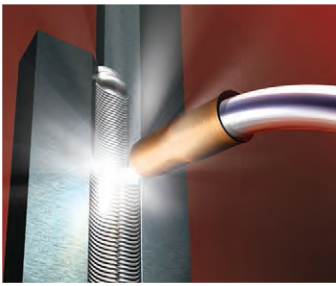

Frequently Asked Questions
Welding Fume Control

Users and employers have sole responsibility for and control over workplace conditions, including the manner in which work is performed and the safety measures taken. Always read and follow applicable OSHA regulations as well as all information on product labeling and material safety datasheets when using Lincoln Electric products:

MSDSs are available at http://www.lincolnelectric.com/products/msds/default.asp

Information regarding the safe use of Lincoln Electric products may be found at http://www.lincolnelectric.com/community/safety/

The operation of welding fume control equipment is affected by various factors including proper use and positioning of such equipment, and the specific welding process, procedure and application involved. Employers and users should have an industrial hygienist evaluate worker exposure to be certain they are within applicable OSHA PEL and/or ACGIH TLV limits.

This information is provided as an accommodation to customers and users of Lincoln Electric products and is based upon information known at this time to the Lincoln Electric Company. Lincoln Electric assumes no liability for the information and does not assume any reasonability to update or correct the information given. Lincoln Electric expressly disclaims any warranty of any kind, including any warranty of fitness for any particular purpose, with respect to this information.

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Rev. 1.0

Hexavalent Chromium Compliance

Question: What are the requirements of the new Hexavalent Chromium Standard?

OSHA issues New Standard for Hexavalent Chromium

On February 28, 2006, the Occupational Safety & Health Administration (OSHA) issued a new standard relating to occupational exposure to hexavalent chromium, also known as Cr(VI) or hexchrome. Elemental or metallic chromium is present in a wide variety of industrial activities, including the manufacture of stainless steel, arc welding, painting and pigment application, electroplating, and other surface coating processes. OSHA determined that the new standard is necessary to reduce health risks posed by occupational exposure to Cr(VI).

The following is a general summary of the new regulations. Employers should always review and follow the specific regulations applicable to their industry (see FAQ: "Who has to comply with the new Hexavalent Chromium Standards?" for more information.)

The new standard lowers OSHA's permissible exposure limit (PEL) for hexavalent chromium, and for all Cr(VI) compounds, **to 5 micrograms of Cr(VI)** per cubic meter of air as an **8-hour time-weighted average** (this is the same as 0.005 milligrams per cubic meter). The new PEL is one-tenth of the old PEL.

Industries to which the Standard applies: The standard covers occupational exposure to hexavalent chromium (Cr(VI)) in general industry, construction and shipyards. New Cr(VI) regulations have been issued for each industry.

Requirements. The new standard requires industries to control worker exposures to Cr(VI) so the new PEL is not exceeded. This may be done through engineering and work practice controls or through the use of respirators, if engineering and work practice controls are not sufficient. Other requirements include worker Cr(VI) exposure determination, respiratory protection, protective work clothing and equipment, medical surveillance and hazard communications.

Start-up date for all provisions, except engineering controls: The requirements are phased in as follows:

- Employers with 20 or more employees: November 27, 2006
- Employers with less than 20 employees: May 30, 2007
- This period is designed to allow employers sufficient time to complete initial exposure assessments, obtain appropriate work clothing and equipment, and comply with other provisions of the standard.

...(continued)

...(Continued from previous page)

Start-up date for engineering controls: Engineering controls must be implemented by all employers by May 31, 2010. Feasible engineering controls to control exposures must be in use by this date, even if respirators must also be used to control worker exposure.

Exposure Assessments: Employers must determine what the full shift exposures of each of its employees is to Cr(VI). Some employers may have a safety or industrial hygiene department capable of performing that determination. Other employers will need to contact an industrial hygiene consultant to help them (see the consultants list in the attached references). In general, employers must perform an initial assessment to determine what worker exposures are and perform follow up monitoring if the exposure is above the action level which is one-half of the PEL or if there is a change, for example to the materials or processes involved, which may affect exposure. There are two options for determining an employee's exposure:

> **(1) Scheduled monitoring option. (i) "The employer shall perform initial monitoring to determine the 8-hour TWA exposure for each employee** on the basis of a sufficient number of personal breathing zone air samples to accurately characterize full shift exposure on each shift, for each job classification, in each work area. Where an employer does representative sampling instead of sampling all employees in order to meet this requirement, the employer shall sample the employee(s) expected to have the highest chromium (VI) exposures…" 29CFR1910.1026(d)(2)
>
> **(2) Performance-oriented option.** "The employer shall determine the 8-hour TWA exposure for each employee on the basis of any combination of air monitoring data, historical monitoring data, or objective data sufficient to accurately characterize employee exposure to chromium (VI)." 29CFR1910.1026(d)(3)
>
> **Air Monitoring Exemption:** "Where the employer has objective data demonstrating that a material containing chromium or a specific process, operation, or activity involving chromium cannot release dusts, fumes, or mists of chromium (VI) in concentrations at or above 0.5 $\mu g/m^3$ as an 8-hour time-weighted average (TWA) under any expected conditions of use…" 29CFR1910.1026(d)(4)

Respirators: If the use of work practice controls does not control exposures to the PEL, employers may use respirators, provided other requirements for respirators are met (29CFR1910.134). The use of engineering controls to control exposures is encouraged, but not required until May 31, 2010.

After May 31, 2010 respirators will, in general, only be permitted if engineering controls have been implemented and are not able to keep exposures below the PEL. Engineering controls must be in use even if respirators are also required.

Arc Welding: Because the new PEL will now be much lower, it will be important for employers to determine if there is an exposure in all arc welding applications, not just for welding with stainless or hard facing consumables. If a MSDS lists chromium under "Hazardous Ingredients" then the new standard applies to you. Chromium is often found on MSDSs as a "Hazardous Ingredient" in stainless steel and hard facing consumables. The standard applies because during the arc welding process some metallic chromium is vaporized and reacts with oxygen to form hexavalent chromium.

In addition, the new standard may apply to you, even if the MSDS for welding related materials does not list chromium in the "Hazardous Ingredients" because chromium may be present on the base metal as a plating or coating. Further, chromium may have been used as an alloying ingredient in the base metal and electrode steel or is present in the base metal or welding electrode as an impurity of the steel manufacturing process. For this reason, an exposure assessment should be done for arc welding and cutting applications involving mild and low alloy steels.

KEY REFERENCE:

American Industrial Hygiene Association Consultants List
http://www.aiha.org/Content/AccessInfo/consult/consultantsearch.htm

OSHA's Hexavalent Chromium Standards
http://www.osha.gov/SLTC/hexavalentchromium/standards.html

Small Entity Compliance Guide for the Hexavalent Chromium Standards, OSHA Publication 3320, (2006), http://www.osha.gov/Publications/OSHA_small_entity_comp.pdf

Date 8/24/07 FAQ-2
Rev. 1.0

Hexavalent Chromium Compliance

Question: How has compliance with the "new" regulations changed from compliance with the "old" hexavalent chromium regulations?

Historically OSHA regulated hexavalent chromium under 29CFR 1910.1000 (Table Z-1); which set a Permissible Exposure Limit (PEL) of 52 μg/m^3 or 0.052 mg/m^3. Exceedence of the PEL triggered the implementation of engineering and/or work practices controls. When such controls were not feasible to reduce the worker's exposure to less than the PEL, then personal protective equipment and/or any other protective measures could be used to keep the exposure of employees below the PEL.

In the new standard, the 8-hour Time-Weighted-Average PEL has been reduced to 5 μg/m^3 or 0.005 mg/m^3 with an action level set at 2.5 μg/m^3. These new limits are used to trigger the implementation of specific protective measures including: exposure determination, engineering and work practice controls, respiratory protection, clothing, hygiene, housekeeping, medical surveillance, hazard communications and recordkeeping.

KEY REFERENCES:

29 CFR 1910.1000 Permissible Exposure Limits for Air Contaminants http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9991

Small Entity Compliance Guide for the Hexavalent Chromium Standards, OSHA Publication 3320, (2006), http://www.osha.gov/Publications/OSHA_small_entity_comp.pdf

Date 7/24/07 FAQ-3
Rev. 1.0

Hexavalent Chromium Compliance

Question: Why did OSHA change the Permissible Exposure Limit for Hexavalent Chromium?

OSHA's decision to lower the Hexavalent Chromium [Cr(VI)] Permissible Exposure Limit (PEL) was based "upon the best evidence currently available that [at the 8-hour Time Weighted Average PEL of 52 μg/m^3] workers face a significant risk to material impairment of their health. The evidence in the record for this rulemaking indicates that workers exposed to Cr(VI) are at an increased risk of developing lung cancer. The record also indicates that occupational exposure to Cr(VI) may result in asthma, and damage to the nasal epithelia and skin." (Federal Register 71:10099; February 28, 2006) http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FEDERAL_REGISTER&p_id=18599

Date 8/24/07 FAQ-4
Rev. 1.0

Hexavalent Chromium Compliance

Question: Who has to comply with the new Hexavalent Chromium Standards?

The standards apply to all occupational exposures to Cr(VI), with only limited exceptions. OSHA has separate standards for Cr(VI) exposures in general industry, shipyards, and construction:

- General industry (29 CFR 1910.1026),
- Shipyards (29 CFR 1915.1026), and
- Construction (29 CFR 1926.1126).

Employers should review their welding related material safety data sheets (MSDSs) to identify whether chromium-containing materials are present in the consumables, base materials or coatings.

If a MSDS lists chromium under "Hazardous Ingredients" then the new standard applies to you. Chromium is often found on MSDSs as a "Hazardous Ingredient" in stainless steel and hard facing consumables. The standard applies because during the arc welding process some metallic chromium is vaporized and reacts with oxygen to form hexavalent chromium.

In addition, the new standard may apply to you, even if the MSDS for welding related materials does not list chromium in the "Hazardous Ingredients" because chromium may be present on the base metal as a plating or coating. Further, chromium may have been used as an alloying ingredient in the base metal and electrode steel or is present in the base metal or welding electrode as an impurity of the steel manufacturing process. For this reason, an exposure assessment should be done for arc welding and cutting applications involving mild and low alloy steels.

KEY REFERENCES:

OSHA's Hexavalent Chromium Standards
http://www.osha.gov/SLTC/hexavalentchromium/standards.html

Small Entity Compliance Guide for the Hexavalent Chromium Standards, OSHA Publication 3320, (2006), http://www.osha.gov/Publications/OSHA_small_entity_comp.pdf

Date 8/24/07 FAQ-5
Rev. 1.0

Hexavalent Chromium Compliance

Question: How can Lincoln Electric help me comply with the new Hexavalent Chromium Standard?

1.) Lincoln Electric's Technical Sales Representative can help you assess the total welding system solutions available to you. For more information see FAQ "What are some Welding Fume Control Solutions?

Lincoln Electric's North America Sales Office Locations can be found at:
http://www.lincolnelectric.com/corporate/findus/default.asp

2.) Lincoln Electric's Material Safety Data Sheets (MSDS) provide important baseline information for your hazard assessment. For more information see FAQs "How do I find out if chromium is present in any of the Lincoln consumables I use?" and "How do I use the "Max Fume Exposure Guideline" given on Lincoln Electric's MSDSs?"

Lincoln Electric's MSDSs are included with each consumable product and can be obtained from Lincoln Electric's website at:
http://www.lincolnelectric.com/products/msds/

3.) Lincoln Electric has resource material available on welding safety. The most up to date information is available on a Lincoln Electric's website at: http://www.lincolnelectric.com/community/safety/

4.) Lincoln Electric's Environmental System's Group can be contacted by phone at: 1-888-935-3878 x 4

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FAQ-6

Hexavalent Chromium Compliance

Question: How do I find out if chromium is present in any of the Lincoln consumables I use?

Lincoln Electric lists the chemical and common name(s) of the consumable ingredients, including metallic chromium, on its Material Safety Data Sheets (MSDSs). Lincoln Electric's MSDSs are included with each consumable product and can be obtained from Lincoln Electric's website at: http://www.lincolnelectric.com/products/msds/.

In addition, the new standard may apply to you, even if the MSDS for welding related materials does not list chromium in the "Hazardous Ingredients" because chromiuum may be present on the base metal as a plating or coating. Further, chromium may have been used as an alloying ingredient in the base metal and electrode steel or is present in the base metal or welding electrode as an impurity of the steel manufacturing process. For this reason, an exposure assessment should be done for arc welding and cutting applications involving mild and low alloy steels.

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Hexavalent Chromium Compliance

Question: How do I determine the welders' and nearby workers' exposure to hexavalent chromium are?

Each employer who has a workplace or work operation covered by the standard shall determine the full shift (8-hour) exposure for each employee exposed to chromium (VI) by either:

(1) Performing initial monitoring on each employee,

(2) Performing representative air sampling for a group of employees with similar exposure,

(3) Determining the exposure of each employee by the use of performance-oriented data.

Air monitoring option: Under the OSHA standard, the employer shall perform initial monitoring of each potentially exposed employee to determine their 8-hour TWA exposure. for each potentially exposed employee. Alternately, where an employer does representative sampling to group employees by similar exposure instead of sampling each employee; then the employer shall sample the employee(s) expected to have the highest (worst case) exposure for each grouping.

Performance-oriented option: The employer shall determine the 8-hour TWA exposure for each employee on the basis of any combination of air monitoring data, historical monitoring data, or objective data sufficient to accurately characterize employee exposure.

As a performance based standard the outcome of the initial monitoring will determine the requirements for additional monitoring and other requirements.

See the FAQ: "Where can I find help to perform employee exposure monitoring?"

KEY REFERENCE:

Small Entity Compliance Guide for the Hexavalent Chromium Standards, OSHA Publication 3320, (2006), http://www.osha.gov/Publications/OSHA_small_entity_comp.pdf

Date 9/10/07 FAQ-8
Rev. 1.0

Hexavalent Chromium Compliance

Question: Can my welders wear respirators to comply with the Hexavalent Chromium standard?

When engineering and work practice controls cannot reduce employee Cr(VI) exposure to below the PEL, employers must provide employees with respirators. That said, the following quotation from Page 11 of the Small Entity Compliance Guide for the Hexavalent Chromium Standards provides additional guidance (see the reference below):

> "Specifically, respirators are useful during:
>
> - Periods necessary to install or implement feasible engineering and work practice controls, specifically the Hexavalent Chromium Standard gives employers until May 31st, 2010 to allow sufficient time for the process of designing, obtaining, and installing equipment and adopting new work methods;
> - Work operations, such as maintenance and repair activities, for which engineering and work practice controls are not feasible;
> - Work operations for which an employer has implemented all feasible engineering and work practice controls and such controls are not sufficient to reduce exposures to or below the PEL;
> - Work operations where employees are exposed above the PEL for fewer than 30 days per year, and the employer has elected not to implement engineering and work practice controls to achieve the PEL; or
> - Emergencies (i.e., uncontrolled releases of Cr(VI) that result in significant and unexpected exposures; see definition of "Emergency"…) [in the Small Entity Compliance Guide below].
>
> Where respirator use is required, the employer must establish a respiratory protection program in accordance with OSHA's Respiratory Protection standard (29 CFR 1910.134). *Note: Before the appropriate respirator can be selected, the potential exposure levels must be determined.* [see reference below]"

KEY REFERENCES

Small Entity Compliance Guide for the Hexavalent Chromium Standards, OSHA Publication 3320, (2006), http://www.osha.gov/Publications/OSHA_small_entity_comp.pdf

Small Entity Compliance Guide for the Respiratory Protection standard. (1998) http://www.osha.gov/Publications/SECG_RPS/secgrev-current.pdf

Date 9/10/07 FAQ-9
Rev. 1.0

Welding Fume Control

Question: What are some Welding Fume Control Solutions?

Before you assess your possible welding fume control solutions you should clearly identify and assess, as well as you can, the risks/ hazards of the process, consumables, procedures, work practices etc. of your operation. Allow your Lincoln Electric's Technical Sales Repre-sentative to help you in this investigation as they can bring expertise and access resources to assist you. No solution should lead to a less acceptable product or less effective process.

The control of welding fumes follows a generally accepted approach to determining which solution(s) might be applicable and effective for the welding operation to achieve the level of fume control needed to keep exposures below their appropiate limit.

Welding Fume Control Solutions

- Change the welding process, procedure, or consumable as permitted by the welding application, to reduce the amount of fume generated.
- Change the manufacturing process to an automated or robot work cell which allows the station to be enclosed and fume contained and efficiently removed.
- Install local and/or general exhaust ventilation to remove the fume.
- Improve work practices, assuring they complement the use of the engineering controls.
- Use respirators, protective clothing, hygiene facilities, etc. to control personal exposure.

OSHA's general policy is that feasible engineering and work practice controls must be used, if needed, to control workplace exposure to welding fume and its constituents to within the PEL. If engineering and work practices controls are not sufficient to reduce employee exposure to or below the PEL, then the employer must use such controls to reduce the exposure to the lowest level achievable in addition to using respirators. For hexavalent chromium, all requirements of the standard must be in place at this time except for engineering controls; engineering controls must be in place by May 31, 2010. This mean employers must implement work practice controls to control exposure to hexavalent chromium. If work practice controls are not sufficient to control exposures to within the PEL then respirators may be used to achieve compliance until May 31, 2010.

KEY REFERENCE:

29 CFR 1910.1000 (e) Controlling Air Contaminants
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9991

Method of Compliance, Pages 9-10; Small Entity Compliance Guide for the Hexavalent Chromium Standards, OSHA Publication 3320, (2006), http://www.osha.gov/Publications/OSHA_small_entity_comp.pdf

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Rev. 1.0

Welding Fume Control

Question: What engineering controls are available to help me comply with exposure based OSHA regulations?

Lincoln Electric's Technical Sales Representatives can provide information about alternative fume control solutions, including process, consumable and procedure selection; and ventilation engineering controls.

Lincoln Electric has a line of exhaust systems for most welding applications. Again your TSR can provide information about engineering solutions available from Lincoln Electric for your application.

These systems span from:

- small exhaust systems that might be used in confined space applications,
- portable systems that can be carried around a construction site,
- mobile units that can be rolled around a shop floor;

to customized:

- centralized source extraction systems,
- general facility exhaust systems,
- isolation and enclosure of the operation,
- fume extraction guns.

Environmental Systems Product Line (Ventilation Equipment)
http://www.mylincolnelectric.com/Catalog/equipmentseries.asp?browse=103|1010|

For more information see FAQs:
"How can Lincoln Electric help me comply with the new Hexavalent Chromium Standard?"
"What are some Welding Fume Control Solutions?"

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Rev. 1.0

Welding Fume Control

Question: How do I use the "Maximum Fume Exposure Guideline" given on some Lincoln Electric MSDSs?

Some Lincoln Electric MSDSs provide a "Maximum Fume Exposure Guideline" (MFEG) in Section V (Reactivity Data) to assist users as a screening tool that can be used as a guideline to more efficiently determine if sampling and analysis should be done for individual fume constituents. In general, if the total fume exposure is below the MFEG, then the exposure to all the fume constituents is estimated to be below either the PEL or TLV; whichever is the lower limit. Although the MFEG is not a complete substitute for the analysis of individual fume constituents, it may be used to identify those exposures which are close to the MFEG and therefore require individual constituent analysis of the fume.

There are a number of factors that can contribute to the composition and quantity of the fumes and gases to which a worker may be exposed; including the presence of plating and paint pigment on the metal being welded. The MFEG presumes the base metal is clean and free of coatings. If an application includes such factors, the fume must be analyzed to determine if the exposure to fume constituents is below applicable limits.

The MFEG is calculated for each consumable. The following is an example of a MFEG for a stainless steel electrode:

> *The Maximum Exposure Guideline for this product (based on Hexavalent Chromium content) is 0.08 milligrams per cubic meter.*

This means that if total fume exposure is controlled to less than 0.08 mg/m^3 and the base metal is clean and free of coatings, then the worker exposure will generally be less than the Hexavalent Chromium PEL of 0.005 mg/m^3.

Lincoln Electric's MSDSs are included with each consumable product and can be obtained from Lincoln Electric's website at: http://www.lincolnelectric.com/products/msds/.

See "TLVs and PELs of Typical Electrode Ingredients" on page 32 of this booklet.

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FAQ-12

Welding Fume Control

Question: How does OSHA specify and enforce "adequate" ventilation?

OSHA considers "adequate" ventilation to be that ventilation required (natural or mechanical) to maintain or reduce personal exposures below the Permissible Exposure Limits specified in 29 CFR 1910.1000. When permissible exposure limits are exceeded, citations may be issued for those specific exposure limits which have been exceeded and then also issued for failure to provide adequate ventilation.

Ventilation requirements, including minimum flow rates, are specified in 29 CFR 1910.252(c). However the ventilation needed in an application depends upon many factors, including:

(1) Volume and configuration of the space in which operations occur;

(2) Number and type of operations generating contaminants;

(3) Allowable levels of specific toxic or flammable contaminants being generated;

(4) Natural air flow rate and general atmospheric conditions where work is being done); and

(5) Location of the welder's and other persons' breathing zones in relation to the contaminants or sources.

KEY REFERENCES:

08/27/1993 - Enforcement of ventilation requirements for welding operations
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=21242

29 CFR 1910.1000 (e) Controlling Air Contaminants
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9991

Date 9/10/07 FAQ-13
Rev. 1.0

Welding Fume Control

Question: Where can I find help to perform employee exposure monitoring?

Air monitoring should be performed by a Certified Industrial Hygienist (CIH) or other technically qualified person. If you do not have an industrial hygiene or safety department capable of performing exposure determinations then you might consider the following three options:

(1) Your company's worker compensation insurance may provide industrial hygiene services. You should check with your worker compensation underwriter or broker to determine the level of IH services provided by your plan.

(2) Every state has an OSHA funded safety consultation services which is free to any business in that state. Such programs reasonably require you to take action to address non-compliance if a non-compliance is found.

The state workplace safety consultation offices are funded by OSHA. However they are separate from the OSHA enforcement offices by mission, objectives and physical location. The state workplace safety consultation offices are known for working with companies in a positive and professional manner. Ask your state's consultation office to discuss services, confidentially, and expectations with you. A complete listing of each state's consultation service contact can be found in Appendix III.D of the ""Small Entity Compliance Guide for the Hexavalent Chromium Standards, OSHA Publication 3320, (2006). http://www.osha.gov/Publications/OSHA_small_entity_comp.pdf

(3) The American Industrial Hygiene Association maintains a list of IH consultants by state and areas of expertise. See: http://www.aiha.org/Content/AccessInfo/consult/consultantsearch.htm

Date 9/10/07 FAQ-14
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Welding Fume Control

Question: What are the requirements for temporarily ventilating a confined space?

Confined spaces can include tanks, vessels, pits, vaults, hoppers, manholes etc. These spaces are not designed for human occupancy, have limited entry and exit access, and are large enough that an employee can bodily enter and perform the assigned work. A hazardous atmosphere in a confined space means the presence of any substance with the risk of death, incapacitation, impairment of ability to self-rescue, injury, or acute illness. Both exhaust and forced ventilation are effective tools in providing worker protection in a confined space. See OSHA's Permit-required Confined Space regulations in 29 CFR 1910.147 for more requirements.

The OSHA Construction Standard for Welding, Cutting or Heating in a confined space [29CFR 1926.353(b)] requires sufficient ventilation be provided to maintain welding fumes and gases within applicable exposure limits by either general mechanical ventilation or local exhaust ventilation.

There are number of conditions which can affect general mechanical ventilation in a confined space such as:

- Limited makeup air entry ways,
- Obstructions in the air entry way,
- "Short circuiting" of airflow through the enclosed space,
- Reduction of air flow or air pressure rates by long runs of equipment duct or hosing.
- Equipment obstructions in the confined space, etc.

The net result of these and other conditions is they tend to reduce the air exchange rate of the confined space. Under these conditions local exhaust ventilation systems may be appropriate. OSHA regulations which relate to welding in confined spaces are too detailed to be easily summarized here. Employers which have welding operations in confined spaces should review the applicable regulations including the Key References below.

Finally other employees exposed to the same atmosphere as the welders or burners are required to be protected in the same manner as the welder or burner. OSHA regulations which relate to welding in confined spaces are too detailed to be easily summarized here. Employers which have welding operations in confined spaces should review the applicable regulations including the Key Reference's below.

Finally other nearby employees exposed to the same atmosphere as the welders or cutters are required to be protected in the same manner as the welder or cutters.

KEY REFERENCES:

OSHA's Permit-required Confined Space Standard:29 CFR 1910.147
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9797

OSHA Construction Standard for Welding, Cutting or Heating: 29CFR 1926.353
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10699

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Welding Fume Control

Question: What are the environmental regulations for exhausting welding fume outside a building?

The answer to this question will depend on the requirements and limitations of your facility air permit. If you have an air permit then you certainly need to consider the impact on your air permit conditions. If you don't know if you need an air permit then you should contact your state or federal air permitting authority for guidance. For local air permitting contact information, see http://www.epa.gov/nsr/where.html

Any facility that could be a source of air pollution is subject to air permitting requirements. These air pollution sources must be evaluated for compliance with federal, state, and local air standards. The owner or operator of any facility that is a significant source of air pollution must apply for and obtain a Permit to Install (PTI) and a Permit to Operate (PTO) the air pollution source. A PTI must be obtained before beginning the construction of an air pollution source. If you do not know what air permitting rules apply to you, then contact the state and/or local authority listed on the website above. The owner or operator of an air pollution source is responsible for proper permitting even if the authority to obtain such permits is delegated to a third party. Failure to comply with air authority requirements in your region can result in significant fines.

The following sources for emission factor information are available:

The American Welding Society outlines the four methods for estimating airborne emissions and lists emission factors for some common consumables in the ANSI/AWS F1.6:2003, Guide for Estimating Welding Emissions for EPA and Ventilation Permit Reporting; https://www.awspubs.com/product_info.php?products_id=227

The USEPA publishes emission factors for electric arc welding in AP-42 Section 12.19;
http://www.epa.gov/ttn/chief/ap42/ch12/final/c12s19.pdf

Lincoln Electric can also provide you with emission information which should be requested through your Lincoln Electric Technical Sales Representative.

Date 9/10/07 FAQ-16
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Ventilation System Operations

Question: How do filters work?

Air cleaners incorporate a filtering medium (fiberglas, cellulose, or polyester fibers) made from microscopic fibers woven in sheet and pleated in a "V" pattern that trap and hold airborne particulate. The pleating of the material increases the surface area of the filter allowing air to flow through the filter. Filters are rated by their collection efficiency as determined by a standardized test.

As particles are trapped in the filter, the medium becomes a better filter, and the ventilation system motor/fan has to work harder to try and maintain the optimum air flow. Eventually the resistance of the filter reduces the air flow and the filter has to be replaced. Monitoring the static pressure drop across the filter is a good indicator of the trade off between desired flow rate and filter efficiency.

Filter life is determined by (1) how long it takes the fine particles to penetrate into the filter weave and form a cake, and (2) the type of material (i.e. oily vs. dry) penetrating the filter medium.

Some ventilation systems utilize filters capable of being cleaned by compressed air blown backwards through the filter (called reverse pulse). Typically these filters have a significant extended filter life because the cake on the outside of the filter is removed.

In addition filters may have a pre-coating to provide additional initial collection efficiency. Where a pre-coat is used with a self-cleaning filter, the pre-coat facilitates the release of the filter cake, delays the penetration of fine particulate into the filter weave, and helps release oily particles. As the pre-coat is removed over successive back flushes, the fine particulate begins to accumulate in the weave with the outcome that filter resistance rises, the airflow decreases, and the filter has to be replaced.

Date 9/11/07 FAQ-17
Rev. 1.0

Ventilation System Operations

Question: Can I re-circulate filtered welding exhaust to save energy costs?

The air from a welding fume ventilation system that exhausts to the outside of the building has to be replaced. The replacement or make-up air has to be conditioned (heated or cooled) which can result in a substantial energy cost. Alternately, welding fumes can be filtered from the ventilation system exhaust air and re-circulated. However, in order to avoid the potential risk of accumulating contaminants in the workplace environment, safeguards need to be designed into the ventilation system based on the process, procedures and materials to be used in the facility and implemented by the building owner or operator.

In addition to OSHA's occupational safety and health regulations, state OSHA programs may have additional requirements for recirculation of process exhaust air, and local building codes may be applied by local building inspectors. Consequently, a review of the potential risks, hazards and applicable requirements should be made during the design phase of the project to determine the feasibility of re-circulating the welding fume exhaust.

The following measures should be considered and implemented when appropriate:

1. hazard evaluation and assessment by a competent industrial hygienist;
2. special precautions for exhaust air with acutely toxic, highly toxic or carcinogenic materials;
3. specification of air cleaning equipment;
4. methods and equipment to be used to identify the contaminant generated during normal and upset conditions;
5. responses, equipment and procedures to assure worker protection during an upset condition;
6. facility owner and management responsibility for a higher level of preventive maintenance and operational integrity than a conventional exhaust system, and
7. air contaminant monitoring program to evaluate actual usage and potential worker exposure after system installation.

KEY REFERENCE:

Recirculation of Air from Industrial Process Exhaust Systems, ANSI/AIHA Z9.7-2007
http://www.aiha.org/Content/InsideAIHA/Standards/z9.htm

Michigan OSHA rule on recirculation of air from exhaust systems
http://www.michigan.gov/documents/CIS_WSH_part520_54650_7.pdf

Minnesota OSHA Guideline on "Recirculation of Process Ventilation Exhaust Air - Minnesota Rules 5202.0110"; MINOSHA Instruction STD 5-1.1, November 28, 2005

Date 9/10/07 FAQ-18
Rev. 1.

Ventilation System Operations

Question: How do I determine the regulatory requirements for proper disposal of a spent exhaust system filter?

Determining the regulatory requirements applicable to you for proper disposal of your welding fume exhaust filter depends upon answering the following questions:

1. What is your company or facility's hazardous waste generator status?
2. Do you have sufficient generator knowledge to "profile" the waste stream?
3. Do you need to perform testing to determine what the hazardous waste code(s) are?

If you are unable to answer these questions then you should contact your state environmental regulatory agency or third party for guidance on the requirements of your state's environmental rules. See the key reference below.

What is your facility's hazardous waste generator status?

Your generator status is based on the amount of hazardous waste (HW) you generate or accumulate on-site per month. The more HW you generate in a calendar month or have on-site at any given time, the more requirements with which you have to comply. Generator status significantly affects disposal options and costs.

Do you have sufficient generator knowledge to "profile" the waste stream?

A waste stream's profile is written by the generator and describes the source of the waste, chemical ingredients, EPA hazardous waste code(s), DOT proper shipping name and safety guidelines. It is used by all parties in the disposal path to make sure the waste is properly managed.

Do you need to perform testing to determine what the hazardous waste code(s) are?

Testing determines whether or not a particular substance is present at a level that would designate it as a hazardous waste. For welding fume this test is the TCLP metal analysis (Toxicity Characteristic Leaching Procedure). Each metal has its own hazardous waste code. Changes in the process would require additional testing to ensure the analysis is still representative.

In conclusion always keep files of your waste profiles, decision making information and testing data.

KEY REFERENCE:

State websites with hazardous waste and RCRA compliance resources:
http://www.envcap.org/statetools/hzrl/index.cfm

For more information see the FAQ: "How do you properly handle and dispose of ventilation system filter and collection bin debris?"

Date 9/10/07 FAQ-19
Rev. 1.0

Ventilation System Operations

Question: How do you properly handle and dispose of ventilation system filter and collection bin debris?

Proper handling and disposal of ventilation exhaust system filters require consideration of environmental, health and safety regulatory requirements including:

- determination of your company's hazardous waste generator status,
- hazardous waste "characterization" and "profiling" of the spent filter,
- any other applicable Federal, State and local hazardous waste regulations,
- hazard "identification" and training of employees performing the handling and disposal,
- other applicable OSHA requirements such as the Hazard Communications Standard and the Hexavalent Chromium Standard, and
- employees following engineering and work practice controls including the proper use of personal protective equipment.

Prior to the removal of the ventilation system filter or cleaning of the collection bin the above elements should be considered in developing a safe and regulatory compliant handling and disposal procedures.

The particulate on the ventilation filters and in the self-cleaning collection bin may or may not be an EPA hazardous waste. Consequently, worker protection should assume that the waste stream(s) are hazardous until the employer has sufficient knowledge to determine otherwise.

Users may wish to use the following filter handling and disposal elements in developing their own procedures; please refer to OSHA and EPA regulations for specific requirements.

Draft Handling Procedure for Hexavalent Chromium

- Anticipating that Cr(VI) dust could potentially be released during the change out of the filter(s), it is recommended that the employee(s) performing the task wear appropriate respirator and gloves. Further, depending upon site-specific conditions other personal protective equipment may be necessary such as the employee wearing disposable protective clothing over their street clothes.

...(continued)

.(Continued from previous page)

- Removal of Cr(VI) from protective clothing and equipment by blowing, shaking, or any other means that disperses Cr(VI) into the air is prohibited. The OSHA Hexavalent Chromium standard requires the use of a HEPA- filtered vacuum or wet methods to clean any surfaces contaminated with Cr(VI).
- Release of any dust should be minimized during the opening of the ventilation system and removal of the filter and collection bin debris. Loose and spilled dust should be cleaned-up with a HEPA-filtered industrial vacuum cleaner or wet method.
- Perform the filter removal and collection bin cleaning in an area separated from near-by workers and interfering air movement (i.e. open overhead doors). Remove the power plug from the wall receptacle.
- Remove the filter housing cover following the direction in the exhaust system's user manual.
- As the ventilation system is opened up, any excess dust which has accumulated along edges of the filter/ housing interface should be vacuumed or wet wiped before moving the filter.
- Using two people, lift the filter out of the filter housing and place in an impermeable disposal container (bag). Seal the bag and make sure the container is properly labeled. If no Federal, State or local hazardous wastes requirements apply, then labeling requirements specified under OSHA's Hazard Communication standard should be used.
- Vacuum or wet wipe loose and spilled dust from the surface of the ventilation system.
- Dispose of the container according to your company's hazardous waste generator status and the Federal, State or local hazardous waste requirements.

Note: The OSHA Hazard Communications standard contains the applicable employee communications and training requirements unless the ventilation system is being used on a Federal or State hazardous waste site. http://www.osha.gov/SLTC/hazardcommunications/index.html

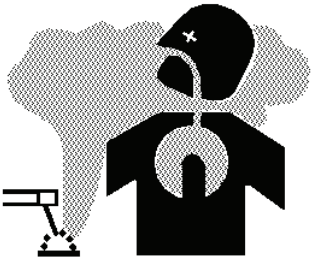
For more information see the FAQ: How do I determine the regulatory requirements for proper disposal of a spent exhaust system filter?

E205

Arc Welding Safety

Welding Fumes and Gases
Safety Practices in Welding

⚠ WARNING



FUMES & GASES can be dangerous to your health

- **Keep fumes and gasses from your breathing zone and general area.**
- **Keep our head out of the fumes.**
- **Use enough ventilation or exhaust at the arc, or both, to keep fumes from your breathing zone and general area.**

Fumes and Gases
Because of the variables involved in fume and gas generation from arc welding, cutting and allied processes (such as the welding process and electrode, the base metal, coatings on the base metal, and other possible contaminants in the air), we'll have to treat the subject in a rather general way, lumping all but the more hazardous situations together. The precautions we describe will hold true for all arc welding processes.

The **fume plume** contains solid particles from the consumables, base metal, and base metal coating. For common mild steel arc welding, depending on the amount and length of exposure to these fumes, most immediate or short term effects are temporary, and include symptoms of burning eyes and skin, dizziness, nausea, and fever. For example, zinc fumes can cause metal fume fever, a temporary illness that is similar to the flu.

Long-term exposure to welding fumes can lead to siderosis (iron deposits in the lungs) and may affect pulmonary function. Bronchitis and some lung fibrosis have been reported.

Some consumables contain certain compounds in amounts which may require special ventilation and/or exhaust. These Special Ventilation products can be identified by reading the labels on the package. If Special Ventilation products are used indoors, use local exhaust. If Special Ventilation products are used outdoors, a respirator may be required. Various compounds, some of which may be in welding fume, and reported health effects, in summary, are:

Welding Fumes and Gases
Safety Practices in Welding

Barium: Soluble barium compounds may cause severe stomach pain, slow pulse rate, irregular heart beat, ringing of the ears, convulsions and muscle spasms. In extreme cases can cause death.

Cadmium also requires extra precautions. This toxic metal can be found on some steel and steel fasteners as a plating, or in silver solder. Cadmium fumes can be fatal even under brief overexposures, with symptoms much like those of metal fume fever. These two conditions should not be confused. Overexposure to cadmium can be enough to cause fatalities, with symptoms appearing quickly, and, in some circumstances, death a few days later.

Chromium: Chromium is on the IARC (International Agency for Research on Cancer) and NTP (National Toxicology Program) lists chromium as posing a carcinogenic risk to humans. Fumes from the use of stainless steel, hardfacing and other types of consumables contain chromium and/or nickel. Some forms of these metals are known or suspected to cause lung cancer in processes other than welding and asthma has been reported. Therefore, it is recommended that precautions be taken to keep exposures as low as possible. OSHA recently adopted a lower PEL (Permissible Exposure Limit) for chromium (see Supplement 3). The use of local exhaust and/or an approved respirator may be required to avoid overexposure.

Coatings on the metal to be welded, such as paint, may also contain toxic substances, such as lead, chromium and zinc. In general, it is always best to remove coatings from the base metal before welding or cutting.

Cobalt: Exposure to cobalt can cause respiratory disease and pulmonary sensitization. Cobalt in metallic form has been reported to cause lung damage.

Copper: Prolonged exposure to copper fume may cause skin irritation or discoloration of the skin and hair.

Manganese: Manganese overexposure may affect the central nervous system, resulting in poor coordination, difficulty in speaking, and tremor of arms or legs. This condition is considered irreversible.

Nickel: Nickel and its compounds are on the IARC (International Agency for Research on Cancer) and NTP (National Toxicology Program) lists as posing a carcinogenic risk to humans.

Silica: Crystalline silica is present in respirable dust form submerged arc flux. Overexposure can cause severe lung damage (silicosis).

Zinc: Overexposure to zinc (from galvanized metals) may cause metal fume fever with symptoms similar to the common flu.

Welding Fumes and Gases
Safety Practices in Welding

The **gases** that result from an arc welding process also present potential hazard. Most of the shielding gases (argon, helium, and carbon dioxide) are non-toxic, but, as they are released, they **displace oxygen** in your breathing air, causing dizziness, unconsciousness, and death, the longer your brain is denied the oxygen it needs. Carbon monoxide can also be developed and may pose a hazard if excessive levels are present.

The **heat and UV radiation** can cause irritation to the eyes and lungs. Some degreasing compounds such as trichlorethylene and perchlorethylene can decompose from the heat and ultraviolet radiation of an arc. Because of the chemical breakdown of vapor-degreasing materials under ultraviolet radiation, arc welding should not be done in the vicinity of a vapor-degreasing operation. Carbon-arc welding, gas tungsten-arc welding and gas metal arc welding should be especially avoided in such areas, because they emit more ultraviolet radiation than other processes. Also, keep in mind that ozone and nitrogen oxides are formed when UV radiation passes through the air. These gases cause headaches, chest pains, irritation of the eyes, and an itchiness in the nose and throat.

There is one easy way to **reduce the risk** of exposure to hazardous fumes and gases: **keep your head out of the fume plume!** As obvious as this sounds, the failure to follow this advice is a common cause of fume and gas overexposure because the concentration of fume and gases is greatest in the plume. Keep fumes and gases from your breathing zone and general area using natural ventilation, mechanical ventilation, fixed or moveable exhaust hoods or local exhaust at the arc. Finally, it may be necessary to wear an approved respirator if adequate ventilation cannot be provided (see Ventilation section).

Welding Fumes and Gases
Safety Practices in Welding

As a rule of thumb, for many mild steel electrode, if the air is visibly clear and you are comfortable, then the ventilation is generally adequate for your work.The most accurate way to determine if the worker exposure does not exceed the applicable exposure limit for compounds in the fumes and gases is to have an industrial hygienist take and analyze a sample of the air you are breathing. This is particularly important if you are welding with stainless, hardfacing or Special Ventilation products. All Lincoln MSDS have a maximum fume guideline number. If exposure to total fume is kept below that number, exposure to all fume from the electrode (not coatings or plating on the work) will be below the TLV.

There are also steps that you can take to identify hazardous substances in your welding environment. First, read the product label and material safety data sheet for the electrode posted in the work place or in the electrode or flux container to see what fumes can be reasonably expected from use of the product and to determine if special ventilation is needed. Secondly, know what the base metal is, and determine if there is any paint, plating, or coating that could expose you to toxic fumes and/or gases. Remove it from the metal being welded, if possible. If you start to feel uncomfortable, dizzy or nauseous, there is a possibility that you are being overexposed to fumes and gases, or suffering from oxygen deficiency. Stop welding and get some fresh air immediately. Notify your supervisor and co-workers so the situation can be corrected and other workers can avoid the hazard. Be sure you are following these safe practices, the consumable labeling and MSDS and improve the ventilation in your area. Do not continue welding until the situation has been corrected.

NOTE: The MSDS for all Lincoln consumables is available on Lincoln's website: www.lincolnelectric.com

TLVs and PELs of Typical Electrode Ingredients (E205 Supplement 3)

LISTED BELOW ARE SOME TYPICAL INGREDIENTS IN WELDING ELECTRODES AND THEIR TLV (ACGIH) GUIDELINES AND PEL (OSHA) EXPOSURE LIMITS

Ingredients	CAS No.	TLV mg/m^3	PEL mg/m^3
Aluminum and/or Aluminum Alloys (as Al)*****	7429-90-5	1.0	15
Aluminum Oxide and/or Bauxite*****	1344-28-1	1.0	5**
Barium Compounds (as BA)*****	513-77-9	0.5	0.5
Chromium and Chromium Alloys or Compounds (as Cr)*****	7440-47-3	0.5[(b)]	0.5[(b)]
Hexavalent Chromium (Cr VI)	18540-29-9	0.05(b)	.005(b)
Copper Fume	7440-50-8	0.2	0.1
Cobalt Compounds	7440-48-4	0.02	0.1
Fluorides (as F)	7789-75-5	2.5	2.5
Iron	7439-89-6	10*	10*
Limestone and/or Calcium Carbonate	1317-65-3	10*	15
Lithium Compounds (as Li)	554-13-2	15	10*
Magnesite	1309-48-4	10	15
Magnesium and/or Magnesium Alloys and Compounds (as Mg)	7439-95-4	10*	10*
Manganese and/or Manganese Alloys and Compounds (as Mn)*****	7439-96-5	0.02	5.0[(c)]
Mineral Silicates	1332-58-7	5**	5**
Mollybdenum Alloys (as Mo)	7439-98-7	10	10
Nickel*****	7440-02-0	0.1	1
Silicates and other binders	1344-09-8	10*	10*
Silicon and/or Silicon Alloys and Compounds (as Si)	7440-21-3	10*	10*
Strontium Compounds (as Si)	1633-05-2	10*	10*
Zirconium Aloys and Compounds (as Zr)	12004-83-0	5	5

TLVs and PELs of Typical Electrode Ingredients (E205 Supplement 3)

Supplemental Information:

(*) Not listed. Nuisance value maximum is 10 milligrams per cubic meter. PEL value for iron oxide is 10 milligrams per cubic meter. TLV value for iron oxide is 5 milligrams per cubic meter.

(**) As respirable dust.

(*****) Subject to the reporting requirements of Sections 311, 312, and 313 of the Emergency Planning and Community Right-to-Know Act of 1986 and of 40CFR 370 and 372.

(b) The PEL for chromium (VI) is .005 milligrams per cubic meter as an 8 hour time weighted average. The TLV for water-soluble chromium (VI) is 0.05 milligrams per cubic meter. The TLV for insoluble chromium (VI) is 0.01 milligrams per cubic meter.

(c) Values are for manganese fume. STEL (Short Term Exposure Limit) is 3.0 milligrams per cubic meter. OSHA PEL is a ceiling value.

(****) There is no listed value for insoluble barium compounds. The TLV for soluble barium compounds is 0.5 mg/m3.

TLV and PEL values are as of April 2006. Always check Material Safety Data Sheet (MSDS) with product or on the Lincoln Electric website at http://www.lincolnelectric.com

PRODUCT SPECIFICATIONS TEXT

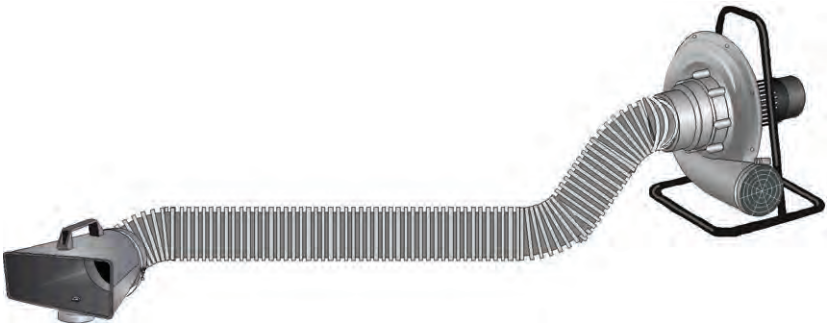
Mobiflex™ 100-NF

For hard to reach areas, indoor or outdoor applications, use the Mobiflex™ 100-NF to exhaust welding fumes away from the welding arc.

- For hard to reach places
- Lightweight and portable, 37.4 lbs (17 kg)
- 725 CFM airflow rate (16 ft length hose)
- Flexible, steel reinforced exhaust hose, up to 32 ft in length
- Maximum noise level 69dBA

◀ Mobiflex™ 100-NF

Mobiflex™ 100-NF with 16 ft (4.9 m) Flex Hose ▼



Miniflex™

Portable high vacuum system designed for the removal and filtration of welding fumes in light duty applications.

- For MIG and TIG welding and light duty Stick or Flux-Cored welding
- Extremely lightweight and portable at only 36 lbs (16 kg)
- Great for maintenance and general shop welding applications
- Five-Stage filtration system for high filter efficiency
- Use with fume extraction guns or a wide variety of extraction nozzles to remove fumes from the welding arc

Hose Attachment ▲
of the Miniflex™

Miniflex™ ▶

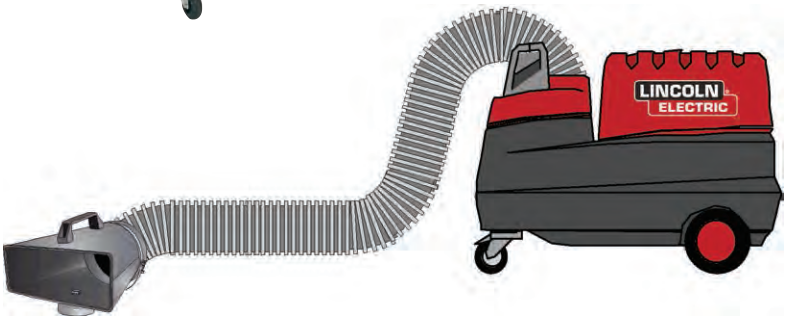
Mobiflex™ 200-M

Mobile low vacuum disposable filter system for medium duty extraction and filtration of welding fumes.

- 735 CFM airflow rate for Stick, MIG or Flux-Cored Welding applications
- Large 50 square meter LongLife filter with ExtraCoat pretreatments provides superior performance and filter efficiency
- Disposable filter design allows for simple removal and replacement of filters
- Lightweight and rugged design, with standard front wheel casters and large back wheels allows for easy shop mobility
- Flexible extraction arms, 10 ft (3.1 m) or 13 ft (4.1 m) in length, are easy to use and move with virtually no effort

◀ Mobiflex™ 200-M with LFA 4.1 (13 ft) Arm

Mobiflex™ 200-M with 16 ft (4.9 m) Flex Hose ▼



Mobiflex™ 400-MS

Mobile low vacuum self cleaning filter system for heavy duty extraction and filtration of welding fumes.

- 735 CFM airflow rate for Stick, MIG or Flux-Cored Welding applications
- Large 30 square meter LongLife filter cartridge with ExtraCoat pretreatments provides superior performance and filter efficiency
- Self-Cleaning filter design provides up to 4 times long filter life, ideal for heavier welding applications
- Lightweight and rugged design, with standard front wheel casters and large back wheels allows for easy shop mobility
- Flexible extraction arms, 10 ft (3.1 m) or 13 ft (4.1 m) in length, are easy to use and move with virtually no effort

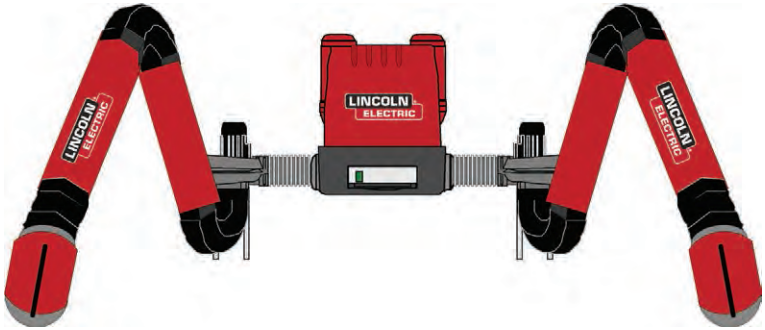
◀ Mobiflex™ 400-MS with LFA 4.1 (13 ft) Arm

Mobiflex™ 400-MS Self Cleaning Filter ▼

Statiflex™ 200-M and Statiflex™ 400-MS

Wall mounted stationary versions of our popular mobile units provide medium and heavy duty extraction and filtration of welding fumes. Keeping the units off the floor provides space saving convenience and ease of use.

- 735 CFM airflow rate for Stick, MIG or Flux-Cored Welding applications
- Large LongLife filter cartridge with ExtraCoat pretreatments provides superior performance and filter efficiency
- Disposable or Self-Cleaning filter designs provides long filter life, ideal for industrial shop or welding school applications
- A wide variety of extraction arms are available for small welding school booth applications to industrial factory floors with requirements of up to 27 ft reach capability
- Optional dual arm unit for Statiflex 200-M model provides further flexibility. Great for schools and lighter duty applications where one filtration unit can be easily used for two welding stations



▲ Statiflex™ 200-M Dual Arm Model

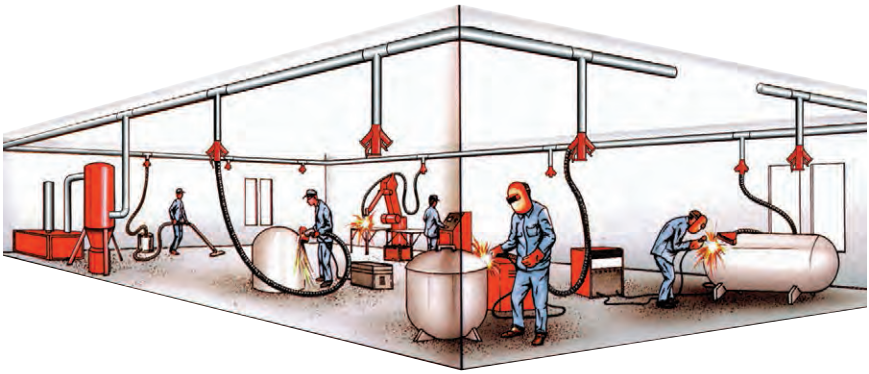
◀ Statiflex™ 400-MS Single Arm Model

Central Systems for Schools and Industry

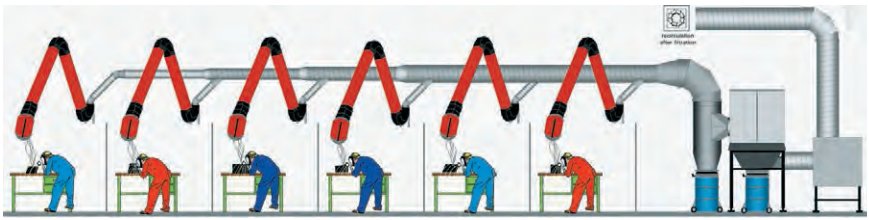
For applications where exhausting multiple welding stations in a relatively uniform setup is required. Ideal for welding schools and production welding applications.

- Central fan and filtration systems for industrial welding applications
- For Stick, MIG and Flux-Cored Welding applications

High Vacuum Central Systems ▼



Low Vacuum Central Systems ▼



NOTES

LINCOLN® ELECTRIC
THE WELDING EXPERTS®

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