Turbo Speed Sensor Kit

Bill of Materials & Precautions

Application:
All Catalog Garrett GT Turbos

Part Numbers: 781328-0001: *Street Kit*
781328-0002: *Pro Kit*

Parts List

Item	Description	Qty.
1	Speed sensor 769366-0001	1
2	Spacer block	1
3	Layout (machining drawing) 776243	1
4	Installation Instructions	1
5	M4 x 0.70 x 18mm screw	1
6	M4 x 0.70 x 20mm screw	1
7	M4 x 0.70 x 22mm screw	1
8	Main Wiring Harness 778178-0001	1
9	Power / Logger Pigtail 778178-0002	1
10	Gauge	1
11	Gauge Extension Harness 778178-0003	1

Table of Contents

Tools Needed

- 10mm open-end wrench
- Wire cutters / crimpers
- Threadlocking compound
- Heat-shrink or electrical tape
- 20-gauge connectors for 12V power and ground
- Zip-ties to secure wiring harness
- 6mm wrench or socket for gauge bracket
- Wrench(es) to remove compressor housing and turbo if necessary

• NOTE: Bolt and fastener sizes may be different from one model year to the next depending on OE specifications. Different tools than those listed above may be required.

Recommended Other Items

- Factory Service Manual (if applicable)
- Safety glasses
- Anti-seize compound

PLEASE INSURE THAT THE PART NUMBER THAT HAS BEEN RECEIVED WAS THE INTENDED PART NUMBER BEFORE BEGINNING INSTALLATION.

See Honeywell Turbo Technologies' return policy if the incorrect kit has been ordered.

IMPORTANT INFORMATION - PLEASE READ CAREFULLY

We recommend that this Garrett product be installed by a qualified automotive technician. If you have any doubts as to your ability to install this product, consult with a local automotive repair company. Please be sure to carefully read all of the attached instructions prior to starting the installation process. If you have any questions about the enclosed parts or the instructions, call the distributor that you purchased the kit from for clarification.

Prior to the Garrett product installation, be sure that the vehicle is parked on a level surface and the engine is cool. Engine fluids and components can be extremely hot following normal vehicle operation. Avoid direct contact of engine fluids or components with your skin which may cause personal injury.

Installation Instructions

7. Test fit the speed sensor. If the lock nut is not accessible by wrench once installed, apply a threadlocking compound that will cure slowly enough to allow adjustment and final tightening. Install the speed sensor loosely in the housing – do not tighten the lock nut yet.

IMPORTANT: Make sure the **tip** of the sensor is approximately flush with the inside contour of the housing. (see figure 8). Tighten the M4 spacer screw once the sensor has been installed in the housing.

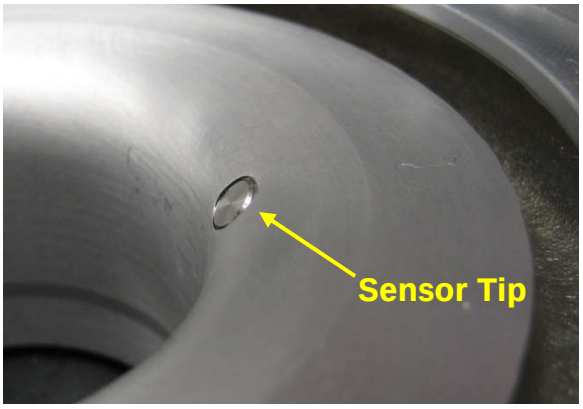

Fig. 8

8. Count the number of blades on your compressor wheel, including small (splitter) blades. Record this number below; you will need it later (see figure 9).

Number of Compressor Wheel Blades:_____

9. Install the housing on the turbocharger with its bolts and clamps. Make sure housing orientation is correct. Reinstall the wastegate actuator with bracket. Tighten and torque the clamping bolts, according to the tabulated columns “Comp. Housing Clamp Bolt Torque” and “Clamp Bolt Thread Type” on the layout (776243) for your turbocharger.

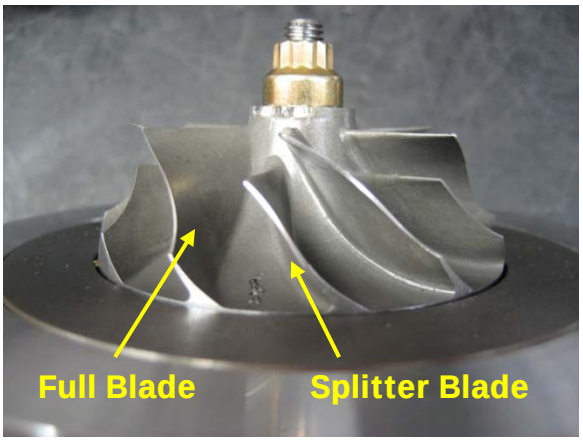

Fig. 9

Installation Instructions

10. Setting the sensor depth: if the turbocharger is still in the vehicle, ensure that there is enough space to adjust the sensor by turning it in and out. Also ensure there is sufficient space to turn the compressor wheel by hand. If not, remove the turbocharger from the vehicle. Slowly turn the sensor clockwise, while simultaneously spinning the wheel very slowly. Turn the sensor inwards, just until the tip contacts the edge of a compressor wheel blade (see figure 7). Be extremely careful not to jam the wheel into the sensor – the blades or sensor could be damaged. You should be able to feel a SLIGHT resistance and noise while gently turning the wheel as it contacts the sensor. Then turn the sensor back counterclockwise, approximately **1.6** full turns. This sets the sensor depth correctly. The nominal distance from the blade edge is 0.8mm. The sensor thread pitch is 0.5mm/thread (0.5mm/thread × 1.6 threads = 0.8mm).

NOTE: If the Garrett Turbo Speed Sensor Kit is being used with an older Garrett (T-Series) turbo, or with a non-Garrett unit, refer to figure 10 below for general placement of the sensor. It should always be installed at 0.8mm clearance from the wheel. The sensor hole should be drilled at an angle, placing the sensor near the base of the wheel below the level of the splitter blades, in order to accurately measure the speed. On custom applications the sensor can be used with or without the spacer block.

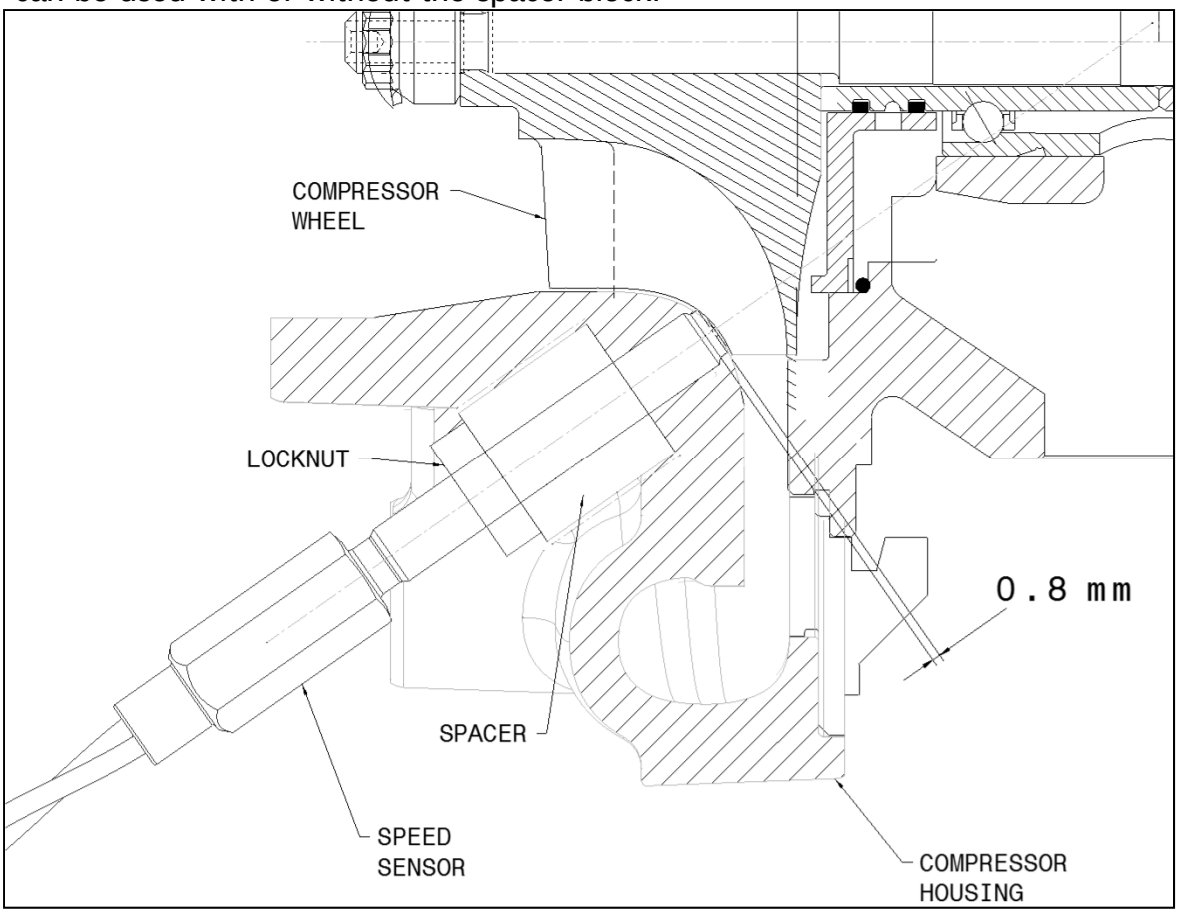

Fig. 10

Installation Instructions

11. Tighten the speed sensor lock nut firmly with a 10mm wrench. If there is not enough clearance to use a wrench, use needle-nose or similar pliers in conjunction with threadlocking compound to tighten the nut as securely as possible. (see figures 11 and 12).

Fig. 11

12. Reinstall your turbocharger if it is not already in the vehicle.

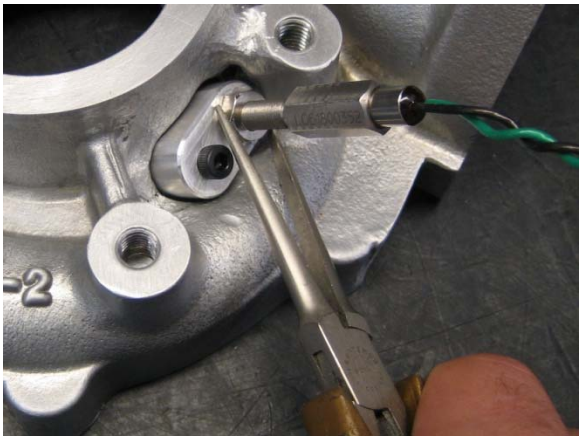

Fig. 12

13. Unpack the 3-way wiring harness and find the longest end (3 pins, approx. 35.5 in / 900mm long). This end connects to the speed sensor. Connect the harness to the sensor and lay the harness out in the engine bay to begin determining wiring harness routing. See figure 13 below.

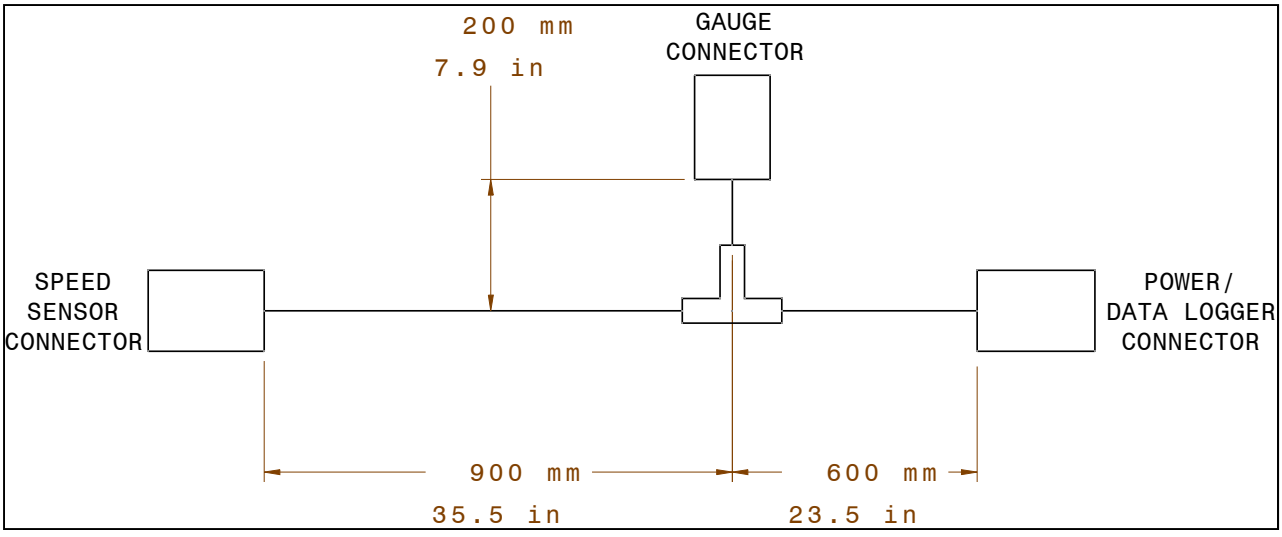

Fig. 13: Wiring Harness Diagram

Installation Instructions

Section A: STREET KIT WITH GAUGE ONLY

1. Locate the second-to-longest end of the harness (approx. 23.5 in / 600mm) Connect the power/data logger pigtail, which has 4 loose wires extending from the connector. Connect the red wire to a fused 12V DC power source. Connect the black wire to a chassis ground point. Crimp-on or soldered connectors are recommended.

Fig. 14
12 Blade Setting

2. Set the gauge for your particular compressor wheel. There are 4 dip-switches on the back of the gauge. Set the switches to the correct number of compressor blades based on figure 15 below. (If you desire to use the sensor to pick up a single magnet or machined flat on a shaft, choose 1 blade, or 2 blades if there are 2 magnets or flats, etc.). See figure 14 for example setting for 12 blades. Disregard the “8-6-4” above the dip switches.

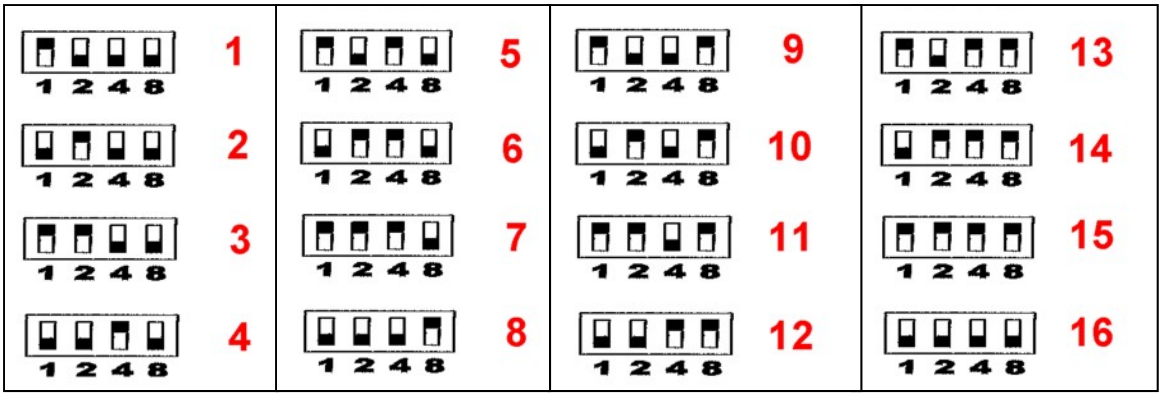

Fig. 15: Compressor Wheel Blade Setting Diagram

Black dot represents switch. Example: for 12 blades, switches are down, down, up, up.

Installation Instructions

3. The orange and green wires on the pigtail are not needed unless you plan on data-logging the speed signal (see Section C below). Cover the ends with electrical tape or heat-shrink tubing and secure the wires. To install the gauge, connect the gauge extension harness to the shortest end of the main wiring harness (7.9 in / 200mm). Run the extension into the vehicle interior and connect the gauge after determining a suitable mounting location. The gauge itself is a standard 2 1/16" diameter and should mount in any properly-sized gauge pod using the included bracket and nuts. The gauge extension harness can be left out if the main harness is long enough without it.

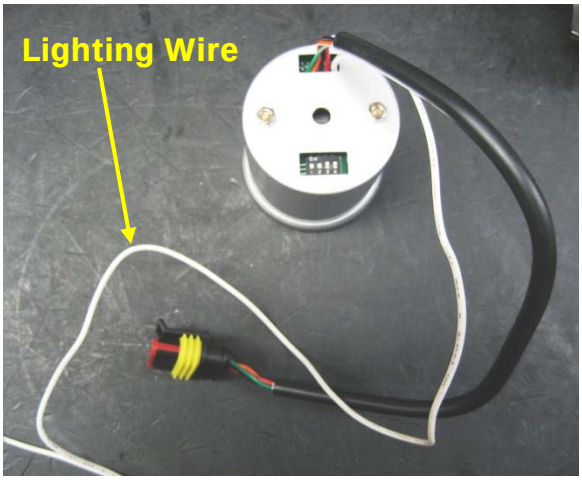

Fig. 16

4. Gauge lighting: refer to a wiring diagram for your vehicle and connect the white gauge wire to the output of the dash light dimmer knob, or directly to the headlight switch if desired (see figure 16).

Section B: PRO KIT WITH DATA LOGGING, **NO GAUGE**
(data logger not included)

1. For data logging, connect the orange wire on the pigtail to a +5V DC (±0.5V) source. This supplies sensor power. Your data logging device may have a 5V DC source available. The sensor output signal is carried by the green wire. Connect the green wire to the data logging device on a channel selected for turbo speed signal. Connect the black wire to data logger ground. The red wire is not used; cover the end with electrical tape or heat-shrink.

CAUTION: DO NOT CONNECT THE ORANGE WIRE IF SENSOR IS USED WITH A DATA LOGGER IN ADDITION TO THE SPEED GAUGE (see section C below).

(*continued on next page)*

Installation Instructions

Sensor Signal: the speed sensor will output a square-wave signal at 1/8 the input frequency(originally intended for 8-blade wheel). The input frequency is simply one pulse per blade, as the blades pass by the sensor. The sensor therefore measures the following input frequency (in rpm):

$$RPM = (60*8)*(f_{out}/N)$$

Equation 1

where N is the number of blades, and RPM is the turbo speed.

Therefore, your data logger needs to convert the speed sensor signal based on equation 1.

For example, with a 12-bladed wheel,

$$RPM = 480*(f_{out}/12) = f_{out}*40$$

Example

Therefore the logger would need to multiply the sensor signal by 40 in order to record true turbo RPM (for a 12-bladed wheel).

IF your ECU already converts the signal to RPM then you will need a conversion factor to adjust the input to the correct number of blades.

$$Conversion\_Factor = (8/N)$$

Equation 2

For example, with a 12-bladed wheel,

$$Conversion\_Factor = (8/12) = 0.75$$

Example

Therefore the signal to the ECU will need to be multiplied by 0.75 for correct turbo speed.

Section C: STREET KIT WITH GAUGE AND DATA LOGGER
(data logger not included)

For data logging with the Street Kit (gauge installed), follow all instructions in sections A and B above, EXCEPT: DO NOT connect the orange wire to 5V DC. The orange wire will *not* be used. Vehicle 12V DC power is connected to the red wire as in section A, and the green wire is connected to the data logger as in section B. The black wire is connected to ground. Cover the end of the orange wire with electrical tape or heat-shrink and secure it out of the way.

Installation Instructions (cont'd)

Section D: MAXIMUM SPEED RECALL FUNCTION

1. Push the recall button once to display the last maximum speed.

2. Push the recall button again and release it immediately to go back to normal operation mode. The speed gauge will return to normal operation mode after 5 seconds if the button is not pressed again.

TO RESET:

1. Push and hold the recall button for at least 2 seconds to reset the recorded maximum speed.

2. Push the recall button again to verify that the previous max speed has been cleared.

Section E: Mapping

If you are familiar with turbocharger operational theory (as explained in the Turbo Tech sections on www.TurboByGarrett.com), you can use the turbo speed data to plot operating points on your compressor map, which can enable you to make a close estimate of airflow through the engine. For example, during a full-throttle acceleration test up to redline, you can observe maximum boost and maximum turbo speed (which will be near redline), and use this information to estimate flow at redline.

From the boost gauge pressure you can estimate Pressure Ratio across the compressor by accounting for atmospheric pressure and losses in the intake plumbing, as in Turbo 103 on the Garrett website. Draw a horizontal line on the map at this estimated PR value. The compressor's operating point is where it intersects the estimated speed line, based on turbo speed observed from the test. From this point, draw a vertical line down to the airflow axis, and you will have your flow estimate.

(continued on next page)

Installation Instructions (cont'd)

For a more accurate estimate of airflow, you will need to "correct" the turbo speed for the compressor inlet temperature, since flow on a compressor map is corrected for standard atmospheric conditions. Using a thermocouple or equivalent temperature sensor installed as close as possible to the compressor inlet, use the following equation to correct the turbo speed:

$$RPM_{corrected} = \frac{RPM_{measured}}{\sqrt{(T_{1c} + 460)/545}}$$

Where T_{1c} is the measured compressor inlet air temperature in degrees Fahrenheit. After calculating the corrected speed for each point, plot corrected speed vs. pressure ratio on the map, and find the corrected airflow on the horizontal axis. In this way, a boost gauge and the Garrett Turbo Speed Sensor Kit can be used to gauge the effectiveness of performance upgrades (such as free-flowing air filters or head porting) by comparing airflow before and after the upgrade. This method will also help to validate your turbo selection and guide decisions to upgrade your turbo, by showing "where you are" on the compressor map more accurately than otherwise possible.

If you are interested in the *actual* airflow (in lb/min) through the compressor, you will need to "uncorrect" the flow estimate with the following equation:

$$W_{act} = \frac{W_c\left(P_{1c}/13.95\right)}{\sqrt{\left(T_{1c} + 460\right)/545}}$$

Where P_{1c} is the measured compressor inlet pressure (in psi) and W_c is the corrected airflow estimate from the map (lb/min). You can use corrected airflow to make before-and-after comparisons, but calculating the actual airflow will give a more accurate measurement of the true flow through the engine.

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