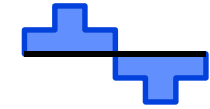


Reasons for Using Adjustable Speed Drives

Why learn the reasons for using adjustable speed drives?

- Understanding the ultimate objective is often the key to properly selecting and applying a drive.
- Describing the reasons for purchasing drives helps to define the adjustable speed drive market.

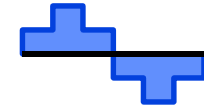


Reasons for Using Adjustable Speed Drives

Adjusting Speed is a Means of Controlling a Process

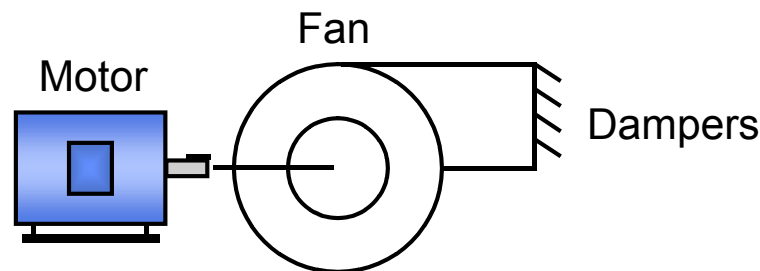
- Consider the process of driving to work.
 - If you drove at the fastest speed possible, you would probably cause an accident.
 - If you drove at a single speed that would be safe for every part of the route, it would take a long time to get to your destination.
 - Adjusting your speed to suit the route minimizes the time to achieve the objective of the process within the limits of reliable operation.
 - Controlling the process is the primary consideration in adjusting your speed.

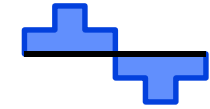
Reasons for Using Adjustable Speed Drives



Adjusting Speed Can Be a Means of Saving Energy

- An adjustable speed drive often uses less energy than an alternative fixed speed mode of operation.
 - Fans and pumps are the most common energy saving applications.
 - When a fan is driven by a fixed speed motor, the airflow may sometimes be higher than it needs to be.
 - Airflow can be regulated by using dampers to restrict the flow, but it is more efficient to regulate the airflow by regulating the speed of the motor.

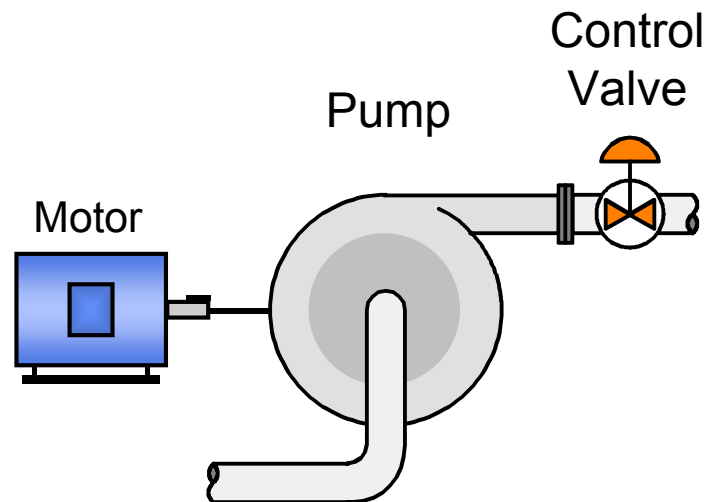


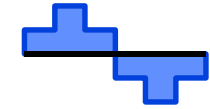


Reasons for Using Adjustable Speed Drives

Saving Energy

- Saving energy with adjustable speed pump operation is similar to saving energy with adjustable speed fan operation.
- It is more efficient to regulate the flow of fluid by regulating the speed of the motor rather than by restricting the flow using a valve.



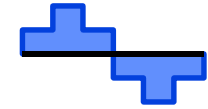


Reasons for Using Adjustable Speed Drives

Energy Savings and Process Control are the Two Primary Reasons for Using Adjustable Speed Drives

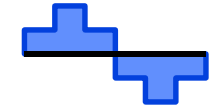
- Energy Savings
 - Flow control
- Process Control
 - Provide smoother operation
 - Provide acceleration control
 - Use a Different Operating Speed for Each Process
 - Compensate for Changing Process Variables
 - Allow Slow Operation for Setup Purposes
 - Adjust the Rate of Production
 - Allow Accurate Positioning
 - Control Torque or Tension

Reasons for Using Adjustable Speed Drives



Provide Smoother Operation

- An adjustable speed drive can often provide smoother operation than an alternative fixed speed mode of operation.

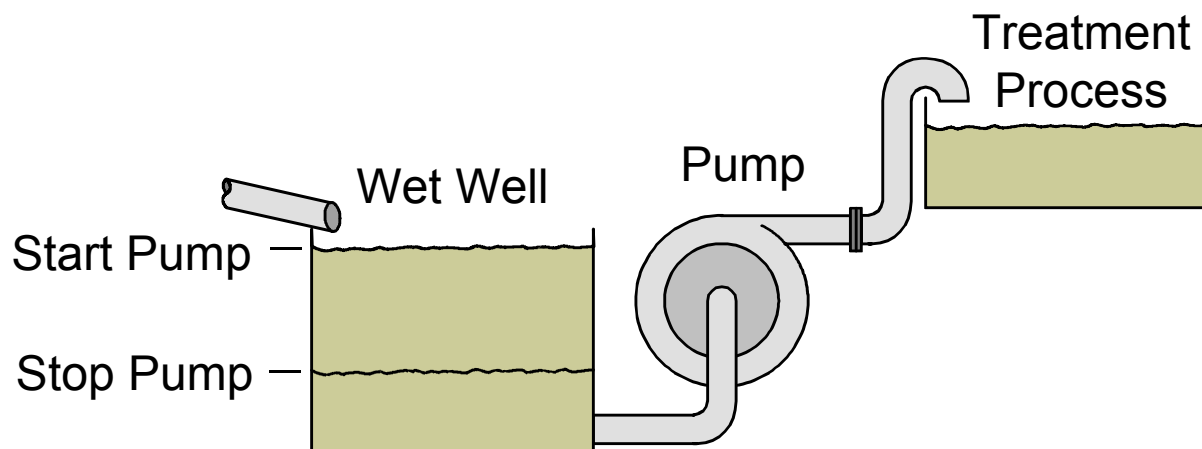


Reasons for Using Adjustable Speed Drives

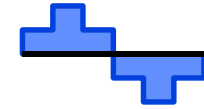
Provide Smoother Operation

■ Sewage Lift Station Pumps

- Sewage usually flows through sewer pipes under the force of gravity to a wet well location. From there it is pumped up to a treatment process.
- When fixed speed pumps are used, the pumps are set to start when the level of the liquid in the wet well reaches some high point and stop when the level has been reduced to a low point.



Reasons for Using Adjustable Speed Drives



Provide Smoother Operation

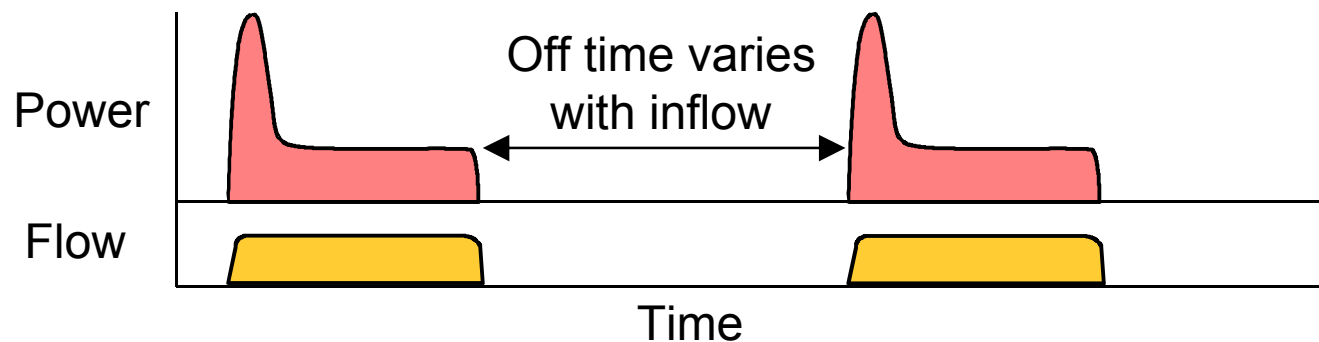
■ Sewage Lift Station Pumps

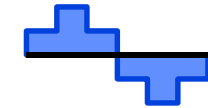
- Cycling the pumps on and off results in frequent high surges of electrical current to start the motors and intervals of high power usage alternating with intervals of low power usage.

≡ This mode of operation causes electromagnetic and thermal stresses in the motors and power control equipment.

≡ The pumps, pipes, etc. are subjected to mechanical and hydraulic stresses.

≡ The sewage treatment process is forced to accommodate surges in the flow of sewage through the process.



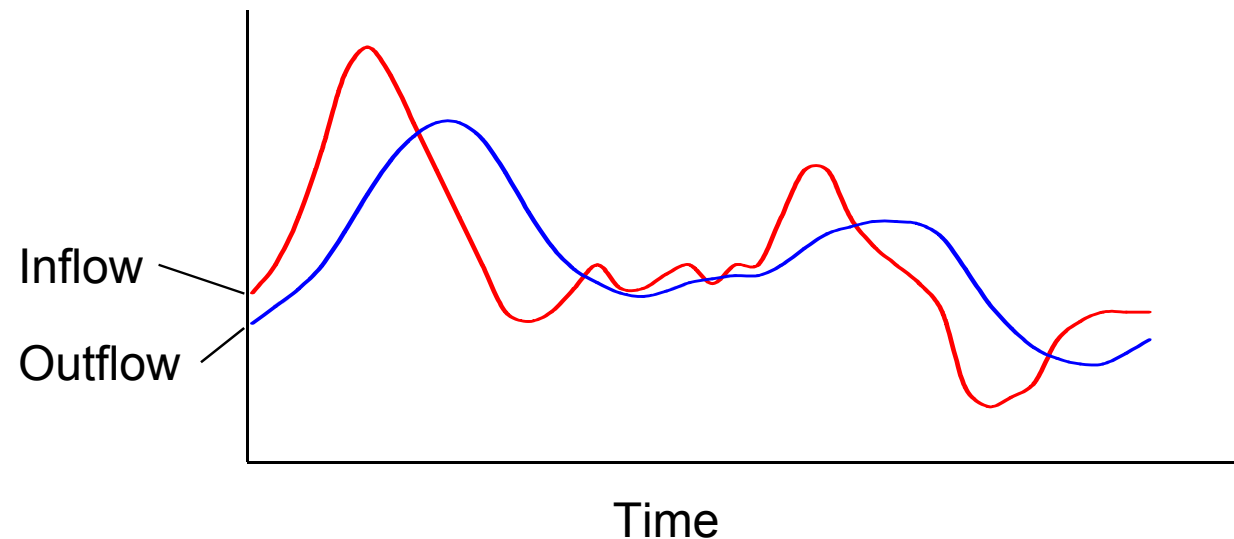


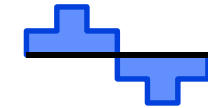
Reasons for Using Adjustable Speed Drives

Provide Smoother Operation

■ Sewage Lift Station Pumps

- When adjustable speed drives are used, the pumps operate continuously at a speed that increases as the wet well level increases. This matches the outflow to the average inflow and provides a much smoother operation of the process.

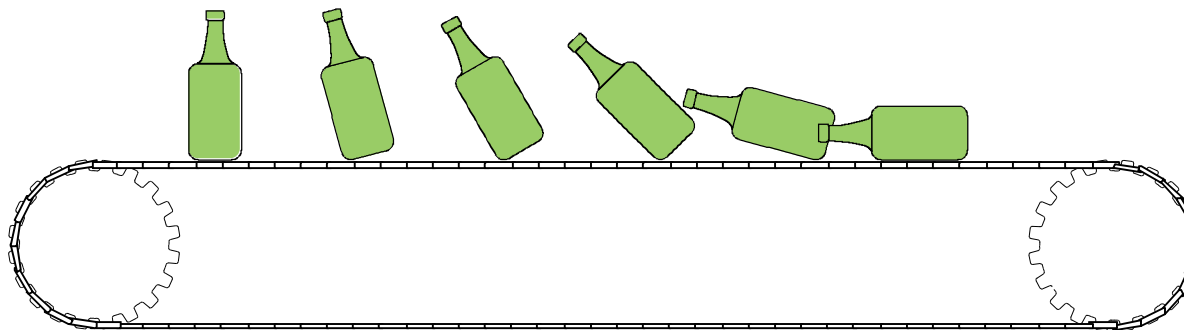


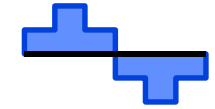


Reasons for Using Adjustable Speed Drives

Acceleration Control

- Using an adjustable speed drive to control the acceleration of a machine avoids the shock of sudden acceleration.
 - Conveyor

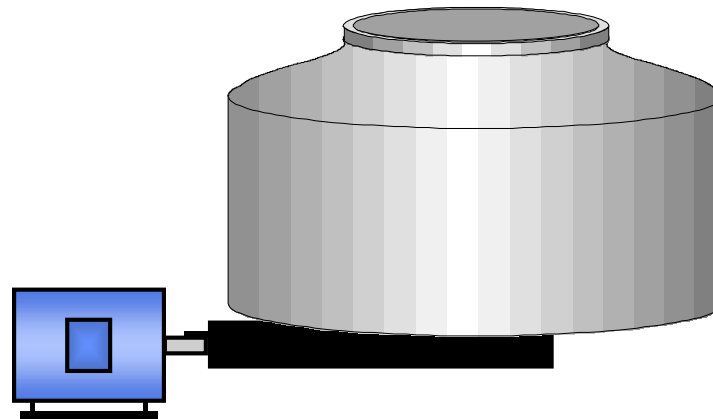




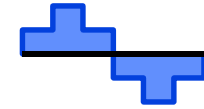
Reasons for Using Adjustable Speed Drives

Acceleration Control

- An adjustable speed drive can accelerate a high inertia without overheating the motor. Using an extended acceleration time reduces the accelerating torque to a level that is much less stressful on the motor.
 - Centrifuge

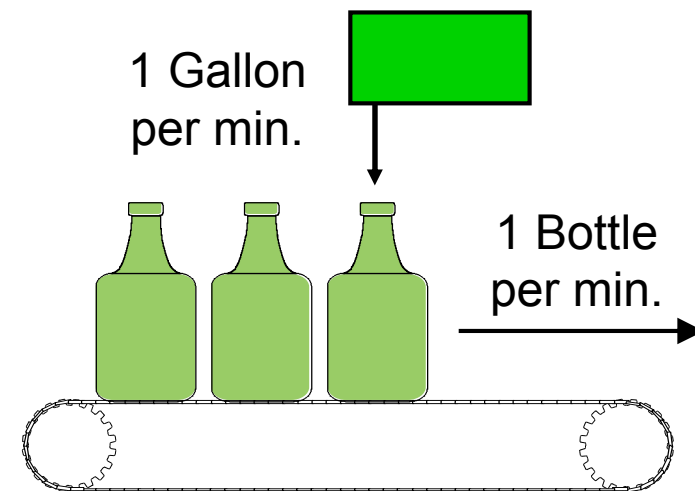
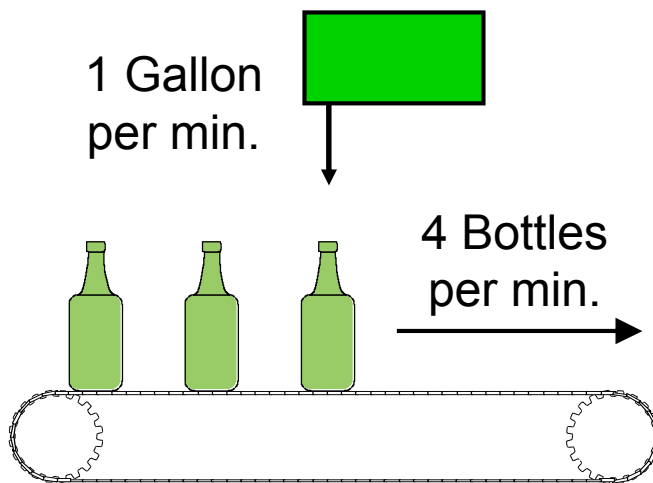


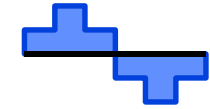
Reasons for Using Adjustable Speed Drives



Use a Different Operating Speed for Each Process

- A particular set of process machinery may be used for several different processes. Changing the operating speed may be required to accommodate different products or process operations.
- If a set of bottle filling equipment is used to fill various size containers, the speed may need to be reduced when the setup is changed from filling quart bottles to filling gallons.

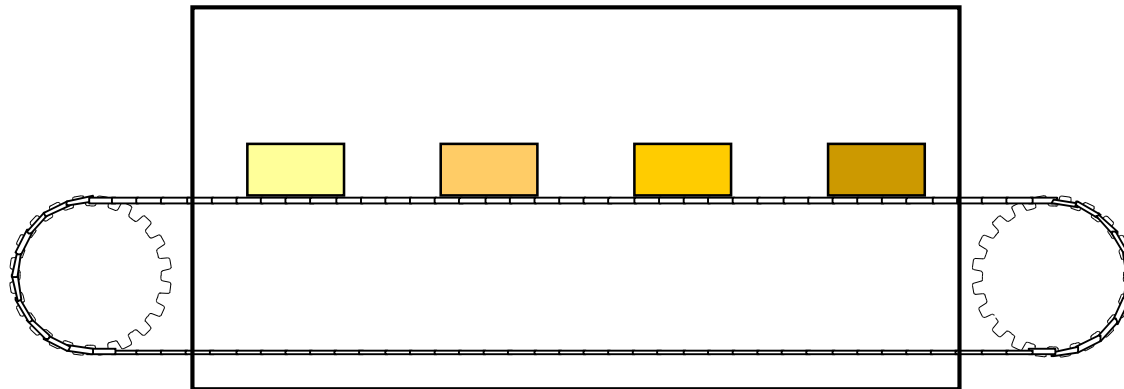


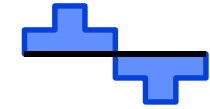


Reasons for Using Adjustable Speed Drives

Use a Different Operating Speed for Each Process

- In food processing, the speed of the conveyor that moves the product through the oven may be adjusted to set the baking time. Different recipes may require different speeds.

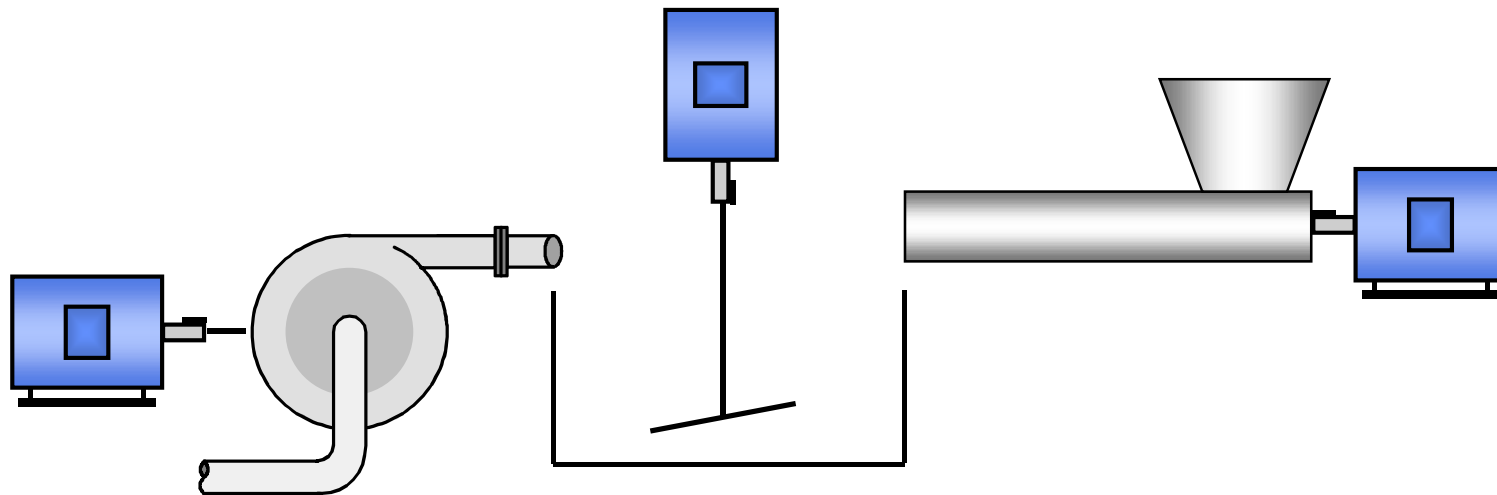




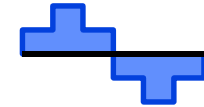
Reasons for Using Adjustable Speed Drives

Use a Different Operating Speed for Each Process

- Adjustable speed pumps or conveyors can be used to meter ingredients into a process according to a particular recipe.

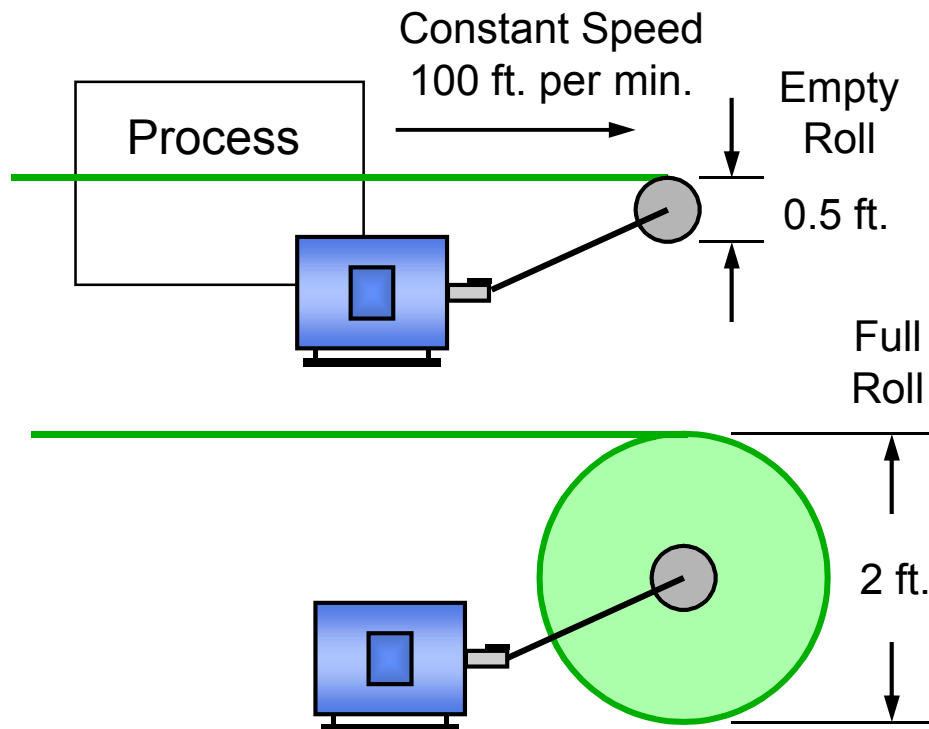


Reasons for Using Adjustable Speed Drives



Compensate for Changing Process Variables

- Adjust the speed of a center driven winder to compensate for roll buildup

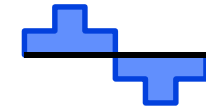


$$1 \text{ revolution} = 0.5 \times \pi = 1.57 \text{ ft.}$$

$$\text{Speed} = \frac{100 \text{ ft./min.}}{1.57 \text{ ft./revolution}} = 63.7 \text{ RPM}$$

$$1 \text{ revolution} = 2 \times \pi = 6.28 \text{ ft.}$$

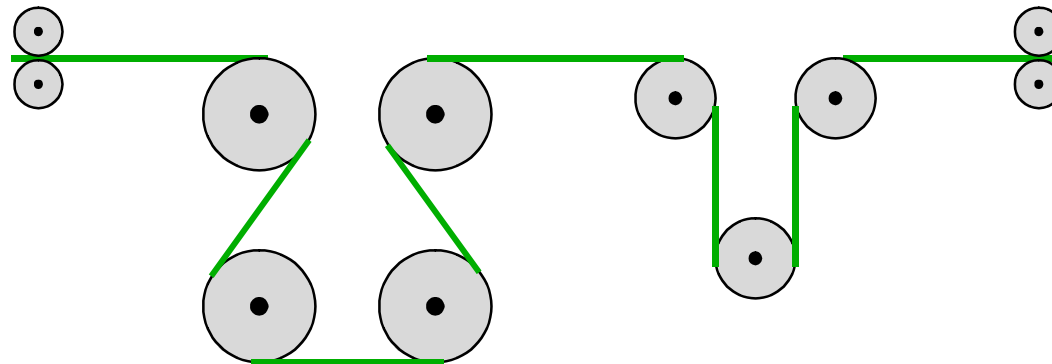
$$\text{Speed} = \frac{100 \text{ ft./min.}}{6.28 \text{ ft./revolution}} = 15.9 \text{ RPM}$$

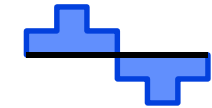


Reasons for Using Adjustable Speed Drives

Allow slow operation for setup purposes

- In many processes the machinery is operated at a slow speed to allow material to be manually threaded through the machine at startup.
- Some processes must be brought up to operating speed gradually as equipment warms up and adjustments are made.
- Slow operation during the equipment adjustment and warm-up time may also reduce waste because unusable material is often produced during that time.

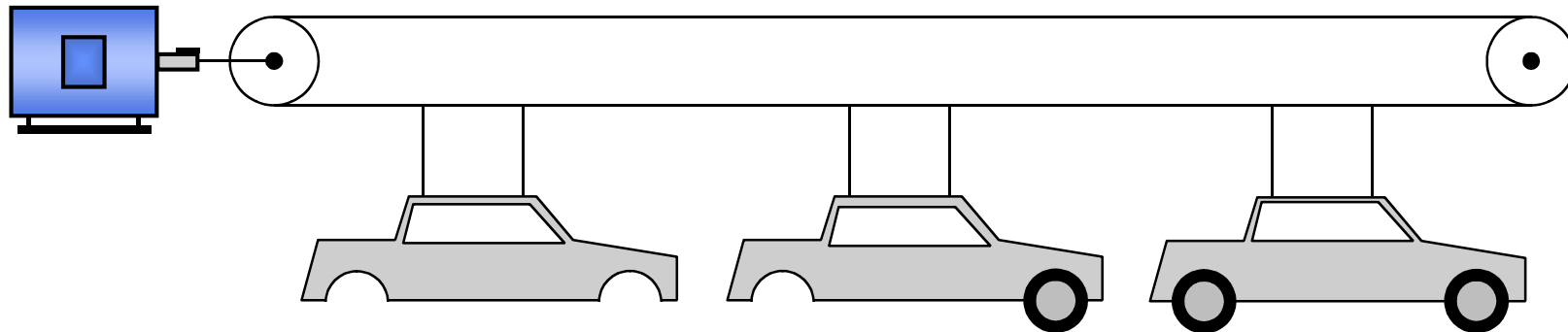


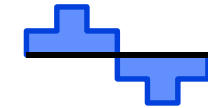


Reasons for Using Adjustable Speed Drives

Adjust the Rate of Production

- Assembly line conveyor speed sets the number of units produced per day and the time available for workers to complete their tasks.

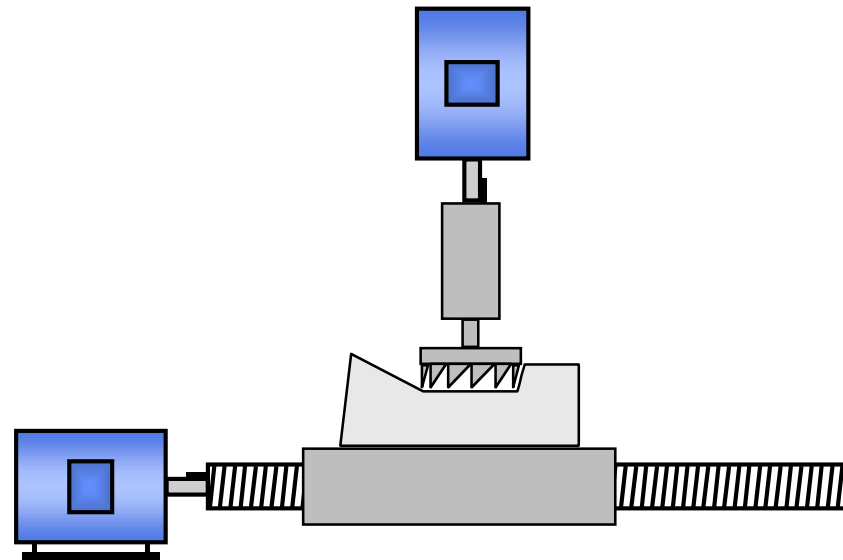




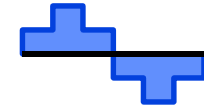
Reasons for Using Adjustable Speed Drives

Allow Accurate Positioning

- Position controlling drives can regulate either absolute position or relative position.
 - Absolute Positioning
 - ≡ Absolute position control is used to move an object to a specific location. Precision positioning is used in machining operations.



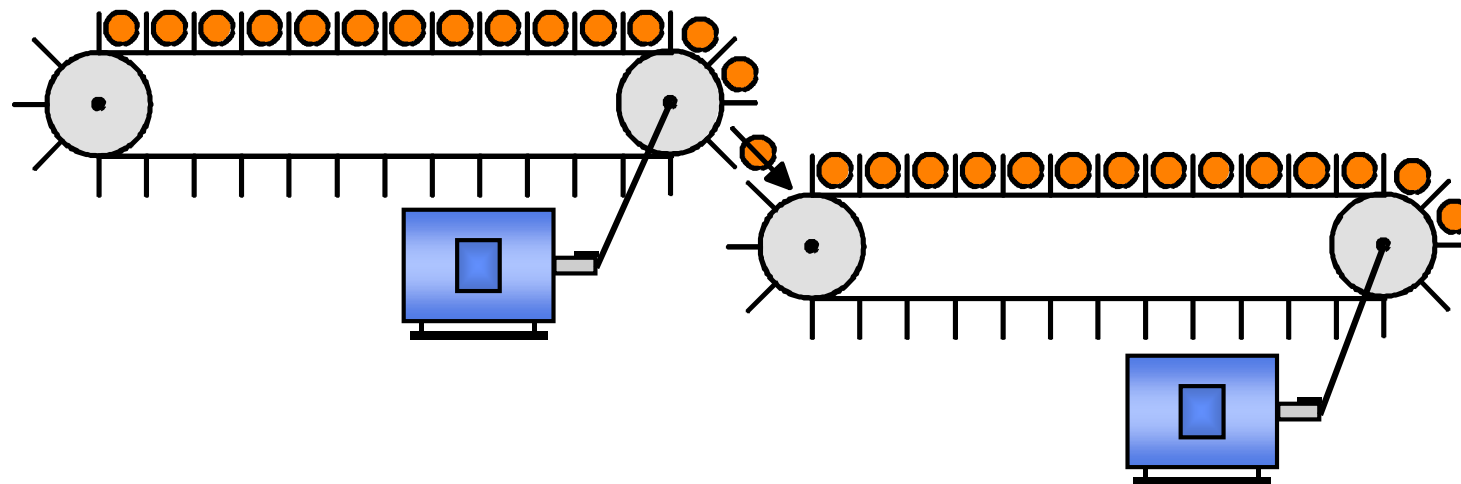
Reasons for Using Adjustable Speed Drives



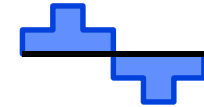
Allow Accurate Positioning

- Relative Positioning

- ≡ Relative position control maintains the position relationship between two points on machines that are operating at the same speed.
- ≡ Position synchronization allows objects to be smoothly transferred between two moving machines.



Reasons for Using Adjustable Speed Drives



Control Torque or Tension

- Torque controlled drives allow machine speed to vary while maintaining a constant value of operating torque or material tension.
 - ≡ In this web process, example, the first drive sets the speed of the material and the second drive provides the correct tension to pull the material through the process without damaging it.

