BME 400 - Silicone Oil Applicator

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Overview

- Background
- Problem Statement
- Existing Devices
- Design Specifications
- Enclosed Box Design
- Prototypes 1-4
- Materials
- Future Work

Background

- Silicone oil aerosol spray is widely used as a lubricant in medical industry.
- Used by anesthesiologists
- Lubricant applied to inside and outside of tubes during operations

Figure 1 – RUSCH silicone oil lubricant aerosol spray ("Rusch Silkospray", 2011)

Some Devices Needing Lubrication

- Fiber optic bronchoscopes
- Single and double lumen endotracheal tubes
- Airway exchange catheters
- Aintree intubation catheters
- Laryngeal mask airways
- Bronchial blockers

Figure 2 – Bronchoscope

Problem Statement

- Current method of application causes:
  - Slippery work environment
  - Risk for cryogenic burns
  - Release of particles into air that can be inhaled

- A different effective method of applying the silicone oil lubricant is sought.

Existing Devices

Figure 3 – Brush applicator for silicone oil lubricant (Tool Shack, 2011)

- Do not work with lubricant UW hospital uses
- Expensive

Figure 4 – Syringe Lubricant Applicator (High Island Health, 2011)

Figure 5 – Automatic silicone oil spray chamber (McClellan Automation System, 2011)

Motivation & Client Requirements

- Eliminate/reduce potential hazards in the OR
- Compatible with the current spray
- Coat inside and outside of a tube/scope
- Portable

Enclosed Box Design

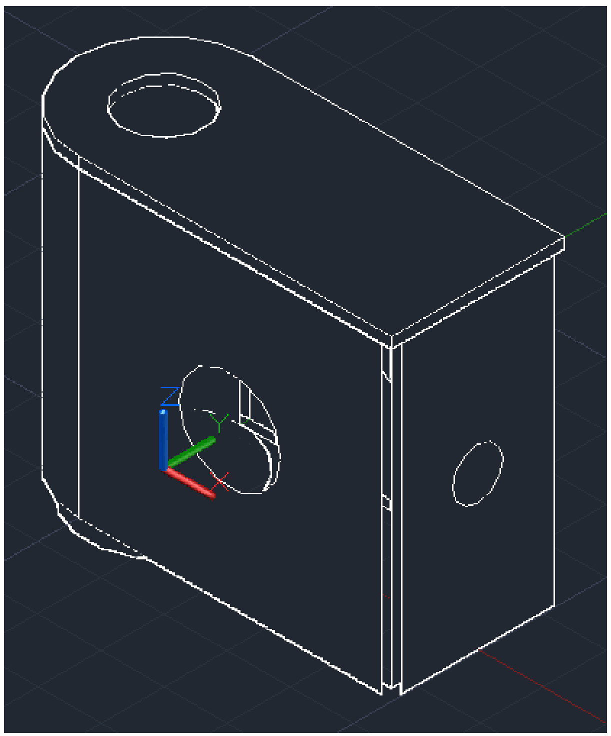

Figure 5. The Enclosed Box Design

- Features:
  - Works with current spray
  - Minimizes overspray
  - Can lubricate inside and outside
  - Disposable
  - Gaskets and pull tab to contain the spray

First Prototype

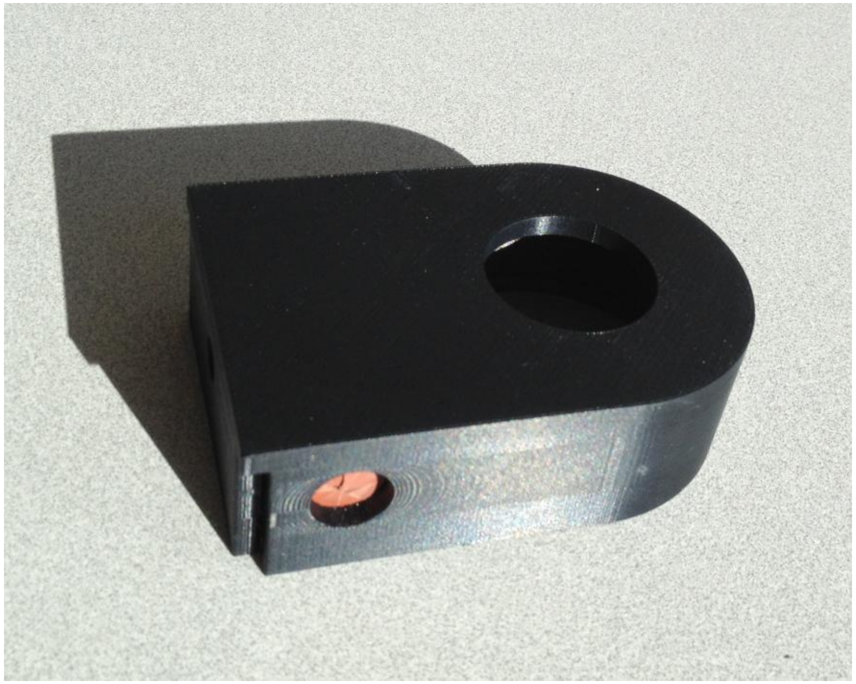

Figure 6. The First Prototype

- Features:
  - Three holes to allow for even coating of tubes
- Problems:
  - Does not fit onto the can
  - Overall too large
  - Nozzle opening through the top

Second Prototype

Figure 7. The second prototype

- Features:
  - Step design allows for increased access to the nozzle
  - Eliminates back-spray
  - Testing is promising
    - Reduces overspray from 5900 cm^2 to 0 cm^2
    - Effectively coats inside and outside
- Problems:
  - Gasket material too stiff
  - Sharp corners and edges
  - Cannot fully access the nozzle
  - Difficult to manufacture

Third Prototype

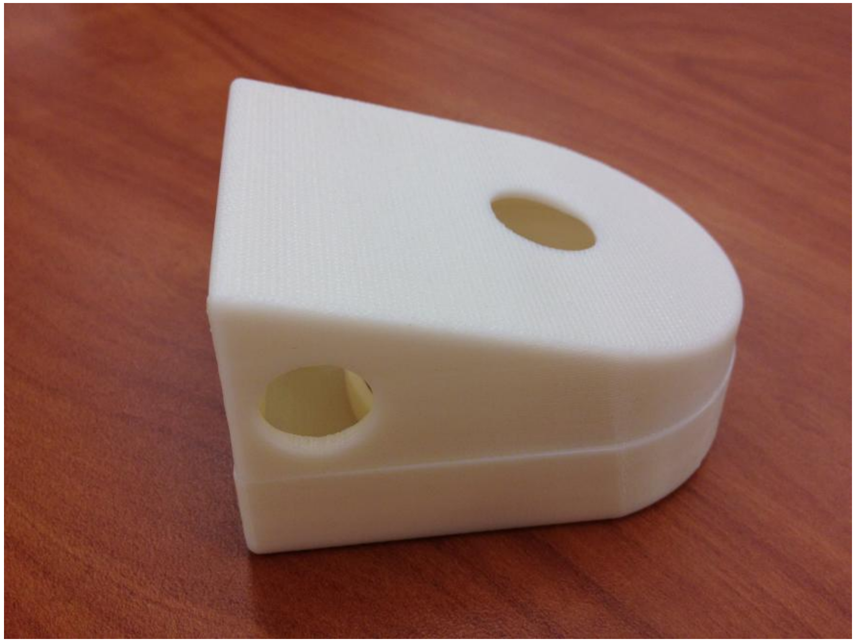

Figure 8. The third prototype

- Features:
  - Two pieces – able to injection mold
  - Slanted top instead of step
  - Rounded corners
  - Tapered
  - Nozzle is accessible
- Problems:
  - Does not promote effective air flow
  - Does not fit onto the can

Fourth Prototype

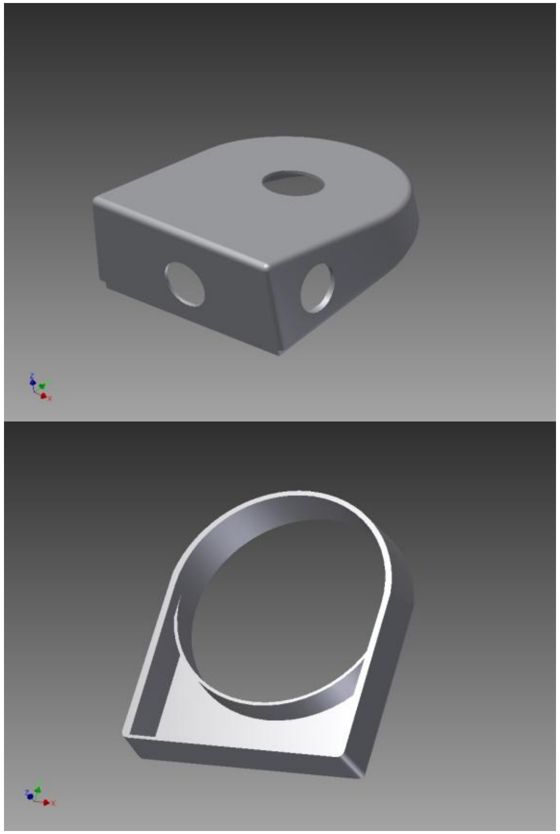

Figure 9. The fourth prototype

- Features:
  - Bottom fits on can
  - Holes moved back
  - Lip for stronger attachment

- Problems:
  - To be determined

Materials - Body

Criteria	Possible Materials							
	Weight	PC	PMMA	**HDPE**	LDPE	PET	ABS	PP
Cost	5	2	1	**5**	3	5	4	5
FDA Approved	2.5	2.5	2.5	**2.5**	2.5	2.5	2.5	2.5
Transparency	1	1	1	**0.5**	0.5	0.5	0.5	0.5
Young's Modulus	1.5	1	1.5	**1.5**	0.25	0.25	0.5	1.25
Total	10	6.5	6	**9.5**	6.25	8.25	7.5	9.25

Table 1. Design matrix for the body material

Materials - Gasket

Criteria		Possible Materials			
	Weight	PTFE	Neoprene	**Silicone Rubber**	Nitrile Rubber
Cost	5	4	1	**5**	3
FDA Approved	2.5	2.5	1	**2.5**	2
Young's Modulus	2.5	.5	1.5	**2.25**	2
Total	10	7	3.5	**9.75**	7

Table 2. Design matrix for the gasket material

Future Work

- Print and test fourth prototype
- Contact manufacturers
- Burrill Competition

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References

- 3M. (2010). "Material Safety Data Sheet for Silicone Lubricant."
- <http://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xl8_BPxm1Ov70k17zHvu9lxtD7SS>
- Betco. (2007). "Material Safety Data Sheet for Silicone Spray Lubricant."
- <http://www.betco.com/MSDS/045.pdf>
- Camp, D., Ateaque, A., Dickson, W. A. (2003). "Cryogenic burns from aerosol sprays: a report of two cases and review of the literature." *British Association of Plastic Surgeons*. 56: 815–817. doi:10.1016/j.bjps.2003.08.009
- Conrad, F. (1994). "Surgical and other aerosols-Protection in the operating room." *Professional Safety*. 39.8: 28. Proquest Research Library. Retrieved 22 September 2011. <http://ezproxy.library.wisc.edu/login?url=http://search.proquest.com/docview/200434141?accountid=465>
- Dupont. (2011). "DuPont "Teflon" Pure Silicone Lubricant – Aerosol." Dupont Safety Data Sheet. <http://www2.dupont.com/Products_and_Services/en_AU/assets/downloads/dcse%20msds/teflon%20lubes/Pure%20silicone%20lube%20MSDS.pdf>
- Grimes, C., Aughwane, P., Klein, M. (2010). "A reaction to silicone spray." *Endoscopy*. 42: E128. doi: 10.1055/s-0029-1243985
- High Island Health. (2011). "Lubricant Applicator." <http://www.highisland.com/detail.php?bid=&productid=7>
- IMS Company. (2011). "Material Safety Data Sheet for Silicone Grease Lubricant." <http://www.imscompany.com/msds/100585-100586-100830.pdf>
- Lacour, M. and Le Coultre, C. (1991). "Spray Induced Frostbite in a Child: A new hazard with novel aerosol propellants." *Pediatric Dermatology*. 8:207-209.
- LPS. (2011). "Material Safety Data Sheet for Heavy Duty Silicone Lubricant." <http://www.lpslabs.com/technical_info/msds/11516.pdf>
- McClellan Automation Systems. (2011). "Silicone Oil Atomization Spray Chamber." <http://www.mcclellan-automation.com/>
- Moser, S. (1999). "Aerosol-Induced Frostbite Injury." *Resource Library-The CBS Interactive Business Network*. < http://findarticles.com/p/articles/mi_m0689/is_9_48/ai_59407920/>
- (2011). "Rusch Silkospray." Teleflex Medical Inc. <www.teleflex.com>
- Silicone and Silicon. (2006). Accessed 21 September 2011. <http://www.silicon-silicone.com/>
- Tool Shack. (2011). "Ken Tool Bead Lubricant Applicator." <http://www.toolshackanaheim.com/SearchResults.asp?mfg=Ken-Tool>
- Valencia, et al. (2006). "Lubricant for conveying containers." United States Patent. Patent #US2006/0211582A1.

Questions?