Rotor 8

- Français
- English

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Git project

Original model

Rotor 8 is part of a research program to study the effects of blade row solidity on efficiency and stall margin of an axial-flow compressor rotor. It is one of a series of rotors designed to further study the effects of solidity : rotor 8 with a tip solidity of 1.5, rotor 12 with a tip solidity of 1.7 and rotor 14 with a tip solidity of 1.3. Tip solidity are being changed by varying the number of blades while maintaining the same velocity diagrams and flow path. These stages were designed such that the tip solidity of both the rotor and stator blades are the same.

- Original technical report [(cite:osborn1973design>Osborn. «Performance of a single-stage transonic compressor with a blade-tip solidity of 1.5 and comparison with 1.3- and 1.7-solidity stage » 1973. pdf)]:

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@TechReport{osborn1973design,
  author           = {Osborn, Walter M. and Urasek, Donald C. and Moore,
R. D.},
  date             = {1973},
  institution      = {NASA Lewis Research Center Cleveland, OH, United
States},
  title            = {Performance of a single-stage transonic compressor
with a blade-tip solidity of 1.5 and comparison with 1.3- and 1.7-solidity
stages},
  number           = {NASA-TM X-2926},
  url              = {https://ntrs.nasa.gov/citations/19740002621},
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- Picture :

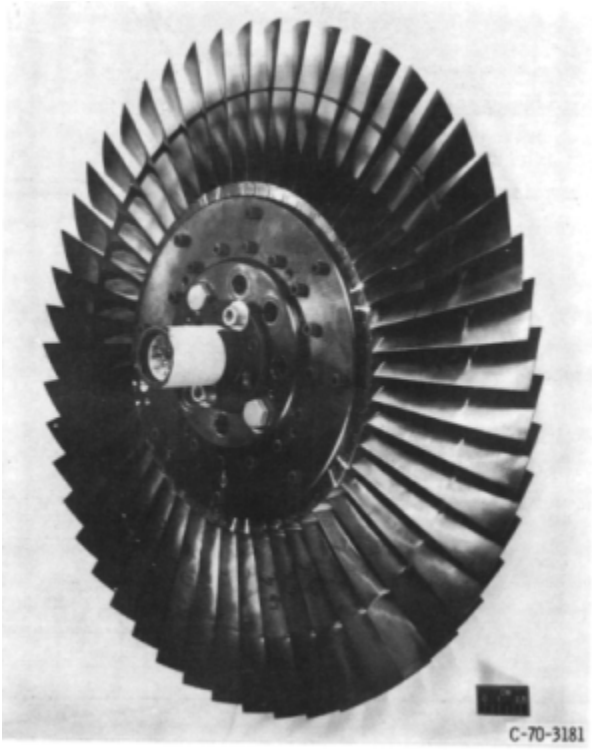


Fig1. https://ntrs.nasa.gov/citations/19740002621 p.67

Useful documents

- PDF of the NASA report : rotor8.pdf
- CSV file of the blade geometry : rotor8_original.csv

Geometry

The geometry of rotor 8 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 8

RP	PERCENT SPAN	RADII RI	RO	BLADE ANGLES KIC	KTC	KOC	DELTA INC	CONE ANGLE
TIP	0.	25.082	24.701	62.92	60.67	52.34	2.49	-9.298
1	5.	24.568	24.193	61.67	59.64	51.79	2.72	-8.836
2	10.	24.021	23.685	60.41	58.43	51.04	2.98	-7.644
3	30.	21.754	21.653	55.93	52.88	46.27	4.06	-1.996
4	43.	20.287	20.383	53.47	49.53	41.81	4.74	1.771
5	45.	19.989	20.129	52.99	48.87	40.74	4.88	2.542
6	48.	19.690	19.875	52.52	48.23	39.60	5.01	3.325
7	50.	19.388	19.621	52.06	47.59	38.38	5.15	4.114
8	53.	19.085	19.367	51.60	46.97	37.09	5.28	4.908
9	70.	16.891	17.589	48.50	42.58	26.07	6.19	10.851
10	90.	14.175	15.557	45.39	39.25	6.42	7.05	18.759
11	95.	13.447	15.049	44.77	38.97	-0.40	7.20	20.972
HUB	100.	12.700	14.541	44.22	38.93	-7.94	7.32	23.205

RP	BLADE THICKNESSES TI	TM	TO	AXIAL DIMENSIONS ZIC	ZMC	ZTC	ZOC
TIP	0.051	0.152	0.051	1.020	2.104	2.330	3.347
1	0.051	0.162	0.051	0.970	2.098	2.290	3.379
2	0.051	0.172	0.051	0.918	2.094	2.246	3.417
3	0.051	0.216	0.051	0.723	2.082	2.039	3.598
4	0.051	0.244	0.051	0.609	2.072	1.879	3.715
5	0.051	0.250	0.051	0.586	2.069	1.844	3.739
6	0.051	0.256	0.051	0.564	2.066	1.808	3.764
7	0.051	0.262	0.051	0.542	2.063	1.772	3.789
8	0.051	0.267	0.051	0.519	2.060	1.734	3.815
9	0.051	0.309	0.051	0.354	2.032	1.439	4.000
10	0.051	0.359	0.051	0.138	1.977	1.037	4.208
11	0.051	0.373	0.051	0.071	1.958	0.920	4.253
HUB	0.051	0.387	0.051	0.000	1.935	0.797	4.295

Aerodynamic design

	unit	values
pressure ratio	[-]	1.75
mass flow	[kg/s]	29.5
tip speed	[m/s]	423
tip solidity	[-]	1.5
aspect ratio	[-]	2.4
number of blades	[-]	49
rotative speed	[rad/s]	1686

Material properties

The original material of the rotor 8 is not defined in the NASA report.

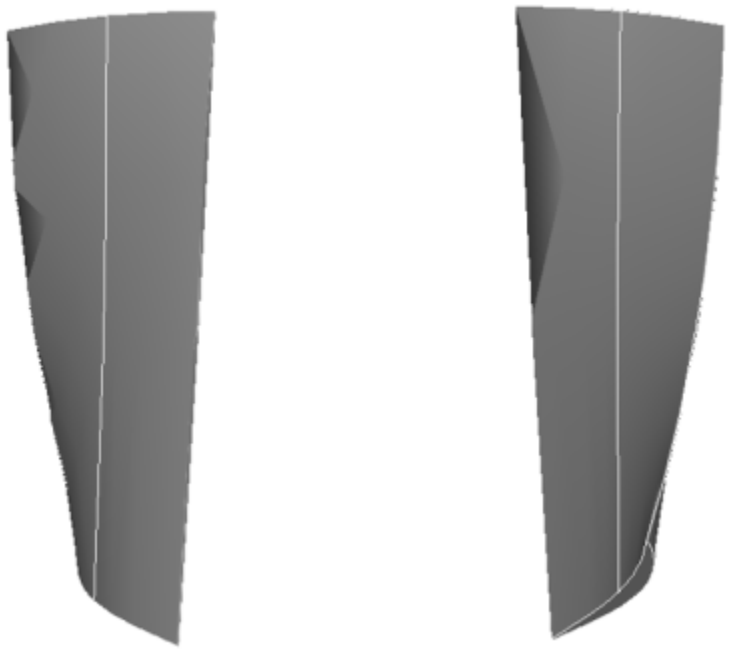
Considered properties: Ti-6Al-4V, generic titanium :

	unité	valeurs
alloy	[-]	Ti-6Al-4V
Young's modulus	[GPa]	108
density	[kg/m3]	4400
Poisson's ratio	[-]	0.34
yield stress	[GPa]	0.824

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

1. (1B): 1802.3 rad/s / 286.8 Hz
2. (2B): 6522.4 rad/s / 1038.1 Hz
3. (1T): 8772.5 rad/s / 1396.2 Hz

CAD



Fichiers téléchargeables
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Libre accès

lien vers le projet Git

Modèle original

Le rotor 8 fait partie d'un programme de recherche visant à étudier les effets de la solidité des rangées d'aubes sur l'efficacité et la marge de décrochage d'un rotor de compresseur à flux axial. Il fait partie d'une série de rotors conçus pour étudier plus profondément les effets de la solidité : le rotor 8 avec une solidité en tête de 1.5, le rotor 12 avec une solidité en tête de 1.7 et le rotor 14 avec une solidité en tête de 1.3. La solidité est modifiée en faisant varier le nombre d'aubes tout en conservant les mêmes triangles de vitesse et le même trajet d'écoulement. Ces étages ont été conçus de manière à ce que la solidité en tête du rotor et du stator soit la même.

- Rapport technique original [(cite:osborn1973design>Osborn. «Performance of a single-stage transonic compressor with a blade-tip solidity of 1.5 and comparison with 1.3- and 1.7-solidity stage » 1973. pdf)]:

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- Photographie :

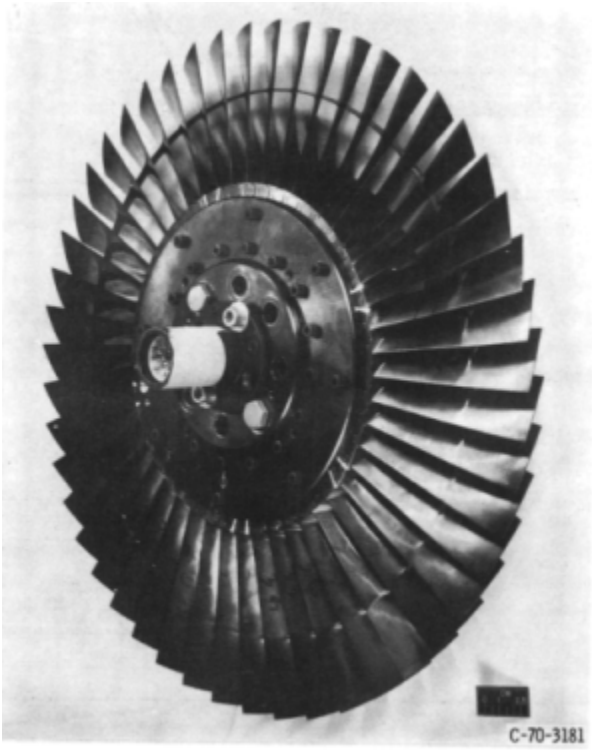


Fig1. https://ntrs.nasa.gov/citations/19740002621 p.67

Documents utiles

- downloadable models (Git project)
- PDF du rapport de la NASA :

  rotor8.pdf
- Fichier CSV de la géométrie :

  rotor8_original.csv

Géométrie

La géométrie du rotor 8 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	0.387	0.051	0.000	1.935	0.797	4.295

Caractéristiques aérodynamiques

	unités	valeurs
taux de compression	[-]	1,75
débit massique	[kg/s]	29,5
vitesse en tête	[m/s]	423
solidité en tête	[-]	1,5
allongement	[-]	2,4
nombre d'aubes	[-]	49
vitesse de rotation	[rad/s]	1686

Propriétés matériau

Le matériau original du rotor 8 n'est pas défini dans le rapport de la NASA.

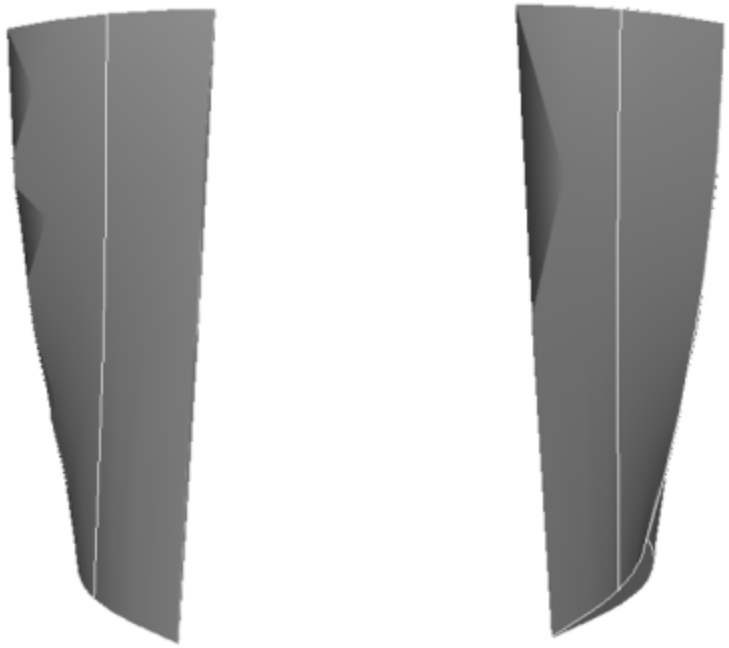
Propriétés considérées : alliage de titane Ti-6Al-4v :

	unité	valeurs
alliage	[-]	Ti-6Al-4v
module d'Young	[GPa]	108
masse volumique	[kg/m3]	4400
coefficient de Poisson	[-]	0,34
limite élastique	[GPa]	0,824

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

1. (1B): 1802,3 rad/s / 286,8 Hz
2. (2B): 6522,4 rad/s / 1038,1 Hz
3. (1T): 8772,5 rad/s / 1396,2 Hz

CAO



Document issu de la page wiki:
https://wiki.lava.polymtl.ca/public/modeles/rotor_08/accueil?rev=1677041106

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