Needs of Design Criteria

Number	Needs	Design Criteria
1	The system will not be clogged with dust or other.	Monitor dust in the silos and in line. Add programming to PLC to alert when there is large amounts of dust in the system.
2	The system is able to easily clear out dust.	Notifies the worker ahead of time while keeping out extra dust from flowing in.
3	The system needs to be able to stop the process safely.	Emergency button, when the button is pressed, all machinery stops working.
4	The user can operate the system with ease.	Smart system or simple disassembly and installation.
5	The system is easily maintained.	able to be extracted from soil/ filter easily by being attachable (the idea can be changed)
6	The system is cost effective.	Create various compact tools that connect to each other using programming

Design requirements:

	Design specifications				
	Function requirements	**Relation (=, < or >)**	**value**	**units**	**Verification method**
1	The sensor can measure up to the exact amount of dust to be disposed of	=	100	kg	Test
2	Sensor can be small enough to fit in or around the silos/ filters /	< or =<=	20000	cm^3	Get measurements of the silo/pipes/cleaning pump
3	sensor can scan up to 3000 kg of malt per min	> or =<=	3000 kg/min	kg/min	test
4	Concerns the safety of the workers cleaning the dust.	=	yes	N/A	test
5	Can alert the dust pump to lower the frequency of the pumps	<	3000 kg/min	kg/min	test
6	Connection between the sensor and stopper will always be working	=	yes	N/A	test
7	Stopper Will stop any amount of dust(say up to 200kg)	<	200	kg	test

8	Easily deployable within mins	<	10	mins	test
	Non-Functional				
1	keep malt dust humid enough to not become fragile	<=	60%	%	test
2	Can organize more than one bag full	>	1	bags	test and confirm if it can fill more than one bag efficiently
	Constraints				
1	Type of material/durability of material	=	N/A	N/A	Refer to the specs
2	Cost effective	<=	CAD	150 CAD	Should be less than the allocated budget

1. Prioritized Design Criteria for a Dust Cleaner for a Brewery:

Functionality: The dust cleaner must effectively remove dust and debris from the brewery.
Efficiency: The dust cleaner must be efficient in terms of cleaning time and energy consumption.
Safety: The dust cleaner must not pose any safety hazards to the brewery workers or equipment.
Maintenance: The dust cleaner must be easy to maintain and have low maintenance costs.
Durability: The dust cleaner must be durable and able to withstand the harsh brewery environment.
Noise level: The dust cleaner must operate at a low noise level to minimize disruption to brewery operations.
Size: The dust cleaner must be compact in size and easy to maneuver within the brewery.
Cost: The dust cleaner must be cost-effective and provide value for money.

Metrics:

Dust removal efficiency: Measured as the percentage of dust removed from the brewery after cleaning.
Cleaning time: Measured in minutes required to clean a specific area.
Energy consumption: Measured in kilowatt-hours per cleaning cycle.
Safety incidents: Measured as the number of incidents reported during cleaning operations.
Maintenance costs: Measured in dollars per cleaning cycle.
Durability: Measured in terms of the number of cleaning cycles before replacement or repair is necessary.
Noise level: Measured in decibels during operation.
Cost-effectiveness: Measured in terms of the cost per cleaning cycle compared to alternative solutions.

Target specifications:

Dust removal efficiency: 95% or higher.
Cleaning time: 10 minutes or less per 100 sq. ft.
Energy consumption: 2 kilowatt-hours or less per cleaning cycle.
Safety incidents: 0 incidents reported during cleaning operations.
Maintenance costs: $50 or less per cleaning cycle.
Durability: 10,000 cleaning cycles or more before replacement or repair is necessary.
Noise level: 60 decibels or less during operation.
Cost-effectiveness: $0.10 or less per sq. ft. cleaned.

Reflection: The client meeting has confirmed the importance of safety, efficiency, and cost-effectiveness in the dust cleaner design. These requirements have been given the highest priority in the design criteria and target

specifications. The updated need for durability has also been added based on the client's request for a long-lasting solution.
The following information can be gathered from the technical benchmarking:

2. **Product features:** Understanding the key features of existing products, such as dust removal efficiency, cleaning time, energy consumption, safety, and maintenance requirements.
Performance data: Analyzing performance data such as dust removal efficiency, cleaning time, energy consumption, and maintenance costs.
User perceptions: Gathering information about user perceptions of the existing products, such as ease of use, durability, noise level, and overall satisfaction.
Price comparison: Comparing the prices of existing products and determining the cost-effectiveness of each solution.

The information gathered from the technical benchmarking can be used to refine the target specifications and design criteria for the dust cleaner. For example, if the research shows that current products in the market have a dust removal efficiency of 97%, this can be used to set the target specification for the dust cleaner.

User benchmarking involves gathering information about user perceptions and experiences with similar products. This can be done through surveys, focus groups, and online reviews. The information gathered from user benchmarking can be used to refine the design criteria and target specifications based on user feedback and preferences. For example, if user feedback shows that noise level is a major concern, this can be reflected in the target specifications and design criteria by setting a lower noise level target.

3. The following are some of the target specifications for the dust cleaner:
Dust removal efficiency: A minimum dust removal efficiency of 95% is desired to ensure that the dust cleaner effectively removes dust from the brewery.
Cleaning time: The cleaning time should not exceed 30 minutes to minimize downtime and ensure that the brewery can operate efficiently.
Weight: The weight of the dust cleaner should not exceed 20 kilograms to ensure ease of handling and mobility.
Dimensions: The dimensions of the dust cleaner should be within the range of 600mm x 800mm x 1000mm to ensure that it can fit within the brewery's existing infrastructure.
Ease of use: The dust cleaner should be easy to use and require minimal training to ensure that employees can operate it efficiently. A target of 15 minutes is set for the time needed for a user to become familiar with the product.
Energy consumption: The dust cleaner should consume minimal energy to reduce operating costs and environmental impact. A maximum energy consumption of 800 watts is desired.
Noise level: The noise level of the dust cleaner should not exceed 75 decibels to ensure a safe and comfortable working environment for employees.

These target specifications will provide measurable design goals that can be used to evaluate potential solution ideas and ensure that the final solution meets the design criteria and user needs. The same list of metrics must be used in each step of the deliverable (prioritized list, benchmarking, and target specifications) to ensure consistency and comparability of results.

Benchmarking Similar Products:

Products to consider: Dust sensors (along the silos), **cleaning device** (density sensor), **water sprinkler suppression system**, Central Dust Collection Systems, Local Dust Collection Systems, Portable Dust Collectors, Industrial Vacuum Cleaners, Dust Extractors, **Industrial liquid stoppers**

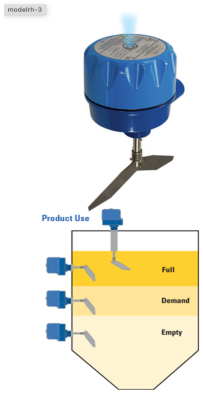
Dust sensors:

https://lcdmcorp.com/distribution/silo-level-sensors/

https://blueleveltechnologies.com/

Blue Level Technology:

The bin level sensor uses rotary paddles, turned by a small synchronous motor, to monitor the bin level. The paddles are attached to the shaft, which extends inside the bin. When there is little to no dust/malt, the paddle will turn freely in the air as an indication. When the material piles up, its weight will prevent the paddles from turning, alerting the system to close off further access to the container. Different levels of sensor can also be triggered to ensure better maintenance.



MODEL RH/RHX

Our industry standard workhorse level detection sensor for powders and bulk solids – reliable, low maintenance, high value and high reliability.

LEARN MORE

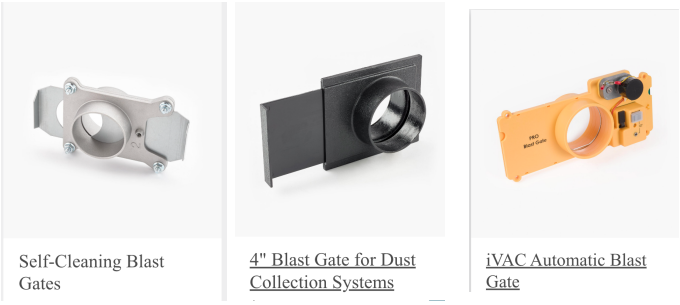
Stoppers:

https://www.leevalley.com/en-us/search#q=blast%20gate&t=product-search-tab&sort=relevance layout=card&numberOfResults=25

Blast Gates:

For use with the iVAC Pro dust collection control system, this 4" blast gate synchronizes with the dust collector and power tools in the network. This automation ensures you can't forget to open a gate before working or inadvertently leave it open afterward, reducing suction elsewhere in the system.

The system can be set to ensure that at least one gate is open whenever the vacuum is running to prevent overloading the motor. Up to eight blast gates can operate on one iVAC Pro network. The gate can also be operated using the iVAC Pro remote control or manually using a toggle switch.



Self-Cleaning Blast Gates

4" Blast Gate for Dust Collection Systems

iVAC Automatic Blast Gate

Water Suppression Systems:

https://www.jdultrasonics.co.uk/products/spray-nozzles/sonicom-ultrasonic-nozzles/

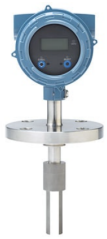
https://www.agg-net.com/resources/articles/health-safety/a-practical-guide-to-dust-suppression

Mitigating dust from its source by spraying water mixed with dust perversion agents. As the dust absorbs the agent it readily turns into bulk material that can be disposed of easily. With the dust particles unable to be airborne it prevents hazards like military explosions, safer and cleaner environment for manual cleaning workers. Different types of water suppression systems include: Dry fog-suppression, Sprinklers, Wet suppression

Density Meter:

https://www.lakesidecontrols.com/products/measurement-instrumentation/density-viscosity/micro-motion-fdm-fork-density-meter/

The Insertion Liquid Density Meter based on the principle of density increases, the frequency decreases; as the density decreases, the frequency increases. The direct insertion fork densitometer is installed inside the cleaning system, during the cleaning process, the dust dropped by the wheat will be mixed with water. The densitometer will continuously check the density of the mixture and alert the staff to clean the dust when a certain density of the mixture is reached.



Dimensions for similar products:

Product	Weight	Time to operate	Dimension	Efficiency	Made from
Bluelevel	N/A	24/7 connected to electricity	N/A	Low Level ≥ 5lbs/ft³, High Level ≥ 10lbs/ft³	Die-cast aluminum
iVAC Pro dust collection	N/A	24/7 connected to electricity	4"	Self maintained	Steel and cast aluminum
Fog suppression	495 gms	24/7 connected to electricity	N/A	5 bar air and 1 bar water	316 stainless steel
Density Meter	N/A	24/7 connected to electricity	0.5m-2m	0-3000 kg/m3	316L stainless steel, Alloy C22, Titanium, or Zirconium

Reflect:

The client meeting had a significant impact on the development of the design criteria and specifications for the dust cleaner for the brewery. The meeting allowed the team to gather additional information about the user needs and constraints, which helped to refine the list of design criteria and specifications.

During the meeting, the team learned that the client places a high priority on the efficiency of the dust cleaner, as well as its ease of use. The client also highlighted the need for the dust cleaner to be energy-efficient and have a low noise level, as these are important factors in creating a safe and comfortable working environment for employees.

Based on these insights, the team adjusted the relative importance of the design criteria and updated the needs that have changed from Deliverable B. For example, the efficiency of the dust cleaner was given a higher priority, and the target specifications for energy consumption and noise level were refined to better reflect the client's requirements.

In conclusion, the client meeting provided valuable information that allowed the team to develop a more accurate and comprehensive list of design criteria and specifications. The team used this information to prioritize the design criteria, perform technical benchmarking, and determine target specifications that will aid in the development of the final solution.