Guardrails shall be able to withstand a minimum force of 1,000 Newtons without visible permanent deformation.

When this occurs on the jobsite the problem is commonly ignored and leads to rail being damaged or shaken loose. Visibility is obstructed with current design. Full visibility at all times is very important.

Guardrail is located on the left hand side of D8T track-type tractor and is mounted to the fender. Purpose is to assist operator in refilling various fluids and tending to common maintenance items.

DEF Fill, Fuel Fill, Batteries, Cab Air Filter, E-Bar Lube, Cab Window Washer Fluid, Window/Light Cleaning. Current design is rigidly mounted and receives heavy vibrations ignored and leads to rail being damaged or shaken loose. Hazard is formed when guardrail is removed.

Guardrails should be provided along the side of the platform if the platform is 3 meters or more above the ground and the platform could use improvement to common maintenance items and is mounted to the fender.

Customer Requirements:
- Functionality
- Lightweight and easy to use guardrail
- 10,000 hours field life

Standards/Safety Requirements:
- Guardrail must have a rail placed midway between the top rail and the platform
- Guardrails should be provided along the side of the platform if the platform is 3 meters or more above the ground

Minimum height: 1,000 mm
Maximum height: 1,100 mm
Guardrails shall be able to withstand a minimum force of 1,000 Newtons without visible permanent deformation.

Problem:
- Common to see guardrail be ripped off machine accidentally or purposefully removed
  - Hazard is formed when guardrail is removed
- Current design is rigidly mounted and receives heavy vibrations
  - When this occurs on the jobsite the problem is commonly ignored and leads to rail being damaged or shaken loose
- Visibility is obstructed with current design
  - Full visibility at all times is very important

Background:
- Guardrail is located on the left hand side of D8T track-type tractor and is mounted to the fender
- Purpose is to assist operator in refilling various fluids and tending to common maintenance items
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Sponsor(s):
Caitlin Hubner (ASM), Cole Callaway (ASM), Elliot Moughler (ASM)

Technical Advisor:
Dr. Engel
Dr. Stwalley

Instructors:
Dr. Stwalley

Acknowledgements:
Scott Brand
Research Machining Services

Solution Evaluation
- All options were designed, and evaluated before choosing a final design.
- Option 1 would of been over budget and not met the time constraints.
- Option 2 did not meet testing requirements and would of had a short life span.
- Option 3 met all of the criteria for the guardrail constraints.

Alternative Solutions:
Option 1: Single Fold Guardrail
- Decrease platform width
- Use existing guardrail, but eliminate vertical center bar
- Install two Variloc hinging mechanisms on each side right below horizontal bar
- Make it actuated so that the guardrail is always in the safe position

Option 2: Swinging Guardrail
- Use existing guardrail
- Hinge the mounting platform so the guardrail swings towards the cab door
- Install locking mechanism so the guardrail locks in place

Option 3 Final Design: Double Fold Guardrail
- Use existing guardrail, but eliminate vertical center bar
- Install two Variloc hinging mechanisms on each side right below horizontal bar and right above both mounting brackets
- Use a cable activation system to actuate the guardrail

Impact on Society/Sustainability
- Keeps operators safe during maintenance without being an inconvenience.
- Increased the life of the guardrail.
- Increased durability of the guardrail will decrease the amount spent on replacements.
- Decreases the damage done to the work environment by previous guardrail design.
- Increased durability of the guardrail will decrease the amount of material and manufacturing.
- Cost of Production Goal: ~ $440
- Actual Cost of Production: $473
  - Cost of production includes materials of the guardrail only.

Economic Analysis
The collapsible guardrail project used $700. The adjustable locking hinges causes an increase in the production cost of the guardrail comparable to the previous design.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot; OD x 1/4&quot; Wall HR CS Tubing</td>
<td>$81</td>
</tr>
<tr>
<td>Variloc Heavy Duty Locking Hinges</td>
<td>$372</td>
</tr>
<tr>
<td>Mounting Brackets</td>
<td>$20</td>
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<tr>
<td>Cable Release</td>
<td>$20</td>
</tr>
<tr>
<td>Misc. Hardware</td>
<td>$40</td>
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<td>Welding &amp; Bending</td>
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This data is used to make informed decisions and improve the design process.