

## Annex A (normative)

### Micro-fan $p$ - $q$ curve measurement method

#### A.1 Scope

In this standard, it is prerequisite for airborne noise measurement to get the  $p$ - $q$  curve of fan under test. Generally, for this purpose, various methods in ISO 5801 based on measurement using an air chamber are quoted.

As set forth in ISO 5801 itself, the lower limit of application of those methods is 12 000 in Reynolds number (See Table 5 in ISO 5801:1997 or Table 4 in 22.4.2, ISO 5801:2007). In this case, Reynolds number 12 000, in terms of lower limit of air flow rate, corresponds to about 0.001 m<sup>3</sup>/s (See Figure A.1).

This Annex specifies the method to find micro air flow-static pressure fan's static pressure-air flow rate characteristics ( $p$ - $q$  curve) which cannot actually be measured by the methods specified in ISO 5801.

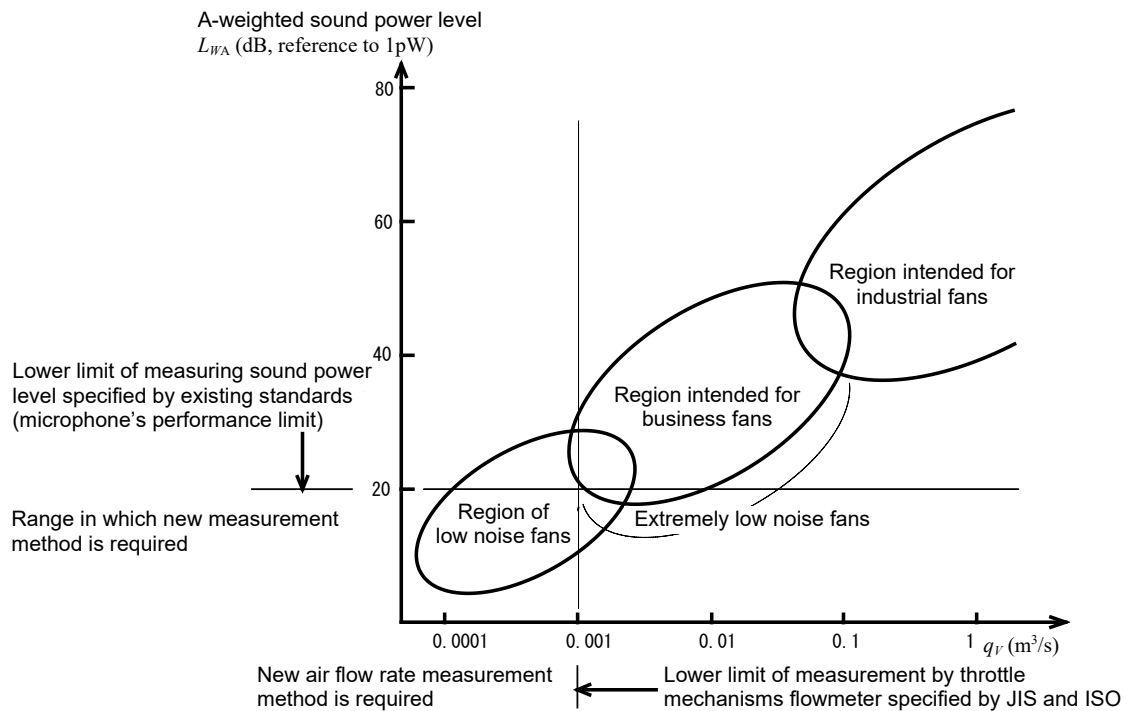


Figure A.1 — Schematic correlation of applicability of this annex and corresponding noise emissions (not to scale)

#### A.2 Limit of application of ISO 5801 and the solution method

##### A.2.1 Air flow rate measurement limit

For computing air flow rate, in ISO 5801, differential pressure type flowmeters such as nozzles, orifices, and pitot tubes are used. Among them, the nozzle is able to measure relatively small air flow rate; however, the lower limit of application of Reynolds number ( $Re \geq 12\,000$ ) is specified in it. Practically, the lower limit of air flow rate measurement range is about 0.01 m<sup>3</sup>/s. Fan's static pressure-air flow rate characteristics ( $p$ - $q$

characteristics) are measured from the maximum air flow rate to the closing point; practically, the fan having maximum air flow rate, 0.001 - 0.01 m<sup>3</sup>/s (0.06 - 0.6 m<sup>3</sup>/min) is the limit of application.

This limit is determined simply by the flowmeter; the part of differential pressure type flowmeter can be replaced by the flowmeter which is able to resolve the problem. However, it is desirable that the flowmeter to be used can be calibrated and traceable to domestic standards.

### A.2.2 Static pressure measurement accuracy

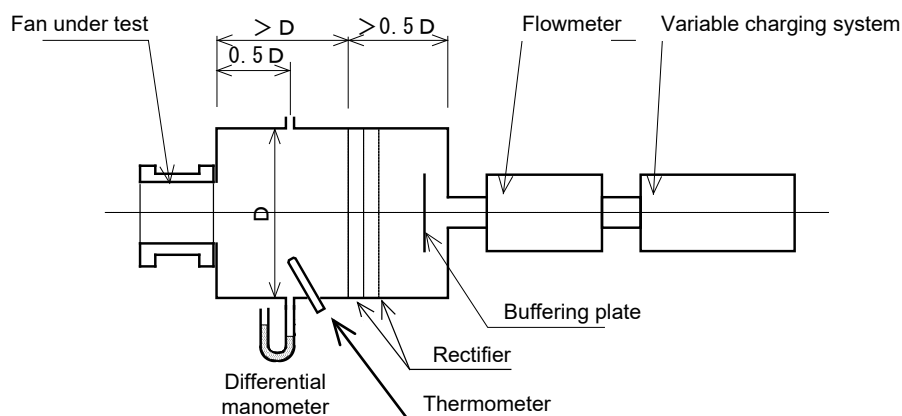
**ISO 5801** specifies that “a manometer used to measure pressure difference has inaccuracy under steady pressure and after making corrections by calibration (temperature difference from the calibration temperature, G-forces, etc.), it should not exceed either  $\pm 1$  % of significant pressure or 1.5 Pa whichever is larger”. For example, in the case of a micro fan having maximum static pressure about 10 Pa, if manometer’s accuracy stays 1.5 Pa, inevitably it becomes 15 % of static pressure measurement range, so it is impractical to set corresponding air flow rate point.

For this reason, in terms of accuracy of manometer for static pressure measurement, in measuring fan’s static pressure-air flow rate characteristics, it follows **ISO 5801**, however, in actual operations, due attentions must be paid to the followings.

- In the case where accuracy of  $\pm 1$  % of significant static pressure is not secured, accuracy of the manometer used is to be recorded.
- The manometer to use shall have  $\pm 1$  % degradation ability of cutoff static pressure of the fan under test.
- Reproducibility (including hysteresis) of zero point (0 point of static pressure) also should be within  $\pm 1$  % of cutoff static pressure of the fan under test.

### A.3 Configuration of micro air flow rate measuring equipment and the scope of application

- Range of air flow rate 0.015 m<sup>3</sup>/s or less
- Flowmeter It is able to measure the maximum air flow rate of the fan under test with accuracy of  $\pm 3$  %.
- Size of wind tunnel See Figure A.2.



**Figure A.2 — Configuration of micro air flow rate measuring equipment**

- Flow direction of this equipment can be either push or suck against the wind tunnel.
- Configuration of the wind tunnel shall be square or round shape of section size D.
- Within the scope covered by Annex A, section size D is to be 300 mm or more. However, when cross-section surface of blowing/sucking comes close to the wind tunnel wall, it should be expanded. Also when air flow rate is small, section area can be reduced down to 200 mm at minimum proportional to the maximum air flow rate in use.
- Two metal meshes should be installed at the fan side of the rectifier as specified in **ISO 5801**. At the other side, punched metal plate with opening ratio 20 % - 30 % is to be used.
- At the hook-up of the wind tunnel and the flowmeter, a buffering plate should be installed.

- i) As for a flowmeter and variable charging system, the flow direction of air supply/discharge can be changed and flow rate range can be expanded depending on combinations.
- j) In order to measure by expanding air flow rate range, plural flowmeters can be arranged by connecting in parallel. However, leak from any unused flowmeter is not allowed.