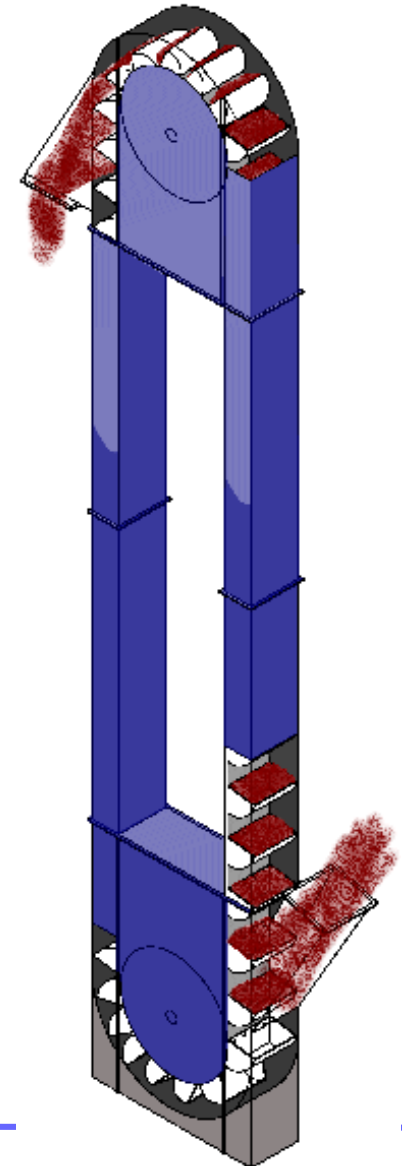


# Bucket Elevator

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<http://www2.hcmuaf.edu.vn/?ur=danngin>

# Objectives

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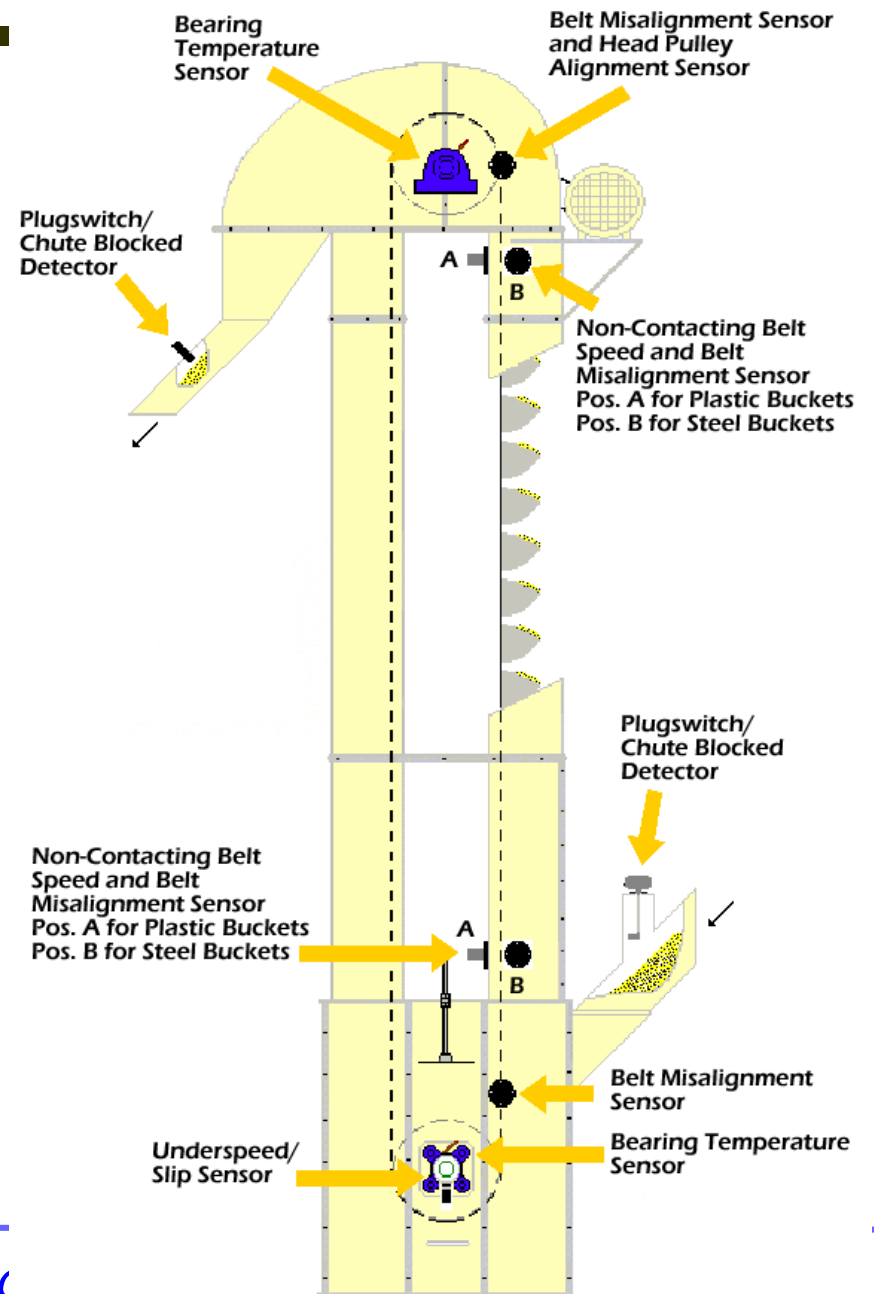
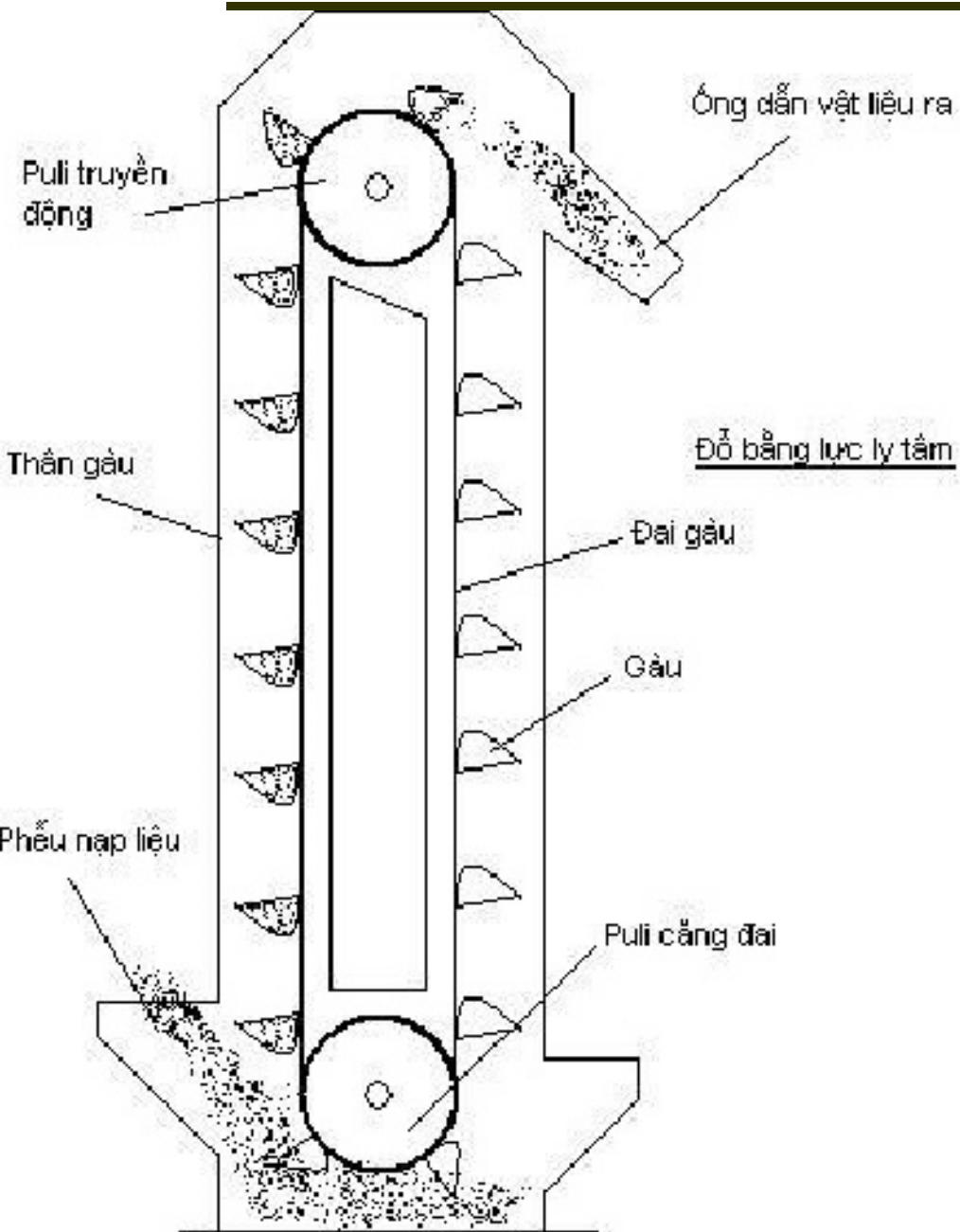
- **Definition**
- **General Characteristics**
- **Types of Bucket Elevators**
- **Parts of Bucket Elevators**
- **Capacity Calculation**
- **Power Requirement**
- **Gầu tải bang – xích**
- **Others types**

# 1. Definition/ Description (1)

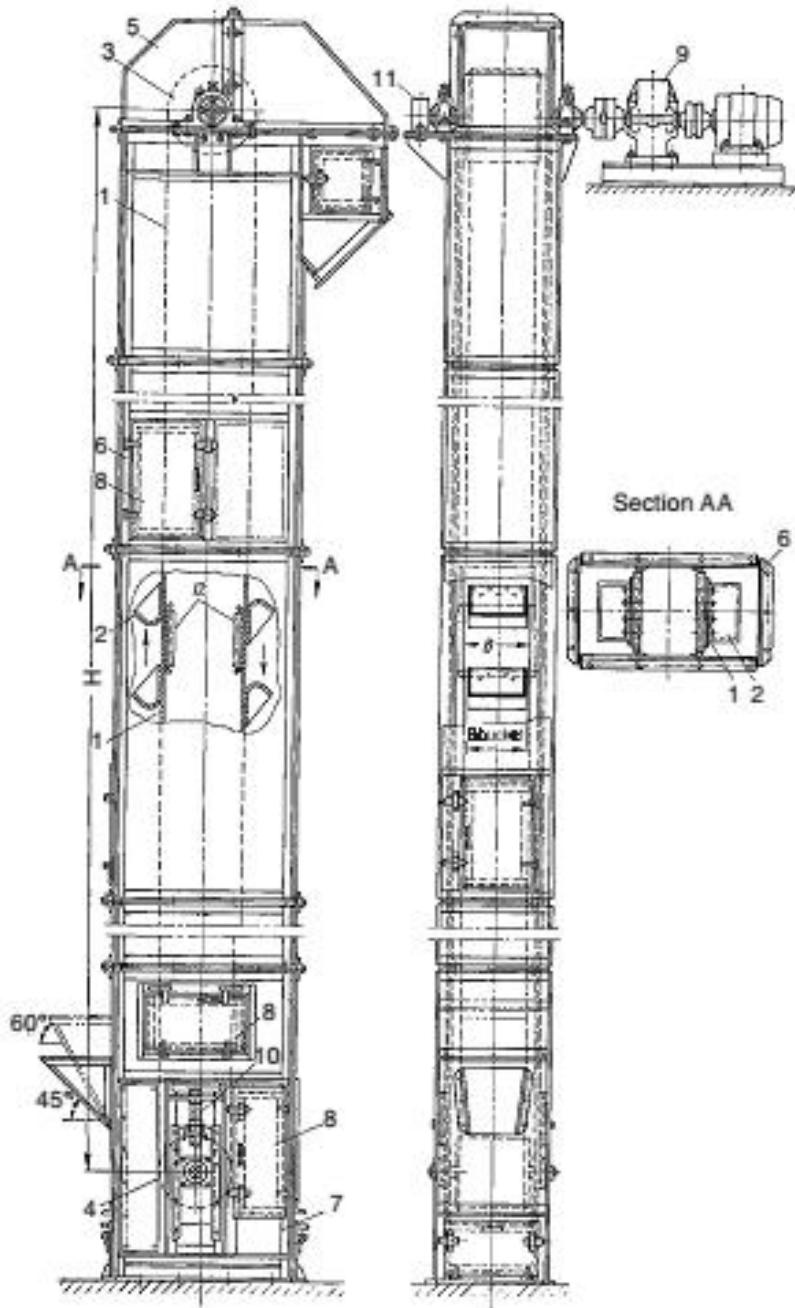
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- **These are powered equipment for conveying bulk materials in a vertical or steep inclined path, consisting of an endless belt, or chain/s to which metallic buckets are fixed. With the flexible belt/chain, the buckets move unidirectionally within a casing and collect bulk materials at bottom end of the equipment and delivers it at the top end.**
- **The vertical lift may be a few meters to more than 50 m.**
- **Capacity may vary from 2 to 4 t/hour to as much as 25, 50, or even 100 t/hour.**

# 1. Definition (2)



# A vertical belt-and-bucket elevator



- 1-belt;
- 2-bucket;
- 3-driving pulley;
- 4-take-up pulley;
- 5-upper casing section;
- 6-intermediate casing sections;
- 7-lower casing section (boot);
- 8-manholes;
- 9-drive unit;
- 10-take-up;
- 11- holdback brake;
- 12-guides.

## 2. General Characteristics (1)

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- i. An endless pulling member- flat belt or chain.**
- ii. Driving and take up pulleys or sprockets at top and bottom respectively, mounted on bearings and blocks.**
- iii. Metal casing covering the entire elevator. It consists of head at the top, boot at the bottom and intermediate sections, all joined at flanges by fasteners.**
- iv. Buckets, generally made out of sheet metal, which are attached at definite pitch to the pulling member by fasteners (screw and nuts, riveted etc.)**

## 2. General Characteristics (2)

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- i. Drive at the top consisting of an electric motor, gearbox, and couplings.**
- ii. Hold back brake attached to the top pulley/sprocket shaft, to prevent reverse motion of the elevator when drive is stopped.**
- iii. Feed hopper attached to the boot for feeding materials to the elevator.**
- iv. Delivery/ discharge spout fixed with the top part of the casing, through which the material is discharged.**
- v. Manholes are provided at the casing to check operations of the elevator.**
- vi. Guides and guide sprockets are provided for belt and chain respectively to keep them in a straight path.**

## 3. Types of bucket elevators

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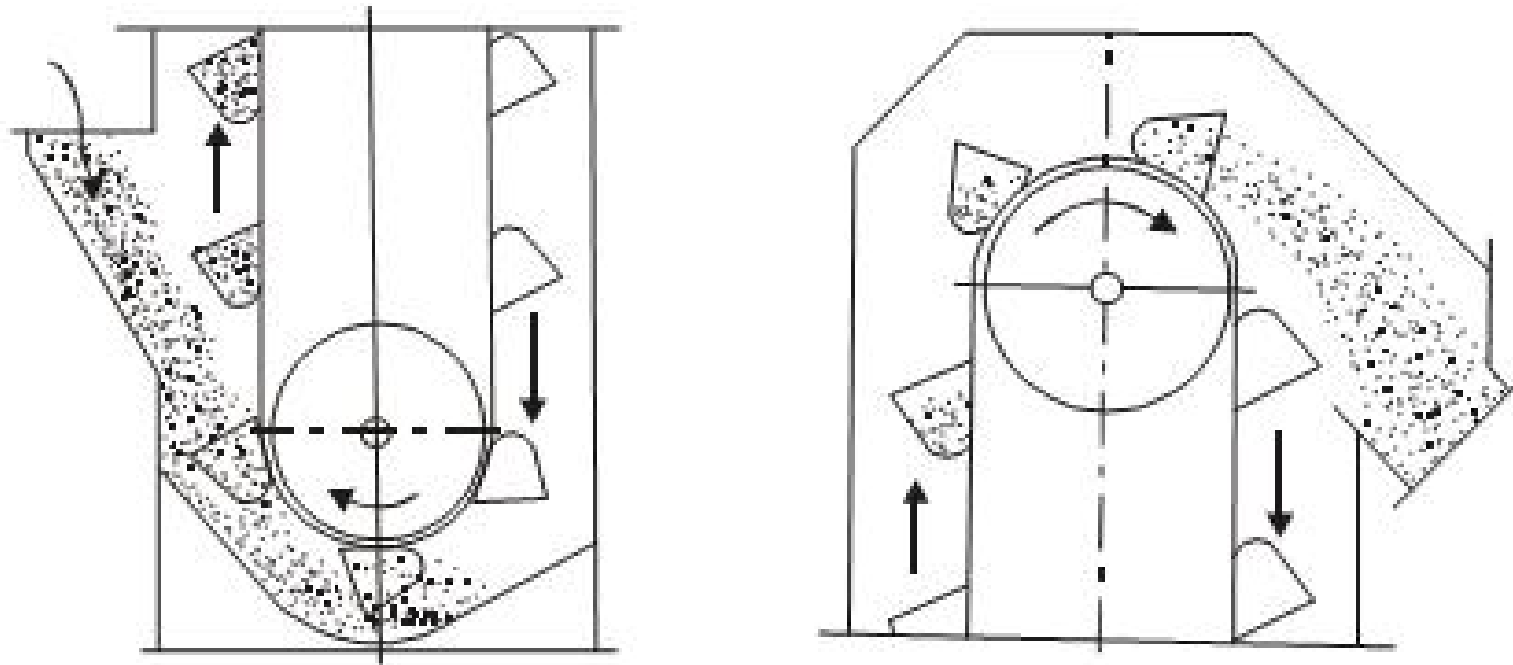
Bucket elevators are classified based on bucket spacing and mode of discharge of materials. As per IS:7167-1974, “Code for Selection and Use of Bucket Elevators,” they are classified into following three basic types.

- 1. Centrifugal discharge elevators  
(designated as type I)**
- 2. Positive discharge elevators (designated  
as type III)**
- 3. Continuous discharge elevators  
(designated as type II)**



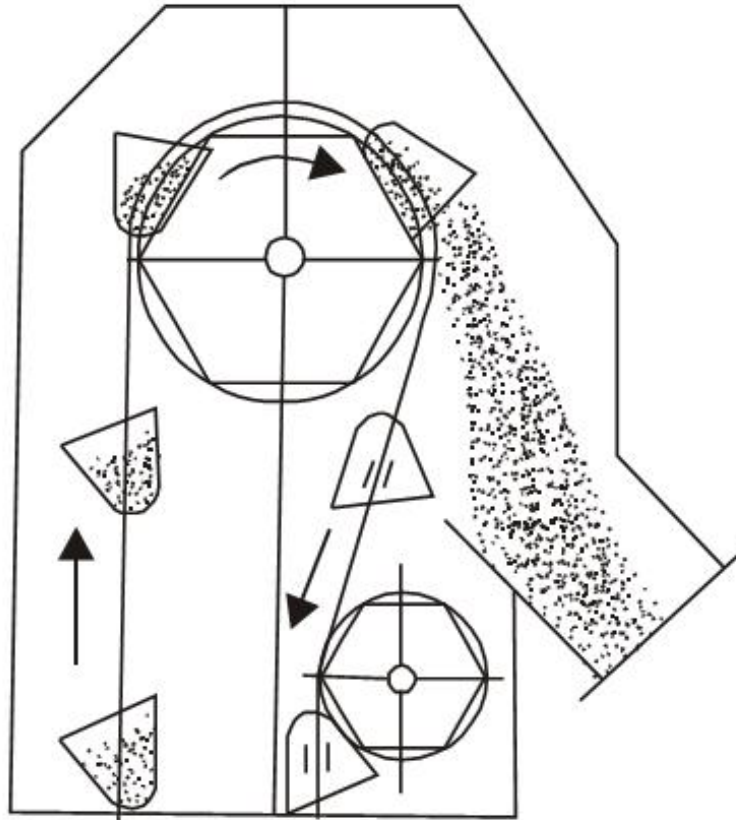
## 3.1. Centrifugal discharge elevators

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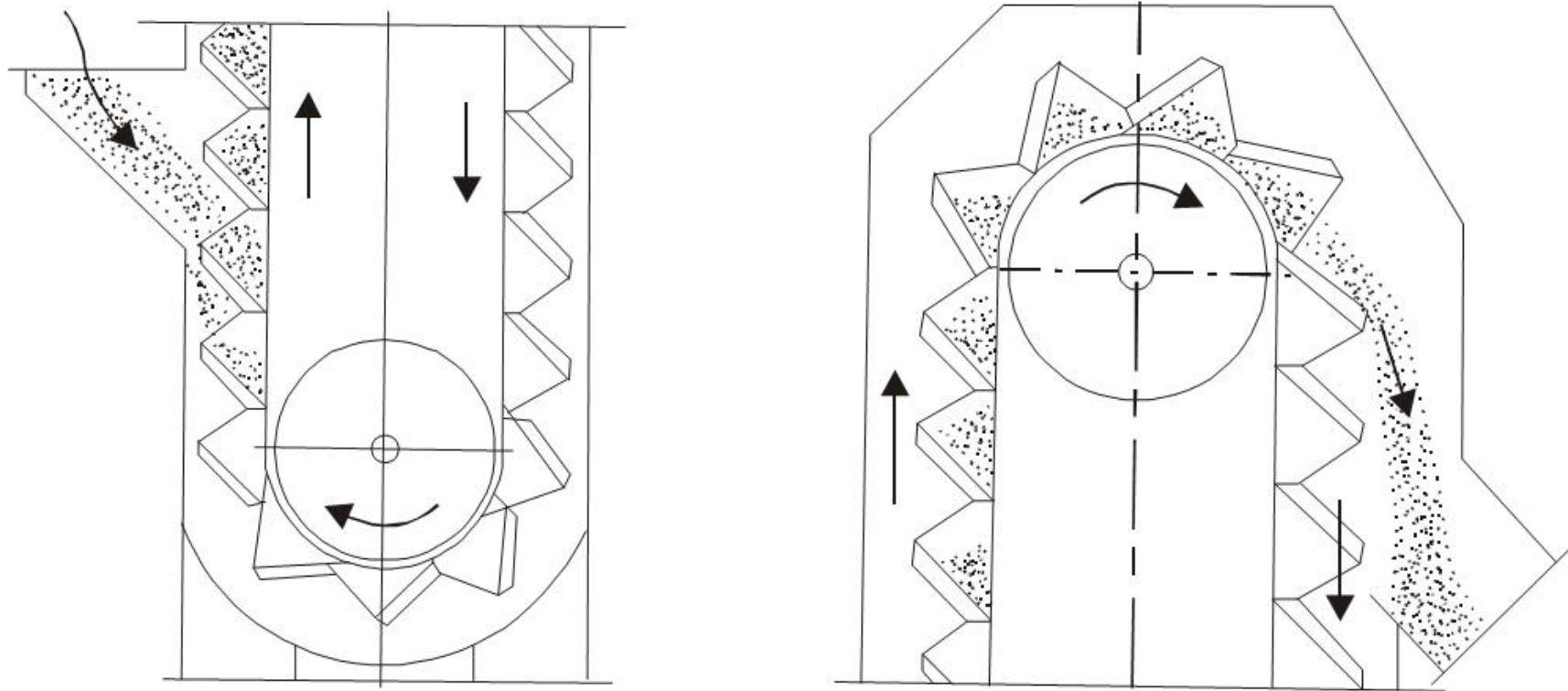
## 3.2. Positive discharge elevators

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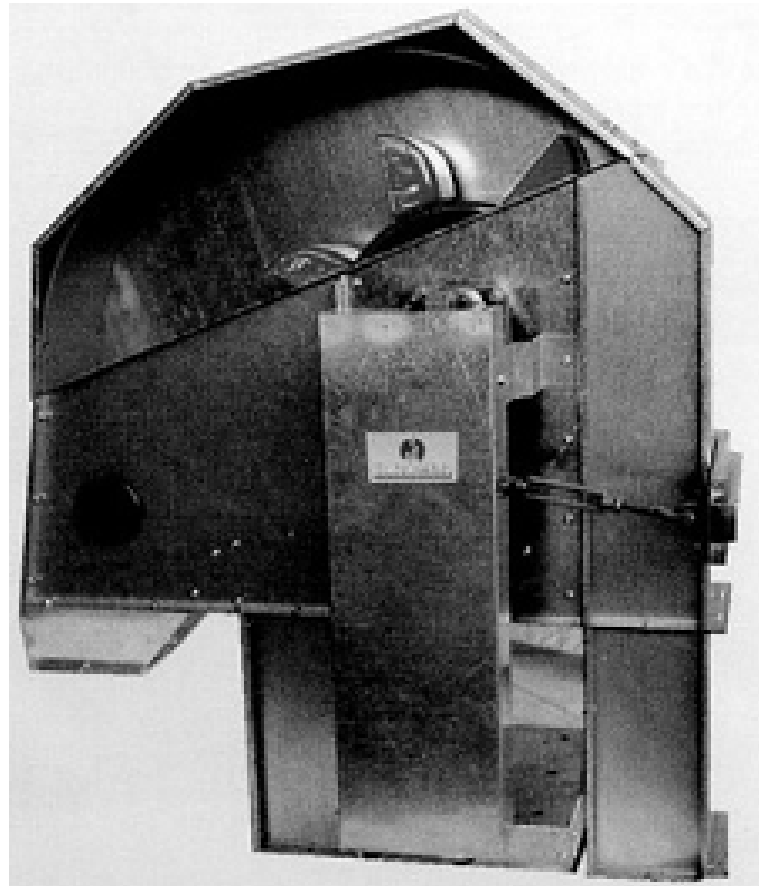
## 3.3. Continuous discharge elevators

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# Part cover removed head section

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## 3.5. Selection of type of elevator

Table. 8.4.1. Recommendation for Selection of Bucket Elevators

Materials	Bulk density, kg/m <sup>3</sup>	Belt /chain	Type of elevator (see note)
Alum, lumpy	800-960	Chain	I, III
Aluminum ore	1200-1350	Chain	I, III
Ashes	560-640	Chain	I
Bauxite, crushed and dry	1200-1350	Chain/belt	I, III
Carbon, black pelletized	320-400	Chain	III
Carbon, black powder	65-100	Chain	II
Cement, Portland	1200-1350	Chain	I, III
Chalk, pulverized	1120-1200	Belt / Chain	III
Coal anthracite	960	Chain/belt	I, III
Coke, loose	370-510	Belt	I
Gypsum calcined	880-960	Chain	I, III
Lime, ground	960	Chain	I, III
Lime, hydrated	560-720	Chain/belt	III
Malt, dry ground	320-335	Belt/ Chain	I, II
Rice, bran	320	Belt/ Chain	I
Salt, dry coarse	720-800	Belt/ Chain	I, III
Sand, damp	1760-2080	Belt/ Chain	I
Sand dry	1440-1760	Belt	I
Sugar raw	880-1040	Chain/belt	I
Talc	800-960	Belt	I

## 4. Parts of a Bucket Elevator

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- 1.HEAD SHAFT: with pulley for belting or sprockets for chain.
- 2.THE DRIVE, gear reducer, and motor drives, which may be V-belt, AN drive chain and sprockets, or direct-coupled with flexible coupling or shaft-mounted reducer.
- 3.FOOT SHAFT: with pulley or sprockets.
- 4.ELEVATOR BUCKETS mounted on belt or chain
- 5.THE ELEVATOR HOUSES the bucket and belting or chain assembly and general provide mounting and enclosure for the rotating machinery.
- 6.PLATFORMS, LADDERS, AND HOIST BEAMS are frequently mounted on elevator housings for maintenance access.

## 4.1. Bucket of Bucket Elevators

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- The different components of a bucket elevator have been mentioned under “descriptive specification” in section 8.4.1 (A). The buckets used in a bucket elevator needs further elaborations
- Buckets are classified into two types from consideration of their shape: Rounded bottom buckets are used in spaced bucket elevators and are classified as A1, A2, A3 and A4 type. V-type buckets are used in continuous bucket elevators, and are classified as B1, B2, B3 and B 4 type. Fig. 8.4.5 illustrates geometrical features of the various types of buckets.
- Specified dimensions of these buckets namely length, projection, depth and capacity of the individual buckets are given in IS:6833-1973. Table 8.4.2 below indicates only the range of recommended dimensions of such buckets

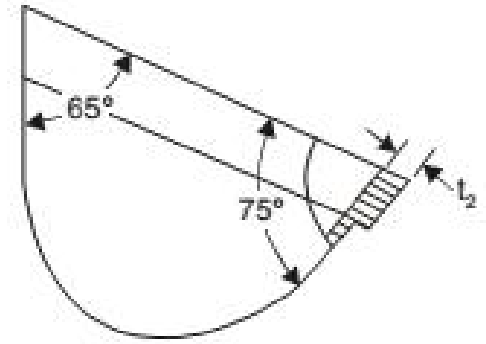
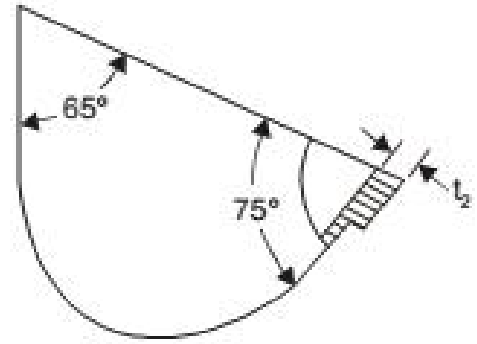
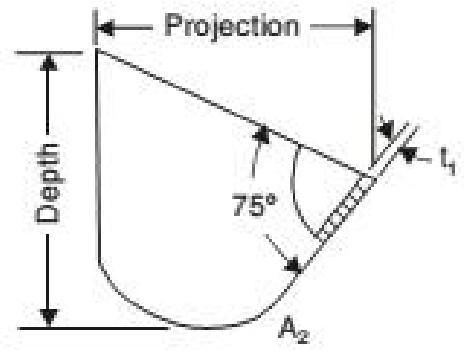
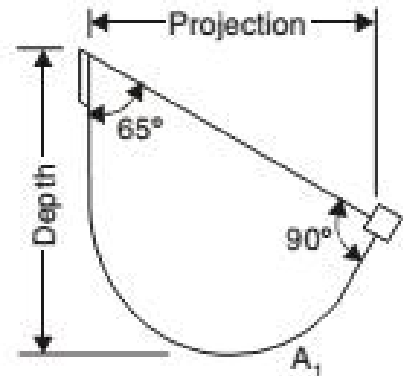
## 4.1.1 Range of dimensions for buckets

Table 8.4.2. Range of dimensions for buckets.

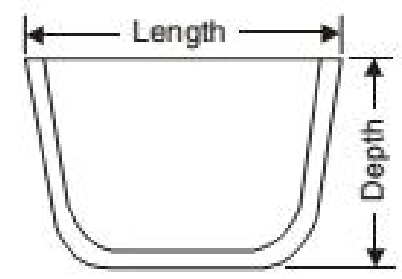
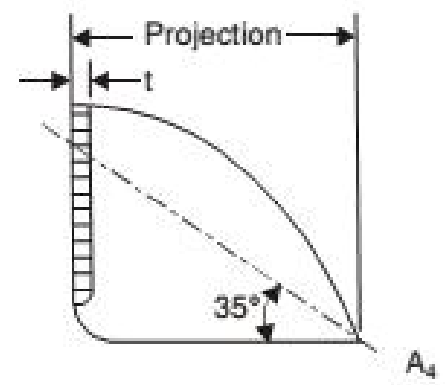
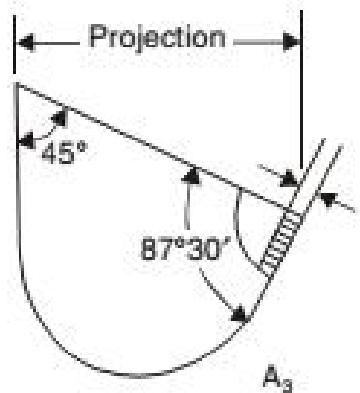
Bucket Type	Range of Bucket Size, mm			Capacity, litres	
	Length, mm	Projection, mm	Depth, mm		
A <sub>1</sub>	150 to 1000	95 to 250	100 to 260	0.87 to 36.50	
A <sub>2</sub>	150 to 1000	100 to 255	110 to 270	0.85 to 38.00	
A <sub>3</sub>	150 to 410	90 to 165	130 to 230	0.71 to 6.80	
A <sub>4</sub>	150 to 410	115 to 180	100 to 140	0.735 to 4.47	<b>S dimension</b>
B <sub>1</sub> and B <sub>4</sub>	150 to 610	75 to 300	145 to 460	0.81 to 41.0	20 to 50 for B <sub>1</sub>
B <sub>2</sub>	150 to 610	75 to 300	145 to 460	0.81 to 41.0	20 to 50
B <sub>3</sub>	150 to 610	75 to 300	145 to 460	0.93 to 45.6	



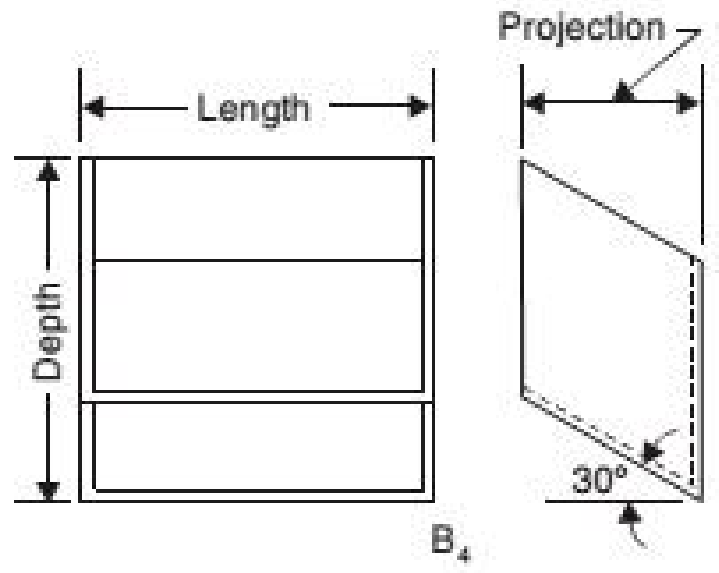
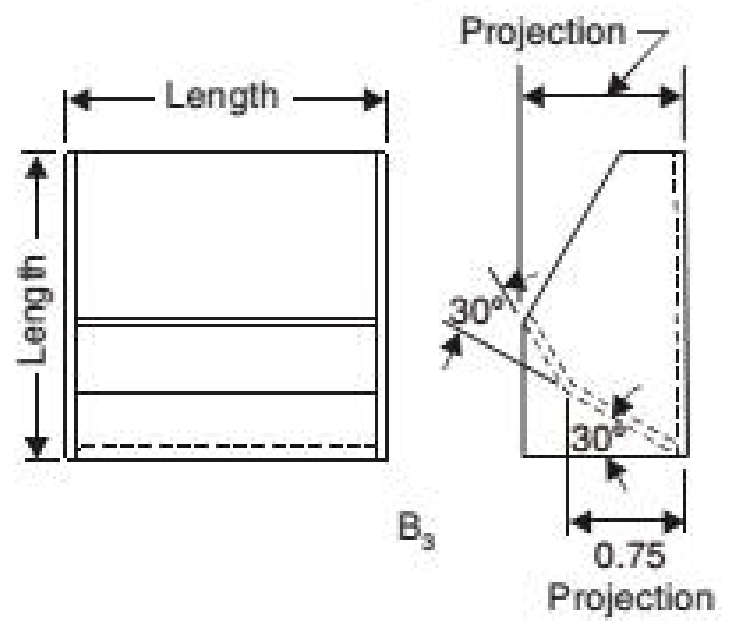
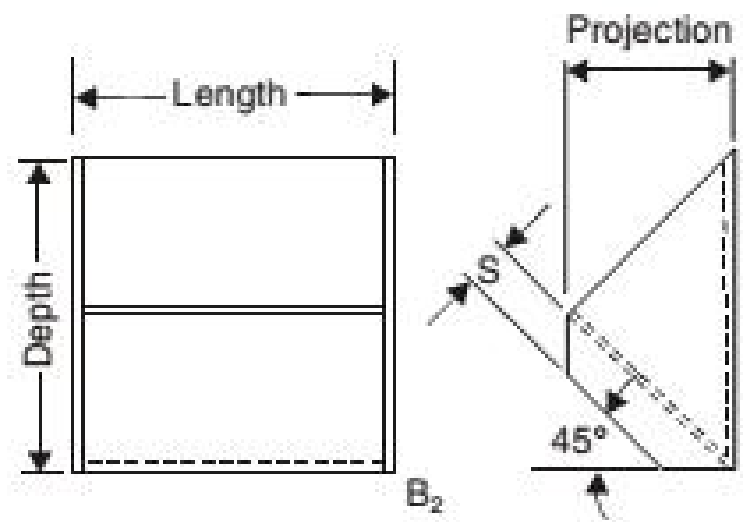
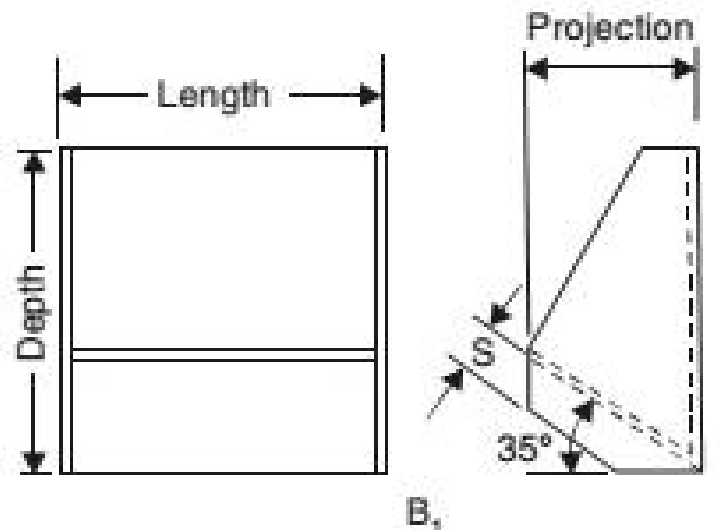
# 4.1.2. Geometrical features of various types of buckets (1)



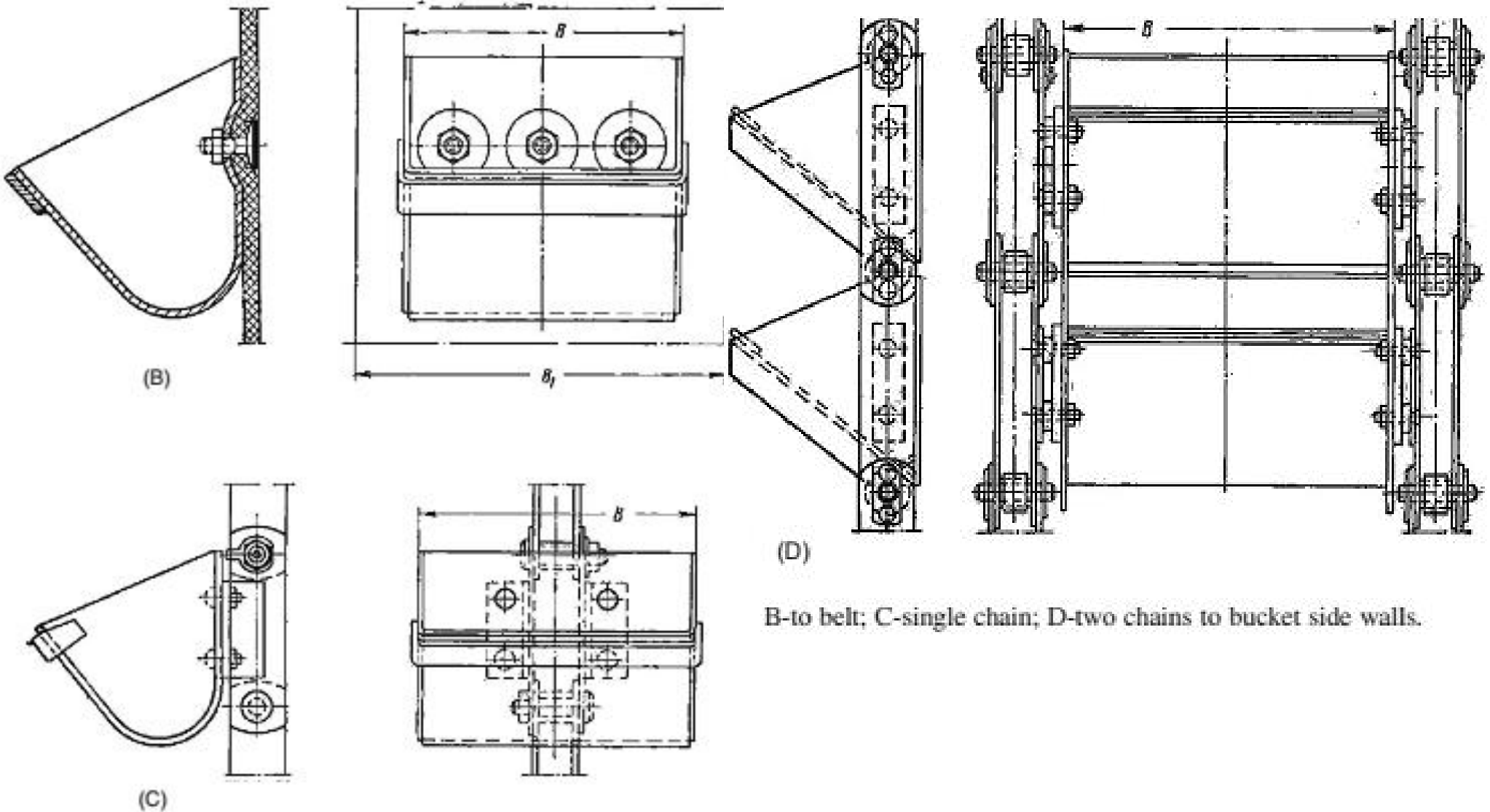
A<sub>2</sub> with reinforcement of rim



# 4.1.2. Geometrical features of various types of buckets (2)



## 4.1.3. Typical bucket fixing arrangement



## 4.1.4. Fixing arrangement of buckets

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- **Fixing of buckets to belt - B.**
  - **Fixing of buckets to chains passing through back of buckets – C**
  - **Fixing of buckets to chains passing through side of buckets - D**
- Typical bucket fixing arrangements are shown in Fig. 8.4.6.**

## 4.1.5. Selection of Bucket

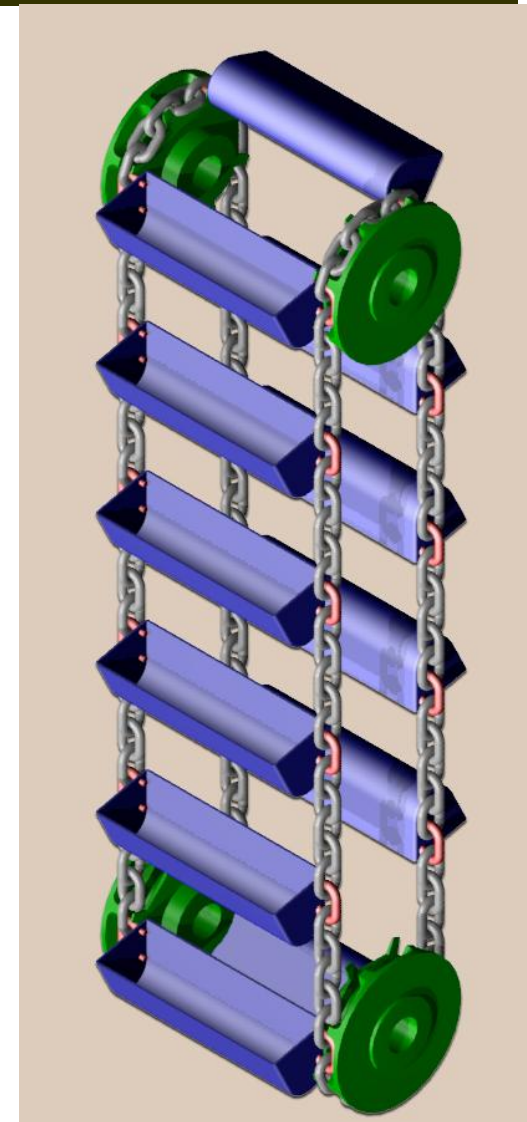
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Table 8.4.3. Selection of Bucket

Type of elevator discharge	Type of bucket IS:6833	Recommended Application
Centrifugal and positive discharge	A <sub>1</sub>	For powdered and free flowing material.
	A <sub>2</sub>	For cement, coal, sand, gravel, stone, ores, fertilisers.
	A <sub>3</sub>	For wet, stinky materials. Also for coarse broken materials.
	A <sub>4</sub>	Sugar, clay, salt, wet ores.
Continuous discharge	B <sub>1</sub>	For pulverized and sluggish materials that stick.
	B <sub>2</sub>	For average materials.
	B <sub>3</sub>	For large lumps and extra capacity.
	B <sub>4</sub>	For inclined elevators.

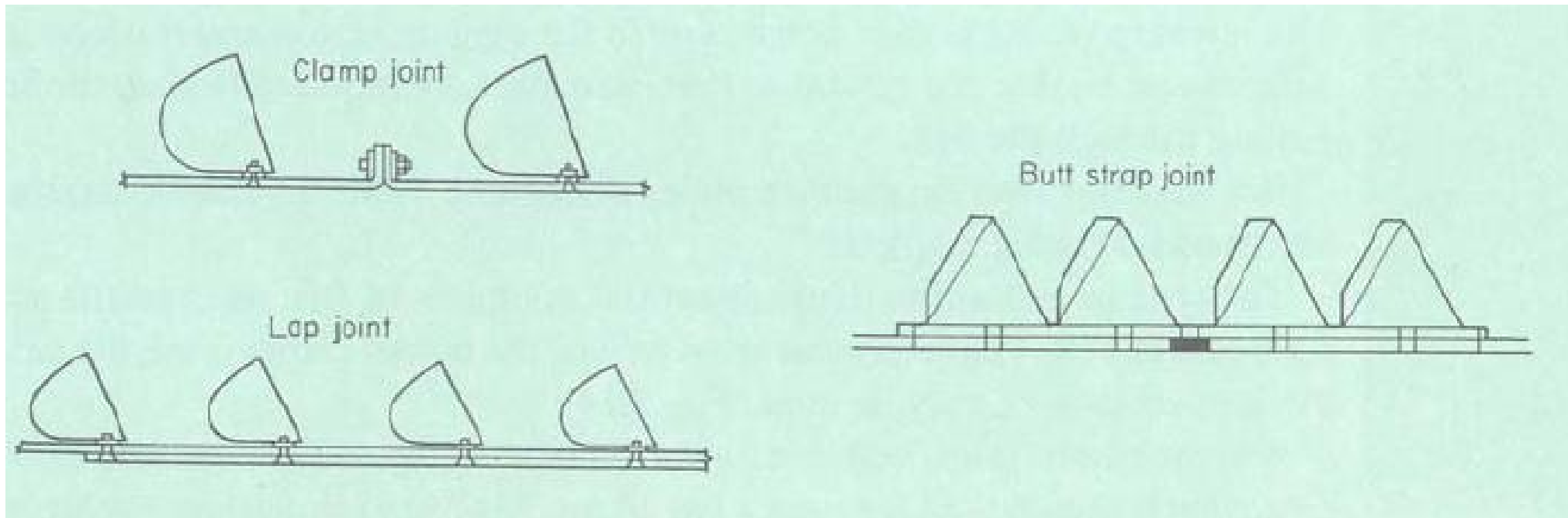
## 4.1.6. Belts for bucket elevator

- Belts
- Chains



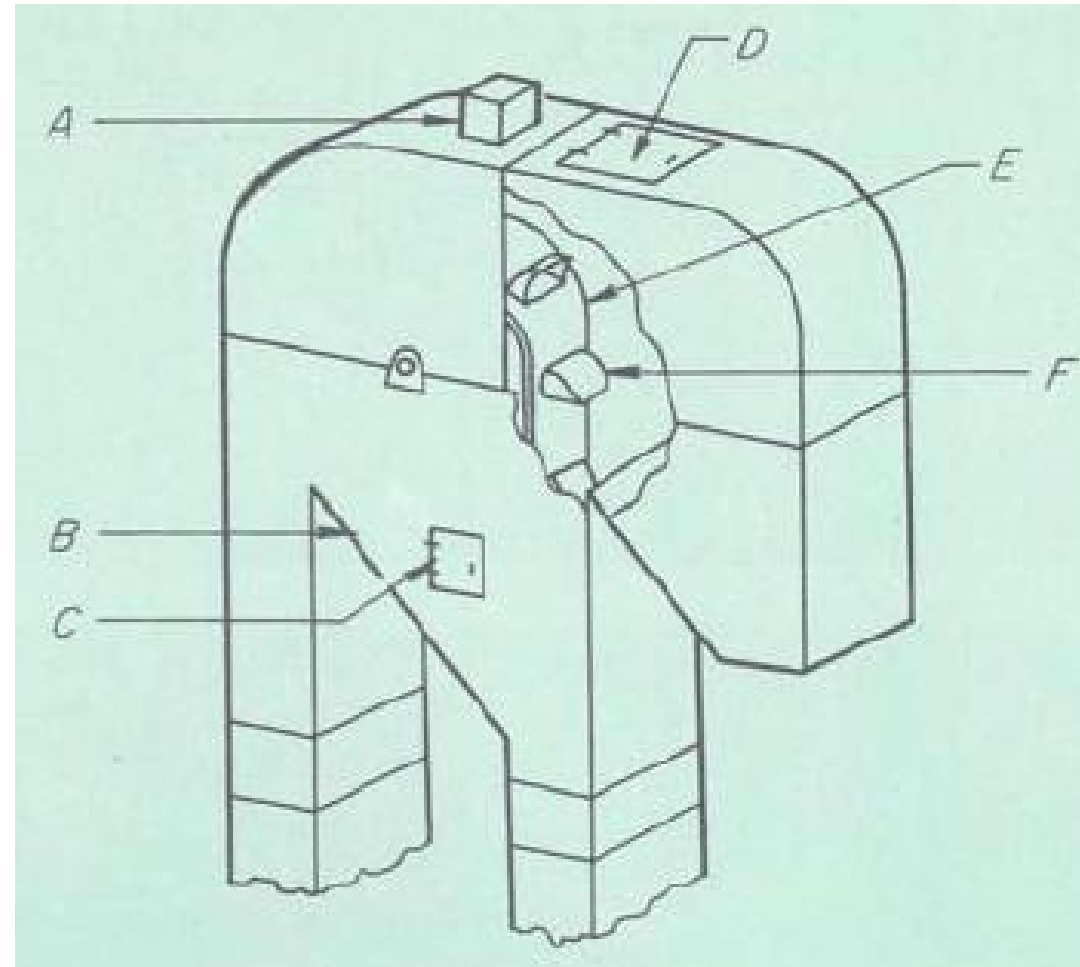
## 4.1.7. Splicing elevator belts.

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## 4.2. Elevator Head Section (1)

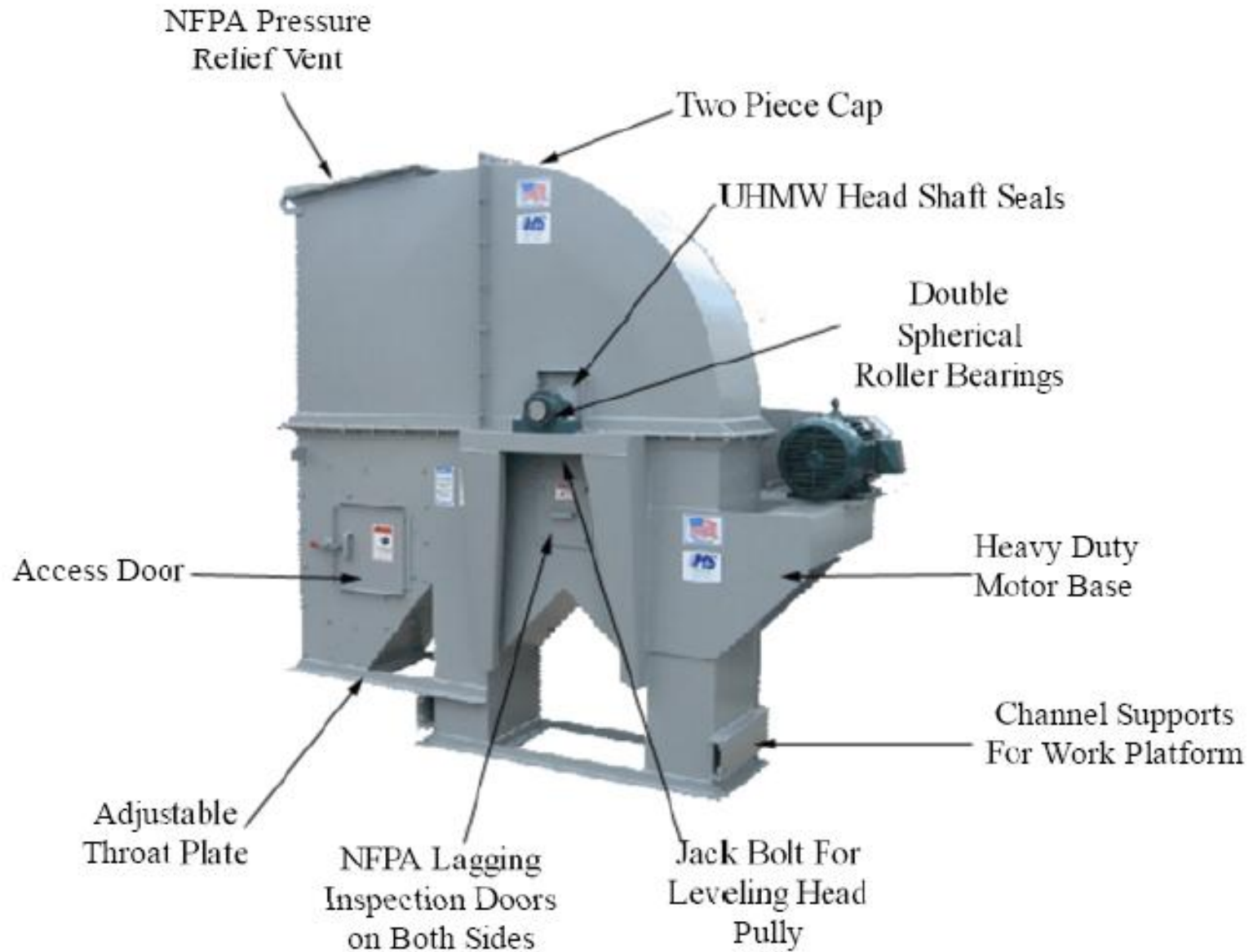
- A, sprinkler head and alarm;**
- B, strut slanted to down leg;**
- C, cleanout opening;**
- D, inspection door;**
- E, lagged head pulley;**
- F, buckets. Belt should be 2.5 cm wider than buckets, pulley should be 2 cm wider than belt.**





## 4.2. Elevator Head Section (2)

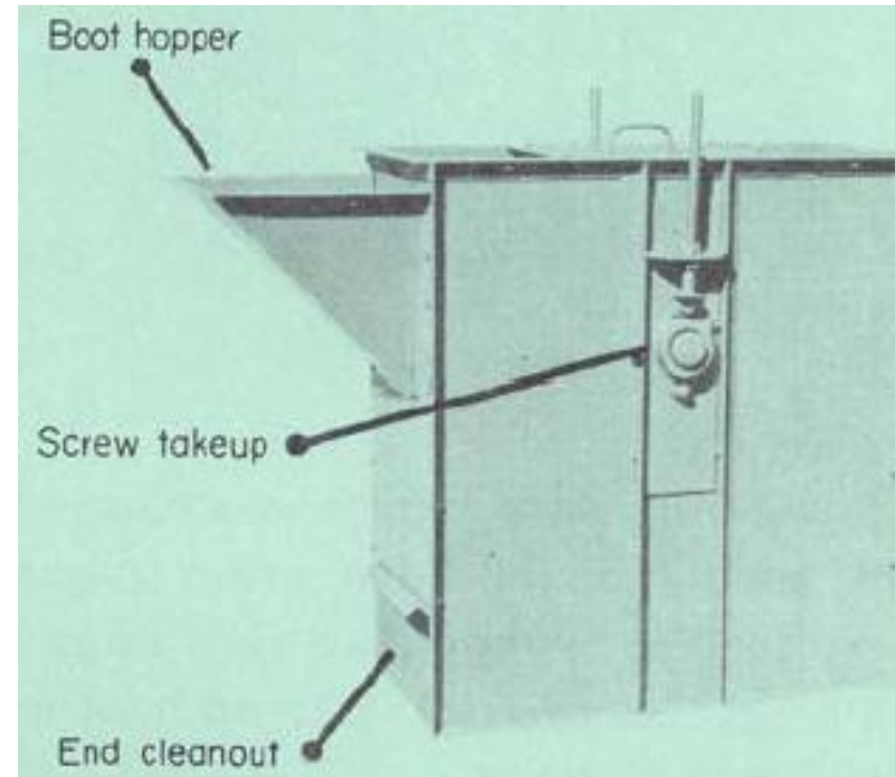
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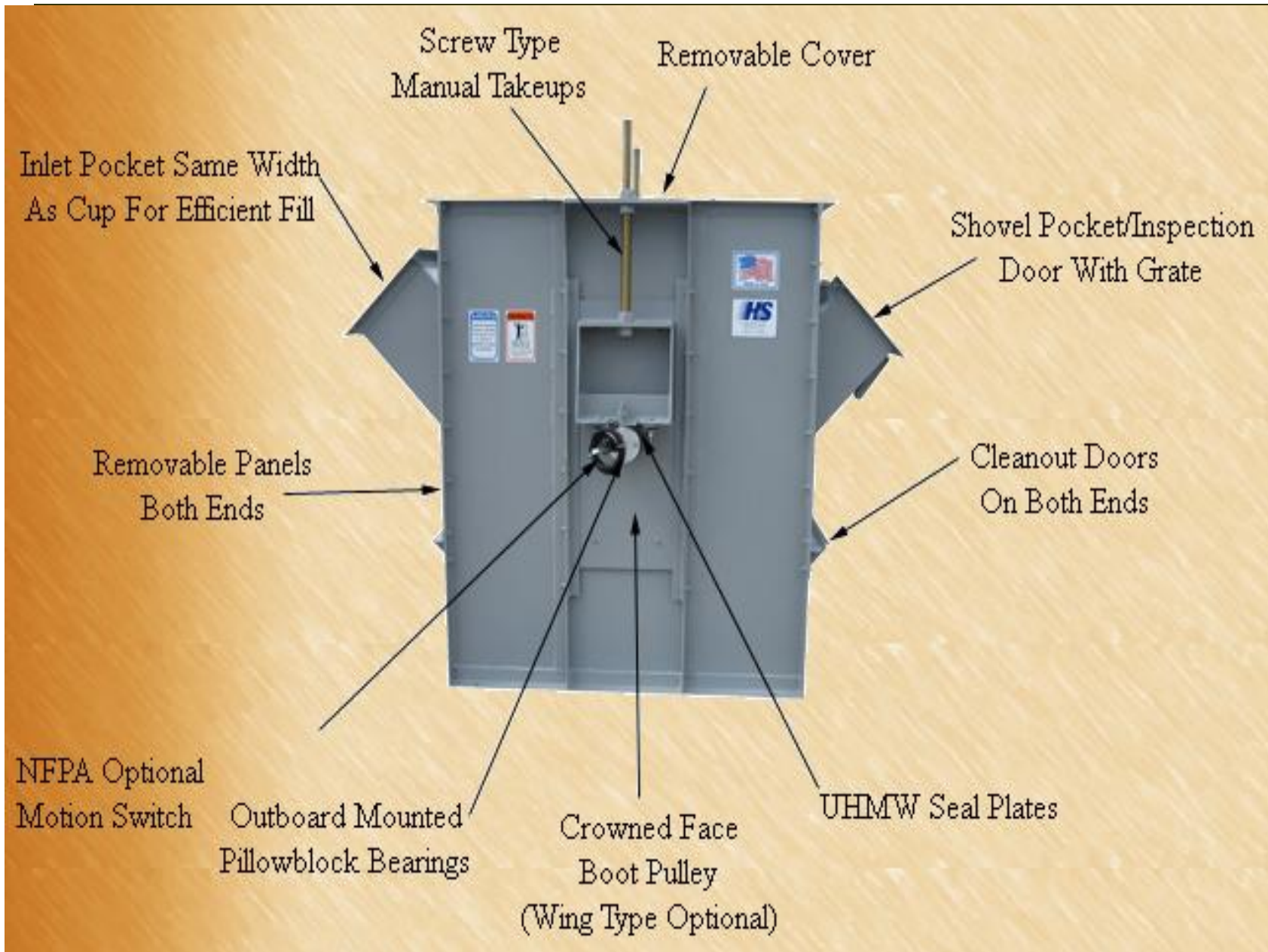
## 4.3. Elevator boot section (1)

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Most bucket elevators provide in the boot section a belt take-up device to tighten the belt as required and to train it so that it runs true and does not rub on either side of the boot. A manual screw-type takeup is most often used. On tall, heavy-capacity legs an automatic take-up boot pulley is used. This provides the correct belt tension at all times



## 4.3. Elevator boot section (2)



<http://www.encler.com/vr/10-04-01-01>

## 5. Capacity Calculation

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$$Q = \frac{C \times F}{1000} \times \frac{3600v}{s} \times \frac{\rho}{1000} \text{ tph}$$

where, C = capacity of each bucket, litres

F = bucket filling factor, a constant.

v = elevator speed, m/sec

s = bucket spacing, m

$\rho$  = material bulk density, kg/m<sup>3</sup>.

# Bucket Filling Factor

**Table 8.4.4. Bucket Filling Factor, F**

Material Characteristics	Type of Bucket Elevator	F
Powdered (ground) <i>e.g.</i> coal dust, cement, chalk, phosphate fertiliser etc.	Positive discharge	0.85
	Centrifugal discharge	0.75
Granular and small lumped (60 mm) mildly abrasive <i>e.g.</i> saw dust, dry clay in lumps, coal peat, grain, etc.	Centrifugal discharge	0.7 to 0.8
Granular and small lumped (60 mm) highly abrasive <i>e.g.</i> gravel, ore, slag, sand, ash, earth, rock, etc.	Continuous discharge	0.7 to 0.85
	Centrifugal discharge	0.5 to 0.7
Medium and large lumped (60 mm) highly abrasive <i>e.g.</i> crushed ore, stone, slag	Continuous discharge	0.6 to 0.8
Lumped, fragile, down graded by crushing <i>e.g.</i> charcoal, coke etc.	Continuous discharge	0.6
Sluggish, powdered and granular, moist <i>e.g.</i> moist chemicals, fluffed peat, earth, wet sand, wet powdered chalk etc.	Positive discharge	0.4 to 0.6
	Centrifugal discharge	0.4 to 0.6

## 6. Power requirements

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$$hp = \frac{Q H F}{4562}$$

Q: capacity (kg/min)

H: Lift (meter)

F = 1,5 for elevators loaded on the down side of the boot,  
= 1,2 for elevators loaded on the up side of the boot.

Actual horsepower requirements are 10 to 15% higher than this theoretical value because of friction, power transmission, and drive losses.

## 7. Gàu tải băng – Gàu tải xích:

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- Vận chuyển vật liệu dạng bột, hạt, cục nhỏ, khô.
  - Dễ nạp và tháo liệu.
  - Làm việc êm, tốc độ chuyển động của băng từ 0,8 – 3,5m/giây.
  - Năng suất đến 80m<sup>3</sup>/giờ.
  - H = 50m.
  - Hạn chế về độ bền của băng.
- Vận chuyển vật liệu dạng cục to, ẩm.
  - Khó xúc.
  - Làm việc nặng, tốc độ chuyển động của băng từ 0,4 – 1,6m/giây.
  - Năng suất đến 300m<sup>3</sup>/giờ.
  - Gàu 1 xích có bề rộng 160 – 250 mm, gàu 2 xích làm việc với gàu rộng hơn.

## 8. Ưu nhược điểm của gàu tải

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- Kích thước bao trong hình chiếu bằng nhỏ, dải năng suất từ 5 – 30 m<sup>3</sup>/h. Chiều cao nâng lớn, cá biệt có thể đạt đến 75m.
- Không cho phép quá tải, cấp liệu một cách điều hòa. Trường hợp quan trọng cần đặt thêm một gàu tải phụ.



## 9. Other types

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