

Rotor 1

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Original model

Rotor 1 is part of a research program to study aspect ratio because the use of high aspect ratio blading can lead to a decrease in the axial length of compressors and therefore a reduction of their size and weight. To investigate the effects of aspect ratio on compressor range and efficiency, two transonic rotors (rotor 1 and 2) were designed and tested. The variation in aspect ratio was based on a change in aerodynamic chord, and the solidity was kept the same by varying the number of blades.

- Original technical report ^[1]:

```
@TechReport{hager1974design,  
author      = {Hager, Roy D. and Lewis, George W.},  
title       = {Effect of damper on overall and blade-element performance  
of a compressor rotor having a tip speed of 1151 feet per second and an  
aspect ratio of 3.6},  
institution = {NASA Lewis Research Center Cleveland, OH, United States},  
note        = {NASA-TM X-3041, url~:  
\url{https://ntrs.nasa.gov/citations/19740018135}, 1974}}
```

- Pictures :

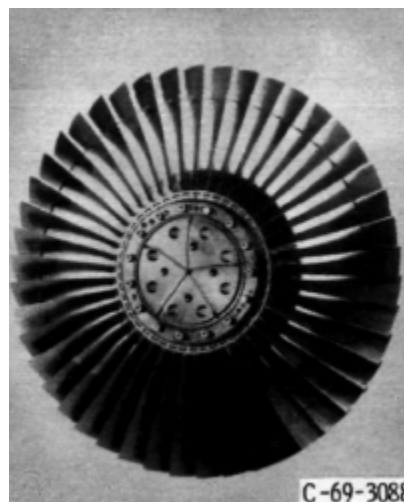


Fig1. <https://ntrs.nasa.gov/citations/19740018135> p.68

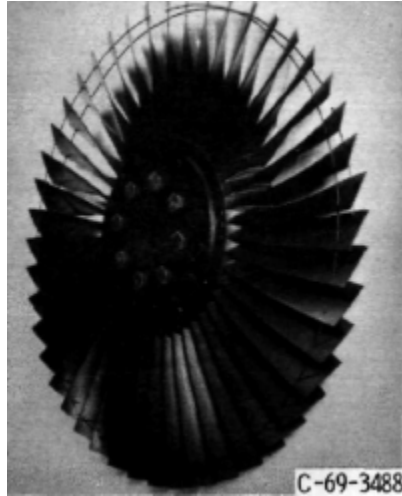


Fig2. <https://ntrs.nasa.gov/citations/19740018135> p.68

Useful documents

- PDF of the NASA report :

rotor1.pdf

- CSV file of the blade geometry :

rotor1_original.csv

Geometry

The geometry of rotor 1 is described in the original [NASA report](#) by the following tables. The length are in inches and the angles in degrees.

ROTOR 1 - MOD 1

RP	PERCENT RADII			BLADE ANGLES			DELTA [INC
	SPAN	RI	RO	KIC	KTC	KOC	
TIP	0.	10.000	9.900	59.46	52.90	46.35	3.21
1	5.	9.730	9.657	57.70	51.81	45.80	3.31
2	10.	9.442	9.413	56.00	50.54	45.00	3.43
3	20.	8.883	8.927	53.05	47.75	42.30	3.64
4	22.	8.740	8.810	52.40	46.97	41.50	3.70
5	25.	8.604	8.684	51.70	46.21	40.40	3.75
6	28.	8.460	8.560	51.20	45.37	39.00	3.80
7	30.	8.313	8.430	50.50	44.48	37.80	3.87
8	33.	8.160	8.300	49.80	43.52	36.40	3.92
9	50.	7.193	7.467	45.70	36.53	26.30	4.33
10	70.	5.991	6.494	39.90	25.27	10.00	5.09
11	90.	4.630	5.521	33.45	10.69	-10.50	6.38
HUB	100.	4.000	5.050	30.78	4.42	-21.94	7.07

RP	BLADE THICKNESSES			AXIAL DIMENSIONS			CONE ANGLE
	TI	TM	TO	ZMC	ZTC	ZOC	
TIP	0.020	0.073	0.020	0.501	0.501	1.084	-3.800
1	0.020	0.074	0.020	0.520	0.520	1.116	-2.100
2	0.020	0.075	0.020	0.540	0.540	1.149	-0.900
3	0.020	0.078	0.020	0.574	0.574	1.215	1.600
4	0.020	0.078	0.020	0.582	0.582	1.231	2.300
5	0.020	0.079	0.020	0.589	0.589	1.248	2.900
6	0.020	0.080	0.020	0.597	0.597	1.265	3.700
7	0.020	0.081	0.020	0.604	0.604	1.282	4.400
8	0.020	0.082	0.020	0.612	0.612	1.300	5.100
9	0.020	0.089	0.020	0.659	0.659	1.409	10.100
10	0.020	0.103	0.020	0.710	0.710	1.513	16.900
11	0.020	0.127	0.020	0.720	0.720	1.506	29.600
HUB	0.020	0.143	0.020	0.686	0.686	1.398	36.600

Aerodynamic design

	unit	values
pressure ratio	[-]	1.53
mass flow	[kg/s]	33.5
tip speed	[m/s]	350.8
tip solidity	[-]	1.3
aspect ratio	[-]	3.6
rotative speed	[rad/s]	1381.25

Material properties

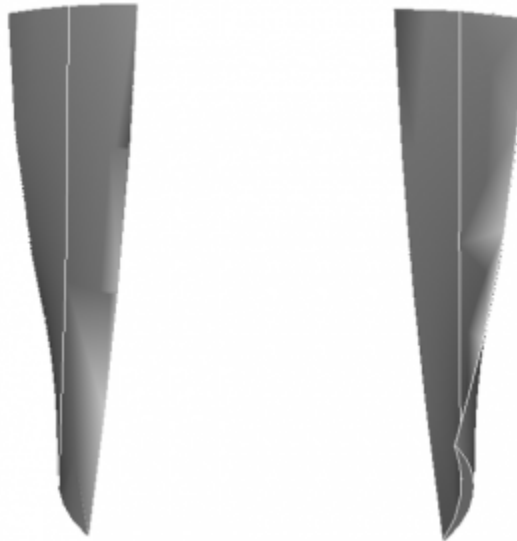
Rotor 1 is made of a 200-grade maraging steel

	unité	valeurs
alloy	[-]	18-Ni-200-maraging
Young's modulus	[GPa]	180
density	[kg/m ³]	8000
Poisson's ratio	[-]	0.3
yield stress	[GPa]	1.38

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

1. (1F) : 940.8 rad/s / 149.7 Hz
2. (1T) : 3479.2 rad/s / 553.7 Hz
3. (2F) : 5530.2 rad/s / 880.2 Hz

CAD



Fichiers téléchargeables

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Libre accès

[lien vers le projet Git](#)

Modèle original

Le rotor 1 fait partie d'un programme de recherche visant à étudier l'allongement des aubes, car l'utilisation d'un fort allongement peut conduire à une diminution de la longueur axiale des compresseurs et donc à une réduction de leur taille et poids. Pour étudier les effets de cet allongement sur les rendements des compresseurs, deux rotors transsoniques (rotor 1 et 2) ont été conçus et testés. La variation d'allongement entre ces deux rotors a été effectuée grâce à une modification de la corde aérodynamique et la solidité a été maintenue identique en faisant varier le nombre d'aubes.

- [Rapport technique original ^{\[1\]}](#):

```
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author      = {Hager, Roy D. and Lewis, George W.},  
title       = {Effect of damper on overall and blade-element performance  
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- Photographies :

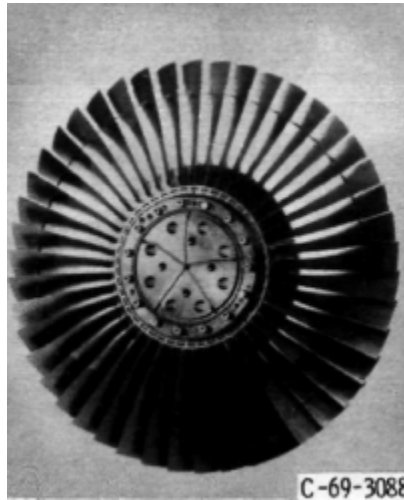


Fig1. <https://ntrs.nasa.gov/citations/19740018135> p.68

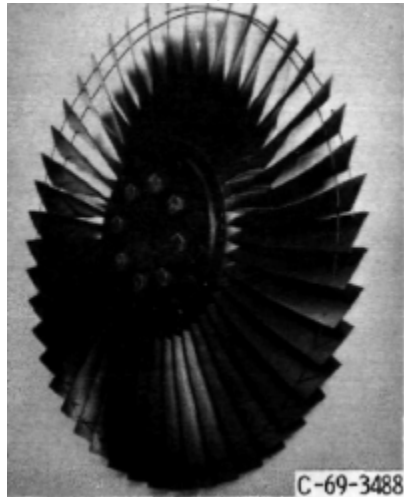


Fig2. <https://ntrs.nasa.gov/citations/19740018135> p.68

Documents utiles

- PDF du rapport de la NASA :
- Fichier CSV de la géométrie :

rotor1.pdf

rotor1_original.csv

Géométrie

La géométrie du rotor 1 est décrite dans le [rapport d'origine de la NASA](#) par les tableaux suivants. Les grandeurs sont en pouces et en degrés.

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11	0.020	0.127	0.020	0.720	0.720	1.506	29.600
HUB	0.020	0.143	0.020	0.686	0.686	1.398	36.600

Caractéristiques aérodynamiques

	unités	valeurs
taux de compression	[-]	1,53
débit massique	[kg/s]	33,5
vitesse en tête	[m/s]	350,8
solidité en tête	[-]	1,3
allongement	[-]	3,6
vitesse de rotation	[rad/s]	1381,25

Propriétés matériau

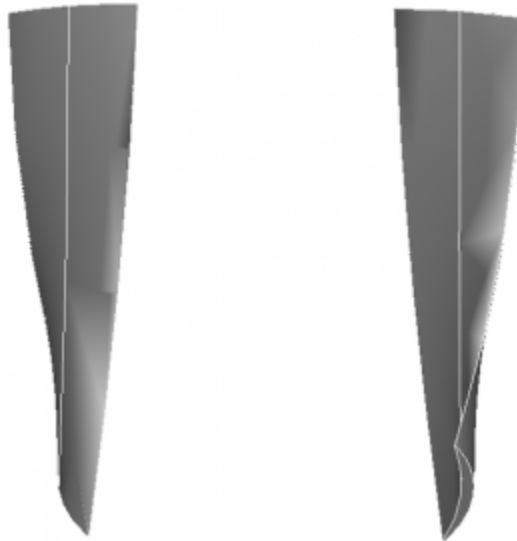
Le matériau du rotor 1 est un alliage à base de nickel : un acier maraging de grade 200

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

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

1. (1F) : 940,8 rad/s / 149,7 Hz
2. (1T) : 3479,2 rad/s / 553,7 Hz
3. (2F) : 5530,2 rad/s / 880,2 Hz

CAO



</tabs>

1. ^{a, b} Hager. «Effect of damper on overall and blade-element performance of a compressor rotor having a tip speed of 1151 feet per second and an aspect ratio of 3.6 » 1974. [pdf](#)

Document issu de la page wiki:

https://lava-wiki.meca.polymtl.ca/public/modeles/rotor_01/accueil

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