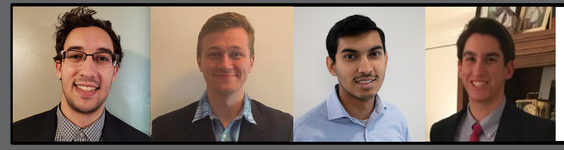

Engineers Brewery Consultancy

ENME 444 Mechanical Engineering Systems Design Spring 2020

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Project Objective

The objective of this project was to limit the number of can tip-overs that occur in the Depalletizer (Depal) and First Conveyor Belt Transition (FCBT) sections of the Jailbreak Brewing Companies canning line. The solutions must be easy to install and be able to be maintained by typical in-house tools and components.

System Requirements

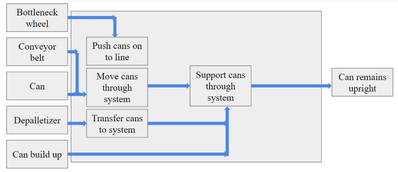


Figure 1: FBD for Depal

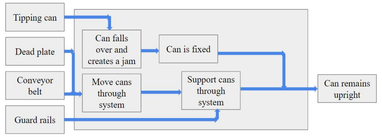


Figure 2: FBD for FCBT

Table 1: System Requirements for Depal

ID	Description	Rationale	Verification
1.1	Shall be able to be used for both 12 oz and 16 oz cans [1]	User Request	Analysis
1.2	Shall load cans into downward slope without cans tipping over	Design Goal	Demonstration/ Analysis
1.3	Shall not interfere with Oxidized Air Can cleaner (OAC) and the cleaning of empty cans [1]	User Request	Demonstration
2.1	The system shall run at a consistent 50 cans per minute with a tip-over occurring with no more than 5% of cans	Design Goal	Analysis
2.2	Shall not decrease the existing can filling rate	Design Goal/ User Request	Test
3.1	Shall not mark up or indent the can in any way [2]	Regulatory/ Standards	Demonstration
3.2	Shall not tamper with the beer upon leaving the filler tubes [2]	Regulatory/ Standards	By Design

Table 2: System Requirements for FCBT

ID	Description	Rationale	Verification
1.1	Shall be able to be used for both 12 oz and 16 oz cans [1]	User Request	Analysis
1.2	Shall prevent full and sealed cans from tipping between sealer platform and dead plate	Design Goal	Analysis
1.3	Shall prevent cans from tipping from dead plate to third conveyor belt	Design Goal	Test/ Analysis
1.4	Shall not decrease the original rate of cans being weighed by the weigh station [1]	User Request/Design Goal	Demonstration
2.1	The system shall run at a consistent 50 cans per minute with a tip-over occurring with no more than 5% of cans	Design Goal	Analysis
2.2	Shall not decrease the existing can filling rate	User Request/ Regulatory	Test
2.3	The cans must be evenly spaced when on the conveyor belt	Design Goal/ Safety	Analysis/ Test
3.1	Shall not mark up or indent the can in any way [2]	Regulatory/ Standards	Demonstration
3.2	Shall not tamper with the beer upon leaving the filler tubes [2]	Regulatory/ Standards	By Design

- The system requirements for the Depal and FCBT were determined from the analysis of the canning line, customer requirements, and canning standards
- Figures 1 and 2 display the Functional Block Diagram (FBD) for both sections where cans tend to tip over. The inputs for the FBD's are seen in Figures 3 and 4, their respective System Boundary Diagrams' (SBD)
- The final design goal for each Can Tip-Prevention System (CTPS) is to support the cans through each system to ensure they remain upright through the canning process

System Boundary Diagram

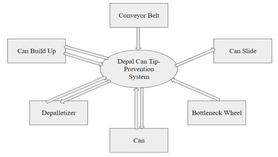


Figure 3: SBD for Depal

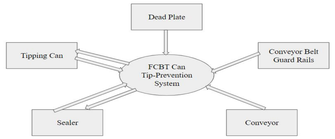


Figure 4: SBD for FCBT

Design and Development

Figure 5: This Depal CTPS prototype iteration 1 was an 8.5" x 11" sheet of paper that had a paper weight of 32 lbs.This prototype extends off of the existing can guardrails.

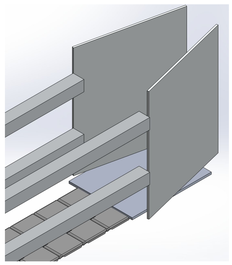
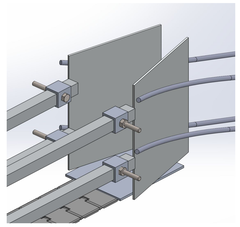


Figure 6: The Depal CTPS worked by providing slight resistance to the sides of the leading empty can, which allowed the can immediately behind it to push the lead can through.

Figure 7: Prototype Iteration 2- The height and length were decreased to 7" and 6" respectively allowing for gradual squeezing of the cans. The material was selected to be ORBIS Plastic Divider Sheets.



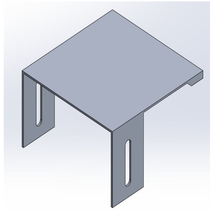


Figure 8: The FCBT CTPS prototype iteration 1 replaced the dead plates' non slick stature covering the loose section of the third conveyor belt. A width selected to hug the conveyor belt shelling and allow for secure fastening.

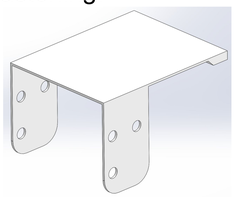
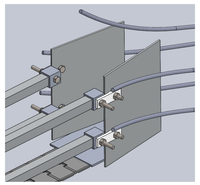


Figure 9: Prototype Iteration 2- The material was selected to be High Density Polyethylene Plastic (HDPE). The mounting system designed to line up with conveyor channels.

Final Design and Testing

Figure 10: Depal mounting system designed to be fastened by nuts and bolts to existing can guide rails.Output width set to 2.5" which determined a mounting angle of 10 degrees.



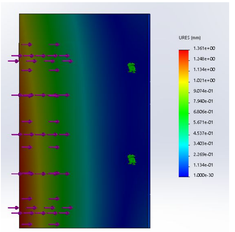
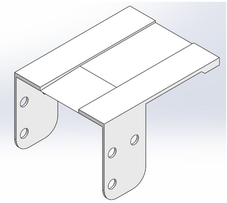


Figure 11: A distributed load of 0.02 lbs was applied to the Depal CTPS. Max deflection was insignificant at less than 1/16". Modified Goodman Criterion determined Depal CTPS has infinite life.

Figure 12: Plate thickness increased from 1/8" to 1/4". A 3" wide, 1/8" deep channel was added as a pathway for the cans. Final 3" has a gradual decline for safe transition back onto the conveyor belt.



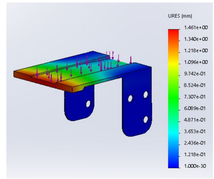


Figure 13: A 3.5 lb distributed load was applied to the channel, which yielded a less than 1/16" maximum displacement. A vibrational analysis showed the CTPS would displace by 1/128".

Future Work

- Manufacture Depal CTPS and FCBT CTPS
- Install final designs into canning line
- Test for efficiency and effectiveness based upon system requirements
- Modify final design based on test results

Acknowledgements

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