

Shop and Personal Safety

1. Identify general lab/shop safety rules and procedures.

In an automotive shop, safety rules and procedures are essential to prevent accidents, injuries, and damage to equipment. These rules are designed to protect both technicians and the environment, ensuring that operations run smoothly and safely. Below are some of the most critical safety guidelines in an automotive shop:

- **Personal Protective Equipment (PPE):**
 - Technicians must always wear appropriate PPE, including safety glasses, gloves, steel-toed boots, and ear protection. Safety glasses protect the eyes from debris, chemicals, and sparks, especially during tasks like grinding or working with batteries. Gloves should be task-specific—nitrile gloves for handling chemicals and leather gloves for high-heat applications. Ear protection is essential in areas where loud machinery is in use, as prolonged exposure to high decibel levels can cause hearing damage.
 - PPE should meet industry safety standards, such as ANSI Z87.1 for eyewear and OSHA regulations for hearing protection. PPE must be inspected regularly for wear and tear and replaced as needed.
- **Proper Tool and Equipment Use:**
 - Technicians must only use tools and equipment for their intended purpose and should be trained on how to operate each piece of equipment correctly. Improper use of tools, such as using the wrong size wrench or handling power tools without the correct safety guards, increases the risk of injury.
 - Lifting equipment, such as hydraulic jacks and hoists, must be inspected before each use to ensure it is in proper working condition. Vehicles should always be lifted at the manufacturer's designated lifting points, and jack stands should be used to secure the vehicle once raised.
- **Housekeeping and Hazard Prevention:**
 - Keeping the shop clean and organized is crucial for preventing accidents. Tools should be returned to their proper places, and any spills of oil, coolant, or other fluids must be cleaned up immediately to prevent slips and falls.
 - Electrical cords and air hoses should be coiled properly when not in use to reduce tripping hazards. Additionally, flammable materials, such as oil-soaked rags, must be stored in fire-resistant containers, and all employees should be familiar with the location of fire extinguishers and other emergency equipment. Regular safety audits help ensure these practices are consistently followed.

2. Utilize safe procedures for handling of tools and equipment.

Proper handling of tools and equipment is critical to ensure the safety of both technicians and vehicles. Following strict safety procedures minimizes the risk of accidents, equipment damage, and injury. Below are key safety protocols for handling tools and equipment in an automotive environment:

- **General Tool Safety:**
 - Technicians should inspect hand tools before use, checking for cracks, wear, or damage that could cause the tool to fail. For example, wrenches with worn-out jaws can slip and cause injury, while cracked screwdriver handles can break under pressure.
 - Tools must always be used for their intended purpose. For instance, a hammer should not be used to strike a wrench, and a screwdriver should not be used as a pry bar. Misusing tools increases the likelihood of damage to both the tool and the workpiece, as well as the risk of injury to the technician.
- **Power Tool and Heavy Equipment Use:**
 - When operating power tools such as pneumatic wrenches, drills, or grinders, technicians must follow the manufacturer's guidelines and wear appropriate personal protective equipment (PPE), including gloves, eye protection, and hearing protection. It is essential to secure loose clothing or jewelry, as they can get caught in moving parts, leading to injury.
 - Heavy equipment, such as hydraulic presses and lifts, requires careful inspection before each use. Technicians should ensure that load ratings are adhered to and that all moving parts, such as lift arms and hydraulic lines, are in proper working order. When lifting vehicles, jack stands must be placed under the vehicle for added safety, as hydraulic jacks alone are not sufficient for long-term support.
- **Tool Storage and Maintenance:**
 - Tools and equipment should be stored in their designated areas when not in use to reduce clutter and prevent accidents. For instance, leaving tools on a vehicle's engine bay or underfoot can lead to trips, falls, or damage to the vehicle or tool itself.
 - Regular maintenance of tools is critical to extending their lifespan and ensuring safe operation. Power tools should be lubricated and cleaned according to the manufacturer's recommendations, while hand tools should be free of rust and corrosion. Keeping tools in good working order reduces the likelihood of malfunction and contributes to a safer working environment.

3. Identify and use proper placement of floor jacks and jack stands.

The proper use and placement of floor jacks and jack stands are essential for technician safety and vehicle stability. Incorrect usage can result in vehicle collapse, leading to severe injury or damage. Below are the key safety procedures related to the use and placement of these lifting tools:

- **Pre-Inspection and Placement of Floor Jacks:**
 - Before using a floor jack, technicians must inspect it for any signs of wear, leaks, or damage. Hydraulic fluid levels should be checked regularly, and the jack should be free from cracks or faulty components. If any issues are identified, the jack must be repaired or replaced to prevent failure during lifting.
 - The floor jack must be positioned on a level, stable surface to ensure safe operation. Technicians should always consult the vehicle manufacturer's guidelines to locate the appropriate lifting points. Using improper lifting points, such as suspension components or body panels, can lead to vehicle damage or instability during the lift.
- **Proper Use of Jack Stands:**
 - Jack stands are crucial for safely supporting the vehicle once it has been raised. Relying solely on a floor jack is unsafe because hydraulic systems can fail over time, causing the vehicle to collapse. After lifting the vehicle to the desired height, jack stands should be placed under the vehicle at the manufacturer-recommended support points.
 - The jack stands must be adjusted to the correct height and locked securely before lowering the vehicle onto them. To ensure stability, the vehicle should be gently shaken to confirm that it is firmly seated on the stands and that there is no risk of shifting or falling. Only after this confirmation should technicians begin work underneath the vehicle.
- **Post-Lift Safety and Removal:**
 - Once work is completed, the area around the vehicle must be cleared of tools and obstructions before lowering the vehicle. The floor jack is then re-positioned under the vehicle, and the weight is carefully transferred from the jack stands to the jack. The vehicle should be lowered slowly and steadily to avoid sudden movements that could damage components or create hazards.
 - Jack stands should be stored properly after use, and both jacks and stands must be routinely inspected and maintained to ensure they are in good working condition for future use. Following these procedures reduces the risk of accidents, ensuring that both the technician and the vehicle are protected during lifting operations.

4. Identify and use proper procedures for safe lift operation, ensuring the configuration and weight rating of the lift is appropriate for the vehicle being lifted, including xEVs.

The proper operation of vehicle lifts is vital for both technician safety and vehicle stability. Lifts must be operated in compliance with safety protocols, ensuring the equipment's configuration and weight rating are appropriate for the specific vehicle being lifted. Below are detailed safety procedures for safe lift operation, especially in light of the increasing presence of electric vehicles (xEVs) with different weight distribution and structural considerations:

- **Pre-Use Inspection and Lift Configuration:**
 - Before using a lift, technicians should conduct a thorough inspection to ensure all components are in proper working order. This includes checking for hydraulic fluid leaks, wear on cables or chains, and ensuring the safety latches are functional. Regular maintenance logs should be kept to track service intervals, ensuring the lift operates reliably and safely.
 - The lift must be configured for the specific vehicle to be raised, considering both its size and weight. Technicians should consult the lift's rated capacity, ensuring it meets or exceeds the gross vehicle weight rating (GVWR) of the vehicle being lifted. Overloading a lift can result in catastrophic failure, potentially injuring technicians and damaging the vehicle.
- **Safe Vehicle Positioning and Weight Distribution:**
 - Proper vehicle positioning is critical for safe lift operation, particularly with electric vehicles (xEVs), which often have non-traditional weight distributions due to the placement of battery packs. For both internal combustion engine vehicles and xEVs, technicians must use the manufacturer-recommended lifting points to ensure the vehicle is stable and does not shift during lifting. Incorrect positioning, such as lifting from suspension components or underbody panels, can lead to instability and cause the vehicle to fall off the lift.
 - For two-post lifts, the arms must be evenly spaced and correctly adjusted to support the vehicle's weight distribution. In xEVs, the battery pack can significantly affect weight distribution, often concentrating more weight in specific areas. If the vehicle is not centered correctly on the lift, there is a heightened risk of tipping or uneven lift operation. Technicians must remain aware of these considerations when lifting electric or hybrid vehicles.
- **Weight Rating and Lift Safety for xEVs:**
 - xEVs generally weigh more than traditional vehicles due to the presence of large battery packs. These vehicles can exceed the weight rating of lifts designed for smaller, lighter vehicles. Therefore, it is essential to ensure that the lift's capacity is appropriate for xEVs, and that the load is distributed evenly across the lift arms or platform. Lifts specifically rated for the increased weight of electric vehicles may be necessary in shops that frequently service xEVs.
 - Technicians must be mindful of xEV-specific safety protocols, such as avoiding contact with high-voltage components located near the vehicle's undercarriage. Lifting points for these vehicles may differ from those of conventional vehicles, requiring technicians to familiarize themselves with the manufacturer's guidelines to avoid damaging sensitive electrical components or battery enclosures.

- **Post-Lift Safety and Lowering Procedures:**
 - After the vehicle has been serviced, it must be safely lowered by reversing the lift operation. Technicians should clear the area around the lift, ensuring no tools or personnel are obstructing the path of the vehicle. The vehicle should be lowered slowly and steadily to avoid sudden movements that could cause damage or accidents.
 - Once the vehicle is on the ground, the lift arms should be retracted fully, and the vehicle should be checked for proper placement before moving it off the lift. Regular lift safety training, combined with these operating procedures, ensures that both technicians and vehicles are protected, particularly when working with heavier, more complex xEVs.

5. Utilize proper ventilation procedures for working within the lab/shop area.

Proper ventilation in an automotive shop is essential to ensure technician safety and to control the exposure to hazardous fumes, gases, and airborne particles. A well-ventilated shop reduces the risk of inhaling toxic substances that can result from engine exhaust, welding, painting, and chemical usage. Below are key ventilation procedures to maintain a safe working environment in an automotive shop:

- **General Ventilation Systems:**
 - All automotive shops should have a mechanical ventilation system that includes exhaust fans, air ducts, and filtration systems designed to remove contaminants from the air. These systems must be capable of exchanging air at a rate that effectively dilutes and removes harmful gases such as carbon monoxide (CO), nitrogen oxides (NO_x), and volatile organic compounds (VOCs), which are often produced by engines and solvents. The ventilation system should be regularly inspected to ensure that fans are operational, ducts are clear, and filters are clean to maintain optimal air quality in the shop.
 - Proper airflow must also be maintained to prevent the buildup of hazardous fumes, especially when running engines indoors. Shops should include local exhaust systems, such as tailpipe extraction hoses, to directly capture and expel exhaust gases before they can circulate through the workspace. These systems are particularly important for modern shops that work with a variety of fuel types, including gasoline, diesel, and electric vehicles with cooling systems that may release harmful gases.
- **Localized Ventilation for Hazardous Tasks:**
 - Areas in the shop where welding, grinding, or painting occur must be equipped with specialized local exhaust ventilation (LEV) systems. Welding generates toxic metal fumes such as hexavalent chromium and manganese, which can lead to respiratory illnesses if not properly ventilated. Fume extraction hoods or downdraft tables should be used to capture these emissions at the source and remove them from the breathing zone of the technician.
 - Similarly, when handling solvents, paints, or adhesives, technicians must work in well-ventilated areas with fume hoods or spray booths designed to capture and filter VOCs. These localized systems should be used in conjunction with general ventilation to ensure that hazardous chemicals do not accumulate within the shop. Regular inspections of these systems, including checking the integrity of ductwork and the condition of filters, are critical to maintaining effective operation.
- **Compliance and Monitoring Air Quality:**
 - Automotive shops must comply with Occupational Safety and Health Administration (OSHA) standards that dictate permissible exposure limits (PELs) for various airborne contaminants. To ensure compliance, shops should regularly monitor air quality using gas detectors or air sampling equipment, especially in high-risk areas where hazardous materials are used. Carbon monoxide detectors should be installed in areas where engines are frequently run, providing immediate alerts in case of dangerous CO buildup.

- In addition to mechanical ventilation, natural ventilation should be utilized when possible by keeping doors and windows open to allow fresh air to circulate. However, natural airflow alone is often insufficient to handle the high levels of contaminants produced in an automotive shop, making mechanical ventilation systems indispensable for maintaining safe working conditions.

6. Identify marked safety areas.

Marked safety areas are essential for ensuring a well-organized, hazard-free work environment. These designated zones clearly indicate where specific activities should take place, preventing accidents and promoting efficient workflow. Below are key considerations for marking and maintaining safety areas in an automotive shop:

- **Designation of High-Risk Zones:**
 - Areas around vehicle lifts, welding stations, and heavy machinery should be clearly marked with brightly colored lines—typically yellow or red—on the floor. These marked zones serve to restrict unauthorized personnel from entering potentially dangerous areas where heavy equipment is in use or hazardous processes like welding and grinding occur. For example, welding areas should be marked to prevent others from being exposed to harmful sparks or ultraviolet light, while zones around lifts help ensure that no one is under a vehicle when it is being raised or lowered.
 - Hazardous materials storage areas, such as fuel or chemical cabinets, should also be marked with high-visibility signage and floor markings. These areas must be kept free from clutter and easily accessible, ensuring that technicians can quickly locate fire extinguishers or other safety equipment in the event of an emergency.
- **Pathways and Emergency Exits:**
 - Safety walkways must be marked throughout the shop to create clear, unobstructed pathways for foot traffic. These pathways are usually outlined in green or white and direct employees away from high-risk areas like tool stations, vehicle lifts, and active service bays. Clear paths reduce the risk of collisions, slips, and falls, particularly in busy or confined shop spaces where technicians frequently move between workstations.
 - Emergency exits should be clearly labeled, with prominent signage and marked floor paths leading directly to them. These exits must remain free from any obstructions to allow for a quick and safe evacuation in the event of a fire or hazardous material spill. Emergency equipment, including fire extinguishers and first aid kits, should also be highlighted with floor markings and signs to ensure they are easily identifiable and accessible in emergencies.
- **Regular Audits and Maintenance of Marked Areas:**
 - Safety areas must be regularly inspected to ensure that floor markings, signs, and barriers remain visible and in good condition. Over time, paint on the floor can wear away due to heavy foot traffic or machinery, which can compromise the visibility of designated zones. Regular re-painting and updating of safety signs are necessary to maintain a safe working environment.
 - Safety audits should also be conducted to verify that all designated zones remain relevant to the current shop layout and operations. If new equipment is added or the layout is reconfigured, marked safety areas should be adjusted accordingly to ensure continued compliance with safety regulations and to protect employees from unnecessary risks.

7. Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.

Fire safety is of paramount importance due to the presence of flammable materials such as gasoline, oils, and solvents. The proper location and use of fire extinguishers and other fire safety equipment play a crucial role in minimizing the risk of fire-related accidents. Below are detailed guidelines for fire safety equipment placement, types, and usage procedures in an automotive shop:

- **Location and Accessibility of Fire Extinguishers:**
 - Fire extinguishers must be strategically located throughout the shop, particularly near areas where fire hazards are most likely to occur, such as fuel storage zones, welding stations, and areas where flammable chemicals are handled. Extinguishers should be mounted in visible, accessible locations that comply with OSHA standards, typically within 75 feet of any potential fire hazard. They must be placed along designated evacuation routes, near exits, and in locations where they can be quickly reached in case of emergency.
 - In larger shops, additional fire extinguishers should be positioned at intervals to ensure coverage of all workspaces. Additionally, fire extinguishers should be inspected monthly to ensure they are in working order, with regular maintenance checks that include verifying pressure gauges, pin security, and the condition of the extinguishing agent.
- **Types of Fire Extinguishers in an Automotive Shop:**
 - Automotive shops typically require several types of fire extinguishers to handle different fire classes. Class B extinguishers, which are designed for flammable liquids like gasoline and oil, are essential in areas where fuel and solvents are used. Class C extinguishers are necessary for electrical fires, which can occur in areas with power tools, wiring, or vehicle electrical systems. Multi-purpose ABC fire extinguishers are also common, as they can handle Class A (ordinary combustibles), B, and C fires, providing flexibility for various fire types.
 - In certain areas, such as welding stations or battery storage zones, Class D extinguishers may be required to combat fires involving combustible metals like magnesium or lithium. These extinguishers use dry powder agents designed to smother metal fires, which can burn at extremely high temperatures and are difficult to extinguish with water or other standard agents.
- **Other Fire Safety Equipment:**
 - In addition to fire extinguishers, automotive shops should be equipped with fire blankets, particularly in areas where welding or cutting operations take place. Fire blankets can be used to smother small fires, especially those involving flammable liquids or electrical components. They are also useful for extinguishing fires on clothing or individuals.

- Emergency shutoff systems should be installed to quickly disconnect power to high-voltage equipment in case of an electrical fire. These systems, often placed near breaker panels or workstations, allow technicians to instantly cut power, preventing the spread of electrical fires. In high-risk areas like paint booths or chemical storage rooms, automatic fire suppression systems should be installed. These systems are typically activated by heat or smoke and can disperse foam or dry chemical agents to suppress fires before they spread.
- **Procedures for Using Fire Extinguishers and Fire Safety Equipment:**
 - Proper training in the use of fire extinguishers is crucial for all employees in an automotive shop. The PASS method—Pull, Aim, Squeeze, and Sweep—should be emphasized. First, technicians must **pull** the safety pin to activate the extinguisher. Next, they should **aim** the nozzle at the base of the fire, as targeting the flames will not effectively extinguish the source. The technician should then **squeeze** the handle to release the extinguishing agent and **sweep** the nozzle from side to side until the fire is fully extinguished.
 - Fire extinguishers should only be used if the fire is small and manageable. If the fire spreads rapidly, the technician should immediately evacuate and call emergency services. Fire safety drills and regular training on evacuation procedures, fire extinguisher use, and the location of fire safety equipment ensure that all personnel are prepared to act quickly and efficiently in the event of a fire emergency.

8. Identify the location and use of eye wash stations.

The presence of eye wash stations is critical for ensuring safety when working with hazardous chemicals, metal shavings, and other potential eye irritants. Proper placement, maintenance, and usage of these stations are essential to provide immediate first aid in case of eye exposure to harmful substances. Below are the key considerations for the location and use of eye wash stations in an automotive environment:

- **Location and Accessibility of Eye Wash Stations:**
 - Eye wash stations must be strategically placed within 10 seconds of high-risk areas where technicians handle chemicals, solvents, or other substances that pose a threat to eye safety. This includes battery charging stations, paint mixing areas, and chemical storage locations. OSHA guidelines recommend that these stations be within 55 feet of hazardous work zones to ensure rapid access. The stations should be highly visible, marked with clear signage, and kept free of obstructions to allow for immediate use in the event of an emergency.
 - In larger automotive shops, multiple eye wash stations should be installed to ensure full coverage of all areas where exposure risks are present. These stations should be inspected regularly to confirm that they are functional and capable of delivering a continuous flow of clean water or saline solution for at least 15 minutes, as required by ANSI Z358.1 standards.
- **Use of Eye Wash Stations During Emergencies:**
 - In the event of eye contamination, immediate action is necessary to prevent long-term damage. The affected individual should go directly to the nearest eye wash station and activate the water or saline flow by pushing the lever or foot pedal. The technician must hold both eyelids open and ensure that the water flushes across the entire eye surface, including under the eyelids, for at least 15 minutes to effectively dilute and remove the contaminant. During this time, the individual should rotate their eyes to maximize exposure to the flushing liquid, ensuring all harmful particles or chemicals are washed away.
 - If the exposure involves highly corrosive substances such as battery acid or brake cleaner, longer flushing may be required, followed by immediate medical evaluation. Eye wash stations should also be equipped with sterile eye pads and instructions for aftercare, providing additional safety measures once the initial rinse is complete.
- **Maintenance and Training for Eye Wash Stations:**
 - Regular maintenance of eye wash stations is vital to ensure their functionality during emergencies. This includes checking for blockages, ensuring the water flow is within the correct pressure range, and replacing any expired saline solutions. Inspections should be conducted weekly to meet OSHA and ANSI standards, with maintenance logs kept for each station.
 - Additionally, all shop employees should receive training on the location, operation, and proper use of eye wash stations. This training should include regular safety drills to familiarize workers with emergency procedures and to ensure they can respond quickly and efficiently if an incident occurs. Maintaining well-placed, operational eye wash stations and providing adequate training

significantly reduces the risk of permanent eye damage in an automotive shop setting.

9. Identify the location of the posted evacuation routes.

Clearly posted evacuation routes are a critical component of overall safety planning. These routes ensure that all employees can safely exit the premises in the event of an emergency, such as a fire, chemical spill, or electrical hazard. Below are essential guidelines for the proper location and maintenance of posted evacuation routes in an automotive environment:

- **Strategic Placement and Visibility of Evacuation Routes:**
 - Evacuation routes must be clearly marked throughout the shop, with highly visible signs and floor markings that lead to designated emergency exits. These signs should be placed in prominent locations, particularly near high-risk areas such as welding stations, chemical storage rooms, and fuel storage areas, where the potential for emergencies is greater. OSHA requires that all evacuation route signs and emergency exit doors be illuminated and visible at all times, even during a power outage. Exit signs should also be placed at regular intervals along the evacuation path to ensure that employees can easily follow them to safety.
 - In large or complex shop layouts, evacuation route maps should be posted in common areas, including break rooms, entrances, and near workstations. These maps must clearly display primary and secondary escape routes, ensuring that employees have multiple options for exiting the building in case one path is blocked by hazards. Regular drills and inspections help familiarize employees with the routes and verify that paths remain clear and accessible.
- **Compliance and Maintenance of Evacuation Routes:**
 - It is critical that evacuation routes remain unobstructed at all times. Pathways should be wide enough to accommodate the number of employees in the shop and should not be blocked by vehicles, equipment, or stored materials. Emergency exits must never be locked or blocked, and doors should open outward to allow for quick egress during an emergency. Shops must also ensure that evacuation routes are compliant with OSHA's emergency action plan (EAP) requirements, which mandate regular inspection and updating of evacuation plans.
 - Evacuation route signs and maps should be regularly inspected for clarity and functionality, especially in shops that undergo frequent layout changes or expansions. If new equipment or partitions are added, evacuation routes must be reassessed and re-marked as needed to maintain clear, accessible escape paths. Routine safety audits and employee training sessions on evacuation procedures are essential for ensuring that the posted routes are effective and can be safely followed during emergencies.

10. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.

The use of personal protective equipment (PPE) such as safety glasses, ear protection, gloves, and protective footwear is essential to minimize the risk of injury and ensure a safe working environment. These items protect technicians from various hazards, including flying debris, loud noises, chemicals, and heavy objects. Below are detailed guidelines on the appropriate use and selection of PPE during shop activities:

- **Safety Glasses and Eye Protection:**
 - Safety glasses are a critical component of PPE in an automotive shop, protecting the eyes from flying debris, sparks, and chemical splashes. Technicians working with power tools, grinders, or chemicals must wear ANSI Z87.1-rated safety glasses or goggles at all times. This rating ensures that the eyewear is impact-resistant and capable of shielding the eyes from both physical debris and harmful liquids. For operations such as welding, specialized face shields or welding helmets with auto-darkening lenses are required to protect against UV and infrared radiation, which can cause permanent eye damage.
 - Eye protection must fit securely and comfortably to avoid slipping during tasks. Goggles may also be necessary when working with corrosive chemicals or solvents, as they offer a seal around the eyes, preventing liquid splashes from entering. All eye protection should be inspected regularly for scratches or damage that may impair vision or reduce the level of protection provided.
- **Ear Protection for Noise Hazards:**
 - Ear protection is essential for technicians exposed to high levels of noise from pneumatic tools, compressors, or other loud machinery. OSHA mandates the use of hearing protection when noise levels exceed 85 decibels over an 8-hour workday. Common forms of ear protection include earplugs and earmuffs, both of which must have a sufficient noise reduction rating (NRR) to block out potentially harmful sounds.
 - Technicians should choose ear protection that fits comfortably and provides the appropriate level of sound attenuation for the task. For environments with intermittent loud noises, such as when operating air-powered tools or running a vehicle dyno, earmuffs with electronic noise-cancelling features may offer additional comfort by allowing normal conversation levels while blocking out harmful noise spikes.
- **Gloves for Hand Protection:**
 - Gloves are necessary for handling sharp objects, hot components, and hazardous chemicals in an automotive shop. Technicians must select gloves suited to the task at hand. Nitrile gloves are ideal for handling oils, solvents, and chemicals, as they offer chemical resistance without compromising dexterity. For tasks involving heat or sharp objects, such as working with exhaust systems or metal components, heavy-duty leather or cut-resistant gloves should be worn to prevent burns and lacerations.
 - Gloves should be inspected before each use for signs of wear, such as holes or tears, which can compromise protection. In tasks requiring high precision or

tactile feedback, technicians should choose gloves that provide a balance between protection and dexterity. Disposable gloves should be changed frequently, especially when dealing with chemicals, to avoid cross-contamination or degradation of the material.

11. Identify and wear appropriate clothing for lab/shop activities.

Wearing appropriate clothing is essential for maintaining personal safety and preventing accidents. Loose, inappropriate, or non-protective clothing can increase the risk of injury when working with heavy machinery, chemicals, or hot surfaces. Below are critical considerations for wearing the proper attire during lab and shop activities:

- **Non-Loose, Flame-Resistant Clothing:**
 - Technicians should wear close-fitting, flame-resistant (FR) clothing to minimize the risk of getting caught in moving parts or suffering burns from sparks or flames. Loose sleeves, pant legs, or untucked shirts can easily become entangled in power tools, vehicle components, or machinery, leading to serious injuries. FR clothing is particularly important for technicians performing welding, cutting, or grinding, where exposure to sparks and high heat is frequent.
 - Clothing made from natural fibers like cotton is preferable over synthetic materials, which can melt onto the skin if exposed to high temperatures. For tasks involving extreme heat or potential fire hazards, technicians should wear specially designed flame-retardant overalls or jackets that meet industry safety standards, such as those set by NFPA (National Fire Protection Association).
- **Long Sleeves and Full-Length Pants:**
 - Long sleeves and full-length pants are recommended to provide comprehensive skin coverage, protecting technicians from burns, chemical splashes, and sharp objects. Bare skin can be vulnerable to hot surfaces, such as exhaust systems or engine components, and exposure to fluids like oil, coolant, or solvents can cause irritation or chemical burns. By covering all exposed skin, technicians can significantly reduce their risk of injury.
 - While long-sleeve shirts and full-length pants are crucial, they should not restrict movement. Flexible, durable fabrics allow technicians to move freely and comfortably while ensuring protection. Garments should also be free from rips or tears, which can expose the skin to hazards or catch on equipment, increasing the risk of injury.
- **High-Visibility and Weather-Appropriate Clothing:**
 - In large or busy shop environments, high-visibility clothing is often necessary to ensure technicians are easily seen by others, particularly when operating or working near moving vehicles or heavy equipment. High-visibility vests, shirts, or jackets equipped with reflective strips improve safety by making workers more visible in dimly lit areas or during evening shifts. This is especially important in shops that also serve as warehouses or operate outdoor service bays.
 - Technicians working in varying environmental conditions should also wear weather-appropriate clothing. For example, during cold-weather operations, technicians should wear insulated jackets and pants that provide warmth without compromising mobility. Conversely, in hot shop environments, moisture-wicking, breathable fabrics can help technicians stay cool while still offering protection from shop hazards.
- **Durable, Chemical-Resistant Materials:**

- In an automotive shop, technicians frequently come into contact with hazardous chemicals, such as solvents, degreasers, and coolant. Clothing made from chemical-resistant materials is essential to prevent these substances from penetrating the fabric and contacting the skin. Aprons, coveralls, or specialty chemical-resistant suits should be worn in areas where technicians handle dangerous fluids, ensuring maximum protection against spills or splashes.
- Additionally, technicians should avoid wearing jewelry, watches, or other accessories that could potentially become entangled in equipment or react with chemicals. Synthetic materials that degrade when exposed to oils or chemicals should also be avoided in favor of more durable, resistant fabrics. All clothing should be cleaned regularly to prevent the buildup of hazardous materials and maintain its protective properties.

12. Secure hair and jewelry for lab/shop activities.

Strict safety protocols regarding hair and jewelry are necessary to prevent serious injuries when working around machinery and hazardous materials. Loose hair and jewelry can easily become entangled in moving parts, leading to accidents that could otherwise be avoided. Below are essential safety practices regarding hair and jewelry in an automotive shop:

- **Hair Safety and Containment:**
 - Technicians with long hair must ensure it is securely tied back or contained within a hat or protective cap to prevent it from becoming caught in moving parts, such as drills, belts, or rotating equipment. Hair that is loose or exposed can quickly become entangled in machinery, causing severe scalp or neck injuries. OSHA standards recommend that hair be fully restrained when operating or working near equipment with exposed moving components.
 - In situations involving welding or working with flammable materials, hair should be covered with flame-resistant headgear to prevent accidental ignition from sparks or high heat. Additionally, any product used on hair should be non-flammable to reduce the risk of catching fire during tasks that involve open flames, welding, or high-temperature components.
- **Jewelry Safety Protocols:**
 - Jewelry, including rings, necklaces, bracelets, and watches, should not be worn in the automotive shop. Loose or dangling jewelry can easily become caught in moving parts, leading to severe injuries, such as crushed fingers or broken wrists. Metal jewelry also poses an electrical hazard, as it can conduct electricity, increasing the risk of electric shock when working with vehicle wiring, batteries, or electrical systems.
 - Technicians should remove all jewelry before entering the shop to prevent accidents and ensure their safety. In cases where jewelry cannot be removed, such as medical ID bracelets, it should be tightly secured and covered with non-conductive materials to reduce the risk of entanglement or electrical injury. Following these guidelines helps prevent potentially life-threatening incidents related to the improper handling of hair and jewelry in an automotive work environment.

13. Identify vehicle systems which pose a safety hazard during service such as: supplemental restraint systems (SRS), electronic brake control systems, stop/start systems, and remote start systems.

Several modern vehicle systems present unique safety hazards during service and require specific precautions to ensure the safety of technicians. Systems such as supplemental restraint systems (SRS), electronic brake control systems, stop/start systems, and remote start systems involve complex electrical and mechanical components that can pose risks if not handled properly. Below are detailed safety considerations for each of these systems during service:

- **Supplemental Restraint Systems (SRS):**
 - The Supplemental Restraint System (SRS), which includes airbags and seatbelt pretensioners, poses a significant safety risk during vehicle service due to its explosive charge. Airbags are designed to deploy rapidly in the event of a collision, and accidental deployment can cause serious injury to technicians. Before working on any part of the SRS, technicians must disconnect the vehicle's battery and wait the recommended amount of time, typically at least 10 minutes, to ensure the system is deactivated.
 - Special care must also be taken when handling SRS components. Airbags should be stored face up on a flat surface away from heat and electrical sources. When servicing areas near airbag sensors, such as the steering wheel, dashboard, or side panels, technicians should avoid striking or jarring these components, as this can inadvertently trigger deployment.
- **Electronic Brake Control Systems:**
 - Modern vehicles equipped with electronic brake control systems, such as Anti-lock Braking Systems (ABS) and Electronic Stability Control (ESC), pose electrical and mechanical hazards during service. These systems operate under high pressure and may contain electrically actuated components that could activate unexpectedly if not properly de-energized. Technicians must first disconnect the vehicle's battery before servicing the brake system to avoid unintended activation.
 - Furthermore, ABS systems often contain hydraulic components under pressure, which can pose a risk of injury when servicing. Proper procedures for safely releasing hydraulic pressure must be followed before disassembling or replacing components such as brake lines or actuators. Failure to follow these procedures can result in high-pressure fluid discharge, leading to serious injury.
- **Stop/Start Systems:**
 - Stop/start systems, designed to automatically shut off and restart the engine to improve fuel efficiency, present unique hazards during service. These systems are often active even when the ignition is off, meaning the engine could restart unexpectedly if certain conditions are met, such as opening a door or depressing the brake pedal. To prevent accidental engine start, technicians must disable the stop/start system by disconnecting the vehicle's battery or using the manufacturer's recommended procedure to put the system into service mode.
 - Additionally, stop/start systems are often integrated with advanced electrical systems, including high-capacity batteries and alternators, which can pose

electrical hazards if mishandled. Technicians should wear appropriate PPE, such as insulated gloves, and avoid making direct contact with the electrical components when servicing vehicles with stop/start systems.

- **Remote Start Systems:**

- Remote start systems, which allow a vehicle to be started from a distance, pose a significant risk if the vehicle unexpectedly starts during service. This can occur if a remote signal is received while a technician is working under the hood or beneath the vehicle. To prevent accidental engine start, technicians must ensure that remote start functionality is disabled by either removing the key fob from the vicinity or disconnecting the system entirely before beginning service.
- Moreover, technicians should always be aware of the possibility that the vehicle could be inadvertently started by someone unaware of the service being performed. Clear communication with all personnel in the shop is essential, and the use of warning tags or signs indicating that a vehicle is undergoing service can further reduce the risk of accidental remote starting.

14. Identify vehicle systems which pose a safety hazard during service due to high voltage such as: xEV drivetrains, lighting systems, ignition systems, A/C systems, injection systems, etc.

Certain vehicle systems present significant safety hazards due to the presence of high voltage components. Electric and hybrid-electric vehicles (xEVs), as well as high-voltage lighting, ignition, air conditioning (A/C), and fuel injection systems, can pose risks of electric shock or fire if not properly handled during service. Below are detailed safety considerations for these systems:

- **xEV Drivetrains:**
 - Hybrid and electric vehicle (xEV) drivetrains operate at high voltage levels, typically between 200 to 800 volts, posing a serious risk of electric shock or electrocution if safety precautions are not followed. Technicians working on these systems must be specially trained and certified to handle high-voltage components. Before servicing, the vehicle's high-voltage system must be de-energized using the manufacturer's recommended procedure, which typically involves disconnecting the high-voltage battery and waiting a specified amount of time for capacitors to discharge.
 - Appropriate personal protective equipment (PPE), including high-voltage insulated gloves, safety glasses, and protective footwear, is essential when working with xEV drivetrains. Additionally, technicians must use insulated tools specifically rated for high-voltage work to avoid accidental contact with live components. Clear labeling of high-voltage wiring and connectors with orange insulation is standard practice in xEVs, helping technicians easily identify high-voltage parts.
- **High-Voltage Lighting Systems:**
 - Modern vehicles are equipped with high-intensity discharge (HID) and light-emitting diode (LED) lighting systems, which operate at voltages that can exceed 20,000 volts during ignition. These systems can present a significant shock hazard during service if proper precautions are not taken. Technicians must ensure that power to the lighting system is fully disconnected before attempting to service or replace any components.
 - HID lighting systems, in particular, use ballasts that convert low-voltage direct current (DC) into high-voltage alternating current (AC), creating additional electrical hazards. When handling these systems, technicians should avoid touching the ballast or wiring while the system is energized and must wait for capacitors to discharge fully after the vehicle is powered down. Gloves and insulated tools should be used to prevent accidental contact with high-voltage components.
- **Ignition Systems:**
 - Modern ignition systems, especially those using coil-on-plug (COP) or distributor-less ignition technology, generate high voltage (up to 40,000 volts) to create the spark necessary for combustion. While the voltage is brief, it can still cause severe electric shock if a technician comes into direct contact with live

components during service. Before working on ignition systems, technicians must ensure that the ignition switch is off and the system is fully de-energized.

- When diagnosing or testing ignition systems, technicians should use specialized testing equipment designed to handle high-voltage outputs, such as insulated spark testers and high-voltage probes. Additionally, technicians should avoid wearing conductive jewelry and should keep their hands and tools away from ignition components while the engine is running or during diagnostic testing.
- **A/C and Fuel Injection Systems:**
 - Air conditioning (A/C) systems in vehicles are powered by high-voltage electric compressors, particularly in hybrid and electric vehicles. These systems can generate significant voltage, posing an electrocution hazard if not properly deactivated. Before servicing A/C components, technicians must ensure the high-voltage circuit is disconnected and that the system is allowed to discharge any residual electricity. Additionally, refrigerants used in A/C systems can become dangerous if exposed to high voltage, potentially leading to chemical hazards or fire risks.
 - Fuel injection systems, particularly direct injection, operate at high pressures and may involve electrical components that control fuel delivery. These systems are typically powered by high-voltage injectors and fuel pumps, which can create a shock hazard if mishandled. Technicians should always disconnect the fuel system from its power source before attempting to service injectors, fuel lines, or pumps to avoid electrical shock or accidental fuel ignition.

15. Locate and demonstrate knowledge of safety data sheets (SDS).

Safety Data Sheets (SDS) are essential for ensuring that technicians have access to critical information about the hazardous substances they may encounter. The Occupational Safety and Health Administration (OSHA) requires that SDS be readily available for all chemicals used in the workplace, detailing important safety guidelines for handling, storage, and disposal. Below are key considerations regarding the location, knowledge, and use of SDS in an automotive shop environment:

- **Location and Accessibility of SDS:**
 - SDS must be stored in a central, accessible location within the shop, ensuring that all technicians can quickly reference them when necessary. This could include a designated binder placed in a visible area, such as near the chemical storage room or a main work area, or an electronic system that can be accessed via shop computers or mobile devices. OSHA mandates that SDS must be available at all times, so it is crucial that technicians know where to find them and can access the information during emergencies or routine tasks.
 - In larger shops or multi-station environments, having multiple SDS locations or digital access points ensures that all personnel can reach the data sheets without delay. Clear signage should direct employees to the SDS location, especially in areas where hazardous chemicals are handled regularly.
- **Understanding and Knowledge of SDS Information:**
 - Technicians must be trained in how to read and interpret the information provided in an SDS. Each sheet contains 16 standardized sections, covering details such as the chemical's identity, potential hazards, first-aid measures, personal protective equipment (PPE) requirements, and proper handling procedures. It is critical that technicians understand how to quickly identify key information, such as hazard symbols, exposure limits, and emergency procedures. This knowledge enables them to mitigate risks effectively when working with potentially dangerous chemicals.
 - Regular training sessions on the use of SDS should be conducted, ensuring that all employees are familiar with the layout and specific content of the sheets. This training is particularly important for new hires or when new chemicals are introduced to the shop. Proper SDS education helps technicians understand the risks associated with each substance and the steps required to work with them safely.
- **Use of SDS for Safe Chemical Handling and Emergency Response:**
 - SDS provide essential guidance on the safe use of chemicals, including the proper PPE required for handling specific substances, such as gloves, goggles, or respirators. Before beginning any task involving chemicals, technicians should review the relevant SDS to confirm that they are using the appropriate protective gear and following safe handling practices. This includes instructions on proper ventilation, storage conditions, and compatibility with other substances, reducing the risk of chemical reactions or spills.

- In the event of an accident or chemical exposure, SDS also provide first-aid and emergency response information, such as the correct procedure for treating chemical burns, inhalation, or ingestion. Technicians should be able to quickly locate and apply the appropriate SDS guidelines in emergency situations, ensuring swift and effective action. Additionally, knowing the proper disposal methods for chemicals, as outlined in the SDS, helps prevent environmental contamination and complies with regulatory requirements.

16. Demonstrate knowledge of personal protective equipment (PPE) required for use in high voltage/electric vehicle circuits.

Working with high-voltage systems, particularly in electric vehicles (EVs) and hybrid electric vehicles (xEVs), requires specialized personal protective equipment (PPE) to safeguard technicians from the risk of electrical shock, burns, or electrocution. Electric vehicle circuits can operate at voltages between 200 to 800 volts or higher, posing significant safety hazards if not handled correctly. Below are critical guidelines for the PPE required when working with high-voltage systems:

- **High-Voltage Insulated Gloves and Leather Protectors:**
 - Insulated rubber gloves are mandatory when working with high-voltage circuits, offering protection against electrical shock. These gloves must be rated for the specific voltage being handled and meet the standards set by ASTM International, typically Class 0 or Class 1 gloves rated for up to 1,000 volts. Additionally, these gloves should be worn with leather protectors to prevent punctures or tears that could compromise the insulating properties of the gloves. Technicians should regularly inspect their gloves for wear or damage before each use and replace them immediately if any defects are found.
 - Glove testing is required before use, including visual inspections and inflation tests to check for leaks. These gloves must also be stored properly in protective bags to avoid damage from environmental factors such as moisture, heat, or sharp objects, which could degrade their effectiveness.
- **Arc Flash Protection:**
 - High-voltage systems can produce dangerous arc flashes, which generate intense heat, light, and pressure, potentially causing severe burns or injury. To protect against these hazards, technicians working on EV circuits must wear arc-rated flame-resistant (FR) clothing that complies with the National Fire Protection Association (NFPA) 70E standards. This clothing includes long-sleeve shirts, pants, jackets, and coveralls designed to withstand the extreme temperatures generated during an arc flash event.
 - The arc rating of FR clothing must match the potential energy level of the high-voltage system being serviced. In addition to protective clothing, arc-rated face shields, hoods, and safety glasses are essential to protect the face and eyes from the thermal effects of an arc flash. Properly fitted and maintained FR clothing reduces the risk of severe injury, ensuring technicians remain protected during high-voltage work.
- **High-Voltage Safety Footwear and Tools:**
 - Insulated footwear is another key component of PPE for high-voltage work, as it prevents technicians from grounding themselves and potentially creating an electrical path through their body. High-voltage safety boots should have dielectric properties that provide insulation against electrical currents. These boots, often rated to ASTM standards, feature rubber soles that are specifically

designed to resist electrical hazards, reducing the risk of shock while working in close proximity to live circuits.

- Additionally, insulated tools must be used when working on high-voltage systems. These tools, such as screwdrivers, pliers, and wrenches, are coated with non-conductive materials rated for high-voltage applications, ensuring that technicians can handle live components safely. Tools should be regularly inspected for wear or damage, and only tools specifically designed for high-voltage work should be used to avoid accidental electrical conduction.