MAINTAINING NON-METALLIC ELEVATOR BUCKETS

Maximizing elevator efficiency and meeting customer requirements

By Thorsten Rogner

TAPCO INC.

Modern Plastic Bucket

Advantages versus Steel

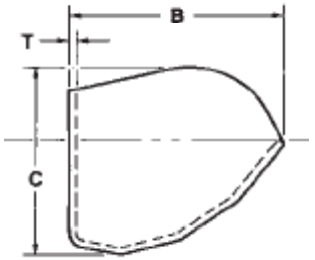
- Light Weight (energy efficient)
- Non-Sparking (prevents explosions)
- Rust Free
- Food Grade
- Flexible (plastic memory)
- Comparable Durability

Identifying Elevator Buckets

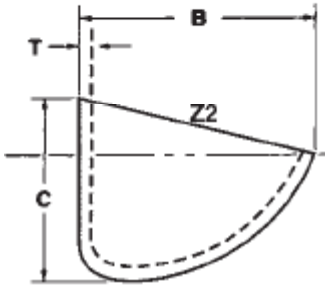
- Style
- Material
- Dimensions
- Speed
- Discharge method
- Conveying type
- Product to be conveyed

Bucket Styles

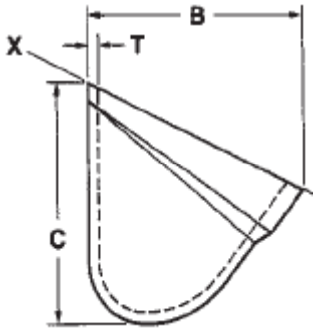
CC Style

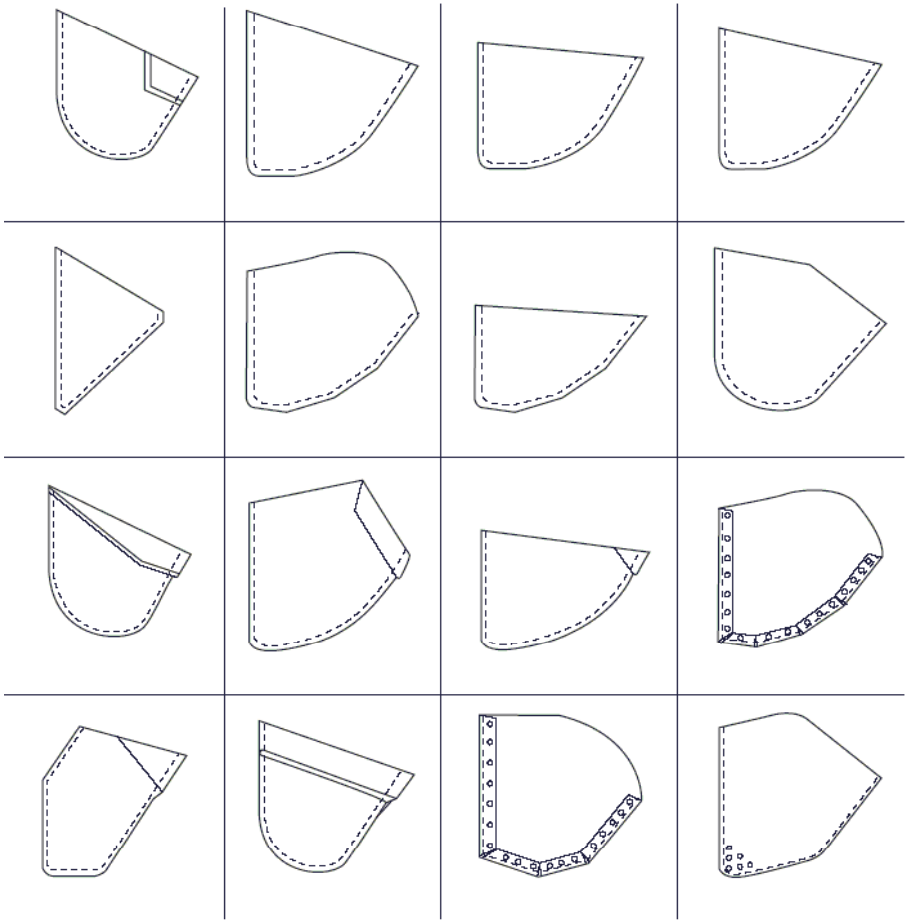


European Style



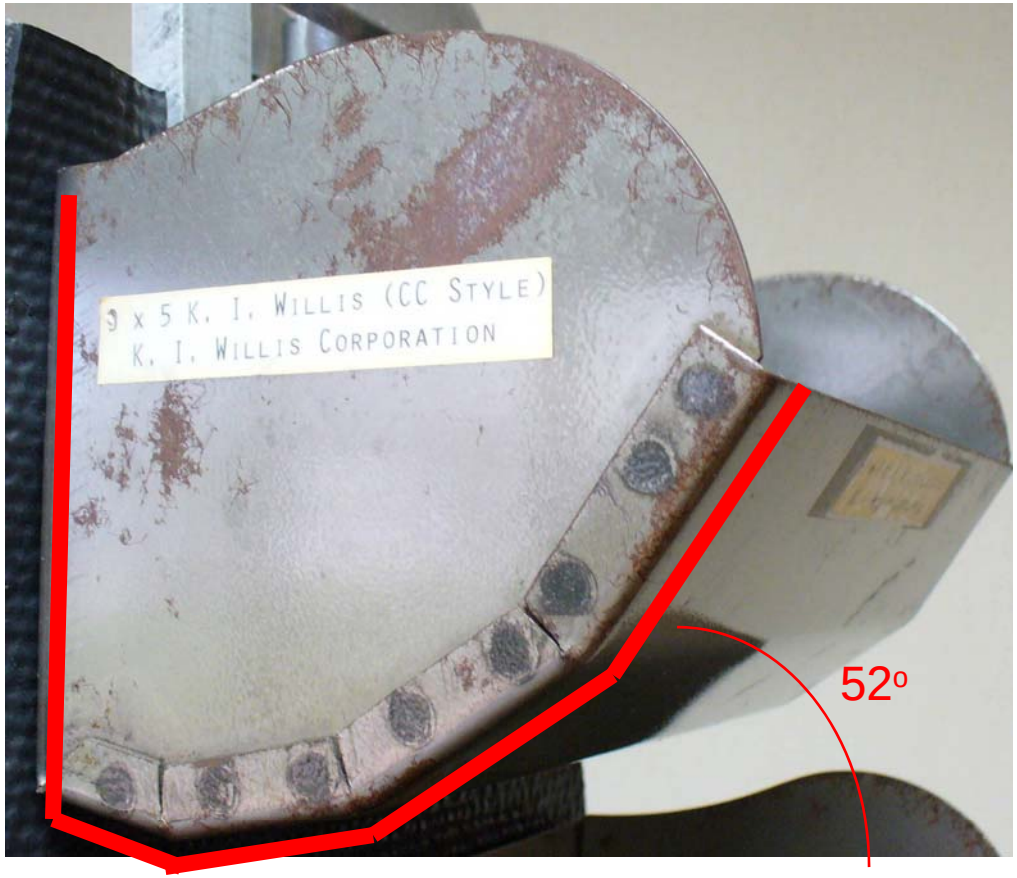
AA Style





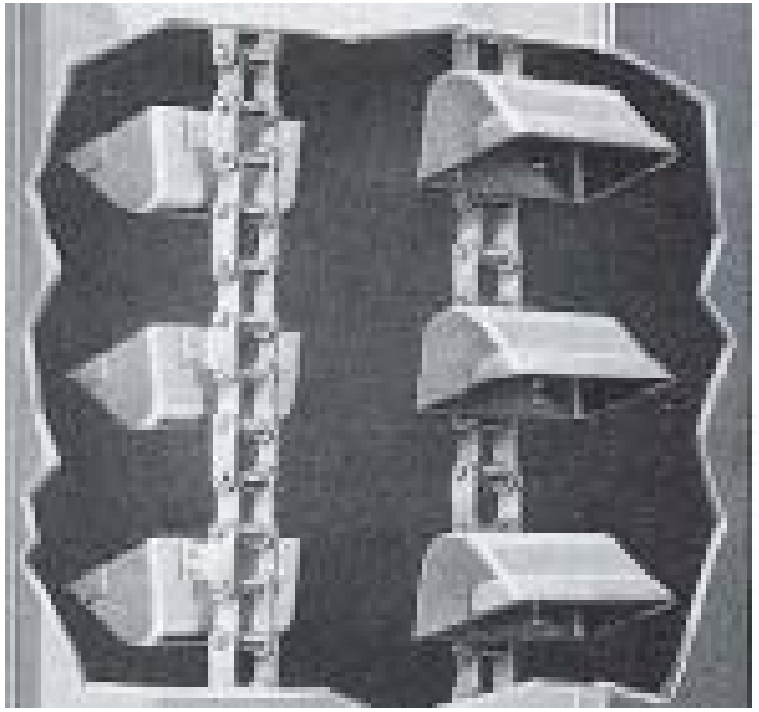
CC Style Grain Bucket

- CC Style or Close Centers – Originally introduced by K.I. Willis in 1938. Has an ideal discharge trajectory over a wide range of speeds and pulley diameters



AA Style Bucket

- Originally manufactured in steel by Link Belt Company
- Mounted on chain or belt
- Slow moving centrifugal discharge



CCHD vs. AA Style Buckets

- Both centrifugal discharge
- Operating speeds
  - CCHD runs at greater than 300 ft per minute
  - AA runs at less that 300 ft per minute
- Vertical Bucket spacing
  - CCHD can be spaced as close as physically possible
  - AA requires additional spacing
- Different Bucket Geometry

Different Bucket Geometries

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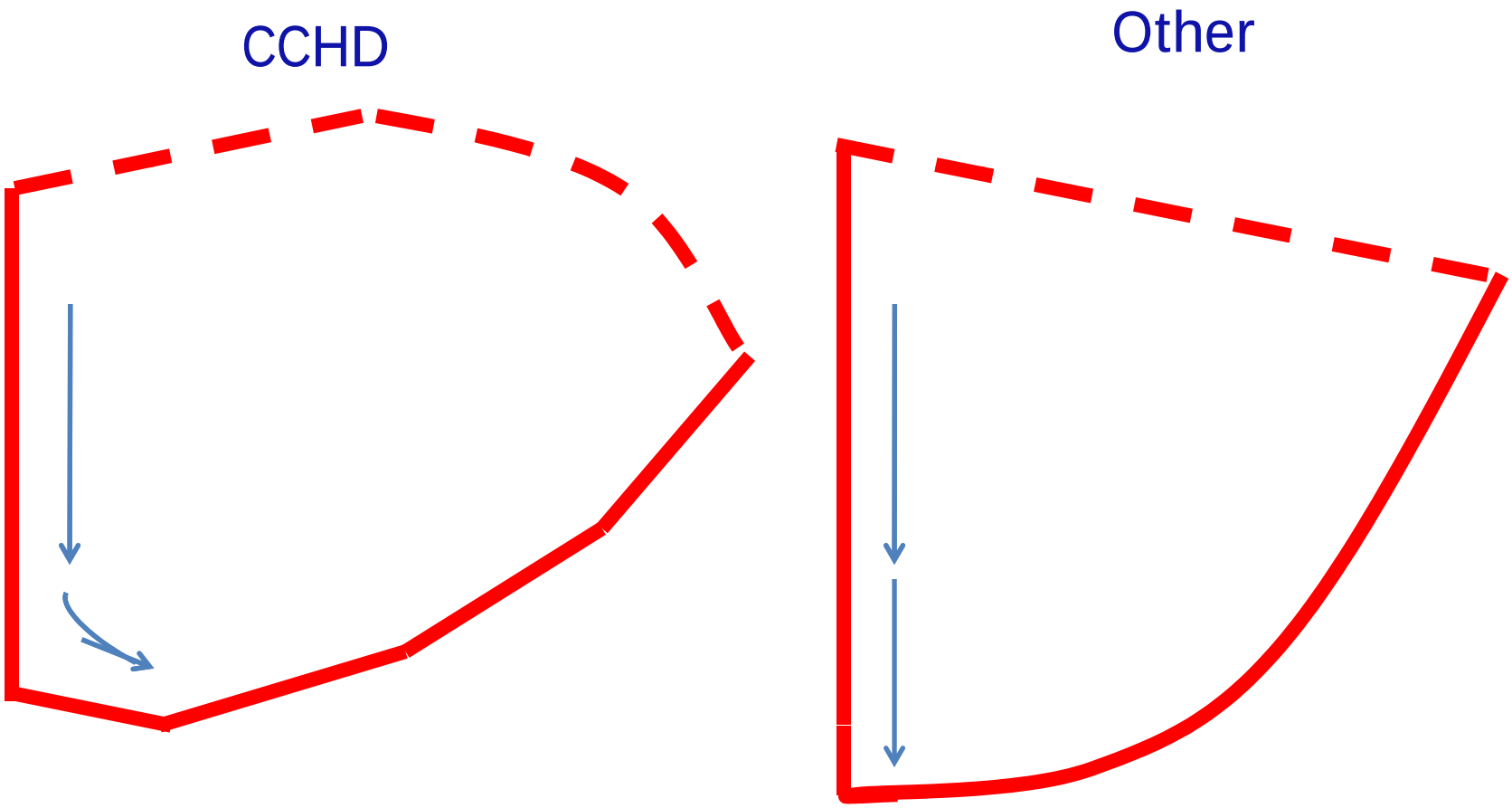
Centrifugal Force on the CC Style Bucket



INTERPRETING CUSTOMER REQUIREMENTS

What Product?

Determine the type of product to be conveyed

- Size and shape
- Bulk density
- Temperature
- Flow-ability
- Moisture content
- Abrasion

What Capacity?

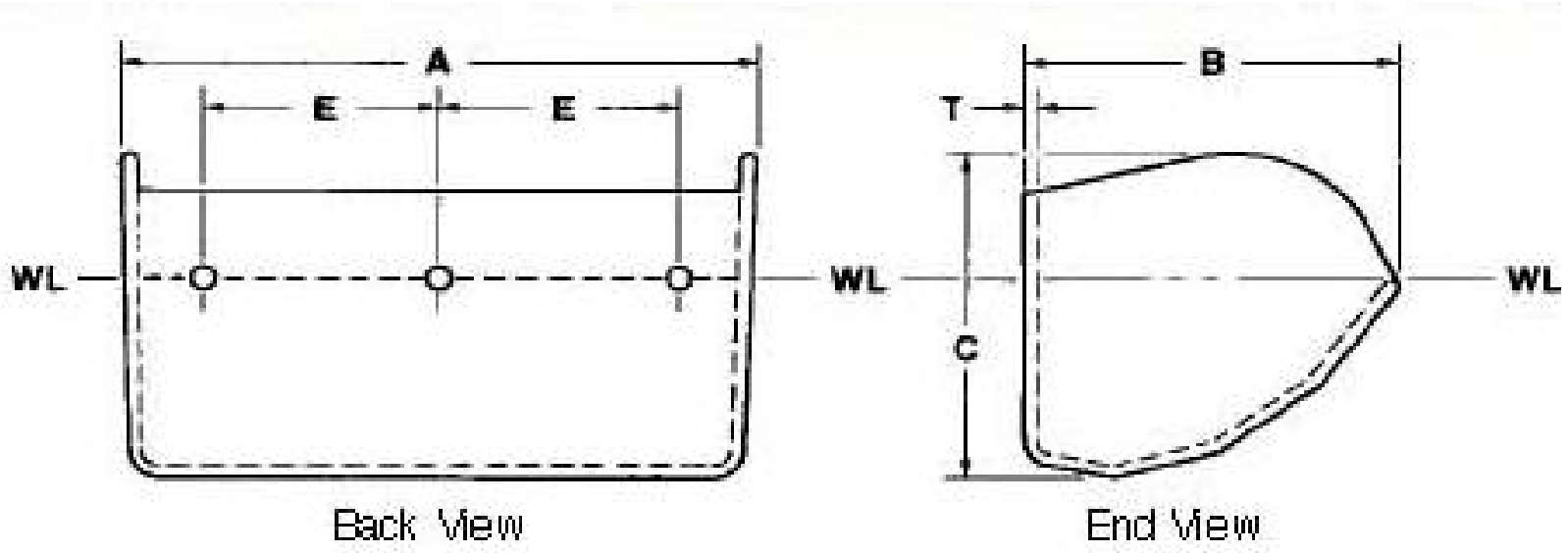
Determine the throughput requirement

- What stage of material processing (i.e.. receiving, processing, mixing)
- Required capacity (i.e.. metric tons, bushels, kilograms)
- Elevation height (distance between the bottom and top pulley heads)
- Speed of the elevator

Specifying the Bucket

(A) length, (B) projection, and (C) depth.

(T) thickness, (WL) water level, (E) Hole Centers



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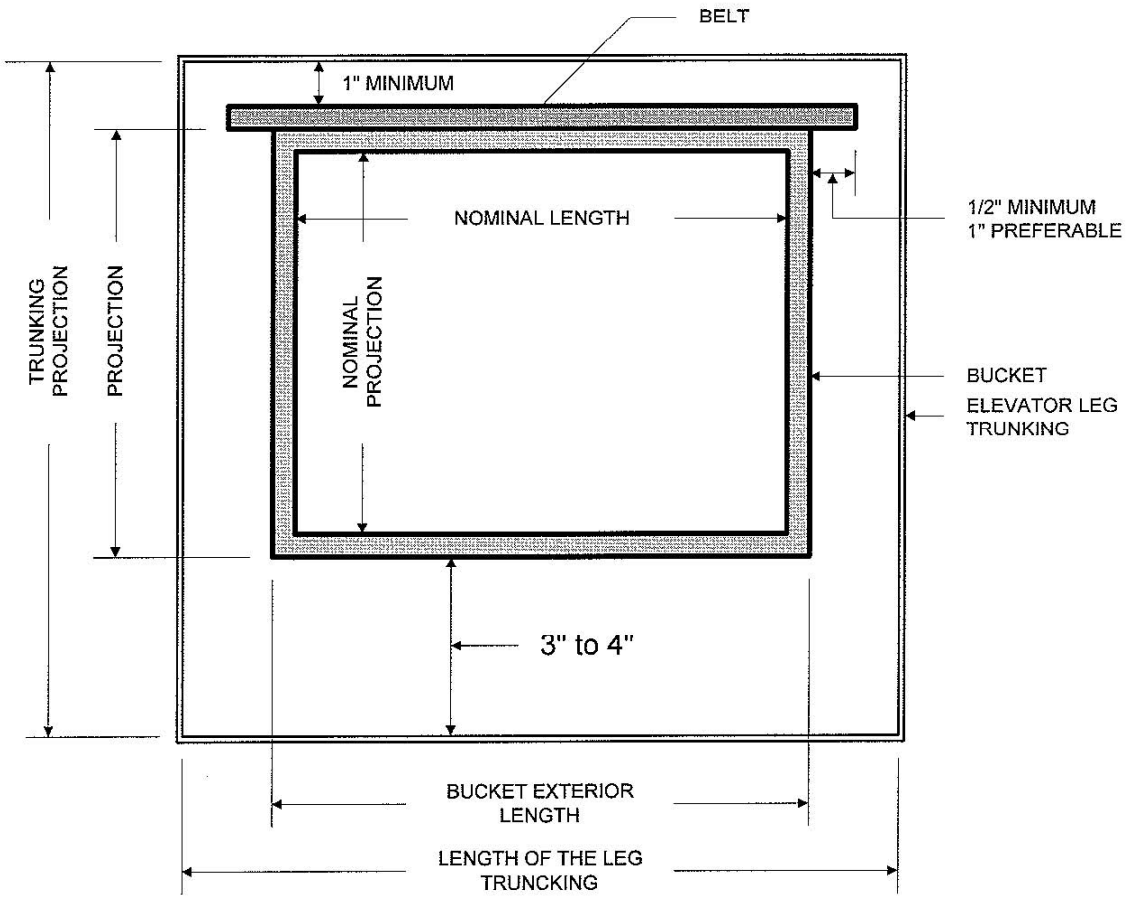
Specifying the Bucket

Belt not less than 1”
wider than bucket.

Bucket Length	Trunking Width
1 – 8”	+ 3
9 – 12”	+ 4
13 – 15”	+ 5
16” +	+ 6



Specifying the Bucket

Calculating Elevator Capacity

CAPACITY FORMULAS (Based on water level bucket fill)

For BUSHELS per hour:

capacity of bucket water level		spacing multiplier		number of rows		speed feet/min.		min./hr.		cu. in./bu.		bu./hr. water level		+10% actual capacity		bu./hr. actual
9x6																
136	x	1.5	x	1	x	314	x	60	÷	2,150	=	1787	x	1.10	=	1965
	x		x		x		x	60	÷	2,150	=		x	1.10	=	
	x		x		x		x	60	÷	2,150	=		x	1.10	=	

For CUBIC FEET per hour:

capacity of bucket water level		spacing multiplier		number of rows		speed feet/min.		min./hr.		cu. in./cu. ft.		cu. ft./hr. water level		+10% actual capacity		cu. ft./hr. actual
	x		x		x		x	60	÷	1,728	=		x	1.10	=	
	x		x		x		x	60	÷	1,728	=		x	1.10	=	
	x		x		x		x	60	÷	1,728	=		x	1.10	=	
	x		x		x		x	60	÷	1,728	=		x	1.10	=	

For TONS per hour: First determine cubic feet/hr. at water level using above formula then proceed as follows:

cu. ft./hr. water level		product weight per cu. ft.(lbs.)		lbs./ton		tons/hr. water level		+10% actual capacity		tons/hr. actual
	x		÷	2,000	=		x	1.10	=	
136	x	45	÷	2,000	=	3.06	x	1.10	=	3.37
	x		÷	2,000	=		x	1.10	=	

For METRIC TONS per hour: First determine cubic feet/hr. at water level using above formula then proceed as follows:

cu. ft./hr. water level		product weight per cu. ft.(lbs.)		lbs. metric tons		metric tons/hr. water level		+10% actual capacity		metric tons/hr. actual
	x		÷	2,204.62	=		x	1.10	=	
	x		÷	2,204.62	=		x	1.10	=	
	x		÷	2,204.62	=		x	1.10	=	

SPACING multipliers: For determining number of buckets per foot of belt or chain. Below multipliers are calculated by dividing one foot (12") by the bucket spacing dimension in inches.

Bucket Spacing on belt or chain	3½"	4"	4½"	5"	5½"	6"	6½"	7"	7½"	8"	8½"	9"	9½"	10"	10½"	11"	11½"	12"	13"	14"	15"	16"	17"	18"
Multiplier	3.43	3.00	2.67	2.40	2.18	2.00	1.85	1.71	1.60	1.50	1.41	1.33	1.26	1.20	1.14	1.09	1.04	1.00	.92	.86	.80	.75	.71	.67

FEET PER MINUTE FORMULA: Belt or chain speed can be determined if the head pulley or sprocket diameter and R.P.M. of the head shaft is known.

π		head pulley dia./in.		RPM		in./ft.		feet/min.
3.1416	x	24	x	50	÷	12	=	314.16

SPEED RANGE FOR TAPCO BUCKETS - Contact Tapco Inc. for engineering recommendations on either new or existing elevators.

Specifying the Bucket

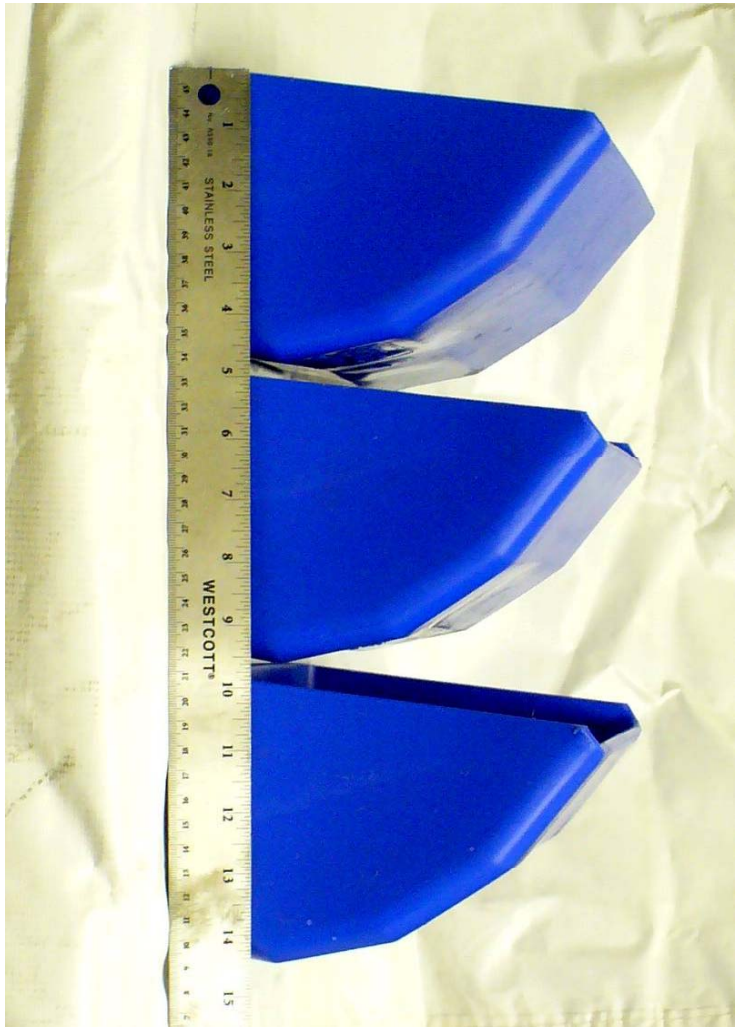
Vertical Spacing of Buckets

- Traditional Spacing: +2” Nominal Projection
- Modern Spacing: +1” Nominal Projection
- Low Profile: -1” less than nominal projection

(However, 0” to <2” has been achieved for both styles)

Adding Capacity with Low Profile

- Low Profile – Bucket back and ends are cut down to allow for closer vertical spacing on the belt and thereby increasing capacity.



POLYETHYLENE, NYLON, URETHANE

LONGER LIFE WITH THE CORRECT PLASTIC

Which Plastic ?

- High Density Polyethylene (HDPE)
- Thermoplastic Polyurethane (Urethane)
- Impact Modified Nylon (Nylon)

Which Plastic ?

High Density Polyethylene (HDPE)

- Economical
- Tough and flexible
- Light weight
- Food Grade Material (FDA)

Grains, Feeds, Fertilizers, Seeds and Food Products

Which Plastic ?

Urethane

- More flexible than Nylon and Polyethylene
- Extreme abrasion resistance
- Clean discharge of “sticky” products
- High throughput elevators handling a wide variety of inputs
- Available with food grade additive

Pelletized feeds, soybeans, oyster shells, beans, buck wheat and paddy rice.

Which Plastic ?

Nylon

- More rigid than Polyethylene or Urethane
- Outstanding impact resistance
- Abrasion resistance
- High throughput elevators handling a wide variety of inputs
- Available with food grade additive

Soybeans, fertilizers, salt, sand and chemicals

VENTING AND MAINTINANCE

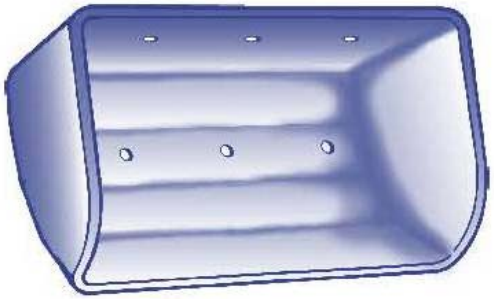
SOLVING ISSUES IN BUCKET ELEVATORS

Common Bucket Elevator Problems

- Product sticking in bucket
- Back legging (product discharge late or early)
- Loose Bolts
- Broken buckets
- Excessive wear
- Insufficient capacity

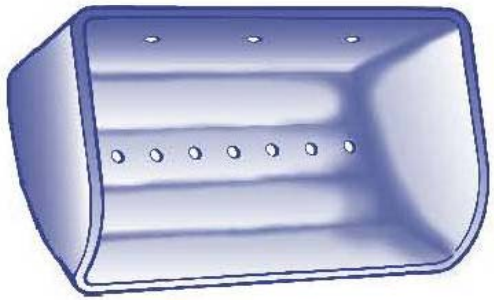
Bucket Venting

- Venting can improve efficiency



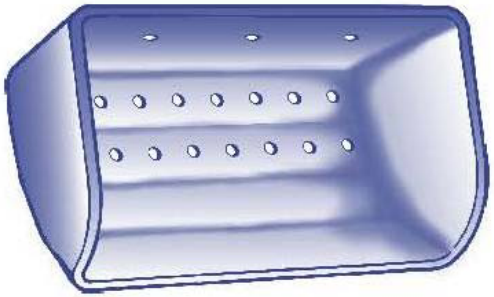
Vent Pattern 1

Same hole diameter, centers, and number of holes in body as mounting holes in back.



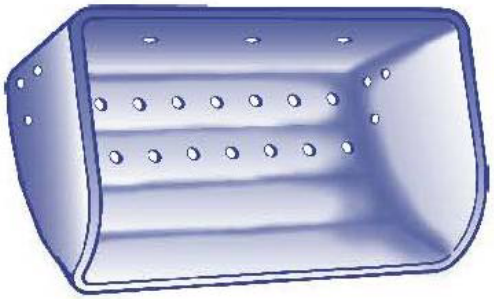
Vent Pattern 2

One row of 9/32" or 11/32" holes in body on 1-1/8" centers.



Vent Pattern 3

Two rows of 9/32" or 11/32" holes in body on 1-1/8" centers.



Vent Pattern 4

Two rows of 9/32" or 11/32" holes in body on 1-1/8" centers, three holes each end.

Bucket Venting

Venting can improve efficiency.

- For **dense materials**, such as flour, meals or mash feeds, the vents allow air to escape as the cups fill. During discharge, air can return into the cup preventing a vacuum that could hold product in the cup and cause back legging.
- For **extremely light materials** such as alfalfa or bran, venting minimizes blowing and turbulence in the leg. A reduction in air currents minimizes the vacuum which can draw a light product through the down leg and back to the boot.

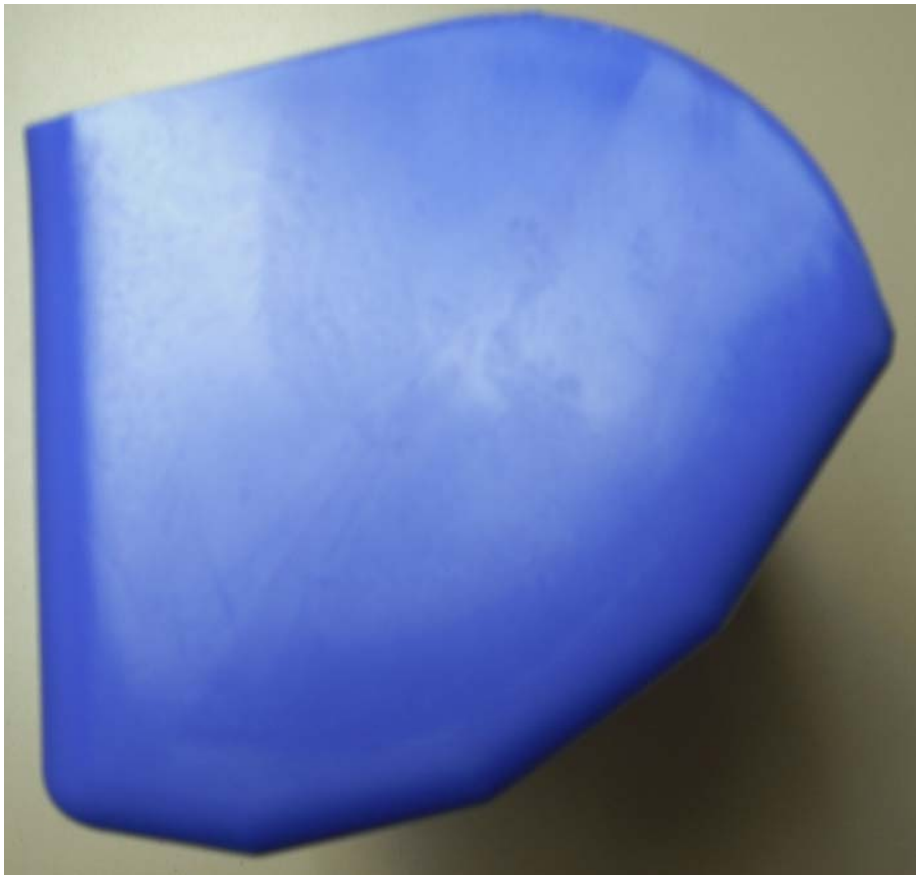
Normal Wear

Lip and front corners worn

- Reduces bucket capacity / inefficient discharge

- Replace bucket.

Signs of Abnormal Wear



New bucket

Damaged bucket

Signs of Abnormal Wear

Side abraded due to contact with elevator casing.

- Reduces bucket life.

- Adjust belt tracking.
- Tighten belt.

Signs of Abnormal Wear

Worn and torn from inside. Sandblast effect due to excessive entrance velocity.

- Reduces bucket life / effects capacity

- Replace with urethane bucket.

- Reduce conveyor input feed speed or install baffles.

Signs of Abnormal Wear

Front lip stretched out or broken due to impact with internal obstruction.

- Reduces bucket life / inefficient discharge
- Check casing, boot and throat plate clearances and for obstructions such as inspection doors or tramp metal. Tighten belt. Replace with Nylon.

Signs of Abnormal Wear

Sticky build up.

- Reduces bucket life. Adds weight and decreases capacity

- Replace with Urethane

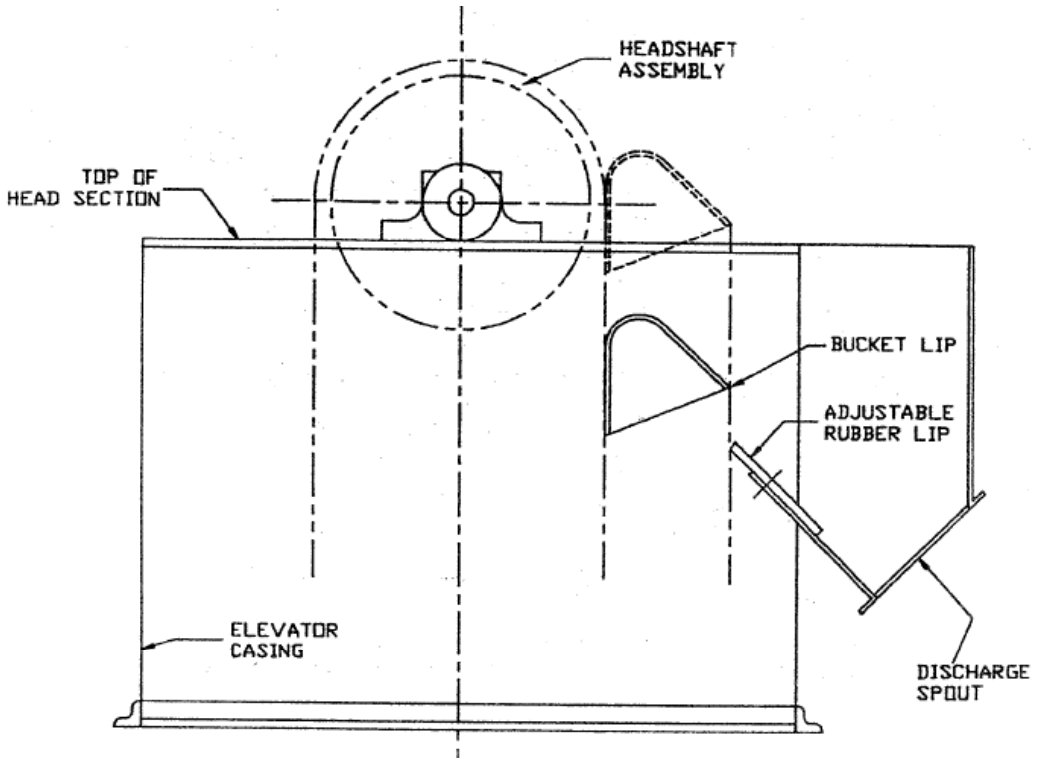
Signs of Abnormal Wear

- Extreme temperatures can weaken bucket integrity

Polyethylene:	Min:+93°C	Max: +93°C
Nylon:	Min: -40°C	Max: +135°C
Urethane:	Min: -51°C	Max: +100°C

Elevator Discharge Check List

- Bucket venting
- Belt tightness
- Pulley lagging
- Throat plate
- Spouting size
- Bucket filling speed
- Belt speed
- Motor drive to shaft V belt



Summary

- Check for damaged buckets or loose bolts
- Correctly replace worn buckets
- Check for belt wear, stretch or de-lamination
- Clean the boot area
- Check throat plate and adjust if necessary
- Clean around the elevator and drive equipment

Summary

To maximize elevator throughput and efficiency, have a regularly scheduled inspection program

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