

# Rotor 74A1

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## Original model

Compressor 74A is part of a research program to study fans and compressors for advanced airbreathing engines to assess and improve the technology needed for high pressure ratio, good efficiency, and adequate stall margin in as few stages as possible. This compressor consists of inlet guide vanes and five stages, and it is designed for a 9.271 pressure ratio. Rotor 74A1 is the rotor of the first stage of this compressor.

- Original technical report <sup>[1]</sup>:

```
@TechReport{steinke1986design,  
author      = {Steinke, Ronald J.},  
title       = {Design of 9.271-Pressure-Ratio Five-Stage Core Compressor  
and Overall Performance for First Three Stages},  
institution = {NASA Lewis Research Center Cleveland, OH, United States},  
note        = {NASA-TP-2597, url~:  
\url{https://ntrs.nasa.gov/citations/19870008266}, 1986}}
```

## Useful documents

- PDF of the NASA report :

rotor74a1.pdf

- CSV file of the blade geometry :

rotor74a1\_original.csv

## Geometry

The geometry of rotor 74A1 is described in the [original NASA report](#) by the following tables. The length are in centimeters and the angles in degrees.

(b) Rotor 1

RP	PERCENT		RADI		BLADE ANGLES			DELTA INC	CONE ANGLE
	SPAN	RI	RO	KIC	KTC	KOC			
TIP	0.	25.613	24.973	64.13	60.20	49.27	2.97	-9.556	
1	5.	25.057	24.468	62.69	58.89	48.63	3.20	-8.420	
2	10.	24.444	23.963	61.22	57.51	47.85	3.44	-6.616	
3	20.	23.229	22.952	58.73	54.88	45.72	3.93	-3.550	
4	30.	22.008	21.941	56.48	51.41	43.25	4.41	-1.800	
5	40.	20.776	20.931	54.37	48.31	39.85	4.88	1.729	
6	50.	19.520	19.920	52.33	45.34	35.29	5.34	4.186	
7	60.	18.229	18.909	50.33	42.53	29.34	5.77	6.689	
8	70.	16.889	17.899	48.33	39.61	22.00	6.13	9.324	
9	80.	15.483	16.888	46.33	36.67	12.99	6.35	12.175	
10	90.	13.993	15.877	44.33	33.78	1.70	6.33	15.336	
11	95.	13.211	15.372	43.33	32.36	-5.09	6.19	17.060	
HUB	100.	12.509	14.867	42.43	31.10	-11.85	6.06	18.117	

RP	BLADE THICKNESSES			AXIAL DIMENSIONS			
	TI	TM	TO	ZI	ZMC	ZTC	ZO
TIP	.027	.222	.027	1.877	3.610	4.170	5.679
1	.028	.239	.028	1.778	3.600	4.097	5.755
2	.030	.257	.030	1.677	3.591	4.016	5.829
3	.036	.294	.036	1.506	3.577	3.841	5.974
4	.040	.331	.041	1.326	3.564	3.625	6.137
5	.044	.368	.045	1.159	3.549	3.383	6.293
6	.048	.407	.050	.994	3.529	3.116	6.454
7	.053	.447	.055	.825	3.503	2.814	6.622
8	.059	.490	.060	.642	3.471	2.480	6.793
9	.064	.537	.066	.446	3.436	2.119	6.959
10	.070	.589	.071	.229	3.396	1.719	7.099
11	.074	.618	.074	.108	3.372	1.504	7.151
HUB	.078	.645	.077	-.000	3.350	1.311	7.204

## Aerodynamic design

	unit	values
pressure ratio	[-]	1.792
mass flow	[kg/s]	29.71
tip speed	[m/s]	430
tip solidity	[-]	1.35
aspect ratio	[-]	1.45
number of blades	[-]	28
rotative speed	[rad/s]	1680

## Material properties

Rotor 74A1 is made of titanium

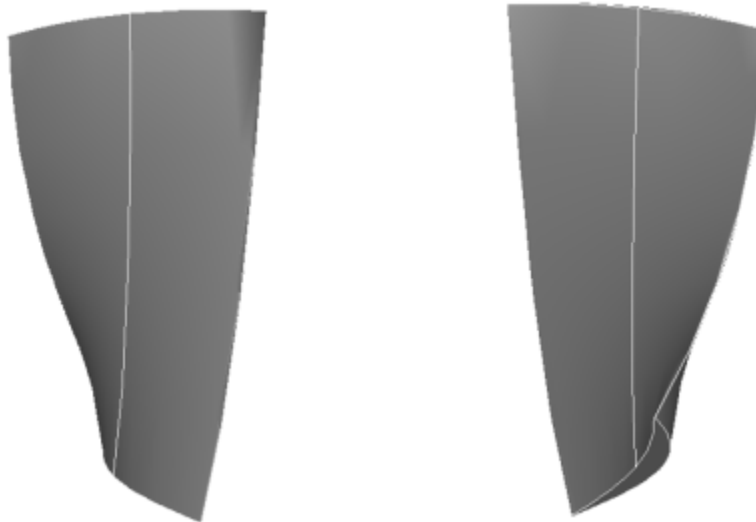
	unité	valeurs
alloy	[-]	Ti-6Al-4V
Young's modulus	[GPa]	108
density	[kg/m <sup>3</sup> ]	4400
Poisson's ratio	[-]	0.34
yield stress	[GPa]	0.824

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

1. (1B): 2593.0 rad/s / 412.7 Hz
2. (1T): 8396.1 rad/s / 1336.3 Hz

3. (2B): 11696.6 rad/s / 1861.6 Hz

## CAD



Fichiers téléchargeables

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## Modèle original

Le compresseur 74A fait partie d'un programme de recherche visant à étudier les soufflantes et les compresseurs pour les moteurs avancés afin d'évaluer et d'améliorer la technologie nécessaire pour obtenir un rapport de pression élevé, un bon rendement et une marge de décrochage adéquate avec le moins d'étages possible. Ce compresseur est composé d'aubes directrices en entrée et de cinq étages, et il est conçu pour un rapport de pression de 9,271. Le rotor 74A1 est le rotor du premier étage de ce compresseur.

- [Rapport technique original](#) <sup>[1]</sup>:

```
@TechReport{steinke1986design,  
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\url{https://ntrs.nasa.gov/citations/19870008266}, 1986}}
```

## Documents utiles

- PDF du rapport de la NASA :  
rotor74a1.pdf
- Fichier CSV de la géométrie :  
rotor74a1\_original.csv

## Géométrie

La géométrie du rotor 74A1 est décrite dans le [rapport d'origine de la NASA](#) par les tableaux suivants. Les grandeurs sont en centimètres et en degrés.

(b) Rotor 1

RP	PERCENT SPAN		RADII		BLADE ANGLES			DELTA INC	CONE ANGLE
	SPAN		RI	RO	KTC	KTC	KOC		
TIP	0.		25.613	24.973	64.13	60.20	49.27	2.97	-9.556
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11	.074	.618	.074	.108	3.372	1.504	7.151
HUB	.078	.645	.077	-.000	3.350	1.311	7.204

## Caractéristiques aérodynamiques

	unités	valeurs
<b>taux de compression</b>	[-]	1,792
<b>débit massique</b>	[kg/s]	29,71
<b>vitesse en tête</b>	[m/s]	430
<b>solidité en tête</b>	[-]	1,35
<b>allongement</b>	[-]	1,45
<b>nombre d'aubes</b>	[-]	28
<b>vitesse de rotation</b>	[rad/s]	1680

## Propriétés matériau

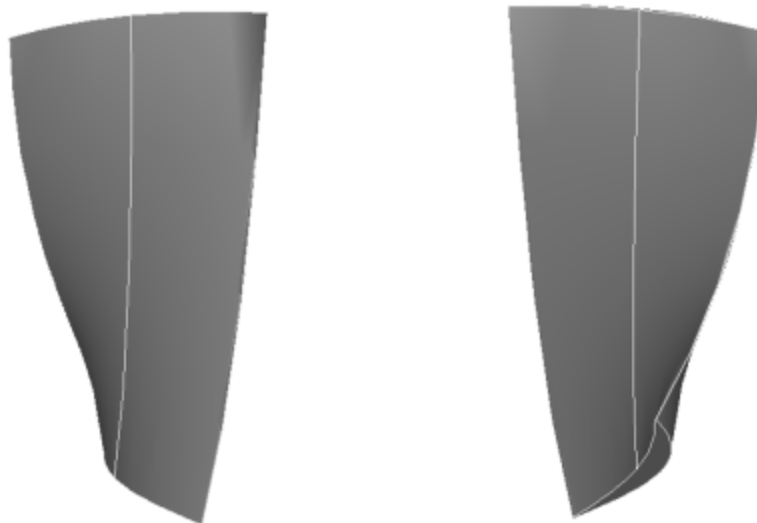
Le matériau du rotor 74A1 est le titane d'après le rapport.

	unité	valeurs
<b>alliage</b>	[-]	Ti-6Al-4V
<b>module d'Young</b>	[GPa]	108
<b>masse volumique</b>	[kg/m <sup>3</sup> ]	4400
<b>coefficient de Poisson</b>	[-]	0,34
<b>limite élastique</b>	[GPa]	0,824

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

1. (1B): 2593,0 rad/s / 412,7 Hz
2. (1T): 8396,1 rad/s / 1336,3 Hz
3. (2B): 11696,6 rad/s / 1861,6 Hz

## CAO



1. <sup>a, b</sup> Steinke. «Design of 9.271-Pressure-Ratio Five-Stage Core Compressor and Overall Performance for First Three Stages » 1986. [pdf](#)

Document issu de la page wiki:

[https://lava-wiki.meca.polymtl.ca/public/modeles/rotor\\_74a1/accueil?rev=1668794169](https://lava-wiki.meca.polymtl.ca/public/modeles/rotor_74a1/accueil?rev=1668794169)

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