

# Rotor 2

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## Original model

Rotor 2 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 <sup>[1]</sup>:

```
@TechReport{reid1974design,  
author      = {Reid, L. and Tysl, Edward R.},  
title       = {Performance of a transonic compressor rotor with an aspect  
ratio of 6.5},  
institution = {NASA Lewis Research Center Cleveland, OH, United States},  
note        = {NASA-TN D-7662, url~:  
\url{https://ntrs.nasa.gov/citations/19740018136}, 1974 }}
```

- Picture :

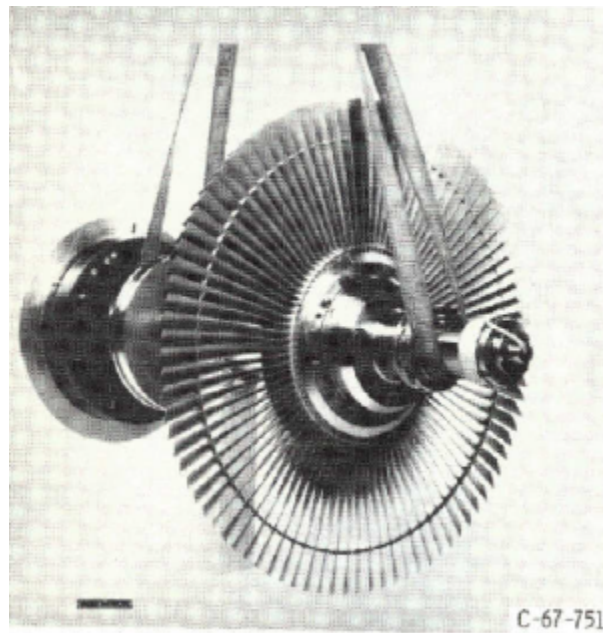


Fig1. <https://ntrs.nasa.gov/citations/19740018136> p.61

## Useful documents

- PDF of the NASA report : [rotor2.pdf](#)
- CSV file of the blade geometry : [rotor2\\_original.csv](#)

## Geometry

[The geometry of rotor 2 is described in the original NASA report](#) by the following tables. The length are in inches and the angles in degrees.

TABLE III. - BLADE GEOMETRY FOR ROTOR 2

RP	PERCENT		RADIO		BLADE ANGLES			DELTA INC
	SPAN	RI	RO	KIC	KTC	KOC		
TIP	0.	10.000	9.900	60.31	55.15	50.05	2.07	
1	5.	9.734	9.647	58.77	54.04	49.32	2.10	
2	10.	9.451	9.395	57.23	52.71	48.19	2.15	
3	20.	8.880	8.889	54.39	49.55	44.70	2.30	
4	30.	8.308	8.384	51.87	45.75	39.65	2.50	
5	33.	8.168	8.258	51.28	44.73	38.20	2.54	
6	35.	8.030	8.131	50.71	43.68	36.67	2.59	
7	38.	7.892	8.005	50.15	42.60	35.06	2.63	
8	40.	7.755	7.879	49.61	41.49	33.36	2.67	
9	50.	7.193	7.373	47.16	36.38	25.59	3.00	
10	60.	6.622	6.868	44.49	30.45	16.41	3.50	
11	90.	4.708	5.352	35.36	10.55	-14.26	7.27	
HUB	100.	4.000	4.847	32.21	4.44	-23.34	10.23	

RP	BLADE THICKNESSES			AXIAL DIMENSIONS			CONE ANGLE
	TI	TM	TO	ZMC	ZTC	ZOC	
TIP	0.020	0.037	0.020	0.248	0.248	0.530	-6.411
1	0.020	0.037	0.020	0.257	0.257	0.545	-5.531
2	0.020	0.038	0.020	0.266	0.266	0.562	-3.612
3	0.020	0.039	0.020	0.286	0.286	0.602	0.599
4	0.020	0.041	0.020	0.306	0.306	0.647	4.884
5	0.020	0.041	0.020	0.310	0.310	0.658	5.733
6	0.020	0.041	0.020	0.315	0.315	0.668	6.522
7	0.020	0.042	0.020	0.319	0.319	0.679	7.252
8	0.020	0.042	0.020	0.323	0.323	0.690	7.923
9	0.020	0.045	0.020	0.344	0.344	0.739	11.459
10	0.020	0.049	0.020	0.366	0.366	0.789	15.435
11	0.020	0.083	0.020	0.402	0.402	0.838	35.893
HUB	0.020	0.111	0.020	0.392	0.392	0.799	43.582

## Aerodynamic design

	unit	values
pressure ratio	[-]	1.53
mass flow	[kg/s]	30.7
tip speed	[m/s]	350.8
tip solidity	[-]	1.3
aspect ratio	[-]	6.5
rotative speed	[rad/s]	1381.25

## Material properties

Rotor 2 is made of a 200-grade maraging steel

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

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

1. (1B): 1686.8 rad/s / 268.5 Hz
2. (2B): 6385.2 rad/s / 1016.2 Hz
3. (1T): 8140.1 rad/s / 1295.5 Hz

## CAD



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## Modèle original

Le rotor 2 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 <sup>[1]</sup>:

```
@TechReport{reid1974design,
author      = {Reid, L. and Tysl, Edward R.},
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- Photographie :

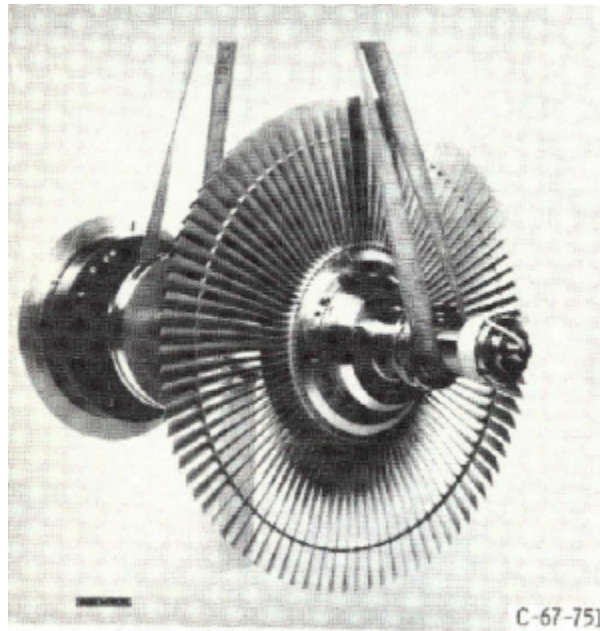


Fig1. <https://ntrs.nasa.gov/citations/19740018136> p.61

## Documents utiles

- PDF du rapport de la NASA :

rotor2.pdf

- Fichier CSV de la géométrie :

rotor2\_original.csv

## Géométrie

La géométrie du rotor 2 est décrite dans le [rapport d'origine de la NASA](#) par les tableaux suivants. Les grandeurs sont en pouces et en degrés.

TABLE III. - BLADE GEOMETRY FOR ROTOR 2

RP	PERCENT		RADI		BLADE ANGLES			DELTA INC
	SPAN	R1	R0	K1C	K7C	K0C		
TIP	0.	10.000	9.900	60.31	55.15	50.05	2.07	
1	5.	9.734	9.647	58.77	54.04	49.32	2.10	
2	10.	9.451	9.395	57.23	52.71	48.19	2.15	
3	20.	8.880	8.889	54.39	49.55	44.70	2.30	
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HUB	100.	4.000	4.847	32.21	4.44	-23.34	10.23	

RP	BLADE THICKNESSES			AXIAL DIMENSIONS			CONE ANGLE
	T1	TM	TO	ZMC	Z7C	Z0C	
TIP	0.020	0.037	0.020	0.248	0.248	0.530	-6.411
1	0.020	0.037	0.020	0.257	0.257	0.545	-5.531
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10	0.020	0.049	0.020	0.366	0.366	0.789	15.435
11	0.020	0.083	0.020	0.402	0.402	0.838	35.893
HUB	0.020	0.111	0.020	0.392	0.392	0.799	43.582

## Caractéristiques aérodynamiques

	unités	valeurs
taux de compression	[-]	1,53
débit massique	[kg/s]	30,7
vitesse en tête	[m/s]	350,8
solidité en tête	[-]	1,3
allongement	[-]	6.5
vitesse de rotation	[rad/s]	1381,25

## Propriétés matériau

Le matériau du rotor 2 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

	unité	valeurs
<b>limite élastique</b>	[GPa]	1,38

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

1. (1B): 1686,8 rad/s / 268,5 Hz
2. (2B): 6385,2 rad/s / 1016,2 Hz
3. (1T): 8140,1 rad/s / 1295,5 Hz

## CAO



</tabs>

1. <sup>a, b</sup> Reid. «Performance of a transonic compressor rotor with an aspect ratio of 6.5 » 1974. [pdf](#)

Document issu de la page wiki:

[https://wiki.lava.polymtl.ca/public/modeles/rotor\\_02/accueil?rev=1663352051](https://wiki.lava.polymtl.ca/public/modeles/rotor_02/accueil?rev=1663352051)

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