

# NOZZLE DIVERGENCE OPTIMIZATION

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## ABSTRACT

A Nozzle is a relatively simple device , just a specially shaped tube through which hot gases flow. Nozzles come in a variety of shapes and sizes depending upon the mission of aircraft. Nozzles are frequently used to control the rate of flow, speed, direction, mass, shape, and/or the pressure of the stream that emerges from them. In nozzle velocity of fluid increases on the expense of its pressure energy. Simple turbojets, turboprops ,often have a fixed geometry convergent nozzle.

## 1. INTRODUCTION

Nozzles is described as convergent (narrowing down from a wide diameter to a smaller diameter in the direction of the flow).Convergent nozzles accelerate subsonic fluids. If the nozzle pressure ratio is high enough, then the flow will reach sonic velocity at the narrowest point (i.e. the nozzle throat). In this situation, the nozzle is said to be choked. CFD Analysis is shown here in which we check the optimization of the nozzle having minimum Pressure drop.

## 2. OBJECTIVE

By taking the specific dimensions, nozzle in 2-D{fig.1} is made in Addition with the 3-D{fig.2} model which are shown below:-

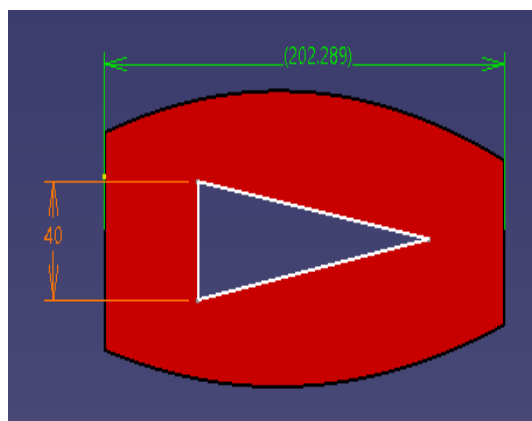


FIG 1

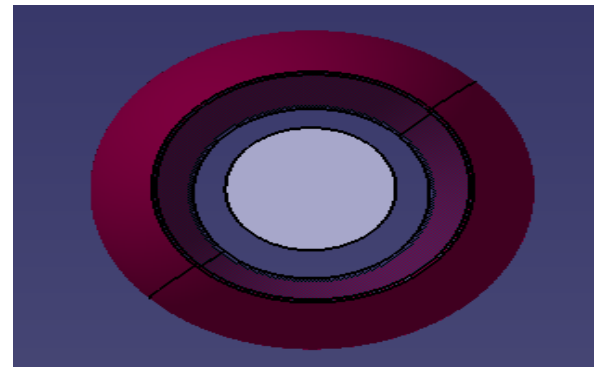


FIG.2(FRONT VIEW)

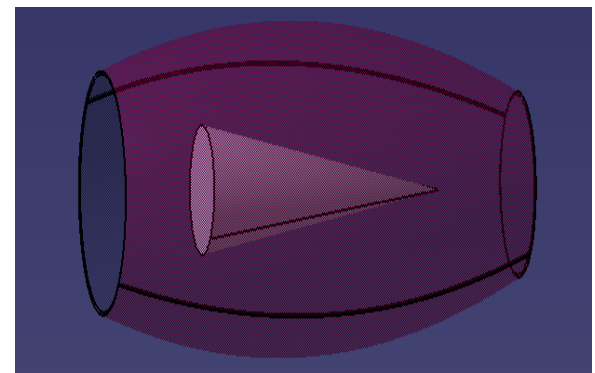


FIG.3(SIDE-VIEW).

## 3. MATERIAL SPECIFICATION

Selection of aircraft materials depends upon any consideration, which can in general be categorized as cost and structural performance. Cost includes initial material cost, and maintenance cost. The key material properties that are pertinent to maintenance cost and structural performance are

\*High temperature resistant

\*stiffness

\*strength

\*damage tolerance

\*corrosion resistant

Titanium is Strong, lightweight, corrosion-resistant, thermally stable which is used for manufacturing of Nozzle. To improve its malleability titanium is often alloyed with other metals such as nickel and aluminum.

## 4. ANALYSIS & CALCULATIONS

Analysis of Nozzle is done by ANSYS in which we performed various operations like meshing(Fig3),CFD Analysis(fig.4)calculations(Fig.5) in CFD to figure out the pressure drop of nozzle and afterwards selecting the nozzle having minimum pressure drop.

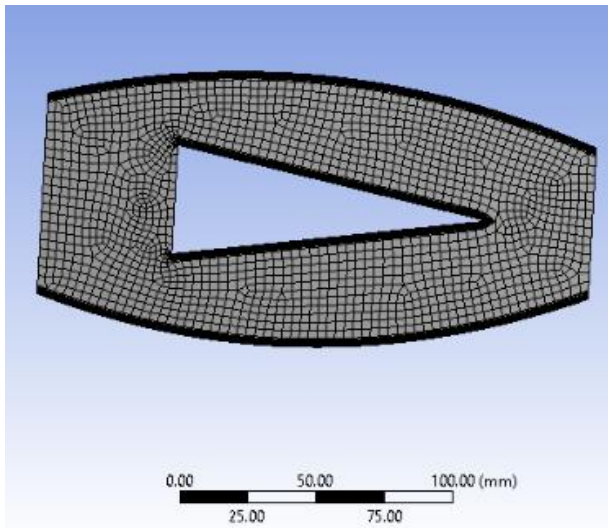


FIG.3

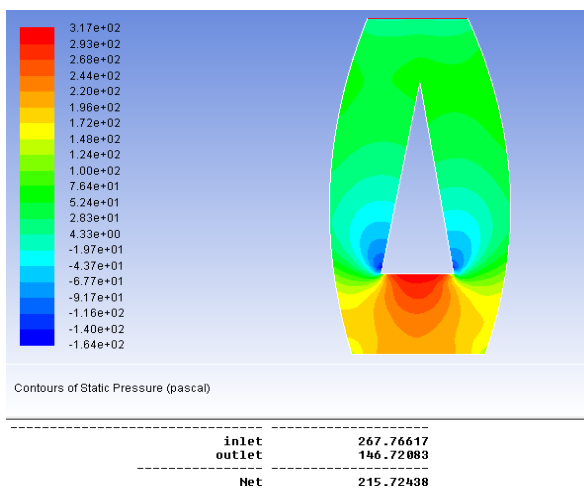


FIG.4A

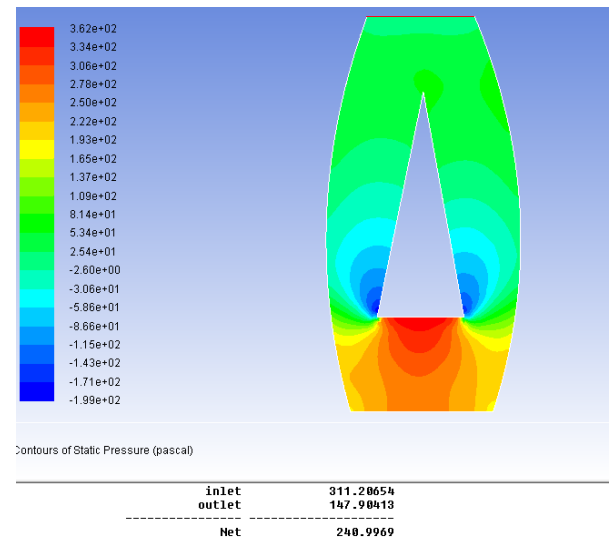


FIG.4B

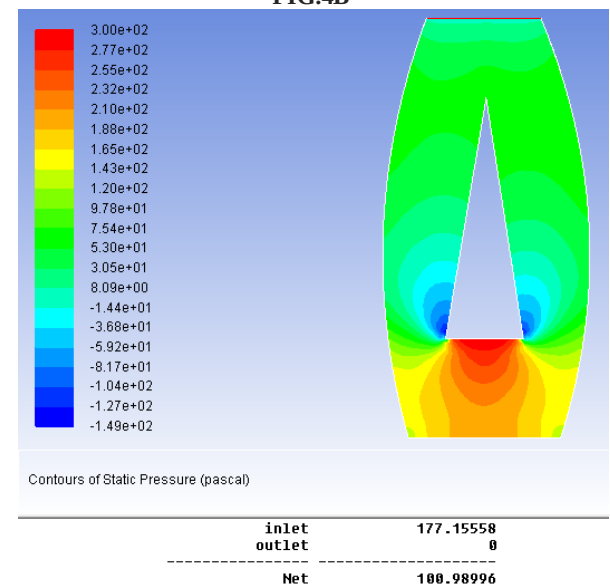


FIG.4C

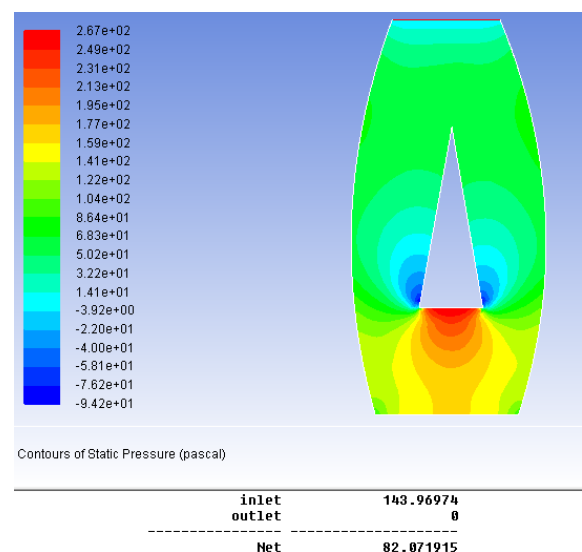


FIG.4D

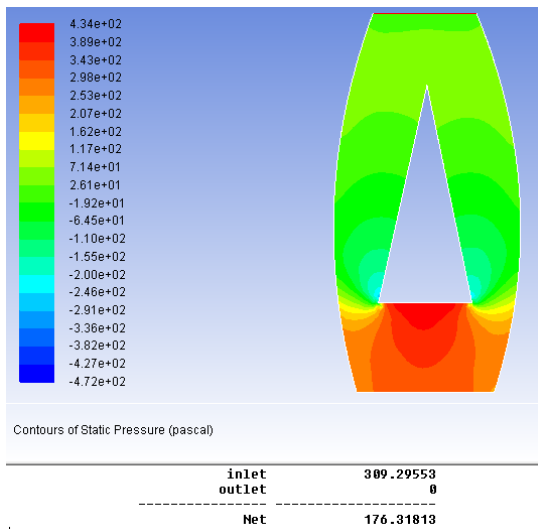


FIG.4E

| NOZZLE IN | INLET  | OUTLET | PRESSURE DROP |
|-----------|--------|--------|---------------|
| 33.25     | 143.96 | 0      | 143.96        |
| 37.5      | 177.15 | 0      | 177.15        |
| 40        | 267.76 | 146.72 | 121.04        |
| 45        | 311.2  | 147.9  | 163.3         |
| 50        | 309.29 | 0      | 309.29        |

FIG.5

Hence, we got nozzle having minimum pressure drop.

## 5. ACKNOWLEDGMENTS

We wish to express our most sincere gratitude to everyone who helped us in our research efforts and acknowledge the initial encouragement received from Friends and Parents.

## 6. REFERENCES

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- [2] Computational fluid dynamics by JOHN F. WENDT
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