

## 1. Commentary on the summary annual tabular survey

### 1.1 Overview of measuring methods

#### 1.1.1 Overview of measuring methods in the network of automated monitoring stations (AMS)

Component	Abbreviation	Method	Type of method
SO <sub>2</sub>	UVFL	ultraviolet fluorescence	reference
NO <sub>x</sub>	CHML	chemiluminescence	reference
PM <sub>10</sub> , PM <sub>2.5</sub>	RADIO	radiometry	equivalent
	TEOM	tapered element oscillating microbalance	equivalent
CO	IRABS	IR correlation absorption spectrometry	reference
O <sub>3</sub>	UVABS	ultraviolet absorption photometry	reference
BTX	GCH-FID	gas chromatography – flame-ionization detection	reference
	GCH-PID	gas chromatography – photo-ionization detection	
Hg	AFS	low-temperature gas atomic fluorescence	

#### 1.1.2 Overview of measuring methods in the network of manual stations

Component	Abbreviation	Method	Type of method
SO <sub>2</sub>	WGAE	spectrophotometry using TCM and fuchsin (West-Gaeke)	reference
	IC	ion chromatography	equivalent
	FUCEL	electrochemical fuel cell	equivalent
	CLM	coulometry	equivalent
	PD	passive sampler	
NO <sub>2</sub>	CLM	coulometry	equivalent
	PD	passive sampler	
NO <sub>x</sub>	FUCEL	electrochemical fuel cell	equivalent
	GUAJA	guajacol (modified Jakobs-Hochheiser) spectrophotometry	equivalent
	TLAM	triethanolamine spectrophotometry	equivalent
SPM, PM <sub>10</sub> , PM <sub>2.5</sub>	GRV	gravimetry	reference
HM	AAS	atomic absorption spectrometry	reference
	PLRG	polarography	equivalent
	ICP-AES	inductively coupled plasma – atomic emission spectrometry	equivalent
	XRF	X-ray fluorescence	equivalent
	ICP-MS	inductively coupled plasma – mass spectrometry	equivalent
SO <sub>4</sub> <sup>2-</sup>	XRF	X-ray fluorescence	equivalent
NH <sub>3</sub>	BERTH	Berthelot spectrophotometry	
NH <sub>4</sub> <sup>+</sup>	BERTH	Berthelot spectrophotometry	
VOC	GCH-VOC	gas chromatography	reference
PAH	GCH-MS	gas chromatography with mass detection	
	HPLC	high performance liquid chromatography	

### 1.1.3 Overview of measuring methods of supplementary meteorological elements

Component	Abbreviation	Method
Wind direction and velocity	OPEL	optoelectronically
	U-SONIC	ultrasonic anemometer
Global radiation (GLRD)	TDM	temperature difference method

### 1.1.4 Descriptions of methods

#### Atomic absorption spectrometry

Samples are taken on membrane nitrocellulose filters Synpor, followed by mineralization using hot nitric acid and hydrogen peroxide, final AAS analysis.

Same chemicals, but in a microwave field (MLS 1200 MEGA) are used in CHMI.

Use: CHMI metals in SPM, after 1998 only Cd, Pb, since 2001 As, HS and ORGREZ (ČEZ Inc.) stations

#### Berthelot method – spectrometry

Ammonium ions are captured on the first located teflon filter, gaseous  $\text{NH}_3$  is captured on the filter impregnated with oxalic acid,  $\text{NH}_4^+$  ions eluted by demineralized water react with alkaline solution of phenol and  $\text{NaClO}$ . Spectrophotometrical measurement at 630 nm is used.

Use:  $\text{NH}_3$ ,  $\text{NH}_4^+$

#### Coulometry

Electrochemical method where electrolytical current is proportional to gas concentration according to Faraday's law.

Use:  $\text{SO}_2$ ,  $\text{NO}_2$

#### El. fuel cell

A semiautomatic method, APM analyzer of City Technology Corp. with a selective micro-fuel cell.

Use:  $\text{SO}_2$ ,  $\text{NO}_x$  at HS stations

#### Gravimetry

The sample is taken through continuous filtration of ambient air on selected filtering material (membrane nitrocellulose with a mean pore size of 0.85  $\mu\text{m}$ , teflon with a mean pore size of 2  $\mu\text{m}$  or glass fibre with capturing capacity > 99.5). The difference between the weight of the filter prior to and after the exposure is determined gravimetrically.

Use: SPM at manual stations,  $\text{PM}_{10}$  at Black Triangle stations

#### Guajacol (modified Jakobs-Hochheiser) spectrophotometry

After oxidation  $\text{NO}_2$  is absorbed into the solution of  $\text{NaOH}$  with addition of guajacol and is converted to nitrites. Reaction in acid medium of  $\text{H}_3\text{PO}_4$  with a solution of sulfanilamide and N-(1-naphthyl)ethylene diamine dihydrochloride (NEDA) follows to form a red colour. The intensity of the colour is measured spectrophotometrically at 560 nm.

Use:  $\text{NO}_x$ ,  $\text{NO}_2$  at manual stations

#### Mass spectrometry with inductively coupled plasma

High-volume sampling on glass-fibre filters, mineralization, ICP-MS (mass spectrometry) analysis.

Use: SPM at manual stations, Black Triangle

#### Chemiluminescence

Nitrogen molecule excitation by ozone. With the conversion of the molecule into the basic energetic level, release of radiation as chemiluminescence occurs. This radiation is detected by a photomultiplier.

Use:  $\text{NO}$ ,  $\text{NO}_2$ ,  $\text{NO}_x$

#### Ion chromatography

The air is drawn through a filter to capture sulphate particles and then through another filter impregnated with sodium hydroxide to determine sulphur dioxide. The exposed filters are leached out using deionized water with peroxide and the sulphate ion is determined by ion chromatography.

Use: sulphates,  $\text{SO}_2$  at manual stations

### **IR-correlation absorption spectrometry**

The radiation from an infra-red source passes through two parallel cells, one of which contains a non-absorbing background gas, the other contains the analyzed flowing sample of ambient air. The difference in energy between the sample and the reference cell is proportional to the carbon monoxide concentration.

*Use: CO at AIM stations*

### **Low-temperature gas atomic fluorescence**

Mercury vapour is captured in the block with ultra-clean golden absorbent in the form of amalgam from which mercury is released by heating and decoded.

*Use: Hg at AIM stations*

### **Optoelectronic method**

The wind direction and velocity are measured using a wind vane and an anemometer. The position of the vane is taken optoelectronically or transferred to electrical voltage using a circular potentiometer. The rotation speed of the anemometer sensor is measured optoelectronically or transferred to electrical voltage using a tachodynamo.

*Use: wind direction and velocity at AIM stations*

### **Tapered element oscillating microbalance**

It measures the mass of the sample captured on a replaceable filter according to the oscillating tapered element frequency variation. The air sample passes through a filter where the dust particles are captured and runs through a hollow tapered element to a vacuum pump with an electronic flow control.

*Use: PM<sub>10</sub> at AIM HS stations*

### **Passive sampler**

The sampling method – the measured air pollutant is captured at the medium (usually impregnated filter or a tube with sorbent) by passive diffusion. After the capture the pollutant reacts with the impregnation agent, or the pollutant is bound with sorbent.

The captured pollutant is extracted or released from the sorbent and its concentration is determined by appropriate analysis.

Based on the detected concentration and the length of exposure the average pollutant concentration in the monitored area for the period of exposure is calculated using the experimentally set coefficients.

The exposure time is usually 1–2 weeks.

*Use: screening measurements for first assessment of air pollution levels in the given area.*

### **Gas chromatography – photo-ionization detection**

Continual measurement of aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylenes) by BTX analyzers Chrompac and gas chromatography method. It is a case of standard linkage to a sampling probe in a container. The method is based on photoionization detection.

*Use: Ústí n. L., Praha-Libuš, Pardubice-Rosice*

### **Gas chromatography – flame-ionization detection**

Continual measurement of aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylenes) by BTX analyzers Syntech and gas chromatography method. It is a case of standard linkage to a sampling probe in a container.

Ionization of organic substances in flame (hydrogen- air), increase of ion current proportional to the concentration of the measured substances at constant gas flow.

*Konkrétní použití: Praha-Libuš, Praha-Strahovský tunel, Rudolice, Mikulov-Sedlec, Most, Ostrava-Přívov.*

### **Gas chromatography**

Persistent organic pollutants (POPs) are captured on glass-fibre and polyurethan filters using high-volume pump sampling. Exposed filters are eluted with dichlormethane. After purification and preconcentration the selected POPs are measured by gas chromatography with mass detection.

*Use: CHMI- MS Košetice, HS stations*

### **Gas chromatography**

Volatile organic compounds (VOCs) are determined by gas chromatography. Air samples taken in special vacuum steel canisters on Monday and Thursday of each week at 12:00 UTC for a period of 10 minutes (CHMI). At Public Health Service's stations the 24-hour samples are taken every 6th day during the heating period (November–March) and every 12<sup>th</sup> day in the non-heating period (April–October). Samples from transportation canisters are modified by cryogenic concentration prior to the GCH analysis.

*Use: CHMI and HS stations*

**Polarography**

Sampling on membrane filter, acid decomposition, differential pulse polarography DPPAFW.

*Use: HM at HS stations up to 1991–93*

**Potentiometry**

Potentiometric titration to equiv. point pH 4.5

*Use: SO<sub>2</sub> at ORGREZ stations*

**Radiometry – absorption of beta radiation**

It stands on beta-ray absorption in a sample captured on filtering material. The difference between the beta-ray absorption of the exposed and non-exposed filtering material, which is proportional to the mass of the captured suspended particulate matter, gives the information on its concentration.

*Use: SPM, PM<sub>10</sub> at AIM stations*

**X-ray fluorescence**

Non-destructive analysis with sampling on teflon filter exposed to X-rays.

*Use: metals and sulphates in SPM*

**Spectrophotometry with TCM and fuchsin – West-Gaeke**

The sulphur dioxide is absorbed into a sodium tetrachloromercury solution (TCM) containing Chelaton III. The compound formed reacts with fuchsin and formaldehyde in acid medium to yield a red-purple colour, which is measured spectrophotometrically at 586 nm.

*Use: SO<sub>2</sub> at manual stations*

**Temperature difference method**

Energy of solar radiation (GLRD) is measured in W.m<sup>-2</sup> using temperature difference method. The temperature difference of black and white coloured segments of sensor surface with different reflection to short-wave solar radiation is measured.

**Triethanolamine spectrophotometry**

After oxidation NO<sub>2</sub> is absorbed into the solution of thiethanolamine with sulfanilic acid in acid medium of H<sub>3</sub>PO<sub>4</sub> using NEDA. The intensity of the colour is measured spectrophotometrically at 540 nm.

*Use: NO<sub>x</sub> at manual HS stations*

**Ultrasonic anemometer**

Comparison of the times taken for an ultrasonic puls to travel between ultrasonic transducers.

**UV absorption**

The method rests upon absorption of radiation with the wavelength of 254 nm by ozone in the analyzed sample. The radiation source is an UV-lamp and clean air (zero) and the sample itself are alternately measured in cell.

*Use: ozone at AIM stations*

**UV fluorescence**

The analysed sample is exposed to UV-lamp irradiation with energetic excitation of SO<sub>2</sub> molecule. With the backward conversion of the molecule into the basic energetic level, energy as fluorescing radiation is released. This radiation is proportional to the sulphur dioxide concentration and is detected by a photomultiplier.

*Use: SO<sub>2</sub>, H<sub>2</sub>S at AIM stations*

**High performance liquid chromatography****Gas chromatography – mass detection (for PAH)**

Samples are captured on a filter and further adsorbing material for PAH in gaseous phase. The samples are processed in a chemical laboratory and analyzed by the HPLC method or GCH-MS method.

### 1.1.5 Overview of methods of analysis in the CHMI precipitation network

Observed components in precipitation	Sampling period	Sampling type	Analytical methods in laboratory
amount of precipitation	daily	rain gauge	
conductivity	weekly	wet-only	conductometry
pH	weekly	wet-only	pH meter
F <sup>-</sup>	weekly	wet-only	ion chromatography
Cl <sup>-</sup>	weekly	wet-only	ion chromatography
SO <sub>4</sub> <sup>2-</sup>	weekly	wet-only	ion chromatography
NO <sub>3</sub> <sup>-</sup>	weekly	wet-only	ion chromatography
Na <sup>+</sup>	weekly	wet-only	flame atomic absorption spectrometry
Mg <sup>2+</sup>	weekly	wet-only	flame atomic absorption spectrometry
Ca <sup>2+</sup>	weekly	wet-only	flame atomic absorption spectrometry
K <sup>+</sup>	weekly	wet-only	flame atomic absorption spectrometry
NH <sub>4</sub> <sup>+</sup>	weekly	wet-only	spectrophotometry using indophenol blue
Zn, Fe	weekly	bulk	flame atomic absorption spectrometry
Cd, Pb, Ni, Mn	weekly	bulk	graphite furnace atomic absorption spectrometry

**Notes:**

At the station in Košetice monthly bulk samples are also collected as well as monthly throughfall samples using the same analytical methods. In addition, daily wet-only samples are also collected there using the analysis of commonly determined ions incl. the analysis of POPs-PCB and POPs-PAH.

Wet-only sampling is realized by automatic collectors supplied by Eigenbrodt Co.

Collectors for bulk sampling were provided from NILU (Norwegian Institute for Air Research).

The detailed description of sampling methods and analysis methods is presented in "The methodology of measuring basic pollutants in the ambient air" (Prague, 1977).

### 1.2 Database of the annual processing and Air Quality Information System

The periodically published Tabular Survey is a result of the statistical processing of air pollution data systematically stored over the calendar year in the air pollution database from all significant networks monitoring air pollution in the country. From the introductory tables it is apparent from how many monitoring stations data were stored and processed in 2004.

Since 1992, the current information technology has been utilized to prepare and further develop the Air Quality Information System (ISKO). The restructured Air Pollution Information System (IIS) has become its integral component, along with other information sources for evaluating air quality.

Since the establishment of the ISKO system there have been a lot of changes in data collecting and publishing and the requirements to extend the utility function of the database system have increased. The new data model ISKO2 project was developed and implemented in 2003 under RDBMS Oracle. ISKO2 meets the growing demands on data presentation in various forms incl. internet publication. The new model enables much larger possibilities of data storage, verification, export and further processing. This applies also to metadata, i.e. data about localities and measuring programmes used in these localities. ISKO2 provides the strong, constantly developing software support facilitating the activities connected with the measured data and metadata processing and presentation.

The Air Quality Information System ISKO collects and generally provides access to data gathered within significant air pollution monitoring networks. It thus allows more effective general utilization of this expensive data. The integrated regionalised evaluation of air pollution levels, and analysis of the development over time of the status of air pollution in this country would not be feasible without collecting and archiving systematically at one place all the air pollution data available. The continuous need to make this assessment objective also necessitates simultaneous accessibility of emission, meteorological and climatic data and geographic information on the locations of pollution sources, the extent and location of forest growth, residential areas, roadways and similar information.

Fig. 1 schematically depicts ISKO's links to data sources and co-operating systems. The scheme outlines the interconnection of air quality monitoring networks and sources of data on emissions with data processing and information layers represented by ISKO, and the linkage to a higher-level layer – "cross-sectional" information systems.

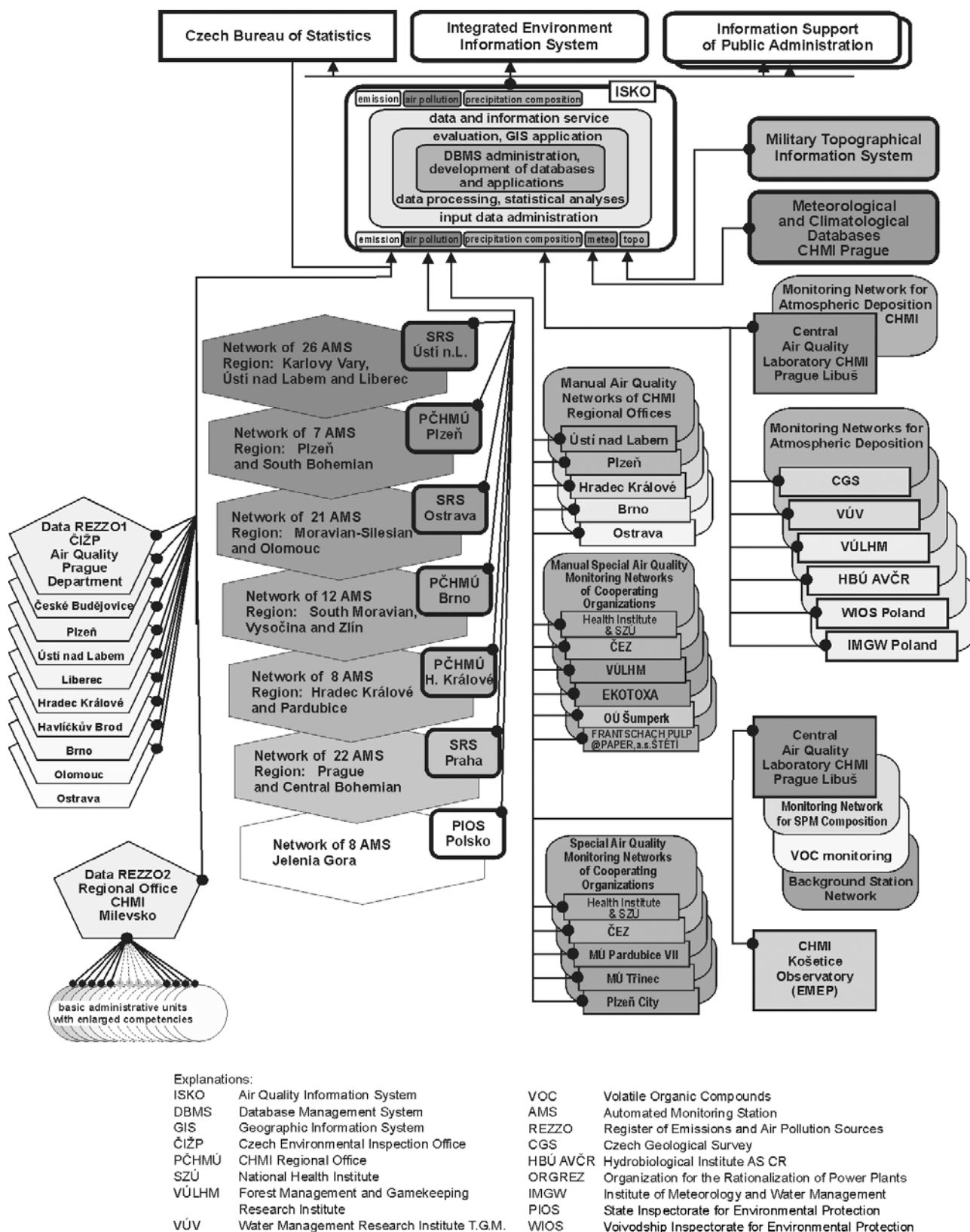


Fig. 1 Scheme of ISKO's links to data sources and cooperating systems in 2004

### 1.2.1 Computer system

Starting from 1993, both the Tabular Survey and the Graphic Yearbook were completely prepared using a computer system with the SUN database server with the installed Ingres multi-user relative database system under the SOLARIS operating system. In 2003 there was a change to RDBMS Oracle. The data core of the information system is implemented under RDBMS with predominant utilization of client-server architecture. The concept of the system is based on distributed processing in the local network at working stations and personal computers with direct access of processing and analytical programmes, such as the ARC/INFO and ArcGIS geographical information systems, the statistical programmes SPSS, Systat, tabular and graphical programmes, to the data in the central database on the SUN server with features of uninterrupted and backed-up operation.

The Czech Hydrometeorological Institute has its regional offices in all the former regional capitals, which are mainly concerned with measurements, data collection and initial processing within their respective regions, including the laboratory analysis. The offices are connected to the central system in Prague via CHMI's packet private data network, and recently via the new virtual private network (VPN).

### 1.2.2 Air pollution assessment

In 2002 a new Clean Air Act No. 86/2002 Coll. on air quality protection and amendment of some other acts and the Government Order No. 350/2002 Coll. setting forth limit values and procedures of monitoring, assessment, evaluation and management of air quality came into force. The new legislation fully reflects the requirements of the European Union. The following tables show the limit values and margins of tolerance set by the Government Order No. 350/2002 Coll.

**The limit values for the protection of human health, ecosystems and vegetation pursuant to the Government Order No. 350/2002 Coll., setting forth limit values and procedures of monitoring, assessment, evaluation and management of air quality**

#### *Limit values for health protection*

Pollutant	Averaging interval	Limit value	Margin of tolerance <sup>1)</sup> for the year 2004	Maximum tolerated number of exceedences per calendar years
SO <sub>2</sub>	calendar year	50 µg.m <sup>-3</sup>	–	0
	24 hours	125 µg.m <sup>-3</sup>	–	3
	1 hour	350 µg.m <sup>-3</sup>	30 µg.m <sup>-3</sup>	24
NO <sub>2</sub>	calendar year	40 µg.m <sup>-3</sup>	12 µg.m <sup>-3</sup>	0
	1 hour	200 µg.m <sup>-3</sup>	60 µg.m <sup>-3</sup>	18
PM <sub>10</sub>	calendar year	40 µg.m <sup>-3</sup>	1.6 µg.m <sup>-3</sup>	0
	24 hours	50 µg.m <sup>-3</sup>	5 µg.m <sup>-3</sup>	35
CO	max. daily 8-h running average	10 000 µg.m <sup>-3</sup>	1700 µg.m <sup>-3</sup>	0
benzene	calendar year	5 µg.m <sup>-3</sup>	3.75 µg.m <sup>-3</sup>	0
O <sub>3</sub>	max. daily 8-h running average	120 µg.m <sup>-3</sup>	–	25, 3-year average
Pb	calendar year	0.5 µg.m <sup>-3</sup>	0.1 µg.m <sup>-3</sup>	0
Cd	calendar year	0.005 µg.m <sup>-3</sup>	0.001 µg.m <sup>-3</sup>	0
NH <sub>3</sub>	24 hours	100 µg.m <sup>-3</sup>	20 µg.m <sup>-3</sup>	0
As	calendar year	0.006 µg.m <sup>-3</sup>	0.0045 µg.m <sup>-3</sup>	0
Ni	calendar year	0.02 µg.m <sup>-3</sup>	0.012 µg.m <sup>-3</sup>	0
Hg	calendar year	0.05 µg.m <sup>-3</sup>	–	0
Benzo(a)pyrene	calendar year	0.001 µg.m <sup>-3</sup>	0.006 µg.m <sup>-3</sup>	0
Dust fallout – deposition limit value	month	12.5 g.m <sup>-2</sup>	–	0

<sup>1)</sup> The margin of tolerance is the per cent of air pollution limit or a part of its absolute value, by which the limit value may be exceeded. This value is reduced regularly in subsequent years until it reaches zero value.

### *Limit values for the protection of ecosystems and vegetation*

Pollutant	Averaging interval	Limit value	Margin of tolerance <sup>1)</sup>	Maximum tolerated number of exceedences per calendar year
SO <sub>2</sub>	Calendar year and winter period (1.10. – 31.3.)	20 µg.m <sup>-3</sup>	–	0
NO <sub>x</sub>	Calendar year	30 µg.m <sup>-3</sup>	–	0
O <sub>3</sub>	AOT40 <sup>2)</sup> calculated from 1h values between May and July, 5-year average	18 000 µg.m <sup>-3</sup> .h	–	0

<sup>1)</sup> The margin of tolerance is the per cent of air pollution limit or a part of its absolute value, by which the limit value may be exceeded. This value is reduced regularly in subsequent years until it reaches zero value.

<sup>2)</sup> AOT40 is the sum of differences between hourly concentrations higher than the threshold concentration 80 µg.m<sup>-3</sup> (40 ppb) and the value 80 µg.m<sup>-3</sup>, in the period from 8 a.m. to 8 p.m. CET

## **1.3 Commentary on the contents of the tables**

### **1.3.1 Survey of the station networks**

As mentioned in the Preface, the yearbook gives a very extensive survey of the air pollution data for the Czech Republic. It includes the measuring results collected by several organizations. The tabular part begins with the summary table giving the numbers of localities from which data were actually received, based on the individual regions and on the owners. The next tables show: the numbers of localities measuring basic pollutants and supplementary quantities at AMS and AMS-SRS stations, based on the regions and the owner; the numbers of localities measuring basic pollutants and supplementary quantities by manual and semiautomatic methods, based on the regions and the owner; the total number of localities with special measurements, based on the owner giving the types and numbers of stations in individual regions, based on the owner and the type of the measured quantity. These surveys include the localities (measuring sites) on the territory of the Czech Republic from which the measured data were supplied to ISKO in 2004.

#### **1.3.1.1 Survey of localities and measuring programmes**

The survey contains all localities and air pollution measuring programmes registered in the ISKO database with at least one registered measurement in the year 2004. Each locality is supplemented by the list of measuring programmes registered in ISKO and their characteristic (name, code, classification, type and registered measurement). The overview of localities is ordered by regions, districts and names of localities.

The maps of the regions of the Czech Republic are presented showing the localities and measuring programmes with the respective codes and the old ISKO numbers.

Finally, the list of stations of the precipitation and atmospheric deposition networks and their localities are presented.

#### **1.3.1.2 Types of measuring programmes**

Owing to the transition to the new ISKO2 model there are some modifications as concerns the terminology of the types of the stations used earlier to correspond with the state of the art. ISKO2 defines the locality (measuring site). Each locality operates one or more measuring programmes. The list of measuring programmes used in 2004 is given in the following table.

Code of measuring programme	Measuring programme	Type of measurement	Interval of sample collection	Analogue values collection and treatment
M	manual	manual	≥ 24 hours	all manual, processing in laboratory
A	automated	continuous	10 min., 30 min., 1h, 3 h (0.5–3 h)	automatic collection and processing in measuring site
K	combined	manual and semiautomatic	≤ 3 hours	processing out of measuring site
P	PAHs	manual	≥ 24 hours	all manual, treated in laboratory
T	heavy metals in SPM	manual	≥ 24 hours	all manual, treated in laboratory



Code of measuring programme	Measuring programme	Type of measurement	Interval of sample collection	Analogue values collection and treatment
0	heavy metals in PM <sub>10</sub>	manual	≥ 24 hours	all manual, treated in laboratory
5	heavy metals in PM <sub>2.5</sub>	manual	≥ 24 hours	all manual, treated in laboratory
V	VOC	manual	≥ 24 hours	all manual, treated in laboratory
D	PD – passive samplers	manual	≥ 7 days	all manual, treated in laboratory

### 1.3.1.3 Codes of localities and measuring programmes

Since 2003 the localities have been defined by a four-letter code as follows:

letter 1: abbreviation for the region;

letters 2–4: abbreviation for the measuring site (locality)

The code of the measuring programme is formed by a five-letter code. The first four letters define the locality and the fifth one is the code of the measuring programme (see 1.3.1.2).

### 1.3.1.4 Classification of air pollution stations

Classification of air pollution monitoring stations for the year 2004 is presented in tabular surveys – *Stations and air quality measurement methods registered in IIS-Air Quality Information System and Summary overviews of air pollution standard exceedences and max. values at stations of the Czech Republic in 2004*.

**This classification for the purpose of exchange of information (EoI)** was presented for the first time in **Council Decision 97/101/EC** and is obligatory for the EU Member States.

As the above Decision is the only document bringing the official European classification it has been applied to all localities in the Czech Republic registered in the ISKO database. The application is described in Sládeček, J., Blažek, Z. (2000): Application of criteria for the classification of stations and station networks pursuant to the EoI Decision 97/101/EC and Criteria for EUROAIRNET to the stations included in the air quality assessment process. The Report on the task DU01-1.E1 of the R&D Project VaV/740/2/00, CHMI, Prague.

The EoI classification was simplified by the Decision of the European Commission 2001/752/EC. The character of the location of some monitoring stations in the Czech Republic, however, corresponds rather with the classification in the original version of 1997 and thus it continues to be used in the ISKO database.

The complete EoI classification (97/101/EC) consisting of 3 fundamental letters divided by strokes is presented only in those stations at which it was officially affirmed by an expert team in accordance with local criteria. In some cases incomplete classification is presented (1–2 letters only) derived from the purpose of the station establishment.

The third column of the table shows only the examples of the combinations of zone characterisation. Any logical combination is possible and the order of letters in the abbreviation is meaningful – the first position is of the highest priority.

### Exchange of Information (EoI) site classes

Type of locality		Type of zone (area)		Characterisation of zone (area)	
Traffic	(T)	Urban	(U)	Residential	(R)
Industrial	(I)	Suburban	(S)	Commercial	(C)
Background	(B)	Rural	(R)	Industrial	(I)
				Agricultural	(A)
				Natural	(N)
				Residential/Commercial	(RC)
				Commercial/Industrial	(CI)
				Industrial/Residential	(IR)
				Residential/Commercial/Industrial	(RCI)
				Agricultural/Natural	(AN)

Source:

Council Decision 97/101/EC of 27 January 1997 establishing a reciprocal exchange of information and data from networks and individual stations measuring ambient air pollution within the Member States. Official Journal of the European Communities, No. L 35/14. EC, 1997.

Larsen, S. et al. (1999) Criteria for EUROAIRNET. The EEA Air Quality Monitoring and Information Network. Technical Report no. 12. EEA, Copenhagen.

Subcategories B/R (2001/752/EC, Criteria for EUROAIRNET, Technical Report no. 12, EEA):

**near-city, code NCI**, located in rural/agricultural areas, with a distance of 3–10 km from built-up areas and other major sources, radius larger than about 5 km.

**regional, code REG**, located in rural/agricultural areas, with a distance of 10–50 km from built-up areas and other major sources, radius larger than about 20 km.

**remote, code REM**, located in rural/natural areas, with a minimum distance of 50 km to built-up areas and other major sources, radius larger than about 60 km.

### 1.3.2 Tabular part of air pollution characteristics

In the part *Summary overviews of limit values exceedences according to the Government Order No. 350/2002 Coll. and maximum values of air pollution characteristics at localities of the Czech Republic in 2004* stations and values for those pollutants whose limit values are set by the above Government Order are presented. The stations at which the limit values including the margin of tolerance were exceeded have dark grey background and the data are printed in bold type. Stations at which the limit values were exceeded have light grey background.

**Other tabular overviews incl. the detailed tabular overview of daily averages at the stations are presented on the attached CD in html format.**

For individual pollutants, the stations are presented according to the regions, districts and further according to the organization in the order: CHMI, Health Institutes, ČEZ Inc., VÚLHM, EKOTOXA, District Authority in Šumperk, Třinec Municipal Authority, Plzeň City, Pardubice Municipal Authority and FRANTSCHACH PULP@PAPER, a.s. Štětí. Stations in the same organization are ordered alphabetically.

The automated station networks of the Saxony Region in Germany and of south-west border region of Poland are included. These stations are presented always in the end of individual tabular sets. Data from Saxony monitoring networks haven't given to processing in the Tabular Survey for the year 2004.

The Tabular Survey presents air pollution characteristics for those pollutants whose air pollution limit values are set in the Government Order No. 350/2002 Coll., in the tables *Hourly, daily, quarterly and annual air pollution characteristics* with the assessment for the year 2004. Other pollutants are presented in the form of tables *Monthly and annual average concentrations and supplementary air pollution characteristics*. The headings of most tables show air pollution limit values for the selected pollutants. The CD contains also the detailed tabular overview of daily averages at the stations.

The monthly and annual air pollution characteristics are calculated from the daily data.

The tabular overviews present the values of air pollution characteristics in accordance with the Government Order No. 350/2002 Coll. for the individual pollutants for individual measurements requested by the above Government Order [25th highest hourly (25MV) and 4th highest 24-h (4MV) SO<sub>2</sub> concentration, 36th highest 24-hour PM<sub>10</sub> concentration, 19th highest hourly (19MV) NO<sub>2</sub> concentration and maximum daily 8-h running average of ozone and CO] with the respective dates of their occurrence. In accordance with the above Government Order requirements also AOT40 for ozone is presented. Further, numbers of exceedences of the given air pollution limit values (VoL) and numbers of exceedences of air pollution limit values including the margin of tolerance (VoM) are given. Quarterly arithmetic means are given instead of monthly means, as well as the number of values from which they are calculated (X1q, C1q, ...).

The overview of heavy metals is also presented for which air pollution limit values are set by the Government Order No. 350/2002 Coll. The table of monthly concentrations was updated: quarterly arithmetic averages and annual characteristics were added.

In the previous type of tables, for each measurement the monthly arithmetic average and the monthly frequency (X<sub>m</sub>, mc) are given in two subsequent lines. Further, the daily maximum for the year and the date of occurrence (MAX. DAT), 95th percentile (95%kv), 50th percentile (50%kv), and 98th percentile (98%kv), or 90th percentile (90%kv) are given as well as the annual arithmetic average and standard deviation (X, S), annual geometric average and standard geometric deviation (XG, SG), number of measurements in the year and the length of the longest continuous shut-down (N, dv).

The table *Heavy metals in suspended particulate matter* gives the average monthly heavy metals concentrations in SPM for the specialized station network of CHMI, HS and ČEZ Inc.

Since 1994 the table presenting measured concentrations of VOCs at CHMI stations has been included. This measurement is carried out within the EMEP programme. Since the year 2000 this set of tables has included also VOC measurements at ZÚ stations carried out within the project MZSO (Population Health State Monitoring) with regard to ambient air. In both cases the samples are collected manually into canisters.

Since 1997 continual measurement of aromatic hydrocarbons has become part of the Tabular Survey. The measurement of persistent organic pollutants (POPs), presented in two tabular sets, have been included since 1997 as well. Polyaromatic hydrocarbons (PAHs) are included in the first set and polychlorinated biphenyls (PCBs) in the second set.

### 1.3.2.1 Principles of data presentation and validity of air pollution characteristics

The measured data are given in this Tabular Survey if the relative share of primary data per year is greater than 16 %. The calculated air pollution characteristics could be presented and regarded as valid if they fulfil the conditions given in the following tables. There are two types of measurement: continuous and indicative.

#### Continuous measurement

In intervals longer than one day recalculation is done for individual days and then the evaluation of validity of the calculated characteristics is carried out according to the conditions presented in the following table.

Data input interval	Calculated characteristic	The longest continuous shut-down	Minimum number of data
30 mins	1 hrs	0	2
30 mins	8 hrs	6	11
30 mins	1 days	8	32
30 mins	1 yrs	1927	11563
1 hrs	8 hrs	2	5
1 hrs	1 days	4	16
1 hrs	1 yrs	964	5782
1 days	1 mos	5	20
1 days	3 mos	10	60
1 days	1 yrs	40	240
7 days	1 mos	7	20
7 days	3 mos	14	60
7 days	1 yrs	42	240
14 days	1 mos	10	20
14 days	3 mos	14	60
14 days	1 yrs	42	240
1 mos	3 mos	0	90
1 mos	1 yrs	40	240

**Indicative measurement**

For presentation and validity assessment of the calculated characteristics the indicative measurement is theoretically converted to continuous measurement by re-calculating according to the interval of the sampling length to the time span of the sampling frequency (re-calculated to the surroundings). Then the validity assessment of the calculated characteristics is carried out according to the conditions presented in the following table.

<i>Data input interval (sampling length/frequency)</i>	<i>Calculated characteristic</i>	<i>The longest re-calculated continuous shut-down</i>	<i>Minimum re-calculated number of data</i>
10min/4d	1 mos	576	3312
10min/4d	3 mos	1728	9936
10min/4d	1 yrs	6912	39744
1d/2d	1 mos	6	18
1d/2d	3 mos	12	60
1d/2d	1 yrs	42	246
1d/3d	1 mos	5	18
1d/3d	3 mos	11	60
1d/3d	1 yrs	41	246
1d/4d	1 mos	5	18
1d/4d	3 mos	11	60
1d/4d	1 yrs	41	246
1d/5d	1 mos	5	20
1d/5d	3 mos	14	60
1d/5d	1 yrs	39	250
1d/6d	1 mos	6	24
1d/6d	3 mos	11	60
1d/6d	1 yrs	41	252
1d/7d	1 mos	6	24
1d/7d	3 mos	11	60
1d/7d	1 yrs	41	252
7d/1m	1 mos	7	21
7d/1m	3 mos	13	63
7d/1m	1 yrs	41	252
7d/3m	1 mos	23	7
7d/3m	3 mos	85	7
7d/3m	1 yrs	85	28
14d/1m	1 mos	10	20
14d/1m	3 mos	14	60
14d/1m	1 yrs	42	240
14d/3m	1 mos	10	20
14d/3m	3 mos	14	60
14d/3m	1 yrs	42	240

### 1.3.2.2 Differentiation of types of letters

**Bold** – exceedence of air pollution limits LV+ MT (the condition of the tolerated number TE of exceedences needn't be fulfilled) assuming that the data fulfil the requirements for validity of data for calculation of the annual air pollution characteristics.

**Dark grey background** – exceedence of air pollution limits LV+MT incl. the condition of the tolerated number TE of exceedences assuming that the data fulfil the requirements for validity of data for calculation of the annual air pollution characteristics.

**Light grey background** – exceedence of air pollution limits LV incl. the condition of the tolerated number TE of exceedences assuming that the data fulfil the requirements for validity of data for calculation of the annual air pollution characteristics.

### 1.3.3 Data on precipitation quality and wet deposition

The Tabular Survey also gives the chemical composition of precipitation and atmospheric deposition. The localities for which data are given for 2004 are depicted on the map; the following table gives more detailed information on stations (altitude, sampling methods and organizations). The stations are ordered alphabetically according to regions and districts, included are stations operated by CHMI, ČGS, VÚV TGM, VÚLHM and HBÚ AV ČR.

Data on chemical composition of atmospheric precipitation are given in the tables as separate daily, weekly and monthly analyses. One-week interval complies with the international EMEP's methodology (Tuesday – Tuesday sampling). For the measuring programmes with one-week sampling interval monthly concentrations are also presented.

The Tabular Survey of precipitation quality and wet deposition monitoring contains also the tables presenting the annual average concentrations weighted by rain amounts and the annual wet depositions given for individual stations and measured parameters. While calculating the monthly [annual] concentrations (depositions) the average concentration for the week covering the end and start of the two months [years] is weighted by daily precipitation. For instance, at the turn of the years 2003/2004 the concentration from the week between 30.12.2003 and 5.1.2004 is first multiplied by precipitation from 30. and 31.12.2003. This deposition is then added to December 2003 and, consequently, to the year 2003. The same concentration is then multiplied by the total precipitation for 1.–5.1. 2004. This result deposition is added to the deposition for January 2004 and, consequently, to the year 2004.

The measured quantities are designated in the tables by the common chemical nomenclature symbols, *cond* is the measured sample conductivity and *rain* denotes the total precipitation measured by the standard method directly at the sampling site or at a station that can be meteorologically considered to be representative for the given site.

### 1.3.4 Surveys of supplementary meteorological data

The Tabular Survey is completed by two tables containing meteorological data measured on air pollution stations. These data are used to determine conditions of transportation, dispersion and chemical transformations of pollutants in the air and they facilitate to relate the interpretation of air pollution measurement to meteorological conditions. These meteorological data do not substitute data from specialized meteorological and climatological CHMI's networks and in comparison with them they can be considered only as supplementary data. The table *Total wind rose* presents measurements of wind directions and velocities measured at 10 m height above terrain. Wind roses are given in % for eight main wind directions, calm and five classes of wind velocity. The intervals applied for wind velocity reflect the classification used in methodology of air pollution modelling.

#### Definition of wind velocity classes

Wind velocity class	Interval [m.s <sup>-1</sup> ]	Class-velocity [m.s <sup>-1</sup> ]
3"light breeze	from 0 to 2.5	1.7
4"gentle breeze	from 2.5 to 7.5	5.0
5"strong breeze	above 7.5	11.0

The second supplementary table presents the global radiation energy in W.m<sup>-2</sup>. There are monthly and annual average values and additional characteristics.

### 1.4.1 Assurance of the quality of the measured data

The quality assurance of air pollution measurements by means of automated methods and their calibration, the manual methods of air pollution, aerosols and precipitation monitoring and the subsequent quality control of the obtained data are in charge of the Central air pollution laboratories, CHMI Prague and laboratories in regional offices in Brno, Hradec Králové, Ostrava and Ústí nad Labem. The quality of the measured data is assured at all levels.

For continuous measurements within the AIM network analysers of gaseous pollutants (SO<sub>2</sub>, NO<sub>x</sub>, CO, O<sub>3</sub>) are used. They are equipped with the zero-span check system carried out in a 23-h interval (72-hour interval at the stations without diluting systems). Twice a year the analysers are checked by five-point calibration using portable calibrator

HORIBA ASGU 364 calibrated in the calibration laboratory which has been accredited for air pollution measurements and has a role of a reference centre on air pollution monitoring.

Manual sampling methods for air pollution measurements, aerosol composition monitoring and precipitation quality are controlled by parallel sampling at selected sites and with the use of blank samples. The quality assurance and control of the activity of chemical laboratories is carried out according to the requirements for trace and ultra-trace chemical determination.

Central Air Pollution Laboratory (CLI) Prague participates regularly in international interlaboratory tests organized by World meteorological organization (WMO/GAW). The activity of CHMI laboratories is regularly controlled in international interlaboratory tests within European monitoring network EMEP. CLI are involved in international programmes and research projects. The central CHMI laboratories also perform regular interlaboratory tests (SO<sub>2</sub> for West-Gaeke method) both for the laboratories of CHMI regional offices and for other cooperating organizations.

The accuracy of laboratory determinations is controlled regularly by the analysis of the certified reference materials. The precision of laboratory determinations is evaluated by repeated analyses of the same sample. The relative uncertainty of determination covers the accuracy and precision of laboratory determination. The presented uncertainties are expanded uncertainties (expansion coefficient k=2). Due to the fact that concentrations of many analytes range close to the margin of detection the users should accept that the presented uncertainties of measurements are relatively high. The detailed description of uncertainty calculation is given in the standard operating procedure (SOP) for each method and the respective sampling of the monitored pollutant.

The ISKO database includes also data from other special-purpose monitoring networks operated by further cooperating organizations (ČGS, VÚLHM, VÚV and HBÚ AV ČR).

#### Detection limit values and uncertainty – manual air pollution measurement methods

ethod	Uncertainty	Margin of detection [ $\mu\text{g}\cdot\text{m}^{-3}$ ]	Calibration range [ $\text{mg}\cdot\text{l}^{-1}$ ]
	Relative Expanded [%]		
SO <sub>2</sub> (West-Gaeke method)	10	3	3
SO <sub>2</sub> (IC jako/as SO <sub>4</sub> <sup>2-</sup> )	8	0.07	50
HNO <sub>3</sub> , NO <sub>3</sub> <sup>-</sup> (IC jako/as $\sum$ NO <sub>3</sub> <sup>-</sup> )	11	0.025	30
NO <sub>x</sub>	23 / 46	1.1	3
NH <sub>3</sub> , NH <sub>4</sub> <sup>+</sup> (SFA jako/as $\sum$ NH <sub>4</sub> <sup>+</sup> )	4	0.028	3
PM <sub>10</sub>	8	5	

#### Detection limit values and uncertainty – automatic air pollution measurement methods

Pollutant	Margin of detection [ $\mu\text{g}\cdot\text{m}^{-3}$ ]	Standard uncertainty	
		abs. [ $\mu\text{g}\cdot\text{m}^{-3}$ ]	rel. [%]
SO <sub>2</sub> TEI-43 A,B,C (UV fluorescence)	2.5	2.5	8
SO <sub>2</sub> TEI-43 S (UV fluorescence)	0.5	0.5	
NO TEI-42 A,C (chemiluminescence)	1.5	1.5	8
NO TEI-42 S (chemiluminescence)	0.2	0.2	
NO ESA-AC32M (chemiluminescence)	0.5	0.5	
NO <sub>2</sub> TEI-42AC (chemiluminescence)	2	2	10
NO <sub>2</sub> TEI-42 S (chemiluminescence)	0.4	0.4	
NO <sub>2</sub> ESA-AC32M (chemiluminescence)	1	1	
NO <sub>x</sub> TEI-42 A,C (chemiluminescence)	2	2	10
NO <sub>x</sub> TEI-42 S (chemiluminescence)	0.4	0.4	

Pollutant	Margin of detection [ $\mu\text{g}\cdot\text{m}^{-3}$ ]	Standard uncertainty	
		abs. [ $\mu\text{g}\cdot\text{m}^{-3}$ ]	rel. [%]
NO <sub>x</sub> ESA-AC32M (chemiluminescence)	1	1	
CO TEI-48A,C,S (IR correlation spectrometry)	120	120	8
O <sub>3</sub> TEI-49 A,C (V absorption photometry)	2	2	8
PM <sub>10</sub> FH62IR (radiometry)	2		20
PM <sub>10</sub> ESA-MP101M (radiometry)	0.5		
BTX Chrompack, Syntech, ESA-VOC71 (gas chromatography)	0.2		20

The given deviations are provisional. The values will be further specified.

#### Detection limit values and uncertainty – dust fallout and trace elements in the air

Method	UNCERTAINTIES		Margin of detection [ $\mu\text{g}\cdot\text{m}^{-3}$ ]	Calibration range up to [ $\mu\text{g}\cdot\text{cm}^{-2}$ ]
	Standard Expanded [ $\mu\text{g}\cdot\text{m}^{-3}$ ]	Relative Expanded [%]		
PM <sub>10</sub>	2.9	8.0	5.0	

Method	UNCERTAINTIES		Margin of detection [ $\text{ng}\cdot\text{m}^{-3}$ ]	Calibration range up to [ $\mu\text{g}\cdot\text{l}^{-1}$ ]
	Relative Expanded [%]			
As (ICP-MS)	20		0.020	40
Cd (ICP-MS)	20		0.005	20
Pb (ICP-MS)	6		0.010	200
Mn (ICP-MS)	20		0.015	200
Ni (ICP-MS)	46		0.01	30
Cu (ICP-MS)	10		0.04	200

**Detection limit values and uncertainty – precipitation quality monitoring**

Method	UNCERTAINTIES	Margin of detection	Calibration range up to
	Standard Expanded		
pH	0.2	0.01	3–8

Method	UNCERTAINTIES	Margin of detection [ $\mu\text{S}\cdot\text{cm}^{-1}$ ]	Calibration range up to [ $\mu\text{S}\cdot\text{cm}^{-1}$ ]
	Relative Expanded [%]		
conductivity	3.6	0.3	1.4–12 880

Method	UNCERTAINTIES	Margin of detection [ $\mu\text{g}\cdot\text{l}^{-1}$ ]	Calibration range up to [ $\text{mg}\cdot\text{l}^{-1}$ ]
	Relative Expanded [%]		
F <sup>-</sup> (IC)	16		
Cl <sup>-</sup> (IC)	6.4	18	25
NO <sub>3</sub> <sup>-</sup> (IC)	6.8	42	21
SO <sub>4</sub> <sup>2-</sup> (IC)	5.0	38	21
Na <sup>+</sup> (AAS)	6	4	1
K <sup>+</sup> (AAS)	12	7	1
Mg <sup>2+</sup> (AAS)	7	1	1
Ca <sup>2+</sup> (AAS)	11	33	1
NH <sub>4</sub> <sup>+</sup> (SFA)	4	23	3
Cd (AAS)	14	0.01	0.001
Fe (AAS)	15	6	1
Mn (AAS)	16	0.42	0.05
Ni (AAS)	12	1	0.05
Pb (AAS)	15	0.51	0.05
Zn (AAS)	11	3	1



#### **1.4.2 Air pollution data control and validation**

Air pollution data submitted to ISKO are checked in compliance with the Operation rules of the National air pollution network and the Operation rules of ISKO air pollution data administration. The measured results are checked twice: the first, monthly control is in charge of the regional network administrator. This is done prior to data affirmation or supply to ISKO. The second control is implemented by ISKO, and namely for each quarter of the current year.

Both procedures are based on the control of formal and logic parameters aimed at the detection and elimination of gross errors which could affect and lower the quality of statistical characteristics of the data file.

Within the second control of the measured results unreliable data are detected from the currently stored national files of daily averages of air pollution data using the database application.

After the collection of air pollution data for the given period is finished the administrator reports this to the researcher responsible for the control of data. The database application used for detecting unreliable data is launched automatically upon each ISKO database update (i.e. input of new data, correction of the stored data etc.) and is given at disposal of the researcher responsible for the reliability control of the stored data.

The detection of unreliable data in the newly stored national files of daily averages of air pollution data is carried out by using the database application. This procedure based on mathematical and statistical methods provides the html page accessible by a standard viewer. This page presents the days with suspicious data supplemented by daily averages and data on five preceding and five subsequent days incl. the daily averages at other seven nearest stations for the same time span. The researcher responsible for the control of data carries out the assessment of the obtained data and then contacts the data supplier and requests the verification of suspicious data and, if necessary, the approval to eliminate the data from the database.

Obvious gross errors and other suspicious data, confirmed by the suppliers as erroneous, are identified by the respective researcher responsible for data control with error codes. With the use of applications for recording the error values the suspicious values are eliminated from the ISKO database tables and transferred to error tables. The records about such transfers are archived. The error tables include the respective error codes.

After the collection of data for the period of one year the researcher responsible for the control of data accuracy carries out also the control of reliability of all measured and calculated (aggregated) air pollution data exceeding the limit values.