Rotor 23B

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Original model

Rotor 23B is part of a research program to study the effects of aspect ratio, diffusion factor, and solidity on rotors. To do so, experimental studies have been conducted on a series of high-hub-tip-radius-ratio compressor stages representative of the middle and latter stages of axial-flow compressors. In fact, 14 middle stages were tested to assess the effects on performance of varying both diffusion through the rotor and stator blades and blade aspect ratio. Among these 14 stages, there are rotors 23B, 24A, 25A, 26B, 27A and 28B. Both the tip diameter and the hub-tip radius ratio were held constant throughout each stage at 50.8 centimeters and 0.8, respectively.

- Original technical report [(cite:britsch1979design>Britsch. «Design and overall performance of four highly loaded, high speed inlet stages for an advanced high-pressure-ratio core compressor » 1979. pdf)]:

```
@TechReport{britsch1979design,
author      = {Britsch, Werner R. and Osborn, Walter M. and Laessig, Mark
R.},
title       = {Effects of Diffusion Factor, Aspect Ratio, and Solidity on
Overall Performance of 14 Compressor Middle Stages},
institution = {NASA Lewis Research Center Cleveland, OH, United States},
note        = {NASA-TP-1523, url~:
\url{https://ntrs.nasa.gov/citations/19790025039}, 1979 }}
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- Picture :



https://catalog.archives.gov/id/17446275

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@Misc{brown1975records,
author   = {BROWN, M.},
title    = {Rotor 23B - Stator 20B. {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/17446275}{https://catalog.archives.gov/
id/17446275}, 1975 }, % for Fig. 1}
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Useful documents

- PDF of the NASA report :

  rotor23b.pdf

- CSV file of the blade geometry :

  rotor23b_original.csv

Geometry

The geometry of rotor 23B is described in the original NASA report by the following tables. The length are in centimeters and the angles in degrees.

TABLE 8. - BLADE GEOMETRY FOR ROTOR 23B

RP	PERCENT SPAN	RADII RI	RADII RO	BLADE ANGLES KIC	BLADE ANGLES KTC	BLADE ANGLES KOC	DELTA INC	CONE ANGLE
TIP	0.	25.400	25.400	63.54	58.04	53.62	2.26	0.057
1	5.	25.168	25.146	63.31	57.75	53.11	2.44	-0.478
2	10.	24.912	24.892	63.06	57.39	52.55	2.63	-0.425
3	15.	24.656	24.638	62.80	56.98	51.83	2.85	-0.370
4	30.	23.886	23.876	62.01	55.69	49.57	3.59	-0.198
5	50.	22.856	22.860	60.91	53.92	46.30	4.11	0.079
6	70.	21.829	21.844	59.75	52.02	42.55	4.33	0.277
7	85.	21.055	21.082	58.84	50.45	39.17	5.28	0.469
8	90.	20.797	20.828	58.53	49.86	37.85	5.44	0.532
9	95.	20.538	20.574	58.22	49.16	36.15	5.59	0.600
HUB	100.	20.320	20.320	57.95	48.52	34.34	5.72	0.057

RP	BLADE THICKNESSES TI	BLADE THICKNESSES TM	BLADE THICKNESSES TO	AXIAL DIMENSIONS ZIC	AXIAL DIMENSIONS ZMC	AXIAL DIMENSIONS ZTC	AXIAL DIMENSIONS ZOC
TIP	0.051	0.151	0.051	0.336	1.557	1.695	2.935
1	0.051	0.158	0.051	0.325	1.558	1.679	2.962
2	0.051	0.167	0.051	0.313	1.559	1.662	3.001
3	0.051	0.176	0.051	0.299	1.559	1.643	3.022
4	0.051	0.201	0.051	0.255	1.559	1.584	3.090
5	0.051	0.233	0.051	0.194	1.560	1.497	3.186
6	0.051	0.264	0.051	0.126	1.560	1.400	3.290
7	0.051	0.286	0.051	0.069	1.560	1.319	3.377
8	0.051	0.293	0.051	0.048	1.559	1.289	3.411
9	0.051	0.300	0.051	0.023	1.558	1.255	3.450
HUB	0.051	0.306	0.051	-0.000	1.557	1.226	3.492

Aerodynamic design

	unit	values
pressure ratio	[-]	1.257
mass flow	[kg/s]	9.46
tip speed	[m/s]	243.8
tip solidity	[-]	1.6
aspect ratio	[-]	1
number of blades	[-]	50
rotative speed	[rad/s]	960.28

Material properties

The original material of the rotor 23B is not defined in the NASA report.

Considered properties: 200-grade maraging steel :

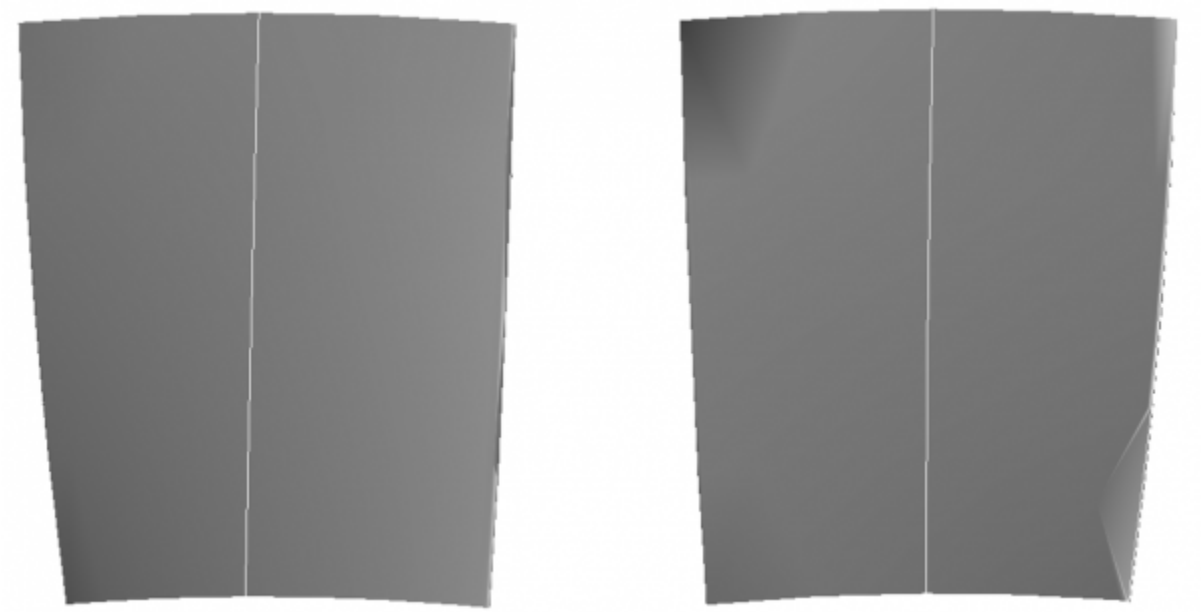
	unité	valeurs
alloy	[-]	18-Ni-200-maraging
Young's modulus	[GPa]	180
density	[kg/m3]	8000
Poisson's ratio	[-]	0.3
yield stress	[GPa]	1.38

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

1. (1B): 7194.7 rad/s / 1145.1 Hz

2. (1T): 15383.6 rad/s / 2448.4 Hz
3. (2B): 28053.6 rad/s / 4464.9 Hz

CAD



Fichiers téléchargeables
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Modèle original

Le rotor 23B fait partie d'un programme de recherche visant à étudier les effets de l'allongement, du facteur de diffusion et de la solidité des rotors. Pour ce faire, des études expérimentales ont été menées sur une série d'étages de compresseurs à fort rapport entre les rayons du moyeu et de la tête d'aube, représentatifs des étages moyens et avancés des compresseurs à flux axial. En effet, 14 étages intermédiaires ont été testés pour évaluer les effets sur les performances de la variation de la diffusion et de l'allongement des aubes. Parmi ces 14 étages, on trouve les rotors 23B, 24A, 25A, 26B, 27A et 28B. Le diamètre de l'extrémité des aubes et le rapport entre les rayons du moyeu et de la tête d'aube ont été maintenus constants tout au long de chaque étage à 50.8 centimètres et 0.8, respectivement.

- Rapport technique original [(cite:britsch1979design>Britsch. «Design and overall performance of four highly loaded, high speed inlet stages for an advanced high-pressure-ratio core compressor » 1979. pdf)]:

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@TechReport{britsch1979design,
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- Photographie :



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id/17446275}, 1975 }, % for Fig. 1}
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Documents utiles

- PDF du rapport de la NASA :

rotor23b.pdf

- Fichier CSV de la géométrie :

rotor23b_original.csv

Géométrie

La géométrie du rotor 23B est décrite dans le rapport d'origine de la NASA par les tableaux suivants. Les

grandeurs sont en centimètres et en degrés.

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6	70.	21.829	21.844	59.75	52.02	42.55	4.83	0.277
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6	0.051	0.264	0.051	0.126	1.560	1.400	3.290
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HUB	0.051	0.306	0.051	-0.000	1.557	1.226	3.492

Caractéristiques aérodynamiques

	unités	valeurs
taux de compression	[-]	1,257
débit massique	[kg/s]	9,46
vitesse en tête	[m/s]	243,8
solidité en tête	[-]	1,6
allongement	[-]	1
nombre d'aubes	[-]	50
vitesse de rotation	[rad/s]	960,28

Propriétés matériau

Le matériau original du rotor 23B n'est pas défini dans le rapport de la NASA.

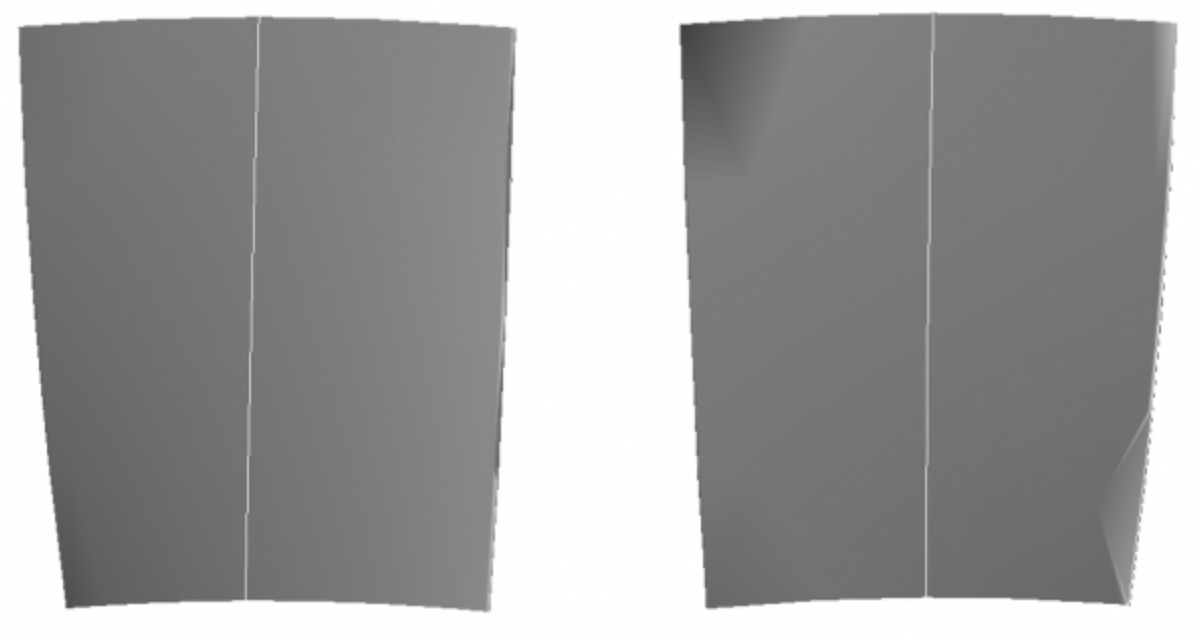
Propriétés considérées : un acier maraging de grade 200 :

	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): 7194,7 rad/s / 1145,1 Hz
2. (1T): 15383,6 rad/s / 2448,4 Hz
3. (2B): 28053,6 rad/s / 4464,9 Hz

CAO



Document issu de la page wiki:
https://wiki.lava.polymtl.ca/public/modeles/rotor_23b/accueil?rev=1663351788

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