

Rotor 25A

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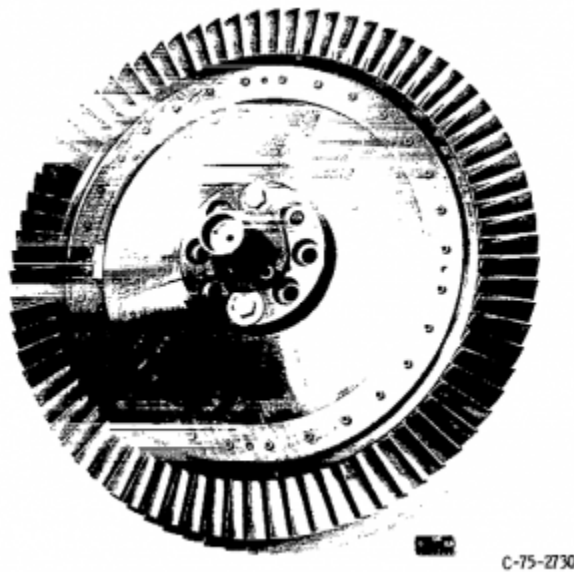
Original model

Rotor 25A 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 ^[1]:

```
@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 }}
```

- Picture :



<https://ntrs.nasa.gov/citations/19790025039> p.101

Useful documents

- PDF of the NASA report : [rotor25a.pdf](#)
- CSV file of the blade geometry : [rotor25a_original.csv](#)

Geometry

The geometry of rotor 25A is described in the [original NASA report](#) by the following tables. The length are in centimeters and the angles in degrees.

TABLE 10. - BLADE GEOMETRY FOR ROTOR 25A

| RP | PERCENT RADII | | BLADE ANGLES | | | DELTA | CONE | |
|-----|---------------|--------|--------------|-------|-------|-------|------|--------|
| | SPAN | R1 | RO | KIC | KTC | KOC | INC | ANGLE |
| TIP | 0. | 25.400 | 25.400 | 64.62 | 56.28 | 53.40 | 1.15 | 0.057 |
| 1 | 5. | 25.167 | 25.146 | 64.39 | 56.05 | 53.01 | 1.34 | -0.958 |
| 2 | 10. | 24.911 | 24.892 | 64.14 | 55.75 | 52.54 | 1.54 | -0.850 |
| 3 | 15. | 24.655 | 24.638 | 63.86 | 55.37 | 51.95 | 1.74 | -0.741 |
| 4 | 30. | 23.885 | 23.876 | 63.07 | 54.11 | 49.96 | 2.33 | -0.399 |
| 5 | 50. | 22.857 | 22.860 | 61.95 | 52.31 | 46.98 | 3.08 | 0.114 |
| 6 | 70. | 21.829 | 21.844 | 60.75 | 50.34 | 43.49 | 3.79 | 0.559 |
| 7 | 85. | 21.057 | 21.082 | 59.80 | 48.67 | 40.34 | 4.30 | 0.935 |
| 8 | 90. | 20.798 | 20.828 | 59.47 | 48.04 | 39.11 | 4.47 | 1.069 |
| 9 | 95. | 20.540 | 20.574 | 59.14 | 47.29 | 37.61 | 4.63 | 1.202 |
| HUB | 100. | 20.320 | 20.320 | 58.86 | 46.62 | 36.02 | 4.76 | 0.057 |

| RP | BLADE THICKNESSES | | | AXIAL DIMENSIONS | | | |
|-----|-------------------|-------|-------|------------------|-------|-------|-------|
| | T1 | TM | TO | Z1C | Z2C | Z3C | Z4C |
| TIP | 0.051 | 0.075 | 0.051 | 0.115 | 0.689 | 1.003 | 1.365 |
| 1 | 0.051 | 0.079 | 0.051 | 0.112 | 0.692 | 0.997 | 1.374 |
| 2 | 0.051 | 0.084 | 0.051 | 0.109 | 0.694 | 0.989 | 1.384 |
| 3 | 0.051 | 0.088 | 0.051 | 0.105 | 0.696 | 0.982 | 1.395 |
| 4 | 0.051 | 0.100 | 0.051 | 0.091 | 0.703 | 0.958 | 1.432 |
| 5 | 0.051 | 0.117 | 0.051 | 0.072 | 0.713 | 0.922 | 1.484 |
| 6 | 0.051 | 0.132 | 0.051 | 0.047 | 0.720 | 0.878 | 1.539 |
| 7 | 0.051 | 0.143 | 0.051 | 0.026 | 0.726 | 0.841 | 1.585 |
| 8 | 0.051 | 0.147 | 0.051 | 0.018 | 0.728 | 0.827 | 1.602 |
| 9 | 0.051 | 0.150 | 0.051 | 0.008 | 0.730 | 0.813 | 1.622 |
| HUB | 0.051 | 0.153 | 0.051 | -0.000 | 0.731 | 0.800 | 1.643 |

Aerodynamic design

| | unit | values |
|------------------|---------|--------|
| pressure ratio | [-] | 1.238 |
| mass flow | [kg/s] | 9.46 |
| tip speed | [m/s] | 243.8 |
| tip solidity | [-] | 1.2 |
| aspect ratio | [-] | 2 |
| number of blades | [-] | 77 |
| rotative speed | [rad/s] | 960.28 |

Material properties

The original material of the rotor 25A is not defined in the NASA report.

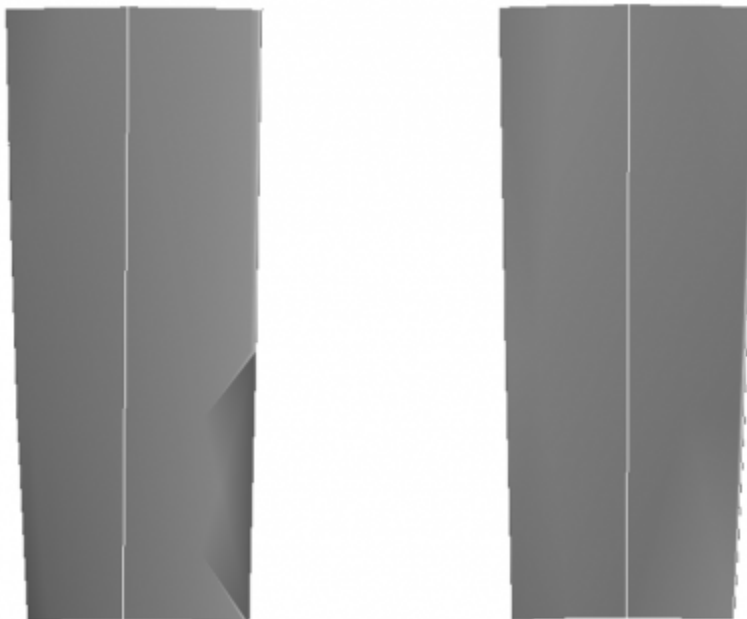
Considered properties: 200-grade maraging steel :

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

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

1. (1B): 3311.4 rad/s / 527.0 Hz
2. (1T): 11300.3 rad/s / 1798.5 Hz
3. (2B): 15371.1 rad/s / 2446.4 Hz

CAD



Fichiers téléchargeables

x

Libre accès

[lien vers le projet Git](#)

Modèle original

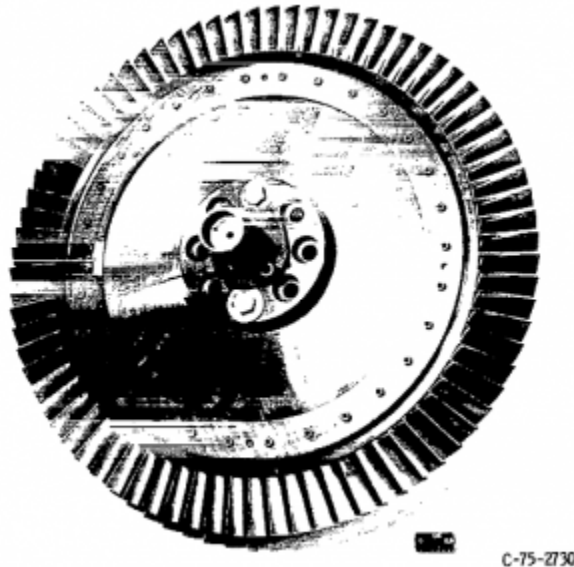
Le rotor 25A fait partie d'un programme de recherche visant à étudier les effets de l'allongement, du facteur de diffusion et de la solidité des rotors. Pour ce faire, des études expérimentales ont été menées sur une série d'étages de compresseurs à fort rapport entre les rayons du moyeu et de la tête 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 ^[1]:

```
@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 }}
```

- Photographie :



<https://ntrs.nasa.gov/citations/19790025039> p.101

Documents utiles

- PDF du rapport de la NASA :
rotor25a.pdf
- Fichier CSV de la géométrie :
rotor25a_original.csv

Géométrie

La géométrie du rotor 25A est décrite dans le [rapport d'origine de la NASA](#) par les tableaux suivants. Les grandeurs sont en centimètres et en degrés.

TABLE 10. - BLADE GEOMETRY FOR ROTOR 25A

| RP | PERCENT RADII | | BLADE ANGLES | | | DELTA INC | CONE ANGLE |
|-----|---------------|---------------|--------------|-------|-------|-----------|------------|
| | SPAN | RI RO | KIC | KTC | KOC | | |
| TIP | 0. | 25.400 25.400 | 64.62 | 56.28 | 53.40 | 1.15 | 0.057 |
| 1 | 5. | 25.167 25.146 | 64.39 | 56.05 | 53.01 | 1.34 | -0.958 |
| 2 | 10. | 24.911 24.892 | 64.14 | 55.75 | 52.54 | 1.54 | -0.850 |
| 3 | 15. | 24.655 24.638 | 63.86 | 55.37 | 51.95 | 1.74 | -0.741 |
| 4 | 30. | 23.885 23.876 | 63.07 | 54.11 | 49.96 | 2.33 | -0.399 |
| 5 | 50. | 22.857 22.860 | 61.95 | 52.31 | 46.98 | 3.08 | 0.114 |
| 6 | 70. | 21.829 21.844 | 60.75 | 50.34 | 43.49 | 3.79 | 0.559 |
| 7 | 85. | 21.057 21.082 | 59.80 | 48.67 | 40.34 | 4.30 | 0.935 |
| 8 | 90. | 20.798 20.828 | 59.47 | 48.04 | 39.11 | 4.47 | 1.069 |
| 9 | 95. | 20.540 20.574 | 59.14 | 47.29 | 37.61 | 4.63 | 1.202 |
| HUB | 100. | 20.320 20.320 | 58.86 | 46.62 | 36.02 | 4.76 | 0.057 |

| RP | BLADE THICKNESSES | | | AXIAL DIMENSIONS | | | |
|-----|-------------------|-------|-------|------------------|-------|-------|-------|
| | TI | TM | TO | ZIC | ZMC | ZTC | ZOC |
| TIP | 0.051 | 0.075 | 0.051 | 0.115 | 0.689 | 1.003 | 1.365 |
| 1 | 0.051 | 0.079 | 0.051 | 0.112 | 0.692 | 0.997 | 1.374 |
| 2 | 0.051 | 0.084 | 0.051 | 0.109 | 0.694 | 0.989 | 1.384 |
| 3 | 0.051 | 0.088 | 0.051 | 0.105 | 0.696 | 0.982 | 1.395 |
| 4 | 0.051 | 0.100 | 0.051 | 0.091 | 0.703 | 0.958 | 1.432 |
| 5 | 0.051 | 0.117 | 0.051 | 0.072 | 0.713 | 0.922 | 1.484 |
| 6 | 0.051 | 0.132 | 0.051 | 0.047 | 0.720 | 0.878 | 1.539 |
| 7 | 0.051 | 0.143 | 0.051 | 0.026 | 0.726 | 0.841 | 1.585 |
| 8 | 0.051 | 0.147 | 0.051 | 0.018 | 0.728 | 0.827 | 1.602 |
| 9 | 0.051 | 0.150 | 0.051 | 0.008 | 0.730 | 0.813 | 1.622 |
| HUB | 0.051 | 0.153 | 0.051 | -0.000 | 0.731 | 0.800 | 1.643 |

Caractéristiques aérodynamiques

| | unités | valeurs |
|----------------------------|---------|---------|
| taux de compression | [-] | 1,238 |
| débit massique | [kg/s] | 9,46 |
| vitesse en tête | [m/s] | 243,8 |
| solidité en tête | [-] | 1,2 |
| allongement | [-] | 2 |
| nombre d'aubes | [-] | 77 |
| vitesse de rotation | [rad/s] | 960,28 |

Propriétés matériau

Le matériau original du rotor 25A n'est pas défini dans le rapport de la NASA.

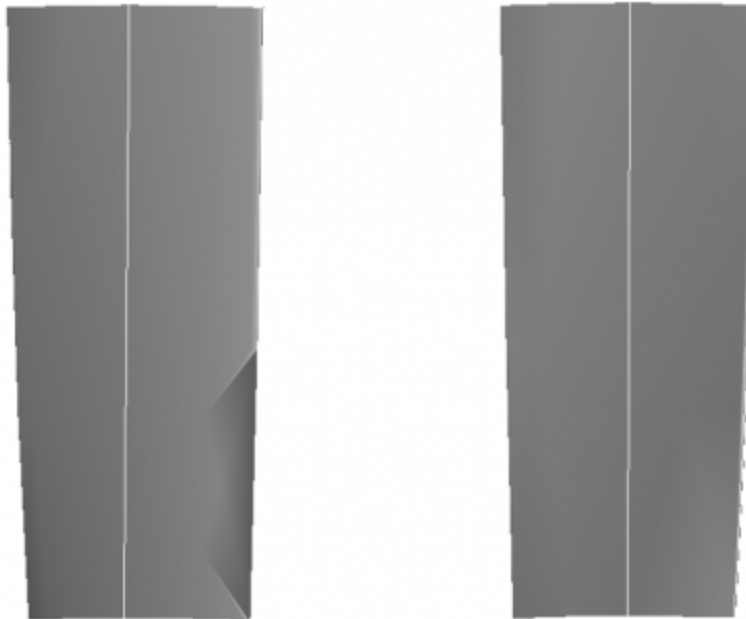
Propriétés considérées : un acier maraging de grade 200 :

| | unité | valeurs |
|-------------------------------|----------------------|--------------------|
| alliage | [-] | 18-Ni-200-maraging |
| module d'Young | [GPa] | 180 |
| masse volumique | [kg/m ³] | 8000 |
| coefficient de Poisson | [-] | 0,3 |
| limite élastique | [GPa] | 1,38 |

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

1. (1B): 3311,4 rad/s / 527,0 Hz
2. (1T): 11300,3 rad/s / 1798,5 Hz
3. (2B): 15371,1 rad/s / 2446,4 Hz

CAO



1. ^{a, b} Britsch. «Design and overall performance of four highly loaded, high speed inlet stages for an advanced high-pressure-ratio core compressor » 1979. [pdf](#)

Document issu de la page wiki:

https://lava-wiki.meca.polymtl.ca/public/modeles/rotor_25a/accueil

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