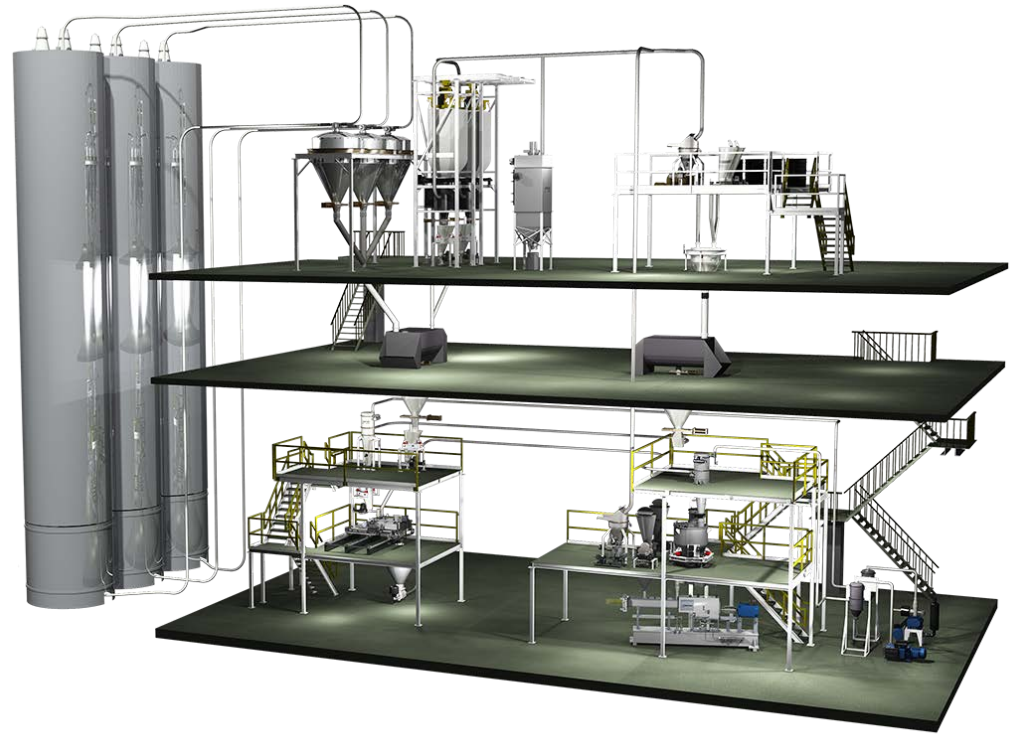


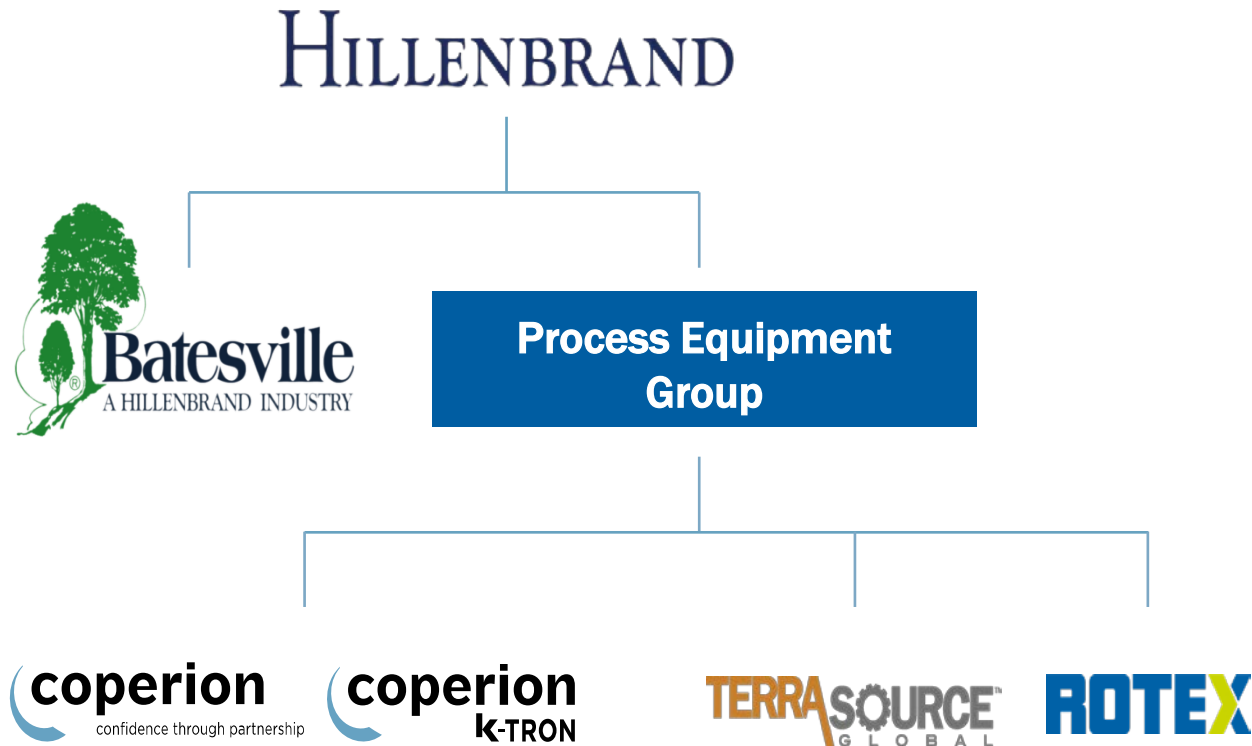
Taking the Next Step:

What are the Process Solutions Available for Improving and Automating your Tortilla Manufacturing Process??

Sharon Nowak
Stuart Wilson
Coperion K-Tron



Who is Coperion K-Tron?



What are the Products?

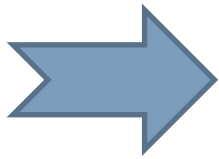
- Volumetric and gravimetric feeding equipment
 - Pneumatic conveying and material handling systems and components
 - Electronic design and assembly manufacturing
 - Integrated systems with Coperion brand of twin screw extrusion
-
- Coperion K-Tron is a **wholly owned subsidiary of Hillenbrand Industries Inc.**, with headquarters in Pitman, NJ, USA



What are the current Global Food Industry Trends?

Food manufacturers are looking for ways to:

- Boost Production rates
- Simplify Clean Up and Sanitation
- Reduce Changeover time between runs
- Minimize the number of line workers required
- Increase the ability to process a variety of product types and sizes



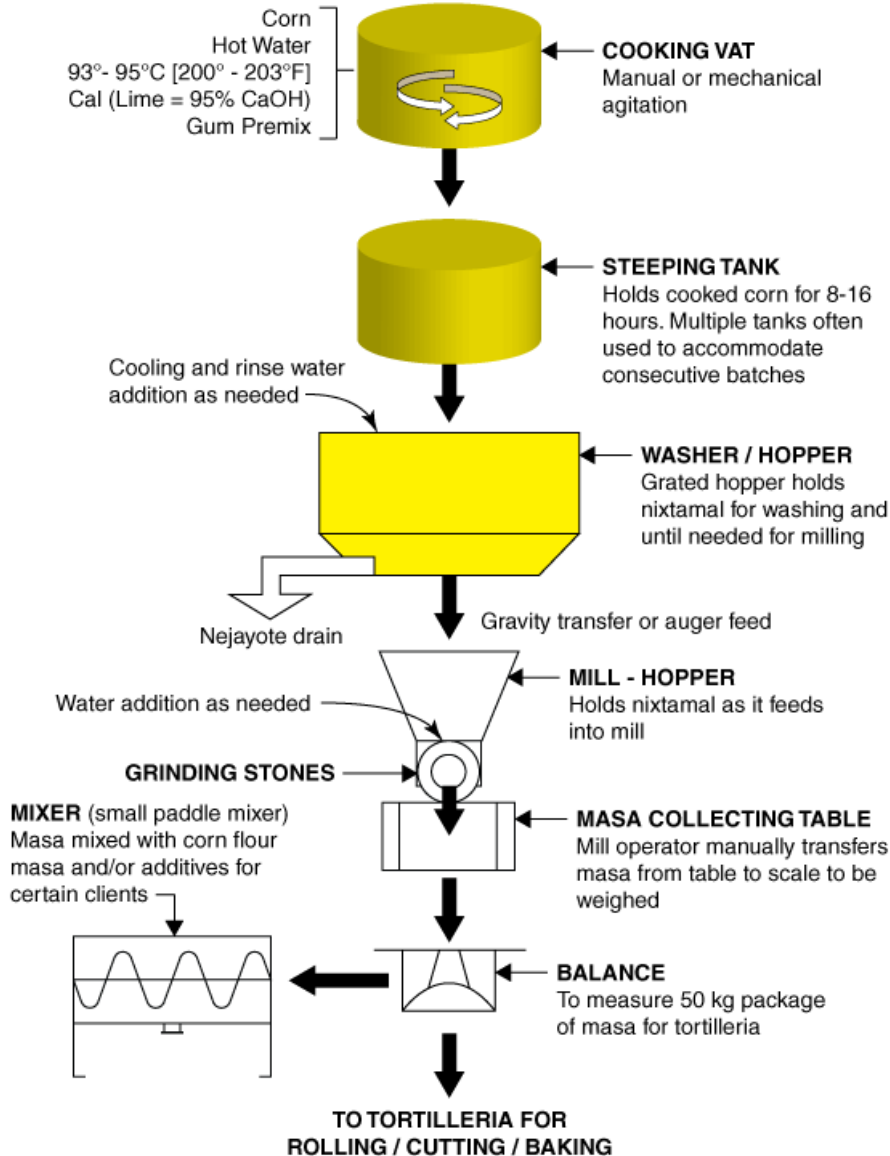
**Automated Material Handling
Systems**

Automated Material Handling Processes: Batch Processing vs Continuous Processing

Relative Benefits

	BATCH	CONTINUOUS
Initial Capital Equipment Cost	Low	High
Production Yield	Low	High
Shut-down times	Often	Rare
Labor Costs	High	Low
Equipment Footprint	Large	Small
Energy Consumption	High	Low
Ease of change	Easy	Difficult

Traditional Corn Flour Nixtamalization Process



- Ingredients transferred to cooking vats, tempering bin, grinding mill and mixers
- Lime is added before cooking process
- Additives and vitamin fortification are added to flour blend manually
- Finished corn flour blend is weighed for packaging or loaded for trucks

Typical Obstacles in a **Manual** Corn Flour Tortilla Production Process

- Transfer of raw ingredients and final blends
 - ✓ Labor intensive
 - ✓ High costs associated with lost product during manual transfer
 - ✓ Manual transfer (e.g. drum dumping, sack tipping, etc.) can also be dusty with “housekeeping” issues
- Inaccurate weighing and addition of ingredients to the blend results in high cost and poor product quality
 - ✓ Fortifiers- e.g. vitamin A, riboflavin, niacin- can be costly if not added in correct amounts
 - ✓ Lime addition not metered properly – affects quality

What are the Options Available for an Automated Process?

➤ Pneumatic Transfer

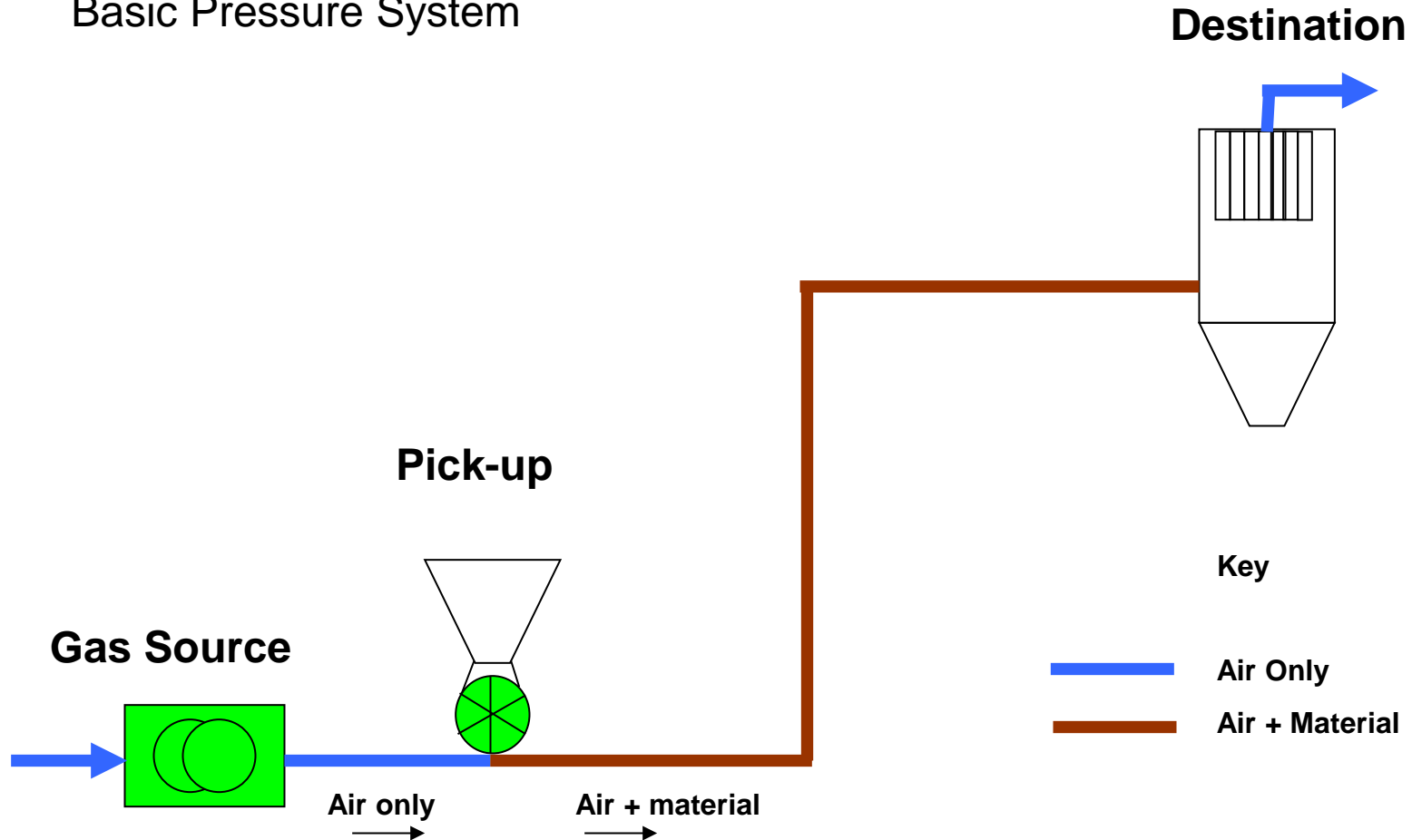
- Conveying (pressure and vacuum) flour from trucks, railcars to storage silos
- Conveying macro ingredients of flour blends to mixers
- Multiple flour recipe conveying and versatility – e.g. 100% white corn, 100% yellow corn or blend of both can be done through control system and pneumatic handling/diverter system

➤ Automated Feeding

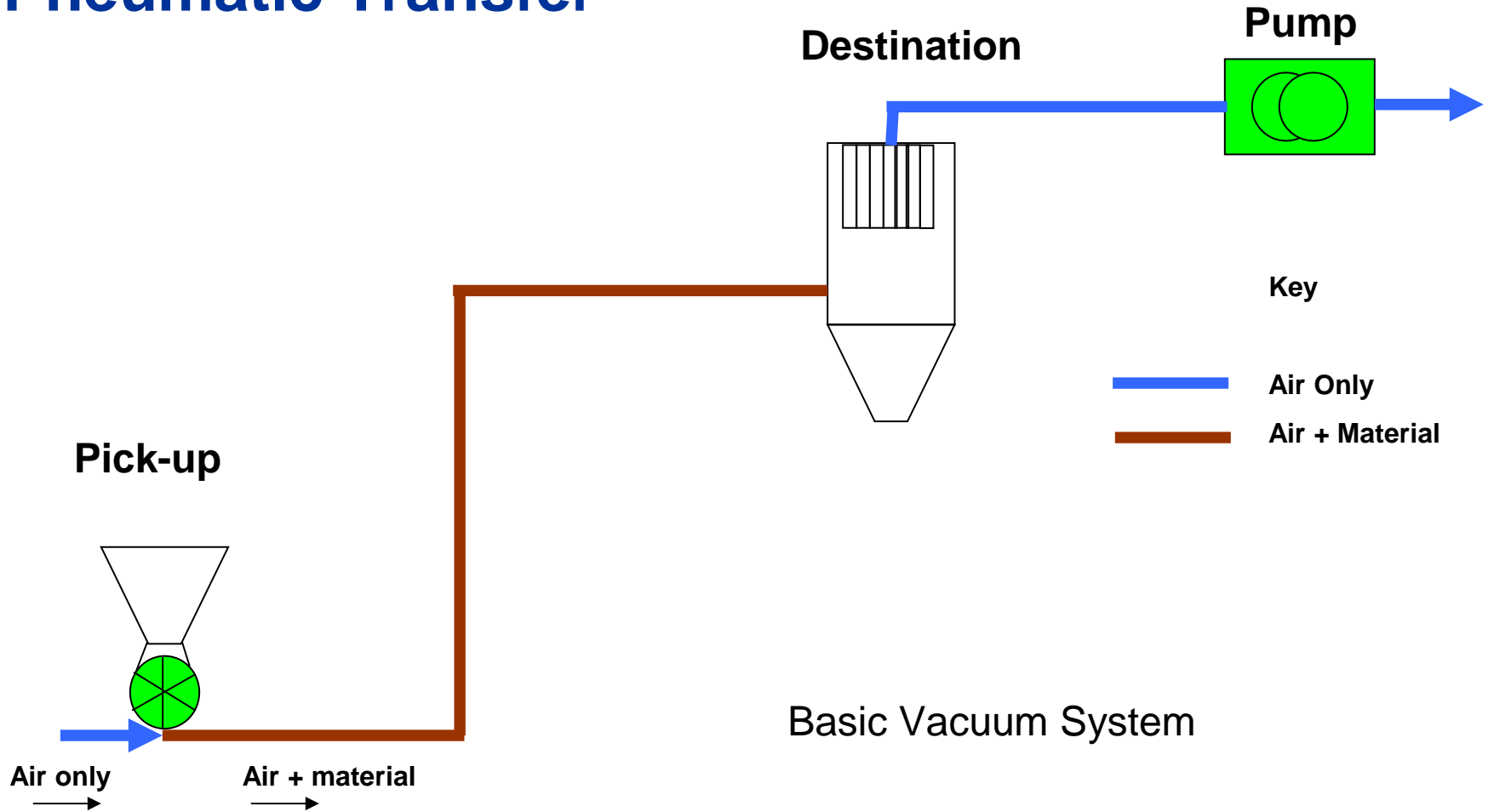
- Feeding of lime for nixtamalization process
- Feeding of vitamin fortifiers to the tortilla flour mix
- Batch weighing of ingredients via loss-in-weight or gain-in-weight feeding/scaling to mixing process

Pneumatic Transfer

Basic Pressure System



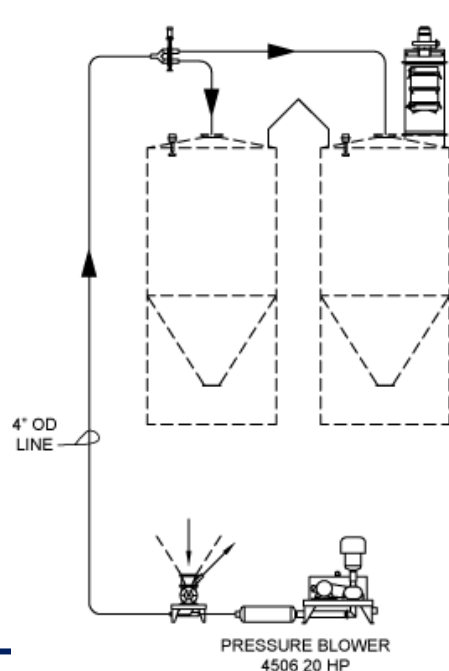
Pneumatic Transfer



Vacuum vs. Pressure?

➤ Pressure Advantages

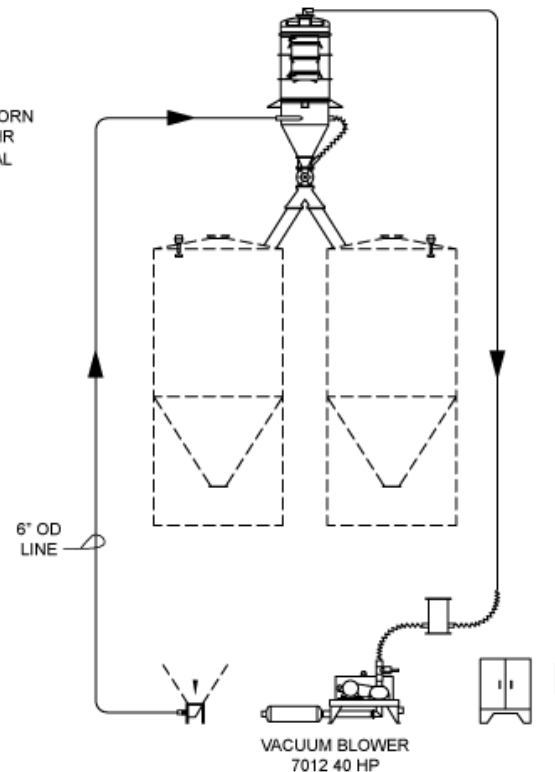
- Better rate and performance
- Much easier for multiple destinations
- Smaller separator



MATERIAL: WHOLE CORN
RATE: 30,000 LBS/HR
150 FT HORIZONTAL
60 FT VERTICLE
(4) - 90 ELBOWS

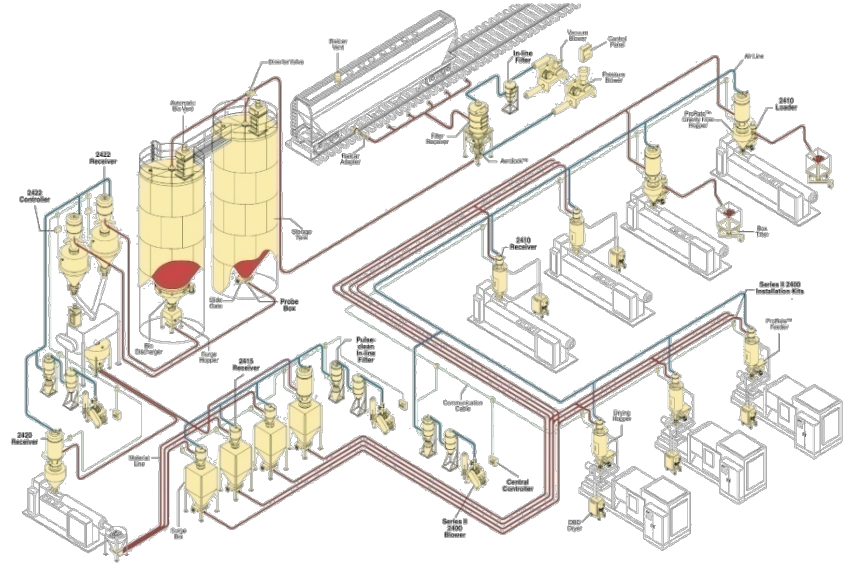
➤ Vacuum Advantages

- Much easier (and smaller) at pick-up
- Less dusting
- Avoid temperature problems



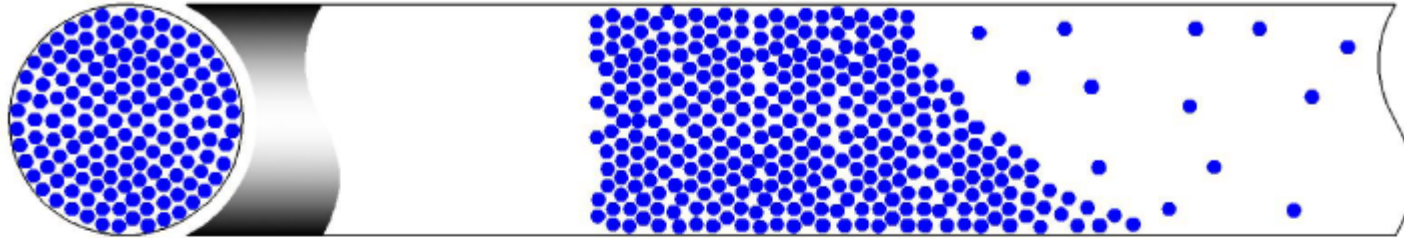
Pneumatic Transfer Options

- Continuous Vacuum Systems
- Continuous Pressure Systems
- Vacuum/Pressure Systems
- Weighing and Scaling Systems
- Closed-Loop Systems
- Vacuum Sequencing Systems

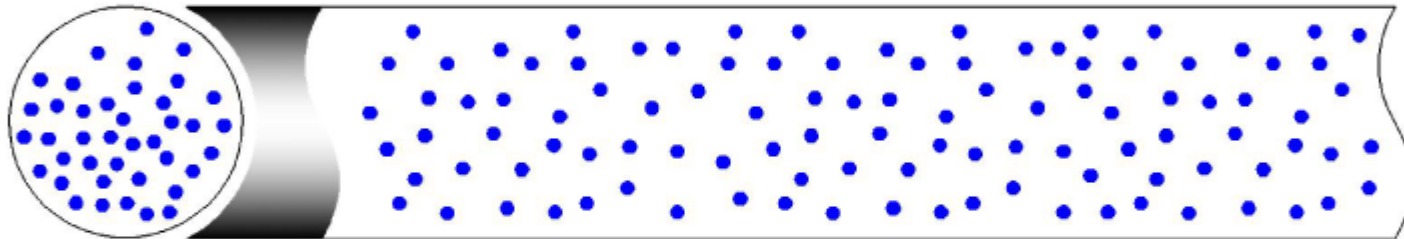


Whole corn loading of silos for corn flour

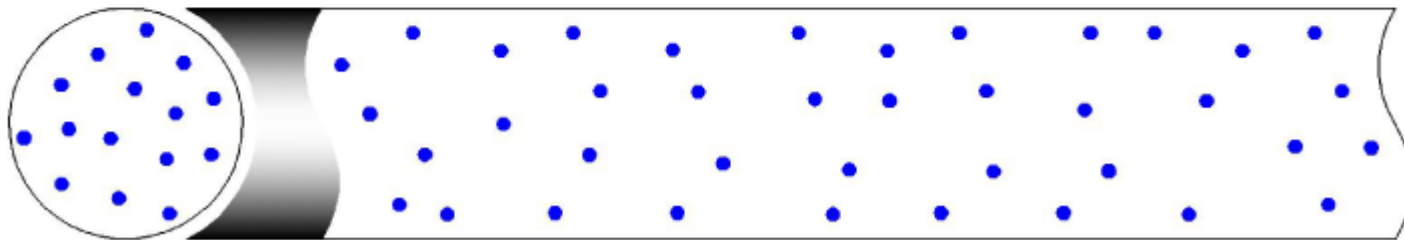
Pneumatic Conveying –Dense and Dilute Phase



Dense Phase Flow (slugs)



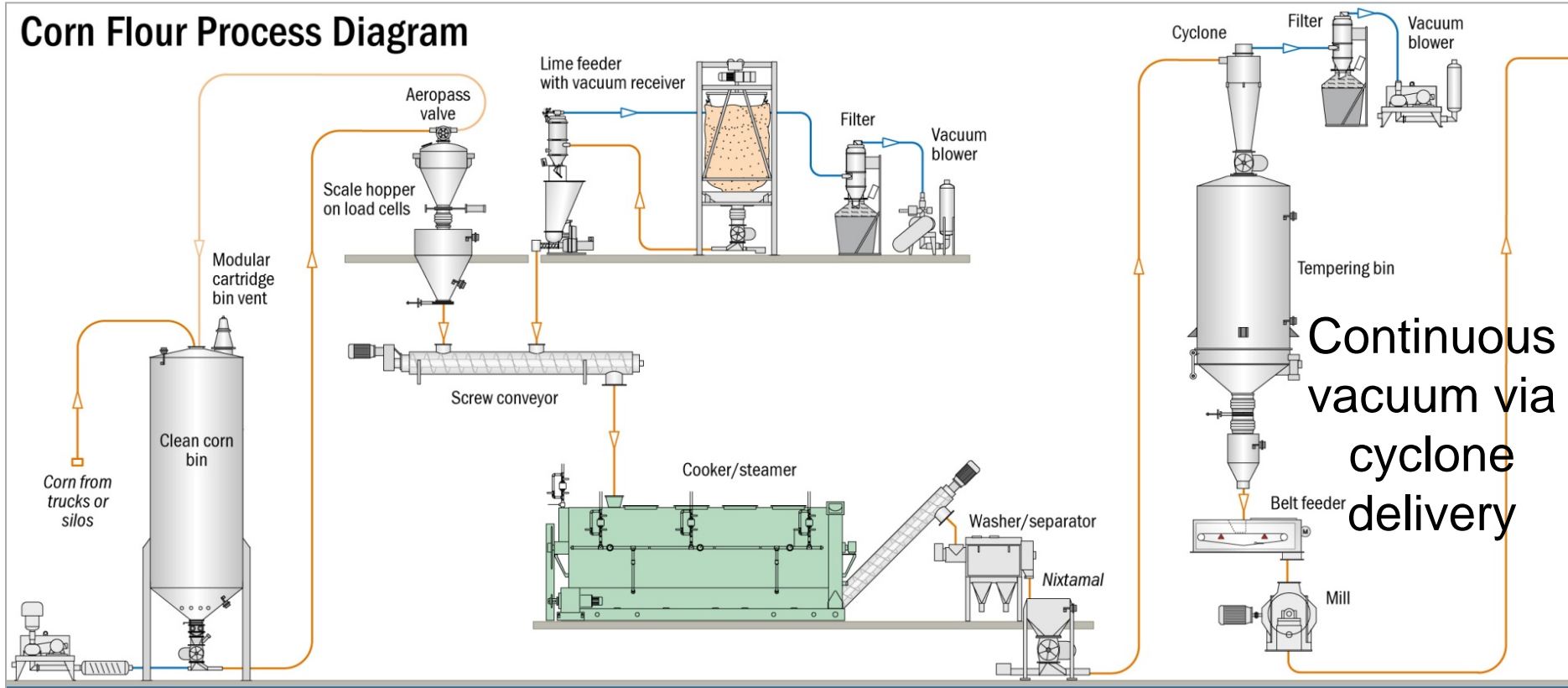
Dilute Phase Normal Material Loading



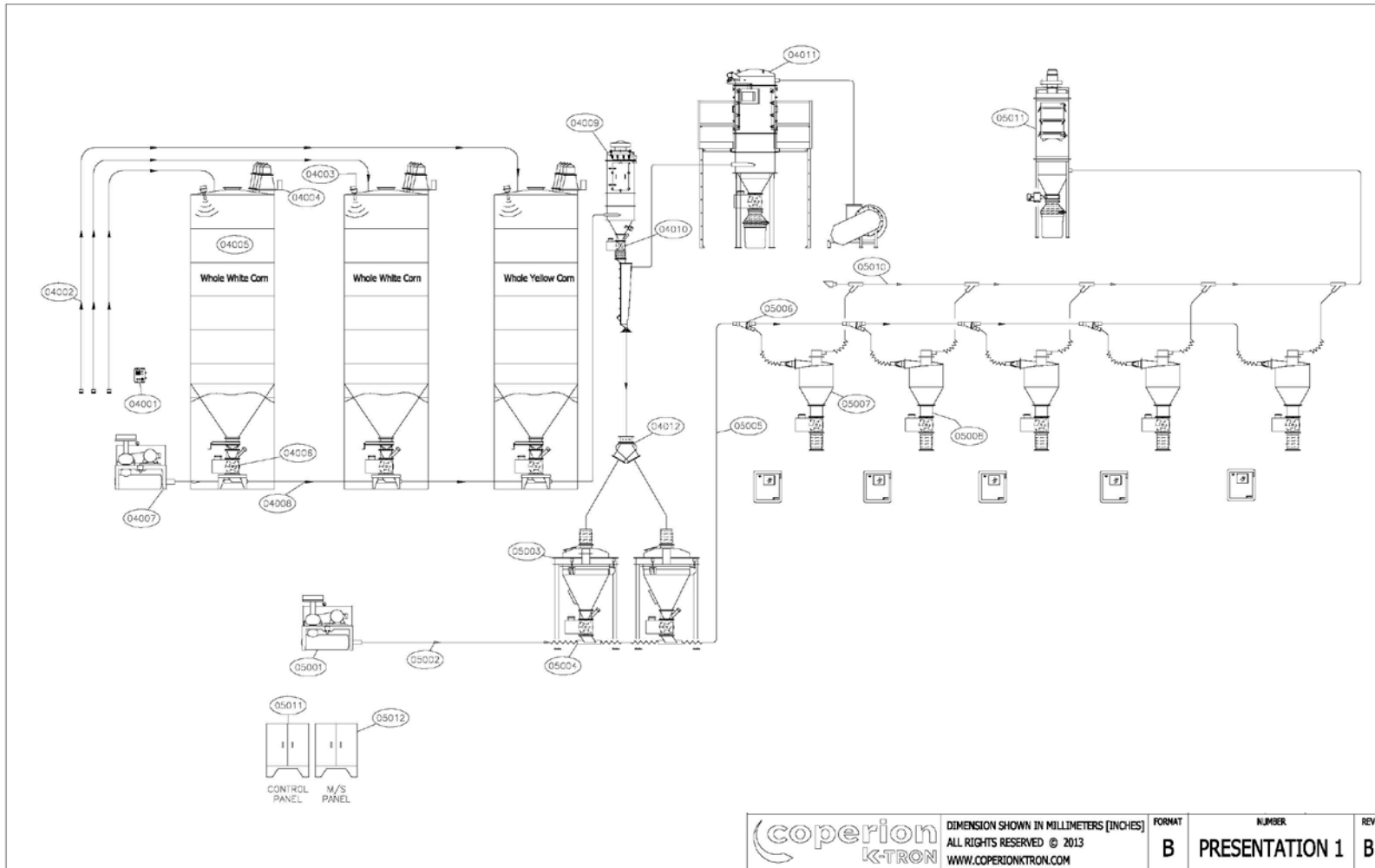
Dilute Phase Low Material Loading

Conveying Example: Unload and Delivery of Corn to Cookers and Mill

Corn Flour Process Diagram



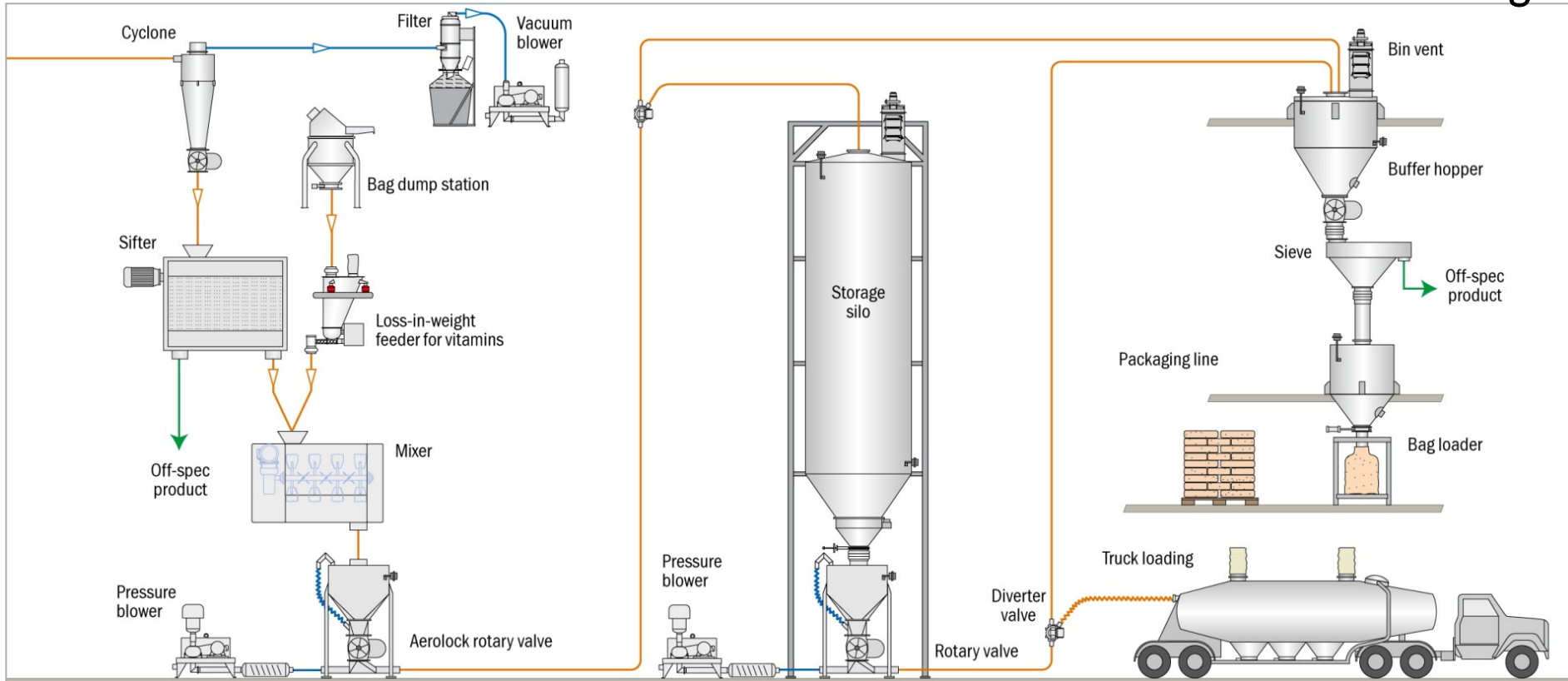
Pressure conveying whole corn



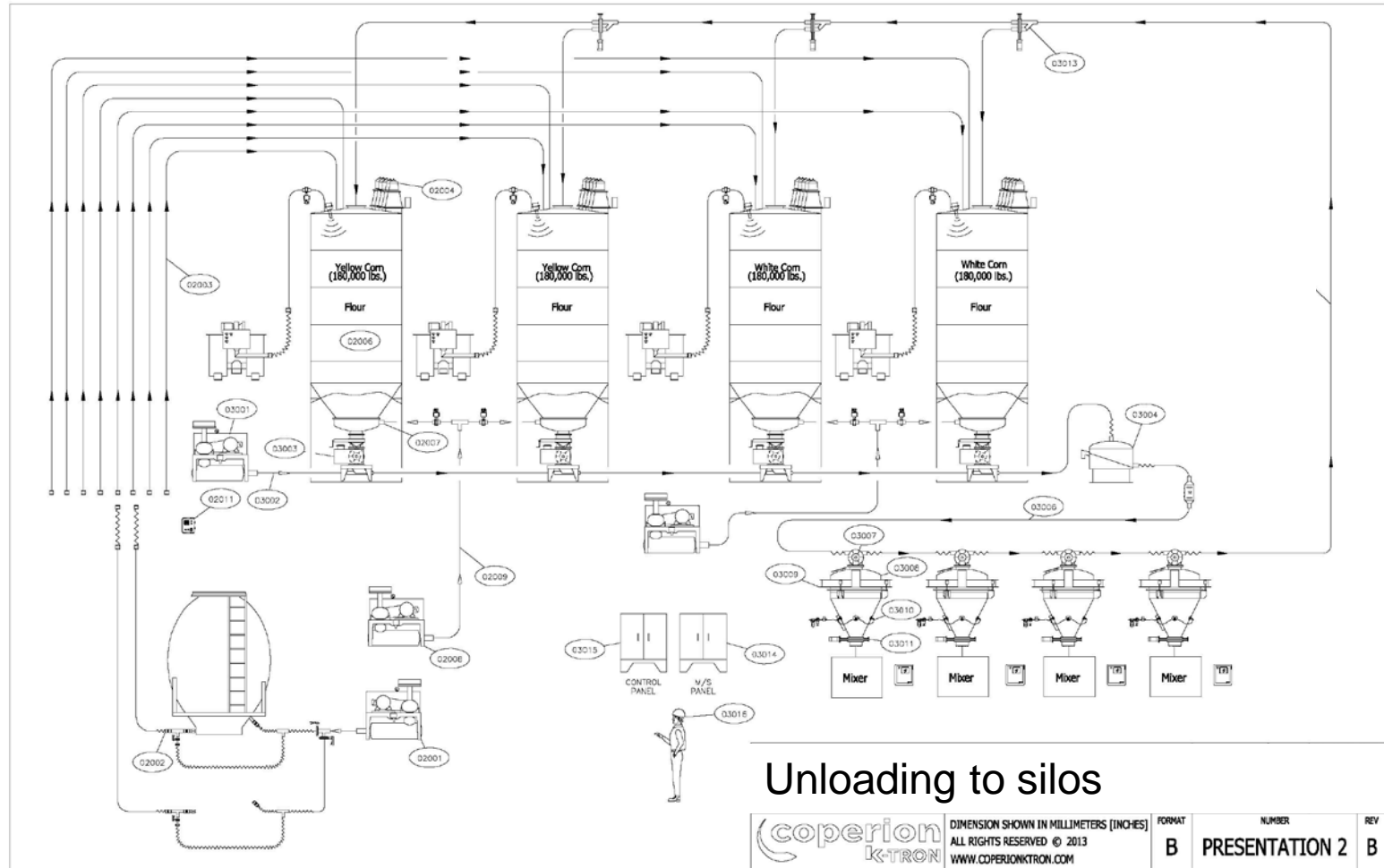
Conveying Example: Typical Corn Flour Production Line

Mixing blends to final product delivery

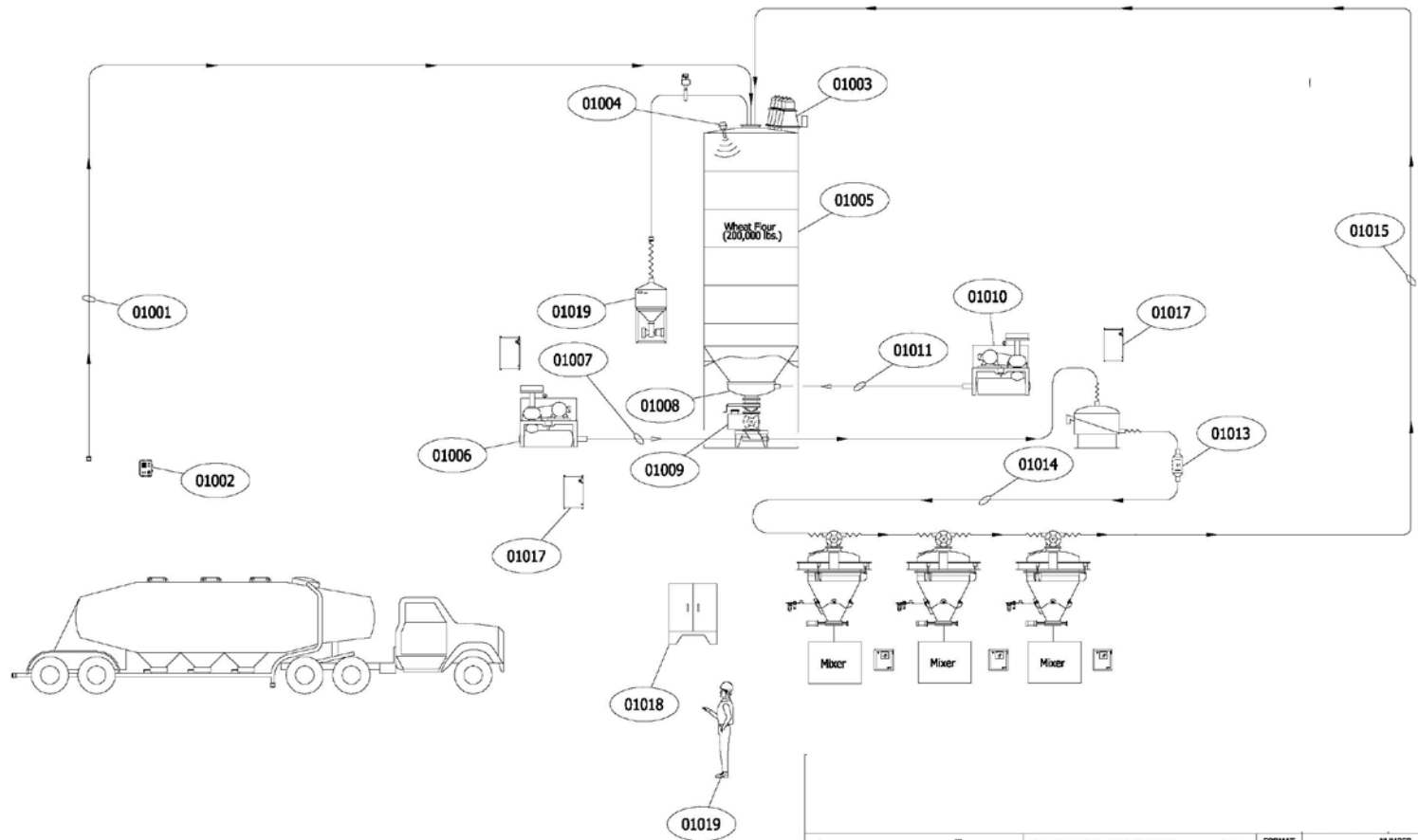
Conveying direct from silo for truck loading



Conveying Yellow and White Corn Flours via Pressure and PD Rail Unload



Conveying Wheat Flour, GIW Batching to Mixers



coperion
K-TRON

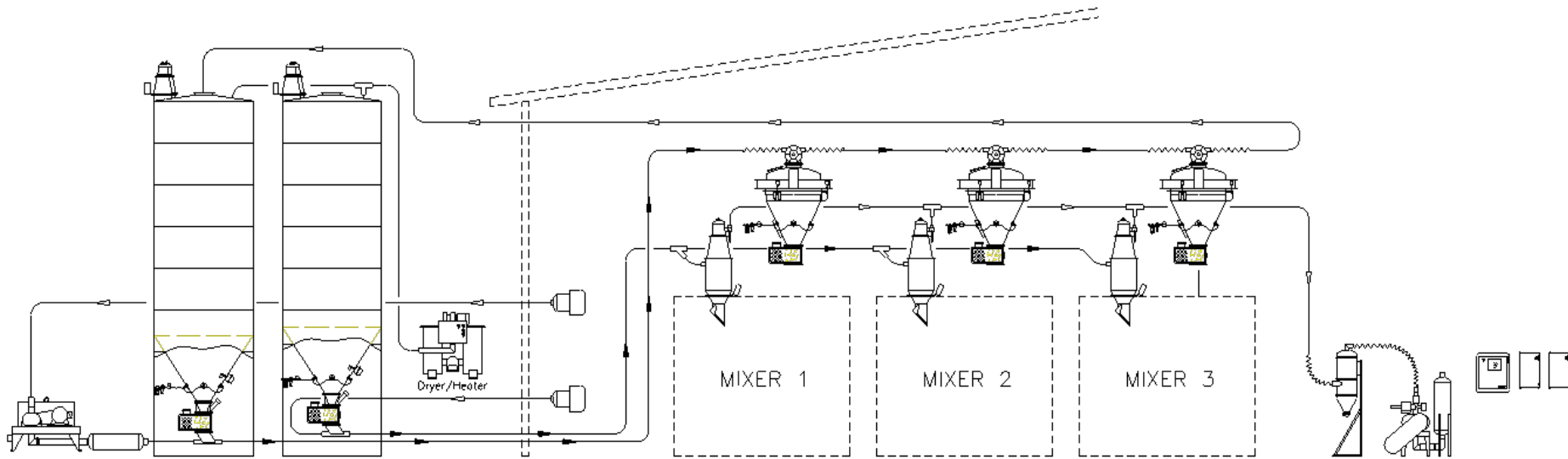
DIMENSION SHOWN IN MILLIMETERS [INCHES]
ALL RIGHTS RESERVED © 2013
WWW.COPERIONKTRON.COM

FORMAT
B

NUMBER
PRESENTATION 3

REV
A

Typical flour convey flow for humid conditions

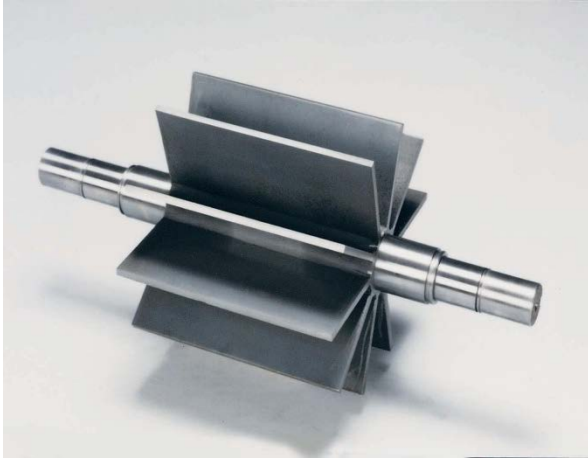


Requirement for the Continuous System: Rotary Valves

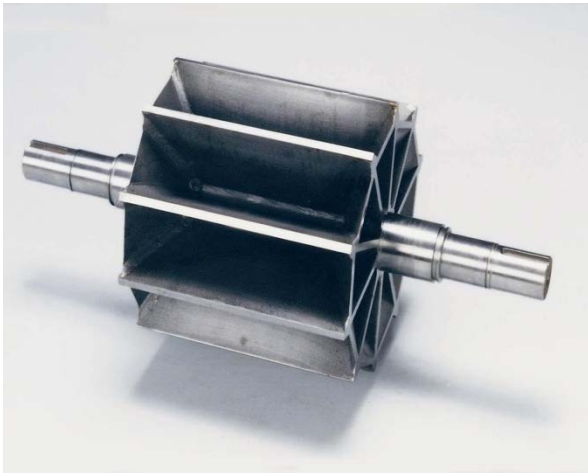
- **Operation:**
 - Series of pockets deliver material volumetrically to process
- **Advantages:**
 - Simple design – good for free flowing materials
 - Overcome pressure gradient
 - Can be designed for explosion containment
- **Disadvantages:**
 - Not ideal for packing/cohesive materials
 - Limited turndown capabilities



Optional Rotor Configurations



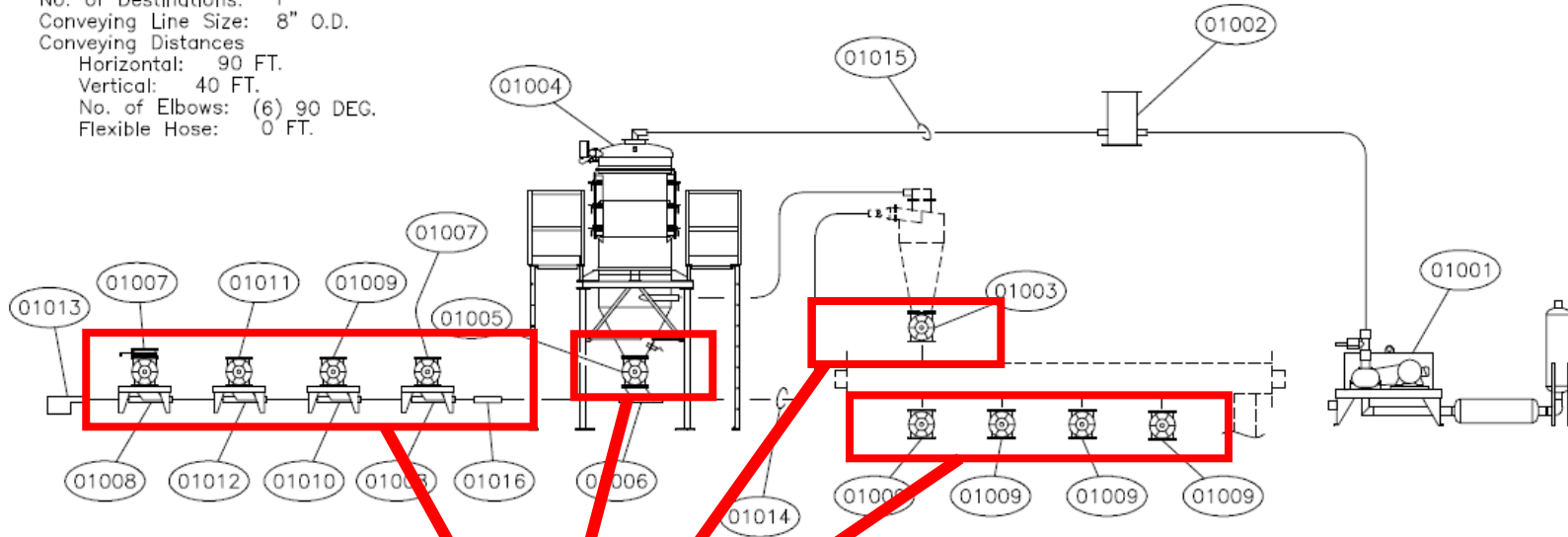
- Hubbed (straight and tapered)
- Reduced displacement (tapered, scalloped and blocked)
- Honeycombed pockets
- Rotor tips can be relief tipped (beveled) or standard
- Rotor materials of construction include carbon steel, 304SS, 316SS and wear alloy
- Coatings including Nedox and T.C.
- Variety of clearances



Continuous Vacuum Systems for Corn Flour Transfer

SYSTEM 1 PROFILE

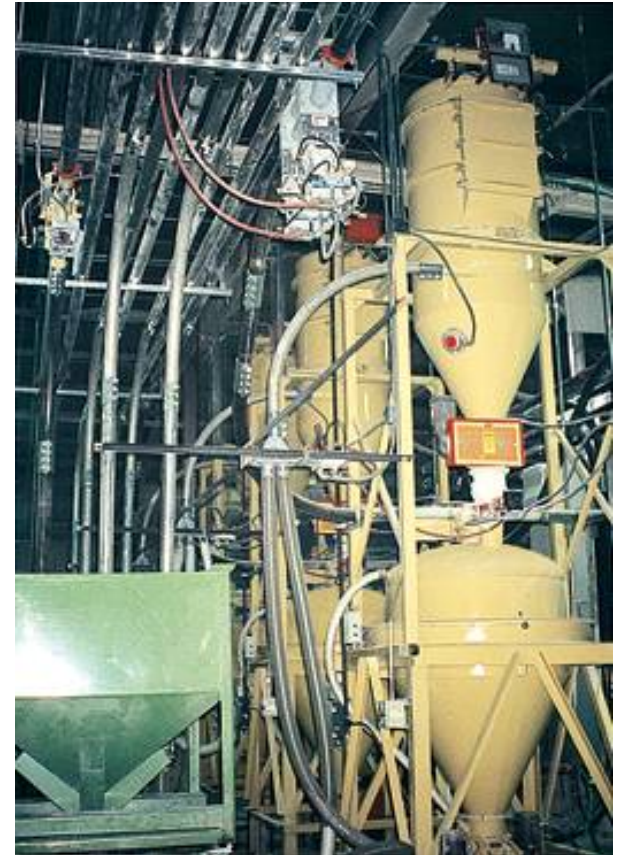
System Type: Continuous Vacuum Conveying
Material: Corn Flour
Bulk Density: 28 LBS./CU. FT.
Conveying Rate: 53,000 LBS./HR.
No. of Sources: 4
No. of Destinations: 1
Conveying Line Size: 8" O.D.
Conveying Distances
Horizontal: 90 FT.
Vertical: 40 FT.
No. of Elbows: (6) 90 DEG.
Flexible Hose: 0 FT.



Rotary Valves

Automated Ingredient Weighing/Dosing: Batch Processing & Continuous Processing

- Gain in Weight Batch Weighing
 - Scale Hoppers
 - Volumetric Feeders
- Loss in Weight Batch Weighing
- Continuous Loss in Weight Feeding



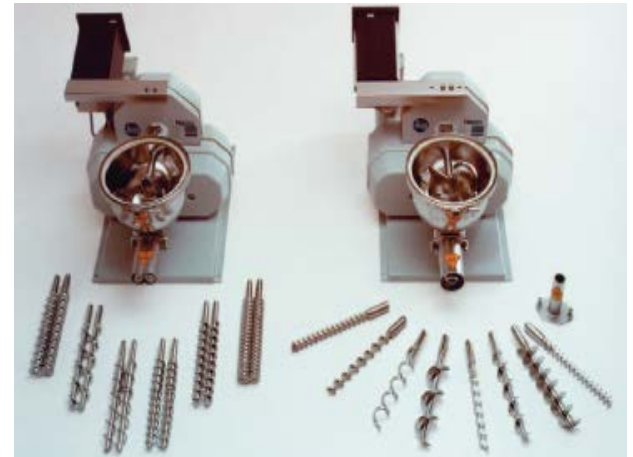
Material Characteristics which influence equipment & system design

- Bulk Density - Loose and Packed /Tapped
- Particle Size- Shape - Aspect Ratio
- Moisture and Temperature Sensitivity
- Angle of Repose
- Kinematic Angle of Surface Friction
- Gas Permeability
- Particle friability
- Compressibility/Springback



Feeder Choices

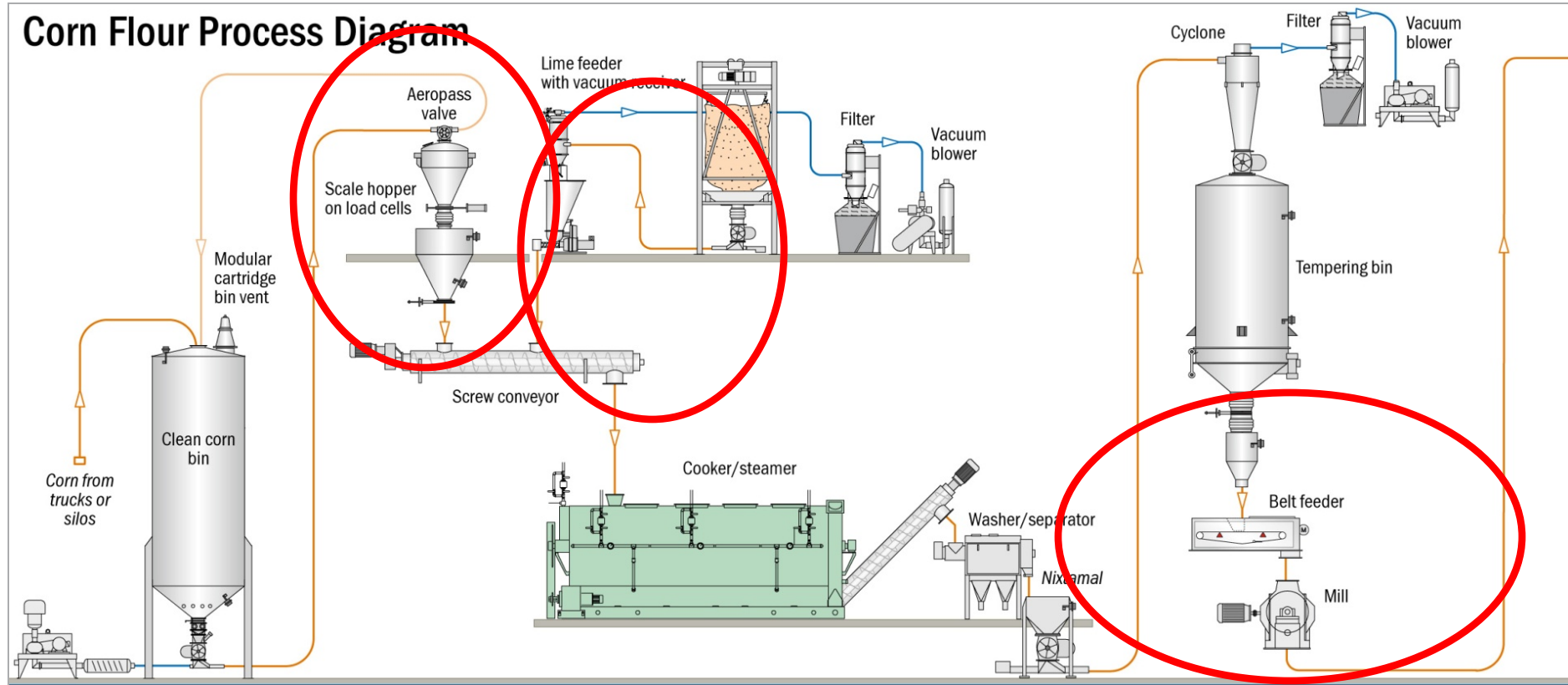
- Screw (single or twin)
- Vibrating Tray
- Rotary Valve
- Belt
- Discs



Feeding Example: Unload and Delivery of Corn to Cookers and Mill

Macro Ingredient Weighing

LIW Lime Feeding to Cooker



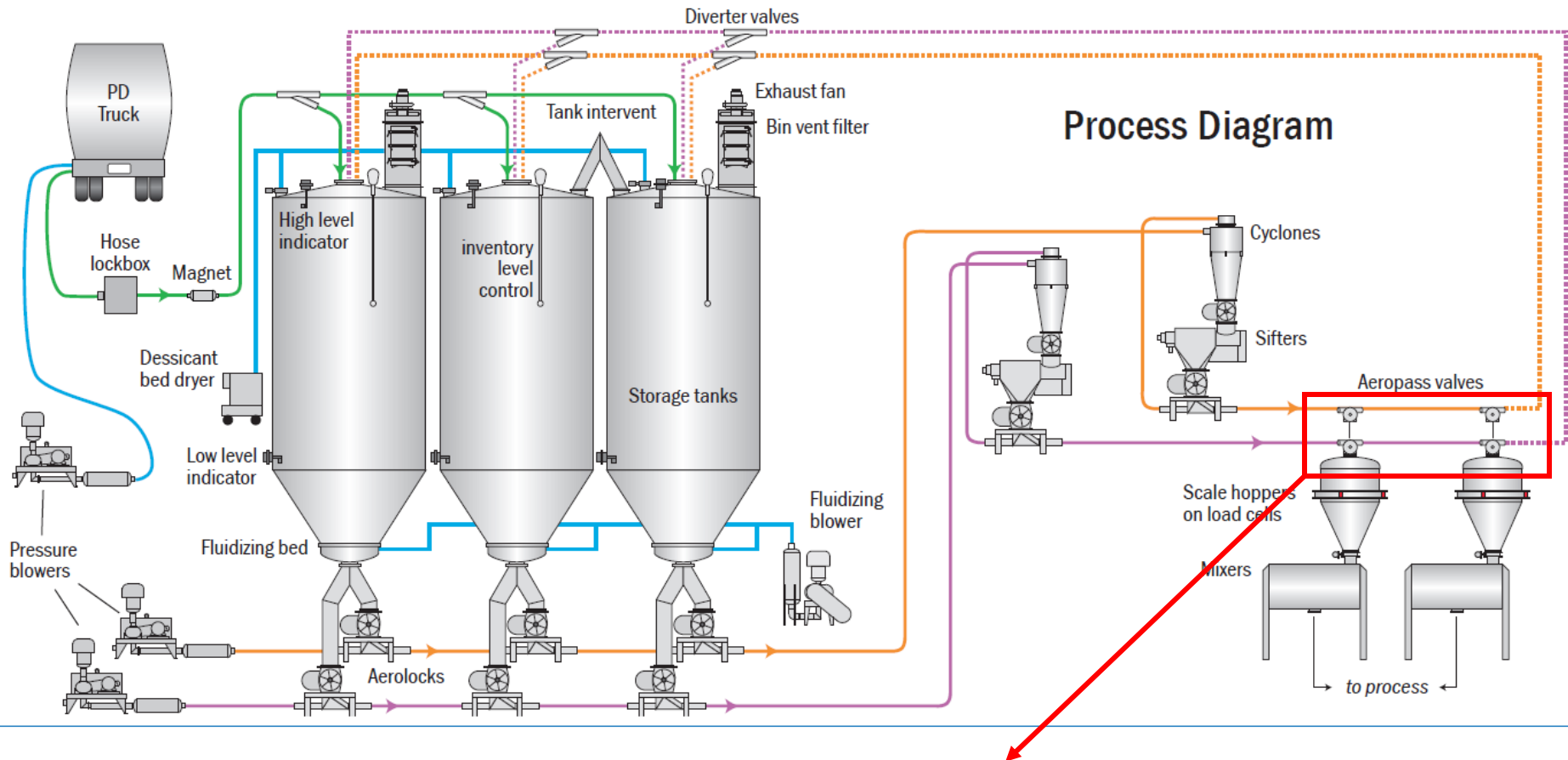
Weigh Belt Feeding to Mill

Batching or Dispensing

- Also known as “Scaling”
 - Receiver vessel on load cells
- Installed accuracy with a margin of error no greater than $\pm 0.5\%$ of full scale capacity
- Often used for macro ingredient dosing
- Also used as a means of batch “totalization” and check weighing of all ingredients prior to mixing or extrusion steps



Batch Scaling in Tortilla Corn Flour Transfer from Trucks to Storage to Sifter/Mixers

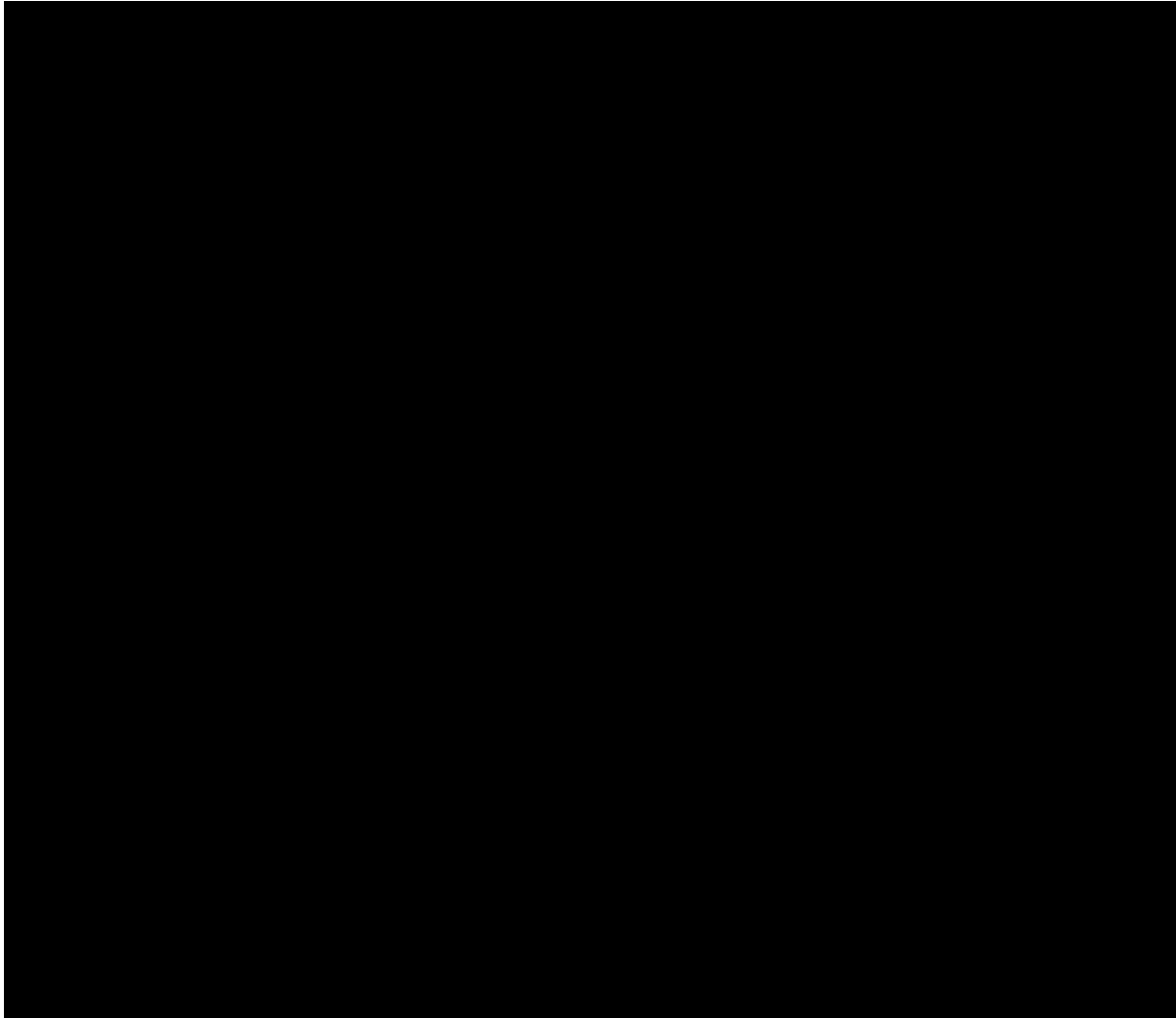


Aeropass Valves

Gain in Weight Batch Weighing using Pneumatic Transfer



Gain in Weight Batch Principle



Gain-in-Weight Batch Systems

Advantages

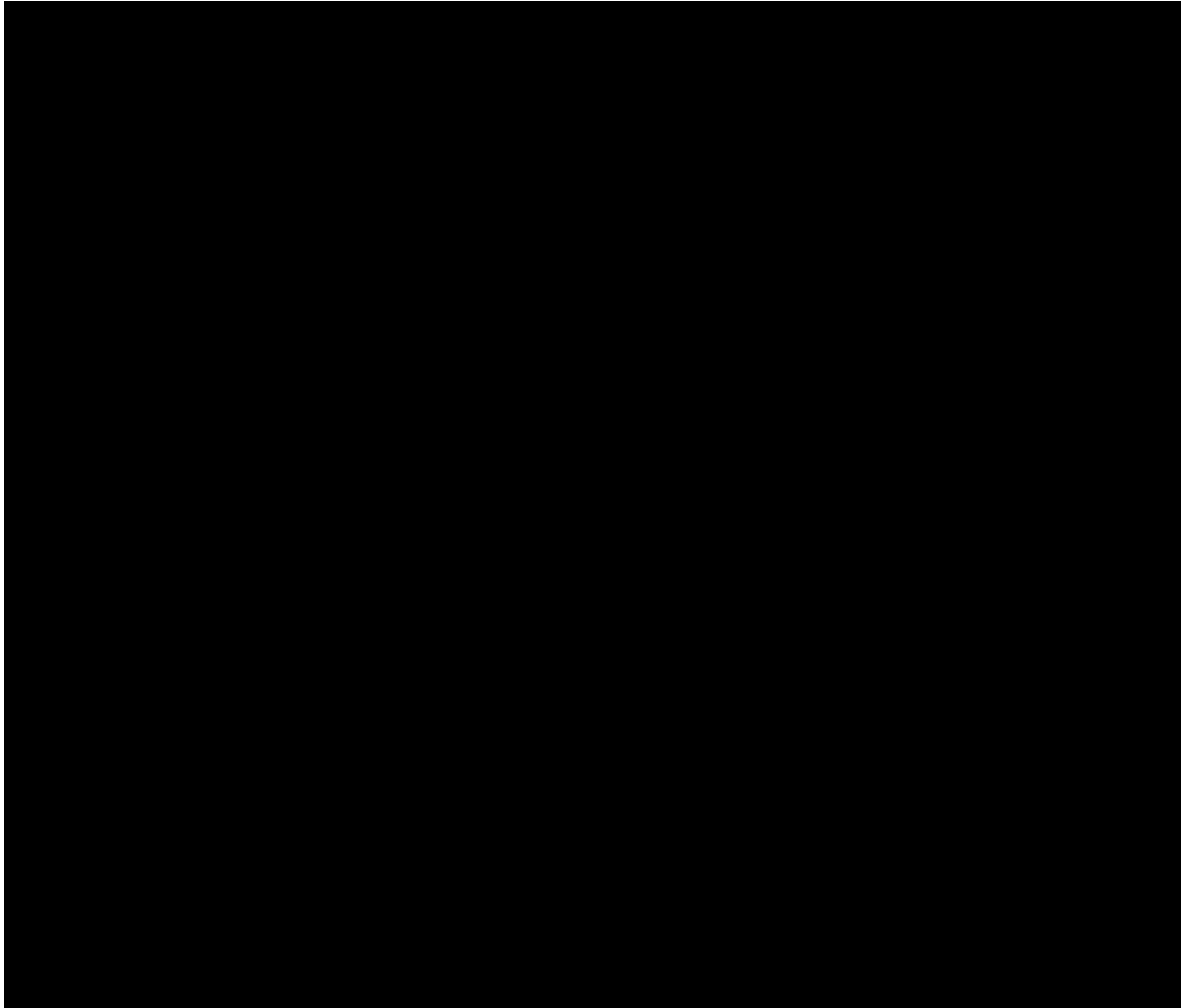
- Only one scale device for load hopper
- Cost effective since feeders are volumetric
- Well suited to large batches

Disadvantages

- Total batch time is dependent upon the number of individual batch times necessary
- Combination of large single batches and very small batches not as versatile (due to large taring values of the collection hopper)



Loss-in-Weight Batch Principle



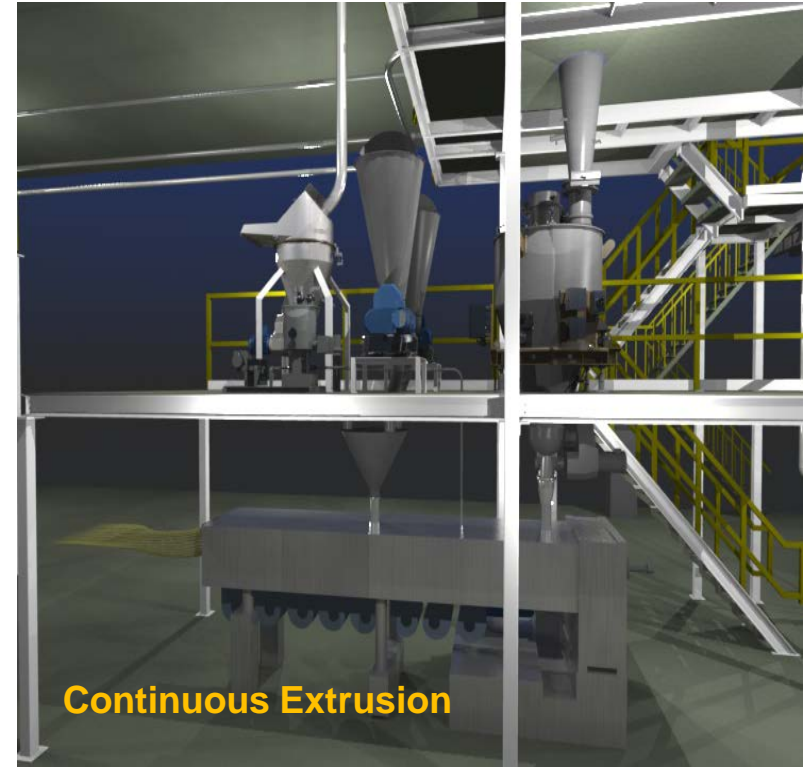
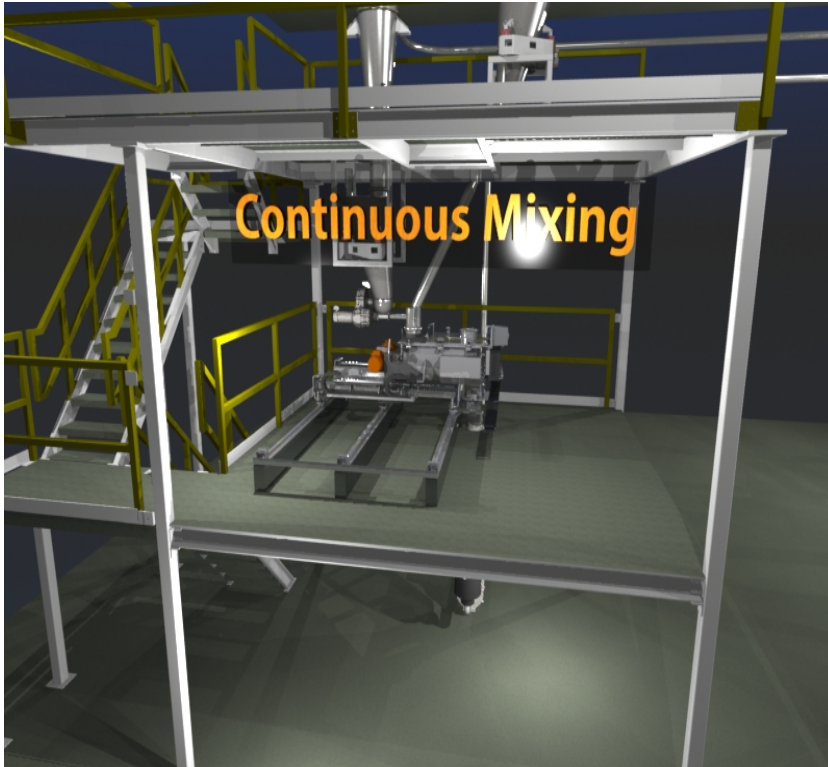
Loss-in-Weight Batch Systems

Advantages

- Each ingredient is batched out in its own LIW feeder
- Feeders can then operate simultaneously, making overall batching process shorter
- Can also batch out variety of ingredients at different bulk densities and high variation in mix percentages with high accuracy
- Used for minor and micro ingredient weighing where individual percentages and accuracies required are outside the realm of GIW or scaling applications (0.5% of full load)



Loss In Weight Feeding for Continuous Mixing and Extrusion



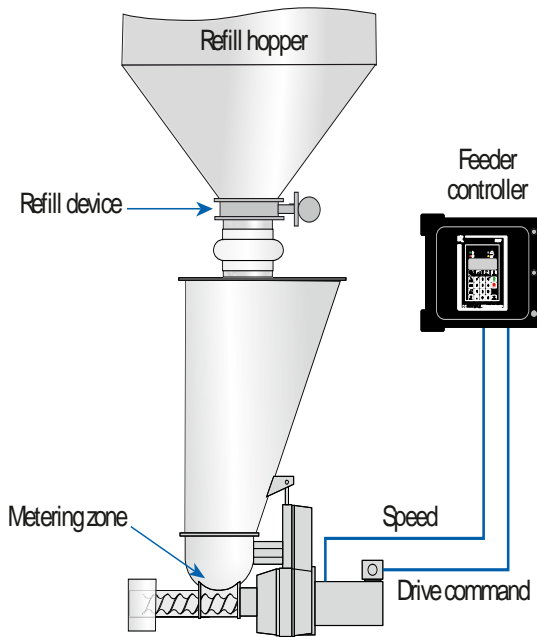
Single Screw Feeder running Corn Meal



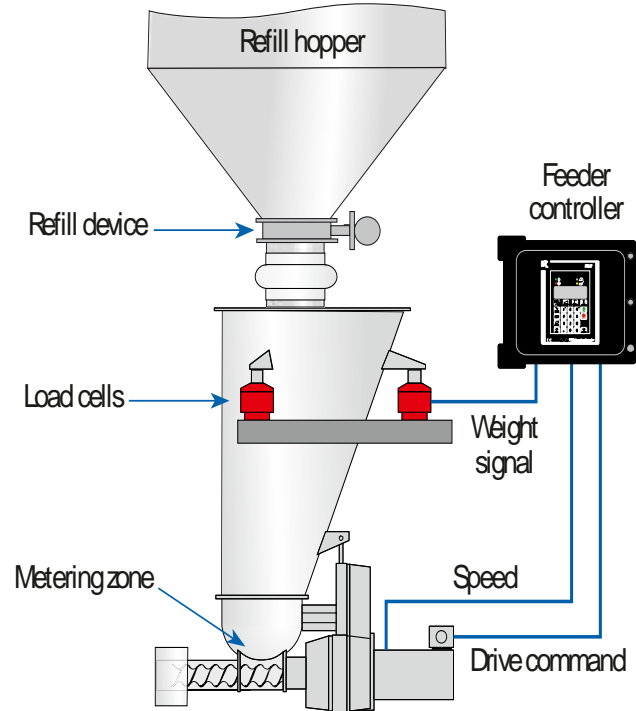
Twin Screw Feeder running Lactose



Volumetric vs. Gravimetric Principles

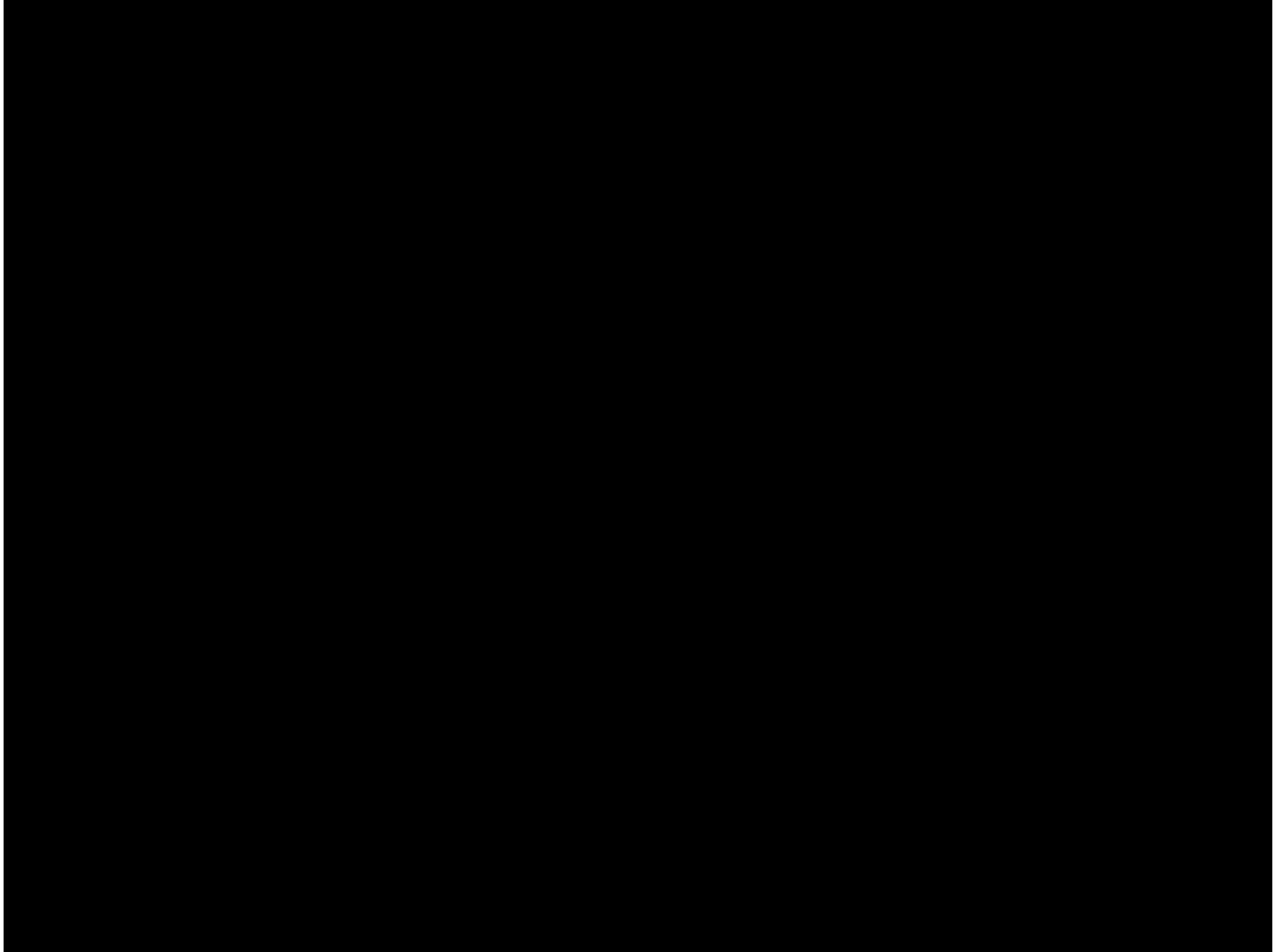


Feed rate is regulated by speed adjustment of the feed screws

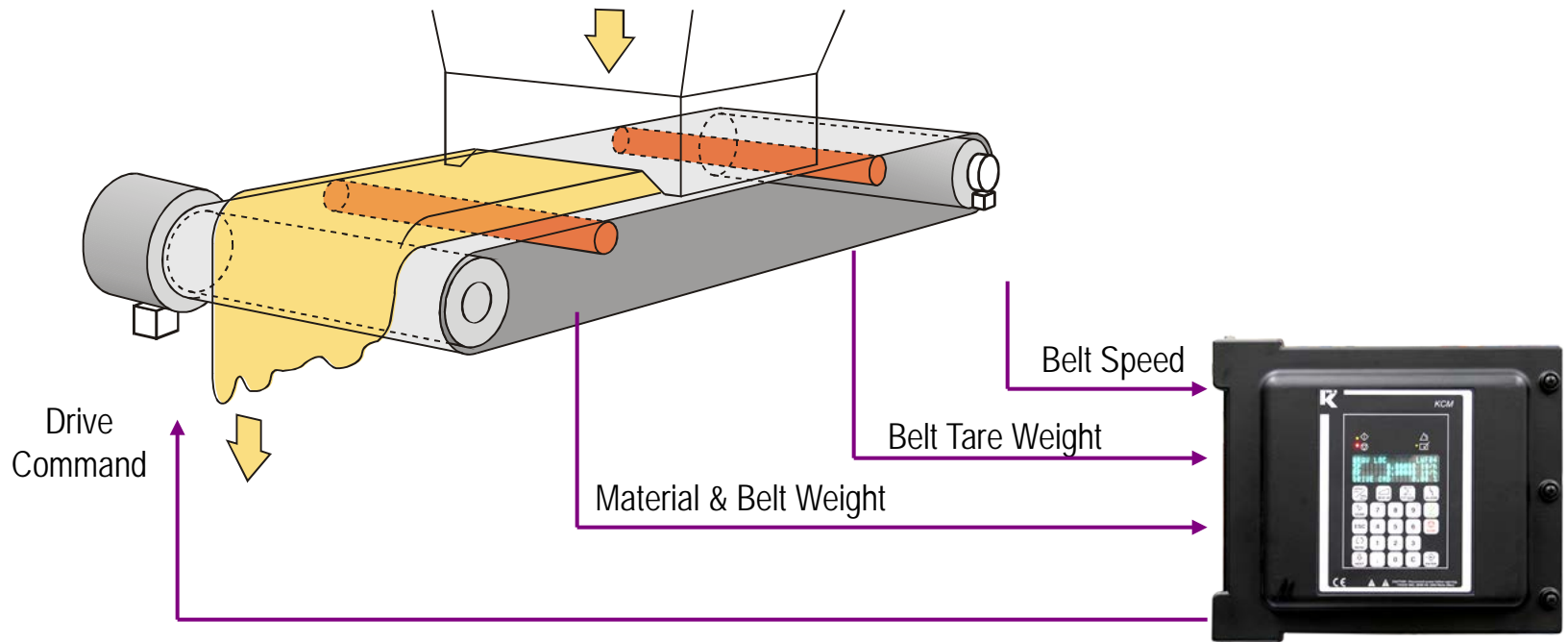


LIW controller adjusts feeder speed to produce a rate of weight loss equal to the desired feed rate setpoint

LWF Refill Sequence Operation



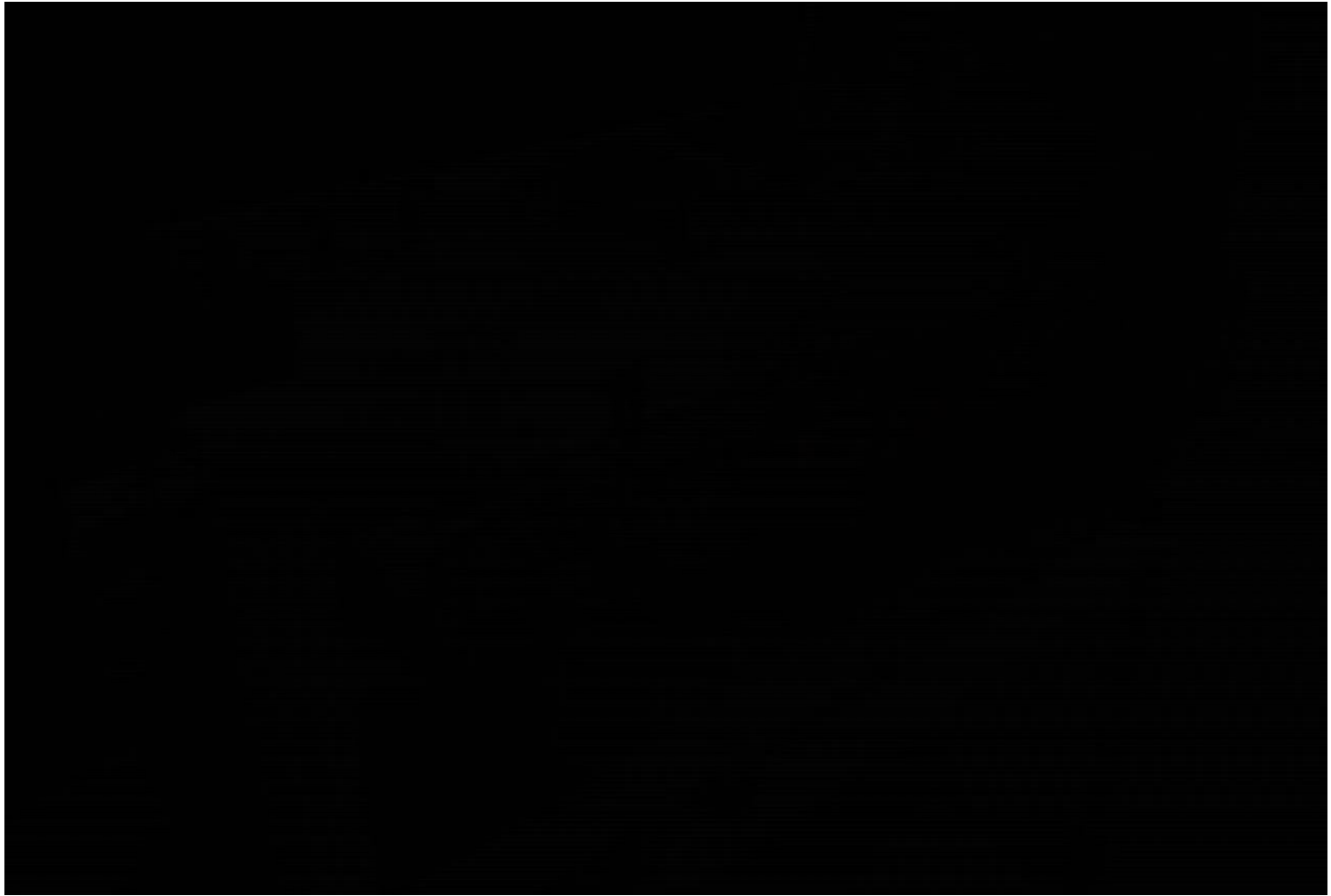
Weigh Belt Feeding



Belt feeder with optional secondary weigh bridge for continuous tare function

- a) Improves long term stability
- b) Reduces maintenance / frequency of calibration
- c) Auto indication that belt cleaning or replacement is required
- d) Lower feed-rate possibilities

Weigh Belt Feeder for Nut Blends



Weigh Belt Feeder Benefits

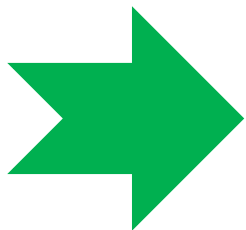
- Low cost for high volumes of flow
- Function easy to understand
- Compact for high flow rates
- Can be extended to use as a conveyor
- Handle large particle size bulk material
- Low power requirements
- Works well in difficult environments



Other Food Industry Trends which help in optimization of automated design

FSMA (Food Safety Modernization Act) driving manufacturers to:

- Design equipment to have quick and easy access for cleaning
 - **Dry Cleaning**
 - **Manual Wet Cleaning**
 - **Automatic Wet Cleaning (Clean in Place)**
- Build in control points for process controls



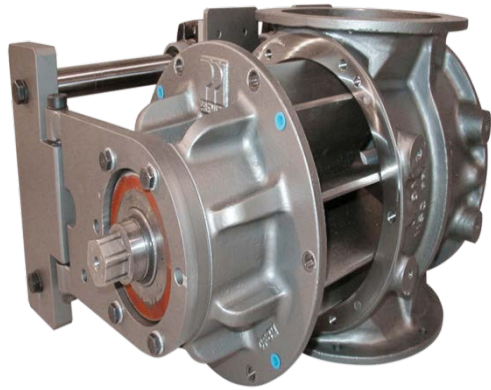
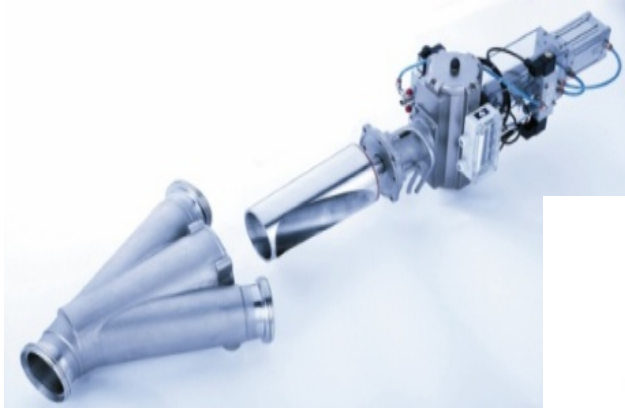
**Sanitary Equipment Designs
for Food Safety**

Key Design Features in Food System Design

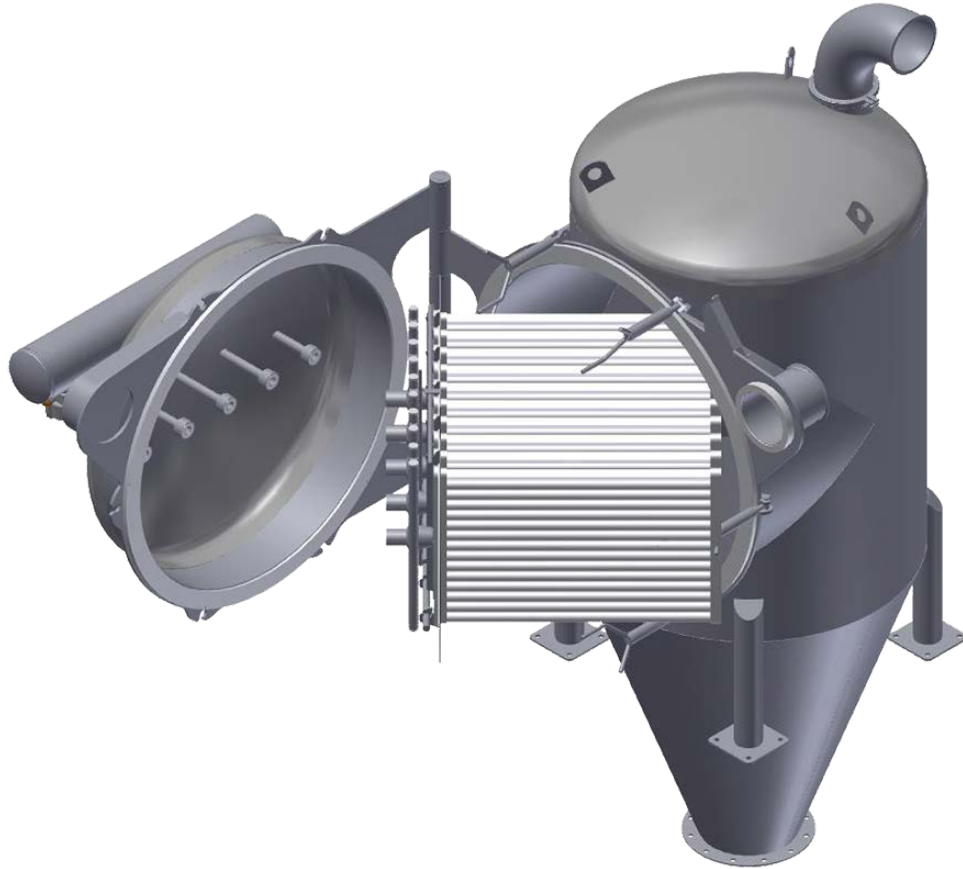
- Regulations to be adhered
 - 3A, FDA, EHEDG, ATEX, UL
 - Explosion Protection Requirements
 - Sugar, Flour Installations, e.g.
- Options in sanitary design and execution
 - Cleaning / Washing in Place
 - Materials of construction - compatability with cleaning materials
 - Material Certification
 - Containment
- FAT Requirement



Sanitary Material Handling Component Examples



Sanitary Design Filter Receiver

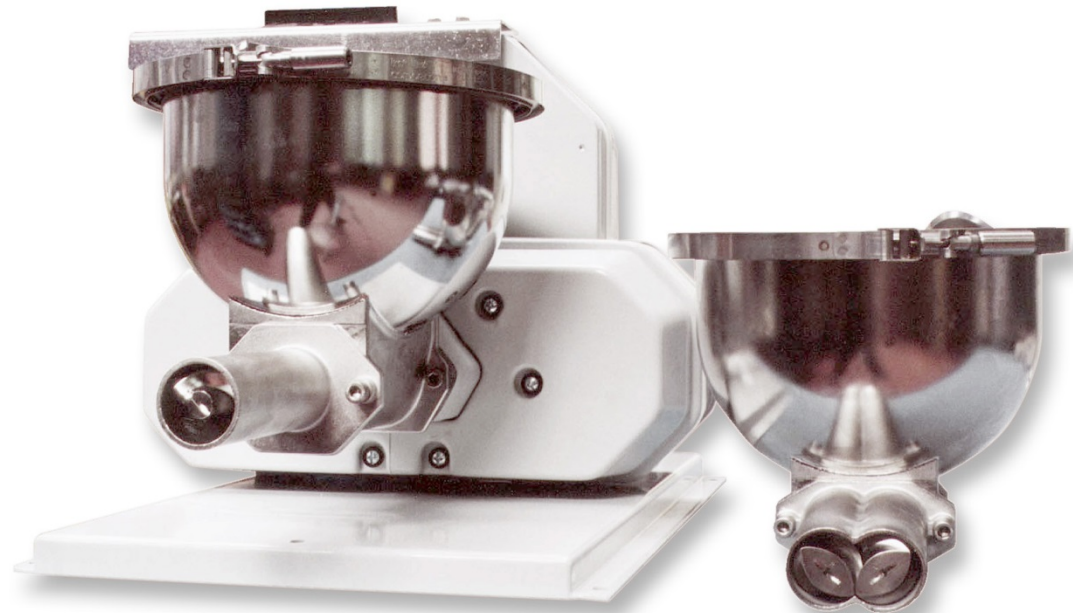


- Quick access body allows clean and filter change in approx 15 minutes
- Tool-less access and captive fixings
- Inlet and outlet connections remain in place when accessing internal surfaces



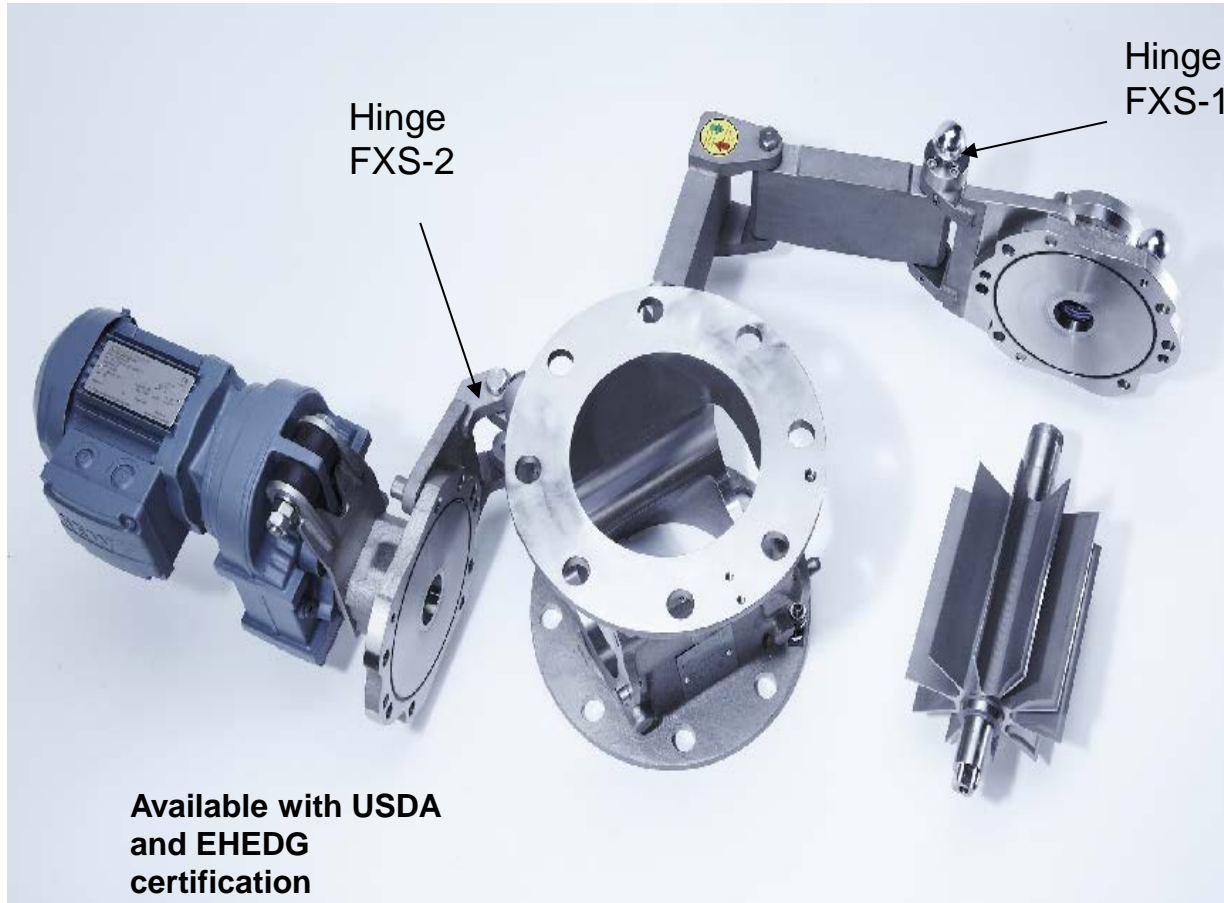
Quick Exchange Feeder

- Gearing integral to feed module
- Single screw can be changed to a twin screw within seconds



Rotary Valves

Quick cleaning versions



UNITED STATES DEPARTMENT OF AGRICULTURE
MARKETING AND REGULATORY PROGRAMS
AGRICULTURAL MARKETING SERVICE

EQUIPMENT ACCEPTANCE CERTIFICATE

Firm: Coperion GmbH
Niederhager Straße 9
88250 Weingarten, Germany

Model Designation: Rotary Valve
ZRD 300.5 SS

April 26, 2016
Date of Issuance

April 23, 2015
Date of Expiration

U.S. Department of Agriculture
Marketing and Regulatory Programs
Agricultural Marketing Service
Dairy Grading Branch
1400 Independence Ave., SW
Washington, DC 20250-0230

The issuance of this form is based on U.S. Department of Agriculture, Dairy Grading Branch, Equipment Design Review Section, evaluation of the equipment listed above for compliance with:

USDA Dairy Equipment Review Guidelines

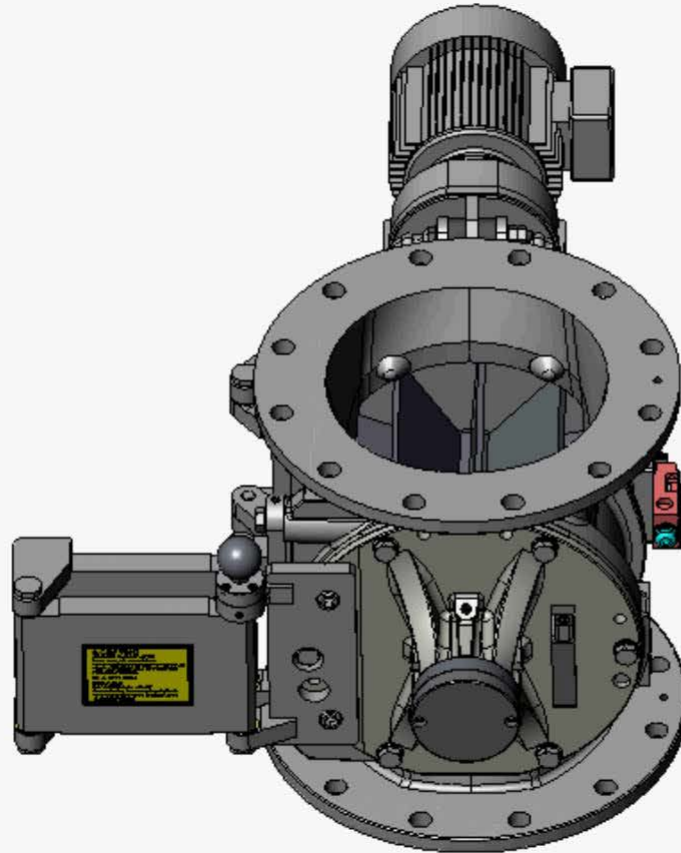
This form does not limit USDA's responsibility to take appropriate action in cases in which evidence of non-compliance, improper maintenance, or non-sanitary conditions have been observed.

USDA United States Department of Agriculture

34-107 (20-00) (Revised previous editions)



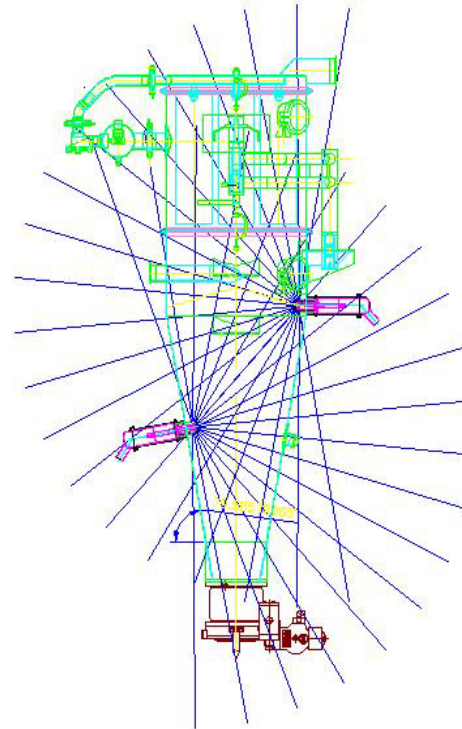
Sanitary Rotary Valve



“CIP” Design Options

Retractable spray balls

- True design is as WIP – Wash in place
- Typical procedure to wet internally first, then remove filter elements and wet inside again
- Spray balls typically of retractable (activated by water pressure) design



Sanitary Diverter Valve

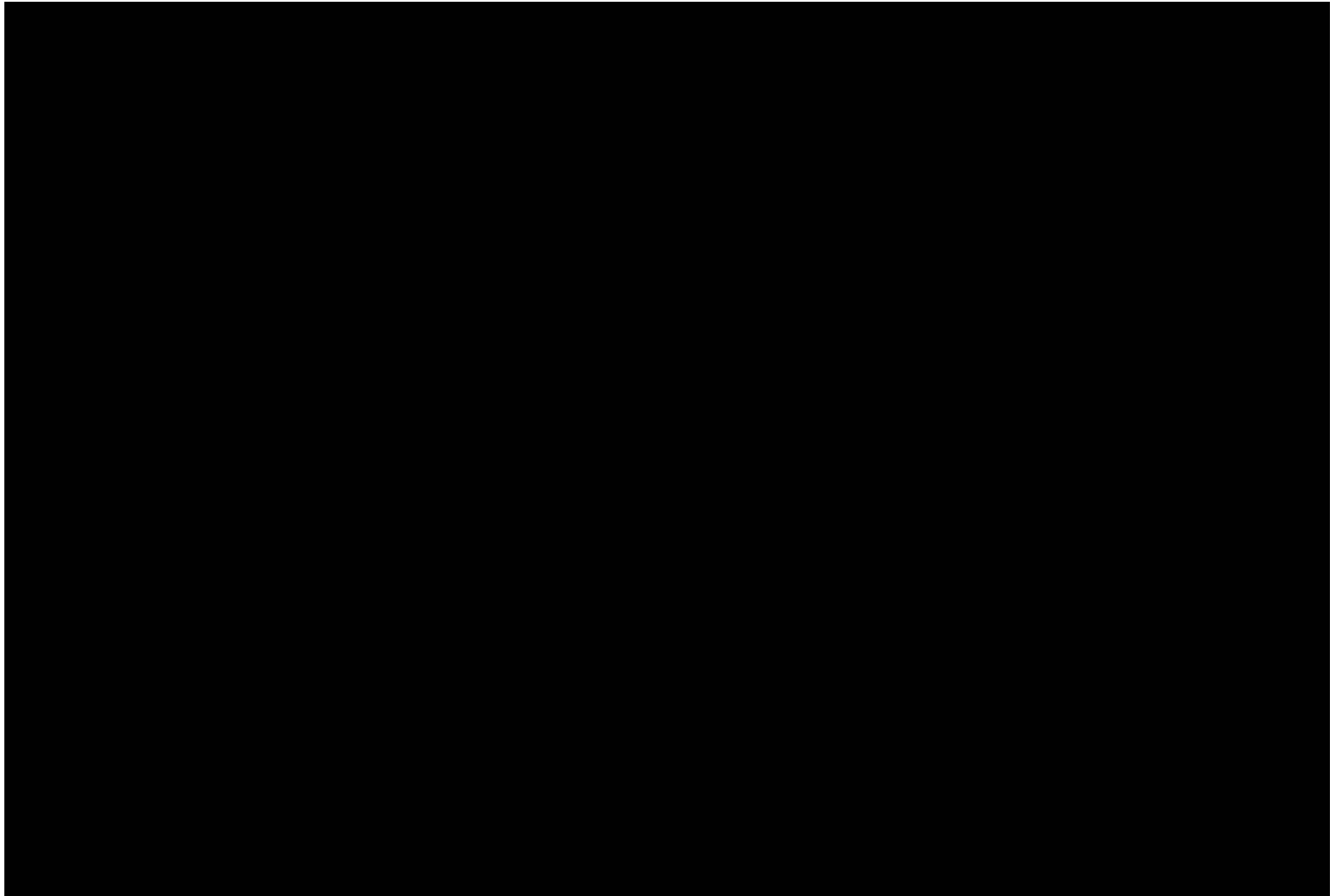


Twin swivel actuator for
switching ports

Extraction
actuator



Sanitary Diverter Valve



Summary: Why Automate Even the Most Simple Process??

- **Labor cost reduction**

- Automation can reduce labor intensive steps of :
 - Truck or silo loading and unloading
 - Lime or ingredient weighing to cooker or mixer
 - Bagging or packaging line delivery

- **Maximized production efficiencies**

- More accurate weighing of ingredients has shown to reduce ingredient cost and waste
- Recipe control via automation with PLC recipe allows for quick turn around

- **Increased quality control**

Thank You!

K-Tron Salina

- Salina, Kansas
- **Contact:**
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 - Office: 785-825-3864
 - Mobile: 785-787-0887

K-Tron Pitman

- Pitman, New Jersey
- **Contact:**
 - Sharon Nowak, Global Business Dev Mgr, Food and Pharmaceutical
 - Office: 856-256-3119
 - Mobile: 856-236-7922



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