What you need to know about

September 2019
Price: $19.99

Autonomous Vehicle Inspection

HUNTER TRAINING

HUNTER Engineering Company

Contents

Autonomous Inspection — How It Works...

Quick Check DRIVE

P R N 2 1

As the vehicle drives through, cameras measure distances to the tire to calculate total toe and individual camber.

Hunter's patented system acquires up to 16 results. Measurement outliers are removed and the other results are averaged to provide utmost accuracy.

On-board cameras (or optional external camera) record the vehicle's license plate to obtain the vehicle's VIN. The VIN is used (via HunterNet®) to identify the vehicle manufacturer's alignment specs which are compared with the measurements just taken by the Quick Check Drive® unit.

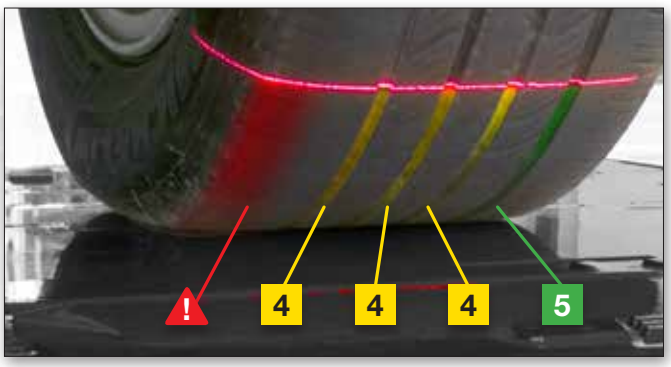
Simultaneously, four on-board cameras each take about 10 images of the vehicle as it rolls between the towers. Images are used to identify pre-existing body damage (if claim of damage occurs).

The vehicle's license plate is also recorded, its state identified, its characters identified, and its VIN number is obtained in seconds.

Quick Tread EDGE HUNTER

As the vehicle drives over Hunter's tread depth unit, lasers accurately calculate tread depth for each tire groove, data is analyzed, and tread health of each tire is obtained.

Large data sample generates a 3D image of the four-inch tire segment. The Quick Tread Edge® unit precisely measures wet and dirty tires as well as identify edge wear on otherwise healthy-looking tires.



Alignment — Basic Theory

Wheel alignment is the process of adjusting the angles of vehicle wheels to vehicle manufacturer specifications.

One of the primary goals is to prolong tire life.

Other goals include:

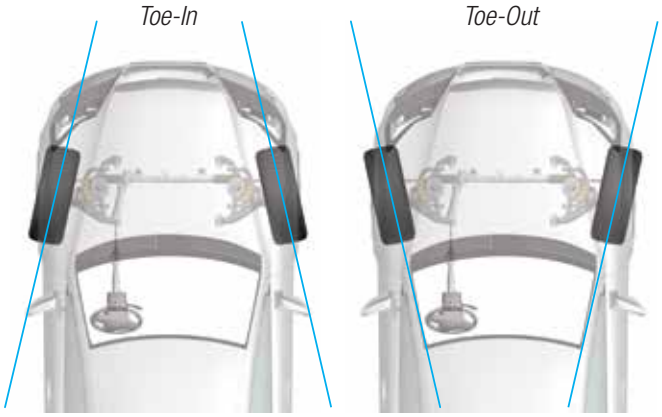
- ✔ Level steering wheel
- ✔ Proper tracking
- ✔ Directional stability
- ✔ Handling
- ✔ Predictability

Total toe is the primary tire wear concern as it causes tire wear more rapidly than camber.

Total Toe:

Total toe is the angle formed by the intersection of lines drawn through left and right tires on the same axle. Total toe is considered positive (or "toe-in") when the lines intersect forward of the tires. Total toe is considered negative (or "toe-out") when the lines intersect behind the tires.

The result of incorrect total toe is premature tire wear beginning on the tire's shoulders and then shaving across the tire's tread surface.



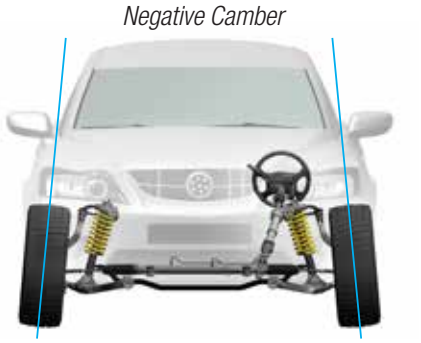
Camber:

Camber is the inward or outward tilt of the top of the tire when viewed from the front of the vehicle. Camber is positive when the top of the tire is leaning out from the center of the car. Camber is negative when the top of the tire is leaning inward towards the center of the car.

Camber angles change as the vehicle's ride height changes and components wear. If the camber angle is excessive, the shoulder area of the tire will wear prematurely.

The result of incorrect camber is premature tire wear isolated to the tire's shoulders.

While other angles and measurements exist, they don't contribute directly to tire wear and will often result in a customer complaint if something is wrong.



Tire Wear — Basic Theory

Why do tires wear out?

Inflation

Overly inflated tires ride heavily on the center tread, wearing it down. Tires that are under inflated place excessive load on the outer treads, wearing these areas down. Both inflation problems can be solved by using a pressure gauge when inflating tires.

Alignment issues

Toe misalignment has the greatest affect on tread wear, generally causing feathering on the tire. Camber misalignment causes excessive wear on the inner or outer edges of the tire.

Standard wear

Tire wear is natural, even if factors mentioned above are controlled. This tire wear is the result of and price paid for traction and grip of the road's surface.

Aggressive driving

Hard cornering, spinning the tires when accelerating, and abrupt stopping can wear tread very quickly.

Worn parts

Worn parts are frequently responsible for alignment issues that contribute to tire wear. Such parts are:

- Tie rod ends
- Sagging springs / bent suspension parts
- Ball joints
- Control arm bushings

Worn struts or shock absorbers also contribute to tire wear as they allow the wheels to bounce excessively, resulting in a cupped wear pattern on the tire.

Normal pressure *Low pressure* *Excess pressure*

Normal pressure *Low pressure* *Excess pressure*

= *Excessive wear / heat areas*

Wear Indicator *Over Inflation* *Under Inflation*

Camber Wear *Toe Wear* *Chopped Wear*

(Toe In or Toe Out) *(Cupping)*

Autonomous Inspection — Information for Shop Owners

Statistics suggest 50% of vehicles tested will show alignment issues that could cause tire wear. But tire wear alone is a poor indicator of alignment condition — only 10% of vehicles with irregular wear need an alignment. Quick Check Drive® facilitates a fast, accurate, touchless alignment inspection. If a vehicle fails inspection, it will likely need an alignment.

- ✔ Fastest way to check tire wear angles
- ✔ Doesn't tie up alignment bay
- ✔ Allows shop to check every car, every time
- ✔ Does not require a technician

HunterNet® helps you price alignments

What type of alignment does the vehicle require?

- ✔ Total 4-wheel
- ✔ 4-wheel thrust
- ✔ ADAS resets (Advanced Driver Assist System)

What tools will be required?

- ✔ Special OE tools
- ✔ CodeLink® (electronic steering system reset)

What parts are needed?

- ✔ Cam bolts
- ✔ Aftermarket shims

HunterNet® is an online database that provides useful information to price an alignment. If internet access is unavailable, Hunter's Wheel Alignment Adjustment Guide is a printed copy of this information.

Situations to avoid

Vehicles with any pre-alignment requirements, such as those with ride height-dependent specifications are not good candidates for Hunter's Quick Check Drive®. These vehicles represent a small percentage of vehicles on the road.

When performing the test, avoid abrupt stops and turns entering the bay. Drivers should be instructed to pull completely through the towers at a constant speed.

Autonomous Inspection — Information for Vehicle Owners

- ✔ Fastest way to check tire wear angles
- ✔ Free service
- ✔ No damage to wheels

What Quick Check reveals

Unlike a crooked steering wheel or pull, alignment issues created by or causing tire wear typically remain unnoticed until an established wear pattern develops.

Although a portion of the tire has not been affected, the prematurely worn tread has doomed the tire for replacement. Once a wear pattern has developed, it never goes away.

Why measure total toe?

Total toe is the chief tire wear concern as it causes tire wear more rapidly than camber. By measuring total toe during an inspection, discovering alignment issues can help extend the life of the tires — one of the primary goals of wheel alignment.

COMMON OBJECTIONS

"I don't have time."

The autonomous inspection system takes only 3-5 seconds, and was completed as you entered the shop today.

"My car is driving fine."

While a car may currently feel as though it is driving fine, if it is driving on tires that are rapidly decreasing in quality, the increase in tire wear angles cannot be felt until the tires are completely non-functional.

"Alignment is too expensive."

If a vehicle shows tire wear angles and the problem is not corrected, the vehicle owner is literally throwing away money in the form of healthy tire that was never used. Incorrect alignment also leads to decreased fuel economy.

Toe-In

Toe-Out

Negative Camber

Positive Camber

Toe Wear

A vehicle one inch out of alignment is equivalent to dragging the tire sideways 100 feet per mile.

(Source: Tire Business)

Camber Wear

While misalignment may cause irregular tire wear, tire wear alone is a poor indicator of alignment condition.

Tire Wear & Wheel Alignment

Irregular tread wear does not always mean a vehicle is out of alignment

- ✔ While tread depth measurements are useful for recommending tire replacement, tread depth results alone are not sufficient for recommending wheel alignment.
- ✔ Tire wear patterns, which frequently result in tread depth deterioration, are permanent and will remain until the tire is replaced.
- ✔ Even after a proper wheel alignment, the tire will still be flagged with irregular tire wear when tested.
- ✔ By the time a tire shows signs of irregular wear it is too late as most of the useful life of the tire is already passed.

The Importance of Tread Depth

Knowing tire tread depth is important as the grooves in tires remove debris, rain, and snow, so that tires can hit the road and keep the vehicle running smoothly.

As tread depth decreases, so does a tire's performance, increasing the wet weather stopping distance and potential for accidents.

Signs tire replacement is needed

- ✔ Tread depth results of 2/32 or below
- ✔ Wear bars are visible
- ✔ Visible bulges, deep cracks, or tread separation from casting
- ✔ Vehicle stopping distance noticeably increased from initial stopping distance

Measuring tire edge tread wear is critical to proactive tire safety

A bald edge will affect wet weather traction, resulting in longer stopping distances and poor handling.

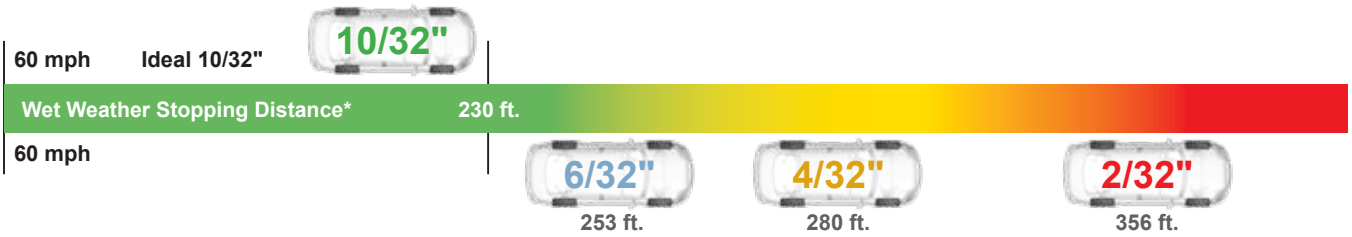
- ✔ When a vehicle is moving, the tire's contact patch expands to include the tire's edges
- ✔ Worn edges cannot shed water
- ✔ Edge wear is difficult to detect using visual inspection methods

Did you know? **In a 25,000 vehicle study, 51% of all vehicles had no irregular tire wear, but needed an alignment. Only 10% had irregular wear and needed an alignment.**

Tread Depth Affects Vehicle Stopping Distance

Tire tread depth is important because a tire's grooves squeeze out water, debris and snow so tires can hit the road and keep the vehicle running safely.

As tires wear, the grooves become shallow and compromise the tire's ability to make solid contact with the road. As tread depth decreases, the vehicle's wet weather stopping distance increases.



Proper Tread Depth Means Control in Wet Conditions

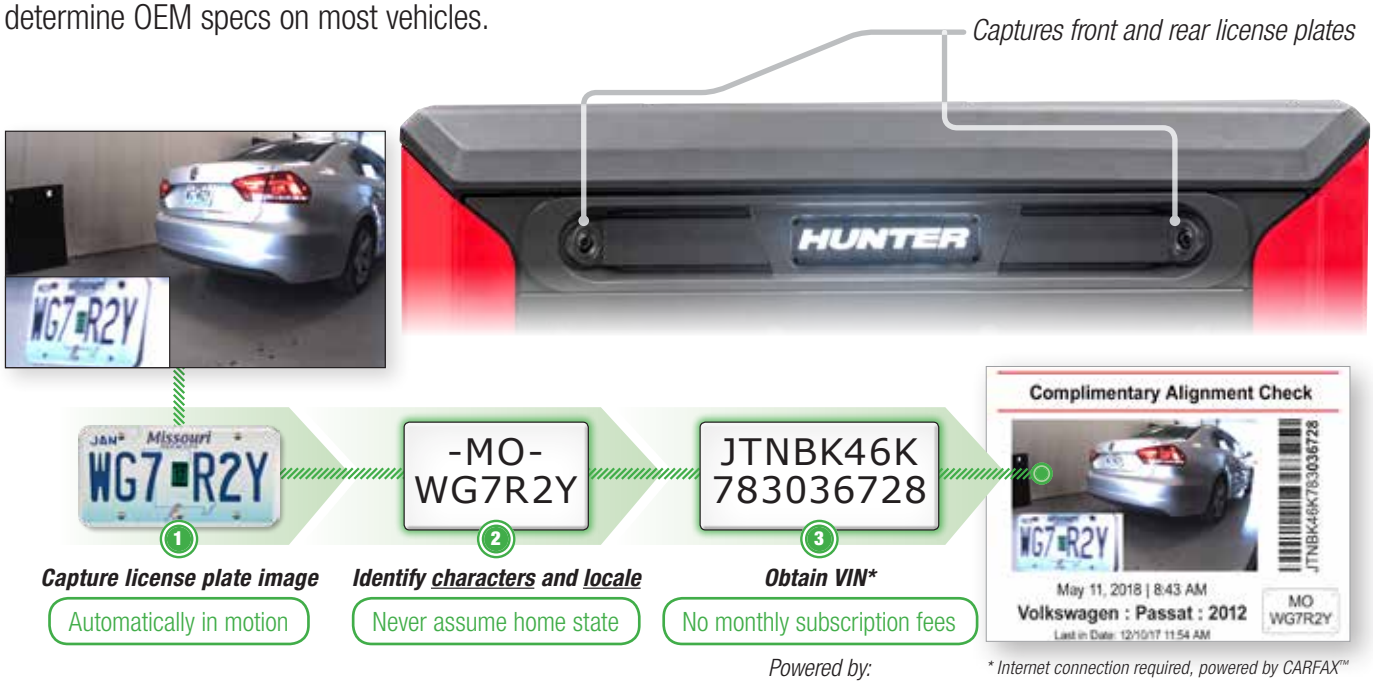
Darker area represents amount of tread making contact with the road surface at varying conditions.

	10/32"	4/32"	2/32"
AT REST	New tires show clearly defined tread ensuring efficient water displacement. 	When comparing stationary tires, little difference in tread definition between new tire tread and a tire worn to 4/32" is obvious. 	At the minimal tread depth, tread definition is barely visible — already illustrating that water displacement will be inefficient. 
45 MPH	Any tire in motion will lose some contact with the road, but tires with well-defined tread will maintain better contact. 	Unable to displace water efficiently, water begins to pool at the front of a tire with worn tread. 	Tires with severely worn tread have far less contact with the road and allow a dangerous amount of water to pool at the front of the tire. 
60 MPH	At high speeds, even tires with well-defined tread cannot sufficiently displace water. Eventually, only the sides and back of the tire will make contact with the road. 	Tire's center has no contact with the road. With only the sides of the tire somewhat in control, high-speed road travel is hazardous on slightly worn tread. 	At high speeds, with minimal tread depth, water can no longer be displaced properly, lifting the tire off the road surface — hydroplaning out of control. 

Automatic Vehicle Identification

PATENT PENDING

Standard, built-in cameras capture vehicle's license plate as it enters or exits the Quick Check Drive® unit's field of vision. Automatically determine OEM specs on most vehicles.



Requires WinAlign® 15.0 or newer.

External Camera for Challenging Situations

OPTIONAL

Hunter's external vehicle identification camera captures better quality photos — especially on challenging license plate designs and special character layouts.*

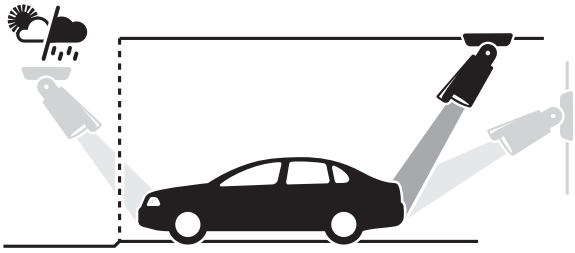
- ✔ External camera solves difficult install situations such as low lighting, daylight glare, and field of view obstacles
- ✔ Identify characters better, more often
- ✔ Special characters are more recognizable at higher resolution
- ✔ Distinguish characters from plate design more easily

Standard Quick Check Drive® camera resolution

Optional external camera resolution

Extensive license plate coverage

- ✔ Every U.S. state and most Canadian Provinces**
- ✔ Custom character plates
- ✔ State vanity plates
- ✔ New plates available regularly with spec updates



Flexible camera installation options

- ✔ Indoor or outdoor
- ✔ Ceiling- or wall-mounted, center or off-center
- ✔ Front or rear license plate position
- ✔ Quick Tread Edge® or Quick Check Drive® camera trigger

** See form 7604-T for a map of states with challenging license plates.*

*** Character recognition in all Canadian Provinces; CARFAX not supported in Alberta, Nunavut, Québec, and Yukon Territory.*

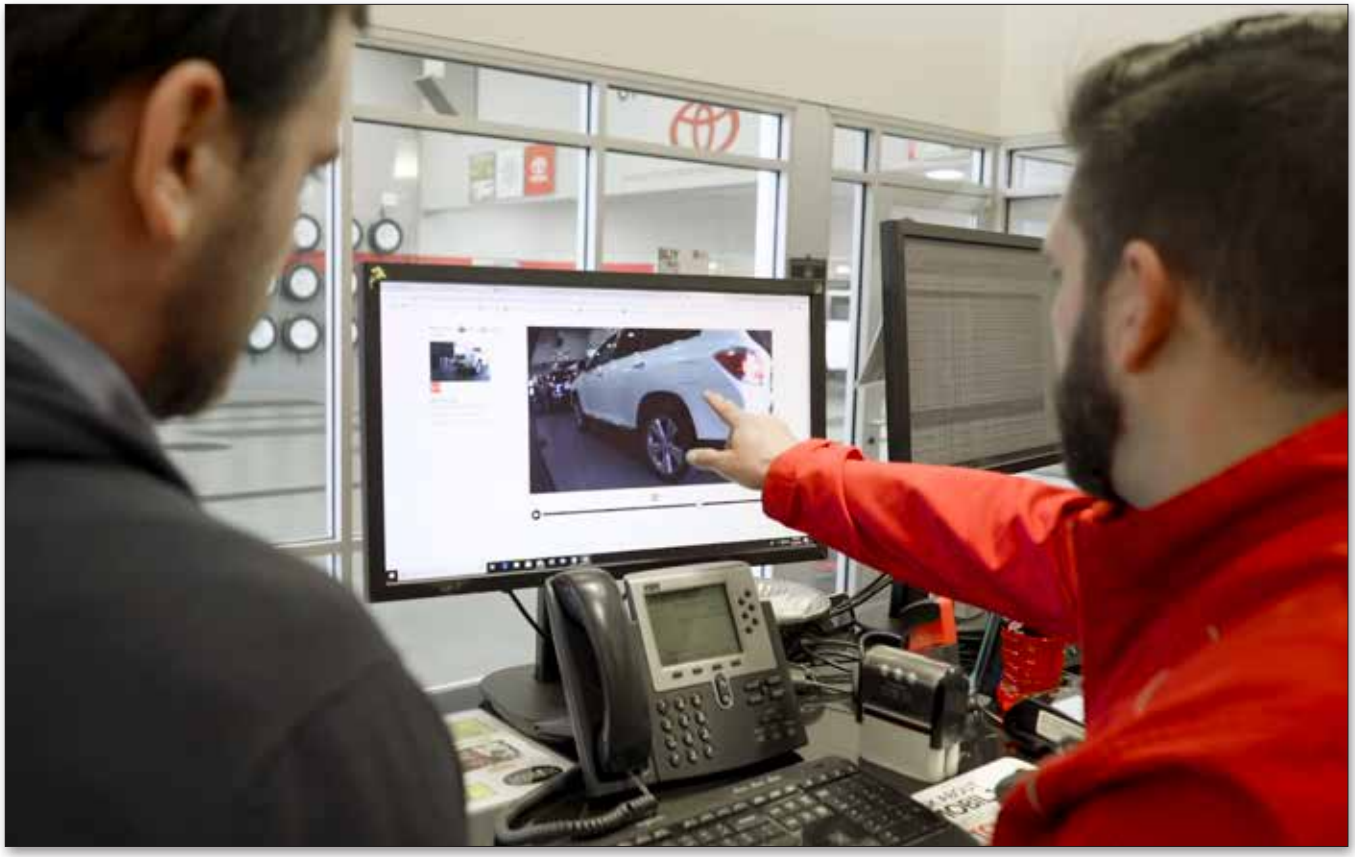
Requires WinAlign® 16.0 or newer.

Body Damage Camera

a feature of Quick Check DRIVE and HunterNet

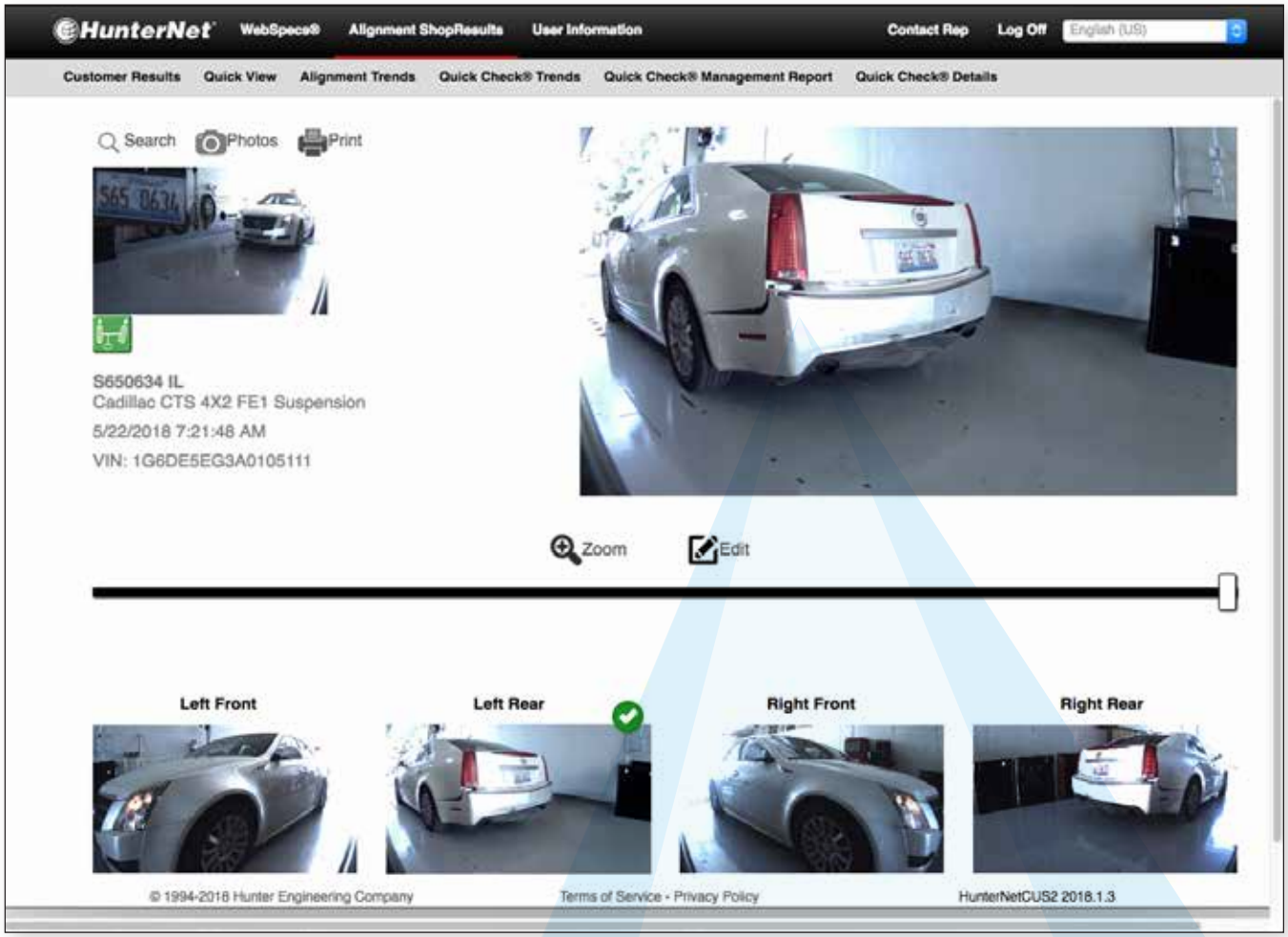
OPTIONAL

Using the same built-in high-definition cameras, the body damage camera enables your shop to capture 40 or more images per vehicle in the same time it takes to check wheel alignment.



- ✔ Save your shop thousands of dollars in false vehicle-damage claims
- ✔ Immediate access to your body damage camera images — no need to contact a third-party surveillance company and wait for the images
- ✔ Camera location optimal to capture body images
- ✔ Use HunterNet® to quickly review vehicle images, vehicle information, and date of service

Did you know? **Body damage cameras can save thousands of dollars per month on false damage claims. It is not uncommon for customers to be "mistaken" about when damage occurs.**



Four cameras capture an average of 10 images each

- ✔ HunterNet® enables quick review of vehicle images using the intuitive body damage camera interface
- ✔ Display vehicle information and date of service
- ✔ 15-day image storage standard
- ✔ Premium 90-day storage package available

Flightboard™ Guide

Increase service acceptance rate, revenue, and return on investment with autonomous selling tool

What is Flightboard™?

FlightBoard is an online, digital display board that is accessed via web browser with connected device like TV or PC.*

Why Flightboard™

- ✔ Sell more work with easy sales tool
- ✔ Ensure findings are always presented
- ✔ Reduce or eliminate printing costs
- ✔ Enhance customer experience and transparency

Ideal Locations

Service Drive

Waiting Area

Flightboard™ results**

Customizable Header

Quick Check Drive / Quick ID

Quick Check Drive / Quick Check

Quick Tread Edge / Quick Tread

Vehicle Information

- ✔ Image with license plate
- ✔ Make, model & year
- ✔ Open recall notification
- ✔ Time of visit

Wheel Alignment Results

- ✔ Pass or fail
- ✔ Safety System Alignment® statement if applicable

Tire Health Results

- ✔ 3D images of customer tires
- ✔ Tire tread depth
- ✔ Tire edge wear†

** Requires an authorized CARFAX EULA (End User License Agreement) be on file*

† Edge wear reading requires Quick Tread Edge®

*** Display will have different results depending on products connected to Flightboard™ (See 7394-T Flightboard Setup Guide for more details)*

Interactive Inspection Results

ShopResults™

- Quickly view vehicle service opportunities
- Access and email detailed inspection results
- Review body image photos to assess damage claims
- Edit or resolve vehicle information for proper alignment specs
- Desktop- and mobile-friendly

Powered by HunterNet®

Push Reports Overview

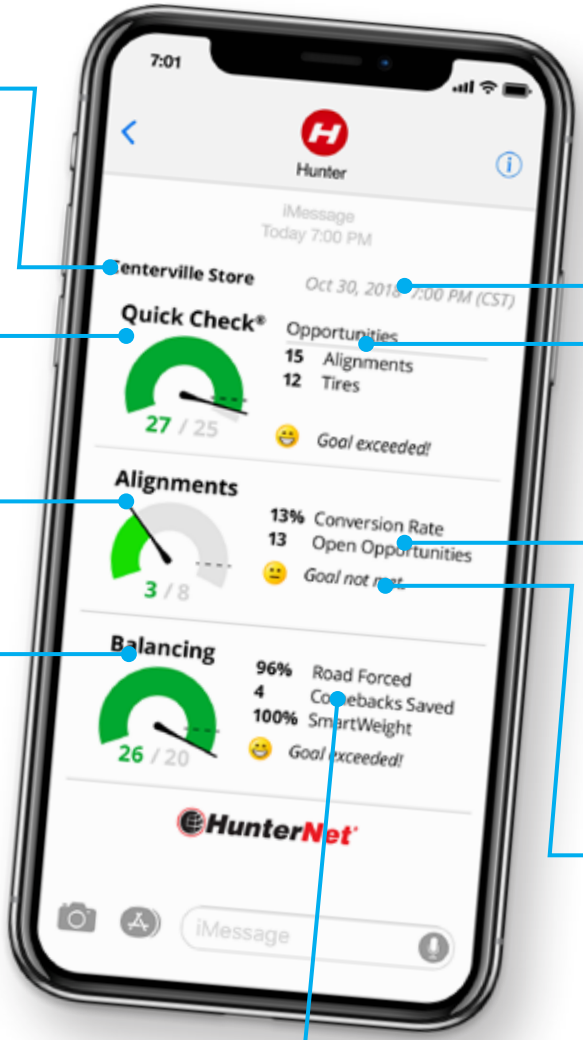
"Push Reports" compile mid-day and end-of-day information from your customers' Hunter Quick Check® units, HawkEye Elite® Aligners, and Road Force Elite® Balancers connected to HunterNet® and compares the results to goals set by management.

Shop name will appear in the top left. *Ex: Centerville Store.*

The **Quick Check® Tile** shows how many vehicles were inspected compared to goal. *Today, this shop surpassed its Quick Check goal, so the gauge is mostly green.*

The **Alignments Tile** shows how many alignments were performed compared to goal. *Today, this shop did not hit its alignment goal, so the gauge is in mostly grey.*

The **Balancing Tile** shows how many wheel tire assemblies were balanced compared to goal. *Today, this shop surpassed its balancing goal, so the gauge is all green.*



Customer can choose times when mid-day and end-of-day reports are sent. This example is an end of day report.

On the right is a summary of all the Opportunities found.

Using VIN match, the Alignment conversion rate compares opportunities found on a Quick Check® unit to alignments performed on an Aligner on the same day.

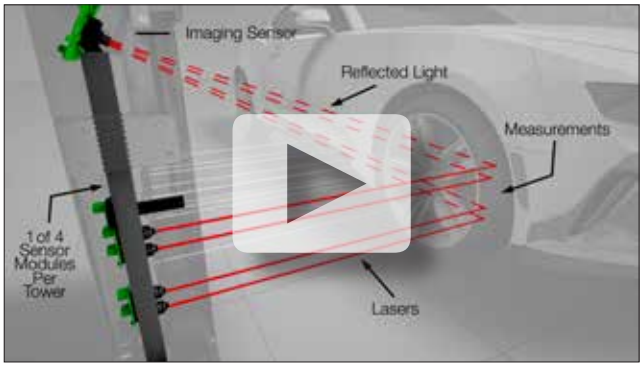
Note: If an alignment is performed without a corresponding Quick Check, or on a later date, it will not count toward the conversion rate, but will count toward the total Alignment goal for the day. Open opportunities are calculated as Quick Check alignment opportunities that have not yet been performed on the wheel aligner based on VIN matching.

Balancers report what percentage of assemblies were "Road Forced," the percentage of weights applied with SmartWeight®, and how many potential comebacks were saved.

Videos

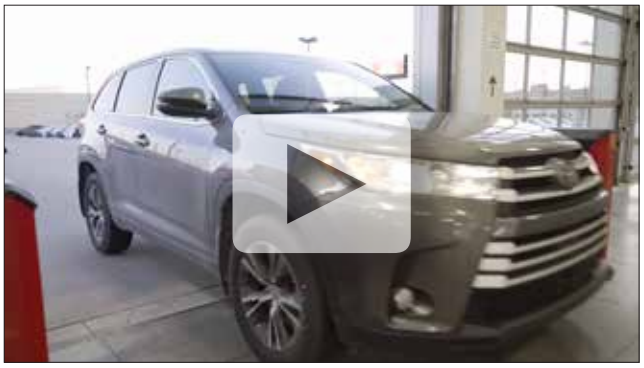
Using your mobile device, scan the QR code to watch each video, search "Quick Check Drive" on YouTube®, or visit the Hunter channel at www.youtube.com/HunterEngCo.

Touchless Alignment Inspection
https://youtu.be/d4HeoAwSRNM



Patented Measurement Technology
https://youtu.be/6uNpTeS24k0

Jay Wolfe Toyota
https://youtu.be/9c8cKqj-Uo4



Eddy's Toyota
https://youtu.be/ccwEX-7c6Pw

Introduction to Wheel Alignment
https://www.hunter.com/inspection-quiz

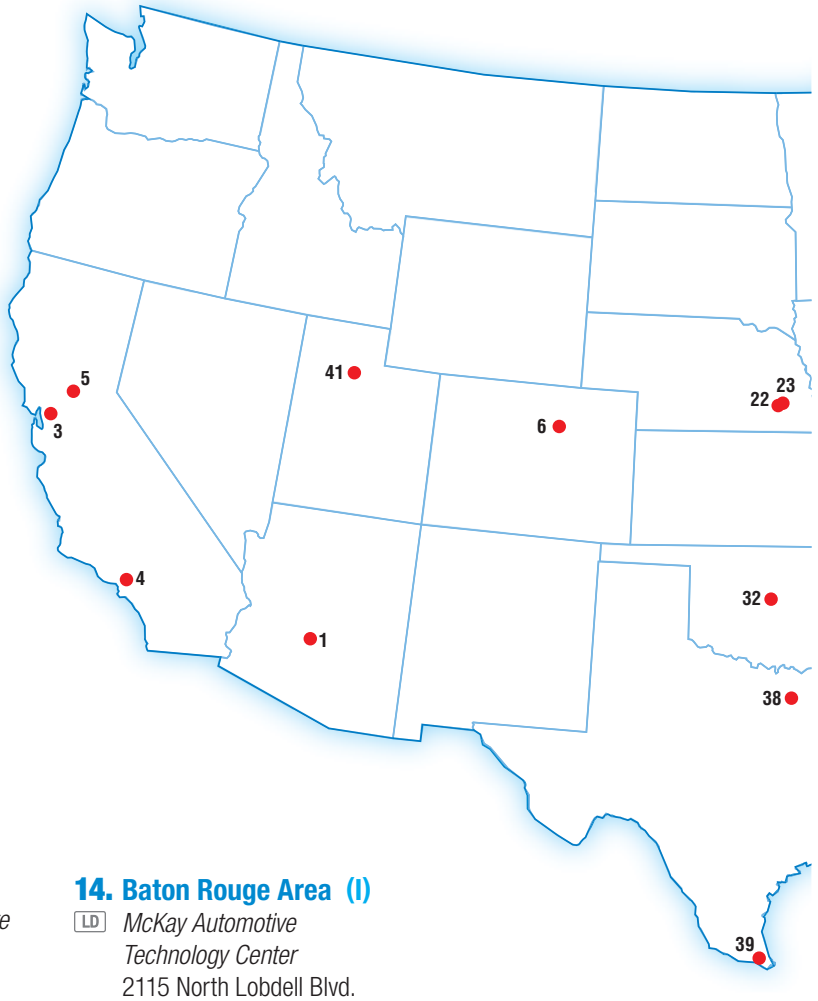
Communicating with the Customer
https://www.hunter.com/inspection-quiz

Hunter Training Centers in the United States

HUNTER TRAINING

HD Heavy-Duty Training Location

LD Passenger/Light-Duty Training Location



1. Phoenix Area (E)
LD *Mesa Community College*
1833 West Southern Avenue
Mesa, AZ 85202

2. Springdale Area (H)
HD *Northwest Technical Institute*
LD 709 S Old Missouri Rd.
Springdale, AR 72764

3. San Francisco Area (F)
LD *Chabot College*
25555 Hesperian Blvd.
Hayward, CA 94545

4. Los Angeles Area (F)
LD *Hunter Facility*
5 Holland, Ste. 119
Irvine, CA 92618

5. Sacramento Area (F)
HD *Universal Technical Institute (UTI)*
4100 Duckhorn Dr.
Sacramento, CA 95834

6. Denver Area (A)
LD *Pickens Technical College*
500 Airport Blvd.
Aurora, CO 80011

7. Waterbury Area (G)
LD *Naugatuck Valley Community College*
750 Chase Parkway
Waterbury, CT 06708

8. Jacksonville Area (I)
HD *Florida State College at*
LD *Jacksonville*
401 West State St.
Jacksonville, FL 32202

9. Orlando Area (I)
HD *Universal Technical Institute*
2256 West Taft-Vineland Road
Orlando, FL 32837

10. Atlanta Area (J)
LD *Hunter Facility*
5025 Old Ellis Pt., Ste. 100
Roswell, GA 30077

11. Joliet Area (D)
LD *Joliet Junior College*
1215 Houbolt Rd.
Joliet, IL 60431

12. Glendale Heights Area
HD (C)
Universal Technical Institute (UTI)
2611 Corporate W. Dr.
Lisle, IL 60532

13. Indianapolis Area (C)
LD *Ivy Tech Community College*
1331 East Washington St.
Indianapolis, IN 46202

14. Baton Rouge Area (I)
LD *McKay Automotive Technology Center*
2115 North Lobdell Blvd.
Baton Rouge, LA 70806

15. Auburn Area (G)
LD *Central Maine Community College*
1250 Turner St.
Auburn, ME 04210

16. Baltimore Area (J)
LD *Hunter Facility*
8975 Henkels Ln.
Annapolis Jct., MD 20701

17. Boston Area (G)
LD *MassBay Community College*
250 Eliot St.
Ashland, MA 01721

18. Boston Area (G)
HD *Universal Technical Institute (UTI)*
1 Upland Rd. #200
Norwood, MA 02062

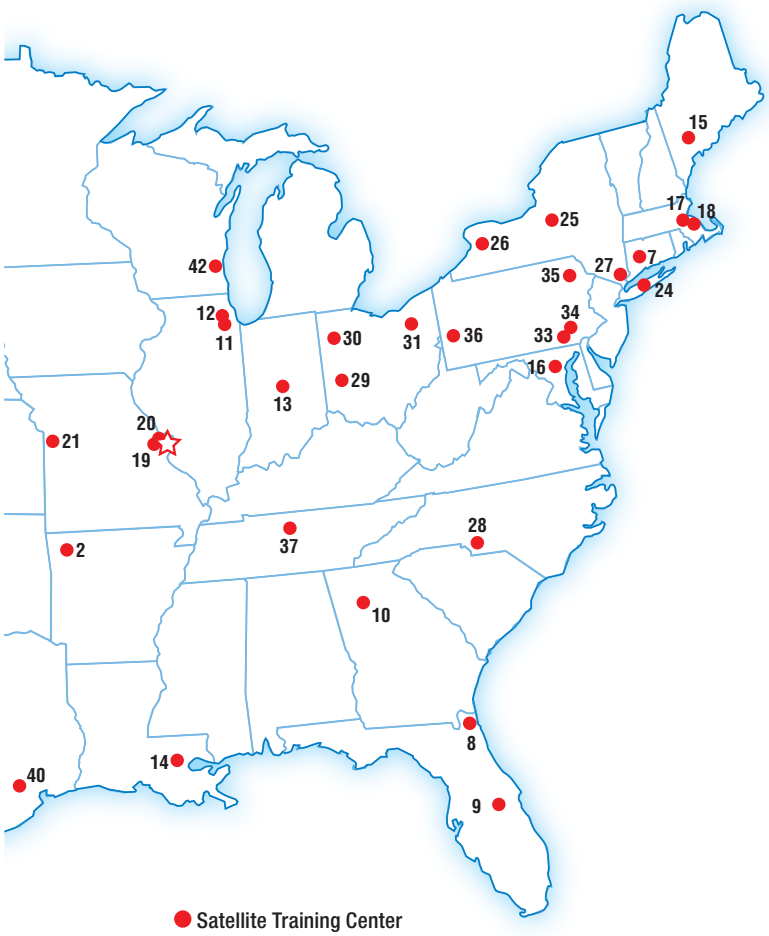
19. St. Louis Area (D)
HD *Ranken Technical College*
755 Parr Road
Wentzville, MO 63385

20. St. Louis Area (D)
LD *Federal Mogal*
3168 Riverport Tech Drive
Maryland Heights, MO 63043

21. Kansas City Area (H)
LD *Longview Community College*
500 SW Longview Rd.
Lee's Summit, MO 64081

22. Lincoln Area (H)
LD *Southeast Community College*
8800 O Street
Lincoln, NE 68520

www.hunter.com/training



Accredited Training Provider

23. Lincoln Area (H)
HD *Southeast Community*
LD *College*
600 State Street
Milford, NE 68405

24. Long Island (U)
LD *Suffolk Community College*
Automotive Technology Bldg
533 College Rd
Selden, NY 11784

25. Syracuse Area (G)
LD *Subaru Training Center*
8 Technology Blvd
Canastota, NY 13032

26. Buffalo Area (C)
LD *Erie Community College*
5885 Big Tree Rd.
Orchard Park, NY 14127

27. New York Area (G)
LD *Subaru Distributors Corp.*
6 Ramland Rd.
Orangeburg, NY 10962

28. Charlotte Area (J)
HD *Hunter Facility*
LD 521 Eagleton Downs Dr.
Pineville, NC 28134

29. Dayton Area (C)
LD *Sinclair Community College*
220 Edwin C Moses Blvd.
Dayton, OH 45402

30. Lima Area (C)
HD *University of Northwestern*
LD *Ohio*
1411 N. Cable Dr.
Lima, OH 45805

31. Canton Area (C)
LD *Stark State College*
Automotive Tech Center
5600 Whipple Ave. N.W.
North Canton, OH 44720

32. Oklahoma City Area
LD
Oklahoma City
Community College
7777 South May
Oklahoma City, OK 73159

33. Exton Area (G)
HD *Universal Technical*
Institute (UTI)
750 Pennsylvania Dr.
Exton, PA 19341

34. Lansdale Area (G)
LD *North Montco Tech*
Career Center
1265 Sumney Town Pike
Lansdale, PA 19446

35. Nanticoke Area (G)
LD *Luzerne County Community*
College
1333 South Prospect St.
Nanticoke, PA 18634

36. Pittsburgh Area (C)
LD *CCAC West Hills Center*
1000 McKee Rd.
Oakdale, PA 15071

37. Nashville Area (I)
HD *Lincoln College of*
LD *Technology*
1524 Gallatin Rd.
Nashville, TN 37206

38. Dallas Area (E)
HD *Hunter Facility*
LD 1812k Reliance Pkwy
Bedford, TX 76021

39. McAllen Area (E)
HD *Texas State Technical*
LD *College*
1902 North Loop 499
Harlingen, TX 78550

40. Houston Area (E)
LD *Lone Star College*
2700 W Thorne Blvd.
Houston, TX 77073

41. Salt Lake City Area (A)
LD *Salt Lake Community College*
9750 South 300 West
Sandy, UT 84070

42. Milwaukee Area (D)
LD *Waukesha County*
Technical College
800 Main St.
Pewaukee, WI 53072

Autonomous Inspection Primer — Key Points

Alignment

- The three most common symptoms of wheel alignment issue are:
  - crooked steering wheel
  - pull
  - premature tire wear
- A vehicle owner can notice a crooked steering wheel or vehicle pull, but not tire wear angles
- Front and rear total toe are primary tire wear angle concerns and have a fast rate of development
- Camber is also a primary tire wear angle, but develops much more slowly than toe wear
- Never before has a system been able to measure camber and total toe angles and compare them to manufacturer's specifications in less than one minute
- HunterNet® is a web-based information system providing all the necessary information a technician requires to perform the alignment

Tire Wear

- Common premature tire wear causes include:
  - improper inflation
  - excessive camber or toe
  - worn steering components
- Uneven tread depth is a visual indicator of premature tire wear
- Tire wear alone is a poor indicator of alignment condition — only 10% of vehicles with irregular wear need an alignment
- Tire wear patterns are permanent and will remain until the tire is replaced — even after a proper wheel alignment, the tire will still be flagged with irregular tire wear when tested

Connected Equipment

- Data gathered from connected equipment such as Quick Check Drive® and Quick Tread Edge® as well as accessories like external cameras is integrated through HunterNet®
- HunterNet® allows shops to operate more efficiently by eliminating the need for manual data re-entry and paper inspections
- Service advisors can provide an enhanced customer experience by quickly share diagnostic results with customers via Flightboard™ and ShopResults™
- Push Reports provide shop owners tools to manage their business and keep track of their service goals

HUNTER Engineering Company
www.hunter.com

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Form 7721-T, 09/19