Nederman

OSHA Standards for Hexavalent Chromium in Welding Fumes

GUIDELINES FOR WELDERS

OSHA Vol. 71, No. 39, 10262

OSHA has determined that the primary controls most likely to be effective in reducing employee exposure to Cr(VI) are local exhaust ventilation and improvement of general dilution ventilation.

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This Guide is intended to provide information about Hexavalent Chromium safety and health standards promulgated by OSHA or by a state with an OSHA-approved state plan*.
This Guide is not a standard or regulation, and it creates no legal obligations.

**) States that administer their own OSHA-approved occupational safety and health plans may have different requirements.*

CONTENTS

New standards to reduce exposure to hexavalent chromium Cr (VI)

Hexavalent chromium, also known as Cr(VI), poses serious threats to health and safety. Therefore, on February 28, 2006, the Occupational Safety & Health Administration (OSHA) issued a new standard relating to occupational exposure to hexavalent chromium.

The new standard lowered the permissible exposure limit (PEL) of hexavalent chromium by more than 10 times, from 52 to 5 micrograms.

The OSHA decision to lower the exposure limit was based on a finding that employees exposed to Cr(VI) face an increased risk of significant health effects like lung cancer, asthma, nasal septum ulcerations and perforations, skin ulcerations ("chrome holes"), allergic and irritant contact deramatitis.

OSHA's permissible exposure limit (PEL) for hexavalent chromium:

5 micrograms of Cr(VI) per cubic meter of air (µg/m3) during 8-hour time-weighted average (TWA)

Understanding the new OSHA regulation

OSHA's 2006 regulation for employee exposure to hexavalent chromium also includes provisions relating to preferred methods for controlling exposure, respiratory protection, protective work clothing and equipment, hygiene, medical surveillance, hazard communication and record keeping. This rule applies to all manufacturing processes where hexavalent chromium is present.

Industries most likely to be affected by the regulation include:

• Electroplating – hard chrome electroplating
• Thermal spraying
• Welding – all types could be affected, but the highest concentration is in stainless steel welding
• Steel mills – rolling mills and forging operations
• Metal cutting – all types including laser, plasma and oxyacetylene

Complete information and a copy of the regulation (Volume 71, Number 39, 10099-10385) are available at the OSHA web site: www.osha.gov/SLTC/ hexavalentchromium/index.html.

What is the best way to capture the hexavalent chromimum weld fumes?

There is normally two different ways of maintaining air quality:

• *On-torch fume extraction*

• *Source capture using a dust or fume collection device and exhaust arms with hoods*

Choosing the right solution depends on the type and quantity of contaminant generated.

OSHA Standard: Exposure control

The OSHA standard requires industries to control worker exposures to Cr(VI) so the PEL is not exceeded. This may be done through work practice control and engineering control.

"To protect workers from Cr(VI) hazards, whenever exposures exceed the PEL employers must use engineering and work practice controls to reduce and maintain Cr(VI) exposures to or below the PEL. These are the most effective controls. Whenever feasible engineering and work practice controls are not sufficient to reduce exposures to or below the PEL, the employer must use such controls to reduce exposures to the lowest levels achievable and supplement them by the use of respiratory protection."(OSHA)

In many cases, work practice controls complement engineering controls in providing worker protection.

Work practice controls

Work practice controls involve adjustments in the way a task is performed. Workers must know the proper way to perform a task in order to minimize their exposure and to maximize the effectiveness of the control. For example, a welder should be properly trained to correctly position himself and the local exhaust ventilation to minimize exposure to the welding fume.

Engineering controls - alternatives

1. Substitution
It is feasible and practical to modify or replace your current welding process, consumable, gas, welding procedure or equipment technology with an alternative process that generates less welding fumes?

2. Isolation
Is it feasible and practical to isolate and separate your welding operation by moving it to a regulated area, by automatic/ventilating the welding process and/or by placing a barrier between the employee and the source?

3. Ventilation
Is it feasible and practical to control the welding fume path between the source and the worker through source, local and/or general shop extraction/ventilation equipment?

Obligatory implementation latest May 31, 2010

After May 31, 2010 engineering control is mandatory and the employer must have implemented engineering and work practice controls to reduce exposures to the lowest levels achievable.

Respirators can, after this day, in general, only be used to comply with the PEL if engineering and work practice controls are unable to reduce exposures to levels at or below the PEL*).

**** Exceptions to the general requirement for primary use of feasible engineering and work practice controls to reduce worker exposures to within permissible limits:***
If the employer can demonstrate that a particular process or task does not result in worker exposures to Cr(VI) exceeding the PEL for 30 or more days during any 12 consecutive months, the employer is allowed to use any combination of controls, including respirators alone, to achieve the PEL. Historical data, objective data, or exposure monitoring data may be used for this purpose.

OSHA Standard: Exposure Monitoring

"Each employer who has a workplace or work operation covered by the OSHA Cr(VI) standards must determine the 8-hour TWA exposure for each worker exposed to Cr(VI)." (OSHA)

Who can make air monitoring?

Air monitoring should be performed by a Certified Industrial Hygienist (CIH) or other technically qualified person.
The American Industrial Hygiene Association maintains a list of IH consultants by state and areas of expertise*

Assessment Procedure

The employers can choose between two options for performing the exposure monitoring:
- Scheduled monitoring option
- Performance-oriented option

Scheduled monitoring

Scheduled monitoring implies that the employer performs an initial exposure monitoring to determine the exposure to Cr(VI) for each worker. This involves taking 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.

The monitoring results must indicate the worker's time weighted average (TAW) exposure to airborne Cr(VI) over a typical 8-hour workday.

In some cases the employer will need to monitor all exposed workers, while in other cases it will be sufficient to monitor "representative" personnel. Representative exposure sampling is permitted when a number of workers perform essentially the same job under the same conditions.

Performance-Oriented Option

The performance-oriented option allows the employer to determine the 8-hour TWA exposure for each worker on the basis of any combination of air monitoring data, historical monitoring data, or objective data sufficient to accurately determine current worker exposure to Cr(VI). This option is intended to allow employers flexibility in assessing the Cr(VI) exposures of their personnel.

** Consult an American Industrial Hygiene Association (AIHA)-accredited laboratory for assistance in selecting the appropriatesampling and analytical method.* ***www.aiha.org***

Hexavalent Chromium in Welding Fumes

Welding fume formation

Welding fume particles are generated by vaporization of metal and flux. When cooled down the vapor condenses and reacts with the atmospheric oxygen and fine particles are formed. The size of the particles (0.01 -1µm) tends to influence the toxicity of the fumes. Smaller particles present a greater danger. Additionally, many processes produce various gases (most commonly carbon dioxide and ozone, but others as well) that can prove dangerous if ventilation is inadequate.

Fume composition

The fume composition is determined by the composition of the welding electrode (consumable). Around 90% of the fume originates from the consumable, while the base metal only contributes very little.
The fume contains all the elements present in the consumable, but often in very different proportions.

The welding process affects the fume composition

The amount of welding fume varies between different welding processes.
Fumes from **Manual Metal Arc Welding** (MMA) and **Flux Cored Arc Welding** (FCAW) contain a high proportion of components coming from the electrode coating or the flux core. Comparatively little comes from the filler metal.

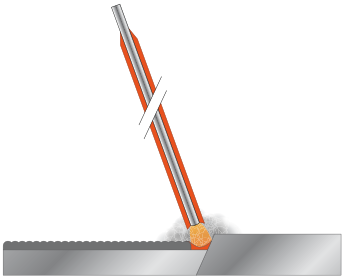
Fume from **Metal Inert Gas Welding** (MIG) and **Metal Active Gas Welding** (MAG) contains high concentrations of the metals being deposited.

Chromium VI - Cr(VI)

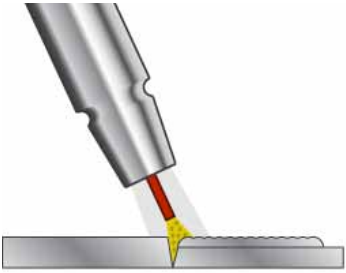
Stainless steel is a ferrous alloy with a minimum of 10.5 % chromium content. The chromium in the steel combines with oxygen in the atmosphere to form a thin, invisible layer of chrome-containing oxide, which enhances the corrosion resistance.
Hexavalent Chromium or Cr(VI) compounds are those that contain the element chromium in the +6 oxidation state.

Chromium in the base material and the welding electrode does not normally appear in the form of hexavalent chromium. However, during the welding process the alkali based flux compound reacts with the chromium generating CR(VI), which emits into the welding fumes.
Cr(VI) is a known carcinogen and investigations have clearly shown that exposure to Cr(VI) can have a very dangerous effect on health.

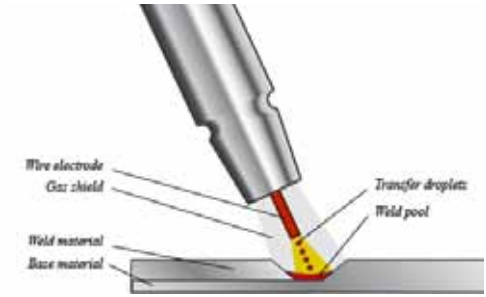
Fume generation during welding.
The intense heat of the electric arc vaporizes a fraction of the metal in the electrode and weld pool. Any metal vapor that escapes the arc area condenses as it cools and oxidizes into weld fume. The vapor that develops condenses as it cools and oxidizes into weld fume containing a complex mixture of metal oxides.



Manual Metal Arc Welding (MMA)
During the welding process the flux coating on the rod disintegrates and then forms a gas that shields the weld from the atmosphere. The slag that is produced by the flux coating prevents the weld metal from oxidizing.



Flux Cored Arc Welding (FCAW)
The flux filled wire is automatically fed through the center of the gun. A shielding gas is normally used and this is supplied via the gun, to protect the weld pool from oxidation.



Metal Inert Gas Welding (MIG) and Metal Active Gas Welding (MAG)
MIG is a form of arc welding where the molten weld pool is protected from oxidization by a shielding gas (usually argon). The wire electrode is fed from a reel through the tip of the welding torch simultaneously with the gas. The gas forms a plasma to sustain the arc and channels the weld material from the electrode onto the weld pool. MAG welding uses CO2 as shielding gas.

Welding fume control solutions

”OSHA concludes that engineering controls, such as local exhaust ventilation (LEV), process control, and process modification or substitution can be used to control exposures in most operations”
(OSHA Vol. 71, No. 39, 10334)

“OSHA has determined that the primary controls most likely to be effective in reducing employee exposure to Cr(VI) are local exhaust ventilation and improvement of general dilution ventilation. … This includes installing duct work, a type of hood, and/or a collection system.” (OSHA Vol. 71, No. 39, 10262).

General Ventilation Systems are not sufficient

Welding should always take place in a well ventilated area to allow the toxic fumes and gases to escape.

NB. General ventilation systems are often completely inadequate: the welder or operator and all others around cannot avoid inhaling the fumes as these always contaminate the general airflow. Nor are systems like these cost-effective: they require a great deal of power to run as they extract enormous quantities of heated (or cooled) air from the premises.

Extraction-at-source most effective

Wherever it is a viable solution, it has been proven that extraction-at-source is the most effective and efficient method of capturing and removing welding and similar fumes. Using this method, the risk of the welder or operator being subject to hazardous fumes is minimized.

Welding torches

Welding torches with integrated extraction (on-torch extra¨ction) is a form of extraction-at-source which allows the welder to work over big areas as well as inside constructions. Extraction efficiency ranges from 70-98% depending on the welding method, type of shielding gas, the material and the skills of the welder. On-torch extraction is especially suitable for robotic welding.
On-torch extraction implies that lower air volumes are extracted from the workshop, which is cost effective as it reduces the amount of heated/conditioned air extracted from the premises.

Robotic welding

Welding operations using automated welding equipment requires careful monitoring. Operators and service personnel need to be protected in a similar way to manual welding procedures. Nederman solutions for robotic welding include both on torch extraction and extraction systems with hoods.

Central Systems

Central vacuum/filtering systems provide overall vacuum power for capturing of welding fumes, extraction of dust from grinding, sanding and cutting, collection of scraps from process lines and for general housekeeping. The filtered air can, under certain precautions, be discharged to the outdoors. However, any business that is a source of air pollution is subject to air permitting requirements*.

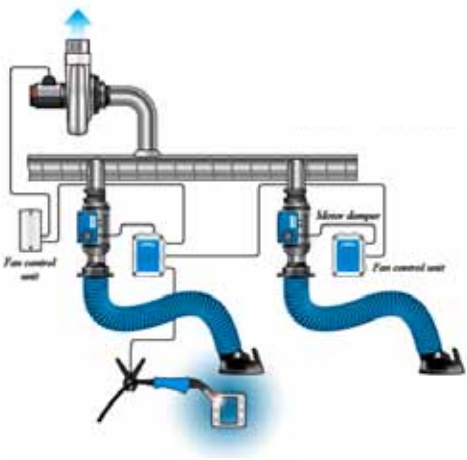
Energy saving solutions

Recirculation of extracted air back into the premises can save a lot of energy. However, recirculation is not allowed in many states and countries**. Still Nederman offers other solutions to save energy.

With a **Nederman fan inverter** the fan operation is constantly adjusted to the number of extractions points in use to ensure the required airflow to those in operation. Combined with **Nederman motor dampers**, which open and shut the connections to each extraction point, the efficiency and operation cost is further improved.

Nederman fan control unit (often used in smaller systems) activates the central fan to run only during welding operations. The fan is activated manually or automatically at welding.

Low vacuum *is used for extraction of fumes, dust exhaust and other airborne particles with extraction arms, exhaust nozzles, enclosures and canopies over machines, robots etc.*
High vacuum *is used in systems covering many work places via a duct system. Typical applications are extraction from welding guns, on-tool extraction from grinding and sanding tools, and machine cleaning.*



** To check that you comply with federal, state, and local air standards see: www.epa.gov/nsr/where.html)*

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

Extraction arms

The Nederman range of low vacuum extraction arms covers a wide variety of applications. All arms are highly flexible, and simple to position, extend and retract. Different attachments are available for wall, ceiling or extension bracket mounting as well as a number of accessories, including hoods and dampers to improve efficiency.

The arms are connected to a vacuum and filter system removing the contaminants from the extracted air so that it can be returned to the atmosphere or recycled without negative effects.

						
Applications	**Standard**	**Tele-scopic**	**Original/ Original CR**	**NEX MD**	**NEX HD**	**Welding/ grinding table**
Fumes, vapours and dust. Limited spaces, small booths.	X	X	X			
Fumes, vapours and dust. Small workshops, metal fabrication shops.	X	X	X	X		X
Heavy smoke, vapours and dust. Heavy engineering workshops, welding, laser cutting, grinding with spatter.				X	X	X
Recommended airflows, m^3/h (cfm)	600-900 (350-525)	600-1000 (350-600)	700-1000 (400-600)	900-1300 (525-800)	1000-1900 (600-1100)	1000-4000 (600-2400)

Mobile extraction units

Nederman mobile extraction/ filtering units offer easy, trouble-free operation and flexibility to be used wherever needed in the workshop. They can also be used in confined spaces to ensure that fumes and gases do not exceed safe exposure limits as found in OSHA. Most of them can be equipped with HEPA filter.

Fume Eliminator 840/841

Lightweight, and handy extraction unit. To be connected to a welding torch or to an extraction nozzle. Manual or automatic start/stop and indicator for filter exchange.

FilterCart Original

For light welding and extraction applications. Extraction Arm Original (2 or 3 m) with integrated spotlight,.

FilterCart W3

For light production applications. Fufills the legislations W3 from BGIA. Metal hood with integrated spotlight Warning signal when the filter is full.

FilterBox

Modular extraction/filter system. Can be combined to work as a mobile unit or as a fixed modular unit with expandable capacity. Manual, semi-automatic or fully automatic filter cleaning.

WeldFilter

A cost-effective solution wherever fume extraction is needed. Cleanable long life cartridge filter keeps the operating costs low. Automatic filter alarm. The cleaning is made with a blowgun (included).
(With 2 arms available autumn 2010)


FumeCare

Housekeeping

OSHA:
The Cr(VI) standard for general industry includes housekeeping measures. The standard stipulates that employers must ensure that all surfaces are maintained as free as practicable of accumulations of Cr(VI). Spills and releases of Cr(VI)-containing material must be cleaned up promptly.

Surfaces contaminated with Cr(VI) must be cleaned by HEPA filtered vacuuming or other methods that minimize exposure to Cr(VI), including wet methods such as wet sweeping or wet scrubbing.

Cleaning equipment must be handled in a way that minimizes the re-entry of Cr(VI) into the workplace. HEPA-filtered vacuum equipment must be cleaned and maintained carefully to avoid unnecessary exposure to Cr(VI). Filters must be changed when needed, and the contents must be disposed of properly to avoid unnecessary Cr(VI) exposure"

• Dry methods (e.g., dry shoveling, dry sweeping and dry brushing) are only allowed in cases where HEPA-filtered vacuuming or other methods that minimize the likelihood of exposure to Cr(VI) have been tried and found not to be effective.

• Use of compressed air for cleaning surfaces is only allowed when used in conjunction with a ventilation system designed to capture the dust cloud or when no alternative method is feasible.

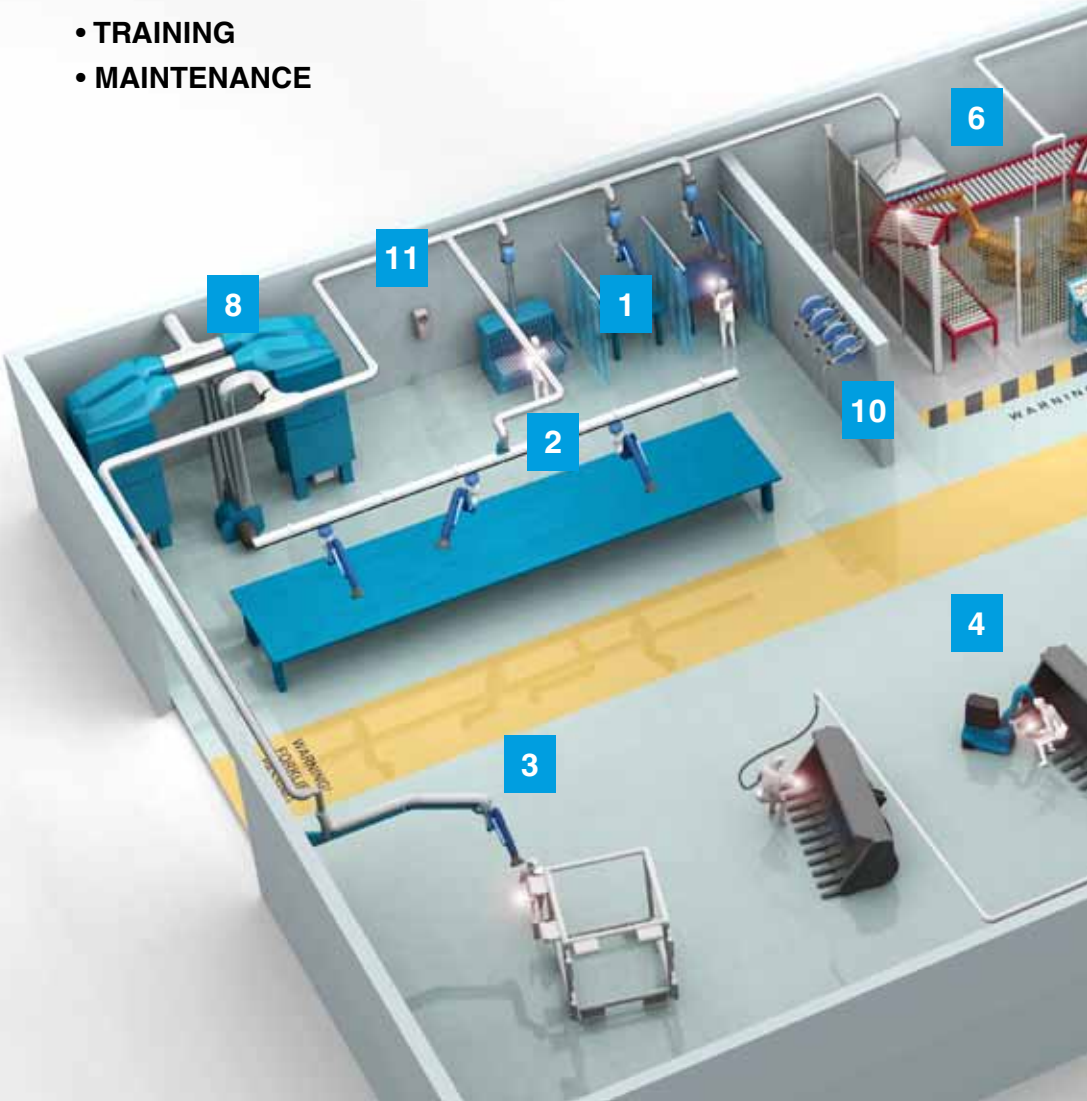
• Employers must ensure that waste, scrap, debris and any other materials contaminated with Cr(VI) are collected and disposed of in sealed, impermeable bags or other closed, impermeable containers.

• Bags or containers of waste, scrap, debris and any other materials contaminated with Cr(VI) must be labeled in accordance with the requirements of the Hazard Communication standard, 29 CFR 1910.1200.

Nederman offers a wide range of solutions for efficient hosekeeping, from mobile vacuum units to stationary, central vacuum system with HEPA filters. The range also includes EX approved equipment.

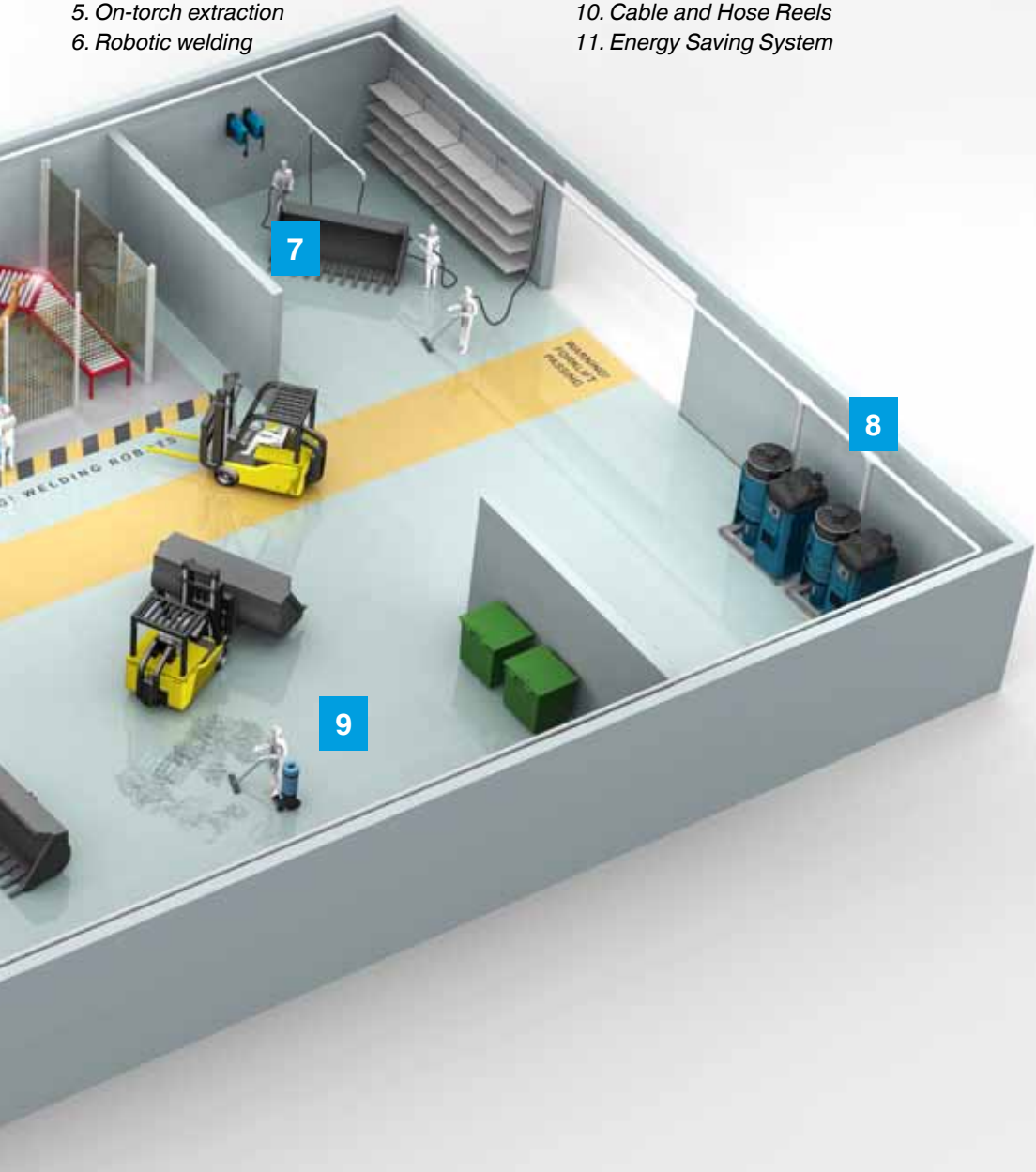
Nederman complete solutions for welding worksho
Safe, energy efficient and profitable

- PRE-STUDIES
- PLANNING
- SYSTEM DESIGN
- INSTALLATION
- COMMISSIONING
- TRAINING
- MAINTENANCE



ops:

1. *Extraction at-source with arms*
2. *Arm on rail*
3. *Extension arm*
4. *Mobile extraction/filtering units*
5. *On-torch extraction*
6. *Robotic welding*
7. *On-tool Extraction*
8. *Stationary high and low vacuum/ filtering systems*
9. *Mobile vacuum units*
10. *Cable and Hose Reels*
11. *Energy Saving System*



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