WALKER TAPE CONTOUR MACHINE

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WALKER TAPE®

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Introduction

Walker Tape has eight machines that all cut double sided tape strips, or contours, for use with hair products and clothing. Each machine is slightly different, making repairs a difficult and time-consuming process. The counting mechanism is completely mechanical. This causes it to wear out very quickly and is extremely loud to operate; contours often jam while exiting the machine. Our upgrades are focused on replacing these two systems to reduce machine downtime, increase product throughput and adhere to OSHA standards.

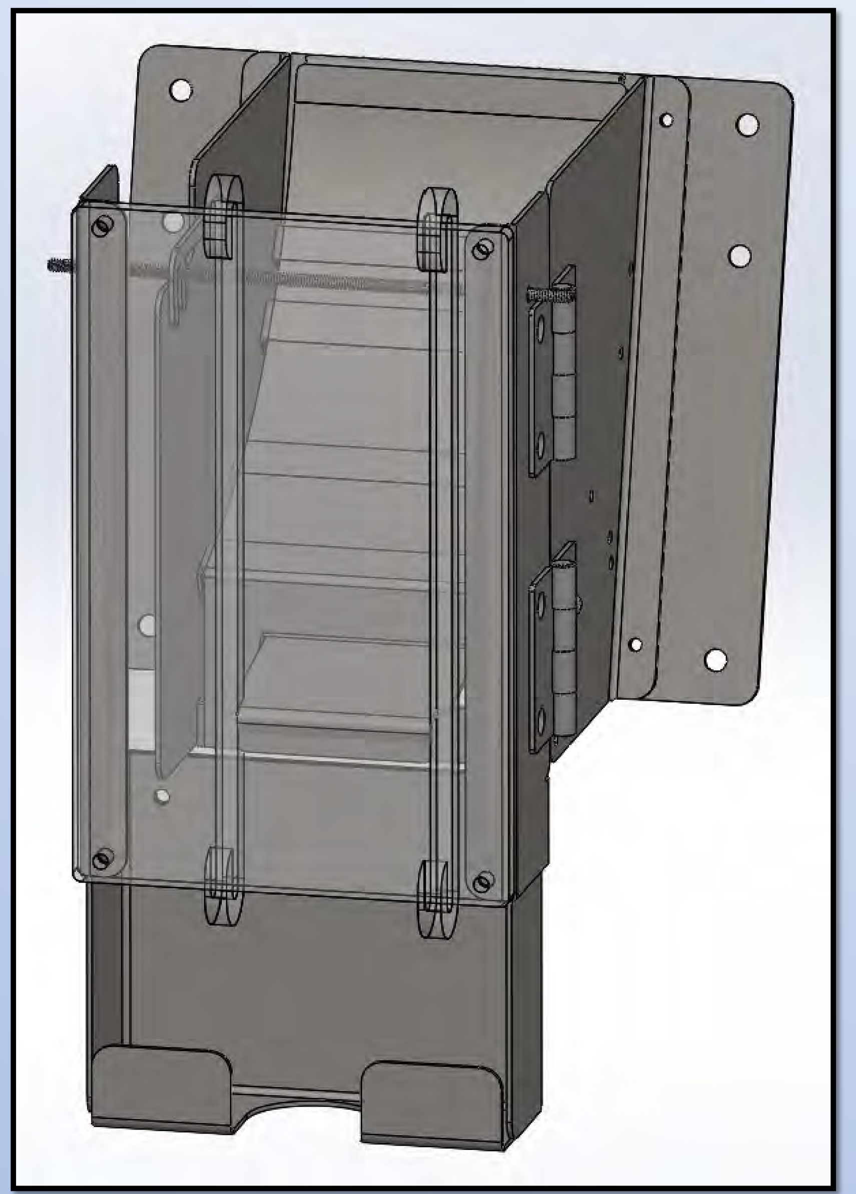

Fig. 2: Model of the chute system.

Chute System

This is a rendering of the new chute product we provided to Walker Tape. The design reduces jamming and incorporates full covering for the safety of the user. The body is made of steel with a clear polycarbonate front to be able to observe any issues that might arise. The hinges allow for easy access while still meeting OSHA standards.

Critical Metrics

Metric #	Metric	Imp.	Unit	Marginal	Ideal
1	Solutions work with each existing machine	2	binary	yes	yes
2	Built with standard order parts	1	binary	yes	yes
3	Increase production throughput	3	% contours	+5%/hr	+25%/hr
4	Contour stack can be extracted within time limit	3	seconds	< 5	< 3
5	Maintenance requires minimal tools	2	tools	1	0
6	Meets appropriate safety standards	3	binary	OSHA 1910. 212(a)(3)(ii), 1926.404(f)(7)(iv)(C)(2)	same
7	Contour stack size is within acceptable tolerance	3	contours	+/- 1	+/- 0

Bending Calculations for Sheet Metal Chute

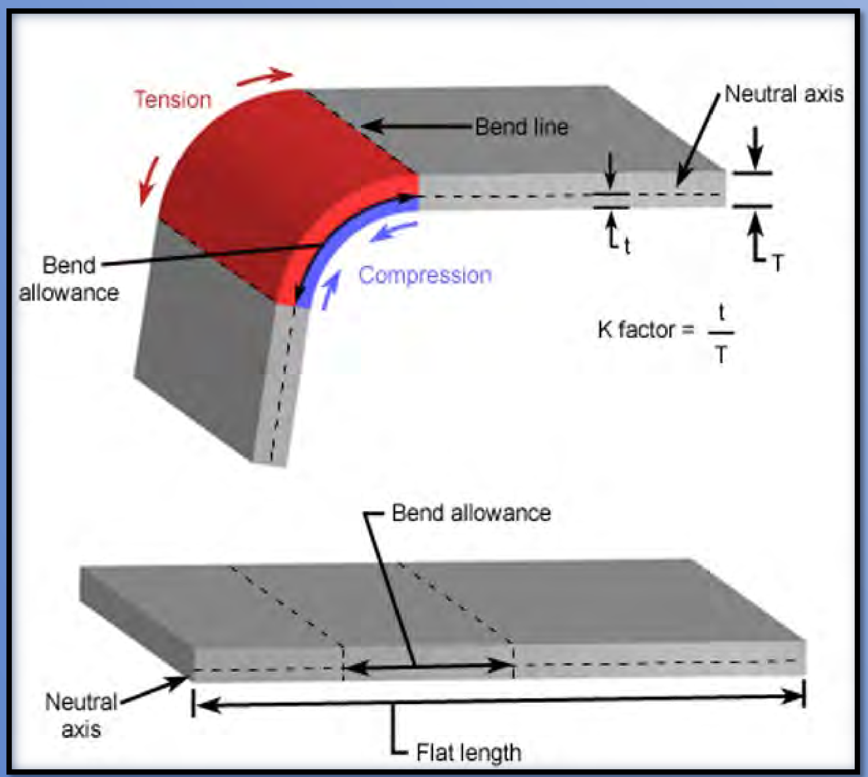

Fig. 1: Diagram showing equations used in bending metal.

$$K\ Factor = \frac{Bend\ Allowance}{Bend\ Angle \cdot Thickness} - \frac{Bend\ Radius}{Thickness}$$

$$l_1 = 3.25 - T - r_B \qquad l_1 = 3.112218254$$

$$l_2 = 0.52 - T - r_B \qquad l_2 = 0.3822182540$$

$$B_A = L - l_1 - l_2 \qquad B_A = 0.1755634918$$

$$K = \frac{B_A}{\frac{\pi}{2} \cdot T} - \frac{r_B}{T} \qquad K = 0.5664240715$$

$$Bend\ Radius = \frac{Chord}{2\sin\left(\frac{1}{2} Bend\ Angle\right)}$$

$$r_B = \frac{0.11}{\left(2\sin\left(\frac{1}{2}\left(\frac{\pi}{2}\right)\right)\right)} \qquad r_B = 0.07778174593$$

To create our project in a material that would be sufficiently durable we needed to run numerous calculations to determine what an acceptable bend and K factor would be for the steel we used.

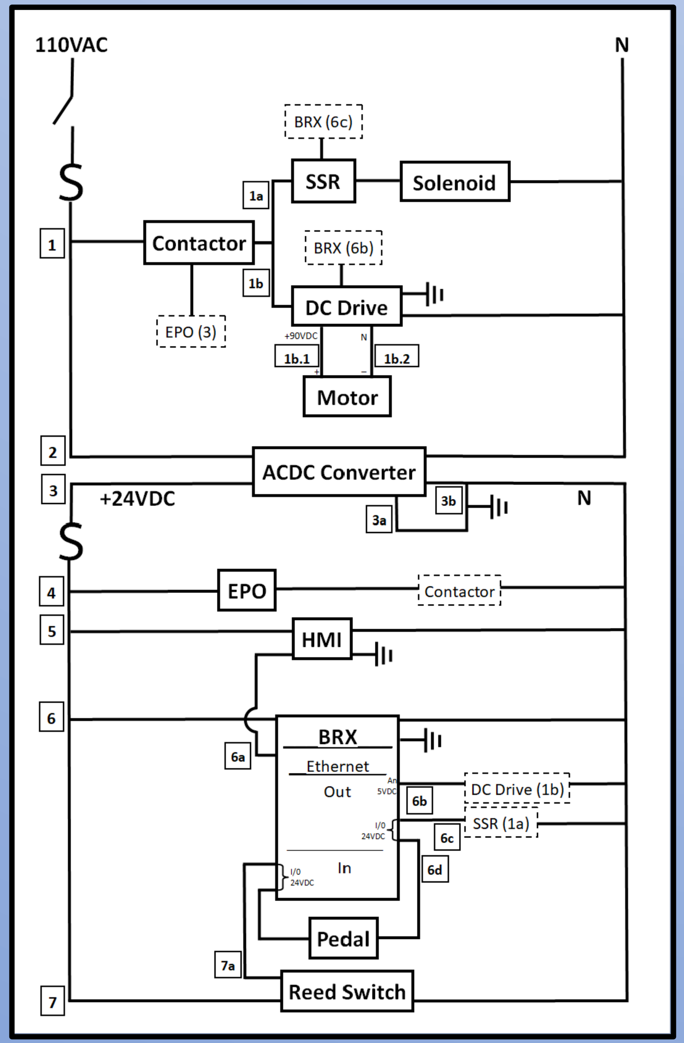

Fig. 3: Control system ladder diagram.

Wiring Schematic

We implemented a PLC controller and electronic sensor to count how many contours have been cut. Doing this also reduces the wear and tear of the machine and the noise in the working area from their mechanical counter. We set up this ladder diagram to ensure we are directing currents and voltages where needed. This allowed us to by the proper parts for the PLC.

PLC CAD Drawing

We set up a CAD drawing of all the physical components needed for our PLC to work. We implemented two different voltages across the top two rails. The top rail is 120 V, and the second rail is 24 V. We color coded each block according to voltage.

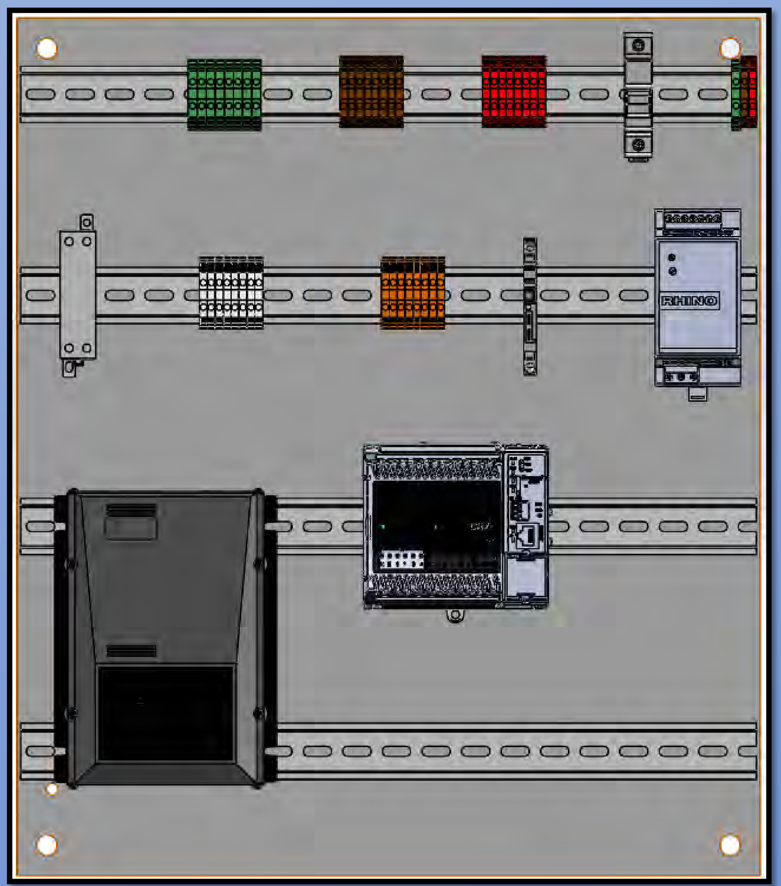

Fig. 4: Model of the controls system.

Fuse Sizing for PLC Cabinet

$$I_{24VDC} = 1.2(1A + 6.5A) = 9A \ \rightarrow 10A\ DC\ fuse$$

$$I_{110VAC} = 1.2\left(1.2A + 10.8A + \left(9A * \frac{24V}{110V}\right)\right) = 16.8A \ \rightarrow 20A\ AC\ motor\ rated\ fuse$$

Conclusion

We were able to create a product that meets the metrics and goals we had from Walker Tape. Our product is made in a way that they will be able to easily recreate and implement the product into each of their other machines.

Future Work

Going forward Walker Tape would like to continue upgrading other aspects of their machines. Increasing usability for the operators, making each machine uniform, and increasing the efficiency of die changes are opportunities for future work.