Fusion3

# EDGE 3D Printer

## OPERATION:
## BED LEVELING

Revision 2/24/2023

# BED LEVELING

Information on how the bed leveling systems work on EDGE

## INTRODUCTION

The term "bed leveling" encompasses two related but distinct concepts:

- The relative distance from the tip of the nozzle to the print surface over its entire span (bed level).
- The gap between the tip of the nozzle and the print surface at z=0 (first layer height)

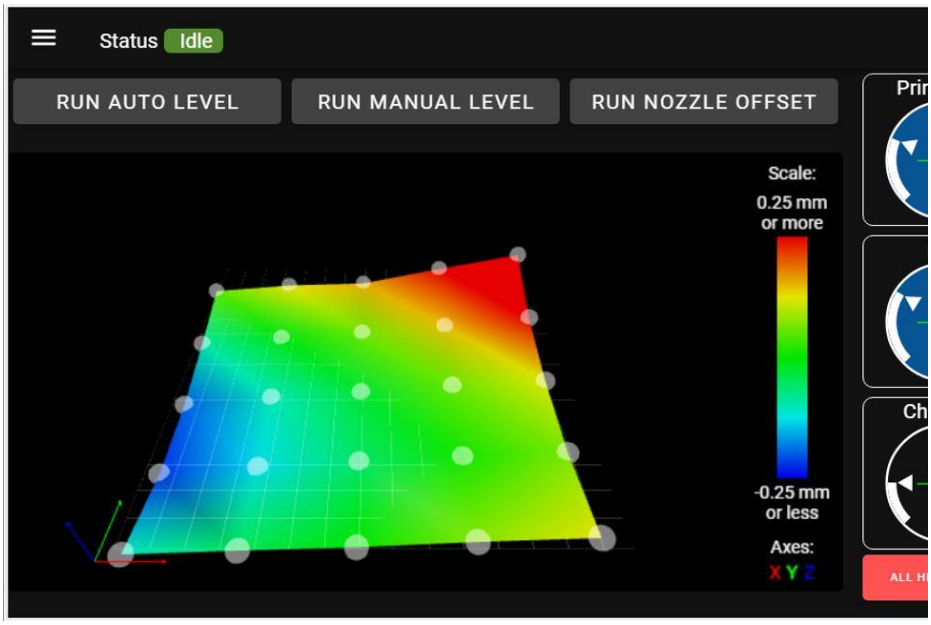
Note that neither of these concepts have anything to do with how level the print surface is relative to the rest of the world. In other words, please do not use a bubble level to try to "level the bed". **The printer only cares that the print surface is the same height away from the tip of the print head at all points**.

There are 4 major components to the bed leveling and first layer height systems:

1. Auto bed leveling process
2. Nozzle / probe offset calibration process
3. Babystepping
4. Manual bed leveling

## AUTO BED LEVELING

The auto bed leveling process is run automatically at the beginning of every print. The printer will probe the bed in a 5x5 grid (25 points total).

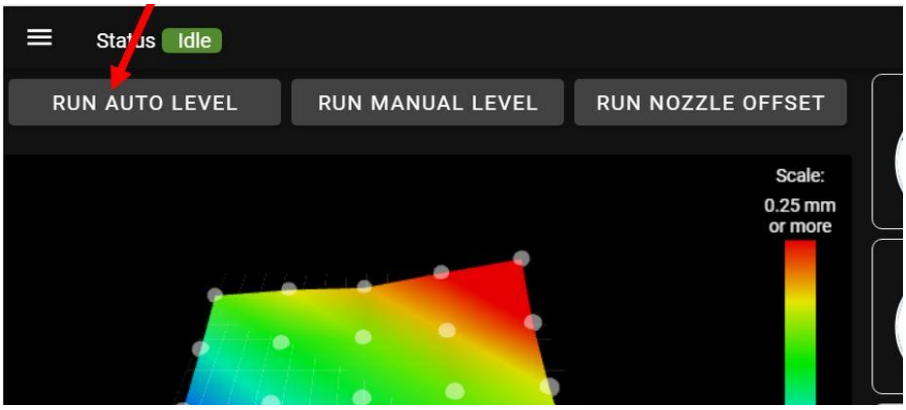



The results of the bed level are shown on the *Menu > Utilities > Bed Leveling* screen.

During the first layer of a print, the printer uses the height data it collected to automatically adjust the height of the bed as the print head moves in X and Y.

If the printer detects a difference in bed height (max-min) of more than 2.0 mm, it will stop the print and prompt you to manually level the bed.

**IMPORTANT: The auto bed leveling system does not mechanically / physically adjust the level of the z axis. There is a limit to what you can expect this system to successfully compensate for. If your bed / Z axis is so out of level that it binds or doesn't move smoothly, you will need to manually level the bed (see below).**




If you need to run the auto bed level outside of a print, use the "*Run Auto Level*" button on the *Bed Leveling* screen.

**NOTE: The "Run Auto Level" button will only probe a 3x3 (9 point) grid, to save time.**

### Quick-Turn Mode & Auto Bed Level

If quick-turn mode is enabled, the printer will skip the 5x5 grid and instead do a single probe point in the center of the bed, and use the existing bed height map stored in memory.

This reduces the time needed to start a print. However, it means that if the bed level has changed since the height map was generated, your first layer may not print correctly. You may see areas that are too close to the bed, or too far away.

If you encounter issues with first layer height/adhesion after enabling quick-turn mode, we recommend disabling it again.

## NOZZLE / PROBE OFFSET CALIBRATION

The nozzle offset calibration process is run automatically at the start of every print.

1. **Heat**: The printer will heat up the print head.
2. **Clean**: The printer will clean the print head by pumping out the molten plastic and scrubbing it in the print head scrubber (back right corner of the bed).

3. **Touch nozzle**: The tip of the print head is touched against an electrically conductive surface to register its position.
4. **Touch probe**: The bed probe is deployed and checked on the same spot.
5. **Math**: The nozzle offset is calculated and used to make sure the first layer height is perfect on every print.

For more detailed information on this process, see https://www.youtube.com/watch?v=E6vnoPltXwk

If you need to run the nozzle offset outside of a print, use the "*Run Nozzle Offset*" button on the *Bed Leveling* screen.

### Quick-Turn Mode & Nozzle Offset

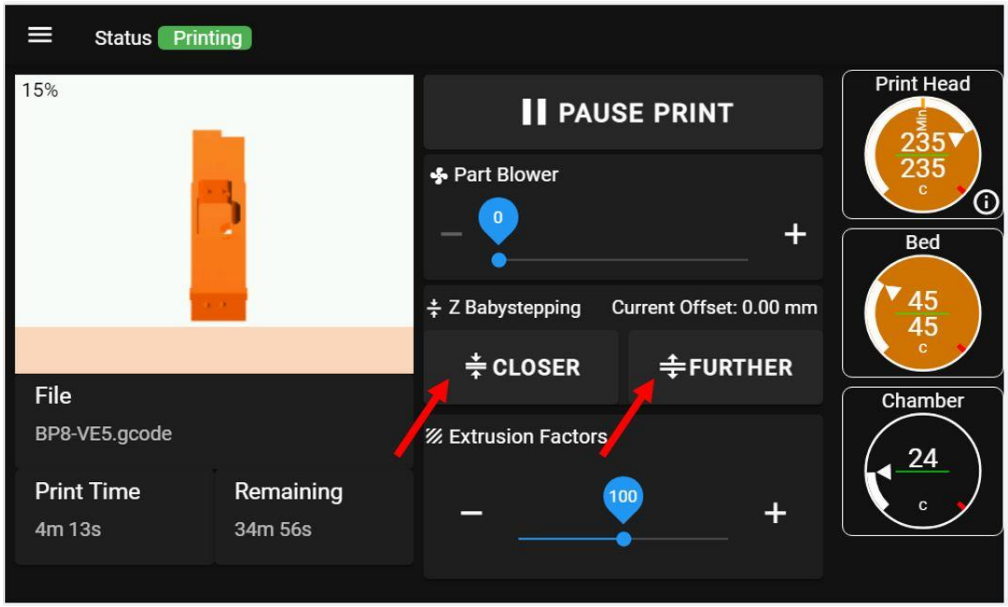
If quick-turn mode is enabled, the printer will skip the entire nozzle offset process, and instead use the last value stored in memory.

This reduces the time needed to start a print.  However, it means that if the nozzle offset has changed since the value in memory was generated, your first layer may not print correctly (too close or too far away).

It is possible to correct the first layer height by using the Babystepping functionality (described below). However, if you don't want to do that, we recommend leaving quick-turn mode disabled.

## BABYSTEPPING

During a print, another function becomes available to you called babystepping.  This is a function that allows you to make on-the-fly adjustments to the first layer height in very small increments. Its purpose is to allow you to fine-tune your first layer height without needing to cancel and restart a print.




On the main screen, you will see two buttons labeled "closer" and "further".

- Press "closer" to move the nozzle and bed closer together in 0.05mm increments

- Press "further" to move the nozzle and bed further away in 0.05mm increments

If you find that your first layer is consistently off in the same direction for multiple prints in a row:

- If quick-turn mode is enabled, disable it OR run *Menu > Utilities > Bed Leveling > Run Nozzle Offset*.
- If quick-turn mode is disabled, inspect the nozzle offset system (scrubber, touch plate, bed probe) for mechanical issues. Contact Fusion3 Customer Support for more information & assistance.

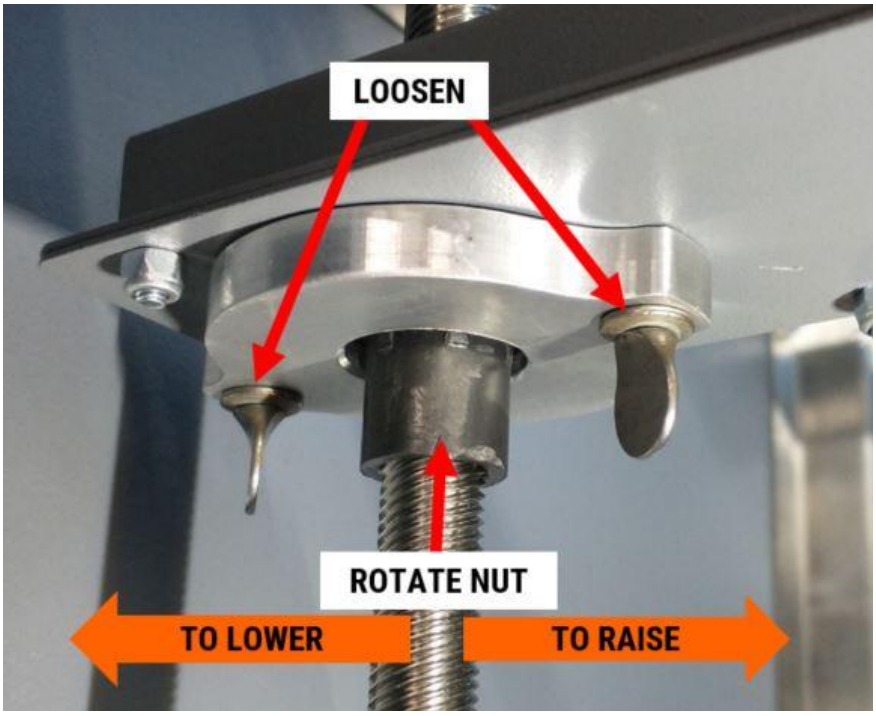
**NOTE: Babystepping can be used at any point during a print job. However, it is INTENDED to be used during the first and second layers only.**

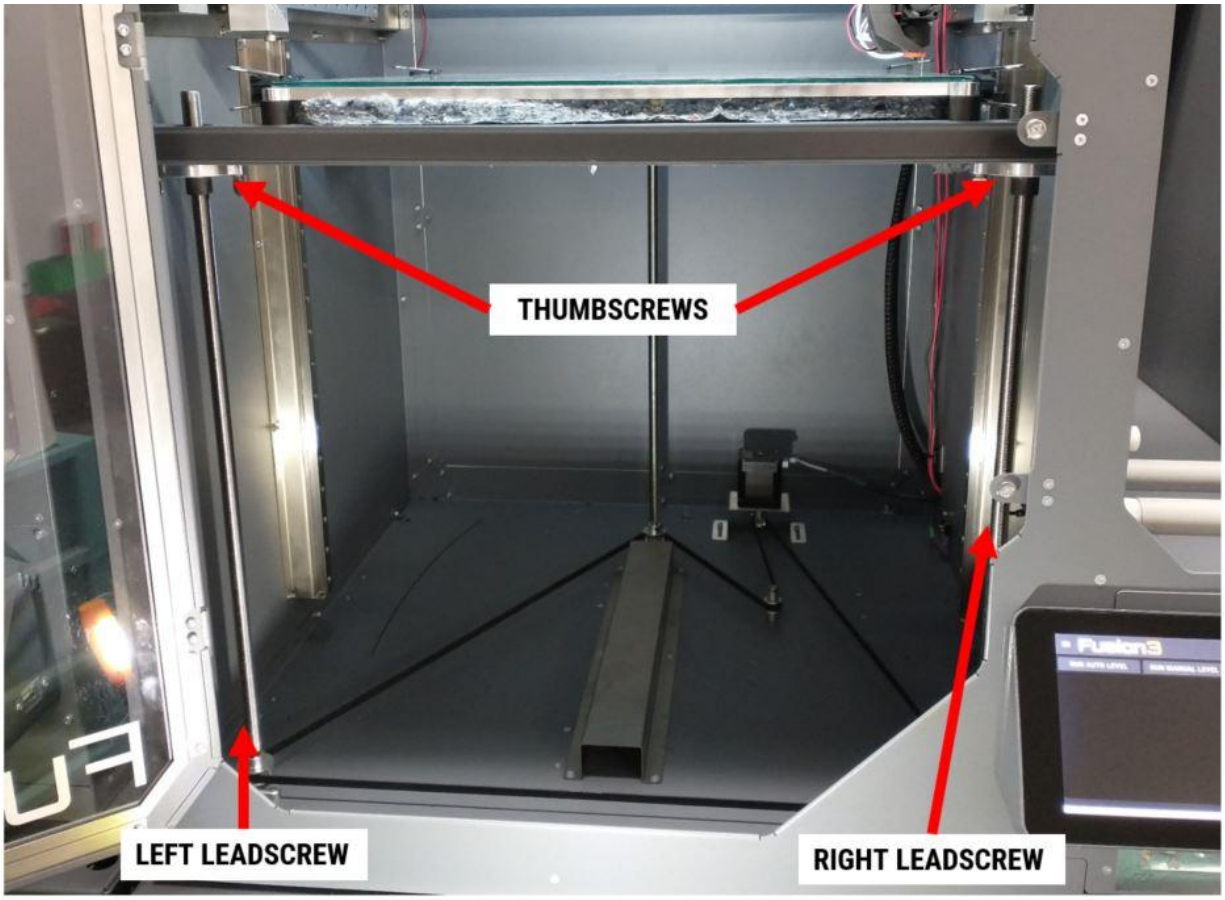
## MANUAL BED LEVELING

The manual bed leveling process is the only method that physically changes the level of the z axis and bed; everything else mentioned in this guide compensates for things being out of level. So this is an important process, even though you should not have to do it very often.

The easiest way to manually level the bed is to not use the "*Run Manual Level*" wizard. Do this instead:

1. Run "*Run Auto Leve*l".
2. Look at the results to determine how the bed level needs to be adjusted. Remember, your two adjustment points are the front two leadscrews. So we're looking at the front 2 corners relative to the center rear of the bed (fixed non-adjustable leadscrew). **Unlike F410 and F400, the corners of the bed are not adjustable - you adjust the Z axis substrate itself**.
3. Example scenarios:
    a. If the **front** of the bed is **higher** than the back: **lower both** front leadscrews
    b. If the **left corner** is **high**: **lower** the **left** leadscrew
    c. If the **right corner** is **high**: **lower** the **right** leadscrew.
4. Once you decide what adjustment needs to be made, loosen the thumbscrews on the appropriate leadscrew and use the pictures as a guide to make your adjustment.
    a. Remember 1 full rotation (360º) of a leadscrew nut is 10mm of vertical travel. So to make a 1mm adjustment in height, you'd rotate the nut slightly less than 45º (36º to be exact).




5. After you make your adjustment, make sure the thumbscrews are tight and re-run "*Run Auto Level*". Once the results update, you will see the outcome of your adjustment and you can decide if further adjustments need to be made.  Iterate through this process as many times as needed to get the bed leveled to your satisfaction.

    a. Remember: EDGE has a built-in tolerance of 2mm.  As long as min-max is less than 2mm, it'll let you run a print.

### FAQ

**The back of my bed is tilted left-to-right.  How do I fix this?**
In most cases, you don't need to fix this at all.  If the front of the bed is level, the left-to-right tilt at the rear of the bed is usually less than 0.5mm.

If the rear of your bed is out more than this, or you're chasing a perfect bed level, you can ***gently*** apply twisting force to the rear of the Z axis substrate to level it out.

**My bed has a strange high/low spot in it that seems unrelated to the level of the 3 leadscrews.  What do I do?**
First, make sure this isn't due to your print surface: Remove your print surface and run "*Run Auto Level*" on the bare tool plate.

Second, if this is not causing an actual first layer height issue during your prints, you can ignore it.

If this **is** causing print issues, please reach out to our support team for help.

### When To Manually Level

- If the printer prompts you to manually level based on its Auto Bed Level measurements, at the beginning of a print.
- If you notice binding or sticking as the Z axis tries to raise the bed (usually accompanied by the noise of the motor stalling).
- If motion up or down is very stiff when moved by hand.
- If you have to perform maintenance or repairs on the z axis in a way that potentially may have affected the level of the bed (belt tension, leadscrews, etc).

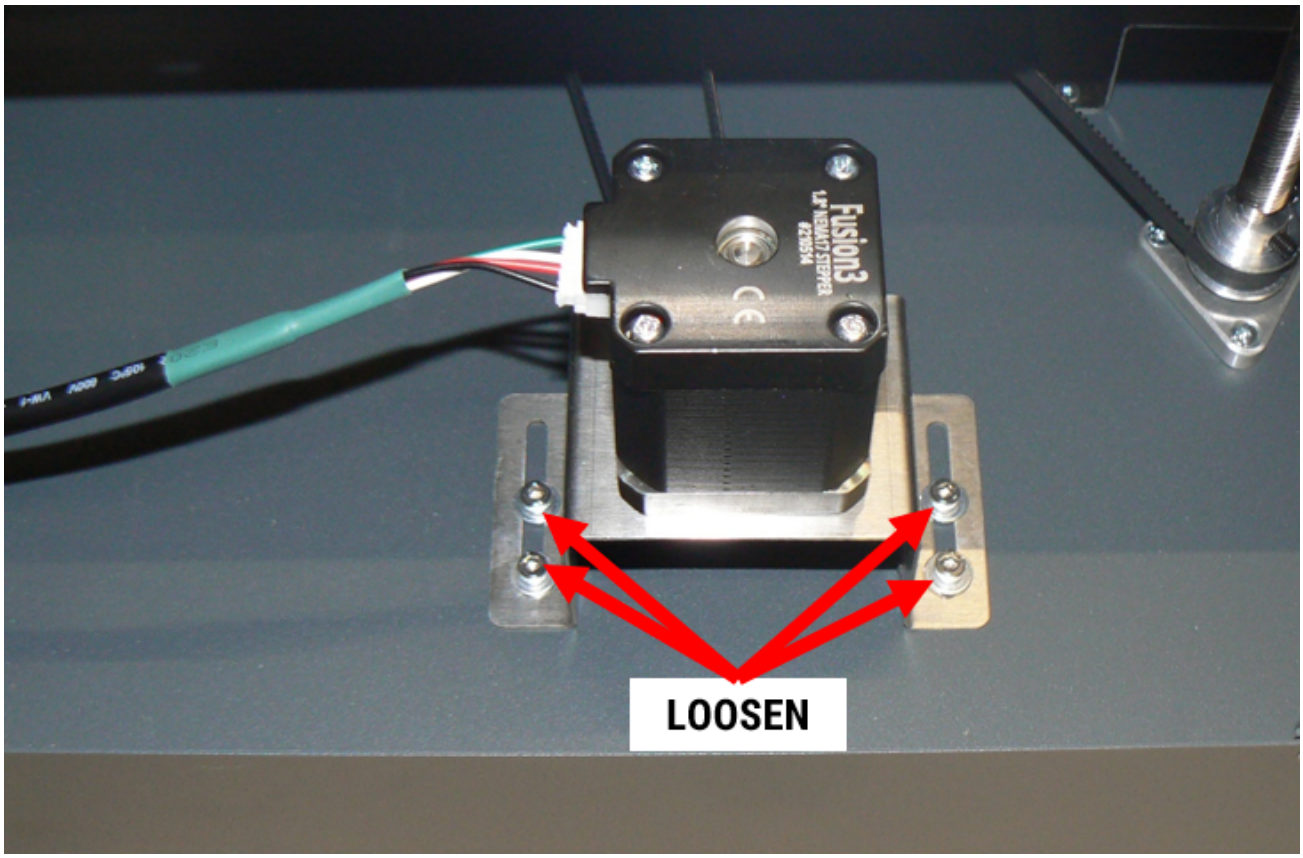
## Z AXIS BELT TENSION

If the Z axis belt is not tight enough, the following may happen:

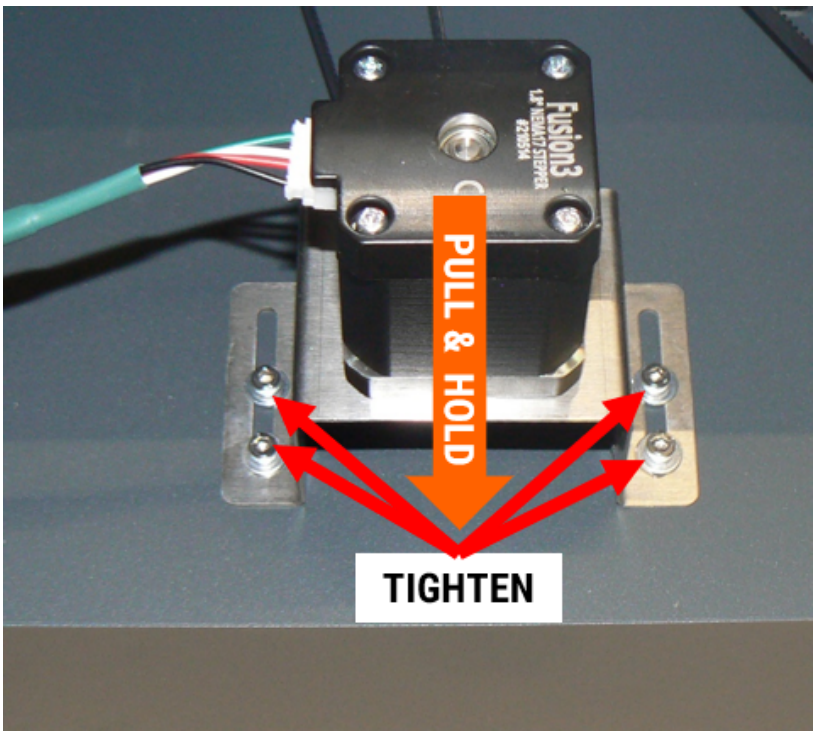
- Inconsistent first layer height (one area tight, one area loose OR variations print-to-print)
- Inconsistent bed level results
- Belt slips on a leadscrew pulley (loud "clunk" or "thunk" noise that sounds similar to a stepper motor skipping).

## How to Tighten the Z Axis Belt

1. Remove the rear service panel.
2. Loosen 4x screws holding the Z axis motor mount




3. Firmly pull the mount to the rear of the machine and retighten the screws.



4. Belt should be tight enough to thrum like a bass string.  Guitar string is too tight.
5. Run *Utilities > Bed Leveling > Run Auto Level* to make sure your bed level has not changed. Sometimes adding tension causes one leadscrew to rotate more than the others.