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Comparison of 2-D-Cascade Tests Done in the VKI and AVA Cascade Wind Tunnels

by

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The charakteristic data of a high turning gas turbine cascade, described in Ref. [1], were measured in the wind tunnels for straight cascades and for rotating (annular) cascades of the AVA-DFVLR-Göttingen. The exit flow conditions were changed from subsonic up to supersonic velocities. The turning and the losses obtained in the two facilities are compared to those measurements done in the VKI-cascade wind tunnel. The surface pressure distribution measured in the straight cascade wind tunnels of VKI and AVA were also compared.

The results of these comparisons can be summarized as follows: The pressure distribution measurements of VKI and AVA are in a good agreement except of a small region at the end of the suction side of the blade. These deviations are certainly due to differences of the Reynoldsnumbers in both facilities. The turning measured in all three facilities is in agreement in the sub- and supersonic flow regime; only in the case of transonic flow there are derivations up to 1.5 degrees.

The losses are - within a certain scatter of 1% -point - in a good agreement up to that Machnumber, where the losses increase rapidly, i.e. in this case up to Machnumber of $M_2 \approx 1.1$. It is interesting to note that the wind tunnel for rotating cascades gives the same results as the wind tunnels for straight cascases up to the downstream Machnumber of $M_2 \approx 1.1$.

A detailed description of the above mentioned comparison of experimental results is given in Ref. [2], including results obtained by theoretical methods.

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Comparison of 2-D and rotation measurements of cascades with flat plate profiles

by

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Two flat plate cascades of different geometry are investigated in the 2-D-cascade wind tunnel and the facility for rotating (annular) cascades to compare the results. Moreover, measurements are taken for another tip-section cascade, the geometry and profile of which are described in Ref. [1]. This cascade is developed and also examined at the VKI, Rhode St. Genese, Belgium. The exit flow conditions are changed from subsonic up to supersonic velocities. The inlet angle is also varied. The pitch-chord ratio and the stagger angle of the first flat plate cascade are $g/c = 1.2$ and $\gamma = 15^0$ and for the other one $g/c = 1.0$ and $\gamma = 25^0$. The wake flow measurements are compared in the case of the flat plate cascades for both DFVLR-AVA facilities. In the case of the third tip-section cascade the surface pressure measurements and the wake flow measurements are compared with the results of the VKI.

The main results are as follows:

All results are in good agreement for all cascades, except for supersonic Machnumbers in the outlet plane. In this case the results for the 2-D-wind tunnel and the facility for rotating cascades do not agree. The increase of losses happens in the case of the facility for rotating cascades at a lower Machnumber than in the case for the 2-D-wind tunnel. An explanation for this fact can be given looking for the different test conditions: in the case of the 2-D-wind tunnel only the losses produced by a limited number of blades are taken into account and in the case of the facility for rotating cascades the measurements are taken for an infinite cascade. Another reason may be the centrifugal forces in the facility for rotating cascades, because the rpm of the test wheels is up to 13 000/min. It seems to be necessary to investigate this influence by