



MONITORING OF THE AIR QUALITY  
AT MARSAXLOKK AND BIRZEBBUGA  
ANALYSIS OF METALS DURING SAHARAN DUST EVENTS AND  
PM10 EXCEEDANCES

July 2012

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## 1 SCOPE OF THE WORK

The objective of this work is to analyze the presence of metals in the days in which there are exceedances of the daily concentration of PM<sub>10</sub> and at the same time there is the contribution of the Saharan Dust.

This work is part of a larger project assessment of the air quality near the Delimara site, a 144MW power station owned by Enemalta Corporation and located in the south eastern part of Malta. This power station is subjected to an Integrated Pollution Prevention and Control (IPPC) permit issued by the Malta Environment and Planning Authority and as part of the IPPC conditions, air quality monitoring is requested.

According to the MEPA specifications, the monitoring campaign will determine the daily concentration of PM<sub>10</sub> and PM<sub>2.5</sub>, near Delimara power station, in compliance with the standards specified in LN 478 of 2010 (*Ambient Air Quality Regulations*). The period of execution of this monitoring programme is one calendar year and it has been agreed with MEPA to carry out this sampling activity in two different locations: Marsaxlokk and Birzebbuga. It is also requested to monitor the concentrations of Arsenic, Cadmium, Nickel, Lead and Vanadium on a quarterly basis to evaluate the amount of these metals present in the PM<sub>10</sub> filters.

L.N. 478/2010 transposes the Directive 2004/107/EC relating to Arsenic, Cadmium, Mercury and Nickel and Polycyclic Aromatic Hydrocarbons in ambient air and Directive 2008/50/EC on ambient air quality and cleaner air for Europe. L.N. 478/2010 specifies the limit values to be achieved and the reference methods for sampling and measuring all the monitoring parameters analyzed in this study.

Specifically, the monitoring parameters are derived through the standard gravimetric sampling method which consists of aspirating ambient air at a constant flow rate and force it to pass through a membrane filter that captures all the particulate matter with a diameter smaller than 10µm or 2,5µm, according to the sampling head used. The filter is changed automatically every 24 hours and because of this, the laboratory analysis give as result an average daily concentration in µg/m<sup>3</sup>, derived by the division of the different filter weight (before and after the sampling) by the actual air sampling volume. The construction characteristics of the sampling instrument have to conform with the criteria determined in the reference methods EN12341 and EN14907 for the measurement of PM<sub>10</sub> and PM<sub>2,5</sub> concentration, respectively.

Power stations are one of the major primary sources of PM<sub>10</sub> and PM<sub>2,5</sub> emissions in the atmosphere. This monitoring is required to assess the direct influence of the Delimara power station on the air quality in the surrounding area.



## 1.1 MONITORING OVERVIEW

### 1.1.1 Delimara power station

The Delimara power station is located at Marsaxlokk bay. It was originally commissioned in 1992 and has a capacity of 144MW generated by eight Wartsila 18V46 four-stroke medium speed diesel engines. It is owned by Enemalta, the entity responsible for the generation of electricity (sole provider) in the Maltese Islands. Figure 2 shows a closer view of the Delimara power station. The large surface extension of the site and the predominance of the agricultural fields in its surrounding area can be noted. The nearest town, Marsaxlokk, is more than 1,3Km far away, while Birzebbuga, the other main urban area, is more than 2 Km, far.



Figure 1: Location map of Delimara power station

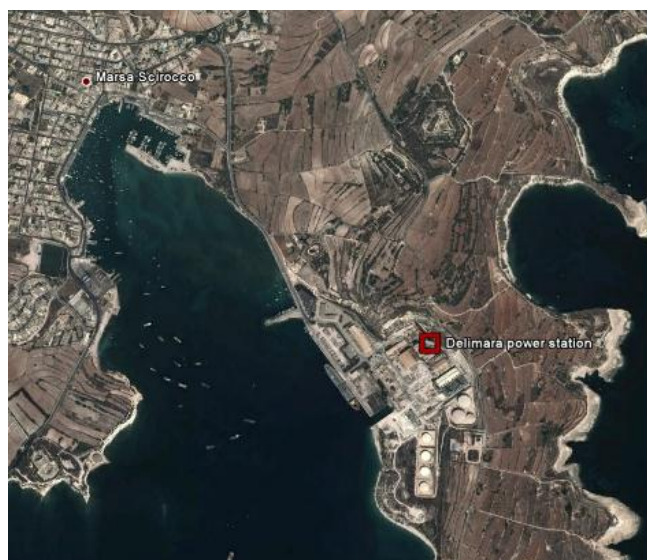


Figure 2: Location map of Delimara power station - closer view

A 144MW extension to the Delimara Power station has recently been constructed consisting of eight Wartsila 18V46 four-stroke medium speed diesel engines whose primary design fuel is 0.7% Sulphur Heavy Fuel Oil. The engines can be switched over to gasoil when and as the need arises. The power block is made up of four trains. Each train contains two diesel engines, two silencers, two DeNO<sub>x</sub> units (SCR), two exhaust gas boilers (EGB) and one common DeSO<sub>x</sub> unit (FGD). Each FGD unit is made up of one reactor and one bag filter system.

Figure 3 shows a view of the Delimara power station from Marsaxlokk. The stack is the highest built structure (150m) in Malta.



**Figure 3: Picture of Delimara power station taken from Marsaxlokk**

#### 1.1.2 Monitoring sites

The two monitoring sites were chosen in the urban areas closer to the power station: Marsaxlokk and Birzebbuga. From 5 April 2012 to the 26 April 2012 the monitoring took place inside the local council buildings of the two towns and the samplers (one for PM<sub>10</sub> and the other for PM<sub>2,5</sub>) were positioned on a balcony (see Figure 5 and Figure 6). This respected the EN12341 method, which requires that the sampling height has to be between 1.5 to 8 m from the ground.



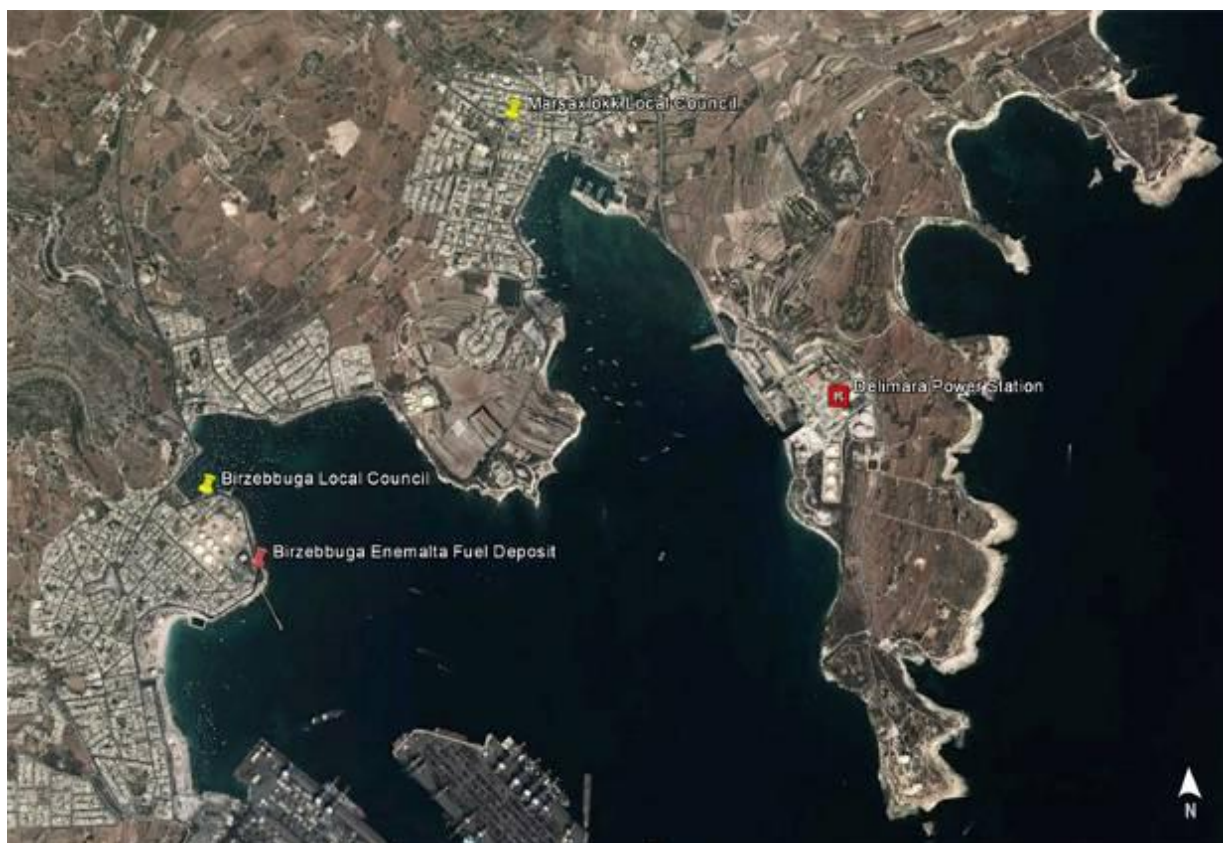


Figure 4: Location of the monitoring sites – from 27 April 2012

In Marsaxlokk, the two samplers were moved to another balcony but in the same local council building. On the other hand in Birzebbuga, the samplers were moved to the rooftop of the Enemalta fuel deposit, located about 600m far from the previous site and closer to the Delimara power station, as it can be seen from the Figure 7. Figures 8 and 9 below show the relocated sites.



**Figure 5: Birzebbuga - location site from 27 April 2012 to 27 August 2012**



**Figure 6: Marsaxlokk – location site from 27 April 2012 to 27 August 2012**

On the 27 August 2012, the monitoring site locations were changed again following MEPA instructions so that the LVS samplers are closer to the BAM instruments. This is clearly shown in the below figures.

### 1.1.3 Technical specification of the monitoring

#### 1.1.3.1 Duration of monitoring

The duration of this monitoring campaign is 1 year. The campaign has started, for each station, on **the 5 April 2012 at 00:05 and it will be end on the 31 March 2012 at 23:55**. The contract for this work defines the minimum data capture as 92% of the total time period so, the effective number of monitored days has to be **335**. This value conforms with the data quality objective determined by the L.N. 478/2010, which states that data capture ratio for PM<sub>10</sub> and PM<sub>2,5</sub> should be at least 90% of the monitoring time period. Also for the daily measurement, the sampling time should be at least 1296 minutes (90% of 24h) to be considered valid data. The monitoring program provides for continuous sampling without interruption.

#### 1.1.3.2 Monitoring parameters and time schedule

A summary of the monitored pollutants is given in the following table. All these pollutants are detected daily in each monitoring site, chemical analysis of metals conducted on the sample filter. The metals are analyzed in the PM<sub>10</sub> fraction for the filters that have registered a Saharan Dust Contribution.

Pollutants	Sampler	Filter type	Limit value (L.N. 478/2010)		Reference method for sampling and measurement
Metals (As, Cd, Pb, Ni, V)	SKYPOST PM HV	Quartz filters	As <sup>1</sup>	6 ng/ m <sup>3</sup>	EN 14902:2005; EPA 6020A 2007; EPA 6010C 2007
			Cd <sup>1</sup>	5 ng/ m <sup>3</sup>	
			Ni <sup>1</sup>	20 ng/ m <sup>3</sup>	
			Pb	500 ng/ m <sup>3</sup>	

**Table 1: Monitored pollutants**

<sup>1</sup> Target value: level fixed with the aim of avoiding, preventing or reducing harmful effects on human health or the environment as a whole, to be attained where possible over a given period. It is determined for the total content in the PM<sub>10</sub> fraction averaged over a calendar year.

#### 1.1.4 Standards and guidelines

L.N. 478/2010 determines the reference methods, known as European Norm (EN) that must be applied for sampling and measuring the pollutants in ambient air in Malta. These technical specifications are developed by the European Committee for Standardization, which is a European Institute that develops and unifies norms and procedures in any technical field. To conduct this monitoring campaign, the following EN specifications have been applied:

- Reference method for measurement of Pb/Cd/As/Ni in the PM<sub>10</sub> fraction of suspended matter: EN 14902:2005 *“Standard method for the measurement of Pb, Cd, AS and Ni in the PM<sub>10</sub> fraction of suspended particulate matter”*

These methods have to be fulfilled in order to carry out a certified air quality monitoring campaign that respects the common standard regulations for the European countries.

#### 1.1.5 Description of the sampling instrument

The air sampling is being carried out using the standard gravimetric method, as required by the L.N.478/2010, Schedule 10 - *Reference methods for the assessment of concentrations of group A pollutants, group B pollutants and ozone.*

The main concepts of this method is to force a constant volume of ambient air (2.3 m<sup>3</sup>/h – flow rate determined by EN12341 and EN14907 for Low Volume Sampler) to pass through an entry of particular geometry (sampling head – see Figure 44 and Figure 45), where the suspended matter is separated in fractions without activity and the monitored PM size (PM<sub>10</sub> or PM<sub>2,5</sub>) is collected on a filter for a period of 24h. The mass of the PM<sub>10</sub> or PM<sub>2,5</sub> material is determined by weighing the filter at constant conditions before and after collection of the particulate matter. Finally the daily average concentration is found dividing the PM mass by the air sampling volume.

The type of instrument used for this campaign is the SKYPOST PM model (manufactured by TECORA Company), a particulate matter dedicated station for continuous sequential sampling. It is realized in a weather-proof case for outdoor uses. SKYPOST PM HV has been installed in each of the four monitoring stations.



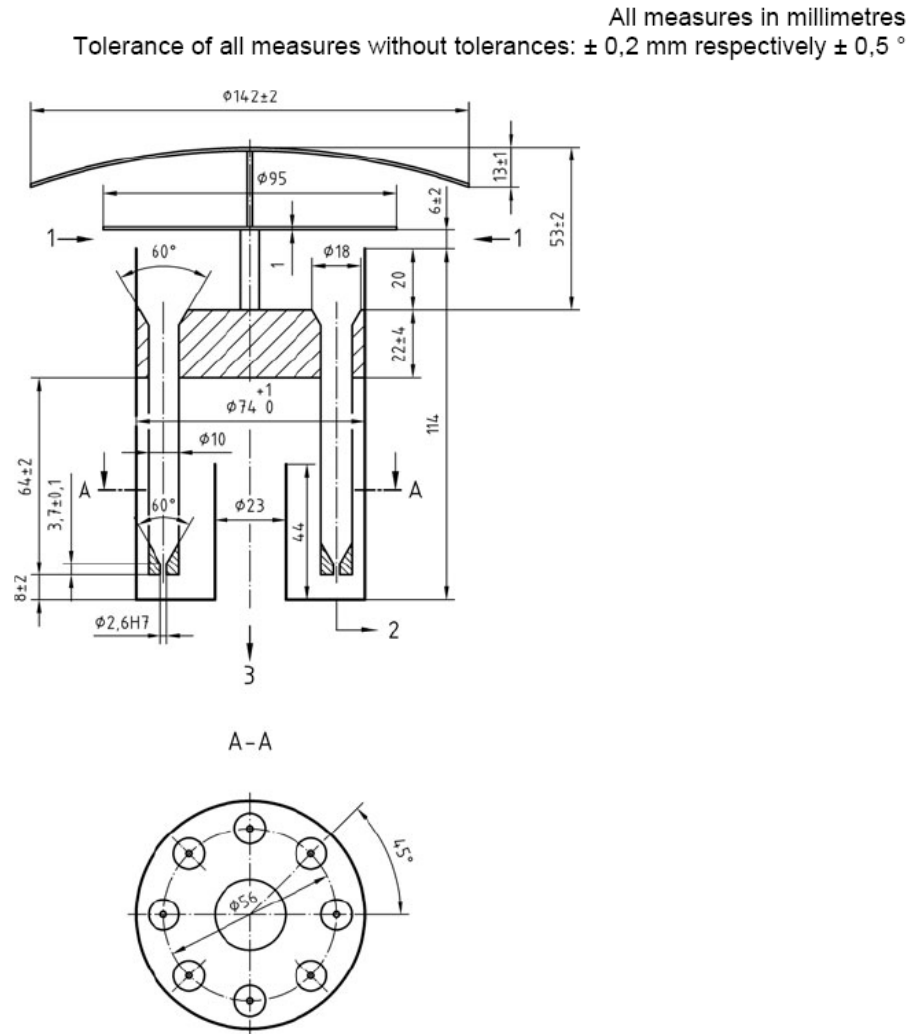
**Figure 7: SKYPOST PM HV sampler**

The characteristics of this sampler meet and exceed the requirements of the EN 12341 and EN14907, that establish the methodology for correct sampling, and it is certified by TUV and UNI EN ISO 9001. The sampling head is the main part of the instrument and it has to be made with a specific geometry (Figure 44 and Figure 45) according to the particular matter to be monitored. These construction features of the sampling head are fundamental because they allow only the particulate matter with a diameter less than 10  $\mu\text{m}$  or 2,5  $\mu\text{m}$  to enter the suction tube (Figure 46) and consequently be captured by the filter. Conversely, the particulate matter with an equivalent diameter bigger than 10  $\mu\text{m}$  or 2,5  $\mu\text{m}$  remain on the impaction plate, placed below the nozzles. Because of this configuration, the impaction plate will be cleaned and greased every 15 consecutive monitoring days. The incoming air enters the suction tube of 23mm diameters and then passes through the filter membrane with a diameter of 47 mm which it is automatically substituted every 24h with a clean one.



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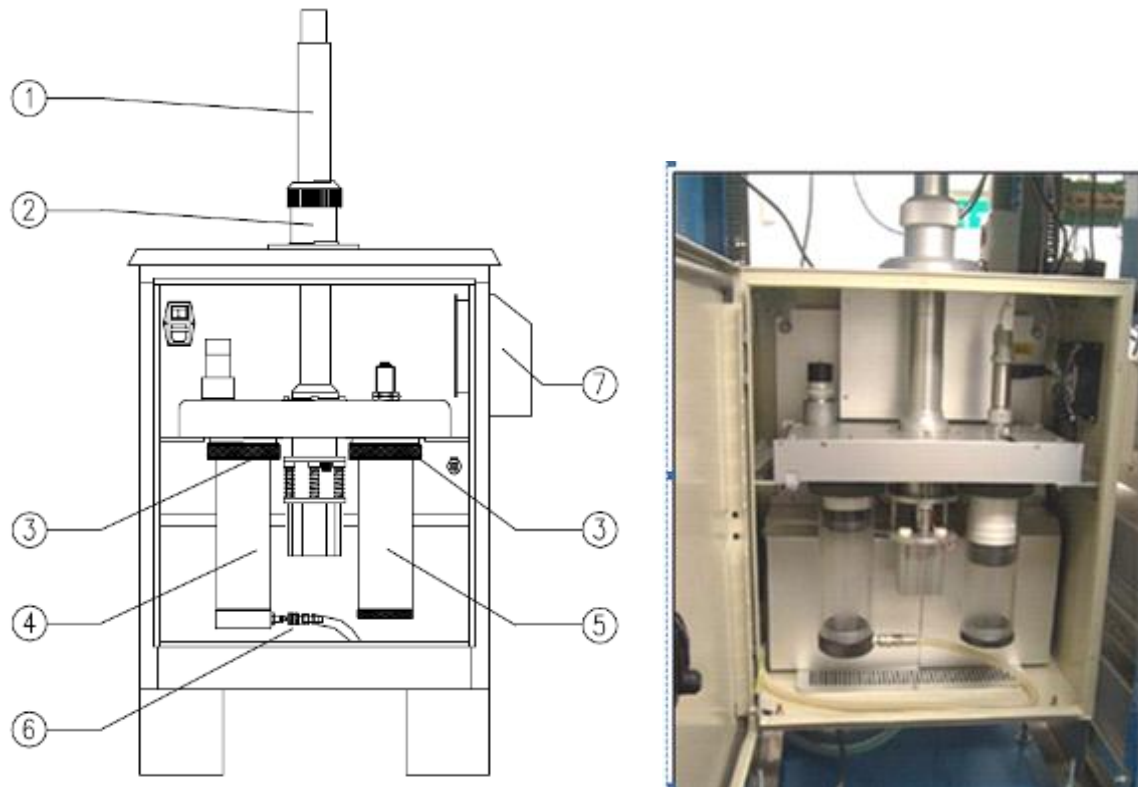


#### Key

- 1 Air sample
- 2 Drainage for impacted water
- 3 To filter
- H7 Manufacturing tolerance

Figure 9: Design of 2,3 m<sup>3</sup>/h standard sampling head for PM<sub>2,5</sub> measurements (source EN14907).

The sampling instruments for monitoring of the PM<sub>10</sub> and PM<sub>2,5</sub> differ only for the geometry of the sampling head. The SKYPOST PM is equipped with the following features:



1. Suction tube
2. Slide device for suction tube complete of a waterproof o-ring gasket
3. Filter reservoir tightening screwed rings
4. Clean filter reservoir
5. Exposed filter reservoir
6. Pneumatic quick connection for filter load
7. Internal ventilation air exit

**Figure 10: SKYPOST PM HV - front side detail**

The completely straight suction tube with its round shape and the separation of the storage filter zone from internal and radiant source of heat, allows collecting and keeping the integrity of the pollutants. The pneumatic tube serves to push up the clean filter in the mobile horizontal panel which, every time there is a change of the filter, it moves to the right to discharge the exposed filter in the exposed filter reservoir and, at the same time, to place the unexposed filter in the sampling position. Thus, the upper filter contained in the exposed reservoir represents the last day of sampling.

Internal ventilation system guarantees to maintain the deviation between the internal temperature and the ambient temperature less than  $\pm 5^{\circ}\text{C}$ , as requested by the EN14907.

The clean filter reservoir can contain up to 16 filter cassettes and this it can allow 16-days of monitoring without the need to go on the field and replace new filters. Filter cassette consist of two plastic rings and a micro drilled filter screen in AISI 316. These are used to handle the filter without compromising its integrity (Figure 47 and Figure 48).

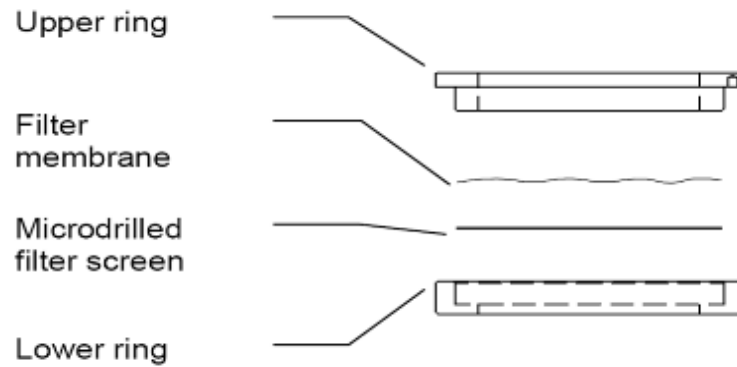


Figure 11: Filter cassette - assembling parts



Figure 12: Filter cassette without the filter

Since the sampler has to work with a constant flow rate of  $2.3 \text{ m}^3/\text{h} \pm 2\%$  (EN 12341 and EN14907), the SKYPOST has installed a dry gas meter within 2% precision and it can electronically control the flow. SKYPOST is also equipped with a sensor to measure the atmospheric pressure and temperature and the pressure drop on filter. This sensor is installed on the suction tube and protected against bad meteorological conditions (Figure 49). The data from the sensors and the volumetric measurements are automatically printed by the instruments and these can also be downloaded in the field by using the dedicated software and a RS 232 interface connection.

**Temperature &  
pressure sensor**



**Figure 13: Detail of the atmospheric pressure and temperature sensor**

The pump is placed on the rear end of the instrument, below the front panel keyboard and printer (see Figure 50). An hours counter keeps the information of the total working hours of the pumps. It is highly recommended from the manufacturer to perform pump maintenance every 6000 hours.



Figure 14: SKYPOST PM HV – rear end detail

The next table summarizes the technical characteristics of the SKYPOST:

TECHNICAL CHARACTERISTICS	
Autonomy	16 filters
Filter diameter	47mm
Power supply	220 V 50Hz
Dimensions (b*b*h)	400*250*600 mm
Box	In fire painted steel
Weight Kg	42 Kg
Pump type	Rotary vane 6 m <sup>3</sup> /h
Flow rate range	0,6-3 m <sup>3</sup> /h

Figure 15: SKYPOST technical characteristics

The SKYPOST PM can be set up for any sampling time interval and the exposed and unexposed filters can easily be replaced without interrupting the sampling. In fact, the sampler is set up to change automatically the sample filter every 24 hours. The sampler can be paused for any reason (e.g. cleaning the sampling head, fix out a technical problem) and re-started again without losing data or compromise the sampling. However, it has to be considered that, according to the L.N. 478/2010, the minimum data capture for PM<sub>10</sub> and PM<sub>2,5</sub> should not be less than 90% of the daily monitoring time (24h).

Before the beginning of the campaign, a leak test and a flow rate calibration have been carried out in the manufacturer's laboratory, as requested by the EN 12341. These instrument verifications will be repeated in the monitoring sites every three months by a technician.

The SKYPOSTs are furnished with a supplementary pump in case permanent damages occurred and a pump substitution is needed.

#### 1.1.6 Monitoring field activity

The field activities performed before the beginning of the sampling campaign, for both the PM10 and PM2.5 measurements were the following:

- SKYPOSTs were located in the chosen monitoring sites, the technician set up the power connection between the sampler and the power supply available in situ.
- The clean filter reservoir was unsealed and screwed in the proper ring and connected to the pneumatic tube (see Figure 46). The clean filter reservoir arrived directly from AMBIENTE laboratory, where in an uncontaminated environment the clean filters were inserted in each cassette and then placed in the cylinder following an order that associated the position in the cylinder with the filter code (no mark was made on the filter to prevent possible alteration of the chemical analysis). These clean filter reservoirs were sealed and shipped from AMBIENTE laboratory to Malta in protected and isolated boxes. The methodology of filter preparation, classification and handling in the lab is described in the next paragraph.
- Then, the technician set up the duration of the campaign (1 year – from the 5 April 2012 to the 31 March 2013) and the time interval between filter change (24h – from 0:05 to 23:55<sup>2</sup>).

During the whole duration of the monitoring campaign, the field activities are listed below:

- Every 15<sup>th</sup> day of monitoring, the exposed filter reservoir is collected and replaced with an empty one. Then, this cylinder is immediately sealed and inserted into a small container to protect it from possible damage during handling and transportation from the site to the laboratory.

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<sup>2</sup> The stop time of 10 minutes was set up to allow the machine to perform the filter change. It has to be noted that the monitoring time is largely within the daily minimum capture data (90%).





**Figure 16: Petri dish containing a filter cassette and an exposed filter**

- Every 15<sup>th</sup> day of monitoring, before leaving the sites, the technician downloads the monitoring report details from the sampler (stop time, flow rate, air sample volume, atmospheric pressure and temperature) that are required to determine the validation of the monitored parameters. Besides, the instrument memory is reset to avoid loss of sampling data due to insufficient memory capacity.

#### 1.1.7 Maintenance operations

- Every 15<sup>th</sup> day of monitoring, the technician has to clean and grease the inlet impaction plate using a silicon gel, as requested by the EN 12341 and EN14907. During this process, it has to be assured that the suction tube is completely sealed and no air enters the tube because the 15<sup>th</sup> filter is present in the sampling position. The time interval, in which the sampling is stopped, cannot to exceed 10% of the day time, thus no more than 144 minutes. Otherwise, the 15<sup>th</sup> filter would not be valid. Finally, the technician dismounts and cleans the cap, the distributor-disk and the water container.
- Every month, the technician dismounts and cleans the nozzles.
- Every three months, the flowmeter calibration and leak tests are performed for each sampler to assure the quality of the measurements.
- Every six months of monitoring (e.g. one time in this campaign), an intensive cleaning of the samplinghead (sampler inlet, suction pipe, filter change mechanism, filter cassettes, nozzles) has to be performed, this has to be made in compliance with the EN 14902.
- After about 250 sampling days (e.g. 6000 pump working hours), the technician will perform maintenance of the pump.

All the maintenance operations will add up to about 13 days of stop monitoring and consequently the effective number of sampling days will be 352. However, the minimum data capture defined in the contract (335 days) is largely reached and this may prevent unexpected interruption, such as power failure, that would cause the loss of that daily data.

#### 1.1.8 Laboratory activity

The laboratory activity can be subdivided in two main phases:

1. Preparation of the clean filters
2. Analysis of the exposed filters

##### 1.1.8.1 Preparation of the clean filters

For this monitoring campaign, filters made by quartz fibres are used, with an aerodynamic diameter of 0,22  $\mu\text{m}$ . This type of filter is in compliance with the filter specifications stated in the reference methods.

In each laboratory activity, the filters are handled using blunt tweezers to avoid contamination and damage. These filter characteristics are in compliance with the EN 12341, EN14907 and EN 14902. The laboratory activities for the filter preparation are the following:

- One filter from any new batch arriving in the Laboratory, is tested to confirm that the filter blank variability is sufficiently low to meet the following requirements: less than or equal to 10% of the limit value for Pb and less than or equal to 10% of the target values for Cd, As and Ni. All the new filters are checked to detect imperfection or possible transport contamination (EN 14902).
- Then, the filters are conditioned for at least 48 hours in special perforated trays, protected against possible dust or other particulate deposition, at  $20\text{ }^{\circ}\text{C}\pm 1$  and  $(50\pm 5)\%$  of relative humidity.



**Figure 17: Perforated tray used for conditioning**

The above conditioning technique was used for the first month of monitoring only. This technique ensured that the micro-climate inside the jar is the same as that of the conditioning room (which is conditioned and monitored for temperature and humidity). The glass jar was fitted with a valve to allow ambient conditions to match the same ambient as that of the room and yet prevent the possibility of any further unlikely alien dust deposits. Continuous readings were also taken of temperature and humidity within the glass jar to ensure that the micro-climatic conditions match those of the room. Homogeneity was observed between the values.

As from the 26 April 2012, a similar but probably enhanced conditioning technique was used by ambiente. The exposed filters were placed into dedicated cassettes open at one end (bottom) but covered at the top (reference to the below figures). All cassettes are placed on a multi-level rack, which is then located in a dedicated conditioning chamber, with controlled micro-climatic conditions equipped with a meteo station. Filters are at each stage protected from alien dust deposits as required by the Reference Method. It is also ensured that no electrostatic charges interfere with the filters. Between conditioning and weighing, the glass jars as shown in Figure 20 are used in transporting filters, preventing dust deposits.



**Figure 18: Multi-level rack conditioning technique**

- After the conditioning, each filter is weighed using a balance with a resolution of at least 10  $\mu\text{g}$ , as stated in the EN12341 and EN14907. The filter weight is determined by averaging three consecutive measures and obtained following a stabilization of the weight determined by the balance (this is easily distinguishable because the scale display identifies the same constant weight). The laboratory is provided with the analytical balance Mettler Toledo XP6 that has the following characteristics:

<b>Nominal and guaranteed values</b>	<b>XP6</b>
Maximum capacity	6.1 g
Readability	0.001 mg
Repeatability - at nominal load	0.0008 mg
- at low load (measured at)	0.0006 mg (0.2 g)
Linearity	0.004 mg
Eccentric load deviation (test load) <sup>1)</sup>	0.005 mg (2 g)
Sensitivity offset	$7 \times 10^{-6}$
Sensitivity temperature drift <sup>2)</sup>	0.0001 %/°C
Sensitivity stability <sup>3)</sup>	0.0001 %/a
<b>Technical data - typical values<sup>4)</sup></b>	
Repeatability (sd)	$0.0004 \text{ mg} + 3 \times (10^{-8}) \cdot R_{gr}$
Differential linearity deviation (sd)	$\sqrt{1.5 \times (10^{-13})} \cdot g \cdot R_{nt}$
Differential eccentric load deviation (sd)	$5 \times (10^{-7}) \cdot R_{nt}$
Sensitivity offset (sd) <sup>2)</sup>	$1.5 \times (10^{-6}) \cdot R_{nt}$
Minimum weight* (according to USP)	$1.2 \text{ mg} + 9 \times (10^{-5}) \cdot R_{gr}$
Minimum weight* (@ U=1 %, 2 sd)	$0.08 \text{ mg} + 6 \times (10^{-6}) \cdot R_{gr}$
Settling time	< 8 s

<sup>1)</sup>According to OIML R76

<sup>2)</sup>In the temperature range 10...30°C

<sup>3)</sup>Stability of sensitivity as from first installation with FACT

<sup>4)</sup>Can be used for the estimation of uncertainty sd: standard deviation R<sub>gr</sub>: gross weight R<sub>nt</sub>: net weight (sample weight) a: year (annum)

\*Repeatability and minimum weight can be improved and affected by the following measures: - choice of suitable weighing parameters, - moving to better location, - using smaller tare containers

The laboratory is also equipped with a robotic arm for movement of the filters within the scale. The robotic arm passes on to the next filter. This automated equipment ensures that the weighing procedures are in compliance with the EN12341 and EN14907.

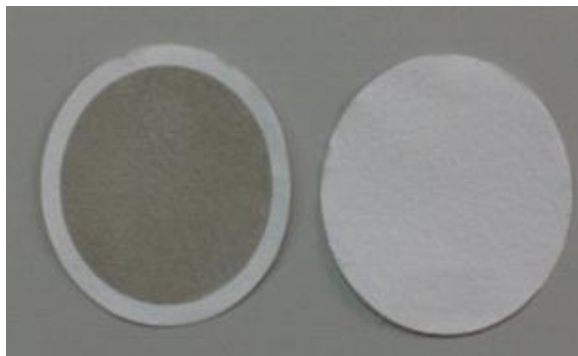


**Figure 19: analytical balance Mettler Toledo XP6**

- The filters are then placed in a labeled sealed cassette. A laboratory report with the use of each filter (e.g. PM10, PM2,5 or metals), their position in the cylinder and the correspondence between cassette and filter weight (to avoid contamination, no marking is made on the filter surface) is written.
- After 15 filters are put in the clean reservoir, it is sealed and shipped to Malta, ready to be directly inserted in the SKYPOST sampler.

#### ***1.1.8.2 Analysis of the exposed filters***

The returning cylinder, with the exposed filters is checked in their physical integrity and then stored in an uncontaminated weighing room to proceed with the laboratory analysis.



**Figure 20: exposed filter (left) - unexposed filter (right)**

The filters are analyzed to determine the PM10 and PM2,5 concentrations by gravimetric method:



- *PM10 and PM2,5 determination:* filters are exposed, as for the unexposed filters, in a conditioning room at a temperature of 20°C and relative humidity of 50% for 120 hours in order to reach the equilibrium. After that, they are weighed using the analytical balance. Finally, the PM concentration is determined by the following formula:

$$C_{PM} = (W_{EF} - W_{UF}) / V$$

Where:

$C_{PM}$  = PM concentration in ( $\mu\text{g}/\text{m}^3$ )

$W_{EF}$  = Weight of the exposed filter ( $\mu\text{g}$ )

$W_{UF}$  = Weight of the unexposed filter ( $\mu\text{g}$ )

$V$  = Actual sampling volume ( $\text{m}^3$ )

The concentration of the metals is determined in the following way:

#### 1.1.9 Metals determination

The sample filter is transported to the laboratory and the metals are taken into solution by closed vessel microwave digestion using nitric acid and hydrogen peroxide. The resultant solution is analyzed by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS). The laboratory is equipped with ICP-MS Agilent Technologies S.p.A. – 7500cx

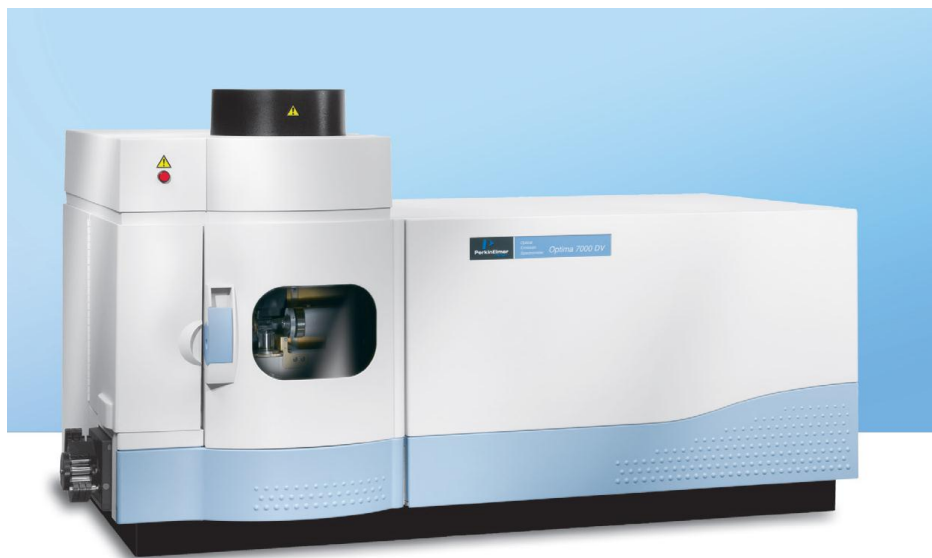


Figure 21: ICP -MS Agilent technologies S.p.A. - 7500cx

The digestion occurs in the following microwave: Microwave Reaction System – Perkin Elmer Anton Paar – Multiwave 3000



**Figure 22: Multiwave 3000 - Perkin Elmer Anton Paar**

## 2 RESULTS

This section reports the average daily concentrations of the most critical heavy metals (Arsenic, Cadmium, Nickel, Lead and Vanadium) only when it has been measured an exceedances of the PM10 daily limit value of 50  $\mu\text{g}/\text{m}^3$ .

For each month, when at least one exceedance of the PM10 limit value was found in Marsaxlokk and/or Birzebbuga, the heavy metals concentrations are given.

### 2.1 AUGUST 2012

The analysis of the air monitoring data has determined that during the month of August 2012 the following PM10 exceedances occurred:

- at Birzebbuga site, exceedance of daily limit value of PM10, occurred on:
  - 08<sup>th</sup> of August - daily concentration of 75.66  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - 09<sup>th</sup> of August - daily concentration of 64.47  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - 27<sup>th</sup> of August - daily concentration of 51.78  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
- at Marsaxlokk site, exceedance of daily limit value of PM10, occurred on:
  - 24<sup>th</sup> of August - daily concentration of 52.24  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$

The following table summarizes the average PM10 concentrations measured at the two ENEMALTA monitoring sites of Marsaxlokk and Birzebbuga:

Date	Enemalta air monitoring stations	
	Marsaxlokk	Birzebbuga
August 08	n.a.	75.66
August 09	n.a.	64.47
August 24	52.24	35.01
August 27	36.47	51.78

Table 2: PM10 measurements on 08<sup>th</sup>, 09<sup>th</sup>, 24<sup>th</sup> and 27<sup>th</sup> of August

### 2.1.1 Heavy metals concentrations

In the next table, the daily average heavy metals concentrations are given:

**Table 3 – Heavy metals concentrations in Birzebbuga**

reference	Arsenic	Cadmium	Nickel	Lead	Vanadium
method	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
Date	ng/mc	ng/mc	ng/mc	ng/mc	ng/mc
2012-08-08	<1.83	<1.83	23.81	18.32	20.15
2012-08-09	<1.83	<1.83	31.14	9.71	21.98
2012-08-27	<1.83	<1.83	25.70	5.51	11.02

Only the Nickel compound has registered an average concentration higher than the annual target limit of 20 ng/mc established by the Directive 2004/107/EC. Actually, there is not any regulatory limit for Vanadium.

**Table 4 – Heavy metals concentrations in Marsaxlokk**

reference	Arsenic	Cadmium	Nickel	Lead	Vanadium
method	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
Date	ng/mc	ng/mc	ng/mc	ng/mc	ng/mc
2012-08-24	<1,83	<1,83	9,17	11,00	11,00

## 2.2 SEPTEMBER 2012

The analysis of the air monitoring data has determined that during the month of September 2012 the following PM10 exceedances occurred:

- at Birzebbuga site, on 01<sup>st</sup> September - daily concentration of 57.73 µg/m<sup>3</sup> against daily limit value of 50.0 µg/m<sup>3</sup>
- at Birzebbuga site, on 24<sup>th</sup> September - daily concentration of 51.78 µg/m<sup>3</sup> against daily limit value of 50.0 µg/m<sup>3</sup>
- at Birzebbuga site, on 30<sup>th</sup> September - daily concentration of 54.26 µg/m<sup>3</sup> against daily limit value of 50.0 µg/m<sup>3</sup>

- at Marsaxlokk site, on 01<sup>st</sup> September - daily concentration of 54.79 µg/m<sup>3</sup> against daily limit value of 50.0 µg/m<sup>3</sup>

The following table summarizes the average PM<sub>10</sub> concentrations measured at the two ENEMALTA monitoring sites of Marsaxlokk and Birzebbuga:

Date	Enemalta air monitoring stations	
	Marsaxlokk	Birzebbuga
September 01	54.79	57.73
September 24	35.18	51.78
September 30	46.38	54.26

Table 5: PM<sub>10</sub> measurements on 01<sup>st</sup>, 24<sup>th</sup> and 30<sup>th</sup> of September

#### 2.2.1 Heavy metals concentrations

In the next table, the daily average heavy metals concentrations are given for the investigated days:

Table 6 – Heavy metals concentrations in Birzebbuga

	Arsenic	Cadmium	Nickel	Lead	Vanadium
reference method	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
Date	ng/mc	ng/mc	ng/mc	ng/mc	ng/mc
2012-09-01	<1.83	<1.83	9.16	5.50	3.67
2012-09-24	<1.83	<1.83	16.49	3.67	12.83
2012-09-30	<1.83	<1.83	3.67	6.78	3.67

Table 7 – Heavy metals concentrations in Marsaxlokk

	Arsenic	Cadmium	Nickel	Lead	Vanadium
reference method	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
Date	ng/mc	ng/mc	ng/mc	ng/mc	ng/mc
2012-09-01	<1.83	<1.83	14.66	7.33	5.50

Referring to the annual target values established by the Directive 2004/107/EC, no critical heavy metals concentrations were measured on the investigated days of September 2012 in both the monitoring points. Actually, there is not any regulatory limit for Vanadium. The metal that assumes the relative highest concentrations is the Nickel.

## 2.3 OCTOBER 2012

The analysis of the air monitoring data has determined that during the month of October 2012 the following PM10 exceedances occurred:

- at Birzebbuga site, on 1<sup>st</sup> October - daily concentration of 50,77  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
- at Marsaxlokk site, on 27<sup>th</sup> October - daily concentration of 72,63  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$

### 2.3.1 Heavy metals concentrations

In the next table, the daily average heavy metals concentrations are given for the investigated days:

**Table 8 – Heavy metals concentrations in Birzebbuga**

	<b>Arsenic</b>	<b>Cadmium</b>	<b>Nickel</b>	<b>Lead</b>	<b>Vanadium</b>
<b>reference method</b>	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
<b>Date</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>
2012-10-01	<1.83	<1.83	23.83	7.33	12.83

**Table 9 – Heavy metals concentrations in Marsaxlokk**

	<b>Arsenic</b>	<b>Cadmium</b>	<b>Nickel</b>	<b>Lead</b>	<b>Vanadium</b>
<b>reference method</b>	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
<b>Date</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>
2012-10-27	<1.83	<1.83	33.01	7.52	4.95



## 2.4 NOVEMBER 2012

The analysis of the air monitoring data has determined that during the month of November 2012 the following PM10 exceedances occurred:

- at Marsaxlokk site, on 28<sup>th</sup> November - daily concentration of 67.41 µg/m<sup>3</sup> against daily limit value of 50.0 µg/m<sup>3</sup>

At Birzebbuga, the daily PM10 concentration was not available for 28<sup>th</sup> November.

### 2.4.1 Heavy metals concentrations

In the next table, the daily average heavy metals concentrations are given:

**Table 10 - Heavy metals concentrations in Marsaxlokk**

	<b>Arsenic</b>	<b>Cadmium</b>	<b>Nickel</b>	<b>Lead</b>	<b>Vanadium</b>
<b>reference method</b>	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
<b>Date</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>
2012-11-28	<1.83	<1.83	10.44	3.11	3.30

Referring to the annual target values established by the Directive 2004/107/EC, no critical heavy metals concentrations were measured on 28<sup>th</sup> of November 2012. Actually, there is not any regulatory limit for Vanadium.

## 2.5 DECEMBER 2012

The analysis of the air monitoring data has determined that during the month of December 2012 the following PM10 exceedances occurred:

- at Marsaxlokk site, on 27<sup>th</sup> December - daily concentration of 56,21 µg/m<sup>3</sup> against daily limit value of 50.0 µg/m<sup>3</sup>
- at Marsaxlokk site, on 29<sup>th</sup> December - daily concentration of 66,65 µg/m<sup>3</sup> against daily limit value of 50.0 µg/m<sup>3</sup>
- at Marsaxlokk site, on 30<sup>th</sup> December - daily concentration of 61,32 µg/m<sup>3</sup> against daily limit value of 50.0 µg/m<sup>3</sup>
- at Marsaxlokk site, on 31<sup>th</sup> December - daily concentration of 59,32 µg/m<sup>3</sup> against daily limit value of 50.0 µg/m<sup>3</sup>

At Birzebbuga, the daily PM10 limit value was not exceeded on these investigated days. However, the following table reports the PM10 daily concentrations on both the monitoring points to have a complete summary of the monitoring results.

Date	Enemalta air monitoring stations	
	Marsaxlokk	Birzebbuga
December 27	56.21	47.26
December 29	66.65	33.88
December 30	61.32	29.67
December 31	59.32	35.53

#### 2.5.1 Heavy metals concentrations

In the next table, the daily average heavy metals concentrations are given:

**Table 11 - Heavy metals concentrations in Marsaxlokk**

reference method	Arsenic	Cadmium	Nickel	Lead	Vanadium
	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
Date	ng/mc	ng/mc	ng/mc	ng/mc	ng/mc
2012-12-27	<1.83	<1.83	7.33	1.83	<1.83
2012-12-29	<1.83	<1.83	1.83	3.66	1.83
2012-12-30	<1.83	<1.83	1.83	5.50	1.83
2012-12-31	<1.83	<1.83	3.67	12.83	3.67

Referring to the annual target values established by the Directive 2004/107/EC, no critical heavy metals concentrations were measured on the investigated days of December 2012. Actually, there is not any regulatory limit for Vanadium.

## 2.6 JANUARY 2013

The analysis of the air monitoring data has determined that during the month of January 2013 the following PM10 exceedances occurred:

- at Birzebbuga site, exceedance of daily limit value of PM10, occurred on:
  - 20<sup>th</sup> of January - daily concentration of 83.94  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - 24<sup>th</sup> of January - daily concentration of 61.93  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
- at Marsaxlokk site, exceedance of daily limit value of PM10, occurred on:
  - 03<sup>rd</sup> of January - daily concentration of 61.51  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - 20<sup>th</sup> of January - daily concentration of 82.60  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - 24<sup>th</sup> of January - daily concentration of 69.60  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$

The following table reports the PM10 daily concentrations on both the monitoring points to have a complete summary of the monitoring results.

Date	Enemalta air monitoring stations	
	Marsaxlokk	Birzebbuga
January 03	61.51	21.43
January 20	82.60	83.94
January 24	69.60	61.93

2.6.1 Heavy metals concentrations

In the next table, the daily average heavy metals concentrations are given:

Table 12 - Heavy metals concentrations in Birzebbuga

	Arsenic	Cadmium	Nickel	Lead	Vanadium
<b>reference method</b>	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
<b>Date</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>
20/01/2013	<1.83	<1.83	11.00	3.67	14.66
24/01/2013	<1.83	<1.83	5.50	3.66	3.66

Table 13 - Heavy metals concentrations in Marsaxlokk

	Arsenic	Cadmium	Nickel	Lead	Vanadium
<b>reference method</b>	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
<b>Date</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>
03/01/2013	<1.83	<1.83	5.49	36.62	5.49
20/01/2013	<1.83	<1.83	12.82	5.49	10.99
24/01/2013	<1.83	<1.83	7.33	3.66	3.66

Referring to the annual target values established by the Directive 2004/107/EC, no critical heavy metals concentrations were measured on the investigated days. Actually, there is not any regulatory limit for Vanadium.

## 2.7 FEBRUARY 2013

The analysis of the air monitoring data has determined that during the month of February 2013 the following PM10 exceedances occurred:

- at Birzebbuga site, exceedance of daily limit value of PM10, occurred on:
  - 02<sup>nd</sup> of February - daily concentration of 100.2  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
- at Marsaxlokk site, exceedance of daily limit value of PM10, occurred on:
  - 02<sup>nd</sup> of February - daily concentration of 96.87  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$

### 2.7.1 Heavy metals concentrations

In the next table, the daily average heavy metals concentrations are given:

Table 14 - Heavy metals concentrations in Birzebbuga

	Arsenic	Cadmium	Nickel	Lead	Vanadium
reference method	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
Date	ng/mc	ng/mc	ng/mc	ng/mc	ng/mc
02-02-2013	<1.83	<1.83	3.66	5.50	5.50

Table 15 - Heavy metals concentrations in Marsaxlokk

	Arsenic	Cadmium	Nickel	Lead	Vanadium
reference method	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
Date	ng/mc	ng/mc	ng/mc	ng/mc	ng/mc
02-02-2013	<1.83	<1.83	3.66	5.49	5.49

Referring to the annual target values established by the Directive 2004/107/EC, no critical heavy metals concentrations were measured on the investigated days. Actually, there is not any regulatory limit for Vanadium.

## 2.8 MARCH 2013

The analysis of the air monitoring data has determined that during the month of March 2013 the following PM10 exceedances occurred:

- at Marsaxlokk site, exceedance of daily limit value of PM10, occurred on:
  - on 13<sup>th</sup> of March - daily concentration of 51.29  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 18<sup>th</sup> of March - daily concentration of 72.89  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 24<sup>h</sup> of March - daily concentration of 103.29  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 28<sup>th</sup> of March - daily concentration of 54.08  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 29<sup>th</sup> of March - daily concentration of 64.45  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  
- at Birzebbuga site, exceedance of daily limit value of PM10, occurred on:
  - on 13<sup>th</sup> of March - daily concentration of 50.73  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 18<sup>th</sup> of March - daily concentration of 82.44  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 24<sup>h</sup> of March - daily concentration of 102.23  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 28<sup>th</sup> of March - daily concentration of 94.77  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 29<sup>th</sup> of March - daily concentration of 69.58  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$

### 2.8.1 Heavy metals concentrations

In the next table, the daily average heavy metals concentrations are given:

**Table 16 - Heavy metals concentrations in Marsaxlokk**

	<b>Arsenic</b>	<b>Cadmium</b>	<b>Nickel</b>	<b>Lead</b>	<b>Vanadium</b>
<b>reference method</b>	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
<b>Date</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>
03/13/2013	<1.83	<1.83	3.66	14.65	3.66
03/18/2013	<1.83	<1.83	3.66	3.66	3.66
03/24/2013	<1.83	<1.83	1,83	3.66	1.83
03/28/2013	<1.83	<1.83	9.22	5.53	1.84
03/29/2013	<1.83	<1.83	9.16	10.99	18.31

**Table 17 - Heavy metals concentrations in Birzebbuga**

	<b>Arsenic</b>	<b>Cadmium</b>	<b>Nickel</b>	<b>Lead</b>	<b>Vanadium</b>
<b>reference method</b>	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
<b>Date</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>
03/13/2013	<1.83	<1.83	9.16	1.83	12.82
03/18/2013	<1.83	<1.83	3.66	3.66	3.66
03/24/2013	<1.83	<1.83	3.66	3.66	3.66
03/28/2013	<1.83	<1.83	5.53	1.84	9.21
03/29/2013	<1.83	<1.83	10.99	12.82	21.97

Referring to the annual target values established by the Directive 2004/107/EC, no critical heavy metals concentrations were measured on the investigated days for March 2013. Actually, there is not any regulatory limit for Vanadium.

## 2.9 APRIL 2013

The analysis of the air monitoring data has determined that during the month of April 2013 the following PM10 exceedances occurred:

- at Marsaxlokk site, exceedance of daily limit value of PM10, occurred on:
  - on 23<sup>rd</sup> of April - daily concentration of 55.67  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 24<sup>th</sup> of April - daily concentration of 65.39  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 25<sup>th</sup> of April - daily concentration of 63.00  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
- at Birzebbuga site, exceedance of daily limit value of PM10, occurred on:
  - on 22<sup>nd</sup> of April - daily concentration of 51.29  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 23<sup>rd</sup> of March - daily concentration of 63.56  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 24<sup>th</sup> of April - daily concentration of 65.77  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 25<sup>th</sup> of April - daily concentration of 74.74  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$

The following table reports the PM10 daily concentrations on both the monitoring points to have a complete summary of the monitoring results.

Date	Enemalta air monitoring stations	
	Marsaxlokk	Birzebbuga
April 22	45.24	51.29
April 23	55.67	63.56
April 24	65.39	65.77
April 25	63.00	74.74

### 2.9.1 Heavy metals concentrations

In the next table, the daily average heavy metals concentrations are given:



Table 18 - Heavy metals concentrations in Marsaxlokk

	Arsenic	Cadmium	Nickel	Lead	Vanadium
<b>reference method</b>	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005+ EPA 6020A 2007
<b>Date</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>
04/23/2013	<1.83	<1.83	3.66	5.49	7.33
04/24/2013	1.83	<1.83	7.33	5.50	5.50
04/25/2013	<1.83	<1.83	12.82	3.66	7.33

Table 19 - Heavy metals concentrations in Birzebuga

	Arsenic	Cadmium	Nickel	Lead	Vanadium
<b>Reference method</b>	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005+ EPA 6020A 2007
<b>Date</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>
04/22/2013	<1.83	<1.83	25.65	5.50	7.33
04/23/2013	1.83	<1.83	3.66	5.49	9.16
04/24/2013	<1.83	<1.83	3.66	3.66	5.50
04/25/2013	<1.83	<1.83	7.33	3.66	10.99

Referring to the annual target values established by the Directive 2004/107/EC, no critical heavy metals concentrations were measured on the investigated days for April 2013. There is only one peak value for Nickel in Birzebuga on 2013/04/22 but it is balanced by three very low values that reduce the average for this period below the target value of 20 ng/mc. Actually, there is not any regulatory limit for Vanadium.

## 2.10 MAY 2013

The analysis of the air monitoring data has determined that during the month of May 2013 the following PM10 exceedances occurred:

- at Marsaxlokk site, exceedance of daily limit value of PM10, occurred on:
  - on 10<sup>th</sup> of May - daily concentration of 135.11  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 11<sup>th</sup> of May - daily concentration of 190.23  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 12<sup>th</sup> of May - daily concentration of 150.91  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 13<sup>th</sup> of May - daily concentration of 54.75  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 14<sup>th</sup> of May - daily concentration of 67.56  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 15<sup>th</sup> of May - daily concentration of 109.14  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 16<sup>th</sup> of May - daily concentration of 339.12  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 17<sup>th</sup> of May - daily concentration of 208.46  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 18<sup>th</sup> of May - daily concentration of 241.18  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 19<sup>th</sup> of May - daily concentration of 310.55  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 20<sup>th</sup> of May - daily concentration of 256.31  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 21<sup>th</sup> of May - daily concentration of 227.25  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 22<sup>nd</sup> of May - daily concentration of 404.84  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 31<sup>st</sup> of May - daily concentration of 60.09  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$

- at Birzebbuga site, exceedance of daily limit value of PM10, occurred on:
  - on 5<sup>th</sup> of May - daily concentration of 57.33  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 10<sup>th</sup> of May - daily concentration of 75.83  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 11<sup>th</sup> of May - daily concentration of 108.10  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 12<sup>th</sup> of May - daily concentration of 65.22  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 16<sup>th</sup> of May - daily concentration of 182.83  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 17<sup>th</sup> of May - daily concentration of 108.10  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 18<sup>th</sup> of May - daily concentration of 151.48  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 19<sup>th</sup> of May - daily concentration of 146.47  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 20<sup>th</sup> of May - daily concentration of 136.14  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 21<sup>th</sup> of May - daily concentration of 282.42  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 22<sup>nd</sup> of May - daily concentration of 422.10  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 24<sup>th</sup> of May - daily concentration of 54.38  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$
  - on 31<sup>st</sup> of May - daily concentration of 59.74  $\mu\text{g}/\text{m}^3$  against daily limit value of 50.0  $\mu\text{g}/\text{m}^3$

The following table reports the PM10 daily concentrations on both the monitoring points to have a complete summary of the monitoring results.

Date	Enemalta air monitoring stations	
	Marsaxlokk	Birzebbuga
5 May	49.46	57.33
10 May	135.11	75.83
11 May	190.23	108.10
12 May	150.91	65.22
13 May	54.75	N.A.
14 May	67.56	N.A.
15 May	109.14	N.A.
16 May	339.12	182.83
17 May	208.46	108.10
18 May	241.18	151.48
19 May	310.55	146.47
20 May	256.31	136.14
21 May	227.25	282.42
22 May	404.84	422.10
24 May	47.78	54.38
31 May	60.06	59.74

#### 2.10.1 Heavy metals concentrations

In the next table, the daily average heavy metals concentrations are given:

Table 20 - Heavy metals concentrations in Marsaxlokk

reference method	Arsenic	Cadmium	Nickel	Lead	Vanadium
	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
Date	ng/mc	ng/mc	ng/mc	ng/mc	ng/mc
05/10/2013	1,83	<1,83	9,15	5,49	18,31
05/11/2013	1,83	<1,83	7,32	7,32	10,99
05/12/2013	1,83	<1,83	5,49	5,49	9,16
05/13/2013	1,83	<1,83	3,66	3,66	5,49
05/14/2013	1,83	<1,83	14,65	7,32	27,47
05/15/2013	1,83	<1,83	7,33	1,83	5,49
05/16/2013	1,83	<1,83	9,16	5,49	14,65
05/17/2013	1,83	<1,83	12,82	7,33	21,98
05/18/2013	1,83	<1,83	18,32	3,66	32,97
05/19/2013	1,84	<1,83	9,22	3,69	9,22
05/20/2013	1,83	<1,83	14,65	9,15	18,31
05/21/2013	1,83	<1,83	10,99	1,83	12,82
05/22/2013	1,83	<1,83	14,65	5,49	12,82
05/31/2013	1,83	<1,83	18,31	1,83	25,64

Table 21 - Heavy metals concentrations in Birzebbuga

reference method	Arsenic	Cadmium	Nickel	Lead	Vanadium
	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
Date	ng/mc	ng/mc	ng/mc	ng/mc	ng/mc
05/05/2013	1,83	<1,83	10,99	5,50	18,32
05/10/2013	1,83	<1,83	7,33	7,33	12,82
05/11/2013	1,83	<1,83	5,50	5,50	9,16
05/12/2013	1,83	<1,83	1,83	1,83	5,50
05/16/2013	1,83	<1,83	7,33	5,50	12,83
05/17/2013	1,83	<1,83	12,83	5,50	25,65
05/18/2013	1,83	<1,83	12,82	3,66	29,31
05/19/2013	1,85	<1,83	7,38	3,69	11,07
05/20/2013	1,83	<1,83	7,33	1,83	14,66
05/21/2013	1,83	<1,83	5,50	1,83	9,16
05/22/2013	1,83	<1,83	3,66	1,83	3,66
05/24/2013	1,83	<1,83	10,99	3,66	7,32
05/31/2013	1,83	<1,83	16,49	3,67	20,16

Referring to the annual target values established by the Directive 2004/107/EC, no critical heavy metals concentrations were measured on the investigated days for May 2013. Actually, there is not any regulatory limit for Vanadium.

## 2.11 JUNE 2013

The analysis of the air monitoring data has determined that during the month of June 2013 the following PM10 exceedances occurred:

- at Marsaxlokk site, exceedance of daily limit value of PM10, occurred on:
  - on 4<sup>th</sup> of June - daily concentration of 52.94 µg/m<sup>3</sup> against daily limit value of 50.0 µg/m<sup>3</sup>
  - on 5<sup>th</sup> of June - daily concentration of 53.66 µg/m<sup>3</sup> against daily limit value of 50.0 µg/m<sup>3</sup>
- at Birzebbuga site, exceedance of daily limit value of PM10, occurred on:
  - on 2<sup>nd</sup> of June - daily concentration of 56.78 µg/m<sup>3</sup> against daily limit value of 50.0 µg/m<sup>3</sup>
  - on 3<sup>th</sup> of June - daily concentration of 54.22 µg/m<sup>3</sup> against daily limit value of 50.0 µg/m<sup>3</sup>
  - on 5<sup>th</sup> of June - daily concentration of 54.40 µg/m<sup>3</sup> against daily limit value of 50.0 µg/m<sup>3</sup>

The following table reports the PM10 daily concentrations on both the monitoring points to have a complete summary of the monitoring results.

Date	Enemalta air monitoring stations	
	Marsaxlokk	Birzebbuga
2 June	39.92	<b>56.78</b>
3 June	44.69	<b>54.22</b>
4 June	<b>52.94</b>	46.72
5 June	<b>53.66</b>	<b>54.40</b>

2.11.1 Heavy metals concentrations

In the next table, the daily average heavy metals concentrations are given:

Table 22 - Heavy metals concentrations in Marsaxlokk

	Arsenic	Cadmium	Nickel	Lead	Vanadium
<b>reference method</b>	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
<b>Date</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>
06/04/2013	1,831837333	<1,83	9,16	1,83	5,50
06/05/2013	1,843997787	<1,83	14,75	3,69	11,06

Table 23 - Heavy metals concentrations in Birzebbuga

	Arsenic	Cadmium	Nickel	Lead	Vanadium
<b>reference method</b>	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005	UNI EN 14902:2005 + EPA 6020A 2007
<b>Date</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>	<b>ng/mc</b>
06/02/2013	1,83	<1,83	12,82	1,83	7,33
06/03/2013	1,83	<1,83	12,82	1,83	10,99
06/05/2013	1,83	<1,83	12,82	1,83	10,99

Referring to the annual target values established by the Directive 2004/107/EC, no critical heavy metals concentrations were measured on the investigated days for June 2013. Actually, there is not any regulatory limit for Vanadium.