

# MEASUREMENT OF CONCENTRATION SOLID AEROSOLS IN WORKING ENVIRONMENT

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**Abstract:** Dust measurement is very important as one of factor of working environment. In this time under the legislative of European union is working environment and influence of possible harmful pollutants to employee well watched and under the control of state institutions. Methodology of dust measurement is not unite but some deciding factors must be observed.

**KEYWORDS:** MEASUREMENT, DUST, SAMPLE TAKE

## 1. Introduction

Dust measurement in working environment is unnecessary for assessment of concentration of solid aerosols in working environment and next measures for reducing exposition of solid aerosols.

## 2. Prerequisites and means for solving the problem

The most important factors of dust measurement is location, time and time of taking sample. For measurement at the beginning is desirable divide solid aerosols to two size fractions.

- respirable,
- inhalable.

Respirable fraction is created by the particles with diameter to 2,5 µm. Inhalable fraction is created by the particles which is possible inhale by the nose or mouth (respirable fraction is included).

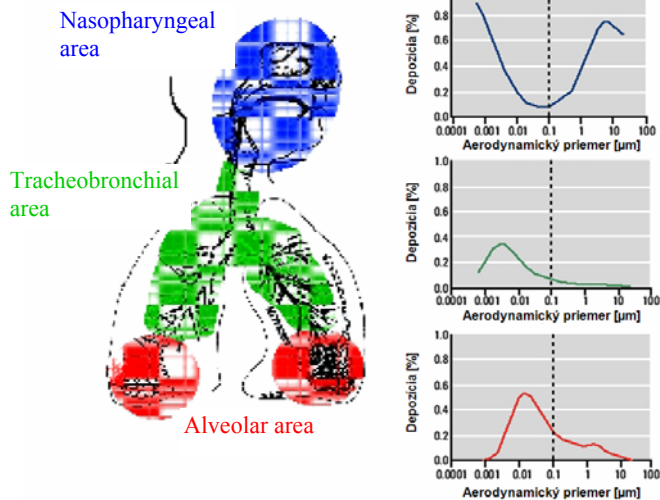


Fig. 1 Assumed deposition of inhalable aerosols in human body

## 3. Solution of the examined problem

After the fraction assessment which is going to be measured is necessary to set location for sample taking and have to be executed decision if stationary or personal sample taking will be realised. Stationary sample taking is dust sample taking whole time of measurement realised at one station. This station are chosen by the experienced person or these station are desired by the state institutions.

Equipment for personal sample taking is placed directly to worker and solid aerosol are taking by sampling equipment near the respiratory tract of worker during whole working period.

On the base of employer request realised measurement of solid aerosol was executed at the determined working stations.

The scope of the measurement was assessment of overall concentration of solid aerosols in the air in working environment during the welding operations and next comparison with limit values.

Acquired value will be decided for workers classification to risk groups.

## Description of working environment

Company where is measurement executed is concerning about production and assembly of steel constructions. Employers are mainly welders, fitter, setter and help workers.

Measurement was executed in component building 90 x 21 m. Building consist of three main parts: storehouse of materials, shearing workstation, assembly workstation where was measurement realised (Fig.2). Building is self ventilated and is also added air compressors.

Disposition of working station and working places where was measurement executed (P1, P2, P3) is displayed in Fig. 2.

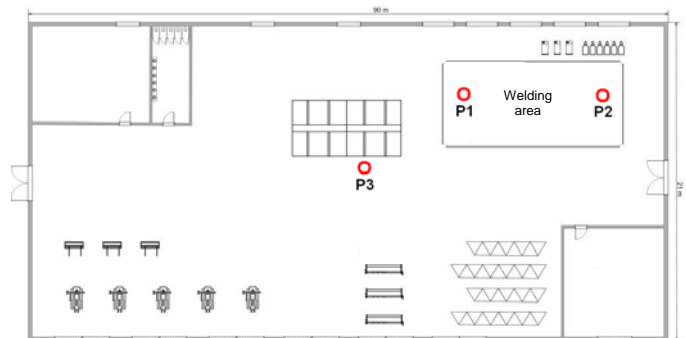


Fig. 2 Disposition of working station and working places

## Execution of the measurement

During welding operations are produced different pollutants, Influence of these pollutant to human health is very negative. Other negative influence to welders is noise, vibrations, physical weight, radiation and unsuitable working positions but the most negative factor is inhalation of solid aerosols.

Unnecessary condition for measurement is important period of measurement. Span of measurement have to be at least 75 % of working period. During this period is acquired sample which is representative. Measurement was scoped for assessment of concentration of solid aerosols by personal sampling.

Used equipment:

- personal sampling pumps AirCheck 2000,
- sampling heads IOM for sampling inhalable and respirable fractions of solid aerosols,
- glass microfibre filters GMF,
- calibrated air flowmeter DC-Lite.

Concentration of solid aerosols in the air is evaluated by gravimetric method. The case with filter has to be weighed before and after measurement. Difference between weight before and after is weight of solid aerosols. Proportion between weight of solid aerosols and airflow is assessed concentration of solid aerosols in working environment. Personal sampling air pumps were placed to three workers, two welders and one fitter. For each working position was realized three samplings. After the sampling was determined capacity of the air intake air pumps. And after the measurement were always changed filters. The used filters were subsequently in laboratory evaluated by the gravimetric method. Each filter was signed by numeric symbols. Time average concentration of solid aerosols was appointed from acquired three samples.

During the measurement were also captured microclimate conditions.

Tab. 1 Microclimate conditions

Time of measurement (h)	Temperature (°C)	Atmospheric pressure (kPa)	Relative humidity (%)	Airflow velocity (m.s <sup>-1</sup> )
<b>P1</b>				
9:30	14,8	98,4	38,3	0,16
11:00	15,0	98,4	35,5	0,15
13:30	15,8	98,4	31,5	0,09
<b>P2</b>				
9:30	14,5	98,4	38,1	0,16
11:00	15,7	98,4	35,1	0,19
13:30	15,6	98,4	32,5	0,14
<b>P3</b>				
9:30	14,7	98,4	36,1	0,13
11:00	15,3	98,4	36,1	0,07
13:30	15,2	98,4	33,6	0,06

During measurement was also captured macroclimate conditions.

Tab. 2 Macroclimate conditions

Time of measurement (h)	Temperature (°C)	Atmospheric pressure (kPa)	Relative humidity (%)	Airflow velocity (m.s <sup>-1</sup> )
7:50	4,1	98,4	57,2	0,55
13:40	7,4	98,4	47,8	1,78

#### 4. Results and discussions

In Slovak republic limits of solid aerosols are appointed in government directive. Allowed limits of concentration solid aerosols for welding operations is 5 mg/m<sup>3</sup>. After measurement in laboratory was appointed time average concentration of solid aerosols, and concentration was compared with allowed limits. Results are displayed in table 3.

Tab. 3 Results of sampling

Time of measurement (h)	Volume of air (m <sup>3</sup> )	Overall concentration of solid aerosol (mg.m <sup>-3</sup> )	Time average of concentration solid aerosol (mg.m <sup>-3</sup> )
<b>P1</b>			
8:00 – 9:30	0,173	4,22	4,90 (< 5,00)
9:30 – 11:00	0,176	3,74	
11:00 – 13:30	0,286	5,37	
<b>P2</b>			
8:00 – 9:30	0,172	9,54	<b>9,70 (&gt; 5,00)</b>
9:30 – 11:00	0,176	11,56	
11:00 – 13:30	0,296	7,45	
<b>P3</b>			
8:00 – 9:30	0,173	5,84	4,84 (< 5,00)
9:30 – 11:00	0,177	3,66	
11:00 – 13:30	0,296	4,26	

Measurement findings show that allowed limits get over for working position P2 – welder and due this reason have to be executed unnecessary measures.

#### Proposed measures

Due the reason of exceeded allowed limits (almost double) have to be executed next measures:

- increase performance of air climate equipment,
- use personal protective equipment,
- change the risk group of workers and it means often medicine control.

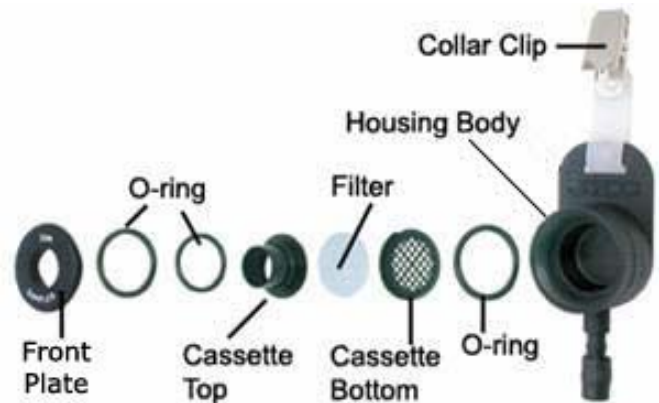


Fig. 3 IOM Inhalable Dust Sampler

#### 5. Conclusion

Final decision which measure will be realized in the concrete workstation is up to management. If measures are sufficient will be shown after the next measurement of concentration solid aerosols.

Presented results are part of solution of the project KEGA 3/7426/09.

#### 6. References

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