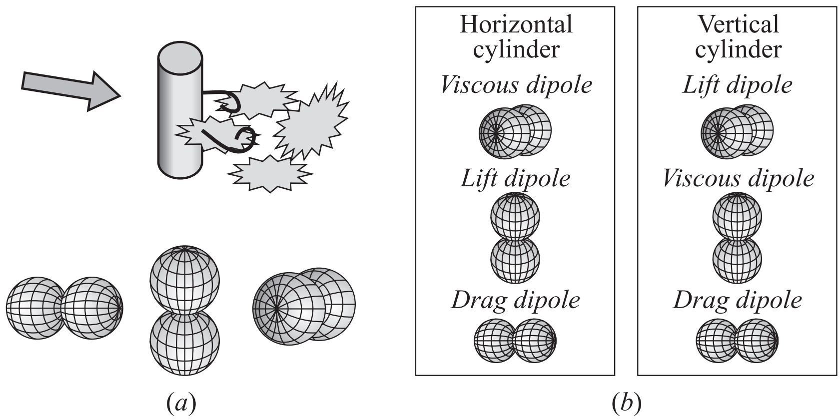

Figure 7 Directivities of drag, viscous, and lift dipoles

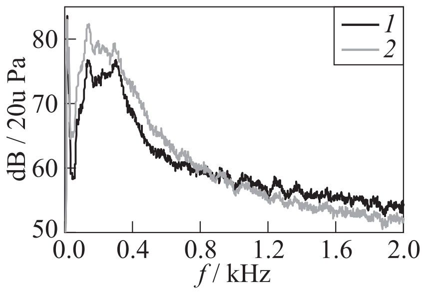

Figure 8 Microphone 1, lift dipole, $\Delta \sim 4$ dB: *1* — truncated and *2* — circular cylinders

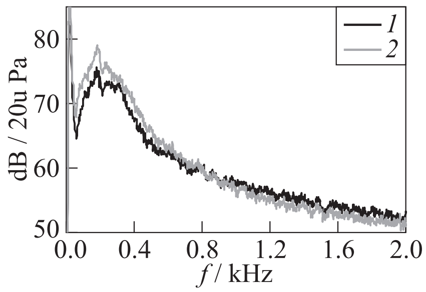

Figure 9 Microphone 6, mix of drag and lift dipoles, $\Delta \sim 2$ dB: *1* — truncated and *2* — circular cylinders

cal/numerical airframe noise prediction models. The applicability of the main concept for noise reduction is considered for large-scale models (Fig. 5). Polar array with microphones (Fig. 6) located in the plane parallel to the floor is used for measurements in far field of dipole components (drag, viscous, and lift dipoles, Fig. 7).

For vertical cylinder, microphone 1 measures only lift dipole (Fig. 8); microphones 2–6 measure mix of lift and drag dipoles (Fig. 9). For horizontal cylinder, microphone 1 measures only viscous dipole (Fig. 10); microphones 2–6 measure mix of lift and drag dipoles (Fig. 11). Amplitude of viscous dipole negligibly small (up to 15 dB) in comparison with lift dipole (Fig. 12).

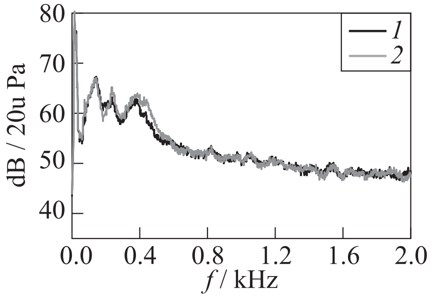

Figure 10 Microphone 1, viscous dipole, $\Delta < 1$ dB: *1* — truncated and *2* — circular cylinders

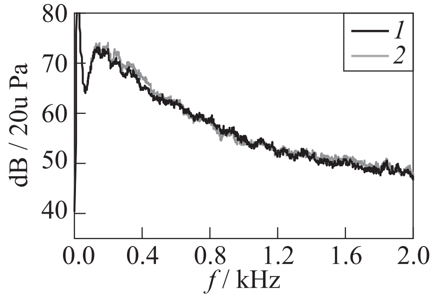

Figure 11 Microphone 6, mix of drag and viscous dipoles, $\Delta \sim 2$ dB: *1* — truncated and *2* — circular cylinders

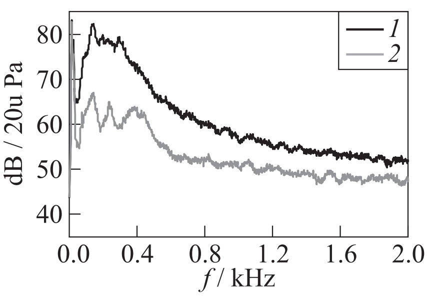

Figure 12 Comparison of lift dipole and viscous dipole amplitudes (microphone 1 data for vertical (*1*) and horizontal (*2*) cylinders, respectively), $\Delta \sim 15$ dB. Viscous dipole is important only for the angles where lift dipole is absent

3 CONCLUDING REMARKS

The effect of noise reduction for truncated geometry is most effective for lift dipole (up to 4 dB). To measure the lift dipole by polar array with microphones located in the plane parallel to the floor, one needs to use vertical position of cylinder. Lift dipole is usually dominate in the radiation of bluff cylinders and this type of radiation is attributed as cylinder dipole noise (without splitting the total dipole noise to three orthogonal components). The drag dipole is smaller (at least, in the present experiments) and the viscous dipole (orthogonal to lift and drag dipoles) is negligible. For small-scale cylinder, it is 30 dB smaller than lift dipole noise. For large-scale model, viscous dipole 15 dB smaller than lift dipole noise was just obtained; therefore, it would be important only for the angles where lift dipole is absolutely absent. Due to this value of orders, even small mistakes (in the orientation of cylinder etc.) could add some input to measurement data; therefore, the spectra peculiarities could be unstable (but due to the small value of the radiation amplitude, these possible mistakes seem to be without any sense). To measure the lift dipole, the cylinder is put in vertical position (shifted 80 cm downstream the nozzle exit). Thus, the noise reduction for truncated geometry is quite obvious for large Reynolds number (i. e., for large-scale models and high flow velocity).

REFERENCES

1. Kopiev, V. F., M. Yu. Zaitsev, and R. K. Karavosov. 2004. Experimental investigation of azimuthal structure of dipole noise for rigid cylinder inserted in turbulent jets. AIAA Paper No. 2004-2927.
2. Kopiev, V. F., M. Yu. Zaitsev, and N. N. Ostrikov. 2006. New noise source mechanism of flow/surface interaction as applied to airframe noise reduction. AIAA Paper No. 2006-2717.
3. Terracol, M., and V. Kopiev. 2008. Numerical investigation of the turbulent flow around a truncated cylinder: Noise reduction aspects. AIAA Paper No. 2008-2868.