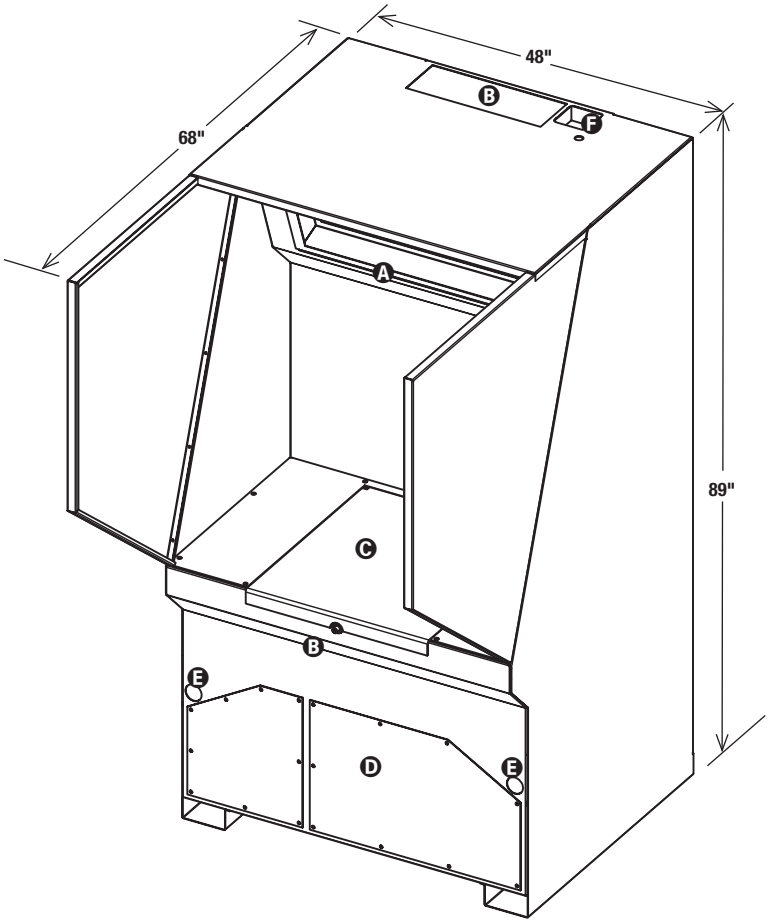
Spark Arrestance:
Two Layers, (1) FB-17402, (1) MM-17402

Configuration: Table Size: 30 x 48in

Options:

- Weld Current Sensor & Timer Module — VB-CST-2 (Onsite Install Required for all Optional Equipment)
- Curtain Kit — VB-CRT
  Weld flash curtain kit includes:
  curtain, hang bar and brackets
- Light Kit — VB-LK
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



Ⓐ Inlet Area
Ⓑ Clean Air Exhaust
Ⓒ Filter Access
Ⓓ Motor
Ⓔ Particulate Clean-Out
Ⓕ Electrical/Air Hookup

MODEL
S310

2 75

Maximum filter life will be achieved with this product when one or two welders are welding up to 75 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 1500 CFM @ 4.5 in.W.G.

Motor: 2HP, Direct Drive

Voltage: 3 Phase, 480V, 60Hz

Full Load Amps: 3.4

Blower: Reverse inclined high performance blower wheel

Sound Level: 72 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 70" x 24" x 24"

Weight: 370 lbs.

Filter Cartridge: (1) VB-14D36-13-SF

Filter Media Area: 355 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 1/4"NPT compressed air connection

Dust Containment: Vacuum / sweep out filter plenum

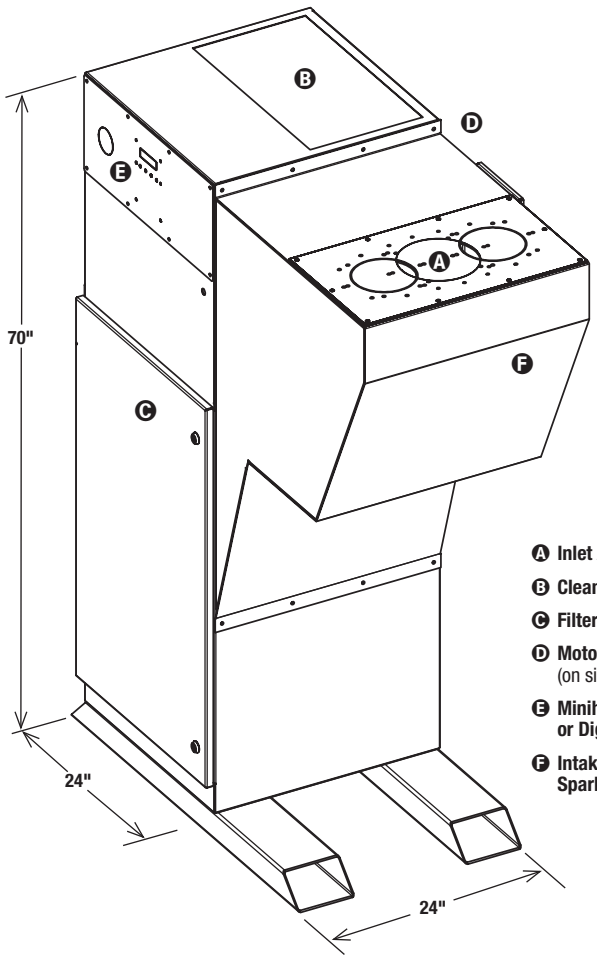
Spark Arrestance:
(1) FB-24242, (1) MM-24242

Configuration:
FloorMount with Intake Boot and Spark Arrestance

Options:

- Digital Controller Upgrade — VB-UP-ETECH-S300
- Silencer — AP-S300
  24"W x 24"D x 14"H
- Weld Current Sensor & Timer Module — VB-CST-2
  (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Filter — HP-S310
  HEPA Frame — HFR-S310
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



Ⓐ Inlet Area
Ⓑ Clean Air Exhaust
Ⓒ Filter Access Door
Ⓓ Motor/Blower Access (on side)
Ⓔ Minihelic Filter Gauge or Digital Controller
Ⓕ Intake Transition and Spark Arrestance

MODEL
S311/S312

1 75

Maximum filter life will be achieved with this product when one welder is welding up to 75 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 1500 CFM @ 4.5 in.W.G.

Motor: 2HP, Direct Drive

Voltage: 3 Phase, 480V, 60Hz

Full Load Amps: 3.4

Blower: Reverse inclined high performance blower wheel

Sound Level: 72 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 70" x 24" x 24"

Weight: 370 lbs.

Filter Cartridge: (1) VB-14D36-13-SF

Filter Media Area: 355 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 1/4"NPT compressed air connection

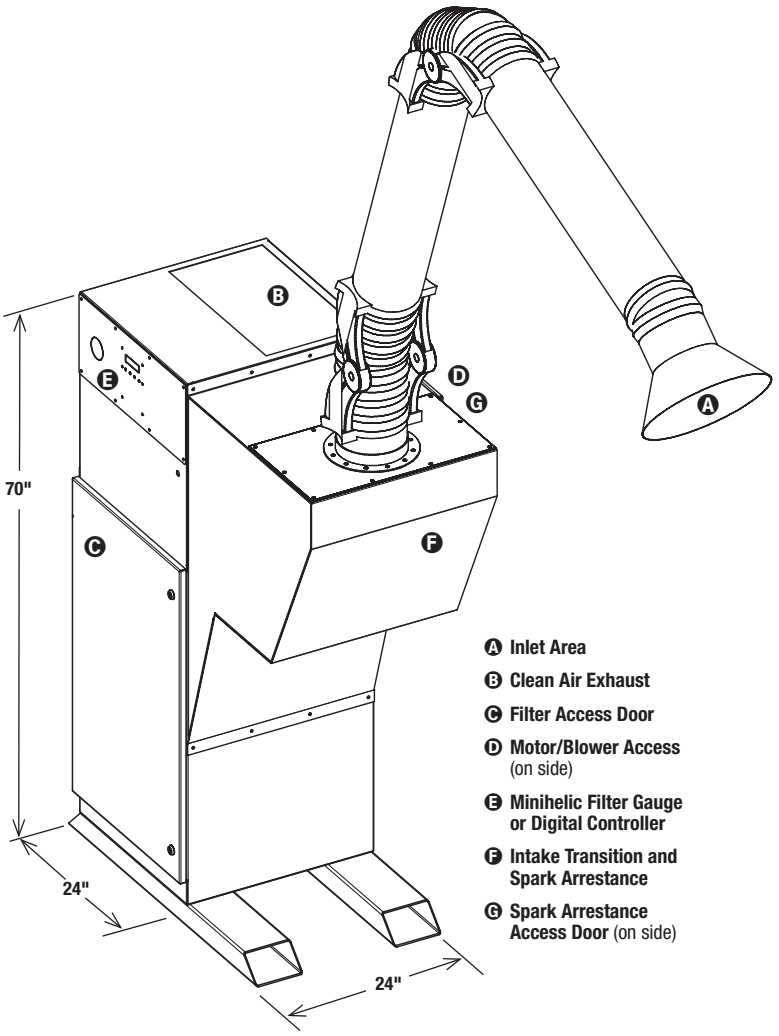
Dust Containment: Vacuum / sweep out filter plenum

Spark Arrestance:
(1) FB-24242, (1) MM-24242

Configurations:
- **S311:** FloorMount with (1) 8" x 10' FumeArm
- **S312:** FloorMount with (1) 8" x 14' FumeArm

Options:
- Digital Controller Upgrade — VB-UP-ETECH-S300
- Silencer — AP-S300
  24"W x 24"D x 14"H
- Weld Current Sensor & Timer Module — VB-CST-2
  (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Filter — HP-S310
  HEPA Frame — HFR-S310
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



Ⓐ Inlet Area
Ⓑ Clean Air Exhaust
Ⓒ Filter Access Door
Ⓓ Motor/Blower Access (on side)
Ⓔ Minihelic Filter Gauge or Digital Controller
Ⓕ Intake Transition and Spark Arrestance
Ⓖ Spark Arrestance Access Door (on side)

MODEL
S313/S314

2 75

Maximum filter life will be achieved with this product when one or two welders are welding up to 75 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 1500 CFM @ 4.5 in.W.G.

Motor: 2HP, Direct Drive

Voltage: 3 Phase, 480V, 60Hz

Full Load Amps: 3.4

Blower: Reverse inclined high performance blower wheel

Sound Level: 72 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 70" x 24" x 24"

Weight: 370 lbs.

Filter Cartridge: (1) VB-14D36-13-SF

Filter Media Area: 355 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 1/4"NPT compressed air connection

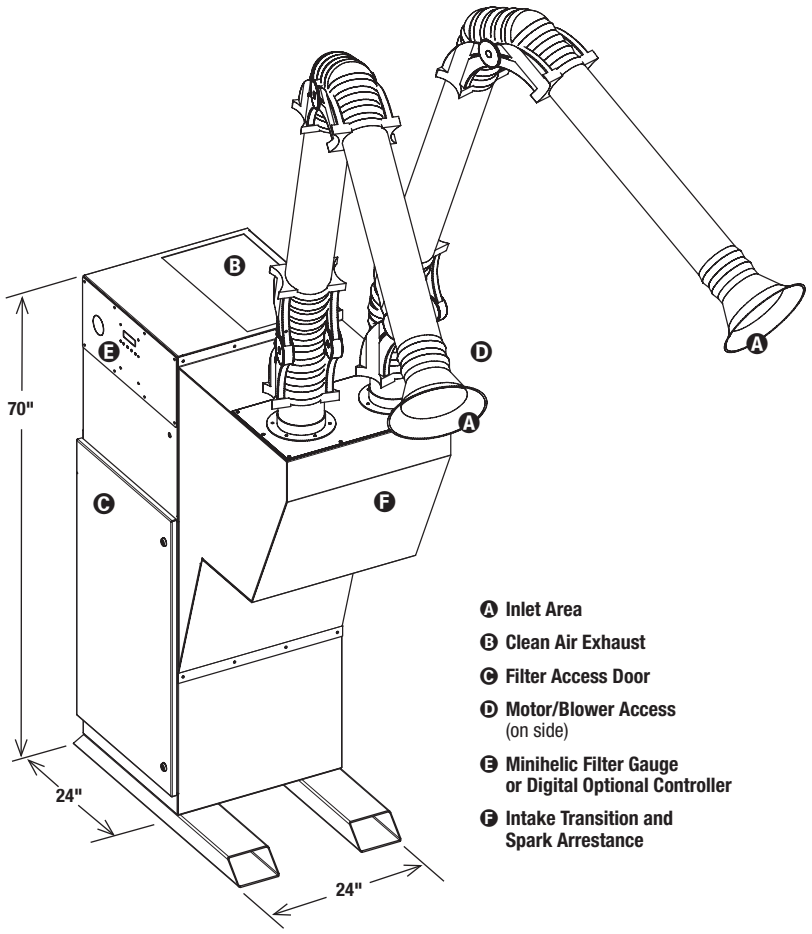
Dust Containment: Vacuum / sweep out filter plenum

Spark Arrestance:
(1) FB-24242, (1) MM-24242

Configurations:
- S313: FloorMount with (2) 6" x 10' FumeArms
- S314: FloorMount with (2) 6" x 14' FumeArms

Options:
- Digital Controller Upgrade — VB-UP-ETECH-S300
- Silencer — AP-S300
  24"W x 24"D x 14"H
- Weld Current Sensor & Timer Module — VB-CST-2
  (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Filter — HP-S310
  HEPA Frame — HFR-S310
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



A Inlet Area
B Clean Air Exhaust
C Filter Access Door
D Motor/Blower Access (on side)
E Minihelic Filter Gauge or Digital Optional Controller
F Intake Transition and Spark Arrestance

MODEL
S315

2 75

Maximum filter life will be achieved with this product when one or two welders are welding up to 75 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 1500 CFM @ 4.5 in.W.G.

Motor: 2HP, Direct Drive

Voltage: 3 Phase, 480V, 60Hz

Full Load Amps: 3.4

Blower: Reverse inclined high performance blower wheel

Sound Level: 72 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 67" x 24" x 24"

Weight: 370 lbs.

Filter Cartridge: (1) VB-14D36-13-SF

Filter Media Area: 355 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 1/4"NPT compressed air connection

Dust Containment: Vacuum / sweep out filter plenum

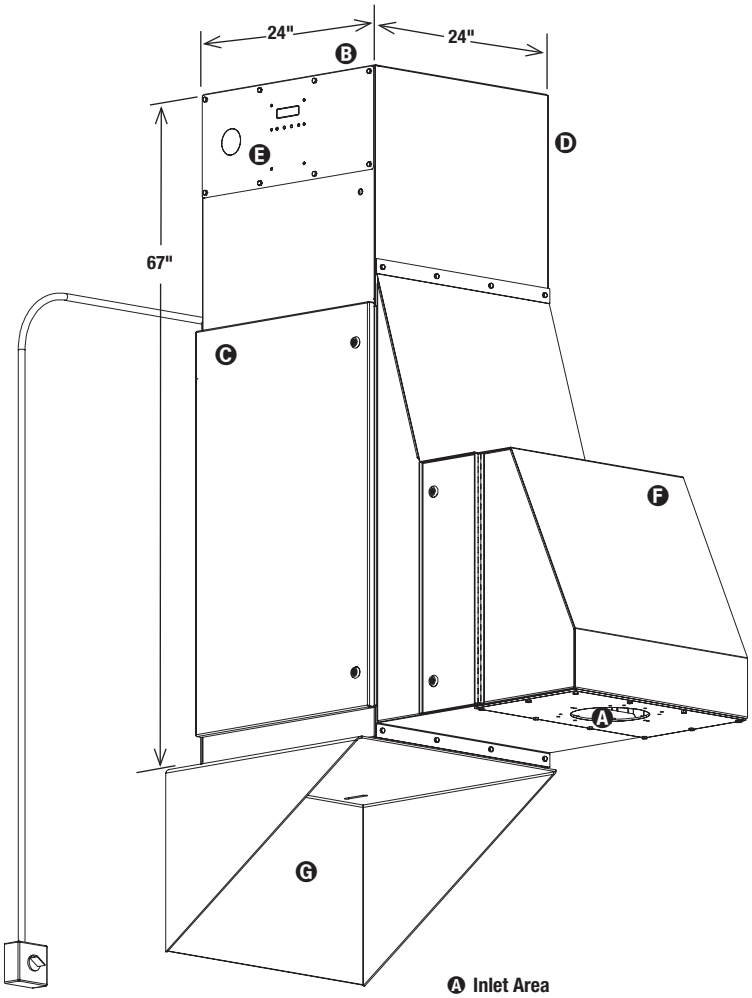
Spark Arrestance:
(1) FB-24242, (1) MM-24242

Configuration:
FloorSaver with Intake Boot and Spark Arrestance

Options:

- Digital Controller Upgrade — VB-UP-ETECH-S300
- Hanging Hardware Kit — VB-HG-HK
- Wall Bracket Kit — VB-WB-S300
- Silencer — AP-S300
  24"W x 24"D x 14"H
- Weld Current Sensor & Timer Module — CST-2
  (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Filter — HP-S310
  HEPA Frame — HFR-S310
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



A Inlet Area
B Clean Air Exhaust
C Filter Access Door
D Motor/Blower Access (on side)
E Minihelic Filter Gauge or Optional Digital Controller
F Intake Transition and Spark Arrestance
G Wall Bracket Kit (optional)

MODEL
S316/S317

1 75

Maximum filter life will be achieved with this product when one welder is welding up to 75 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 1500 CFM @ 4.5 in.W.G.

Motor: 2HP, Direct Drive

Voltage: 3 Phase, 480V, 60Hz

Full Load Amps: 3.4

Blower: Reverse inclined high performance blower wheel

Sound Level: 72 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 67" x 24" x 24"

Weight: 370 lbs.

Filter Cartridge: (1) VB-14D36-13-SF

Filter Media Area: 355 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 1/4"NPT compressed air connection

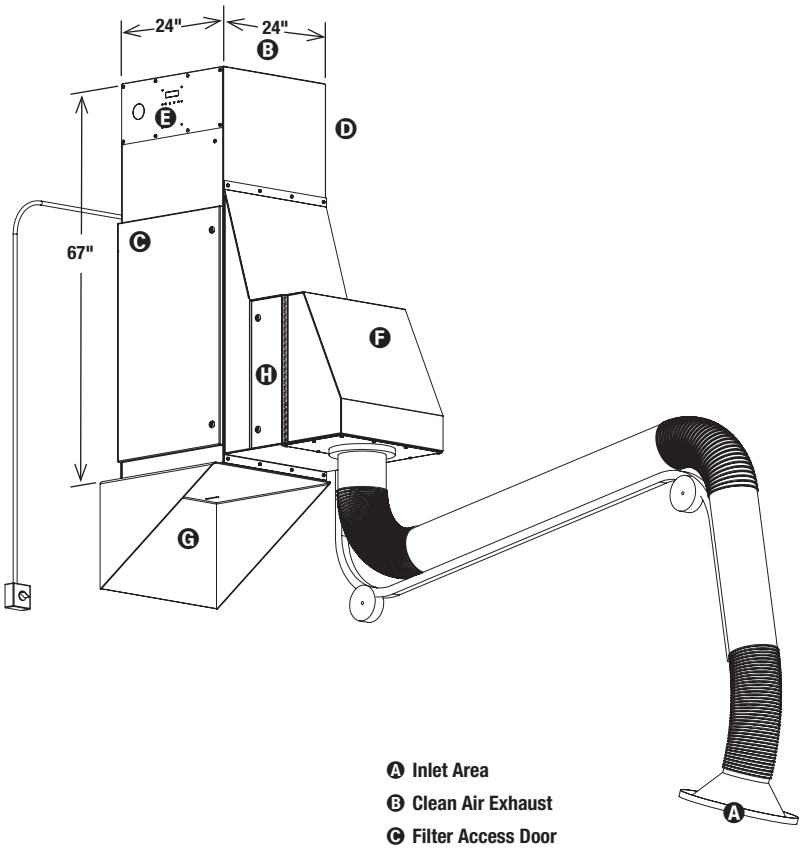
Dust Containment: Vacuum / sweep out filter plenum

Spark Arrestance:
(1) FB-24242, (1) MM-24242

Configurations:
- **S316:** FloorSaver with (1) 8" x 10' FumeArm
- **S317:** FloorSaver with (1) 8" x 14' FumeArm

Options:
- Digital Controller Upgrade — VB-UP-ETECH-S300
- Hanging Hardware Kit — VB-HG-HK
- Wall Bracket Kit — VB-WB-S300
- Silencer — AP-S300
  24"W x 24"D x 14"H
- Weld Current Sensor & Timer Module — VB-CST-2
  (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Filter — HP-S310
  HEPA Frame — HFR-S310
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



A Inlet Area
B Clean Air Exhaust
C Filter Access Door
D Motor/Blower Access (on side)
E Minihelic Filter Gauge or Optional Digital Controller
F Intake Transition and Spark Arrestance
G Wall Bracket Kit (optional)
H Spark Arrestance Access Door

MODEL
S318/S319

2 75

Maximum filter life will be achieved with this product when one or two welders are welding up to 75 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 1500 CFM @ 4.5 in.W.G.

Motor: 2HP, Direct Drive

Voltage: 3 Phase, 480V, 60Hz

Full Load Amps: 3.4

Blower: Reverse inclined high performance blower wheel

Sound Level: 72 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 67" x 24" x 24"

Weight: 370 lbs.

Filter Cartridge: (1) VB-14D36-13-SF

Filter Media Area: 355 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 1/4"NPT compressed air connection

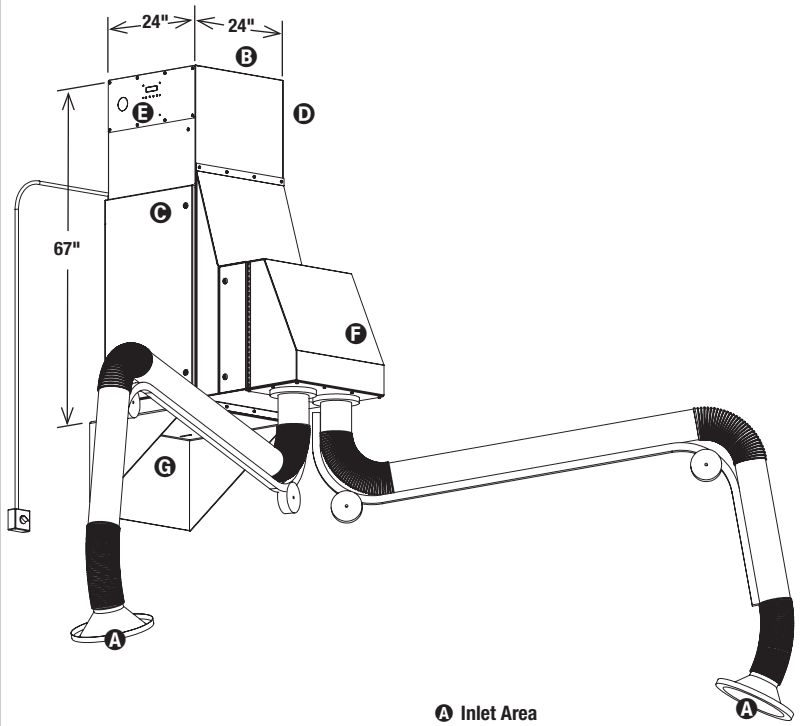
Dust Containment: Vacuum / sweep out filter plenum

Spark Arrestance:
(1) FB-24242, (1) MM-24242

Configurations:
- **S318:** FloorSaver with (2) 6" x 10' FumeArms
- **S319:** FloorSaver with (2) 6" x 14' FumeArm

Options:
- Digital Controller Upgrade — VB-UP-ETECH-S300
- Hanging Hardware Kit — VB-HG-HK
- Wall Bracket Kit — VB-WB-S300
- Silencer — AP-S300
  24"W x 25"D x 14"H
- Weld Current Sensor & Timer Module — VB-CST-2
  (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Filter — HP-S310
  HEPA Frame — HFR-S310
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



Ⓐ Inlet Area

Ⓑ Clean Air Exhaust

Ⓒ Filter Access Door

Ⓓ Motor/Blower Access
(on side)

Ⓔ Minihelic Filter Gauge or Optional Digital Controller

Ⓕ Intake Transition and Spark Arrestance

Ⓖ Wall Bracket Kit
(optional)

MODEL
S320

1 75

Maximum filter life will be achieved with this product when one welder is welding up to 75 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 1500 CFM @ 4.5 in.W.G.

Motor: 2HP, Direct Drive

Voltage: 3 Phase, 480V, 60Hz

Full Load Amps: 3.4

Blower: Reverse inclined high performance blower wheel

Sound Level: 72 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 70" x 24" x 42"

Weight: 370 lbs.

Filter Cartridge: (1) VB-14D36-13-SF

Filter Media Area: 355 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 1/4"NPT compressed air connection

Dust Containment: Vacuum / sweep out filter plenum

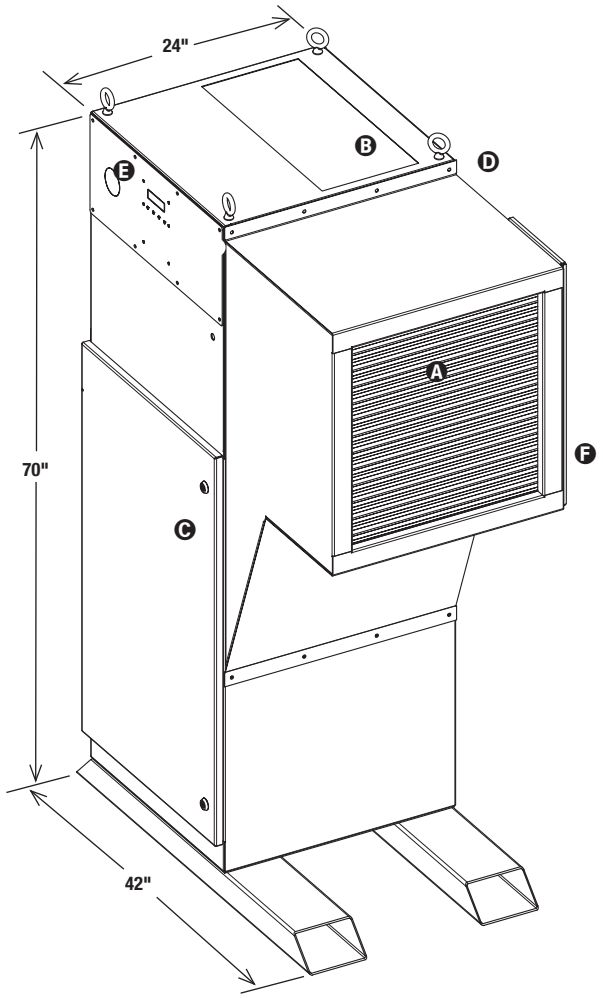
Spark Arrestance:
Two Layer, (1) FB-24242, (1) MM-24242

Configuration: 2' x 2' Opening, Spark Arrestance Intake

Options:

- Digital Controller Upgrade — VB-UP-ETECH-S300
- Silencer — AP-S300
  24"W x 24"D x 14"H
- Weld Current Sensor & Timer Module — VB-CST-2
  (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Filter — HP-S310
  HEPA Frame — HFR-S310
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



A Spark Arrestance Intake

B Clean Air Exhaust

C Filter Access Door

D Motor/Blower Access
(on back)

E Minihelic Filter Gauge or Optional Digital Controller

F Spark Arrestance Access Door
(on side)

MODEL
S321

1 75

Maximum filter life will be achieved with this product when one welder is welding up to 75 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 1500 CFM @ 4.5 in.W.G.

Motor: 2HP, Direct Drive

Voltage: 3 Phase, 480V, 60Hz

Full Load Amps: 3.4

Blower: Reverse inclined high performance blower wheel

Sound Level: 72 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 67" x 24" x 44"

Weight: 370 lbs.

Filter Cartridge: (1) VB-14D36-13-SF

Filter Media Area: 355 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 1/4"NPT compressed air connection

Dust Containment: Vacuum / sweep out filter plenum

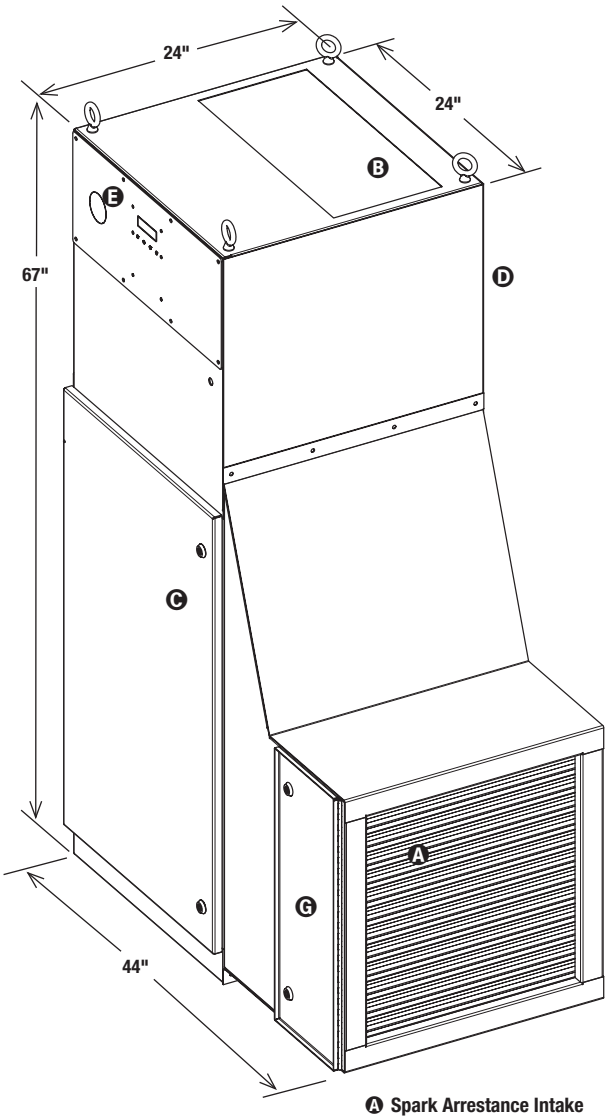
Spark Arrestance:
Two Layer, (1) FB-24242, (1) MM-24242

Configuration: BackDraft, 2' x 2' Opening

Options:

- Digital Controller Upgrade — VB-UP-ETECH-S300
- Hanging Hardware Kit — VB-HG-HK
- Wall Bracket Kit — VB-WB-S300
- Silencer — AP-S300
  24"W x 24"D x 14"H
- Weld Current Sensor & Timer Module — VB-CST-2
  (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Filter — HP-S310
  HEPA Frame — HFR-S310
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



Ⓐ Spark Arrestance Intake

Ⓑ Clean Air Exhaust

Ⓒ Filter Access Door

Ⓓ Motor/Blower Access
(on back)

Ⓔ Minihelic Filter Gauge or Optional Digital Controller

Ⓕ Wall Bracket Kit
(not shown)

Ⓖ Spark Arrestance Access Door

MODEL
S350

2 75

Maximum filter life will be achieved with this product when one or two welders are welding up to 75 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 1500 CFM @ 4.5 in.W.G.

Motor: 2HP, Direct Drive

Voltage: 3 Phase, 480V, 60Hz

Full Load Amps: 3.4

Blower: Reverse inclined high performance blower wheel

Sound Level: 72 dBA

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: Manual on/off switch, Minihelic Filter Condition Gauge

Cabinet Dimensions (HxLxD): 67" x 24" x 24"

Weight: 370 lbs.

Filter Cartridge: (1) VB-14D36-13-SF

Filter Media Area: 430 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, manual activated push-button filter pulse cleaning, 1/4"NPT compressed air connection

Dust Containment: Vacuum / sweep out filter plenum

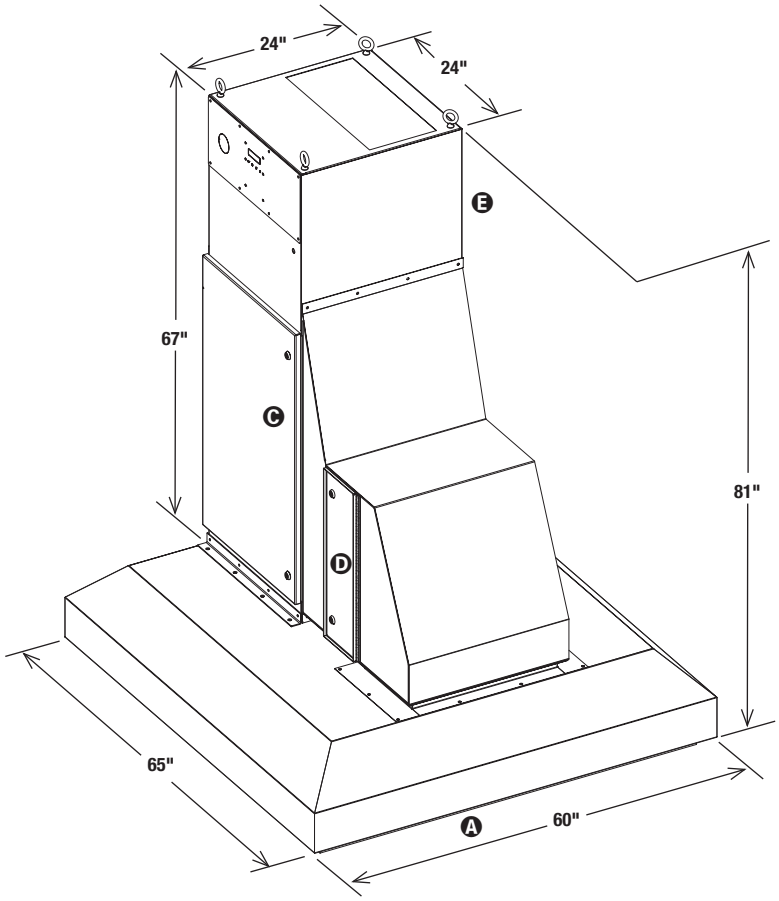
Spark Arrestance:
Triple Layer, (1) FB-24242, (2) MM-24242

Configuration: Canopy - 60"W x 65"D

Options:

- Digital Controller Upgrade — VB-UP-ETECH-S300
- Hanging Hardware Kit — VB-HG-HK
- Wall Bracket Kit — VB-WB-S300
- Weld Curtain — WC-40-0606
- Silencer — AP-S300
  24"W x 24"D x 14"H
- Weld Current Sensor & Timer Module — VB-CST-2
  (Onsite Install Required for all Optional Equipment)
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- HEPA Filter — HP-S310
  HEPA Frame — HFR-S310
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



Ⓐ Inlet Area
Ⓑ Clean Air Exhaust
Ⓒ Filter Access Door
Ⓓ Spark Arrestance Access
Ⓔ Motor Access (on side)

MODEL
S410

MODEL	A:C RATIO	CFM @ 8" WG	MOTOR (HP)	FULL LOAD AMPS
S410	1.7 :1	1500	3.0	4.8
S410	2.2 :1	1950	5.0	7.6
S410	3.3 :1	2850	7.5	11.0

Voltage: 3 Phase, 480V, 60Hz

Blower: Reverse inclined high performance blower wheel

Silencing: Optional

Controls: eTech Digital Controls

Cabinet Dimensions (HxLxD):
85" x 30" x 45" not including the Motor

Weight: 1300-1490 lbs.

Filter Cartridge: (2) VB-14D44-13-SF

Filter Media Area: 868 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: Responsive Pulse Controller;
Online, Offline and Maintenance Cleaning Modes.
3/4" NPT compressed air connection

Air Monitor: Included

Dust Containment: Dust Tray

Spark Arrestance: Optional

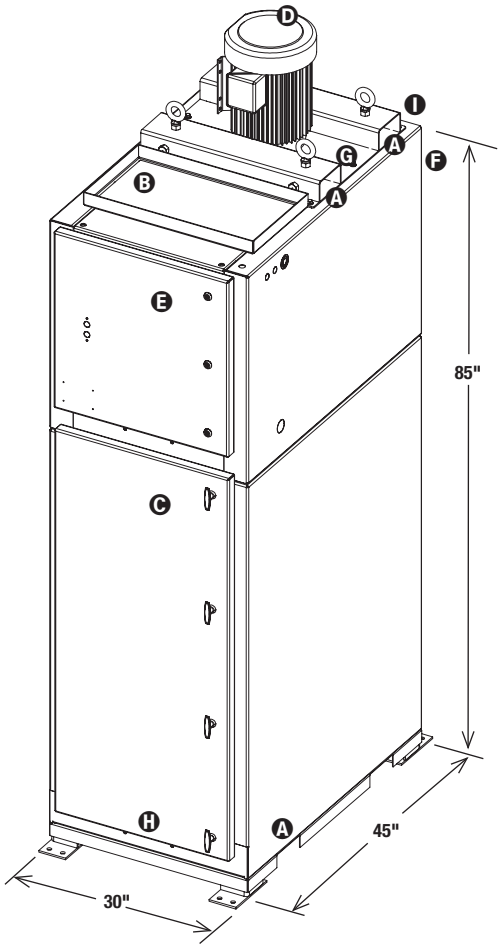
Configuration: Stand Alone Collector

Options:

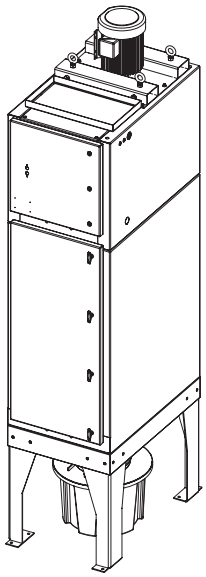
- Hopper & Short Drum (20 Gal. capacity) — HSD-S410-2 Adds 33" to height
- Acoustic Silencing in Motor Area (recommended) — S410-2-FKA
- Intake Boot — Contact Customer Service
- Spark Arrestance — Contact Customer Service
- Explosion Panel — Contact Customer Service
- Barrel Sensor (Some field wiring required) — VB-BLS-110
- Discharge Fire Damper — DFD-VB-S410
- Sprinkler Head Port — VB-FS-SPKLR
- ABC Dry Chemical Fire Suppression System — ABC-DC-EXT
- Other Voltages: 230V or 575V
- Acoustical Silencer Plenum (required for outdoor installation) — AFP-S410-2

Warranty:
Visit **ventboss.com/terms** for full warranty details.

FULLY WELDED STEEL CONSTRUCTION



- **A Fork Access**
- **B Clean Air Exhaust**
- **C Filter Access Door**
- **D Motor**
- **E Electrical Enclosure**
- **F Air Tank & Solenoid Access** (on back)
- **G Compressed Air Connection 3/4" NPT**
- **H Dust Tray** (inside Filter Access Door)
- **I Blower Access** (on back)



Optional Hopper & 20 Gallon Drum

MODEL
S411

MODEL	A:C RATIO	CFM @ 8" WG	MOTOR (HP)	FULL LOAD AMPS
S411	1.5 :1	1950	5.0	7.6
S411	2.2 :1	2850	7.5	11.0
S411	3.1 :1	4100	7.5	11.0

Voltage: 3 Phase, 480V, 60Hz

Blower: Reverse inclined high performance blower wheel

Silencing: Optional

Controls: eTech Digital Controls

Cabinet Dimensions (HxLxD):
85" x 30" x 61" not including the motor

Weight: 1300-1640 lbs. (depending on options)

Filter Cartridge: (3) VB-14D44-13-SF

Filter Media Area: 1,302 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: Responsive Pulse Controller;
Online, Offline and Maintenance Cleaning Modes.
3/4" NPT compressed air connection

Air Monitor: Included

Dust Containment: Dust Tray

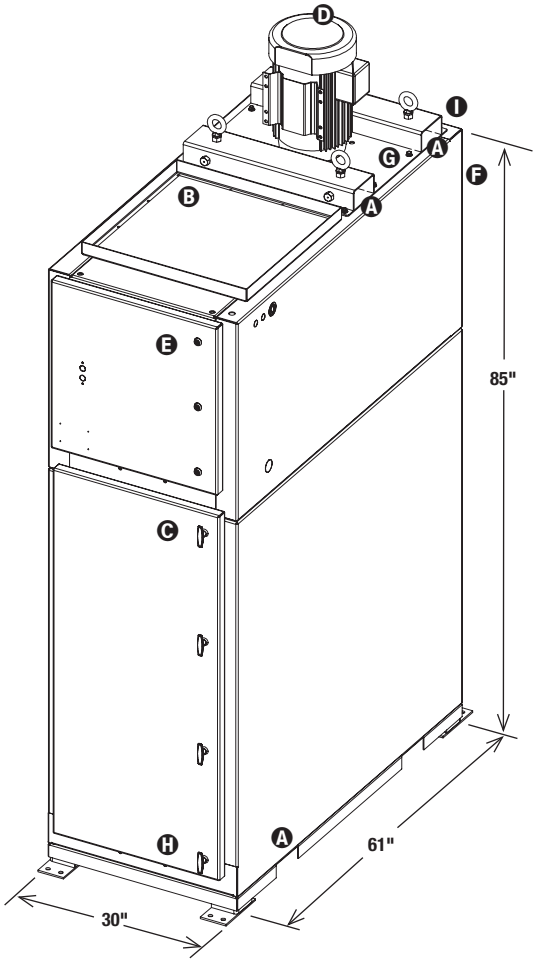
Spark Arrestance: Optional

Configuration: Stand Alone Collector

Options:

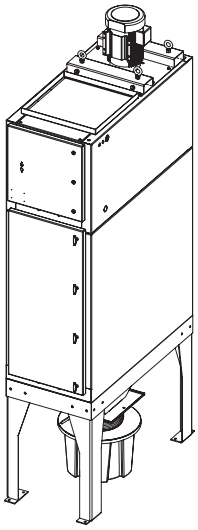
- Hopper & Short Drum (20 Gal. capacity) — HSD-S411-3 Adds 41" to height
- Hopper & Long Legs (55 Gal. capacity) — HLL-S411-3 Adds 61" to height
- Acoustic Silencing in Motor Area (recommended) — S411-3-FKA
- Intake Boot — Contact Customer Service
- Spark Arrestance — Contact Customer Service
- Explosion Panel — Contact Customer Service
- Barrel Sensor (Some field wiring required) — VB-BLS-110
- Discharge Fire Damper — DFD-VB-S411
- Sprinkler Head Port — VB-FS-SPKLR
- ABC Dry Chemical Fire Suppression System — ABC-DC-EXT
- Other Voltages: 230V or 575V
- Acoustical Silencer Plenum (required for outdoor installation) — AFP-S411-3

Warranty:
Visit **ventboss.com/terms** for full warranty details.

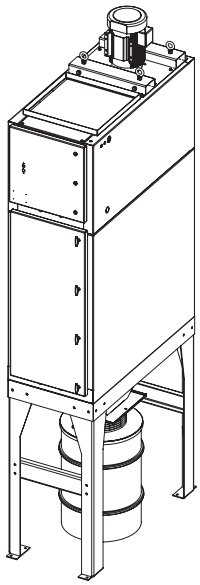


FULLY WELDED STEEL CONSTRUCTION

- **A Fork Access**
- **B Clean Air Exhaust**
- **C Filter Access Door**
- **D Motor**
- **E Electrical Enclosure**
- **F Air Tank & Solenoid Access** (on back)
- **G Compressed Air Connection 3/4" NPT**
- **H Dust Tray** (inside Filter Access Door)
- **I Blower Access** (on back)



Optional Hopper & 20 Gallon Drum



Optional Hopper & 55 Gallon Drum

MODEL
S412

MODEL	A:C RATIO	CFM @ 8" WG	MOTOR (HP)	FULL LOAD AMPS
S412	1.6 :1	2850	7.5	11.0
S412	2.4 :1	4100	7.5	11.0
S412	3.2 :1	5600	10.0	14.0

Voltage: 3 Phase, 480V, 60Hz

Blower: Reverse inclined high performance blower wheel

Silencing: Optional

Controls: eTech Digital Controls

Cabinet Dimensions (HxLxD):
85" x 30" x 77" not including the Motor

Weight: 1750-1810 lbs. (Depending on Options)

Filter Cartridge: (4) VB-14D44-13-SF

Filter Media Area: 1,736 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: Responsive Pulse Controller;
Online, Offline and Maintenance Cleaning Modes.
3/4" NPT compressed air connection

Air Monitor: Included

Dust Containment: Dust Tray

Spark Arrestance: Optional

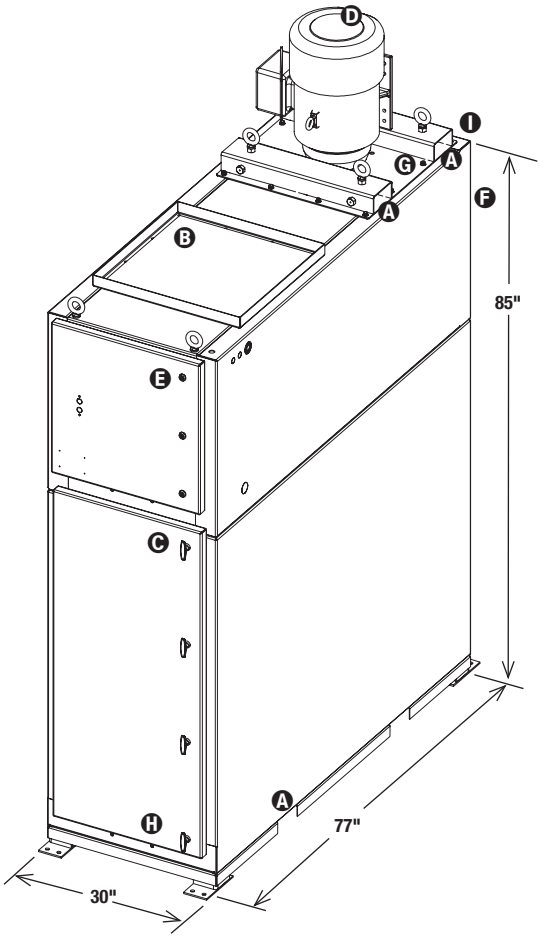
Configuration: Stand Alone Collector

Options:

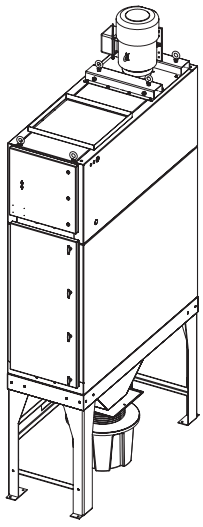
- Hopper & Short Drum (20 Gal. capacity) — HSD-S412-4 Adds 48" to height
- Hopper & Long Legs (55 Gal. capacity) — HLL-S412-4 Adds 67" to height
- Acoustic Silencing in Motor Area (recommended) — S412-4-FKA
- Intake Boot — Contact Customer Service
- Spark Arrestance — Contact Customer Service
- Explosion Panel — Contact Customer Service
- Barrel Sensor (Some field wiring required) — VB-BLS-110
- Discharge Fire Damper — DFD-VB-S412
- Sprinkler Head Port — VB-FS-SPKLR
- ABC Dry Chemical Fire Suppression System — ABC-DC-EXT
- Other Voltages: 230V or 575V
- Acoustical Silencer Plenum (required for outdoor installation) — AFP-S412-4

Warranty:
Visit **ventboss.com/terms** for full warranty details.

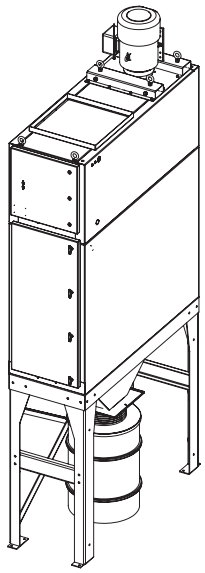
FULLY WELDED STEEL CONSTRUCTION



- **A Fork Access**
- **B Clean Air Exhaust**
- **C Filter Access Door**
- **D Motor**
- **E Electrical Enclosure**
- **F Air Tank & Solenoid Access** (on back)
- **G Compressed Air Connection 3/4" NPT**
- **H Dust Tray** (inside Filter Access Door)
- **I Blower Access** (on back)



Optional Hopper & 20 Gallon Drum



Optional Hopper & 55 Gallon Drum

MODEL
S413

MODEL	A:C RATIO	CFM @ 8" WG	MOTOR (HP)	FULL LOAD AMPS
S413	1.6 :1	4100	7.5	11.0
S413	2.2 :1	5600	10.0	14.0
S413	3.1 :1	8000	20.0	27.0

Voltage: 3 Phase, 480V, 60Hz

Blower: Reverse inclined high performance blower wheel

Silencing: Optional

Controls: eTech Digital Controls

Cabinet Dimensions (HxLxD):
85" x 49" x 61" not including the Motor

Weight: 2320-2910 lbs. (Depending on Options)

Filter Cartridge: (6) VB-14D44-13-SF

Filter Media Area: 2,604 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: Responsive Pulse Controller;
Online, Offline and Maintenance Cleaning Modes.
1" NPT compressed air connection

Air Monitor: Included

Dust Containment: Dust Tray

Spark Arrestance: Optional

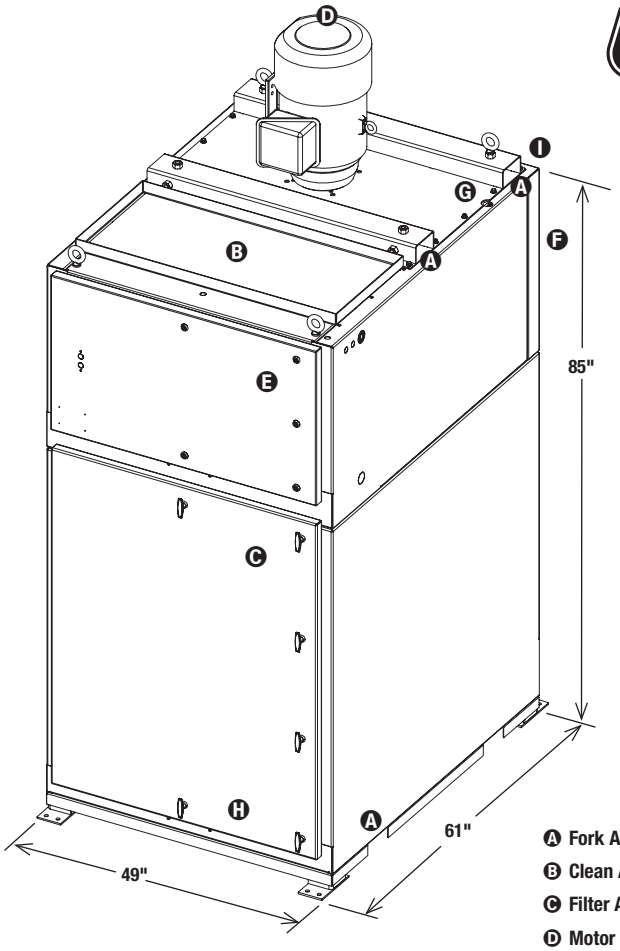
Configuration: Stand Alone Collector

Options:

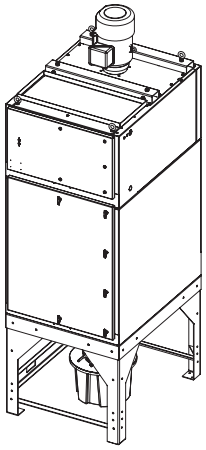
- Hopper & Short Drum (20 Gal. capacity) — HSD-S413-6 Adds 40" to height
- Hopper & Long Legs (55 Gal. capacity) — HLL-S413-6 Adds 59" to height
- Acoustic Silencing in Motor Area (recommended) — S413-6-FKA
- Intake Boot — Contact Customer Service
- Spark Arrestance — Contact Customer Service
- Explosion Panel — Contact Customer Service
- Barrel Sensor (Some field wiring required) — VB-BLS-110
- Discharge Fire Damper — DFD-VB-S413
- Sprinkler Head Port — VB-FS-SPKLR
- ABC Dry Chemical Fire Suppression System — ABC-DC-EXT
- Other Voltages: 230V or 575V
- Acoustical Silencer Plenum (required for outdoor installation) — AFP-S413-6

Warranty:
Visit **ventboss.com/terms** for full warranty details.

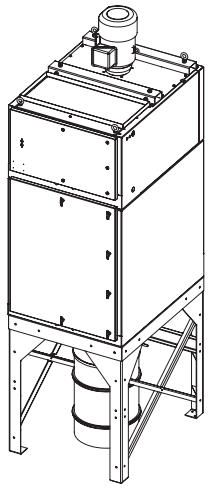
FULLY WELDED STEEL CONSTRUCTION



A Fork Access
B Clean Air Exhaust
C Filter Access Door
D Motor
E Electrical Enclosure
F Air Tank & Solenoid Access (on back)
G Compressed Air Connection 1" NPT
H Dust Tray (inside Filter Access Door)
I Blower Access (on back)



Optional Hopper & 20 Gallon Drum



Optional Hopper & 55 Gallon Drum

MODEL
S414

MODEL	A:C RATIO	CFM @ 8" WG	MOTOR (HP)	FULL LOAD AMPS
S414	1.6 :1	5600	10.0	14.0
S414	2.3 :1	8000	20.0	27.0
S414	2.9 :1	10200	25.0	34.0

Voltage: 3 Phase, 480V, 60Hz

Blower: Reverse inclined high performance blower wheel

Silencing: Optional

Controls: eTech Digital Controls

Cabinet Dimensions (HxLxD):
85" x 49" x 77" not including the Motor

Weight: 3010-4630 lbs. (Depending on Options)

Filter Cartridge: (8) VB-14D44-13-SF

Filter Media Area: 3,472 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: Responsive Pulse Controller;
Online, Offline and Maintenance Cleaning Modes.
1" NPT compressed air connection

Air Monitor: Included

Dust Containment: Dust Tray

Spark Arrestance: Optional

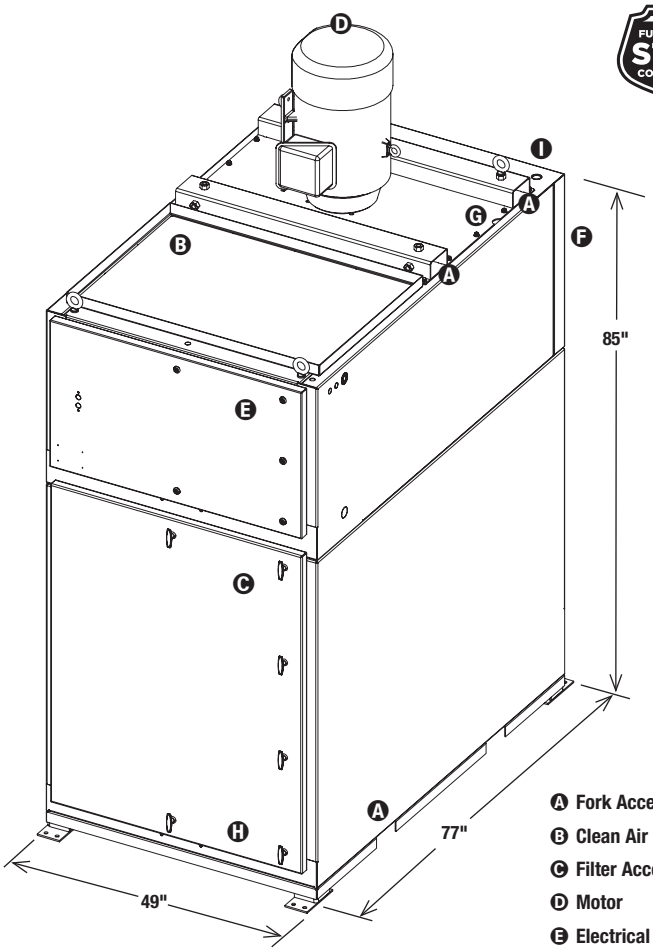
Configuration: Stand Alone Collector

Options:

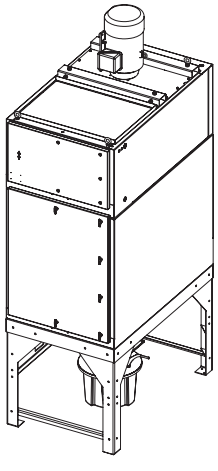
- Hopper & Short Drum (20 Gal. capacity) — HSD-S414-8 Adds 48" to height
- Hopper & Long Legs (55 Gal. capacity) — HLL-S414-8 Adds 67" to height
- Acoustic Silencing in Motor Area (recommended) — S414-8-FKA
- Intake Boot — Contact Customer Service
- Spark Arrestance — Contact Customer Service
- Explosion Panel — Contact Customer Service
- Barrel Sensor (Some field wiring required) — VB-BLS-110
- Discharge Fire Damper — DFD-VB-S414
- Sprinkler Head Port — VB-FS-SPKLR
- ABC Dry Chemical Fire Suppression System — ABC-DC-EXT
- Other Voltages: 230V or 575V
- Acoustical Silencer Plenum (required for outdoor installation) — AFP-S414-8

Warranty:
Visit **ventboss.com/terms** for full warranty details.

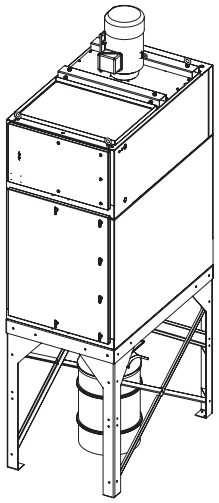
FULLY WELDED STEEL CONSTRUCTION



- **A Fork Access**
- **B Clean Air Exhaust**
- **C Filter Access Door**
- **D Motor**
- **E Electrical Enclosure**
- **F Air Tank & Solenoid Access** (on back)
- **G Compressed Air Connection 1" NPT**
- **H Dust Tray** (inside Filter Access Door)
- **I Blower Access** (on back)



Optional Hopper & 20 Gallon Drum



Optional Hopper & 55 Gallon Drum

MODEL
S415

MODEL	A:C RATIO	CFM @ 8" WG	MOTOR (HP)	FULL LOAD AMPS
S415	1.8 :1	8000	20.0	27.0
S415	2.4 :1	10200	25.0	34.0
S415	3.2 :1	14000	40.0	52.0

Voltage: 3 Phase, 480V, 60Hz

Blower: Reverse inclined high performance blower wheel

Silencing: Optional

Controls: eTech Digital Controls

Cabinet Dimensions (HxLxD):
85" x 49" x 92" not including the Motor

Weight: 3690-4310 lbs. (Depending on Options)

Filter Cartridge: (10) VB-14D44-13-SF

Filter Media Area: 4,340 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: Responsive Pulse Controller;
Online, Offline and Maintenance Cleaning Modes.
1" NPT compressed air connection

Air Monitor: Included

Dust Containment: Dust Tray

Spark Arrestance: Optional

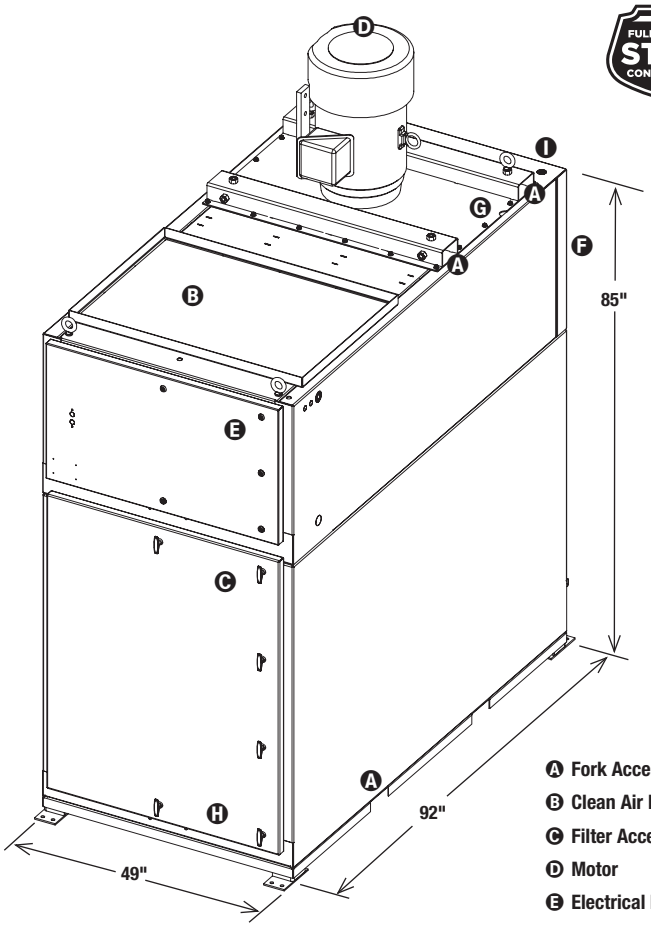
Configuration: Stand Alone Collector

Options:

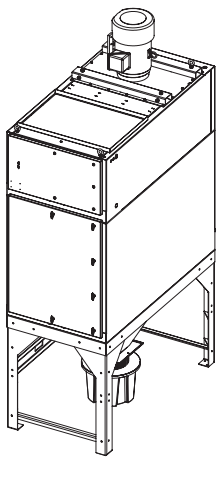
- Hopper & Short Drum (20 Gal. capacity) — HSD-S415-10 Adds 55" to height
- Hopper & Long Legs (55 Gal. capacity) — HLL-S415-10 Adds 74" to height
- Acoustic Silencing in Motor Area (recommended) — S415-10-FKA
- Intake Boot — Contact Customer Service
- Spark Arrestance — Contact Customer Service
- Explosion Panel — Contact Customer Service
- Barrel Sensor (Some field wiring required) — VB-BLS-110
- Discharge Fire Damper — DFD-VB-S415
- Sprinkler Head Port — VB-FS-SPKLR
- ABC Dry Chemical Fire Suppression System — ABC-DC-EXT
- Other Voltages: 230V or 575V
- Acoustical Silencer Plenum (required for outdoor installation) — AFP-S415-10

Warranty:
Visit **ventboss.com/terms** for full warranty details.

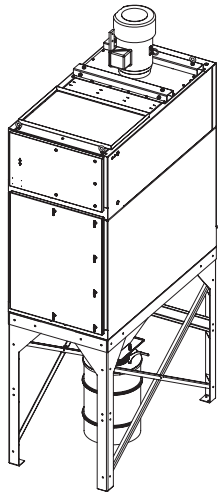
FULLY WELDED STEEL CONSTRUCTION



- **A Fork Access**
- **B Clean Air Exhaust**
- **C Filter Access Door**
- **D Motor**
- **E Electrical Enclosure**
- **F Air Tank & Solenoid Access** (on back)
- **G Compressed Air Connection 1" NPT**
- **H Dust Tray** (inside Filter Access Door)
- **I Blower Access** (on back)



Optional Hopper & 20 Gallon Drum



Optional Hopper & 55 Gallon Drum

MODEL
S610/S620

30,000 180

This product can cover up to 30,000 cubic feet of space and up to 180 pounds of weld wire per week

FULLY WELDED STEEL CONSTRUCTION

Capacity: 4000 CFM @ 5 in.W.G.

Motor: 5HP, Direct Drive

Voltage: 3 Phase, 480V, 60Hz

Full Load Amps: 7.6

Blower: Reverse inclined high performance blower wheel

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: eTech Digital Controls

Cabinet Dimensions (HxLxD):
- **S610:** 142" x 41" x 41"
- **S620:** 123" x 41" x 41"

Weight: 1200 lbs.

Filter Cartridge: (2) VB-22D36-13

Filter Media Area: 1116 sq. ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, both manual and automatic pulse cleaning setting, 3/4"NPT compressed air connection

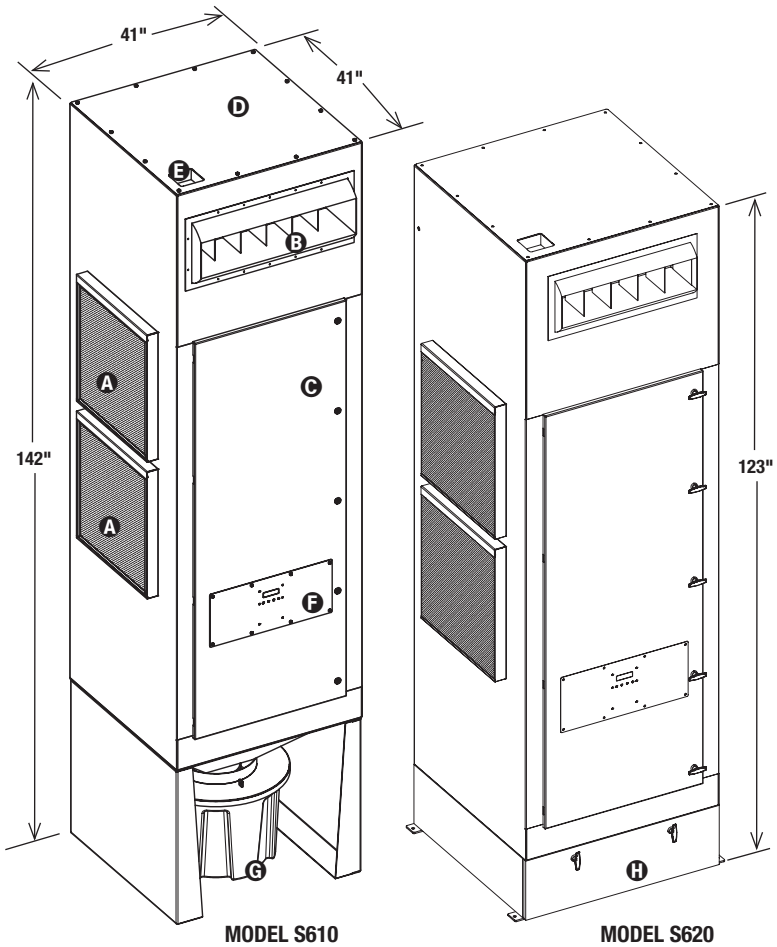
Dust Containment:
- **S610:** 20 Gallon Drum
- **S620:** Dust Tray

Spark Arrestance: One Layer, (4) - FB-24242

Configurations:
- **S610:** With Hopper and Short Drum
- **S620:** With Dust Tray

Options:
- CSA Certification — CSA-100
- UL Certification — Contact Customer Service
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



MODEL S610 **MODEL S620**

- **A Inlet Area & Spark Arrestance**
- **B Directional Outlet Louver**
- **C Filter Access**
- **D Motor and Blower**
- **E Electrical Hookup**
- **F Digital Controller**
- **G Hopper and 20 Gallon Drum**
- **H Dust Tray**

MODEL
S710

2 25

Maximum filter life will be achieved with this product when one or two welders are welding up to 25 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 200 CFM @ 60 in.W.G.

Motor: 2.5HP, 1500+ Hour Blower

Voltage: Single phase, 110V, 60Hz

Full Load Amps: 30

Blower: High-Vacuum
(NOT for continuous duty)

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: On/Off Switch

Cabinet Dimensions (HxLxD): 36" x 22" x 35"

Weight: 350 lbs.

Filter Cartridge: (1) VB-18D16-13

Filter Media Area: 203 sq.ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: Filter manual blow-out port

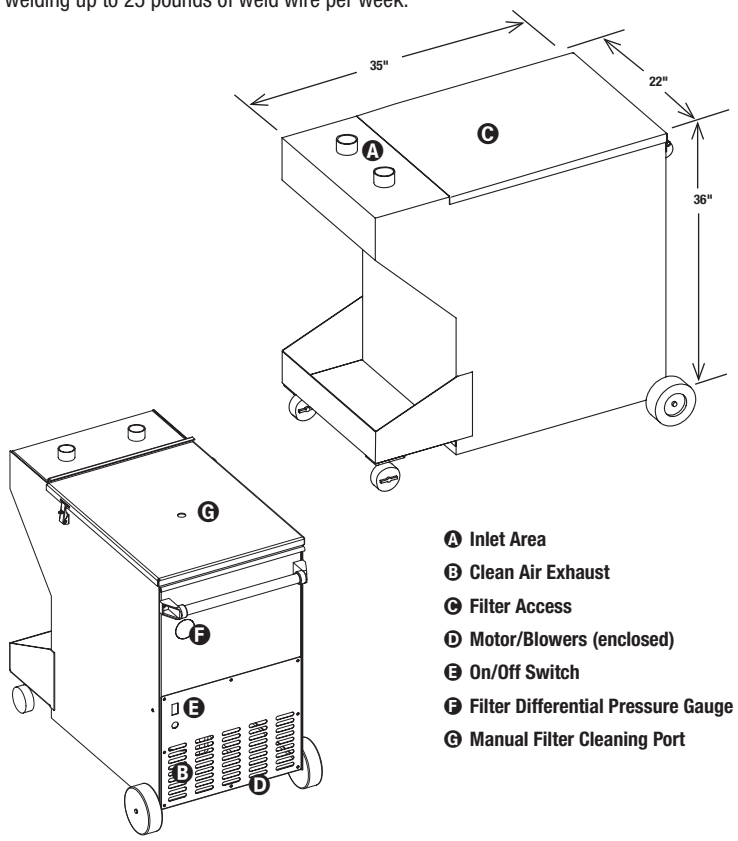
Dust Containment: Vacuum / sweep out filter plenum

Spark Arrestance: (1) Metal Mesh Screen MM-16202

Configuration: (2) 2-inch Hose Ports

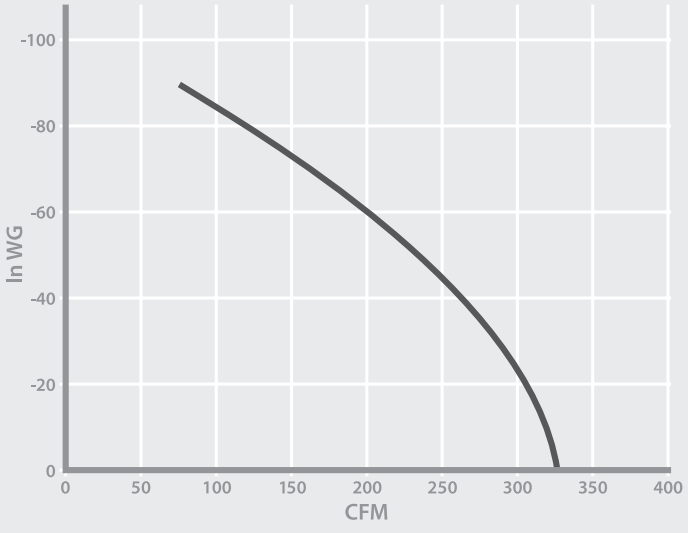
Options:
- 2 inch Hose 15 feet long — PP-2-HPH15
- Intake Attachments:
  - Flared Cone 7" x 10" W — FC-VB
  - Slotted Hood 15" L — ST-VB
  - 2" Pipe with Magnetic Base — GNT-VB

Warranty:
Visit **ventboss.com/terms** for full warranty details.



A Inlet Area
B Clean Air Exhaust
C Filter Access
D Motor/Blowers (enclosed)
E On/Off Switch
F Filter Differential Pressure Gauge
G Manual Filter Cleaning Port

Airflow Capacity Chart:



MODEL
S720

2 50

Maximum filter life will be achieved with this product when one or two welders are welding up to 50 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 175 CFM @ 80 in.W.G.

Motor: 4HP Single Stage Regenerative Hi-Vac Blower

Voltage: 3 Phase, 480V, 60Hz

Full Load Amps: 7.6

Blower: High-Vacuum Continuous Duty

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: eTech Digital Controls

Cabinet Dimensions (HxLxD): 67" x 30" x 24"

Weight: 485 lbs.

Filter Cartridge: (1) VB-14D26-13-SF

Filter Media Area: 256 sq.ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, both manual and automatic pulse cleaning setting, 3/4"NPT compressed air connection

Dust Containment: Vacuum / sweep out filter plenum

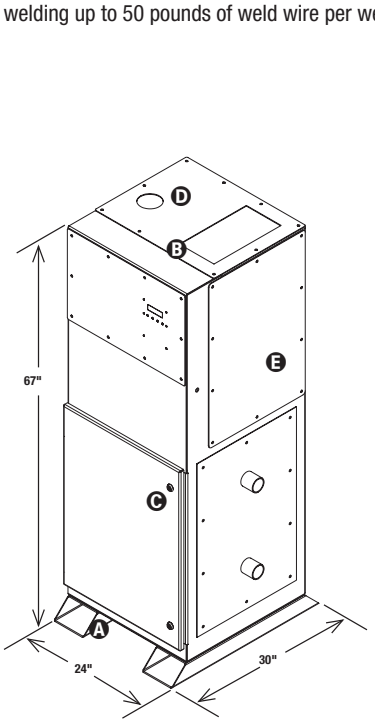
Spark Arrestance: Optional

Configuration: (2) 2-inch Hose Ports

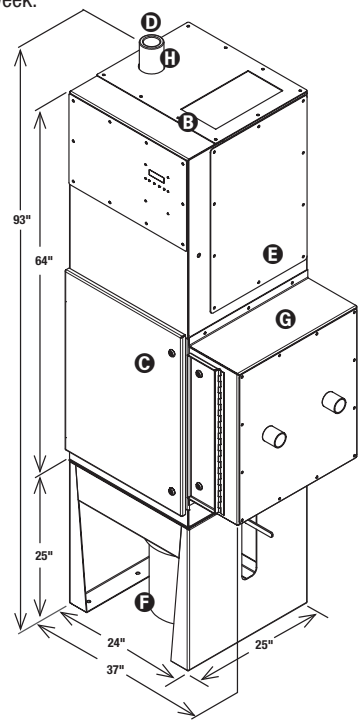
Options:

- 2 inch Hose 15 feet long — PP-2-HPH15
- Intake Attachments:
  - Flared Cone 7" x 10" W — FC-VB
  - Slotted Hood 15" L — ST-VB
  - 2" Pipe with Magnetic Base — GNT-VB
- Hopper Short Drum (5 Gallon capacity) — HLL-S720
- Spark Arrestance — SAP-S720
- Additional Silencer — AP-S720
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



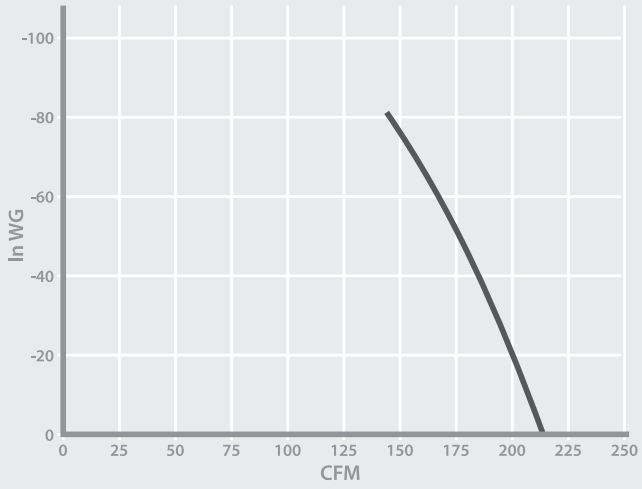
Standard Configuration



Shown with all options

- **A Fork Pockets**
- **B Clean Air Exhaust**
- **C Filter Access Door**
- **D Motor (enclosed)**
- **E Compressed Air & Solenoid Access**
- **F Hopper & Short Drum** (optional)
- **G Spark Arrestance** (optional)
- **H Additional Silencer** (optional)

Airflow Capacity Chart:



MODEL
S730

4 100

Maximum filter life will be achieved with this product when up to four welders are welding up to 100 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 350 CFM @ 80 in.W.G.

Motor: 10HP Single Stage Regenerative Hi-Vac Blower

Voltage: 3 Phase, 480V, 60Hz

Full Load Amps: 14.0

Blower: High-Vacuum Continuous Duty

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: eTech Digital Controls

Cabinet Dimensions (HxLxD): 92" x 30" x 29"

Weight: 850 lbs.

Filter Cartridge: (1) VB-14D36-13-SF

Filter Media Area: 354 sq.ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, both manual and automatic pulse cleaning setting, 3/4"NPT compressed air connection

Dust Containment: Vacuum / sweep out filter plenum

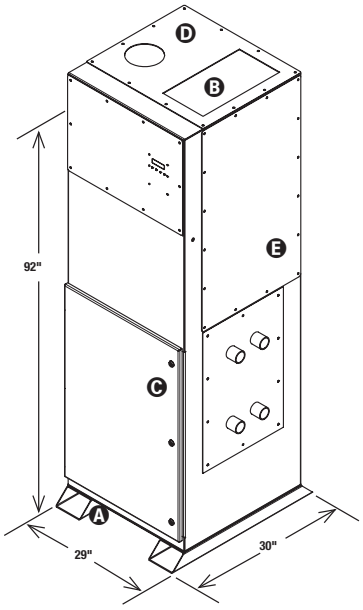
Spark Arrestance: Optional

Configuration: (4) 2-inch Hose Ports

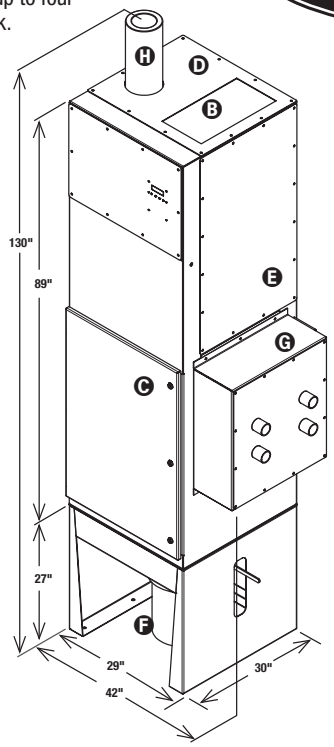
Options:

- 2 inch Hose 15 feet long — PP-2-HPH15
- Intake Attachments:
  - Flared Cone 7" x 10" W — FC-VB
  - Slotted Hood 15" L — ST-VB
  - 2" Pipe with Magnetic Base — GNT-VB
- Hopper Short Drum (5 Gallon capacity) — HLL-S730
- Spark Arrestance — SAP-S730
- Additional Silencer — AP-S730
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



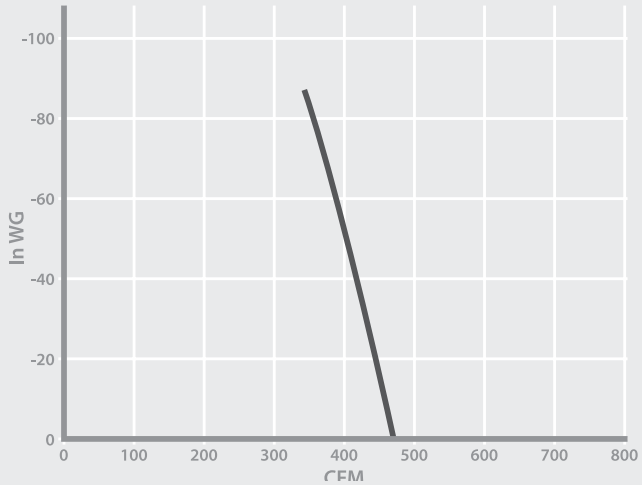
Standard Configuration



Shown with all options

- **A Fork Pockets**
- **B Clean Air Exhaust**
- **C Filter Access Door**
- **D Motor (enclosed)**
- **E Compressed Air & Solenoid Access**
- **F Hopper & Short Drum** (optional)
- **G Spark Arrestance** (optional)
- **H Additional Silencer** (optional)

Airflow Capacity Chart:



MODEL
S740

6 150

Maximum filter life will be achieved with this product when up to six welders are welding up to 150 pounds of weld wire per week.

FULLY WELDED STEEL CONSTRUCTION

Capacity: 550 CFM @ 80 in.W.G.

Motor: 15HP Single Stage Regenerative Hi-Vac Blower

Voltage: 3 Phase, 480V, 60Hz

Full Load Amps: 21.0

Blower: High-Vacuum Continuous Duty

Silencing: Integral Acoustical Plenum with Low Frequency Dampening

Controls: eTech Digital Controls

Cabinet Dimensions (HxLxD): 92" x 45" x 30"

Weight: 1140 lbs.

Filter Cartridge: (2) VB-14D36-13-SF

Filter Media Area: 708 sq.ft.

Filter Type: Nanofiber MERV13

Filter Cleaning: On board compressed air tank, both manual and automatic pulse cleaning setting, 3/4"NPT compressed air connection

Dust Containment: Vacuum / sweep out filter plenum

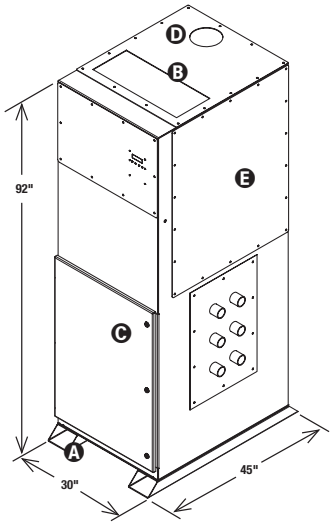
Spark Arrestance: Optional

Configuration: (6) 2-inch Hose Ports

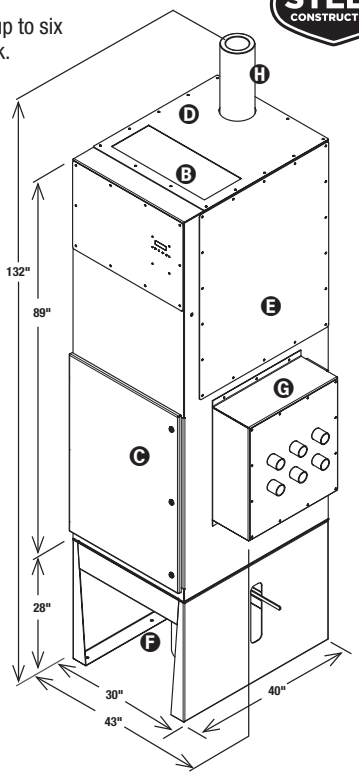
Options:

- 2 inch Hose 15 feet long — PP-2-HPH15
- Intake Attachments:
  - Flared Cone 7" x 10" W — FC-VB
  - Slotted Hood 15" L — ST-VB
  - 2" Pipe with Magnetic Base — GNT-VB
- Hopper Short Drum (5 Gallon capacity) — HLL-S740
- Spark Arrestance — SAP-S740
- Additional Silencer — AP-S740
- Other Voltages: 230V or 575V

Warranty:
Visit **ventboss.com/terms** for full warranty details.



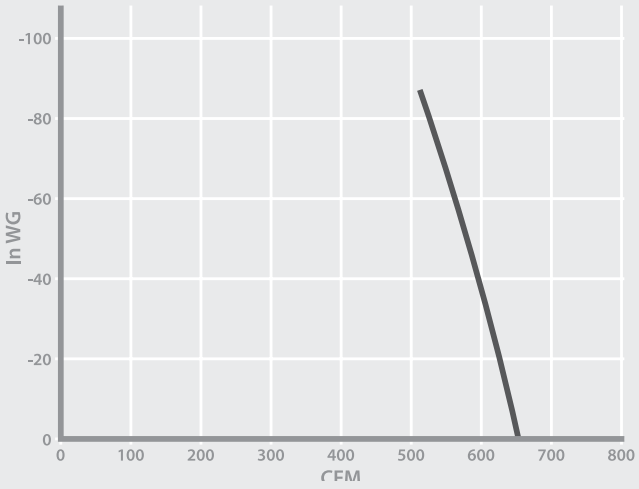
Standard Configuration



Shown with all options

A Fork Pockets
B Clean Air Exhaust
C Filter Access Door
D Motor (enclosed)
E Compressed Air & Solenoid Access
F Hopper & Short Drum (optional)
G Spark Arrestance (optional)
H Additional Silencer (optional)

Airflow Capacity Chart:



HOOD SYSTEM

FULLY WELDED STEEL CONSTRUCTION

HS10 | FASCIA
Perimeter Frame, 120in (10ft) long, trim to size as needed.

HS20 | FASCIA JOINER
36" long, predrilled tek screw holes, connects 2 lengths of Fascia together, for straight sides over 120".

HS30 | CORNER
Connects Fascia pieces at 90°, predrilled tek screw holes.

HS40 | SUPPORT RIB
Spans across cell, 288" (24ft) long, trim to size as needed, screws to Fascia, supports the edges of the Polygal Sheeting.

HS50 | POLYGAL SHEETING
Twin Wall translucent polycarbonate sheeting lets plant light through, sheet size 24" x 288", cut to size as required, fastens to Fascia and Support Ribs with tek screws and washers.

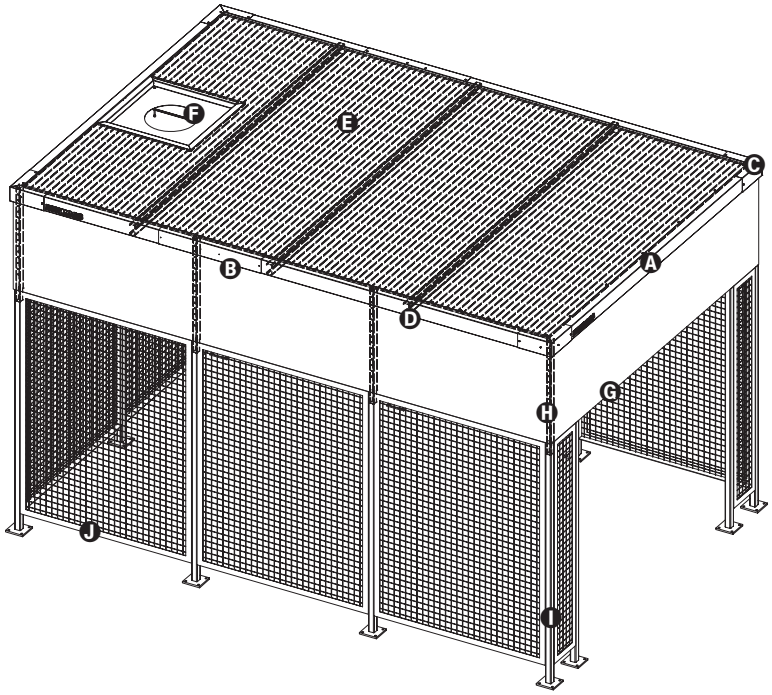
HS60 | DUCT CONNECTION
Screws onto PolyGal Sheeting, supported by Fascia and Support Ribs, 33" x 33", suits duct up to 24" diameter, includes spark baffle plate, attached on threaded rod standoffs.

HS70 | HARDWARE KIT
Fastener and hardware kit for assembling hood system.

HS80/90/100 | CURTAIN
Weld Curtain, screws to bottom lip of Fascia with tek screws and washers, cut to size as required, necessary to infill area between Hood Roof and top of guarding, to retain generated smoke within the cell area to be captured by the connected ventilation equipment.

HS110 | POST EXTENSION
36" high, trim to length where needed, fits into 2" x 2" standard guarding support post, screws into Fascia.

HS120 | POST
To support hood without mounting on existing guarding, 120" (10ft) high, trim to length as needed, 4 bolts through base plate to anchor to floor.



- **A Facia**
- **B Facia Joiner**
- **C Corner**
- **D Support Rib**
- **E Polygal Sheeting**
- **F Duct Connection**
- **G Curtain**
- **H Post Extension**
- **I Post**
- **J Existing Guarding**

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 Issue 07.01.2015

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards. This *Material Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard (29 CFR 1910.1200). Other government regulations must be reviewed for applicability to these products.*

WARNING: PRODUCT COMPONENTS PRESENT HEALTH AND SAFETY HAZARDS. READ AND UNDERSTAND THIS MATERIAL SAFETY DATA SHEET (M.S.DS.). ALSO, FOLLOW YOUR EMPLOYER'S SAFETY PRACTICES. The information contained herein relates only to the specific product. If the product is combined with other materials, all component properties must be considered. **BE SURE TO CONSULT THE LATEST VERSION OF THE MSDS. MATERIAL SAFETY DATA SHEETS ARE AVAILABLE FROM J.W. HARRIS CO., INC.**

E-MAIL: salesinfo@jwharris.com **TELEPHONE: 513-754-2000** **WEB SITE:** www.jwharris.com

STATEMENT OF LIABILITY-DISCLAIMER

To the best of the J.W. Harris Company, Inc.'s knowledge, the information and recommendations contained in this publication are reliable and accurate as of the date prepared. However, accuracy, suitability, or completeness are not guaranteed, and no warranty, guarantee, or representation, expressed or implied, is made by J.W. Harris Co., Inc. as to the absolute correctness or sufficiency of any representation contained in this and other publications; J.W. Harris Co., Inc. assumes no responsibility in connection therewith; nor can it be assumed that all acceptable safety measures are contained in this and other publications, or that other or additional measures may not be required under particular or exceptional conditions or circumstances . Data may be changed from time to time.

PART I *What is the material and what do I need to know in an emergency?*

1. PRODUCT IDENTIFICATION

TRADE NAME (AS LABELED): **LISTED IN SECTION 2 UNDER CLASS**
CHEMICAL NAME/CLASS: Metal Alloy
SYNONYMS: **LOW-ALLOY STEELS AND TOOL STEELS**
PRODUCT USE: Metal Welding
DOCUMENT NUMBER: 0057
SUPPLIER/MANUFACTURER'S NAME: **J.W. HARRIS CO, INC.**
ADDRESS: 4501 Quality Place, Mason, Ohio 45040
EMERGENCY PHONE: CHEMTREC: 1-800-424-9300
BUSINESS PHONE: 1-800-733-4043
DATE OF PREPARATION: February 27, 2004

2. COMPOSITION and INFORMATION ON INGREDIENTS

Class	C	Mn	Si	V	W	Cr	Mo	Fe
4130	0.28-0.33	0.40-0.60	0.15-0.60			0.8-1.1	0.15-0.25	Balance
ER80S-B2	0.07-0.12	0.40-0.70	0.40-0.70	(a)	(C)	1.20-1.50	0.40-0.65	Balance
ER80S-B6	0.10	0.40-0.70	0.50	(a)	(C)	4.50-6.00	0.45-0.65	Balance
ER90S-B3	0.07-0.12	0.40-0.70	0.40-0.70	(a)	(C)	2.30-2.70	0.90-1.20	Balance
3OH	1.00	1.20	0.30	0.10	0.50	0.50		Balance
3HW	0.30-0.450	0.20-0.50	0.80-1.20	0.50	1.00-1.80	4.75-5.50	1.25-1.80	Balance
3HSS	0.90	0.30	0.30	2.00	6.50		5.00	Balance
3FH	0.30	0.50	0.50			1.00	0.20	Balance
3AH	0.95-1.05	1.00	0.50	0.15-0.50		4.75-5.50	0.90-1.40	Balance
3WH	1.05	0.20	0.20	0.20		(a)		Balance
COATED ELECTRODES (Flux Coating listed in the next table)								
4WH	0.50-1.00	0.25-0.75	0.20-0.50	0.25-0.50		1.00-1.50	1.50-2.00	Balance
4HSS	0.70-1.00	0.75	1.00	1.00-2.50	5.00-7.00	3.00-5.00	4.00-6.00	Balance
4AH	0.70-1.00	0.25-0.50	0.25-0.50	0.75-1.00	1.00-1.25	4.75-5.25	1.75-2.25	Balance
4HW	0.25-0.50	0.50-1.00	0.50-1.00	0.25-0.50	1.00-1.50	4.75-5.50	1.50-2.00	Balance
4OH	0.75	1.00	0.50	0.50	0.50	1.50	1.50	Balance
4FH	0.25-0.35	0.40-0.60	0.15-0.30			0.80-1.10	0.15-0.25	Balance
Single values are maximums., S and P = 0.40% max ., (a) :Cu=0.50,(C):Ni=0.6								

2. COMPOSITION and INFORMATION ON INGREDIENTS

(FOR COATING ON ELECTRODES)

CHEMICAL NAME	CAS #	% w/w	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA			
			TLV mg/m^3	STEL mg/m^3	PEL mg/m^3	STEL mg/m^3	IDLH mg/m^3	OTHER mg/m^3
Potassium Oxalate	6487-48-5	1.50	NE	NE	NE	NE	NE	NE
Potassium Silicate	1312-76-1	10.00	NE	NE	NE	NE	NE	NE
Potassium Titanate	12056-51-8	10.00	NE	NE	NE	NE	NE	Carcinogen: MAK-A2 (fibrous dust)
Quartz	14808-60-7	5.00	0.1 (Respirable particulate fraction)	NE	30 mg/m^3 (Total dust) % SiO_2 + 2 250 mppcf (Respirable dust) % SiO_2 +5 or 10 mg/m^3 (Respirable dust) % SiO_2 + 2 0.1 (vacated 1989 PEL)		25	NIOSH REL: 0.05 (Respirable dust) DFG MAK: 0.15 (Respirable fraction) Carcinogen: IARC-2A, NIOSH-X, NTP-2A
Bentonite	70131-50-9	6.00	NE	NE	NE	NE	NE	NE
Calcium Carbonate	1317-65-3	50.00	10	NE	15 (Total Dust) 5 (Respirable fraction)	NE	NE	NIOSH REL: 10 (Total Dust) 5 (Respirable fraction)
Calcium Fluoride (exposure limits are for Fluoride, F)	14542-24-5	20.00	2.5, A4 (Not Classifiable as a Human Carcinogen)	NE	2.5	NE	NE	NIOSH REL: 2.5 DFG MAK: 2.5
Sodium Carboxymethyl Cellulose	9004-32-4	5.00	NE	NE	NE	NE	NE	NE
Sodium Silicate	1344-09-8	11.00	NE	NE	NE	NE	NE	NE
Talc (containing no asbestos fibers)	14807-96-6	5.00	2, A4 (Not Classifiable as a Human Carcinogen)	NE	20 mppcf (containing < 1% quartz) 2 (Respirable dust) (vacated 1989 PEL)		1000	NIOSH REL: 2 (Respirable dust) DFG MAK: 2 (Respirable fraction) Carcinogen: IARC-3
Graphite	7782-42-5	1.60	2	NE	15 mppcf	NE	1250	NIOSH REL: 2.5 (Respirable dust) DFG MAK: 6 (Respirable fraction)

NE = Not Established. See Section 16 for Definitions of Terms Used. Single values shown are maximum, unless otherwise noted.

NOTE (1): The ACGIH has an established exposure limit for Welding Fumes, Not Otherwise Classified. The Threshold Limit Value is 5 mg/m^3. NIOSH classifies welding fumes as carcinogens.

NOTE (2): ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-1998 format. These products have been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

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2. COMPOSITION and INFORMATION ON INGREDIENTS (Continued) (for solid wire or rods)

CHEMICAL NAME	CAS #	EXPOSURE LIMITS IN AIR					
		ACGIH		OSHA			OTHER mg/m^3
		TLV mg/m^3	STEL mg/m^3	PEL mg/m^3	STEL mg/m^3	IDLH mg/m^3	
Chromium	7440-47-3	0.5 0.5 (Cr. III)* 0.05 (Cr. VI,)*	NE	1.0 0.5 (Cr. III)*	NE 0.1(Ceiling on Cr. VI As CrO_3)*	250	NIOSH REL : TWA = 0.5 Carcinogen: EPA-D, EPA-CBD, IARC-3, TLV-A4 NIOSH REL : 0.5(Cr. III)* 0.001(Cr. VI)*
Iron (exposure limits are for iron oxide dust and fume [Fe_2O_3], as Fe)	7439-89-6	5, A4 (Not Classifiable as a Human Carcinogen)	NE	10	NE	2500	NIOSH REL: 5 DFG MAK: 6
Manganese (exposure limits are for Manganese, elemental, inorganic compounds, and fume, as Mn)	7439-96-5	0.2	NE	1 (Vacated 1989 PEL)	5 C 3 (Vacated 1989 PEL)	500	NIOSH REL: TWA: 1 STEL: 3 DFG MAK: 0.5 Carcinogen: EPA-D
Molybdenum	7439-98-7	NE	NE	15 10(vacated 1989 PEL)	NE	5000	NE
Carbon (exposure limits are for Particles Not Otherwise Specified)	7440-44-0	10 (Inhalable) 3 (Respirable)	NE	50 mppcf or 15 (Total Dust) 15 mppcf or 5 (Respirable Fraction)	NE	NE	DFG MAKs: TWA = 4 (Inhalable fraction); 1.5 (Respirable Fraction)
Silicon	7440-21-3	10	NE	15 (Total dust) 5 (Respirable fraction) 10 (Total dust) (vacated 1989 PEL)	NE	NE	NIOSH REL: 10 (Total dust) 5 (Respirable fraction)
Tungsten	7440-33-7	5	10	NE	NE	NE	NIOSH REL: TWA = 5 STEL = 10
Vanadium (exposure limits are for vanadium pentoxide, as V2O5, respirable dust of fume)	7440-62-2	0.05, A4 (Not Classifiable as a Human Carcinogen)	NE	NE	0.5 C (Respirable dust) 0.1 C (fume) 0.05 C (vacated 1989 PEL)	35	NIOSH REL: STEL = 0.05 C (15 minutes, total dust, as vanadium) DFG MAK: TWA = 0.05
Low Hazard constituents each present in less than 1 percent		NE	NE	NE	NE	NE	NE

NE = Not Established. See Section 16 for Definitions of Terms Used. Single values shown are maximum, unless otherwise noted.

NOTE (1): The ACGIH has an established exposure limit for Welding Fumes, Not Otherwise Classified. The Threshold Limit Value is 5 mg/m^3. NIOSH classifies welding fumes as carcinogens. * Compounds as Cr. & Cr. VI Water Soluble

NOTE (2): ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-1998 format. These products have been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: These products consist of solid wire or rods, which are odorless and may be copper coated or flux coated rods that are odorless. Chromium and Quartz (components of this product) are possible carcinogens. There are no immediate health hazards associated with the wire or rod form of this product. These products are not reactive. If involved in a fire, these products may generate irritating iron fumes and a variety of iron compounds. Emergency responders must wear personal protective equipment suitable for the situation to which they are responding.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: During welding operations, the most significant route of over-exposure is via inhalation of fumes.

INHALATION: Inhalation is not anticipated to be a significant route of over-exposure to the wire or rods. Inhalation of large amounts of particulates generated by these products during metal processing operations may result in pneumoconiosis (a disease of the lungs). Repeated over-exposures, via inhalation, to the dusts or fumes generated by these products may have adverse effects on the lungs with possible pulmonary edema and emphysema (life-threatening lung injuries). Refer to Section 10 (Stability and Reactivity) for information on the specific composition of welding fumes and gases.

CONTACT WITH SKIN or EYES: Contact of these products with the skin is not anticipated to be irritating. Contact with the wire or rod form of these products can be physically damaging to the eye. Fumes generated during welding operations can be irritating to the skin and eyes. Symptoms of skin over-exposure may include irritation and redness; prolonged or repeated skin over-exposures may lead to dermatitis. Contact with the molten wire or rods will burn contaminated skin or eyes.

SKIN ABSORPTION: Skin absorption is not known to be a significant route of over-exposure for any component of these products.

INGESTION: Ingestion is not anticipated to be a route of occupational exposure for these products.

HAZARDOUS MATERIAL INFORMATION SYSTEM

HEALTH	(BLUE)	0
FLAMMABILITY	(RED)	0
REACTIVITY	(YELLOW)	0
PROTECTIVE EQUIPMENT		X

EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8

For routine industrial applications for the rods

INJECTION: Though not a likely route of occupational exposure for these products, injection (via punctures or lacerations in the skin) may cause local reddening, tissue swelling, and discomfort.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Symptoms associated with over-exposure to these products and the fumes generated during welding operations are as follows:

ACUTE: The chief acute health hazard associated with these products would be the potential for irritation of contaminated skin and eyes when exposed to fumes during welding operations. Inhalation of large amounts of particulates generated by these products during metal processing operations can result in pneumoconiosis (a disease of the lungs). Contact with the molten material will burn contaminated skin or eyes.

CHRONIC: Chronic skin over-exposure to the fumes of these products during welding operations may produce dermatitis (red, inflamed skin). Repeated over-exposures to the fumes generated by these products via inhalation can have adverse effects on the lungs (e.g., pulmonary edema and emphysema). Repeated or prolonged ingestion exposures to > 50–100 mg of Iron per day can result in deposition of iron in the body tissues, which can cause disease.

PART II *What should I do if a hazardous situation occurs?*

4. FIRST-AID MEASURES

SKIN EXPOSURE: If fumes generated by welding operations involving these products contaminate the skin, begin decontamination with running water. If molten material contaminates the skin, immediately begin decontamination with cold, running water. Minimum flushing is for 15 minutes. Victim must seek medical attention if any adverse reaction occurs.

4. FIRST-AID MEASURES (Continued)

EYE EXPOSURE: If fumes generated by welding operations involving these products enter the eyes, open victim's eyes while under gently running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Victim must seek immediate medical attention.

INHALATION: If fumes generated by welding operations involving these products are inhaled, remove victim to fresh air. If necessary, use artificial respiration to support vital functions.

INGESTION: If swallowed call physician immediately! Do not induce vomiting unless directed by medical personnel. Rinse mouth with water if person is conscious. Never give fluids or induce vomiting if person is unconscious, having convulsions, or not breathing.

Victims of chemical exposure must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take a copy of label and MSDS to health professional with victim.

5. FIRE-FIGHTING MEASURES

FLASH POINT, °C (method): Not flammable.

AUTOIGNITION TEMPERATURE, °C: Not flammable.

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): Not applicable.
Upper (UEL): Not applicable.

FIRE EXTINGUISHING MATERIALS:

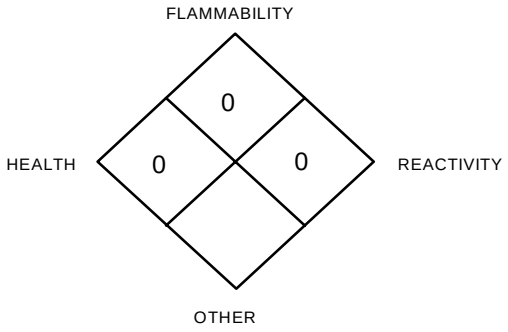
Water Spray: YES	Carbon Dioxide: YES
Halon: YES	Foam: YES
Dry Chemical: YES	Other: Any "ABC" Class

UNUSUAL FIRE AND EXPLOSION HAZARDS If melted these products may decompose and produce irritating fumes containing iron compounds and metal oxides. The molten material can present a significant thermal hazard to firefighters.

Explosion Sensitivity to Mechanical Impact: Not sensitive.
Explosion Sensitivity to Static Discharge: Not sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: N/A

NFPA RATING



See Section 16 for Definition of Ratings

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: N/A

PART III *How can I prevent hazardous situations from occurring*

7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting these products ON YOU or IN YOU. Wash hands after handling these products. Do not eat or drink while handling these products. Use ventilation and other engineering controls to minimize potential exposure to these products.

STORAGE AND HANDLING PRACTICES: All employees who handle these products should be trained to handle it safely. Use in a well-ventilated location. Avoid breathing fumes of these products during welding operations. Open containers on a stable surface. Packages of these products must be properly labeled.

When these products are used during welding operations, follow the requirements of the Federal Occupational Safety and Health Welding and Cutting Standard (29 CFR 1910 Subpart Q) and the safety standards of the American National Standards Institute for welding and cutting (ANSI Z49.1).

Store packages in a cool, dry location. Storage in an atmosphere that is wet, moist, or highly humid may lead to corrosion of these products. Store away from incompatible materials (see Section 10, Stability and Reactivity).

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided in Section 2 (Composition and Information on Ingredients). Prudent practice is to ensure eyewash/safety shower stations are available near areas where these products are used.

RESPIRATORY PROTECTION: Maintain airborne contaminant concentrations below guidelines listed in Section 2 (Composition and Information on Ingredients). If respiratory protection is needed (i.e., a Weld Fume Respirator, or AirLine Respirator for welding in confined spaces), use only protection authorized in 29 CFR 1910.134 or applicable State regulations. Respiratory Protection is recommended to be worn during welding operations. Use supplied air respiration protection if oxygen levels are below 19.5% or are unknown.

EYE PROTECTION: When these products are used in conjunction with welding, wear safety glasses, goggles, welding helmet, or face-shield with filter lens of appropriate shade number (per ANSI Z49.1-1988, "Safety in Welding and Cutting").

HAND PROTECTION: Wear gloves for routine industrial use. When these products are used in conjunction with welding, wear gloves that protect from sparks and flame (per ANSI Z49.1-1988, "Safety in Welding and Cutting").

BODY PROTECTION: Wear body protection appropriate for task.

9. PHYSICAL and CHEMICAL PROPERTIES

The following information is for elemental iron:

RELATIVE VAPOR DENSITY (air = 1): Not applicable.
SPECIFIC GRAVITY (water = 1): 7.86
SOLUBILITY IN WATER: Insoluble.
VAPOR PRESSURE, mm Hg @ 20°C: Not applicable.
ODOR THRESHOLD: Not applicable.
EVAPORATION RATE (nBuAc = 1): Not applicable.
FREEZING/MELTING POINT: 1535°C (2795°F)
pH: Not applicable.
BOILING POINT: 3000°C (5432°F)
COEFFICIENT OF OIL/WATER DISTRIBUTION (PARTITION COEFFICIENT): Not applicable.

The following information is for the product:

APPEARANCE AND COLOR: These products consist of solid wire or rods, which are odorless and may be coated electrodes or copper coated rods.

HOW TO DETECT THIS SUBSTANCE (warning properties): The appearance is a distinctive characteristic of these products.

10. STABILITY and REACTIVITY

STABILITY: Stable.

DECOMPOSITION PRODUCTS: Iron compounds, carbon monoxide, carbon dioxide and metal oxides.

NOTE: The composition and quality of welding fumes and gases are dependent upon the metal being welded, the process, the procedure, and the electrodes used. Other conditions that could also influence the composition and quantity of fumes and gases to which workers may be exposed include the following: any coatings on metal being welded (e.g., paint, plating, or galvanizing), the number of welders and the volume of the work area, the quality of ventilation, the position of the welder's head with respect to the fume plume, and the presence of other contaminates in the atmosphere. When the electrode is consumed, the fume and gas decomposition products generated are different in percent and form from the ingredients listed in Section 2 (Composition and Information on Ingredients). Fume and gas decomposition products, and not the ingredients in the electrode, are important. Concentration of the given fume or gas component may decrease or increase by many times the original concentration. New compounds in the electrode may form. Decomposition products of normal operations include not only those originating from volatilization, reaction, or oxidation of the product's components but also those from base metals and any coating (as noted previously). The best method to determine the actual composition of generated fumes and gases is to take an air sample from inside the welder's helmet if worn or in breathing zone. For additional information, refer to the American Welding Society Publication, "Fumes and Gases in the Welding Environment".

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids, strong oxidizers, mineral acids, and halogens.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Avoid uncontrolled exposure to extreme temperatures and incompatible materials.

PART IV *Is there any other useful information about this material?*

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: Presented below are human toxicological data available for the components of these products present in concentration greater than 1%. Other data for animals are available for the components of these products, but are not presented in this Material Safety Data Sheet.

IRON:
TDLo (oral, child) = 77 mg/kg; BAH, gastrointestinal tract, blood effects

MANGANESE:
TCLo (inhalation, man) = 2300 μg/m^3; BRN, central nervous system effects

QUARTZ:
TCLo (inhalation, human) = 16 mppcf/ 8 hours/ 17.9 years/ intermittent; pulmonary system effects
LCLo (inhalation, human) = 300 μg/m^3/ 10 years/ intermittent; systemic effects

SUSPECTED CANCER AGENT: The components of these products are listed as follows:

Chromium :ACGIH TLV-A4 (Not Classifiable as a Human Carcinogen; agents which cause concern that they could be carcinogenic for humans but which cannot be assessed conclusively because of lack of data), EPA-D (Not Classifiable as to Human Carcinogenicity (inadequate human and animal evidence of carcinogenicity or no data available), EPA-CBD (Cannot Be Determined); IARC-3 (Unclassifiable as to Carcinogenicity in Humans)

CHROMIUM VI: ACGIH TLV-A1 (Confirmed Human Carcinogen : Agent is carcinogenic to humans based epidemiologic studies of, or convincing clinical evidence in, exposed humans),EPA-A (Human Carcinogen: sufficient evidence from epidemiologic studies to support a causal association between exposure and cancer), IARC-1(Carcinogenic to Humans: sufficient evidence of carcinogenicity),NIOSH-X (Carcinogen defined with no further categorization),NTP-1(Known to be carcinogenic: sufficient evidence from human studies), MAK-1(Substances which are considered to be carcinogenic for man because adequate results of long-term animal studies or evidence from animal and epidemiological studies)

Manganese :EPA-D, Not Classifiable as to Human Carcinogenicity (inadequate human and animal evidence of Carcinogenicity or no data available).

Quartz:IARC Group 2A, Probably Carcinogenic to Humans (limited human evidence, sufficient evidence in experimental animals).
NIOSH-X, Carcinogen defined with no further categorization.
NTP-2A, Reasonably anticipated to be a carcinogen (limited evidence of carcinogenicity from studies in humans, which indicates that causal relationship is credible).

Talc:IARC Group 3, Not Classifiable as to Carcinogenicity to Humans.

The other components of these products are not found on the following lists: FEDERAL OSHA Z LIST, NTP, IARC, and CAL/OSHA and therefore are not considered to be, nor suspected to be, cancer-causing agents by these agencies.

IRRITANCY OF PRODUCT: Dusts or fumes of these products may be irritating to contaminated skin and eyes. Fumes may be irritating to the respiratory system.

SENSITIZATION TO THE PRODUCT: The components of these products are not known to be sensitizers with repeated or prolonged use.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of these products and their components on the human reproductive system.

Mutagenicity: These products are not reported to produce mutagenic effects in humans. Animal mutation data are available for Molybdenum (a component of these products); these data were obtained during clinical studies on specific animal tissues exposed to high doses of this compound.
Embryotoxicity These products are not reported to produce embryotoxic effects in humans.

REPRODUCTIVE TOCICITY INFORMATION (continued):

Teratogenicity: These products are not reported to cause teratogenic effects in humans. Clinical studies on test animals exposed to relatively high doses of Molybdenum and Tungsten (components of these products) indicate teratogenic effects.
Reproductive Toxicity: These products are not reported to cause reproductive effects in humans. Clinical studies on test animals exposed to relatively high doses of Molybdenum and Tungsten (components of these products) indicate adverse reproductive effects.

A mutagen is a chemical, which causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An embryotoxin is a chemical, which causes damage to a developing embryo (i.e., within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical, which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance, which interferes in any way with the reproductive process.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Skin, respiratory, pancreas, and liver disorders may be aggravated by prolonged over-exposures to the dusts or fumes generated by these products.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and eliminate overexposure.

BIOLOGICAL EXPOSURE INDICES: Currently, there are no Biological Exposure Indices (BEIs) associated with components of these products.

12. ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

ENVIRONMENTAL STABILITY: The components of these products occur naturally in the environment and are expected to persist in the environment for an extended period of time. Iron will react with water and air to form a variety of stable iron oxides.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: The components of these products occur naturally in the environment and are essential for plant and animal life.

EFFECT OF CHEMICAL ON AQUATIC LIFE: These products are not expected to cause adverse effects on aquatic life.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. These products, if unaltered by use, may be disposed of by treatment at a permitted facility or as advised by your local hazardous waste regulatory authority.

EPA WASTE NUMBER: Wastes of this product should be tested per the Toxicity Characteristic Leaching Procedures requirements of RCRA to determine if such wastes meet the following characteristic: D007 (Chromium) 5.0 mg/L (Regulated Level.

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS NOT HAZARDOUS (Per 49 CFR 172.101) BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Not applicable. **HAZARD CLASS NUMBER and DESCRIPTION:** Not applicable.
UN IDENTIFICATION NUMBER: Not applicable. **PACKING GROUP:** Not applicable.
DOT LABEL(S) REQUIRED: Not applicable.

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER, 1996: Not applicable.

MARINE POLLUTANT: No component of these products is designated as a marine pollutant by the Department of Transportation (49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS NOT CONSIDERED AS DANGEROUS GOODS.

15. REGULATORY INFORMATION

SARA REPORTING REQUIREMENTS: The components of these products are subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

COMPONENT	SARA 302	SARA 304	SARA 313
Chromium	No	Yes	Yes
Chromium (III) Oxide (Chromium Compound Category)	No	Yes	Yes
Manganese	No	No	Yes
Vanadium (fume or dust)	No	No	Yes

SARA THRESHOLD PLANNING QUANTITY: Not applicable. **TSCA INVENTORY STATUS:** The components of these products are listed on the TSCA Inventory. **CERCLA REPORTABLE QUANTITY (RQ):** Chromium = 5000 lbs.

OTHER FEDERAL REGULATIONS: Not applicable.

STATE REGULATORY INFORMATION: The components of these products are covered under specific State regulations, as denoted below:

Alaska-Designated Toxic and Hazardous Substances: Calcium Carbonate, Graphite, Chromium, Chromium (III) Compounds), Manganese, Molybdenum, and Tungsten, Vanadium (V_2O_5 fume or dust).

California-Permissible Exposure Limits for Chemical Contaminants: Calcium Carbonate, Graphite, Chromium, , Manganese, Silicon, and Tungsten.

Florida-Substance List: Chromium, Graphite, Manganese , Molybdenum, and Tungsten.

Illinois-Toxic Substance List: Chromium, Graphite, , Manganese, Molybdenum, Silicon, and Tungsten.

Kansas-Section 302/313 List: Chromium, Manganese, and Vanadium.

Massachusetts-Substance List: Calcium Carbonate, Graphite, Chromium, Chromium (III) Compounds), Manganese, Molybdenum, and Tungsten.

Michigan - Critical Materials Register: Chromium.

Minnesota-List of Hazardous Substances: Calcium Carbonate, Graphite, Chromium, Manganese, Silicon, and Tungsten.

Missouri-Employer Information/Toxic Substance List: Calcium Carbonate, Graphite, Chromium, Chromium (III) Compounds), Manganese, Molybdenum, Silicon, and Tungsten.

New Jersey-Right to Know Hazardous Substance List: Chromium, Chromium (III) Compounds), Manganese, Molybdenum, Tungsten, and Vanadium.

North Dakota-List of Hazardous Chemicals, Reportable Quantities: Chromium.

Pennsylvania-Hazardous Substance List: Calcium Carbonate, Graphite, Chromium, , Manganese, Molybdenum, Silicon, Tungsten, and Vanadium.

Rhode Island-Hazardous Substance List: Calcium Carbonate, Graphite, Chromium, Manganese, Molybdenum, Silicon, and Tungsten.

Texas-Hazardous Substance List: Graphite, Chromium, Manganese, and Molybdenum, Vanadium (V_2O_5 fume or dust).

West Virginia-Hazardous Substance List: Graphite, Chromium, Manganese, and Molybdenum, Vanadium (V_2O_5 fume or dust).

Wisconsin-Toxic and Hazardous Substances: Graphite, Chromium, Manganese, and Molybdenum, Vanadium (V_2O_5 fume or dust).

15. REGULATORY INFORMATION (Continued)

CALIFORNIA PROPOSITION 65: The Quartz (as silica, crystalline) and Chromium components of these products are on the California Proposition 65 List. **WARNING: These products may contain chemicals, and when used for welding may produce fumes or gases containing chemicals, known to the State of California to cause cancer, and/or birth defects (or other reproductive harm.)**

LABELING (Precautionary Statements): WARNING:

PROTECT yourself and others. Read and understand this information. **FUMES AND GASES** can be hazardous to your health. **ARC RAYS** can injure your eyes and burn skin. **ELECTRIC SHOCK** can kill.

- Before use, read and understand the manufacturer's instructions. Material Safety Data Sheets (MSDSs), and your employer's safety policies.
- Keep your head out of the fumes.
- Use enough ventilation, exhaust at the arc, or both, to keep fumes and gases from your breathing zone and the general area.
- Wear correct eye, ear, and body protection.
- See American National Standard Z49.1 *Safety in Welding, Cutting, and Allied Processes*, published by the American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33126. OSHA Safety and Health Standards, *29 CFR 1910*, available from the U.S. Government Printing Office, Washington, DC 20402.

DO NOT REMOVE THIS INFORMATION.

TARGET ORGANS: For fumes: Skin, eyes, respiratory system, pancreas and liver.

WHMIS SYMBOLS: Not applicable.

16. OTHER INFORMATION

DATE OF PRINTING: April 20, 2004

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these, which are commonly used, include the following:

CAS #: This is the Chemical Abstract Service Number, which uniquely identifies each constituent. It is used for computer-related searching.

EXPOSURE LIMITS IN AIR:

ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. **TLV -** Threshold Limit Value - an airborne concentration of a substance, which represents conditions under which it is generally believed that nearly all workers, may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour Time Weighted Average **(TWA)**, the 15-minute Short Term Exposure Limit, and the instantaneous Ceiling Level **(C)**. Skin absorption effects must also be considered.

OSHA - U.S. Occupational Safety and Health Administration.

PEL - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL, which was vacated by Court Order. **IDLH -** Immediately Dangerous to Life and Health **-** This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury. **The DFG - MAK** is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). NIOSH issues exposure guidelines called Recommended Exposure Levels (**REL**s). When no exposure guidelines are established, an entry of **NE** is made for reference.

HAZARD RATINGS:

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM: Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); **3** (Class IB and IC flammable liquids with flash points below 38°C [100°F]); **4** (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]. Reactivity Hazard: **0** (normally stable); 1 (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures).

NATIONAL FIRE PROTECTION ASSOCIATION: Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure causes death or major residual injury). Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the National Fire Protection Association (**NFPA**). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Human and Animal Toxicology: Possible health hazards as derived from human data, animals studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD_{50}** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC_{50}** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m^3** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **Cancer Information:** The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. **Other Information: BEI** - ACGIH Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV. **Ecological Information:** EC is the effect concentration in water. **BCF** = Bioconcentration Factor, which is used to determine if a substance will concentrate in lifeforms which consume contaminated plant or animal matter. Coefficient of Oil/Water Distribution is represented by **log K_{ow}** or **log K_{oc}** and is used to assess a substance's behavior in the environment.

REGULATORY INFORMATION:

This section explains the impact of various laws and regulations on the material. **U.S.: EPA** is the U.S. Environmental Protection Agency. **DOT** is the U.S. Department of Transportation. **SARA** is the Superfund Amendments and Reauthorization Act. **TSCA** is the U.S. Toxic Substance Control Act. **CERCLA (or Superfund)** refers to the Comprehensive Environmental Response, Compensation, and Liability Act. Labeling is per the American National Standards Institute (**ANSI Z129.1**). **CANADA: CEPA** is the Canadian Environmental Protection Act. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **TC** is Transport Canada. **DSL/NDSL** are the Canadian Domestic/Non-Domestic Substances Lists. **The CPR is the Canadian Product Regulations.** This section also includes information on the precautionary warnings, which appear, on the materials package label.

SAFETY DATA SHEET

Issuing Date 28-May-2020 **Revision date** 28-May-2020 **Revision Number** 1

1. Identification

Product identifier

Product Name MG 289

Other means of identification

Product Code(s) WN00019

Synonyms MG 289 electrode

Recommended use of the chemical and restrictions on use

Recommended use Covered Electrode for Shielded Metal Arc Welding (SMAW)

Restrictions on use

Details of the supplier of the safety data sheet

Supplier Address
MG Welding, N94W14355 Garwin Mace Dr., Menomonee Falls, WI 53051, USA

Manufacturer Address
MG Welding, N94W14355 Garwin Mace Dr., Menomonee Falls, WI 53051, USA

Emergency telephone number

Company Phone Number 1-262-532-4677

Emergency Telephone Chemtrec 1-800-424-9300

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin sensitization	Category 1
Carcinogenicity	Category 1A
Specific target organ toxicity (repeated exposure)	Category 1

Hazards not otherwise classified (HNOC)
Not applicable

Label elements

Danger

Hazard statements
May cause an allergic skin reaction

May cause cancer
Causes damage to organs through prolonged or repeated exposure

Appearance Coated electrode **Physical state** Solid **Odor** Odorless

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Wear protective gloves/protective clothing/eye protection/face protection
Contaminated work clothing must not be allowed out of the workplace
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product

Precautionary Statements - Response
IF exposed or concerned: Get medical advice/attention
Specific treatment (see on this label)
IF ON SKIN: Wash with plenty of water and soap
If skin irritation or rash occurs: Get medical advice/attention
Wash contaminated clothing before reuse

Precautionary Statements - Storage
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container to an approved waste disposal plant

Other information
Very toxic to aquatic life with long lasting effects
When this product is used in a welding process, the hazards are mostly from electric shock, heat, radiation, fumes and gases. Electric shock can kill. Arc rays, spatter, and melting metals can severely injure eyes and burn skin. Welding arc and sparks can cause fire
Fumes and gases can be dangerous to your health. Certain medical studies have suggested that nervous system and/or lung damage can result from overexposure to welding fumes and gases
The welding fumes and gases produced from welding rod, coating flux, and base metal in a welding process may contain manganese and manganese compounds, nickel and nickel compounds, chromium (VI) and chromium compound, carbon dioxide, carbon monoxide, nitrogen dioxide, and ozone
Overexposure to manganese and its compounds may cause metal fume fever and affect the central nervous system. Prolonged inhalation of nickel and chromium (VI) compounds above safe exposure limits can cause cancer

Unknown acute toxicity 97.0884 % of the mixture consists of ingredient(s) of unknown toxicity
8.41 % of the mixture consists of ingredient(s) of unknown acute oral toxicity
94.9304 % of the mixture consists of ingredient(s) of unknown acute dermal toxicity
97.0884 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (gas)
97.0884 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (vapor)
97.0884 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (dust/mist)

3. Composition/information on ingredients

Substance

Not applicable.

Mixture

Synonyms MG 289 electrode.

Chemical name	CAS No.	Weight-%	Trade secret
Nickel	7440-02-0	15-40	*
Diiron trioxide	1309-37-1	1-5	*
Natural Mineral Graphite	7782-42-5	1-5	*
Aluminum	7429-90-5	1-5	*
Limestone	1317-65-3	1-5	*
Calcium Fluoride	14542-23-5	1-5	*
Bentonite	1302-78-9	0.5-1.5	*

*The exact percentage (concentration) of composition has been withheld as a trade secret.

4. First-aid measures

Description of first aid measures

General advice Show this safety data sheet to the doctor in attendance. IF exposed or concerned: Get medical advice/attention.

Inhalation Remove to fresh air.

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin contact Wash with soap and water. May cause an allergic skin reaction. In the case of skin irritation or allergic reactions see a physician.

Ingestion Clean mouth with water and drink afterwards plenty of water.

Most important symptoms and effects, both acute and delayed

Symptoms Itching. Rashes. Hives.

Indication of any immediate medical attention and special treatment needed

Note to physicians May cause sensitization in susceptible persons. Treat symptomatically.

5. Fire-fighting measures

Suitable Extinguishing Media Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media CAUTION: Use of water spray when fighting fire may be inefficient.

Specific hazards arising from the chemical Product is or contains a sensitizer. May cause sensitization by skin contact.

Explosion data
Sensitivity to mechanical impact None.
Sensitivity to static discharge None.

Special protective equipment for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Personal precautions Avoid contact with skin, eyes or clothing. Ensure adequate ventilation. Use personal protective equipment as required. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak.

Other information Refer to protective measures listed in Sections 7 and 8.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Pick up and transfer to properly labeled containers.

7. Handling and storage

Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes or clothing. Ensure adequate ventilation. In case of insufficient ventilation, wear suitable respiratory equipment such as an air supplied respirator. Do not eat, drink or smoke when using this product. Take off contaminated clothing and wash before reuse.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place. Store locked up. Keep out of the reach of children.

8. Exposure controls/personal protection

Control parameters

Exposure Limits .

Chemical name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Nickel 7440-02-0	TWA: 1.5 mg/m³ inhalable particulate matter	TWA: 1 mg/m³ (vacated) TWA: 1 mg/m³	IDLH: 10 mg/m³ TWA: 0.015 mg/m³
Diiron trioxide 1309-37-1	TWA: 5 mg/m³ respirable particulate matter	TWA: 10 mg/m³ fume TWA: 15 mg/m³ total dust TWA: 5 mg/m³ respirable fraction (vacated) TWA: 10 mg/m³ fume and total dust Iron oxide (vacated) TWA: 5 mg/m³ respirable fraction regulated under Rouge	IDLH: 2500 mg/m³ Fe dust and fume TWA: 5 mg/m³ Fe dust and fume
Natural Mineral Graphite 7782-42-5	TWA: 2 mg/m³ respirable particulate matter all forms except graphite fibers	TWA: 15 mg/m³ total dust synthetic TWA: 5 mg/m³ respirable fraction synthetic (vacated) TWA: 2.5 mg/m³ respirable dust natural (vacated) TWA: 10 mg/m³ total dust synthetic (vacated) TWA: 5 mg/m³ respirable fraction synthetic TWA: 15 mppcf natural	IDLH: 1250 mg/m³ TWA: 2.5 mg/m³ natural respirable dust
Aluminum	TWA: 1 mg/m³ respirable	TWA: 15 mg/m³ total dust	TWA: 10 mg/m³ total dust

7429-90-5	particulate matter	TWA: 5 mg/m³ respirable fraction (vacated) TWA: 15 mg/m³ total dust (vacated) TWA: 5 mg/m³ respirable fraction	TWA: 5 mg/m³ respirable dust
Limestone 1317-65-3	No data available	TWA: 15 mg/m³ total dust TWA: 5 mg/m³ respirable fraction (vacated) TWA: 15 mg/m³ total dust (vacated) TWA: 5 mg/m³ respirable fraction	TWA: 10 mg/m³ total dust TWA: 5 mg/m³ respirable dust
Calcium Fluoride 14542-23-5	TWA: 2.5 mg/m³ F	TWA: 2.5 mg/m³ F (vacated) TWA: 2.5 mg/m³	IDLH: 250 mg/m³ F TWA: 2.5 mg/m³ F
Bentonite 1302-78-9	TWA: 1 mg/m³ respirable particulate matter	-	-

Appropriate engineering controls

Engineering controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles).

Hand protection Wear suitable gloves.

Skin and body protection Wear suitable protective clothing.

Respiratory protection No protective equipment is needed under normal use conditions. If exposure limits are exceeded or irritation is experienced, ventilation and evacuation may be required.

General hygiene considerations Do not eat, drink or smoke when using this product. Wash hands before breaks and immediately after handling the product.

9. Physical and chemical properties

Information on basic physical and chemical properties

Physical state Solid
Appearance Coated electrode
Color black
Odor Odorless
Odor threshold

Property	Values	Remarks • Method
pH	No data available	None known
Melting point / freezing point	No data available	None known
Boiling point / boiling range	No data available	None known
Flash point	No data available	None known
Evaporation rate	No data available	None known
Flammability (solid, gas)	No data available	None known
Flammability Limit in Air		None known
Upper flammability or explosive limits	No data available	
Lower flammability or explosive limits	No data available	
Vapor pressure	No data available	None known
Vapor density	No data available	None known

Relative density	No data available	None known
Water solubility	No data available	None known
Solubility in other solvents	No data available	None known
Partition coefficient	No data available	None known
Autoignition temperature	No data available	None known
Decomposition temperature	No data available	None known
Kinematic viscosity	No data available	None known
Dynamic viscosity	No data available	None known

Other information
Explosive properties
Oxidizing properties
VOC Content (%)

10. Stability and reactivity

Reactivity .

Chemical stability Stable under normal conditions.

Possibility of hazardous reactions None under normal processing.

Conditions to avoid None known based on information supplied.

Incompatible materials None known based on information supplied.

Hazardous decomposition products None known based on information supplied.

11. Toxicological information

Information on likely routes of exposure

Product Information

Inhalation Specific test data for the substance or mixture is not available.

Eye contact Specific test data for the substance or mixture is not available.

Skin contact May cause sensitization by skin contact. Specific test data for the substance or mixture is not available. Repeated or prolonged skin contact may cause allergic reactions with susceptible persons. (based on components).

Ingestion Specific test data for the substance or mixture is not available.

Symptoms related to the physical, chemical and toxicological characteristics

Symptoms Itching. Rashes. Hives.

Acute toxicity

Numerical measures of toxicity

The following values are calculated based on chapter 3.1 of the GHS document .

ATEmix (oral)	13,191.30 mg/kg
ATEmix (dermal)	6,770.10 mg/kg

Unknown acute toxicity 97.0884 % of the mixture consists of ingredient(s) of unknown toxicity
8.41 % of the mixture consists of ingredient(s) of unknown acute oral toxicity
94.9304 % of the mixture consists of ingredient(s) of unknown acute dermal toxicity

97.0884 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (gas)
97.0884 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (vapor)
97.0884 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (dust/mist)

Component Information

Chemical name	Oral LD50	Dermal LD50	Inhalation LC50
Nickel 7440-02-0	> 9000 mg/kg (Rat)	-	> 10.2 mg/L (Rat) 1 h
Diiron trioxide 1309-37-1	> 10000 mg/kg (Rat)	-	-
Natural Mineral Graphite 7782-42-5	-	-	> 2000 mg/m³ (Rat) 4 h
Calcium Fluoride 14542-23-5	= 4250 mg/kg (Rat)	-	-
Bentonite 1302-78-9	> 5000 mg/kg (Rat)	-	-

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation .

Serious eye damage/eye irritation .

Respiratory or skin sensitization May cause sensitization by skin contact.

Germ cell mutagenicity .

Carcinogenicity Classification based on data available for ingredients.

The table below indicates whether each agency has listed any ingredient as a carcinogen.

Chemical name	ACGIH	IARC	NTP	OSHA
Nickel 7440-02-0	-	Group 2B	Reasonably Anticipated	X
Diiron trioxide 1309-37-1	-	Group 3	-	-
Calcium Fluoride 14542-23-5	-	Group 3	-	-

Legend

IARC (International Agency for Research on Cancer)
Group 2B - Possibly Carcinogenic to Humans
Group 3 - Not Classifiable as to Carcinogenicity in Humans
NTP (National Toxicology Program)
Known - Known Carcinogen
Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen
OSHA (Occupational Safety and Health Administration of the US Department of Labor)
X - Present

Reproductive toxicity .

STOT - single exposure .

STOT - repeated exposure Causes damage to organs through prolonged or repeated exposure.

Target organ effects Respiratory system, Eyes, Skin, Central Vascular System (CVS), Lungs, Nasal Cavities.

Aspiration hazard .

Other adverse effects .

Interactive effects .

12. Ecological information

Ecotoxicity Very toxic to aquatic life with long lasting effects.

Chemical name	Algae/aquatic plants	Fish	Toxicity to microorganisms	Crustacea
Nickel 7440-02-0	EC50: 0.174 - 0.311mg/L (96h, Pseudokirchneriella subcapitata) EC50: =0.18mg/L (72h, Pseudokirchneriella subcapitata)	LC50: =10.4mg/L (96h, Cyprinus carpio) LC50: =1.3mg/L (96h, Cyprinus carpio) LC50: >100mg/L (96h, Brachydanio rerio)	-	EC50: =1mg/L (48h, Daphnia magna) EC50: >100mg/L (48h, Daphnia magna)
Diiron trioxide 1309-37-1	-	LC50: =100000mg/L (96h, Danio rerio)	-	-
Natural Mineral Graphite 7782-42-5	-	LC50: >100mg/L (96h, Danio rerio)	-	-
Bentonite 1302-78-9	-	LC50: =19000mg/L (96h, Oncorhynchus mykiss) LC50: 8.0 - 19.0g/L (96h, Salmo gairdneri)	-	-

Persistence and degradability .

Bioaccumulation There is no data for this product.

Other adverse effects .

13. Disposal considerations

Waste treatment methods

Waste from residues/unused products Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

Chemical name	RCRA	RCRA - Basis for Listing	RCRA - D Series Wastes	RCRA - U Series Wastes
Nickel 7440-02-0	-	Included in waste streams: F006, F039	-	-

California Hazardous Waste Status This product contains one or more substances that are listed with the State of California as a hazardous waste.

Chemical name	California Hazardous Waste Status
Nickel 7440-02-0	Toxic powder Ignitable powder
Aluminum 7429-90-5	Ignitable powder

14. Transport information

DOT Not regulated

TDG	Not regulated
MEX	Not regulated
ICAO (air)	Not regulated
IATA	Not regulated
IMDG	Not regulated
RID	Not regulated
ADR	Not regulated
ADN	Not regulated

15. Regulatory information

International Inventories

TSCA	Contact supplier for inventory compliance status.
DSL/NDSL	Contact supplier for inventory compliance status.
EINECS/ELINCS	Contact supplier for inventory compliance status.
ENCS	Contact supplier for inventory compliance status.
IECSC	Contact supplier for inventory compliance status.
KECL	Contact supplier for inventory compliance status.
PICCS	Contact supplier for inventory compliance status.
AICS	Contact supplier for inventory compliance status.

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

US Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazard Categories
Should this product meet EPCRA 311/312 Tier reporting criteria at 40 CFR 370, refer to Section 2 of this SDS for appropriate classifications. Under the amended regulations at 40 CFR 370, EPCRA 311/312 Tier II reporting for the 2017 calendar year will need to be consistent with updated hazard classifications.

CWA (Clean Water Act)
This product contains the following substances which are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

Chemical name	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
Nickel 7440-02-0	-	X	X	-

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302).

Chemical name	Hazardous Substances RQs	Extremely Hazardous Substances RQs
Nickel 7440-02-0	100 lb	-

US State Regulations

California Proposition 65
This product contains the following Proposition 65 chemicals:.

Chemical name	California Proposition 65
Nickel - 7440-02-0	Carcinogen
Silica, fused - 7631-86-9	Carcinogen
QUARTZ - 14808-60-7	Carcinogen

U.S. State Right-to-Know Regulations

US State Regulations

Chemical name	New Jersey	Massachusetts	Pennsylvania
Nickel 7440-02-0	X	X	X
Diiron trioxide 1309-37-1	X	X	X
Natural Mineral Graphite 7782-42-5	X	X	X
Aluminum 7429-90-5	X	X	X
Limestone 1317-65-3	X	X	X
Calcium Fluoride 14542-23-5	X	-	-
Manganese 7439-96-5	X	X	X
Silicon 7440-21-3	X	X	X

U.S. EPA Label Information

EPA Pesticide Registration Number Not applicable

16. Other information

NFPA **Health hazards** 2 **Flammability** 0 **Instability** 0 **Physical and chemical properties** -

HMIS **Health hazards** 2 * **Flammability** 0 **Physical hazards** 0 **Personal protection** X

Chronic Hazard Star Legend ** = Chronic Health Hazard*

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Key literature references and sources for data used to compile the SDS
Agency for Toxic Substances and Disease Registry (ATSDR)
U.S. Environmental Protection Agency ChemView Database
European Food Safety Authority (EFSA)
EPA (Environmental Protection Agency)

Acute Exposure Guideline Level(s) (AEGL(s))
U.S. Environmental Protection Agency Federal Insecticide, Fungicide, and Rodenticide Act
U.S. Environmental Protection Agency High Production Volume Chemicals
Food Research Journal
Hazardous Substance Database
International Uniform Chemical Information Database (IUCLID)
Japan GHS Classification
Australia National Industrial Chemicals Notification and Assessment Scheme (NICNAS)
NIOSH (National Institute for Occupational Safety and Health)
National Library of Medicine's ChemID Plus (NLM CIP)
National Library of Medicine's PubMed database (NLM PUBMED)
National Toxicology Program (NTP)
New Zealand's Chemical Classification and Information Database (CCID)
Organization for Economic Co-operation and Development Environment, Health, and Safety Publications
Organization for Economic Co-operation and Development High Production Volume Chemicals Program
Organization for Economic Co-operation and Development Screening Information Data Set
RTECS (Registry of Toxic Effects of Chemical Substances)
World Health Organization

Issuing Date 28-May-2020

Revision date 28-May-2020

Revision Note .

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: Tech-rod® 112
Product Size: 1/8" (3.2 mm)

Other means of identification
SDS number: 200000001175

Recommended use and restriction on use
Recommended use: SMAW (Shielded Metal Arc Welding)
Restrictions on use: Not known. Read this SDS before using this product.

Manufacturer/Importer/Supplier/Distributor Information

Company Name:	The Lincoln Electric Company
Address:	22801 Saint Clair Avenue Cleveland, Ohio 44117 USA
Telephone:	+1 (216) 481-8100
Contact Person:	Safety Data Sheet Questions: www.lincolnelectric.com/sds Arc Welding Safety Information: www.lincolnelectric.com/safety

Company Name:	Lincoln Electric Mexicana S.A. de C.V.
Address:	Calz. Azcapotzalco La Villa No. 869 Delegacion Azcapotzalco 02300 Mexico, D.F. Mexico
Telephone:	+1 52 55 5063 0030
Contact Person:	Safety Data Sheet Questions: www.lincolnelectric.com/sds Arc Welding Safety Information: www.lincolnelectric.com/safety

Company Name:	The Lincoln Electric Company of Canada LP
Address:	179 Wicksteed Avenue Toronto, Ontario M4G 2B9 Canada
Telephone:	+1 (416) 421-2600
Contact Person:	Safety Data Sheet Questions: www.lincolnelectric.com/sds Arc Welding Safety Information: www.lincolnelectric.com/safety

Emergency telephone number:

USA/Canada/Mexico	+1 (888) 609-1762
Americas/Europe	+1 (216) 383-8962
Asia Pacific	+1 (216) 383-8966
Middle East/Africa	+1 (216) 383-8969

3E Company Access Code: 333988

2. HAZARDS IDENTIFICATION

Hazard Classification Not classified as hazardous according to applicable GHS hazard classification criteria.

Label Elements
Hazard Symbol: No symbol

Signal Word: No signal word.

Hazard Statement: Not applicable

Precautionary Statements: Not applicable

Other hazards which do not result in GHS classification: None.

Substance(s) formed under the conditions of use: The welding fume produced from this welding electrode may contain the following constituent(s) and/or their complex metallic oxides as well as solid particles or other constituents from the consumables, base metal, or base metal coating not listed below.

Chemical Identity	CAS-No.
Carbon dioxide	124-38-9
Carbon monoxide	630-08-0
Nitrogen dioxide	10102-44-0
Ozone	10028-15-6
Manganese	7439-96-5
Chromium (VI)	18540-29-9
Nickel	7440-02-0
Chromium oxide	1308-38-9
Fluorides (as F)	16984-48-8

3. COMPOSITION / INFORMATION ON INGREDIENTS

Reportable Hazardous Ingredients
Mixtures

Chemical Identity	CAS number	Content in percent (%)*
Nickel	7440-02-0	20 - <50%
Chromium and chromium alloys or compounds (as Cr)	7440-47-3	10 - <20%
Titanium dioxide (synthetic)	13463-67-7	5 - <10%
Molybdenum	7439-98-7	5 - <10%
Limestone	1317-65-3	5 - <10%
Cryolite	15096-52-3	1 - <5%
Calcium fluoride	7789-75-5	1 - <5%
Niobium	7440-03-1	1 - <5%
Titanium dioxide (naturally occurring)	13463-67-7	1 - <5%
Sodium silicate	1344-09-8	1 - <5%
Iron	7439-89-6	1 - <5%
Potassium hydroxide	1310-58-3	0.1 - <1%
Manganese	7439-96-5	0.1 - <1%
Titanium	7440-32-6	0.1 - <1%
Potassium oxide	12136-45-7	0.1 - <1%
Bentonite	1302-78-9	0.1 - <1%
Vanadium alloys (as V)	7440-62-2	0.1 - <1%
Tin	7440-31-5	0.1 - <1%
Tungsten	7440-33-7	0.1 - <1%

Zinc	7440-66-6	0.1 - <1%
Silicon dioxide (amorphous)	7631-86-9	0.1 - <1%
Magnesite	546-93-0	0.1 - <1%
Sodium alginate	9005-38-3	0.1 - <1%
Potassium carbonate	584-08-7	0.1 - <1%
Aluminum and/or aluminum alloys (as Al)	7429-90-5	0.1 - <1%
Silicon	7440-21-3	0.1 - <1%
Copper and/or copper alloys and compounds (as Cu)	7440-50-8	0.1 - <1%
Quartz	14808-60-7	0.1 - <1%
Iron oxide	1309-37-1	0.1 - <1%
Cobalt and compounds (as Co)	7440-48-4	0.1 - <1%

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

Composition Comments: The term “Hazardous Ingredients” should be interpreted as a term defined in Hazard Communication standards and does not necessarily imply the existence of a welding or allied process hazard. The product may contain additional non-hazardous ingredients or may form additional compounds under the condition of use. Refer to Sections 2 and 8 for more information.

4. FIRST AID MEASURES

Ingestion: Avoid hand, clothing, food, and drink contact with fluxes, metal fume or powder which can cause ingestion of particulate during hand to mouth activities such as drinking, eating, smoking, etc. If ingested, do not induce vomiting. Contact a poison control center. Unless the poison control center advises otherwise, wash out mouth thoroughly with water. If symptoms develop, seek medical attention at once.

Inhalation: Move to fresh air if breathing is difficult. If breathing has stopped, perform artificial respiration and obtain medical assistance at once.

Skin Contact: Remove contaminated clothing and wash the skin thoroughly with soap and water. For reddened or blistered skin, or thermal burns, obtain medical assistance at once.

Eye contact: Dust or fume from this product should be flushed from the eyes with copious amounts of clean, tepid water until transported to an emergency medical facility. Do not allow victim to rub or keep eyes tightly closed. Obtain medical assistance at once.

Arc rays can injure eyes. If exposed to arc rays, move victim to dark room, remove contact lenses as necessary for treatment, cover eyes with a padded dressing and rest. Obtain medical assistance if symptoms persist.

Most important symptoms/effects, acute and delayed

Symptoms: Short-term (acute) overexposure to fumes and gases from welding and allied processes may result in discomfort such as metal fume fever, dizziness, nausea, or dryness or irritation of nose, throat, or eyes. May aggravate pre-existing respiratory problems (e.g. asthma, emphysema). Long-term (chronic) overexposure to fumes and gases from welding and allied processes can lead to siderosis (iron deposits in lung), central nervous system effects, bronchitis and other pulmonary effects. Refer to Section 11 for more information.

Hazards:	The hazards associated with welding and its allied processes such as soldering and brazing are complex and may include physical and health hazards such as but not limited to electric shock, physical strains, radiation burns (eye flash), thermal burns due to hot metal or spatter and potential health effects of overexposure to fumes, gases or dusts potentially generated during the use of this product. Refer to Section 11 for more information.

Indication of immediate medical attention and special treatment needed

Treatment:	Treat symptomatically.

5. FIRE-FIGHTING MEASURES

General Fire Hazards:	As shipped, this product is nonflammable. However, welding arc and sparks as well as open flames and hot surfaces associated with brazing and soldering can ignite combustible and flammable materials. Read and understand American National Standard Z49.1, "Safety in Welding, Cutting and Allied Processes" and National Fire Protection Association NFPA 51B, "Standard for Fire Prevention during Welding, Cutting and Other Hot Work" before using this product.

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media:	As shipped, the product will not burn. In case of fire in the surroundings: use appropriate extinguishing agent.
Unsuitable extinguishing media:	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical:	Welding arc and sparks can ignite combustibles and flammable products.

Special protective equipment and precautions for fire-fighters

Special fire-fighting procedures:	Use standard firefighting procedures and consider the hazards of other involved materials.
Special protective equipment for fire-fighters:	Selection of respiratory protection for fire fighting: follow the general fire precautions indicated in the workplace. Self-contained breathing apparatus and full protective clothing must be worn in case of fire.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures:	If airborne dust and/or fume is present, use adequate engineering controls and, if needed, personal protection to prevent overexposure. Refer to recommendations in Section 8.
Methods and material for containment and cleaning up:	Absorb with sand or other inert absorbent. Stop the flow of material, if this is without risk. Clean up spills immediately, observing precautions in the personal protective equipment in Section 8. Avoid generating dust. Prevent product from entering any drains, sewers or water sources. Refer to Section 13 for proper disposal.
Environmental Precautions:	Avoid release to the environment. Prevent further leakage or spillage if safe to do so. Do not contaminate water sources or sewer. Environmental manager must be informed of all major spillages.

7. HANDLING AND STORAGE

Precautions for safe handling: Prevent formation of dust. Provide appropriate exhaust ventilation at places where dust is formed.

Read and understand the manufacturer's instruction and the precautionary label on the product. Refer to Lincoln Safety Publications at www.lincolnelectric.com/safety. See American National Standard Z49.1, "Safety In Welding, Cutting and Allied Processes" published by the American Welding Society, http://pubs.aws.org and OSHA Publication 2206 (29CFR1910), U.S. Government Printing Office, www.gpo.gov.

Conditions for safe storage, including any incompatibilities: Store in closed original container in a dry place. Store in accordance with local/regional/national regulations. Store away from incompatible materials.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Control Parameters

Occupational Exposure Limits: US

Chemical Identity	Type	Exposure Limit Values	Source
Nickel - Inhalable fraction.	TWA	1.5 mg/m3	US. ACGIH Threshold Limit Values (12 2010)
Nickel - as Ni	REL	0.015 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Nickel	IDLH	10 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Nickel - as Ni	PEL	1 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Chromium and chromium alloys or compounds (as Cr) - as Cr	PEL	1 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
	REL	0.5 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Chromium and chromium alloys or compounds (as Cr) - Inhalable fraction. - as Cr(0)	TWA	0.5 mg/m3	US. ACGIH Threshold Limit Values (03 2018)
Chromium and chromium alloys or compounds (as Cr)	IDLH	250 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Titanium dioxide (synthetic)	TWA	10 mg/m3	US. ACGIH Threshold Limit Values (12 2010)
	IDLH	5,000 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Titanium dioxide (synthetic) - Total dust.	PEL	15 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Titanium dioxide (synthetic) - Respirable fraction.	TWA	5 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (03 2016)
Titanium dioxide (synthetic) - Total dust.	TWA	50 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (03 2016)
Titanium dioxide (synthetic) - Respirable fraction.	TWA	15 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (03 2016)
Titanium dioxide (synthetic) - Total dust.	TWA	15 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (03 2016)
Molybdenum - Total dust. - as Mo	PEL	15 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Molybdenum - Inhalable fraction. - as Mo	TWA	10 mg/m3	US. ACGIH Threshold Limit Values (03 2014)
Molybdenum - Respirable fraction. - as Mo	TWA	3 mg/m3	US. ACGIH Threshold Limit Values (03 2014)
Molybdenum	IDLH	5,000 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Molybdenum - Respirable	TWA	3 mg/m3	US. ACGIH Threshold Limit Values (01

particles.			2021)
Molybdenum - Inhalable particles.	TWA	10 mg/m3	US. ACGIH Threshold Limit Values (01 2021)
Molybdenum - Total dust.	TWA	15 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
	TWA	50 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
Molybdenum - Respirable fraction.	TWA	5 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
	TWA	15 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
Limestone - Total dust.	PEL	15 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Limestone - Respirable fraction.	PEL	5 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Limestone - Respirable.	REL	5 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Limestone - Total	REL	10 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Limestone - Inhalable particles.	TWA	10 mg/m3	US. ACGIH Threshold Limit Values (01 2021)
Limestone - Respirable particles.	TWA	3 mg/m3	US. ACGIH Threshold Limit Values (01 2021)
Limestone - Total dust.	TWA	50 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
Limestone - Respirable fraction.	TWA	5 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
Limestone - Total dust.	TWA	15 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
Limestone - Respirable fraction.	TWA	15 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
Cryolite - as F	TWA	2.5 mg/m3	US. ACGIH Threshold Limit Values (12 2010)
Cryolite - Respirable fraction.	TWA	1 mg/m3	US. ACGIH Threshold Limit Values (12 2010)
Cryolite - as F	REL	2.5 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
	PEL	2.5 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Cryolite - Dust.	TWA	2.5 mg/m3	US. OSHA Table Z-2 (29 CFR 1910.1000) (02 2006)
Cryolite	IDLH	250 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
	IDLH	250 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Calcium fluoride - as F	TWA	2.5 mg/m3	US. ACGIH Threshold Limit Values (12 2010)
Calcium fluoride	IDLH	250 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
	IDLH	250 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Calcium fluoride - as F	PEL	2.5 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Calcium fluoride - Dust.	TWA	2.5 mg/m3	US. OSHA Table Z-2 (29 CFR 1910.1000) (02 2006)
Titanium dioxide (naturally occurring)	TWA	10 mg/m3	US. ACGIH Threshold Limit Values (12 2010)
	IDLH	5,000 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Titanium dioxide (naturally occurring) - Total dust.	PEL	15 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)

Titanium dioxide (naturally occurring) - Respirable fraction.	TWA	5 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (03 2016)
Titanium dioxide (naturally occurring) - Total dust.	TWA	50 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (03 2016)
Titanium dioxide (naturally occurring) - Respirable fraction.	TWA	15 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (03 2016)
Titanium dioxide (naturally occurring) - Total dust.	TWA	15 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (03 2016)
Potassium hydroxide	Ceiling	2 mg/m3	US. ACGIH Threshold Limit Values (12 2010)
	Ceil_Time	2 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2016)
Manganese - Fume. - as Mn	Ceiling	5 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
	REL	1 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
	STEL	3 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Manganese - Inhalable fraction. - as Mn	TWA	0.1 mg/m3	US. ACGIH Threshold Limit Values (03 2014)
Manganese - Respirable fraction. - as Mn	TWA	0.02 mg/m3	US. ACGIH Threshold Limit Values (03 2014)
Manganese	IDLH	500 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Tin - as Sn	PEL	2 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
	REL	2 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Tin	IDLH	100 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Tin - Inhalable fraction.	TWA	2 mg/m3	US. ACGIH Threshold Limit Values (01 2019)
Tungsten - as W	REL	5 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
	STEL	10 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Tungsten - Respirable fraction. - as W	TWA	3 mg/m3	US. ACGIH Threshold Limit Values (03 2017)
Silicon dioxide (amorphous)	TWA	20 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (2000)
	TWA	0.8 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (2000)
	REL	6 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
	IDLH	3,000 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Silicon dioxide (amorphous) - Inhalable particles.	TWA	10 mg/m3	US. ACGIH Threshold Limit Values (01 2021)
Silicon dioxide (amorphous) - Respirable particles.	TWA	3 mg/m3	US. ACGIH Threshold Limit Values (01 2021)
Silicon dioxide (amorphous) - Total dust.	TWA	50 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
Silicon dioxide (amorphous) - Respirable fraction.	TWA	15 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
	TWA	5 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
Silicon dioxide (amorphous) - Total dust.	TWA	15 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
Magnesite - Total	REL	10 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Magnesite - Respirable.	REL	5 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)

Magnesite - Total dust.	PEL	15 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Magnesite - Respirable fraction.	PEL	5 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Magnesite - Respirable particles.	TWA	3 mg/m3	US. ACGIH Threshold Limit Values (01 2021)
Magnesite - Inhalable particles.	TWA	10 mg/m3	US. ACGIH Threshold Limit Values (01 2021)
Magnesite - Total dust.	TWA	15 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
	TWA	50 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
Magnesite - Respirable fraction.	TWA	15 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
	TWA	5 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
Aluminum and/or aluminum alloys (as Al) - Respirable fraction.	TWA	1 mg/m3	US. ACGIH Threshold Limit Values (12 2010)
Aluminum and/or aluminum alloys (as Al) - Total dust. - as Al	PEL	15 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Aluminum and/or aluminum alloys (as Al) - Welding fume or pyrophoric powder. - as Al	REL	5 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Aluminum and/or aluminum alloys (as Al) - Respirable.	REL	5 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Aluminum and/or aluminum alloys (as Al) - Total	REL	10 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Aluminum and/or aluminum alloys (as Al) - Respirable fraction. - as Al	PEL	5 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (03 2016)
Silicon - Total dust.	PEL	15 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Silicon - Respirable fraction.	PEL	5 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Silicon - Respirable.	REL	5 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Silicon - Total	REL	10 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Silicon - Respirable particles.	TWA	3 mg/m3	US. ACGIH Threshold Limit Values (01 2021)
Silicon - Inhalable particles.	TWA	10 mg/m3	US. ACGIH Threshold Limit Values (01 2021)
Silicon - Respirable fraction.	TWA	5 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
Silicon - Total dust.	TWA	50 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
	TWA	15 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
Silicon - Respirable fraction.	TWA	15 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (09 2016)
Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu	TWA	1 mg/m3	US. ACGIH Threshold Limit Values (03 2014)
Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu	TWA	0.2 mg/m3	US. ACGIH Threshold Limit Values (03 2014)
	REL	0.1 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2016)
Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu	REL	1 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2016)

Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu	PEL	0.1 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu	PEL	1 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Copper and/or copper alloys and compounds (as Cu)	IDLH	100 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Quartz - Respirable.	TWA	2.4 millions of particles per cubic foot of air	US. OSHA Table Z-3 (29 CFR 1910.1000) (2000)
	TWA	0.1 mg/m3	US. OSHA Table Z-3 (29 CFR 1910.1000) (2000)
Quartz - Respirable dust.	REL	0.05 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Quartz - Respirable dust.	TWA	0.05 mg/m3	US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050) (03 2016)
	OSHA_ACT	0.025 mg/m3	US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050) (03 2016)
Quartz - Respirable dust.	PEL	0.05 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (03 2016)
Quartz	IDLH	50 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Quartz - Respirable fraction.	TWA	0.025 mg/m3	US. ACGIH Threshold Limit Values (02 2020)
Iron oxide - Respirable fraction.	TWA	5 mg/m3	US. ACGIH Threshold Limit Values (12 2010)
Iron oxide - Fume.	PEL	10 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Iron oxide - Dust and fume. - as Fe	REL	5 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Iron oxide	IDLH	2,500 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Cobalt and compounds (as Co) - Dust and fume. - as Co	REL	0.05 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
	PEL	0.1 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Cobalt and compounds (as Co)	IDLH	20 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Cobalt and compounds (as Co) - Inhalable fraction. - as Co	TWA	0.02 mg/m3	US. ACGIH Threshold Limit Values (01 2021)

Occupational Exposure Limits: Canada

Chemical Identity	Type	Exposure Limit Values	Source
Nickel	TWA	1.5 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
Nickel - as Ni	TWA	0.05 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2018)
Nickel - Inhalable fraction.	TWA	1.5 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2011)
Nickel - Inhalable fraction. - as Ni	TWA	1 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (06 2015)
	8 HR ACL	1.5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)

	15 MIN ACL	3 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Nickel - Inhalable dust.	TWA	1.5 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (03 2020)
Chromium and chromium alloys or compounds (as Cr) - as Cr	TWA	0.5 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	0.5 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	8 HR ACL	0.5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	1.5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Chromium and chromium alloys or compounds (as Cr)	TWA	0.5 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Chromium and chromium alloys or compounds (as Cr) - Inhalable fraction. - as Cr(0)	TWA	0.5 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2018)
Chromium and chromium alloys or compounds (as Cr) - Total	TWA	0.5 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2018)
Titanium dioxide (synthetic)	TWA	10 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
Titanium dioxide (synthetic) - Total dust.	TWA	10 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
Titanium dioxide (synthetic) - Respirable fraction.	TWA	3 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
Titanium dioxide (synthetic)	TWA	10 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2011)
	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	8 HR ACL	10 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	20 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Titanium dioxide (synthetic) - Total dust.	TWA	10 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Molybdenum - Inhalable fraction. - as Mo	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	8 HR ACL	10 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)

Molybdenum - Respirable fraction. - as Mo	8 HR ACL	3 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Molybdenum - Inhalable fraction. - as Mo	15 MIN ACL	20 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Molybdenum - Respirable fraction. - as Mo	15 MIN ACL	6 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	TWA	3 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2014)
Molybdenum - Inhalable fraction. - as Mo	TWA	10 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2014)
Molybdenum - Respirable fraction. - as Mo	TWA	3 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (06 2015)
Molybdenum - Total particulate.	TWA	10 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (01 2019)
Molybdenum - Respirable particles.	TWA	3 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (01 2019)
Molybdenum - Respirable. - as Mo	TWA	3 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (06 2020)
Molybdenum - Inhalable - as Mo	TWA	10 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (06 2020)
Molybdenum - Inhalable particles.	TWA	10 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (01 2021)
Molybdenum - Respirable particles.	TWA	3 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (01 2021)
	TWA	3 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Molybdenum - Inhalable particles.	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Molybdenum - Respirable fraction.	TWA	3 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Molybdenum - Inhalable fraction.	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Molybdenum - Respirable dust. - as Mo	TWA	3 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (03 2020)
Molybdenum - Inhalable dust. - as Mo	TWA	10 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (03 2020)
Limestone	TWA	10 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
Limestone - Total dust.	STEL	20 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)

	TWA	10 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
Limestone - Respirable fraction.	TWA	3 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
Limestone	8 HR ACL	10 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	20 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Limestone - Total dust.	TWA	10 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Limestone - Inhalable particles.	TWA	10 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (01 2021)
Limestone - Respirable particles.	TWA	3 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (01 2021)
Limestone - Inhalable fraction.	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Limestone - Inhalable particles.	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Limestone - Respirable particles.	TWA	3 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Limestone - Respirable fraction.	TWA	3 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Cryolite - as F	TWA	2.5 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	2.5 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	2.5 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
	TWA	2.5 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2011)
Cryolite - Respirable fraction.	TWA	1 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2011)
Cryolite - as F	TWA	2.5 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
Cryolite - Respirable fraction.	TWA	1 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
Cryolite - as F	8 HR ACL	2.5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as

			amended (05 2009)
Cryolite - Dust. - as Al	15 MIN ACL	20 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	8 HR ACL	10 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Cryolite - as F	TWA	2.5 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Cryolite - Respirable.	TWA	1.0 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (06 2020)
Calcium fluoride - as F	TWA	2.5 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	2.5 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	2.5 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
	TWA	2.5 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2011)
	TWA	2.5 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	8 HR ACL	2.5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	TWA	2.5 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Titanium dioxide (naturally occurring)	TWA	10 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
Titanium dioxide (naturally occurring) - Total dust.	TWA	10 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
Titanium dioxide (naturally occurring) - Respirable fraction.	TWA	3 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
Titanium dioxide (naturally occurring)	TWA	10 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2011)
	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	8 HR ACL	10 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)

	15 MIN ACL	20 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Titanium dioxide (naturally occurring) - Total dust.	TWA	10 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Potassium hydroxide	CEILING	2 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	CEILING	2 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
	CEILING	2 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2011)
	CEV	2 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (07 2010)
	Ceiling	2 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	CEILING	2 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Manganese - as Mn	TWA	0.2 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	8 HR ACL	0.2 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	0.6 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Manganese - Respirable fraction. - as Mn	TWA	0.02 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2014)
Manganese - Inhalable fraction. - as Mn	TWA	0.1 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2014)
Manganese - as Mn	TWA	0.2 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (06 2015)
Manganese - Fume, total dust. - as Mn	TWA	0.2 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Manganese - Respirable. - as Mn	TWA	0.02 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2018)
Manganese - Total - as Mn	TWA	0.2 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2018)
Tin - as Sn	TWA	2 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
Tin	TWA	2 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07

			2007)
Tin - as Sn	TWA	2 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	8 HR ACL	2 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	4 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Tin	TWA	2 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Tin - Inhalable fraction.	TWA	2 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2019)
Tungsten - as W	STEL	10 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	5 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
Tungsten	STEL	10 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
	TWA	5 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
Tungsten - as W	TWA	5 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	STEL	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	8 HR ACL	5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	10 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	TWA	5 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
	STEL	10 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Tungsten - Respirable fraction. - as W	TWA	3 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2017)
Silicon dioxide (amorphous)	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (07 2010)
Silicon dioxide (amorphous) - Total particulate.	TWA	10 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (01 2019)
Silicon dioxide (amorphous) - Respirable particles.	TWA	3 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (01 2019)
Silicon dioxide (amorphous) - Respirable fraction.	TWA	3 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances,

			Occupational Health and Safety Regulation 296/97, as amended) (06 2020)
Silicon dioxide (amorphous) - Total dust.	TWA	10 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (06 2020)
Silicon dioxide (amorphous) - Respirable particles.	TWA	3 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (01 2021)
Silicon dioxide (amorphous) - Inhalable particles.	TWA	10 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (01 2021)
Silicon dioxide (amorphous) - Respirable fraction.	TWA	3 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Silicon dioxide (amorphous) - Inhalable particles.	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Silicon dioxide (amorphous) - Inhalable fraction.	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Silicon dioxide (amorphous) - Respirable particles.	TWA	3 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Silicon dioxide (amorphous) - Inhalable fraction.	15 MIN ACL	20 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (06 2016)
Silicon dioxide (amorphous) - Respirable fraction.	15 MIN ACL	6 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (06 2016)
	8 HR ACL	3 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (06 2016)
Silicon dioxide (amorphous) - Inhalable fraction.	8 HR ACL	10 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (06 2016)
Silicon dioxide (amorphous) - Total dust.	TWA	10 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (03 2020)
Magnesite - Total dust.	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (07 2010)
Magnesite	8 HR ACL	10 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	20 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Magnesite - Total dust.	TWA	10 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Magnesite - Respirable particles.	TWA	3 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (01 2019)
Magnesite - Total particulate.	TWA	10 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (01 2019)
Magnesite - Respirable fraction.	TWA	3 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (06 2020)

Magnesite - Total dust.	TWA	10 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (06 2020)
Magnesite - Respirable particles.	TWA	3 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (01 2021)
Magnesite - Inhalable particles.	TWA	10 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (01 2021)
Magnesite - Respirable particles.	TWA	3 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Magnesite - Respirable fraction.	TWA	3 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Magnesite - Inhalable particles.	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Magnesite - Inhalable fraction.	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Aluminum and/or aluminum alloys (as Al) - Pyrophoric powder. - as Al	TWA	5 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
Aluminum and/or aluminum alloys (as Al) - Dust.	TWA	10 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
Aluminum and/or aluminum alloys (as Al) - Respirable fraction.	TWA	1 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2011)
	TWA	1 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
Aluminum and/or aluminum alloys (as Al) - Pyrophoric powder. - as Al	8 HR ACL	5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Aluminum and/or aluminum alloys (as Al) - Dust. - as Al	8 HR ACL	10 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Aluminum and/or aluminum alloys (as Al) - Pyrophoric powder. - as Al	15 MIN ACL	10 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Aluminum and/or aluminum alloys (as Al) - Dust. - as Al	15 MIN ACL	20 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Aluminum and/or aluminum alloys (as Al)	TWA	10 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Aluminum and/or aluminum alloys (as Al) - as Al	TWA	5 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Aluminum and/or aluminum alloys (as Al) - Welding fume. - as Al	TWA	5 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Aluminum and/or aluminum alloys (as Al) - Respirable.	TWA	1.0 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (06 2020)
Silicon - Total dust.	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (07 2010)
Silicon	8 HR ACL	10 mg/m3	Canada. Saskatchewan OELs

			(Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	20 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Silicon - Total dust.	TWA	10 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Silicon - Respirable particles.	TWA	3 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (01 2019)
Silicon - Total particulate.	TWA	10 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (01 2019)
Silicon - Total dust.	TWA	10 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (06 2020)
Silicon - Respirable fraction.	TWA	3 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (06 2020)
Silicon - Inhalable particles.	TWA	10 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (01 2021)
Silicon - Respirable particles.	TWA	3 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (01 2021)
Silicon - Respirable fraction.	TWA	3 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Silicon - Inhalable fraction.	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Silicon - Inhalable particles.	TWA	10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Silicon - Respirable particles.	TWA	3 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (01 2020)
Copper and/or copper alloys and compounds (as Cu) - Fume.	TWA	0.2 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu	TWA	1 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu	TWA	0.2 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu	TWA	1 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
	TWA	1 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2014)
Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu	TWA	0.2 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2014)
Copper and/or copper alloys and compounds (as Cu) -	TWA	1 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical

Dust and fume. - as Cu			Agents), as amended (06 2015)
Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu	8 HR ACL	1 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu	15 MIN ACL	0.6 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu	15 MIN ACL	3 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu	8 HR ACL	0.2 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu	TWA	1 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu	TWA	0.2 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
	TWA	0.2 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (08 2017)
Quartz - Respirable particles.	TWA	0.025 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
Quartz - Respirable fraction.	8 HR ACL	0.05 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	TWA	0.10 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (06 2015)
Quartz - Respirable dust.	TWA	0.1 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Quartz - Respirable fraction.	TWA	0.025 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (06 2020)
	TWA	0.025 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (01 2021)
Iron oxide - Respirable.	TWA	5 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
Iron oxide - Total dust.	TWA	10 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
Iron oxide - Dust. - as Fe	TWA	5 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
Iron oxide - Fume. - as Fe	STEL	10 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
Iron oxide - Respirable fraction.	TWA	3 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances,

			Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
Iron oxide - Fume. - as Fe	TWA	5 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
Iron oxide - Respirable fraction.	TWA	5 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2011)
	TWA	5 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
Iron oxide	8 HR ACL	10 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	20 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Iron oxide - Dust and fume. - as Fe	15 MIN ACL	10 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	8 HR ACL	5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	TWA	5 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Cobalt and compounds (as Co) - as Co	TWA	0.02 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	0.02 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	8 HR ACL	0.02 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	0.06 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	TWA	0.02 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Cobalt and compounds (as Co) - Inhalable fraction. - as Co	TWA	0.02 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (01 2021)

Occupational Exposure Limits: Mexico

Chemical Identity	Type	Exposure Limit Values	Source
Nickel - Inhalable fraction. - as Ni	VLE-PPT	1.5 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Chromium and chromium alloys or compounds (as Cr)	VLE-PPT	0.5 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
	VLE-PPT	0.05 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)

	VLE-PPT	0.01 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Titanium dioxide (synthetic)	VLE-PPT	10 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Molybdenum - Respirable fraction. - as Mo	VLE-PPT	0.5 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Limestone - Inhalable fraction.	VLE-PPT	10 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Limestone - Respirable fraction.	VLE-PPT	3 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Cryolite - Respirable fraction.	VLE-PPT	1 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Cryolite - as F	VLE-PPT	2.5 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Calcium fluoride - as F	VLE-PPT	2.5 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Titanium dioxide (naturally occurring)	VLE-PPT	10 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Iron - as Fe	VLE-PPT	1 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Potassium hydroxide	VLE-P	2 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Manganese - as Mn	VLE-PPT	0.2 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Tin	VLE-PPT	2 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Tungsten - as W	VLE-CT	10 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
	VLE-PPT	5 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Silicon dioxide (amorphous) - Inhalable fraction.	VLE-PPT	10 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Silicon dioxide (amorphous) - Respirable fraction.	VLE-PPT	3 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Magnesite - Respirable fraction.	VLE-PPT	3 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)

Magnesite - Inhalable fraction.	VLE-PPT	10 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Aluminum and/or aluminum alloys (as Al) - Respirable fraction.	VLE-PPT	1 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Silicon - Inhalable fraction.	VLE-PPT	10 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Silicon - Respirable fraction.	VLE-PPT	3 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu	VLE-PPT	0.2 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu	VLE-PPT	1 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Quartz - Respirable fraction.	VLE-PPT	0.025 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Iron oxide - Respirable fraction.	VLE-PPT	5 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Cobalt and compounds (as Co) - as Co	VLE-PPT	0.02 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)

Biological Limit Values: US

Chemical Identity	Exposure Limit Values	Source
Nickel (Nickel: Sampling time: End of shift at end of work week.)	5 µg/l (Urine)	ACGIH BEI (01 2021)
Chromium and chromium alloys or compounds (as Cr) (Total chromium: Sampling time: End of shift at end of work week.)	0.7 µg/l (Urine)	ACGIH BEI (01 2021)
Cryolite (Fluoride: Sampling time: Prior to shift.)	2 mg/l (Urine)	ACGIH BEI (03 2013)
Cryolite (Fluoride: Sampling time: End of shift.)	3 mg/l (Urine)	ACGIH BEI (03 2013)
Calcium fluoride (Fluoride: Sampling time: Prior to shift.)	2 mg/l (Urine)	ACGIH BEI (03 2013)
Calcium fluoride (Fluoride: Sampling time: End of shift.)	3 mg/l (Urine)	ACGIH BEI (03 2013)
Cobalt and compounds (as Co) (Cobalt: Sampling time: End of shift at end of work week.)	15 µg/l (Urine)	ACGIH BEI (03 2015)

Biological Limit Values: Mexico

Chemical Identity	Exposure Limit Values	Source
Cryolite (fluorides: Sampling time: End of shift.)	10 mg/g (Creatinine in urine)	MX IBE (06 2012)
Cryolite (fluorides: Sampling time: Prior to shift.)	3 mg/g (Creatinine in urine)	MX IBE (06 2012)
Calcium fluoride (fluorides:	10 mg/g (Creatinine in urine)	MX IBE (06 2012)

Sampling time: End of shift.)		
Calcium fluoride (fluorides: Sampling time: Prior to shift.)	3 mg/g (Creatinine in urine)	MX IBE (06 2012)
Cobalt and compounds (as Co) (Cobalt: Sampling time: End of shift at end of work week.)	15 µg/l (Urine)	MX IBE (06 2012)
	1 µg/l (Blood)	MX IBE (06 2012)

Additional exposure limits under the conditions of use: US

Chemical Identity	Type	Exposure Limit Values		Source
Carbon dioxide	TWA	5,000 ppm		US. ACGIH Threshold Limit Values (12 2010)
	STEL	30,000 ppm		US. ACGIH Threshold Limit Values (12 2010)
	PEL	5,000 ppm	9,000 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
	STEL	30,000 ppm	54,000 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
	REL	5,000 ppm	9,000 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
	IDLH	40,000 ppm		US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Carbon monoxide	TWA	25 ppm		US. ACGIH Threshold Limit Values (12 2010)
	PEL	50 ppm	55 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
	REL	35 ppm	40 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
	Ceil_Time	200 ppm	229 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
	IDLH	1,200 ppm		US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Nitrogen dioxide	TWA	0.2 ppm		US. ACGIH Threshold Limit Values (02 2012)
	Ceiling	5 ppm	9 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
	STEL	1 ppm	1.8 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
	IDLH	20 ppm		US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
	IDLH	13 ppm		US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Ozone	PEL	0.1 ppm	0.2 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
	Ceil_Time	0.1 ppm	0.2 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
	TWA	0.05 ppm		US. ACGIH Threshold Limit Values (03 2014)
	TWA	0.10 ppm		US. ACGIH Threshold Limit Values (03 2014)
	TWA	0.08 ppm		US. ACGIH Threshold Limit Values (03 2014)
	IDLH	5 ppm		US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
	TWA	0.20 ppm		US. ACGIH Threshold Limit Values (02 2020)
Manganese - Fume. - as Mn	Ceiling		5 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
	REL		1 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
	STEL		3 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)

Manganese - Inhalable fraction. - as Mn	TWA	0.1 mg/m3	US. ACGIH Threshold Limit Values (03 2014)
Manganese - Respirable fraction. - as Mn	TWA	0.02 mg/m3	US. ACGIH Threshold Limit Values (03 2014)
Manganese	IDLH	500 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Chromium (VI)	TWA	0.005 mg/m3	US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050) (02 2006)
	OSHA_ACT	0.0025 mg/m3	US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050) (02 2006)
	Ceiling	0.1 mg/m3	US. OSHA Table Z-2 (29 CFR 1910.1000) (02 2006)
Chromium (VI) - as Cr(VI)	REL	0.0002 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2016)
Chromium (VI) - Inhalable fraction. - as Cr(VI)	TWA	0.0002 mg/m3	US. ACGIH Threshold Limit Values (03 2018)
	TWA	0.0002 mg/m3	US. ACGIH Threshold Limit Values (03 2018)
	STEL	0.0005 mg/m3	US. ACGIH Threshold Limit Values (03 2018)
	STEL	0.0005 mg/m3	US. ACGIH Threshold Limit Values (03 2018)
Chromium (VI)	IDLH	15 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (2018)
Nickel - Inhalable fraction.	TWA	1.5 mg/m3	US. ACGIH Threshold Limit Values (12 2010)
Nickel - as Ni	REL	0.015 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2005)
Nickel	IDLH	10 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Nickel - as Ni	PEL	1 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Chromium oxide - as Cr	PEL	0.5 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Chromium oxide - Inhalable fraction. - as Cr(III)	TWA	0.003 mg/m3	US. ACGIH Threshold Limit Values (03 2018)
Chromium oxide - as Cr(III)	REL	0.5 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2016)
Chromium oxide	IDLH	25 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)
Chromium oxide - Inhalable fraction. - as Cr(III)	TWA	0.003 mg/m3	US. ACGIH Threshold Limit Values (01 2021)
Fluorides (as F) - as F	TWA	2.5 mg/m3	US. ACGIH Threshold Limit Values (12 2010)
	PEL	2.5 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
Fluorides (as F) - Dust.	TWA	2.5 mg/m3	US. OSHA Table Z-2 (29 CFR 1910.1000) (02 2006)
Fluorides (as F)	IDLH	250 mg/m3	US. NIOSH. Immediately Dangerous to Life or Health (IDLH) Values (10 2017)

Additional exposure limits under the conditions of use: Canada

Chemical Identity	Type	Exposure Limit Values		Source
Carbon dioxide	STEL	30,000 ppm	54,000 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	5,000 ppm	9,000 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	5,000 ppm		Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety

				Regulation 296/97, as amended) (07 2007)
	STEL	15,000 ppm		Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
	TWA	5,000 ppm		Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2011)
	STEL	30,000 ppm		Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2011)
	STEL	30,000 ppm		Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	TWA	5,000 ppm		Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	8 HR ACL	5,000 ppm		Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	30,000 ppm		Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	TWA	5,000 ppm	9,000 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
	STEL	30,000 ppm	54,000 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Carbon monoxide	TWA	25 ppm	29 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	25 ppm		Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
	STEL	100 ppm		Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
	TWA	25 ppm		Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2011)
	TWA	25 ppm		Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (07 2010)
	8 HR ACL	25 ppm		Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	190 ppm		Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	TWA	35 ppm	40 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
	STEL	200 ppm	230 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Nitrogen dioxide	STEL	5 ppm	9.4 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)

	TWA	3 ppm	5.6 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	CEILING	1 ppm		Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
	TWA	0.2 ppm		Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2012)
	STEL	5 ppm		Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	TWA	3 ppm		Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	8 HR ACL	3 ppm		Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	5 ppm		Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	TWA	3 ppm	5.6 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Ozone	STEL	0.3 ppm	0.6 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	0.1 ppm	0.2 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	0.05 ppm		Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
	TWA	0.1 ppm		Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
	TWA	0.08 ppm		Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
	TWA	0.2 ppm		Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
	TWA	0.1 ppm	0.2 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (07 2010)
	STEL	0.3 ppm	0.6 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (07 2010)
	15 MIN ACL	0.15 ppm		Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	8 HR ACL	0.05 ppm		Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as

				amended (05 2009)
	CEILING	0.1 ppm	0.2 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (12 2008)
	TWA	0.05 ppm		Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2014)
	TWA	0.08 ppm		Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2014)
	TWA	0.10 ppm		Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2014)
	TWA	0.20 ppm		Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (02 2020)
Manganese - as Mn	TWA		0.2 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	8 HR ACL		0.2 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL		0.6 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Manganese - Respirable fraction. - as Mn	TWA		0.02 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2014)
Manganese - Inhalable fraction. - as Mn	TWA		0.1 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2014)
Manganese - as Mn	TWA		0.2 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (06 2015)
Manganese - Fume, total dust. - as Mn	TWA		0.2 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Manganese - Respirable. - as Mn	TWA		0.02 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2018)
Manganese - Total - as Mn	TWA		0.2 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2018)
Chromium (VI) - as Cr	TWA		0.01 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA		0.05 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA		0.05 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	15 MIN ACL		0.03 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL		0.15 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	8 HR ACL		0.01 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as

			amended (05 2009)
	8 HR ACL	0.05 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	TWA	0.05 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
	TWA	0.01 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Chromium (VI) - Inhalable fraction. - as Cr(VI)	STEL	0.0005 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2018)
	STEL	0.0005 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2018)
	TWA	0.0002 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2018)
	TWA	0.0002 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2018)
Chromium (VI) - Total - as Cr	CEILING	0.1 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (06 2020)
	TWA	0.025 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (06 2020)
Nickel	TWA	1.5 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
Nickel - as Ni	TWA	0.05 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2018)
Nickel - Inhalable fraction.	TWA	1.5 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2011)
Nickel - Inhalable fraction. - as Ni	TWA	1 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (06 2015)
	8 HR ACL	1.5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	3 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
Nickel - Inhalable dust.	TWA	1.5 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (03 2020)
Chromium oxide - as Cr	TWA	0.5 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	0.5 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	8 HR ACL	0.5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)

	15 MIN ACL	1.5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	TWA	0.5 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)
Chromium oxide - Inhalable fraction. - as Cr(III)	TWA	0.003 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2018)
Chromium oxide - Total - as Cr	TWA	0.5 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2018)
Chromium oxide - Inhalable fraction. - as Cr(III)	TWA	0.003 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (01 2021)
Fluorides (as F) - as F	TWA	2.5 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	2.5 mg/m3	Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2), as amended (07 2009)
	TWA	2.5 mg/m3	Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Biological Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007)
	TWA	2.5 mg/m3	Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act), as amended (03 2011)
	TWA	2.5 mg/m3	Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents), as amended (11 2010)
	8 HR ACL	2.5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	15 MIN ACL	5 mg/m3	Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21), as amended (05 2009)
	TWA	2.5 mg/m3	Canada. Quebec OELs. (Ministry of Labor - Regulation respecting occupational health and safety), as amended (09 2017)

Additional exposure limits under the conditions of use: Mexico

Chemical Identity	Type	Exposure Limit Values	Source
Carbon dioxide	VLE-CT	30,000 ppm	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
	VLE-PPT	5,000 ppm	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Carbon monoxide	VLE-PPT	25 ppm	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Nitrogen dioxide	VLE-PPT	0.2 ppm	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Ozone	VLE-P	0.1 ppm	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended

			(04 2014)
Manganese - as Mn	VLE-PPT	0.2 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Chromium (VI)	VLE-PPT	0.05 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Nickel - Inhalable fraction. - as Ni	VLE-PPT	1.5 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Chromium oxide	VLE-PPT	0.5 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)
Fluorides (as F) - as F	VLE-PPT	2.5 mg/m3	Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control), as amended (04 2014)

Appropriate Engineering Controls

Ventilation: Use enough ventilation and local exhaust at the arc, flame or heat source to keep the fumes and gases from the worker's breathing zone and the general area. Train the operator to keep their head out of the fumes. **Keep exposure as low as possible.**

Individual protection measures, such as personal protective equipment

General information:

Exposure Guidelines: To reduce the potential for overexposure, use controls such as adequate ventilation and personal protective equipment (PPE). Overexposure refers to exceeding applicable local limits, the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) or the Occupational Safety and Health Administration's (OSHA) Permissible Exposure Limits (PELs). Workplace exposure levels should be established by competent industrial hygiene assessments. Unless exposure levels are confirmed to be below the applicable local limit, TLV or PEL, whichever is lower, respirator use is required. Absent these controls, overexposure to one or more compound constituents, including those in the fume or airborne particles, may occur resulting in potential health hazards. According to the ACGIH, TLVs and Biological Exposure Indices (BEIs) "represent conditions under which ACGIH believes that nearly all workers may be repeatedly exposed without adverse health effects." The ACGIH further states that the TLV-TWA should be used as a guide in the control of health hazards and should not be used to indicate a fine line between safe and dangerous exposures. See Section 10 for information on constituents which have some potential to present health hazards. Welding consumables and materials being joined may contain chromium as an unintended trace element. Materials that contain chromium may produce some amount of hexavalent chromium (CrVI) and other chromium compounds as a byproduct in the fume. In 2018, the American Conference of Governmental Industrial Hygienists (ACGIH) lowered the Threshold Limit Value (TLV) for hexavalent chromium from 50 micrograms per cubic meter of air (50 µg/m³) to 0.2 µg/m³. At these new limits, CrVI exposures at or above the TLV may be possible in cases where adequate ventilation is not provided. CrVI compounds are on the IARC and NTP lists as posing a lung cancer and sinus cancer risk. Workplace conditions are unique and welding fume exposures levels vary. Workplace exposure assessments must be conducted by a qualified professional, such as an industrial hygienist, to determine if exposures are below applicable limits and to make recommendations when necessary for preventing overexposures.

Eye/face protection:

Wear helmet or use face shield with filter lens shade number 12 or darker

for open arc processes – or follow the recommendations as specified in ANSI Z49.1, Section 4, based on your process and settings. No specific lens shade recommendation for submerged arc or electroslag processes. Shield others by providing appropriate screens and flash goggles.

Skin Protection

Hand Protection: Wear protective gloves. Suitable gloves can be recommended by the glove supplier.

Other: **Protective Clothing:** Wear hand, head, and body protection which help to prevent injury from radiation, open flames, hot surfaces, sparks and electrical shock. See Z49.1. At a minimum, this includes welder's gloves and a protective face shield when welding, and may include arm protectors, aprons, hats, shoulder protection, as well as dark substantial clothing when welding, brazing and soldering. Wear dry gloves free of holes or split seams. Train the operator not to permit electrically live parts or electrodes from contacting the skin . . . or clothing or gloves if they are wet. Insulate yourself from the work piece and ground using dry plywood, rubber mats or other dry insulation.

Respiratory Protection: Keep your head out of fumes. Use enough ventilation and local exhaust to keep fumes and gases from your breathing zone and the general area. An approved respirator should be used unless exposure assessments are below applicable exposure limits.

Hygiene measures: Do not eat, drink or smoke when using the product. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Determine the composition and quantity of fumes and gases to which workers are exposed by taking an air sample from inside the welder's helmet if worn or in the worker's breathing zone. Improve ventilation if exposures are not below limits. See ANSI/AWS F1.1, F1.2, F1.3 and F1.5, available from the American Welding Society, www.aws.org.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Steel rod with extruded flux coating.
Physical state:	Solid
Form:	Solid
Color:	No data available.
Odor:	No data available.
Odor threshold:	No data available.
pH:	No data available.
Melting point/freezing point:	No data available.
Initial boiling point and boiling range:	No data available.
Flash Point:	No data available.
Evaporation rate:	No data available.
Flammability (solid, gas):	No data available.
Upper/lower limit on flammability or explosive limits	
Flammability limit - upper (%):	No data available.
Flammability limit - lower (%):	No data available.
Explosive limit - upper:	No data available.

Explosive limit - lower:	No data available.
Vapor pressure:	No data available.
Vapor density:	No data available.
Density:	No data available.
Relative density:	No data available.
Solubility(ies)	
Solubility in water:	No data available.
Solubility (other):	No data available.
Partition coefficient (n-octanol/water):	No data available.
Auto-ignition temperature:	No data available.
Decomposition temperature:	No data available.
Viscosity:	No data available.

10. STABILITY AND REACTIVITY

Reactivity:	The product is non-reactive under normal conditions of use, storage and transport.
Chemical Stability:	Material is stable under normal conditions.
Possibility of hazardous reactions:	None under normal conditions.
Conditions to avoid:	Avoid heat or contamination.
Incompatible Materials:	Strong acids. Strong oxidizing substances. Strong bases.
Hazardous Decomposition Products:	Fumes and gases from welding and its allied processes such as brazing and soldering cannot be classified simply. The composition and quantity of both are dependent upon the metal to which the joining or hot work is applied, the process, procedure - and where applicable - the electrode or consumable used. Other conditions which also influence the composition and quantity of the fumes and gases to which workers may be exposed include: coatings on the metal being welded or worked (such as paint, plating, or galvanizing), the number of operators and the volume of the work area, the quality and amount of ventilation, the position of the operator's head with respect to the fume plume, as well as the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing activities.) In cases where an electrode or other applied material is consumed, the fume and gas decomposition products generated are different in percent and form from the ingredients listed in Section 3. Decomposition products of normal operation include those originating from the volatilization, reaction, or oxidation of the materials shown in Section 3, plus those from the base metal and coating, etc., as noted above. Reasonably expected fume constituents produced during arc welding and brazing include the oxides of iron, manganese and other metals present in the welding consumable or base metal. Hexavalent chromium compounds may be in the welding or brazing fume of consumables or base metals which contain chromium. Gaseous and particulate fluoride may be in the fume of consumables or flux materials which contain fluoride. Gaseous reaction products may include carbon monoxide and carbon dioxide. Ozone and nitrogen oxides may be formed by the radiation from the arc associated

with welding.

11. TOXICOLOGICAL INFORMATION

General information: The International Agency for Research on Cancer (IARC) has determined welding fumes and ultraviolet radiation from welding are carcinogenic to humans (Group 1). According to IARC, welding fumes cause cancer of the lung and positive associations have been observed with cancer of the kidney. Also according to IARC, ultraviolet radiation from welding causes ocular melanoma. IARC identifies gouging, brazing, carbon arc or plasma arc cutting, and soldering as processes closely related to welding. Read and understand the manufacturer's instructions, Safety Data Sheets and the precautionary labels before using this product.

Information on likely routes of exposure

Inhalation: Potential chronic health hazards related to the use of welding consumables are most applicable to the inhalation route of exposure. Refer to Inhalation statements in Section 11.

Skin Contact: Arc rays can burn skin. Skin cancer has been reported.

Eye contact: Arc rays can injure eyes.

Ingestion: Health injuries from ingestion are not known or expected under normal use.

Symptoms related to the physical, chemical and toxicological characteristics

Inhalation: Respiratory exposure to the crystalline silica present in this welding electrode is not anticipated during normal use. Respiratory overexposure to airborne crystalline silica is known to cause silicosis, a form of disabling pulmonary fibrosis which can be progressive and may lead to death. Crystalline silica is on the IARC (International Agency for Research on Cancer) and NTP (National Toxicology Program) lists as posing a cancer risk to humans. Note: All regional authorities do not use the same criteria for assigning carcinogenic classifications to chemicals. For example, the European Union (EU) CLP does not require classifying crystalline silica as a carcinogenic compound. Short-term (acute) overexposure to fumes and gases from welding and allied processes may result in discomfort such as metal fume fever, dizziness, nausea, or dryness or irritation of nose, throat, or eyes. May aggravate pre-existing respiratory problems (e.g. asthma, emphysema). Long-term (chronic) overexposure to fumes and gases from welding and allied processes can lead to siderosis (iron deposits in lung), central nervous system effects, bronchitis and other pulmonary effects.

Information on toxicological effects

Acute toxicity (list all possible routes of exposure)

Oral

Product: Not classified

Specified substance(s):

Limestone	LD 50 (Rat): 6,450 mg/kg
Calcium fluoride	LD 50 (Rat): 4,250 mg/kg
Sodium silicate	LD 50 (Rat): 1.1 g/kg
Iron	LD 50 (Rat): 98.6 g/kg
Potassium hydroxide	LD 50 (Rat): 333 mg/kg
Potassium carbonate	LD 50 (Rat): 1,870 mg/kg
Copper and/or copper alloys and compounds (as Cu)	LD 50 (Rat): 481 mg/kg

Cobalt and compounds (as Co)	LD 50 (Rat): 550 mg/kg

Dermal

Product:	Not classified
Specified substance(s):	
Potassium carbonate	LD 50 (Rabbit): > 2,000 mg/kg

Inhalation

Product:	Not classified
Specified substance(s):	
Aluminum and/or aluminum alloys (as Al)	LC 50 (Rat, 1 h): 7.6 mg/l
Cobalt and compounds (as Co)	LC 50 (Rat, 4 h): <= 0.05 mg/l

Repeated dose toxicity
Product: Not classified

Skin Corrosion/Irritation
Product: Not classified

Serious Eye Damage/Eye Irritation
Product: Not classified

Respiratory or Skin Sensitization
Product: Not classified

Carcinogenicity
Product: Arc rays: Skin cancer has been reported.

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:

Nickel	Overall evaluation: 2B. Possibly carcinogenic to humans.
Titanium dioxide (synthetic)	Overall evaluation: 2B. Possibly carcinogenic to humans.
Titanium dioxide (naturally occurring)	Overall evaluation: 2B. Possibly carcinogenic to humans.
Quartz	Overall evaluation: 1. Carcinogenic to humans.
Cobalt and compounds (as Co)	Overall evaluation: 2B. Possibly carcinogenic to humans.

US. National Toxicology Program (NTP) Report on Carcinogens:

Nickel	Reasonably Anticipated to be a Human Carcinogen.
Quartz	Known To Be Human Carcinogen.
Cobalt and compounds (as Co)	Reasonably Anticipated to be a Human Carcinogen.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050), as amended:

Quartz	Cancer

Germ Cell Mutagenicity

In vitro
Product: Not classified

In vivo
Product: Not classified

Reproductive toxicity

Product:	Not classified

Specific Target Organ Toxicity - Single Exposure

Product:	Not classified

Specific Target Organ Toxicity - Repeated Exposure

Product:	Not classified

Aspiration Hazard

Product:	Not classified
Other effects:	Organic polymers may be used in the manufacture of various welding consumables. Overexposure to their decomposition byproducts may result in a condition known as polymer fume fever. Polymer fume fever usually occurs within 4 to 8 hours of exposure with the presentation of flu like symptoms, including mild pulmonary irritation with or without an increase in body temperature. Signs of exposure can include an increase in white blood cell count. Resolution of symptoms typically occurs quickly, usually not lasting longer than 48 hours.

Symptoms related to the physical, chemical and toxicological characteristics under the condition of use

Inhalation:

Specified substance(s):

Manganese	Overexposure to manganese fumes may affect the brain and central nervous system, resulting in poor coordination, difficulty speaking, and arm or leg tremor. This condition can be irreversible.
Chromium (VI)	Chromates may cause ulceration, perforation of the nasal septum, and severe irritation of the bronchial tubes and lungs. Liver damage and allergic reactions, including skin rash, have been reported. Asthma has been reported in some sensitized individuals. Skin contact may result in irritation, ulceration, sensitization, and contact dermatitis. Chromates contain the hexavalent form of chromium. Hexavalent chromium and its compounds are on the IARC (International Agency for Research on Cancer) and NTP (National Toxicology Program) lists as posing a cancer risk to humans.
Nickel	Nickel and its compounds are on the IARC and NTP lists as posing respiratory cancer risk, and are skin sensitizers with symptoms ranging from slight itch to severe dermatitis.

Additional toxicological Information under the conditions of use:

Acute toxicity

Oral

Specified substance(s):

Chromium (VI)	LD 50 (Rat): 27 - 59 mg/kg
Fluorides (as F)	LD 50 (Rat): 4,250 mg/kg

Inhalation

Specified substance(s):

Carbon dioxide	LC Lo (Human, 5 min): 90000 ppm
Carbon monoxide	LC 50 (Rat, 4 h): 1300 ppm
Nitrogen dioxide	LC 50 (Rat, 4 h): 88 ppm
Ozone	LC Lo (Human, 30 min): 50 ppm
Chromium (VI)	LC 50 (Rat, 4 h): 33 - 70 mg/m3

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:

Specified substance(s):

Chromium (VI)	Overall evaluation: 1. Carcinogenic to humans.
Nickel	Overall evaluation: 2B. Possibly carcinogenic to humans.
Chromium oxide	Overall evaluation: 3. Not classifiable as to carcinogenicity to humans.

US. National Toxicology Program (NTP) Report on Carcinogens:
Specified substance(s):

Chromium (VI)	Known To Be Human Carcinogen.
Nickel	Reasonably Anticipated to be a Human Carcinogen.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050), as amended:
Specified substance(s):

Chromium (VI)	Cancer

Other effects:
Specified substance(s):

Carbon dioxide	Asphyxia
Carbon monoxide	Carboxyhemoglobinemia
Nitrogen dioxide	Lower respiratory tract irritation
Nickel	Dermatitis Pneumoconiosis

12. ECOLOGICAL INFORMATION

Ecotoxicity
Acute hazards to the aquatic environment:
Fish

Product:	Not classified.
Specified substance(s):	
Nickel	LC 50 (Fathead minnow (Pimephales promelas), 96 h): 2.916 mg/l
Molybdenum	LC 50 (Rainbow trout,donaldson trout (Oncorhynchus mykiss), 96 h): 800 mg/l
Cryolite	LC 50 (Rainbow trout,donaldson trout (Oncorhynchus mykiss), 96 h): 47 mg/l
Calcium fluoride	LC 50 (96 h): 340 mg/l
Sodium silicate	LC 50 (Western mosquitofish (Gambusia affinis), 96 h): 1,800 mg/l
Potassium hydroxide	LC 50 (Gambusia affinis, 96 h): 80 mg/l
Bentonite	LC 50 (Rainbow trout,donaldson trout (Oncorhynchus mykiss), 96 h): 19,000 mg/l
Zinc	LC 50 (Fathead minnow (Pimephales promelas), 96 h): 1.277 - 3.649 mg/l
Potassium carbonate	LC 50 (Fathead minnow (Pimephales promelas), 96 h): < 750 mg/l
Aluminum and/or aluminum alloys (as Al)	LC 50 (Grass carp, white amur (Ctenopharyngodon idella), 96 h): 0.21 - 0.31 mg/l
Copper and/or copper alloys and compounds (as Cu)	LC 50 (Fathead minnow (Pimephales promelas), 96 h): 1.6 mg/l
Cobalt and compounds (as Co)	LC 50 (Rainbow trout,donaldson trout (Oncorhynchus mykiss), 28 d): > 0.17 - < 15.61 mg/l

Aquatic Invertebrates

Product:	Not classified.
Specified substance(s):	
Nickel	EC 50 (Water flea (Daphnia magna), 48 h): 1 mg/l
Calcium fluoride	EC 50 (Daphnia magna; Daphnia sp., 48 h): 270 mg/l
Sodium silicate	EC 50 (Water flea (Ceriodaphnia dubia), 48 h): 22.94 - 49.01 mg/l
Manganese	EC 50 (Water flea (Daphnia magna), 48 h): 40 mg/l
Zinc	EC 50 (Water flea (Daphnia magna), 48 h): 2.8 mg/l
Potassium carbonate	LC 50 (Water flea (Ceriodaphnia dubia), 48 h): 580 - 670 mg/l
Copper and/or copper alloys and compounds	EC 50 (Water flea (Daphnia magna), 48 h): 0.102 mg/l

(as Cu)

Chronic hazards to the aquatic environment:

Fish

Product: Not classified.

Aquatic Invertebrates

Product: Not classified.

Toxicity to Aquatic Plants

Product: Not classified.

Specified substance(s):

Copper and/or copper alloys and compounds (as Cu)	LC 50 (Green algae (Scenedesmus dimorphus), 3 d): 0.0623 mg/l

Persistence and Degradability

Biodegradation

Product: No data available.

Bioaccumulative potential

Bioconcentration Factor (BCF)

Product: No data available.

Specified substance(s):

Nickel	Zebra mussel (Dreissena polymorpha), Bioconcentration Factor (BCF): 5,000 - 10,000 (Lotic) Bioconcentration factor calculated using dry weight tissue conc
Zinc	Brown shrimp (Penaeus aztecus), Bioconcentration Factor (BCF): > 400 - < 600 (Static)
Copper and/or copper alloys and compounds (as Cu)	Blue-green algae (Anacystis nidulans), Bioconcentration Factor (BCF): 36.01 (Static)
Cobalt and compounds (as Co)	Brown shrimp (Penaeus aztecus), Bioconcentration Factor (BCF): > 2,250 - < 2,500 (Static)

Mobility in soil: No data available.

13. Disposal considerations

General information: The generation of waste should be avoided or minimized whenever possible. When practical, recycle in an environmentally acceptable, regulatory compliant manner. Dispose of non-recyclable products in accordance with all applicable Federal, State, Provincial, and Local requirements.

Disposal instructions: Disposal of this product may be regulated as a Hazardous Waste. The welding consumable and/or by-product from the welding process (including, but not limited to slag, dust, etc.) may contain levels of leachable heavy metals such as Barium or Chromium. Prior to disposal, a representative sample must be analyzed in accordance with US EPA's Toxicity Characteristic Leaching Procedure (TCLP) to determine if any constituents exist above regulated threshold levels. Discard any product, residue, disposable container, or liner in an environmentally acceptable manner according to Federal, State and Local Regulations.

Contaminated Packaging: Dispose of contents/container to an appropriate treatment and disposal facility in accordance with applicable laws and regulations, and product

characteristics at time of disposal.

14. TRANSPORT INFORMATION

DOT

UN number or ID number:	
UN Proper Shipping Name:	NOT DG REGULATED
Transport Hazard Class(es)	
Class:	NR
Label(s):	–
Packing Group:	–
Marine Pollutant:	No

IMDG

UN number or ID number:	
UN Proper Shipping Name:	NOT DG REGULATED
Transport Hazard Class(es)	
Class:	NR
Label(s):	–
EmS No.:	
Packing Group:	–
Marine Pollutant:	No

IATA

UN number or ID number:	
Proper Shipping Name:	NOT DG REGULATED
Transport Hazard Class(es):	
Class:	NR
Label(s):	–
Packing Group:	–
Marine Pollutant:	No
Cargo aircraft only:	Allowed.

TDG

UN number or ID number:	
UN Proper Shipping Name:	NOT DG REGULATED
Transport Hazard Class(es)	
Class:	NR
Label(s):	–
Packing Group:	–
Marine Pollutant:	No

15. REGULATORY INFORMATION

US Federal Regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

None present or none present in regulated quantities.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050), as amended

Chemical Identity	OSHA hazard(s)
Quartz	kidney effects lung effects immune system effects Cancer

CERCLA Hazardous Substance List (40 CFR 302.4):

Chemical Identity	Reportable quantity
Nickel	100lbs.
Chromium and chromium alloys or compounds (as Cr)	5000lbs.
Potassium hydroxide	1000lbs.
Manganese	Included in the regulation but with no data values. See regulation for further details.
Zinc	1000lbs.
Copper and/or copper alloys and compounds (as Cu)	5000lbs.
Cobalt and compounds (as Co)	Included in the regulation but with no data values. See regulation for further details.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories

Not classified

Not classified

SARA 302 Extremely Hazardous Substance

None present or none present in regulated quantities.

SARA 304 Emergency Release Notification

None present or none present in regulated quantities.

SARA 311/312 Hazardous Chemical

Chemical Identity	Threshold Planning Quantity

SARA 313 (TRI Reporting)

Chemical Identity	Reporting threshold for other users	Reporting threshold for manufacturing and processing
Nickel	10000 lbs	25000 lbs.
Chromium and chromium alloys or compounds (as Cr)	10000 lbs	25000 lbs.
Cobalt and compounds (as Co)	10000 lbs	25000 lbs.

Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3)

Chemical Identity	Reportable quantity
Potassium hydroxide	Reportable quantity: 1000 lbs.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):

None present or none present in regulated quantities.

US State Regulations

US. California Proposition 65

WARNING: This product can expose you to chemicals including, Nickel, Titanium dioxide (synthetic), Titanium dioxide (naturally occurring), Quartz, Cobalt and compounds (as Co), which is [are] known to the State of California to cause cancer.

For more information go to www.P65Warnings.ca.gov.

WARNING: This product contains or produces a chemical known to the State of California to cause cancer and birth defects (or other reproductive harm). (California Health & Safety Code Section 25249.5 et seq.)
WARNING: Cancer and Reproductive Harm – www.P65Warnings.ca.gov

US. New Jersey Worker and Community Right-to-Know Act

Chemical Identity

US. Massachusetts RTK - Substance List

Chemical Identity

Nickel
Chromium and chromium alloys or compounds (as Cr)
Quartz

US. Pennsylvania RTK - Hazardous Substances

Chemical Identity

Nickel
Chromium and chromium alloys or compounds (as Cr)
Titanium dioxide (synthetic)
Molybdenum
Limestone
Cryolite
Calcium fluoride
Titanium dioxide (naturally occurring)

US. Rhode Island RTK

No ingredient regulated by RI Right-to-Know Law present.

Canada Federal Regulations

List of Toxic Substances (CEPA, Schedule 1)

Chemical Identity

Cryolite
Zinc

Export Control List (CEPA 1999, Schedule 3)

Not Regulated

National Pollutant Release Inventory (NPRI)

Canada. National Pollutant Release Inventory (NPRI) Substances, Part 5, VOCs with Additional Reporting Requirements

NPRI PT5	Not Regulated

Canada. National Pollutant Release Inventory (NPRI) (Schedule 1, Parts 1-4)

NPRI	Not Regulated

Greenhouse Gases

Not Regulated

Controlled Drugs and Substances Act

CA CDSI	Not Regulated
CA CDSII	Not Regulated
CA CDSIII	Not Regulated
CA CDSIV	Not Regulated
CA CDSV	Not Regulated
CA CDSVII	Not Regulated
CA CDSVIII	Not Regulated

Precursor Control Regulations

Not Regulated

Mexico. Substances subject to reporting for the pollutant release and transfer registry (PRTR): Not applicable

Inventory Status:

Canada DSL Inventory List:	One or more components are not listed or are exempt from listing.
EINECS, ELINCS or NLP:	On or in compliance with the inventory
Japan (ENCS) List:	One or more components are not listed or are exempt from listing.
China Inv. Existing Chemical Substances:	On or in compliance with the inventory
Korea Existing Chemicals Inv. (KECI):	On or in compliance with the inventory
Canada NDSL Inventory:	One or more components are not listed or are exempt from listing.
Philippines PICCS:	One or more components are not listed or are exempt from listing.
New Zealand Inventory of Chemicals:	On or in compliance with the inventory
Japan ISHL Listing:	One or more components are not listed or are exempt from listing.
Japan Pharmacopoeia Listing:	One or more components are not listed or are exempt from listing.
Mexico INSQ:	One or more components are not listed or are exempt from listing.
Ontario Inventory:	One or more components are not listed or are exempt from listing.
Taiwan Chemical Substance Inventory:	On or in compliance with the inventory
Australia Industrial Chem. Act (AIIC):	One or more components are not listed or are exempt from listing.
US TSCA Inventory:	On or in compliance with the inventory
Switzerland New Subs Notified/Registered:	One or more components are not listed or are exempt from listing.
Thailand Existing Chemical Inv. List:	One or more components are not listed or are exempt from listing.
Vietnam National Chemical Inventory:	One or more components are not listed or are exempt from listing.

16. OTHER INFORMATION

Definitions:

Revision Date: 04/25/2022

Further Information: Additional information is available by request.

Disclaimer: The Lincoln Electric Company urges each end user and recipient of this SDS to study it carefully. See also www.lincolnelectric.com/safety. If necessary, consult an industrial hygienist or other expert to understand this information and safeguard the environment and protect workers from potential hazards associated with the handling or use of this product. This information is believed to be accurate as of the revision date shown above. However, no warranty, expressed or implied, is given. Because the conditions or methods of use are beyond Lincoln Electric's control, we assume no liability resulting from the use of this product. Regulatory requirements are subject to change and may differ between various locations. Compliance with all applicable Federal, State, Provincial, and local laws and regulations remain the responsibility of the user.

Compliant SDS for GHS: HazCom 2012 / United States; WHMIS 2015 / Canada; NMX-R-019-SCFI-2011 / Mexico

The content of this SDS is also valid in Spanish Mexican language to cover all Central, South America (except Brazil) and the Caribbean countries.

SAFETY DATA SHEET

Carbon Arc electrodes

RADNOR®

Section 1. Identification

GHS product identifier Carbon Arc electrodes

Other means of identification : Not available.

Product code :RAD64002220, RAD64002221, RAD64002222, RAD64002223, RAD64002224, RAD64002225 RAD64002226,RAD64002229,RAD64002230, RAD64002232, RAD64002233, RAD64002234,RAD64002235

Product type : Solid.

Identified uses

Arc metal removal.

Supplier's details : Randor Products
PO Box 6675
Radnor, PA 19087

Product Information (866) 924-7427

In case of emergency (866) 734-3438

Emergency telephone number (with hours of operation) : CHEMTREC, U.S. : 1-800-424-9300 International: +1-703-527-3887 (24/7)

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : CARCINOGENICITY - Category 1A
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 1
AQUATIC HAZARD (ACUTE) - Category 1
AQUATIC HAZARD (LONG-TERM) - Category 1

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : H350 - May cause cancer.
H372 - Causes damage to organs through prolonged or repeated exposure.
H410 - Very toxic to aquatic life with long lasting effects.

Precautionary statements

Prevention : P201 - Obtain special instructions before use.
P202 - Do not handle until all safety precautions have been read and understood.
P281 - Use personal protective equipment as required.
P273 - Avoid release to the environment.
P260 - Do not breathe dust.
P270 - Do not eat, drink or smoke when using this product.
P264 - Wash hands thoroughly after handling.

Section 2. Hazards identification

Response : P391 - Collect spillage.
P314 - Get medical attention if you feel unwell.
P308 + P313 - IF exposed or concerned: Get medical attention.

Storage : P405 - Store locked up.

Disposal : P501 - Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified (HNOC)

Physical hazards not otherwise classified (PHNOC) : None known.

Health hazards not otherwise classified (HHNOC) : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Mixture

Other means of identification : Not available.

CAS number/other identifiers

CAS number : Not applicable.

Product code : Not available.

Ingredient name	%	CAS number
Copper	10 - 30	7440-50-8
Crystalline silica, quartz	0.1 - 1	14808-60-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 20 minutes. Get medical attention.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 20 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Section 4. First aid measures

Ingestion : Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Get medical attention. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : This material is very toxic to aquatic life with long lasting effects. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
metal oxide/oxides

Section 5. Fire-fighting measures

Special protective actions for fire-fighters : No special measures are required.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. Collect spillage.

Methods and materials for containment and cleaning up

Small spill : Move containers from spill area. Avoid dust generation. Do not dry sweep. Vacuum dust with equipment fitted with a HEPA filter and place in a closed, labeled waste container. Dispose of via a licensed waste disposal contractor.

Large spill : Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Avoid dust generation. Do not dry sweep. Vacuum dust with equipment fitted with a HEPA filter and place in a closed, labeled waste container. Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not ingest. Avoid release to the environment. If during normal use the material presents a respiratory hazard, use only with adequate ventilation or wear appropriate respirator. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Empty containers retain product residue and can be hazardous. Do not reuse container.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Section 8. Exposure controls/personal protection

Control parameters

United States

Occupational exposure limits

Ingredient name	Exposure limits
Copper	**ACGIH TLV (United States, 4/2014).** TWA: 1 mg/m³, (Cu) 8 hours. Form: Dusts and mists TWA: 0.2 mg/m³ 8 hours. Form: Fume **OSHA PEL (United States, 2/2013).** TWA: 1 mg/m³ 8 hours. Form: Dusts and mists TWA: 0.1 mg/m³ 8 hours. Form: Fume **NIOSH REL (United States, 10/2013).** TWA: 1 mg/m³, (Cu) 10 hours. Form: Dusts and mists
Crystalline silica, quartz	**OSHA PEL Z3 (United States, 2/2013).** TWA: 10 mg/m³ 8 hours. Form: Respirable TWA: 250 mppcf 8 hours. Form: Respirable **NIOSH REL (United States, 10/2013).** TWA: 0.05 mg/m³ 10 hours. Form: Respirable dust **ACGIH TLV (United States, 4/2014).** TWA: 0.025 mg/m³ 8 hours. Form: Respirable fraction

Canada

Occupational exposure limits		TWA (8 hours)			STEL (15 mins)			Ceiling			
Ingredient	List name	ppm	mg/m³	Other	ppm	mg/m³	Other	ppm	mg/m³	Other	Notations
Natural graphite	US ACGIH 4/2014	-	2	-	-	-	-	-	-	-	[a]
	AB 4/2009	-	2	-	-	-	-	-	-	-	[b]
	BC 7/2013	-	2	-	-	-	-	-	-	-	[c]
	ON 1/2013	-	2	-	-	-	-	-	-	-	[a]
	QC 1/2014	-	2	-	-	-	-	-	-	-	[d]
Copper, Cu	US ACGIH 4/2014	-	1	-	-	-	-	-	-	-	[e]
	US ACGIH 4/2014	-	0.2	-	-	-	-	-	-	-	[f]
	AB 4/2009	-	1	-	-	-	-	-	-	-	[e]
		-	0.2	-	-	-	-	-	-	-	[f]
	BC 7/2013	-	1	-	-	-	-	-	-	-	[e]
		-	0.2	-	-	-	-	-	-	-	[f]
Copper	ON 1/2013	-	1	-	-	-	-	-	-	-	[e]
	ON 1/2013	-	0.2	-	-	-	-	-	-	-	[f]
Copper, Cu	QC 1/2014	-	1	-	-	-	-	-	-	-	[e]
	QC 1/2014	-	0.2	-	-	-	-	-	-	-	[f]
Crystalline silica, quartz	US ACGIH 4/2014	-	0.025	-	-	-	-	-	-	-	[a]
	AB 4/2009	-	0.025	-	-	-	-	-	-	-	[g]
	BC 7/2013	-	0.025	-	-	-	-	-	-	-	[c]
	ON 1/2013	-	0.1	-	-	-	-	-	-	-	[a]
	QC 1/2014	-	0.1	-	-	-	-	-	-	-	[d]
Graphite, synthetic	QC 1/2014	-	2	-	-	-	-	-	-	-	[d]

Form: [a]Respirable fraction [b]Respirable (all forms except graphite fibres) [c]Respirable [d]Respirable dust [e]Dusts and mists [f]Fume [g]Respirable particulate.

Mexico

Ingredient name	Exposure limits
Natural graphite	**NOM-010-STPS (Mexico, 9/2000).** LMPE-PPT: 2 mg/m³ 8 hours.
Graphite, synthetic	**NOM-010-STPS (Mexico, 9/2000).** LMPE-PPT: 2 mg/m³ 8 hours. Form: Powder. LMPE-PPT: 10 mg/m³ 8 hours.
Copper	**NOM-010-STPS (Mexico, 9/2000).** LMPE-PPT: 1 mg/m³, (Cu) 8 hours. Form: powder and fog LMPE-CT: 2 mg/m³, (Cu) 15 minutes. Form: powder and fog LMPE-CT: 2 mg/m³, (Cu) 15 minutes. Form: smoke LMPE-PPT: 0.2 mg/m³, (Cu) 8 hours. Form: smoke
Crystalline silica, quartz	**NOM-010-STPS (Mexico, 9/2000).** LMPE-PPT: 0.1 mg/m³ 8 hours.

Section 8. Exposure controls/personal protection

Appropriate engineering controls : If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, particulate filter respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Personal protective equipment (Pictograms) :

Section 9. Physical and chemical properties

Appearance

Physical state : Solid. [Rod.]

Color : Black.

Odor : Odorless.

Odor threshold : Not available.

pH : Not available.

Melting point : Weighted average: 1112.71°C (2034.9°F)

Boiling point : Not available.

Flash point : Not available.

Section 9. Physical and chemical properties

Evaporation rate : Not available.

Flammability (solid, gas) : Not available.

Lower and upper explosive (flammable) limits : Not available.

Vapor pressure : Not available.

Vapor density : Not available.

Relative density : Not available.

Solubility : Insoluble in the following materials: cold water and hot water.

Partition coefficient: n-octanol/water : Not available.

Auto-ignition temperature : Not available.

Decomposition temperature : Not available.

Viscosity : Not available.

Volatility : Not available.

VOC (w/w) : Not available.

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : No specific data.

Incompatible materials : Incompatible with some strong acids.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

There is no data available.

Irritation/Corrosion

There is no data available.

Sensitization

There is no data available.

Carcinogenicity

Classification

Product/ingredient name	OSHA	IARC	NTP	ACGIH	EPA	NIOSH
Crystalline silica, quartz	-	1	Known to be a human carcinogen.	A2	-	+

Specific target organ toxicity (single exposure)

There is no data available.

Section 11. Toxicological information

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
Crystalline silica, quartz	Category 1	Inhalation	kidneys, respiratory tract and testes

Aspiration hazard

There is no data available.

Information on the likely routes of exposure : Dermal contact. Eye contact. Inhalation. Ingestion.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : No known significant effects or critical hazards.

Potential delayed effects : No known significant effects or critical hazards.

Long term exposure

Potential immediate effects : No known significant effects or critical hazards.

Potential delayed effects : No known significant effects or critical hazards.

Potential chronic health effects

General : Causes damage to organs through prolonged or repeated exposure.

Carcinogenicity : May cause cancer. Risk of cancer depends on duration and level of exposure.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

There is no data available.

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
Copper	Acute EC50 1100 µg/L Fresh water	Aquatic plants - Lemna minor	4 days
	Acute EC50 2.1 µg/L Fresh water	Daphnia - Daphnia longispina - Juvenile (Fledgling, Hatchling, Weanling)	48 hours
	Acute IC50 13 µg/L Fresh water	Algae - Pseudokirchneriella subcapitata - Exponential growth phase	72 hours
	Acute IC50 5.4 mg/L Marine water	Aquatic plants - Plantae - Exponential growth phase	72 hours
	Acute LC50 0.072 µg/L Marine water	Crustaceans - Amphipoda - Adult	48 hours
	Acute LC50 7.56 µg/L Marine water	Fish - Periophthalmus waltoni - Adult	96 hours
	Chronic NOEC 2.5 µg/L Marine water	Algae - Nitzschia closterium - Exponential growth phase	72 hours
	Chronic NOEC 7 mg/L Fresh water	Aquatic plants - Ceratophyllum demersum	3 days
	Chronic NOEC 0.02 mg/L Fresh water	Crustaceans - Cambarus bartonii - Mature	21 days
	Chronic NOEC 2 µg/L Fresh water	Daphnia - Daphnia magna	21 days
	Chronic NOEC 0.8 µg/L Fresh water	Fish - Oreochromis niloticus - Juvenile (Fledgling, Hatchling, Weanling)	6 weeks

Persistence and degradability

There is no data available.

Bioaccumulative potential

There is no data available.

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling empty containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Section 14. Transport information

	DOT	TDG / NOM-003-SCT	IMDG	IATA
UN number	Not regulated.	Not regulated.	Not regulated.	Not regulated.
UN proper shipping name	-	-	-	-

Section 14. Transport information

Transport hazard class(es)	-	-	-	-
Packing group	-	-	-	-
Environmental hazards	No.	No.	No.	No.
Additional information	-	-	-	-

AERG : Not applicable.

DOT-RQ Details : Copper 5000 lbs / 2270 kg

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **United States inventory (TSCA 8b)**: All components are listed or exempted.
Clean Water Act (CWA) 307: Copper

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Delayed (chronic) health hazard

Composition/information on ingredients

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
Crystalline silica, quartz	0.1 - 1	No.	No.	No.	No.	Yes.

Section 15. Regulatory information

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	Copper	7440-50-8	10 - 30
Supplier notification	Copper	7440-50-8	10 - 30

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : The following components are listed: Natural graphite; Copper; Crystalline silica, quartz

New York : The following components are listed: Copper

New Jersey : The following components are listed: Natural graphite; Copper; Crystalline silica, quartz

Pennsylvania : The following components are listed: Natural graphite; Copper; Crystalline silica, quartz

California Prop. 65

WARNING: This product contains a chemical known to the State of California to cause cancer.

Ingredient name	Cancer	Reproductive	No significant risk level	Maximum acceptable dosage level
Carbon Arc electrodes	Yes.	No.	No.	No.
Crystalline silica, quartz	Yes.	No.	No.	No.

Canada

Canadian lists

Canadian NPRI : The following components are listed: Copper

CEPA Toxic substances : None of the components are listed.

Canada inventory : All components are listed or exempted.

International lists

National inventory

Australia : All components are listed or exempted.

China : All components are listed or exempted.

Europe : All components are listed or exempted.

Japan : Not determined.

Malaysia : Not determined.

New Zealand : All components are listed or exempted.

Philippines : All components are listed or exempted.

Republic of Korea : All components are listed or exempted.

Taiwan : Not determined.

Section 16. Other information

History

Date of issue mm/dd/yyyy : 05/15/2015

Date of previous issue : 05/15/2014

Version : 5

Prepared by : KMK Regulatory Services Inc.

Section 16. Other information

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Attachment 2

Supplemental Information for Chemical Usage Data

File is being provided electronically as "Attachment 2. Chemical Usage Data 2023-0901.xlsx".

Attachment 3

Revised Emission Calculation Workbook

An electronic version of the workbook is being provided as "Attachment 3. Covanta Pollutant Emissions Summary 2023-0901.xlsx".

Attachment 4

Revised Emission Inventory Form AQ520

This file is being provided electronically via email to Oregon DEQ.