

Stage 2 Research Project B

Assessment Type 2: Research Outcome

How could the armed forces use compressed air systems to launch supplies?

Introduction

For my research project I have built a compressed air device, for the purpose of launching supplies over a distance. This was to test my idea of building a much larger compressed-air cannon that could be used to launch supplies to soldiers in the front line. The idea behind this concept is to eliminate the need for helicopters to fly overhead and drop the supplies. When a helicopter drops vital supplies it must fly at a low altitude, slow down, descend and drop the supplies. By doing this the helicopter puts itself at great risk of being targeted by a range of anti-air weaponry. These attacks often result in multiple casualties and the loss of multimillion dollar vehicles. Therefore I designed a system that will be used to launch supplies from a safe distance to soldiers on the front line, without the use of a helicopter or expensive equipment. This should reduce the risk of life and injuries from the pilots and crew of the helicopters. I have designed my, down sized, prototype to be cheap, safe, effective and easy to use.

Synthesis 3
A well structured introduction with a clear topic sentence and logical explanation provides evidence of coherent expression of ideas.

Design

The initial design of the supply launcher came from a Nazi scientist in WWII, Faulker Feurstrum was a major influence with his unique concept of a wind cannon¹. I set about the task of specifying the best design for the tasks it would face. A family member², who had served in Afghanistan, told me how important the conservation of space was. This is because most military equipment has to be transported to various places, and the smaller the equipment, the easier this task is. After the consideration of size, I decided that one air tank would provide enough power and the shortening the hose would also reduce size. I added a curve from the air tank to the barrel, this allows for the barrel to be positioned over the barrel, reducing the length.

Synthesis 2
Each step in the process of designing the launcher is substantiated including managing the size and what materials to use.

Selecting material

Selecting the right material was a key component of the product. I started with an inspiration of my previously designed PVC air cannons. This required the use of a bike pump to charge the PVC chamber. I intend for my final product to be used by the armed forces, and from witnessing the current terrain faced by the armed forces on ABC's Hungry Beast³ I knew it would have to be durable. With the desert and sub zero terrains that the armed forces faced, I knew PVC would stress and fracture in these conditions.

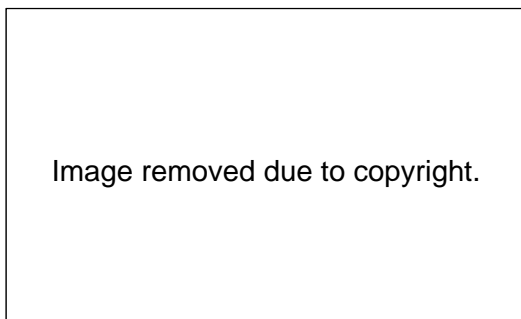


Figure 1]

This picture shows the type of environment in which the supply launching system would most likely face if introduced to the armed forces in coming years.

1. <http://www.bing.com/images/search?q=Iraq+Landscape&FORM=RESTAB>

For this reason I decided that I needed to use steel as it is strong and durable and would easily cope with the stresses of these environments, as well as being easily modified.

1. <http://disaircraft.greyfalcon.us/FAULKER%20FEUERSTURM.htm>
2. Discussion with family member
3. <http://www.abc.net.au/tv/hungrybeast/stories/australian-soldiers-speak-about-afghanistan/index.html>

Sourcing and selection of materials

The next key step was to choose the valve that would release the air from the charging tank into the barrel. This needed to be able to hold back a lot of air pressure while being able to release it quickly. The faster the valve is released the more pressure is forced against the supplies in the barrel. This puts the supplies under more force while in the barrel and results in a larger launch velocity. After my informal discussion with the weapons expert¹, he suggested I use a solenoid valve [Figure 2]. I went to various plumbing shops and made inquiries however the valves were far too weak to hold the pressure I was using, from what the shop assistants² were telling me. For this reason I chose the much stronger, manually operated, quarter turn valve [Figure 3].

Synthesis 2

Although the key finding about the solenoid valve is substantiated by a weapons expert and shop assistant this could be confirmed or cross-referenced with other sources to ensure validity and thoroughness.

Image removed due to copyright.	Solenoid valve [Figure 2] http://www.bing.com/images/search?q=solenoid+valve+&qs=n&form=QBIR&pq=solenoid+valve+&sc=0-6&sp=-1&sk	Image removed due to copyright.	Quarter turn valve [Figure 3] http://search.avg.com/images?s?s=sideNav&cid=%7bBFACDF69-E409-4F57-BE96-BDF1B0D09CA7%7d&mid=2898c970c5dc47d0aebd1943ef801149-fb882aa1e17812e25ad4f93359ba40e9906b0dd5&lang=en&ds=AVG&pr=fr&d=2012-07-22+16%3a04%3a17&v=14.2.0.1&pid=avg&sg=&sap=dsp&q=quarter+turn+valve
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I needed a barrel that was strong, as well as light weight for transporting, from information provided to me by a family member who served in the military³. I decided on using PVC pipe, as I have used it on other similar projects and I know that it is reliable and fits the requirements needed for the armed forces. This material can be heated and clamped to the valve to allow for a strong and air tight connection. It is also a cheap material and easily adaptable, two more key reasons that made it the material of choice for the barrel. [Figure 4]

Synthesis 2

Key findings demonstrate considered knowledge but not all are substantiated. There is no evidence to support some of these conclusions.



This is PVC, the chosen material for the barrel of the supply launching system.

[Figure 4]

1. Discussion with weapons expert
2. Inquiry with shop assistants
3. Discussion with family member

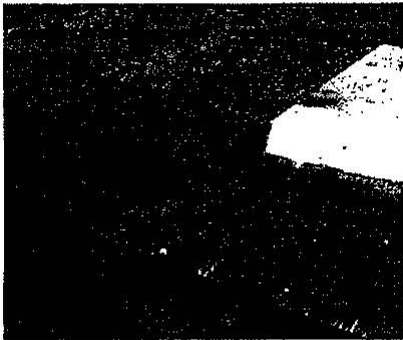
Finally I had to choose the best hose for connecting the high pressure SCUBA tank to my custom reserve tank. Because the SCUBA tank holds high pressure air and the custom reserve tank can only hold low pressure air, it meant that the air had to pass through a regulator to make it safe. However, the weapons expert warned me that I would struggle to find a company that would clamp a hose that would attach my tanks. They were correct, as I tried over 5 companies

Text removed due to privacy

The shop owner also supplied me with the correct fitting to attach the hose. I now had all the components needed to build the supply launching system.

Building

Assembling the components for the supply launching system was fairly straight forward. I started by cutting a 100 by 100 mm wide section of hollow steel square section, 560mm long. [Figure 5]



This is the steel, square hollow section selected for the custom tank.

[Figure 5]

The length was vital; as if it was too small the volume would be reduced, thus reducing the range, as explained to me by the weapons expert. If it was too large then the tank would take too long to charge to an effective pressure. I showed the cut piece to the weapons expert and he agreed that it was around the right length and volume. I then cut the end pieces to cap the ends of the square hollow section in my home work station [Figure 6].

Synthesis 2
Photographic evidence, support from an expert and practical experimentation provide substantiation.

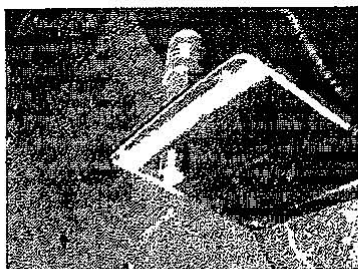
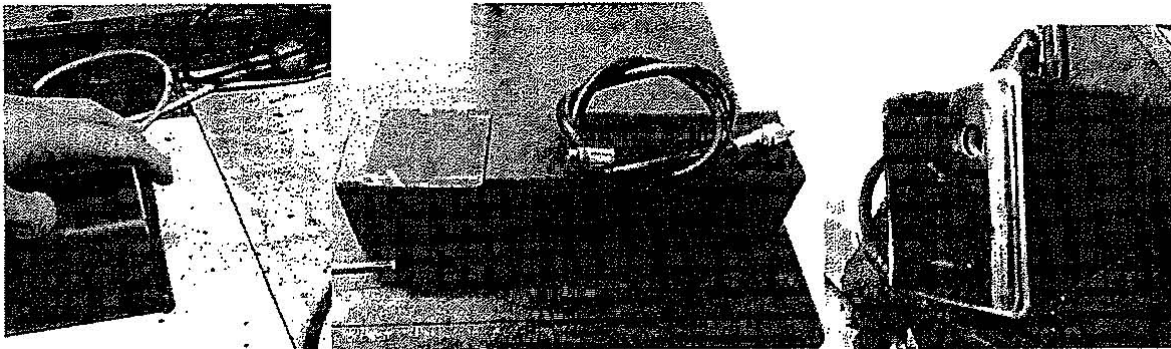


Using an angle grinder to cut the pieces of the custom reserve tank.

[Figure 6]

When the end pieces were cut roughly with the angle grinder, I remeasured and finally cut the end pieces on the cold cut saw at school technology lab on the 8th of April. One of the end pieces was then drilled and a female hose attachment was bolted through the hole [Figure 7,8,9,10].

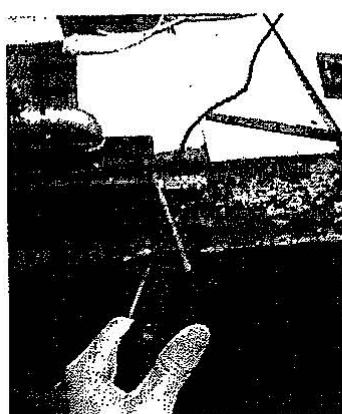
1. Discussion with shop assistant
2. Discussion with SCUBA shop manager
3. Discussion with weapons expert



Stages of the reserve tank as the end piece is drilled and the valve is bolted through.

[Figure 7,8,9,10]

Now that the end plate had the female attachment fitted, it was ready to be welded on to the square hollow section. A technology teacher¹ insisted that he use the school MIG welder to weld these pieces, as he had the ability to create a strong air tight weld. I then used an Arc welder to add extra strength at home [Figure 10] as recommended by the weapons expert¹.

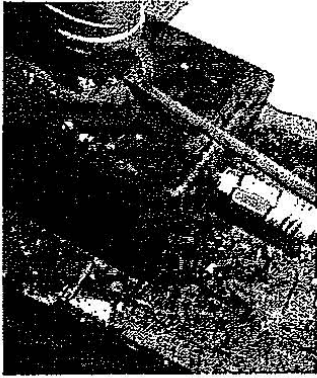


Adding the final strengthening welds to the end pieces.

[Figure 11]

Next I had to drill another hole into the top of the square hollow section. This hole was drilled as large as possible and a simple steel link was welded around the hole. This was a tricky circular weld and the teacher again recommended he did the initial air tight weld. I then strengthened it with the arc welder. [Figure 12]

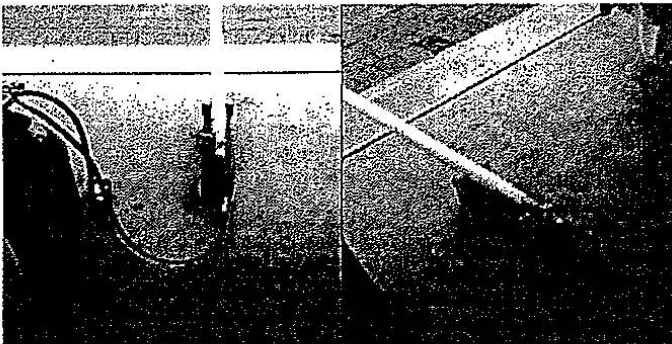
1. Discussion with the weapons expert



Adding the final, strengthening welds to the steel link, connecting the barrel to the tank.

[Figure 12]

Then I simply screwed a 90 degree turn into the steel link, the quarter turn valve then screwed into that and then I clamped on the PVC pipe, completing the supply launch system [Figure 13]



The final product

[Figure 13]

Safety

From previous buildings of similar systems, and from the knowledge gained in tech¹ subjects at school, I knew that **safety was the first priority in both construction and use of the compressed air system.** During construction **I wore the correct personal protection equipment.** Such as, safety glasses and ear defenders when angle grinding. A welding mask, gloves and overcoat were worn when welding the custom tank. During the firing of the supply launch system, I wore ear defenders to protect from the loud sound of firing and eye protection to prevent dust going in my eyes after discharge.

Skills

Skills were needed in construction of the supply launching system to produce a quality system that would be safe for the user. The **safety and basic operational skills used in construction were gained from technology studies** I have taken at school. **I also have taken civil construction course that taught me the more advance techniques of welding and cutting metal.**

Results

I have put the launching system through **a series of tests so far.** I have been **using fruit as supplies** and testing the velocity of short distances. **The results have been very promising.** **The fruit is staying intact during the flight and travels well over 200 meters currently.** This is possibly only a fraction of the power that is achievable by the supply launching system. However I have only been limited by having a large enough space to test fire, without losing the projectile. I hope to be able to travel to a remote field where I can test the full potential of the launching system.

Synthesis 1
Considered synthesis of knowledge and skills to produce a "safe" resolution to the question. The launcher is tested and the successes and limitations of the resolution have been assessed honestly. Reference to the initial question and military applications is limited and the documentation of the tests is brief and unsubstantiated.

1. Lessons with technology teachers at schools, teaching standard safety procedures

Bibliography

Primary research

1. 27th of March, 2013, Weapons Expert, pers. Comm.
2. 24th of February, 2013, , Armed Forces, pers. Comm.
3. 12th of February, 2013, , police officer and ex firearms officer, pers. Comm.
4. 3rd of April, 2013, SCUBA shop owner, pers. Comm.
5. 8th of April, school technology teacher, pers. Comm.
6. Various dates, shop assistants on varied, plumbing and compression specialist shops.

Secondary research

1. <http://www.abc.net.au/tv/hungrybeast/stories/australian-soldiers-speak-about-afghanistan/index.html>
2. Unknown author, "images of Middle Eastern landscape", bing images, unknown date
<http://www.bing.com/images/search?q=Iraq+Landscape&FORM=RESTAB>
3. Rob Arnett, "FAULKER FEUERSTURM", Google search, 25th of February 2013,
<http://disaircraft.greyfalcon.us/FAULKER%20FEUERSTURM.htm>
4. Ian Hog, (1998)*Twentieth-century artillery*, unknown publisher.

Additional Comments

The Research Outcome is a B grade.

Stage 2 Research Project B Performance Standards

	Planning	Development	Synthesis	Evaluation
		Assessment Type 1: Folio		
			Assessment Type 2: Research Outcome	
				Assessment Type 3: Evaluation
A	<p>P1 Thorough consideration and refinement of a research question.</p> <p>P2 Thorough planning of research processes that are highly appropriate to the research question.</p>	<p>D1 Thorough and highly resourceful development of the research.</p> <p>D2 In-depth analysis of information and exploration of ideas to develop the research.</p> <p>D3 Highly effective development of knowledge and skills specific to the research question.</p> <p>D4 Thorough and informed understanding and development of one or more capabilities.</p>	<p>S1 Insightful synthesis of knowledge, skills, and ideas to produce a resolution to the research question.</p> <p>S2 Insightful and thorough substantiation of key findings relevant to the research outcome.</p> <p>S3 Clear and coherent expression of ideas.</p>	<p>E1 Insightful evaluation of the research processes used, specific to the research question.</p> <p>E2 Critical evaluation of decisions made in response to challenges and/or opportunities specific to the research processes used.</p> <p>E3 Insightful evaluation of the quality of the research outcome</p>
B	<p>P1 Consideration and some refinement of a research question.</p> <p>P2 Considered planning of research processes that are appropriate to the research question.</p>	<p>D1 Considered and mostly resourceful development of the research.</p> <p>D2 Some complexity in analysis of information and exploration of ideas to develop the research.</p> <p>D3 Effective development of knowledge and skills specific to the research question.</p> <p>D4 Informed understanding and development of one or more capabilities.</p>	<p>S1 Considered synthesis of knowledge, skills, and ideas to produce a resolution to the research question.</p> <p>S2 Substantiation of most key findings relevant to the research outcome.</p> <p>S3 Mostly clear and coherent expression of ideas.</p>	<p>E1 Considered evaluation of the research processes used, specific to the research question.</p> <p>E2 Some complexity in evaluation of decisions made in response to challenges and/or opportunities specific to the research processes used.</p> <p>E3 Considered evaluation of the quality of the research outcome</p>
C	<p>P1 Some consideration of a research question, but little evidence of refinement.</p> <p>P2 Satisfactory planning of research processes that are appropriate to the research question.</p>	<p>D1 Satisfactory development of the research.</p> <p>D2 Satisfactory analysis of information and exploration of ideas to develop the research.</p> <p>D3 Satisfactory development of knowledge and skills specific to the research question.</p> <p>D4 Satisfactory understanding and development of one or more capabilities.</p>	<p>S1 Satisfactory synthesis of knowledge, skills, and ideas to produce a resolution to the research question.</p> <p>S2 Substantiation of some key findings relevant to the research outcome.</p> <p>S3 Generally clear expression of ideas.</p>	<p>E1 Recount with some evaluation of the research processes used.</p> <p>E2 Some evaluation, with mostly description of decisions made in response to challenges and/or opportunities specific to the research processes used.</p> <p>E3 Satisfactory evaluation of the quality of the research outcome</p>
D	<p>P1 Basic consideration and identification of a broad research question.</p> <p>P2 Partial planning of research processes that may be appropriate to the research question.</p>	<p>D1 Development of some aspects of the research.</p> <p>D2 Collection rather than analysis of information, with some superficial description of an idea to develop the research.</p> <p>D3 Superficial development of some knowledge and skills specific to the research question.</p> <p>D4 Basic understanding and development of one or more capabilities</p>	<p>S1 Basic use of information and ideas to produce a resolution to the research question.</p> <p>S2 Basic explanation of ideas related to the research outcome.</p> <p>S3 Basic expression of ideas.</p>	<p>E1 Superficial description of the research processes used.</p> <p>E2 Basic description of decisions made in response to challenges and/or opportunities specific to the research processes used.</p> <p>E3 Superficial evaluation of the quality of the research outcome</p>
E	<p>P1 Attempted consideration and identification of an area for research.</p> <p>P2 Attempted planning of an aspect of the research process.</p>	<p>D1 Attempted development of an aspect of the research.</p> <p>D2 Attempted collection of basic information, with some partial description of an idea.</p> <p>D3 Attempted development of one or more skills that may be related to the research question.</p> <p>D4 Attempted understanding and development of one or more capabilities.</p>	<p>S1 Attempted use of an idea to produce a resolution to the research question.</p> <p>S2 Limited explanation of an idea or an aspect of the research outcome.</p> <p>S3 Attempted expression of ideas.</p>	<p>E1 Attempted description of the research process used.</p> <p>E2 Attempted description of decisions made in response to a challenge and/or opportunity specific to the research processes used.</p> <p>E3 Attempted evaluation of the quality of the research outcome</p>