

Hexavalent Chromium (CrVI)

From
3M

Occupational Health and
Environmental Safety Division

Things to Know.....

- OSHA Website: www.Osha.gov
- 3M Website: www.3M.com/occsafety
- 3M Fax On-Demand #(800) 646-1655
- rmrickerson1mmm.com
- **(636) 699-7937**

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Summary

1. Introduction "What is Hexavalent Chromium?"
2. Safety Topics
 - Welding Safety
 - Heavy Duty Paints and Coatings Safety
 - Electroplating Safety
3. The New Hexavalent Chromium Standard
4. Manganese and Beryllium Updates
5. Product Review

What is Hexavalent Chromium?

- Derived from Chromium which is a Metal Particle
- Highly Reactive (Valence of six)
- Strong Oxidizer (Ability to gain electrons from other elements)
- More soluble in water & more readily absorbed by biological systems than Trivalent Chromium Cr(III)
- Used in Metal plating; Pigments in Paint, Inks and Plastics; Anti-Corrosion Agent in Protective Coatings; **Welding and Cutting of Stainless Steel.**

What is Hexavalent Chromium?

- Can Cause Lung Cancer, Asthma, Nasal Septum Ulcerations and perforations, skin ulcerations, allergic and irritant dermatitis.
- OSHA predicts standard will affect Businesses in 30 Different Industrial Codes
- Erin Brochovich?

OSHA'S LIST OF IMPACTED INDUSTRIES

SIC CODES: 13, 15, 16, 17, 24, 28, 32, 33, 34, 37, 75

- | | |
|---|---|
| 1. ELECTROPLATING | 16. CHROMIUM DIOXIDE PRODUCERS |
| 2. WELDING | 17. CHROMIUM DYE PRODUCERS |
| 3. PAINTING | 18. CHROMIUM SULFATE PRODUCERS |
| 4. PRODUCERS OF CHROMATES AND RELATED CHEMICALS FROM CHROMITE ORE | 19. CHEMICAL DISTRIBUTORS |
| 5. CHROMATE PIGMENT PRODUCTION | 20. TEXTILE DYEING |
| 6. CHROMATED COPPER ARSENATE PRODUCERS | 21. PRODUCERS OF COLORED GLASS |
| 7. CHROMIUM CATALYST PRODUCTION | 22. PRINTING |
| 8. PAINT AND COATINGS PRODUCTION | 23. LEATHER TANNING |
| 9. PRINTING INK PRODUCERS | 24. CHROMIUM CATALYST USERS |
| 10. PLASTIC COLORANT PRODUCERS AND USERS | 25. PRODUCERS OF REFRACTORY BRICK |
| 11. PLATING AND MIXTURE PRODUCTION | 26. WOODWORKING |
| 12. WOOD PRESERVING | 27. SOLID WASTE INCINERATION |
| 13. CHROMIUM METAL PRODUCTION | 28. OIL AND GAS WELL DRILLING |
| 14. STEEL MILLS | 29. PORTLAND CEMENT PRODUCERS |
| 15. IRON AND STEEL FOUNDRIES | 30. NONFERROUS SUPERALLOY PRODUCERS AND USERS |
| | 31. CONSTRUCTION |
| | 32. PRODUCERS OF PRE-CAST CONCRETE PRODUCTS |

Welding Safety

Welding Metal Particle Hazards

- Metal Particle Hazards Associated with Welding:

Aluminum	Chromium
Beryllium	Manganese
Lead	Magnesium
Ferrous Oxide	Nickel
Cadmium	Vanadium Oxide
Copper	Zinc

- Chromium Exposure in welding are primarily associated with welding stainless steel & other chrome-containing alloys.

Contaminants Generated By:

Fume Generation



Grinding & Polishing



Arc Radiation & Chemical Interactions



Factors Affecting Respiratory Exposures in Welding

- Work Position (Proximity to Fume)
- Work environment (Enclosure vs open air)
- Type of Welding
 - Electrode & Base Metals
 - Flux vs. Shielding Gas
- Voltage/Amperage
- Coatings on Metal

Welding Types

- Stick and Flux Core Welding Produce more smoke.
- Mig and Tig produce less smoke.

Welding Methods with Source of Welding Fume

Process:	Evaporation of metal electrode	Metal Particles from Flux Flux combustion	Evaporation from Molten Weld Pool	Flux combustion shifting balance to more CrVI from CrIII
Stick	X	X	X	X
Flux Core	X	X	X	X
MIG	X		X	
TIG			X	

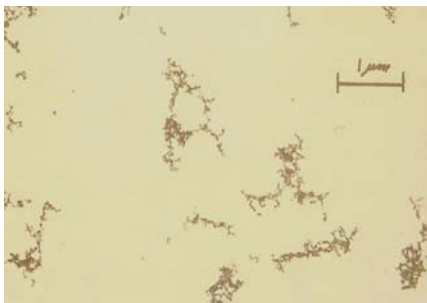
Fumes

- Fumes come from welding rods, base metal, and any coating such as Zinc.
- Metal Oxides condense from small Seed particles to form feathery aggregate particles.
- Particles are charged from welding arc and oxidation of metals.
- They tend to cake on outer surfaces of filters, and rapidly increase pressure drop.

Fumes

- A Fume is a particle that can be filtered with:
- N95 Filter (With no aerosols are present)
- R95 or P95 where aerosols are present.
- A filtering facepiece or half-mask respirator with appropriate filters.
- OSHA substance specific standards for Lead, Cadmium and Arsenic require 100 Class filters.

Fume



Industrial Paints and Coatings

Industrial Paints and Coatings

- Respiratory Hazards associated with Industrial Paintings and Coatings:

Vapors

Isocyanate
Toluene
Xylene
Butyl Acetate
Methyl Isobutyl Ketone
Isopropanol
Ethyl Acetate
Acetone
Ethanol

Particles

Chromium
Lead
Cadmium
Zinc
Beryllium
Copper
Nickel

Industrial Paints & Coatings

Mist is generated by Spraying the paint or Coating



Particles contained in Pigments are released During Grinding, sanding or welding



Organic Vapors Are released from Solvents in the paint Or coatings



Industrial Paints & Coatings

Mists and Pigments are particles that can be filtered with:

- N95 Filters with no aerosols present
- R95 & P95 where aerosols are present
- OSHA Substance Specific Standards for Lead, Cadmium and Arsenic require Class Filters.

Industrial Paints & Coatings

- Organic Vapors released from paints and coatings may be filtered with OV Cartridges
- A cartridge service life based on concentration of the contaminant, must be generated when using cartridges
- Prefilters appropriate for the particles must be used on top of cartridges due to the mist released
- A PEL is the maximum amount of contaminant OSHA allows workers to be exposed to in an 8 hour workday
- Eye protection should be worn with the respirator

Electroplating

Electroplating Hazards

- Respiratory Hazards associated with electroplating may include:

Mists

Chromic acid
(Used in chrome plating & anodizing)

Cyanide Salt Solutions
(Used in cadmium, Copper, silver, brass, Zinc and bronze plating)

Particles

Cadmium
Chromium
Copper
Gold
Nickel
Silver

Alloys of the above metals

Gases

Hydrogen Cyanide
Hydrogen Sulfide
Nitrogen Oxides
(released from pickling Baths containing nitric Acid- used to remove Heavy scale)

The Standard

OSHA Proposed Standard

- Permissible Exposure Level 1.0 ug/M³
- Public Discussions Held in Washington DC in 2005
- 1st Deadline was October 2005
- 2nd Target Date was January 18, 2006 postponed due to Hurricane Katrina
- No Mention as to Size of Employer

New Standard

- New PEL is 5 ug/M³
- Action Level is 2.5 ug/M³
- Federal Register on February 28, 2006
- Becomes Law on May 30, 2006
- Compliance:

20 Employees + Over-November 27, 2006
Under 20 Employees-May 30, 2007
Engineering Controls- May 2010

Standard

- Action Level is the level at which requirements such as medical surveillance kick in. It is also based upon an 8 hr TWA.
- To select the proper Respirator, the employer must determine the 8 hr TWA of **each employee**. The standard permits this to be done in two ways:
 1. Scheduled Monitoring Option
 2. Performance-Oriented Option

Monitoring

- If initial monitoring indicates that employee exposures are below the action level (2.5), the employer may discontinue monitoring.
- If at or above the action level, the employer shall perform periodic monitoring at least every 6 months.
- If exposures are above the PEL, the employer shall perform periodic monitoring at least every 3 months.

Monitoring

- If periodic monitoring indicates exposures below action level, and results are confirmed by another monitoring, then employer may discontinue monitoring.
- The employer shall perform additional monitoring if changes occur to production process, raw materials, equipment, work practices that could result in additional exposures of Cr(VI).
- OR when employer has any reason to believe that new or additional exposures have occurred.

Air Monitoring Assistance

- Call your Insurance Carrier
- Contact AIHA (American Industrial Hygiene Association)
www.aiha.org Choose "Consultants"

Recordkeeping

- The Employer must maintain an accurate record of all air monitoring conducted to comply with the requirements of this standard. These records must include:
 - Date of Measurements
 - The operation involving Cr(VI)
 - Sampling & analytical methods used, & evidence of their accuracy
 - Number, duration & results of samples taken
 - Type of PPE such as respirators worn
 - Name, SSN and Job Classification of all employees represented by the monitoring, indicating which employees were actually monitored

What does It Mean

- 1st Have an I.H. Do Air Sampling to Determine Exposure Levels based on 8 Hr TWA (Contact AIHA for Certified IH at: www.aiha.org)
- 2nd, If above new PEL, look into Engineering +/- Admin Controls to get to safe level If “Economically Feasible”
- 3rd, Issue Respirators if not feasible

The Standard and Air Sampling

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St. Louis, Missouri

Air Sampling Procedures

- **Air Sampling Pump**
- **PVC Filter**
 - Limited to Cr (VI) and Total Particulates
- **Welding Hoods**
 - Samples should be collected within the welding hood
- **Other sampling notes**
 - Non-welding periods
 - Proper handling procedures

Full-shift vs. Short-term

- **Full-shift Sampling**
 - Determines average exposure for a typical work shift (generally 7–8 hrs)
 - Compare results to the OSHA PEL (8-hour time weighted average)
 - Adjustments for longer work shifts (ie 10–12 hour shift)
- **Short-term Sampling**
 - Determines potential exposure peaks (PPE issues) or short term activities
 - Can also be used to evaluate various welding methods or work practices
 - Professional judgment needed when comparing to the PEL

Results

- **Comparison to applicable regulatory limits**
 - OSHA PEL: 5.0 µg/m³
 - OSHA Action Limit: 2.5 µg/m³
 - ACGIH Threshold Limit Values
- **Cautions**
 - Use of the time weighted average
 - Snapshot of that day
 - Variability in process / environment
 - Change in conditions may vary / change results
 - Should be consistent with other data

Sampling Personnel

- Self-Administered (Kits from Labs)
- Air Sampling Technician
 - Better if under the direction of a Certified Industrial Hygienist (CIH)
- Industrial Hygienist
 - Better if under the direction of a CIH
- Certified Industrial Hygienist

Qualified Personnel

- **Quality of Work**
 - More confidence in the accuracy of the results
 - Avoids the potential for questionable data
- **Experience**
 - Has better understanding of results
 - Evaluation of previous data (may use total particulate results for comparison of data)
 - More meaningful recommendations

Example Welding Exposures

Task / Description	Sampling Duration	Cr (VI) Result (µg/m³)	Total Particulate (mg/m³)
Welder No. 1: Grinding on stainless steel plates	467	ND (0.013)	0.33
Welder No. 2: TIG/MIG welding on stainless st. plates	501	0.025	0.36
Welder No. 3: MIG welding on stainless steel plates	496	0.051	0.4
Welder No. 4: TIG/MIG Welding on stainless st plates	492	0.85	1.2

- Full-Shift Monitoring Activities
- Effective general dilution ventilation system with exhaust fans directly overhead of the welding activities

Example Welding Exposures

Task / Description	Sampling Duration	Cr (VI) Result (µg/m³)	Total Particulate (mg/m³)
Gas Tungsten Arc (TIG) welding of stainless steel pipes (Gas Shielded)			
Welder No. 1	50 min	0.61	< 0.30
Welder No. 2	27 min	0.83	< 0.56
Shielded Metal Arc (SMAW) welding of stainless steel pipes (Non-Gas Shielded)			
Welder No. 1	123 min	8.1	2.6
Welder No. 2	41 min	6.6	1.8

- Comparison of Welding Methods
- Overhead canopy ventilation system
- General dilution ventilation with area fans

Example Welding Exposures

Task / Description	Sampling Duration	Cr (VI) Result ($\mu\text{g}/\text{m}^3$)	Total Particulate (mg/m^3)
Shielded Metal Arc (SMAW) welding of stainless steel plates (non-Gas Shielded) <i>Filling gouges of stainless steel plates with high chrome welding rods</i>	114 min	76	3.4
Area Sample – 12' Downwind of welding activities	112 min	55	2.9

- Short-term Activity
- Area fan ventilation inside heavy industrial facility
- Exposure data varied due to site conditions

Laboratory Services

Dave Siegel
EnviroHealth Technologies, Inc.
(314) 531-9868
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St. Louis, Missouri

Containment and Collection

Addressing Fugitive Weld Fumes
within your facility.

Presented by:
John Waites
The Waites Company
314.644.5556

Hooding

What options do we have to collect fume from our process or intermittent welding operations?

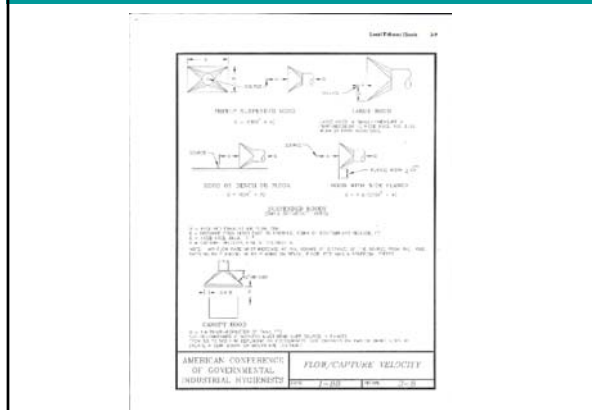
3.22 Selection Tables

HOOD TYPE	APPLICABLE	APPROX. AIR FLOW	APPROX. AIR FLOW
SNIP	ALL WELDING	2 - 375 CFM	
FLATBED HOOD	ALL WELDING	2 - 275 CFM	
FLAN HOODING	ALL WELDING AND CUTTING	2 - 300 CFM	
PARALLEL BEARING	ALL WELDING AND CUTTING	2 - 675 CFM	
ROOF	ALL WELDING	2 - 100 CFM	
TRAP	ALL WELDING	2 - 100 CFM	
FLAN HOODING WITH WELDING AND CUTTING	ALL WELDING AND CUTTING	2 - 300 CFM	
FLAN HOODING WITH WELDING AND CUTTING	ALL WELDING AND CUTTING	2 - 300 CFM	
FLAN HOODING WITH WELDING AND CUTTING	ALL WELDING AND CUTTING	2 - 300 CFM	

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS HOOD TYPES

Which Hood is Best?

The objective is to design a containment device that is efficient, non-obstructive, and with the least amount of air volume.



Canopy Hood

Probably the most common and most inefficient option!

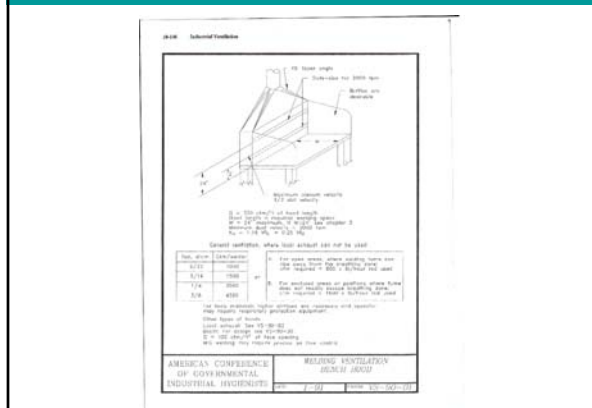
$$Q = 1.4PVD$$

Example: Lets look at a 4 x 6 hood that is 4ft. Above the work surface.

$$Q = 1.4 \times 20 \times 150 \times 4$$

$$Q = 16,800 \text{ cfm}$$

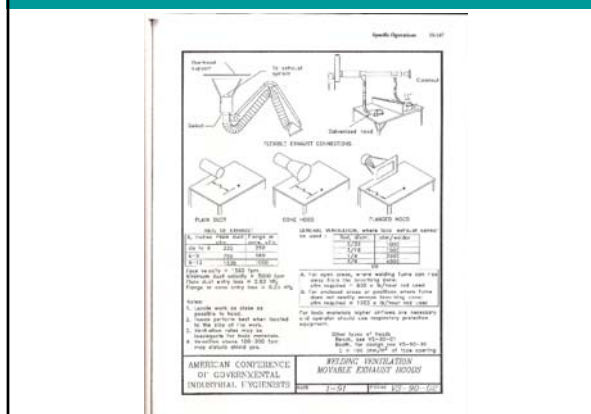
$$Q = \$\$\$\$\$$$



Slot Hood

A common method for capturing fumes from table top operations - restricted to working from one side.

Air Flow requirements are much less than a Canopy Hood Design.



Source Capture Hoods

The most efficient and effective hood. However - performance is a function of the operator's involvement.

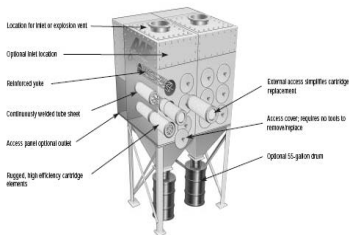
A minimal amount of air required, but operator participation is mandatory.

A good choice for intermittent/maintenance operations

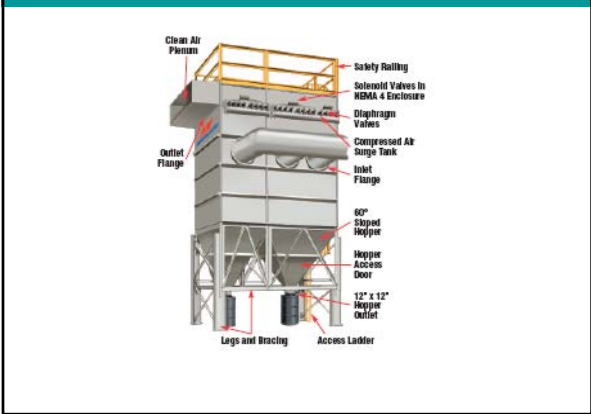
What to do with Collected Fume

1. Exhaust to atmosphere and make up.
2. Filter and exhaust to atmosphere and make up.
3. Filter and return clean air to the space.

What Type of Control Equipment?









Respiratory Protection & Compliance

Respiratory Protection

- There is no respirator selection table issued under this standard.
- The Standard refers to CFR 1910.134 for selection.

Compliance

- Regulated Areas: (Does not apply to construction and shipyard employees)
- The employer shall establish a regulated area wherever employee's exposures to airborne Cr(VI) is or can reasonably be expected to be in excess of the PEL.
- Regulated Areas shall be demarcated from the rest of the workplace in a manner that adequately establishes & alerts employees of the boundaries of the regulated areas.
- Access shall be limited.

Compliance

- **Methods of Compliance:** The employer shall use engineering & work practice controls to reduce & maintain employee exposures to or below the PEL unless the employer can demonstrate those controls are not feasible.

Compliance

- Wherever feasible engineering & work practice controls are not sufficient to reduce employee exposure to or below the PEL, the employer shall use them to reduce employee exposures to the lowest level achievable & supplement them by the use of respiratory protection.

Compliance

- **Methods of Compliance-Aerospace Industry Exception:**

Where painting of aircraft or large aircraft parts is performed in the aerospace industry, the employer shall use engineering and work practice controls to reduce & maintain employee exposure to or below 25 ug/M³ unless the employer can demonstrate that such controls are not feasible. The employer shall supplement engineering & work practice controls with the use of respiratory protection to achieve the PEL of 5 ug/M³.

Compliance

- General Exceptions:
- Where the employer can demonstrate that a process or task does not result in any employee exposure above the PEL for 30 or more days per year (12 consecutive months), the requirement to implement engineering & work practice controls to achieve the PEL does not apply to that process or task.
- Rotation of employees to different jobs to comply with the PEL is not permitted.

Medical Surveillance

- Employers responsible to make available to employees at no cost, & reasonable time & place.
 - Employees who are of may be occupationally exposed at or above the action level for 30 or more days per 12 months.
 - Experiencing signs or symptoms of the adverse health effects associated with Cr(VI) exposure.
 - Exposed in an emergency

Medical Surveillance

- All Medical examinations conducted under supervision of a PLHCP.
- Must provide:
 - Copy of Hexavalent Chromium Standard
 - Description of affected employee's former, current & anticipated duties as they relate to occupational exposure.
 - The employees former, current & anticipated exposures.
 - Description of any PPE used or to be used by the employee, including when & how long employee has used the equipment.

Medical Surveillance

- The employer must obtain a written medical opinion from the PLHCP which contains:
 - Any recommended limitations on the employee's exposure to Cr(VI)
 - Any recommended limitations on the use of PPE such as respirators

Medical Surveillance- Recordkeeping

- The employer must establish & maintain an accurate record for each employee covered by medical surveillance under paragraph (k). This record must include:
 - Name, SSN
 - A copy of the PLHCP's written opinions
 - A copy of the information provided to the PLHCP.

Communication of Hazard

- Communication of Cr(VI) Hazards to employees.
- In addition to the requirements of communicating the Hazard to the employees, the employer must ensure that each employee can at least demonstrate knowledge of the contents of this standard & a purpose & description of the required medical surveillance program.

Recordkeeping

- All records must be maintained and made available in accordance with CFR1910.1020

Manganese Update

- Manganese: American Conference of Government Industrial Hygienists proposed reducing the TLV of manganese from 0.2 mg/m³, to 0.03 mg/m³. In 2003, they withdrew the proposal.
- Manganese is thought to produce Parkinson-like symptoms.
- OSHA does not have manganese PEL reduction on their agenda.

Beryllium Update

- Possible movement towards a proposed rule due to the November 2002 solicitation for information, but no official date has been set.
- On November 26, 2002, OSHA published a request for information pertinent to occupational exposure to beryllium.

Midwest Hexavalent Chromium Education Consortium by **3M**

Respiratory Ranges of Protection For Hexavalent Chromium CrVI

	OCAW/CRG Level (Min-Max usage)	Proposed OSHA (Min-Max usage)	Standard (Minimum Requirement) (Min-Max usage)	ACGIH Current level (Min-Max usage)
N95, Negative Pressure APF= 10X	0.5-5.0 ug/M ³	1.0-10.0 ug/M ³	5-50 ug/M³	1.0-10.0 ug/M ³
Full Face, Negative Pressure QNFT APF= 50X	0.5-25.0 ug/M ³	1.0-50.0 ug/M ³	5-250 ug/M³	1.0-50.0 ug/M ³
Adflo PAPR APF= 25X	0.5-12.5 ug/M ³	1.0-25.0 ug/M ³	5-125 ug/M³	1.0-25.0 ug/M ³
Fresh Air II (SAR) APF= 25X	0.5-12.5 ug/M ³	1.0-25.0 ug/M ³	5-125 ug/M³	1.0-25.0 ug/M ³
L905 PAPR/SAR APF= 1,000X	0.5-500 ug/M ³	1.0-1,000 ug/M ³	5-5,000 ug/M³	1.0-1,000 ug/M ³


Midwest Hexavalent Chromium Education Consortium by **3M**

Respirator Usage


5 to 50 ug/M ³	10X	N95: 8515, 8212, 8512, 8214, 8515, 6000/7500 Half Face, 7800 QLFT
5 to 125 ug/M ³	25X	Adflo
5 to 250 ug/M ³	50X	7800S QNFT
Above 250 ug/M ³		Supplied Air/L905, 7800S or L905/GVP

Midwest Hexavalent Chromium Education Consortium by **3M**


MFR Negative Pressure APF 10X



8515



8212/8512



8214/8514

3M Maintenance Free Respirators N95 For Welding



- **8212, 8214, 8512, 8514**
 - 3M Welding web
 - 3M Cool Flow Valve
 - Cake-resistant filter media
 - Fully adjustable straps
 - Face seal (**8212/8214** only)
 - Nuisance level organic vapor relief, ozone (**8214/8514**)

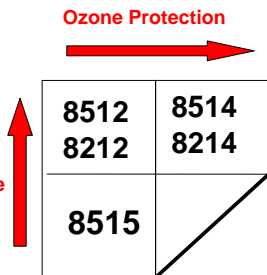


- 3M **8515** – entry level welding

Welding Product Positioning



Longer respirator life
and increased fit
customization



Negative Pressure APF 10X – 50X



6000 Series



7500 Series



7800S With 7990/7991 Clip On
Welding Shield



3M PAPRS (APF=25)



L-Series with GVP PAPR



Adflo PAPR with Flexview



Supplied Air APF 25-1,000X



Speedglas
25X



Air Filter Panel



L-Series
L-905 1,000X
