

Rotor 66

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Original model

Rotor 66 is part of a 51 centimeter-diameter, five-stage compressor having a design weight flow of 29.7 kilograms per second with a pressure ratio of 9.27. Performance data obtained from tests indicated that the first stage was not meeting its design performance.

- Original technical report ^[1]:

```
@TechReport{urasek1976design,  
author      = {Urasek, Donald C. and Steinke, Ronald J. and Lewis, George  
W.},  
title       = {Performance of inlet stage of transonic compressor},  
institution = {NASA Lewis Research Center Cleveland, OH, United States},  
note        = {NASA-TM X-3345, url~:  
\url{https://ntrs.nasa.gov/citations/19760009935}, 1976}}
```

- Picture :



Fig1. <https://catalog.archives.gov/id/17423368>

```
@Misc{brown1974records,
author   = {Brown, M.},
title    = {First stage rotor wheel from 5 stage compressor. {R}ecords of the
{N}ational {A}eronautics and {S}pace {A}dministration, 1903 - 2006.
{P}hotographs relating to agency activities, facilities and personnel, 1973 -
2013},
note     =
{\href{https://catalog.archives.gov/id/17423368}{https://catalog.archives.gov/
id/17423368}, 1974 }, % for Fig. 1}
```

Useful documents

- PDF of the NASA report : [rotor66.pdf](#)
- CSV file of the blade geometry : [rotor66_original.csv](#)

Geometry

The geometry of rotor 66 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 66

RP	PERCENT RADII		BLADE ANGLES			DELTA INC	CONE ANGLE	
	SPAN	RI	RO	KIC	KTC			KOC
TIP	0.	25.324	25.222	62.51	63.11	58.81	2.68	-3.238
1	5.	24.794	24.657	61.59	62.04	57.92	2.93	-4.225
2	10.	24.216	24.092	60.60	60.87	57.03	3.20	-3.688
3	20.	23.041	22.962	58.61	58.47	55.18	3.75	-2.213
4	30.	21.841	21.831	56.67	55.94	52.98	4.27	-0.268
5	38.	20.866	20.927	55.14	53.75	50.75	4.69	1.522
6	46.	19.878	20.023	53.63	51.48	48.06	5.07	3.444
7	50.	19.378	19.571	52.87	50.29	46.46	5.26	4.458
8	70.	16.811	17.310	48.96	44.21	35.52	6.08	10.070
9	80.	15.470	16.180	46.91	40.93	27.52	6.39	13.261
10	90.	14.079	15.049	44.75	37.49	17.34	6.59	16.722
11	95.	13.361	14.484	43.60	35.80	11.47	6.65	18.571
HUB	100.	12.700	13.919	42.52	34.26	5.34	6.68	19.462

RP	BLADE THICKNESSES			AXIAL DIMENSIONS			
	TI	TM	TO	ZIC	ZMC	ZTC	ZOC
TIP	0.025	0.115	0.025	0.808	1.689	1.936	2.604
1	0.028	0.126	0.028	0.778	1.688	1.910	2.636
2	0.030	0.138	0.030	0.746	1.687	1.879	2.667
3	0.035	0.161	0.035	0.681	1.684	1.809	2.730
4	0.041	0.184	0.041	0.615	1.680	1.726	2.795
5	0.044	0.202	0.044	0.561	1.677	1.650	2.852
6	0.048	0.218	0.048	0.505	1.672	1.565	2.913
7	0.050	0.227	0.050	0.476	1.670	1.518	2.946
8	0.059	0.265	0.059	0.320	1.650	1.244	3.130
9	0.062	0.282	0.062	0.226	1.635	1.075	3.237
10	0.066	0.298	0.066	0.117	1.616	0.879	3.347
11	0.068	0.305	0.068	0.057	1.606	0.772	3.399
HUB	0.069	0.312	0.069	0.000	1.596	0.672	3.450

Aerodynamic design

	unit	values
pressure ratio	[-]	1.61
mass flow	[kg/s]	29.7
tip speed	[m/s]	426
tip solidity	[-]	1.4
aspect ratio	[-]	3.1
number of blades	[-]	57
rotative speed	[rad/s]	1679.94

Material properties

The original material of the rotor 66 is not defined in the NASA report.

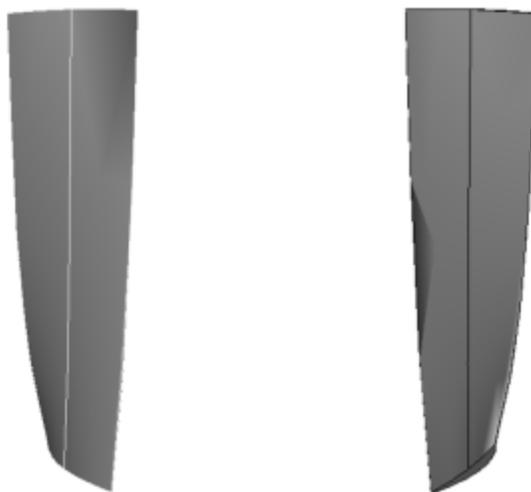
Considered properties: Ti-6Al-4V, generic titanium :

	unité	valeurs
alloy	[-]	Ti-6Al-4V
Young's modulus	[GPa]	108
density	[kg/m ³]	4400
Poisson's ratio	[-]	0.34
yield stress	[GPa]	0.824

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

1. (1B): 1342.0 rad/s / 213.6 Hz
2. (2B): 4557.2 rad/s / 725.3 Hz
3. (1T): 8209.0 rad/s / 1306.5 Hz

CAD



Fichiers téléchargeables

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Modèle original

Le rotor 66 fait partie d'un compresseur à cinq étages de 51 centimètres de diamètre ayant un débit nominal de 29,7 kilogrammes par seconde et un taux de compression de 9,27. Les données de performance obtenues lors de tests ont indiqué que le premier étage n'atteignait pas ses performances de conception.

- Rapport technique original ^[1]:

```
@TechReport{urasek1976design,  
author      = {Urasek, Donald C. and Steinke, Ronald J. and Lewis, George  
W.},  
title       = {Performance of inlet stage of transonic compressor},  
institution = {NASA Lewis Research Center Cleveland, OH, United States},  
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\url{https://ntrs.nasa.gov/citations/19760009935}, 1976}}
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- Photographie :



Fig1. <https://catalog.archives.gov/id/17423368>

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{P}hotographs relating to agency activities, facilities and personnel, 1973 -  
2013},  
note     =  
{\href{https://catalog.archives.gov/id/17423368}{https://catalog.archives.gov/  
id/17423368}, 1974 }, % for Fig. 1}
```

Documents utiles

- PDF du rapport de la NASA :

rotor66.pdf

- Fichier CSV de la géométrie :

rotor66_original.csv

Géométrie

La géométrie du rotor 66 est décrite dans le [rapport d'origine de la NASA](#) par les tableaux suivants. Les grandeurs sont en centimètres et en degrés.

TABLE IV. - BLADE GEOMETRY FOR ROTOR 66

RP	PERCENT RADII			BLADE ANGLES			DELTA INC	CONE ANGLE
	SPAN	R1	R0	K1C	KTC	KOC		
TIP	0.	25.324	25.222	62.51	63.11	58.81	2.68	-3.238
1	5.	24.794	24.657	61.59	62.04	57.92	2.93	-4.225
2	10.	24.216	24.092	60.60	60.87	57.03	3.20	-3.688
3	20.	23.041	22.962	58.61	58.47	55.18	3.75	-2.213
4	30.	21.841	21.831	56.67	55.94	52.98	4.27	-0.268
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HUB	100.	12.700	13.919	42.52	34.26	5.34	6.68	19.462

RP	BLADE THICKNESSES			AXIAL DIMENSIONS			
	T1	TM	T0	Z1C	ZMC	ZTC	Z0C
TIP	0.025	0.115	0.025	0.808	1.689	1.936	2.604
1	0.028	0.126	0.028	0.778	1.688	1.910	2.636
2	0.030	0.138	0.030	0.746	1.687	1.879	2.667
3	0.035	0.161	0.035	0.681	1.684	1.809	2.730
4	0.041	0.184	0.041	0.615	1.680	1.726	2.795
5	0.044	0.202	0.044	0.561	1.677	1.650	2.852
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8	0.059	0.265	0.059	0.320	1.650	1.244	3.130
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HUB	0.069	0.312	0.069	0.000	1.596	0.672	3.450

Caractéristiques aérodynamiques

	unités	valeurs
taux de compression	[-]	1,61
débit massique	[kg/s]	29,7
vitesse en tête	[m/s]	426
solidité en tête	[-]	1,4
allongement	[-]	3,1
nombre d'aubes	[-]	57
vitesse de rotation	[rad/s]	1679,94

Propriétés matériau

Le matériau original du rotor 66 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

	unité	valeurs
limite élastique	[GPa]	0,824

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

1. (1B): 1342,0 rad/s / 213,6 Hz
2. (2B): 4557,2 rad/s / 725,3 Hz
3. (1T): 8209,0 rad/s / 1306,5 Hz

CAO



1. ^{a, b} Urasek. «Performance of inlet stage of transonic compressor» 1976 [pdf](#)

Document issu de la page wiki:

https://wiki.lava.polymtl.ca/public/modeles/rotor_66/accueil?rev=1663351364

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