



ESAB

FUME REDUCTION **SOLUTIONS**

How to reduce fumes in a welding environment*

WE CARE

ESAB has the knowledge and expertise to help you find the most effective solutions for reducing welding fumes in workshops and the exposure to welders.

FORMATION OF WELDING FUMES

Why is welding fume generated?

Welding fumes consist mainly of metal oxides that are formed when the melted metal is vaporized in the arc and then condenses and oxidizes in contact with the surrounding air.

In MIG/MAG welding a stable arc is a major factor for reduction of fume generation and the Filler Metal is the main source of the fume emissions (approx. 90%) while the base metal contributes very little.

The chemical composition of welding fumes reflects the chemical composition of the wire, however the contents of elements with high volatility, e.g. manganese are usually significantly elevated compared with the level in the wire.

What other factors affect the formation of welding fumes?

- Droplet transfers, arc properties and spatter
- Turbulence and oxidizing elements in the shielding gas
- Torch angles and positions
- Wire and base material surfaces

How can welding fumes and exposure be reduced?

- Minimize the amount of welding fumes generated by optimized selection of filler metals, welding machine/weld modes, shielding gas and optimization of parameter settings
- Capture the fumes generated at the source
- Provide appropriate personal protective equipment to all welders
- General ventilation in the workshop should be 2-5 times the total volume of the room per hour, depending on the extent of the welding
- Ensure compliance with local governmental and regulatory guidelines

IARC STATEMENT

The IARC (International Agency for Research on Cancer) has classified welding fumes as a carcinogen.

At an EU level, there is no OEL (Occupational Exposure Limits) specific for welding fumes. However, some Member States have established a specific OEL for welding fumes for TWA (8 hour Time Weight Average value). The OELs for welding fumes are currently part of a study financed by the European Commission to decide if welding fumes shall be included in annex I of the CMRD (Carcinogens, Mutagens and Reprotoxic substances Directive). *

OEL is measured in the workshop's ambient air, therefore sufficient general ventilation is of most importance.

As an industry leader in welding consumables, equipment, cutting systems and gas control equipment for medical, high purity and industrial needs, **ESAB** is committed to acting as a socially responsible and sustainable manufacturer while also providing a safe and healthy work environment for all workers.

* ECHA Scoping Study report, 17 November 2022

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ESAB Filler Metal Research Centre has fume capture testing capabilities in accordance with EN ISO 15011-1, Fume Emission Rate measurements and chemical analysis of fume in compliance with EN ISO 15011-4 for Fume Data Sheets.

Equipped with advanced technology for measurement and data collection with very high accuracy and possibilities to measure fume emission correlated to productivity. Not only to create Fume Emission Rate data for product Fume Data Sheets - but to be able to perform tests with parameters and settings corresponding to what is used by our customers to investigate and verify solutions to reduce fume emissions.

Test Results from ESAB Research Centre

- Parameters adapted to reality - simulating 5mm throat thickness

SETTINGS	WFS (m/min)	CTWD (mm)	GAS (l/min)	TRAVEL SPEED (mm/min)	
LOW	12.0	18	16	420	MANUAL PARAMETERS
HIGH	16.0	22	18	600	ROBOTIC PARAMETERS

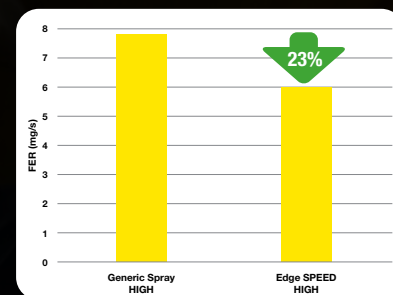
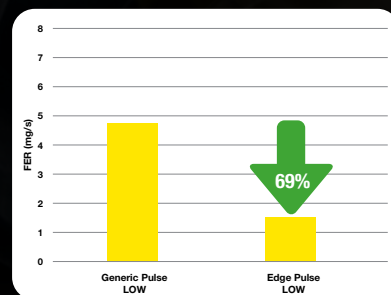
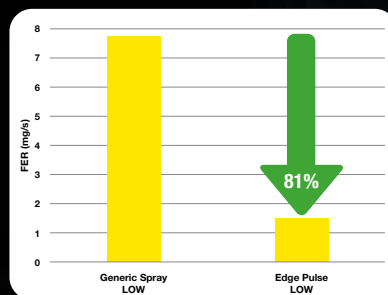
- OK Autrod 12.51 and OK AristoRod 12.50 in Ø 1.2 mm, EN ISO 14341-A G3Si1/AWS A5.18 ER70S-6
- Shielding Gas: 8% CO₂/92% Ar (M20) and 18% CO₂/82% Ar (M21), (EN ISO 14175 classification)

Weld Modes

The outstanding out-of-the-box performance of Warrior Edge 500 CX II and Aristo Edge 500 R ensures a higher process stability, reduced spatter, precise arc length control and specific to Pulse, a balanced metal transfer, 1 droplet per pulse. This enables, not only great weld pool control with excellent welding properties, but also a reduction in fume emission in many applications.

The predetermined welding properties have been packaged in different weld modes, Pulse, SPEED, etc., to meet the different application requirements.

- OK Autrod 12.51 and shielding gas 18% CO₂/82% Ar (M21) have been used in the tests.



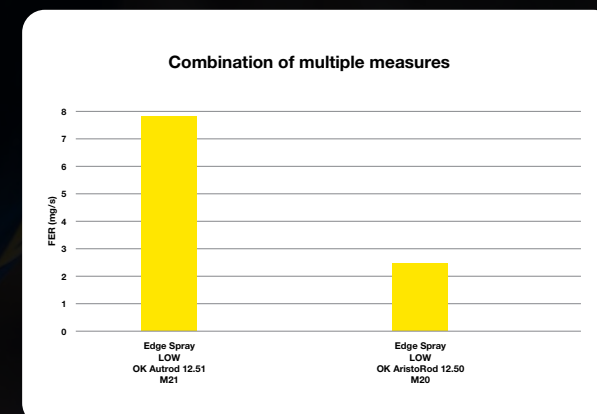
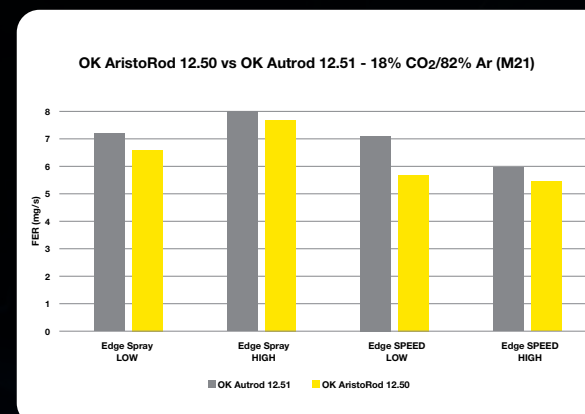
FUME REDUCTION SOLUTIONS

AristoRod coating versus copper coating

In general the Fume Emission Rate (FER) is somewhat lower with OK AristoRod 12.50 compared to OK Autrod 12.51 - due to a very stable arc when using high energies in the arc, extremely low level of spatter, consistent feedability and good starting properties.

Tests performed have shown that depending on parameter settings, environmental conditions and welding modes - up to 20% reduction of FER can be achieved.

The copper content in the welding fumes is reduced from 0.3% Cu with OK Autrod 12.51 to 0.1% Cu with OK AristoRod 12.50.



By combining several measures and optimizing parameter settings, selection of solid wire and changing to a shielding gas with less oxidizing elements - from 18% CO₂/82% Ar (M21) to 8% CO₂/92% Ar (M20) - a significant reduction of FER can be achieved.

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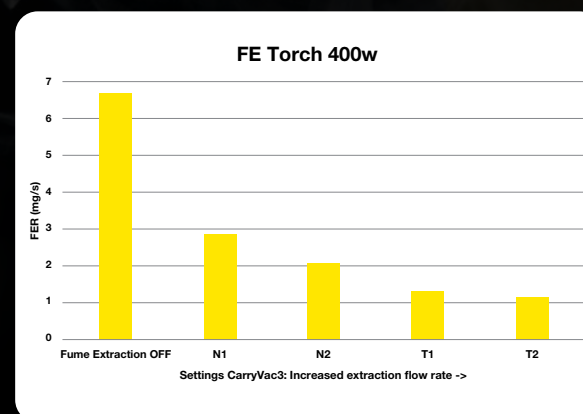
Fume Extraction Torches

The most efficient way to reduce the welding fumes at the source is to use a fume extraction torch. This requires great caution regarding gas flow, avoidance of turbulence and correct extraction - since higher extraction increases the risk of porosity.

All our tests have been X-rayed to verify porosity free welds.

WELD MODE	SHIELDING GAS	WFS (m/min)	CTWD (mm)	GAS (l/min)	WELD SPEED (mm/min)	CURRENT (A)	VOLTAGE (A)
EDGE SPRAY	M21	12	20	18	420	340	33

- Fume Extraction Torch: FE Torch 400w - torch angle 10° push
- CarryVac 3 - settings N1, N2, T1 and T2, for increased extraction flow rate
- OK AristoRod 12.50 Ø 1.2mm



ESAB offers an easy-to-use Airflow meter tool for FE torches. With this, an accurate extraction flow can be secured, which ensures excellent fume extraction capacity without compromising the shielding gas coverage.

ESAB products used during testing

Warrior Edge 500 CX II (incl. SPEED)
 Aristo Edge 500R (Robot specific)
 OK AristoRod 12.50 1.2mm 18kg
 OK Autrod 12.51 1.2mm 18kg
 FE Torch 400w, 4m
 CarryVac 3 Portable fume extractor 230V EU

Part No. 0446300884
 Contact your local **ESAB** Sales
 Part No. 1A50126910
 Part No. 1251126710
 Part No. 0700027021
 Part No. 0700003890

FUME REDUCTION PRODUCTS

ESAB AIR FED HELMETS



SENTINEL A60 Air
 Part No. 0700600861



SAVAGE A50 Air LUX
 Part No. 0700500951



EPR-X1.1 PAPR Unit
 Part No. 0700500920

ESAB FUME EXTRACTION



Origo Vac Cart W3
 Part No. 0700003895



CarryVac 3 Extractor
 Part No. 0700003890



Origo Vac Fan
 Part No. 0700003020

ESAB FUME EXTRACTION TORCHES

FE torch air cooled models MINI 200, MINI 250, 300
 FE torch liquid cooled models MINI 320w and 400w
 TBI MIG/MAG Fume Extraction Torches

For more information on FE torches please visit esab.com



This is just a selection of ESAB's fume reduction solutions. Ask your ESAB sales representative or visit esab.com for more information.

WE CARE WITH EVERY WELD.

WeCare Campaign for a Safer Welding Industry

At **ESAB**, we are dedicated to more than just producing high-quality products- we are committed to sustainability and the well-being of workers in the welding industry. The safety and health of every worker is our top priority. Through our **ESAB WeCare** initiative, we work to minimise exposure to harmful welding fumes, creating safer workplaces and healthier futures. By reducing welding fumes, we are actively supporting the long-term health of our workers and the sustainability of our industry.

For more information please visit **esab.com**

Please note:

*The results contained in this brochure are our tests and results, conducted under strict conditions specific for **ESAB Filler Metal Research Centre Laboratory**.

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