

THE HIDDEN LINK BETWEEN WINDSHIELDS AND ROAD SAFETY



The role of advanced driver assistance systems (ADAS) in Canada's quest for the world's safest roads



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EXECUTIVE SUMMARY

Canada has declared that it wants to make its roads the safest in the world.¹

To help achieve this goal, all stakeholders in road safety must continue to share their best thinking. For example, the Canadian Council of Motor Transport Administrators (CCMTA) cites automated vehicles and their proper maintenance as key factors that can improve road safety.²

The mass commercialization of fully automated vehicles in Canada is still several years away. Yet the gradual integration of highly innovative technologies into this country's cars is a very promising development in road safety.

The number of vehicles with advanced driver assistance systems (ADAS) is growing. According to research firm SBD Automotive, ADAS are already in about 13% of all vehicles on the road in Canada and are projected to reach 15%, or 3.7 million vehicles, by the end of 2019.³

One of the central components of ADAS is the forward-facing digital camera—also known as the image processing module (IPM)—located on the windshield behind the rear-view mirror. With a properly calibrated camera, ADAS can help avoid dangerous traffic situations if a driver's awareness or reaction time falters. Yet, even a slight misalignment in the camera can impact the collision avoidance performance of ADAS.

Only 28% of Canadian drivers know that their digital camera must be calibrated when their windshield is replaced.⁴



According to a recent survey, 72% of Canadian drivers are not aware that the forward-facing digital camera (IPM) must be calibrated when a windshield is replaced. Half of all Canadian drivers have little to no familiarity with ADAS.⁵ Yet no DIYers, few independent garages, and not all original equipment manufacturer (OEM) dealerships are trained or equipped to handle these calibrations.

That's worrying, when the latest research shows that ADAS technologies have the potential to avoid up to 36% of all road crashes, up to 35% of injuries from road accidents, and up to 28% of deaths in passenger vehicles.⁶

As the country's industry leader in auto glass service, Belron Canada is ideally positioned to discuss the hidden link between windshields and road safety. Through this white paper, Belron Canada aims to offer road safety stakeholders a deeper understanding of ADAS functions and why it is essential to properly calibrate the windshield forward-facing digital camera.

Belron Canada is proud to be a key partner in Canada's quest to have the safest roads in the world.

Sylvie Leduc

Vice-President, Brand & Customer Promise
Belron Canada

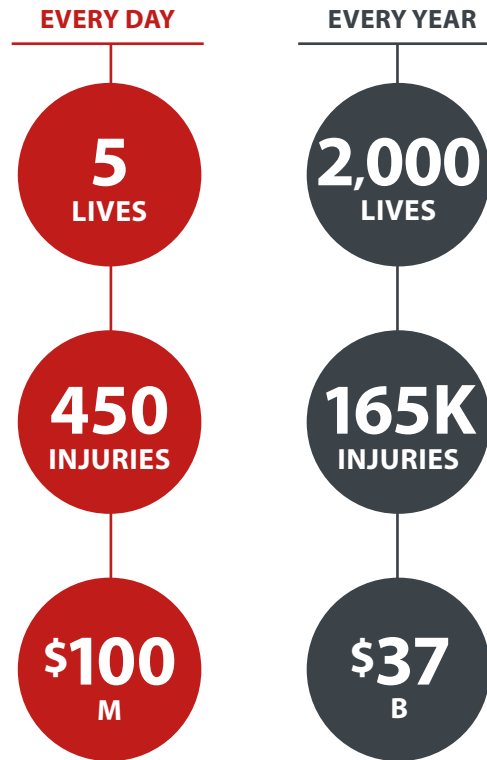
THE CHALLENGE: ROAD SAFETY IN CANADA

You—or someone you know—has likely been affected by a motor vehicle accident.

Each year in Canada, about 2,000 people are killed and 165,000 seriously injured on Canada’s roads.⁷ The hard cost to society is \$37 billion annually (2.2% of the Canadian GDP).⁸

Every single day, traffic accidents cost Canadians more than 5 lives, 450 serious injuries, and \$100 million.

By any measure, these are staggering numbers.



A recent study by the Senate of Canada titled *Driving Change: Technology and the Future of the Automated Vehicle* confirms that “road traffic collisions remain the leading cause of preventable deaths for children and teenagers and exert a heavy financial and emotional toll on many families across the country.”⁹

Today nearly all (94%) traffic accidents in Canada are blamed on driver error.¹⁰ The most significant errors are distracted driving, speeding and impaired driving.

While the number of car accidents in Canada has been declining fairly steadily for 40 years, fatalities have begun to trend up again, increasing from 1,848 in 2014 to 1,898 in 2016.¹¹

Distracted driving may well be the cause.

THE SOLUTION: BETTER SAFETY MEASURES IN CARS

Since the 1960s, Canada has seen more and more safety measures introduced in vehicles. Some of the innovations introduced over the past 50 years include:¹²

- Shatterproof windshield glass (1960s)
- Mandatory seatbelts (1970s)
- ABS brakes and front airbags (1980s)
- Side air bags (1990s)
- Adaptive cruise control (2000s)

Since 2000, many safety features based on digital electronics have been introduced, including blind spot monitoring, lane departure warning and forward automatic emergency braking.

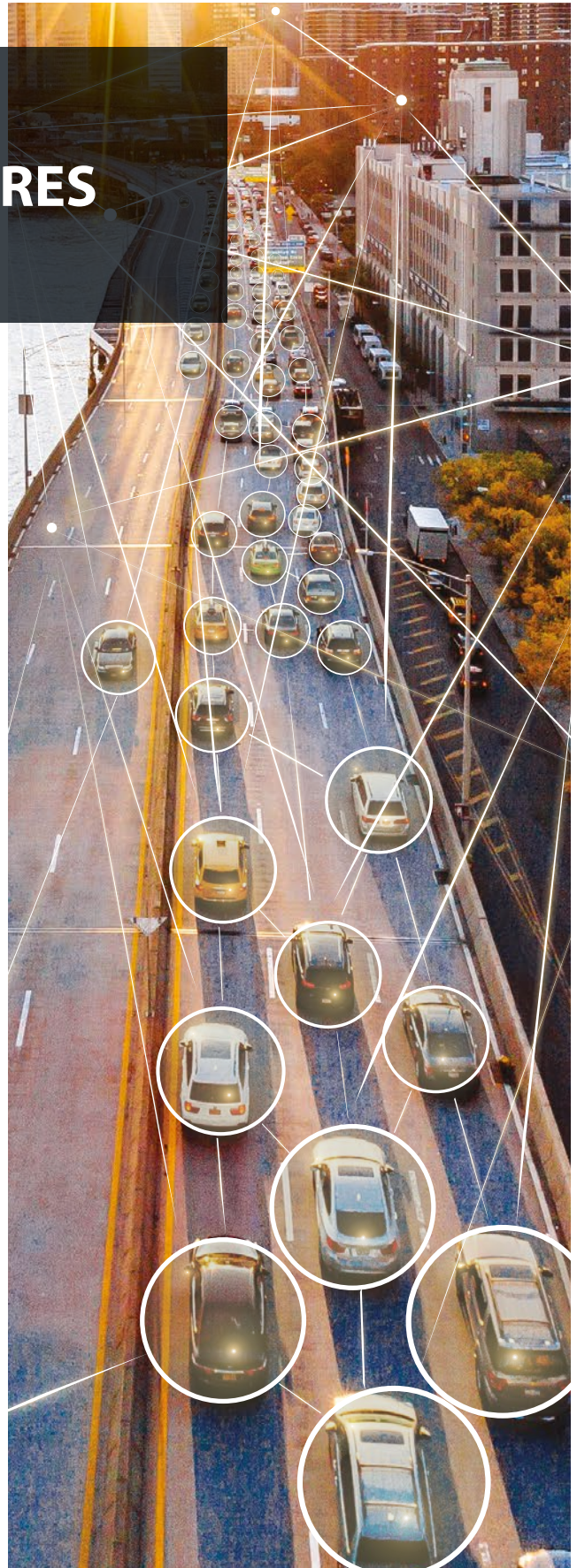
As we approach 2020, these advanced driver assistance system (ADAS) features will become more and more commonplace.

In addition, Canada adopted a *Vision Zero* policy in 2001. This groundbreaking approach to road safety, first introduced in Sweden in 1997, argues that loss of human life for mobility is unacceptable.

It proposes that, where human failings exist, other systems must provide appropriate safeguards, chiefly through road design and infrastructure, vehicle technology and law enforcement.¹³

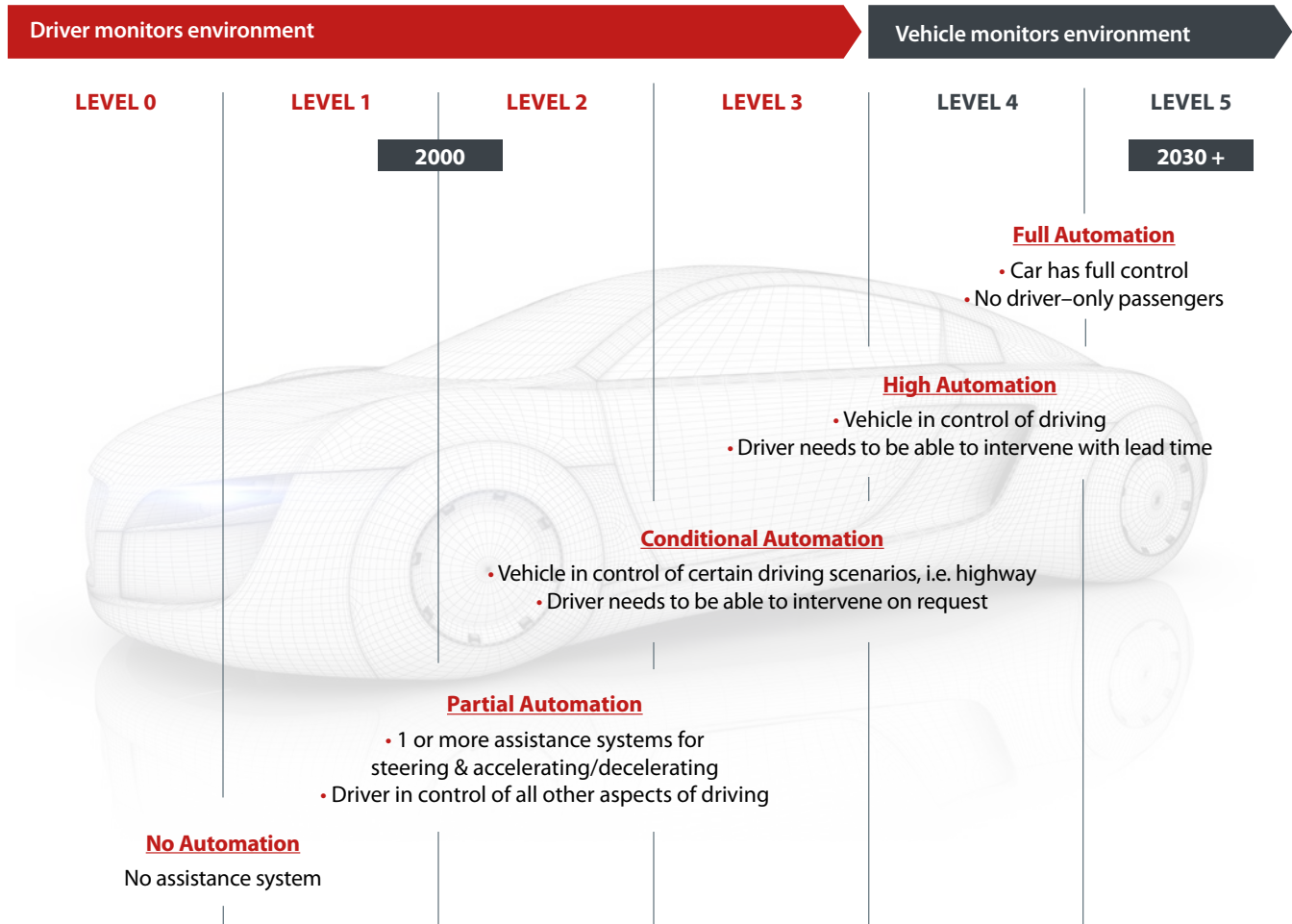
ADAS features could prevent 28% of all deaths involving passenger vehicles¹⁴

For overcoming the key human failing of distracted driving, ADAS technology offers extraordinary promise.



Not all autonomous vehicles are created equal. In fact, the Society of Automotive Engineers (SAE) has defined five discrete levels of vehicle autonomy, as shown in the following diagram.

The advanced driver assistance systems (ADAS) currently available in a growing number of passenger vehicles in North America meet the criteria for Level 2 autonomy.



A recent report by the AAA Foundation for Traffic Safety estimated that a few select ADAS features—forward automatic emergency braking, forward collision warning, lane departure warning and lane keeping assistance—could prevent 28% of all deaths involving passenger vehicles.¹⁵

The more ADAS-equipped cars we have on the roads, the more likely we are to reach this number.

We're making steady progress.

In 2019, an estimated one-third of all new cars sold in Canada (737,000) will be equipped with a forward-facing digital camera (IPM). This means that 3.7 million cars will have this technology by the end of 2019. That's nearly 15% of all the vehicles on the road in Canada.¹⁶

The forward-facing digital camera (IPM) is one of the primary pieces of equipment that supports key ADAS features such as lane departure warning and forward automatic emergency braking.

While the advantages of ADAS may seem obvious, these features are still new. A recent survey showed that 51% of Canadian drivers have little or no familiarity with these systems.¹⁷

Many drivers don't understand their limitations: they may rely on the ADAS features too much and stop looking over their shoulder as they drive.¹⁸

In any case, every stakeholder in road safety must do everything possible to ensure that all drivers are properly educated about ADAS features and benefits.


On the other hand, a significant number of drivers turn off these features. In the UK, almost 6 out of 10 ADAS owners turn off the forward collision warning and lane keeping assistance functions.¹⁹

Many drivers were never offered any information or training by their dealers when they bought their vehicles.

Clearly, better education is needed to fully reap the benefits that these innovative safety technologies hold.

You could argue that under the *Vision Zero* approach, law enforcement has a certain responsibility to educate drivers and to apply any legislated penalties for disabling recognized safety systems.

There is a precedent, since this is already the case with airbags. For example, under section 205.2(2) of Manitoba's *Highway Traffic Act* "no person shall disable or interfere with the proper functioning of an air bag in a motor vehicle" under penalty of a fine up to \$5,000.²⁰



Clearly, better education is needed to reap the full benefits that these innovative safety technologies hold.

KEEPING ADAS FUNCTIONS WORKING PROPERLY

More education is needed on a related front as well.

Not many drivers realize that most ADAS features rely on data from the forward-facing digital camera (IPM) located behind their rear-view mirror.

Even fewer know that this camera requires calibration whenever any damage happens to the windshield that can obscure the camera's view, offset the camera's correct seated position or inflict any damage to the camera itself.

According to a national survey conducted by Ipsos in February 2019, 72% of Canadian drivers are not aware that the ADAS forward-facing digital camera must be calibrated when a windshield is replaced.²¹

Each vehicle manufacturer sets different calibration requirements. This reinforces the need for well-trained technicians and top-quality calibration tools and equipment.

In accordance with manufacturer requirements, there are currently three protocols used to calibrate a camera:

STATIC CALIBRATION

Uses fixed devices installed around the vehicle and aligned to targets via laser while the vehicle is parked. The targets' distance, height, pitch and yaw are carefully adjusted, while the level of the gas tank, tire pressure and the trunk load of the vehicle are also checked.

Depending on the manufacturer, model and trim, a static calibration can take up to a few hours to complete.

DYNAMIC CALIBRATION

Involves driving the vehicle on roadways using special diagnostic handheld computer equipment that the technician can monitor in real time.

This requires suitable road conditions, clearly visible lane markings and no direct sunlight. Sometimes two technicians are required for this process.

UNIVERSAL CALIBRATION

Combines both static and dynamic calibration.

Both calibrations must be completed within a prescribed timeframe, which can vary from one manufacturer to another.

This entire process may take up to a few hours to complete and may require two technicians.



An overlooked or poorly calibrated forward-facing camera poses clear risks to the safety of drivers, passengers, pedestrians and other roadway users. For ADAS features to work correctly, the camera must be calibrated properly.

THE INDUSTRY IS ILL-PREPARED

Unfortunately, Canada has been labelled “ill-prepared” for the arrival of this new technology. The Senate report cited above concludes that “Canada must start preparing now to ensure that the country is ready for this period of technological change.”²²

For example, many Canadians still rely on a large number of service providers that will soon prove to be inadequate in this new era. These include DIYers, independent garages or mechanics and original equipment manufacturer (OEM) dealerships.



As shown in Table 1, the first requirement for proper ADAS service is **basic awareness of the need for forward-facing digital camera (IPM) calibration**. Without that, nothing else can happen.

Local surveys of service providers have revealed that not everyone is aware that replacing a windshield triggers the need for camera calibration. Canada is not alone. In a study issued in Fall 2018, IIHS revealed that some dealerships were not even aware of camera calibration requirements.²³

Table 1: How Prepared are Canada’s Service Providers to Do Forward-facing Digital Camera (IPM) Calibration

Type of Service Provider	Awareness	Tools and Resources	Training and Experience
DIYer	?	No	No
Independent garage or mechanic	?	Not likely	Not likely
OEM dealership	Growing	?	?

Sources: Belron Canada, Insurance Institute for Highway Safety (IIHS), *The Globe and Mail*



The second requirement is **proper tools and resources**. This includes access to all manufacturer standards, technical bulletins and calibration procedures, software, targets, and facilities needed to complete a precise precalibration diagnostic and the actual calibration.

This is a significant investment, especially since there is near-zero standardization between manufacturers.

In a research document issued by the American Automobile Association (AAA) in January 2019, the Association identified up to 20 different names among 34 manufacturers for the same ADAS feature and a variety of different calibration procedures.²⁴

In Canada alone, over 2,000 different brand, model, trim and year combinations of vehicles on Canada’s roads already feature ADAS technologies.

Gathering all the resources to deal with such a complex calibration environment can easily break the six-figure mark. For an independent mechanic, that expense is hard to justify.



The third requirement is enough **training** to gain basic familiarity with the calibration process, followed by enough repeat **experience** to gain confidence and learn the best practices involved.

For example, technicians may be trained on a popular line of vehicles, but their outlet may not do calibrations often enough for them to get much practice.

Let's look at each type of service provider in more detail, according to the three criteria of awareness, tools and resources, and training and experience.



THE DO-IT-YOURSELFER (DIYer)

As the name suggests, these individuals usually perform vehicle repairs and maintenance in their home garage. Windshield replacements cannot and should not be performed by a DIYer.

This entire scenario is best summed up by a recent *Globe and Mail* story that notes, "Do-it-yourself repairs can pose significant public safety issues due to the complexity of the modern vehicle. The days of DIY repairs are over."²⁵

THE INDEPENDENT GARAGE OR MECHANIC

An independent garage will often focus on the most popular makes and models and thrive on routine maintenance such as oil changes and brake jobs.

When it comes to replacing a windshield and calibrating a forward-facing digital camera (IPM), any independent garage runs into the same obstacles as the DIYer. They may not be aware of the need for calibration. And the investment in equipment and training will likely never pay off with the low demand for this type of service.

Some independent mechanics replace windshields, and a limited number repair windshields. Most often, these jobs are entrusted to specialized glass shops.

When it comes to digital camera (IPM) calibration, there's no question that they need to refer that process to a trained, experienced technician using professional calibration tools.

As an example, a poorly aligned camera will often generate continuous fault codes such as "Forward Automatic Emergency Braking Unavailable." As a result, the customer may bring the vehicle back again and again, a frustrating experience for both customer and mechanic, not to mention the associated safety issues.

Forward automatic emergency braking (FAEB) begins when an object is detected within a certain distance from the vehicle. If the forward-facing digital camera (IPM) is even one degree out of alignment, this tiny offset at the windshield grows to nearly a foot at 100 yards.

That is a big enough "blind spot" for the forward-facing digital camera (IPM) to fail to "see" a child or pedestrian.

In the worst case, someone could be seriously injured or killed because the windshield replacement and camera calibration weren't done with the appropriate equipment and skills.

Any independent garage runs into the same obstacles as the DIYer.



Car dealerships generally encourage customers to return for service, promising better-quality OEM parts and better-trained mechanics.

Often, glass-related repairs and replacements are outsourced by OEM dealerships to an auto glass specialist for three main reasons:

Deferred liabilities

Windshield glass is easy to break and requires care from someone who routinely handles it. The third-party specialist assumes any warranty work and costs involved with reworking vehicles.

Profit

The dealer charges the payer (customer or insurance company) a markup over the third-party invoice, ensuring the dealer a profit for next to no effort.

Time

For routine maintenance, most customers expect a rapid turnaround. But anyone who needs a new windshield is probably prepared to wait a day or two. The dealer is happy to outsource windshield replacement and forward-facing digital camera (IPM) calibration to reduce the service space tied up for these tasks.

Knowing all this, let's look at those two key claims made by OEM dealers. First, do dealers really deliver better-quality OEM parts?

Not according to a recent advisory from the Insurance Institute for Highway Safety (IIHS), which found no significant differences between OEM and aftermarket windshields after performing tests on vehicles from eight different manufacturers.

This conclusion was based on the following six criteria:²⁶

Forward collision warning/forward automatic emergency braking—real-world tests of forward collision warning and forward automatic emergency braking

Laser accuracy—the deviation of a laser pointed at a target 8 m (26.25 ft) away

Lane departure warning—real-world tests of lane departure warning

Mounting—how well the brackets provided secure all hardware

Precision measurements—glass characteristics and mounting feature locations

Refractive index—clarity and transmissivity of glass

Similar results were seen by PMG Technologies, the only laboratory entrusted by Transport Canada to do vehicle compliance testing.

In October 2018, the lab systematically tested two 2017 vehicles fitted with OEM and original equipment equivalent (OEE) windshields.

After 90 calibration tests on each vehicle, researchers concluded that both windshields generated similar—often identical—performance for forward automatic emergency braking and lane keeping assistance.

It is well known in the industry that many OEM and OEE windshields are actually made in the same factories using the same equipment and standards, then packaged and labelled with different branding.

So the claim that OEM dealers offer superior windshields doesn't hold water.

Second, do OEM dealerships really provide better-trained mechanics who deliver better service?

In terms of forward-facing digital camera (IPM) calibrations, the same IIHS report notes that most of the dealers they interviewed exhibit a "spotty pattern of knowledge, training and equipment."²⁷ And their prices for this service were not standardized.

On this score, many OEM dealerships are subject to the same failings as DIYers and independent garages.

The fact is, none of these three service options are prepared to deal with the precise calibration of forward-facing digital cameras (IPMs) that power many ADAS features.



None of these three service options are prepared to deal with the precise calibration of the digital cameras that power many ADAS features

THE SOLUTION IS ALREADY HERE




Since all three service options discussed above are not adequate for forward-facing digital camera (IPM) calibration, there is a clear need for a specialized provider that focuses on that service. Fortunately, there is already a type of service provider in Canada that is well prepared to take on this role.

As shown in Table 2, a fourth type of service provider for windshield replacements and forward-facing digital camera (IPM) calibrations is a specialty auto glass outlet. Since auto glass is their business, these outlets are likely well aware of the need for calibration when replacing windshields.

They are also more likely to have the tools and resources available for at least the most popular models, depending on their focus, and they are more likely to have the basic training and frequent experience in calibrations to do a precise job. Moreover, auto glass outlets should be able to guarantee their work and issue calibration certificates.

It is clear that these outlets are far better prepared to handle windshield replacements and forward-facing digital camera (IPM) calibrations than any other service option in Canada.

Table 2: A Better Option for Forward-facing Digital Camera (IPM) Calibration

Type of Service Provider	 Awareness	 Tools and Resources	 Training & Experience
DIYer	?	No	No
Independent garage or mechanic	?	Not likely	Not likely
OEM dealership	Growing	?	?
Specialty auto glass outlet	Likely	Likely	Likely

The largest specialty auto glass service provider in the country is Belron Canada®, which operates such well-known banners as Speedy Glass®, Lebeau Vitres d’autos®, Apple Auto Glass®, Broco Glass® and Duro Vitres d’autos®.

Belron Canada has invested more than \$5 million to equip and train more than 200 service centres to calibrate the forward-facing digital cameras (IPMs) in 96% of their customers’ vehicles.

This includes stocking many hundreds of different windshields and the related mounting hardware, as well as acquiring software and targets for the vast majority of the brands offering at least one ADAS-equipped vehicle model in Canada.



Sources: Belron Canada, Insurance Institute for Highway Safety (IIHS), *The Globe and Mail*



Belron Canada has invested more than \$5 million to equip more than 200 service centres to do ADAS digital camera calibrations

In some instances, to yield truly professional calibrations, service centres' floors must be levelled, and ambient lighting adjusted. Garage bays must sometimes be reconfigured to allow for sufficient distance for the installation of calibration targets, which often must be positioned a few metres away from the car.

Belron Canada provides a warranty and a certificate for each calibration executed successfully within its network, over and above an added bonus for every customer: an initial diagnostic of the vehicle systems to make sure there are no pre-existing problems with the ADAS features.

Belron Canada gives Canadian drivers and insurers a significant price break.

Replacing a windshield costs five to 10 times more than repairing it. Belron Canada takes a repair-first philosophy that gives Canadian consumers and insurers a significant price break.

That explains why Belron Canada consistently leads the industry in a significant metric, the repair-to-replacement ratio.

Belron Canada is committed to educating drivers and all road safety stakeholders by investing in a nationwide communication initiative and by offering free and engaging materials. These educational materials discuss ADAS features and provide information about the vital need to calibrate the windshield forward-facing digital camera (IPM) for these features to work properly, revealing the hidden link between windshields and road safety.

For all these reasons, Belron Canada is a key stakeholder in the drive to achieve Canada's goal of having the safest roads in the world.

RECOMMENDATIONS

We recommend that each stakeholder in road safety consider the following next steps.

1

Consumer associations: Become a frontline stakeholder in public education by publishing articles and public service announcements about ADAS, the safety benefits for drivers, and the need to ask about windshield forward-facing digital camera (IPM) calibration.

2

Fleet managers: Explore how to control maintenance costs by setting up calibration service contracts with auto glass specialists like Belron Canada. Ask for incentives on insurance costs for professional drivers who maintain proper-functioning ADAS that promote safe driving records.

3

Insurers: Educate and provide incentives for the proper use of ADAS features, such as discounts for safe driving records. Explore national ADAS training certification for service providers. Train adjusters to direct consumers to the appropriate auto glass repair specialists to ensure their safety.

4

Journalists and bloggers: Inform readers about the vital need to calibrate the forward-facing digital camera (IPM) after replacing their windshield. Strive to make ADAS features as well understood as current mainstream features.

5

Law enforcement agencies: Be prepared to enforce any new regulations regarding ADAS. Support national ADAS training certification for service providers.

6

OEM dealerships: Offer training on all ADAS features to all buyers. Inform your buyers of the importance of the forward-facing digital camera (IPM). Manufacturers should agree to ADAS-feature naming uniformity and clear fact-based sustained requirements for camera calibrations.

7

Policy makers: Dedicate the necessary diligence to understanding how forward-facing digital camera (IPM) calibration can affect road safety. Undertake public safety education campaigns to reach all Canadians and consider these extensions to existing regulations:

- Discourage disabling ADAS features through appropriate fines
- Prohibit any amateur windshield replacement with forward-facing digital camera (IPM)
- Require professional calibration services after any windshield replacement
- Introduce calibration standards and training requirements for technicians

CONCLUSIONS

The automotive industry is going through rapid changes. Car makers must be commended for their many innovations to help improve safety on our roads, especially the latest developments in ADAS.

More than 13% of the cars on the road in Canada already operate at Autonomous Level 2. With automated vehicle technology already here, all stakeholders in road safety need to rapidly adjust as the new era unfolds before our eyes. In particular, we must all understand the hidden link between windshields and road safety.

ADAS operate through sophisticated forward-facing digital cameras (IPMs) that must remain precisely calibrated. No amateur or improper service can be tolerated. The risk to human lives and the enormous toll that accidents take on families and society are unacceptable.

The Canadian government is seeking to achieve global leadership in road safety. Fortunately, a key part of the solution is already in place: a nationwide network of auto glass specialists that can expertly handle windshield forward-facing digital camera (IPM) calibration: **Belron Canada**.

All stakeholders in road safety must understand the hidden link between windshields and road safety



ABOUT BELRON CANADA



Belron Canada's pursuit of excellence in windshield repair, replacement and forward-facing digital camera (IPM) calibration is relentless. Belron Canada is part of Belron, a global leader in auto glass repair and replacement.

Somewhere in the world, Belron technicians complete 1 such repair every minute, 30 by the time you have read this document, 11,000 per week.

Founded in 1897, Belron has been in the glass business for over 120 years. Recently, Belron Canada invested \$5 million to ensure precise ADAS calibration methods and processes from coast to coast.

This investment prepared Belron Canada's highly trained technicians to work on more than 2,000 vehicle makes, models and trim lines.

Belron ensures that all technicians around the world use the best tested and patented tools, the same methods, the same training and the same best practices. This standardized operational control has become known as "The Belron Way of Fitting."

Belron even challenges its technicians once a year to a global glass repair competition. "The Best of Belron" is a multi-day event where each country selects its best technicians to compete in all aspects of technical work. In 2018, Canada's own Ryan Adams placed second.

Belron invests \$10 million in this global challenge, inspiring the best in all those who participate. Combined with the "Belron Way of Fitting," this challenge helps the company promote safety and create peace of mind for practically all automotive consumers, anywhere in the world. As proof, more than 83% of Belron Canada's customers would recommend its services to their friends.

To find out more about how Belron Canada can help you contribute to safer roads in Canada, please contact Nadine Hoduc (Marketing Director, Belron Canada) at nhoduc@belroncanada.com.

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APPENDIX A: ADAS COMPONENTS AND FUNCTIONS

This appendix provides a brief high-level definition of all the main ADAS features currently available on late-model cars.

Many popular vehicle manufacturers offer ADAS features with their vehicles such as blind spot monitoring, blind spot assistance, lane departure warning, lane keeping assistance, forward collision warning, rear cross traffic warning, traffic sign recognition, driver condition monitoring, forward automatic emergency braking, intelligent emergency braking, adaptive cruise control and parking assistance.

In all cases, ADAS features get information from radars, lidars, sensors and digital cameras (IPMs). This data controls the operation of two primary vehicle systems: braking and steering. The following description of components represents the hierarchy of modules that are responsible for all levels of ADAS functionality in these systems.

BRAKE CONTROLS

- Image processing module (IPM)
- Anti-lock braking system (ABS) control module
- Hydraulic control unit (HCU)
- Front right, front left, rear right, rear left ABS wheel speed sensors
- Powertrain control module (PCM)
- Adaptive speed control module (ASCM)
- Body control module (BCM)
- Instrument cluster (IC)
- Heads-up display (HUD)
- Clockspring (CLKSPG), steering angle sensor (SAS)

The ADAS features that fall under the auspices of braking controls are forward automatic emergency braking (FAEB) and intelligent emergency braking (IEB) (with adaptive cruise control activated).

Both FAEB and IEB utilize data collected from the IPM to apply braking pressure when a collision with a vehicle or pedestrian is determined to be “imminent.”

While impact energy is reduced with these features activated, collision avoidance is also noted as avoidable in some circumstances. Neither of these features will work correctly if any visual occlusions or misalignments are present with the IPM.

STEERING CONTROLS

- Image processing module (IPM)
- Power steering control module (PSCM)
- Instrument cluster (IC)
- Steering wheel module (SWM)
- Parking aid control module (PACM)
- Body control module (BCM)
- Powertrain control module (PCM)
- Anti-lock braking system (ABS) control module
- Transmission control module (TCM)
- Torque sensor

The ADAS features that fall under the auspices of steering controls are blind spot assistance and lane keeping assistance.

Blind spot assistance will apply a corrective input to the steering if an object is detected in the direction of lateral travel regardless of lane change signal deployment. In other words, even if the driver intends to change lanes, uses the directional signal and doesn't see an approaching vehicle, the system will offer corrective steering input.

On the other hand, lane keeping assistance will apply corrective input to steering if unintentional drift out of the vehicle's travel lane is detected.

While impacts are intended to be avoided with both of these features when activated, obstructions to the IPM will severely impair the system's performance.

5 most widespread camera-related features



Forward collision warning (FCW)



Forward automatic emergency braking (FAEB)



Lane departure warning (LDW)



Lane keeping assistance (LKA)



Adaptive cruise control (ACC)

Lastly, the previously mentioned remaining ADAS features fall under the auspices of more generalized collision avoidance systems or driver aids.

Features such as blind spot monitoring, lane departure warning, forward collision warning and rear cross traffic warning are all audio-visual in nature with no corrective action taken by the vehicle's automatic systems; these warnings are a formal request for the driver to intervene.

Driver monitoring is another alert-only warning where the vehicle determines deficiencies in the driver's alertness through measurable changes in steering module, braking and acceleration inputs.

Adaptive cruise control utilizes forward-facing digital camera (IPM) data to keep vehicle speed synchronous with the flow of traffic where the only automated intervention possible is with brake controls (intelligent emergency braking, which is a subtask of adaptive cruise control).

Parking assistance is still considered an ADAS feature, since it utilizes the full spectrum of system modules and cameras even though its primary function is driver assistance, not collision avoidance.

Rounding out the ADAS feature set is traffic sign recognition, which utilizes forward-facing digital camera (IPM) data (and in some cases GPS data) to display the current posted speed limit.



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