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SECTIONAL MODELING OF A CENTRIFUGAL COMPRESSOR (TP054)

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ABSTRACT

The prediction of compressor performance using steady-state methods has had limited success for multistage configurations. Accepted limitations of the computational methods such as streamline curvature effects have been ignored because of a more dominant issue of the interface between the rotating and stationary components and the change in pitch between the vaned-stationary components. The most common model reported in the literature for centrifugal compressor stage analysis is known as the frozen-rotor or implicit model. Its selection, however, is normally driven for numerical stability reasons not for accuracy. The literature has shown that this method does not provide physically correct solutions for off-design predictions. The current work attempts to improve the steady-state modeling approach by employing an interface modeling that assumes that the tip speed is much greater than the through flow velocity. This model is referred to as circumferential averaging and is less stable than the frozen rotor model. The next proposed improvement is to model all of the vaned-stationary passages in order to preserve geometric periodicity. The last novel improvement is in the area of the diffuser inlet region where a portion of the secondary flow path is included to resolve the entrance loss into the diffuser. This approach was used to model two sections of a high pressure centrifugal compressor. The results are presented for design and off-design flows. The calculations are compared with test data taken from full scale testing.