

Rotor 37

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Original model

Rotor 37 is part of a research program to study a advanced-core compressor design with a high compression ratio (20:1). It is therefore the third stage rotor of this eight stage transonic compressor. Of these eight stages, the first four have been designed and tested : rotors 35, 36, 37 and 38. For more information, here is a link to [report from NASA](#).

- Original technical report ^[1]:

```
@TechReport{moore1980design,  
author      = {Moore, R. D. and Reid, L.},  
title       = {Performance of Single-Stage Axial-Flow Transonic Compressor  
With Rotor and Stator Aspect Ratios of 1.19 and 1.26, Respectively, and  
With Design Pressure Ratio of 2.05},  
institution = {NASA Lewis Research Center Cleveland, OH, United States},  
note        = {NASA-TP-1659, url~:  
\url{https://ntrs.nasa.gov/citations/19800012840}, 1980 }}
```

- Pictures :

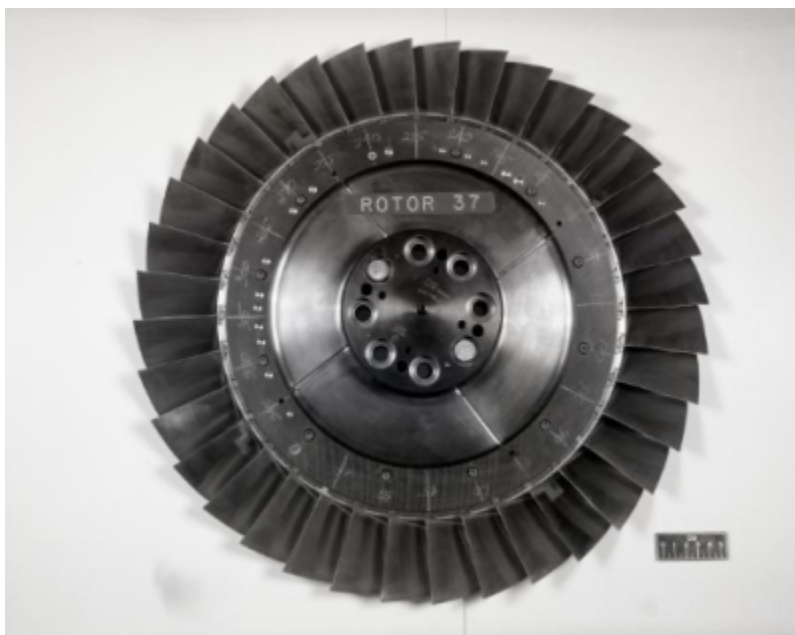


Fig1. <https://catalog.archives.gov/id/17468361>



Fig2. <https://catalog.archives.gov/id/17468389>

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@Misc{huebler1977records,  
author   = {Huebler, D.},  
title    = {Rotor 37 and stator 37 assembly. {R}ecords of the {N}ational  
{A}eronautics and {S}pace {A}dministration, 1903 - 2006. {P}hotographs  
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id/17468361}, 1977 }, % for Fig. 1  
note     =  
{\href{https://catalog.archives.gov/id/17468389}{https://catalog.archives.gov/  
id/17468389}, 1977 }, % for Fig. 2}
```

Useful documents

- PDF of the NASA report :

rotor37.pdf

- CSV file of the blade geometry :

rotor37_original.csv

Geometry

The geometry of rotor 37 is described in the [original NASA report](#) by the following tables. The length are in centimeters and the angles in degrees.

(a) Rotor 37

RP	PERCENT RADII			BLADE ANGLES			DELTA INC	CONE ANGLE
	SPAM	RI	RO	KIC	KTC	KOC		
TIP	0.	25.230	24.506	62.53	62.83	49.98	2.10	-15.233
1	5.	24.935	24.218	61.66	61.86	49.07	2.39	-14.582
2	10.	24.597	23.929	60.76	60.86	48.18	2.69	-13.139
3	15.	24.254	23.641	60.07	60.09	47.34	2.94	-11.768
4	30.	23.211	22.775	58.48	58.09	44.22	3.40	-7.804
5	50.	21.761	21.622	56.53	54.49	38.87	4.19	-2.276
6	70.	20.246	20.468	54.24	50.48	32.37	5.49	3.311
7	85.	19.030	19.603	52.67	47.60	25.28	6.54	8.010
8	90.	18.603	19.314	52.37	46.87	22.68	6.83	9.728
9	95.	18.161	19.026	52.18	46.39	19.75	7.16	11.584
HUB	100.	17.780	18.738	52.04	46.03	16.75	7.44	12.602

RP	BLADE THICKNESSES			AXIAL DIMENSIONS			
	TI	TM	TO	ZI	ZMC	ZTC	ZO
TIP	.025	.175	.025	.713	2.430	2.399	3.372
1	.026	.186	.026	.665	2.390	2.372	3.424
2	.028	.199	.028	.615	2.346	2.334	3.475
3	.029	.211	.029	.574	2.304	2.280	3.520
4	.032	.250	.033	.466	2.225	2.094	3.644
5	.037	.303	.038	.317	2.164	1.928	3.822
6	.042	.360	.043	.176	2.069	1.773	4.015
7	.047	.407	.047	.079	2.010	1.733	4.153
8	.048	.425	.049	.048	1.984	1.660	4.198
9	.050	.443	.050	.021	1.957	1.591	4.241
HUB	.051	.458	.051	.000	1.933	1.530	4.283

Aerodynamic design

	unit	values
pressure ratio	[-]	2.05
mass flow	[kg/s]	20.2
tip speed	[m/s]	455
tip solidity	[-]	1.3
aspect ratio	[-]	1.19
number of blades	[-]	36
rotative speed	[rad/s]	1800

Material properties

Rotor 37 is made of a 200-grade maraging steel^[2], but the exact material properties are not provided in the NASA report.

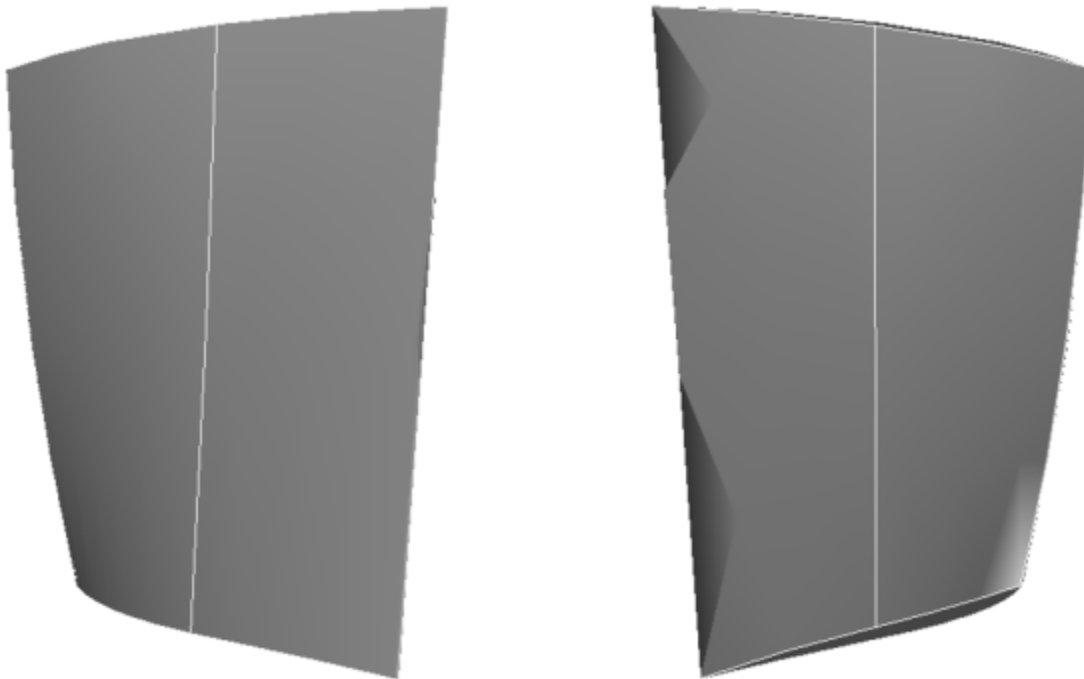
Considered properties: 18-Ni-200-maraging steel :

	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. (1B): 5291.8 rad/s / 842.2 Hz
2. (1T): 15928.2 rad/s / 2535.0 Hz
3. (2B): 19227.7 rad/s / 3060.2 Hz

CAD



Fichiers téléchargeables

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Modèle original

Le rotor 37 appartient à un programme de recherche visant à étudier une conception de compresseur possédant un grand taux de compression (20:1). Il est donc le rotor du troisième étage de ce

compresseur transsonique de huit étages. Parmi ces huit étages, les quatre premiers ont été conçus et testés, ils correspondent aux rotors 35, 36, 37 et 38. Pour plus d'information, voici un lien vers [rapport de la NASA](#).

- Rapport technique original ^[1]:

```
@TechReport{moore1980design,  
author      = {Moore, R. D. and Reid, L.},  
title       = {Performance of Single-Stage Axial-Flow Transonic Compressor  
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- Photographies :

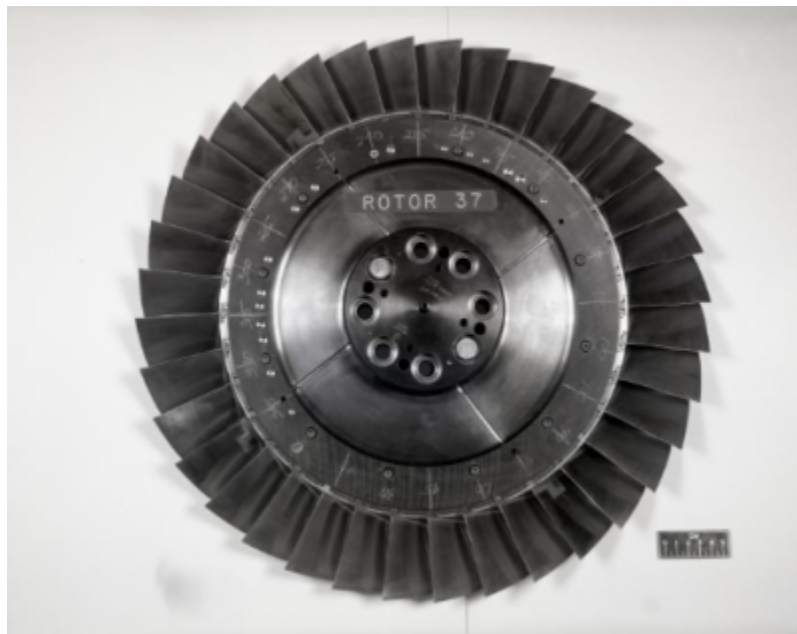


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```

Documents utiles

- PDF du rapport de la NASA :

rotor37.pdf

- Fichier CSV de la géométrie :

rotor37_original.csv

Géométrie

La géométrie du rotor 37 est décrite dans le [rapport d'origine de la NASA](#) par les tableaux suivants. Les grandeurs sont en centimètres et en degrés.

(a) Rotor 37

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9	.050	.443	.050	-.021	1.957	1.591	4.241
HUB	.051	.458	.051	.000	1.933	1.530	4.283

Caractéristiques aérodynamiques

	unités	valeurs
taux de compression	[-]	2,05
débit massique	[kg/s]	20,2
vitesse en tête	[m/s]	455
solidité en tête	[-]	1,3
allongement	[-]	1,19
nombre d'aubes	[-]	36
vitesse de rotation	[rad/s]	1800

Propriétés matériau

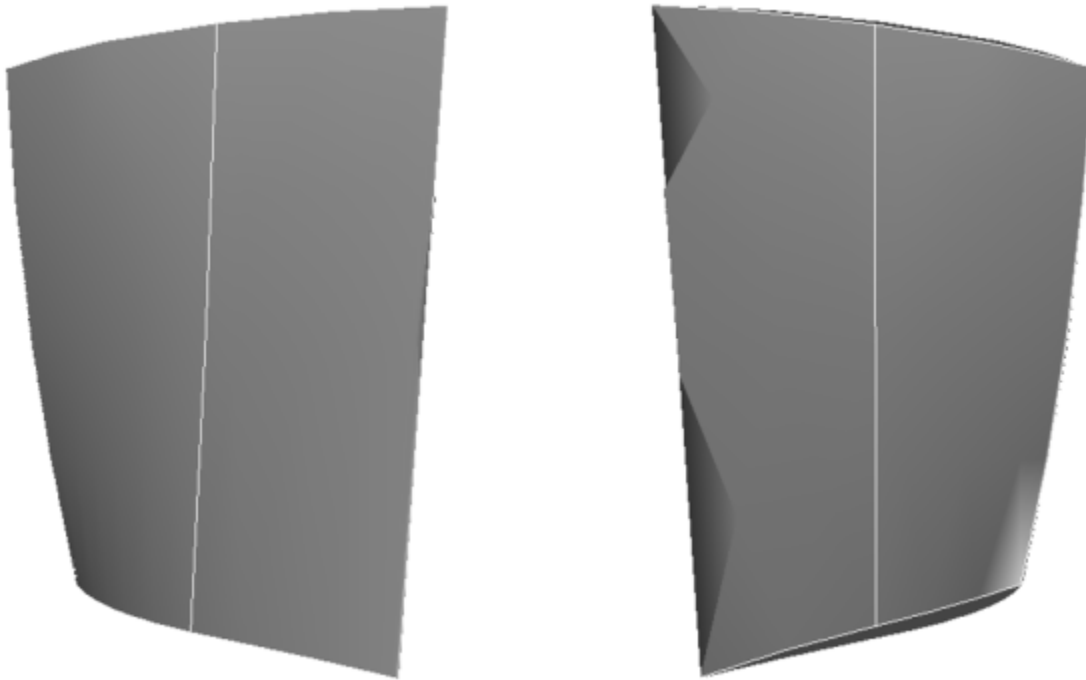
Le matériau du rotor 37 est un alliage à base de nickel : un acier maraging de grade 200

	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 (noeuds de la base encastés) pour le maillage :

1. (1B): 5291,8 rad/s / 842,2 Hz
2. (1T): 15928,2 rad/s / 2535,0 Hz
3. (2B): 19227,7 rad/s / 3060,2 Hz

CAO



1. ^{a, b} Moore. «Performance of Single-Stage Axial-Flow Transonic Compressor With Rotor and Stator Aspect Ratios of 1.19 and 1.26, Respectively, and With Design Pressure Ratio of 2.05 » 1980. [pdf](#)
2. ^a Reid. «Design and overall performance of four highly loaded, high-speed inlet stages for and advanced high-pressure-ratio core compressor» 1978. [pdf](#)

Document issu de la page wiki:

https://lava-wiki.meca.polymtl.ca/public/modeles/rotor_37/accueil?rev=1668792884

Dernière mise à jour: **2023/04/05 08:59**