



2020

**“Stay Connected” through the Corona Virus  
with our customers**

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**Best Practices ESC and Collision Mitigation**

# ESC and Heavy Vehicles



To further enhance the safety of vehicles

- ESP/ESC (Electronic Stability Control) has become standard equipment on both passenger cars and Class 7&8 air-braked commercial trucks and Now IC Buses
- Collision Mitigation has also become a popular feature on passenger cars and is offered as standard equipment and a option on IC Bus
- ESP will be required on school buses in Canada and on commercial buses in the US in 2019 due to regulation.
- NTSB now recommends ESC and Collision Mitigation



# ESC and Heavy Vehicles



## FMVSS 136 – The Stability Mandate

- **Final Rule issued June 2015**
  - 3 Phase implementation
  - Industry supports tech choice
- **Vehicles impacted:**
  - Class 7 & 8 air-braked truck tractors
  - Class 7&8 air-braked and hydraulically-braked (Class 7) motor-coaches
- **Vehicles NOT included:**
  - Single-unit Trucks
  - HD Severe Service - axle that has a gross axle weight rating of 29,000 lbs. or more.
  - **School Buses**      **\*\*Canadian CMVSS 136 DOES include school bus\*\***
  - Perimeter seating buses
  - Transit buses
  - Specialty - Slow moving tractors or buses (33mph in 2 miles)

8/1/2017

6x4 Tractors



6/24/2018

33k+ Comm.  
Buses



8/1/2019

All Tractors  
26k+ Com. Buses

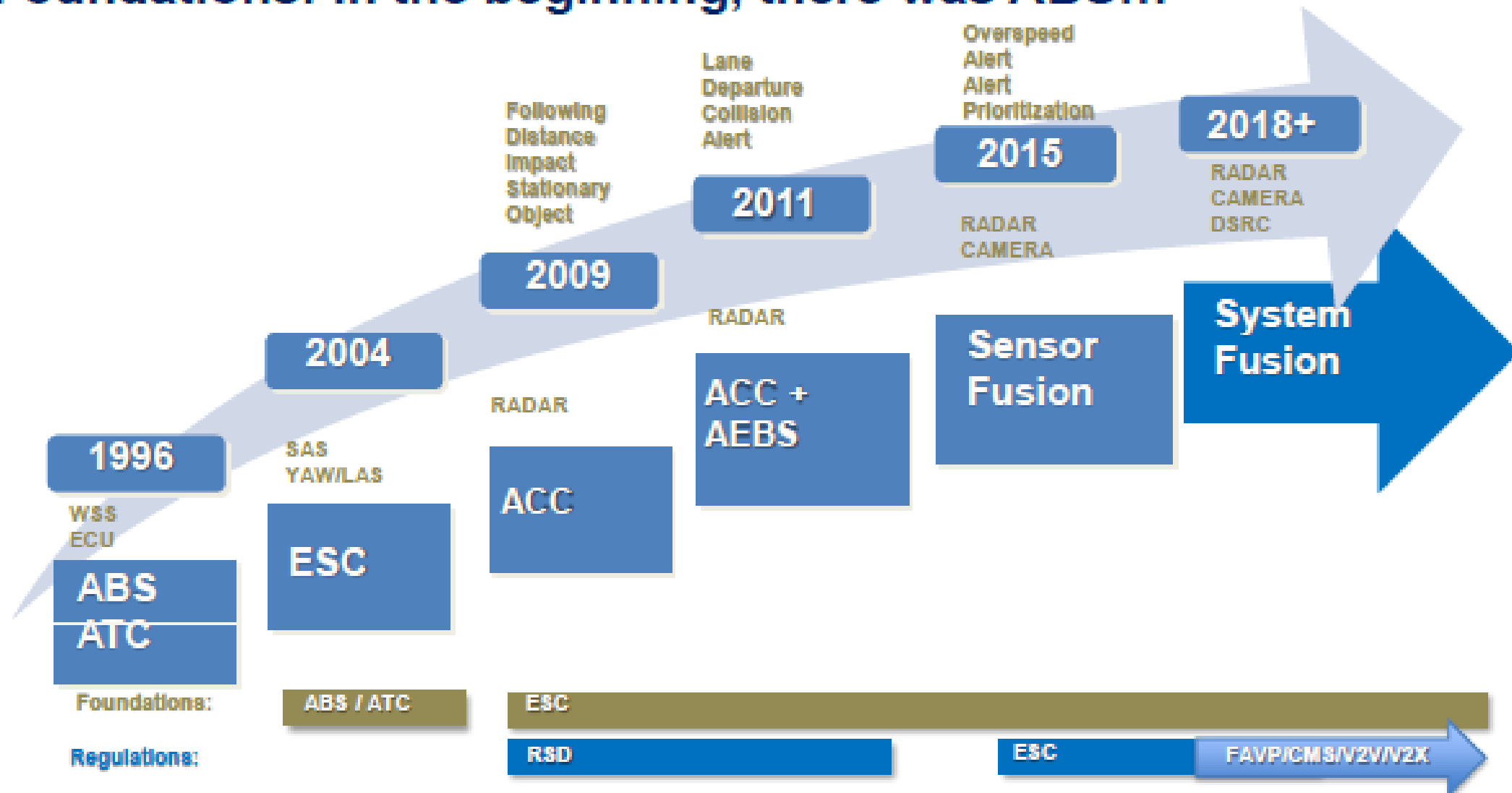


# Progression of Technology

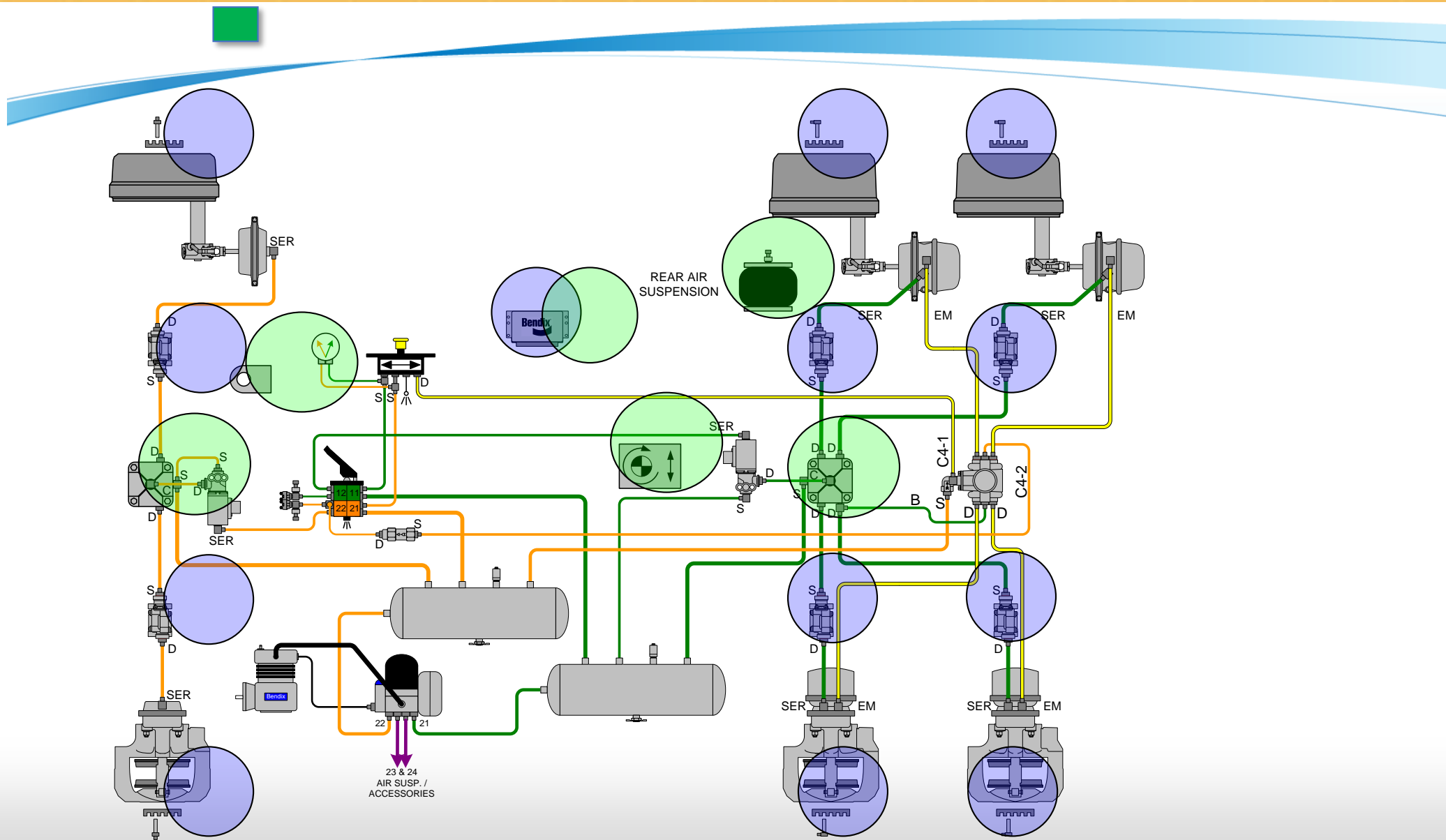
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## Foundations: In the beginning, there was ABS...



# What makes a full stability system?





# Steering Angle Sensor Calibration



*Steering Angle Sensor Calibration:* The Steering Angle Sensor calibration can only be achieved when the sensor is powered by the Bendix ESP EC-80™ Controller. No stand-alone sensor calibration can be carried out. The calibration procedure is performed using Bendix ACom™ Diagnostic software. The sensor must be recalibrated after any of these situations:

- ✓ Replacement of the Steering Angle Sensor
- ✓ Any opening of the connector hub from the Steering Angle Sensor to the column.
- ✓ Any maintenance or repair work on the steering linkage, steering gear or other related mechanism.
- ✓ Adjustment of the wheel alignment or wheel track.
- ✓ After any accident that may have led to damage of the steering angle sensor or assembly.

**Warning:** if the steering angle sensor is not properly calibrated as needed, the yaw control system may not function properly, which can result in a loss of vehicle control.



# Yaw Rate Sensor Calibration

*Yaw Rate Sensor Calibration:* The Yaw rate sensor calibration can only be achieved via the advanced ABS ECU. The sensor must be recalibrated after any of these situations:

- ✓ Replacement of the sensor.
- ✓ After any accident that may have led to damage of the Yaw sensor.

**Warning:** The location of the yaw rate sensor on the vehicle, the means of fastening the unit to the vehicle, and the sensor's orientation, MUST NOT BE ALTERED. When servicing, an identical component must be used in the same orientation (using OEM brackets and torque requirements)



*Brake Demand Sensor Calibration:* Calibration must be performed under the following conditions:

- ✓ After servicing any pressure sensor related DTC's.
- ✓ Replacement of any sensor



## **NATIONAL TRANSPORTATION SAFETY BOARD**

**Public Meeting of May 22, 2018**

**(Information subject to editing)     NTSB/SIR-18/02**

Although school buses are extremely safe, the National Transportation Safety Board (NTSB) continues to investigate school bus crashes in which fatalities and injuries occur. Improved oversight of school bus drivers and enhancements to school bus design—such as installation of passenger lap/shoulder belts, electronic stability control, and automatic emergency braking—could prevent or mitigate such crash outcomes.

### **New Recommendations**

#### **To the National Highway Traffic Safety Administration:**

2. Require all new school buses to be equipped with collision avoidance systems and automatic emergency braking technologies.

#### **To Blue Bird Corporation, Collins Industries, Inc., IC Bus, Starcraft Bus, Thomas Built Buses, Inc., Trans Tech, and Van-Con, Inc.:**

13. Install a collision avoidance system with automatic emergency braking as standard equipment on all newly manufactured school buses.





# System Overview



# System Overview

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- **Esc (Electronic Stability Control)**: Uses lateral, yaw, wheel speed sensors, and a steering wheel position sensor to determine when certain stability limits are being reached. The system uses individual wheel brake applications to regain vehicle stability if needed, and or keep the vehicle within the stability limits
- **Collision Mitigation (Brake assist)** – Uses radar and/or camera technology to detect moving or stationary objects in the path of the vehicle. When a possible collision is detected through a combination of closing speed, and distance, the system will first set off a warning to the driver and throttle back the engine. If there is no driver intervention, the system will then apply the brakes autonomously to avoid, or minimize a collision
- **Radar**: Sensing device used to measure the speed and distance to the object (stationary or moving) in front of the vehicle.
- **Camera**: Camera used to detect stationary objects, recognition of road speed signs and road lane markings.

# Active & Passive Assistance

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**Bendix ESP, Wingman Advanced and Wingman Fusion** each have both **active** and **passive** aspects, which are detailed here.

**Wingman Advanced and Wingman Fusion** will be the only collision mitigation systems in the school bus market that have active features.

## Active Safety System

Takes **action** to help mitigate a potential collision, such as de-throttling the engine and applying the vehicles brakes.

## Passive Safety System

Provides **alerts** to the driver that they may need to take action

# Stability Control – Bendix ESP

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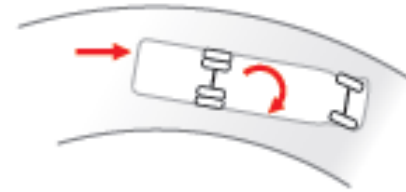


ESP reads vehicle sensors to anticipate loss-of-control or roll-over events.

- Stability technology for straight-chassis vehicles (vs. Roll Stability)
- Monitors what chassis is doing and what driver intends
- May act before the driver realizes a situation exists
- Acts in ways the driver cannot replicate – selective wheel-end brake control
- Has the power to ACT to help the driver avoid or recover from rollover and/or loss of control conditions

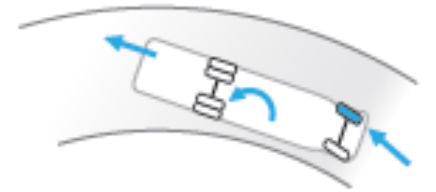
## DRIVING SCENARIO:

The vehicles' speed around a curve has exceeded the ability of the tires to hold the vehicle orientation, causing the vehicle to slide and over-steer.



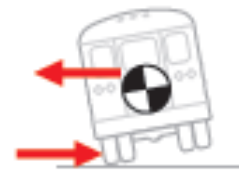
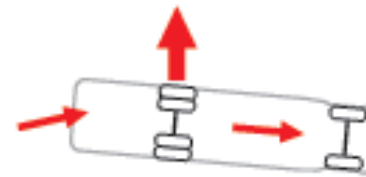
## SYSTEM RESPONSE:

The Bendix®ESP® stability system helps to correct the vehicle orientation by reducing speed and, if required, the system quickly applies braking pressure to the appropriate wheels.



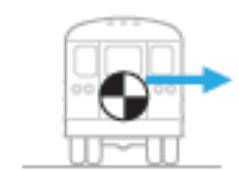
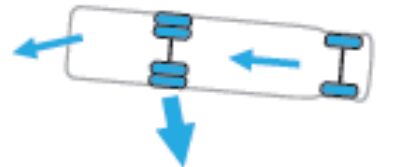
## DRIVING SCENARIO:

A vehicle enters a curve too fast on high friction pavement. The wheels and the pavement create a "hinge" effect allowing the forces at the center of gravity to push the vehicle over.



## SYSTEM RESPONSE:

The Bendix®ESP® stability system applies pressure to all brakes and reduces engine throttle to quickly reduce vehicle speed and help reduce the chance of a roll over.



# Stability Control – Bendix ESP

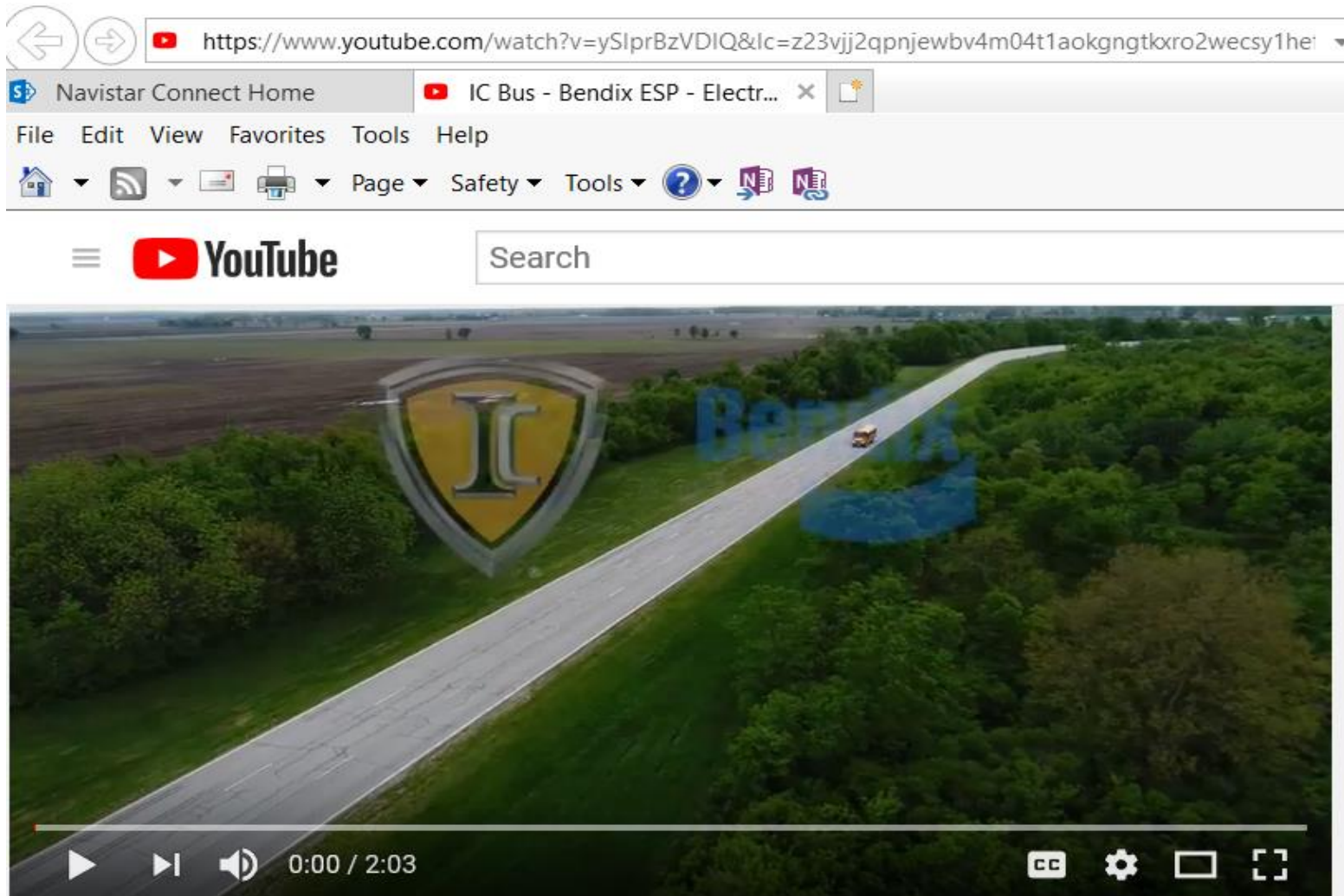
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Situation	Example Description	How Bendix® ESP® Helps
Loss of Control	Slipping and loss of control situations	Helps to mitigate or prevent a rollover or loss-of-control situation by automatically applying foundation brakes by each wheel end.
Roll-overs	Exiting a highway too fast	
Aggressive drivers	Perceived risk of rollover or loss of control is high	Will help notify drivers when they are on the verge of a rollover or lose control.



# Bendix ESP – Electronic Stability Control – YouTube Video



<https://www.youtube.com/watch?v=ySlprBzVDIQ&lc=z23vjj2qpnjewbv4m04t1aokgngtkxro2wecsy1hefkebk0h00410>

IC Bus - Bendix ESP - Electronic Stability Control -  
How it Works



# CMS – Bendix Wingman Advanced

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Wingman Advanced is a collision mitigation system that utilizes a **radar** to identify **metallic** objects in the vehicle path.

## Alerts

- Impact Alert
- Stationary Object Alert
- Following Distance Alert

## Stability

- Built on ESP

## Active Cruise w/Braking

- Automatically maintains about 3.0 second gap with the forward vehicle when cruise is “set”
- Uses dethrottle, engine retard and foundation brakes to help driver maintain gap

## Collision Mitigation

- Can automatically apply foundation braking to help driver mitigate a rear-end collision
- Always available > 15mph

## Data

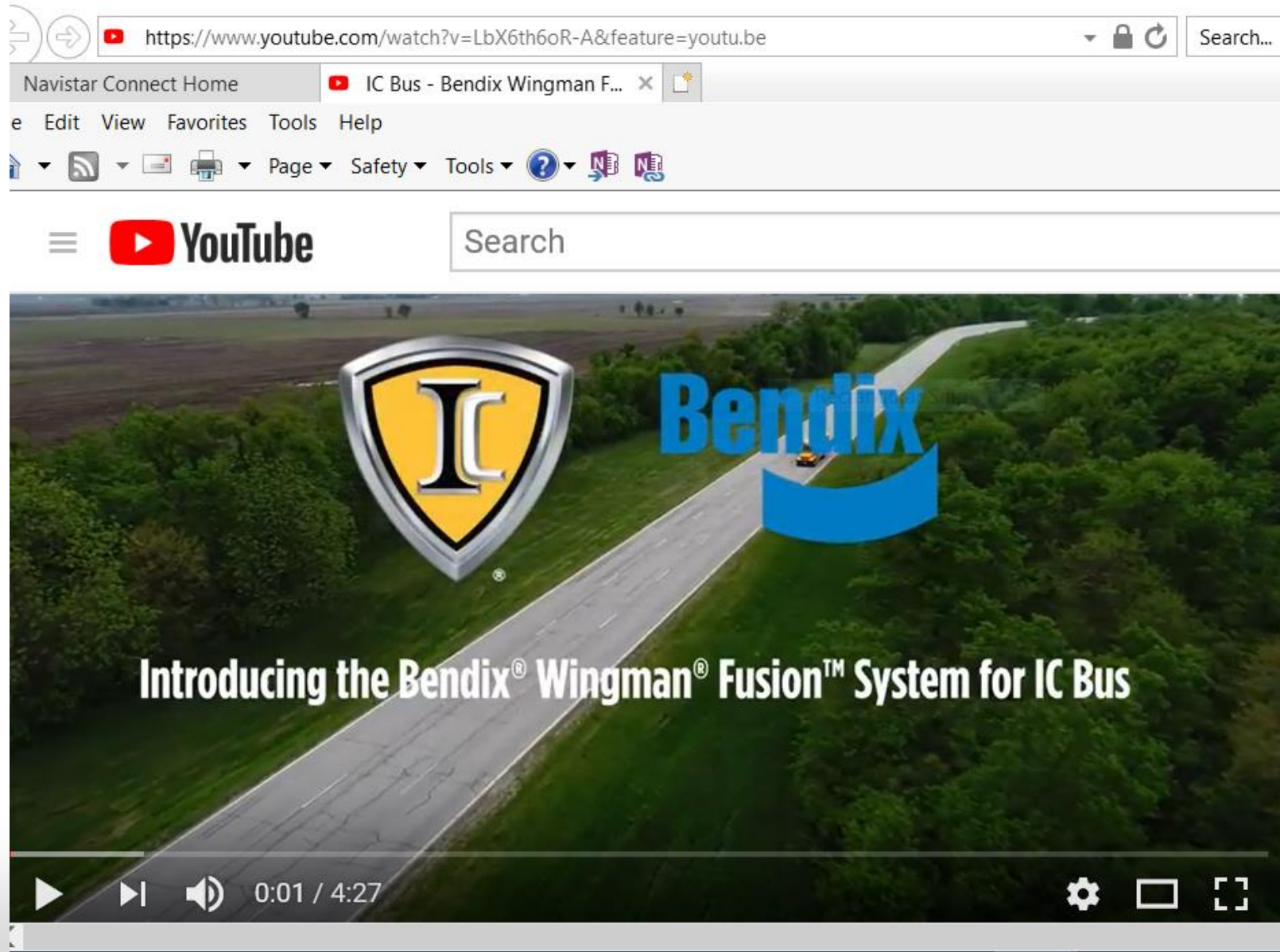
- Supports advanced SafetyDirect features
- Supports basic telematics functions



Radar detects forward object about 500' away

# Wingman Fusion - YouTube Video

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<https://www.youtube.com/watch?v=LbX6th6oR-A&feature=youtu.be>

# CMS – Bendix Wingman Fusion

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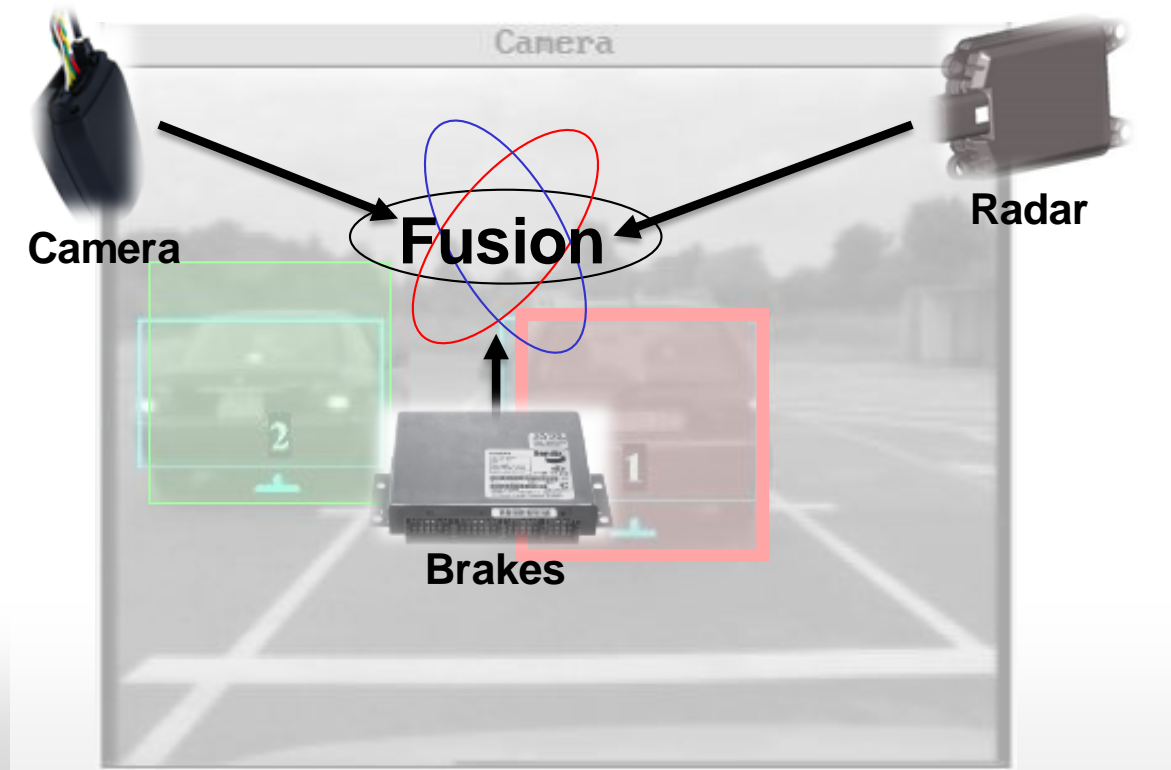


Wingman Fusion works similarly to Wingman Advanced, adds a key piece of hardware – **a camera**. The camera combined with the radar allows for improvements on some of the features offered with Wingman Advanced, as well as the addition of features that are only available with Wingman Fusion.

## Wingman Fusion

### Video enhances:

- Relevant lane recognition
- Object size
- Object elevation
- Object classification



## Wingman Advanced & Wingman Fusion

### Radar is accurate in:

- Distance
- Relative velocity
- Independent of visibility

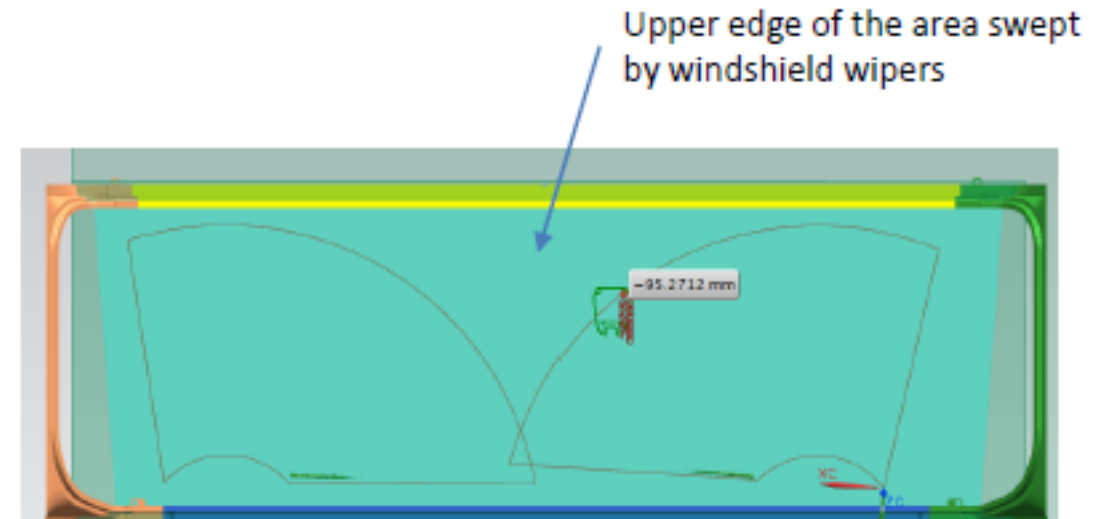
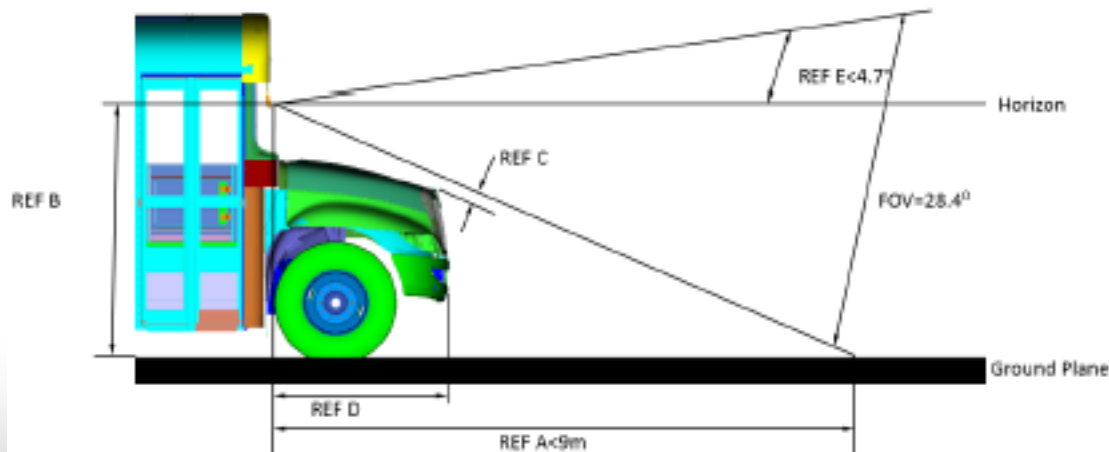


# Component System Requirements



***To achieve the Field of View required for operation of the system, the camera position shall be\*:***

- In the wiped zone
- In the centerline of the vehicle, with allowable offset from center.
- Have an unobstructed view of lane markings less than 9 m from camera position.
- The Field of View angle greater than  $4.7^\circ$  above the centerline horizontal
- To be mounted on the windscreen as high as possible.
- Must be unobstructed, (hood ornaments, bug shields, fender-mounted side view mirrors, etcetera).
- Must be inside the edge of the wiper path.



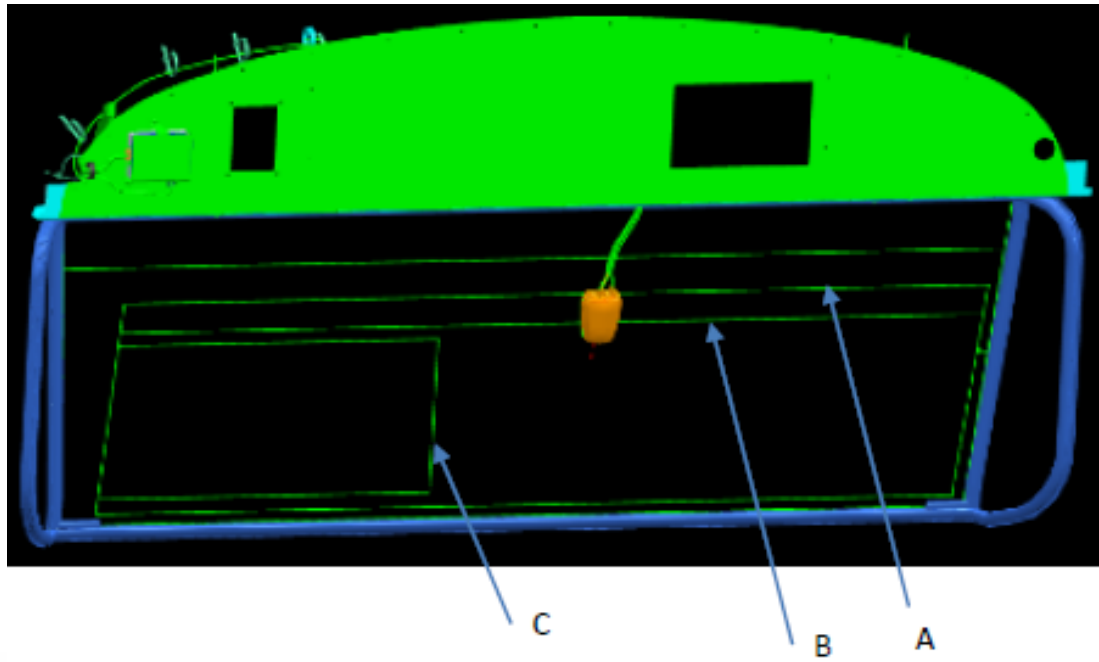
Conforms to the FMCSR 393.60e spec of not more than 100 mm (4") below the upper edge of the area swept by the windshield wiper.

# Definition and View

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- ABC Zones define the areas of the windshield that are important for the driving task.
- These areas are used as targets for wiper and defrost performance.
- The C Zone is the area in front of the driver and is most important.



- 0% of the C Zone is obscured by the camera housing
- <1% of the B and A zone is obscured by the camera housing (allowable per FMCSR 393.60e)



# Eye Viewpoints with Camera Housing

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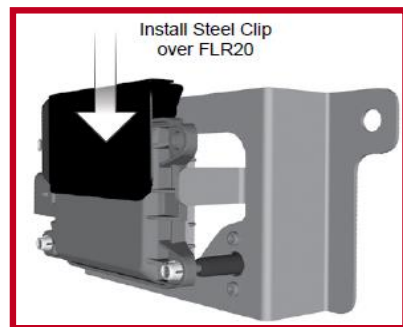
**RH Cross View Mirror View**



**RH Outside Mirror View**



# Basic Radar Alignment



Slide Steel Clip  
K073087



Attach the Alignment  
Tool K096579



Zero the Vertical Alignment  
Using a Digital Inclinometer

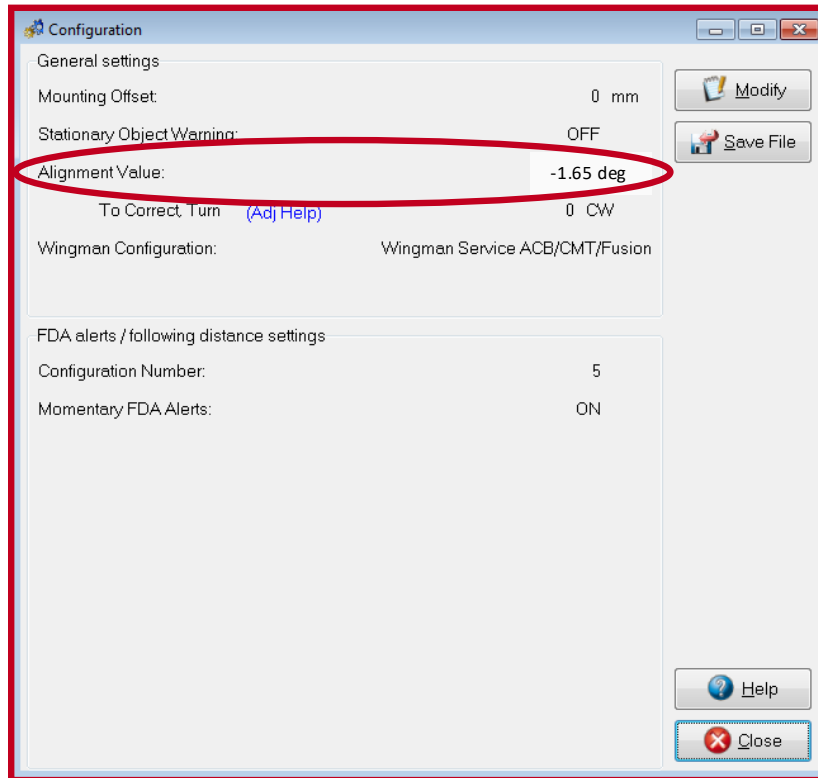


Verify Lateral Alignment  
1/8" or Less from Side to Side



Reset the Alignment Value  
Using ACom™ Diagnostic  
Software

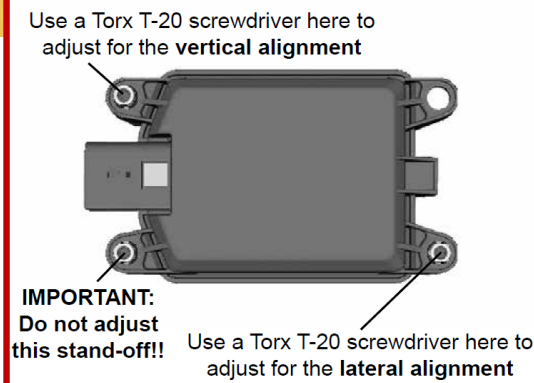
# Lateral Alignment using ACom™ Diagnostic software



ACom™ Diagnostic Software Screen  
Showing the (Lateral) Alignment Value

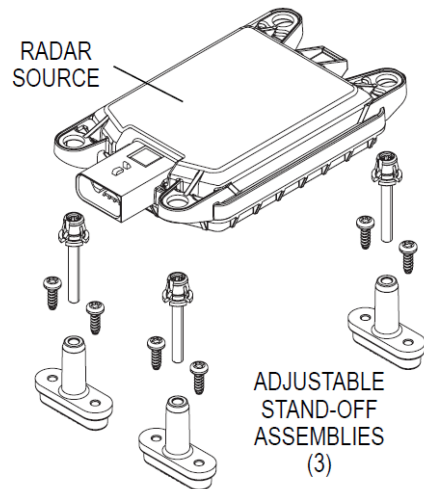
Alignment Value Range (Degrees)	Service Action	Number of Full Turns of the Lateral Alignment Adjustment Screw
-2.0 to -1.8	<b>Adjustment Required</b>	6 clockwise
-1.7 to -1.6		5 clockwise
-1.5 to -1.2		4 clockwise
-1.1 to -0.8	<b>No Adjustment Needed</b>	3 clockwise (optional)
-0.7 to -0.5		2 clockwise (optional)
-0.4 to -0.3		1 clockwise (optional)
-0.2 to 0.2		
0.3 to 0.4		1 counterclockwise (optional)
-0.5 to 0.7		2 counterclockwise (optional)
0.8 to 1.1		3 counterclockwise (optional)
1.2 to 1.5	<b>Adjustment Required</b>	4 counterclockwise
1.6 to 1.7		5 counterclockwise
1.8 to 2.0		6 counterclockwise

Adjustment Screw Rotation Required



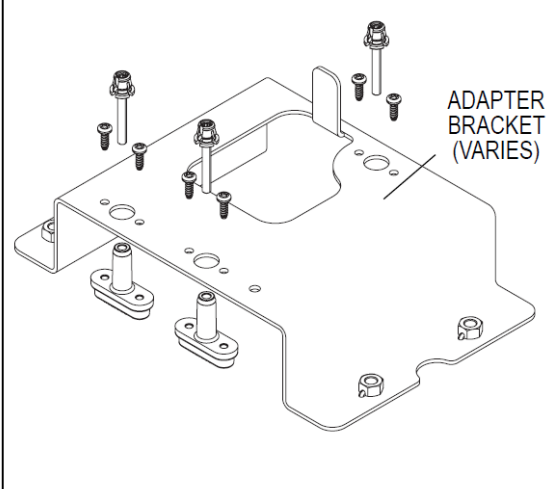
## A.2 REPLACEMENT PARTS

Replacement parts exist for all components shown below. Parts are available from any Bendix authorized parts supplier.



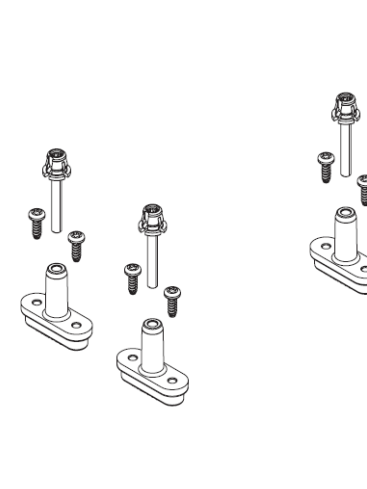
### Radar Sensor with Stand-off Assemblies

- Kit K071772 includes a specifically-programmed Bendix® FLR20™ radar sensor, three stand-off adjustor assemblies, and six mounting screws.



### Bracket (Varies) and Stand-off Assemblies

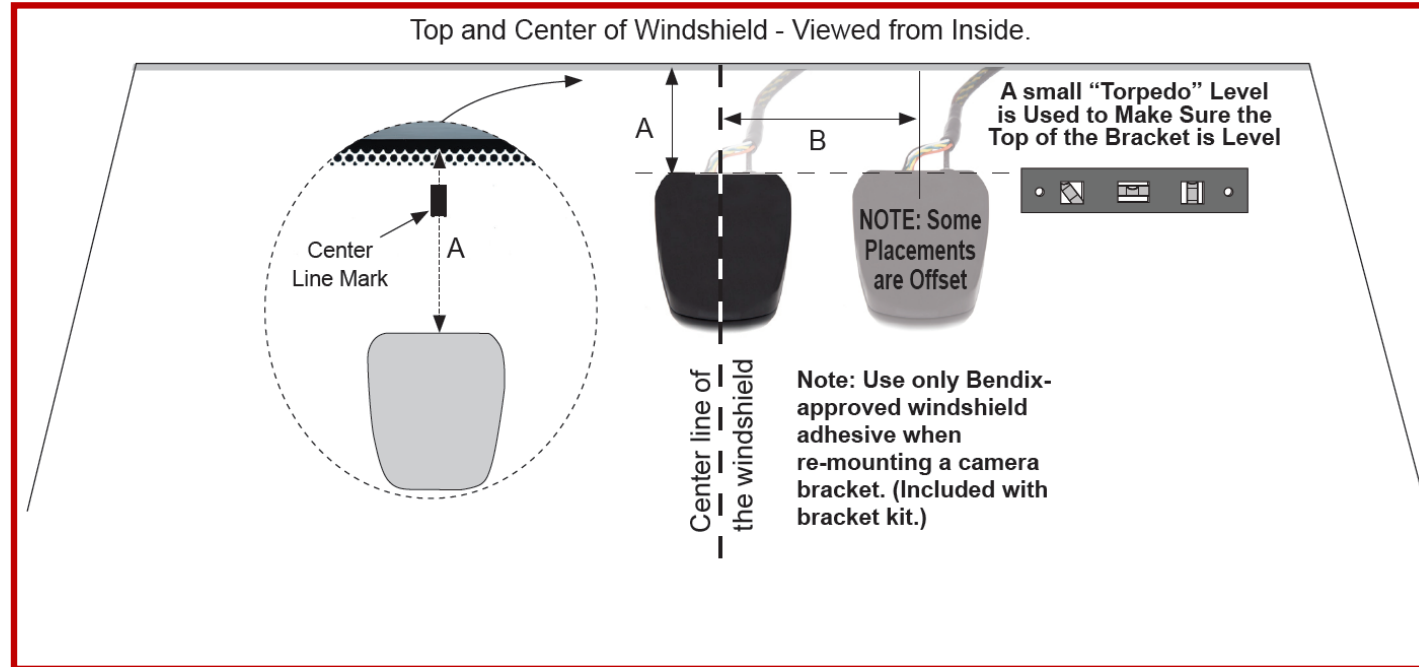
- Provide the bracket part number (see label) when ordering replacements. Kits will include three stand-off adjustor assemblies, and six mounting screws.



### Stand-off Assemblies Only

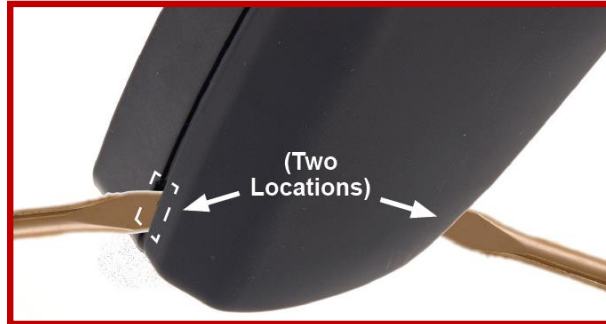
- Kit K073199 includes three stand-off adjustor assemblies, and six mounting screws.

# Camera Windshield Installation



Replacement Bracket  
Part # K109285

# Camera Removal & Installation



1. Engage the top of the camera into the bracket

2. Rotate the camera into the bracket

3. Listen for the click as the bracket engages the camera

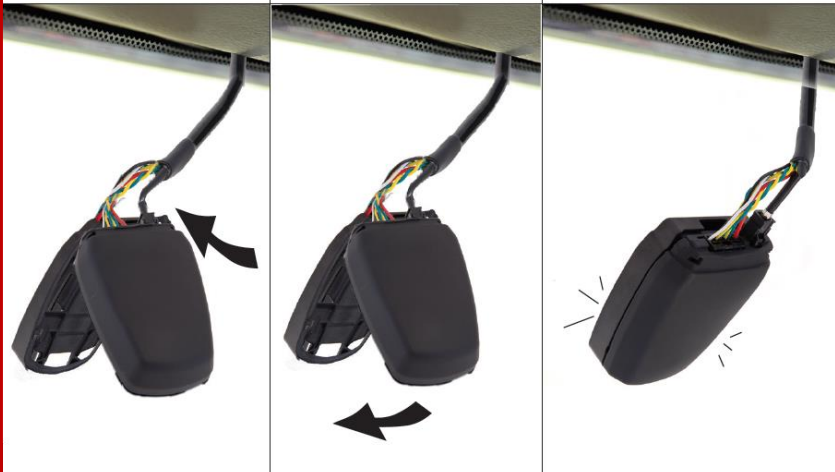


FIGURE 12 - CAMERA INSTALLATION

**IMPORTANT:** Double-check that the camera is fully engaged into the bracket.



Verify that the channel between them has the same gap all the way around, and pull gently on the camera to check that the tabs at the top and bottom are engaged and that there is no play.

# System Comparisons

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ESP

Vehicle Sensors

Wingman Advanced

VS & Radar

Wingman Fusion

VS & Radar & Camera





# Thank you

