Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

# Design and Fabrication of High-Speed Gas Gun for Impact Testing

**Hamza Ali Malik**
Department of Mechanical and Aerospace Engineering, Air University Islamabad, Pakistan Email: hamzaalimalik844@gmail.com

**Muhammad Ubaid Khalid**
Bachelor of science in Mechanical engineering University HITEC UNIVERSITY TAXILA Email: engrubaidkhalid321@gmail.com

**Muhammad Ahmad**
Bachelor of science in Mechanical engineering and Technology, University of Engineering and Technology, Lahore Email: ahmedliaqat0000@gmail.com

**Muhammad Subyyal**
Department of Mechanical engineering International Islamic University Islamabad, Pakistan Email: subyyalmalik928@gmail.com

## ABSTRACT

This Study covered different design of Gas Gun. A single stage gas gun was used for the testing of different shock Phenomena. The study also examined the differences between Single stage Gas and Two Stage Gas Gun. the material selection for the **barrel used in the manufacturing of the gas gun** was discussed in detail. A **high-strength breech** was used for gas storage purpose. A **highly compressible hydraulic pipe** was used for Inlet Purpose. The dimensions of the barrel used in this project were **1 m in length,** with an **inner diameter of 3 inches** and an **outer diameter of 3.5 inches.** A breech of **12 inches length, 3 inches inner diameter**, and **5 inches outer diameter** was used. A **manual valve of 3 inches diameter** was used for operational purposes. All components were attached using **flanges.** A **conical section (nozzle)** was used to accelerate the gas velocity. A **compressor system operating up to 12 bars** was used as the gas source. **Pressure gauges** were installed to monitor the pressure inside the breech.

**Keywords:** Breach, Barrell, Valve, Hydraulic Pipe and Nozzle

## Background

High Speed Gas Guns is a device that is used to perform Experiment of impact testing and can be used in Projects related to research including testing of material strength, Ballistics, and Engineering field. In Gas Gun Projectile (Bullet) of Different masses are fired at a speed range from 100m/s to 1000m/s that can cause sudden impact.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

The High-Speed gun design is very basic which includes a breach (Gas Reservoir). Projectile and Launch Tube (Barrell). The projectile is kept in the Barrell after that compressed gas is allowed to flow through the Barrell which strikes the projectile and forces it to move at high speed. The Speed of the Projectile Leaving the Barrell depend on the Pressure of the gas and length of the Barrell.

The need of the understanding the behavior of the material and responses will be fulfilled by the development of High-Speed Guns. It will help in protective system of many applications like Glasses, Vests.

Archimedes of Syracuse (287 – 212 BC) was the first person who develop the Gas Gun [5]. The work and publication that Archimedes did have not been found yet [5]. Leonardo da Vinci, drawn the first single stage gas gun, and gave credit Archimedes as its inventor. It appears from the notes that system used steam to fire projectile towards enemy. It functions same like Cannon do but it took long time to load and Pressurized so it was not ideal for the battlefield. This Model was Capable of firing Projectile of mass 0.5kg at velocity of 280m/s [5].

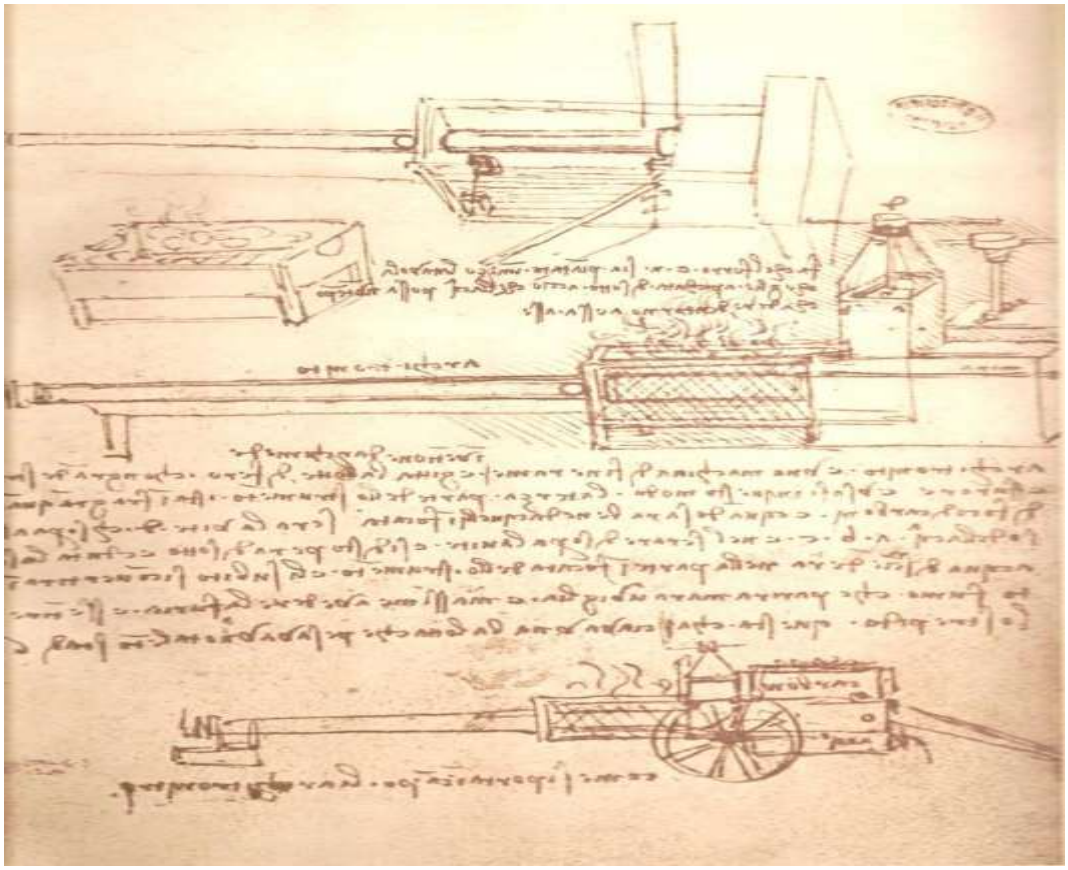


**Figure 1:** The "Architronito" drawn by Leonardo Da Vinci [5]

When we are thinking about gas guns it is necessary to think about strain rate term. Civil engineers do their jobs in the field of deformation of isothermal materials gas gun research is far beyond the medium and high limits voltage level. Gas guns approach even the deformation of materials that are very rigid in nature [5].

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

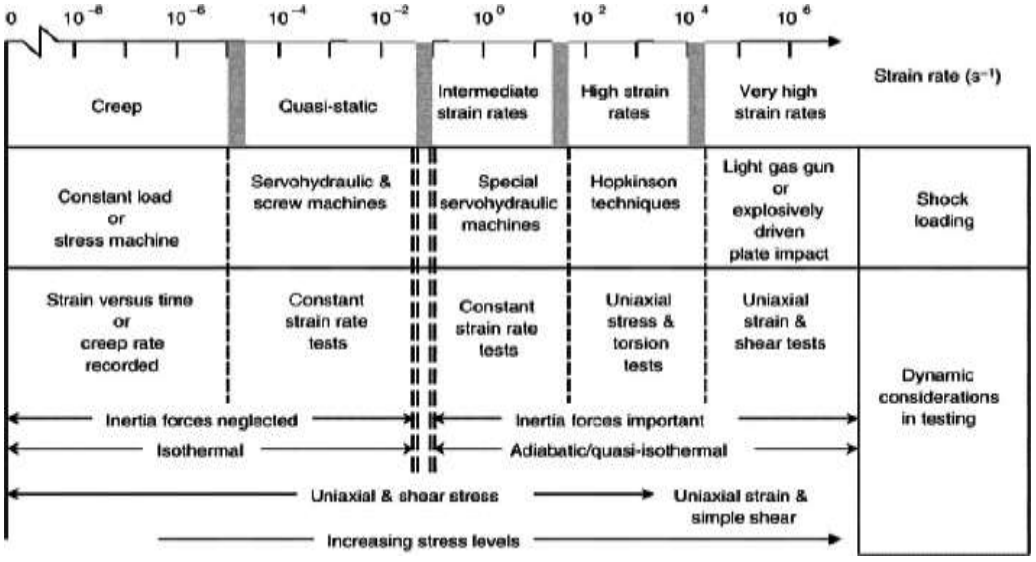



**Figure 2:** Traditional testing setups & methods [5]

Different large and small model of Gas Gun was seen in research papers. some of them are in figure

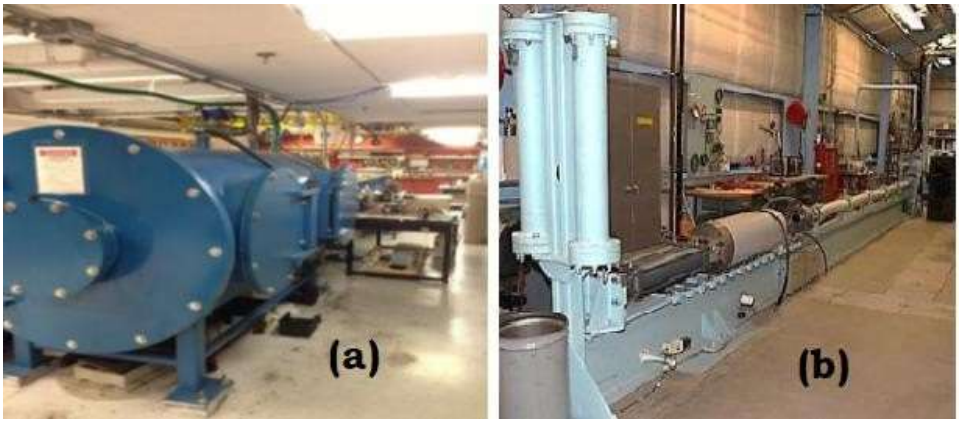



**Figure 3:** Different Design of Gas Guns [6].

As Pakistan is a developing Country Pakistan is facing many Crisis in Industrial Field. Pakistan Defense Industries don't have any Proper setup of impact testing experiments. In this project a parametric study will be undertaken following existing literature as an eccentric part of research carrying out globally on armors equipment for safety applications of mankind. Like Testing of Bulletproof Vests, Helmets and Bulletproof Glasses are performed using Explosive Guns like Ak-47 in Pakistan Industries like POF, Nescom etc. But in these traditional methods required different guns to check the strength of materials as the bullet fired from the one gun cannot be enhance.so instead of using these explosive gun Gas Gun can be used as the velocity of Projectile fired from the Gas Gun can be altered by changing some parameters. These Problems should be solved for the betterment of Pakistan. Literature Review

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

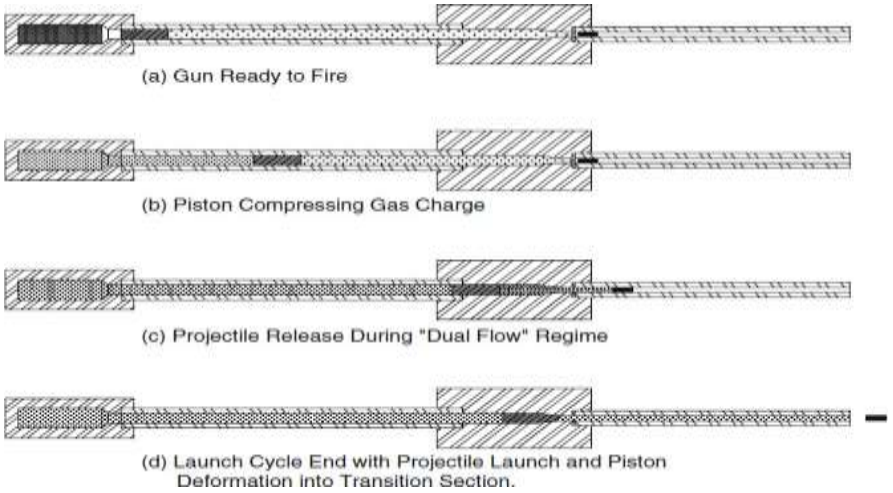
The Types of the Gas Gun that has emerged and have capability of High-Speed Flights is Two Stage Gas Guns. These types of Gas Gun are very reliable and can be used in laboratory very easily. The System that is used for Protecting of Space Vehicles from the Striking of meteoroids and particles like meteoroids is made by using information from gas gun studies of impact studies [10].

**Situation of Technology in World War II:**

The Weapons produced by the German has the capabilities of accelerating projectile to high velocity and improve ability to do work as compared to their enemies. Initially the purpose to distribute is as a canon for aircraft striking but they found it effective against enemy tanks.

As the World War 2 End Some Officers of USA Army were very concerned about the gap in technology to improve the Ordnance Capability of Americans, they initiated the projects related to Research and Development. The development of Rocketry also gave interest to Engineers to explore about the Space. During the Starting phase of Post-War there were nonavailability of Technology that can help in producing various models of velocities. The invention that came was single stage solid Propellant Gas also known as Powder Guns who can fire a Projectile up to velocities of 2.75Km/s [10].

**Invention of Two Stage Gun that uses Gas:**




In 1948 the group of PROFESSOR E.J Workman and himself working at NMIMT came to the USA Army Ballistic of research and gave a proposal to improve the capabilities of gun to launch at velocities [7]. He stated that by decreasing the mass of projectile the launch velocities of gun using powder will increase up to 2.75Km/s. Professor Workman gave idea to replace Powder Guns with the with the gas that will help in launches of Projectile [7]. The gas that is to be used will have low molecular weight as compared to burning propellent. AS the Gas such as Helium has Molecular Weight of 4.0g/mole which is far better than 30g/mole of propellant burn product that consists of $CO_2$ and $N_2$.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

**Figure 4:** Light-gas gun sketches showing various stages in the firing process [13]
The Result of Professor Workman. was very spectacular and the Managers of BRL was very interested in it. They thought that the it is important to in concept of Gas Gun in Military. The Development of Light Gas Gun was terminated as the research was not allowed at Teaching institution at that Time and the Project was handed to BRL. The Project of NMIMT was misplaced as the BRL didn't continue the work [13].

**Making of Technologies needed for Modern Lights Gas Gun:**
This Section will cover abouts the components used to develop Light Gas Gun and Technology used to develop Gas Gun. Basics Sketch of Gas Gun Describe during phase from 1948 is shown in figure.

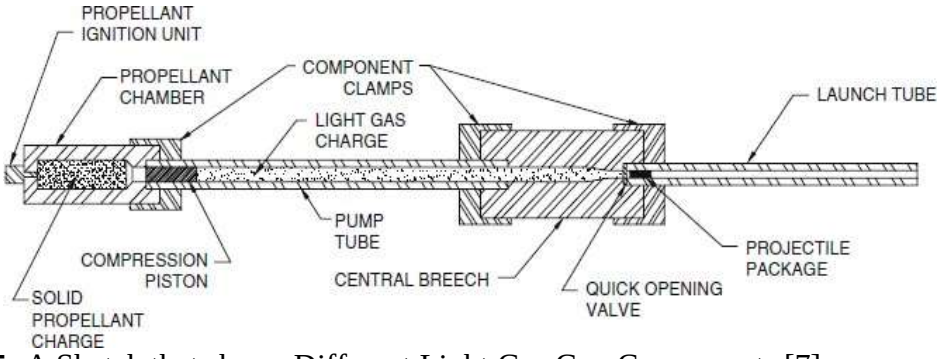


**Figure 5:** A Sketch that shows Different Light Gas Gun Components [7]

**wo Stage Gas Gun (New Invention):**
Two Stage Gas gun can be used to study the characterization of different Materials when a Projectile deform the Materials at very high rate [3]. The Theory that was given by the Rajesh for Two Stage Gas Gun was used to study the Performance of Stage Gas Gun [3]. In this they used Pressure Chamber, Shock Tube, Launch Tube, Piston, Helium Gas and Air to fire the Projectile [3].

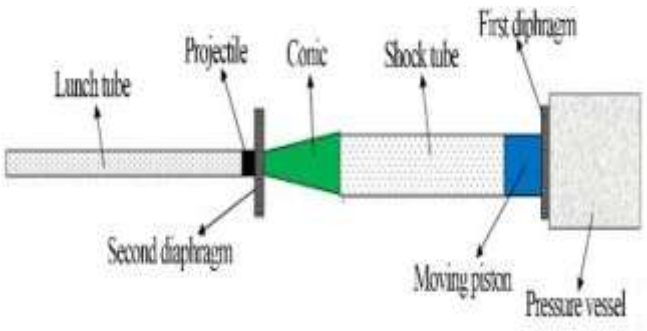


**Figure 6** Two Stage Gas Gun [3]
In the Two Stage Gas Gun Pressure vessels is filled with Air at High Pressure which Brust the First Diaphragm [3]. In Shock Tube High Pressure Helium Gas is Present Air leaving from the Pressure vessels will force the Piston to move Piston will Compress the Helium Gas more that will pass through the Conic Section[3].After

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

passing through the Conic Section Gas will Pass through the Second Diaphragm Due to the Pressure of Gas Diaphragm will Rupture will force the Projectile to move in the Launch Tube[3].Length of Launch Tube can also enhance the Performance of Two Stage Gas Gun[3].

**Single Stage Gas Gun (New Invention):**

The methodology of Single Stage Gun was Developed that can be used for impact testing. The Major Parts on which Gas Gun of Single Stage Consists are Pressure vessel, Barrel and poppet valve. In this a Chronograph was used to measure the velocity of the Projectile that was used. Poppet valve was made of Myler Sheets that has the thickness of 0.50mm. A Vacuum up to 1-5kpa is Created in the Gun barrel using Myler Sheets. The Purpose of Vacuum is to limit the formation of wave shock that are produce in front of Bullet (Projectile) and which allows the Bullet to move with higher speed [1].

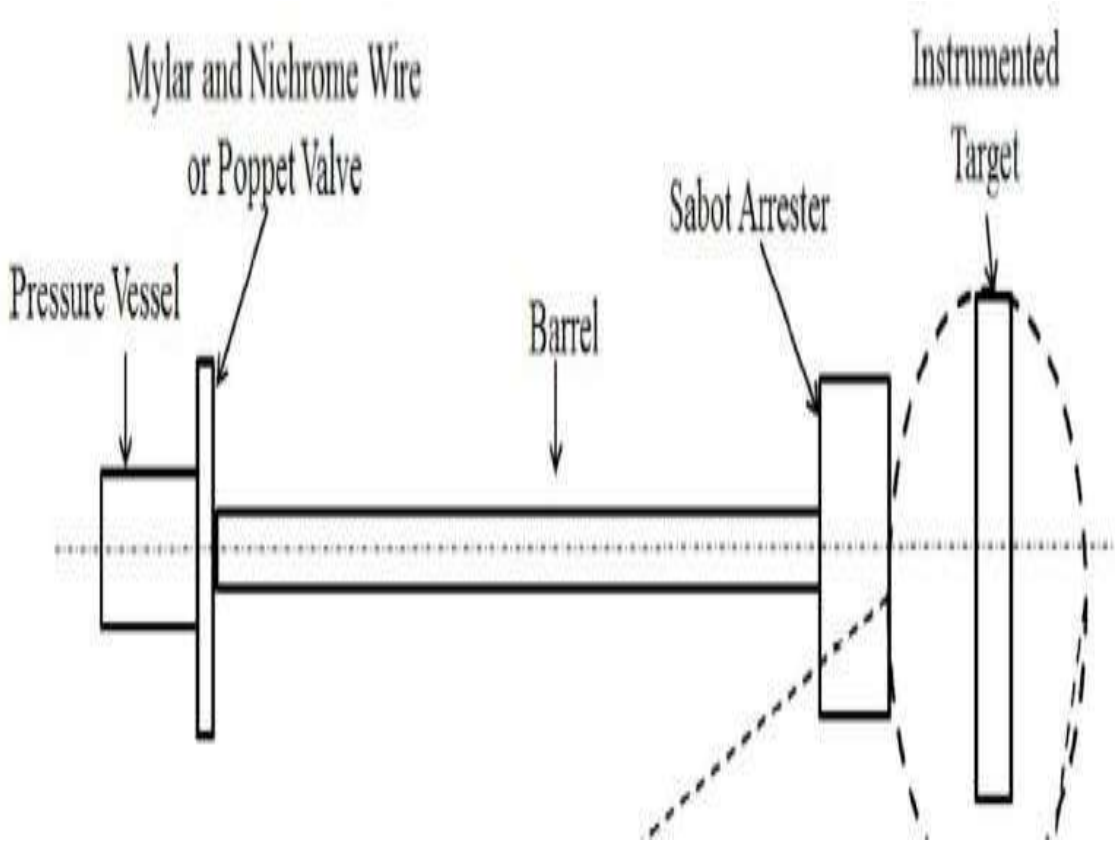



**Figure 7** Single Stage Gas Gun along with Speed Camera [1]

**Design & Testing of Gas Gun for Developing Countries:**

M. de Icaza from National University of Mexico gave the detailed description of Designing of Light Gas Gun. M. de Icaza and his Group mates gave the solution of what developing Countries face during making ogf Gas Gun. Their Designed consists of a Breach with double diaphragm with working Pressure of 40MPa.12.7m length and 75mm bore Barrel was used. Projectile that was used of mass 0.5-2kg it can achieve velocity of 1200m/s. The Main innovation in in this literature was that it used

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

2 Diaphragms in Breach for the Sudden flow of gas. Catcher Tank was also used in this Literature the main Purpose of Catcher tank was to stop the fired Projectile and also to store the gas that were released [9].

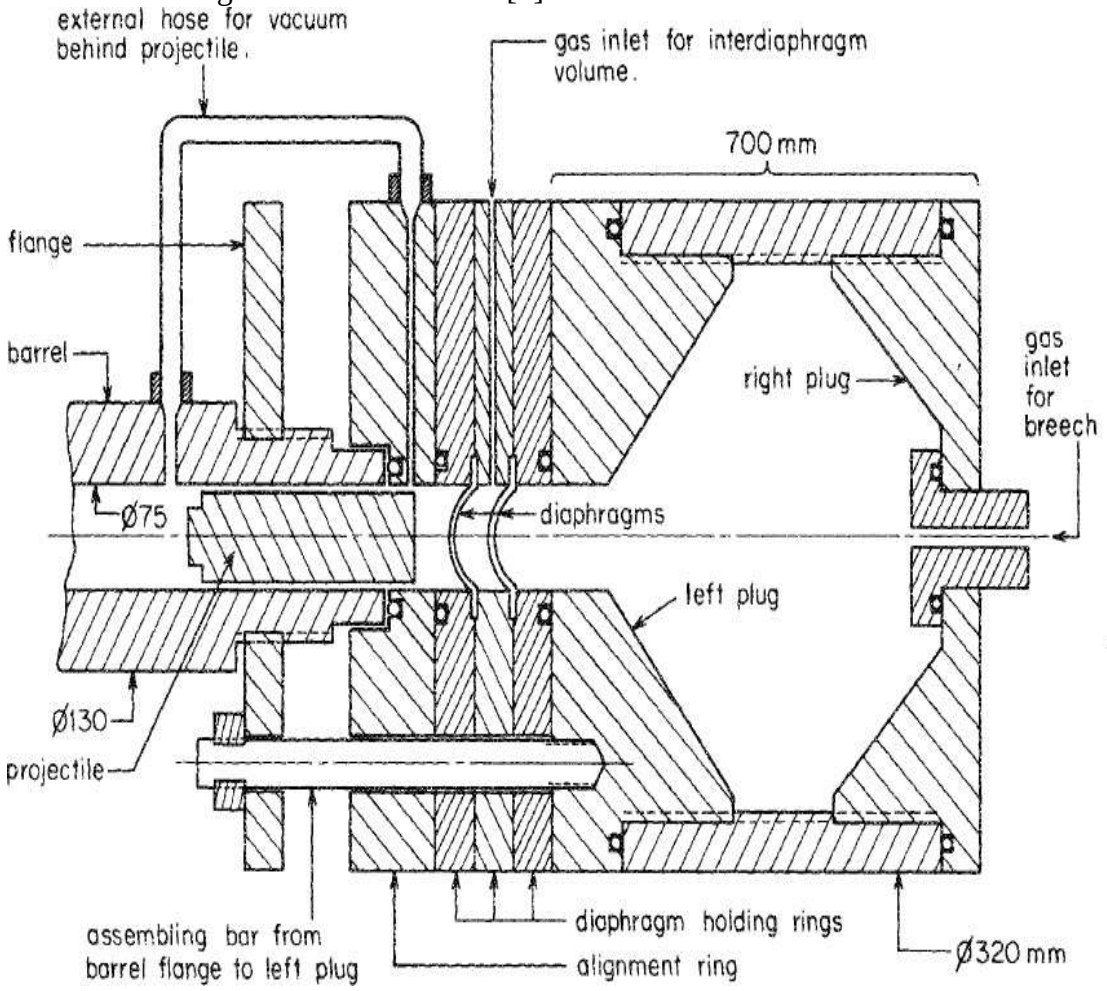



**Figure 8** Double Diaphragm Breach [9]

**Design and Methodology**

**Design description:**

A High-Speed Gas Gun is essential equipment for the testing of material strength. It consists of Air Compressor, Inlet High pressurized pipes, Pressure Gauge, Manual Valve flanges, Breach and Barrell. Air Compressor is used which is the primary source of generating compressed air. After that high-pressure valve are used to flow the air from compressor tank to Breach. Breach is rod that is used as a reservoir of gas. Pressure gauge is installed on the Breach to monitor the gas Pressure in the Breach. The Breach is connected Manual Valve with the help of Flanges. Other End of Valve is connected to Breach with the help of Flanges.

**Design parameters:**

Block Diagram show that Air flow through inlet of Air Compressor

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

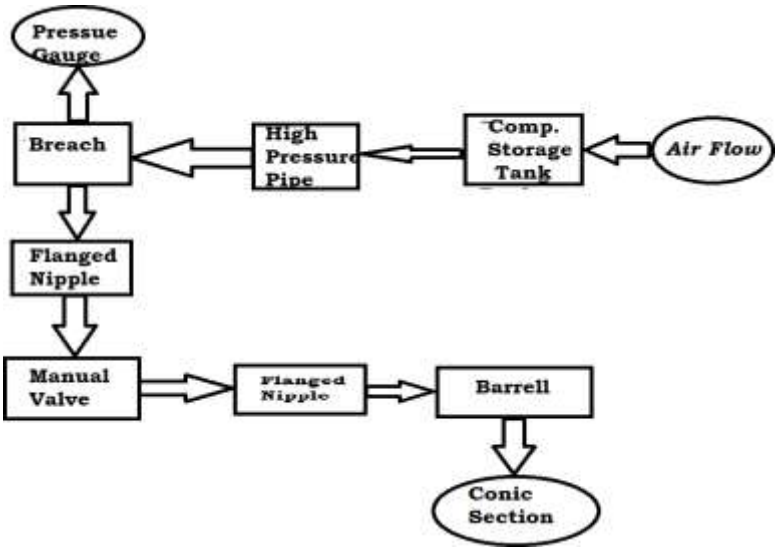



**Figure 9** Block Diagram of Gas Gun

**Design calculations:**
In this Section Design Calculation of Breach, Barrell, Nipple, Valve, Nozzle and Launch tube is cover.

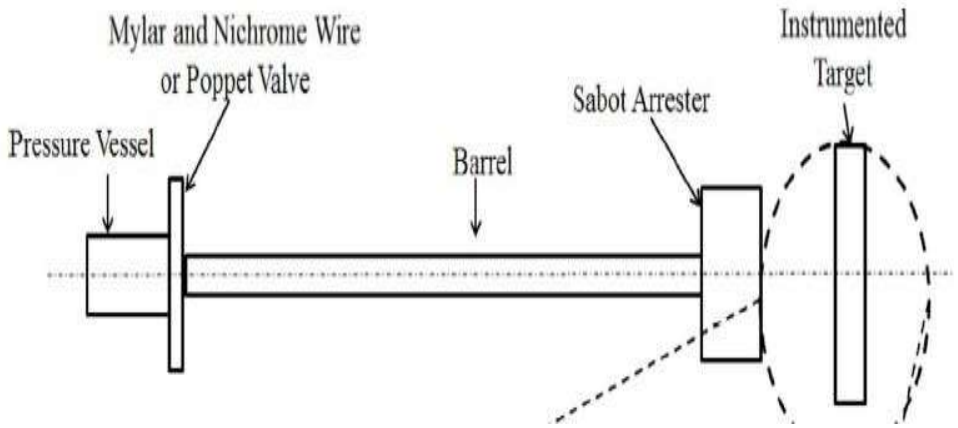



**Figure 10**: Morphology of the Design [1]

**Breach Design:**
Breach Design:
We are considering Breach as a Thick-Walled Cylinder.
Inner Dia.=76 mm (3 in) Inner radius=38mm Outer Dia.=127mm(5in) Outer radius=63.5mm P1=2.7Mpa (27 bar)Tangential Stress:
$Pr_i^2$

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

$r_o{}^2 Tangential\ Stress = {}_{r\ 2} - r\ 2\ (1 + {}_{r^2})$ ——— —

$Tangential\ Stress = Pr_i^2$

$\overline{r_o{}^2 - r_i{}^2 o}$

$(1 + i$

$r_o{}^2$

$\overline{r_i{}^2}$

) Note: $r^2 = r_i{}^2$ Putting the Values:

$0.038^2 * 2.7E6$ $0.063^2$

$Tangential\ Stress = {}_{0.063^2 - 0.038^2\ (1 + 0.054^2)}$ ——— ———

$Tangential\ Stress = 3644026.9\ {}^{N}/_{m^2}$

$Tangential\ Stress = 3.64 Mpa$

Radial Stress:

$Pr_i^2$

$r_o{}^2 Radial\ Stress = {}_{r\ 2} - r\ 2\ (1 - {}_{r^2})$ ——— —

$o$ $i$

$Radial\ Stress = {}_{r_o{}^2 - r_i{}^2 i}{}^{Pr_i{}^2}{}_{i}{}^{2}\ (1 - {}^{r_o{}^2}{}_{2})$ Note: $r^2 = r^{-2}$ Putting the Values:

$0.038^2 * 2.7E6$

$0.063^2 Radial\ Stress = {}_{0.063^2 - 0.038^2\ (1 - 0.054^2)}$ ———

$Radial\ Stress = 555868.5\ {}^{N}/_{m^2}$

Radial Stress = −.55Mpa/

Compare it with Yield Strength of Mild Steel.

Yield Strength of Materials are: For Aluminum=230Mpa

For Stainless Steel=600Mpa For Mild Steel=250Mpa

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

**Brust Pressure Calculation using Barlow's Formula:**

Breach Burst Pressure by using Barlow's Formula: Barlow's Formula:

$$P = \frac{2ST}{(OD)(SF)}$$

T= wall thickness =25.4 mm =1 in OD= outer diameter=127 mm =5 in SF= Safety Factor= 10

S= Yield Strength= 230 Mpa for Aluminum (33358 psi) 250 Mpa for mild steel (36259 psi)

600 Mpa for SS steel (87022.6 psi) For Mild Steel:

$$Brust\ Pressure = \frac{2 * 36259 * 2}{5 * 10}$$

$Brust\ Pressure$ = 14503.600psi (99.9 Mpa)

$Brust\ Pressure$ = (999 bar)

Numerical Simulation:

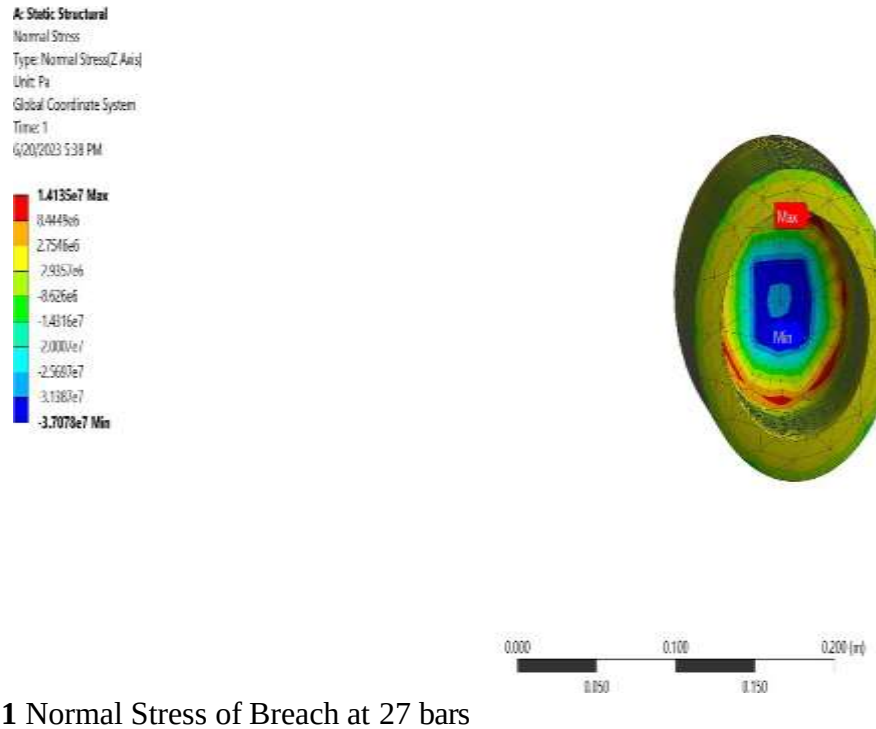



**Figure 11** Normal Stress of Breach at 27 bars

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

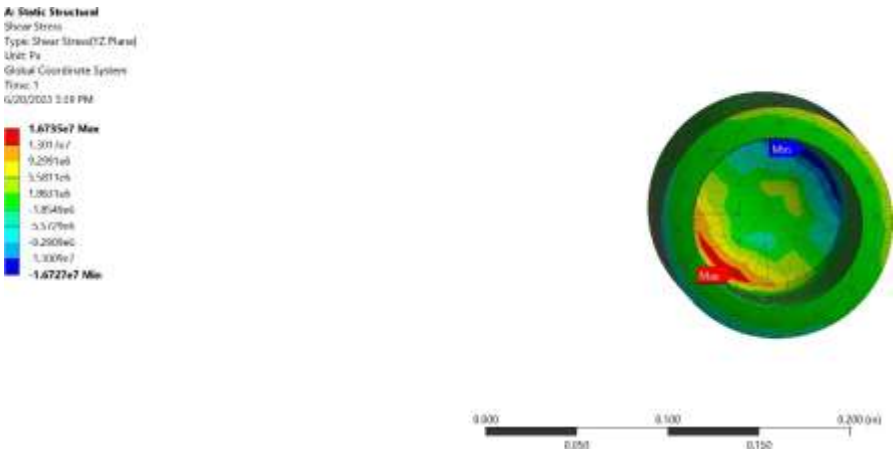


**Figure 12** Shear Stress of Breach at 27 bar

Normal Stresses and Shear Stresses of Breach are Examined in Ansys. A Pressure of 27 bar are applied on the inner surfaces of Breach and Outer Surfaces were Fixed. Tangential Stress and Radial Stress of Breach was calculated using Analytical Formula. Normal and Shear Stress were Calculated using Ansys There might be some difference in the value of Analytical and Numerical due to not Proper Meshing of Breach in Numerical Simulation. As there is a major Difference in the values of Tangential Stresses and Normal Stresses that is Calculated using Ansys.

**Nipple Design:**

Nipple Design:

P=27 bar=2.7N/mm F=P*A

$Force = 2.7 * (43 - 41.5)^2 * 3.14$

=19.07N

Bending Stress on Thread

$$Bending\ Stress = \frac{6 * 19.07 * 0.38}{3.14 * 0.084 * 1 * 0.003}$$

$Bending\ Stress = 54948.43 N/m^2$

Axial Nominal Stress:

$$Nominal\ Stress = \frac{-4F}{3.14 * dr\text{^}2}$$

$$Nominal\ Stress = \frac{-4 * 19.07}{3.14 * 0.084\text{^}2}$$

$Nominal\ Stress$=-3442.88N/m^2

Barrell (Shock Tube) Design:

**Barrel Design:**

We are considering Barrel as a Thick-Walled Cylinder.Inner Dia.=76.2mm Inner radius=38 mm Outer Dia.=89mm Outer radius=45 mm P1=10 Mpa (100bar)

angential Stress:$2Tangential\ Stress = \frac{i}{r_o}$

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

$2 - r\,2\,(1 + r2)$

$Tangential\ Stress = \frac{Pri^2}{(1 + ro^2)}$ : Note: $r^2 = r^2 ro^2 - ri^2 ri^2$ $i$

Putting the Values:

$0.038^2 * 10E6$

$0.045^2 Tangential\ Stress = \frac{}{0.045^2 - 0.038^2\,(1 + 0.038^2)}$

$Tangential\ Stress = 5964888.124\ {}^{N}/_{m^2}$

$Tangential\ Stress = 5.96\ Mpa$

Radial Stress:

$Radial\ Stress = \frac{r_o Pr_i^2}{2 - r\,2\,(1 - r_o^2}$

$r^2)adial\ Stress = \frac{Pri^2}{(1 - ro^2)}$ $Note: r^2 = r^2$ $i$

$ro^2 - ri^2 ri^2 i$Putting the Values:

$0.038^2 * 10\ E6$

$0.045^2 Radial\ Stress = \frac{}{0.045^2 - 0.038^2\,(1 - 0.038^2)}$

$=-4056\ {}^{N}/_{m^2} = -0.58$ Mpa

**Pipe/ Barrell Burst Pressure by using Barlow's Formula:**

Barlow's Formula:

$P = \frac{2ST\ (OD)(SF)}{}$

T= wall thickness =6.5mm =0.25 in OD= outer diameter=89 mm =3.5in SF= Safety Factor= 1.5

S= Yield Strength= 230 Mpa for Aluminum (33358 psi) 250 Mpa for mild steel (36259 psi)

600 Mpa for SS steel (87022.6 psi) For Aluminum:

$=Burst\ Pressure = \frac{2*33358*0.25}{3.5*1.5}$

= 3176psi (21.8 Mpa)

= (218 bar) For Mild Steel:

$=Burst\ Pressure = \frac{2*36259*0.25}{3.5*1.5}$

= 3453psi (23.80 Mpa)

= (238 bar) For stainless steel:

$=Burst\ Pressure = \frac{2*87022*0.25}{}$

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

3.5∗1.5
= (8287 psi) (57.1Mpa)=571 bar

**Table 1:** Stresses and Brust Pressure of Breach and Barrell

| Components | Tangential Stress | Radial Stress | Burst Pressure | Normal Stress | Shear Stress |
|---|---|---|---|---|---|
| **Breach** | **3.64MPa** | **-0.55Mpa** | **99.9MPa** | **14.1MPa** | **16.7MPa** |
| **Barrell** | **5.96MPa** | **-0.58MPa** | **23.80MPa** | **0.35MPa** | **0.447MPa** |

**Drawing:**
**Breach:**
Breach is a part that is used for the storage of Gas. Its Function is same like what Pressure vessels do. Pressurized Air is Stored in the Breach. Pressure Gauge is Connected in Breach to Examine the Pressure in the Breach. Nipple is used along with Flanges to Connect Breach to Valve. Tangential and Radial Stresses were Calculated for the Breach. Also, Brust Pressure for the Breach was also Calculated

**Figure 13** Breach (CAD Model)

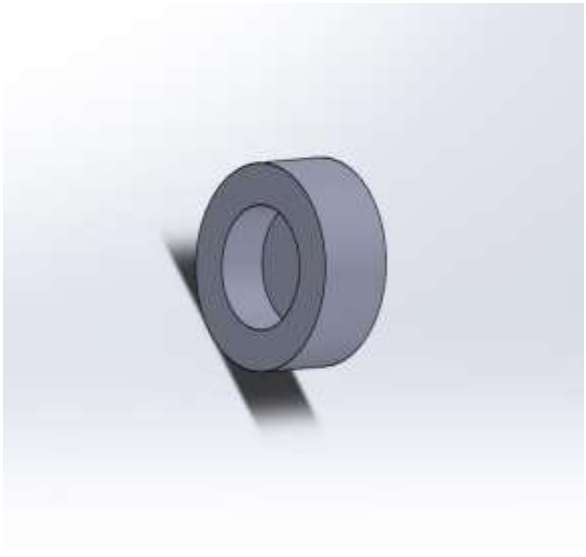


**Figure 14** Breach



Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

(Physical Model)

**Breach and Nipple Picture:**



**Figure 15** Breach and Nipple (CAD Model)



**Figure 16** Breach and Nipple (Physical)

**Safety Valve:**
Safety valve of type Ball is used to allow the flow of Gas from Breach to Barrell.

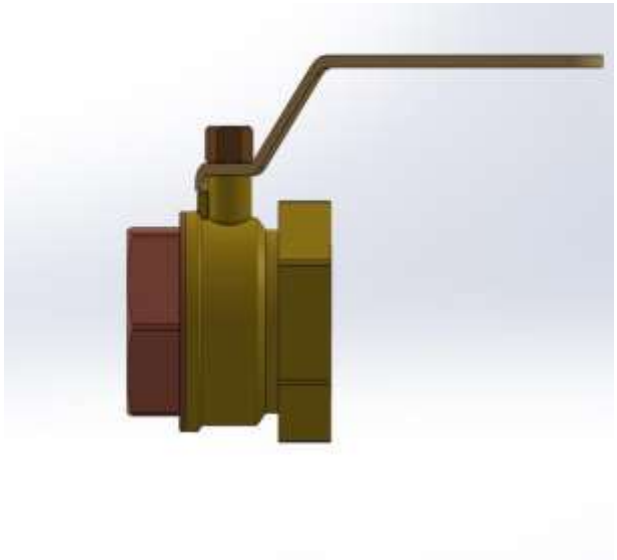


**Figure 17** Ball Valve (CAD Model)



**Figure 18** Ball Valve (Physical Model)

Connection Shock Tube with Valve Picture:
Shock tube also known as Barrell is used in which gas coming from the Breach will Travel.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about





**Figure 19** Ball Valve Connection (Physical)

**Nozzle:Figure 20 Ball Valve Connection (CAD)**
**Nozzle is used to Converge the Air/Gas coming from Barrell. Nozzle will increase the Gas/ Air Velocity.**

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

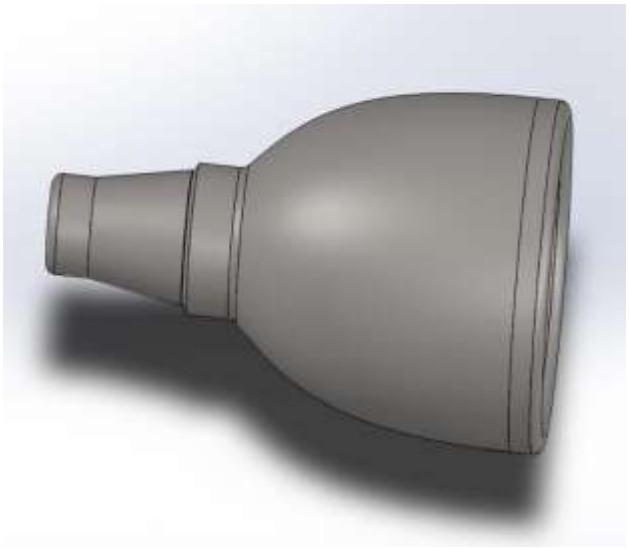


**Figure 21** Conic Section-Nozzle (Physical)



**Figure 22** Conic Section-Nozzle (CAD)

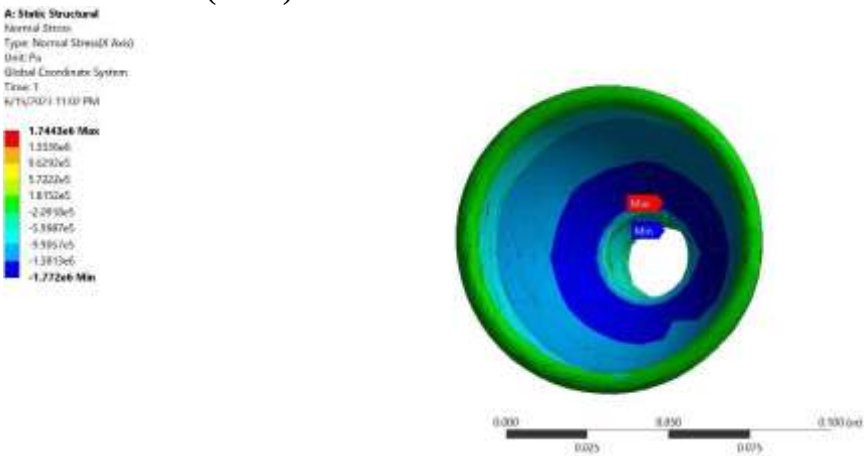
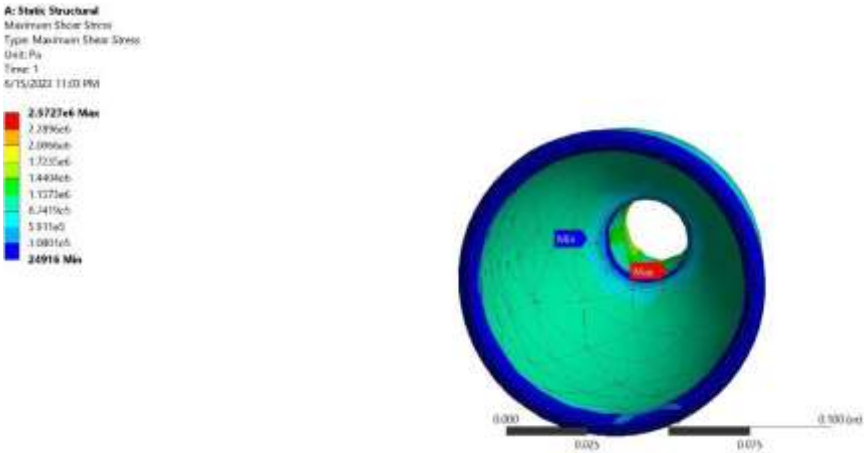



**Figure 23** Normal Stress on Nozzle at 27 bar



Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

**Figure 24** Shear Stress on Nozzle at 27 bar

Normal and Shear Stresses on the Nozzle was simulated in Ansys at 27 bar. The Result was compared with the Yield Strength of Mild Steel which come within the range. Pressure of 27 bar was applied on the surfaces of Nozzle and the Normal and Shear stress were obtained. Max. And Min. value of Stresses on the nozzle were obtained using FEA.

Connection Barrell with Conic Section (Nozzle):

Flanges were used to Connect shock Tube with the Nozzle.





**Figure 25** Connection of Shock Tube with Nozzle (CAD)

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

**Figure 26** Connection of Shock Tube with Nozzle (Physical)

**Connection Launch Tube with Nozzle:**
Small Flanges are used to Connect Launch Tube with Nozzle





**Figure 27** Connection of Launch Tube with Conic Section (CAD Model)

**Figure 28** Connection of Launch Tube with Conic Section (Physical Model)

### 3.5.1 Complete Model of Gas Gun:

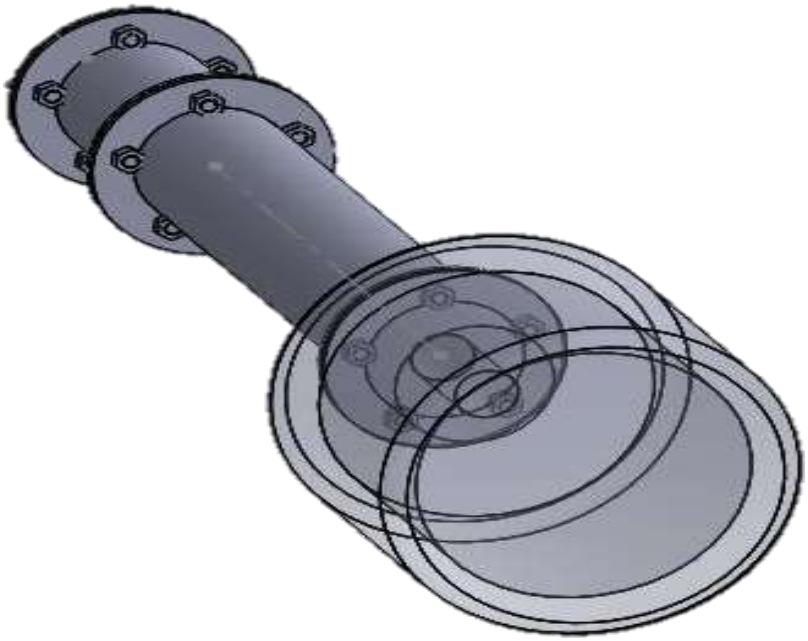


**Figure 29** CAD Model of Gas Gun

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

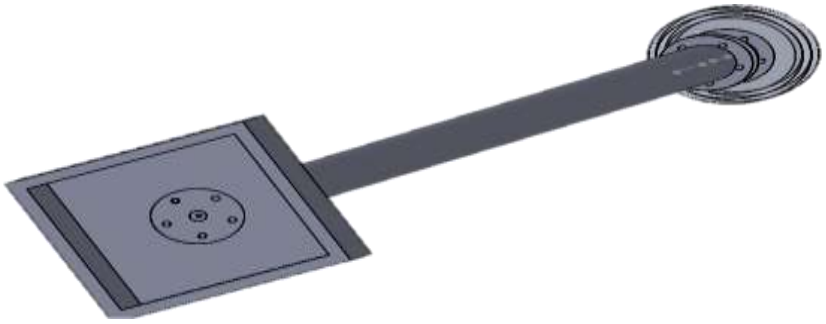


**Figure 30** CAD Model of Gas Gun along with Target Chamber

Fabrication and Testing:

In this Section We have Done the Fabrication of High-Speed Gas Gun. Method that we used in Fabrication are discussed in above Section. Figure of the Fabrication are as Follow:

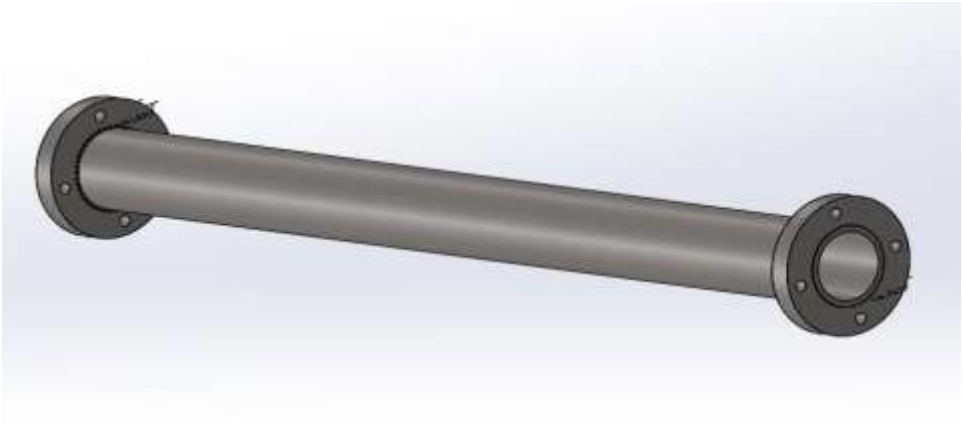


**Figure 31** Connection of Flanges with Barrell

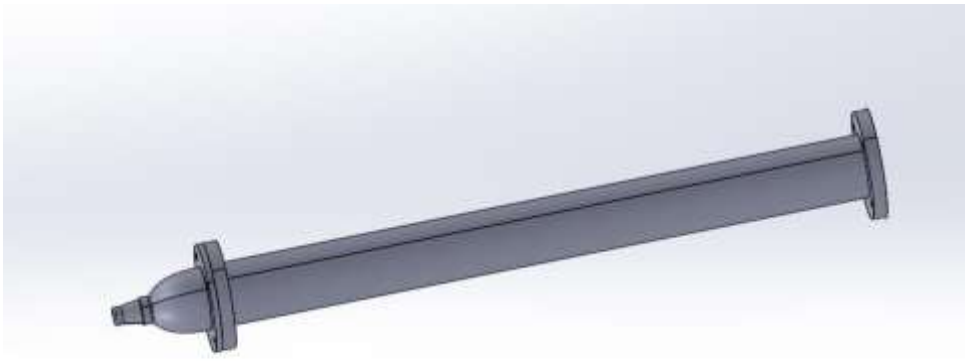


**Figure 32** Connection of Nozzle with Barrell

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about



**Figure 33** Fabricated Model of Gas Gun



**Figure 34** Fabricated Model of Gas Gun on Frame




**Figure 35** Labeled Figure of Gas Gun

**Testing:**

Testing was done with the help of Lab Air Compressor which has the ability to Compress the up-to High Pressure of 12 Bar. But the Safety Valve open at 10 bars. Testing was done for the valve opening we used iron bar to increase the Arm Length of valve handle to increase the Torque. We used Cardboard for making of Projectile that can be fire. Testing was done at different Pressure. Breach Pressure during Testing was 3 bar,5 bar and Maximum of 8 bar.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

**Flow Simulation:**

Flow simulation of Different parts of Gas Gun was done in Fluent Ansys. Contour of Pressure, Velocity Temperature of Barrell along with Nozzle will be shown in Figures. 14532 number of Nodes and 6900 Elements was used during Meshing. Density -base, Absolute Transient, no gravity was used. Domain that is used in Simulation is Cell Type. Inlet was the Barrell one End and Outlet was Nozzle another End. Model that is used Energy on K-epsilon. Air is used as gas to flow through Barrell and Nozzle. Steel was Selected for the material of Barrell and Nozzle. Boundary condition of Inlet (8bar) and Outlet (atm) was used. Method that was used was Implicit of First Order. Absolute criteria of 0.000001 was used. Run Calculation. Time step size (0.01), Number of Time step (100). Max iteration (150) was used in this Simulation. Maximum aspect ratio (6.76006e+01) Minimum orthogonal Quality (1.17816e-04) was used.

2D Velocity, Pressure and Temperature Contour of Barrell and Nozzle:

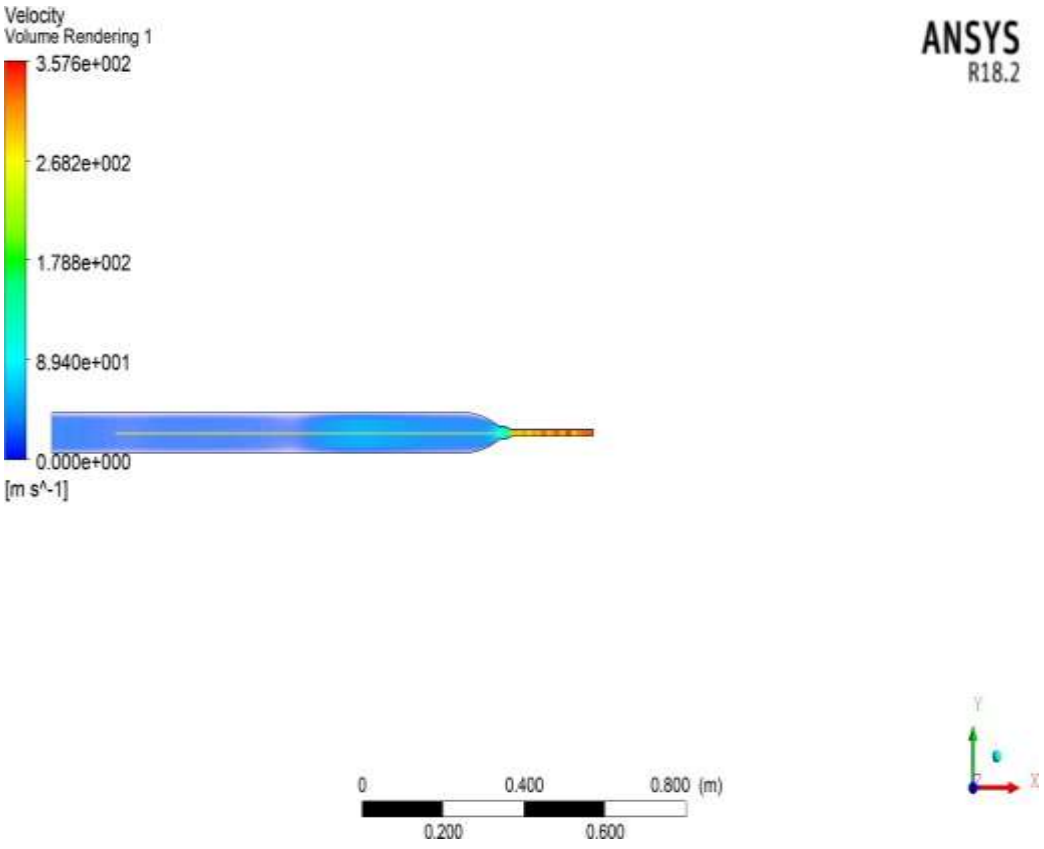



**Figure 36** Velocity Contour of Barrell and Nozzle

Velocity Contour of Barrell and Nozzle when Gas flow through them.it show that Min Velocity is when Gas Flow through the Barrell and it increases when the gas flow to the Nozzle.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

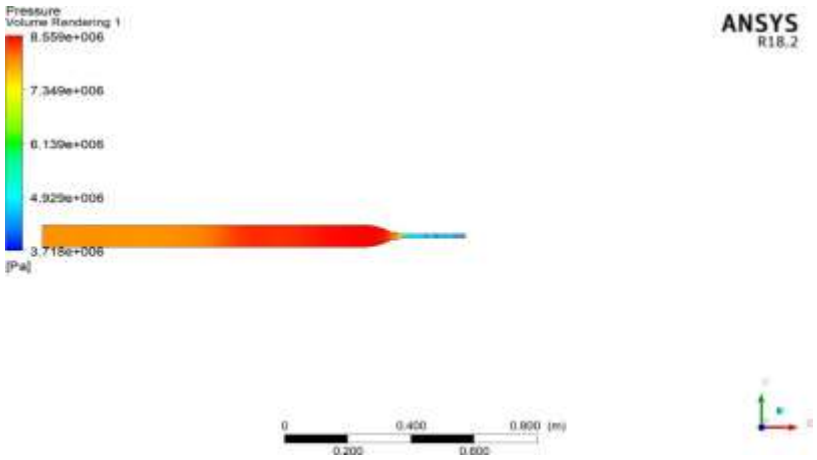



**Figure 37** Pressure Contour of Barrell and Nozzle
Pressure Contour of Barrell and Nozzle when gas flow through them. Pressure of gas is Max. at Barrell and it Decreases when it passes through Nozzle.

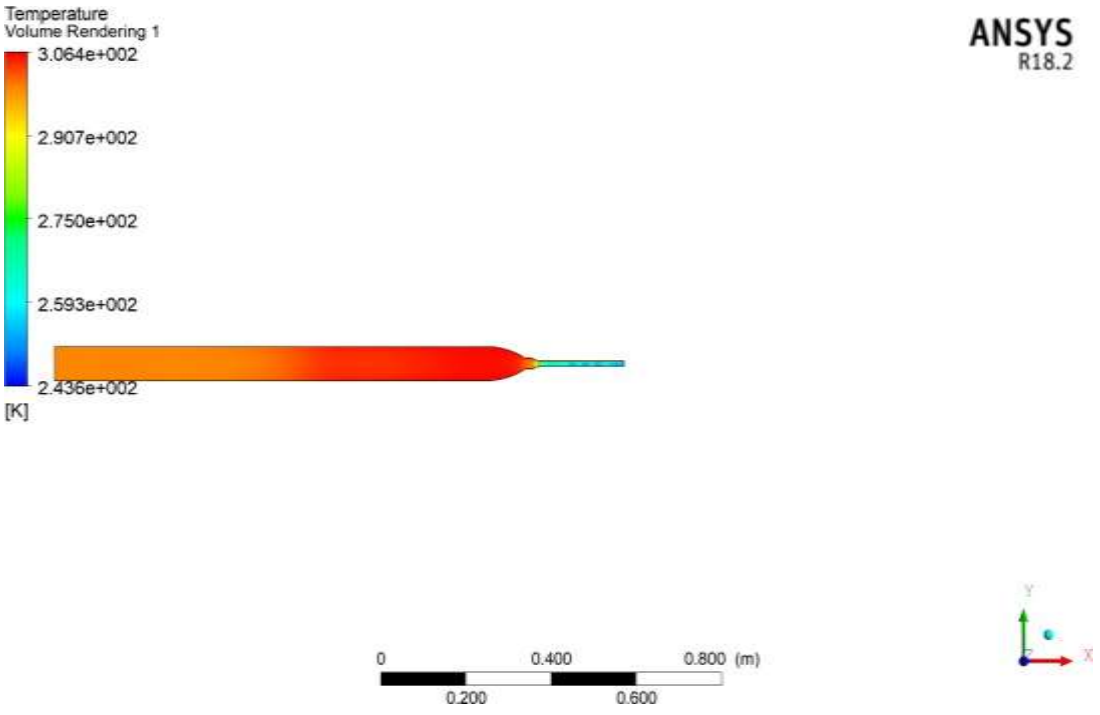



**Figure 38** Temperature Contour of Barrell and Nozzle
Temperature Contour of Barrell and Nozzle when gas flow through them. Temperature of gas is Max. at Barrell and it Decreases when it passes through Nozzle.
Velocity, Pressure and Temperature Contour of Nozzle:

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

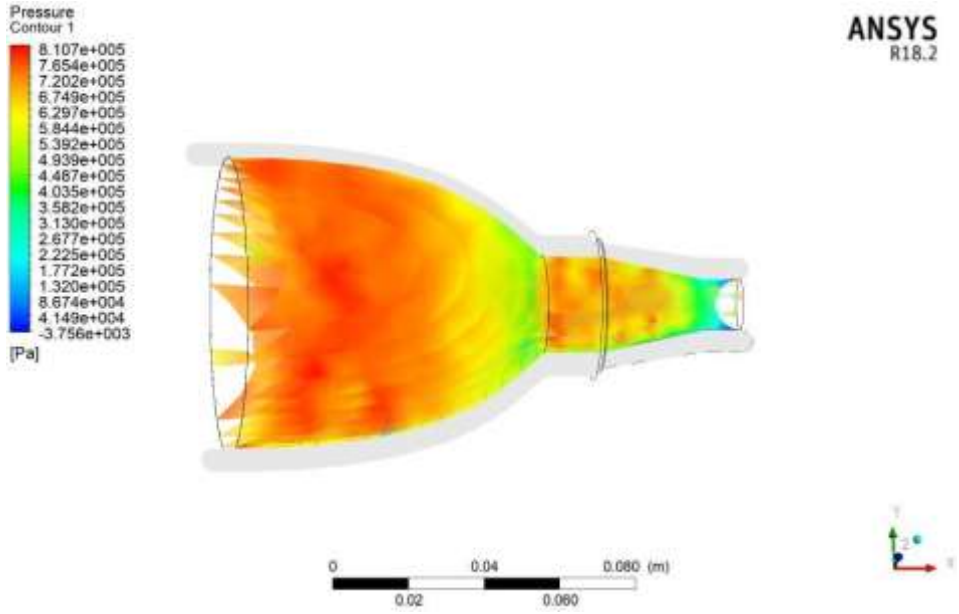



**Figure 39** Pressure Contour of Nozzle

Pressure Contour of Nozzle when Gas flow through it. It shows that Max. Pressure is when Gas Flow through the Left end of Nozzle and it decreases when the gas flow to the Right end Nozzle.

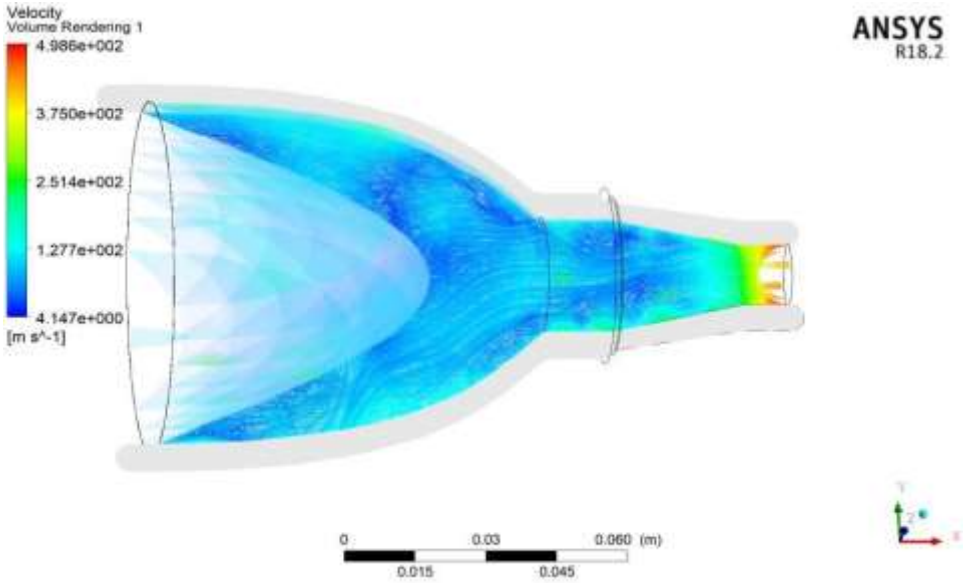



**Figure 40** Velocity Contour of Nozzle

Velocity Contour of Nozzle when Gas flow through it. It shows that Min. Velocity is when Gas Flow through the Left end of Nozzle and it increases when the gas flow to the Right end Nozzle.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

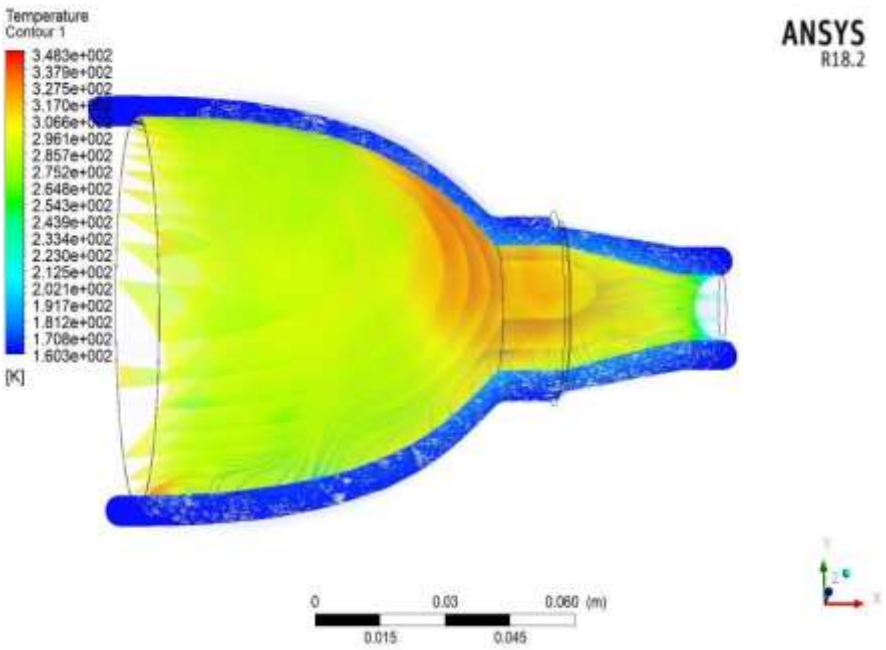



**Figure 41** Temperature Contour of Nozzle

Temperature Contour of Nozzle when Gas flow through it. It shows that Min. and Max. Temperature when Gas Flow through the Nozzle.

Velocity, Pressure Graph of Barrell and Nozzle:

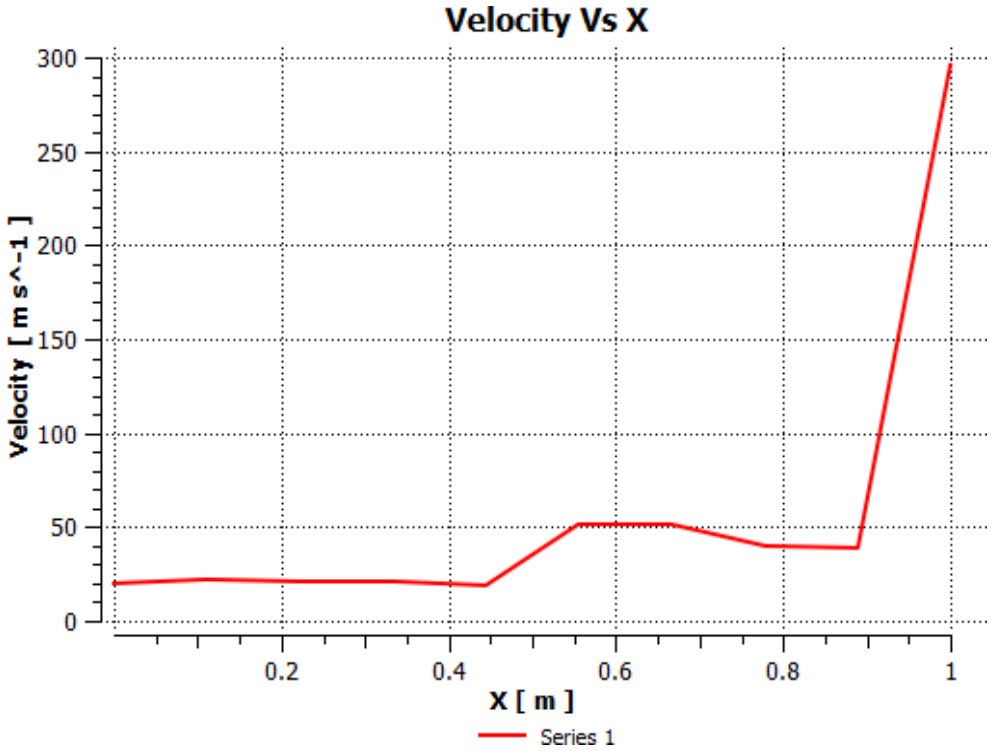



**Figure 42** Velocity Graph of Barrell and Nozzle

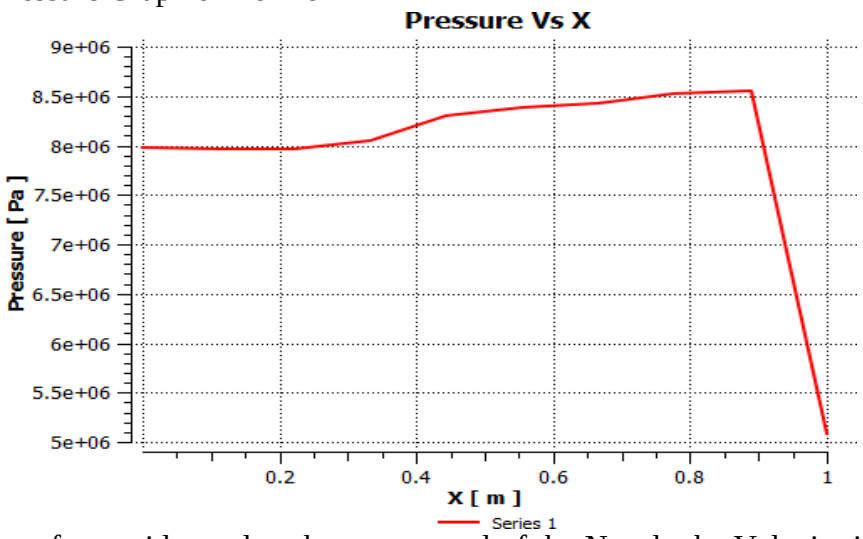
Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

As Gas Move from One End of Barell to Another end of Barell towards Nozzle Velocity Increases and as Shown in Graph.

**Figure 43** Pressure Graph of Nozzle




As Gas moves from wider end to the narrow end of the Nozzle the Velocity increase and Pressure of the Gas decreases as shown in Graph

**Conclusion & Future Recommendations:**

A High-Speed Gas Gun is built using Air, because it has a greater advantage in Impact Testing. This Testing Facilities can be used for checking the strength of Materials. Testing of Material like Bumper, Bullet Proof Vests, Glass can be done using Gas Gun. The Testing was done to ensure the Proper Working of High-Speed Gas Gun. In Future Recommendation we can do many steps to improve the performance of Gas Gun. We can Increase the Length of Barrell, we can Increase the Pressure of the Gas or we can use Helium Gas to improve Performance. The Gas Gun is Designed to Operate at High Pressure it is Limitation that Compressor that we have used only Operate at 12 bar max. Another Limitation is that we don't have facility to measure the Velocity of the Projectile that is Fired from the Gas Gun. It Can Also be in Future Recommendation to make a Device that can be used to detect the Velocity of Projectile at High Speed.

**References**

VanderKlok, Andy, et al. "An experimental investigation into the high velocity impact responses of S2-glass/SC15 epoxy composite panels with a gas gun." International Journal of Impact Engineering 111 (2018): 244-254.

Rahner, C., et al. "Numerical evaluation of a light-gas gun facility for impact test." Modelling and Simulation in Engineering 2014 (2014): 40-40.

Majzoubi, G. H., M. H. Ghaed Rahmati, and M. Kashfi. "Performance of a Two-stages Gas Gun: Experimental, Analytical and Numerical Analysis." International Journal of Engineering 32.5 (2019): 759-768.

Brown, J. R., et al. "A gas-gun facility for material impact studies using low-velocity,

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 12 (2025)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

low-mass projectiles." Journal of Physics E: Scientific Instruments 22.9 (1989): 771.

Helminiak, Nathaniel Steven. Construction and characterization of a single stage dual diaphragm gas gun. Diss. Marquette University, 2017.

Swisdak, M. and Peckham, P., 1985. Validation Tests in Building 327-50-Pound Bombproof (No. NSWC/TR-85-384). NAVAL SURFACE WEAPONS CENTER SILVER SPRING MD.

Chhabildas, Lalit C., Lee Davison, and Yasuyuki Horie, eds. High-pressure shock compression of solids VIII: The science and technology of high-velocity impact.

Springer Science & Business Media, 2004

Kumar, Thoutam Aravind, et al. "Design of gas gun barrel support structure by finite element model updating using optimization techniques." Materials Today: Proceedings 22 (2020): 3027-3036.

De Icaza, M., C. Renero, and F. E. Prieto. "Design operation and test of a light gas gun in a developing country." Review of scientific instruments 60.10 (1989): 3284- 3292.

Workman, E. J. Development of new gun using helium gas for projectile acceleration.

Vol. 70. Final Report NMSM/RDD, 1952

Baker, J. R. "Light-Gas Gun Performance: Theoretical Analysis and Experimental Comparison." Proceedings of the 7th Hypervelocity Impact Symposium. 1964.

Rast, J. J. The design of flat-scored high-pressure diaphragms for use in shock tunnels and gas guns. NAVAL ORDNANCE LAB WHITE OAK MD, 1961.

Swift, Hallock F. "Light-gas gun technology: a historical perspective." High-Pressure Shock Compression of Solids VIII: The Science and Technology of High-Velocity Impact (2005): 1-35.

SWIFT, HALLOCKF, and R. Witcofski. "Concept definition study for an extremely large aerophysics range facility." 28th Joint Propulsion Conference and Exhibit. 1993