Haut Conseil de la santé publique

Statement

On the use of heaters in context of Covid-19 epidemic.

October 14, 2020

The High Council for Public Health (HCSP) was seized on September 7, 2020 by the General Directorate of Health (DGS) for an opinion concerning the use of certain heating devices, particularly in collective confined spaces (Annex 1). Questions arise about the risks of potential transmission of the SARS-CoV-2 virus associated with certain heating methods, such as, for example, unit heaters, the fan of which projects hot air towards the room to be heated, or systems equipped with a fan coil unit, stirring or recycling the air in the rooms. These devices are used in various places (classrooms, workplaces, sports halls / gymnasiums, shops, etc.) where, in many cases, they are the only source of space heating.

In addition, in particular to the opinion of May 6, 2020, relating to heat waves which addresses the issue of the use of ventilators, the General Director of Health asked to indicate the recommendations to be associated with the use of these different types of heating to prevent the risk of transmission of the SARS-CoV-2 virus. These recommendations will, if necessary, be adapted to the scenarios that should be considered, particularly in terms of populations (people affected by Covid-19, people at risk of severe Covid-19, schools, etc.), potentially affected locations (shared spaces, outdoor locations, transport, premises with large volumes, etc.) and compliance with barrier measures (in particular wearing a compulsory mask). These recommendations will incorporate the necessary regular renewal of the air in confined spaces and may take into account recurrent winter epidemic infections.

In order to respond to this referral, the sub-group dedicated to questions relating to Hygiene / Environment / Prevention of the permanent working group "Flu, coronavirus, emerging respiratory infections" co-chaired by Professors Christian Chidiac and Didier Lepelletier and composed of experts, whether or not they are members of the HCSP, were mobilized. The sub-group co-led by Fabien Squinazi and Jean-Louis Roubaty, members of the Specialized Committee on “Risks related to the environment ", auditioned four organizations or associations: CETIAT, AICVF, CSTB and UNICLIMA (Appendices 2 and 3).

The HCSP recalls certain technical and vocabulary points

Ventilation consists of bringing air from outside (fresh air) into a room. It will allow the air contaminants present in the room to be diluted with outside air which will, if necessary, be filtered. It can be natural through openings such as doors or windows (ventilation) or forced with a mechanical system that brings new air into the room and extracts stale air (renewal of the air in the room). This ventilation is mandatory, and a minimum fresh air flow rate is imposed by regulations (RSDT departmental health regulations, provisions of the labor code). The maximum room occupancy rate depends on the incoming fresh air flow.

Air conditioning (heating or cooling) consists of transferring heat or cold into a room. Depending on the process used, the air in the room will be more or less stirred. Stirring will be moderate (by natural convection) when the air comes into contact with a hot or cold wall. For heating, there are

non-blowing radiators and heated floors without being exhaustive. The air circulation in the room may be forced when the system uses fans. Fan heaters, like fan coils, fall into this category.

Filtration. Some devices filter or can filter the air to be conditioned. Processes relying on natural convection do not. The filter may be of fairly coarse porosity with the aim of mainly stopping dust with moderate efficiency on particles containing viruses, or finer with sometimes an almost total capacity to stop the viral load.

The HCSP has taken into account the mode of operation of forced air heating systems

➢ **air heaters** are heating devices for spaces with high ceilings. Very often used in industrial or craft premises, they are also used for heating sports halls, gymnasiums, hangars, warehouses, superstores, exhibition halls, etc. An air heater is equipped with a hot battery and a fan. Attached to the wall and placed at a height (minimum: 1.80 m), it operates in the mode of forced ventilation or forced convection. The air is taken from the room, heated by the device and the hot air is forced out. A minimum air circulation rate of 3 to 4 volumes per hour (for a ceiling height less than or equal to 5 meters) and 2 to 3 volumes per hour (for a ceiling height greater than 5 meters) makes it possible to heat quickly the room air. A remote thermostat has a temperature adjustment dial.

The heating coil can be, in the simplest case, electric or a hot water coil produced by any generator or high-performance boiler (condensing boiler, heat pump, etc.). The gas air heater directly incorporates a burner and behaves like a boiler by directly heating the air.

The fan heater must be oriented downwards so that the air flow contributes to good heat distribution in the room. The air flow should not be forced towards the occupants of the room. If several devices are installed in the same room, they should be positioned so that the heat distribution is the most homogeneous. In high-rise rooms (ceiling height greater than 5 meters and mixing rate less than 4 volumes per hour), hot air accumulates in height. A stratification phenomenon is created, namely hot air above and cold air below. To minimize this phenomenon and allow uniform heating and better comfort, the practice is then to install de-stratifiers (fans) with the unit heaters.

The air flow speed over an air heater is on average 6 m/s and the surface temperature of the heating coil is 60 ° - 80 °C for a hot water coil and it greatly exceeds 100 °C for a gas unit heater.

Unit heaters can only be installed in sufficiently ventilated rooms (natural or forced ventilation).

➢ **fan coils** are terminal units of air conditioning and / or centralized heating, distributed in the premises themselves. They allow the additional heat treatment, hot or cold, to be adapted by mixing the air one or more premises. These units thus make it possible to compensate, independently, occasional thermal variations in one or more rooms and to manage the local temperature of an area. The device comes in the form of a box installed on the wall or ceiling of a room. Some installations allow the system to be inserted into a false ceiling.

A fan coil unit includes both a battery that heats or cools the air drawn in from the room, a coarse filter that retains dust in the air drawn in (some ceiling fan coils can be fitted with more efficient filters), a fan circulating the air in the room equipped with one or two turbines, a recuperator for condensed water (only in cooling mode) connected to a wastewater evacuation network, a steel block protecting the assembly and fitted with a thermostat to regulate the temperature, possibly the air flow but also the speed of the turbines. The condensation mechanism also extracts dust and particles from the air.

The air flow speed over a fan coil is less than 2 meters per second and the surface temperature of the coil is 40 ° - 60 °C for a hot water hydraulic coil and 50 °C for a electric battery.

Fan coils are generally not connected to the air duct network of the air handling installation.

➢ **the central heating coil of a building air treatment plant**, supplied with hot water, steam or electrical energy, provides, if necessary, the preheating of the air and its warming up. The terminal units will then adapt the temperature in the premises.

Rational energy management requires, as provided for in thermal regulations, that at least part of the heat carried by the stale air taken from the premises be retained. Heat recovery systems must guarantee perfect sealing preventing any passage between return air and fresh air in the premises. Particular attention will be paid to rotary exchange systems whose rotor passes alternately through the two air ducts and which can mix a small part of the returned air with fresh air if the correct hierarchy of pressures is not respected or if the purge sector is incorrectly set. This can cause minimal recycling of polluted air which needs to be watched.

The reintroduction into the premises of part of the stale air taken from the premises (recycling) is also used as a means of recovering heat from the premises. Recycling is generally provided through boxes, or mixing chambers, equipped with dampers whose movements are automatically coordinated to maintain the flow of fresh air in the building, regardless of the recycling rate. The recycled air, which is added to the fresh air, the minimum flow of which is calculated from regulatory hygiene requirements, is mixed with the latter either locally before introduction into the premises, or centrally. The recirculated air must be filtered (F7 filter or PM 2,5[1] filter). If this energy recovery system exists in the installation, closing the recycling registers, via the building supervision system or manually, allows switching to "all fresh air" mode.

The HCSP took into account the modes and circumstances of transmission of the SARS-CoV-2 virus

Transmission of the SARS-CoV-2 virus occurs primarily through exposure to droplets and particles in aerosol form from the oropharyngeal tract carrying the infectious virus. These aerosolized droplets and particles are produced during exhaling, sneezing, singing, and speaking and cover a broad spectrum of sizes which can be divided into two categories based on their persistence in air suspension:
- the largest droplets, some of which are visible and which sediment quickly in a few seconds or minutes near the emitting source. They can also become dehydrated and shrink in size during air travel. The kinetics of dehydration depends on the relative humidity of the air in the room.
- the finest droplets and particles or dry residues formed when the fine droplets dry very quickly in the air flow, which can remain suspended in the air as aerosols for several minutes or hours and travel away from the air source emitting by air flows.

As the droplets move away from the emitting source, their concentration decreases both by fallout (larger first, finer later) and by dilution of the finer droplets and residual particles in the increasing volume of air they meet.

The humidity of the air limits the dehydration of large droplets, which has the effect of maintaining their sedimentation and thus limiting their transformation into particles or dry residues in the form of aerosols.

The SARS-CoV-2 respiratory virus infection is mainly transmitted in three ways:

- direct transmission, through close contact, close proximity, by exposure to droplets containing the virus (i.e., the largest and the finest droplets and particles) exhaled by an infected person;

- airborne transmission, by exposure to finer droplets and aerosolized particles containing the virus which can remain suspended in the air over long distances and over time (typically in hours);

[1] Filter with a removal efficiency of 70% or more of atmospheric particles with a diameter of less than 2.5 micrometers

- transmission by skin contact to the face with an infected person or with a recently contaminated surface. The latter case is sometimes called "transmission by a deposit of droplets" also called fomites.

These three modes of transmission are not mutually exclusive.

The circumstances in which airborne transmission of the SARS-CoV-2 virus seems most likely are:

- confined spaces where an infected person exposes people, either in their presence or very soon after leaving the confined space.

- prolonged exposure to oropharyngeal aerosols, often generated by respiratory effort (for example, shouting, singing, exercise) which increases the concentration of viral particles suspended in the air of space.

- inadequate ventilation or air treatment which has allowed the accumulation of viral particles suspended in the air.

Interventions that prevent the spread of the SARS-CoV-2 virus include physical and social distancing, wearing a mask in the community, hand hygiene, and cleaning / disinfecting surfaces, **aeration, ventilation and avoidance of interior spaces with high human density** are particularly relevant for confined spaces, where circumstances may increase the concentration of oropharyngeal aerosols carrying the infectious virus suspended in the air.

The HCSP took into account the conditions of diffusion of the viral aerosol by forced air heating systems

Must be distinguished:

- the **mixing of the air** in the same room carried out by unit heaters or by certain terminal units (fan coils) which are distributed in the room and which suck in the air, heat it and blow it into the same room.

The rate of mixing of the air in the room, obtained by the unit heaters and fan coils, makes it possible to homogenize the oropharyngeal aerosols emitted by an infected transmitter, but more often asymptomatic. On the other hand, shutting down devices or restricting the air flow can lead to pockets of air stagnation and more localized contamination. The speed of passage and the contact temperatures of the heating batteries of these devices would not reduce the viral load, which tends to decrease at a distance from the transmitter. However, the supply of fresh air by the autonomous ventilation system or the regular ventilation of the premises makes it possible to dilute and extract the viral aerosols through the air extraction ducts. In addition, the forced air flows from the unit heaters and fan coils are not directed towards the occupants, who are therefore not directly subjected to the air flows.

- **recycling of the air** taken from the premises of a building, part of which mixed with fresh air, in accordance with regulatory requirements, is reintroduced, after filtration, into the premises.

Even if the size and concentration of respiratory droplets decrease at a distance from the emitting source, all the authors agree to advise against the recycling of the air by boxes or chambers of mixture of stale air returned and fresh air, whose fresh air flow would be insufficient to dilute the viral aerosols and insufficient filtration to trap them. The recycled air could therefore lead to the diffusion through the air ducts of viral aerosols in certain areas of the building (localized recycling) or throughout the premises (centralized recycling).

In addition, recycling of stale air contaminated by viral aerosols could occur in the air supply ducts if the energy recovery (heat exchange) does not allow the air flow to be adequately isolated from stale blown flow (for example, poorly controlled rotary heat exchanger).

The following recommendations apply to premises heated by forced-air heaters, in which may be present, in particular, people affected by Covid-19 or people at risk of severe Covid-19.

The HCSP recommends to:

- maintain the heating of collective enclosed spaces in order to reach a comfortable temperature in line with the activity of staff and visitors.

- ensure the regular renewal of the air in the premises with a supply of fresh air complying with regulatory requirements (standard departmental health regulations, Labor Code) which should, if possible, be increased. It allows, by dilution, to reduce the concentrations of aerosols potentially loaded with infectious virus. This air renewal is provided by:

    - the air treatment installation which also acts as a mechanical ventilation system for the premises with air extraction.

    - natural ventilation by ducts or aeration of enclosed spaces by opening windows, depending on the activities carried out in these spaces (for example, window permanently ajar or open wide at certain times of the day: for example, the start of morning, breaks, late afternoon, cleaning of premises). The heating will be adjusted to take into account the ventilation.

  The continuous measurement of the carbon dioxide (CO_2) concentration in the air using sensors, the cost of which is not excessive, makes it possible to judge the quality of the air renewal. A target value lower than the guide value of 1000 ppm can be proposed in order to improve the renewal of air in the premises.

  - strictly limit the occupancy gauge to what allows the actual flow of fresh air entering the room while respecting physical distancing. The operator will check or have this fresh air flow checked regularly, such as the efficiency of the doors.

  - ensure compliance with the rules for the design, construction and regular maintenance of forced-air heaters and air treatment installations (with data recording) and in particular:

    - periodically clean the air diffusers, batteries and filters of the devices, based on the manufacturer's instructions, to reduce clogging problems and promote the proper functioning of the equipment.

    - not to spray or spray detergents / disinfectants on the filters and batteries so as not to inhale chemical residues during the operation of the device.

    - check the ease and safety of opening windows (mechanical, size).

- keep forced air heaters and mechanical ventilation systems in continuous operation, possibly with a reduction in ventilation rates during the night when the building is not in use or by modifying the on / off schedules, by starting two hours earlier before the building opens and stopping two hours after the building closes. It is recommended to check that there are no obstacles to the proper functioning of the air distribution in the rooms (curtains, objects, plants, etc.).

- eliminate the air recirculation function of the air treatment installation to avoid the possible transfer of viral aerosols in several rooms. When it is not possible to completely desactivate recirculation due to design operating specifications, it is recommended that the system be

operated by adjusting and modifying the amount of fresh air required and reducing the amount of recirculated air. In addition, if possible, it is recommended to open the windows at least for a few minutes several times a day in order to further increase the level of air change.

- ensure during the winter season that the humidity is not too low, that is to say less than 40%, in order to limit the formation of aerosols.

These recommendations, drawn up on the basis of the knowledge available on the date of publication of this statement, may change depending on the updating of knowledge and epidemiological data.

Statement written by a group of experts, whether or not they are members of the High Council for Public Health. Validated on October 14, 2020 by the Chair of the High Council for Public Health.

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Appendice 1 – Request of the General Director of Health, September 7, 2020

De : SALOMON, Jérôme (DGS) <Jerome.SALOMON@sante.gouv.fr>
Envoyé : lundi 7 septembre 2020 09:19
À : CHAUVIN, Franck (DGS/MSR/SGHCSP) <franck.chauvin@sante.gouv.fr>; HCSP-SECR-
Objet : Demande d'avis relatif à l'utilisation des appareils de chauffage dans le contexte de l'épidémie de Covid-19
Importance : Haute

Monsieur le Président, Cher Franck,

Dans le contexte d'épidémie de Covid-19, l'approche de la saison hivernale me conduit à vous solliciter afin de disposer de recommandations concernant l'utilisation de certains appareils de chauffage, notamment dans les espaces clos collectifs.

En effet, des questions se posent quant aux risques de transmission potentielle du virus SARS-CoV-2 associés à certains modes de chauffage, comme par exemples les aérothermes, dont le ventilateur projette l'air chaud vers la pièce à chauffer, ou les systèmes équipés d'un bloc ventilo-convecteur, brassant ou recyclant l'air des pièces. Ces dispositifs sont utilisés dans divers lieux (salles de classe, lieux de travail, salles de sport/gymnases, commerces, etc.) où, dans un grand nombre de cas, ils constituent la seule source de chauffage des locaux.

Ainsi, en complément notamment de l'avis du 6 mai 2020 relatif aux vagues de chaleur qui aborde la question de l'utilisation des ventilateurs, je vous demande de bien vouloir m'indiquer quelles préconisations sont à associer à l'utilisation de ces différents types de chauffage afin de prévenir les risques de transmission du virus SARS-CoV-2.

Vous pourrez adapter, si besoin, ces préconisations aux cas de figure qui seraient à considérer, notamment en termes de populations (personnes atteintes par la Covid-19, personnes à risque de forme grave de Covid-19, milieux scolaires, etc.), de lieux (espaces partagés, lieux extérieurs, transports, locaux avec volumes importants, etc.) potentiellement concernés, et de respect des mesures barrières (notamment le port du masque obligatoire). Ces préconisations intégreront le nécessaire renouvellement régulier de l'air des espaces clos et pourront prendre en considération les infections épidémiques hivernales récurrentes.

Compte tenu de l'approche de la période de chauffe, une réponse pour le 30 Septembre serait souhaitable.

Merci beaucoup d'avance
Amitiés,

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Appendice 2 – People interviewed (France)

Technical Center for Aeraulic and Thermal Industries (CETIAT), France

François Battistoni, Engineer
Bernard Brandon, General Director

Association of Air Conditioning, Ventilation and Refrigeration Engineers and Technicians (AICVF),

Francis Allard, Chair of an International Committee inside AICVF
Christian Feldmann, Member of the Editorial Board of Journal's CDC of AICVF

Scientific and Technical Building Center (CSTB), France

Thi-Lan Ha, Head of the Biological and Air Contaminants Division
Jacques Ribéron, Engineer in the Health and Comfort Department

Union of Thermal, Aeraulic and Refrigeration Industries (UNICLIMA), France

Violaine Ohl-Gasteau, Technical Manager for Air filtration and purification and Communication

Annexe 3 – Composition of the working group that developed these recommendations

Qualified members of the Specialized Commission *« Infectious and emerging diseases », CS MIME:*

- Daniel CAMUS
- Christian CHIDIAC, Chair of the CS MIME, Chair of the permanent committee Covid-19
- Jean-François GEHANNO

Qualified members of the Specialized Commission *« Health System and Patient Safety », CS 3SP:*

- Serge AHO-GLÉLÉ
- Didier LEPELLETIER, Co-Chair of the permanent committee Covid-19, pilot of the working group in charge of this statement

Qualified members of the Specialized Commission « Risks related to the Environment », CS RE :

- Jean-Marc BRIGNON
- Philippe HARTEMANN
- Yves LEVI
- Francelyne MARANO, Vice-Chair of the CS-RE
- Jean-Louis ROUBATY, Co-pilot of the Working Group
- Fabien SQUINAZI, Co-pilot of the Working Group

Representative of the French Public Health Agency :

- Anne BERGER-CARBONNE

Representative of the National Agency of Food, Environmental, Occupational Health Safety

- Nicolas ETERRADOSSI
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October 14, 2020

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