MECHANICAL VENTILATION IN WELDING

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Abstract: Mechanical ventilation is reliable. It can be more effective than natural ventilation. The main mechanical ventilations were presented: ventilations applied in working places where welding techniques as well as allied processes (brazing and spraying) are used. Adequate ventilation depends on: number and type of operations; size and shape of the workplace; type and effectiveness of the ventilation; position of the worker's and welder's head; contents of the fume plume. The case studies presented, as well as the afferent technical data completed the given study.

1. GENERAL PROBLEMS

Mechanical Ventilation is the movement of air through a workplace by a mechanical device such as a fan. Mechanical ventilation is reliable. It can be more effective than natural ventilation.
Local exhaust, local forced air, and general ventilation are examples of mechanical ventilation [1].
Adequate ventilation depends on: number and type of operations; size and shape of the workplace; type and effectiveness of the ventilation; position of the worker's and welder's head; contents of the fume plume [2, 3, 5].

2. SELECTION CRITERIA FOR STATIONARY FILTER EQUIPMENT

When welding metals, different sizes of dust particles are generated. The diameter of the particles is between 0,1 microns and 1,0 microns, mainly in the range under 0,4 microns.

Table 1. Typical distribution of particles in welding fumes

particle Ø in µm	<0.2	<0.4	<0.6	<0.8	<1.0	>1.0
number	800	251	9	0	1	2
% of the number	75.3	23.6	0.9	0	0.1	0.2
% of the mass	15.9	38.7	7.5	0	8.2	29.7
Source: Spiegel-Ciobanu (AWS-study)						

The table shows that 98,9 % of the particles fall in the range of up to 0,4 microns.
These particles are hardly removed at all by class M filters.

- Class ,,M" filters are not sufficient to protect the employees [6, 7]
- It is essential that you use state of the art technology

Figure 1 [10]

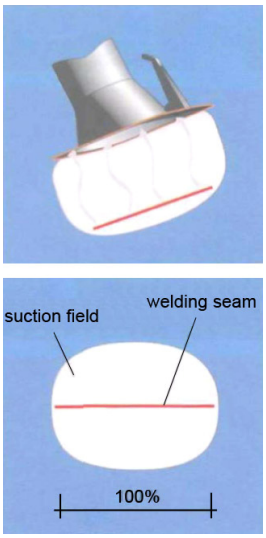

Figure 2 [10]

Correct capturing of contaminants during welding:

- - Capture at source
- - Easily controlled hood
- - Rotating hood
- - Alignment of the hood to correspond to the weld
- - Making secure Investments: meeting future regulations.

Figure 3 presents filtration efficiency:

- 98,9 % of the contaminants created are in the nano-size range, i.e. less than 400 nanometers
- These particles are alveolar and cause cancer
- The usual filtration efficiency measurements of 99 % for particles of over 0,4 microns are not sufficient, and do not include the nanoparticles
- KEMPER plants with ePTFE filters achieve filtration efficiencies of over 99 % even with particles under 0,4 µm

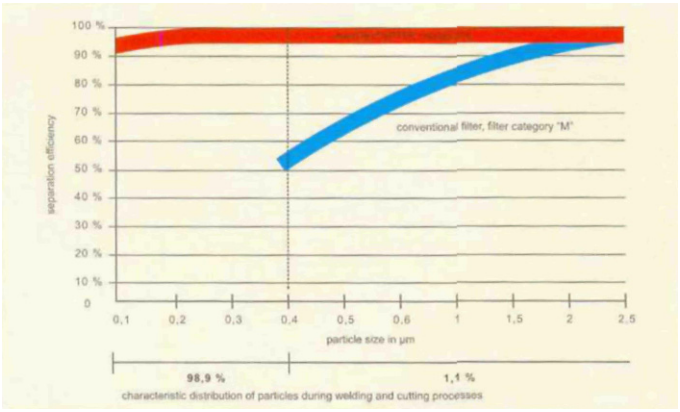

Figure 3 [10]

Table 2 presents selection criteria for stationary filter equipment.

Table 2. Selection criteria for stationary filter equipment

Welding procedure	Welding procedure on stationary work stations
Arc welding - non alloy materials - low alloy materials - Aluminium	• Mechanical welding smoke filter, stationary • Cartridge filter unit, stationary • Electrostatic welding smoke filter, stationary
Manual arc welding - high alloy materials - non - ferrous materials	• Mechanical welding smoke filter, stationary • Cartridge filter unit, stationary • Electrostatic welding smoke filter, stationary each with exhaust duct
MIG - MAG welding • non alloy materials - low alloy materials - Aluminium	• Mechanical welding smoke filter, stationary • Cartridge filter unit, stationary • Electrostatic welding smoke filter, stationary • Dusty • Mini-Weldmaster
MIG -MAG welding - high alloy materials - non - ferrous materials	• Mechanical welding smoke filter, stationary • Cartridge filter unit, stationary • Electrostatic welding smoke filter, stationary each with exhaust duct
TIG welding - non alloy materials - low alloy materials - Aluminium	• Mechanical welding smoke filter, stationary • Cartridge filter unit, stationary • Electrostatic welding smoke filter, stationary
TIG welding - high alloy materials - non - ferrous materials	• Mechanical welding smoke filter, stationary • Cartridge filter unit, stationary • Electrostatic welding smoke filter, stationary each with exhaust duct

3. CASE STUDIES

3.1. Case study 1. Mechanical welding smoke filters, mobile, with two exhaust arms

This mobile welding smoke filter with two exhaust arms offers many advantages for use at changing welding workstations.

The flexible exhaust arms are swiveling by 360° and guarantee easy handling. The flexible exhaust arm can be supplied in lengths of 2 m, 3 m and 4 m with a diameter of 150 mm.

Either flexible exhaust arms or rigid metal tube arms can be chosen for a welding smoke filter. First, the extracted air is fed to the prefilter where larger particles are captured. The main filter guarantees an effective cleaning of the welding smoke with a filter efficiency above 99,9 %.

Figure 4 [10]

This means that even the smallest particles down to a size of 0,3 micron are filtered. Depending to the number of working hours and the substances to be captured the filter needs to be replaced once or twice a year. The unit is equipped with a control panel featuring:

- - On/Off switch
- - Operating control light
- - Filter monitor
- - Fan rotation direction indicator
- - Plug for automatic start-stop

Table 3 present technical data for mechanical welding smoke filters, mobile with two exhaust arms

Table 3. Technical data

Fan performance:	2.200 m3/h
Extraction capacity:	2 x 700 m3/h
Motor power:	1,1 kW
Voltage:	3 x 400 V / 50 Hz
Filter efficiency:	> 99,9 %
Noise level:	approx. 68 dB (A)
Weight (without extraction arm):	95kg
Dimensions (w x d x h):	655 x 655 x 1.020mm

3.2. Case study 2. Mechanical welding smoke filter, mobile, BGIA-certified

When welding high alloy materials, eg. chromium-nickel steel, harmful substances are set free that are highly carcinogenic.

A recycling of extracted and filtered clean air to the workshop is only allowed, when the extraction unit has been tested and certified by the BGIA (government safety organization and institute for occupational health safely).

The BGIA certified, mobile welding fume extraction filter with one exhaust arm meets

several test criteria according to the highest level (W3) for the extracting of welding fumes from high alloy steels also with over 30 % chromium- and nickel content. They are available in 2 m, 3 m or 4 m long flexible or rigid exhaust arm lengths.

Figure 5 [10]

The resulting harmful gas emission is captured by means of an exhaust hood and fed to a Pre-filter, in which the largest contamination are captured Thereby the endurance of the main filter is considerably lengthened The pre-filtered air is then passed through the main filter with a filtration efficiency of >99,9 %. The filtered air is then replaced into the workshop.
All operation and monitoring elements are clearly arranged on a display The maintenance of the mandatory airflow, as well a necessary filter change are reliably monitored and displayed. The unit can also be fitted with an appropriate Start-/Stop Automatic. The integrated rotation field monitor controls the phase sequence and warns of a wrong fan rotation.
Table 4 present technical data for mechanical welding smoke filter, mobile.

Table 4. Technical data

Fan performance	2,200 m3h
Extraction capacity	1,200 m3h
Motor power	1.1 kW
Wage:	3x400 V/ 50 Hz
Noise level	approx 68 dB(A)
Filter efficiency-	> 99.9 %
Weight (without extraction arm)	95kg
Dimensions (w x d x h)	655 x 655 x 1,020 mm

3.3. Case study 3. Mechanical welding smoke filter, stationary, with one exhaust arm
Stationary welding smoke filters have been developed to be used at fixed welding stations, in welding cabins or training workshops. They can be mounted to a wall, a column or a

free-standing pillar.
The stationary welding smoke filter can be equipped with flexible exhaust arms or rigid metal tube arms. In addition to the 2 m, 3 m and 4 m exhaust arms, also 5 m, 6 m or 7 m exhaust arms can be connected. Those will be fixed with an additional console and consist of a 3 m long extension and a standard flexible exhaust arm or a standard rigid metal tube arm.
The stationary unit comes with a control-box that can be mounted at a comfortable height. The control of the machine is located inside the box, so that it can be switched on from there. The display for the filter monitor and the connecting plug for the clamp of the optional automatic start-stop are also located there.

Figure 6 [10]

A preliminary filter cleans the polluted air from coarse particles, before the main filter separates the finest dust particles. The filter insert of the welding smoke filter works according to the principle of depth filtration and will be replaced after saturation by a new one.
Table 5 presents technical data for mechanical welding smoke filter, stationary.

Table 5. Technical data

Fan performance:	2.200 m3/h
Extraction capacity:	1.200m3/h
Motor power	1.1 kW
Voltage:	3 x 400 V / 50 Hz
Filter efficiency:	> 99.9 %
Noise level:	approx. 68 dB (A)
Weight (without exhaust arm):	85kg
Dimensions (w x d x h):	655 x 655 x 1.000 mm

3.4. Case study 4. Mechanical welding smoke filter, stationary, with two exhaust arms
For the use at changing working positions or at two workstations stationary welding smoke filters with two exhaust arms are a cost-saving alternative to two separate units and are very suitable for flexible use in workshops, training workstations or in the industry.

They are equipped with two exhaust arms, either flexible or rigid metal tube arms with a length of 2 m, 3 m or 4 m. 5 m, 6 m or 7 m long exhaust arms will be fixed with an additional console and consist of a 3 m long extension and a standard flexible exhaust arm or rather a standard rigid metal tube arm.

Figure 7 [10]

The version with two exhaust arms can also be equipped with an automatic start-stop. Two start-stop clamps will be supplied, so that it is equipped for the use at two welding places with two welding machines. Both of them can be connected to the control box of the welding smoke filter.
The welding smoke filters with two exhaust arms are available in two different versions to adapt the extraction volume to the welding application, the material and the process. If you want to use both of the exhaust arms at the same time, you should choose the unit with the higher capacity.
Table 6 presents technical data 2200 m^3/h and table 7 presents technical data 3000m^3/h.

Table 6. Technical data 2.200 m^3/h

Fan performance:	2,200 m^3/h
Extraction capacity:	2 x 700 m^3/h
Motor power:	1.1 kW
Voltage:	3 x 400 V / 50 Hz
Filter efficiency:	> 99.9 %
Noise level:	approx. 68 dB (A)
Weight (without exhaust arm):	85kg
Dimensions (w x d x h):	655 x 655 x 1,000 mm

Table 7. Technical data 3.000 m^3/h

Fan performance:	3,000 m^3/h
Extraction capacity:	2x1,000 m^3/h
Motor power:	1,5kW
Voltage:	3 x 400 V / 50 Hz
Filter efficiency:	> 99.9 %
Noise level:	approx. 71 dB (A)
Weight (without exhaust arm):	91 kg
Dimensions (w x d x h):	655 x 655 x 1,050 mm

CONCLUSIONS

1. The main mechanical ventilations were presented, applied in working places where welding techniques are used as well as allied processes (brazing and spraying).
2. The case studies presented, as well as the afferent technical data completed the given study.

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