## INTRODUCTION

Within the last ten years a successful development of new blade design methods has been reported. Names like "Prescribed Velocity Distribution" (PVD), "Controlled Diffusion" (CD) and "Custom Tailored" (CT) Airfoils characterize this development in the turbomachinery world. This was possible because direct and inverse computational codes became available for high subsonic and transonic cascade flow fields which enabled the tailoring of blade geometries according to desired flow fields and boundary layer behaviours.

The idea of this technique is, of course, not a new one. In fact, the NACA airfoils for instance and especially the 6-series have been developed in the same way by prescribing the surface velocity distributions. But due to the lack of fast computers and computational codes it was necessary to adjust the profile geometry to the desired boundary conditions using empirical data and correlations to account for the unknown real flow effects. The drawback of this method is twofold. The high number of geometric as well as flow parameters of a cascade limits the empirical data base on one side and does generally not allow a design optimization with regard to loading, Mach number etc. on the other side. Therefore, quite often axial flow turbomachinery bladings were developed by a time consuming trial and error method.

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*) This lecture is partly identical to the AGARD lecture "Design Criteria for Optimal Blading Design" in AGARD-LS-167, 1989.

Today we are in a better position with regard to our design tools. But still we have to learn how to handle them and how to overcome their existing limitations. In addition these new design tools are time consuming and it is therefore advisable not to start in each blade design from scratch but also to make use of past experience, especially that from experiment. The development of certain criteria for tailoring the best possible velocity distribution under given boundary conditions is such a way. These criteria result from theoretical considerations verified and completed mainly by cascade tests. The linear cascade serves therefore not to develop certain optimized blade shapes rather than to develop otimized surface velocity distributions. According to the boundary conditions, these velocity distributions lead then to different blade shapes in the turbomachines.

Generally, the aim of the aerodynamic optimizations is the reduction of the total pressure losses to a minimum and the increase of the loading to a maximum which means a maximum pitch chord ratio or a minimum blade number. Additionally the off-design operating range should also be as large as possible. Depending on the requirements of the turbomachine the main attention is directed more to one or to the other point or a compromise has to be found. There is, however, little information available on off-design optimizations. So far, the main attention has been directed towards the improvement of the design-point operation.