

Sustainable and hygienic ventilation in commercial kitchens



Enabling Wellbeing

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Kitchen Ventilation



- Kitchen ventilation already exist since 4000 years.
- Babylonian and Sumerian located an opening in the wall above the fireplace which served as ventilation.
- The inhabitants of Ur named the kitchen “room of nutritious aroma”

Basic requirements



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- Guarantee a hygienic environment for food preparation
- Enable a healthy and safety kitchen environment for staff
- Comply with international air requirement & quality standards
- Extract efficiently heat, humidity and pollutants
- Continuous replacement of polluted room air by clean fresh air
- No substances in the room air like bacteria & micro-organism

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Indoor environment quality

Risk of cooking fumes



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Pollutants are released when roasting, grilling and frying. The products of degradation occur in gas, vapor and aerosol form.

Aerosols are ultrafine particles that are deposited in the lungs. Especially critical are toxic ingredients, particularly: short-chain aldehydes (acrolein, tr-2 hexanal) and polycyclic aromatic hydrocarbons, such as benzene (a) pyrene and the carcinogenic and mutagenic properties.

In addition to acute irritation, especially in the mucous membranes; long-term exposure can cause permanent damage that can result in respiratory diseases.

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Risk of cooking fumes – International Studies

Thiebaud (1995) indicates that the fumes generated by frying pork and beef were mutagenicity. So, the cooks are potentially exposed to relatively high levels of airborne mutagens and carcinogens.

Dutch Government (UWV) show the top 3 of work incapacities (WAO) in 2002:

Stonesculpters 3,4 %

Butchers 3,0%

HoReCa/Catering 2,8%

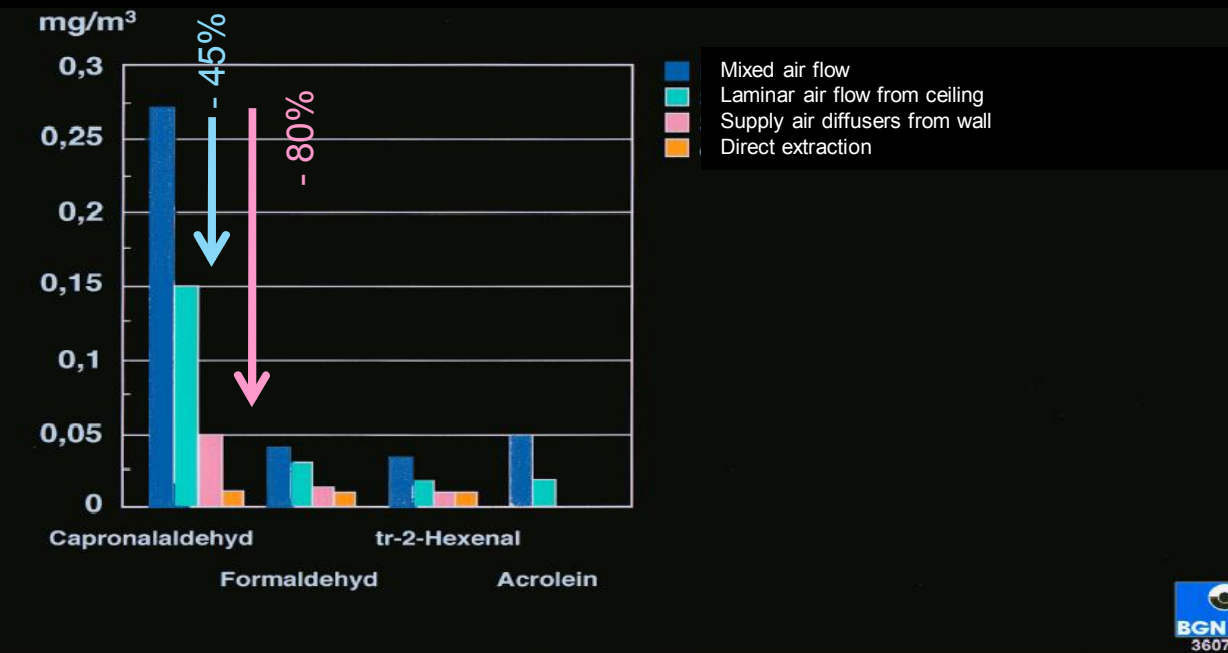
The cancer risk of working in a kitchen is 2 times higher than the risks arising from studying in an air-conditioned classroom

(Guo et al. 2004) - Anne Korpi



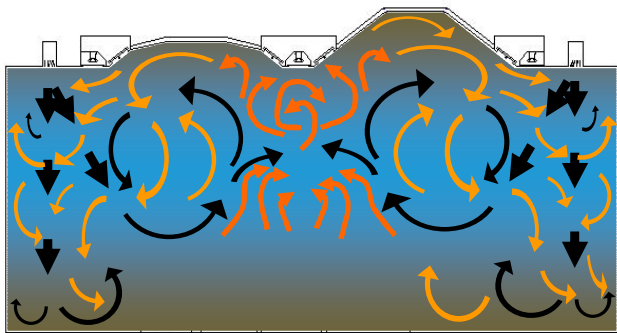
Make up air strategy

Influence of make up air to the concentration of various aldehydes

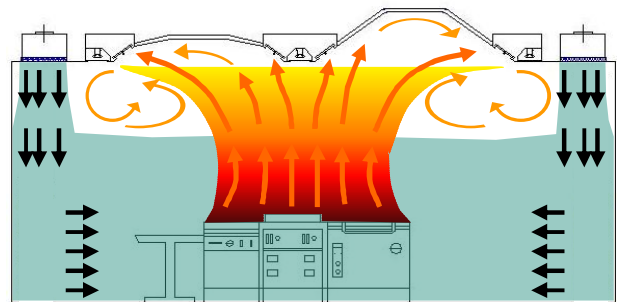
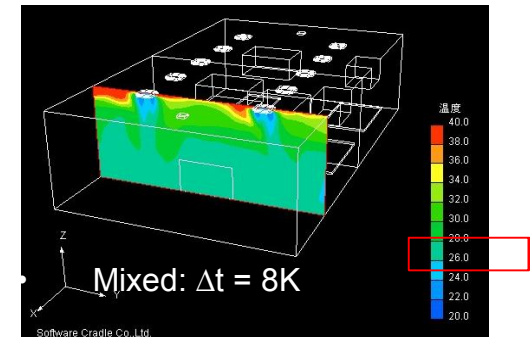


The important impact of the air circulation on the stress situation at the workplace has been explored by the German Food and Restaurant Association

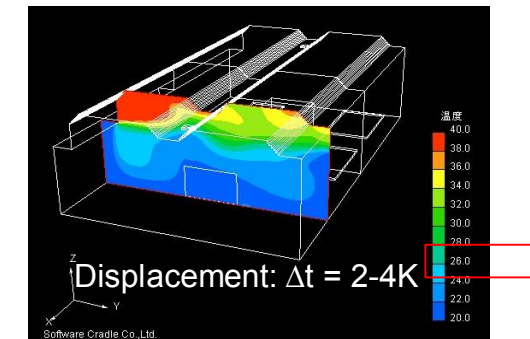
Make up air strategy



Mixed air - system



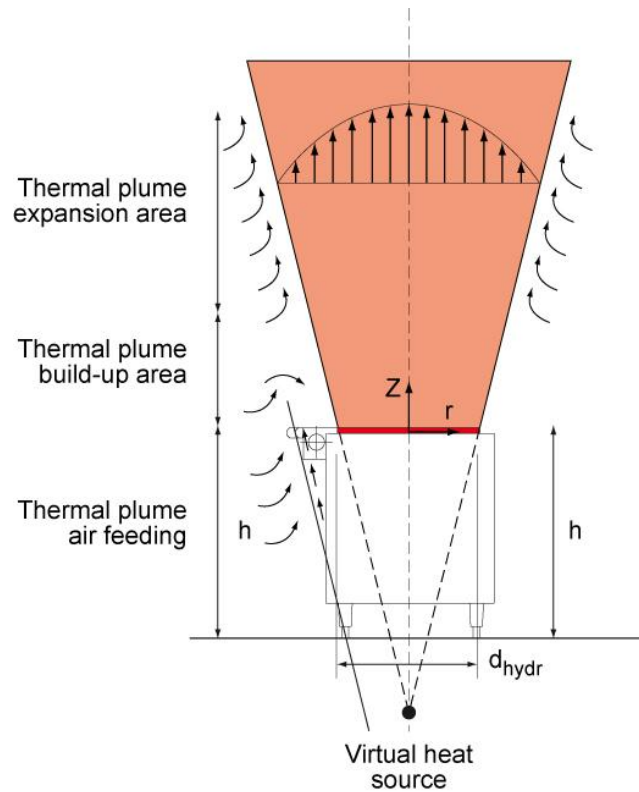
Low velocity - system



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The thermal plume



A free convection flow forms above each kitchen appliance due to differences in temperature or density between:

The air which warm up in contact of cooking appliances
The ambient air.

The flow pattern forms a plume which concentrate all thermal and weight transfers. The plume is fed with the ambient air from the ground.

Exhaust airflow CANNOT be lower than thermal plume!!!

Goal is to exhaust steam and particles with an airflow as near as possible from the thermal plume

EN 16282

Equipment for commercial kitchens - Components for ventilation of commercial kitchens

Part 1: General requirements including calculation method

Part 2: Kitchen ventilation hoods; Design and safety requirements

Part 3: Kitchen ventilation ceilings; Design and safety requirements

Part 4: Air inlets and outlets; Design and safety requirements

Part 5: Air duct; Design and dimensioning

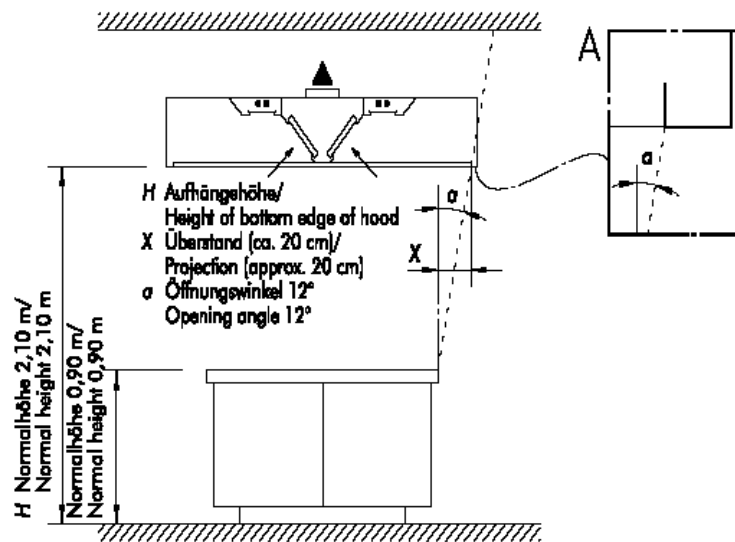
Part 6: Aerosol separators; Design and safety requirements

Part 7: Installation and use of fixed fire suppression systems

Part 8: Installations for treatment of cooking fumes; Requirements and testing

Part 9: Capture and containment performance of extraction systems - Test methods

prEN 16282-2: 2014



Extraction of Part 2:

Kitchen ventilation hoods

Minimum installation height 2,0 m

Minimum overhang: 0,2 m

Opening angle $\alpha \geq 15$

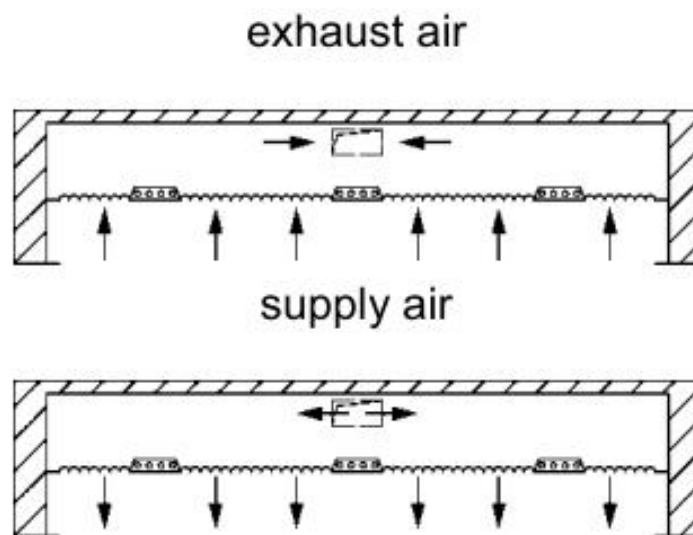
Ovens, steamers with front door ≥ 0.6 m

VDI 2052 – Requirements, DIN 18869

Opening angle $\alpha \geq 12$, Minimum overhang: 0,2 m

Ovens, steamers with front door an overhang of at least: 0.4 m

prEN 16282-3: 2014



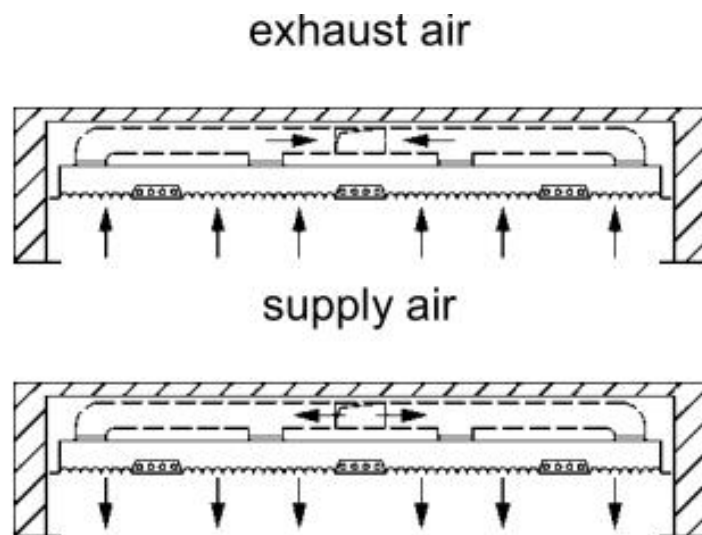
Open ceiling system with ceiling pressure room

Designations: Kitchen ventilation ceiling

EN number: EN 16282-3

Classification: C1

prEN 16282-3: 2014



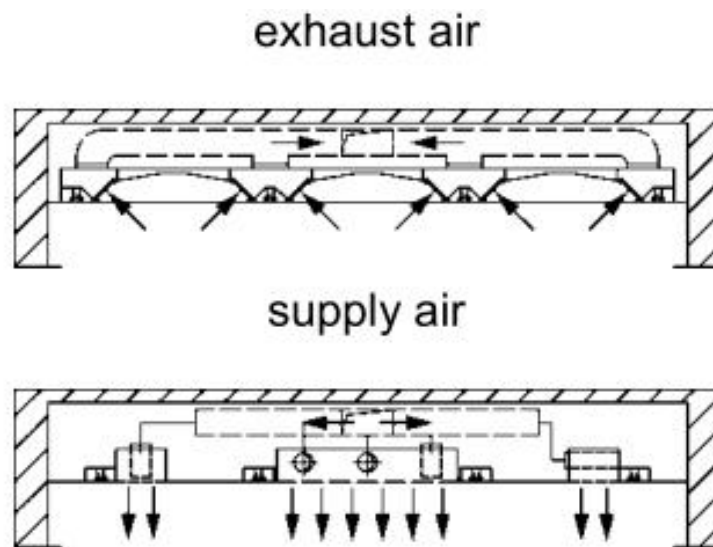
Closed ceiling system with air housing

Designations: Kitchen ventilation ceiling

EN number: EN 16282-3

Classification: C2

prEN 16282-3: 2014



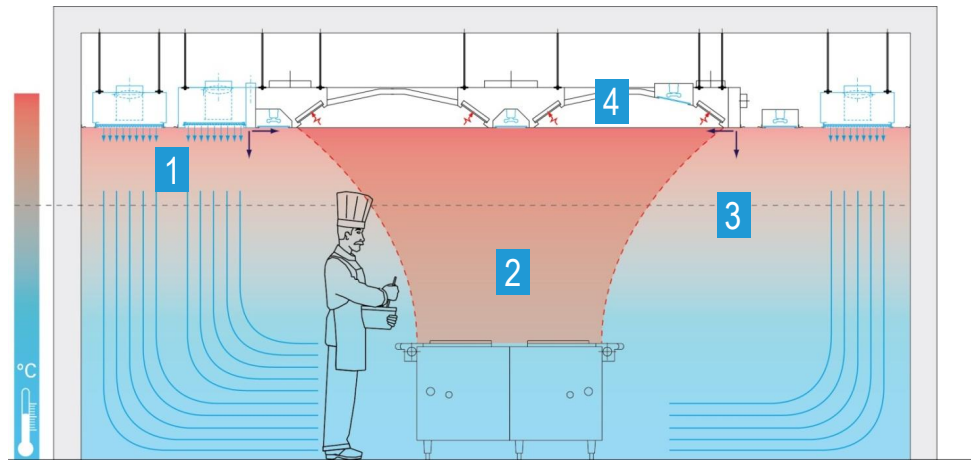
Plenum ceiling system with plenum chamber

Designations: Kitchen ventilation ceiling

EN number: EN 16282-3

Classification: C3

Make up air strategy – Shift zone ventilation



1 - Ceiling laminar flow units

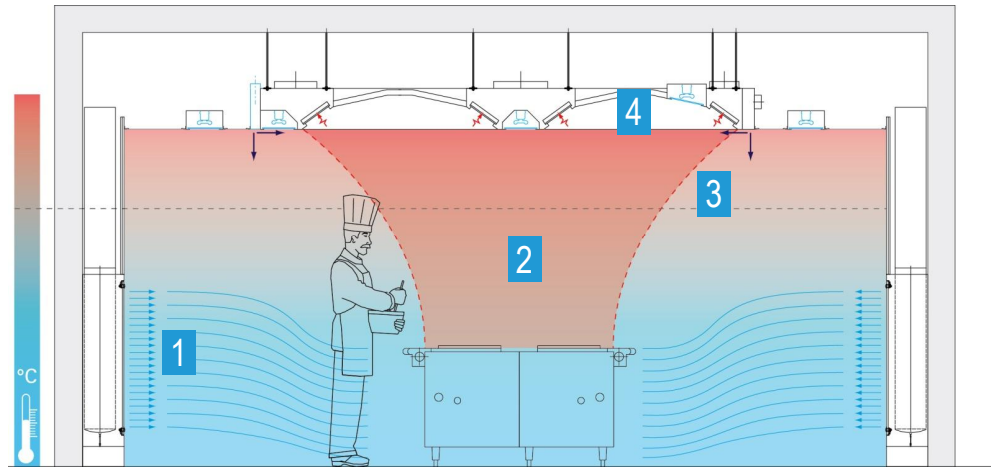
2 - Cooking appliances thermal plumes

3 - Comfort limit height

4 - Ventilated Ceiling

- The air quality in the occupied zone is much better as with mixing flow (Less mixing between fresh and ambient air)
- Heat loads transmitted to the occupied zone reduced by up to 40%
- Temperature reduces by up to 15%
- Much less drafts in the occupied zone leading to the supply units

Make up air strategy – Shift zone ventilation



1 - Low velocity units

2 - Cooking appliances
thermal plumes

3 - Comfort limit height

4 - Ventilated Ceiling

- The air quality in the occupied zone is as good as the one of fresh air (Almost no mixing between fresh and ambient air)
- Heat loads transmitted to the occupied zone reduced by up to 70%
- Temperature reduces by up to 30%
- Less drafts in the occupied zone leading to 1

Make up air strategy – Shift zone ventilation



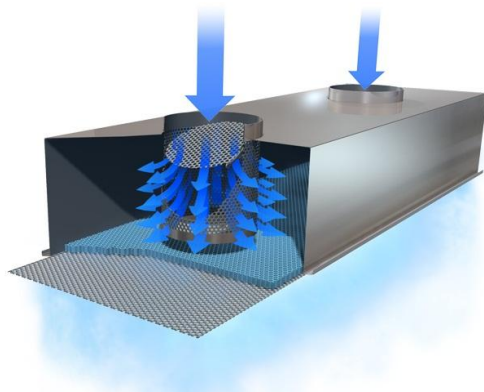
Low velocity units at floor level are not in any case space consuming



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Make up air strategy – Shift zone ventilation



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The air supply modules are designed to spread fresh air through the kitchen at extremely low velocity.

The absence of draughts not only helps to avoid dispersing convective flows from the cooking equipment but also guarantees user comfort.

The modules comprise of a distribution cylinder, which enables flow velocity to be reduced and fresh air to be uniformly distributed in the plenum. The flow is then streamlined, due to the combination of a honeycomb structure and a perforated front.

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Make up air strategy – Shift zone ventilation



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Local air displacement be integrated horizontally at the ceiling level

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Make up air strategy – Mixed air system



- Avoid high velocity diffusers and spot cooling
- Stupid compromises come up

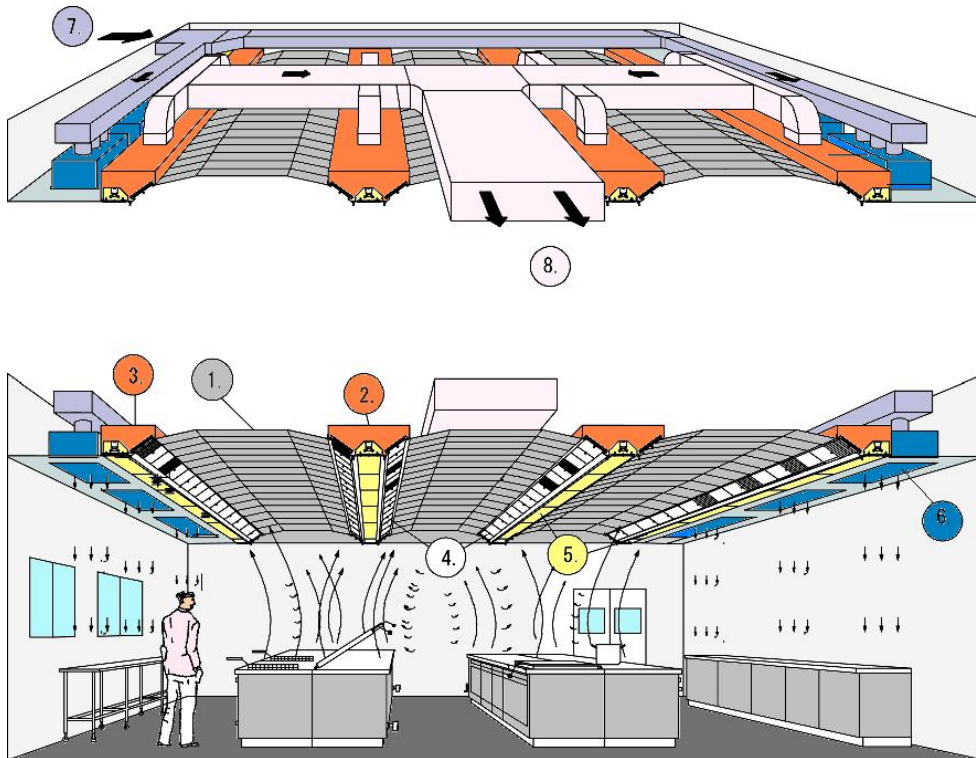
Kitchen ventilation ceiling



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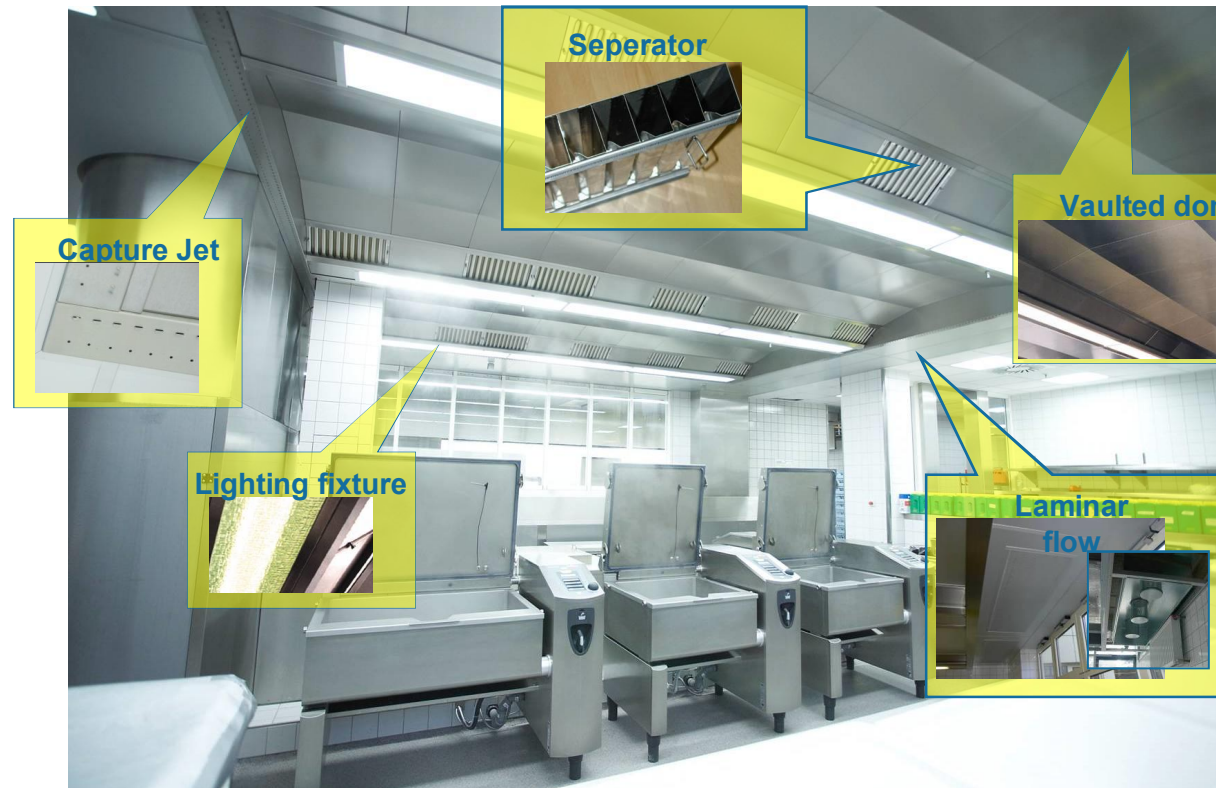
Kitchen ventilation ceiling



Components

1. Vaulted Dome
2. Double Extraction Plenum
3. Single Extraction Plenum
4. Filters / Blind panels
5. Lighting Built in
6. Supply Air Diffusers
7. Supply Air Duct System
8. Exhaust Air Duct System

Kitchen ventilation ceiling



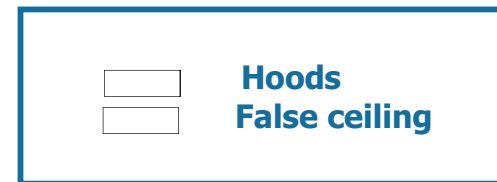
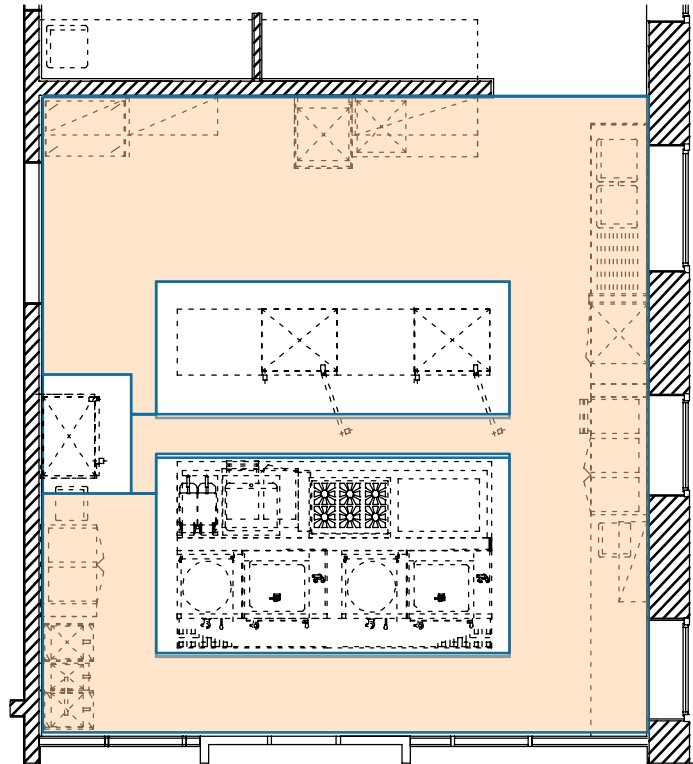
Components

1. Vaulted Dome
2. Double Extraction Plenum
3. Single Extraction Plenum

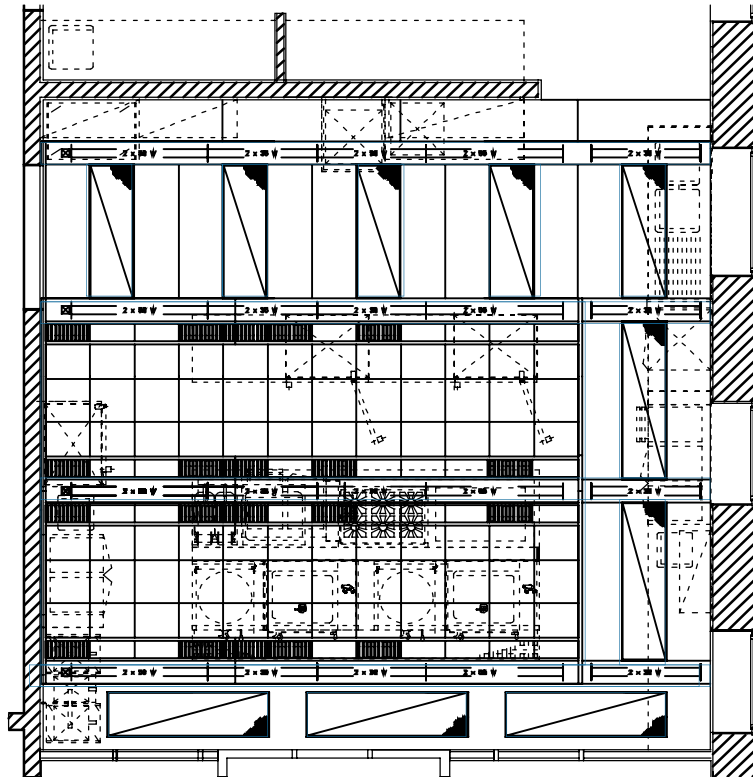
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Kitchen ventilation hoods - Design



Kitchen ventilation ceiling - Design



Exhaust air
Supply air
Lighting built in

Kitchen ventilation ceiling



North Estonia
Medical Centre
(PERH)

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Kitchen ventilation ceiling



North Estonia
Medical Centre
(PERH)



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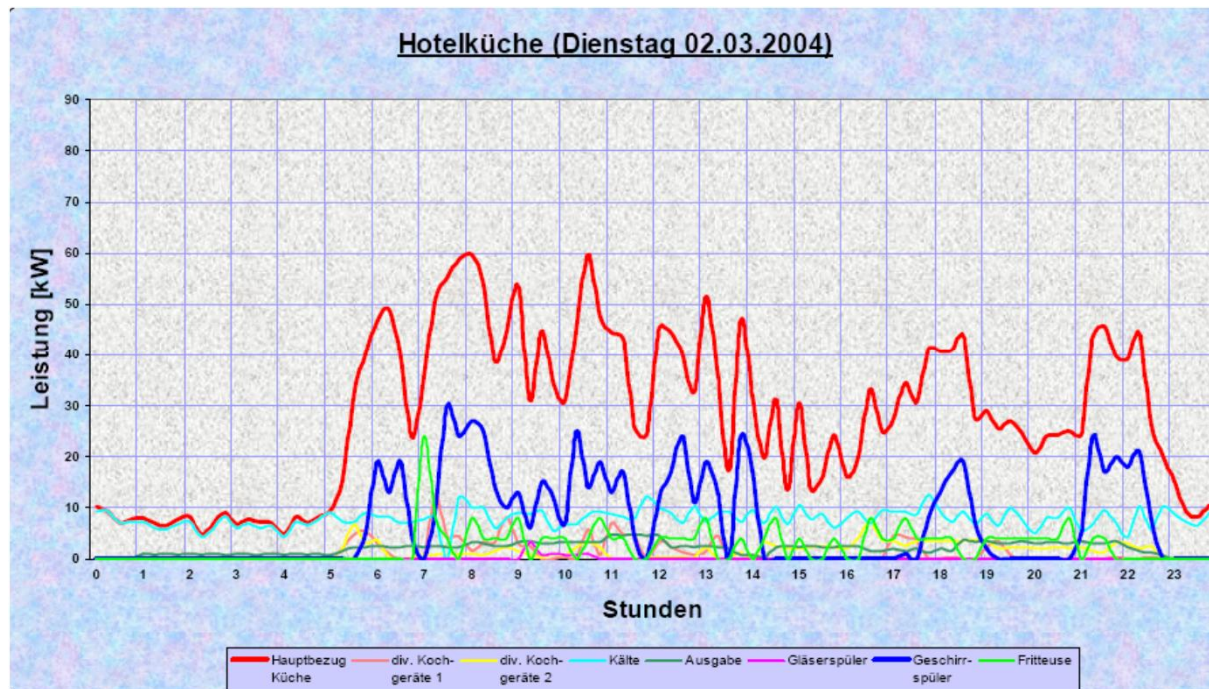
Sustainability - Energy efficiency



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Energy efficiency



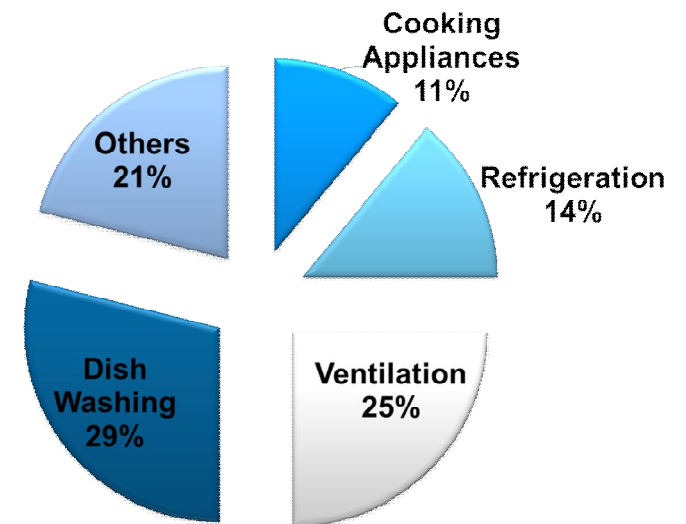
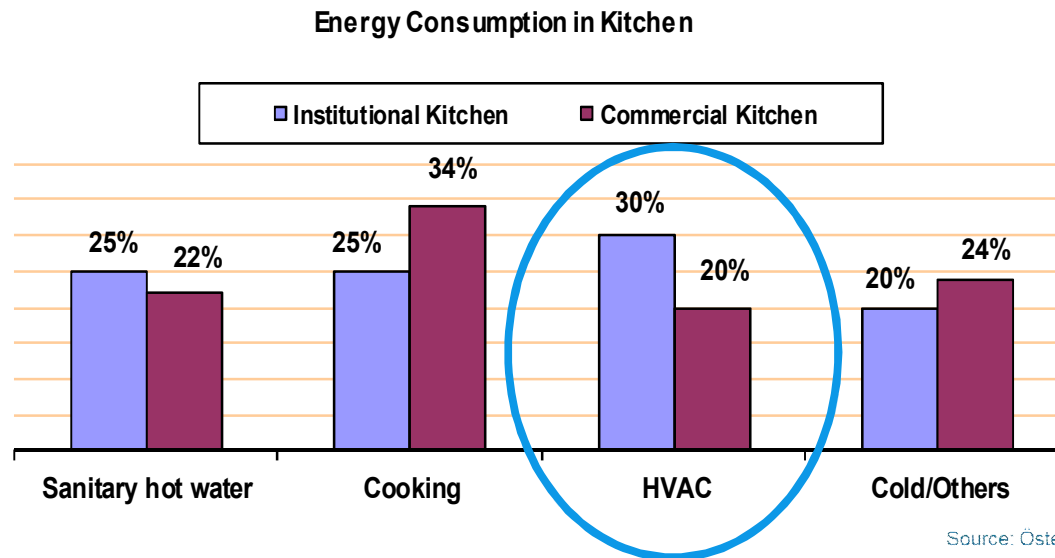
Energy
consumption in a
Cook & Chill
Kitchen

Source: Österreichischer Energiekonsumenten Verband

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Energy efficiency



HVAC accounts for about 20-30% of all energy consumption .

Source: Estimation EDF - publication Néorestauraton N°413 Octobre 2004.

Energy efficiency

Demand control ventilation



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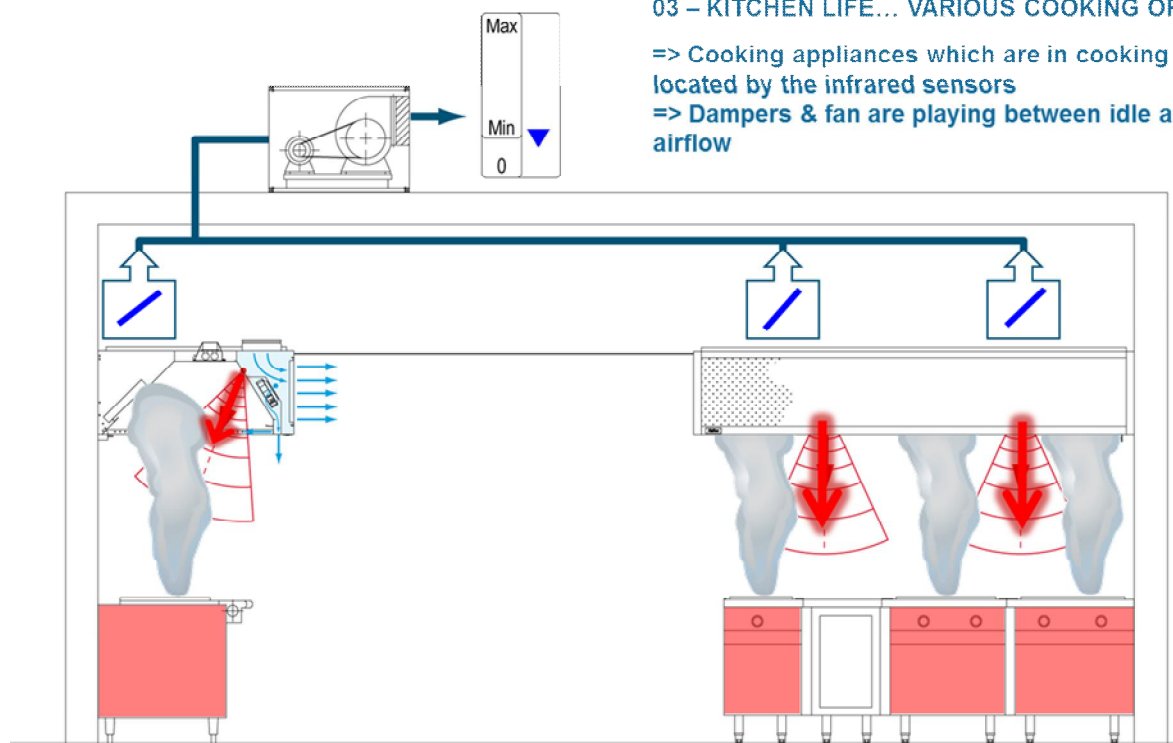
Exhaust airflow is controlled depending on appliance status

- Off
- Idle
- Cooking

Extraction controller detects appliance status via infrared sensor, exhaust air and room air temperature sensors.

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Energy efficiency



03 – KITCHEN LIFE... VARIOUS COOKING OPERATIONS

=> Cooking appliances which are in cooking mode are located by the infrared sensors

=> Dampers & fan are playing between idle and maximum airflow

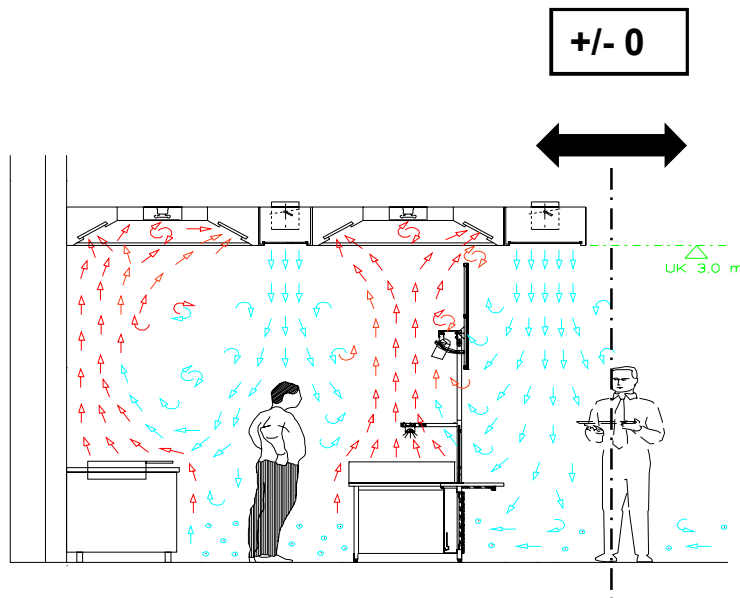
Front Cooking



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Frontcooking - Hygiene Airflow



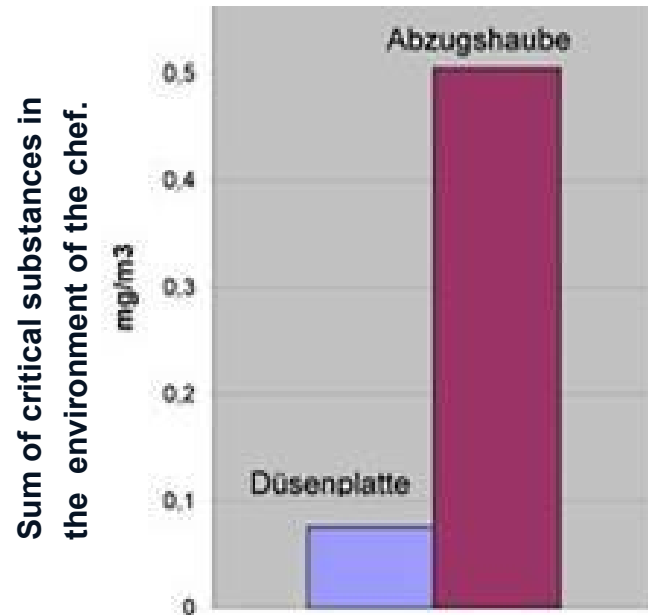
REGULATION (EC) No 853/2004 OF THE
EUROPEAN PARLIAMENT AND OF
THE COUNCIL of 29 April 2004
on the hygiene of foodstuffs

There must be adequate natural or
mechanical ventilation.

Natural or mechanical air flow from a non
hygienic area is not allowed.

Beware of mechanical based air circulation out from a contaminated area (such as a public area).

Frontcooking – Jet Extraction System



Due to the direct extraction above the boiling or roasting kitchen appliances the exhaust efficiency is higher than 95 %.

Frontcooking – Jet Extraction System



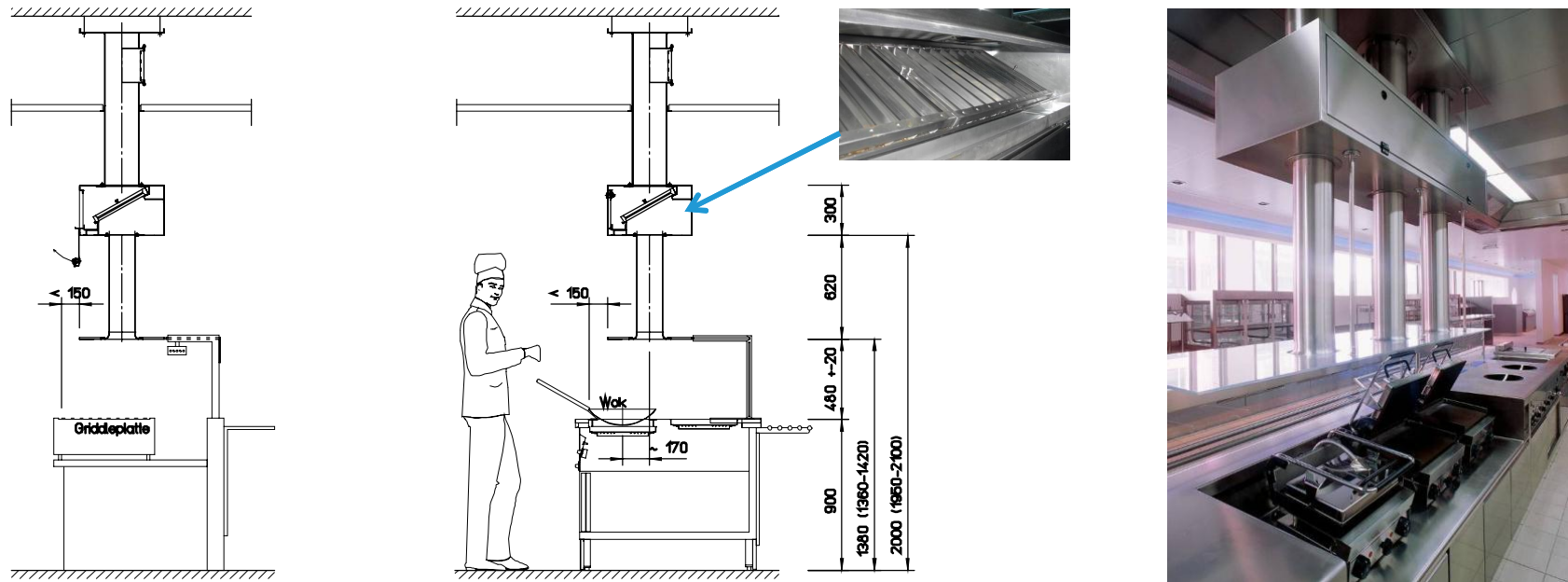
The high filtration efficiency in the exhaust air treatment box reduces the operating costs.

Architectural highlight in every front cooking area.

The glass plate can be used as a shelf for serving meals or as a decorative storage surface.

Kitchen room temperature affects productivity of staff

Frontcooking – Jet Extraction System



At the same time the glass plate serves as a sneeze screen for both the guests and the chefs.

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Frontcooking – Jet Extraction System



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Frontcooking – Jet Extraction System



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Suitable in draft sensitive areas.

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UV-C Air Treatment



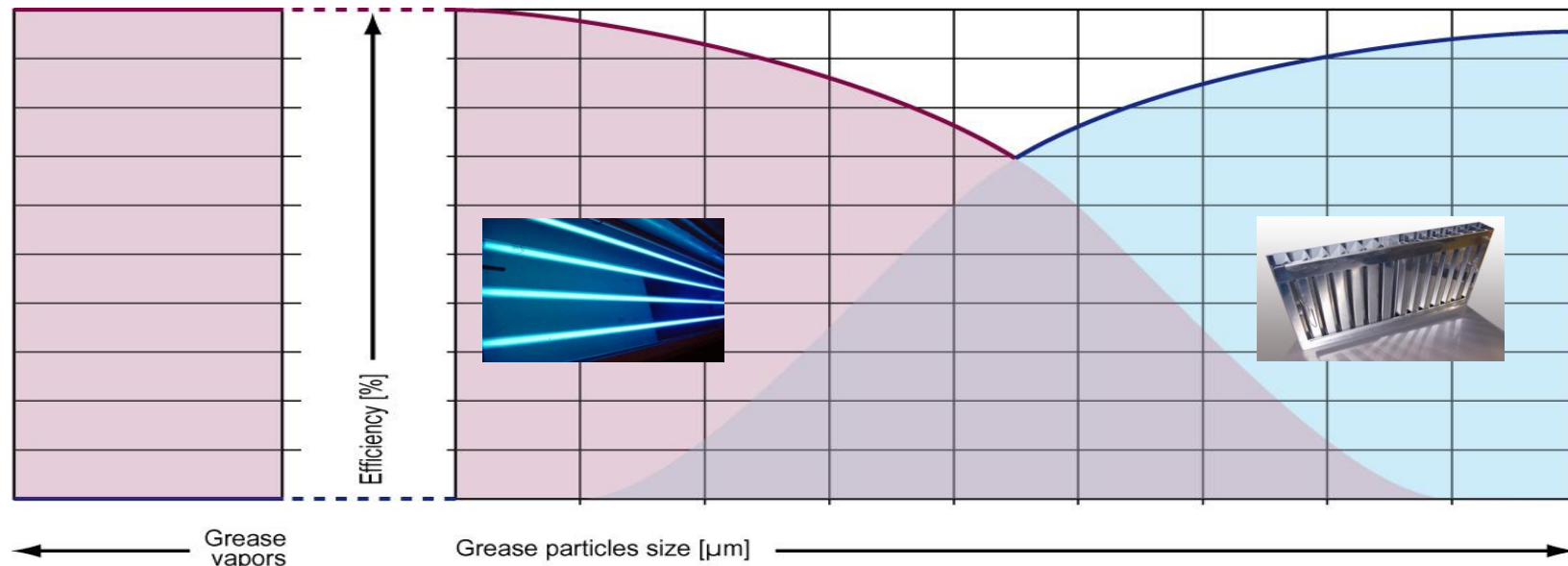
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Installations for treatment of cooking fumes

UV-C System – Improve the filtration efficiency

Schematic profile of FILTER + UV EFFICIENCY on grease particles and vapours

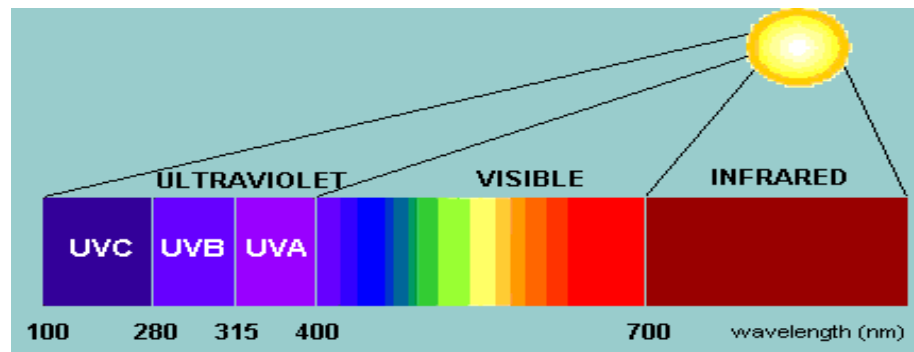


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Installations for treatment of cooking fumes

UV-C System – Improve the filtration efficiency



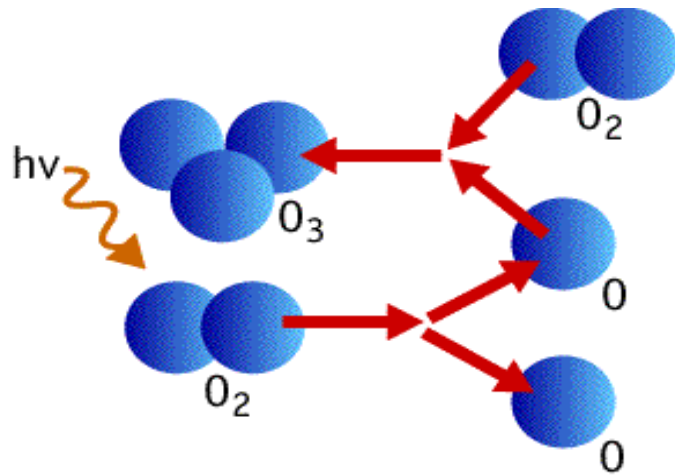
UV light is divided in 3 spectres:
UV-A (allows suntan)
UV-B (provokes sunburns)
UV-C (germicidal properties)

Like the sun's energy, UV can kill microbes, pathogens and degrades organic material.

Further the UV-C spectre is used, providing more powerful radiation and the ability to generate ozone.

Installations for treatment of cooking fumes

UV-C System – Improve the filtration efficiency



THE PHOTOLYSIS

Photolysis is the chemical breakdown of molecules by photons. This is a natural process that is accelerated by the higher energy available in UV radiation.

THE OZONOLYSIS

The ozonolysis takes place at the same time as photolysis and can be extended to the ductwork. Ozonolysis is the creation of ozone or triatomic oxygen to react and oxidise the odours and VOC's.

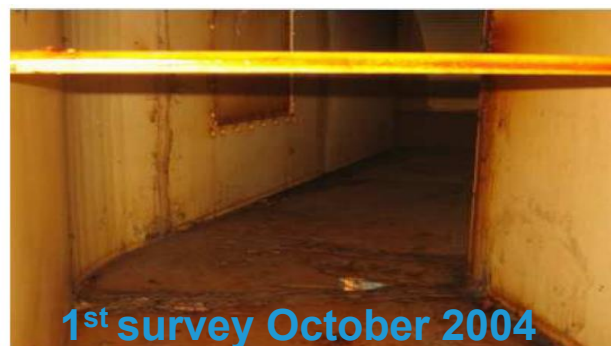
Installations for treatment of cooking fumes

UV-C System – Improve the filtration efficiency



1. Decrease of fat and oil deposit inside the exhaust plenum and the ductwork
2. Decrease the duration and the cost of statutory cleaning operations
3. Decrease ductwork fire hazard
4. Decrease emissions of cold grease odor's
5. Improve the hygienic conditions

UV-C System – Improve the filtration efficiency



Crew Galley, UVC retrofitted end of 2004

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Hotel Dresden, after 2000 hours

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Hygienic



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Hygienic - Dish Washing Area

To Consider



Heat loads

Dishwasher and Wash ware



Humidity loads

Dishwasher, Wash ware, Room



Pollutants

Detergents, mold, germs and bacteria's
from old food



Noise

Dishwasher and Wash ware can
produce up to 105 dB(A)



Lighting

Illumination should fit to the job

Hygienic - Dish Washing Area



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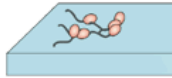
Mold despite a new dishwasher with low „heat and humid“ emissions.

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Hygienic - Dish Washing Area

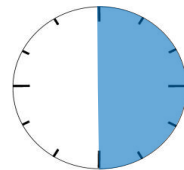
Germ growing in biofilm on wet surfaces

1.
Initial
attachment:



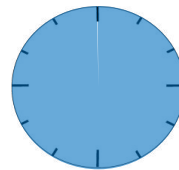
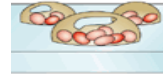
After 2 hours
8 Germs

2.
Irreversible
attachment



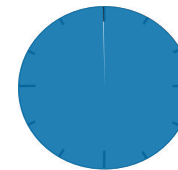
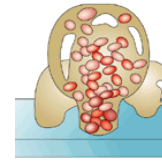
After 6 hours
512
Germs

3.
Colonization I



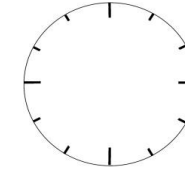
After 12 hours
262.144
Germs

4.
Colonization II



After 24 hours
68.719.476.736
Germs

5.
Dispersion

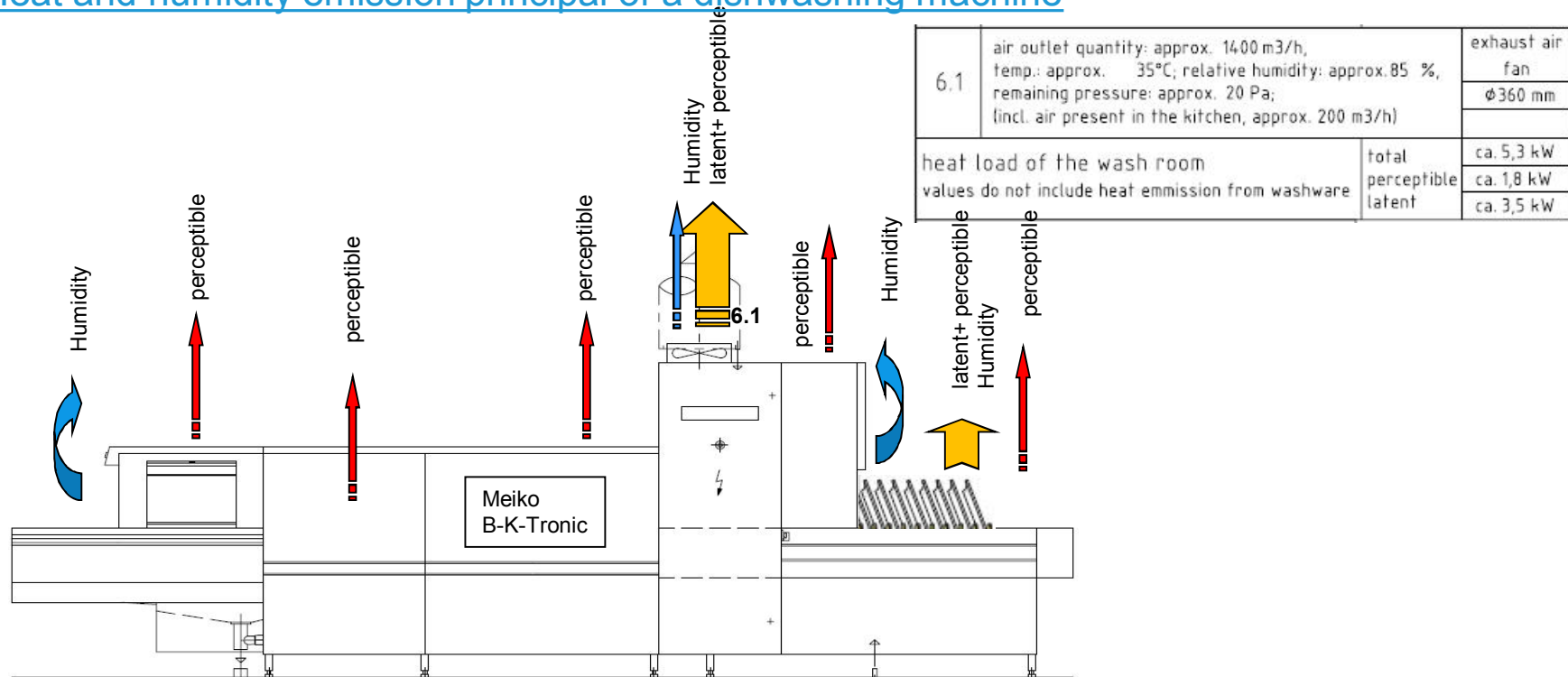


Few hours up
to few month.

The approach! -> To get a kitchen dray within 2 hours after cleaning!

Hygienic - Dish Washing Area

Heat and humidity emission principal of a dishwashing machine



Hygienic - Dish Washing Area

Washing

Dishwashing machine

Sensitive heat emission by convection and radiation caused by dishwashing machine and wash ware.

Latent heat emission by condensation caused by dishwashing machine and wash ware.

Humidity loads caused by dishwashing machine and wash ware.

Cleaning

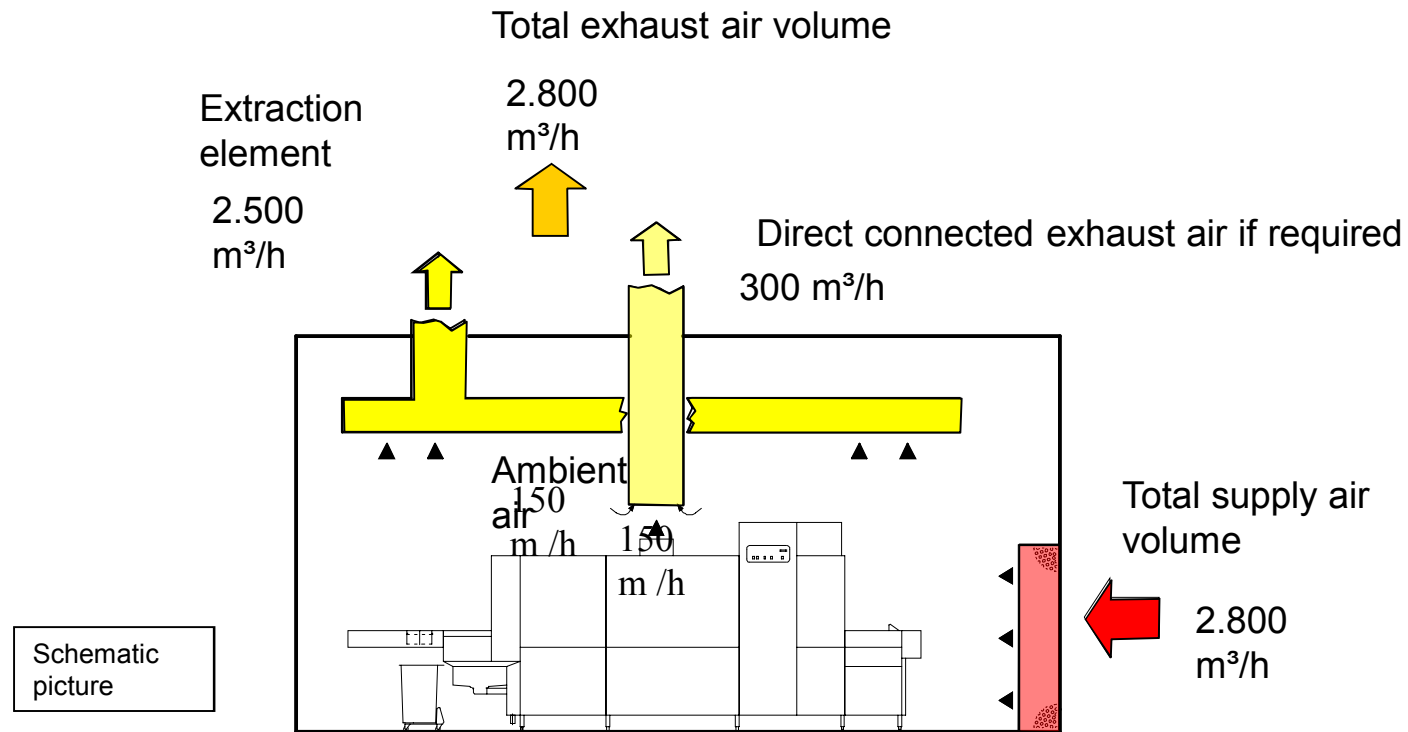
Scullery

Humidity loads caused by surface cleaning.

Humidity loads caused by machine cleaning.



Hygienic - Dish Washing Area



Hygienic - Dish Washing Area



Bad standard in a new kitchen

Misleading information on required air quantities subsequently represents a major problem!

Air cooling units are designed to provide additional cooling and dehumidification.

-> Drafts -> Hygienically very problematic

Hygienic - Dish Washing Area



Bad standard in a new kitchen

Doubtful capture of heat and humidity loads.

Hygienic requirements for the ceiling area are not approached.

Hygienic – Lighting Conditions

Regulations:

Recommendation:

UNCLEAN

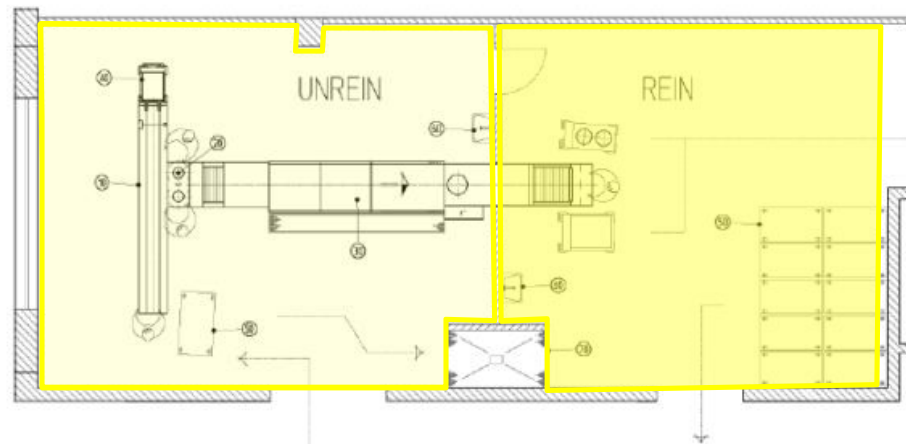
300 Lux

500 Lux

CLEAN

500 Lux

1000 Lux



In the pure range of dishwashing kitchen the quality control of cleaned ware takes place. Respecting this task HALTON recommends 1000 Lux.

Hygienic – Lighting Conditions



Infineon München

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Hygienic – Lighting Conditions



Landesbank
Baden-
Württemberg

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Hygienic – Lighting Conditions



Landeskrankenhaus
Feldkirch, Austria

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Hygienic – Lighting Conditions



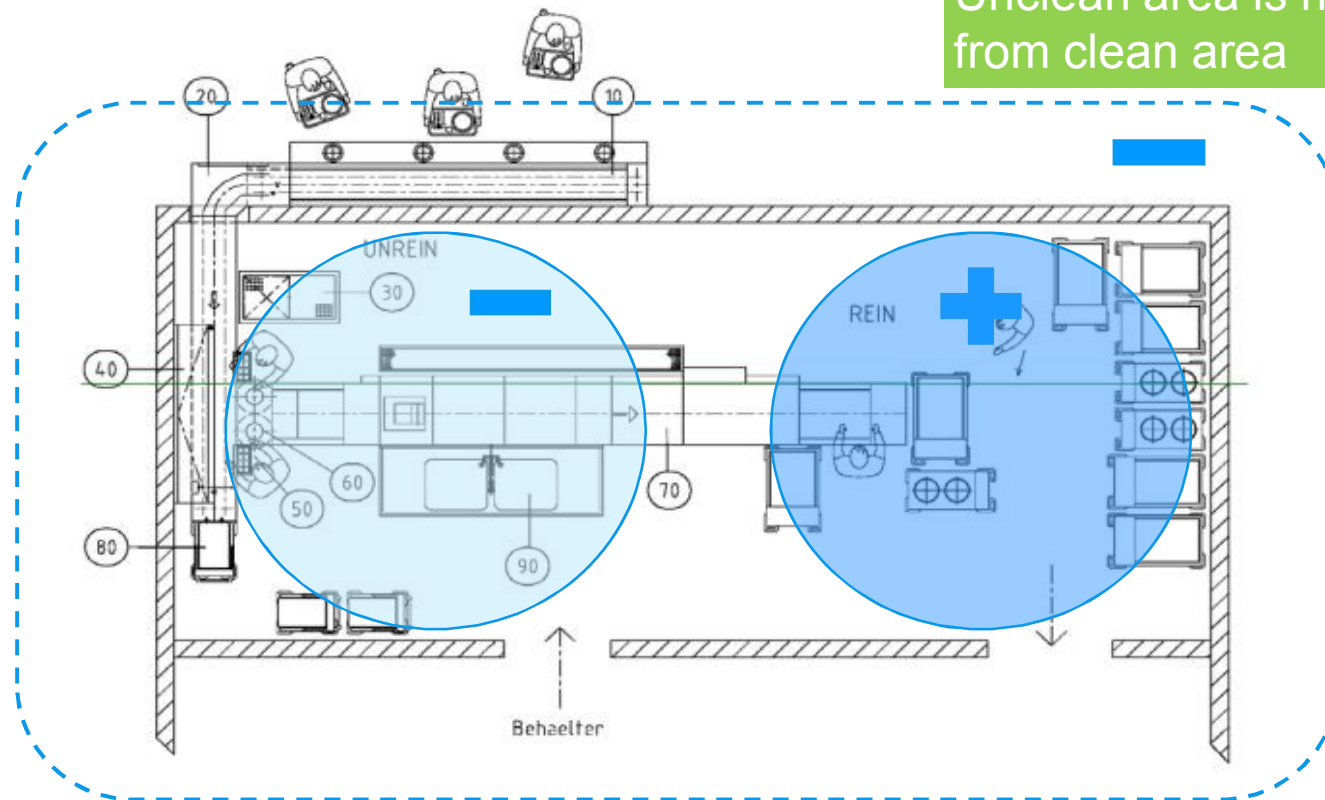
University Mensa
Augsburg, Germany

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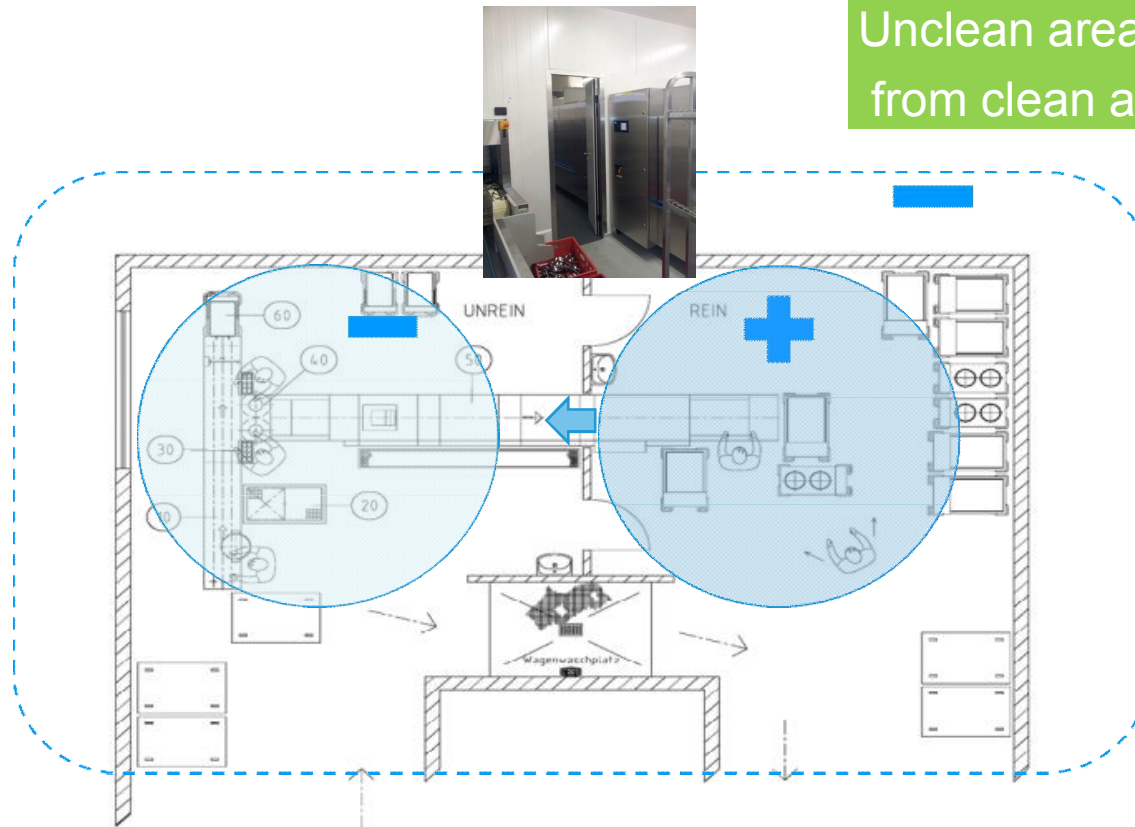
Hygienic – Air Balance

Unclean area is not separated from clean area



Hygienic – Air Balance

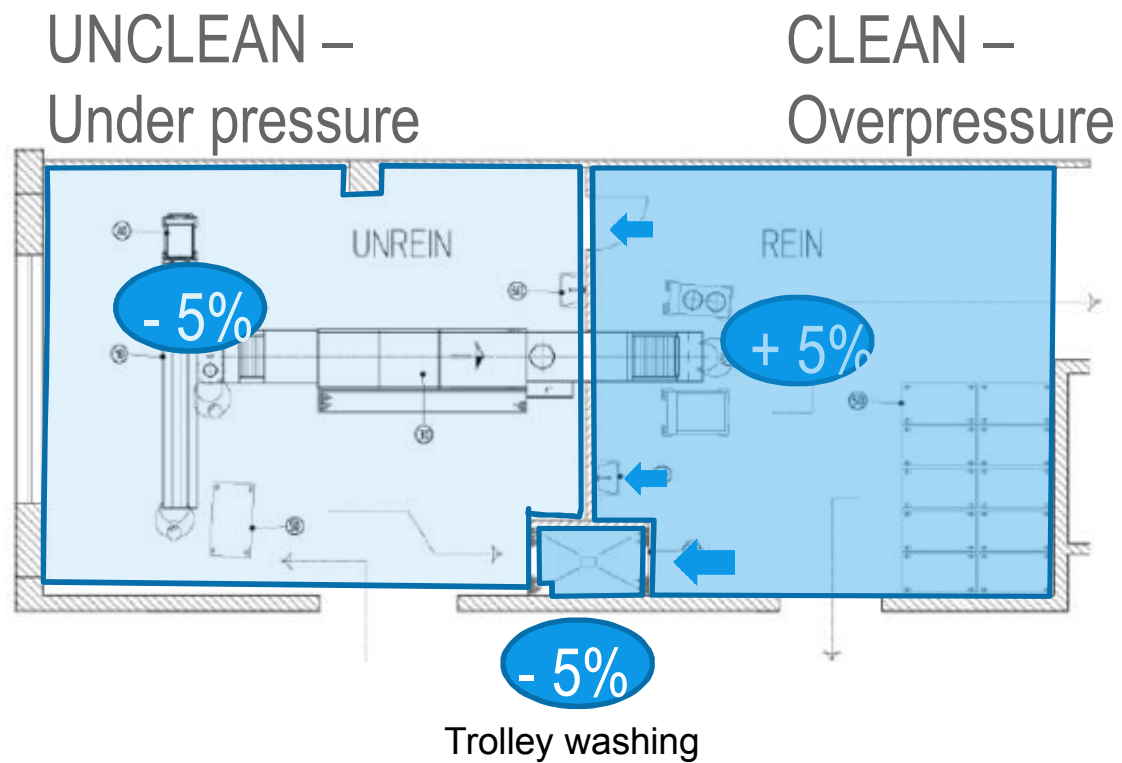
Unclean area is separated
from clean area by a wall.



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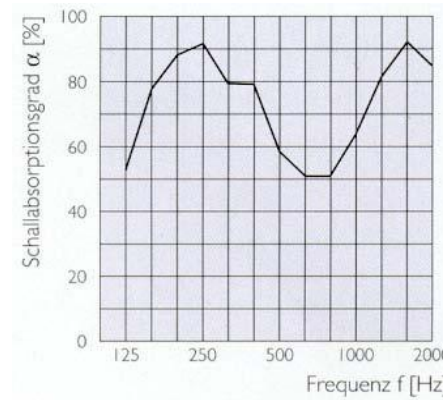
Hygienic – Air Balance



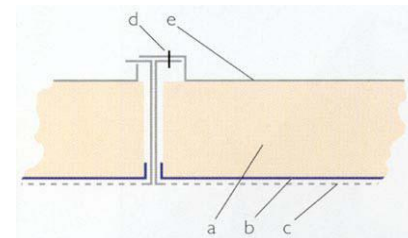
Acoustic Situation



Noise level reduction of about
5 dB to 6 dB (A)
25% to 30%



Schallabsorption nach DIN
52215



- a) Special acoustic foam 20 mm with
- b) PUR-plastic film on front side
- c) Perforated aluminium panel 37%
- d) Screw connection
- e) Cover sheet in galvanized steel

Hygiene – Airflow Frontcooking

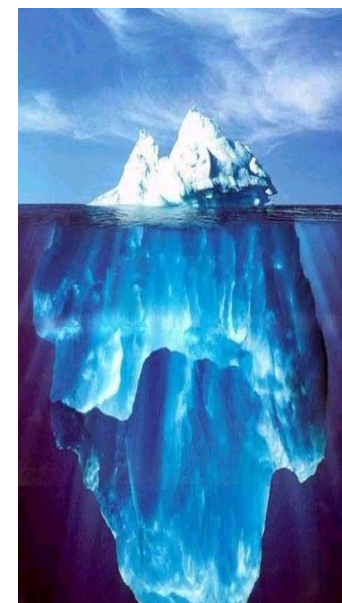
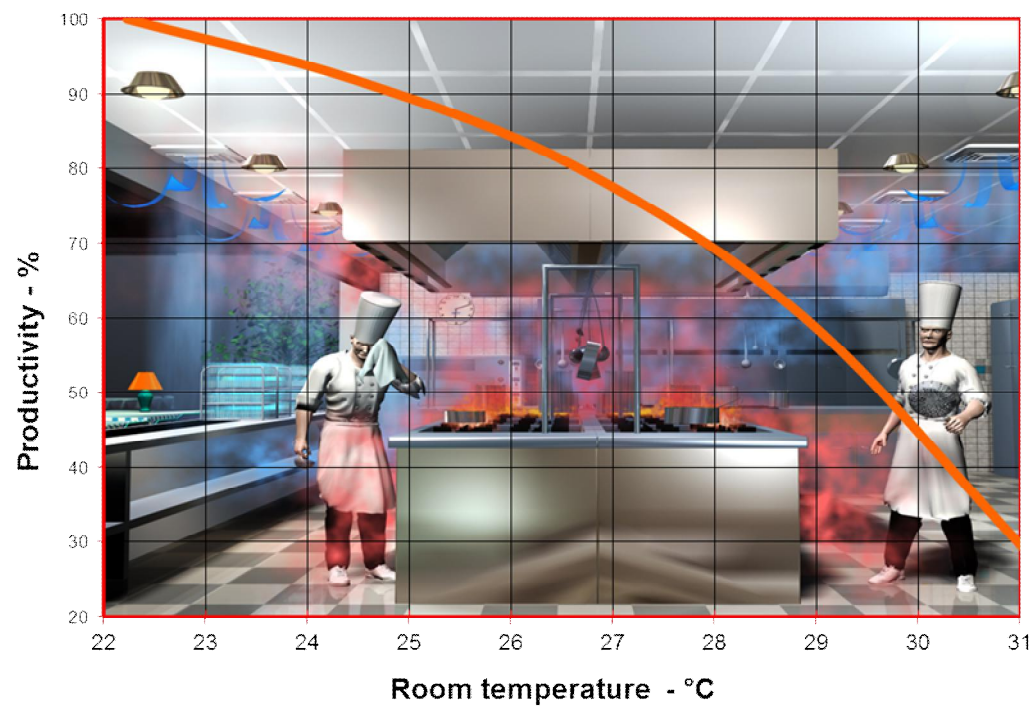


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Indoor Environment Quality



Kitchen room temperature affects productivity of staff

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TÄNAN !

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