USEPA SmartWay Trailer and Aerodynamic Device Program Policy Manual

Version 1

EPA United States Environmental Protection Agency

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Transportation and Climate Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

United States Environmental Protection Agency

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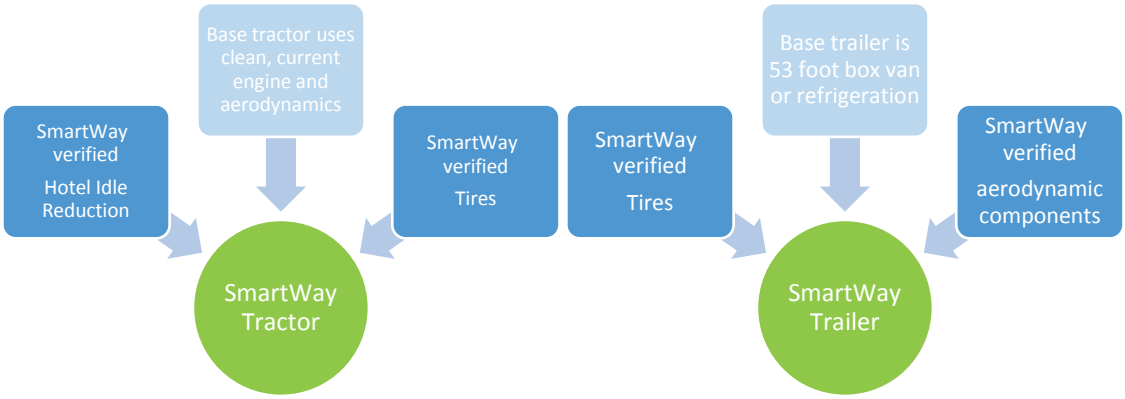
0.0 Purpose of the document

This document describes the policies of the U.S. Environmental Protection Agency's (EPA's) SmartWay Technology Program for SmartWay trailer designation and SmartWay trailer aerodynamic device verification. It is designed to work in conjunction with other EPA SmartWay documents including: the online listing of verified technologies; SmartWay test protocols; SmartWay technical papers; and the "frequently asked questions" (FAQ) document. While this document details how the programs work, the FAQ includes some context for certain policy decisions.

1. SmartWay Technology Program Overview

The EPA SmartWay Technology programs are a set of voluntary programs designed to assist fleets in finding the most fuel-efficient long-haul tractors and trailers available on the market. SmartWay verifies the fuel-savings performance of certain types of devices that can be used on a long-haul, Class 8 tractor or trailer. When these verified fuel-savings devices are installed on trucks, the trucks are eligible to be designated as SmartWay Trailers or SmartWay Tractors. This is illustrated in Figure 1.

Figure 1. Overall Requirements for SmartWay Tractors and Trailers



While many technologies may provide fuel savings, SmartWay only verifies technology types that have a variety of commercially available products, have validated fuel savings performance levels, and there is clear need to assist fleets in differentiating between individual products. The individually verified technology types are described in Table 1.

Table 1.
Overview of SmartWay-verified Technology Types

Technology Type	Description of SmartWay Verification Program	Performance Metric	Potential Fuel Savings at Highway Speeds
Low rolling resistance Tires	SmartWay verifies low rolling resistance tires and retread technologies that reduce fuel use at least 3% compared to popular baseline tires.	Tire and retread technology manufacturers must demonstrate that a tire model or retread technology has a rolling resistance coefficient at or below the designated target values that are specified for the steer, drive or trailer position using either the SAE J1269 or the ISO 28580 tire rolling resistance test method.* .	3% or more*
Trailer aerodynamic devices	SmartWay verifies trailer aerodynamic devices provide fuel savings that meet 1%, 4%, 5%, or 9% fuel savings.	Fuel savings meeting one of the following levels: 1%; 4%, 5%, or 9%.**	1-9% or more depending device or device combination*
Long-duration idle reduction	SmartWay verifies devices that provide truck drivers “hotel” services (8 hours) without using the main engine. These include auxiliary power units (APUs), battery operated units, fuel operated heaters, and thermal storage units.	Idle devices are verified at a single level to provide hotel services while using less fuel than idling the main engine.	***

* The actual rolling resistance that affects fuel economy is not the measured coefficient of rolling resistance for individual tires, but rather a weighted average of the rolling resistance force multiplied by the load placed on each axle.

** Fuel savings based upon a long-haul, combination tractor-trailer configuration at highway cruise (65mph) in controlled testing.

*** Fuel savings relative to idling a traditional tractor engine providing “hoteling” (i.e., long-duration idling of the main engine to satisfy mandated driver rest periods) services will vary depending upon the use of behavior and technological strategies. Savings can be significant depending upon a fleets operations and technology used.

While any fleet will benefit from using SmartWay designated tractor/trailers, and/or verified technologies, the SmartWay programs are intended to support SmartWay Partner fleets with long-haul operations to improve overall freight efficiency. SmartWay Partners know that how you use technology is as important has what technology you choose. Through streamlined freight operations, incorporating practices to accommodate the use of fuel-saving equipment, and proper maintenance, SmartWay Partners apply technology for maximum fuel savings and return on investment.

2. SmartWay Trailers

2.1 Why Should I Use a Designated Trailer?

Fleets that use a SmartWay Trailer can have confidence that the combination of verified tires and aerodynamic devices will provide fuel savings over a conventional trailer. These fuel savings are determined for typical long-haul, tractor-trailer based operations, making a designated trailer a good starting point for fleets that may not have extensive testing resources to determine the fuel savings specific to their operations.

Currently, SmartWay Partners that use a SmartWay Trailer or Tractor may request EPA permission to use a SmartWay logo on the outside of the vehicle. This shows that a fleet uses operational practices and SmartWay-verified technologies to deliver goods in the most efficient way.

Trailer manufacturers may create packages that qualify for SmartWay designation and request permission to use the SmartWay *internal logo* to show prospective buyers that the trailer is SmartWay designated. This internal logo is different than the external logo sticker that a fleet may use on its trailers. The internal logo is temporary and designed to help fleets decide which trailer(s) to purchase. The temporary logo is not used beyond the showroom.

2.2 What is a SmartWay-designated Trailer?

SmartWay van and refrigeration trailers use SmartWay-verified low rolling resistance trailer tires and SmartWay-verified aerodynamic devices. When used together, these tires and devices can total 6% or more fuel savings over traditional trailers. SmartWay trailers are currently limited to 53 foot box trailers that are “van” (i.e., non-climate controlled cargo bay) or refrigeration trailers used for the long haul operations. There are two levels of SmartWay designation for trailers that differ by the aerodynamic drag reduction achieved. These are detailed in Table 2.

Table 2. SmartWay Designation Criteria		
	SmartWay Trailer (53 foot van or refrigeration)	**SmartWay *Elite* Trailer** (53 foot van or refrigeration)
Tires	SmartWay-verified trailer tires	SmartWay-verified trailer tires
Aerodynamics	SmartWay-verified component(s) totaling **5%** or more	SmartWay-verified component(s) totaling **9%** or more

The SmartWay Trailer and SmartWay Elite Trailer designations apply to both van and refrigeration trailers. Because all verified aerodynamic components are tested on van trailers, some engineering judgment is necessary when fleets select components for use with refrigeration trailers. In cases of uncertainty, the fleet should consult the FAQ, SmartWay technical papers, and the EPA staff.

The SmartWay designation can apply to new trailers as well as existing trailers that are retrofitted with SmartWay-verified tires and aerodynamics.

2.2.1 Tires

EPA verifies new tires and retread technologies that are suitable for use on class 8 line haul tractor trailers.

New Tires

New tire manufacturers must demonstrate that a tire model has a rolling resistance coefficient at or below the target values (in kg force/metric ton) using either the SAE J1269 tire rolling resistance test method (with the conditions established in table 3 of SAE J1269) or the ISO 28580 rolling resistance test method.

For multi-position new tires, if the tire qualifies for verification as a trailer tire, it may qualify for verification at all positions. If it qualifies for verification as a steer tire, it may also qualify for verification as a drive tire. Because some tires are intended for specific operations, consult with the tire manufacturer and SmartWay-verified list to determine if a tire is appropriate for your application.

A minimum sample of three tires is to be tested. The average rolling resistance coefficient of the sample is the value to be compared with the new tire target values listed Table 3.

Table 3. New Tire Equivalent Target Values (Rolling Resistance Coefficent in kg-force/metric ton)			
	Steer	Drive	Trailer
J1269 Application Test Point[1] (1.7 m drum)	6.6	7.0	5.5
J1269 Test Point 2 (1.7 m drum)	6.7	6.9	5.5
J1269 5-point Average (1.7 m drum)	6.9	7.0	5.6
ISO 28580 (2 m drum or corrected to 2 m drum)	6.5	6.6	5.1

Retread Technologies

Manufacturers of retread technologies must demonstrate that the tread has a rolling resistance coefficient at our below the retread target values using the ISO 28580 rolling resistance test method.

Prior to testing, the retread technology/tread is affixed to a new tire casing that has been buffed (i.e., tread removed) to a specified depth using the applicable retread manufacturing process. Either a standard or an alternate test casing is used in testing. Typically, a standard test casing is used for all treads for conventional width tires (dual tire axle configurations). Manufacturers wishing to test using an alternate casing must contact EPA to receive approval prior to testing.

For retreads used on single-wide tires, manufacturers may request to use an alternate casing made from any currently EPA verified single-wide new tire.

A minimum sample of three retreads are tested. The average rolling resistance coefficient of the sample is the value to be compared with the retread technology target values listed Table 4.

Table 4. Retread Technology Target Values		
Retread Technology Target Values (Rolling Resistance Coefficent in kg-force/metric ton)	Drive	Trailer
ISO 28580 (2 m drum or corrected to 2 m drum) Standard Casing	7.2	6.0
ISO 28580 (2 m drum or corrected to 2 m drum) Alternative Casing	6.5	5.4

2.2.2 Aerodynamics

For fleets interested in aerodynamic devices for trailers, the SmartWay online list of verified products is a good place to start. Each product is placed into performance bins of 1%, 4%, 5%, or9% or more fuel savings over traditional trailers. In general, these performance bins do not prescribe a specific device type (e.g., skirt, end-fairing) but there are some constraints. Table 5 shows the performance bins.

Table 5.
Description of SmartWay Aerodynamic Device Bins

Bin	Examples of Devices
1% (1.0-3.9%)	Front Fairing ("nose")
4% (4.0-4.9%)	Side Fairing ("skirt") End Fairing ("tail") Undertrailer tray or package
5% (5.0-8.9%)	Side Fairing ("skirt") End Fairing ("tail") Undertrailer tray or package
9% (9.0 or more)	Package of components used together

Note: Fuel savings bins are based upon a long-haul, combination tractor-trailer configuration at highway cruise (65mph) in controlled testing.

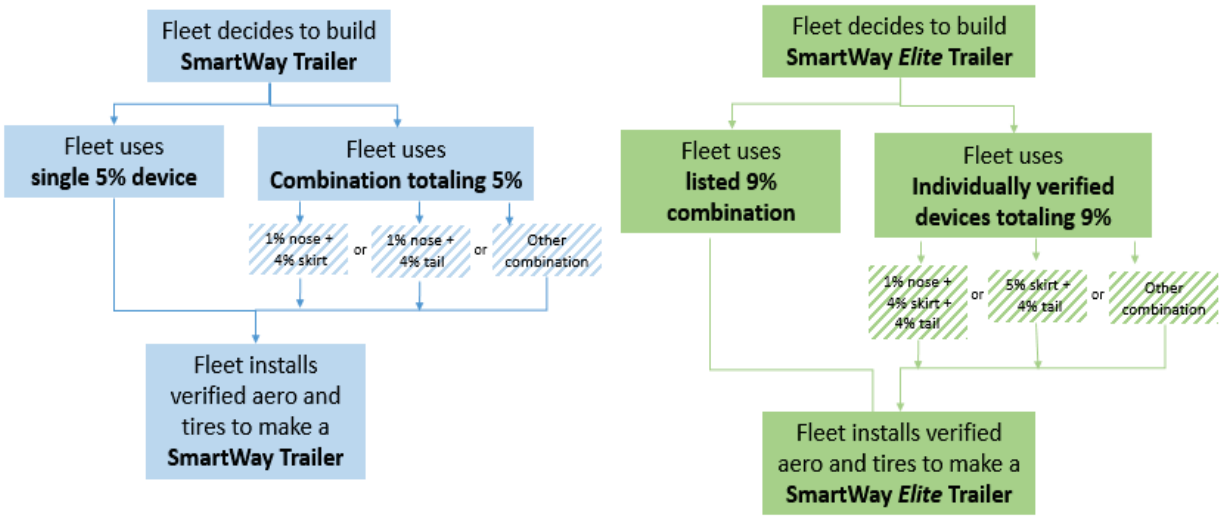
Using the SmartWay aerodynamic device verification webpage, fleets can select individual devices to meet their performance needs, or a combination of devices that total the desired level of fuel savings. For example, the SmartWay trailer threshold of at least 5% fuel savings could be achieved by using a 5% device alone, or by combining a 1% and 4% device. A SmartWay Elite trailer designation could be achieved by using a 9% package (2 or more devices verified together) or pairing a 4% and a 5% device that were verified individually. Figure 2 illustrates the flexibility fleets have when choosing verified components.

When combining devices verified individually, a fleet should understand that the overall performance may be somewhat different than the simple sum of the devices' individual fuel savings (i.e. a 4% device plus a 5% device may not always total 9% in fuel

savings). For these cases, fleets should evaluate the combined performance of their unique package in their operations. Consulting with the

To avoid uncertainty in fuel saving performance, SmartWay encourages fleets to use verified packages (i.e., components tested together) listed on the EPA website. Verified packages consist of two or more trailer devices tested together to demonstrate a satisfactory fuel savings through SmartWay's testing protocols. EPA will only list combinations of devices as a verified 9% package if they've demonstrated they work together by being tested in that configuration using SmartWay protocols.

Figure 2. Examples of Fleets' flexibility in meeting trailer aerodynamic criteria



3. SmartWay Trailer Aerodynamic Devices

3.1 Why verify a trailer aerodynamic device?

For a device to qualify a trailer for SmartWay designation, the aerodynamic component must be SmartWay verified. Hence, aerodynamic device manufacturers are strongly encouraged to apply for SmartWay verification for their device(s). Using a SmartWay Trailer is important to fleets that want to improve their fuel efficiency and may aid fleets operating in California[2].

Manufacturers that verify their trailer aerodynamic devices increase the confidence their customers have that the product will work for a long-haul fleet.

[2] The California Air Resources Board (CARB) heavy-duty, tractor-trailer regulation requires fleets operating in California to use SmartWay Trailers but does provide some exemptions. Any fleet operating in California should contact CARB to determine if they must comply with the rule.

Verification through SmartWay's robust protocols and review process can be critical to product acceptance.

3.2 What are SmartWay-verified aerodynamic devices?

SmartWay verifies aerodynamic equipment for use on long-haul, box and refrigerated trailers. SmartWay "verifies" the fuel saving performance of these devices or combinations of devices relative to a traditional baseline trailer (no aerodynamics components used). The fuel saving performance is based on manufacturer conducted testing using SmartWay's testing protocols.

The SmartWay testing protocols indicate performance at highway cruise conditions (65 mph), with a specific tractor-trailer configuration. Tests are conducted in controlled testing conditions to facilitate comparison of different tests – an apples-to-apples comparison. Fleets operating largely at high cruise speeds with similar configurations will achieve in-use performance most similar to the test results. Fleets may want to use engineering judgment to project how a device may perform for their unique operating conditions. EPA has presented research to assist fleets in understanding how their real-world results may vary from controlled test results.

SmartWay-verified aerodynamic devices are verified based upon manufacturer provided data using at least one SmartWay testing protocol. The method(s) used to verify a device is indicated by having one or more marks ("✓" or "★" symbol) in the appropriate column(s) in the online verified device table. For devices verified prior to 2014, the manufacturer used a track test protocol based on an industry standard with additional SmartWay constraints.[3] These devices are still considered verified and have a "✓" in the "Pre-2014 SmartWay Track Test" column. In this case, the previously verified devices may be re-tested using one of the 2014 protocols to add an additional mark ("✓" or "★" symbol) for each new method used. *(See section 3.4 for an explanation of the "✓" and "★" symbols.)*

SmartWay encourages all previously verified manufacturers to update their testing with the 2014 protocols to increase fleet confidence in their devices' performance. Devices newly verified (in 2014 and later) were tested using one or more of the updated protocols. These would not have a "✓" in the "pre-2014" column but would indicate the 2014 method(s) used in the verification. Figure 3 below illustrates the new matrix format for the online listing of SmartWay verified aerodynamic devices.

[3] The original SmartWay track test was based on the Society of Automotive Engineers Fuel Consumption Type II Procedures (SAE J1321, 1986 reaffirmed) with additional, SmartWay-specific constraints.

Figure 3. Illustration of new format of online SmartWay verified aerodynamic devices listing

Device Name	SmartWay Verification Pre-2014	Wind Tunnel (2014)	Coastdown (2014)	Track Test (2014)	CFD (2014)
Elite Category (9% or Better Fuel Savings)					
Package 1		✓			
Package 2		✓			
Package 3		✓		✓	
5% Fuel Savings					
Skirt 1	✓	✓			
Tail 1			✓	★	
Skirt 2	✓	✓			
Skirt 3	✓				
System 1			✓		★
4% Fuel Savings					
Skirt 4	✓			✓	
Tail 2	✓				
1% Fuel Savings					
Tail 3	✓				
Nose 1	✓				

In some instances, EPA may archive a verified device by moving it from the verified listing to the archive listing. Both of these are online. SmartWay may archive a technology at any time if it is no longer commercially available or if other significant issues arise. Archived products are still considered verified but fleets are encouraged to use currently verified models. The archive listing will indicate the year in which a product was archived.

3.3 How do fleets use verified devices?

Fleets using SmartWay verified aerodynamics devices on their trailers can have confidence the devices have demonstrated fuel savings under highway cruise conditions. While some fleets may make fuel saving projections based solely on the verified list, its common practice for fleets to conduct additional evaluation of how the device(s) perform in their day-to-day operations.

A fleet can select a trailer aerodynamic product by name from the SmartWay online listing. This matrix only lists products that have been verified using SmartWay protocols. In cases where the product includes more than one component, fleets know that they were tested together if it is listed under a single name and must be used in the tested configuration to realize the verified performance levels. For Elite packages, a fleet selecting one that is listed by name knows that it was tested in that configuration.

Will it work in my fleet?

SmartWay has conducted research to help fleets understand how to translate results from controlled verification testing to performance projections in their own operations. This includes understanding the trends at slower operational speeds, different equipment settings (e.g., different tractor-to-trailer gaps, different trailer axle positions), and other key parameters. For more information, please refer to the SmartWay webpage and links to SmartWay research.

Fleets have the flexibility to select individually verified products from performance bins and add them to reach a fuel-savings goal. For example, a 1% device may be added to a 4% device to total 5% fuel savings. Fleets can do the same to make additive "ad-hoc" SmartWay Elite packages. While this additive flexibility can be useful – especially where a trailer may already have a device and the fleet wants to add a complementary component – fleets should understand that the benefits may vary from the simple addition of the projected fuel savings.

Fleets using a simple performance-addition approach should plan for additional variability in return on investment calculations. Fleets must also exercise good engineering judgement and avoid combining individually verified devices that may not be aerodynamically complementary (e.g., side skirts and undertray systems, small tails with large tails, etc). Fleets should consult with SmartWay or the manufacturer if they have questions regarding combining individually verified product that may not be aerodynamically compatible.

Fleets should review the online verified product matrix to see which verification method or methods (i.e., track test, wind tunnel, coastdown, or CFD) were used to verify the product performance. Fleets may use products verified using a method they prefer or consider products tested using multiple methods.[4] Verified products tested using more than one SmartWay protocol will have mark in more than one column. A check ("✓") will be used for the verification method and an additional mark for any additional methods where the manufacturer has tested using that SmartWay protocol. See Figure 3 for an illustration. Find the listing at: http://www.epa.gov/smartway/forpartners/technology.htm under the aerodynamics tab.

[4] Note that different methods provide slightly different types of results. EPA has provided brief introductions to each 2014 test method that will help fleets understand the strengths and weakness of each type of testing.

3.4 How do manufacturers verify devices?

Manufacturers of commercially available trailer aerodynamic devices may request to have their products verified by SmartWay. Verification can only be obtained through applying to SmartWay and device testing. The manufacturer(s) must conduct testing at their own expense using SmartWay verification protocols. Products may not be verified by claiming that they are similar to another previously verified device. Manufacturers of a previously verified device must notify SmartWay if they wish to modify the device in a way that could impact its aerodynamic performance. Whether it is a new product or a potential modification to a previously verified device, the process always begins with contacting SmartWay via the Tech_Center@epa.gov mailbox.

Once the manufacturer has contacted SmartWay and received approval from EPA for its test plan, the manufacturer will test the product using one or more of the SmartWay protocols. These may be found online at http://www.epa.gov/smartway/forpartners/manufacturers.htm. EPA reserves right to observe testing performed for the purpose of SmartWay verification. EPA may ask the manufacturer questions regarding the product (e.g., its intended use, dimensions and mechanical details, and operating principle) or its testing. At the conclusion of testing, the manufacturer must submit the test report using the SmartWay format. While the device manufacturer may contract with a testing organization, EPA considers the device manufacturer the applicant and responsible for all materials submitted in the verification process. EPA will review the report and determine if the device has properly demonstrated fuel savings using SmartWay test protocols. If so, SmartWay verification is granted through letters to the manufacturer and product posting on the SmartWay web page.

What constitutes a modification?

Modifying equipment to meet a fleet's needs is a part of the trucking business. While SmartWay understands there may be some refinement of a product to fit a fleet requirement, the fuel savings are verified for only the configuration tested. Modifying it may change the projected benefit. Manufacturers of a previously verified device must notify SmartWay if they wish to modify the device in a way that could significantly impact its aerodynamic performance based upon sound engineering judgement. EPA reserves the right to either: approve the modification through testing; or, identify the prospective change as a new product. Modifications will not be listed separately but may be noted as part of the original listing. SmartWay may determine the device is "new" if is substantially different from previously verified device in its characteristics or its principles of operations.

SmartWay verification of aerodynamic devices is based upon fuel savings relative to a traditional tractor-trailer at highway cruise (i.e., 65mph). When using the track test protocol it is necessary to use the "percent fuel saved" result and not the "percent improvement." Fuel savings results are reported to the one-hundredths place – that is, two decimal places such as "5.65%." However, for determination of aerodynamic bins SmartWay will truncate the reported result to make an integer. For

example, “5.65%” would be considered a “5%” for determining bins. A “4.93%” would be place into the “4%” bin.

When products are tested using multiple SmartWay protocols, it is possible to get slightly different results. Devices will be binned based upon the first verification testing method submitted to SmartWay. Optional, supplemental testing using other methods will be reviewed by EPA and, if it meets the same threshold (i.e., a device verified at 4% producing results of 4.15% fuel saved using a second method) using a SmartWay protocols, it will earn the product a secondary check (“✓”) in the online verified device matrix for that method. In other words, to earn a check (“✓”) for the verification for any additional test methods, the results must meet the threshold for the same category. Devices from all the verification categories (i.e., 1%, 4%, 5%, and 9%) have the opportunity to earn additional marks for using additional SmartWay protocols providing they meet the same threshold outright.

When reviewing results from a secondary test method for a device already verified in the 5% or 9% categories, EPA will apply a tolerance. In cases where the second result is no more than -1% fuel savings below the first result, EPA will approve this test and different mark (“★” symbol) will be added to the appropriate column. For example, SmartWay may verify an Elite package based upon the first test method used by the manufacturer. This result must exceed 9% fuel savings. If the same device is tested using another method, SmartWay would apply a 1% tolerance – that is 8% or greater fuel savings – in order to receive a star (“★” symbol) in the column for that method. Table 6 summarizes the use of the different symbols. *(See Figure 3 for an illustration of the use of symbols in the verification table.)*

Manufacturers wishing to be verified may test and submit data using the SmartWay track test, wind tunnel, or coastdown protocols. While use of computational fluid dynamics (CFD) programs to evaluate trailer aerodynamic products is encouraged, currently EPA will review CFD as supplemental testing. That is, EPA will evaluate CFD for a product verified using another method, and determine if the technology performance qualifies for a mark (“✓” or “★”) in the CFD column. As the SmartWay program evaluates CFD methods with trailer technologies, this CFD verification policy may change based upon EPA research as well as input from fleets, manufacturers, and testers.

Table 6. SmartWay Aerodynamic Verification Table and Using Different Symbols	
Verification Category	Earning a SmartWay Mark
1% fuel savings	✓ indicates ***verification*** test above 1% fuel saved
	✓ for any additional result above 1% fuel saved
4% fuel savings	✓ indicates ***verification*** test above 4% fuel saved
	✓ for any additional result above 4% fuel saved
5% fuel savings	✓ indicates ***verification*** test above 5% fuel saved
	✓ for any additional result above 5% fuel saved
	★ for any additional result above 4% fuel saved
9% fuel savings	✓ indicates ***verification*** test above 9% fuel saved
	✓ for any additional result above 9% fuel saved
	★ for any additional result above 8% fuel saved

4.0 SmartWay label and trademark

Manufacturers with equipment meeting the SmartWay-designated and SmartWay-designated *Elite* trailer specifications may be eligible to use official SmartWay graphics. The SmartWay Graphics Standards and Usage Guide (http://www.epa.gov/smartway/forpartners/documents/logo-use/420b11014.pdf) provides for general information regarding logo use. Current SmartWay licensees (trailer manufacturers) have a signed EPA-designated SmartWay Mark License Agreement on file with U.S. EPA. Updated versions of the guide and agreement that address technical specifications, graphics standards and logo usage will be available in the next several months.

5.0 SmartWay resources

SmartWay technology programs are intended to help fleets find the fuel saving technologies that provide real savings and work for their operations. As a result EPA provides a variety of technology resources for fleets. These are summarized below in Table 7.

Table 7. SmartWay Technology Resources		
Resource	Description	How to find it
Trailer webpage	Introduction and gateway to the trailer program.	http://www.epa.gov/smartway/forpartners/technology.htm. Use the trailer tab.
Aerodynamics webpage	Introduction and gateway to the trailer aerodynamic device program.	http://www.epa.gov/smartway/forpartners/technology.htm. Use the aerodynamics tab.
Policy manual & FAQ	Comprehensive description of the SmartWay trailer and aerodynamics programs.	http://www.epa.gov/smartway/forpartners/technology.htm.
Protocols	Test protocols used by manufacturers to become verified.	http://www.epa.gov/smartway/forpartners/manufacturers.htm
Program fact sheets	Introduction to SmartWay trailer and aerodynamics programs.	http://www.epa.gov/smartway/forpartners/technology.htm
Test method fact sheets	Easy to read introduction to test methods allowed for SmartWay verification.	http://www.epa.gov/smartway/forpartners/technology.htm
Verification application	Starting point for a manufacturer to apply for verification.	http://www.epa.gov/smartway/forpartners/manufacturers.htm
SmartWay Technology Bulletins	Descriptions of technologies that may save fleets fuel. These include some technology types that fall outside of SmartWay verification programs.	http://www.epa.gov/smartway/about/outreach.htm. Scroll down to the “fuel efficient technologies and strategies” section.
EPA technical white papers	Summaries of EPA research that focus on practical conclusions fleets can use.	*Coming soon*