# Smart Construction
# 3D Machine Guidance Flex
# Calibration Manual

EARTHBRAIN

May 2025
Ver1.0-0003

# Before you read this manual:

- This manual explains the calibration procedures for the Smart Construction 3D Machine Guidance Flex kit (hereinafter referred to as SC 3DMG Flex kit). For the installation procedure, see the separate manual.

- This calibration requires a tablet on which the Smart Construction Pilot Flex application is installed.
  See the separate Tablet App Handling Manual.

- Perform calibration by two persons.

- Several dimensions of the machine body are measured with a tape measure or total station (TS).

- When the GNSS antennas or IMU sensor is removed for such as transportation of the machine, the machine calibration is required each time in principle.

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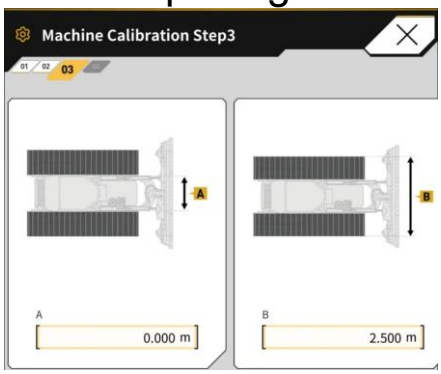
# 01

# Chapter

# Overview

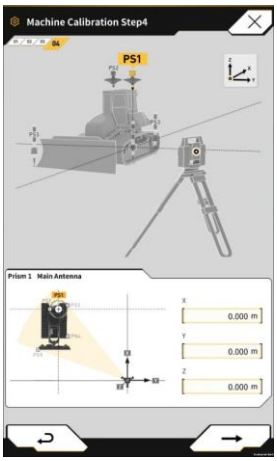
# 1.1 Work flow

- Preparation of machine body (including installation of SC 3DMG Flex kit)
  ↓
- Application settings
  ↓
- Machine body width measurement
  Input the dimension of the machine body in the width direction by actual measurement or quoting from the catalog, etc.

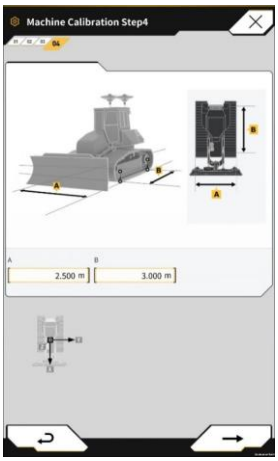



- Select TS coordinate measurement or tape measure measurement, follow the on-screen instructions to take measurements, and input the values.

* Since the measurement with a tape measure is prone to measurement errors, TS measurement is recommended.




TS measurement screen




Tape measure measurement screen

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# 02

## Chapter

# Preparation

# 2.1 Preparation of necessary items

The items required for this calibration work are as follows:

[Always required]
- SC 3DMG Flex kit, complete
  (Tablet device, Wi-Fi router)
- Scaffold steps, ladder

[TS calibration]
- Total station (TS)
- Metal or plastic tape measure

[Calibration with a tape measure]
- Metal or plastic tape measure

# 2.2 Preparation of machine

Satisfy the following conditions before performing calibration.

- Move the machine to a place where the ground is as level and hard as possible (laid of iron plates, concrete surface, etc.). The machine may not be measured accurately on a slope.

# 2.3 Tablet application settings

[Note]
Before you operate the tablet application, check that the following are of the latest version:
• Table application
• Controller firmware

When performing calibration, the “Smart Construction Pilot Flex” application must be installed in a prepared tablet.

Search for “Smart Construction Pilot Flex” at the Google Play Store. When the Smart Construction Pilot Flex application is successfully installed on your tablet device, the following icon is displayed on the home screen.


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# 03

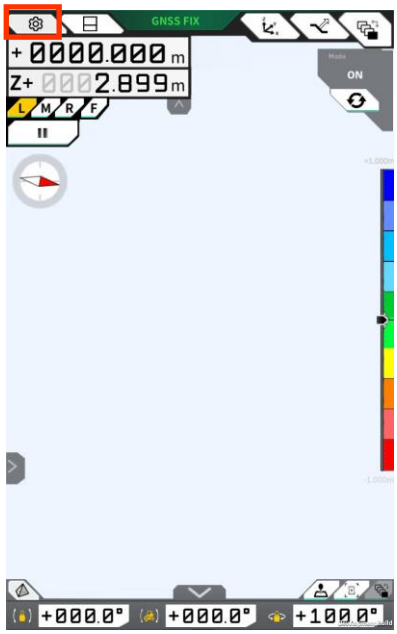
## Chapter

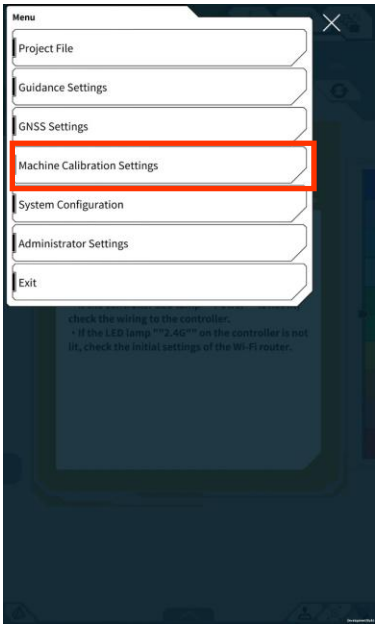
# Calibration

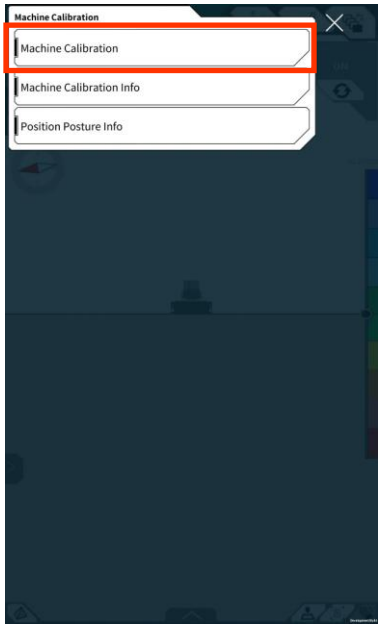
# 3.1 Calibration settings

1. From the machine guidance screen in the tablet application, tap the ⚙ button → Machine Calibration Settings → Machine Calibration.

2. The screen moves to the calibration screen.



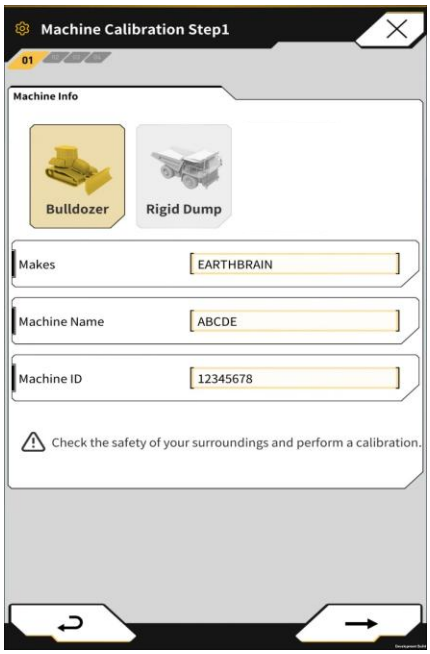
# 3.2 Select machine body type

1. Select the machine body type “Bulldozer” or “Rigid Dump”.

2. Input machine information.
   Values input for the “Machine Name” and “Machine ID” are used on the server for machine management, so input them correctly.

   Machine Name: Input the “Model - Type - Serial No.”.
   Machine ID: Input the number used for machine management in your company.

* Default values are input when the controller is connected for the first time, but **be sure to rewrite them to the individual ID and name.**



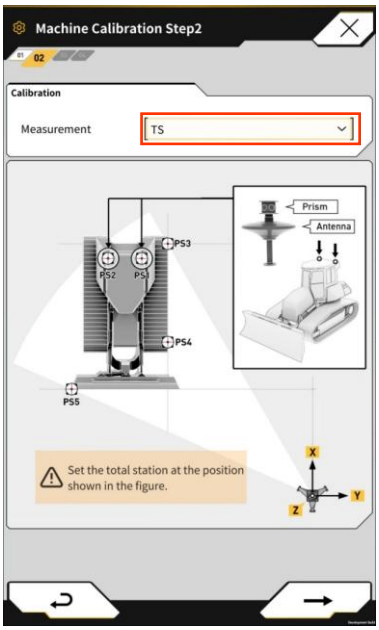

Input example) For the left screen

Makes: KOMATSU
Machine Name: D65PX-18-******
Machine ID: EB20210701

# 3.3 TS calibration

This is a method of calibration using a total station (TS).
See “3.4 Calibration with a tape measure” for calibration by measuring with a tape measure. **A TS calibration is recommended to measure the machine body at a high accuracy.**

1. Select the measurement type “TS” and proceed to the next step  .
   (Select “TS” from the pull-down list of Measurement)




* Set the TS at a position enabling measurement of the left side of the machine body, as shown on the tablet screen.

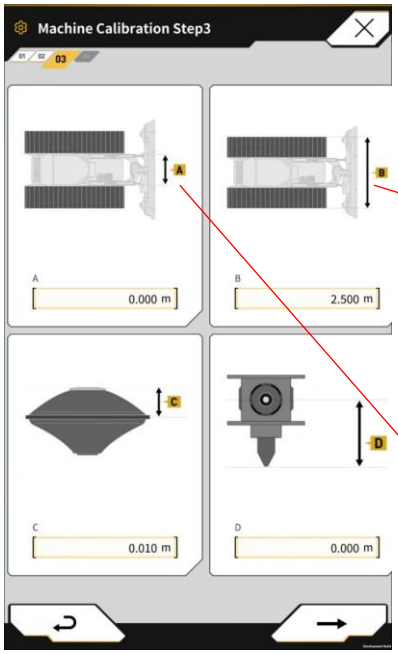
# 3.3 TS calibration

This is a method of calibration using a total station (TS).
See “3.4 Calibration with a tape measure” for calibration by measuring with a tape measure. A TS calibration is recommended to measure the machine body at a high accuracy.

1. Measure and input machine body dimensions A and B.

2. Input dimensions C and D at the time of measurement.

   C: 0.010 m (design value)
   D: Height to center of prism (antenna sight line height)
   This is 0 when the prism height is set on the TS side.




Between outer edges of tracks

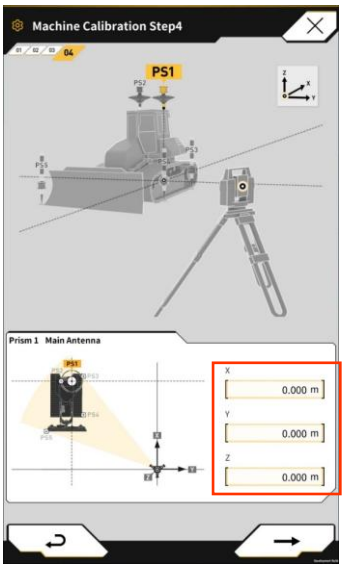
Between inner edges of tracks

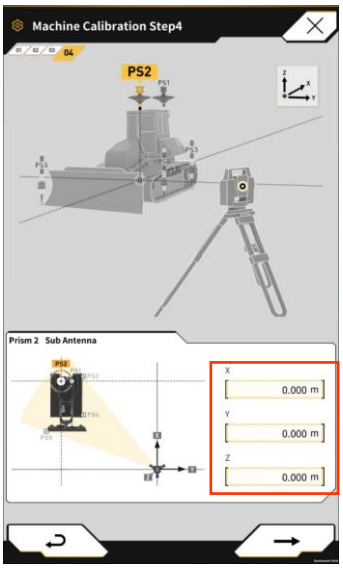
# 3.3 TS calibration

When working at heights such as GNSS antenna measurement, prepare scaffold steps or a ladder if necessary. Pay attention to the main and sub installation locations.
(* In principle, the main antenna should be placed on the left side and the sub antenna on the right side, when facing the direction of travel.)

1. Measure the GNSS antenna 1 (main side) and input the coordinate values of the measurement result.

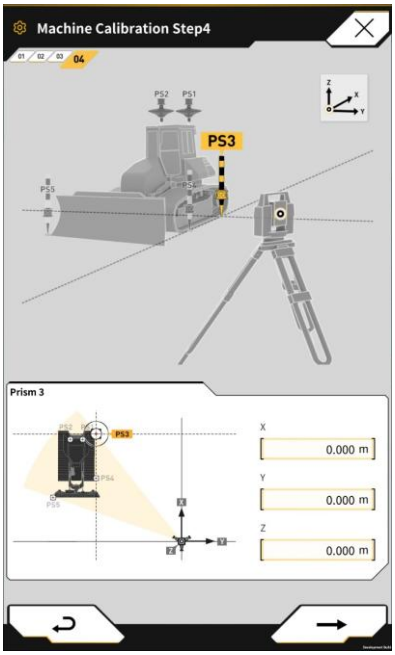
2. Similarly, measure the GNSS antenna 2 (sub side) and input the coordinate values.



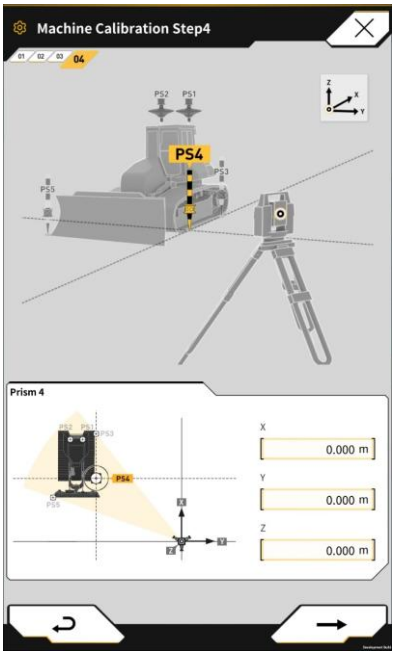




# 3.3 TS calibration

3. Measure the ground contact point on the rear left side of the machine body and input the result on the tablet screen.

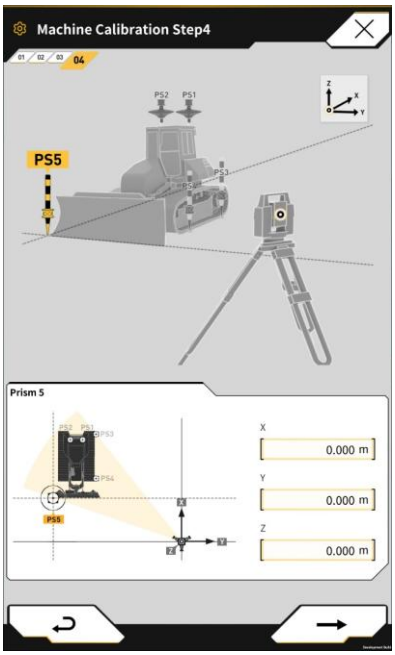



4. Similarly, input the measurement result of the ground contact point on the front left side of the machine body on the tablet screen.




# 3.3 TS calibration

5. Measure the ground contact point on the right side of the machine body (the cutting edge on the right side of the blade of a bulldozer, etc.) and input the result on the tablet screen.

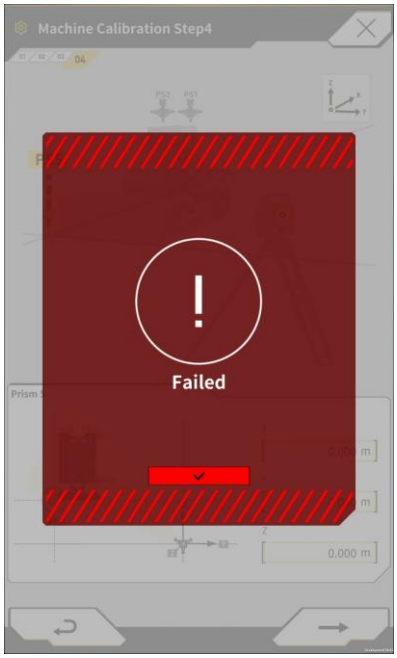



<Supplement>
- The measurements of the third and fourth points affect the results of position measurements and construction record data. In particular, consideration must be given to the height direction, depending on the geological features, etc., of the construction ground.


The measurement of the last fifth point is to recognize the right side of the machine body. Measure the ground contact surface near the right side of the machine body. Refer to the tablet screen.

# 3.3 TS calibration

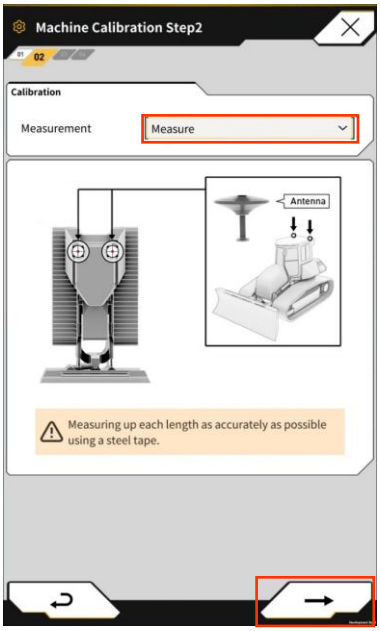
If there are no problems with the calibration calculation results, the calibration is complete. In case of failure, the measurement location may not have been measured correctly or the measurement coordinates may not have been input correctly.

# 3.4 Calibration with a tape measure

This is a method of calibration using a tape measure (metal or plastic). **With this calibration method, measurement errors may occur due to the environment of the measurement location such as the machine class. A TS calibration is recommended to measure the machine body at a high accuracy.** See “3.3 TS calibration”.

1. Select the measurement type “Measure” and proceed to the next step  .
   (Select “Measure” from the pull-down list of Measurement)





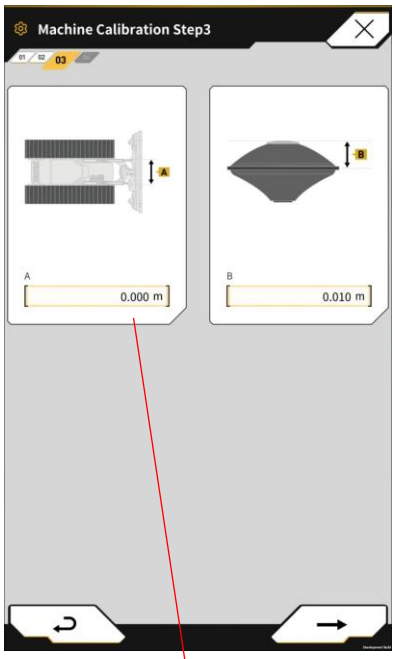
* Measure on as a flat place as possible. The height may not be measured correctly on a slope.

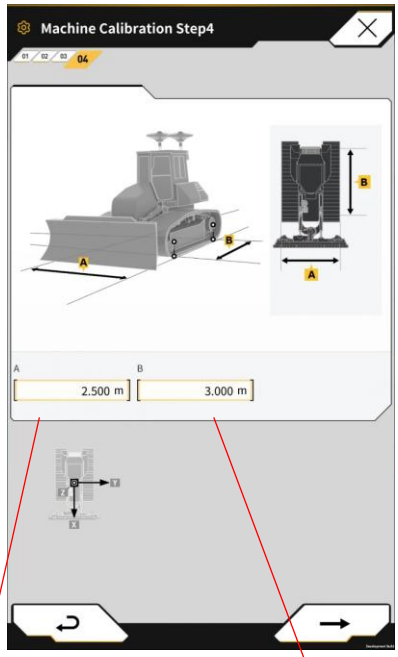
# 3.4 Calibration with a tape measure

2. Input the measurement value of the machine body dimension A (inner width) and the antenna dimension value B on the tablet screen.

   B: 0.010 m (design value)

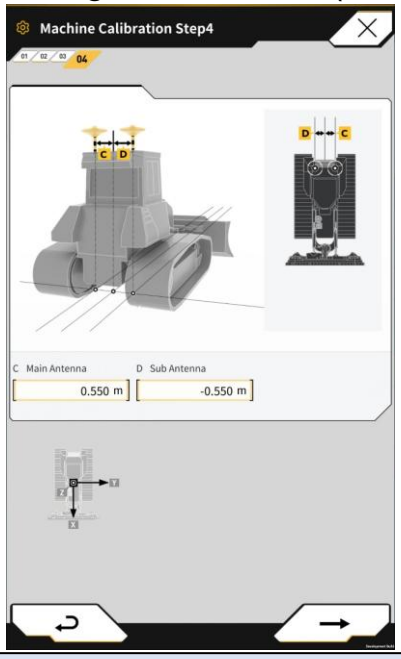
3. Similarly, measure and input the values of the machine body dimension A (outer width) and machine body dimension B.
   Dimension B is between the machine body front and rear ground contact points.

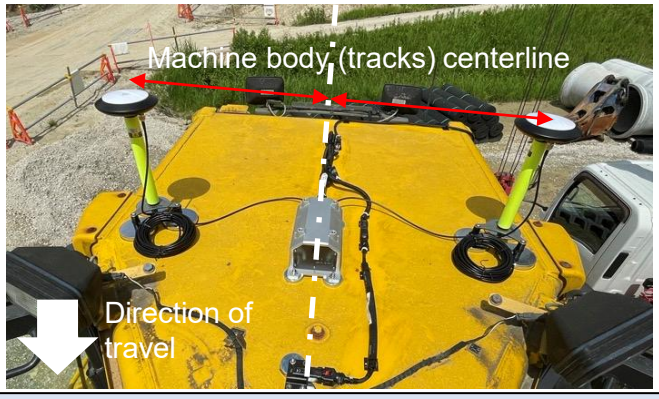



# 3.4 Calibration with a tape measure

4. Measure the distances from the machine body centerline to the main antenna and the sub antenna, respectively. For the main antenna installed on the left side of the machine body center, input the distance in the C field on the tablet screen as a positive number (XX m), and for the sub antenna installed on the right side, input the distance in the D field as a negative number (-XX m).

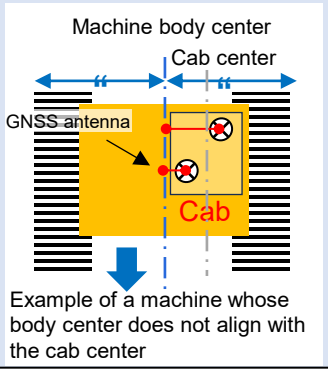



<Supplement>

- On the tablet screen, it is assumed that GNSS antenna 1 (main) is on the left side of the machine body, and GNSS antenna 2 (sub) is on the right side. Check the position of the main and sub antennas carefully to prevent mistakes when inputting. Also, if there is a large error in each measurement value of the main and sub antennas from the center of the machine body (compared to the GNSS antenna position information), the calibration may not be fixed when completed.

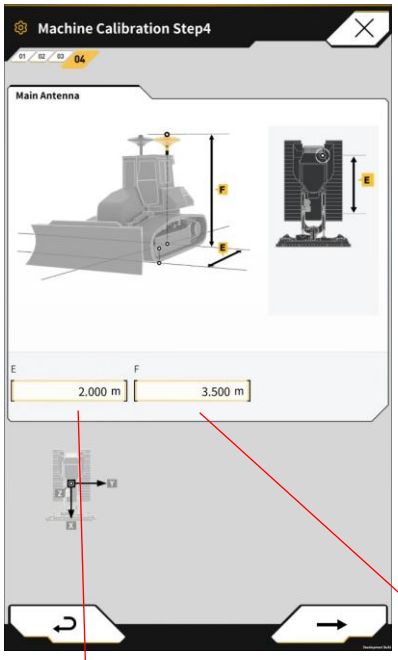
- The center of the machine body is not always in the center of the cab. Check the catalog, etc., of the machine and measure the center of the machine body and the position of each antenna.

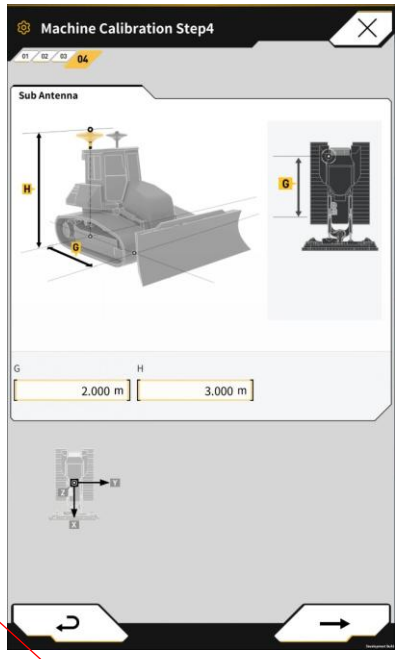


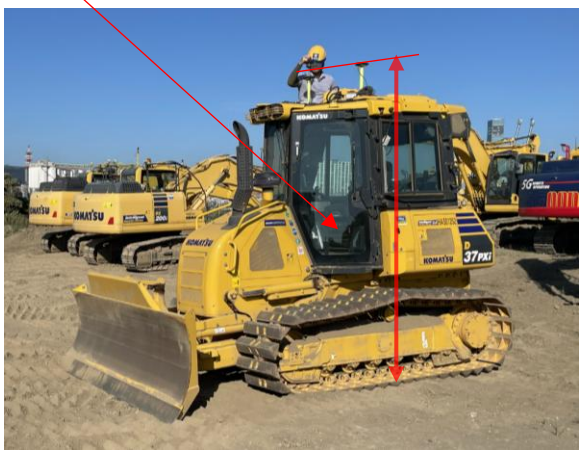
# 3.4 Calibration with a tape measure

5. With the machine body placed on a flat ground (use a level if necessary), measure the distance E between the vertical line through the GNSS antenna on the left side of the machine body extended to the ground contact surface and the measurement point at the front of the machine body, and the GNSS antenna height F from the ground contact surface.

6. Similarly, measure G and H on the right side of the machine body.

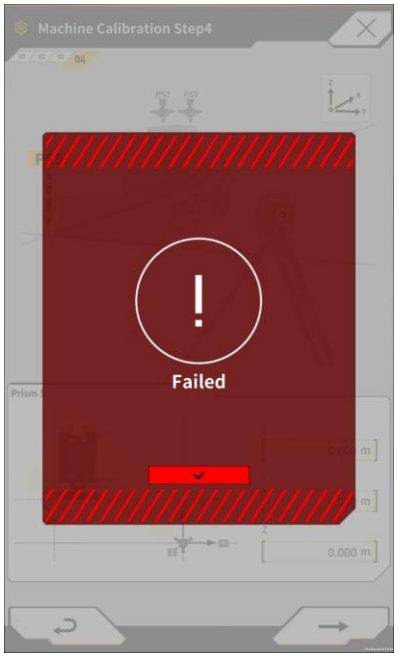


# 3.4 Calibration with a tape measure

If there are no problems with the calibration calculation results, the calibration is complete. In case of failure, the measurement location may not have been measured correctly or the measurement values may not have been input correctly.

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# 04

Chapter

# Position accuracy check

# 4.1 Accuracy check

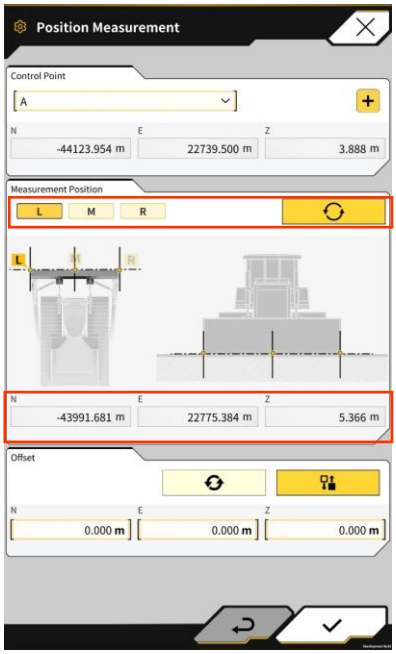
When the machine body calibration is complete, use the position measurement function to check the accuracy, paying attention to the following points.

- The localization file is correct.
- The control point coordinates are correct.

**Target accuracy (reference)　N, E ≤ 100 mm, Z ≤ 50 mm**

Note) This applies only when the machine body is on level ground, the IMU sensor is installed horizontally, and a TS calibration is performed.

It is preferable to use a TS to compare with the position measurement results, but if a TS cannot be prepared, get as close as possible to a control point, etc. and check that there is no error in position or height large enough to interfere with the work.


Measurement

*** Offset button**

* Offset button

Do not press this button unless you intentionally offset the difference from the control point.

# Revision History

| Day | Content | ver |
|---|---|---|
| 2023.9.6 | initial version | Ver1.0-0002 |
| 2025.5.21 | "Review of target accuracy due to changes in As-built acquisition position after the tablet app update (v1.4.3)." | Ver1.0-0003 |
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# Contact information for inquiry

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You can contact support via the following site:
https://support.smartconstruction.com/hc/requests/new
Select your region from the language options at the top right of the page.