

Maisons-Alfort, 21 July 2010

The Director General

OPINION **of the French Agency for Food, Environmental** **and Occupational Health Safety**

in response to the solicited request concerning
“Professional activities and air quality in indoor car parks”

ANSES’s public health mission involves ensuring environmental, occupational and food safety as well as assessing the potential health risks they may entail.

It provides the competent authorities with the necessary information concerning these risks as well as the requisite expertise and technical support for drafting legislative and statutory provisions and implementing risk management strategies (Article L.1313-1 of the French Public Health Code)

This ANSES Opinion incorporates the expert appraisal undertaken by AFSSET. ANSES became legally operational on 1 July 2010 following the official promulgation of the Order of 8 January 2010 which established it. It thus inherited the missions, achievements and values of both AFSSET and AFSSA.

1. PRESENTATION OF THE QUESTION

On 10 April 2008, AFSSET received a solicited request from the Ministry of Labour (Directorate-General for Labour) on the issue of professional activities and air quality in indoor car parks. Considering the results of the previous AFSSET expert appraisal entitled “Recommendations for air quality in indoor car parks” (Afsset, 2007)¹, the regulatory environment, the variety of occupations associated with indoor car parks and the expected increase in the number of operators working in these facilities, the Directorate-General for Labour expected this expert appraisal to:

- ① “provide information and specific data on all the professional activities performed by operators working [...] in indoor car parks”;
- ② “allow on the one hand, the direct observation of a number of activities that clearly involve higher exposure, and on the other hand, for activities involving lower exposure, an assessment of the time spent by operators in the different locations (car parks, specific workplaces) in which they are required to work”;
- ③ “determine exposure scenarios (based on earlier field measurements) for each type of activity listed on the basis of data from observations or from the previous assessment, depending in particular on the frequency and duration of exposure”;
- ④ “offer proposals or lines of enquiry to ensure that the health of operators concerned by professional activities in indoor car parks continues to be protected and even improved”.

2. BACKGROUND

This expert appraisal follows the work on air quality in indoor car parks that was undertaken by AFSSET at the request of the Ministries for Environment and Health (Afsset, 2007). The findings

¹ AFSSET. (2007). Recommendations for air quality in indoor car parks. 1-240, Maisons-Alfort, France, French Agency for Environmental and Occupational Health Safety.

reported health risks that “cannot be considered negligible, in view of the pollutant concentrations measured in the four car parks studied and of what is known about their acute and chronic toxic effects”, especially for professionals working in heavy traffic areas. One recommendation aimed to “better characterise the exposed populations (workers and users) and their patterns of exposure, particularly duration”.

Furthermore, this expert appraisal is in line with recent regulatory developments. Since the abolition of Section 2935 of the document on “Classified Installations for the Protection of the Environment” (ICPE) on 31 May 2006, the current Ministerial Order of 9 May 2006² no longer includes specific provisions for the health and safety of workers in indoor car parks, nor maximum concentration limits for an atmospheric pollution indicator. In addition, this Ministerial Order authorises, as part of normal car park operations and without any additional safety measures, ancillary vehicle activities including vehicle washing areas, installation of small equipment and car accessories (car radios, windscreens, tow-bars, etc.), vehicle rental, and cycle rental and parking.

3. ORGANISATION OF THE EXPERT APPRAISAL

The expert appraisal was conducted by AFSSET in accordance with French Standard NF X 50-110 “Quality in expertise activities - General requirements of competence for an expertise activity (May 2003)” to ensure compliance with the following points: competence, independence, transparency, traceability.

Two rapporteurs undertook a second reading and critical analysis of the health risk assessment and recommendations. The methodological and scientific aspects of the work were regularly submitted to the Expert Committee (CES) on “Assessment of risks associated with air environments”, and the work was approved by the CES at its meeting on 28 April 2010. This expert appraisal was thus done by a group of experts with complementary skills.

The scientific aspects of this Opinion are based on the final report from this collective expertise (“Professional activities and air quality in indoor car parks”, April 2010). The Opinion was written by ANSES.

4. RESULTS

Preamble

There are few data available from which to compile a list of indoor car parks in France. According to the French Parking Association (FNMS), there are probably around 2000 in metropolitan France that provide parking as a public service, of which about 1700 have over 200 parking spaces.

The FNMS estimates that the number of employees working inside indoor car parks solely to operate them³ is falling. This trend can be explained by the automation of payment systems and the introduction of remote management (remote surveillance, management of several “slave” car parks from a “master” car park, etc.).

Regarding user services other than those specific to car park operation (such as vehicle rental and cleaning), these have expanded rapidly. Indeed, indoor car parks under continual surveillance and in areas of high user traffic are very attractive to companies wishing to offer services. Moreover these developments help make the car park more comfortable and attractive to users.

² Ministerial Order of 9 May 2006 approving provisions supplementing and amending the safety regulations for the prevention of fire and panic in establishments open to the public

³ The term ‘operate’ includes mainly reception, surveillance and minor routine car park maintenance but does not include services that are not provided by car park operators (vehicle rental and cleaning, etc.).

Characterisation of professional activities in indoor car parks

Between December 2008 and March 2009, AFSSET conducted a nation-wide (metropolitan France) cross-sectional survey of 467 car parks, primarily to assess for each professional activity:

- the work durations and frequencies,
- the prevalence of different professional activities within the indoor car parks,
- and the number of workers.

The response rate to the survey was 91%. A study sample of 292 car parks spread across 68 towns in metropolitan France was drawn from all the responses. These selected car parks met the following criteria: open to the public, capacity greater than or equal to 200 parking spaces, with low natural ventilation.

The results of the survey revealed that:

- **Car park operation and vehicle cleaning activities accounted for the longest working hours, and therefore the highest exposure durations in the car park.** Indeed, these two activities usually require the worker to be present in the car park every day and (almost) continuously throughout the day. Thus, for operation activities, the time spent outside the reception office, and therefore primarily outside the room fitted with independent mechanical ventilation, was estimated at over 30% of the workday for 90% of workers, and over 60% for 10% of workers.
- **Maintenance and servicing of the car park and its facilities (payment barriers and equipment, ventilation and smoke extraction systems, car park cleaning) globally involved shorter and more variable working times.** Indeed, the worker is often required to be in the car park intermittently during the working day and the year (workers responsible for several car parks, workers whose presence in a car park is only required in the event of a breakdown or for inspection).
- For vehicle cleaning, the number of years worked was significantly lower than the other activities, reaching 10 years at most. This finding may be explained by the lack of opportunities and precarious nature of this activity and by a high employee turnover. The change in the number of years worked by these operators is harder to interpret given the more recent emergence of this occupation. For the other activities, the maximum number of years worked can reach 39 years.
- Vehicle cleaning was observed in 21% of indoor car parks, car rental in 9% and distribution of fuel in less than 1%.

Based on the number of workers identified by the survey and the number of indoor car parks in France considered by the FNMS, it has been estimated that approximately 8000 people work in car park operation in metropolitan France, approximately 3000 in the maintenance of payment barriers and equipment, approximately 3000 in the maintenance of ventilation and smoke extraction systems, and approximately 700 in vehicle cleaning.

Field observations and analysis of professional activities conducted in indoor car parks

In addition, AFSSET asked the National Agency for the Improvement of Working Conditions (ANACT) to collect field observations, analyse various occupational activities in indoor car parks, and gain a better understanding of workers' exposure conditions and durations. ANACT also sought to understand the perceptions the workers had of their working conditions.

Field observations were made in three underground car parks between December 2008 and July 2009. The four following professional activities were analysed: **electrical maintenance, car cleaning, car rental, car park operation.**

The electrical maintenance of indoor car parks includes regular testing of generators, and periodic maintenance of lighting. Approximately three quarters of the working time is spent in vehicle circulation areas or in technical premises. Electricians also conduct more occasional operations that may require prolonged working hours in vehicle circulation areas over one or more days. The number of years worked by the operators may be higher in these specialised occupations requiring accreditation.



This category of workers is concerned by the health risks incurred through exposure to air in the car park. The factors contributing to exposure are their presence in vehicle circulation areas, their postures which may require static effort, and their proximity to airborne particles resuspended by their activity. However, their level of exposure often appears to be limited because there are fewer or no car users in the car park during their shifts.

The cleaning of cars is performed mainly by very small firms located close to the vehicle traffic in the car park.

This category of workers is particularly exposed. The contributory factors are their presence in vehicle circulation areas during almost all their working hours, and their tasks and postures which require physical exertion. Nevertheless, their long-term exposure is limited by the fact that this occupation is generally performed for a shorter duration.

The rental of cars is often managed by private companies whose premises are in the car park. Maintaining and cleaning the rental vehicles involve higher exposure. Nevertheless, the time spent by rental agents performing these tasks in the vehicle circulation areas is limited to about 15% of their working hours.

Car park operation includes a variety of tasks: maintenance, cleaning, emptying ticket bins at payment barriers, providing help and information to users, supervising maintenance operations, ensuring reliability of equipment, monitoring upgrade work and coordinating external contractors, surveillance and counting of vehicles. It sometimes requires a continuous presence (24 hours a day, 7 days a week). The operators observed spent about 50% of their working time in the operations room, 25% in pedestrian circulation areas, and 25% in vehicle circulation and technical areas.

Several of ANACT's observations put forward that in terms of **perception of the health risk associated with the air in the car park**, operators often consider the vehicle circulation area as a "normal" workplace and are not fundamentally concerned by their exposure to ambient air in the car park. The analysis of their activity revealed no strategy to protect workers with regard to the atmosphere in the car park. Regarding electrical maintenance, the fact that workers may be assigned to several car parks complicates the way in which their working conditions are perceived by line management and occupational physicians.

Health risks assessment

The objective was to characterise the health risks related to professional activities in indoor car parks, and in particular to identify the most risky professional activities, and the most problematic pollutants, in order to propose recommendations for prevention.

The health risks associated with chronic exposure to chemical pollutants in the air of the indoor car parks were assessed for moderate (median) and high exposure levels and durations⁴ among workers who regularly perform the following activities:

- park operation (reception, general surveillance, minor routine car park maintenance, car park cleaning, fire surveillance and prevention),
- maintenance of payment barriers and equipment,
- maintenance of ventilation and smoke control equipment,
- park cleaning,
- vehicle cleaning.

The health risks associated with acute exposure were also assessed for these workers, using the maximum concentration levels of pollutants measured in the air of the indoor car parks.

Health risks assessment was based on common benchmarks for risk acceptability, including the values of 10^{-5} and 10^{-6} for the individual excess risk (IER)⁵.

4 exposure levels and durations used are respectively from the indoor car park air measurement campaigns conducted in 2006 (AFSSET, 2007), and from data collected by AFSSET's cross-sectional survey.

5 IERs of 10^{-5} and 10^{-6} correspond respectively to an additional probability of observing a harmful effect of 1/100000 and 1/1000000 in exposed individuals.

The results show that all the professional activities studied generate significant health risks⁶ due to chemical pollution of the ambient air in the indoor car parks (with the exception of the moderate chronic exposure scenario for the maintenance of payment barriers and equipment). **The limitations and uncertainties of this analysis are not however sufficient to call this conclusion into question.**

The risks from acute exposure are mainly due to carbon monoxide (risk of hypoxic effects) **and nitrogen dioxide** (risk of toxic effects on the respiratory system, especially in asthmatics).

The risks from chronic exposure are mainly due to benzene (risk of leukaemia) **and nitrogen dioxide** (risk of toxic effects on the respiratory system, especially in asthmatics), and to a lesser degree due to **fine particles (PM₁₀)** (risk of toxic effects on the respiratory and cardiovascular systems) **and formaldehyde** (risk of ocular and nasal irritation).

Car park operation and vehicle cleaning generally account for the longest working hours, and therefore the highest exposure durations. Consequently these two activities seem the most relevant in terms of worker exposure to atmospheric pollutants in car parks.

Regarding car park operation, the factors limiting exposure and thus health risks for workers include a low level of pollution in the vehicle parking area, effective isolation of the operations room and as much working time as possible spent in this room.

Regarding vehicle cleaning, there seem to be far fewer factors limiting exposure of workers, since this activity usually requires the worker to be present in the car park's vehicle circulation area every day and (almost) continuously throughout the day. The risk estimate for moderate exposure of vehicle washers exceeds the level of acceptability of 10^{-6} (benzene)⁷ even when only considering working hours that equate to 1% of a lifetime⁸.

Regarding the maintenance and servicing of the car park and its facilities (barriers and payment equipment, ventilation and smoke extraction systems, car park cleaning), workers' exposure to the air in the indoor car parks is even more variable, since they are required to be present intermittently in the working day and over the year. Risks exceeding the admissible levels of 10^{-5} and 10^{-6} (benzene) cannot be excluded for some of these workers.

In conclusion, the previous expert appraisal (AFSSET, 2007) had raised questions about the health risks to people working in indoor car parks, in view of the atmospheric concentrations of pollutants measured in these facilities and what is known about their toxic effects. It recommended more thorough characterisation of the exposed populations and their patterns of exposure, particularly duration.

This expert appraisal shows the presence, among these workers, of health risks from chemical pollution of the ambient air in indoor car parks. It is mainly based on a large collection of data on professional activities performed by these workers, their frequency and duration of work.

This conclusion is valid despite continuing difficulties in assessing the risks related to the number of pollutants emitted by vehicles (exhaust, fuel evaporation, braking systems), an insufficient knowledge of the atmospheric concentrations of pollutants in these facilities and the effects of some of them.

Finally, the health risk assessment based on human toxicity values has shown that compliance with occupational exposure limits (OEL) does not always guarantee that risks are maintained at levels considered acceptable.

⁶ Significant health risks are understood to risk levels exceeding the usual benchmarks for risk acceptability, particularly the values of 10^{-5} and 10^{-6} for the IER.

⁷ 10^{-6} (benzene): i.e. one additional expected case of leukaemia for one million exposed individuals.

⁸ As an indication, an effective working time of 8 hours per day, 5 days per week, 48 weeks per year, for 40 years, equates to 13% of an estimated lifetime of 70 years.

5. RECOMMENDATIONS⁹

Having accepted the recommendations of the collective expert appraisal, ANSES has thus issued the following recommendations:

- ① Improve and assess air quality in indoor car parks, particularly by:
 - implementing the recommendations on air quality in indoor car parks given in AFSSET's Opinion of 20 April 2007, and specifically by setting proposed maximum concentration limits for the NO (nitric oxide) atmospheric pollution indicator;
 - implementing the available technical solutions to improve air quality and reduce workers' exposure in indoor car parks: some examples are given in the Annex to this Opinion;
 - ② When a satisfactory level of air quality can no longer be ensured for exposed workers:
 - **do not authorise activities that are not essential to the car parks' core function and that involve workers being in underground levels or levels without large openings to the outside (side walls);** activities requiring workers' frequent and prolonged presence outside the rooms equipped with independent mechanical ventilation will be considered as a priority (e.g. cleaning vehicles);
 - **reduce as far as possible the exposure of workers performing activities which are essential to the car parks' core function (reception, surveillance, maintenance),** mainly by:
 - limiting the duration of their presence to what is strictly necessary in the underground levels and the levels without large openings to the outside (side walls), outside the rooms equipped with an independent mechanical ventilation;
 - encouraging workers to spend time in areas of the car park where air quality is most satisfactory (rooms equipped with specific ventilation, marked pedestrian pathways, etc.);
 - taking air quality into account when work stations are established or modified, whether when designing new car parks or redeveloping existing ones;
 - ③ Ensure strict compliance with the regulations, in the assessment and management of chemical risks in the workplace, in order to reinforce monitoring and supervision of professional activities in indoor car parks.
- In addition, ANSES recommends:
- ④ reviewing as a priority the occupational exposure limits (OELs) for benzene, nitrogen dioxide, and carbon monoxide.

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the Director General

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⁹ The recommendations are not intended to:

- provide instructions in the event of accident or fire;
- prevent health risks unrelated to pollution of the ambient air in the car park, and which may exist for people working in indoor car parks (electrical, chemical, microbiological, mechanical risks, etc.);
- prevent health risks from sources of atmospheric pollution specific to certain occupations such as the emission of suspended dust particularly in car park maintenance and cleaning activities (for example when threading cables), the use of chemical compounds and products, particularly in cleaning activities, the emission of volatile pollutants by furnishing and construction materials in the operations room. To determine whether additional precautions are necessary, a risk analysis taking into account the characteristics specific to the installation, its environment and the activity considered must be performed.

ANNEX: EXAMPLES OF SOLUTIONS TO IMPROVE AIR QUALITY AND REDUCE WORKERS' EXPOSURE

- Automatically control ventilation according to predefined air quality criteria (e.g. the maximum limit for one or more pollution indicators). The strategy may involve varying the controlled fan speed according to the different limits of one or more pollution indicators. Modern ventilation systems have variable speed settings thus allowing ventilation to correspond to the concentrations measured;
- Improve localised control of pollutant levels, for example with adequately designed and maintained dual-flow multidirectional ventilation systems;
- Improve local air quality, for example by blowing a surplus of fresh air into frequently-used areas (lift lobbies, pedestrian areas, etc.);
- Reduce the impact of emissions on air quality in the car park, for example, by opting for a combination of dilution ventilation and a method for extracting air at car exhaust pipe level in high-emission areas (traffic ramps, critical circulation areas, parking spaces). Local extraction vents may in fact reduce the power required for the dilution ventilation system;
- Reduce worker exposure by promoting the development of automated systems that reduce workers' presence in indoor car parks, such as remote management (remote surveillance, remote management of several car parks from a single one), automatic payment terminals, automated car rental systems (car sharing, etc.).
- Prior to the implementation of a ventilation strategy, study its energy cost/ventilation efficacy ratio;
- Reduce vehicle emissions in the car park by optimising vehicle circulation in particular to reduce traffic congestion:
 - o reduce circulation time for vehicles in the car park (directional signage, indication of spaces available);
 - o facilitate vehicles' exit so that they spend as little time as possible leaving the car park (cold engines are generally a source of greater emissions);
 - o limit the possibility of excessive speed, sudden accelerations and decelerations (traffic rules, layout and design of traffic lanes).

For example, a car park designed with many levels can complicate the search for an available parking space and therefore increase the time spent driving in the car park. Certain layouts can improve circulation, such as one-way systems and wider lanes. However wide lanes in long straight lines can also encourage excessive speed. Small parking spaces and narrow traffic lanes tend to increase the duration of the parking manoeuvre and slow down traffic.

- Ascertain the efficacy of ventilation in workplaces equipped with independent mechanical ventilation;
- Develop a standard for auditing air quality in indoor car parks that incorporates air quality in premises equipped with independent ventilation. A series of AFNOR standards already offers a process for auditing indoor air quality in various environments¹⁰;
- In a longer term perspective, for any project to design or modify an indoor car park, prior to its implementation, integrate a plan for managing air quality and bring it to the attention of a competent and independent authority.

¹⁰ For example: buildings for office use and similar premises (Standard X43-401), dwelling houses and similar premises (Standard X43-403), public transport means and stations (Standard X43-105) and education buildings (Standard XP X43-407)