Material Handling Systems

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Major Equipment Categories

- If the only tool you have is a hammer, it's amazing how quickly all your problems seem to look like nails…
- *5 categories*
- ***Transport Equipment***.
  - Equipment used to move material from one location to another (e.g., between workplaces, between a loading dock and a storage area, etc.).
- ***Positioning Equipment***.
  - Equipment used to handle material at a single location

Major Equipment Categories

- ***Unit Load Formation Equipment*.**
  - Equipment used to restrict materials so that they maintain their integrity when handled a single load during transport and for storage.
- ***Storage Equipment*.**
  - Equipment used for holding or buffering materials over a period of time.
  - Some may include the transport of materials (e.g., the S/R machines of an AS/RS, or storage carousels).
- ***Identification and Control Equipment***.
  - collect and communicate the information of the flow of materials
    - within a facility and
    - between a facility and its suppliers and customers.

I. Transport Equipment			
A. Conveyors	B. Cranes	C. Industrial Trucks	D. No Equipment
1. Chute conveyor	1. Jib crane	1. Hand truck	1. Manual
2. Wheel conveyor	2. Bridge crane	2. Pallet jack	
3. Roller conveyor	3. Gantry crane	3. Walkie stacker	
4. Chain conveyor	4. Stacker crane	4. Pallet truck	
5. Slat conveyor		5. Platform truck	
6. Flat belt conveyor		6. Counterbalanced lift truck	
7. Magnetic belt conveyor		7. Narrow-aisle straddle truck	
8. Troughed belt conveyor		8. Narrow-aisle reach truck	
9. Bucket conveyor		9. Turret truck	
10. Vibrating conveyor		10. Order picker	
11. Screw conveyor		11. Sideloader	
12. Pneumatic conveyor		12. Tractor-trailer	
13. Vertical conveyor		13. Personnel and burden carrier	
14. Cart-on-track conveyor		14. Automatic guided vehicle	
15. Tow conveyor			
16. Trolley conveyor			
17. Power-and-free conveyor			
18. Monorail			
19. Sortation conveyor			

II. Positioning Equipment	III. Unit Load Formation Equipment	IV. Storage Equipment	V. Identification and Control Equipment
1. Manual (no equipment)	1. Self-restraining (no equipment)	1. Block stacking (no equipment)	1. Manual (no equipment)
2. Lift/tilt/turn table	2. Pallets	2. Selective pallet rack	2. Bar codes
3. Dock leveler	3. Skids	3. Drive-in rack	3. Radio frequency identification tags
4. Ball transfer table	4. Slipsheets	4. Drive-through rack	4. Voice recognition
5. Rotary index table	5. Tote pans	5. Push-back rack	5. Magnetic stripes
6. Parts feeder	6. Pallet/skid boxes	6. Flow-through rack	6. Machine vision
7. Air film device	7. Bins/baskets/racks	7. Sliding rack	7. Portable data terminals
8. Hoist	8. Cartons	8. Cantilever rack	
9. Balancer	9. Bags	9. Stacking frame	
10. Manipulator	10. Bulk load containers	10. Bin shelving	
11. Industrial robot	11. Crates	11. Storage drawers	
	12. Intermodal containers	12. Storage carousel	
	13. Strapping/tape/glue	13. Vertical lift module	
	14. Shrink-wrap/ stretch-wrap	14. A-frame	
	15. Palletizers	15. Automatic storage/ retrieval system	

I. Transport Equipment – Conveyors

- Conveyors are used:
  - When material is to be moved
    - frequently between specific points
    - To move materials over a fixed path
  - When there is a sufficient flow volume to justify the fixed conveyor investment
- Conveyors can be classified in different ways:
  - Type of product being handled: *unit* load //*bulk* load
  - Location of the conveyor: *in-floor*// *on-floor*, // *overhead*
  - On the conveyor, loads can: *accumulate* // *no accumulation* is possible

I. Transport Equipment – Conveyors

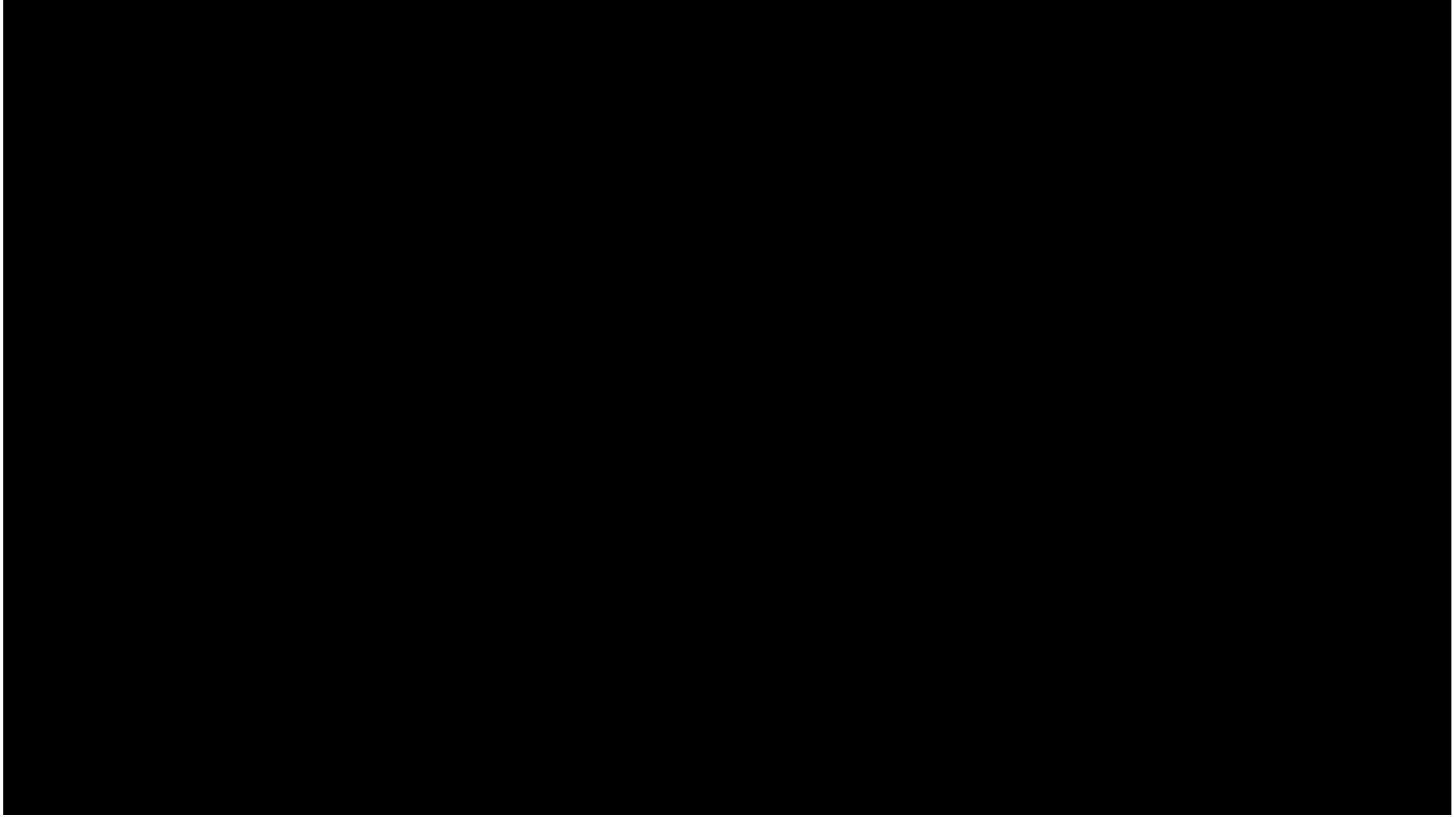
1. Chute conveyor

- Unit/Bulk + On-Floor + Accumulate
- Inexpensive
- Used to link two handling devices
- Used to provide accumulation in shipping areas
- Used to convey items between floors
- Difficult to control position of the items

I. Transport Equipment – Conveyors

2. Wheel conveyor

- Unit + On-Floor + Accumulate
- Uses a series of skatewheels mounted on a shaft (or axle)
- More economical than the roller conveyor
- For light-duty applications
- Flexible, expandable mobile versions available



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I. Transport Equipment – Conveyors

3. Roller conveyor

- Unit + On-Floor + Accumulate
- May be powered (or live) or nonpowered (or gravity)
- Materials must have a rigid riding surface

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I. Transport Equipment – Conveyors

4. Chain conveyor

- Unit + In-/On-Floor + No Accumulation
- Uses one or more endless chains on which loads are carried directly

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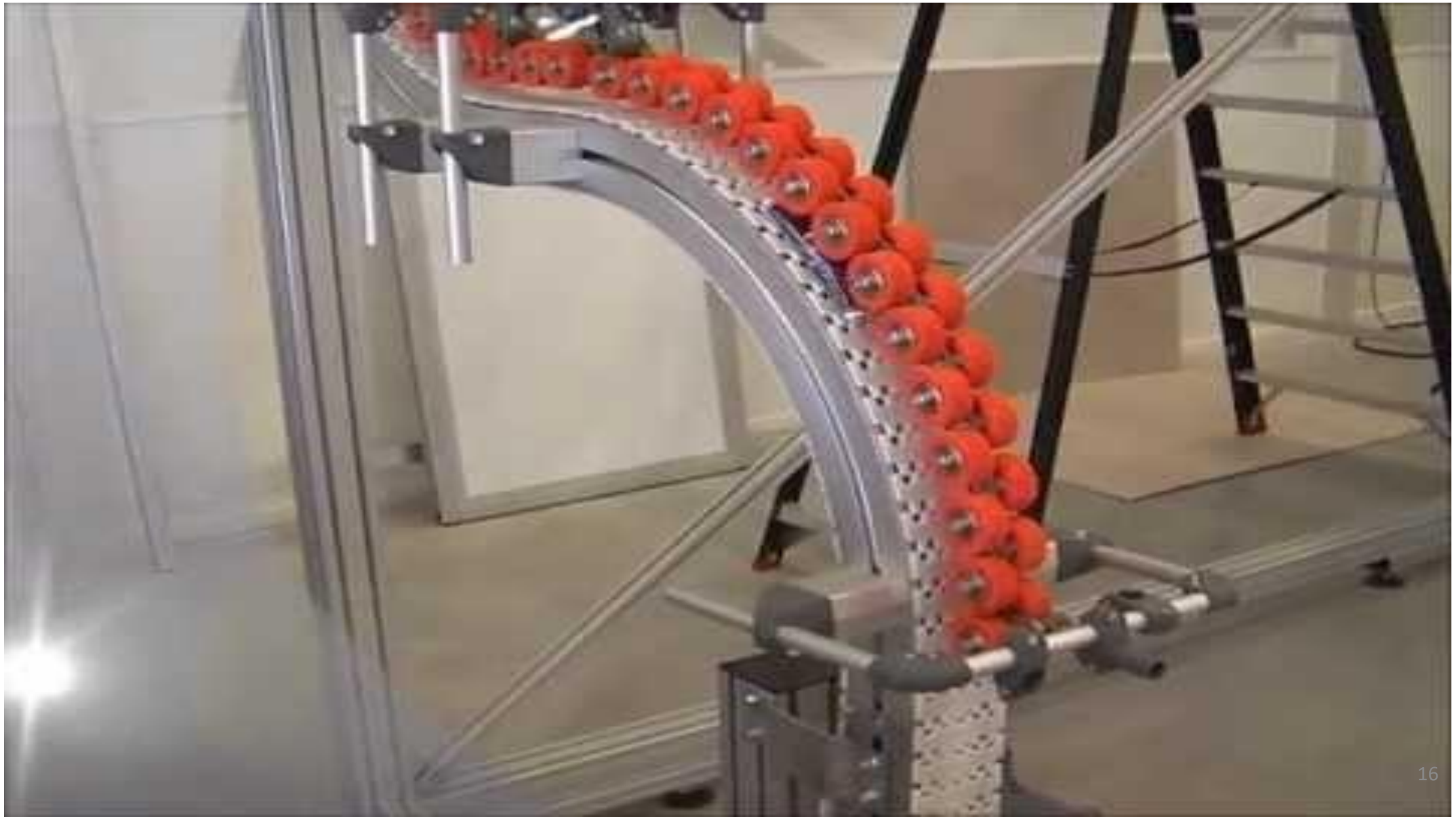

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I. Transport Equipment – Conveyors

5. Slat conveyor

- Unit + In-/On-Floor + No Accumulation
- Uses discretely spaced slats connected to a chain
- Unit being transported retains its position (like a belt conveyor)
- Used for heavy loads or loads that might damage a belt
- *Bottling and canning plants* use flat chain or slat conveyors because of wet conditions, temperature, and cleanliness requirements

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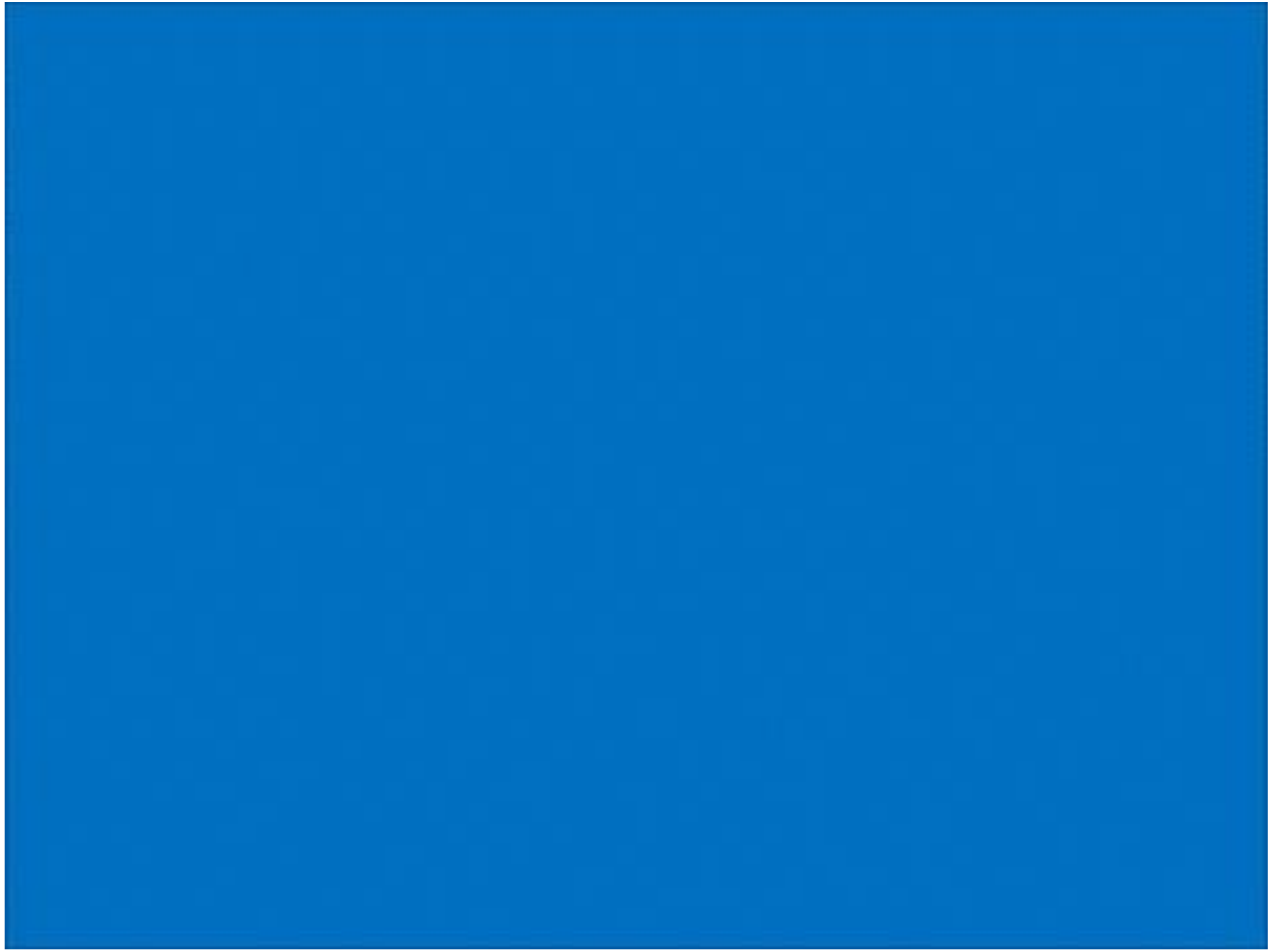
I. Transport Equipment – Conveyors

6. Flat belt conveyor

- Unit + On-Floor + No Accumulation
- For transporting light- and medium-weight loads between operations, departments, levels, and buildings



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I. Transport Equipment – Conveyors

7. Magnetic belt conveyor

- Bulk + On-Floor
- A steel belt and either a magnetic slider bed or pulley is used
- To transport ferrous materials vertically, upside down, and around corners

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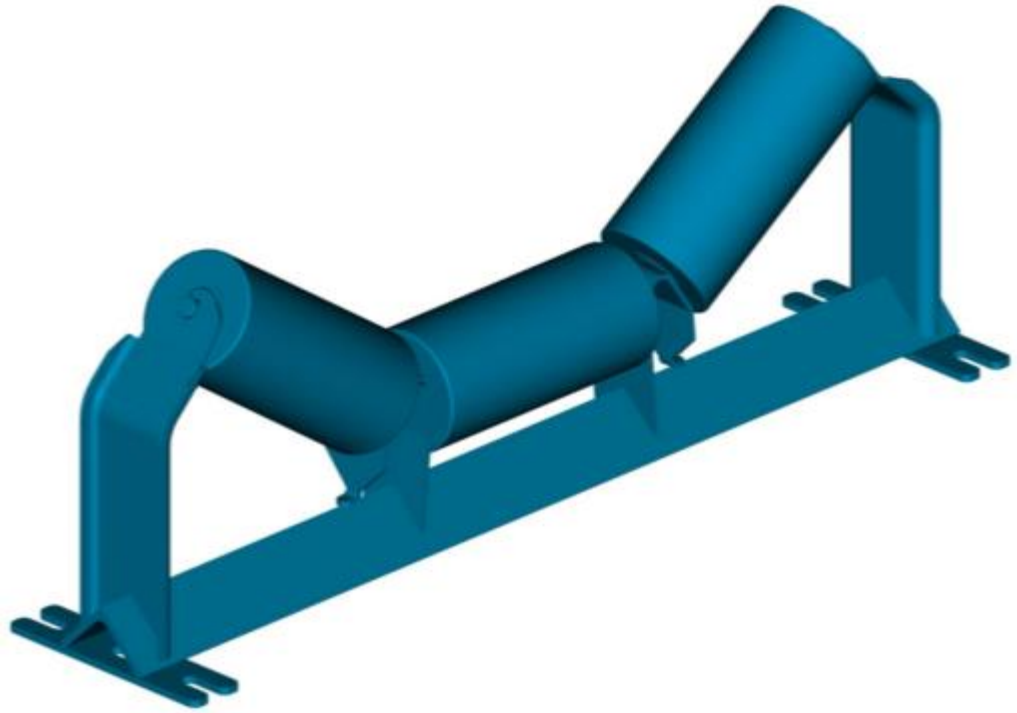
I. Transport Equipment – Conveyors

8. Troughed belt conveyor

- Bulk + On-Floor
- Used to transport bulk materials
- Belt conforms to the shape of the troughed rollers and idlers



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I. Transport Equipment – Conveyors

9. Bucket conveyor

- Bulk + On-Floor
- Used to move bulk materials in a vertical or inclined path
- Buckets are attached to a cable, chain, or belt
- Buckets are automatically unloaded at the end of the conveyor run

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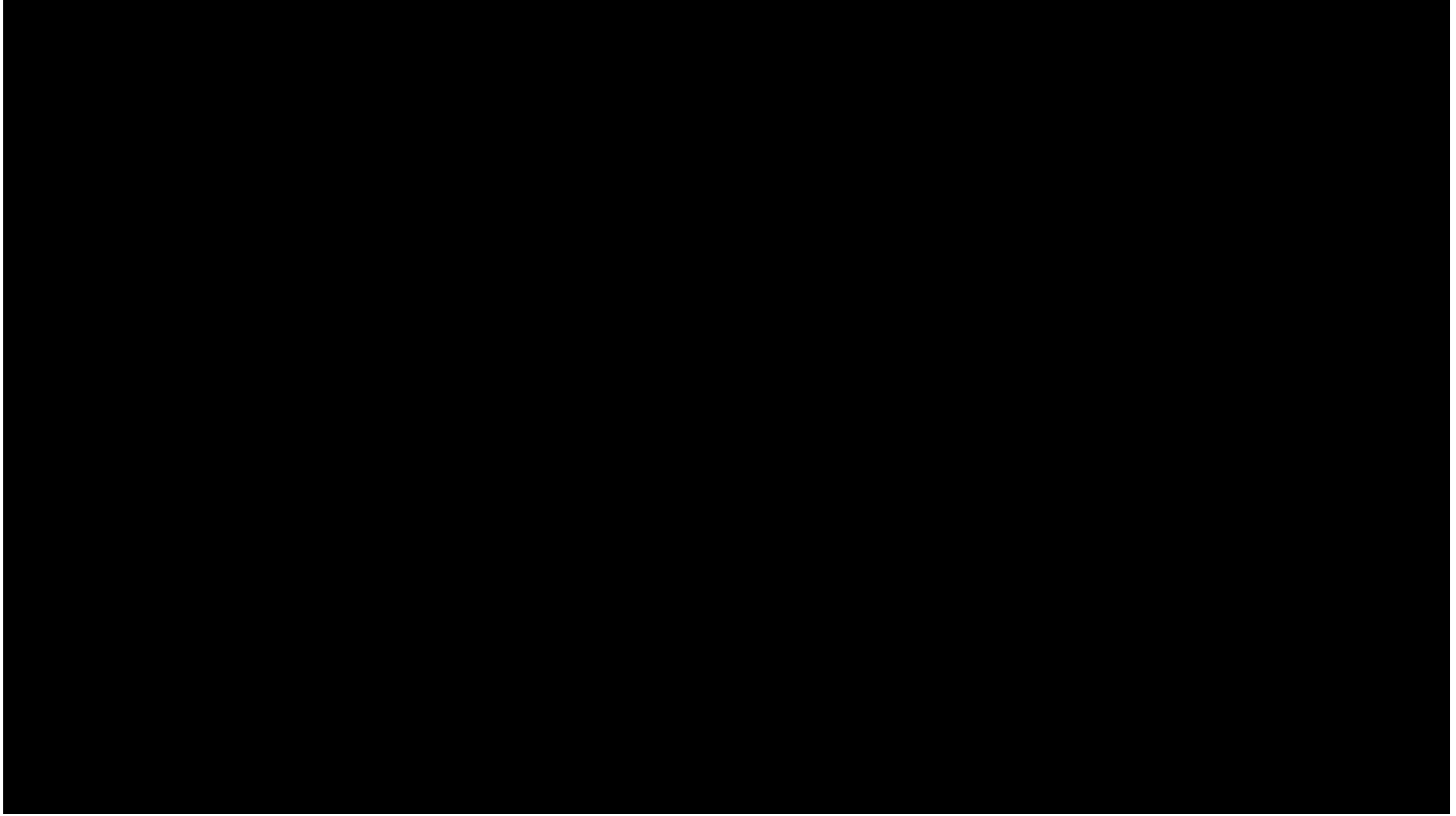
I. Transport Equipment – Conveyors

10. Vibrating conveyor

- Bulk + On-Floor
- Consists of a trough, bed, or tube
- Vibrates at a relatively high frequency and small amplitude
  - in order to convey individual units of products or bulk material
- Can be used to convey almost all granular, free-flowing materials



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I. Transport Equipment – Conveyors

11. Screw conveyor

- Bulk + On-Floor
- One of the most widely used conveyors in the processing industry,
- Many applications in agricultural and chemical processing

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I. Transport Equipment – Conveyors

12. Pneumatic conveyor

- Bulk/Unit + Overhead
- Air pressure is used to convey materials through a system of
  - vertical and horizontal tubes
- Material is completely enclosed
  - It is easy to implement turns and vertical moves

I. Transport Equipment – Conveyors

(a) Dilute-phase pneumatic conveyor

- Moves a mixture of air and solid
- Push (positive pressure) systems
  - from one entry point to several discharge points
- Pull (negative pressure or vacuum) systems
  - from several entry points to one discharge point

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I. Transport Equipment – Conveyors

(b) Carrier-system pneumatic conveyor

- transporting money to/from drive-in stalls at banks
- documents between floors of a skyscraper

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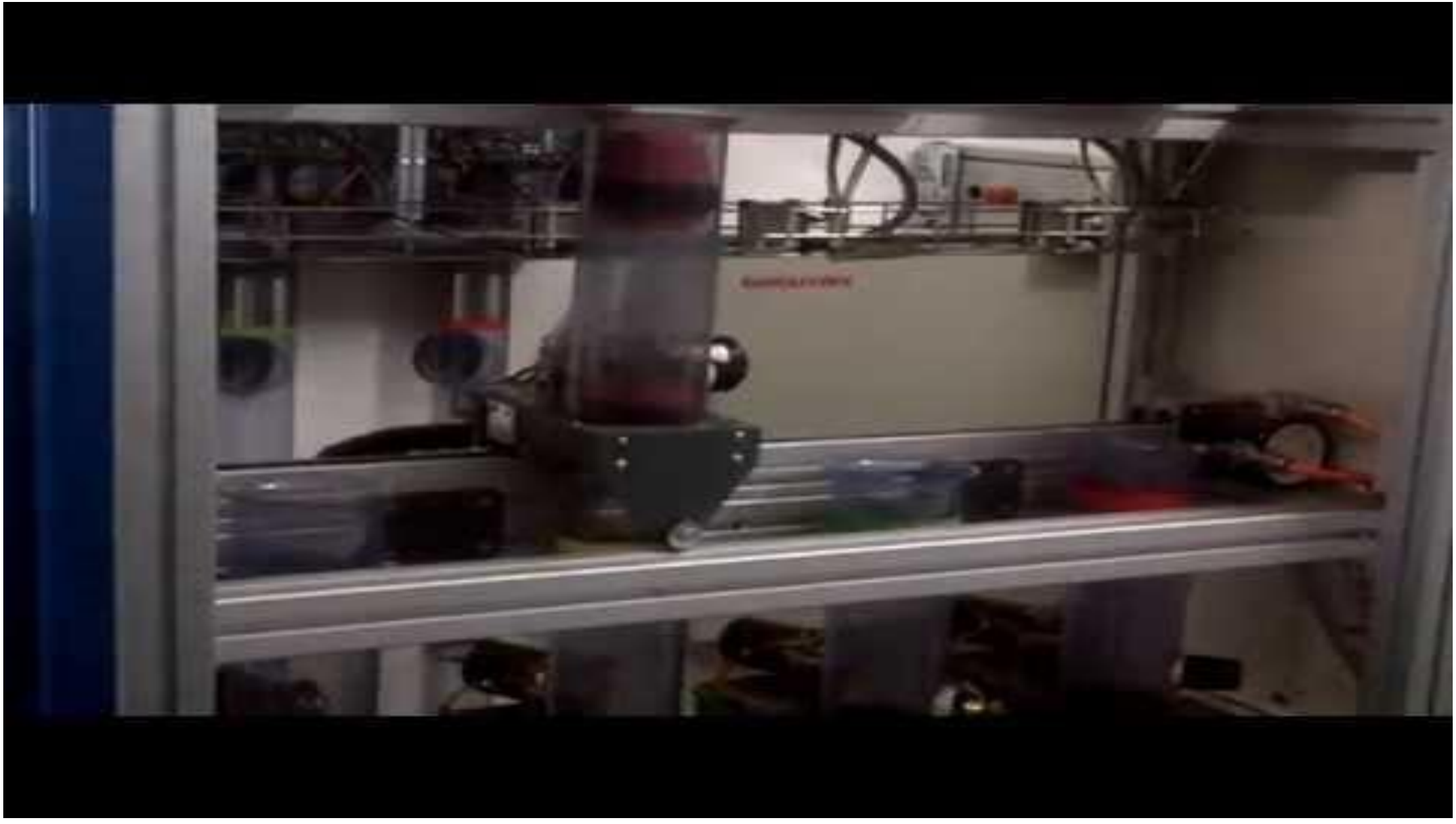

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I. Transport Equipment – Conveyors

13. Vertical conveyor

- Unit + On-Floor + No Accumulation
- Used for low-frequency intermittent vertical transfers
- Not designed or certified to carry people
- Can be manually or automatically loaded and/or controlled
- Alternative to a chute conveyor for vertical “drops”
  - when load is fragile and/or
  - space is limited

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I. Transport Equipment – Conveyors

14. Cart-on-track conveyor

- Unit + In-Floor + Accumulate
- Used to transport carts along a track

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I. Transport Equipment – Conveyors

15. Tow conveyor

- Unit + In-Floor + Accumulate
- Uses towline to provide power to wheeled carriers such as
  - trucks, dollies, or carts that move along the floor
- Used for fixed-path travel of carriers
- Floor or overhead
- Generally used when long distance and high frequency moves are required

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I. Transport Equipment – Conveyors

16. Trolley conveyor

- Unit + Overhead + No Accumulation
- Commonly used in processing, assembly, packaging, and storage operations

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I. Transport Equipment – Conveyors

18. Sortation conveyor

- Unit + On-Floor/Overhead
- Sortation conveyors are used for
  - merging, identifying, inducting and separating products .
- A sortation system is composed of three subsystems:

I. Transport Equipment – Conveyors

- *Merge subsystem*
  - items transported from picking (storage) or receiving areas on conveyors
  - Then consolidated for proper presentation at the induct area.
- *Induct subsystem*
  - destination of each item identified by visual inspection or automatic identification system (e.g., bar code scanner),
  - then a proper gap between items is generated using short variable speed conveyors as they are released to the sort subsystem.
- *Sort subsystem*
  - items are diverted to outbound conveyors to shipping, palletizing, staging, and/or secondary sort subsystems.

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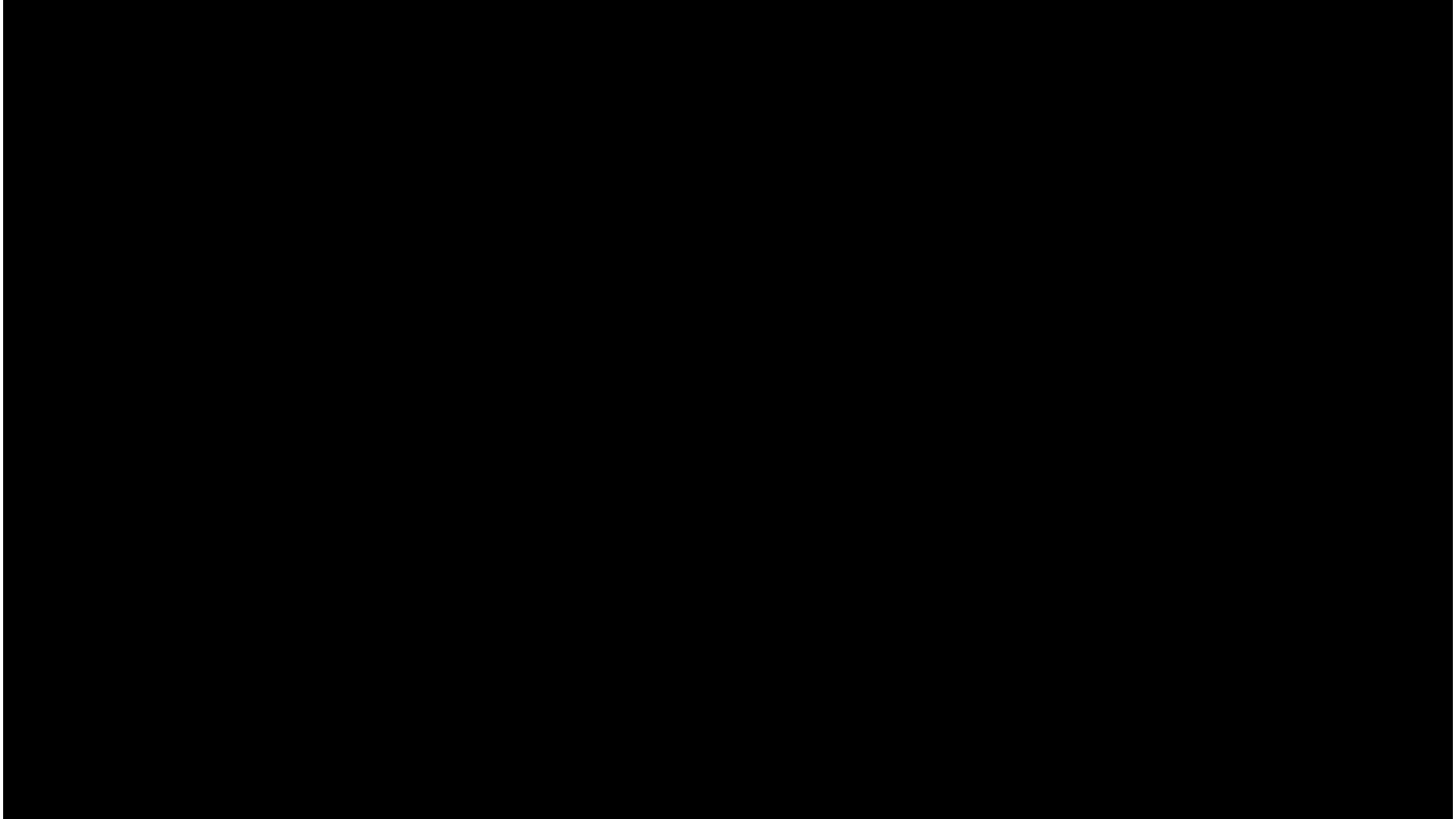
I. Transport Equipment – Conveyors

- There is a trend towards more use of mixed-item loads:
  - instead of a producer sending pallet loads of a single item to a DC for subsequent sortation or consolidation into multi-item customer loads,
    - single pallets can be loaded at a producer with a different mix of items for each customer.
  - This also can enable greater use of cross docking.



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