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Airflow Velocities and Cleanrooms: How fast, how slow, and where to measure?

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Introduction

Air is of fundamental importance to cleanrooms, either as a contamination source (microorganisms carried in the air-stream) or as a control measure to minimize contamination (through the supply of clean air and controlling the direction of air movement). Therefore, controlling a cleanroom requires careful attention to the factors of air filtration, air velocity and air flow. While cleanrooms are typically designed to achieve turbulent airflow, with clean air devices, and EU / WHO GMP Grade A / ISO 14644 class 5 areas, the air is designed to be unidirectional whereby the air direction and air velocity are designed to remove any contamination deposited into the air-stream away from the critical area. These devices contain HEPA filters, which control the air-speed and direction.

Unidirectional flow and be defined as an airflow moving in a single direction, in a robust and uniform manner, and at sufficient speed to sweep particles away from the critical processing or testing area with regularity. Hence the object of the unidirectional airflow is to push outward any contamination which might be deposited into the air-stream and to avoid the potential for contamination dropping out of the air, either though gravity or by striking a object, and falling onto a critical surface.

Part of the control of air rests with air direction and this is a factor of airflow velocity. Poor airflow uniformity leads to turbulent airflow and vortex formation. In terms of the velocity of the air, this is described in some regulatory documents: 0,.45 meters per second within arrange of 20%. Whether achieving good airflow (and thereby avoiding poor airflow) needs to conform to the range specified in regulatory guidance documents has been a long-standing issue, particularly given the non-scientific origins of the regulatory guidance values. This article considers regulatory guidance on airflow velocities and the way that these are verified, and whether satisfactory airflow can be achieved outside of these guidance values. The discussion extends to consideration of the verification of these parameters at working height, especially in light of if this the most appropriate location by which to measure air velocities.

Unidirectional Airflow and a Short History of Air Velocities

Unidirectional airflow is obtained through High Efficiency Particulate Air (HEPA) filters. HEPA filters function through a combination of three important aspects. With this, there are one or more outer filters that work like sieves to stop the larger particles of dirt, dust, and hair. Inside those filters, there is a concertina - a mat of very dense fibres - which traps smaller particles. The inner part of the HEPA filter catch particles as they pass through in the moving air stream. There are different grades of HEPA filters based on their ‘efficiency ratings (1).

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