Rotor 6

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Original model

Rotor 6 is part of a research program to study the effects of blade shape on efficiency and stall margin. A series of transonic rotors, including rotor 6 and 7, were design with the same exit total pressure distribution to investigate the effects of blade shape.

- Original technical report [(cite:reid1973design>Reid. «Overall and blade-element performance of a transonic compressor stage with multiple-circular-arc blades at tip speed of 419 meters per second » 1973. pdf)]:

```
@TechReport{reid1973design,
author      = {Reid, Lonnie and Kovich, George},
title       = {Overall and blade-element performance of a transonic
compressor stage with multiple-circular-arc blades at tip speed of 419
meters per second},
institution = {NASA Lewis Research Center Cleveland, OH, United States},
note        = {NASA-TM X-2731, url~:
\url{https://ntrs.nasa.gov/citations/19730011268}, 1973}}
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- Picture :

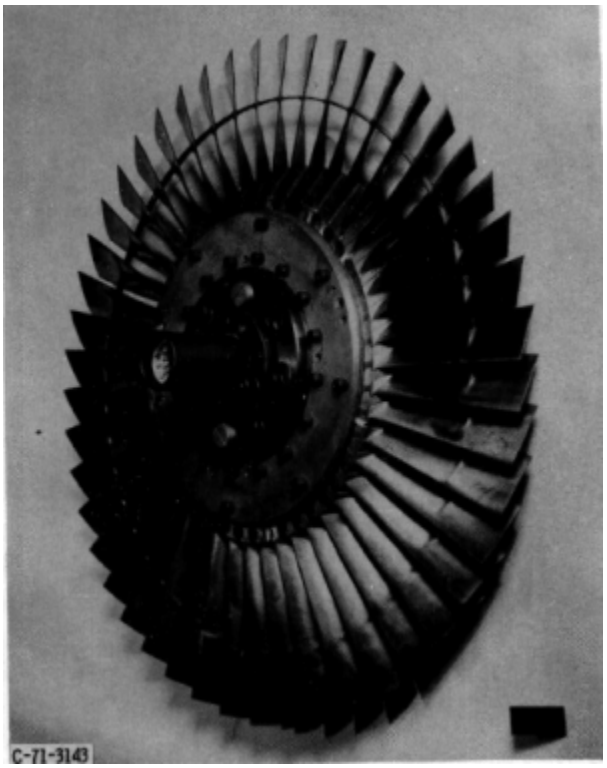


Fig1. https://ntrs.nasa.gov/citations/19730011268 p.63

Useful documents

- PDF of the NASA report : rotor6.pdf
- CSV file of the blade geometry : rotor6_original.csv

Geometry

The geometry of rotor 6 is described in the original NASA report by the following tables. The length are in centimeters and the angles in degrees.

TABLE IV. - BLADE GEOMETRY FOR ROTOR 6

RP	PERCENT SPAN	RADII RI	RADII RO	BLADE ANGLES KIC	BLADE ANGLES KTC	BLADE ANGLES KOC	DELTA INC	CONE ANGLE
TIP	0.	25.024	24.938	61.27	59.53	48.55	2.57	-2.167
1	5.	24.681	24.443	60.39	58.83	48.51	2.75	-5.794
2	10.	24.151	23.949	59.08	57.74	48.33	3.03	-4.776
3	30.	21.932	21.972	54.43	53.07	45.16	4.18	0.842
4	40.	20.778	20.983	52.27	50.40	42.35	4.77	4.083
5	43.	20.485	20.736	51.75	49.69	41.52	4.91	4.922
6	45.	20.190	20.489	51.22	48.96	40.63	5.06	5.771
7	48.	19.893	20.242	50.70	48.23	39.71	5.21	6.638
8	50.	19.593	19.995	50.19	47.49	38.76	5.35	7.520
9	70.	17.083	18.018	46.38	41.40	29.63	6.46	15.492
10	90.	14.203	16.041	44.06	36.61	17.09	7.30	26.699
11	95.	13.376	15.546	43.89	36.11	13.27	7.42	30.360
HUB	100.	12.736	15.052	43.87	35.93	9.32	7.48	31.741

RP	BLADE THICKNESSES TI	TM	TO	AXIAL DIMENSIONS ZIC	ZMC	ZTC	ZOC
TIP	0.051	0.149	0.051	0.773	1.843	2.194	3.055
1	0.051	0.156	0.051	0.745	1.843	2.171	3.087
2	0.051	0.167	0.051	0.704	1.844	2.134	3.119
3	0.051	0.211	0.051	0.541	1.834	1.941	3.257
4	0.051	0.233	0.051	0.460	1.826	1.818	3.335
5	0.051	0.239	0.051	0.440	1.825	1.785	3.356
6	0.051	0.245	0.051	0.420	1.823	1.752	3.378
7	0.051	0.251	0.051	0.399	1.821	1.716	3.399
8	0.051	0.257	0.051	0.377	1.817	1.677	3.418
9	0.051	0.305	0.051	0.206	1.791	1.336	3.578
10	0.051	0.360	0.051	0.055	1.755	0.947	3.709
11	0.051	0.376	0.051	0.023	1.741	0.845	3.728
HUB	0.051	0.389	0.051	0.000	1.728	0.768	3.745

Aerodynamic design

	unit	values
pressure ratio	[-]	1.63
mass flow	[kg/s]	29.6
tip speed	[m/s]	419
tip solidity	[-]	1.3
aspect ratio	[-]	2.5
number of blades	[-]	47
rotative speed	[rad/s]	1675.51

Material properties

The original material of the rotor 6 is not defined in the NASA report.

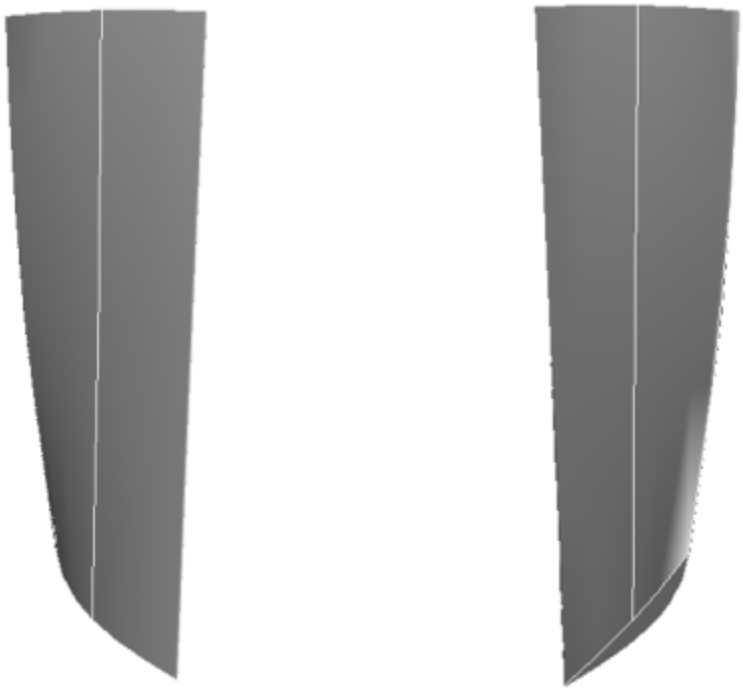
Considered properties: 200-grade maraging steel :

	unité	valeurs
alloy	[-]	18-Ni-200-maraging
Young's modulus	[GPa]	180
density	[kg/m3]	8000
Poisson's ratio	[-]	0.3
yield stress	[GPa]	1.38

First three natural frequencies (with clamped root) for the mesh:

1. (1B): 1686.8 rad/s / 268.5 Hz
2. (2B): 6385.2 rad/s / 1016.2 Hz
3. (1T): 8140.1 rad/s / 1295.5 Hz

CAD



Fichiers téléchargeables
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Modèle original

Le rotor 6 fait partie d'un programme de recherche visant à étudier les effets de la forme des pales sur l'efficacité et la marge de décrochage. Une série de rotors transsoniques ont été conçus avec la même distribution de pression totale de sortie pour étudier les effets de la forme des pales. On retrouve par exemple le rotor 6 et 7.

- Rapport technique original [(cite:reid1973design>Reid. «Overall and blade-element performance of a transonic compressor stage with multiple-circular-arc blades at tip speed of 419 meters per second » 1973. pdf)]:

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- Photographie :

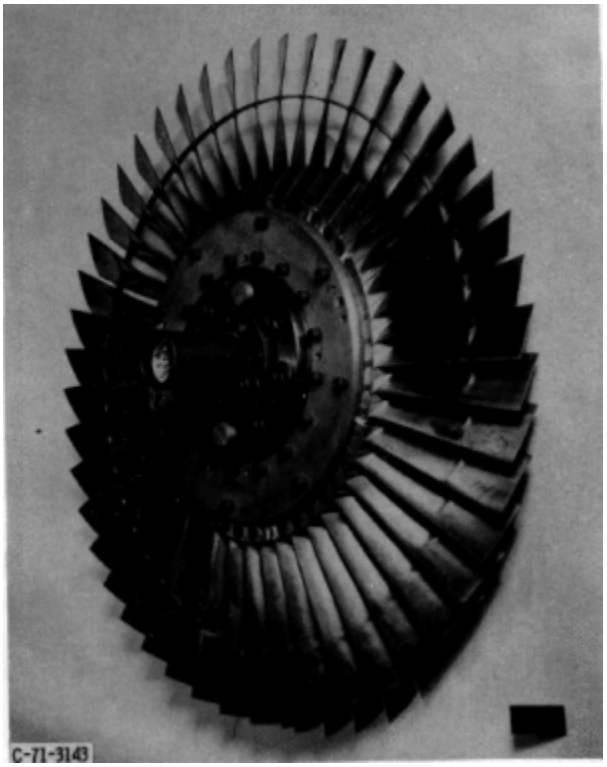


Fig1. https://ntrs.nasa.gov/citations/19730011268 p.63

Documents utiles

- PDF du rapport de la NASA :

rotor6.pdf

- Fichier CSV de la géométrie :

rotor6_original.csv

Géométrie

La géométrie du rotor 6 est décrite dans le rapport d'origine de la NASA par les tableaux suivants. Les grandeurs sont en centimètres et en degrés.

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HUB	0.051	0.389	0.051	0.000	1.728	0.768	3.745

Caractéristiques aérodynamiques

	unités	valeurs
taux de compression	[-]	1,63
débit massique	[kg/s]	29,6
vitesse en tête	[m/s]	419
solidité en tête	[-]	1,3
allongement	[-]	2,5
nombre d'aubes	[-]	47
vitesse de rotation	[rad/s]	1675,51

Propriétés matériau

Le matériau original du rotor 6 n'est pas défini dans le rapport de la NASA.

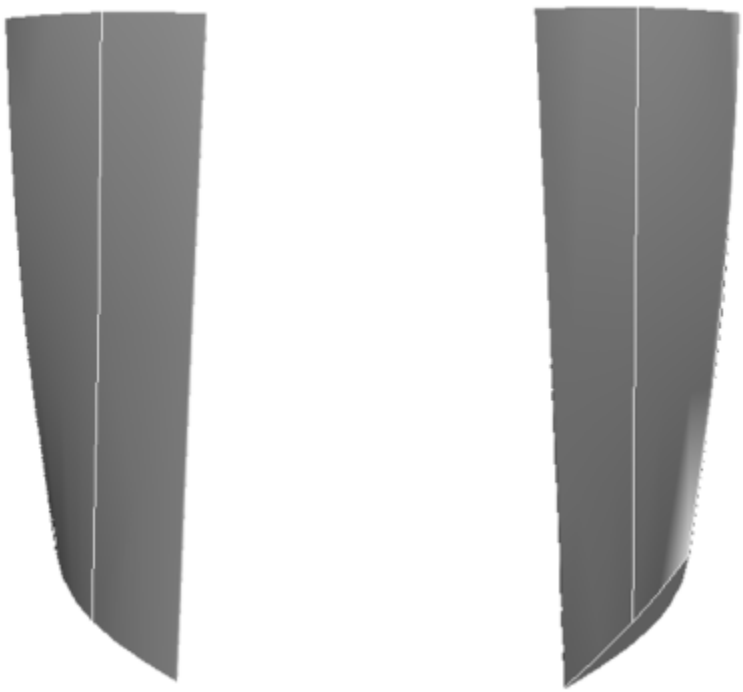
Propriétés considérées : un acier maraging de grade 200 :

	unité	valeurs
alliage	[-]	18-Ni-200-maraging
module d'Young	[GPa]	180
masse volumique	[kg/m3]	8000
coefficient de Poisson	[-]	0,3
limite élastique	[GPa]	1,38

Fréquences des trois premiers modes (noeuds de la base encastrés) pour le maillage :

1. (1B): 1686,8 rad/s / 268,5 Hz
2. (2B): 6385,2 rad/s / 1016,2 Hz
3. (1T): 8140,1 rad/s / 1295,5 Hz

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Document issu de la page wiki:
https://wiki.lava.polymtl.ca/public/modeles/rotor_06/accueil?rev=1663352006

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