FM601 Aerodynamic Noise Exceeds Limit (Inlet / Outlet)

Chapter 6: Comprehensive Technology — Fault model & typical case

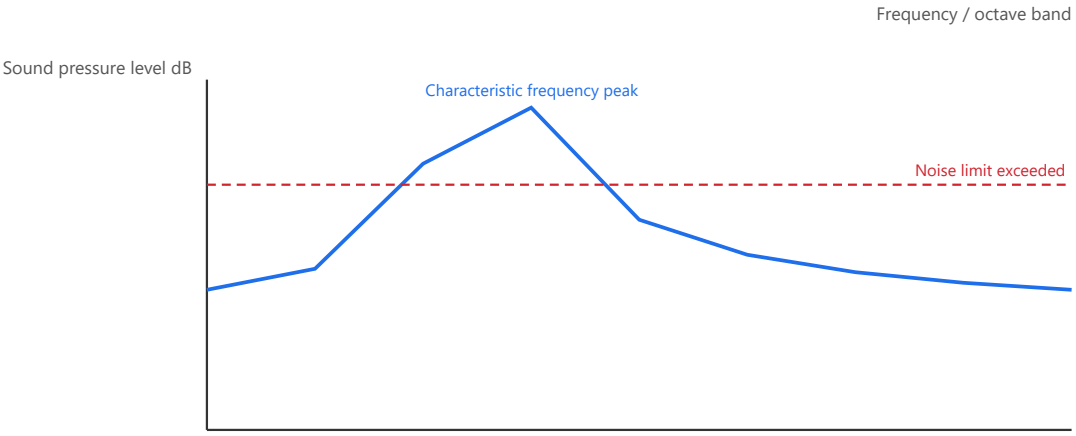
DOCUMENT
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CHAPTER
Comprehensive Technology

RELATED Q&A
6-30, 6-31

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Fault model + typical case. Mechanism, causes, symptoms, diagnosis, corrective actions and prevention are all anchored to the relevant entries of the Fan Engineering Q&A (see front matter for question references).



FM601 Aerodynamic Noise Exceeds Limit (Inlet / Outlet): inlet vortex and impeller-to-tongue interference raise the sound pressure level at the characteristic frequency; treat the source with silencers, sound insulation, balancing or structural improvement.

Failure Mechanism

Inlet vortex, impeller-to-volute-tongue interference and similar effects generate aerodynamic noise (6-30 generation and types, 6-31 control). Exceeding the limit both disturbs neighbours and indicates an abnormal flow field.

Common Causes

- Improper volute tongue (see FM205)
- Turbulent inlet flow

Failure Symptoms

- High-frequency aerodynamic noise

Diagnosis & Evaluation

- Identify the aerodynamic noise peaks in the frequency spectrum

Corrective Actions

- Optimise the volute tongue / inlet, and add a silencer

Preventive Measures

- Predict noise at the design stage

Typical Failure Case (Summary)

- Case 1 (dust-removal system of a large centrifugal fan at a steel company in Zhejiang): the equipment is a large centrifugal fan serving the dust system, Q=280000m³/h, with a 2800mm outlet duct and a 20m high discharge stack. In operation the noise at 1 m from the fan reached 102dB(A), and at a residential point 200 m away the noise was 56dB(A), exceeding the Class I night-time limit of GB12348-2008 *Emission Standard for Industrial Enterprise Noise at Boundary* by 11dB(A). The root cause was predominantly aerodynamic noise (impeller rotation impacting and rubbing against the gas flow). Corrective actions: the original light steel sandwich-panel fan room was demolished and replaced with a low-frequency, high-absorption acoustic room fitted with cooling inlet/outlet silencers; an impedance-type composite silencer was installed at the outlet (air speed reduced from 13m/s to 6.5m/s); and the inlet duct was lagged for sound insulation. Result: noise outside the fan room fell from 102dB(A) to 83dB(A) (a 19dB(A) reduction), and at night outside the residential windows from 56dB(A) to 43dB(A) (a 13dB(A) reduction), meeting the design target.
- Case 2 (dust-removal system of a functional materials company in Changshu): 2 high-power centrifugal fans were the main noise source, with a peak noise of 96.62dB in the equipment area, so that the eastern plant boundary of the residential area only one wall away measured 64dB at night, far exceeding the national environmental protection standard and triggering complaints. Corrective actions: vibration isolators were fitted under the fans and drive motors to cut structure-borne sound; a semi-enclosed acoustic room lined with sound-absorbing material was built; and an impedance-type composite silencer was added at the chimney outlet.

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