

Current Situation of Air Pollution in Tehran with emphasis on District 12

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I. Introduction

Tehran is amongst a few capitals of the world, which is not located around the river or even close to Sea. Mountains surround the City from the North and East. Fig. 1 shows the situation of Tehran; the city is divided into 21 districts. The total area of the City is 700 Km². There are four accurate seasons, with the annual mean rainfall at about 230 mm. The annual mean temperature is 17 °C. The highest temperature is 39 °C in summer and -6 °C in winter. The annual mean humidity is 40% and the highest monthly mean humidity is 65% in January and Lowest being 24% in July and August.

District 12 of Municipality of Tehran is located in the south of Tehran as shown in Fig. 2, it is the oldest part of the city with the Bazaar (old Market), parks, and two lines of underground. This area was built in late eighteen Century. The total area of the district is 16 Km² with a population of around 300,000. One of the oldest markets (bazaar) in Iran is in the centre of the district. There are many historical buildings and a Palace, which was built around 200 years ago. The two lines of the underground cross the area, Line 1 runs from North to South and Line 2 from East to West of the City. Line 1 is only half completed and the other half is under construction. The part that runs through district 12 is fully operational.

There are some major problems that exist in the area. First is the existing market in the area. The second being the number of people that travel to the area for shopping and for doing business from all over Iran, their activities create a lot of solid waste. They also bring in a lot of private cars and use the public transport at an average rate of 1620 buses with 1 367000 passengers daily, Which crosses or terminates in the district, the consistent traffic Jams around the Bazaar and the increasing Air pollution are the result of this huge comings and goings into the District.

The aim of this report is to present information relating to existing Air quality and short discussion about the difficulty of current law and its management. Effort has been made to reduce the Air Pollution and some suggestions are presented for better management of Air pollution Control

II. Current of Air Pollution Situation

Municipality of Tehran established Air Pollution Control Company (AQCC) in 1993. This is a research company involved in presentation of countermeasures to improve the Air Quality in Tehran. This company has a few monitoring stations in Tehran, one of which is situated in District 12 around the Bazaar Area. This station monitors some parameters relating to Air Pollution; these parameters are as follows:

1. Carbon Monoxide (Co)
2. Particulate Matter (PPM)
3. Nitrogen Dioxide (NO₂)
4. Sulphur Dioxide (SO₂)
5. Ozone (O₃)

Fig. 3 shows the monitoring stations, which were installed by AQCC and Department of Environment (DOE). Data from four stations are sent to the AQCC centre and to the digital public billboards for demonstration. Fig 4 shows a photo of one of these Billboards.

Table 1 compares some of the mean annual parameters of Air Pollution taken around the Bazaar area and other Standards from around the World.

Figure 5, 6 and 7 illustrate the annual mean sulphur dioxide parameter, particulate matter parameter (PM-10) and 8-hour average Carbon Monoxide (CO) in Tehran. As shown in these Figures and Table 1 the situation of Air pollution at district 12 is below the world standards.

Table 1 Annual average concentration of pollutants and environmental standards at Bazaar monitoring station (Taken from AQCC)

	SO2	NO	NO2	NOx	CO	O3	PM-10
	PPB	PPB	PPB	PPB	PPM	PPB	µg/m ³
From October 1995 to September 1996	63.4	61.3	49.9	110.5	7.9	24.8	123.2
From March 1995 to March 1996	61.7	60	24.2	84.2	4.89	15.21	71.68
From March 1999 to March 2000	55.4	63.98	21.78	85.76	6.27	17.1	94.7
From March 2000 to October 2001	57	46.7	36.6	83.3	5.76	16.37	68.4
WHO Standard	17-26	--	--	--	--	--	60-90
USA Standard	35	--	60	--	--	--	50/50
Germany Standard	57	--	60	--	--	--	100
Japan Standard	(20)	--	(20~30)	--	--	--	(50)

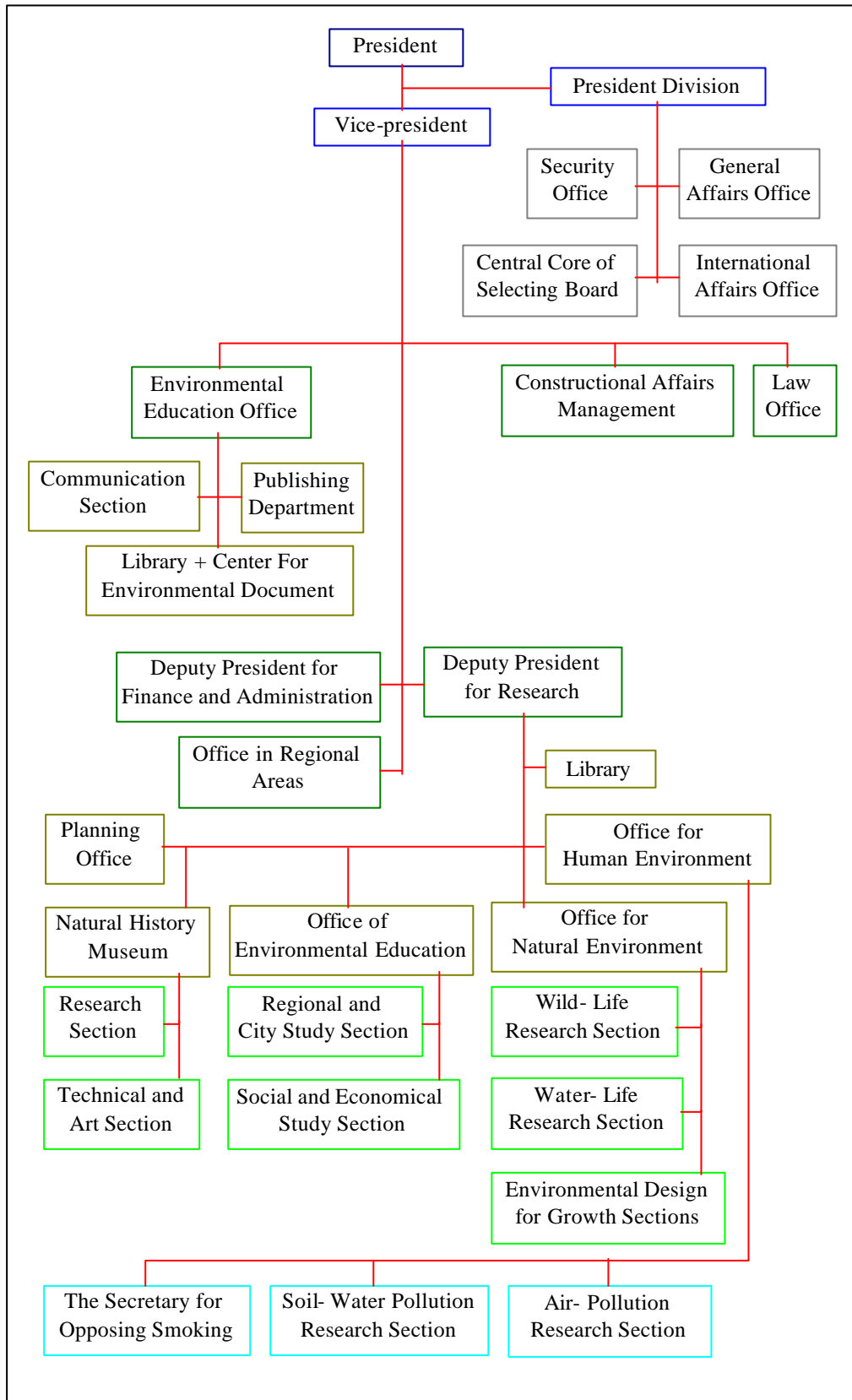
III. Existing Institutional, Regulatory and Enforcement Mechanisms

In accordance with Environmental Protection Act 1973 and clean Air Act 1995, it is the duty of the DOE to prevent air pollution. The DOE is under the provision of a higher committee and president of Iran. Table 2 shows the constitutional chart of the DOE. According to Act 1955, municipality of any city has powers to prevent air pollution in that city. Municipality is under the control of city council. It is the responsibility of police (in Tehran, Traffic police) to stop the vehicles with no Inspection Sticker. Traffic police is under the provision of police and Ministry of Interior.

Clean Air Act (a plan for the control of Air pollution) 1995 was passed by the parliament. It consists of six chapters, thirty-eight sections and twelve provisions. Some sections of the law are as follows:

Section 4: the use of motor vehicles, which emit smoke and other pollutants into the air, above the permitted levels, is forbidden. The permitted level of motor vehicle emissions is determined by the DOE, with the help of the Ministry of Industry and approved by Higher Committee on environmental protection affairs.

Table 2. The constitutional chart representing the Department of Environment (DOE) in Iran



Section 5: all motor vehicles in use must possess a special license indicating compliance with the permitted levels of air polluting emissions. Owners of motor vehicles are bound, each year, to have their vehicles inspected at the DOE's verification centre (established by the Municipality), and to receive a license indicating compliance with the permitted levels of pollution. Those vehicles that do not possess this license will not be allowed to drive on the roads.

Provision: the date for the implementation of this section and its provision will be at most one year after approval of this law. The DOE and the Municipality, as well as other related organisations are charged with gathering in the aforementioned time interval, the necessary contingencies for the implementation of this section.

Section 8: the production and import of motor vehicles, as well as engines and other part related to motor ignition, such as carburettors and filters, must comply with the standards of the DOE.

Section 9: The Ministry of Industry is charged with regulating the policies and production plans of units and companies whose function is to produce motor vehicles so that:

- 1) These units do not produce vehicles with engines and parts that are not up to standards of DOE,
- 2) Priority is given to the production of vehicles for public transport
- 3) Vehicles are produced that are able to use natural gas as well as gasoline.

Section 10: Registration of all motor vehicles requires compliance with the standards of section 8 of this law.

Section 12: Establishing new factories and workshops, and changing the location and/or production line of existing factories and workshops, requires compliance with the regulations and criteria of the DOE.

Provision: Construction of power plants, refineries, petrochemical factories, defence industry factories, airports, and loading terminals require compliance with the regulations and standards of the DOE in regards to their location.

Section 34: The Radio and Television Organisation of the Islamic Republic of Iran is charged with arranging with the help of the DOE, programmes appropriate for the education of the public on the regulations and laws pertaining to the protection of the environment.

Sections 11, 12, 20, of Environmental Act 1973 and amended on 1991 are as follows:

Section 11: The DOE in accordance with regulations and codes of practice, which relate to section ten, identify factories, which cause pollution to Environment. Each owner of the factory responsible for the pollution is given an enforcement notice with relevant reasons. They are then obliged to remove the pollution source in a specified period or stop their activities. Any person, who fails to comply with any requirement imposed by an enforcement notice by the DOE, is prevented from any other activities. If any person concerned questions the enforcement notices ordered by the DOE can appeal the case to the public court in that area and the court will then immediately study the case and if the court finds for the plaintiff they will immediately quash the enforcement notice and the plaintiff is allowed to continue normal activities and decision of the court is final.

Provision: For sources and parameters, which have imminent danger for Environment, chairman of the DOE is able to order to stop the activity of the polluter without any written notification.

Section 12: Owners or the responsible person in the factories and workshops, which were mentioned in section 11 must stop their activities whenever they receive the order of the DOE. Continuation of work or activity depends on the permission of the DOE. If any person fails to comply with the order of the DOE or decision of the relevant court, may be sentenced from 61 days to one year or pay a fine ranging from 5,000 to 50,000 Rials or both. (Prison terms of less than 60 days can be exchanged with cash fine).

Section 20: The DOE can after the approval of Higher Committees, confer some part of his power and duties relating to section 11, 12, 13 of this Act to municipality of any part of the country, while determine their powers and duties the municipality or governmental organisation will then be the enforcement authority.

According to subsection 20 of section 55 of the municipality Act 1955 municipality can prevent air pollution, caused by factories, workshops and residential building.

In the year 2000, cabinet of Iran approved a regulation program relating to integrated master plan of air pollution control in Tehran. It consists of 8 items, some of which are as follows:

Item 1: for reduction of air pollution parameters, fuel optimisation and increase in safety, municipality of Tehran must establish six Vehicle Technical Inspection Centres.

After one year from the finalisation of this project, any motor vehicle with no inspection sticker will be stopped.

Item 4: it is duty of Tehran municipality, to install Intelligent Traffic Signals Controls, especially in crossroads by the end of 2001

Item 5: For partial reduction of air pollution parameters in Tehran, it is the duty of municipality of Tehran to carry out following sub-items during five years.

One) Replacing the paykan's carburettor with the age of less than ten years with fixed Nozzle carburettor

Two) Use of catalyst in gas fuel used taxis and changing the fuel system to run only on LPG.

Three) Installation of catalyst for motorbikes

Item 6: it is the duty of Ministry of oil:

One) To provide at least 70 % of unleaded fuel for consumption in Tehran and also to provide low sulphur gas-oil for public buses in Tehran.

Two) To present and implement a program consisting of timetables and necessary resources to prepare unleaded petrol and LPG by mid 2000.

Enforcement Mechanisms: The DOE is in accordance with sections 11, 12 of Environmental Act 1973, mentioned previously can enforce his power and duty, but enforcement procedure in municipality is different this is as follows:

One) Any person can complain against air pollution, which is caused by any owner's of domestic buildings, workshops and factories to municipality.

Two) Authorised person from municipality can inspect the polluted site and give an enforcement notice with reasonable dates to the owners of factory or domestic buildings to remove air pollution or stop their activity. Each owner or responsible person has ten days for accepting or rejecting the notice. The polluter must send his rejection paper to a committee (members of committee are chosen by city council). The decision of the committee is final (Ghorbani, F. 1990).

At present some sections of the law have not been put into proper practice for example, in section 5, municipality of Tehran must construct six vehicles Technical Inspection Centres; four of which have been completed and two are under planing.

Any motor vehicle with no inspection sticker must be stopped by the traffic police unfortunately there is no appropriate co-operation and interaction between these two centres because they are under the provision of two different organisation. Even if there is a good co-operation, there will still be no satisfactory result because:

- 1) Most of the existing Motor vehicle are below the air Pollution Control Standards
- 2) Some of the car factories still produce cars with fuel emission below the acceptable standards.

Section 10; will be practised when existing problems relating to section 8 have been solved.

Section 8 of this law is not completely in operation. Some of the factories have standard license and some other still does not reach to standards.

IV Existing countermeasures and activities implemented by the authorities

Japan international Co-operation Agency (JICA) studied an integrated master plan for air pollution control in Tehran with contribution of Tehran municipality and other branches of government. JICA presented final report in December 1997. They recommended some suggestion for reduction of air pollution, which the important parts are as follows:

1. Improvement of Automobile Emission.

1-1) Improvement of Automobile Technology (JICA, 1997)

The development of Auto technology in Iran is far behind the developed countries. Improvement in basic design, planning and Quality Control (QC) is of outmost importance. Environmental technology, basic design of car engines, main parts, catalysts for cleaning up the fuel emissions should be developed. Technology transfer from developed countries should be considered, also exchange of engineers with developed countries is an acceptable way to reach those standards required to reduce the Air Pollution.

1-2) Improvement of Automotive Fuel

Introduction of oxygenated gasoline, such as Methyl Tertiary Butyl Ether (MTBE) added gasoline, is needed because CO must be reduced urgently. In view of high altitudes and steep slopes on the country roads, reformation of regulations enforcing the use of Oxygenated Gasoline should be considered. Mixing of Plant Oil Ester with Diesel Oil is an effective way to reduce Black Smoke. After taking such countermeasures to reduce CO, Non leaded Gasoline and three elements Catalytic Converter should be introduced (if economically viable), also efforts to propagate an LPG/CNG car should be continued.

1-3) Reformation of Regulation Relating to Automobiles

At first the Inspection and Maintenance (I/M) system should be implemented with complete coverage and should be combined with a scrappage program of cars with long lives. Introduction of a license for car maintenance engineer to create an incentive to attract more skilled engineers. Furthermore, in view of the present chaotic

traffic conditions, re-education may be required for drivers trying to get new license or renewing their old license.

1-4) Institutional Improvement for Automobiles

The public transportation system should be fully utilised. For promoting the use of public Transportation System, improvement of service is necessary; for example a common ticketing system would simplify the passengers change of line. Also for discouraging roadside parking an abundant of parking spaces would be required, it may become obligatory for a driver to have a designated parking space. A centralised traffic control system with computerised control signals should be established. Enforcement of a controlled traffic zone and implementation of Park & Ride system would be helpful.

1-5) Reform of Present Institution

If Tehran Vehicle Technical Inspection Bureau (TVTIB) is to carry out the I/M system, the capability of TVTIB should be enhanced. A comprehensive traffic environmental research institute would be necessary under Municipality of Tehran (MOT). Drastic amendment of existing organisations may be necessary.

1-6) Promotion of People's environmental awareness.

2. countermeasures for stationary sources

Countermeasures for factory emission should include

- a) Amendment of regulation and relocation of factories
- b) Comprehensive planning for fuel supply, and
- c) Installation of de-sulphurization facilities. Also, countermeasures for commercial and domestic sectors should include switching of fuel to Liquid Petroleum Gas and Liquid Natural Gas (LPG/LNG).

2-1) factory

- a) Amendment of regulation and relocation of factories

The emission standard should be established in the form of a quantity standard as distinct from a connection standard. Also, a routine or non-routine on site inspection should be done. Regulations should be amended stipulating penalty for violation. Desirably a licensed pollution controls engineer and manager should be appointed at each factory.

Also, more factories should be relocated to an industrial complex continuously.

b) Comprehensive planning for fuel supply, and

In order to reduce SO_x pollution, switching of fuel to LPG and LNG should be promoted, and production of low sulphur heavy oil should be increased, and in a smaller factory, low sulphur oil should be used.

c) Installation of de-sulphurisation facilities

A large factory should be equipped with a de-sulphurization cleaner extracting SO_x from exhaust gas.

2-2) Commercial and domestic sectors

More LPG/LNG should be used as automobile fuel replacing gasoline. Also, for domestic combustion equipment should also be improved. Public awareness for health effect of room air pollution should be promoted.

Some parts of the air pollution law and the regulation have been practised; the most important points are as follows.

Domestic fuel of district 12 has been replaced from gas-oil to natural gas by constructing gas pipeline, and this project will be finalised by the end of year 2002 in district 12 except Bazaar section.

There is an electric bus line in east part of the district and now there is project of the electric bus line in south part of the district with half of this project completed and early 2002 will complete the other half

There was a big old fruit market in south part of the district, which was moved to another part of the city, and the old building was demolished and a park with a total area of 60000 m² was built in its place with a library.

Two lines of underground run through this district.

Fuel system of 500 public Buses are now going to be replaced from gas-oil to liquid petroleum gas (LPG) in the area and as a whole by early 2002 fuel system of two thousand public buses will be replaced by LPG in Tehran City.

The fuel of public buses has been changed from higher SO₂ to lower one and 500000 Lt. Of gas-oil which public Bus Company consume every day has lower SO₂ (500 PPM).

Fuel of about 31000 Taxis changed from petrol to LPG and municipality of Tehran intend to replace existing taxis with 70000 new cars (Peugeot) at a cost of US \$ 750m.

In Tehran there are 85 Intelligent Traffic Signals (ITS) in place at intersections, 75 of which are directly connected to control system this number will increase to 400. District 12 has only 1 centre of ITS. There are plans to increase this number to 15 by mid 2002.

The control part of Tehran has been made a controlled traffic zone, which allows only permit holders to enter the zone between the hours of 6.30-17.00 Sat-Wed (district 12 falls into this zone)

From March 2001 Ministry of Industry began to reduce production of cars, which emit gases above the standard of Air pollution and increased production of cars with acceptable level of fuel emission. This trend will continue until all cars produce reaches this satisfactory level.

V. Conclusion and Suggestions

In recent years, the government and the parliament of Iran have had many efforts for solving air pollution in Tehran; some of them are as follows.

1. Passing law relating to air pollution control.
2. Approval of the integrated master plan regulation of air pollution control.
3. Carrying out some sections of the law and items of the regulation

In following items, the efforts of the DOE and municipality of Tehran is not sufficient

- 1) Public education and awareness
- 2) To reach productions of car factories to standard of air pollution
- 3) Implementation the all existing vehicles to reach standard levels of air pollution
- 4) To force the implementation of the laws and regulations.

There is some obstacle, for Iranian authority to implement the actions to improve air pollution in Tehran properly, which are as follow:

- 1) Interaction and Co-ordination between the DOE, Ministry of industrial, Municipality, Police, Radio and Television organisation is not sufficient
- 2) There is an overlap of authority, for example in accordance with the law the DOE and municipality have the same power to prevent air pollution
- 3) The DOE dose not have sufficient power to implement some sections of law for example section 34 (relating to public education and awareness) and section 8 of clean pollution Act as mentioned before. Complete operation of two sections need close co-ordination between the DOE, Radio and Television organisation, and Ministry of industry.
- 4) Integrated programme for public education and awareness does not exist
- 5) There is a financial problem to bring the existing vehicles up to a standard level
- 6) There is some insufficiency in laws, for example, section 34 of clean air Act 1995 public education and awareness is the duty of Radio and Television organisation but all newspapers, magazines are under the provision of Ministry of culture and

Ministry of education should conduct introducing any public awareness course. The two ministries don't have any role in section 34.

- 7) At present all sections of the law and items of the regulation have not been put into practice because there is some division relating to responsibility of Air pollution control Program. Interaction between Ministries and Organisations, which have some responsibility for solving some parts of the problem, is not completed. Timetable of the regulation relating to all items of integrated master plan has not expired yet.

It is suggested the following items be taken under consideration in order to improve the Quality of Environment

- 1) It is recommended that DOE in accordance with section 20 of environmental Act 1974 and amended on 1991 confer his power and duties in city of Tehran to the municipality
- 2) To establish an environmental quality control organisation under provision of municipality of Tehran.
- 3) Responsibility of traffic police relating to urban management, which is now under provision of police force to be under the control of municipality of Tehran.
- 4) For completion of section 5 of the air pollution law it is vital that Ministry of Industry, the DOE, the Municipality, and traffic police should contribute together with good interaction to produce an effective result to practice the section.
- 5) Check the effects of the strategy, which mentioned in this report by some research studies, after finalising integrate master plan for air pollution.
- 6) An integrated programme for public education and awareness with participation of Radio and Television organisation, Ministry of Education, Ministry of Cultural is necessary
- 7) As a whole contribution of the DOE, Municipality , industrial Ministry, Ministry of Oil, police, Courts, Radio and Television organisation Ministry of Educational, and Ministry of Cultural is necessary

- 8) The section 34 of clean air Act 1995 needs to amend. It would be better that the Ministry of culture and the Ministry of Education should, like Radio and Television Organisation, also be held responsible under section 34 of Air pollution.
- 9) Public participation for bringing all existing vehicles up to the standard of Air pollution is necessary. This can be done by providing the public with long-term loans without interest.

E. References

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F. List of symbol

$\mu\text{g}/\text{m}^3$	Micro-gram per cubic meter
AQCC	Air Pollution Control Company
CO	Carbon Monoxide
DOE	Department of Environment
EPA	Environmental Protection Agency (USA)
I/M	Inspection and Maintenance
ITS	Intelligent Traffic Signals
JICA	Japan international Co-operation Agency
LNG	Liquid Natural Gas
LPG	Liquid Petroleum Gas
MOT	Municipality of Tehran
MTBE	Methyl Tertiary Butyl Ether
NO	Nitrogen Monoxide
NO ₂	Nitrogen Dioxide
NO _x	Nitrogen Oxides
O ₃	Ozone
PM-10	Particulate matter less than 10 μ m of particle size
PPB	Part Per Billion
PPM	Part Per Million, normally used as "ppm"

QC	Quality Control
SO ₂	Sulphur Dioxide
TVTIB	Tehran Vehicle Technical Inspection Bureau
WHO	World Health Organisation