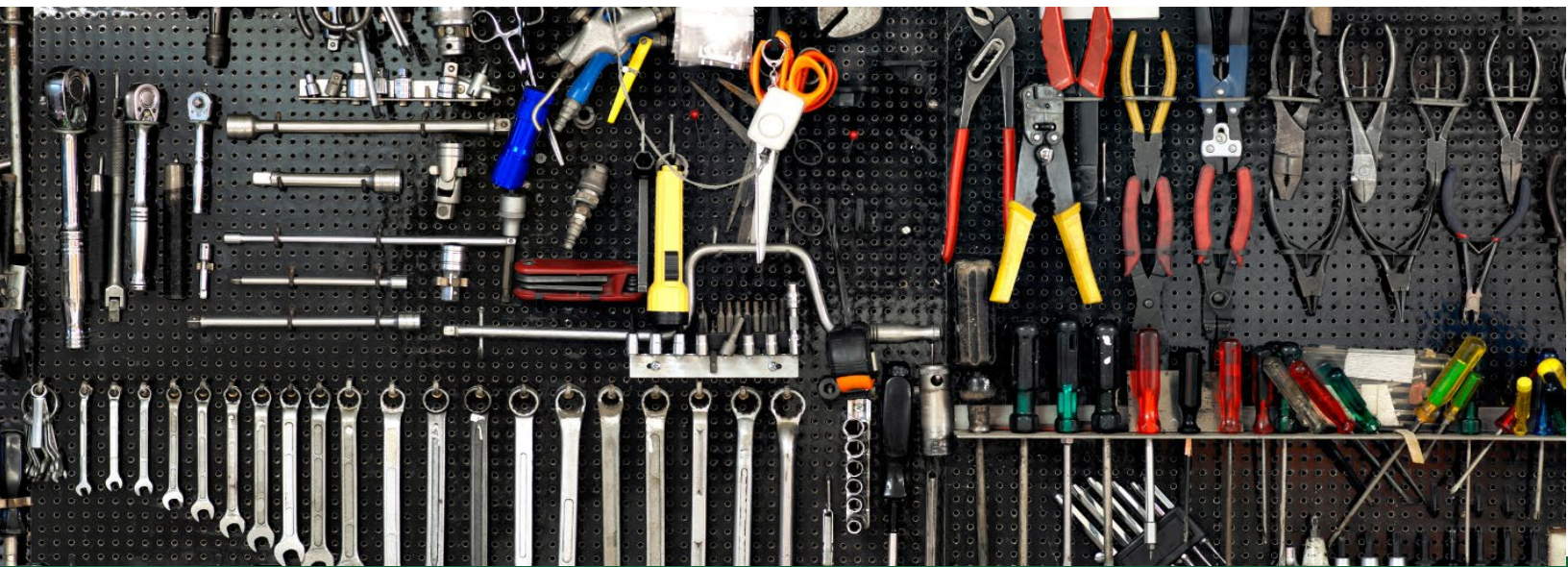


Participant Resource Guide

Mechanical Foundations

September 2026



Course Outline

- Module 1: Fasteners

Module 2: Hydraulics and Pneumatics

- Module 3: Leverage
- Module 4: Physics
- Module 5: Tools Reference Guide



U.S. Department of Transportation
Federal Transit Administration

A program of the Federal Transit Administration administered by the International Transportation Learning Center

Course: Mechanical Foundations

Version Date: September 2026

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Transit Workforce Center

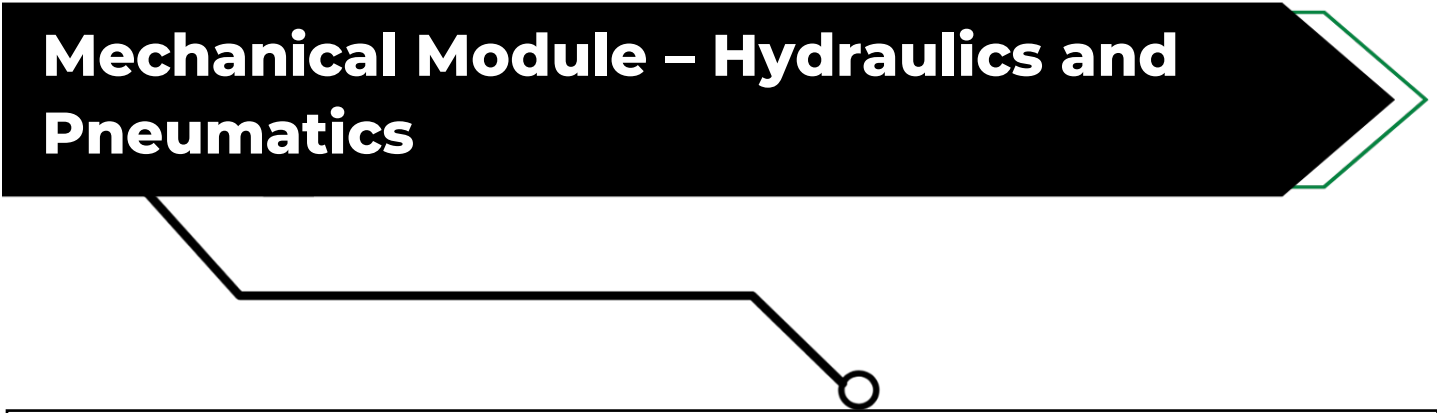
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Mechanical Module – Hydraulics and Pneumatics



Objectives

- Define fluid dynamics and explain how it relates to hydraulic and pneumatic systems.
- Define and differentiate hydraulics and pneumatics.
- Identify mechanisms that use hydraulic and pneumatic systems.
- Explain the importance of hydraulics and pneumatics in transit maintenance.
- Compare the advantages and disadvantages of hydraulic and pneumatic systems.



Participant Resource Guide

Hydraulics and Pneumatics

TWC • TRANSIT WORKFORCE CENTER

Hydraulics and Pneumatics
Mechanical Foundations
Transit Core Competencies Curriculum (TC3)

U.S. Department of Transportation
Federal Transit Administration
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3

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4

Agenda

- Welcome and Warm-Up
- 1.1 Fluid Dynamics
- 1.2 Hydraulics
- 1.3 Pneumatics
- 1.4 Hydraulics and Pneumatics in Transit Maintenance
- Quiz and Wrap-Up

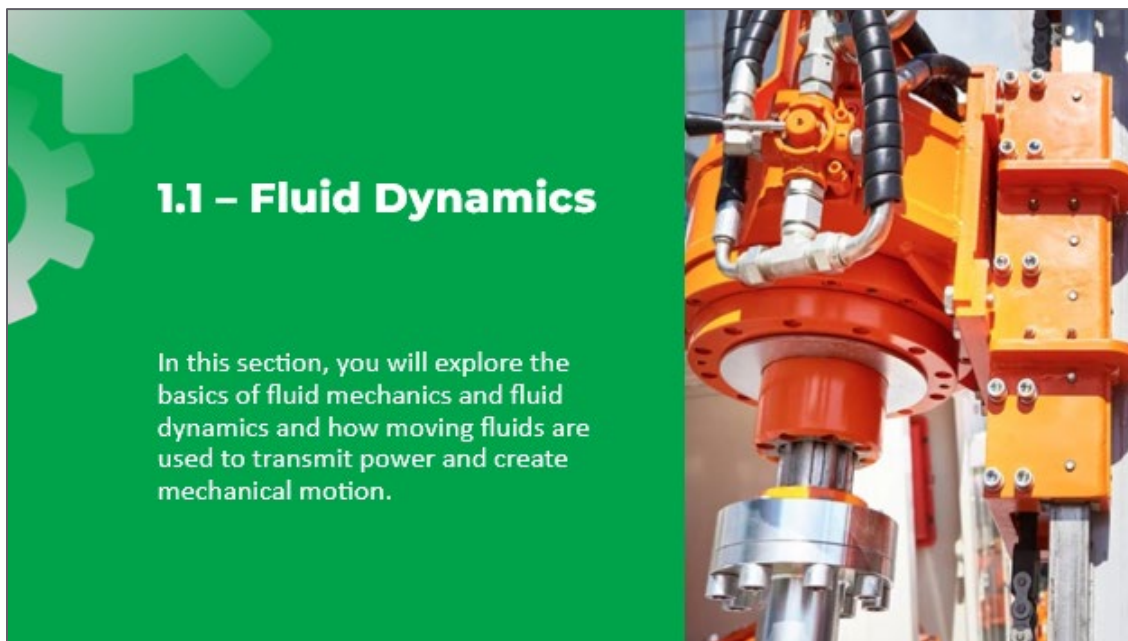


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Notes:

- Take a look at the images on the screen. They represent a variety of tools, machines, and equipment that you may have seen in everyday life or in the workplace. What do these items have in common?
- Take about a minute to discuss your ideas with a partner. Don't worry about finding the "right" answer, just think about what these items might share.
 - What similarities did you notice?
- These items may look very different and perform different jobs, but they all have one important thing in common: **they use fluid power to create force and motion.**
- By the end of this module, you'll be able to explain how each system works, recognize where they're used in transit maintenance, and understand why one system is often chosen over the other depending on the job.



Notes:

- In this section, you will explore the basics of fluid mechanics and fluid dynamics and how moving fluids are used to transmit power and create mechanical motion.

What is a fluid?

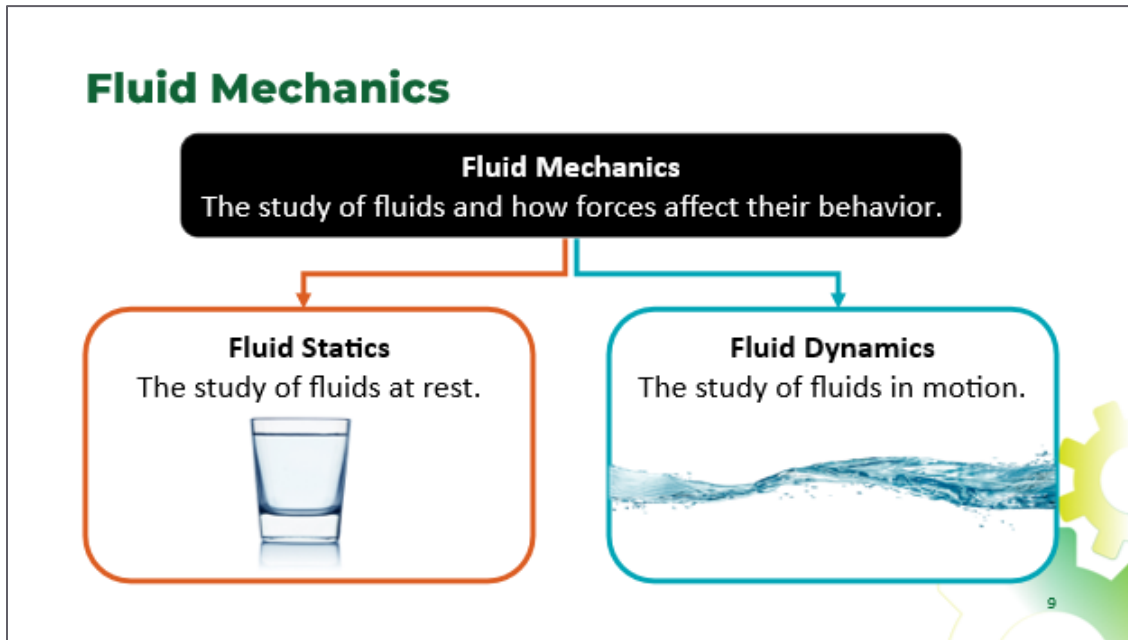
Fluid – A substance that flows when force is applied and takes the shape of its container.

- **Liquids** (Water, oil, fuel, etc.)
- **Gases** (Air, steam, natural gas, etc.)



Notes:

- When you hear the word fluid, you may immediately think of a liquid, like water or oil. But in physics, the term has a broader meaning.
 - A **fluid** is a substance that can flow when a force is applied and takes the shape of its container.
 - Liquids are fluids. Think about pouring water into a glass, the water flows and takes the shape of the glass.
 - But **gases are also fluids**. Air, for example, flows and takes the shape of whatever space or container it occupies. Think about filling a balloon or an air compressor tank.
 - This is important for our course because transportation systems use **both types of fluids** to perform work.
 - Next, let's look at the science used to study fluids: fluid mechanics.
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Notes:

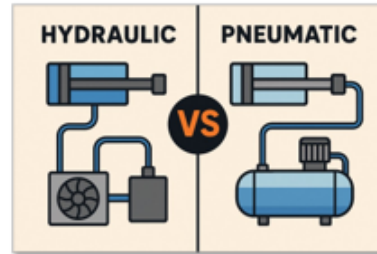
- Now that you know what a fluid is, let's look at fluid mechanics.
- **Fluid mechanics** is the study of fluids and how forces affect their behavior. When we say fluids, we're talking about both liquids and gases.
- Fluid mechanics can be divided into two main areas: fluid statics and fluid dynamics.
 - **Fluid statics** looks at fluids that are at rest. For example, think about the hydraulic fluid sitting inside a reservoir when the system is not operating.
 - **Fluid dynamics** looks at fluids in motion. Water moving through a pipe or compressed air flowing through an air line are examples of fluid dynamics.
- For this course, you'll focus primarily on fluid dynamics because hydraulic and pneumatic systems depend on controlling the movement of liquids and gases to transmit power and perform work.

From Fluid Dynamics to Fluid Power

Fluid Power occurs when moving fluids can transmit force and energy to perform mechanical work.

- **Hydraulics** – pressurized liquid
- **Pneumatics** – compressed air or gas

Pressure and **flow** allow fluid power systems to transmit energy and produce force and motion.



Notes:

- Now that you reviewed fluid dynamics, let's connect it to **fluid power**.
- Moving fluids can carry energy through a system and help create mechanical work, such as lifting, pushing, pulling, or moving a component.
- In fluid power systems, there are two main types to focus on: hydraulics and pneumatics.
- **Hydraulic systems** use pressurized liquid, while **pneumatic systems** use compressed air or gas.
- Although they use different fluids, both systems rely on the same basic ideas of **pressure and flow** to transmit energy through the system.
- When that energy reaches an actuator or another working component, it can produce **force and motion**.
- As you move into the next section, look more closely at hydraulics and see how pressurized liquid is used to perform work in transportation maintenance.

Hydraulics and Pneumatics Safety Considerations

Hydraulic and pneumatic systems can contain high-pressure fluids or air that can cause serious injury.

- Wear appropriate **PPE**
- Follow **LOTO** procedures
- Never use your hands to check for **leaks**
- Follow all agency **safety procedures**

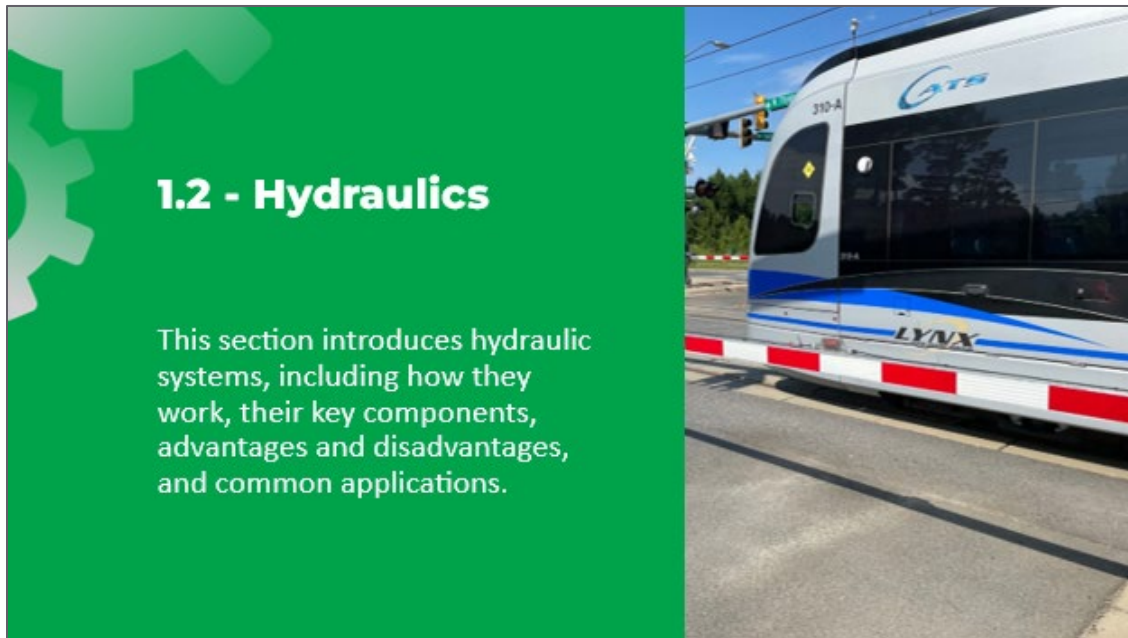


Ex: Leak Check - Use an approved method, such as cardboard, to help locate suspected hydraulic leaks while keeping hands clear



Notes:

- Hydraulic and pneumatic systems operate under high pressure, so following proper safety procedures is extremely important.
- Always wear the appropriate **personal protective equipment**, or PPE, for the work you are performing.
- Before beginning work on a hydraulic or pneumatic system, use the required lockout/tagout, or **LOTO**, procedures.
- Finally, always follow your agency's specific **safety protocols**. Procedures and requirements may vary depending on the equipment and work being performed.
- For example, when checking for a **leak**, never use your hand. Instead, use a piece of cardboard to help locate the leak. High-pressure fluid can penetrate the skin and cause a serious injection injury.
- These basic precautions can help protect you and others when working with hydraulic and pneumatic systems.



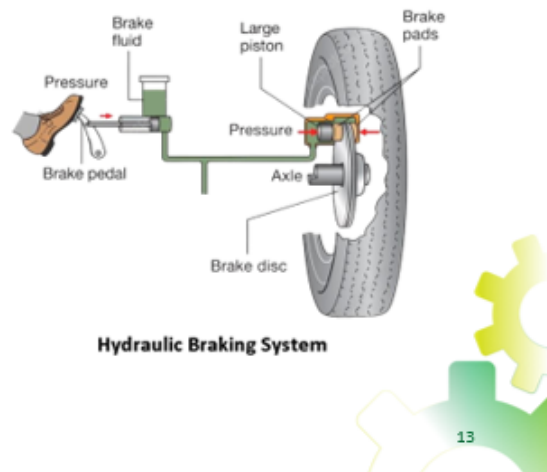
Notes:

- This section introduces hydraulic systems, including how they work, their key components, advantages and disadvantages, and common applications.

What Are Hydraulics?

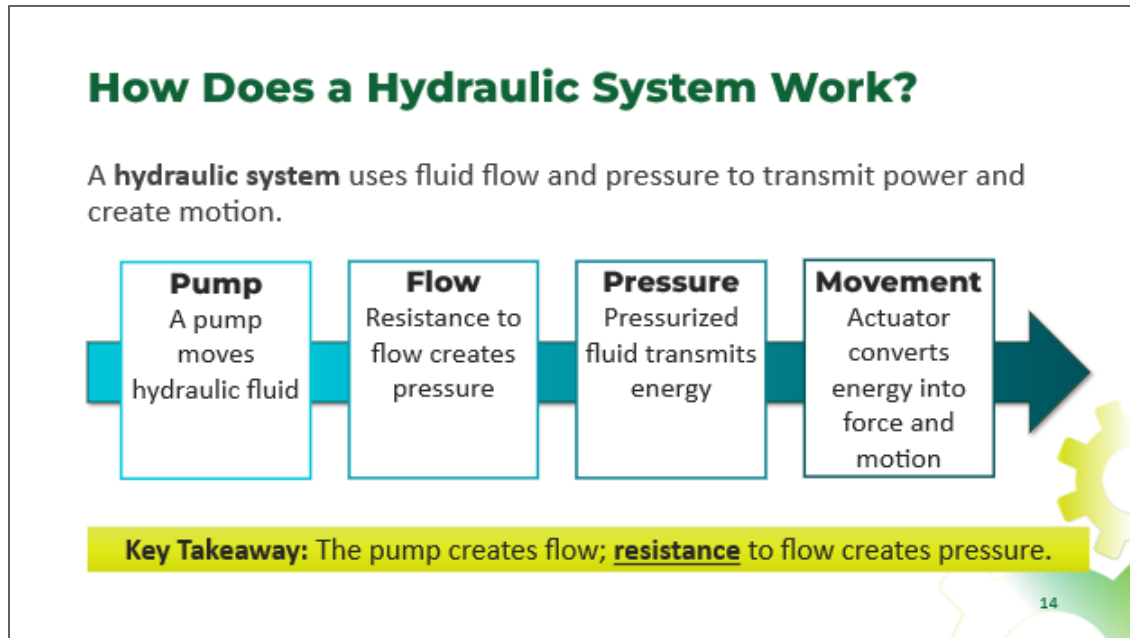
Hydraulics – The use of pressurized liquid to transmit power and perform mechanical work.

- Typically uses oil or other hydraulic fluids
- Transmits power through a confined liquid
- Produces force and motion



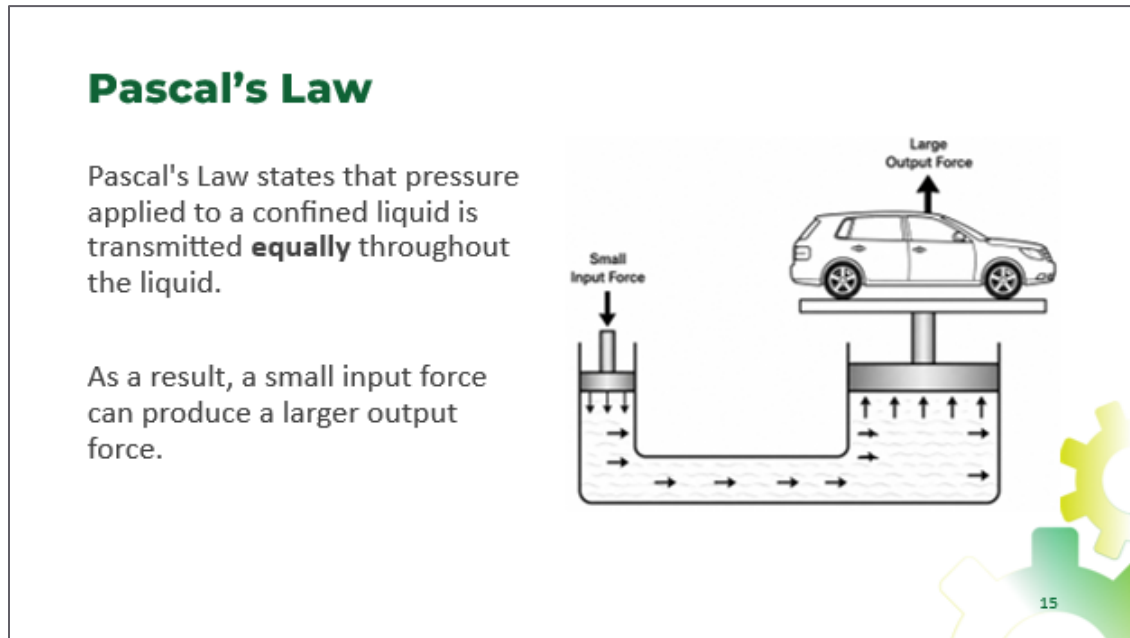
Notes:

- **Hydraulics** is a type of fluid power that uses **pressurized liquid** to transmit power and perform mechanical work.
 - Hydraulic systems can use different types of liquids, but specially formulated hydraulic oils are commonly used because they provide properties needed for reliable system operation.
 - You've probably used a hydraulic system without thinking about it. A common example is the braking system in many vehicles.
 - When you press the brake pedal, force is transmitted through pressurized brake fluid to components at the wheels, which apply the brakes and slow or stop the vehicle.
 - In transportation maintenance, you'll encounter hydraulics in many different systems and pieces of equipment.
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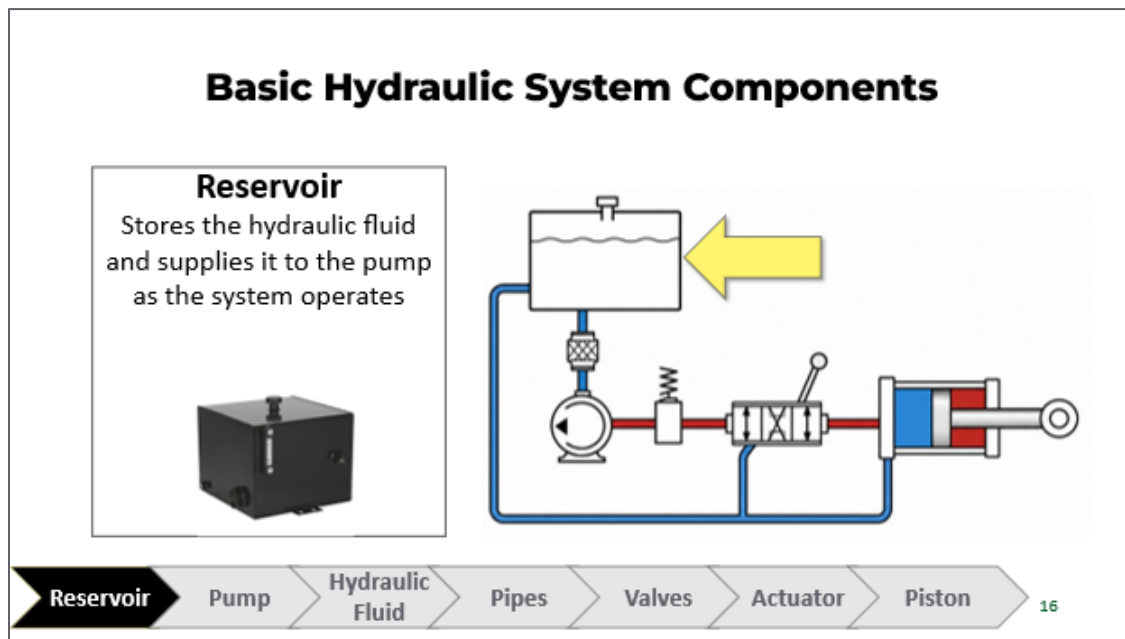
Notes:

- Take a look at the basic process that makes a hydraulic system work.
 - First, a **pump** moves hydraulic fluid through the system.
 - The pump causes the liquid to **flow**.
 - As that fluid encounters resistance in the system, **pressure builds** which can then transmit energy through the hydraulic system.
 - The fluid eventually reaches an **actuator**, such as a hydraulic cylinder, which converts that hydraulic energy into mechanical force and **motion**.
 - So, remember this basic sequence: the **pump creates flow, resistance creates pressure, and the system uses that pressurized fluid to produce force and motion**.
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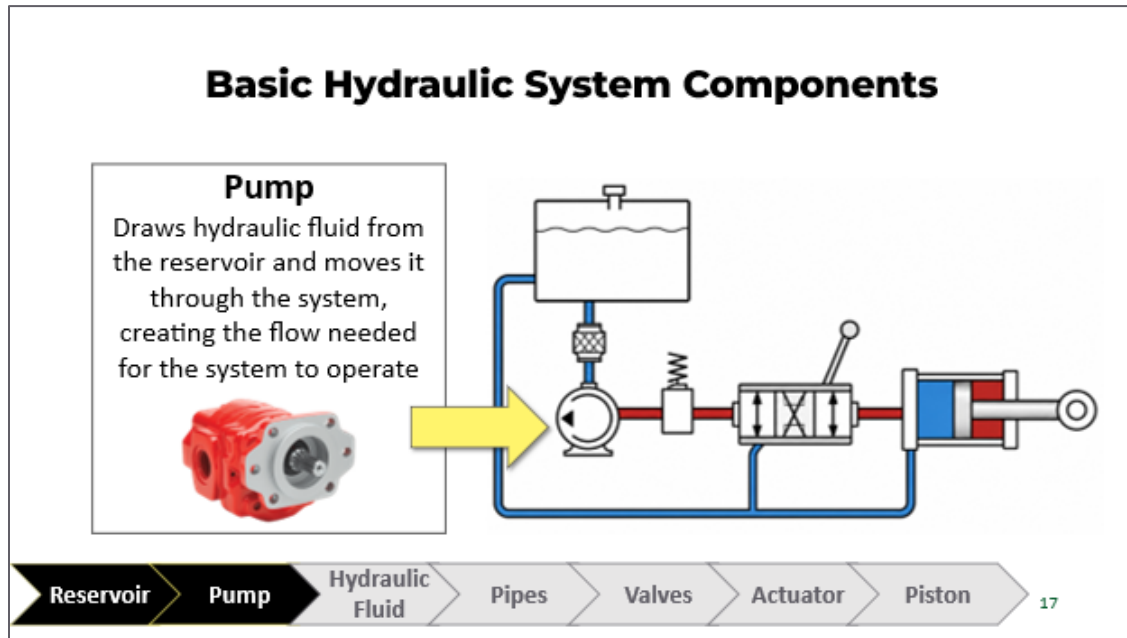
Notes:

- One of the most important principles behind hydraulic systems is Pascal's Law.
- **Pascal's Law** states that when pressure is applied to a confined liquid, that pressure is **transmitted equally throughout the liquid**.
- This means the pressure created at one point in the system is carried through the hydraulic fluid to other parts of the system.
- When that pressure acts on a **larger** piston or cylinder, it can produce a much **greater output force** than the force originally applied.
- This is why hydraulic systems are able to lift buses, operate heavy equipment, and move large components with relatively little input effort.
- Keep in mind that the system isn't creating energy, it is using **pressure** to **transfer force** efficiently through the hydraulic fluid.



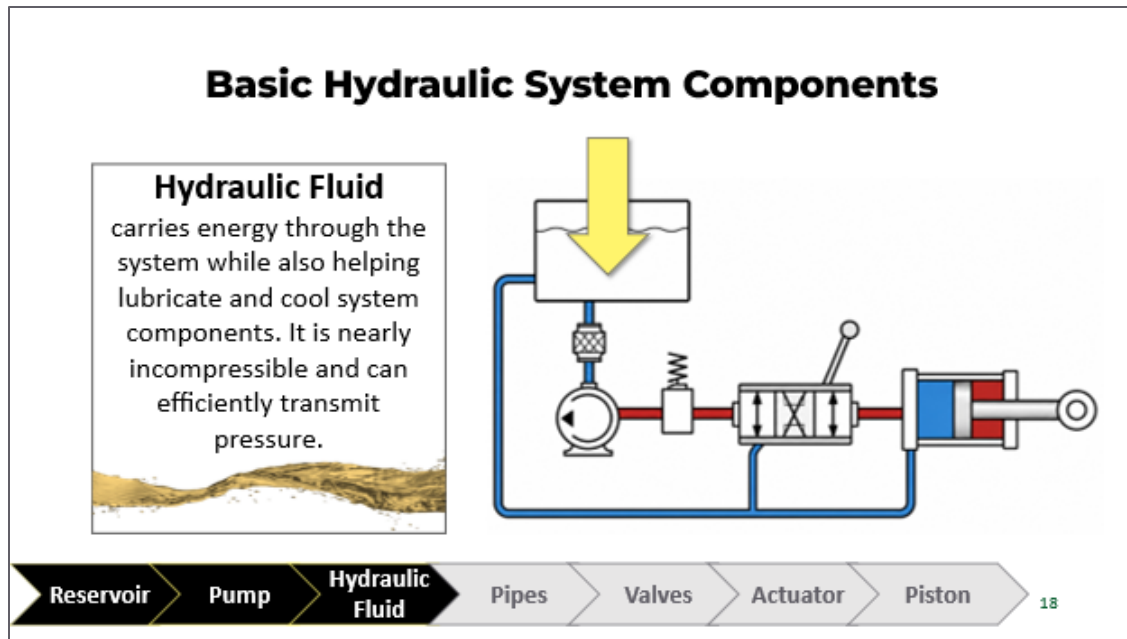
Notes:

- Now that you've seen how a hydraulic system works, let's look at the main components that make it possible.
- First, the **reservoir**, which stores the hydraulic fluid and supplies it to the pump as the system operates.



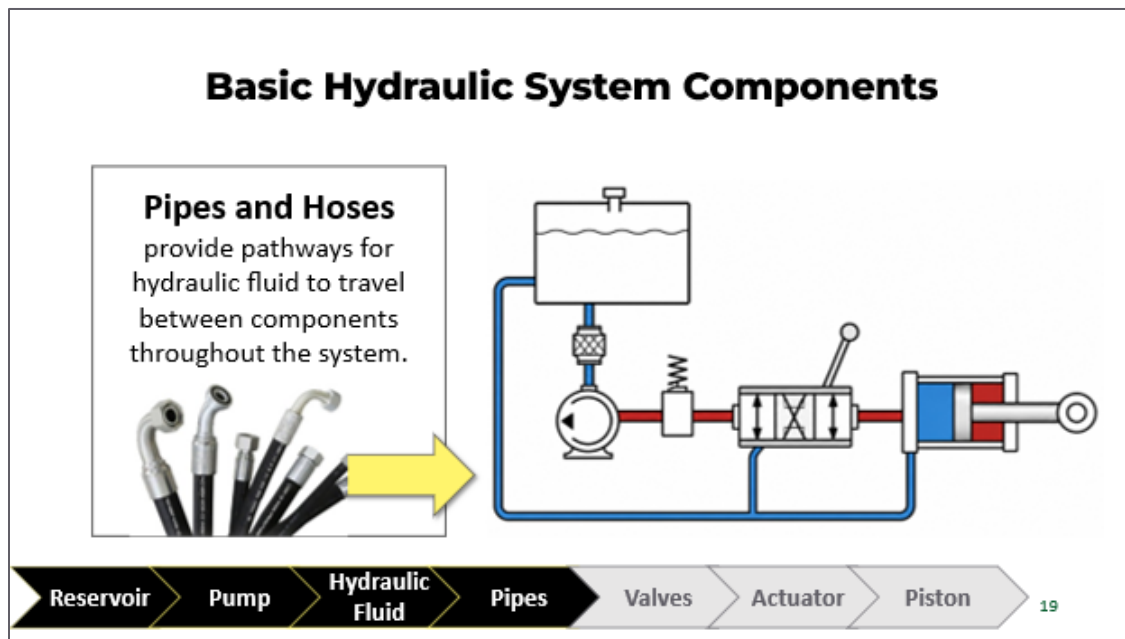
Notes:

- Next, the **pump**, which draws hydraulic fluid from the reservoir and moves it through the system, creating the **flow** needed for the system to operate.



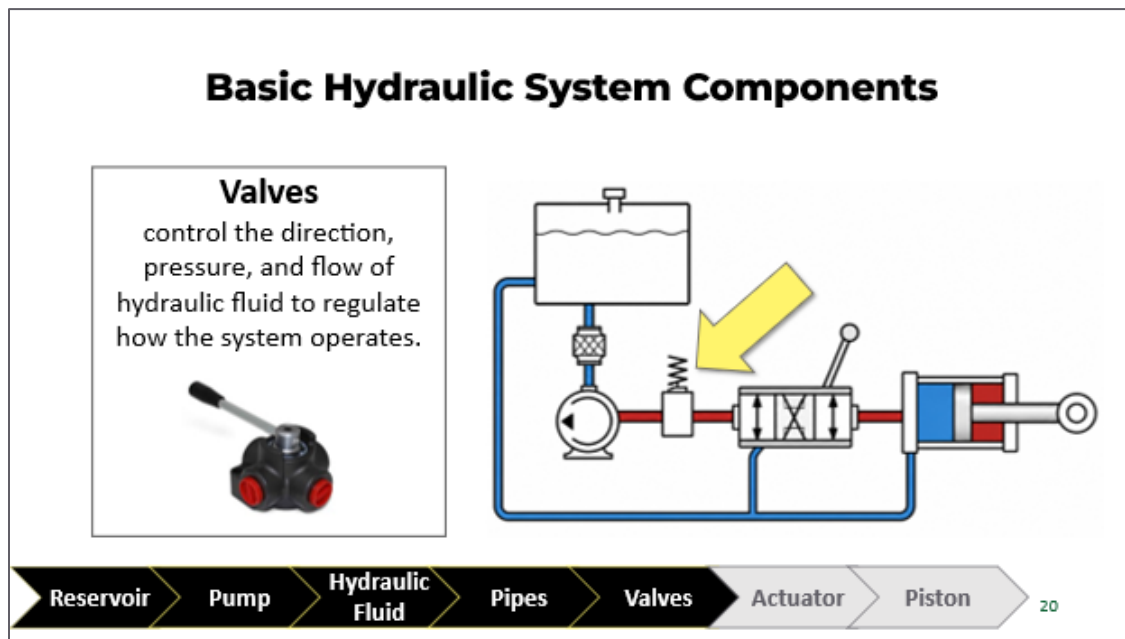
Notes:

- The pump moves **hydraulic fluid** through the system. The fluid transmits **energy** while also helping lubricate and cool system components.
- Because it is nearly incompressible, hydraulic fluid can efficiently transmit pressure.



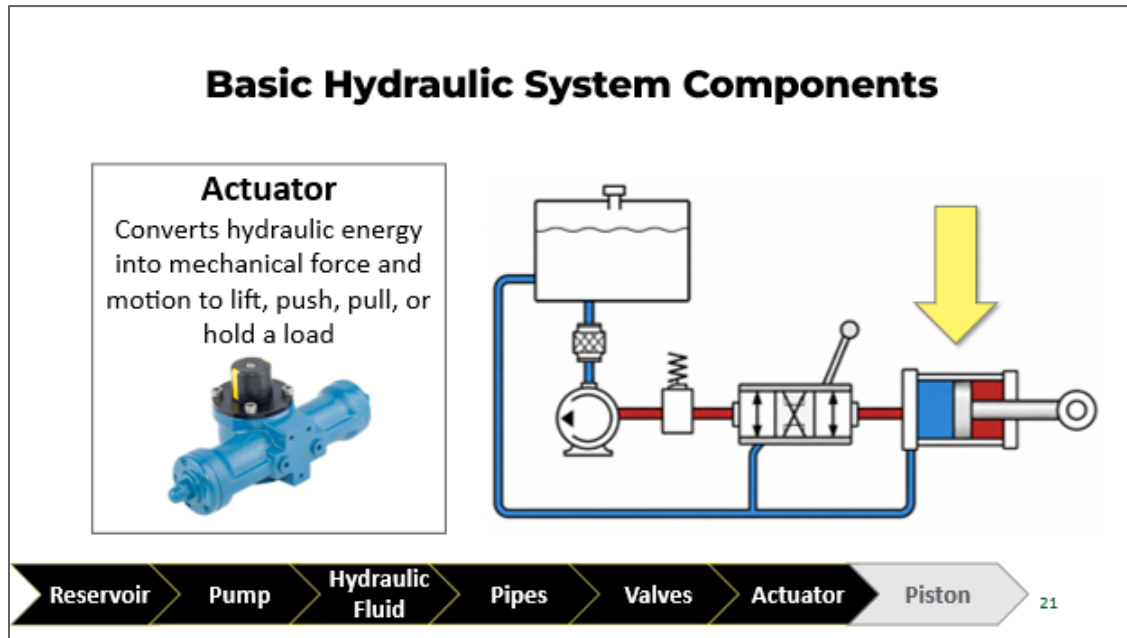
Notes:

- The **pipes and hoses** provide pathways for hydraulic fluid to travel between components throughout the system.



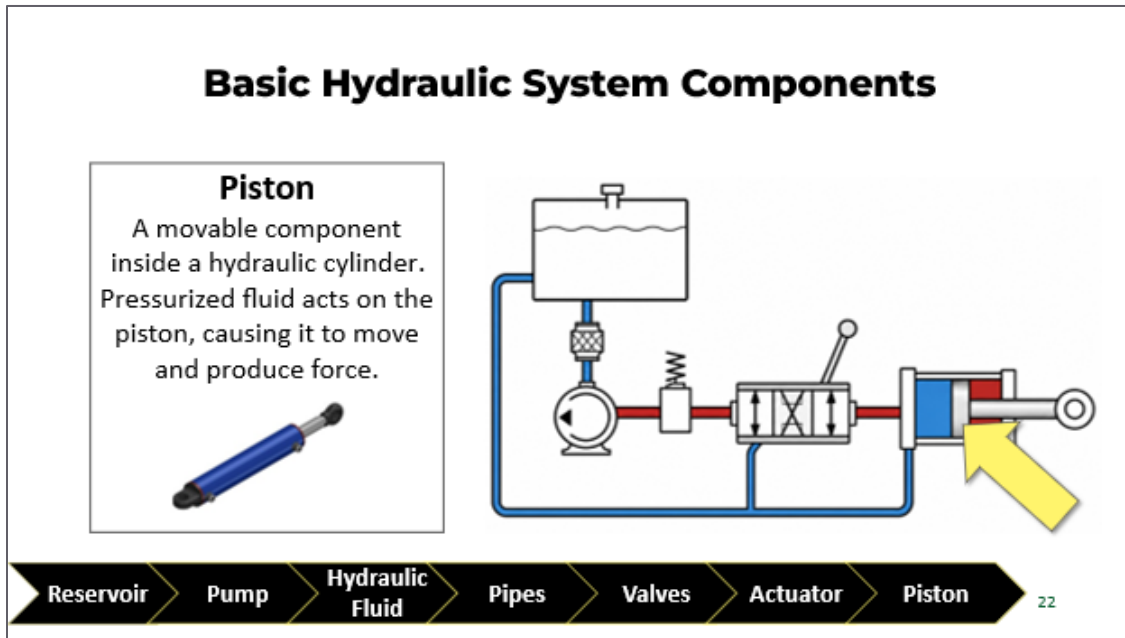
Notes:

- The **valves** control the direction, pressure, and flow of hydraulic fluid to regulate how the system operates.



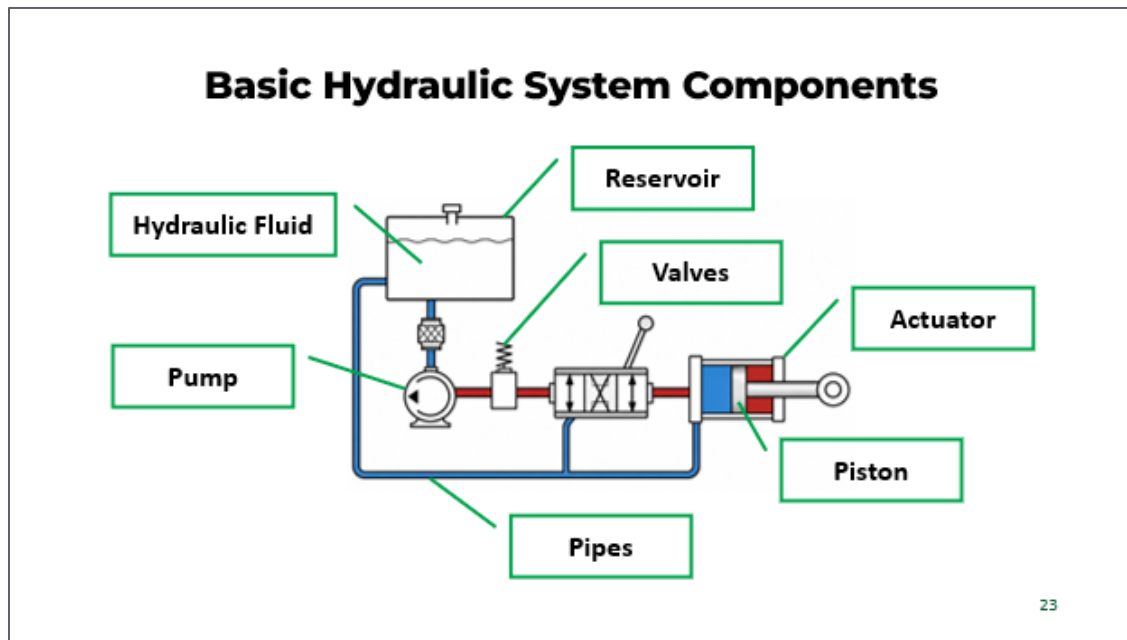
Notes:

- The **actuator** converts hydraulic energy into mechanical force and motion. A **hydraulic cylinder** is a type of actuator that produces linear motion to lift, push, pull, or hold a load.



Notes:

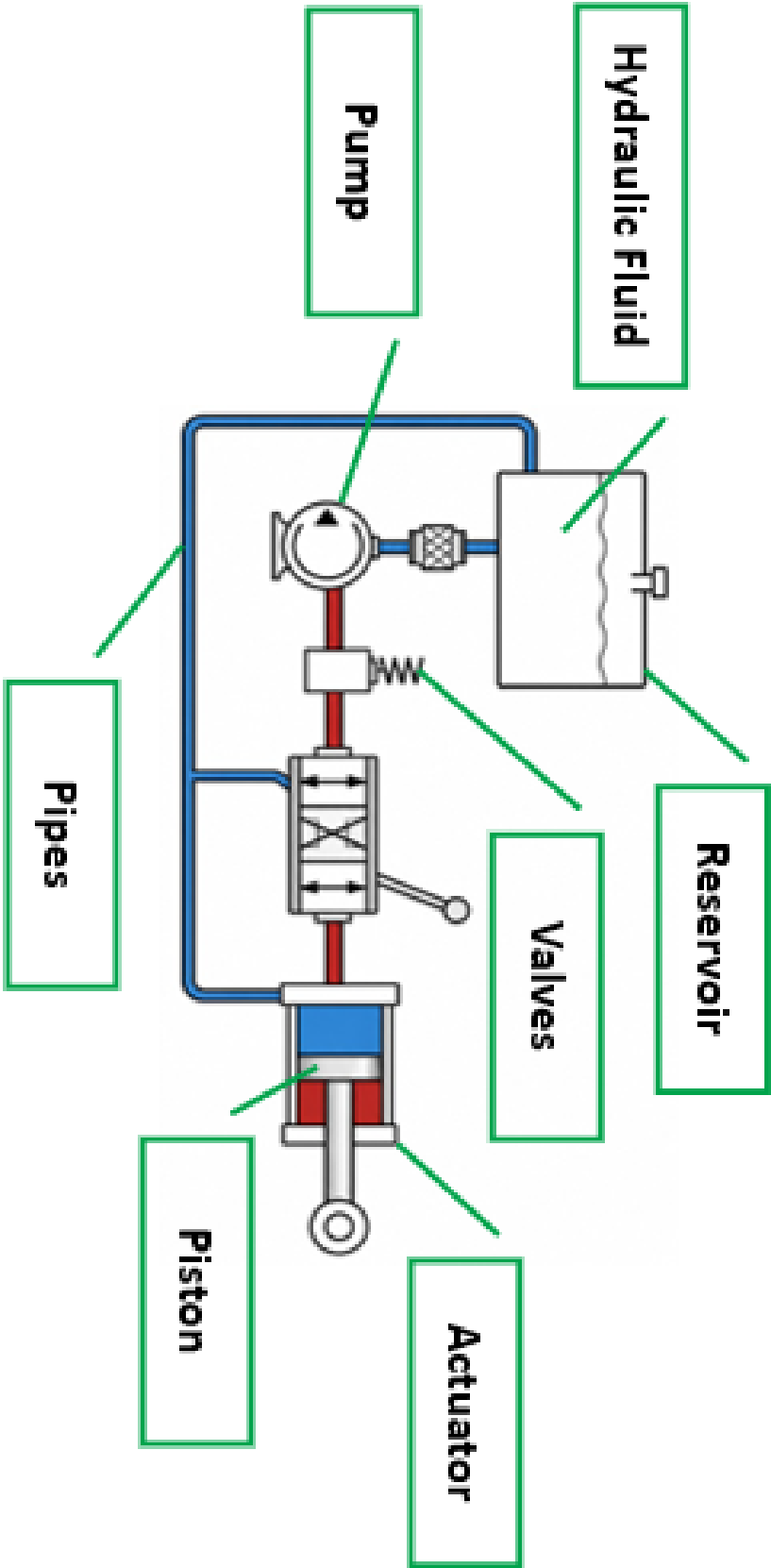
- The piston is a movable component inside an actuator (hydraulic cylinder). Pressurized fluid acts on the piston, causing it to move and produce force.

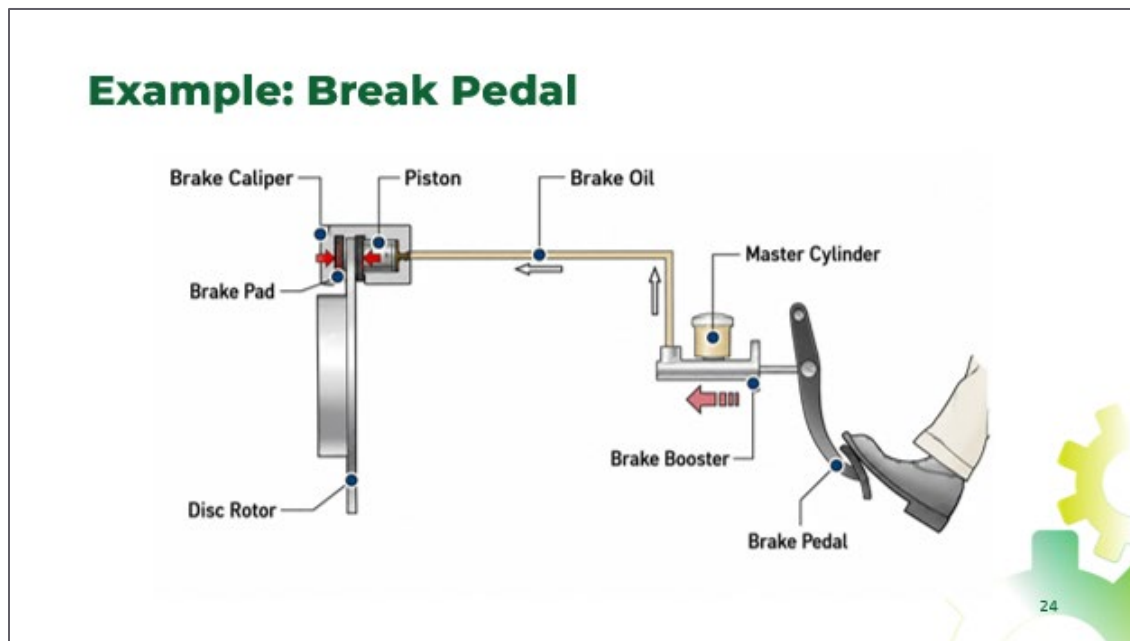


Notes:

- Let's review. Can you explain how a basic hydraulic system functions from start to finish?

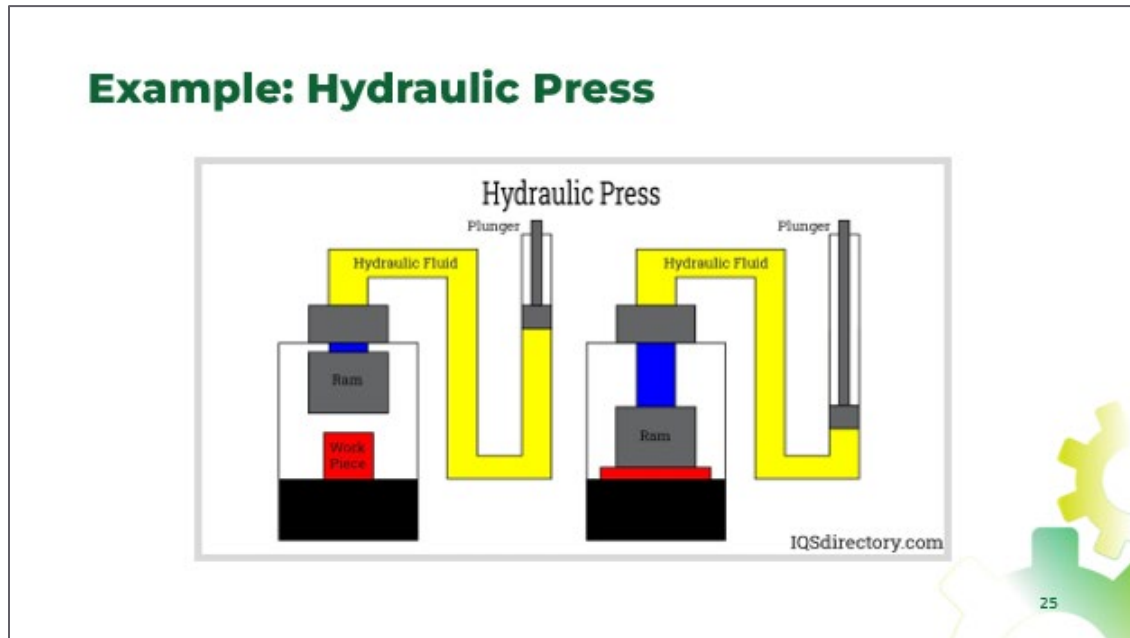
Basic Hydraulic System Components





Notes:

- Now that you have a better understanding of how hydraulic systems work, let's return to this brake pedal graphic from earlier in the presentation.
- In a car's braking system, the driver pressing the brake pedal applies a force to the brake fluid, creating pressure.
- This pressure is then transmitted to the brake caliper and pad, which presses against the rotor to apply the brakes.



Notes:

- In a hydraulic press, a force is applied to a small piston (plunger), generating pressure.
- When this pressure is then transmitted to a larger piston, the force is multiplied, which allows the press to exert a large force on the work piece.

Common Hydraulic Systems

- Elevators
- Dump trucks (lifting mechanism)
- Wheelchair lift
- Hydraulic braking system (bus and trains)
- Power Steering systems
- Hydraulic lift



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Notes:

- Hydraulic systems are used in many different types of equipment because they can produce a large amount of force to move or lift heavy loads.
- You may be familiar with hydraulic systems in **elevators** and **dump trucks**, where hydraulic force is used to lift heavy loads.
- In transit, **wheelchair lifts** are a common example. Hydraulics can provide the controlled lifting force needed to raise and lower the platform.
- Hydraulics are also used in **braking and power steering systems** on some transit vehicles. These systems use pressurized fluid to help control vehicle movement.
- Maintenance facilities also use **hydraulic lifts** to raise vehicles so technicians can safely access components underneath.
- The specific application may change, but the basic principle remains the same: **hydraulic fluid transmits power to produce force and motion.**
- Next, you'll look at some of the advantages and disadvantages of using hydraulic systems.

Advantages of Hydraulic Systems

Hydraulic systems are well suited for applications requiring high force and heavy loads.

- Produce high amounts of force
- Move and lift heavy loads
- Generate high force with smaller actuators
- Fluid provides power, lubrication, and cooling
- Typically operate more quietly than pneumatic systems



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Notes:

- Hydraulic systems have several advantages that make them useful in transportation and other heavy-duty applications.
- One of their biggest advantages is their ability to produce **large amounts of force**. Compared with pneumatic systems, hydraulics typically operate at higher pressures and can produce greater force.
- This makes hydraulics especially useful when equipment needs to lift or move a heavy **load**, such as raising a vehicle on a hydraulic lift.
- Higher operating pressures also allow hydraulic systems to produce significant force from relatively compact **actuators**.
- Hydraulic fluid also performs several jobs within the system. In addition to transmitting power, it can help **lubricate components and carry away heat**.
- Hydraulic systems also tend to operate more **quietly** than pneumatic systems, particularly because they do not have the same compressed-air exhaust noise.
- These advantages help explain why hydraulics are commonly used for heavy-duty applications where high force and controlled movement are important.

Disadvantages of Hydraulic Systems

Hydraulic systems also have limitations that must be considered.

- Can be large and complex
- May require more installation space
- Often have higher costs
- May operate more slowly in some applications
- High-pressure fluid can create safety hazards



Safety Reminder: Always wear appropriate PPE and follow agency safety procedures.



Notes:

- Although hydraulic systems can produce a lot of force, there are also some disadvantages.
- Hydraulic systems can be relatively **large and complex** because they may require pumps, reservoirs, valves, hoses, fluid, actuators, and other components.
- All of those components require **space**, which can be an important consideration when designing or maintaining equipment.
- Hydraulic systems can also be more **expensive** because of their components, installation, and maintenance requirements.
- In some applications, hydraulic systems may operate more **slowly** than pneumatic systems. Hydraulic fluid is more viscous than air and moving it through the system requires **energy**.
- **Safety** is another important consideration. Hydraulic systems can operate under very high pressure, and a high-pressure fluid leak can cause a serious injury.
- As discussed earlier, always wear the appropriate **PPE** and follow your agency's procedures when working with hydraulic equipment.
- Understanding both the advantages and disadvantages helps technicians recognize why hydraulics are appropriate for some applications but not necessarily the best choice for every application.

Knowledge Check



Match the term with the correct definition.

(1.) Fluid Mechanics

(A.) The study of fluids in motion.

(2.) Fluid Dynamics

(B.) The study of fluids and how forces affect their behavior.

(3.) Fluid Statics

(C.) The study of fluids at rest.

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Knowledge Check



What are hydraulics?

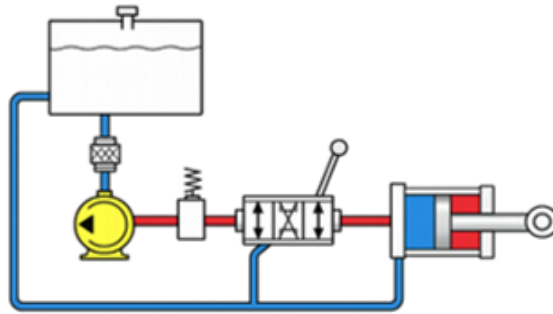
- A. The use of compressed air to transmit power
- B. The use of pressurized liquid to transmit power
- C. The use of electrical energy to transmit power
- D. The use of mechanical gears to transmit power

30

Knowledge Check



What is the function of a pump (highlighted) in a hydraulic system?



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Knowledge Check



**Explain one way
hydraulics are used the
transit industry.**



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Summary and What's Next

- Hydraulics use pressurized liquid to transmit power.
- Hydraulic systems produce high force for heavy loads.
- Pumps, valves, cylinders, and fluid work together to create motion.
- Hydraulics are common in transit vehicles and maintenance equipment.

Now that you understand how hydraulic systems work, it's time to explore pneumatic systems and compare how they differ from hydraulics.

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Notes:

- *What are the key takeaways from this part of our lesson?*
 - Let's review what you've covered about hydraulics.
 - Hydraulic systems use **pressurized liquid** to transmit power and create motion.
 - Because liquids are nearly incompressible, hydraulic systems can generate a large amount of force, making them ideal for lifting and moving heavy loads.
 - You also learned about the major components of a hydraulic system, including the pump, reservoir, valves, hydraulic fluid, and actuator, and learned how they work together to perform mechanical work.
 - Finally, you explored common transit applications, along with the advantages and disadvantages of hydraulic systems.
 - Now that you understand how hydraulic systems operate, let's shift focus to **pneumatic systems** and see how compressed air can also be used to perform mechanical work.
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1.3 - Pneumatics

This section introduces pneumatic systems, including how they work, their key components, advantages and disadvantages, and common applications.



Notes:

- This section introduces pneumatic systems, including how they work, their key components, advantages and disadvantages, and common applications.

What Are Pneumatics?

Pneumatics – The use of pressurized air or gas to transmit power and perform mechanical work.

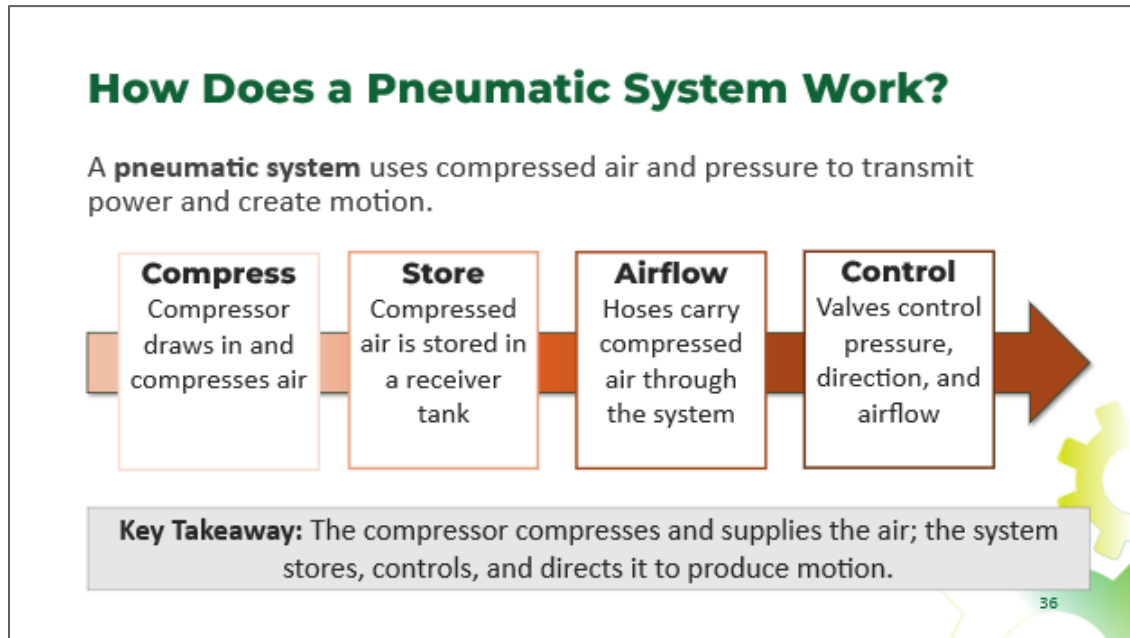
- air pressure produces force and motion
- Common transportation systems

Example: Pneumatic air brakes



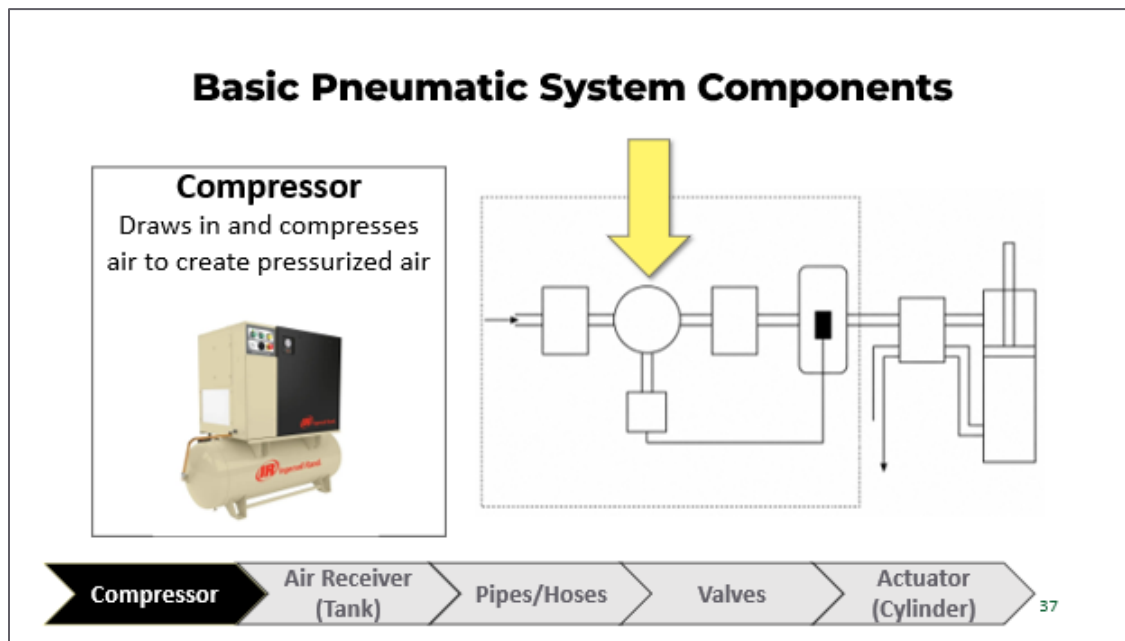
Notes:

- The word *pneumatic* comes from the Greek word *pneuma*, which is associated with breath, wind, and air. That gives us a good clue about how pneumatic systems operate.
 - Pneumatics involves using **pressurized air** or another **gas** to transmit **power** and perform **mechanical work**.
 - A familiar transit example is an **air brake system on a bus**. The system stores and controls compressed air so it can be used as part of the braking process.
 - Remember the basic distinction established: **hydraulics** use **liquid**, while **pneumatics** use **air** or **gas**.
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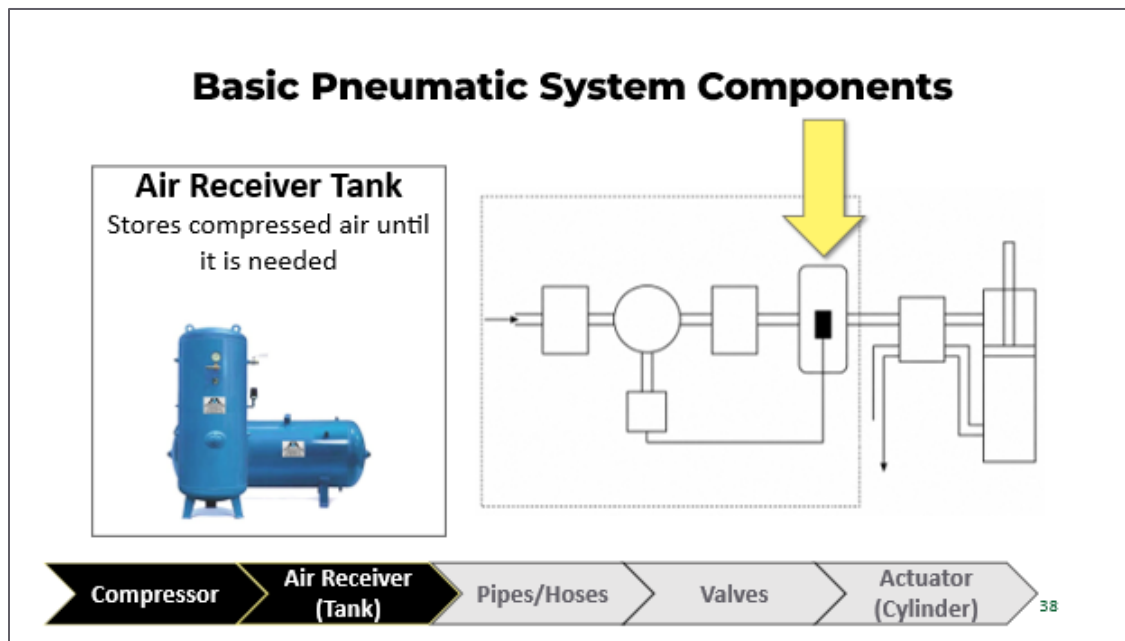
Notes:

- Just like with hydraulics, let's break a pneumatic system down into a basic sequence.
 - First, the **compressor** draws in air and compresses it. This increases the air **pressure** and provides the system with its source of compressed air.
 - The compressed air is typically held in a **receiver tank**, where it is stored until needed.
 - When the system operates, compressed air travels through **hoses or lines** to where it is needed.
 - **Valves** control the pressure, direction, and flow of the compressed air.
 - Finally, the compressed air reaches an **actuator**, such as a pneumatic cylinder. The actuator converts pneumatic energy into mechanical force and motion.
 - So, think of the process as **compress → store → move → control → work**.
 - As you continue, look closely at the individual components that make each of these steps possible.
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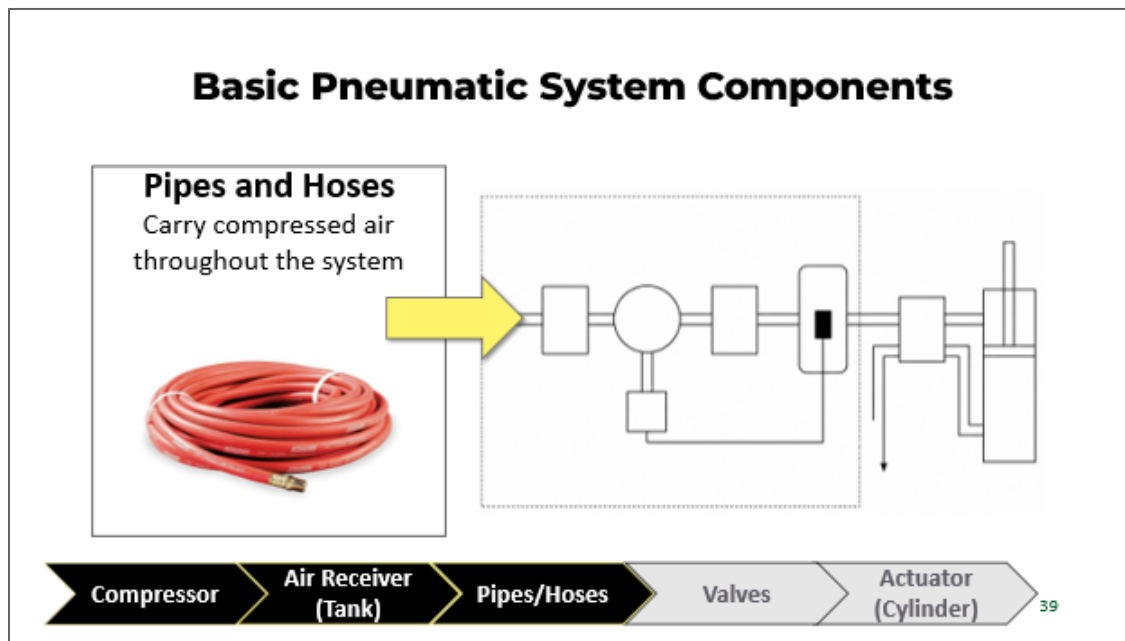
Notes:

- Just like hydraulic systems, pneumatic systems rely on several components working together to produce force and motion.
- The process begins with the **compressor**.
- It draws in air from the atmosphere and compresses it, creating the pressurized air needed to power the system.



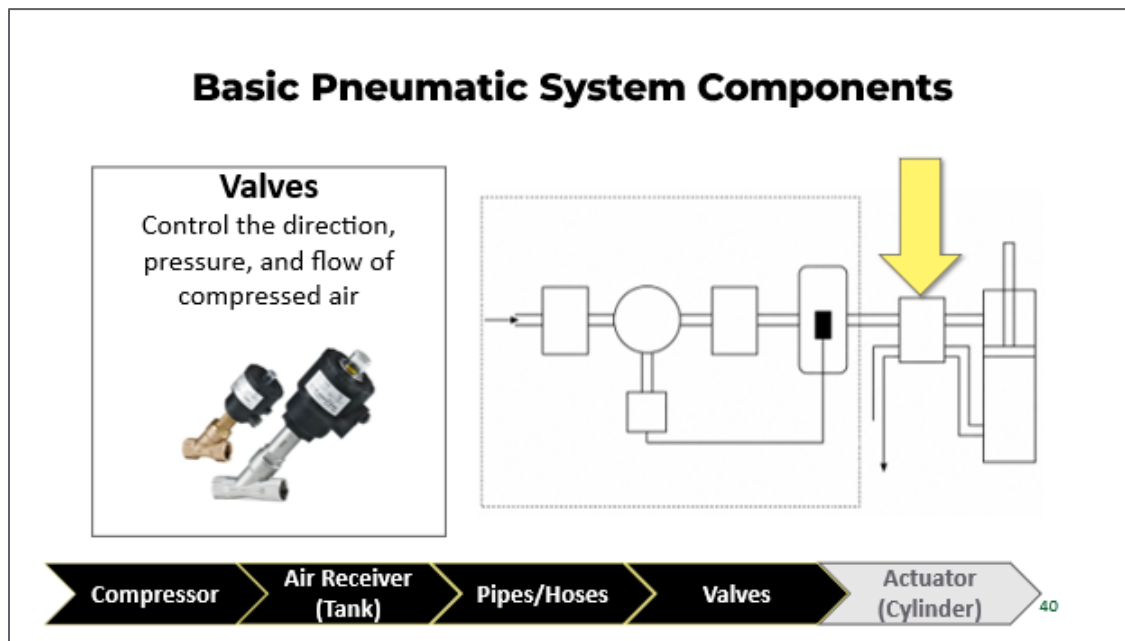
Notes:

- The compressed air is then stored in an **air receiver**, sometimes called a receiver tank.
- This provides a supply of compressed air that is ready when the system needs it.



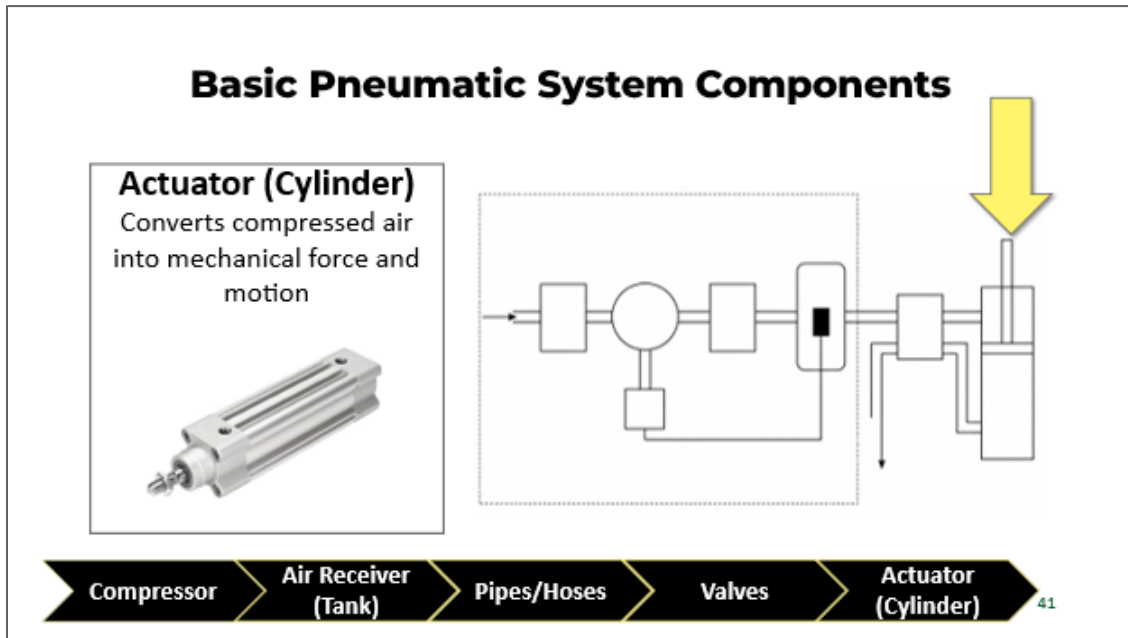
Notes:

- Next, **pipes and hoses** carry the compressed air throughout the system, connecting the different components.



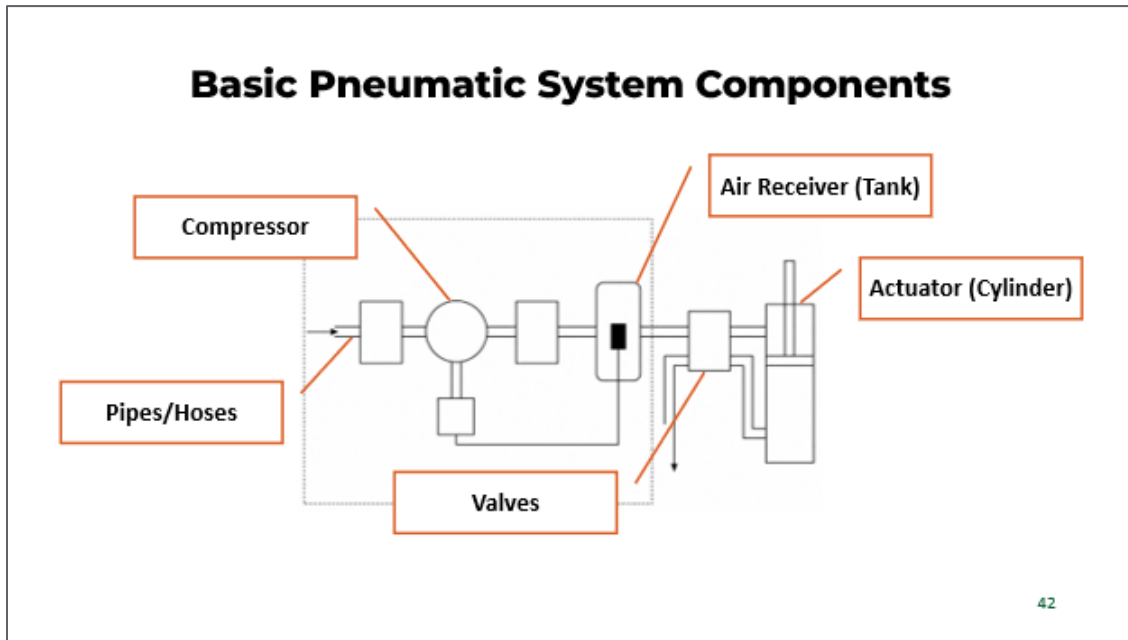
Notes:

- **Valves** control where the compressed air goes and regulate its pressure and flow.
- Depending on the application, valves may be operated manually or automatically.



Notes:

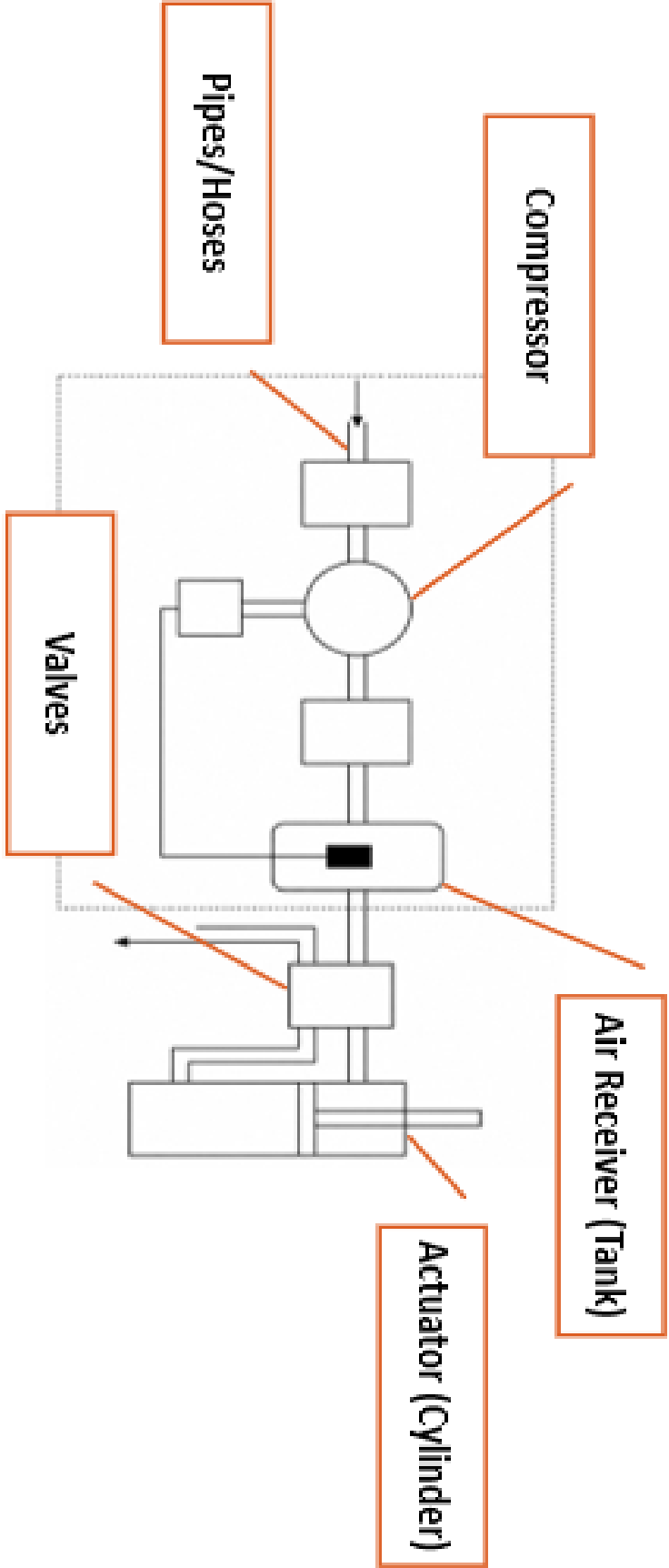
- Finally, the compressed air reaches an **actuator**, such as a pneumatic cylinder.
- The actuator converts the energy of the compressed air into mechanical force and motion to perform work.



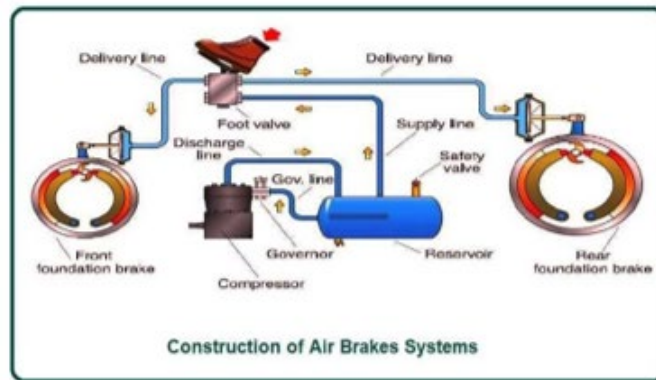
Notes:

- Let's review. Can you explain how a basic pneumatic system functions from start to finish?

Basic Pneumatic System Components



Example: Dump Truck Air Brakes



Notes:

- Let's look at a real-world example of a pneumatic system: an **air brake system** used on heavy vehicles, including buses and trains.
- Pneumatic braking systems use compressed air to actuate the brake shoes or brake pads, applying the force needed to slow or stop the vehicle.
- As you look at the diagram, notice several of the components just discussed.
- The **air compressor** draws in air from the atmosphere, compresses it, and sends it to the **air reservoir**, where the compressed air is stored until it is needed.
- When the driver presses the **brake pedal**, the **brake valve** opens and regulates the flow of compressed air from the storage tank to the brake chambers.
- The pressurized air then actuates the braking mechanism, applying the brakes to slow or stop the vehicle.
- In actual transit vehicles, you'll also find **relay control circuits** in the delivery lines. These help deliver compressed air more quickly and efficiently to the brakes, improving braking response.
- Although air brake systems can vary in design, they all rely on the same basic principles: compress the air, store it, control its flow, and use it to create mechanical braking force.

Common Pneumatic Systems

Pneumatic systems are commonly used where fast, reliable, and repetitive motion is needed.

- Air brakes on buses, trucks, and trains
- Air suspension systems
- Pneumatic tools
- Manufacturing and assembly lines
- Bus and train door systems
- Pneumatic windshield wipers
- Train horns
- Rail sander systems



Notes:

- One of the most familiar examples is **air brakes**, which are used on buses, trucks, and trains to safely stop heavy vehicles.
 - Many transit vehicles also use **air suspension systems** to improve ride quality and help maintain a consistent vehicle height, regardless of passenger load.
 - In maintenance shops, you'll often find **pneumatic tools**, such as impact wrenches and air ratchets, because they are lightweight, durable, and provide consistent power.
 - Outside of transit, pneumatics are widely used in **manufacturing and assembly lines**, where compressed air powers equipment that performs fast, repetitive tasks.
 - Transit vehicles also use pneumatic systems to **open and close passenger doors**, providing reliable operation throughout the day.
 - Other common applications include **pneumatic windshield wipers, train horns, and rail sander systems**, which use compressed air to improve wheel traction during poor weather or low-traction conditions.
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Advantages of Pneumatic Systems

Pneumatic systems are ideal for applications requiring **fast, reliable motion**.

- Lower installation and operating costs
- Require less space than hydraulic systems
- Lower fire and explosion hazards
- Air flows quickly for fast operation
- Simpler design and easier maintenance
- Reliable for repetitive tasks



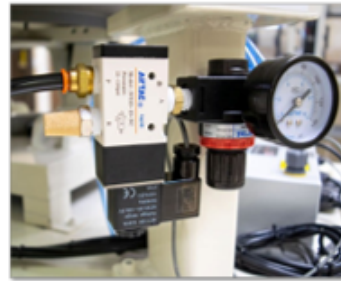
Notes:

- Pneumatic systems offer several advantages that make them a popular choice for many transit and industrial applications.
 - One advantage is their **lower installation cost**. Pneumatic systems are often less expensive to install than hydraulic systems because they typically require fewer components.
 - They also require **less space**, making them a good option when equipment size is limited.
 - Since pneumatic systems use **compressed air instead of hydraulic fluid**, they generally present a lower risk of fires and explosions.
 - Air also moves through the system very quickly, allowing pneumatic systems to respond rapidly. This makes them well suited for applications that require fast, repetitive motion, such as opening and closing bus doors.
 - Finally, pneumatic systems tend to have a **simpler design**, making them easier to maintain and troubleshoot than many hydraulic systems.
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Disadvantages of Pneumatic Systems

Pneumatic systems also have limitations.

- Produce less force than hydraulic systems
- Air pressure fluctuations can affect performance
- Require larger cylinders for the same force
- Lose energy during air compression
- Can be noisy during operation
- Moisture can reduce system performance
- Time is required to build air pressure



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Notes:

- Although pneumatic systems have many advantages, they also have several limitations.
- Compared to hydraulics, pneumatic systems generally produce **less force**. For that reason, hydraulics are often preferred for lifting or moving very heavy loads.
- Because air is compressible, **pressure can fluctuate**, making movement less precise than in hydraulic systems.
- To produce the same amount of force as a hydraulic cylinder, a pneumatic system typically requires a **larger actuator**.
- Another disadvantage is efficiency. Compressing air generates heat, which means some of the input **energy is lost** during the compression process.
- Pneumatic systems can also be **loud**, particularly when compressed air is exhausted from valves and actuators.
- **Moisture** is another concern. Air compressors naturally draw moisture from the atmosphere, and if that moisture isn't removed, it can reduce system performance or damage components.
- Finally, pneumatic systems require **time** to build pressure before they are ready to operate, which can introduce a short delay in some applications.

Hydraulics vs. Pneumatic

	Hydraulics	Pneumatics
Pressure	Higher operating pressure	Lower operating pressure
Force Produced	High force; ideal for heavy loads	Lower force; best for lighter loads
Speed	Generally slower, controlled movement	Faster response and movement
Precision	More precise because liquids are nearly incompressible	Less precise because air is compressible
Maintenance	More complex; requires monitoring for leaks and fluid condition	Simpler; requires moisture control and air system maintenance
Safety Concerns	High-pressure fluid leaks and injection hazards	High-pressure air, noise, and stored energy hazards

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Notes:

- You've now explored both hydraulics and pneumatics individually. This chart summarizes the key differences between the two systems.
- One of the biggest differences is **pressure**. Hydraulic systems operate at much higher pressures than pneumatic systems, allowing them to generate significantly more force.
- Because of that higher pressure, **hydraulics are better suited for lifting and moving heavy loads**, while **pneumatics are typically used for lighter-duty applications that require fast, repetitive movement**.
- Another important difference is **speed and precision**. Hydraulic systems generally provide slower, more controlled, and more precise movement because liquids are nearly incompressible. Pneumatic systems respond more quickly, but because air can be compressed, they are typically less precise.
- The two systems also differ in their **maintenance requirements**. Hydraulic systems require regular monitoring for fluid leaks and fluid condition, while pneumatic systems are generally simpler but require moisture control and maintenance of the compressed air system.
- Finally, both systems have unique **safety considerations**. Hydraulic systems operate under extremely high fluid pressures, creating hazards such as injection injuries. Pneumatic systems store compressed air, which introduces hazards related to high-pressure air, noise, and stored energy.
- Neither system is inherently better than the other. Instead, each is designed for different applications. Understanding the strengths and limitations of both helps maintenance technicians choose the right system for the job and work with it safely and effectively.

Discussion



Read the scenario and decide whether the company should use a hydraulic system or a pneumatic system. Be prepared to explain your reasoning.

A transit agency is installing an automated parts sorting system in its maintenance warehouse. The system must repeatedly push, sort, and position lightweight parts at high speed throughout the day. The equipment should be simple to maintain and inexpensive to install.

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Knowledge Check



What are pneumatics?

- A. The use of compressed air or gas to transmit power
- B. The use of pressurized liquid to transmit power
- C. The use of electrical energy to transmit power
- D. The use of mechanical gears to transmit power

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Knowledge Check



Which system would you choose? Why?

Lifting a 35,000-pound transit bus onto a maintenance lift

Hydraulic System

Pneumatic System

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Knowledge Check



Which system would you choose? Why
Opening and closing bus passenger doors hundreds of times each day

Hydraulic System

Pneumatic System

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Knowledge Check



It is important for transit maintenance technicians to understand both hydraulic and pneumatic systems so they can _____.

- A. replace all pneumatic systems with hydraulic systems
- B. operate every transit vehicle without additional training
- C. eliminate the need for preventive maintenance
- D. identify the correct system, work safely, and perform maintenance effectively

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Summary and What's Next

- Pneumatics use **compressed air or gas** to transmit power.
- Pneumatic systems provide **fast, reliable motion**.
- Compressors, air receivers, valves, and actuators work together.
- Pneumatics are commonly used for **air brakes, doors, and pneumatic tools**.

Next, we'll look at the role of hydraulics and pneumatics in transit maintenance

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Notes:

- *What are the most key takeaways from this part of our lesson?*
 - Pneumatic systems use **compressed air or gas** to transmit power and create motion.
 - While they generally produce less force than hydraulic systems, they are well suited for applications that require quick, reliable, and repetitive movement.
 - You also examined the major components of a pneumatic system—including the compressor, air receiver, valves, pipes and hoses, and actuator—and saw how they work together to produce mechanical motion.
 - Finally, you explored common transit applications, as well as the advantages and disadvantages of pneumatic systems.
 - Next, let's discuss the role of hydraulics and pneumatics in transit maintenance
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Notes:

- This section examines the role of fasteners in transit vehicle maintenance.

Hydraulics and Pneumatics in Transit Maintenance

Understanding hydraulic and pneumatic systems helps technicians:

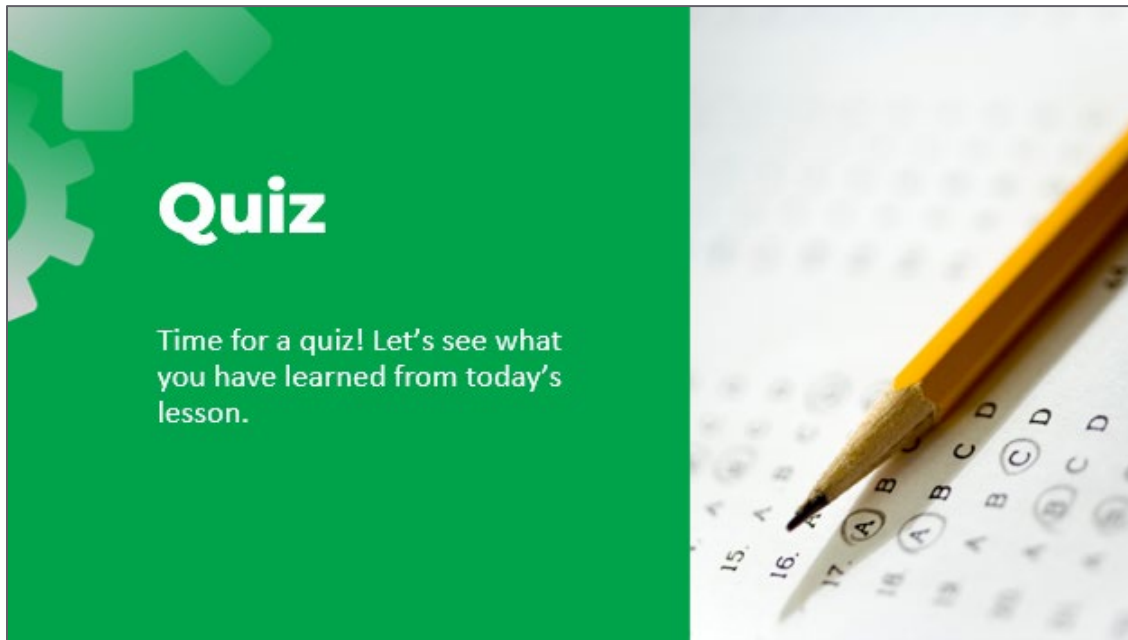
- Diagnose and troubleshoot equipment problems
- Perform repairs safely and efficiently
- Select the right system and tool for the job
- Recognize hazards and follow safe work practices



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Notes:

- Hydraulic and pneumatic systems are found throughout transit vehicles and maintenance facilities.
- As a technician, understanding how these systems operate is an important part of your job.
- First, this knowledge helps you **diagnose and troubleshoot problems** more effectively.
 - When you understand how a system is supposed to work, it's much easier to identify when something isn't working correctly.
- It also helps you **perform repairs safely and efficiently**. Knowing how pressure is generated and stored allows you to follow the proper procedures before working on a system.
- Understanding the differences between hydraulic and pneumatic systems also helps you **select the right system and tool** for the application.
 - As discussed, hydraulics are typically used when high force is needed, while pneumatics are often chosen for fast, repetitive motion.
- Finally, understanding these systems helps you **recognize potential hazards**, such as high-pressure fluid or compressed air, and follow the appropriate safety practices to protect yourself and those around you.



Notes:

- Time for a quiz! Let's see what you have retained from today's lesson.

Revisiting Objectives

- Define fluid dynamics and explain how it relates to hydraulic and pneumatic systems.
- Define and differentiate hydraulics and pneumatics.
- Identify mechanisms that use hydraulic and pneumatic systems.
- Explain the importance of hydraulics and pneumatics in transit maintenance.
- Compare the advantages and disadvantages of hydraulic and pneumatic systems.

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Notes:

- If you were explaining today's objectives to someone else, how would you summarize what they mean and why they matter?
- Which of today's objectives do you feel most confident about? Which were most challenging?
 - Explain your reasoning.
- Can you give an example of how you could apply one of today's objectives in a real-world situation?
