ME 1.05 – Chip Handling System

TEXAS STATE UNIVERSITY
Ingram School of Engineering

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Problem Statement

Our team's goal is to design a chip-handling system for a Haas VF-2 CNC milling machine that ensures complete removal of chips, minimizes cross-contamination for proper recycling, and avoids interfering with machine operation.

Discharge Chute

Auger System

Primary Stakeholders

- Ingram Hall Makerspace
- CNC Machine Operators (students + industry)
- Machine Shop Technicians
- Manufacturing / Production Facilities
- Maintenance Personnel
- Recycling / Waste Handling Personnel

Markets & Competitors

- Existing systems prioritize durability and continuous chip removal
- Performance is strong, but often comes with higher cost and complexity of moving parts
- Many designs struggle with chip variability and clogging issues
- Opportunity exists for a simpler, more adaptable solution that maintains performance

Hennig

Jorgensen

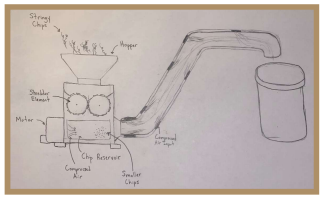
Concept Generation

Critical Sub Problems:

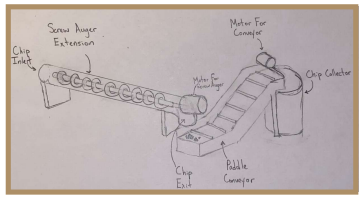
Chip/Coolant Transfer (CNC Machine → Chute): The design of how material will be transferred out of the CNC machine and into our chip handling system.
Accessibility: The design for accessibility of components in the chute to ensure the system is easy to clean, maintain, and fits within the provided clearances.
Primary Transport Method: The design of the primary transport method to ensure that all chips reach the collection bin and the system is reliable.
Electrical/Feedback System: The design of the electrical system ensures usability by giving the user feedback information and control.

We used the critical subproblems to search externally for existing solutions and generated individual concepts for each critical subproblem. 20 full concepts were created by the team and were taken into consideration when moving into concept selection.

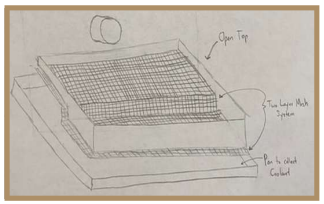
Top Concepts Selected



Chip Shredder with Compressed Air Removal



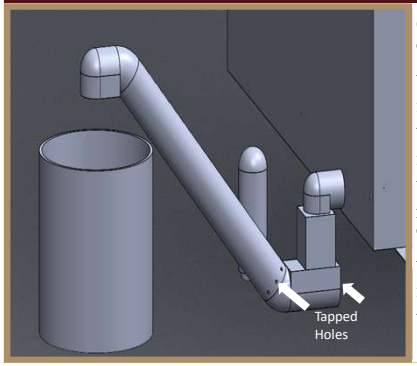
Paddle Conveyer with Auger Extension



Open Top Screen Pan to Collect Chips

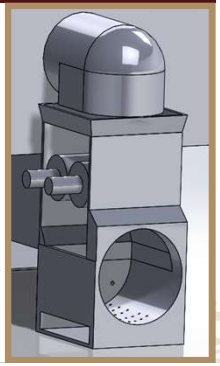
The top concepts were selected based on their ability to effectively address chip transport, coolant separation, and overall system simplicity. Each concept represents a different approach, ranging from mechanical conveyance to passive separation and air-assisted removal. Together, these concepts highlight key strengths that were carried forward and combined into the final design to improve performance and reduce system limitations.

Final Concept



Chip Shredder with Compressed Air

The final concept combines air-assisted transporting with a shredding mechanism to improve overall system performance. First, the shredder breaks down long, stringy chips into smaller pieces. Then, compressed air is used to move chips through the system, reducing buildup and minimizing clogging. The system will draw its power from the AC wall outlet next to the CNC machine. We will install a current sensor on the electric motor to detect current spikes when the motor jams.



Customer Needs

Our team developed 48 secondary needs based on the primary needs listed below.

Primary Needs	Imp.
The system is safe	5
The system is durable	4
The system is ergonomic	3
The system performs chip handling effectively	5
The system prevents cross-contamination	5
The system operates efficiently	4
The system includes useful automated features	3
The system is economically viable	4

Target Specifications

Metric	Imp.	Units	Marginal Value	Ideal Value
Complies with safety standards	5	Binary	Yes	Yes
System reliability (uptime)	5	%	~80	>90
Installation/removal time	4	min	~45	>30
Compatibility with standard bins	5	Binary	Yes	Yes
Chip removal efficiency	5	%	~80	>90
Cross-contamination level	5	%	~30	<20
Design simplicity (part count)	4	#	>30	~2
Operator involvement (steps)	5	#	~2	<2
System cost	4	$	2-5k	~2000

Key Benefits

- Prevents cross-contamination between materials
- Enables on-demand chip transport using air
- Reduces clogging through chip size reduction
- Allows flexible routing (bends, distance)
- Reduces manual cleaning and operator workload
- Automatically detects clogs in the system
- Auto on/off