Slide 1

Production Notes: Title slide. Use image as background. Read VO line 1. Insert Text block and read VO line 2

VO:
Welcome to the Chassis: Braking Diagnosis and Repair web-based training course.

Currently only Firefox browser is certified for use with Hyundai and Genesis Technical Online Training Courses. Other browsers may not record your progress or completion. Select OK to continue.

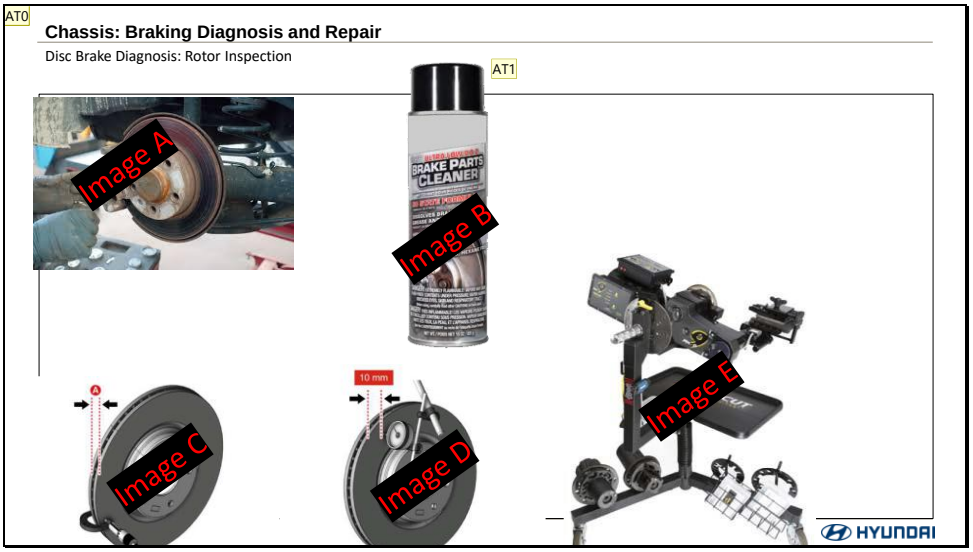
Slide 3

Production Notes:
Open with screen as seen without the bullet points. Read VO while inserting bullet points of course objectives.

VO:
This training is designed to lead the learner to a basic understanding of braking system diagnosis and repair. The learning objectives of this training are to understand disc brake system diagnosis, drum brake system diagnosis, and brake system bleeding.

Internal Information - Polestar

Slide 4



Production Notes:
Open with image A and read VO line 1.
Close image A and insert image B centered on the screen. Read VO line 2
Close image B and insert image C to the left and D to the right. Read VO line 3
Clear screen. Insert image E and read VO line 4

VO:
Brake discs or rotors are designed to wear and should be inspected regularly and serviced or replaced when necessary. If the brakes suddenly start to squeal, pull to one side, or your brake pedal pulsates on deceleration, it may be time to inspect the rotors and pads for wear.

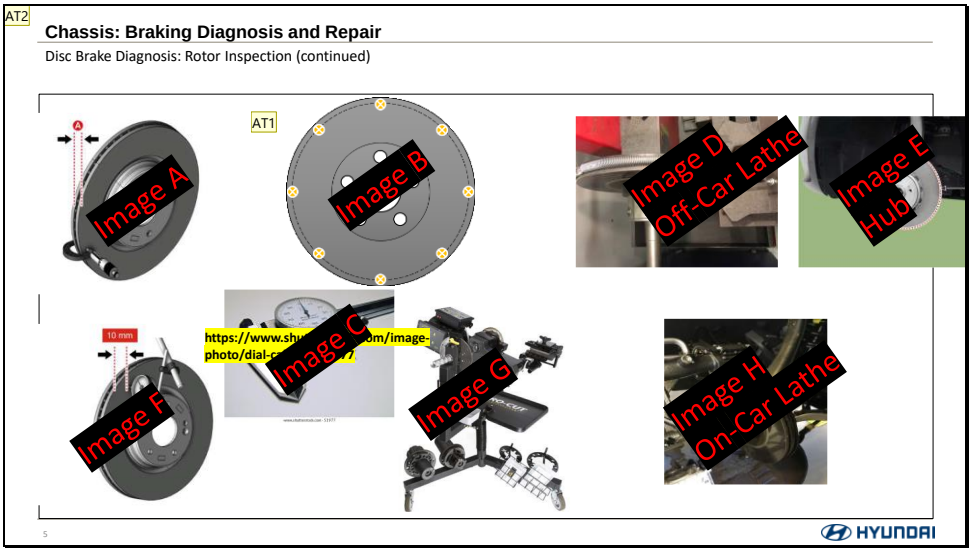
Always remember, before measuring the brake rotor for minimum service thickness and runout, remove all surface contamination and corrosion to ensure an accurate measurement. Brake parts cleaner can be used to ensure the surface of the rotor is free of contaminants.

After cleaning the brake rotors, they should be inspected and measured to determine the current condition. If the rotors are measured and found to be out of specification, show signs of severe wear, or have heavy discoloration, they will need to be replaced.

If the rotors are found to be in decent condition for further service, they may need to be machined using a brake lathe.

Internal Information - Polestar

Slide 5



Production Notes:
Open with image A and B and C. Read VO line 1.
Clear images. Insert images D and E and read VO line 3.
Slide images D and E to either side. Insert image F. Read VO line 3.
Clear screen. Insert image G in the center screen. Read VO line 4. Insert **On-car** image H and **Off-car lathe image D** as mentioned in the VO.

VO:
After inspecting the rotor for obvious wear and damage, the rotor should be measured to determine thickness at multiple points around the rotor. Be sure to place the micrometer close to the outer edge of the rotor. This measurement will help you determine the thickness variation and minimum thickness and should be made using a rotor micrometer or vernier caliper. Be sure to record these measurements.

Next, the rotor can be tested for runout or warpage by either mounting it to the brake lathe, as seen here or mounting it to the vehicle's hub assembly.

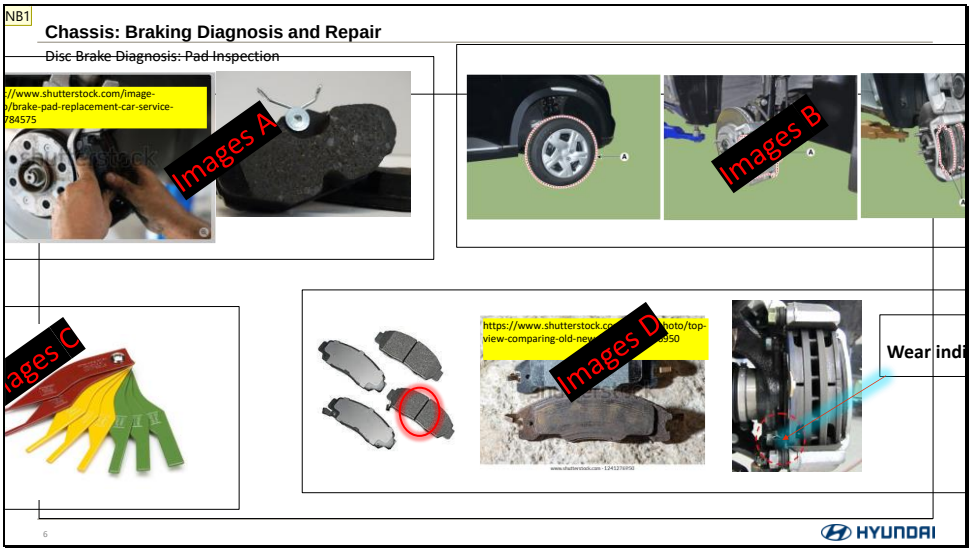
A dial indicator can then be located close to the rotor and set to contact the outermost edge of the rotor. At this point, rotate the rotor and monitor the dial indicator. Record these measurements.

Brake discs can be machined using an on-car or off-car brake lathe. If the obtained measurements indicate warpage, the rotor should be machined following manufacturer specifications. Measure rotor thickness *before* and *after* machining to ensure the brake

Internal Information - Polestar

rotor is within specification after machining. If rotors must be cut below minimum thickness, they must be replaced.

Slide 6



Production Notes:
Open with image A and read VO line 1.
Close image A and insert image B. Read VO and insert images as they are mentioned.
Remove images B. Insert images C. Read VO line 3
Remove images C and insert images D. Begin reading VO line 4 and highlight the brake pad **slot** when mentioned. Add marker text box when **wear indicator** is mentioned.
Close Imaged D and insert image E. Read VO line 5

VO:
Brake pads should be inspected periodically for wear or damage. Brake pads are designed to wear naturally and will need to be replaced over time. Premature wear may be caused by excessive heat or other failing brake components such as stuck caliper pins, brake pad contamination from fluid leaks, or even manufacturer defects. Knowing the condition of the brake pads can help to avoid damage to the rotor and ensure vehicle safety.

In order to inspect the brake pads, you will need to remove the wheel to get a better look. Once the tire is off, remove the caliper to gain access to the brake pads. Now, carefully inspect the brake pads, looking for excessive or abnormal wear, or signs of overheating.

To check the life of the brake pad, you need to determine its thickness. Brake pads are generally measured in 32nds of an inch. When a brake pad

measures 3/32nds of an inch or less, it should be replaced. The brake pad measurement gauge is a useful tool in determining if the brake pads are sufficiently thick, should be checked again soon, or need replacement.

On some brake pads, you might see a wear indicator **slot** down the center of the pad. If the slot is gone or just barely visible, this is an indication that it's time for new brake pads. Besides being visible, the wear indicator can also trigger other warnings. On some vehicles, a dashboard warning light is activated when the pads have worn down to a minimum level. Still, other vehicles use brake pads with a **wear indicator** attached to the pad. This pad design makes a loud squealing noise when the metal "wears indicator" contacts the rotor to warn the driver that the brake pads need to be inspected and possibly changed.

Other things to pay attention to include noises such as grinding squealing or growling sounds when you press the brake pedal. This typically means that the brake pads have worn through and are grinding into the rotors.

Internal Information - Polestar

Slide 7

Production Notes:
Open with all images on the page and read VO line 1. Make each image a selectable button. When the user selects the button, pop out each image full screen. Read each VO related to the images as they are selected by the user.

VO:
Please select from the images to learn more about the different types of brake pad failure that may occur.

Uneven wear: (DON'T READ THIS LINE)
Uneven brake pad wear most commonly occurs as a result of restricted caliper movement or caliper failure. This may mean that the caliper pins are not greased or sliding properly, or the caliper piston is not moving properly in its housing. This could also be caused by damaged or corroded slider plates, bad piston seals, or fluid contamination.

Fluid contamination:(DON'T READ THIS LINE)
Brake pads can be contaminated by oil, grease, or even brake fluid. The pad material can absorb the fluid which will reduce its capacity to provide friction needed to slow and stop the vehicle.

Debris contamination:(DON'T READ THIS LINE)

Internal Information - Polestar

Dirt, dust, rocks, and other particles can become embedded in the friction surface of the pad. This may lead to noise concerns as well as reduce the braking capability of the vehicle.

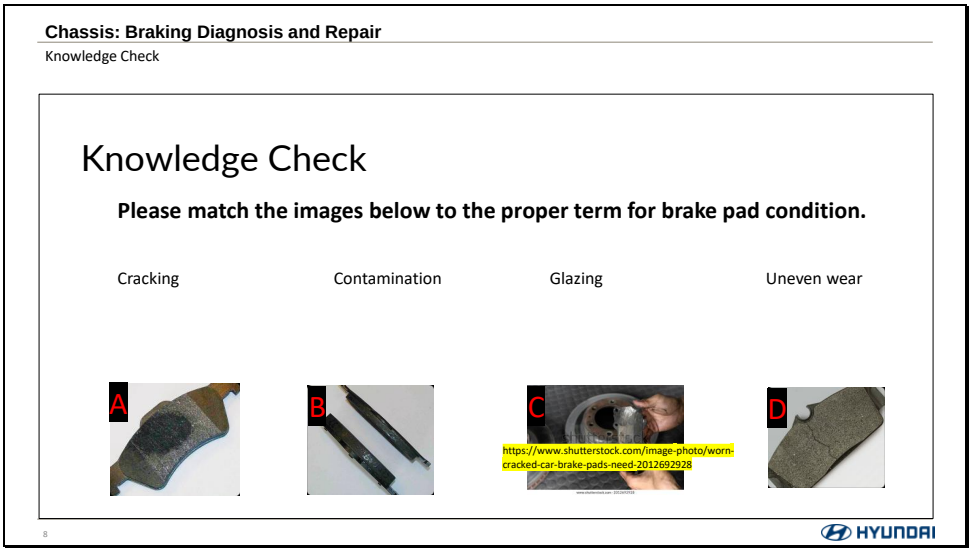
Cracking:(DON’T READ THIS LINE)
Brake pads crack when they are not allowed to slide freely within the caliper. These cracks occur when the pads are forced to flex. Caliper slides need to be properly lubricated. Pads are more prone to cracking when they have been overheated

Glazing:(DON’T READ THIS LINE)
Brake pad glazing happens when pad operating temperatures exceed the brake pad designed temperature limit. The pad material hardens and forms a smooth, slippery pad surface. When glazing occurs, brake pads can't provide the necessary friction with the rotors to stop the vehicle.

Fragmenting:(DON’T READ THIS LINE)
Friction material separation, or fragmenting, can be caused by corrosion intrusion between the friction material and steel backing, as well as extreme temperatures. Low-quality backing plates that are thinner than the original can also bend and cause the friction material to separate from the backing plate. Bonded or glued brake pads can fragment due to the failure of the glue used to attach the friction material to the backing plate.

Internal Information - Polestar

Slide 8



Production Notes:

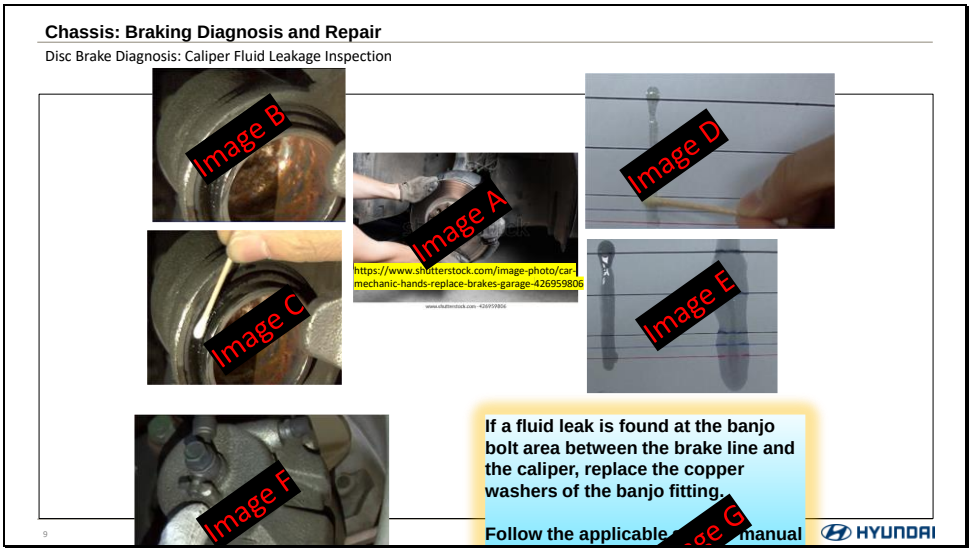
Create drag and drop arrows from the pad condition terms to the images.

Cracking	D
Contamination	A
Glazing	C
Uneven wear	B

VO:

Now, let's see what you've learned. Complete this Knowledge Check before moving on to the next section.

Slide 9



Production Notes:
Open with image A, large, center screen. Read VO line 1
Reduce the size of image A and center in the screen. Insert image B left upper. Read VO line 2
Insert image C Lower Left. Read VO line 3
Insert image D Right upper. Read VO line 4
Insert image E right lower. Read VO line 5. Remove all images.
Insert images F and G side by side full screen. Read VO line 6

VO:
When inspecting or servicing disc brakes, it is important to pay attention to any fluid that may be present near or around the calipers.

If oil or fluid is present on the brake caliper piston area, test the fluid to determine if it is brake fluid or assembly oil.

Use a cotton swab to carefully collect a sample of the fluid. Do not disturb the caliper boot.

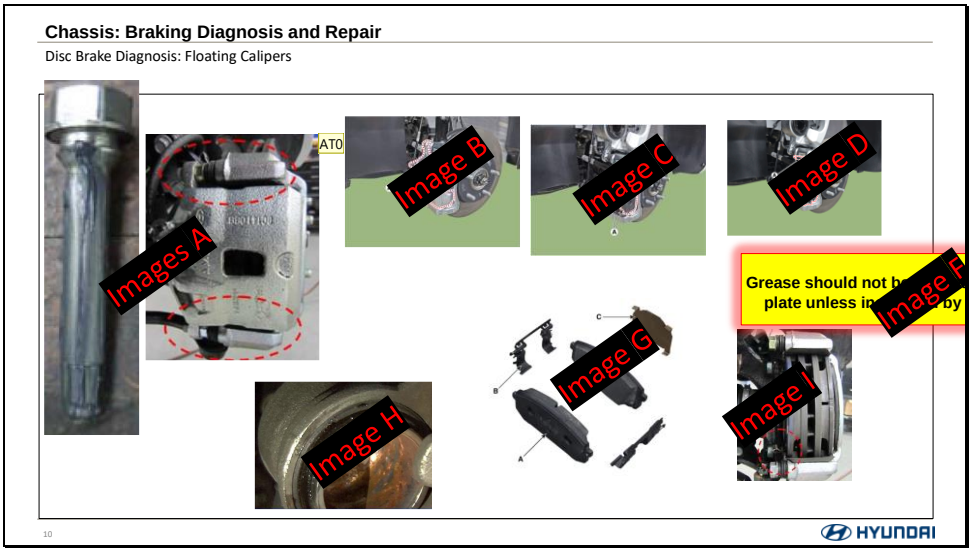
Using an oil or water-based ink pen, draw several horizontal lines on a sheet of paper. Wipe the collected fluid vertically down the ink lines.

If the ink does not smear, the fluid is not brake fluid and is likely to be assembly oil.
 Wipe the excess oil using a clean shop towel.

 Do not disturb the caliper boot. If the ink runs or smears, the fluid is likely to be brake fluid.
 Continue to investigate and repair the source of the brake fluid.

If a fluid leak is found at the banjo bolt area between the brake line and the caliper, replace the copper washers of the banjo fitting. Follow the applicable service manual procedures to replace the washers, bleed the brake system, and inspect for brake fluid leaks.

Slide 10



Production Notes:
Open with images A and read VO line 1 Clear screen.
Insert images B, C and D on the top half of the screen and Image E below. Read VO line 2. Read VO line 3 and insert Text block image F
Clear all images and insert image D. Read VO line 4 Reduce size of image D and slide left. Insert image G. Read VO line 5. Clear screen
Insert image H. Read VO line 6. Clear screen.
Insert Image I. Read VO line 7

VO:
When performing the brake service on floating-type calipers, always remove, clean, and inspect the caliper slide pins and boots. Apply silicone paste to the caliper slide pins before reinstallation.

Remove the caliper and secure it. Never hang the caliper by the brake hose. Remove the pads and clean the pad backing plate and insulators/shims of debris. Inspect the pad friction surface for even wear and pad thickness. Refer to the applicable vehicle shop manual for service limits.

Grease should not be applied to the pad backing plate unless instructed by the shop manual.

Remove the pad retainers and clean the contact surface of the caliper from debris and corrosion. Use a wire brush if necessary. Apply a light coat of Copper Anti-Seize Brake

Internal Information - Polestar

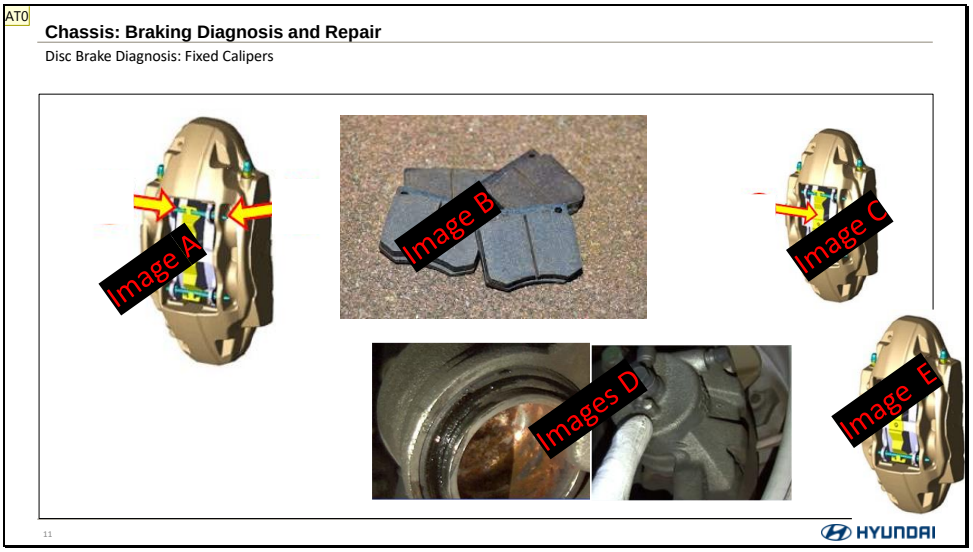
Lube to prevent further corrosion. Clean and inspect the retainers if the pads are reused. Discard damaged retainers.

Always use the retainers included with the new pads.

Inspect the caliper for brake fluid leaks.

When re-installing the brake pads, install the pad with the wear indicator on the inside, as shown. Tighten all bolts to the torque specification recommended in the appropriate vehicle shop manual.

Slide 11



Production Notes:
Open with image A and read VO line 1. Move image A to the left and insert image B.
Read VO line 2. Insert image C. to the right and read VO line 3.
Clear screen. Insert images D. Read VO line 4. Clear screen
Insert image E. Read VO line 5

VO:
When performing the brake service on fixed type calipers, always remove and clean the guide pins and locking retainers using a non-abrasive method. Inspect the pins for deformation or corrosion that would inhibit the pads from moving freely. It is not recommended to grease the pins unless instructed by the shop manual or TSB(s).

Never hang the brake caliper by the brake hose if it is removed.

Remove the pads and clean the pad backing plate and insulators/shims of debris. Never reuse shims on new pads. Inspect the pad friction surface for even wear and pad thickness.

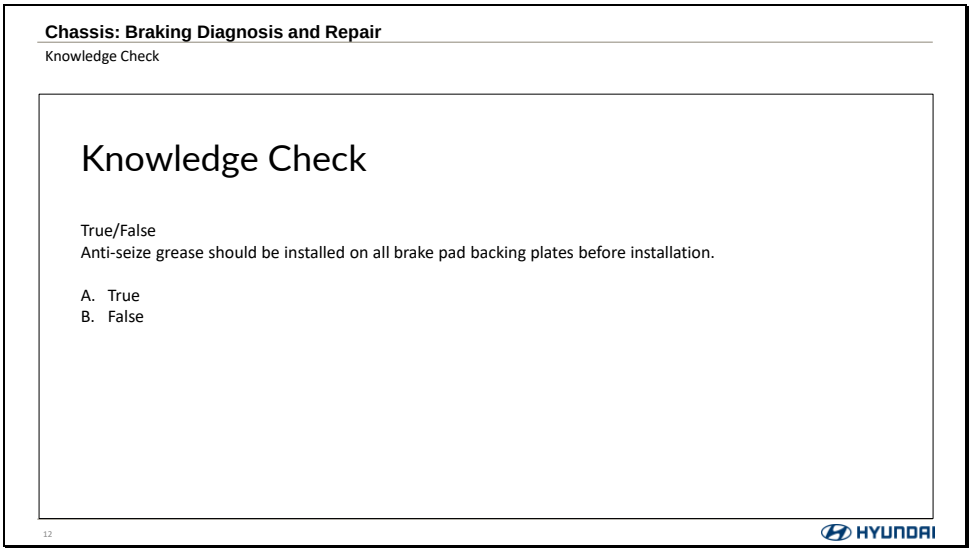
Clean and inspect the pad springs if the pads are reused. Discard damaged springs. Always use the parts included with new pads.

Inspect the caliper for brake fluid leaks from the piston area and the brake line fitting.

Install the brake pads, springs, guide pins, and locking retainers.

Internal Information - Polestar

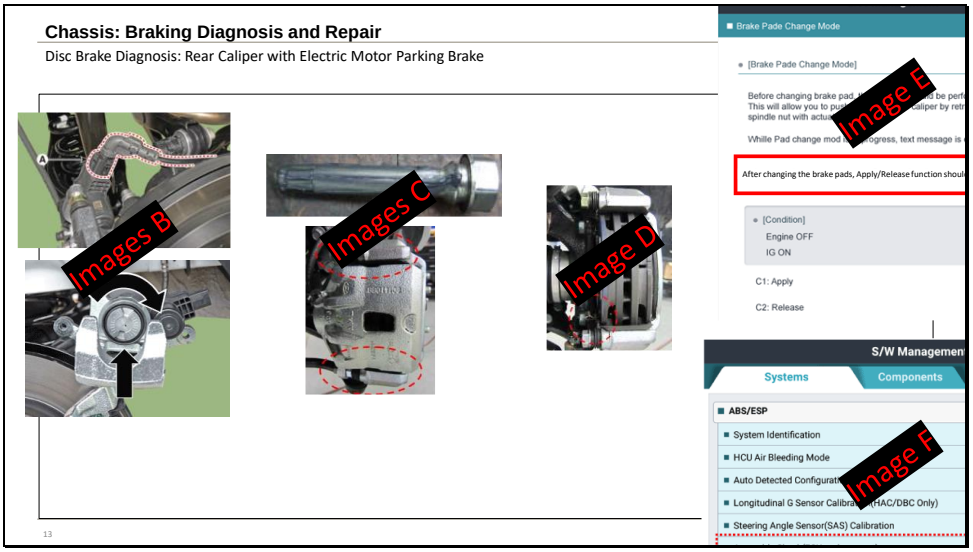
Slide 12



Production Notes:
Answer – B: False

VO:
Now let's see what you've learned. Complete this Knowledge Check question before moving on to the next section.

Slide 13



Production Notes*: (I would love some actual images of the GDS-M screen. These charts are not as clear as I think they could be)*
Open with image A full screen. Read VO line 1. Clear screen
Open images B side by side. Read VO line 2. Clear screen
Open Images C side by side. Read Vo line 3. Clear screen.
Insert image D. Read VO line 4.
Reduce the size of image D and move to the left of screen. Insert image E to the right. Read VO line 5.
Remove image E and insert image F. Read VO line 6.

VO:
When servicing rear brakes on vehicles equipped with an Electronic Parking Brake (EPB), the **Brake Pad Change Mode** function must be performed first to release the rear calipers before the caliper is removed. This can be done using the GDS-M.

Next, disconnect the **Electronic Parking Brake actuator** (A) before removing the caliper from the bracket. If replacing the pads, retract the caliper piston by rotating it using the correct tool.

Remove, clean, and inspect the caliper slide pins and boots. Use a caliper slide pin recommended lubricant. Do not over-lubricate the slide pins. If too much lubricant is applied to the slide pins, air can be trapped at the end of the pin creating an “air spring”. This condition causes the caliper/pad assembly to drag on the rotor. When re-installing the brake pads, install the pad with the wear indicator on the inside.

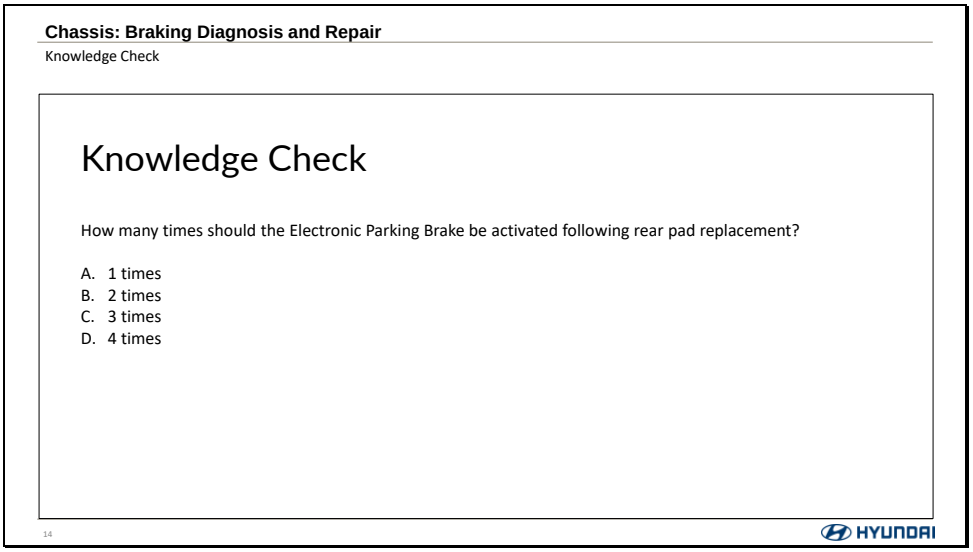
Replace and reinstall parts in reverse order of removal. Tighten all bolts to the torque specification recommended in the appropriate vehicle shop manual.

Following the replacement of parts, use the Brake Pad Change Mode in the GDS-M to apply and release the Electronic Parking Brake. Repeat the apply/release function three times.

After completing the Brake Pad Change Mode, perform the Assembly Check function. This function should be performed after replacing the rear pads, caliper, Electronic Parking Brake actuator, or Electronic Parking Brake Electronic Control Module.

Internal Information - Polestar

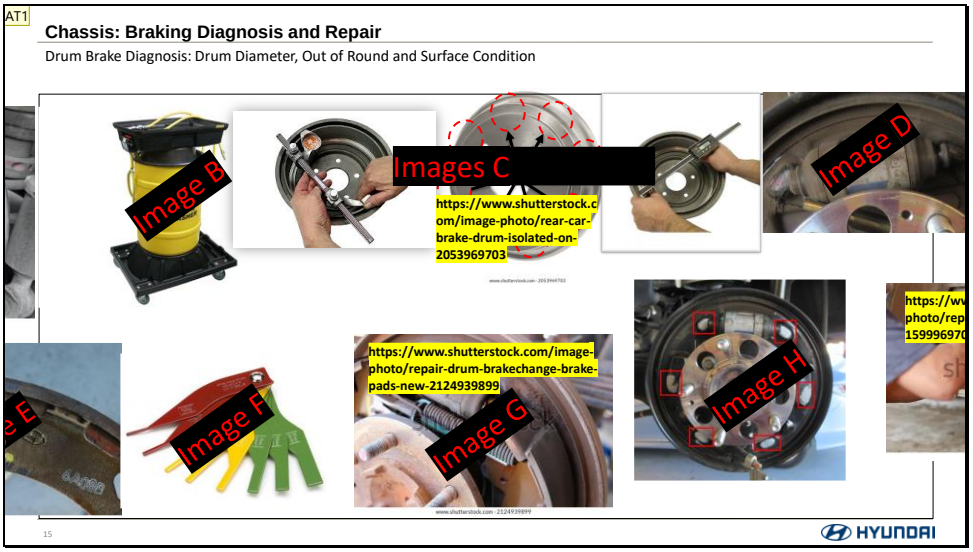
Slide 14



Production Notes:
Answer – C: 3 Times

VO:
Now let's see what you've learned. Complete this Knowledge Check question before moving on to the next section.

Slide 15



Production Notes:
Open with images A and B. Read VO line 1. Clear images.
Open images C. Insert red circles and marking arrows as sentence 2 of line 2 is read. Read Vo line 2.
Clear screen. Insert image D and Read VO line 3.
Clear screen. Insert images E and F and read line 4 of VO.
Clear screen and insert image G. Read VO line 5.
Clear screen and insert image H. Read VO line 6.
Clear screen and insert image I. Read VO line 7.

VO:
When inspecting and measuring the drum brake system, start by cleaning all drum brake assembly components to inspect for wear, damage, and leaks. This can be done using a brake wash or brake parts cleaner. Be sure to measure the inside diameter and runout of the drum *before* and *after* machining to ensure the brake rotor is within specification. When measuring the drum, remove all surface contamination and corrosion to ensure an accurate measurement.

The inside diameter of the drum should be measured using a drum gauge or vernier caliper. The drum should be measured for total inside diameter and out of round by measuring it in multiple locations, as seen here.

Internal Information - Polestar

Next, carefully inspect the wheel cylinder for leaks. Debris on the wheel cylinder and boots is not an immediate indication that the wheel cylinder is leaking. Wheel cylinder inspection will be covered in greater detail later in this training.

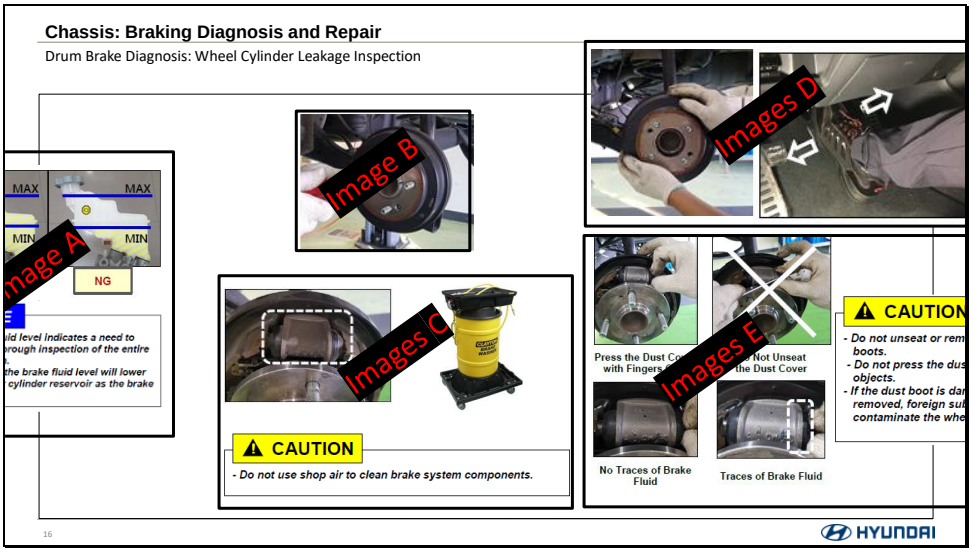
Following the wheel cylinder inspection, inspect the shoe lining for even wear and thickness. The brake lining measuring tool can be used in this process. Refer to the applicable vehicle shop manual for service limits. Be sure to also look for common brake lining damage conditions as mentioned earlier in this training.

Inspect the brake shoe springs. If any of the springs are broken, replace all brake shoe springs. It is also recommended to replace all shoe springs during new brake shoe replacement.

Clean and inspect the backing plate. Refer to the applicable vehicle shop manual for locations regarding where to apply the Copper Anti-Seize Brake Lube to the contact/sliding points between the shoes and brake components.

Reverse the procedure and install all components. The drum brake assembly should be checked for the proper drum-to-shoe running clearance and adjusted if necessary. Reinstall the tire and tighten all bolts to the torque specification recommended in the appropriate vehicle shop manual.

Slide 16



Production Notes:
Open with images A and read VO line 1.
Close images A and insert image B. Read VO line 2.
Close image B and insert images C. Read Vo line 3. Insert CAUTION text when mentioned.
Clear screen. Insert images D. Read VO line 4.
Clear screen and insert images E along with CAUTION. Begin reading VO line 5 and highlight or pop out each of the 4 images to a larger size as they are mentioned.
VO:
When inspecting the brake system, be sure to follow the recommended service procedure. Check the brake fluid level and condition in the brake master cylinder. A low brake fluid level indicates a need to perform a thorough inspection of the entire brake system. Please note that the brake fluid level will lower in the master cylinder reservoir as the brake linings wear.

Raise the vehicle. Remove the wheels and brake drum retaining screws from each brake drum. Remove the brake drums

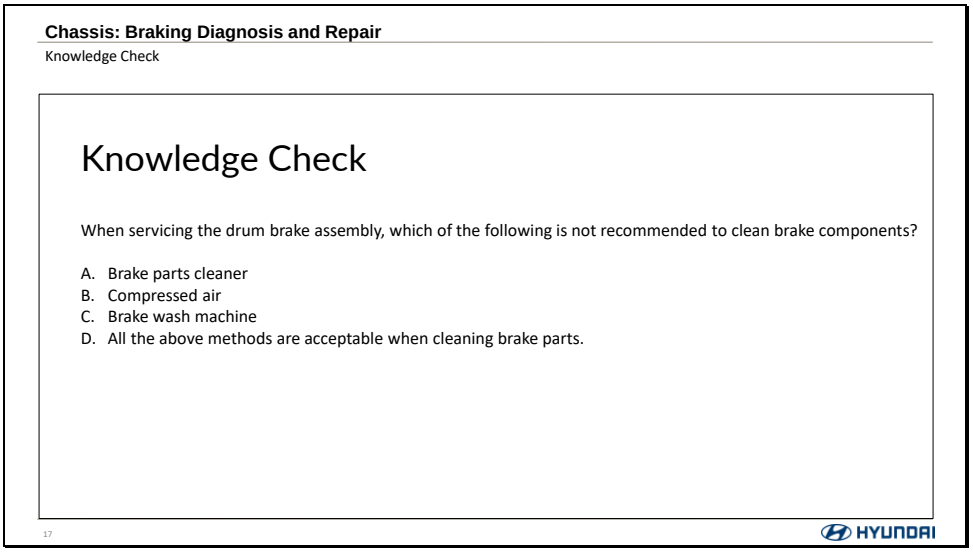
Inspect the wheel cylinders for brake fluid leaks. If there are no signs of possible leakage around the wheel cylinder, the drum brake can be reassembled. If there are signs of possible leakage around the wheel cylinder, clean the wheel cylinder surface using brake parts cleaner or a brake wash machine. Never use shop air to clean brake system components.

Internal Information - Polestar

Reinstall the brake drum. Depress the brake pedal and hold for five seconds. Release the brake pedal for five seconds. Repeat this process of depressing and releasing the brake pedal ten to twenty times.

Remove the brake drum. Check the wheel cylinders for brake fluid leaks by **pressing the dust boot** with your fingers. Take care **not to unseat the dust** cover. Also, do not press the dust boot with sharp objects. If the dust boot is damaged or removed, foreign substances may contaminate the wheel cylinder bore. If **no brake fluid is present** around the dust boot, the wheel cylinder is not leaking and should not be replaced. If there is **brake fluid present** around the dust boot, the wheel cylinder is leaking and should be replaced.

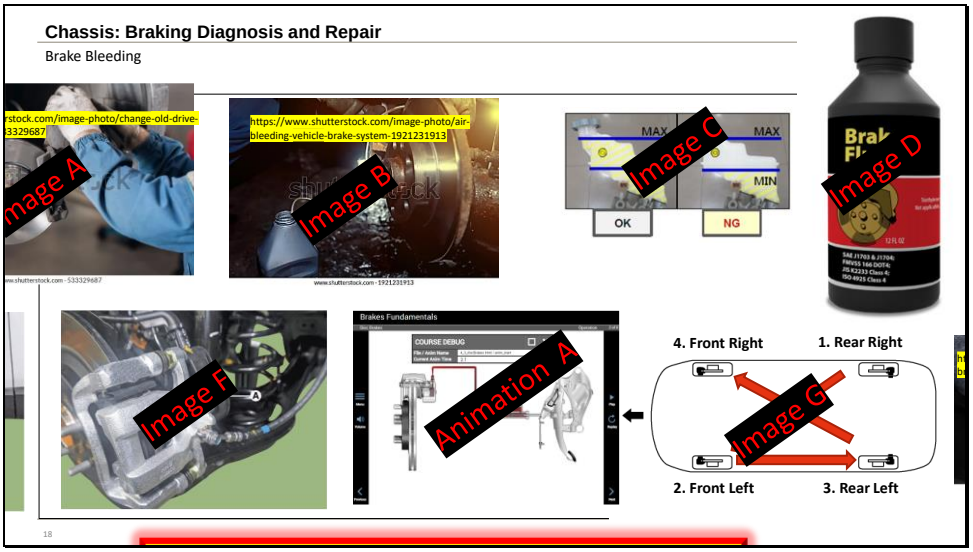
Slide 17



Production Notes:
Answer – B: Compressed Air

VO:
Now let's see what you've learned. Complete this Knowledge Check question before moving on to the next section.

Slide 18



Production Notes:
Open with image A. Read Vo line 1. Close image.
Open image B. Read VO line 2. Close image.
Open Image C and D. Read VO line 3. Close image.
Open images E and F . Read VO line 4.
Remove image E and move image F to the left. Insert animation A to the right. Read VO. Line 5 as animation is playing. Clear screen
Insert image G and Read VO line 6 while highlighting the indicated corners as they are mentioned in the VO.
Slide image G to the left and insert image H. Read VO line 7.
Place Text box **Caution** image on-screen front and center. Read VO line 8

VO:
Any time that brake system hydraulic components need to be removed for repair or replacement, such as caliper replacement, the brake system is left open for the intrusion of air into the system. This air must be removed through a process called bleeding the system. Bleeding the brakes is the process of pushing fluid through a hydraulic brake system to ensure all air bubbles are removed.

This procedure is to be performed by two people. The main technician bleeds the system by manually opening and closing the bleed screw and detecting air coming out of the brake lines. The assistant technician is inside of the vehicle and oversees operating the brake pedal and, in some newer model vehicles, controls functions with a scan tool.

To begin the process, make sure the brake fluid reservoir is at the MAX upper level. Note that the master cylinder reservoir must be checked after every bleeding of each caliper and should be filled as required. Also, always used approved DOT 3 or DOT 4 brake fluids.

Remove the wheels and tires. The main technician connects a clear hose to the right rear brake bleeder and then signals the assistant to depress the brake pedal.

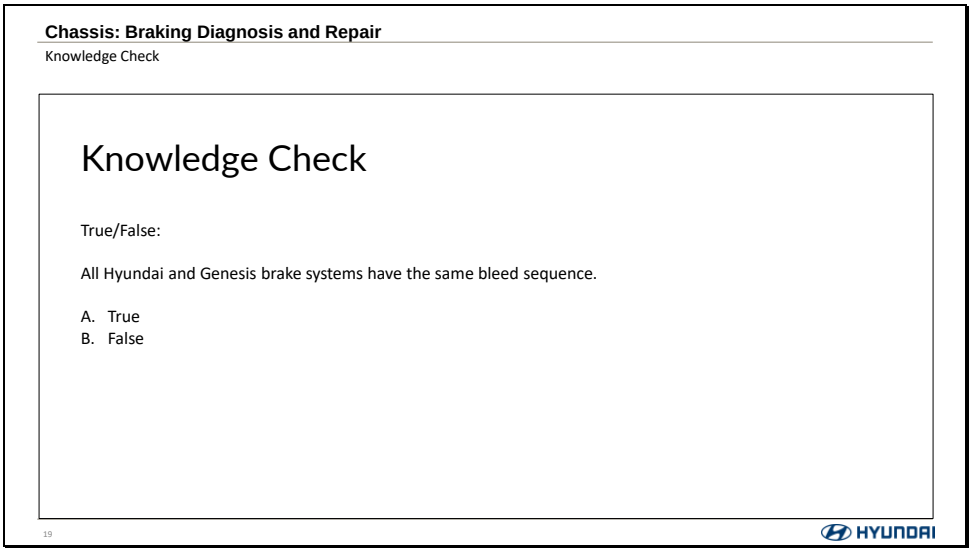
The assistant then pumps the pedal two times with normal brake force ending with the pedal depressed. While the assistant depresses the pedal, the main technician loosens the caliper bleeder screw a quarter turn to remove trapped air from the system and then fastens it again. The bleeder may only be open for a second or two. If air is still present in the fluid, repeat the procedure on the same caliper until a steady stream of brake fluid is present.

Repeat the procedure for each wheel in this sequence:
1. Rear Right
2. Front Left
3. Rear Left
4. Front Right

Once all corners of the vehicle have been bled, check the brake pedal height and be sure to test drive the vehicle to verify the repair.

Caution! Always used published service procedures whenever performing brake bleeding procedures. Exact procedures will vary depending on system configuration.

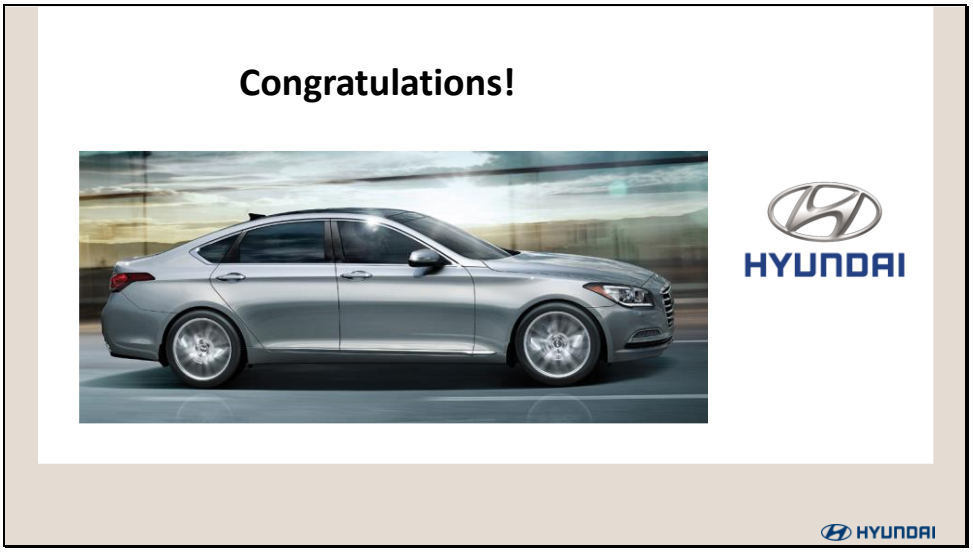
Slide 19



Production Notes:
Answer – B: False

VO:
Now let's see what you've learned. Complete this Knowledge Check question before moving on to the next section.

Slide 20



Production Notes: Final slide
Use image as background

VO:
Congratulations! You have completed the Chassis: Braking Diagnosis and Repair web-based training course. Please continue to the next course when you're ready.