

Rotor 36

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Original model

Rotor 36 is part of a research program to study a advanced-core compressor design with a high compression ratio (20:1). It is therefore the second stage rotor of this eight stage transonic compressor. Of these eight stages, the first four have been designed and tested : rotors 35, 36, 37 and 38. For more information, here is a link to [report from NASA](#).

- Original technical report ^[1]:

```
@TechReport{reid1982design,
author      = {Reid, L. and Moore, R. D.},
title       = {Performance of single-stage axial-flow transonic compressor
with rotor and stator aspect ratios of 1.63 and 1.78, respectively, and
with design pressure ratio of 1.82},
institution = {NASA Lewis Research Center Cleveland, OH, United States},
note        = {NASA-TP-1974, url~:
\url{https://ntrs.nasa.gov/citations/19820011348}, 1982}}
```

- Pictures :



Fig1. <https://catalog.archives.gov/id/17467913>



Fig2. <https://catalog.archives.gov/id/17467884>

```
@Misc{huebler1977records,  
author = {Huebler, D.},  
title = {Rotor 36 assembly and stator 36 casing half. {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/17467913}{https://catalog.archives.gov/  
id/17467913}}, 1977 }, % for Fig. 1  
note =  
{\href{https://catalog.archives.gov/id/17467884}{https://catalog.archives.gov/  
id/17467884}}, 1977 }, % for Fig. 2}
```

Useful documents

- PDF of the NASA report :

rotor36.pdf

- CSV file of the blade geometry :

rotor36_original.csv

Geometry

The geometry of rotor 36 is described in the [original NASA report](#) by the following tables. The length are in centimeters and the angles in degrees.

(a) Rotor 36

| RP | PERCENT RADII | | | BLADE ANGLES | | | DELTA INC | CONE ANGLE |
|-----|---------------|--------|--------|--------------|-------|-------|-----------|------------|
| | SPAN | RI | RO | KIC | KTC | KOC | | |
| TIP | 0. | 25.291 | 24.778 | 62.68 | 64.29 | 57.83 | 2.39 | -15.305 |
| 1 | 5. | 24.983 | 24.465 | 62.03 | 63.32 | 56.46 | 2.69 | -14.857 |
| 2 | 10. | 24.636 | 24.153 | 61.29 | 62.26 | 55.19 | 2.99 | -13.420 |
| 3 | 15. | 24.286 | 23.840 | 60.54 | 61.24 | 54.13 | 3.23 | -11.979 |
| 4 | 30. | 23.212 | 22.903 | 58.52 | 58.56 | 50.95 | 3.64 | -7.659 |
| 5 | 50. | 21.747 | 21.653 | 56.54 | 55.05 | 46.11 | 4.38 | -2.125 |
| 6 | 70. | 20.229 | 20.404 | 54.21 | 51.54 | 40.31 | 5.64 | 3.616 |
| 7 | 85. | 19.020 | 19.467 | 52.48 | 48.18 | 34.05 | 6.65 | 8.615 |
| 8 | 90. | 18.594 | 19.154 | 52.20 | 47.38 | 31.43 | 6.92 | 10.573 |
| 9 | 95. | 18.149 | 18.842 | 52.38 | 47.05 | 28.45 | 7.23 | 12.817 |
| HUB | 100. | 17.780 | 18.529 | 52.63 | 46.88 | 25.40 | 7.48 | 13.676 |

| RP | BLADE THICKNESSES | | | AXIAL DIMENSIONS | | | |
|-----|-------------------|------|------|------------------|-------|-------|-------|
| | TI | TH | TO | ZI | ZMC | ZTC | ZO |
| TIP | .021 | .149 | .021 | .470 | 1.727 | 1.705 | 2.345 |
| 1 | .022 | .157 | .022 | .445 | 1.705 | 1.693 | 2.395 |
| 2 | .023 | .166 | .023 | .415 | 1.681 | 1.673 | 2.442 |
| 3 | .023 | .175 | .023 | .384 | 1.655 | 1.638 | 2.484 |
| 4 | .025 | .202 | .026 | .288 | 1.605 | 1.506 | 2.585 |
| 5 | .029 | .239 | .030 | .189 | 1.568 | 1.394 | 2.719 |
| 6 | .032 | .279 | .033 | .103 | 1.507 | 1.292 | 2.862 |
| 7 | .036 | .311 | .036 | .035 | 1.477 | 1.271 | 2.981 |
| 8 | .037 | .323 | .037 | .019 | 1.463 | 1.223 | 3.021 |
| 9 | .038 | .335 | .038 | .008 | 1.441 | 1.172 | 3.051 |
| HUB | .039 | .346 | .039 | .000 | 1.421 | 1.127 | 3.079 |

Aerodynamic design

| | unit | values |
|------------------|---------|--------|
| pressure ratio | [-] | 1.82 |
| mass flow | [kg/s] | 20.2 |
| tip speed | [m/s] | 455 |
| tip solidity | [-] | 1.3 |
| aspect ratio | [-] | 1.63 |
| number of blades | [-] | 48 |
| rotative speed | [rad/s] | 1800 |

Material properties

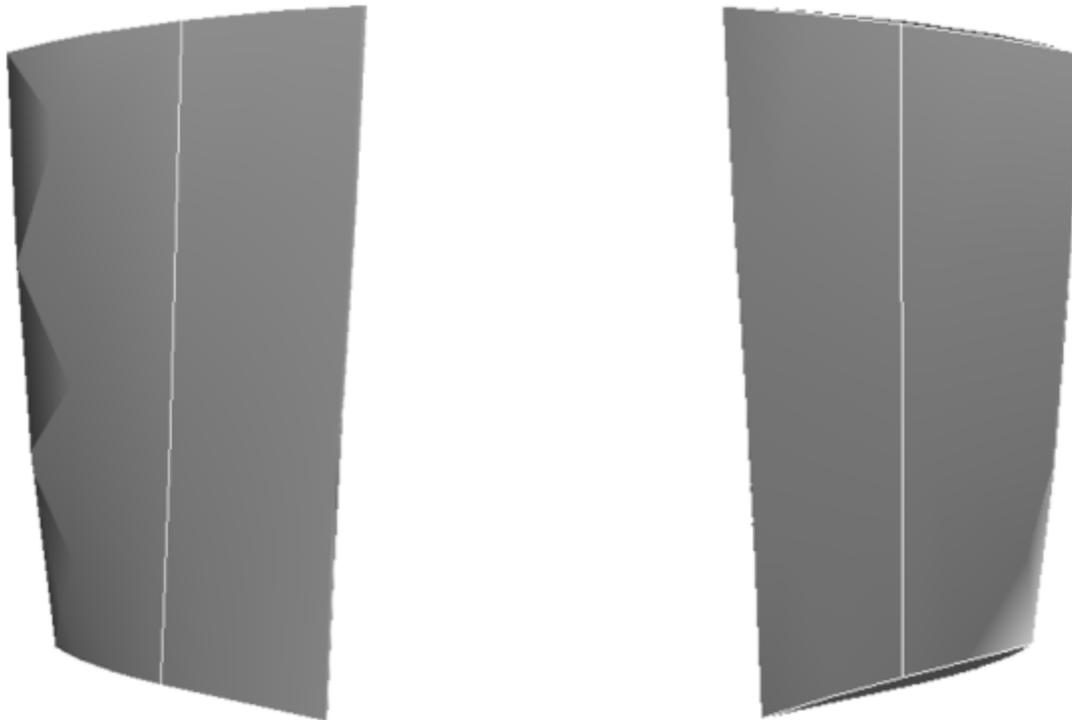
Rotor 36 is made of a 200-grade maraging steel

| | 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): 3567.3 rad/s / 567.7 Hz
2. (1T): 12971.7 rad/s / 2064.5 Hz
3. (2B): 14561.2 rad/s / 2317.5 Hz

CAD



Fichiers téléchargeables

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Libre accès

[lien vers le projet Git](#)

Modèle original

Le rotor 36 appartient à un programme de recherche visant à étudier une conception de compresseur

possédant un grand taux de compression (20:1). Il est donc le rotor du deuxième étage de ce compresseur transsonique de huit étages. Parmi ces huit étages, les quatre premiers ont été conçus et testés, ils correspondent aux rotors 35, 36, 37 et 38. Pour plus d'information, voici un lien vers [rapport de la NASA](#).

- Rapport technique original ^[1]:

```
@TechReport{reid1982design,  
author      = {Reid, L. and Moore, R. D.},  
title       = {Performance of single-stage axial-flow transonic compressor  
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- Photographies :



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note    =
{\href{https://catalog.archives.gov/id/17467884}{https://catalog.archives.gov/
id/17467884}, 1977 }, % for Fig. 2}
```

Documents utiles

- PDF du rapport de la NASA :

rotor36.pdf

- Fichier CSV de la géométrie :

rotor36_original.csv

Géométrie

La géométrie du rotor 36 est décrite dans le [rapport d'origine de la NASA](#) par les tableaux suivants. Les grandeurs sont en centimètres et en degrés.

(a) Rotor 36

| RP | PERCENT RADII | | | BLADE ANGLES | | | DELTA INC | CONE ANGLE |
|-----|---------------|--------|--------|--------------|-------|-------|-----------|------------|
| | SPAN | RI | RO | KIC | KTC | KOC | | |
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| 2 | 10. | 24.636 | 24.153 | 61.29 | 62.26 | 55.19 | 2.99 | -13.420 |
| 3 | 15. | 24.286 | 23.840 | 60.54 | 61.24 | 54.13 | 3.23 | -11.979 |
| 4 | 30. | 23.212 | 22.903 | 58.52 | 58.56 | 50.95 | 3.64 | -7.659 |
| 5 | 50. | 21.747 | 21.653 | 56.54 | 55.05 | 46.11 | 4.38 | -2.125 |
| 6 | 70. | 20.229 | 20.404 | 54.21 | 51.54 | 40.31 | 5.64 | 3.616 |
| 7 | 85. | 19.020 | 19.467 | 52.48 | 48.18 | 34.05 | 6.65 | 8.615 |
| 8 | 90. | 18.594 | 19.154 | 52.20 | 47.38 | 31.43 | 6.92 | 10.573 |
| 9 | 95. | 18.149 | 18.842 | 52.38 | 47.05 | 28.45 | 7.23 | 12.817 |
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| RP | BLADE THICKNESSES | | | AXIAL DIMENSIONS | | | |
|-----|-------------------|------|------|------------------|-------|-------|-------|
| | TI | TM | TO | ZI | ZHC | ZTC | ZO |
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| 1 | .022 | .157 | .022 | .445 | 1.705 | 1.693 | 2.395 |
| 2 | .023 | .166 | .023 | .415 | 1.681 | 1.673 | 2.442 |
| 3 | .023 | .175 | .023 | .384 | 1.655 | 1.638 | 2.484 |
| 4 | .025 | .202 | .026 | .288 | 1.605 | 1.506 | 2.585 |
| 5 | .029 | .239 | .030 | .189 | 1.568 | 1.394 | 2.719 |
| 6 | .032 | .279 | .033 | .103 | 1.507 | 1.292 | 2.862 |
| 7 | .036 | .311 | .036 | .035 | 1.477 | 1.271 | 2.981 |
| 8 | .037 | .323 | .037 | .019 | 1.463 | 1.223 | 3.021 |
| 9 | .038 | .335 | .038 | .008 | 1.441 | 1.172 | 3.051 |
| HUB | .039 | .346 | .039 | .000 | 1.421 | 1.127 | 3.079 |

Caractéristiques aérodynamiques

| | unités | valeurs |
|---------------------|---------|---------|
| taux de compression | [-] | 1,82 |
| débit massique | [kg/s] | 20,2 |
| vitesse en tête | [m/s] | 455 |
| solidité en tête | [-] | 1,3 |
| allongement | [-] | 1,63 |
| nombre d'aubes | [-] | 48 |
| vitesse de rotation | [rad/s] | 1800 |

Propriétés matériau

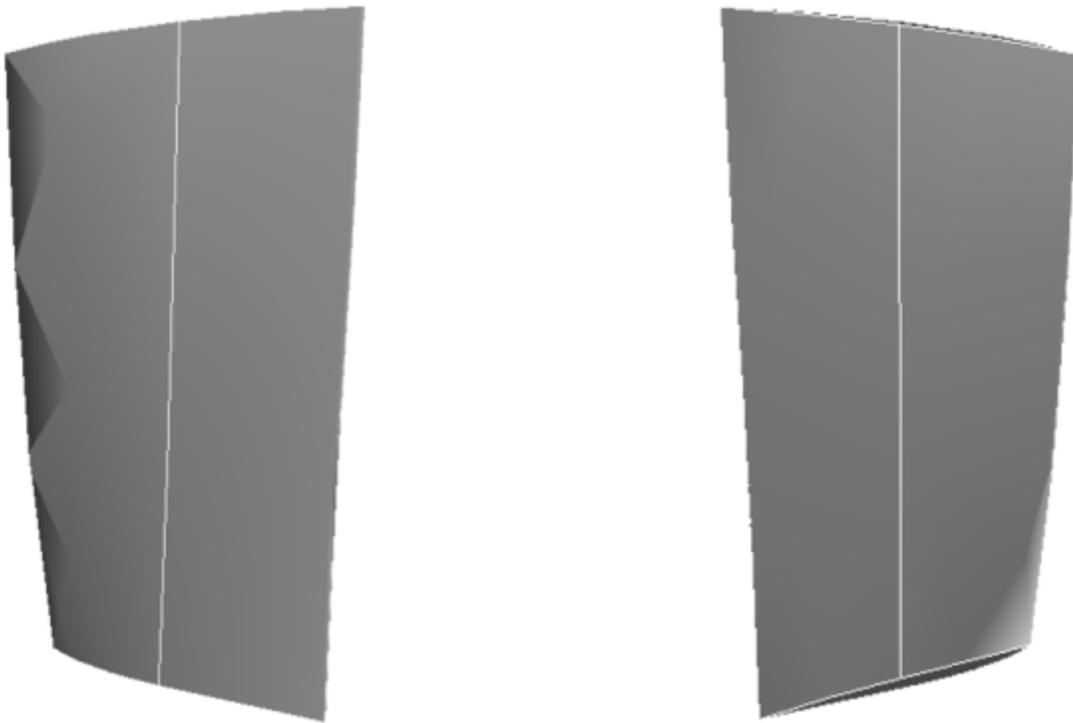
Le matériau du rotor 36 est un alliage à base de nickel : un acier maraging de grade 200

| | unité | valeurs |
|------------------------|----------------------|--------------------|
| alliage | [-] | 18-Ni-200-maraging |
| module d'Young | [GPa] | 180 |
| masse volumique | [kg/m ³] | 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): 3567,3 rad/s / 567,7 Hz
2. (1T): 12971,7 rad/s / 2064,5 Hz
3. (2B): 14561,2 rad/s / 2317,5 Hz

CAO



1. ^{a, b} Reid. «Performance of single-stage axial-flow transonic compressor with rotor and stator aspect ratios of 1.63 and 1.78, respectively, and with design pressure ratio of 1.82 » 1982. [pdf](#)

Document issu de la page wiki:

https://wiki.lava.polymtl.ca/public/modeles/rotor_36/accueil?rev=1663351651

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