Wind Noise And Water Leaks
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Module 1 - Causes And Effects
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Learning Objectives
In order to effectively diagnose wind, noise, and water leaks, it is important to understand the various causes and effects.

Module 1 will discuss how to identify and explain the various causes of wind, noise, and water leaks.

The learning objectives for this module include:

- identifying the different types of wind noise that a vehicle can experience.
- explaining measures taken by vehicle makers to reduce wind noise in vehicles.
- explaining the common causes for each type of wind noise.
- identifying the common causes of water leaks into vehicles.
- explaining the effects of a water leak.
- identifying locations and causes of dust leaks into vehicles.

Wind Noise
Wind noise in vehicles can be broken down into four different categories. The noise may be a whistle, hiss, roar, or a rush. The type of sound a wind noise makes will depend on a number of variables, including the cause and location of the problem. Wind noise may be caused by outside air turbulence as a vehicle moves through the air, or by an air leak in the passenger compartment of the vehicle. Air leaking both out of or into the vehicle can cause wind noise. Most wind noise that is heard in the passenger compartment comes from a source located between the cowl and B-pillar of the vehicle. A small percentage of wind noise problems are from sources in front of the windshield and cowl area, and an even smaller percentage originate from the rear portion.

Advancements In Wind Noise Prevention
Late model vehicles are designed to be very quiet with little or no wind noise. This is due, in part, to specially designed radio antennas and double or triple seals around doors and hatches. There has also been an increase in the use of sound-deadener materials, such as sound-deadening pads and expandable foams to fill cavities and openings.

Refer to Module 1, "Demonstration: Radio Antenna For Wind Noise Prevention" to see an example of a radio antenna designed for wind noise prevention.

Advancements In Wind Noise Prevention (cont’d)
Additional advancements in wind noise prevention that are used on late model vehicles include flush-mounted glass, headlamps, and moldings. Body panels, outside mirrors, and roof racks have also been designed more aerodynamically to help reduce the amount of wind noise.
Wind Whistle
A wind whistle is a high-pitched whistling sound similar to that made by a teapot. Wind whistles are typically caused by inside air escaping past a small opening or gap in a door or window seal to the outside, and not by air leaking into the vehicle.

As a vehicle moves, the airflow around it creates a low pressure area over the top of the vehicle. This causes a difference in air pressure between the inside and outside of the passenger compartment. The faster the vehicle is moving, the greater this pressure difference. Running the HVAC fan increases the pressure inside the passenger compartment and adds to the pressure difference.

The higher-pressure air inside the passenger compartment will force past any small openings or loose seals in the vehicle body, and create a whistling sound. The pitch and volume of the sound will depend on the velocity of the escaping air and the size of the opening.

Air passing through gaps in a misaligned body panel may also cause a whistling sound that can be heard in the passenger compartment.

Wind Hiss
A wind hiss sounds similar to a vacuum leak in an engine, and is typically caused by inside air escaping past door and window seals. The cause is the same inside-outside air pressure difference that causes a wind whistle, but a wind hiss is typically caused by larger openings. As the size of the opening increases, the pitch of the noise decreases.

Wind Roar
A wind roar is described as a low-pitched rumbling sound that is not constant. The sound may come and go, or change in pitch or volume, depending on airflow conditions. Wind roars can be caused by outside air turbulence, an air leak into the vehicle, or outside air passing over or through a large opening. Wind roars are caused by much larger openings than what causes a wind whistle or hiss.

Turbulent air passing through gaps between body panels, or through holes in vehicle accessories or parts, can cause a roaring sound. Large openings in the passenger compartment, such as an open vent window, will keep the air pressure between the outside and inside equalized. This will allow air into the vehicle through the opening, instead of being forced out of the vehicle as with a whistle or hiss.

Wind Rush
A wind rush is described as a rushing or howling sound, and is related to the aerodynamics of the vehicle. Wind rushes are not air leaks, but rather disturbed airflow.
around the vehicle. A wind rush is typically caused by loose trim or moldings that flutter in the wind, or from air flowing around vehicle accessories such as roof racks, mirrors, and aftermarket add-ons.

**Signs Of Air Leaks**

A wind noise is not the only sign that a vehicle has an air leak in the passenger compartment. Built-up dirt or dust residue inside the vehicle interior or trunk is also an indicator of an air leak. A noticeable exhaust odor inside the passenger compartment, or air drafts that can be felt, are also signs of air leaks.

**Air Leak Effects**

A common result of air leaks in a vehicle is dust in the passenger compartment. Dust entry can be a health issue for people with allergies. Dust can also cause dirt to build up on latches, lock cylinders, and movable glass mechanisms. This buildup can cause mechanisms to stick and bind, causing improper operation.

Another serious effect of air leaks in the rear of the vehicle is the potential for exhaust fumes entering the passenger compartment. This is of particular concern on station wagons and SUVs that do not have partitions between the rear compartment and the passenger compartment. Exhaust fumes in the vehicle is a serious health risk to passengers.

**Panel Fit-Up**

One of the more common causes of wind noise is poor weatherstripping-to-part contact on doors, hatches, and movable glass. Poor weatherstripping contact may be caused by damage to the structure of the vehicle or the movable part that seals against the weatherstripping. If either the structure or the movable part is twisted, it may result in areas of improper weatherstripping clamping loads that cause a wind noise.

Clamping load is described as the pressure on a weatherstripping by the surface that it contacts when the part that it seals is fully closed. The clamping load between the weatherstripping and the contact surface must be enough to keep the pressurized air inside the passenger compartment from escaping. Improper adjustment of movable parts and glass can also be a cause of poor weatherstripping clamping loads.

**Panel Fit-Up (cont’d)**

Another cause of wind noise in a vehicle is improper flushness between adjacent body panels, which may not be easily visible. Flushness is also called shingling. Positive flushness, or shingling, is when a panel is set outside of an adjacent panel, and negative flushness, or shingling, is when a panel is set inside of an adjacent panel. A fender with its rear edge set outside of the front edge of the door it is adjacent to would have positive flushness to the door. Conversely, the door would have negative flushness when
compared to the fender. One way to visualize this is to think of running your hand over two adjacent panels. If you go from a panel that has positive flushness to its adjacent panel, your hand would slide smoothly from one panel to the other. However if you slide your hand from a panel with negative flushness to its adjacent panel, your hand will catch on the protruding edge of the adjacent panel.

Positive flushness from front to back on the vehicle may help reduce wind noise, while negative flushness may increase noise. A panel with negative flushness to the panel behind it allows air to be caught by the protruding edge of the rear panel. The air is then forced through the gap between the panels. This may create a howling or whistling sound as the vehicle is driven. Small amounts of panel shingling, as little as one to two millimeters, may have a dramatic effect on the overall noise level inside a vehicle.

Excessive gaps between body panels can also cause wind noise, even when the panels are shingled properly. Excessively large gaps may allow air to travel through the gap or opening instead of over it, causing a howling or roaring sound.

**Vehicle Design**

Some wind noises may be caused by vehicle or part designs. This includes accessories such as radio, cell phone, or navigation antennas, outside mirrors, exterior trim, and other add-ons. These parts may create a disturbance in the airflow around the vehicle, causing a wind noise.

Many vehicles have specially designed antenna masts to reduce the disruption of airflow. Replacing an antenna mast with a part different from that designed for the vehicle may cause a noticeable increase in wind noise. Placement of the cross bars on a roof rack may also affect the amount of wind noise. Also, certain types of windshield moldings can create wind noise under the right conditions. Using the correct type of windshield molding for the application will help ensure that wind noise is not increased.

The amount, location, and type of sound-deadening materials on a vehicle also plays a role in the amount of wind noise noticed in the passenger compartment. Missing or inadequate sound-deadening material may allow wind noise to be more easily heard.

**Loose Or Missing Air Dams Or Plugs**

Another wind noise consideration on vehicles that have been repaired is loose, improperly attached, or missing air dams and hole plugs. This includes the air dams between front fenders and the A-pillar, where handles pass through inner door panels, and where the outside mirror fasteners and wiring or controls pass through the door. Holes in the vehicle chassis or suspension parts, and where wiring harnesses pass through the body shell, typically have plugs and grommets that may create air leaks or wind noise when they are damaged or improperly sealed.
Aftermarket Accessories
Aftermarket accessories can disturb airflow around a vehicle and cause turbulence that results in a wind rush or howling sound. Commonly installed aftermarket accessories include bug shields, sun visors, running boards, spoilers, and ground effects. These parts are more sculpted and aerodynamic compared to older models, which has helped reduce the amount of wind noise caused.

Weatherstripping Problems
Weatherstripping problems can also cause wind noise. These problems include missing or damaged weatherstripping, or installing the wrong type of weatherstripping. Tears or deterioration in weatherstripping may create gaps that air can leak through. Weatherstripping may become collapsed, decreasing its height, which causes inadequate clamping loads. It can also shrink with age, leaving areas where the weatherstripping no longer contacts the part.

Weatherstripping Problems (cont'd)
Additional weatherstripping problems that can cause wind noise include poor clamping loads, inadequate contact surface width and out-of-position connecting joints. The weatherstripping contact surface width may also be called the weatherstripping bearing surface width. This is the area of the weatherstripping that makes actual contact with the part that it seals against. Typically, a bearing surface should be a minimum of 5 millimeters wide for a leak-free seal.

The angle of the pinchweld flange that a weatherstripping is mounted on can have an effect on both the clamping load and bearing surface width. A flange that is angled away from the part that the weatherstripping seals against may cause an inadequate clamping load. A flange with too severe of an angle toward the part may cause an inadequate bearing surface width.

Connecting joints on weatherstrippings are typically placed at the bottom of the opening being sealed. This is because of a difference in inside / outside air pressure between the bottom and top of the vehicle. Placing the connecting joint at the top of the opening may lead to an air leak and a wind whistle.

Water Leaks
As a general rule, an air leak has the potential to also be a water leak, and vice-versa. However, due to the surface tension of water, openings and gaps that leak air may not always leak water. Water typically contains minerals and other impurities that create surface tension. This surface tension is what holds the water molecules together in a sheet and allows the water to sometimes bridge over small openings instead of going through them. Once the surface tension of the water has been broken, by something touching it or
a disruption in the flow, the water will begin to leak into the opening. This is one reason that some leaks may require extended soak time to become apparent.

The location of a water leak may keep it from leaking air. The cowl area will typically have sound deadeners or heat shields that allow water to flow in but keep air out.

**Spot-Free Car Wash Rinse Water**
Spot-free rinse water at commercial car washes has had the impurities and minerals removed. Because of this, the surface tension of this water is less than regular tap water, or rain. The lower surface tension may cause this water to leak in where rain or tap water will not.

**Common Water Leak Locations**
Water can leak into a vehicle in a variety of locations. Some of the common locations include fresh air intake vents and seams in the main vehicle structure. Seals for doors, movable glass, tail lamps, and stationary glass are common locations for water leaks. Also, hole plugs in floor pans and cowls and pass-through grommets for wiring harnesses are common locations of water leaks. Any fastener that passes through into the passenger compartment of the vehicle has the potential to be a water leak location.

**Effects Of Water Leaks**
Water leaking into the passenger compartment has many potential negative effects, including corrosion to the body structure and damage to interior soft trim such as carpeting and seats. Standing water in the passenger compartment can also result in water damage to electronic modules that are located on the floor pan, and to wiring where the connectors are exposed to the water.

Replace any airbag or restraint system electronic control modules or wiring that show evidence of significant soaking or water damage.

**Effects Of Water Leaks (cont’d)**
Water leaking into the vehicle interior can also result in the formation of mildew on the surface of interior trim and parts, and the growth of mold underneath the carpets, and in other areas that hold water. Mold can cause an offensive odor in the vehicle interior, and is a potential health risk to the vehicle occupants. Mold growth occurs when the organic material found in most vehicle carpet pads is allowed to remain wet for extended periods. The mold causes the organic material to decompose. This decomposition is what causes a musty odor.

When working around or cleaning up mold, wear a NIOSH-approved air purifying respirator, rubber gloves, and protective clothing that is easily cleaned or discarded.
Water Drainage Routes
Vehicles are designed to route and drain water in specific areas. Understanding how these drainage routes work may be helpful when trying to determine the entry location of a water leak.

Water Leaks And Vehicle Age
Vehicle age is a factor in the potential for leaks. For example, weatherstripping can dry out as it ages and become hard and brittle with a lack of maintenance or if it has contacted the wrong chemicals. Keeping weatherstripping clean and using appropriate dressings will help extend their usable life. There are both silicone-based and silicone-free products available for the conditioning of rubber seals, plugs, and weatherstripping.

Ensure that any chemicals used to clean and condition weatherstripping are compatible for use on rubber-based products.

Water Leaks And Vehicle Age (cont’d)
Other age-related factors that can lead to water leaks include seals and weatherstripping that are deteriorated from exposure to ultraviolet rays or extreme heat. Tears and collapsed areas are other kinds of damage to weatherstripping that can result in leaks. Heavy soiling of the vehicle and corrosion to seams and seal attachment points can lead to water leaks. A heavy buildup of dirt or other contaminants on weatherstripping and seals can lead to areas of poor weatherstripping contact that allows water to enter the vehicle. Corrosion can lead to water leaks in more than one way. Perforation corrosion of the body shell will create a direct water entry point. Corrosion of the attachment points for seals and weatherstripping may allow water to migrate under the seal or weatherstripping.

Water Leaks After Collision Repairs
Factors related to collision repair that can cause water leaks include the fit of movable body panels and glass, improperly sealed seams in the structure, and weld defects. Improperly adjusted movable panels and glass may have inadequate weatherstripping clamping loads or bearing surface widths. Weatherstripping pinchweld flanges must be straight, even, and at the proper angle to ensure the correct clamping load and bearing surface width. Seams must be properly aligned, with no broken or missing welds, and sealed with the correct type and application of seam sealer to ensure a watertight structure. Something as simple as a broken plug or spot weld may create an opening into the vehicle for water to enter.

Water Leaks After Collision Repairs (cont’d)
Another repair-related factor that may lead to water leaks include plugs or pass-through grommets in the cowl, floor board, and rear body panel areas that are either loose or missing.

Movable parts, such as deck lids, hatches, and doors that have an excessive closing effort may also lead to a water leak. A part with an excessive closing effort may point to an
improper fit, or the part not being completely closed. Either of these may result in an insufficient clamping load resulting in a water leak.

**Water Drains**

There are a number of water drains built into a vehicle. Water leaks may be the result of problems with these drains. Common problems include damaged, disconnected, or plugged drains. Drains can become plugged with dirt and leaves, or material used during the collision repair process. Hoses for drains can get kinked, cutting off the flow of water. Hoses may also be cut, have holes burned in from welding, or be disconnected, allowing the water to drain in another location. Drain channels can be bent or distorted or have holes that allow water to leak into the passenger compartment.

**Water Drain Locations**

Common locations of water drains on vehicles include sliding sunroof assemblies, air conditioning evaporators, door bottoms, quarter panels, tailgates, and convertible top drain troughs. Tailgates and quarter panels typically only have drains when they have movable glass.

**Stationary Glass Water Leaks**

Another common location for a water leak into a vehicle is stationary glass installations. Stationary glass leaks may be caused by improper installation of the glass, pinchweld flange corrosion, or collision damage. Corroded glass pinchweld flanges can cause leaks under the adhesive bead due to inadequate adhesion of the urethane. Excessive corrosion can also cause direct leaks into the vehicle if perforation exists. During a collision, the body structure may flex. This flexing may break the seal between the adhesive bead and the glass or pinchweld flange. If the seal between the adhesive is broken, water may be able to migrate through it. Gasket-set glass can also have damage to either the gasket or gasket-sealing surface that allows water entry.

**Leaks At Movable Glass And Body Panels**

Water may leak around movable body panels and glass that have poor contact between the weatherstripping and the contact surface. Common causes of poor weatherstripping contact include body structure or panel damage, or improper adjustment of the glass or panel. Damage to the structure may result in incorrect body opening dimensions that cause areas of incorrect or no weatherstripping contact. Twisted body shells or movable parts that are improperly aligned or twisted may also result in inadequate weatherstripping clamping loads that cause a leak.

**Seals For Movable Glass And Body Panels**

Water may also leak into a vehicle because of problems with the seals for movable glass and body panels. These problems include the same weatherstripping issues as with wind noise, as well as damaged run and run-channels for glass sealing on framed doors, and outer belt-sealing strips that are damaged or missing, allowing more water into the door than the drains can effectively handle.
Leaks In Seams At Body Structure
Water leaks at seams in the body structure may be caused by cracked or loose seam sealer in joints or the incorrect seam sealer application. Seam sealer can be damaged both during a collision or the repair process. Improper seam sealer application such as skips in the sealer bead or missing sealer in a location can also cause leaks. The wrong type of sealer for the application may lead to water leak issues after the vehicle has been in service for a period of time.

Leaks At Welds
Weld defects can be a source of water leaks in the body structure. Common weld faults that may lead to water leaks include missing welds, cracked welds, broken factory spot welds, and burnthrough of repair welds that leaves a hole into the passenger compartment. Broken spot welds can create a path for water entry into the vehicle. This is an issue where aprons and frame rails weld to the cowl and floor pan of the vehicle. Spot welds may break by the flexing and moving of these areas both during a collision and the structural realignment process.

Leaks At Fasteners
Any fastener that passes through the body structure and into the passenger compartment or trunk has the potential to cause a water leak. Common locations include the attachment points for brake and steering parts such as power boosters and steering column brackets, tail lamps, spoilers, antennas, luggage racks, and body kits. Fasteners that pass through the body shell must have an appropriate sealer to ensure they do not leak water. Replace any sealers with the type recommended by the vehicle maker, or the same type that was used originally if no recommendations exist.

Water Deflectors
Water can also leak into the passenger compartment through water deflectors on the interior of door shells. Problems that can lead to water entry include missing, damaged, or improperly secured water deflectors. Ensure that all water deflectors are installed, securely fastened, and undamaged.

Leaks At Air Vent Intakes
Air vent intakes are designed to allow air entry into the vehicle but keep water out. But air vent intakes are another common location of water leaks into the passenger compartment. Water leaks may be caused by damaged seals between the vent and the upper cowl structure, or damage to the vents and the vent covers themselves. The vents are typically made of plastic. A crack in the housing can allow water entry into the vehicle. Damage to the vehicle structure where the vents attach may also result in a poor seal between the vent and the vehicle.

Leaks at air vent intakes may also be due to vehicle design faults. When a new model is introduced, sometimes problems with water entry through the air vent, under certain circumstances, will occur after the vehicles have been in service for a period of time.
Leaks At Grommets, Plugs, And Boots
Other areas where water may leak into a vehicle include damaged, loose, or missing rubber boots that seal where steering shafts and shifters pass through the body structure into the vehicle. Loose, missing, or damaged wiring grommets, where wiring harnesses pass through the body structure, or plugs in the cowl, floor pan, and rear body panel area may also cause water leaks.

Dust Leaks
Dust leaks into the vehicle are another potential area of concern. Dust may leak into a vehicle at locations where water will not. This is typically true of the lower areas of the body shell and the bottoms of doors. The forward motion of the vehicle may create a vacuum inside the vehicle that pulls air and dust from the outside into the vehicle. Air typically leaks out of the vehicle up high and into the vehicle down low. This is due to the pressure differences created above and below the vehicle while it is in motion.

Dust Leaks (cont’d)
Dust leaks typically leave a trail at the entry point that is either cone shaped or slit shaped. These trails can be used to help find the entry point of a dust leak.

Module Summary
Module 1 discussed how to identify and explain the various causes of wind, noise, and water leaks.

Topics discussed in this module included:

- different types of wind noise that a vehicle can experience.
- measures taken by vehicle makers to reduce wind noise in vehicles.
- common causes for each type of wind noise.
- common causes of water leaks into vehicles.
- effects of a water leak.
- locations and causes of dust leaks into vehicles.
Module 2 - Diagnosis
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Learning Objectives
Along with being able to identify and explain the various causes of wind, noise, and water leaks, it is also important to be able to diagnose the leaks.

Module 2 will discuss the various diagnostic techniques and testing procedures to help pinpoint the location of wind, and water leaks.

The learning objectives for this module include:

- identifying general diagnostic techniques used to check for wind noise.
- performing pinpoint test to locate the source of a wind noise.
- explaining generalized testing procedures used to determine the presence of air or water leaks in vehicles.
- using pinpoint tests to locate the source of air and water leaks in vehicles.
- explaining the purpose and location of common water drains on vehicles.

Wind Noise And Leak Diagnosis Overview
Wind noise, air leak, and water leak problems in a vehicle may coexist. An area that leaks air may cause a wind noise and also result in a water leak. Procedures used to diagnose the source of one type of problem may also be used to diagnose the other complaints. Similar diagnosis procedures are often used to locate the source of wind noise and both air and water leaks.

Wind Noise And Water Leak Diagnosis
When diagnosing the source of a wind noise or a water leak, first determine the conditions when the noise or leak exists. Next, simulate the conditions that cause the problem, and use diagnostic techniques to determine the general area of the leak or noise. After the general area has been determined, pinpoint the noise location or leak entry point. It may require additional testing to pinpoint the exact cause and location.

Water Leak Diagnosis
Water leak diagnosis may require the removal of vehicle parts or interior trim pieces to pinpoint the exact entry location. Pinpointing a water leak location may be challenging because the entry point may be away from where water is visible. This is due to the capillary action of water and the possibility that water may travel behind interior trim and other parts before it becomes visible. The capillary action is where water, due to the forces of adhesion and surface tension, is able to travel upward, against the forces of gravity.

Water Leak Diagnosis (cont'd)
When diagnosing water leaks, more than one test method may be required, and extended soak times may be necessary to produce evidence of the leak. The water may collect
in areas or travel along the interior trim before becoming visible, causing a leak not to appear until after the vehicle has been subjected to water spray for an extended time period. Another factor relating to extended soak times is the surface tension of water. The surface tension may keep water from leaking when it first applied, but once something breaks this surface tension, the water will flow through the leak location.

General testing methods may be used to verify the existence and general location of a water leak, but localized tests may be required to pinpoint the exact entry location.

**Water Leak Types**
A water leak can typically be classified as one of two types - a clean water leak or a dirty water leak.

**Clean Water Leaks**
A clean water leak is typically from rain or wash water, and has an entry point above the beltline such as the roof, windows, upper cowl, door area, deck lids, or rear hatch.

**Dirty Water Leaks**
A dirty water leak is from road splash, and typically has an entry point below the beltline of the vehicle such as the floor pan, toe pan, torque box, lower cowl, or wheelhouse area.

**Customer Consultation**
Before beginning diagnosis of a wind noise or water leak, a consultation with the vehicle owner should take place to help identify the problem. Ask if the concern is a wind noise or a water, air, or dust leak. If the concern is a wind noise, ask if the noise is a whistle, a hiss, a roar, or a rushing sound.

**Customer Consultation (cont'd)**
Other information that should be determined from the consultation includes the customer's perceived location of the problem or concern. Ask the customer if they can identify the general location of the problem or concern. Try to determine whether the problem exists in the front, right or left side, back, top, or bottom of the vehicle.

**Customer Consultation (cont'd)**
Other helpful information that can be gathered during a customer consultation includes the specific conditions under which the concern exists. Also, determine the history of the vehicle by asking about previous accidents or repairs.

For a water leak, it is helpful to know if the leak occurs when the vehicle is parked or moving. If the leak occurs while the vehicle is parked, try to determine if the vehicle is level or inclined when the leak occurs, or if that seems to make no difference. If the concern only occurs while driving, ask about the speed at which the leak occurs. Ask if
a water leak occurs in light or heavy rain, or only at the car wash. For a wind noise, ask if the speed of the ventilation fan seems to make any difference. For dust leaks, knowing what type of road surfaces the vehicle is typically driven on may be helpful.

Refer to Module 1, "Demonstration: Customer Consultation Worksheet" for a demonstration of a customer consultation worksheet.

**General Leak Testing**

General leak testing and verification procedures include a thorough visual inspection, road testing for air leaks and wind noise, and water-test stands or a water hose to check for water leaks. Water-test stands are used to simulate the vehicle sitting in the rain. When using a water hose for general testing, a spray nozzle set to a cone-shaped spray pattern may be used.

**Localized Leak Testing**

Localized leak tests used to help pinpoint exact leak entry include a water hose test, an ultraviolet dye test, a paper test, a powder or chalk test, a positive pressure test, an air hose test, an ultrasonic test, and a light test. For localized testing with a water hose, the water hose should not have a spray nozzle installed.

**Visual Inspection**

A thorough visual inspection should be the first step in the diagnostic process when attempting to locate the source of either a wind noise or a water leak. A visual inspection can be used as both a general or a localized test. When doing a visual inspection, the technician should focus on the areas that have been damaged and repaired. Knowing where the vehicle has been damaged and what type of repairs have been made will give a good starting point when examining a vehicle for problems.

**Visual Inspection Procedure**

When doing a visual inspection, check the fit of the body panels, especially movable ones such as doors, deck lids and hatches, sunroofs, liftoff roof panels, and folding tops. Check the openings for doors, lids and hatches, and lights. Verify that the closing effort of doors, lids, and hatches is not excessive, and that the parts fully close. Look for structural damage that could cause poor weatherstripping contact. Also, check the fit of movable and stationary glass.

**Visual Inspection Procedure (cont’d)**

Additional items that should be checked during a visual inspection include weatherstripping, seals, gaskets, and plugs. Inspect weatherstripping for cuts, tears, and collapsed areas. Check seals and plugs in the floor, wheelhouse, and cowl area. Inspect these for proper fit, complete seating against the body, and any visible damage. Also, inspect the seals on fasteners that go through the body shell. Ensure that all fastener seals are in place and correct for the application.
Visual Inspection Procedure (cont’d)
Other potential sources of leaks that should be checked during a visual inspection include drains for sunroofs and evaporators, lock cylinder seals, pass-through grommets for wiring harnesses, and seals for tail lamps. Ensure that drain hoses are properly connected, and are not plugged or damaged. Check drain holes in the bottom of doors and body panels to ensure they are not plugged. A good way to check drain hoses is to pour water into the channels or troughs that they connect to and look for the water to exit where the hose exits the vehicle. Ensure that all grommets are properly installed and undamaged.

Road Test
A road test can be used as either a generalized or a localized testing procedure. A road test is typically done to check for, or pinpoint, the cause of a wind noise. A road test is a real-world test and not a simulation. It can be done to pinpoint the location of an air leak or to identify causes of turbulence. A road test can also be used to help locate certain water leaks that only happen while the vehicle is being driven, but only if the proper conditions exist.

Road Test (Cont’d)
Ensure that any road testing is done under safe conditions and while obeying all traffic laws. The driver of the vehicle must concentrate solely on the safe operation of the vehicle. Only a properly restrained assistant should listen for the location of wind noise.

Road Test Tools
Common diagnostic tools used during a road test include electronic ears, a stethoscope, small sections of rubber vacuum or heater hose, and wide automotive masking tape. Electronic ears, stethoscopes, and sections of hose are all used to help pinpoint the exact location of air leaks by listening for the sound of air movement. Electronic ears are basically an electronic stethoscope that amplifies sound. This makes hard-to-hear sounds louder, while filtering out background noise. Wide tape can be used to cover areas of suspected leaks on the outside of a vehicle. The vehicle can then be road tested a second time to see if the problem has disappeared.

The help of an assistant is required when doing a road test. One technician should drive the vehicle while a second technician listens for the wind noise.

Road Test Diagnosis Procedure
When doing a road test, drive the vehicle under the appropriate conditions for the complaint being diagnosed. Ensure that vehicle speed and blower fan speed match what the customer stated for the complaint. Blower fan speed is an important consideration, as it pressurizes the passenger compartment and can contribute to wind noise caused by air leaking out of the vehicle. One technician should drive the vehicle while an assistant listens for the wind noise. The assistant should identify the type of noise present, such as a whistle, hiss, rush, or roar, and the perceived location of the noise.
**Road Test Diagnosis Procedure (cont’d)**

After it has been identified that a vehicle has a wind noise and its general location established, one method used to help pinpoint the source includes applying wide tape over areas of suspected leaks and retesting. Moldings or trim suspected of fluttering or creating turbulence may also be taped over to confirm that they may be the cause of a wind noise. Another method would be to remove parts that are suspected of causing turbulence and retesting. If a part has been established as the cause of the wind noise, it should be verified that the correct part has been installed.

**Water Test Stands**

Water test stands are used to check a vehicle for the presence of water leaks or, if a leak exist, to determine the general area. Water test stands simulate the vehicle being in the rain.

**Water Test Stand Tools**

Tools used during water test stand testing include a pair of water test stands, water hoses, a battery-operated light, and a flexible-head mirror. Water test stands use spray nozzles or shower heads to deliver a wide coneshaped spray to the vehicle. Two water hoses are required, one to connect the stands to a water source, and the second to connect the two stands together. The battery-operated light is used for inspecting dark areas of the vehicle interior, and the flexible head mirror is for inspecting areas of the vehicle interior that are hard to see. The help of an assistant may be required to locate the source of a water leak.

Use battery operated light sources only, do NOT use 110-volt lights around water. Being wet or standing in water greatly increases the risk of electrocution.

**Building Water Test Stands**

Items needed to build a pair of water test stands include a pair of spray nozzles capable of delivering a full cone-shaped spray at a 60° angle with water flow volume of 3.7 gallons per minute. If the correct spray nozzle cannot be obtained, household shower heads capable of delivering a full cone-shaped spray may be substituted. Approximately 16 feet of 1/2 inch water pipe, and various 1/2 inch pipe fittings are required. Two regulator valves and a water-pressure gauge are needed for setting the water pressure to the shower heads or spray nozzles. A pressure gauge is only needed on one stand to set the inlet water pressure. Pressure gauges may be fitted to both stands if desired.

Additionally, bases are needed to stabilize and support the stands. The bases can be made from the same pipe as the stands, formed into an X or other shape suitable for stabilizing the weight of the test stand. 12 feet, of 5/8 inch water hose are also required to carry water from one stand to the other, along with a second hose to carry water from the water source to the test stands.
Water Test Stand Diagnosis
The water test stand diagnostic procedure can be used on either the top or bottom of a vehicle. When diagnosing leaks on the lower portion of the vehicle, lay the test stand down and spray water into the wheelwells or floor pan area. This is done to help pinpoint dirty water leaks that are caused by road splash and that would not show up by applying water to the top of the vehicle. This procedure simulates driving the vehicle in the rain or on wet streets. Water pressure should be set 22 psi.

Water Test Stand Diagnosis (cont’d)
When doing a water test stand diagnosis on a vehicle’s upper surfaces, one test stand should be placed on each side of the vehicle. Each stand should deliver a cone-shaped spray pattern and the water spray from the left and right test stands should overlap.

Water Test Stand Diagnosis (cont’d)
To leak test the windshield and front body pillars using water test stands, position the stands on each side of the vehicle towards the front. Aim the water spray 30° down and 45° towards the rear of the vehicle. Have the center of the spray pattern aimed at the upper corners of the windshield.

Water Test Stand Diagnosis (cont’d)
To test the side of a vehicle, position the stands on each side of the vehicle and forward of the area to be tested. Aim the water spray 30° down and 45° towards the rear of vehicle. Have the center of the spray pattern aimed at the center of the door or quarter panel being checked.

Water Test Stand Diagnosis (cont’d)
To test a backglass or deck lid for leaks, position the test stands on either side and towards the rear of the vehicle. Aim the water spray 30° down and 30° towards the front of the vehicle, with the center of the spray pattern aimed at the upper corner of the rear window or the deck lid.

Water Hose Test
The water hose test is typically used as a localized test to help locate the entry point of a water leak. However, it may be used for general leak testing with a spray nozzle installed and set to a cone-shaped spray pattern.

Water Hose Test Tools
If general testing is being done, tools that may be used during a water hose test include a water hose and a spray nozzle capable of producing a cone-shaped spray pattern. Additionally a battery-operated light is needed for inspecting dark areas of the vehicle interior. A flexible-head mirror may also be required for inspecting hard-to-see areas, such as under dash panels and behind headliners. The water hose test typically requires the help of an assistant inside the vehicle to inspect for water entry while the water is applied to the vehicle exterior.
Use battery operated light sources only, do not use 110-volt lights around water. Being wet or standing in water greatly increases the risk of electrocution.

**Water Hose Test**
When doing a water hose test, use low-pressure water. When doing localized testing, do not use nozzles or ends that increase the water pressure on the hose end. Start in the lower section of a suspected leak area and move upwards slowly. Starting below the suspected leak area and working up will help to pinpoint the exact entry point of the leak. Starting at the top will allow the water to leak in before the water hose reaches the level of the leak. This may give a misleading result due to the water traveling under trim or behind reinforcements before becoming visible. Move the hose slowly, and allow water to flow in one spot long enough for the leak to materialize.

When testing with a water hose, have an assistant inside the vehicle follow the path of the water with a light, looking for the leak entry point. A flexible-head mirror is also useful to view areas that are hard to see because of obstructions, such as the instrument panel, headliner, or inner structural parts.

Before placing an assistant in the trunk to find a water leak, ensure that the key is not in his pocket and that an alternate method of opening the trunk from the inside has been identified.

**Ultraviolet Dye Test**
The ultraviolet dye test is a localized test used to help pinpoint the entry location of difficult-to-diagnose water leaks. It is a variation of the water hose test. A mixture of water and ultraviolet dye is sprayed on the vehicle in the area of a suspected leak. Then, an ultraviolet light source is used inside the vehicle to determine the source of the leak.

**UV Dye Test Tools**
Tools required for doing the ultraviolet dye test may be available as a kit. Typically, the parts of a UV test kit include the dye applicator spray nozzle, a bottle of UV dye, an ultraviolet light, and some type of UV-enhancing glasses. The special UV-enhancing glasses or goggles are used to make the leak trail more visible. Additionally, the kit may contain a bottle of UV dye remover that can be used for cleaning spills on the vehicle interior. Full strength dye will stain permanently, but in its diluted form, it may be removed with a special cleaner. A water hose is also required to connect the dye applicator to a water source.

**UV Dye Test Diagnosis**
When using the UV test to pinpoint a water leak, be sure to protect the vehicle interior before applying the dye solution. Spray the water and dye solution on the suspected leak
area using the dye applicator nozzle and low-pressure water. While one technician is applying the dye mixture, an assistant inside the vehicle inspects the interior with a UV light while wearing the UV enhancing glasses. The dye will glow when the UV light is applied to it. Inspecting the vehicle under low light conditions allows the dye solution to be seen easier.

Do not allow full strength UV dye to come in contact with interior soft trim as permanent staining may occur.

UV Dye Test Diagnosis (cont’d)
Considerations when doing the UV dye test include ensuring that all of the dye solution is rinsed from the vehicle exterior following the test. It should also be noted that some dye applicator nozzles may have a compressed air fitting for connecting to a compressed air source. This is used to allow the spray of the dye solution to be applied under pressure and simulate driving the vehicle into a heavy rain.

Never aim a high-pressure stream of the dye solution directly at weatherstripping or seals from a close distance. Aiming the high-pressure spray directly at a weatherstripping may force the dye solution through areas that would not normally leak.

Paper Test
The paper test is a localized test used to check the clamping load of a weatherstripping to its contact surface. Paper tests are used to help pinpoint the source of wind noise, air, and water leaks.

Paper Test Tools
Tools used for a paper test include strips of paper cut one inch wide by eight inches long. Paper currency may be used in place of strips of paper. For checking the fit of sunroof glass to its opening in the roof, a business card may be used.

Paper Test Diagnosis Procedure
When doing a paper test, with the part partially open, place the paper strips or currency between the weatherstripping and the part that it seals against at various points. After inserting the paper strips, fully close the part, trapping the paper strips between the weatherstripping and the surface it contacts. Next, pull the paper strips out, noting the resistance at different points. Areas of lighter resistance may indicate an area of poor weatherstripping clamping load and a possible leak location.

Powder Or Chalk Test
The powder or chalk test is a localized test used to locate areas of poor weatherstripping contact to the surface it seals against. The powder or chalk test is used to verify that a weatherstripping has the proper bearing surface contact width. This test may help
pinpoint the source of both wind noise and water leaks. There is more than one method or procedure that can be used when doing a powder or chalk test.

**Powder Or Chalk Test Tools**

Tools used for doing a powder or chalk test include powder or chalk in either a wet spray or a dry form. Tracing powder spray goes on wet and dries to a powder after application. Lightweight grease can also be used when using dry powder or chalk on the weatherstripping. The grease should be applied in a film that has a minimal width or buildup off of the surface. A thick-bodied grease will build the sealing surface out and may give false results. After the test, cleaning solvents are needed to remove the grease and other solvent-based residue from weatherstripping and the adjacent vehicle surfaces. Make sure the cleaning solvents will not damage paint or rubber.

**Spray Tracing Powder Test Diagnosis**

When doing a powder test with tracing powder spray, begin by cleaning the weatherstripping and the adjacent surface. Use both water and a mild solvent-based cleaner for removing contaminants. Spray tracing powder on the surface that seals against the weatherstripping. Next, close the part completely without slamming. Close the part as gently as possible, but ensure complete closure and latching. Slamming the part or applying excessive pressure while closing will give a false imprint. Finally, open the part and check the transferred powder imprint on the weatherstripping. Skips or missing areas of powder on the transferred imprint line on the weatherstripping indicate areas of poor weatherstripping contact.

Wear nitrile or butyl rubber gloves for hand protection when using solvent-based cleaners.

**Spray Tracing Powder Test Diagnosis (cont'd)**

Verify that any cleaning solvents will not damage rubber or painted surfaces before using them.

**Powder Or Chalk Test Diagnosis**

Use this procedure when using dry powder or chalk to do a powder test. Begin by cleaning the weatherstripping and the adjacent surface. Use both water and a solvent-based cleaner. Next, apply chalk or powder to the surface of the weatherstripping and apply a thin film of grease to the vehicle surface that the weatherstripping contacts. Next, fully close the part without slamming it. Fully close the part as gently as possible, making sure the part has latched. Slamming the part or applying excessive pressure while closing will lead to false results.

Verify that any cleaning solvents will not damage rubber or painted surfaces before using them.
**Powder Or Chalk Test Diagnosis (cont’d)**
To complete the procedure, open the part and look for a powder imprint on the grease. Areas of poor weatherstripping contact will leave a skip in the powder imprint line, or there may be no imprint at all.

**Powder Or Chalk Test Alternate Method**
An alternate method of doing the powder test is to do it with dry powder or chalk. When doing the test this way, begin by cleaning the weatherstripping and the adjacent surface. Use both water and a mild solvent-based cleaner for this. Next, apply dry chalk or powder to the sealing surface of the weatherstripping. Fully close the part and avoid slamming. Fully close the part as gently as possible, making sure the part has latched. Slamming the part or applying excessive pressure while closing it may lead to false results. Finally open the part and inspect the applied line on the weatherstripping. The chalk or powder line on the weatherstripping will be marred where contact is good. Areas where the powder line is not disturbed may indicate poor weatherstripping contact to the sealing surface on the vehicle.

Verify that any cleaning solvents will not damage rubber or painted surfaces before using them.

**Positive Pressure Test**
The positive pressure test is a localized test that is used to help pinpoint the location of an air or water leak, which may be done multiple ways. One advantage of the positive pressure test is that it can be done without an assistant.

**Positive Pressure Test Tools**
Tools that may be used for a positive pressure test include wide automotive masking tape, a soap solution or a leak detection spray, and a battery operated light.

**Positive Pressure Test Tools (cont’d)**
Additional tools that may be required for doing a positive pressure test include a flexible-head mirror for inspecting difficult-to-view areas, and a listening device for detecting escaping air. This detection device may be electronic ears, a stethoscope, or a length of vacuum or heater hose.

Do not use stethoscopes or other sound amplification listening devices around loud noises.

**Positive Pressure Test Diagnosis**
To use the positive pressure test for pinpointing an air or water leak, seal the vehicle’s pressure relief vents with wide masking tape. Then, close the windows and turn the blower motor on HIGH in the defrost mode. Doing this pressurizes the vehicle interior.
When doing a positive pressure test, ensure the doors are unlocked and fully closed.

**Positive Pressure Test Diagnosis (cont’d)**

After pressurizing the interior of a vehicle, apply a soap-and-water solution or leak detection spray over the suspected leak area on the outside of the vehicle. Areas where air leaks out will produce bubbles.

To help locate these areas, slowly move a listening device around the length of the sealing area and listen for escaping air. Wherever escaping air is heard, the seal between the weatherstripping and its contact surface is inadequate.

**Air Hose Test**

The air hose test uses the same general principles as the positive pressure test, but does not require a fully closed and sealed passenger compartment or functioning electrical system to run the HVAC blower. An air hose test is a localized test to help pinpoint exact locations of water or air leaks in a vehicle.

The air hose test is typically done on stationary glass, although it can be done to weatherstripping for movable glass and panels. When used on movable panels and glass weatherstripping, care must be used to ensure that low pressure and adequate distance from the blow gun to the seal are maintained. High-pressure air is capable of moving seals and escaping past areas that are adequate for normal vehicle usage. No more than 205 kilopascals or 30 psi of air pressure should be used.

**Air Hose Test Tools**

Tools used for an air hose test include an OSHA-approved blow gun. OSHA-approved blow guns have nozzles that restrict the pressure output to 30 psi with an inlet pressure of no more than 150 psi. Along with a nozzle, a soap and water solution or leak detection spray is required along with a listening device such as electronic ears, a stethoscope, or length of a rubber hose.

When doing an air hose test, an assistant is required.

**Air Hose Test Diagnosis**

When using an air hose test to pinpoint the location of a leak, have an assistant use the blow gun to direct low pressure air at the suspected leak from inside the vehicle. When using a blow gun, keep the air pressure under 30 psi.

Also, when doing an air hose test, spray a soap and water solution or leak detection spray on the exterior area of the suspected leak. Begin at the bottom and gradually work up and
across the top. As this is done, bubbles will indicate the location of escaping air and the leak can then be repaired.

**Air Hose Test Diagnosis (cont’d)**
An alternate method of locating escaping air during the air hose test is to use a stethoscope, electronic ears, or a length of hose to listen for escaping air.

Pushing in or out on movable parts may help isolate a leak or reveal hard-to-locate and intermittent leaks.

Do NOT use stethoscopes or other sound amplification listening devices around loud noises.

**Ultrasonic Test**
The ultrasonic test is a localized test that uses ultrasonic sound waves to locate areas that air and water may leak into a vehicle. An advantage of the ultrasonic test is that an assistant is not required.

**Ultrasonic Test Tools**
Tools required for the ultrasonic test are typically available as a kit and include an ultrasonic transmitter, a receiver, and headphones, which may be optional. Instead of headphones, the receiver may have a built-in speaker.

**Ultrasonic Test Diagnosis**
When using an ultrasonic tester to check for areas of poor sealing and possible leaks, place the transmitter in the vehicle close to the area being tested. Then fully close all vehicle doors and move the receiver around the sealing surfaces of movable and stationary parts, and areas of suspected leaks.

When a leak is located, an audible tone change will occur. This happens when the receiver passes by an area that has poor sealing, the sound from the ultrasonic transmitter is detected by the receiver and heard through the headphones. Most receivers will also have lights that illuminate when a transmitter signal is detected.

**Light Test**
The light test is typically used as a localized test to pinpoint the entry point of dust or water leaks through the floor pan and lower areas of the vehicle. A light test can be used anywhere a light can be shone, and the opposite side of the panel can be seen to check for light shining through.

**Light Test Requirements**
When doing a light test, a required tool includes a light source such as a floodlight, spotlight, or fluorescent lamp. The dark shop area will help locate possible leak
areas easier than if the shop is illuminated. Also, depending on the type being done, an assistant may be required.

**Light Test Diagnosis**
To locate leaks using light, place the vehicle in a dark area of the shop and shine a light in the area of suspected leaks. When doing this test, shine the light into the vehicle from outside the vehicle. Long florescent tubes can be set underneath the vehicle. Flood or spot lights can be shone around doors, deck lids and hatches. Another way to do a light test is to have an assistant inside the vehicle looking for light entry. This test may require the removal of interior parts such as seats, carpeting, and other trim in order to access the areas where the leak may be.

When located, mark inside the vehicle the areas where light is visible. Anywhere that light can pass through to the interior is a potential air, dust, and water entry point.

**Module Summary**
Module 2 discussed the various diagnostic techniques and testing procedures to help pinpoint the location of wind and water leaks.

Topics discussed in this module included:

- general diagnostic techniques used to check for wind noise.
- pinpoint tests to locate the source of a wind noise.
- generalized testing procedures used to determine the presence of air or water leaks in vehicles.
- pinpoint tests to locate the source of air and water leaks in vehicles.
- the function and location of common water drains on vehicles.
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Module 3 - Repair And Avoidance
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Learning Objectives
It is important to be able to effectively repair wind noise and water leaks.

Module 3 will discuss the various ways in which to repair wind, noise, and water leaks. It will also discuss how to avoid creating leaks during the collision repair process.

The learning objectives for this module include:

- using TSBs to repair common concerns.
- explaining procedures used to shim weatherstripping and correct clamping load problems.
- repairing a leak in a stationary glass installation.
- identifying procedures for repairing leaks in sunroofs.
- repairing leaks at body seams that are caused by damaged seam sealer or weld defects.
- explaining how to avoid wind noise and water leak problems when performing collision repairs.

Technical Service Bulletins (TSBs)
Technical service bulletins or TSBs can be used to help diagnose and repair wind noise and water leak problems. A TSB can be used to help locate and repair problems common to a specific make, model, and year of vehicle.

TSBs typically also have procedures and solutions developed by the vehicle maker for a specific problem on a specific vehicle.

Refer to Module 3, "Demonstration: Vehicle Maker TSBs" to see an example of a vehicle maker TSB.

Common Concerns
When repairing a wind noise or water leak, look for a TSB pertaining to the specific concern. A TSB can be accessed from vehicle maker service information websites or through various aftermarket information providers. Doing internet searches will often reveal more than one way to access a TSB.

To repair a wind noise or water leak, use available networks for the particular vehicle and concern that you are repairing. The use of repair technician trade and auto club internet bulletin boards may help identify a repair for the vehicle being worked on. Along with using networks, use the experience and knowledge of others to help find the cause and
solution for difficult repairs. Some customer complaints may be difficult to repair. Wind noises or air leaks that are common to a vehicle design may be difficult to solve without a vehicle maker TSB or a solution such as redesigned parts. Do not attempt to re-engineer the vehicle to solve a problem.

**Using TSBs**
When using a TSB to help diagnose and repair a concern, verify that the TSB is correct for the application. Also, ensure the TSB corresponds to the exact make, year, and model of the vehicle. There may be specific repair procedures outlined in a TSB for correcting this concern once it has been duplicated.

When using a TSB, installing updated parts or referencing a specific repair manual may be required for the application of the procedure. Always follow the repair guidelines outlined in the TSB, as they have been tested and confirmed to correct the condition.

**Eliminate Cause Of Turbulence**
When trying to correct a wind noise that seems to be coming from the roof rack area, try repositioning the placement of the roof rack cross bar. Also, verify that all caps are properly installed in the ends of the roof bars, and that all covers are in place over the fasteners.

Wind noises may also occur from using an incorrect antenna or from loose trim or moldings that may be fluttering and creating noise. Improperly adjusted body panels, or panels with incorrect gaps or flushness may be the cause of the noise.

**Seal Air Leaks**
Once an air leak is located, seal it by installing, adjusting, or replacing foam dams, fillers, plugs, seam sealer, or weatherstripping. If any of these items are missing, damaged, or loose, it may be the source of the problem.

**Adjusting Weatherstripping Clamping Load**
When initially adjusting the clamping load of a weatherstripping for movable parts, verify correct part alignment, such as the striker, and verify correct shingling. If these steps do not correct the problem, adjust the weatherstripping flange, adjust the weatherstripping housing position, or shim the weatherstripping for better contact.

**Weatherstripping Flange Adjustment**
When adjusting the mounting flange of a weatherstripping, ensure that the entire pinchweld flange is even and undistorted. Uneven areas of a flange may cause inadequate clamping loads at the point of the flange distortion.

When adjusting the pinchweld flange, ensure that there is correct weatherstripping clamping load and contact surface to maintain a proper seal. By adjusting the angle of the
flange, one problem may be corrected but other problems may be created if there is an improper angle on the flange. Moving the flange out tends to increase the contact surface width but may decrease the clamping load. Moving the flange in tends to increase the clamping load but may decrease the contact or bearing surface width.

**Adhesive-Backed Weatherstripping Shims**
Double-faced adhesive-backed strips can be used as shims for moving adhesive or housing-mounted weatherstripping closer to an adjacent part. This can also be done by installing adhesive-backed foam strips between the weatherstripping or the housing of the part that the weatherstripping is attached to.

Refer to Module 3, "Demonstration: Adhesive-Backed Shims" to see an example of an adhesive-backed weatherstripping shim.

**Adhesive-Backed Weatherstripping Shims (cont'd)**
Before installing adhesive-backed weatherstripping shims, thoroughly clean both the weatherstripping and the part it attaches to. Adhesively backed weatherstripping shims require a complete and uninterrupted seal so that water does not leak between the shim stock or the weatherstripping and into the vehicle. Depending on the application, more than one layer of adhesive-backed weatherstripping shim material may be required to achieve the desired clamping load. When doing this procedure, test-fit the shims dry to verify before permanently installing.

**Tests For Locating Stationary Glass Leaks**
Diagnostic tests used to locate water entry locations on stationary glass installations include doing visual inspections, using water test stands, testing with a water hose, or doing an ultraviolet, or UV, dye test.

Other tests include positive pressure tests, air hose tests, and ultrasonic tests.

**Locating Leaks Around Movable Parts**
Some common tests used to locate leaks around movable panels and glass include doing visual inspections, using water test stands, and testing with a water hose.

Other tests include doing a UV dye test, positive pressure test, or an air hose test.

**Locating Leaks Around Movable Parts (cont’d)**
Some additional tests that may be used to locate the entry point of water leaks around movable parts include ultrasonic tests, paper tests and the powder or chalk test.

**Repairing Leaks At Movable Parts**
One of the common repairs for leaks at movable panels and glass is making adjustments for the clamping load of the weatherstripping. Ways of adjusting the weatherstripping
clamping load include adjusting the body panel or glass for proper fit. When adjusting body panels, ensure proper panel shingling is maintained whenever adjusting a movable panel. Clamping load can be changed by adjusting the angle of the weatherstripping flange or by installing shims under or in the weatherstripping. If applicable, adjust the latch striker, but ensure that proper shingling is maintained.

**Repairing Leaks At Movable Parts (cont’d)**

Repairing leaks at movable parts may require replacing the weatherstripping. It may also require replacing glass runs or mechanisms such as motors, latches, and glass regulators.

**Weatherstripping And Water Leaks**

Issues with weatherstripping and water leaks involve nearly identical repairs as those used for wind noise. Unlike wind noise, water can migrate between the weatherstripping carrier seal and the flange through capillary action. When this occurs, water may wick between the pinchweld flange and weatherstripping carrier. To correct this problem, realign stretched weatherstripping carriers to get a tight seal at the flange and ensure that required sealers are in place.

**Repairing Sunroof Leaks**

When a water leak is identified on a sunroof, common repairs include resealing or replacing the sunroof frame-to-roof panel seal. Damaged glass panel-to-roof opening seals may require replacement. If the sunroof glass-to-roof opening seal on a sliding sunroof is missing or damaged, it may allow more water into the sunroof drain channels than the drain hoses are capable of handling. This could result in water leakage. The drain hoses on sliding sunroof assemblies may require replacement or reattachment.

**Sunroof Glass Fit**

The fit of sunroof glass can be checked by sliding a business card between the sunroof glass and the roof panel. This fit should be tight. If the business card is inserted with no resistance, the gap between the glass panel and opening may be excessive. Excessive gaps may allow more water into the drain channel than the drain hoses can handle.

**Adjusting A Sunroof**

When adjusting the fit of a sunroof glass in its opening, first check and adjust the flushness, the glass should be slightly shingled. It should be shingled down 1 mm in the front and up 1 mm in the back. Then, check and adjust how the sunroof glass fits in the roof opening after correcting any flushness problems. To do this, use a business card to ensure an even fit and equal pressure on the seal around the entire glass perimeter.

**Clearing Plugged Sunroof Drains**

When clearing plugged sunroof drain hoses, use compressed air at low pressure, such as 205 kilopascals or 30 psi. Verify that the drain hoses remained attached after using the compressed air. Another diagnostic test is to pour water into the drain channel to verify
that any restriction has been cleared. Some restrictions may not be possible to remove, and may require hose replacement.

**Tests For Leaks At Body Seams**
Typical tests used to locate leaks at body structure seams include water hose testing, water test stands, ultrasonic tests, and visual inspections. Visual inspections include looking for gaps, cracks, or skips in seams and seam sealer. Checking for cracked or broken welds can also identify areas of possible leaks.

Other tests include positive pressure tests, UV dye tests, air hose tests, and light tests.

**Repairing Leaks At Body Seams**
To repair a water leak at a body structure seam, remove loose or damaged seam sealers. Inspect and repair any cracked, broken, or missing welds.

Before applying seam sealer, clean and prepare the area. This may include cleaning with both a water- and solvent-based cleaner, scuffing any paint finishes, and applying a primer to bare metal areas. After doing this, follow the product maker’s procedures for applying the appropriate seam sealer for the joint and application.

**Removing Damaged Seam Sealer**
Damaged seam sealers may be removed using heat from a heat gun or an oxyacetylene torch. Using heat softens the seam sealer to release the bond. Use caution when heating seam sealers, as they are flammable.

Another method for removing seam sealers is using a fiber disc on a rotary tool. Fiber discs work well for removing seam sealers because they do not remove metal. Scrapers are also used in conjunction with heat to remove loose areas of seam sealer. A wire wheel or brush may also be used, since they are more aggressive than fiber discs and work well for removing thick seam sealer.

Use care while using heat to remove seam sealer to ensure that a fire is not started.

**Repairing Weld Problems**
When a water leak has been traced to a problem with a weld, repairing it may include filling the weld burnthrough holes by welding shut or by using a heavy-bodied seam sealer. Another method may include replacing missing welds.

Broken spot welds can be re-welded by making a GMA or MIG plug weld. Cracked fillet and butt joint welds may require removal of the damaged weld bead before re-welding.
Seam Cleaning And Preparation
To clean and prepare an area seam sealer, inspect the area for proper fit and adjust as necessary. Ensure that the panels fit together tightly at the seam and that there are no excessive gaps. Next, clean the seam with both a water-based and solvent-based cleaner to ensure there are no contaminants to affect the adhesion of the seam sealer or primer. Then dry the joint thoroughly, and apply primers as required.

After the seam has been properly prepared, the seam sealer can be applied.

Seam Sealer Usage
When applying seam sealers, use the correct seam sealer type for the specific application. Follow the recommendations of the vehicle maker or product maker for the correct use of the product. When using seam sealers, the type of sealer used depends on the application.

Duplicate the appearance of the OEM sealer when replacing damaged sealers, and when applying sealers to replacement parts. Use a flow-grade re-sealant for spot repairs on sealers that have not been removed and areas that are difficult to access.

Seam Sealer Usage (cont’d)
Follow the vehicle and product maker recommendations for use of seam sealers, such as the specific type of substrates the material is designed for. Also the preparation of the surface may be specific, such as what grade abrasive material should be used when preparing the surface.

Times are also important, such as working time, which is how long the material may be tooled before curing begins. Cure times are how long the material takes to harden. Also pay attention to recommendations for refinishing, such as whether the material requires topcoating, or if it has any UV-resistant properties.

Prevention Measures During Disassembly
Preventing wind noise and water leaks should be thought about throughout the entire repair process. During disassembly of a damaged vehicle, inspect for damaged seams or joints. This is done by looking for loose or cracked seam sealer. Inspect for broken or cracked fillet and butt joint welds.

Also inspect for structural damage to the vehicle that distorts openings for doors and movable glass. Structural damage can also result in flexing of the body, which can cause broken spot welds along flanges that close together after the body shape is restored. This makes the damaged weld difficult to see.
Prevention During Repairs
During the repair process, steps can be taken to help avoid wind noise and water leak concerns. Some of these steps include ensuring all required welds are made and no weld burnthrough exists. Also, use the correct seam sealer for the application and ensure that all recommendations have been followed for its use.

Along with inspecting weld areas, ensure that any adhesives used are correct for the application, and that all applicable procedures are followed.

Prevention During Repairs (cont’d)
While doing the repair process, inspect fasteners that penetrate through the body shell into the passenger compartment. Ensure that all fasteners are in place and sufficiently tightened to specification. Ensure that any sealers used on the fastener are in place and undamaged. Also monitor the fit of movable panels against weatherstripping. Ensure that panels are properly aligned to achieve the correct weatherstripping contact surface width and clamping load.

Prevention During Repairs (cont’d)
For vehicles with repaired structural damage, check the sealing of the body shell before installing additional parts, such as drivetrains, fenders, and instrument panels. These parts may be in the way of diagnosis and repair of any water leak problems after final assembly.

To inspect the sealing integrity of the body shell, do a thorough visual inspection of all seams, joints, fasteners, and welds. A positive pressure test may be able to be done using soapy water, leak detection spray, or a listening device that can verify that all joint seams, fasteners, and welds are airtight. Another test is using a water hose. A water hose can be used to inspect areas, especially repaired areas, for potential leaks.

Prevention During Final Assembly
During final assembly of a collision-damaged vehicle, check that all parts fit properly against weatherstripping and are correct for the application.

When straightening a twisted door shell, ensure that there is a consistent weatherstripping clamping load along the entire perimeter of the opening.

Refer to Module 3, "Demonstration: Wind And Water Leak Product Guide" to see an example of a wind and water leak product guide.

Module Summary
Module 3 discussed the various ways in which to repair wind, noise, and water leaks. It also discussed how to avoid creating leaks during the collision repair process.
Topics discussed in this module included:

- using TSBs to repair common concerns.
- procedures used to shim weatherstripping and correct clamping load problems.
- repairing leaks in stationary glass installations.
- procedures for repairing leaks in sunroofs.
- repairing leaks at body seams that are caused by damaged seam sealer or weld defects.
- avoiding wind noise and water leak problems when performing collision repairs.