从一开始就做对...
这才是最优化。

无菌室

PV Vacuum Engineering Pte Ltd
(A member of Darco Water Technologies Limited)

puzair
A subsidiary of PV Vacuum Engineering Pte Ltd

无菌室清洁

先进的生产方式需要绝对清洁的空气，在大多数情况下，越是小巧轻便的产品，其生产过程对空气清洁度的要求就越高。

例如，在电子行业，超大规模集成电路的生产就需要绝对清洁的制造环境。电路的样板宽度可能是1微米，有时甚至小于1微米。如此一来，在生产过程中，就必须将颗粒污染控制在样板宽度的1/10以下，即不得超过0.1微米。

无菌室的核心是过滤器，而确保为生产过程而创造的清洁环境的可持续性或可靠性至关重要，除房间等级和过滤器的选择等因素之外，还需考虑众多因素。

无菌室清洁就是其中之一，但有时在无菌室设计方面经常会忽略这一点。

与惯性思维相反,便携式高效真空吸尘器不能作为中央清洁真空系统的可选方案。

层流-见图A

无菌室技术方面，为有效清除污染物，需考虑层流(或空气平行流)这一重要因素。当层流波动为非单向时，存在一个重大风险，那就是被污染的空气很有可能会被导入气流，而污染物的移动也会因气流的带动而加剧。大多数层流系统标准已考虑到这点，并针对流速度分布提出了确切要求。

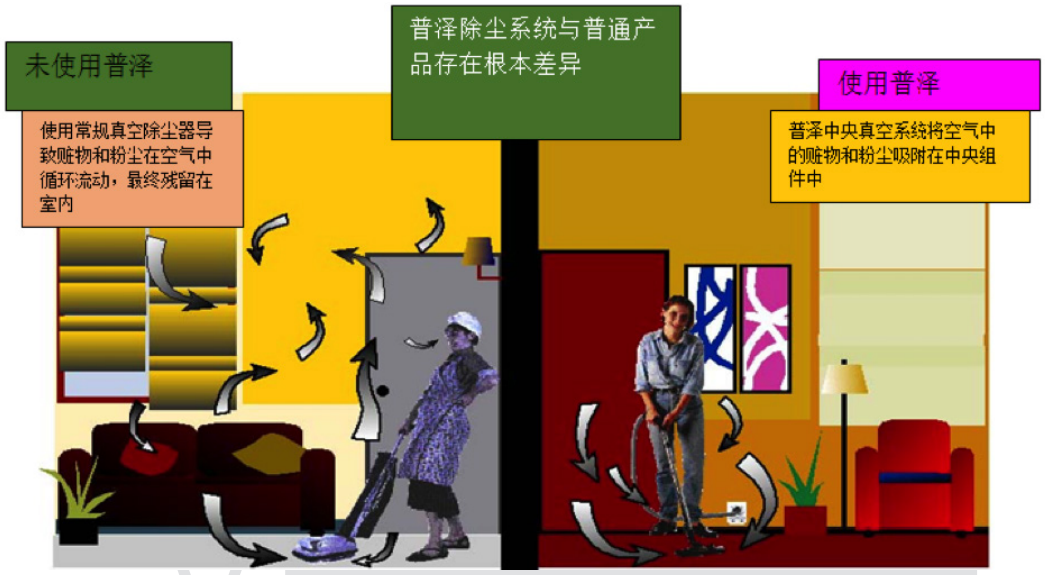
如果过滤器的过滤能力因无菌室工作时产生的不均匀气流而遭到破坏，那么这一原本高效的过滤器将变得一无是处。

便携式高效真空吸尘器在排放的气体时，会连同贴近用户而无法分离的颗粒一起排放在无菌室内。

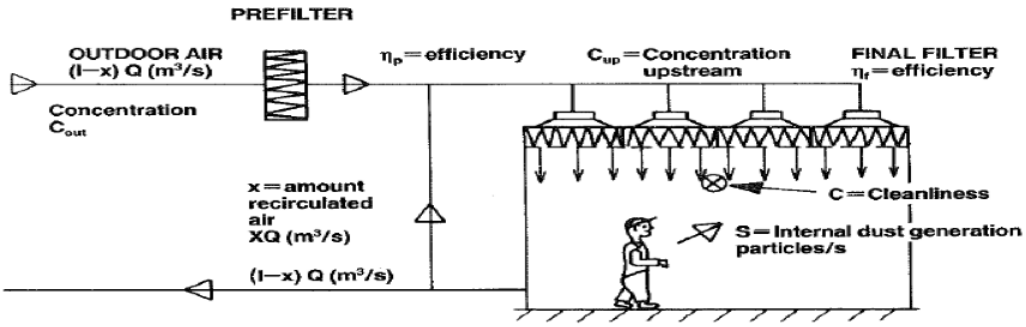
这样的废气会扰乱无菌室中的层流条件，从而产生被污染的空气被导入气流中的重大危险，穿越气流的污染物的移动速度将加剧。

与便携式高效真空吸尘器不同，中央清洁真空系统可将无菌室中被污染的空气和颗粒吸收，将其运离无菌室，并在无菌室外充分过滤后，在远离无菌室的地方排出。

因此，中央清洁真空系统在清洁过程中不会扰乱无菌室内的层流条件。



层流-无菌室 – 图A



Concentration upstream FINAL FILTER

$C_{up} = x\ S/Q + (1-x)\ (1-\eta_p)\ C_{out}$

Cleanliness CLASS downstream FINAL FILTER

$C = [x\ S/Q + (1-x)\ (1-\eta_p)\ C_{out})]\ (1-\eta_F)$

Special Case

A. 100 % outdoor air: x = O

$C_{up} = C_{out}\ (1-\eta_p)$ (conc. upstream)

$C = C_{out}\ (1-\eta_p)\ (1-\eta_f)$ (Cleanliness Class)

B. 100 % recirculated air: x = I

$C_{up} = S/Q$ (conc. upstream)

$C = (1-\eta_f)\ S/Q$ (Cleanliness Class)

有效清洁

便携式高效真空吸尘器的主要设计标准是“便携”，而非“清洁”。为什么？

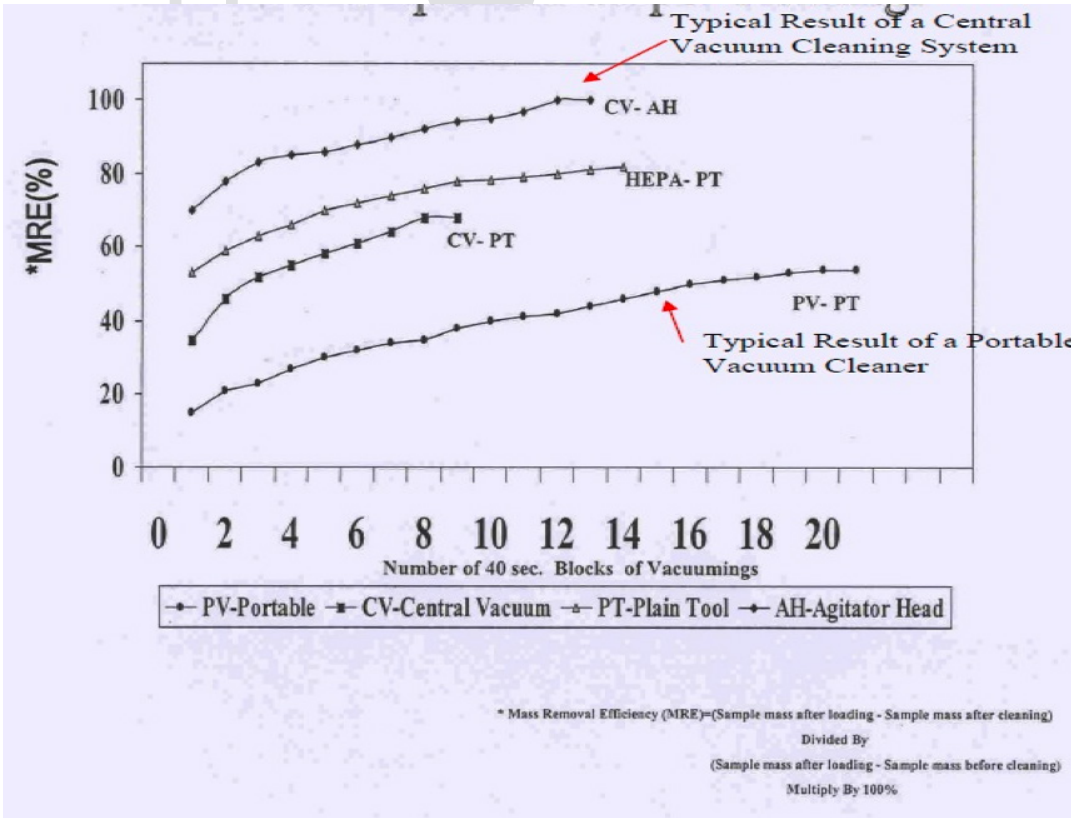
因为如果失去便携性，它的清洁功能也将无法实现。

常规理念告诉我们，便携性和高效清洁性能二者不可兼得；便携性的提升将以真空清洁效率的降低为代价。便携式真空排气机(电动机)很小，因此吸附能力也不足。便携式过滤器吸附赃物的空间有限，因此根本无法吸附所有的赃物。就是这么简单。

许多便携式真空吸尘器的评级与销量都取决于它们的空载真空能力。在机器未运转时，既未带动空气流动且未运行，对其进行评级是不切实际的。如果清洁是预期功能，那么就算这台机器能够拾起保龄球或抬起水柱也毫无意义。打开机器的进气管，空气会大量涌入并撞击真空风扇(电动机)，使其转动减速，从而大大降低产品的吸尘能力。

真正的真空度评级必须将吸尘能力与气流比容相结合。只有当空气流动的时候，空气中的赃物才能被吸附并清除。

设计精良的中央清洁真空系统就不存在此类问题。这是因为中央真空排气机(发生器)无需制成便携式。因此，它的规格定位只需满足主要并且是唯一的设计标准，那就是有效清洁。



延长过滤器使用寿命-节约运营成本

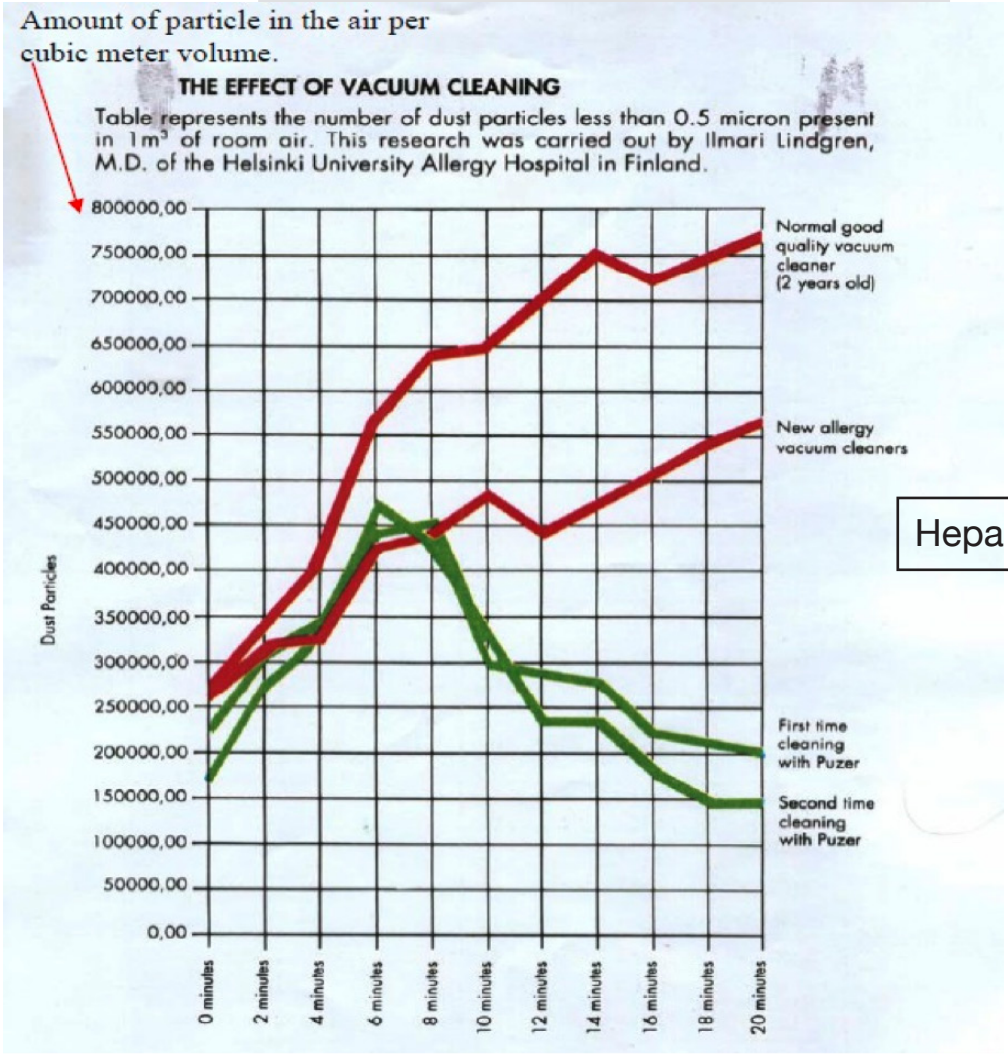
过滤器是无菌室的核心，但与其它类型的过滤器一样，其使用寿命都是一定的。过滤器的寿命在很大程度上取决于它所不断接触的粉尘颗粒数量。

采用更精良的预滤器延长终滤器的使用寿命是一个简单的解决方案。

然而，逃过便携式高效真空吸尘器的高效颗粒空气过滤器的吸附且和废气一起被排出的粉尘体积太小，因而不易被预滤器发现。这些未被吸附的粉尘会加重终滤器的负担，缩短终滤器的使用寿命。

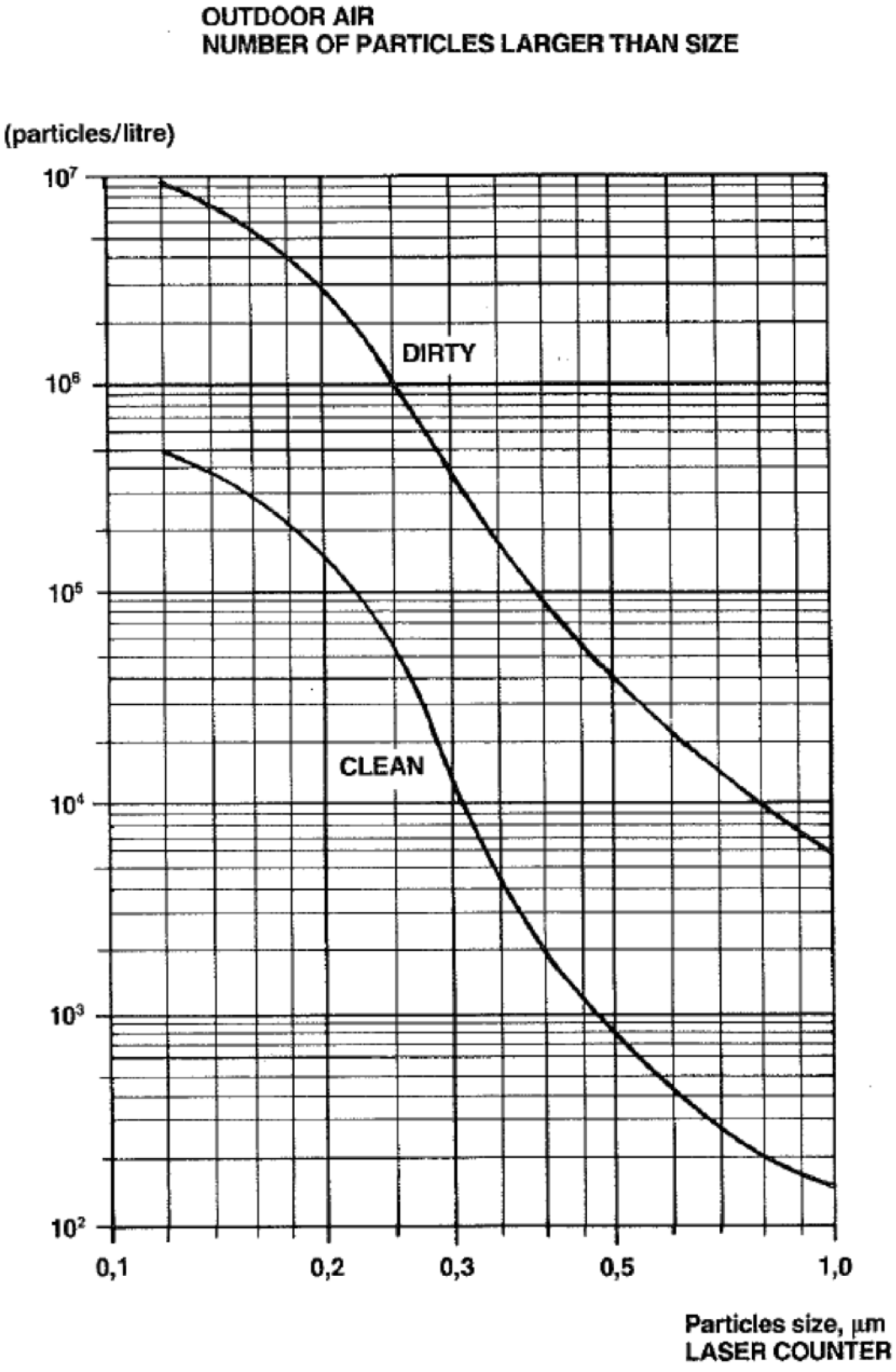
中央清洁真空系统则不存在此类问题，因为中央清洁真空系统可在过滤工作结束之后，将废气连同粉尘一同排放在远离无菌室的地方。

清扫过程中的灰尘数据表

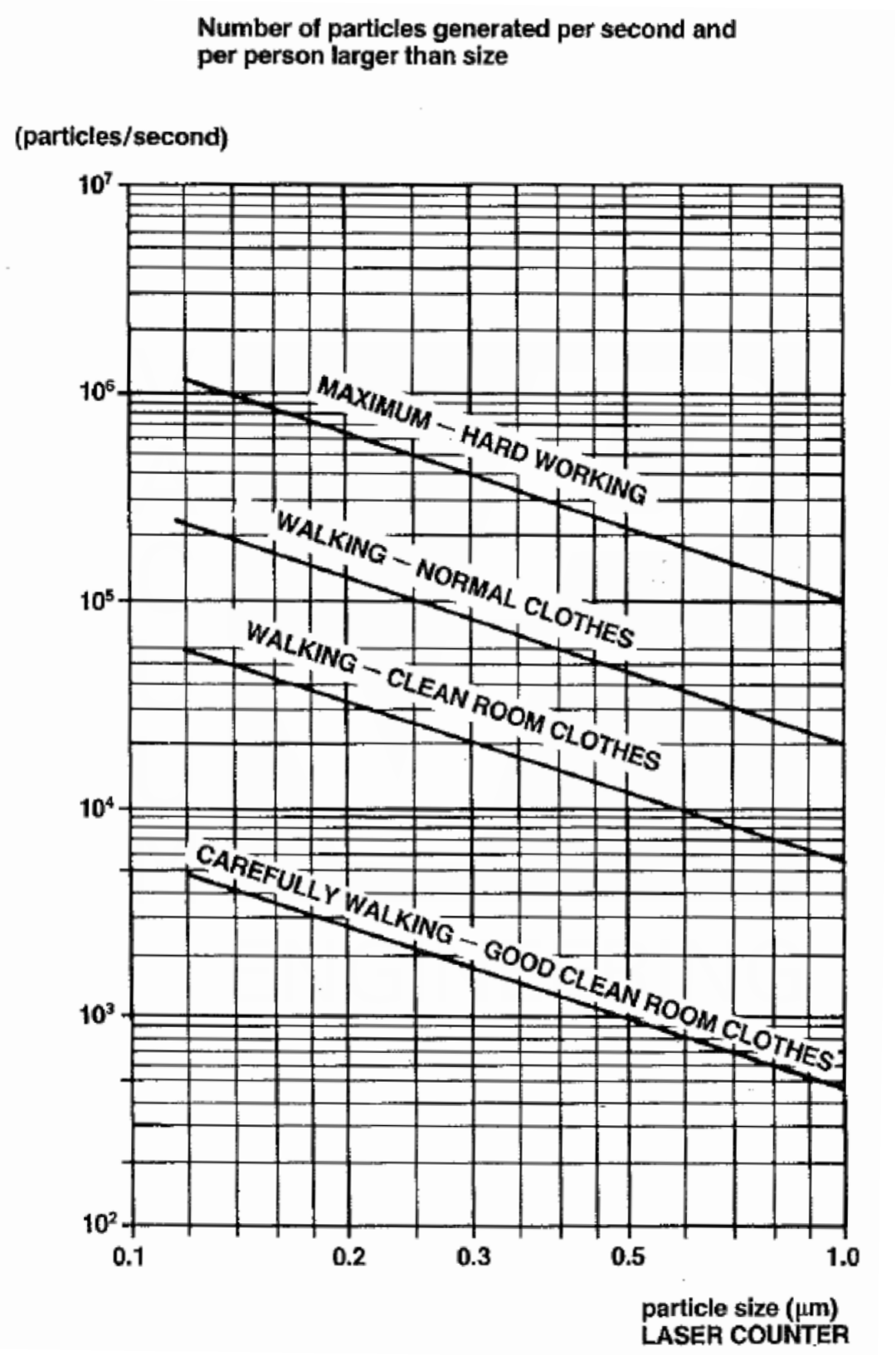


Hepa Type

户外空气颗粒表


OUTDOOR AIR
NUMBER OF PARTICLES LARGER THAN SIZE
(particles/litre)
10⁷
10⁶
10⁵
10⁴
10³
10²
DIRTY
CLEAN
0,1
0,2
0,3
0,5
1,0
Particles size, µm
LASER COUNTER

人类的灰尘产生表


Number of particles generated per second and per person larger than size
(particles/second)
10^7
10^6
10^5
10^4
10^3
10^2
MAXIMUM – HARD WORKING
WALKING – NORMAL CLOTHES
WALKING – CLEAN ROOM CLOTHES
CAREFULLY WALKING – GOOD CLEAN ROOM CLOTHES
0.1
0.2
0.3
0.5
1.0
particle size (µm)
LASER COUNTER

取自于1994年10月版的清洁室

CleanRooms
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Central Vacuum Systems—Effective Particulate Elimination for Cleanrooms

Central vacuum cleaning systems scavenge particulate contaminants from cleanroom floors, walls and furnishings and, unlike portable vacuum cleaners, they evacuate particulates completely out of the cleanroom environment.

Contrary to popular thinking, the work performed by a vacuum cleaner is accomplished by pressure, not suction. Normal room air exerts a pressure of 14.7 pounds per square inch at sea level. Since reducing the pressure inside a vacuum cleaning hose creates a pressure differential, the air in the room will rush toward the low-pressure area and into the hose carrying with it any nearby solid objects. Dirt is therefore pushed through the vacuum system, not pulled.

A cleanroom central vacuum cleaning system consists of a vacuum producer and separator located outside the room, connected to a metal tubing network within the cleanroom walls and/or beneath the floors. Vacuum inlet valves are located inside the cleanroom at convenient points along the tubing runs with vacuum hoses plugged into the inlet valves and fitted with a variety of tools for effective cleaning of walls, floors, ceilings, benches, work surfaces and equipment.

Central vacuum systems are effective for scavenging particulate contaminants from cleanroom floors, walls and furnishings. Unlike small portable vacuum cleaners, which collect and separate contaminants in situ, central systems evacuate particulates completely out of the cleanroom environment to a remotely located separator, preventing recontamination or cross-contamination of other areas. To function effectively, there must be an adequate pressure differential at the cleaning tool so that incoming air will have sufficient velocity to carry dirt particles with it. This pressure differential must also be maintained throughout the hose and tubing system to overcome the system resistance and sustain a conveying velocity.

System Design Criteria

There are four principle factors to consider when designing a central vacuum system: the size and layout of the facility to be cleaned, the location of the vacuum producer, the characteristics of the material to be handled, and the maximum number of simultaneous operators.

A single central vacuum cleaning system can service an individual cleanroom (**Figure 1**), a complex of cleanrooms or an entire facility with office, warehouse, manufacturing, processing and cleanroom areas. Larger cleaning loads, however, will naturally require larger systems with higher vacuum ratings. The vacuum requirement is also influenced by the length of the longest vacuum tubing run in the layout.

Equipment location is also important.

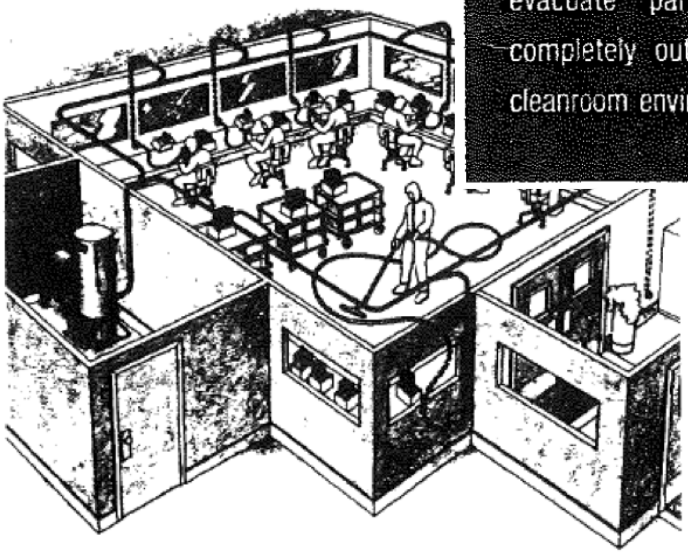

Figure 1. Cleanroom vacuum systems have a vacuum producer and a separator located in an adjacent room and connected via a tubing network to a wall-mounted inlet valve, serving both cleaning and processing applications within the room. Note that exhaust from the central unit is directed outdoors, avoiding chance of cleanroom recontamination.

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