



Understanding Wheel Offset and Backspacing

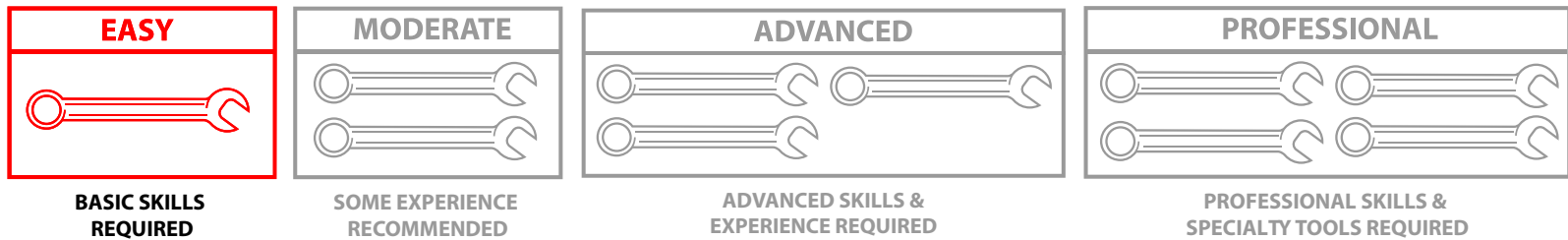


Proper service and repair procedures are vital to the safe, reliable operation of all motor vehicles as well as the personal safety of those performing the repairs. Standard safety procedures and precautions (including use of safety goggles and proper tools and equipment) should be followed at all times to eliminate the possibility of personal injury or improper service which could damage the vehicle or compromise its safety.

INTRODUCTION

ECS Tuning Technical Writings: Understanding Wheel Offset and Backspacing

Why install wheels with different offset and backspacing? For performance and looks both. Wider tires and an increased track width can create a dramatic improvement on traction and handling. Many cars simply look better with larger and wider wheels and tires, especially when looking for an aggressive stance. So whether you are improving the looks of your car or modifying your suspension for performance on the track, there are many different reasons that require different wheel sizing. This technical guide will help you understand the different measurements and how to determine the correct wheel fitment for your car.



Wheel Offset and Backspacing, while two different measurements, are both equally as important and are used in conjunction with each other. When you know one, you can calculate the other. It is very important to understand both and to consider both measurements when determining the best wheel for your car.

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GENERAL PREPARATION AND SAFETY INFORMATION

ECS Tuning cares about your health and safety. Please read the following safety information. This information pertains to automotive service in general, and while it may not pertain to every job you do, please remember and share these important safety tips.

- Park your car in a safe, well lit, level area.
- Shut the engine off and remove the key from the ignition switch.
- Make sure any remote start devices are properly disabled.
- Always wear safety glasses.
- Make sure the parking brake is applied until the vehicle is safely lifted and supported.
- If using an automotive lift, be sure and utilize the factory specified lift points. Lifting a vehicle in an incorrect location can cause damage to the suspension/running gear.
- When lifting a vehicle using a jack, always utilize the factory specified lift points. Lifting a vehicle in an incorrect location can cause damage to the suspension/running gear. Always support the vehicle with jack stands.
- Always read and follow all safety information and warnings for the equipment you are using.



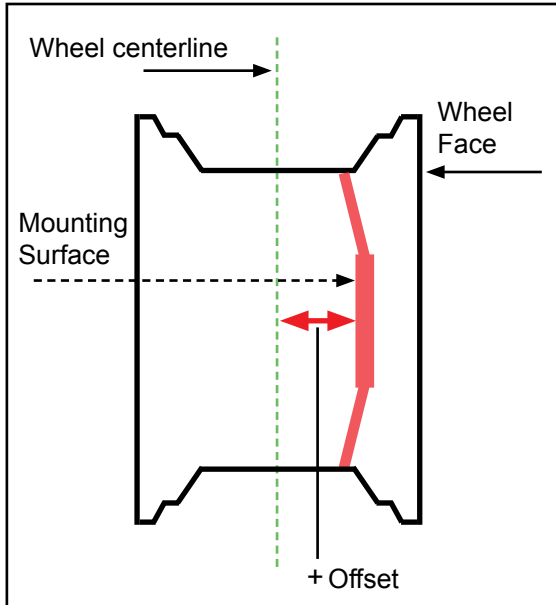
Never get underneath a vehicle that is supported only by a jack. Always make sure that the vehicle is securely supported on jack stands.

UNDERSTANDING WHEEL OFFSET AND BACKSPACING

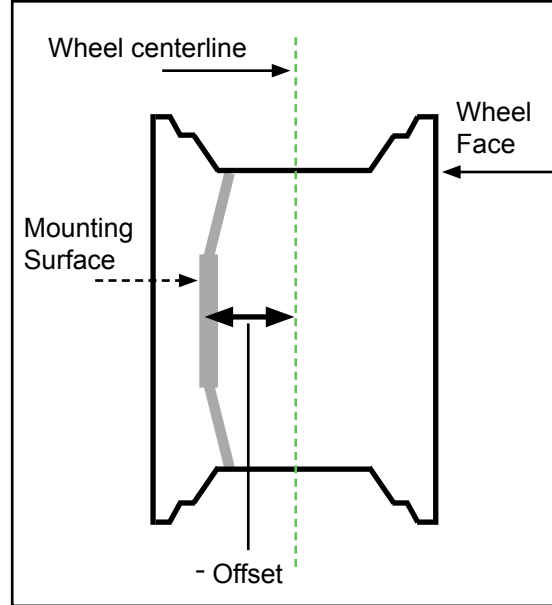
Wheel offset is a measurement that indicates the position of the wheel mounting surface in relation to the wheel centerline. Measured in millimeters, it will be either positive, negative, or zero. Positive offset results when the mounting surface is towards the front, or outside of the wheel. Negative offset results when the mounting surface is towards the back, or inside of the wheel. Zero offset results when the mounting surface of the wheel is even with the centerline.

Most wheels will have the offset measurement stamped into the wheel, usually preceded by the letters "ET". The abbreviation "ET" originates from the german word for offset, "Einpresstiefe". An example of a common offset measurement would be "ET30", which would indicate a positive offset of 30 millimeters.

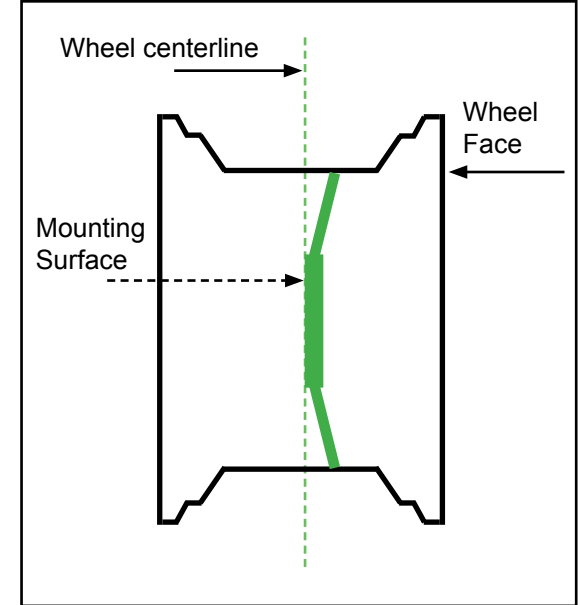
Positive Offset



Negative Offset



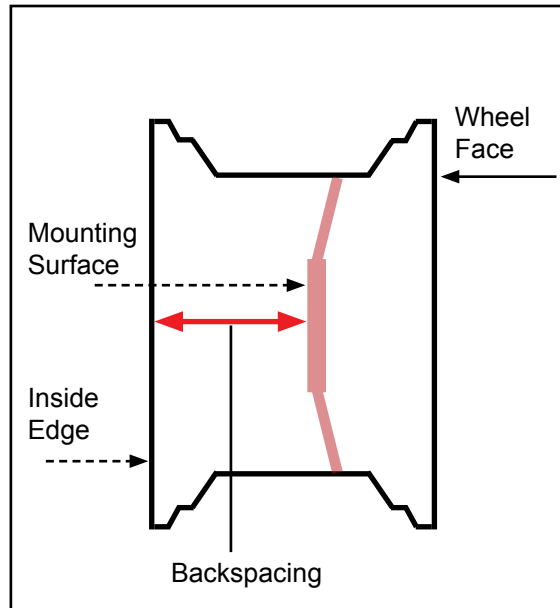
Zero Offset



UNDERSTANDING WHEEL OFFSET AND BACKSPACING

Backspacing is a measurement that indicates the distance between the back, or inside edge of the wheel and the mounting surface. Generally measured in inches, it is a single measurement always indicated as a positive number.

Backspacing

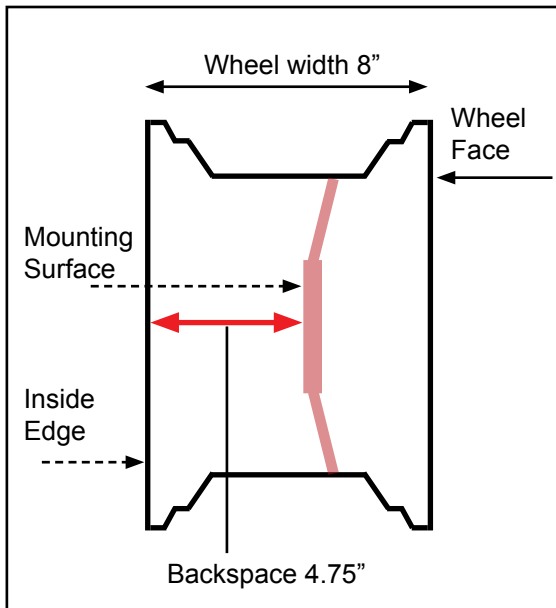


You might ask why there are two different measurements? Backspacing is still a common term and in widespread use, but primarily for wheels that are designed for older American cars and trucks. As the American car industry grew from the 1950's through the 1980's, not much changed in the way of suspension and steering technology. Almost everything had a solid rear axle and an A-arm front suspension with spindle mounted drums or rotors. There were very few changes in wheel diameter and width. The most common, and practically the only modification that most people did was putting wider wheels and tires in the rear to get more horsepower to the ground. Since the overall body structure was very similar between all makes and models, the only concern you had was if wider tires would rub on the inside. As a result, you only needed to measure the inside clearance, and American aftermarket wheel companies provided us with the backspacing measurement we needed. There were generally only a couple different choices of backspace for any given wheel, and that was all that was needed to get the right fit for your car.

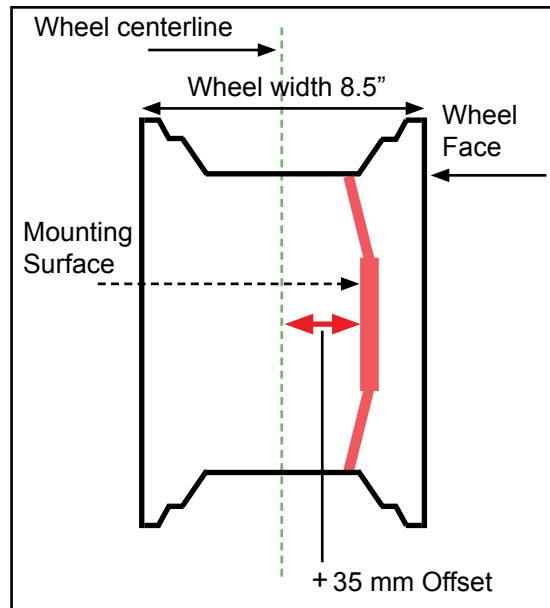
The term "offset" has always been the standard in Europe. As the European car industry grew through the mid 1900's, much more emphasis was put on the handling characteristics of the cars they produced than American cars of the same time. Europe was a series of twisty, winding roads and tight spaces, much different than the wide open long straight roads of America. Wheel offset was just one of the critical dimensions built into the steering and suspension design of these cars, and all components were designed to work together. As the European car market became widespread in America, it brought with it suspension technology and European design principles. Along with the desire for superior handling, we have adopted the terminology that goes along with it, and "Offset" is now part of our everyday language.

UNDERSTANDING WHEEL OFFSET AND BACKSPACING

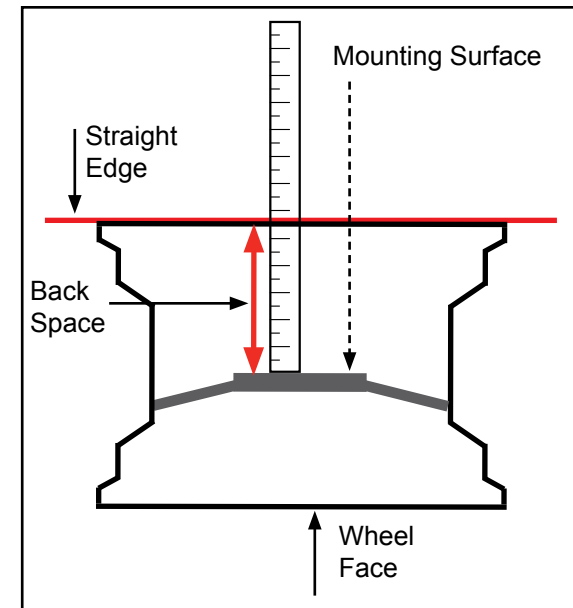
When you know the wheel backspacing and wheel width, you can calculate offset. When you know the offset and wheel width, you can calculate backspacing.



In this example, the wheel width is 8" and the backspace is 4.75". We can easily calculate that the wheel centerline is at the 4" mark. Since backspacing is always measured from the inside edge of the wheel, we know that the mounting surface is .75" past the centerline towards the wheel face, or an offset of positive .75". Since there are 25.4mm in an inch, we multiply $25.4 \times .75$ and get 19.05mm positive offset.



In this example, the wheel width is 8.5" and the offset is positive 35mm. We can easily calculate that the wheel centerline is at the 4.25" mark. If we divide 35mm by 25.4, we get 1.38 inches. We then add 1.38" to 4.25" and we get a backspace measurement of 5.63".



To measure backspacing, place a straight edge across the inside edge of a wheel, then measure straight down to the wheel mounting surface.

UNDERSTANDING WHEEL OFFSET AND BACKSPACING

The primary use for the wheel offset measurement is to keep the relationship between the wheel mounting surface and the centerline of the wheel as close as possible to the original wheel specifications, in order to keep steering and suspension geometry the same.

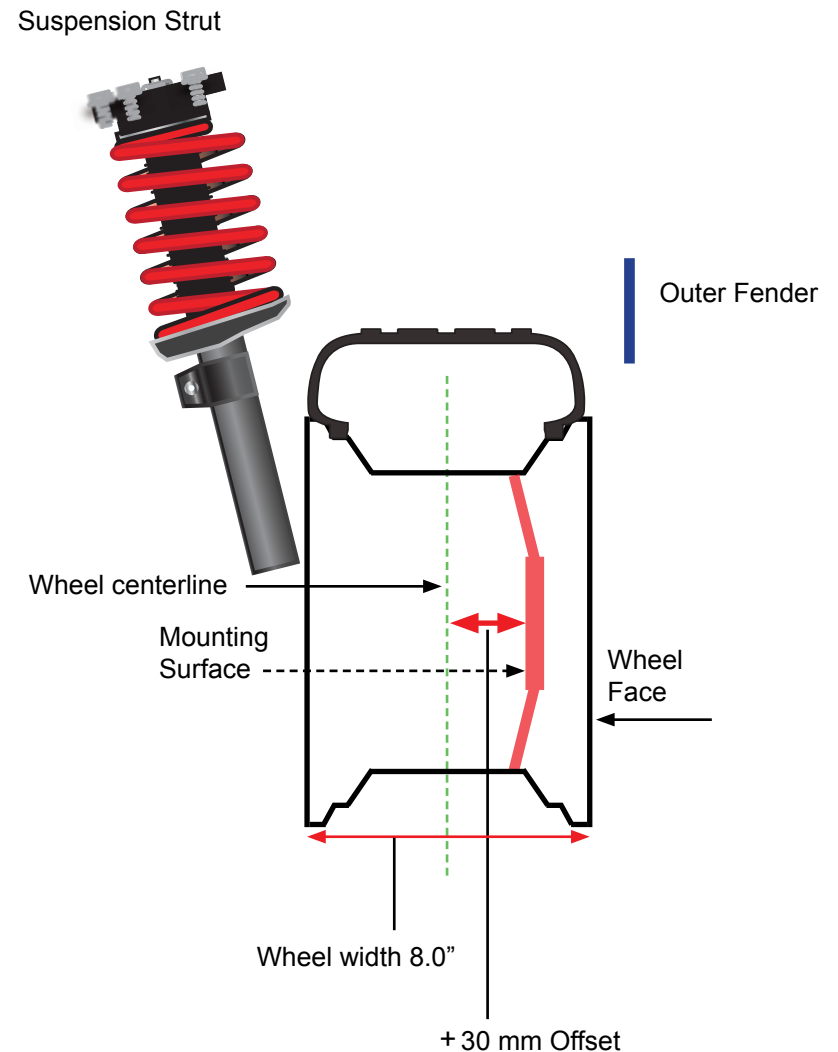
The primary use of the backspacing measurement is to determine inboard clearance.

It's important to understand both measurements. To help clear this up, let's begin with an example of what happens when you change wheel size, and then we'll look at the advantages and disadvantages of changing wheel offset and backspace.

Let's say that you decide that you would like to install wider tires on your car. You learn that in order to install wider tires, you must first purchase wider wheels.

The original wheels on your car are 18" in diameter, have a width of 8.0" and an offset of positive 30mm. You decide to calculate backspace. The wheel centerline is 4.00" You divide 30mm by 25.4 and get 1.18". 1.18" added to 4.00" gives you a backspace of 5.18".

You notice that you have plenty of clearance on the outside between the wheel/tire and the outer fender and also plenty of clearance on the inside between the wheel/tire and the suspension strut.



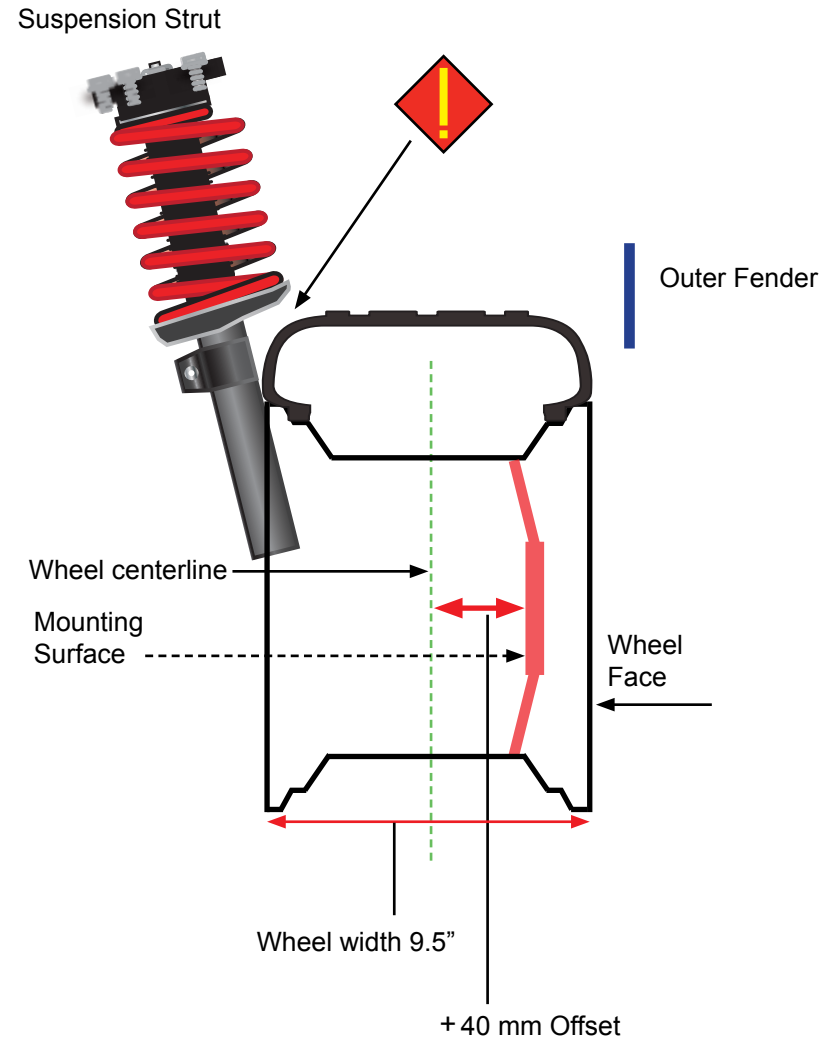
UNDERSTANDING WHEEL OFFSET AND BACKSPACING

A friend of yours has a set of 18" x 9.5" wide wheels with wider tires that they let you try on your car. You install them and you find that while you have plenty of clearance between the outside of the wheel/tire and the outer fender, you have very little clearance on the inside and the wheel/tire is in danger of hitting the suspension strut.

You find a marking on the wheel that says "ET40" so you know that these wheels have a positive offset of 40mm.

You decide to calculate the backspace. The wheel centerline is 4.75". You divide 40mm by 25.4 and get 1.57". 1.57" added to 4.75 inches gives you a backspace measurement of 6.32"

You really like how wide these wheels are and would like to figure out how to put this width on your car but leave more clearance between the wheel/tire and suspension strut. You think that there is plenty of room to move the wheel outward but decide to figure it out to be sure.



UNDERSTANDING WHEEL OFFSET AND BACKSPACING

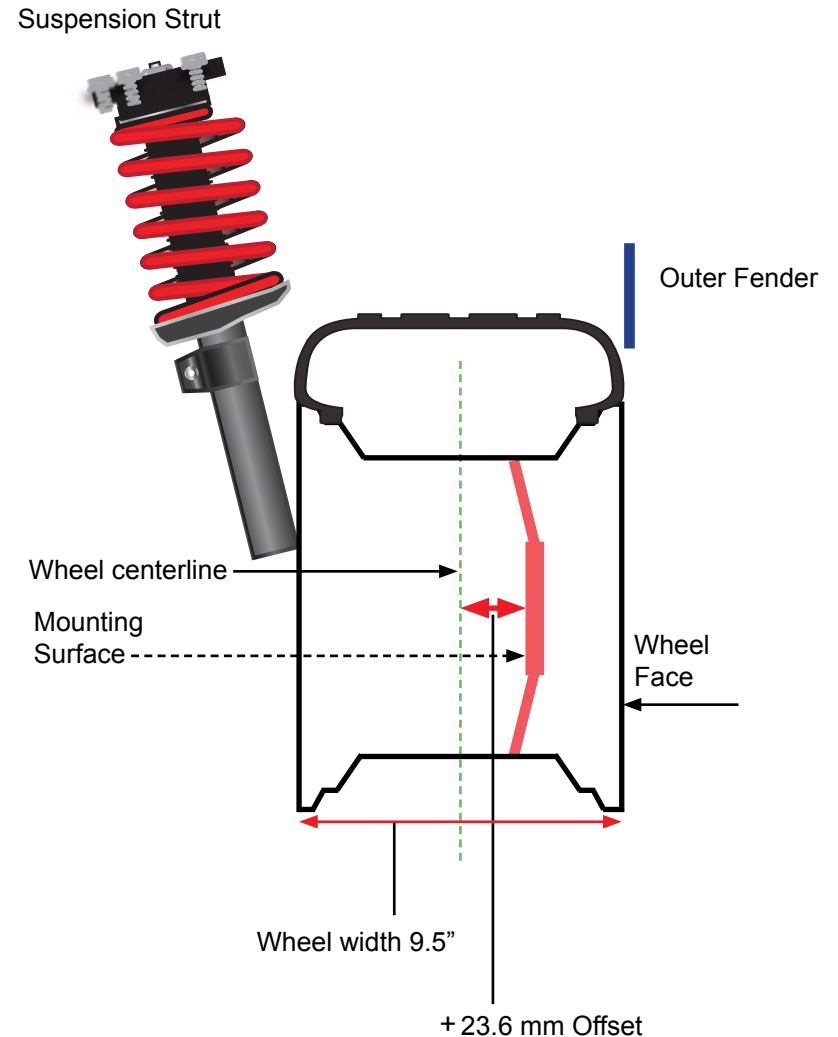
You take some measurements between your original wheel and suspension strut, then between your original wheel and outer fender. You decide that to be safe and still allow for plenty of clearance, you have an additional .5" available on the inside and an additional 1.00" available on the outside.

You want to use 9.5" wide wheels. The backspace on your original wheels is 5.18". Based on your measurements, you know that the backspace could be increased to 5.68" (because you have an additional .5" of clearance available on the inside).

So now you know that you want a backspace of 5.68" on a wheel that is 9.5" wide. The wheel centerline is 4.75". You subtract 4.75" from 5.68" and get .93". You then multiply .93 by 25.4 and get 23.6mm. So now you know that a positive 23.6mm offset on a 9.5" wheel will give you plenty of clearance between the wheel/tire and suspension strut. But will it clear the outer fender? ($5.63 - 4.75 = .93$) ($.93 \times 25.4 = 23.6\text{mm offset}$)

Your original wheels are 8.0" wide with a positive offset of 30mm. The original wheel centerline is 4.0". You divide 30mm by 25.4mm and get 1.18". You subtract 1.18" from 4.0" and get 2.82". So you know that the wheel face is 2.82" outside of the wheel mounting surface. ($30/25.4 = 1.18$) ($4.0 - 1.18 = 2.82$)

To calculate this distance on the 9.5" wheel, you divide the offset of 23.6mm by 25.4mm and get .93". You then subtract .93" from 4.75" and get 3.82". You then subtract 2.82" from 3.82" and you get 1.0". So you know that the wheel face will sit 1.0" further out. You have 1.0" available, so it will be a perfect fit! ($23.6/25.4 = .93$) ($4.75 - .93 = 3.82$) ($3.82 - 2.82 = 1.0$)



UNDERSTANDING WHEEL OFFSET AND BACKSPACING

Even though there are some advantages and benefits of making changes to wheel offset and backspacing, there are some disadvantages as well. Installing wheels that do not fit a vehicle correctly can cause a number of problems including safety concerns.

Advantages of changing wheel offset and backspacing:

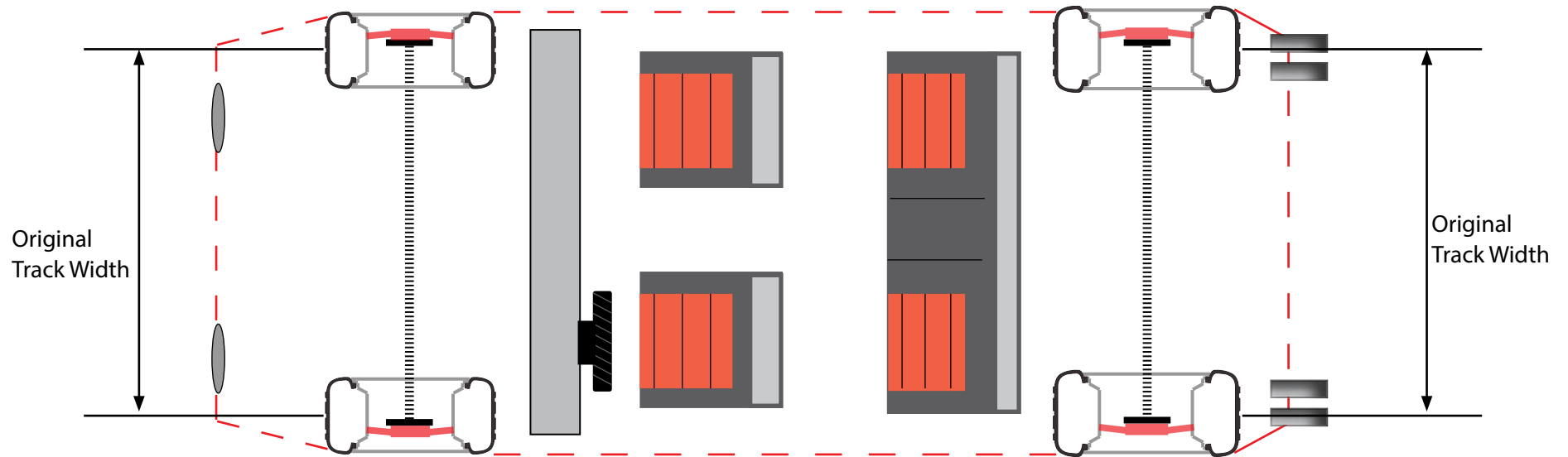
1. Increased Track Width for improved handling.
2. Increasing the Track Width by decreasing positive offset creates more room inside the fender, allowing for wider wheels and tires, providing greater traction.
3. Creates awesome looks and an aggressive “stance” for your car.

Disadvantages of changing wheel offset and backspacing:

1. Increased steering effort.
2. Accelerated tire wear.
3. Increased steering sensitivity to road shock.
4. Differences in traction on opposing sides.
5. Increased bearing wear.
6. Increased wear on ball joints, tie rod ends, and suspension bushings.
7. Fender clearance issues can arise.
8. Inner fender clearance issues can arise.

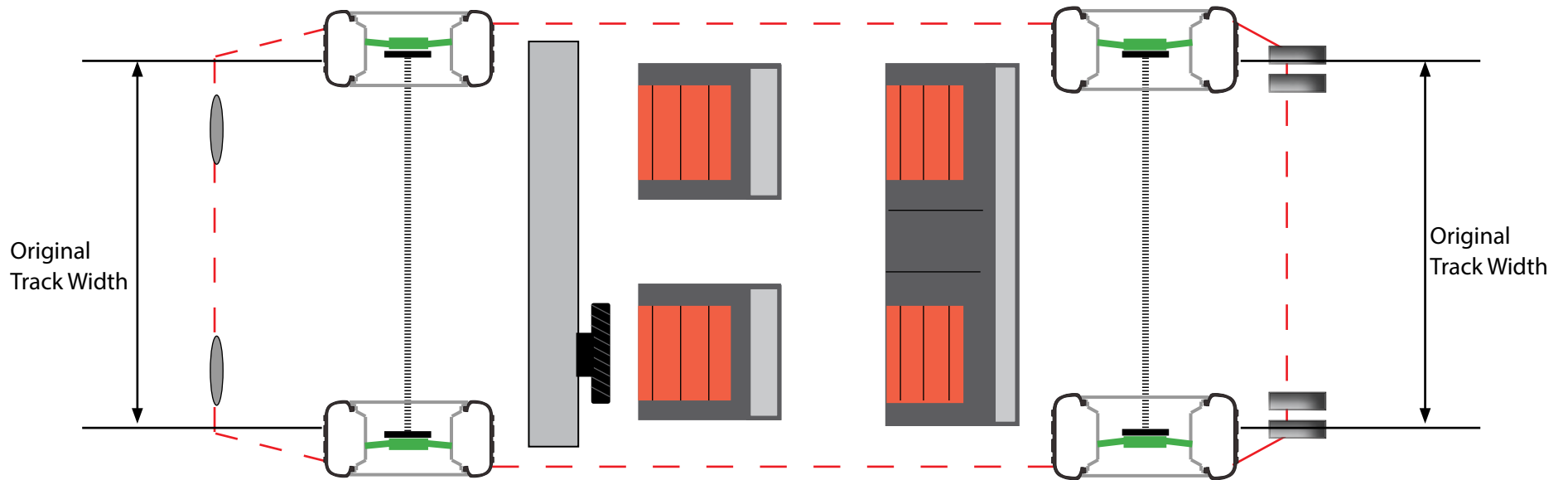
UNDERSTANDING WHEEL OFFSET AND BACKSPACING

Here are a few more examples to give you a visual representation of changing wheel offset and the position of the wheel in relation to the suspension and the body of a car.



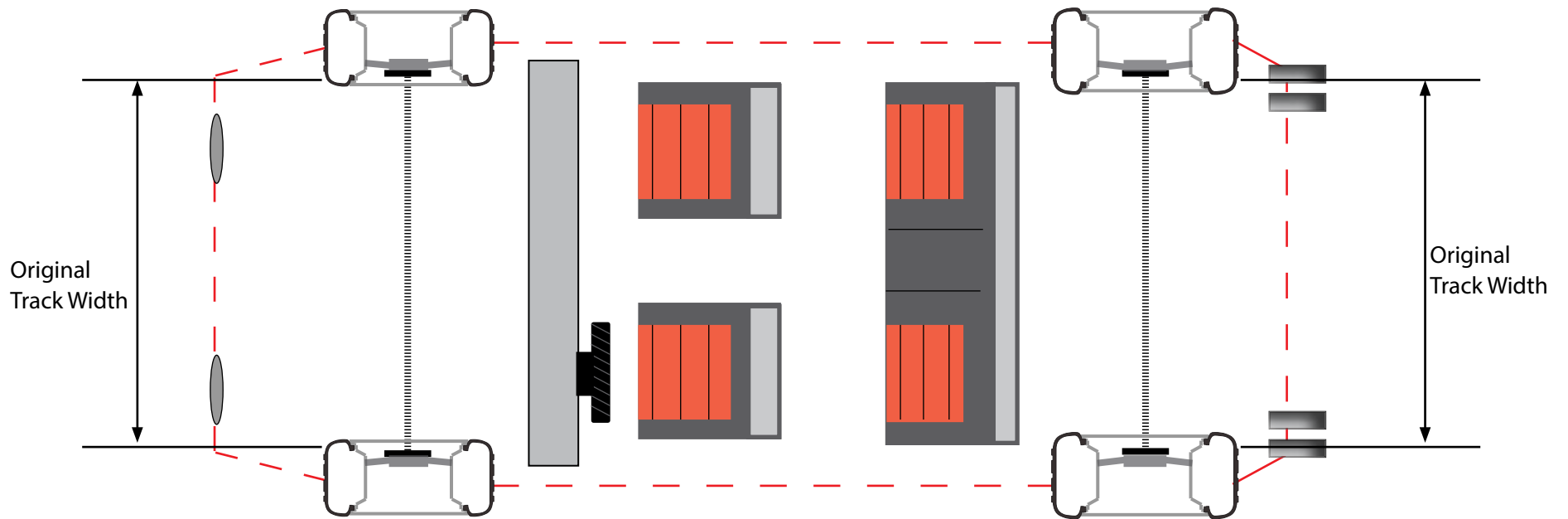
Most modern vehicles are designed with wheels that have a positive offset, so we will begin in this example with positive offset wheels on our car. The wheels sit inside the fenders of the car in both the front and the rear. Notice also the track width measurement (the distance between the centerline of the two wheels on the same axle).

UNDERSTANDING WHEEL OFFSET AND BACKSPACING



In this example, we have installed wheels with a zero offset on our car. Notice how the wheels are sitting further out. This increases the track width, but can also cause problems with fender clearance and interference.

UNDERSTANDING WHEEL OFFSET AND BACKSPACING



In this example, we have installed wheels with a negative offset. You can see the extreme difference in wheel position and track width.

WHEEL OFFSET AND BACKSPACE MEASURING TOOLS

When determining the correct wheels for your car, if you do not have any wheels to test for fitment, there are some different tools that can be used.

The WheelRite tool shown on the right bolts onto your vehicle's hub to precisely simulate bolt pattern, wheel diameter, wheel width, and backspacing. Once you have determined these specifications, you can use the chart below to calculate wheel offset. The WheelRite tool is available on our website. [ES#2770120](#)



		Convert Backspace to Offset																				Measured Backspacing in Inches									
		3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.25	6.50	6.75	7.00	7.25	7.50	7.75	8.00	8.25	8.50	8.75	9.00	9.25	9.50	9.75	10.00		
Wheel Width in Inches	5.5	0	6	12	19	25	32	38	44	51	57	64	70	76	83	89	95	102													
	6.0	-6	0	6	12	19	25	32	38	44	51	57	64	70	76	83	89	95	102												
	6.5	-12	-6	0	6	12	19	25	32	38	44	51	57	64	70	76	83	89	95	102											
	7.0	-19	-12	-6	0	6	12	19	25	32	38	44	51	57	64	70	76	83	89	95	102										
	7.5	-25	-19	-12	-6	0	6	12	19	25	32	38	44	51	57	64	70	76	83	89	95	102									
	8.0	-32	-25	-19	-12	-6	0	6	12	19	25	32	38	44	51	57	64	70	76	83	89	95	102								
	8.5	-38	-32	-25	-19	-12	-6	0	6	12	19	25	32	38	44	51	57	64	70	76	83	89	95	102							
	9.0	-44	-38	-32	-25	-19	-12	-6	0	6	12	19	25	32	38	44	51	57	64	70	76	83	89	95	102						
	9.5	-51	-44	-38	-32	-25	-19	-12	-6	0	6	12	19	25	32	38	44	51	57	64	70	76	83	89	95	102					
	10.0	-57	-51	-44	-38	-32	-25	-19	-12	-6	0	6	12	19	25	32	38	44	51	57	64	70	76	83	89	95	102				
	10.5	-64	-57	-51	-44	-38	-32	-25	-19	-12	-6	0	6	12	19	25	32	38	44	51	57	64	70	76	83	89	95	102			
11.0	-76	-64	-57	-51	-44	-38	-32	-25	-19	-12	-6	0	6	12	19	25	32	38	44	51	57	64	70	76	83	89	95	102			

WHEEL SPACERS

Wheel spacers can be used for a number of different reasons:

1. To make fine adjustments to the ET/offset of a wheel.
2. To change the position of your original wheel in the wheel well.
3. To correct for minor clearance issues.

When using wheel spacers, don't forget that longer bolts or studs may be required.





These instructions are provided as a courtesy by ECS Tuning.

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