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 [(cite:moore1980design>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)]:

```
@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 }}
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- Pictures :

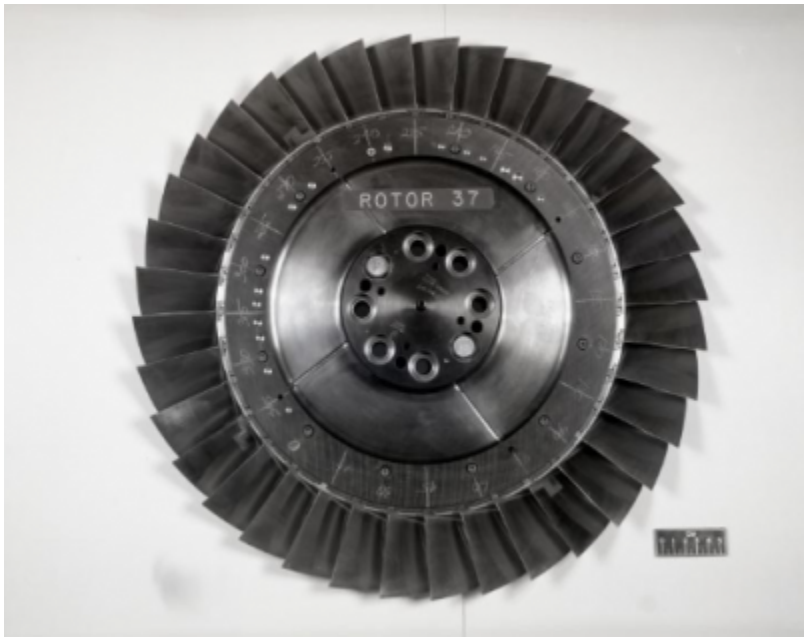


Fig1. https://catalog.archives.gov/id/17468361



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

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author   = {Huebler, D.},
title    = {Rotor 37 and stator 37 assembly. {R}ecords of the {N}ational
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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 SPAN	RADII RI	RADII RO	BLADE ANGLES KIC	BLADE ANGLES KTC	BLADE ANGLES KOC	DELTA INC	CONE ANGLE
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 TI	BLADE THICKNESSES TM	BLADE THICKNESSES TO	AXIAL DIMENSIONS ZI	AXIAL DIMENSIONS ZMC	AXIAL DIMENSIONS ZTC	AXIAL DIMENSIONS 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[(cite:reid1978designandoverall>Reid. «Design and overall performance of four highly loaded, high-speed inlet stages for and advanced high-pressure-ratio core compressor» 1978. pdf)], but the exact material properties are not provided in the NASA report.

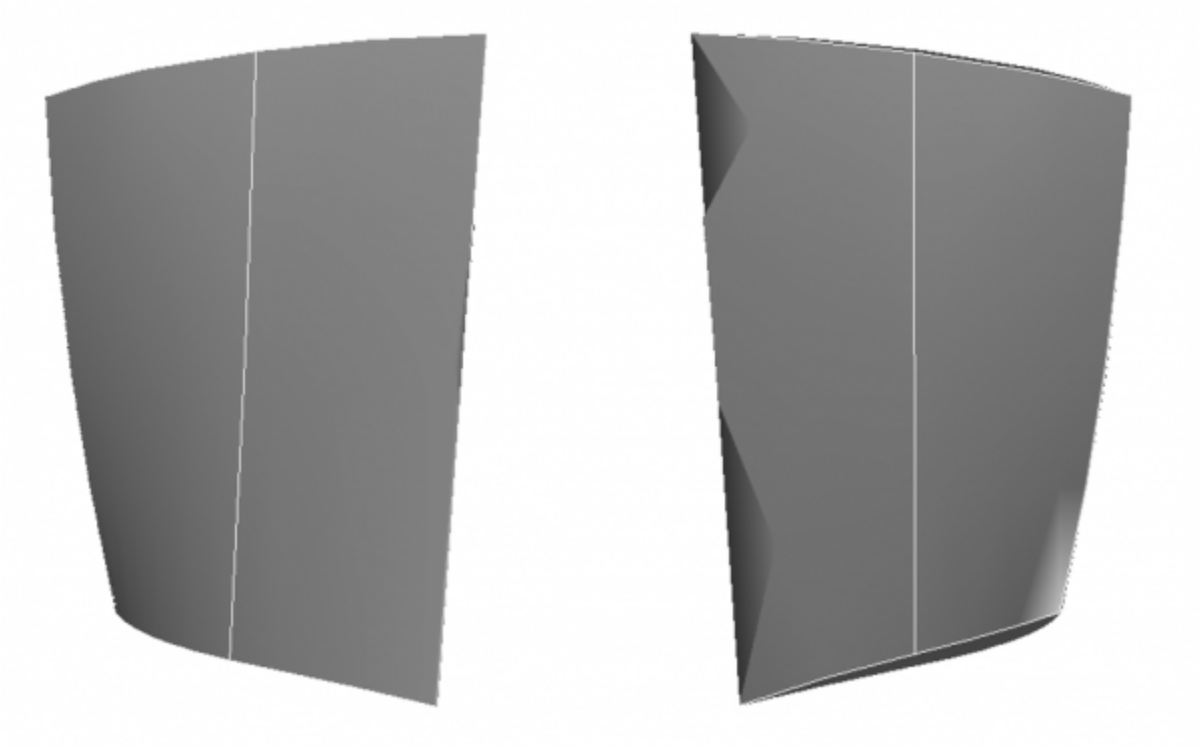
Considered properties: 18-Ni-200-maraging steel :

	unité	valeurs
alloy	[-]	18-Ni-200-maraging
Young's modulus	[GPa]	180
density	[kg/m3]	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 [(cite:moore1980design>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)]:

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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

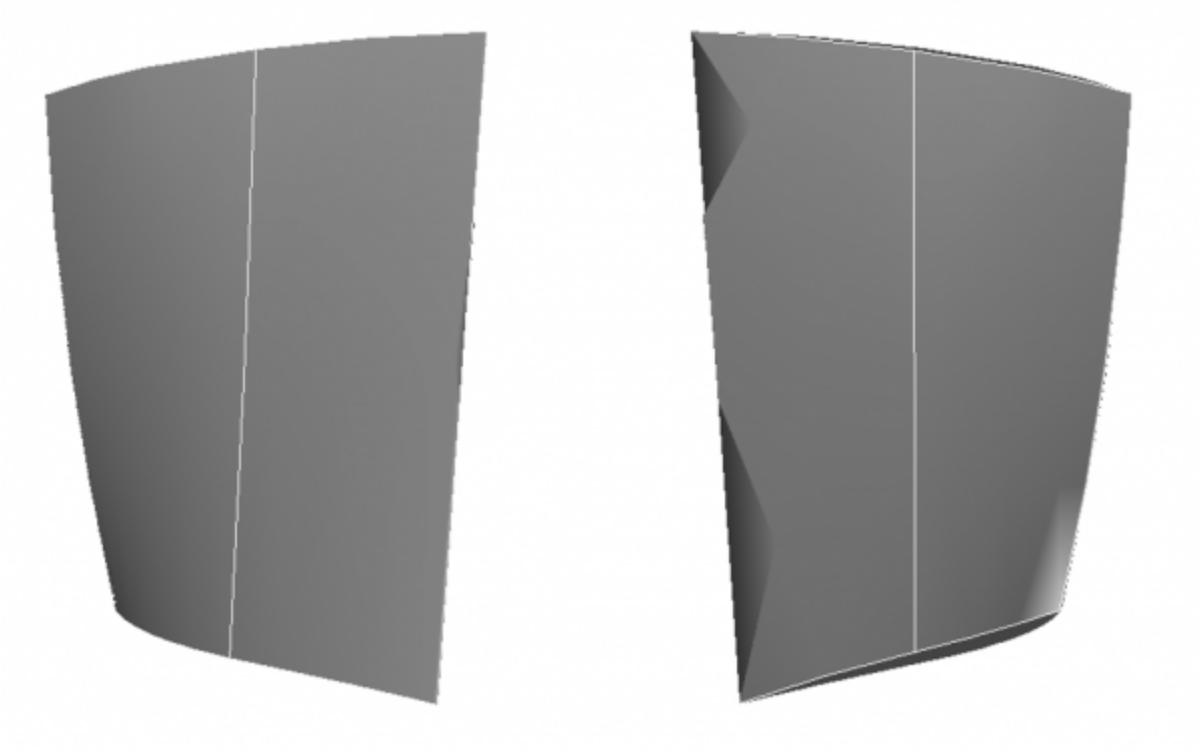
Le matériau du rotor 37 est un alliage à base de nickel : un acier maraging de grade 200

	unité	valeurs
alliage	[-]	18-Ni-200-maraging
module d'Young	[GPa]	180
masse volumique	[kg/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): 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



Document issu de la page wiki:
https://lava-wiki.meca.polymtl.ca/public/modeles/rotor_37/accueil?rev=1668792884

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