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# Design, Analysis and Fabrication of Can-Annular Combustion Chamber

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**ABSTRACT:** The research design refers to the overall strategy on reducing the size of the can such that the weight of the engine will reduce and so this topic “Design, Analysis and Fabrication of Can-annular combustion chamber” is being taken. A combustion chamber is that part of an internal combustion engine (ICE) or a reaction engine in which the fuel/air mix is burned. Catia is mostly used for the entire design procedure of can-annular combustion chamber, from selection to final part generation. CATIA is the world’s engineering and design leading software for product 3D CAD design excellence. It is used to design, simulate, analyze, and manufacture products in a variety of industries including aerospace, automotive, consumer goods, and industrial machinery. Computational Fluid Dynamics is the most commonly used tool for simulation and analysis. 3-D numerical CFD tool is used for simulation of the flow field characteristics inside the turbo machinery. Designing a can-annular type compressor requires theories and calculations with their solutions. Using respective approaches, Aircraft selection, Theories, Design and Analysis. Using the above methodology, a can annular combustion chamber will be designed using CATIA V5R20 software and analysis will be done in ANSYS 19.2. If getting suitable results further we will be reducing can size for further analysis. The outcome of this project forms a strong base for further design and analysis as well as fabrication of can-annular combustion chamber.

**KEYWORDS:** Gas Turbine Combustion Chamber, Can-Annular combustion chamber, Ansys, Catia, Producer Gas etc.

## I. INTRODUCTION

Combustion Chamber is said to be the stomach of a gas turbine engine. Where chemical reaction converts into thrust (hot gases). The combustor is fed with high pressure air by the compression system, adds fuel and burns the mix and feeds the hot, high pressure exhaust into the turbine components of the engine or out the exhaust nozzle-combustion chamber have certain design and operation requirements.

1. Since the gas temperature required at the turbine varies with engine thrust and in the case of turbo propeller engines upon the power required.
  2. The combustion chamber must be capable of maintaining stable and efficient combustion over a wide range of engine operating
  3. High combustion efficiency has become increasingly important
  4. combustion chambers must be able to operate efficiently over a wide range of conditions.
  - 5.Flame tube and Spray nozzle is an atomizer.
  - 6.The gas turbine engine operates on a constant pressure, so the pressure loss should be minimum.
  - 7.Combustion stability.
    8. Uniform Temperature and Velocity distribution at the entrance to the turbine and simplicity of control.
    - 9.Ease and cheapness of manufacture.
- STAGES OCCUR IN COMBUSTION CHAMBER.
    1. Formation of reaction mixture. 2.Ignition. 3.Flame propagation. 4.cooling of the combustion product with air.
    - Types of combustion chamber :

A. Can Type B. Can-annular Type C.

Annular Type

A. Can Type: The earliest aircraft engines made use of can (or tubular) combustors. Air leaving the compressor is split into a number of separate streams, each supplying a separate chamber. These chambers are spaced around the shaft connecting the compressor and turbine, each chamber having its own fuel jet fed from a common supply line. Well suited to engines with centrifugal compressors, where the flow is divided into separate streams in the diffuser.

B. Can-annular: Individual flame tubes are uniformly spaced around an annular casing. Uses a reverse flow arrangement which allows a significant reduction in the overall length of the compressor-turbine shaft and also permits easy access to the fuel nozzles and combustion cans for maintenance. I.e. • Reduced shaft length • Easy maintenance Also like Can Combustor, • Easier development,

C. Annular: The ideal configuration in terms of compact dimensions is the annular combustor, in which maximum use is made of the space available within a specified diameter; this should reduce the pressure loss and results in an engine of minimum diameter. The combustion does not take place in individual flame tubes, but instead in an annular region around the engine.

Overcomes disadvantages of Can type,

- reduces the pressure loss (less surface exposed to air/gas flow)
- Compact size

## II. RELATED WORK

→ Combustion in the normal, open cycle, gas turbine is a continuous process in which fuel is burned in the air supplied

by the compressor; an electric spark is required only for initiating the combustion process, and thereafter the flame must be self-sustaining.

→ Combustion of a liquid fuel involves the mixing of a fine spray of droplets with air, vaporization of the droplets, the breaking down of heavy hydrocarbons into lighter fractions, the intimate mixing of molecules of these hydrocarbons with oxygen molecules, and finally the chemical reactions themselves.

→ A high temperature, such as is provided by the combustion of an approximately stoichiometric mixture, is necessary if all these processes are to occur sufficiently rapidly for combustion in a moving air stream to be completed in a small space

→ But in actual practice A/F ratio is in the range of 100:1, while stoichiometric ratio is around 15:1. This is to reduce the turbine inlet temperatures due to practical limits.

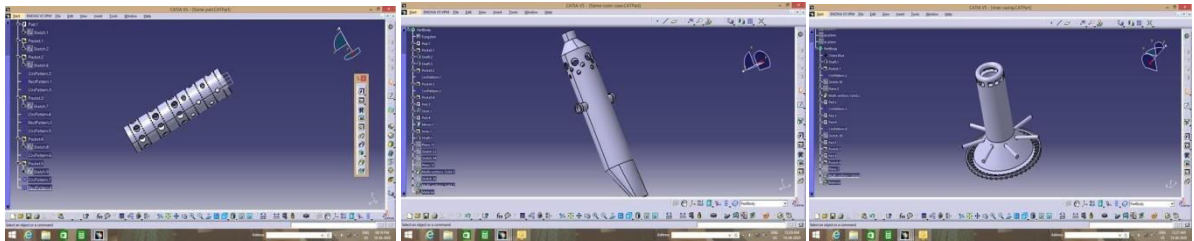
## III. METHODOLOGY

Designing a can-annular type compressor requires theories and research papers for their references, Using respective approaches:

1. Aircraft selection: Based on can-annular combustion chamber selection of aircraft will be done.
2. Theories: calculation and dimensions using reference papers.
3. Design: Using the above methodology a can-annular combustion chamber will be designed using CATIA.
4. Analysis: Once designing is done, the analysis part comes into role and CFD is done in ANSYS 19.2.
5. Fabrication: Fabricating the model.

## IV. EXPERIMENTAL RESULTS

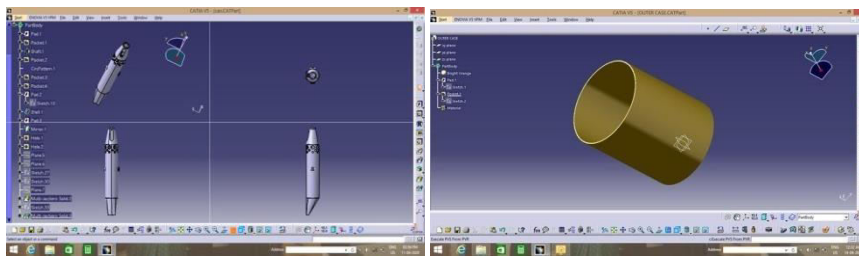
Figures show the results of the can-annular combustion chamber by using CATIA V5R20 and ANSYS 19.2. Figure 1-part model of can-annular combustion chamber 1a) Catia model of flame tube. 1b) Catia model of flame outer case. 1c) Catia model of inner casing. 1d) catia model of can. 1e) catia model of outer casing.



1 a

1 b

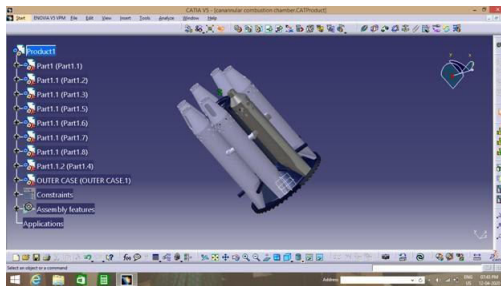
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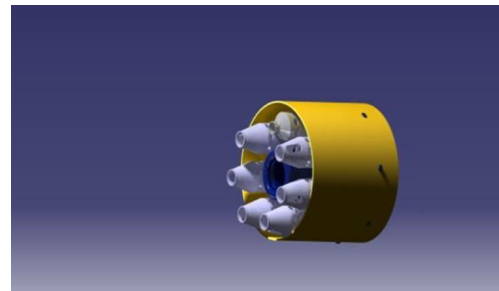
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Fig. 1. Full model of can-annular combustion chamber (a) catia model of can-annular combustion chamber without outer casing. (b) Final model design of can-annular combustion chamber in catia V5R20.

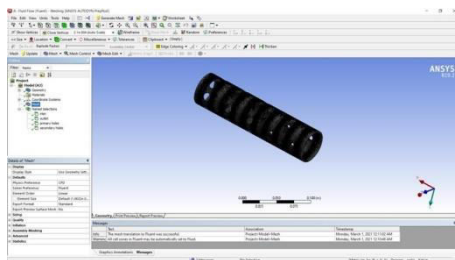


2a

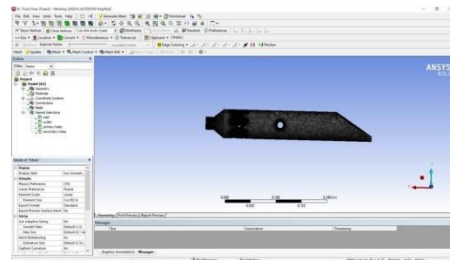


2 b

Fig. 2. Analysis of the model in Ansys 19.2 (a) Meshing of flame tube. (b) Meshing of can (c) 2000 iteration of flame tube. (d) Contour image of flame tube.



3a



3 b

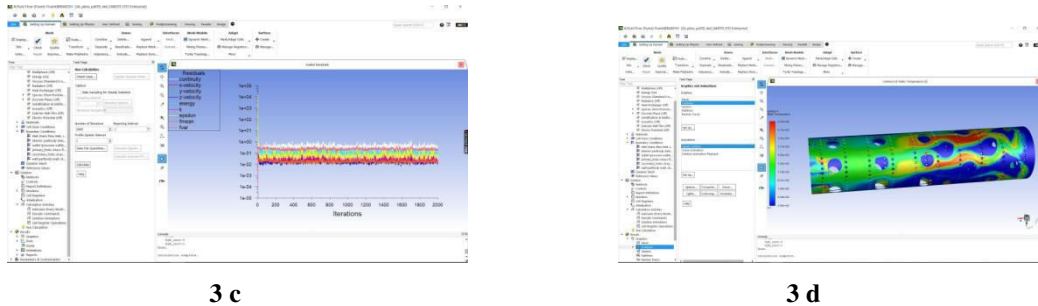


Fig. 3. Analysis of the model in Ansys 19.2 (a) Meshing of flame tube. (b) Meshing of can (c) 2000 iteration of flame tube. (d) Contour image of flame tube.

V. SPECIFICATION

1. DIMENSIONS OF CAN:

TOTAL LENGTH	70MM+110.4MM +69.8MM
DIAMETER	55.11MM
NO. OF DILUTION HOLES AND ANGULAR SPACING	21 & 50°
PRIMARY HOLES	14
SECONDARY HOLES	7

2. DIMENSION OF FLAME TUBE:

LENGTH	200.4MM
NUMBER OF PRIMARY HOLES	16
NUMBER OF SECONDARY HOLES	24
NUMBER OF DILUTION HOLES	360
DIAMETER OF PRIMARY HOLES	8MM
DIAMETER OF SECONDARY HOLES	14MM

SCALE 1:100



## VI. CONCLUSION

In this project we have studied the Can-annular Combustion Chamber and designed it in CATIA V5R20 and obtained dimensions from a research paper and analyse it such that we can reduce the weight of the engine. And further, we will be trying to optimise it by changing the parameters and again analysing till we get the most efficient design. We will try to get some new design with better efficiency after analysing iteratively. Then the design is fabricated and the material is chosen wisely after some research work on materials and keeping in mind the cost.

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