# Rotor 37

- Français
- English

Downloadable files
×

**Open access**

**Git project**

## Original model

Rotor 37 is part of a research program to study a advanced-core compressor design with a high compression ratio (20:1). It is therefore the third 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{moore1980design,
author      = {Moore, R. D. and Reid, L.},
title       = {Performance of Single-Stage Axial-Flow Transonic Compressor
With Rotor and Stator Aspect Ratios of 1.19 and 1.26, Respectively, and
With Design Pressure Ratio of 2.05},
institution = {NASA Lewis Research Center Cleveland, OH, United States},
note        = {NASA-TP-1659, url~:
\url{https://ntrs.nasa.gov/citations/19800012840}, 1980 }}
```

- Pictures :

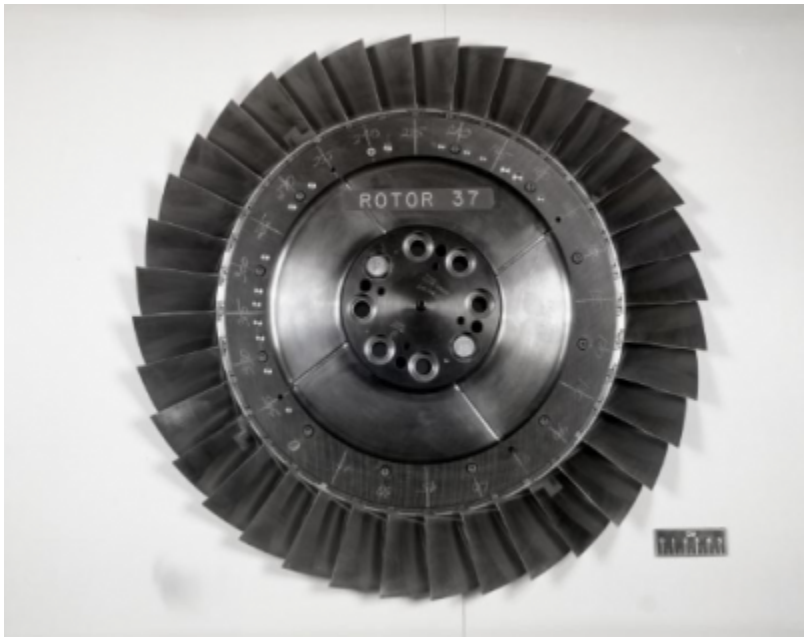



Fig1. https://catalog.archives.gov/id/17468361


Fig2. https://catalog.archives.gov/id/17468389

```
@Misc{huebler1977records,
author   = {Huebler, D.},
title    = {Rotor 37 and stator 37 assembly. {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/17468361}{https://catalog.archives.gov/
id/17468361}, 1977 }, % for Fig. 1
note     =
{\href{https://catalog.archives.gov/id/17468389}{https://catalog.archives.gov/
id/17468389}, 1977 }, % for Fig. 2}
```

# Useful documents

- PDF of the NASA report :

rotor37.pdf

- CSV file of the blade geometry :

rotor37_original.csv

# Geometry

The geometry of rotor 37 is described in the original NASA report by the following tables. The length are in centimeters and the angles in degrees.

(a) Rotor 37

| RP | PERCENT SPAN | RADII RI | RADII RO | BLADE ANGLES KIC | BLADE ANGLES KTC | BLADE ANGLES KOC | DELTA INC | CONE ANGLE |
|---|---|---|---|---|---|---|---|---|
| TIP | 0. | 25.230 | 24.506 | 62.53 | 62.83 | 49.98 | 2.10 | -15.233 |
| 1 | 5. | 24.935 | 24.218 | 61.66 | 61.86 | 49.07 | 2.39 | -14.582 |
| 2 | 10. | 24.597 | 23.929 | 60.76 | 60.86 | 48.18 | 2.69 | -13.139 |
| 3 | 15. | 24.254 | 23.641 | 60.07 | 60.09 | 47.34 | 2.94 | -11.768 |
| 4 | 30. | 23.211 | 22.775 | 58.48 | 58.09 | 44.22 | 3.40 | -7.804 |
| 5 | 50. | 21.761 | 21.622 | 56.53 | 54.49 | 38.87 | 4.19 | -2.276 |
| 6 | 70. | 20.246 | 20.468 | 54.24 | 50.48 | 32.37 | 5.49 | 3.311 |
| 7 | 85. | 19.030 | 19.603 | 52.67 | 47.60 | 25.28 | 6.54 | 8.010 |
| 8 | 90. | 18.603 | 19.314 | 52.37 | 46.87 | 22.68 | 6.83 | 9.728 |
| 9 | 95. | 18.161 | 19.026 | 52.18 | 46.39 | 19.75 | 7.16 | 11.584 |
| HUB | 100. | 17.780 | 18.738 | 52.04 | 46.03 | 16.75 | 7.44 | 12.602 |

| RP | BLADE THICKNESSES TI | BLADE THICKNESSES TM | BLADE THICKNESSES TO | AXIAL DIMENSIONS ZI | AXIAL DIMENSIONS ZMC | AXIAL DIMENSIONS ZTC | AXIAL DIMENSIONS ZO |
|---|---|---|---|---|---|---|---|
| TIP | .025 | .175 | .025 | .713 | 2.430 | 2.399 | 3.372 |
| 1 | .026 | .186 | .026 | .665 | 2.390 | 2.372 | 3.424 |
| 2 | .028 | .199 | .028 | .615 | 2.346 | 2.334 | 3.475 |
| 3 | .029 | .211 | .029 | .574 | 2.304 | 2.280 | 3.520 |
| 4 | .032 | .250 | .033 | .466 | 2.225 | 2.094 | 3.644 |
| 5 | .037 | .303 | .038 | .317 | 2.164 | 1.928 | 3.822 |
| 6 | .042 | .360 | .043 | .176 | 2.069 | 1.773 | 4.015 |
| 7 | .047 | .407 | .047 | .079 | 2.010 | 1.733 | 4.153 |
| 8 | .048 | .425 | .049 | .048 | 1.984 | 1.660 | 4.198 |
| 9 | .050 | .443 | .050 | .021 | 1.957 | 1.591 | 4.241 |
| HUB | .051 | .458 | .051 | .000 | 1.933 | 1.530 | 4.283 |

# Aerodynamic design

| | unit | values |
|---|---|---|
| **pressure ratio** | [-] | 2.05 |
| **mass flow** | [kg/s] | 20.2 |
| **tip speed** | [m/s] | 455 |
| **tip solidity** | [-] | 1.3 |
| **aspect ratio** | [-] | 1.19 |
| **number of blades** | [-] | 36 |
| **rotative speed** | [rad/s] | 1800 |

# Material properties

Rotor 37 is made of a 200-grade maraging steel[2], but the exact material properties are not provided in the NASA report.

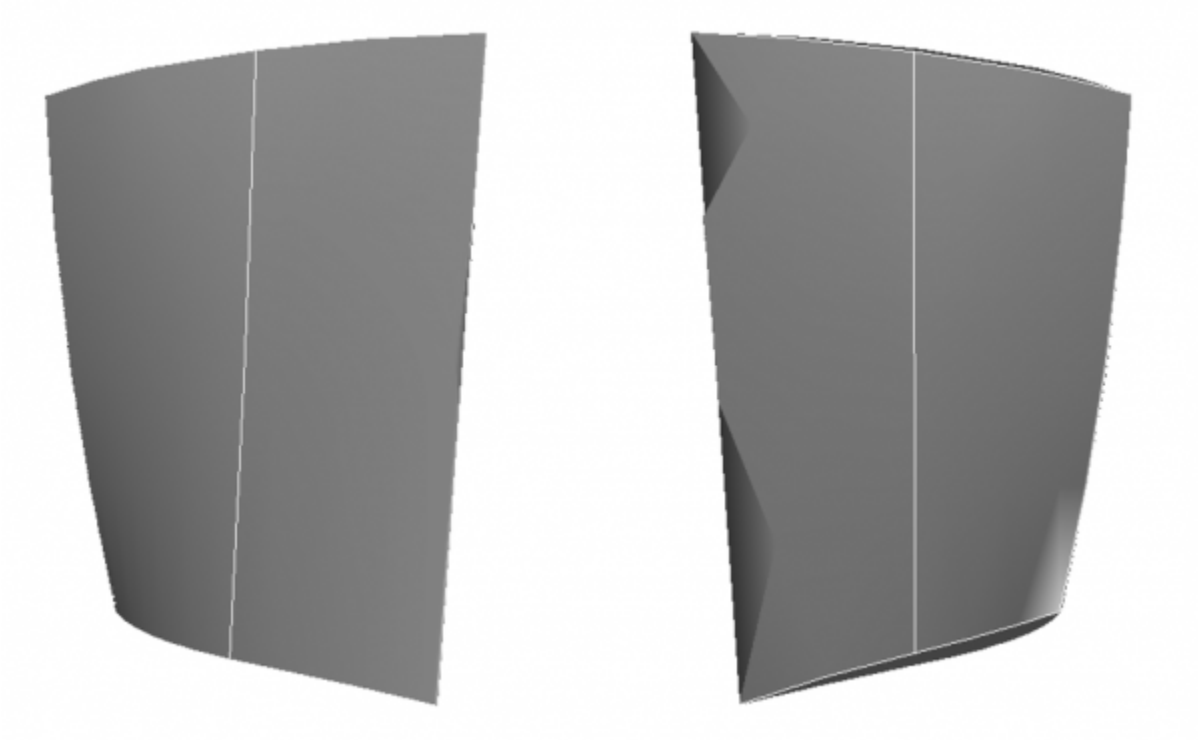
Considered properties: 18-Ni-200-maraging steel :

| | 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): 5291.8 rad/s / 842.2 Hz
2. (1T): 15928.2 rad/s / 2535.0 Hz
3. (2B): 19227.7 rad/s / 3060.2 Hz

# CAD



Fichiers téléchargeables
×

**Libre accès**

**lien vers le projet Git**

# Modèle original

Le rotor 37 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 troisième 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{moore1980design,
author      = {Moore, R. D. and Reid, L.},
title       = {Performance of Single-Stage Axial-Flow Transonic Compressor
With Rotor and Stator Aspect Ratios of 1.19 and 1.26, Respectively, and
With Design Pressure Ratio of 2.05},
institution = {NASA Lewis Research Center Cleveland, OH, United States},
note        = {NASA-TP-1659, url~:
\url{https://ntrs.nasa.gov/citations/19800012840}, 1980 }}
```

- Photographies :

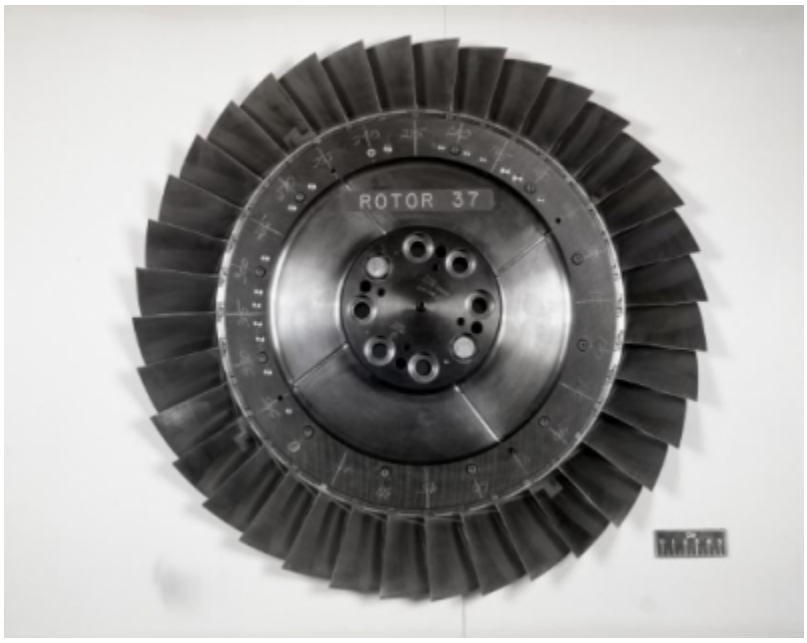



Fig1. https://catalog.archives.gov/id/17468361


Fig2. https://catalog.archives.gov/id/17468389

```
@Misc{huebler1977records,
author   = {Huebler, D.},
title    = {Rotor 37 and stator 37 assembly. {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/17468361}{https://catalog.archives.gov/
id/17468361}, 1977 }, % for Fig. 1
note     =
{\href{https://catalog.archives.gov/id/17468389}{https://catalog.archives.gov/
id/17468389}, 1977 }, % for Fig. 2}
```

## Documents utiles

- PDF du rapport de la NASA :

  rotor37.pdf

- Fichier CSV de la géométrie :

  rotor37_original.csv

## Géométrie

La géométrie du rotor 37 est décrite dans le rapport d'origine de la NASA par les tableaux suivants. Les grandeurs sont en centimètres et en degrés.

(a) Rotor 37

| RP | PERCENT SPAN | RADII RI | RADII RO | BLADE ANGLES KIC | BLADE ANGLES KTC | BLADE ANGLES KOC | DELTA INC | CONE ANGLE |
|---|---|---|---|---|---|---|---|---|
| TIP | 0. | 25.230 | 24.506 | 62.53 | 62.83 | 49.98 | 2.10 | -15.233 |
| 1 | 5. | 24.935 | 24.218 | 61.66 | 61.86 | 49.07 | 2.39 | -14.582 |
| 2 | 10. | 24.597 | 23.929 | 60.76 | 60.86 | 48.18 | 2.69 | -13.139 |
| 3 | 15. | 24.254 | 23.641 | 60.07 | 60.09 | 47.34 | 2.94 | -11.768 |
| 4 | 30. | 23.211 | 22.775 | 58.48 | 58.09 | 44.22 | 3.40 | -7.804 |
| 5 | 50. | 21.761 | 21.622 | 56.53 | 54.49 | 38.87 | 4.19 | -2.276 |
| 6 | 70. | 20.246 | 20.468 | 54.24 | 50.48 | 32.37 | 5.49 | 3.311 |
| 7 | 85. | 19.030 | 19.603 | 52.67 | 47.60 | 25.28 | 6.54 | 8.010 |
| 8 | 90. | 18.603 | 19.314 | 52.37 | 46.87 | 22.68 | 6.83 | 9.728 |
| 9 | 95. | 18.161 | 19.026 | 52.18 | 46.39 | 19.75 | 7.16 | 11.584 |
| HUB | 100. | 17.780 | 18.738 | 52.04 | 46.03 | 16.75 | 7.44 | 12.602 |

| RP | BLADE THICKNESSES TI | BLADE THICKNESSES TM | BLADE THICKNESSES TO | AXIAL DIMENSIONS ZI | AXIAL DIMENSIONS ZMC | AXIAL DIMENSIONS ZTC | AXIAL DIMENSIONS ZO |
|---|---|---|---|---|---|---|---|
| TIP | .025 | .175 | .025 | .713 | 2.430 | 2.399 | 3.372 |
| 1 | .026 | .186 | .026 | .665 | 2.390 | 2.372 | 3.424 |
| 2 | .028 | .199 | .028 | .615 | 2.346 | 2.334 | 3.475 |
| 3 | .029 | .211 | .029 | .574 | 2.304 | 2.280 | 3.520 |
| 4 | .032 | .250 | .033 | .466 | 2.225 | 2.094 | 3.644 |
| 5 | .037 | .303 | .038 | .317 | 2.164 | 1.928 | 3.822 |
| 6 | .042 | .360 | .043 | .176 | 2.069 | 1.773 | 4.015 |
| 7 | .047 | .407 | .047 | .079 | 2.010 | 1.733 | 4.153 |
| 8 | .048 | .425 | .049 | .048 | 1.984 | 1.660 | 4.198 |
| 9 | .050 | .443 | .050 | .021 | 1.957 | 1.591 | 4.241 |
| HUB | .051 | .458 | .051 | .000 | 1.933 | 1.530 | 4.283 |

# Caractéristiques aérodynamiques

| | unités | valeurs |
|---|---|---|
| **taux de compression** | [-] | 2,05 |
| **débit massique** | [kg/s] | 20,2 |
| **vitesse en tête** | [m/s] | 455 |
| **solidité en tête** | [-] | 1,3 |
| **allongement** | [-] | 1,19 |
| **nombre d'aubes** | [-] | 36 |
| **vitesse de rotation** | [rad/s] | 1800 |

# Propriétés matériau

Le matériau du rotor 37 est un alliage à base de nickel : un acier maraging de grade 200[2], mais ses caractéristiques ne sont pas fournies dans le raport de la NASA.

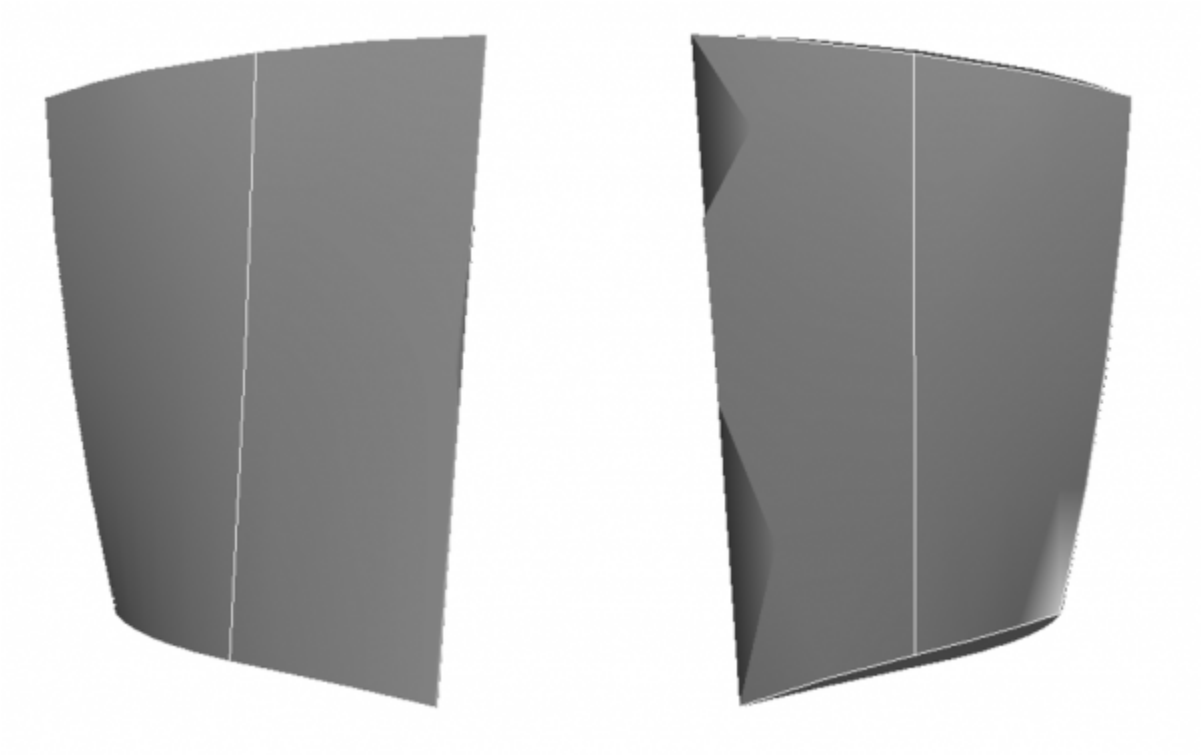
Propriétés considérées : alliage 18-Ni-200-maraging

| | 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): 5291,8 rad/s / 842,2 Hz
2. (1T): 15928,2 rad/s / 2535,0 Hz
3. (2B): 19227,7 rad/s / 3060,2 Hz

# CAO



1. [a, b] Moore. «Performance of Single-Stage Axial-Flow Transonic Compressor With Rotor and Stator Aspect Ratios of 1.19 and 1.26, Respectively, and With Design Pressure Ratio of 2.05 » 1980. pdf
2. [a, b] Reid. «Design and overall performance of four highly loaded, high-speed inlet stages for and advanced high-pressure-ratio core compressor» 1978. pdf