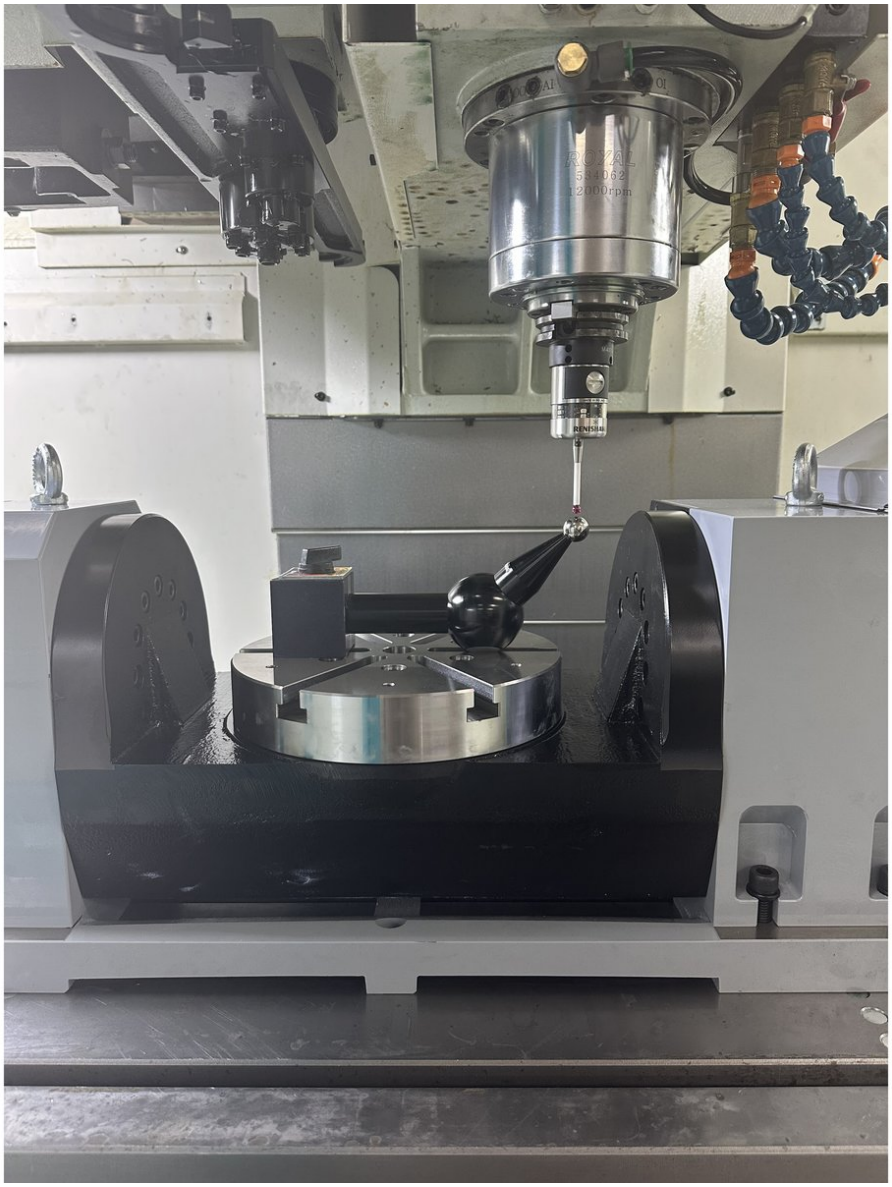
Trunnion (3+2) Calibration

Written By: Ryan Levrini



TOOLS:

- 1-2-3 blocks (1)
- Ring Gauge (1)
- Calibration Sphere (1 Inch) (1)
- Micrometer (1)

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Step 1 — Recalibration Rules & Process Overview



⚠ If at any time a new X, Y, or Z offset is changed in the **[TrakMT Options]** screen, or if X, Y, or Z axis is re-referenced, this entire calibration procedure must be completed again.

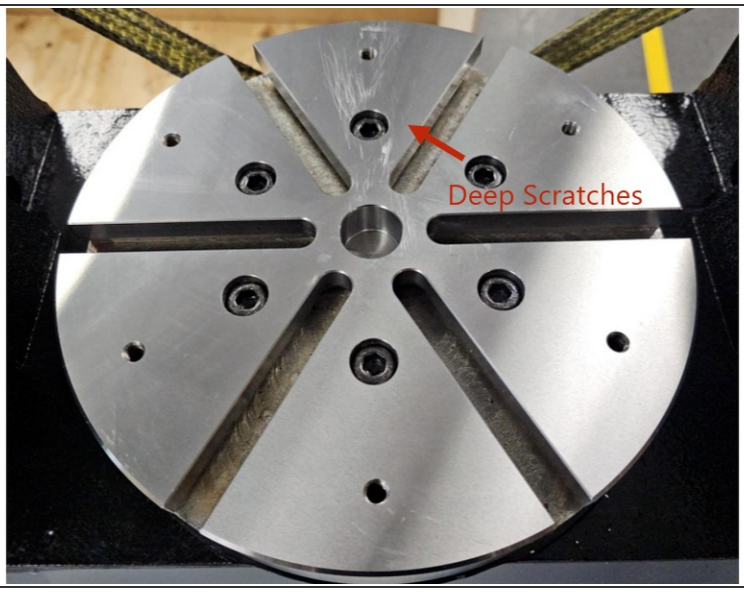
- This process verifies the control's internal kinematic model matches the machine's real geometry.
  - ***(Step 7)*** **5-Axis Kinematic Chain Setup** – The 5AXISKINCHAIN program builds the geometry framework that links the rotary axes (A, C) to the linear axes (X, Y, Z).
  - ***(Step 8)*** **Horizontal & Vertical Measuring** – The calibration sphere is probed in both flat and upright positions to compare results for alignment.
  - **(*Step 11)* Skew Check** – Compares both measurements to ensure the trunnion is aligned within 0.008".
  - ***(Step 12)*** **Correction** – The KIN_CORRECT program updates the kinematic model with measured data. (This is the actual calibration point)

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- ***(Step 14)*** **Verification** – The process is repeated to confirm the corrections are applied and alignment is within spec.

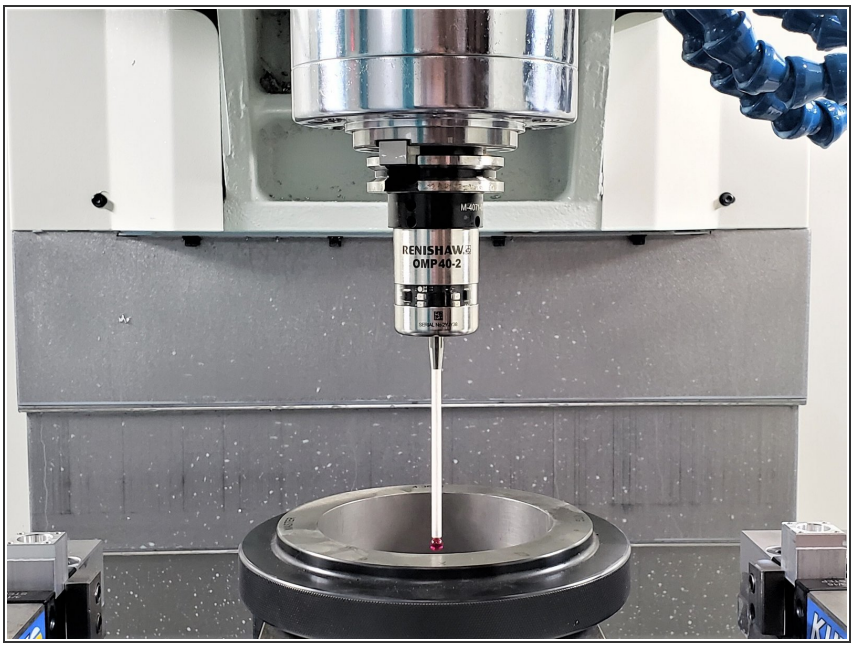
Step 2 — Protect Platter Surface During Calibration Sphere Handling





- Always place a plastic shim between the calibration sphere base and the trunnion platter.
- When removing, disable the magnet first, then lift the sphere straight up
- Never drag the base across the platter surface.

Step 3 — Probe Calibration

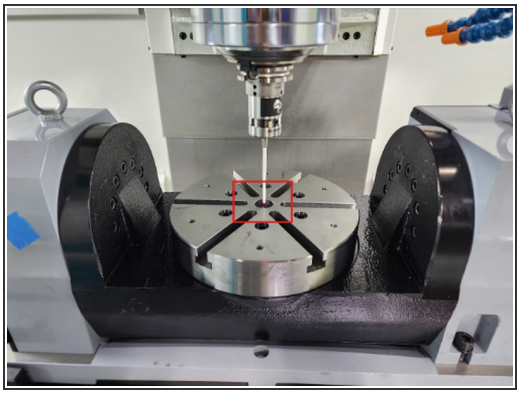


⚠ VMCsi 7 & 10 use 50mm Probe Stylus for Trunnion Calibration.

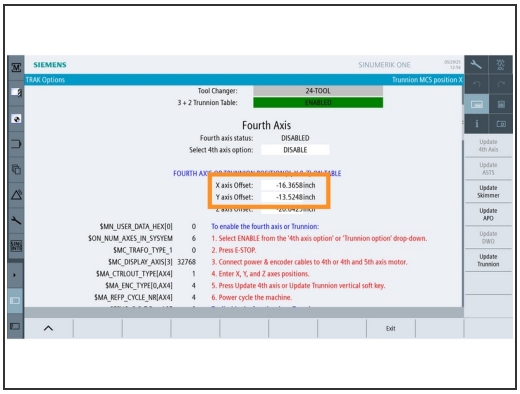
ⓘ 34080-17_STYLUS-PROBE-50MM

- If probe calibration has not been completed, follow the VMCsi Probe Part Option guide to complete the probe setup. Perform the following steps:
  - **Stylus Runout Adjustment** – Ensure the probe stylus is properly aligned.
  - **Calib. Tool: Set Work Offset** – Set the correct work offset using the calibration tool.
  - **Calibrate Probe Length** – Measure accurate probe length.
  - **Calibrate Probe Diameter** – Measure accurate probe diameter.

Step 4 — Find Center Point of Platter (X and Y)



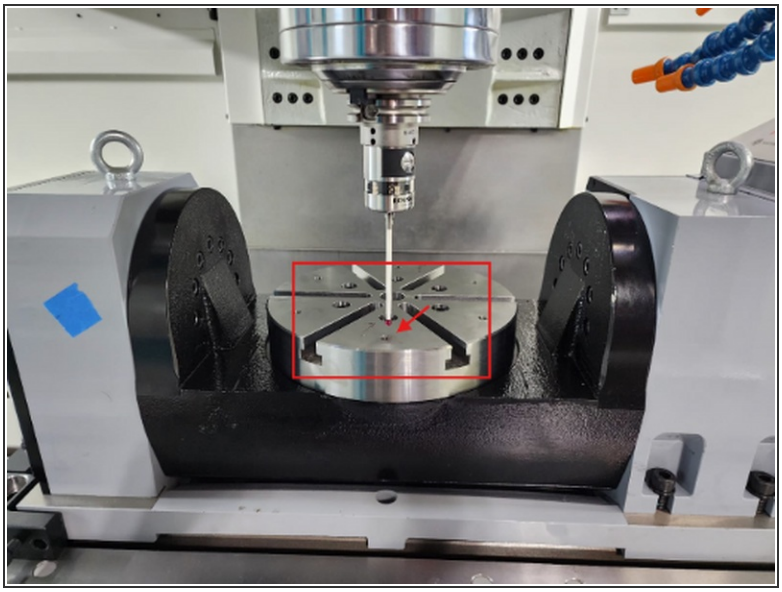


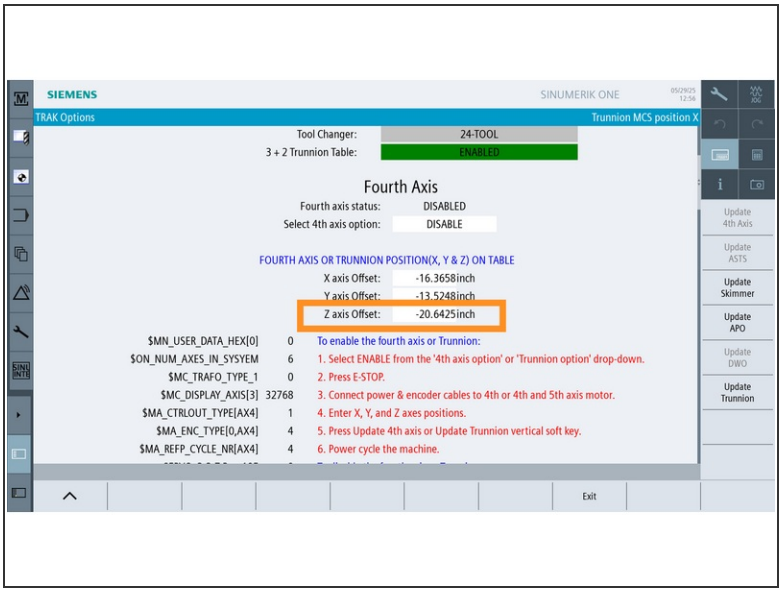


- Set the A-Axis and C-Axis positions to 0.
- Set up the probe at the center of the platter, just below the top surface, as shown in the screenshot for X & Y axis center offset measurement.
- Navigate to **[Machine]** → **[Jog]** on MCP → **[Meas. Workp]** → **[Measure 1 Hole]**.
- Set the hole diameter to **1.0** inch.
- Press **[Cycle Start]**, and the probe will measure the hole and find the center.
- In **[Trak Options]**, input the X and Y values from the probe measurement into the Trunnion Position section.

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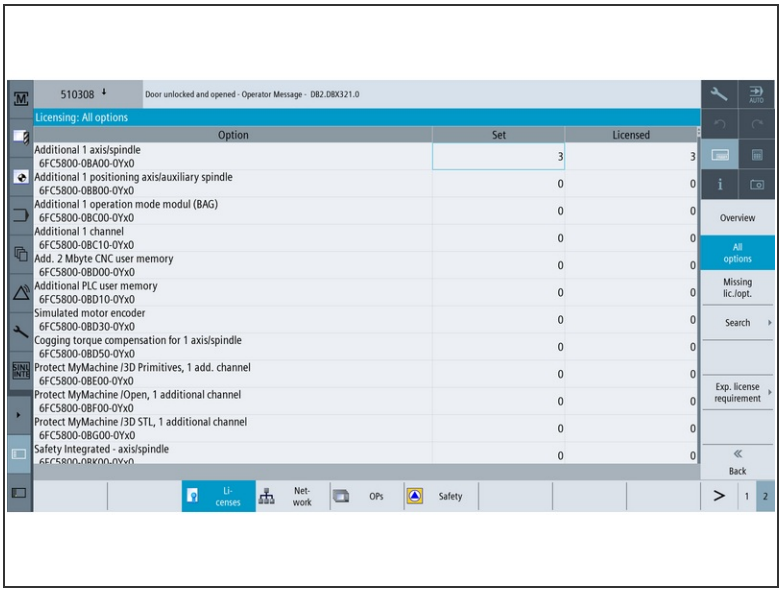
Step 5 — Find Z-Axis Offset Measurement

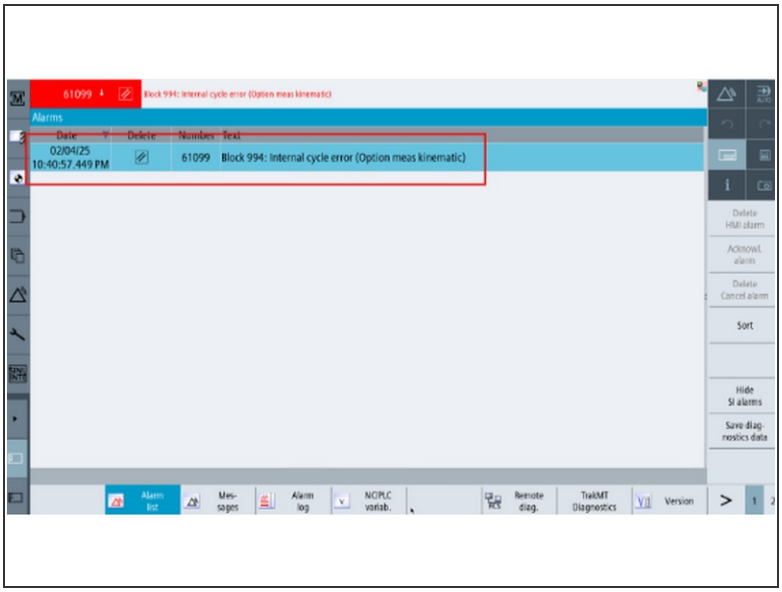




- Set up the probe on top of the platter, as shown in the screenshot, for Z-axis offset measurement.
- Navigate to **[Machine]** → **[Jog]** on MCP → **[Meas. Workp]** → Measure Z-Axis Edge (Square with one arrow).
- Press **[Cycle Start]**, and the probe will measure the Z-axis height of the platter.
- Apply the platter offset correction using the formula: **Measured Z Offset + (-0.2)**
  - ⓘ For Example: (-20.44) + (-0.2) = (-20.64)
  - ⓘ 0.2 accounts for the platter offset relative to the A-axis center of rotation.
- In **[Trak Options]**, input the updated Z-axis measurement with the applied platter offset correction.

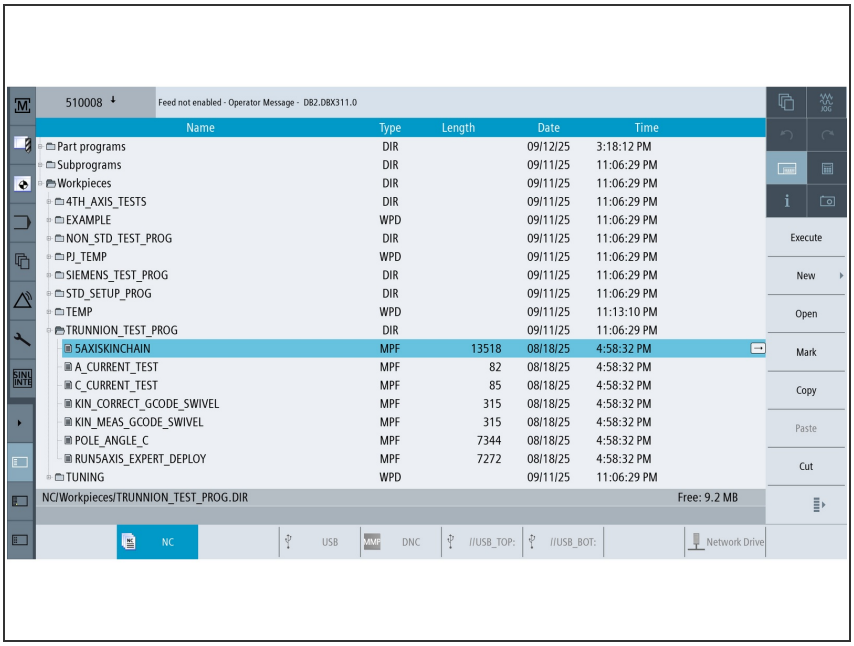
Step 6 — Verify Required Licenses





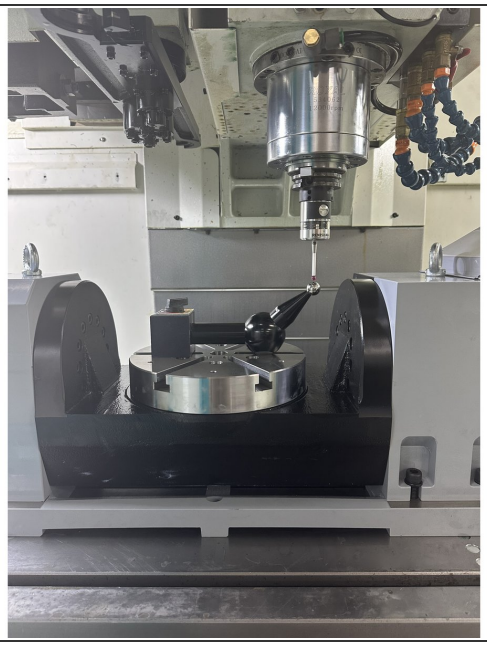
- Navigate to **[Setup]** → **[Page 2]** → **[Licenses]** → **[All Options]**.
- Confirm the following licenses are active before running the 5-Axis Loader program:
  - 2-axis test license: 6FC5800-0BA00-0Yx0
  - 5-axis machining package: 6FC5800-0BS43-0YX0
  - Kinematics measuring license: 6FC5800-0BP18-0Yx0
- If the licenses are not enabled, you will get Error 61099: Block 994 Internal Cycle Error when trying to run 5AXISKINCHAIN in **Step 7**.

Step 7 — Run 5 Axis Loader Program



- Set Manufacture Password.
- Go to **[Program Directory]** → Work Piece → TRUNNION_TEST_PROG.
- Run the 5AXISKINCHAIN program from this folder.
- Press **[Cycle Start]** to execute the program and set up the kinematic chain.
- Press **[Reset PO]** to apply the new offsets. Press **[OK]** to continue through the warnings. The machine will reboot.
- If Error 12550 appears, navigate to **[Setup]** → **[Machine Data]** → **[General MD]** and confirm the following values are set correctly:
  - N18866 $MN_MM_NUM_KIN_TRAFOS = 1
  - N18880 $MN_MM_MAXNUM_KIN_CHAIN_ELEM = 20

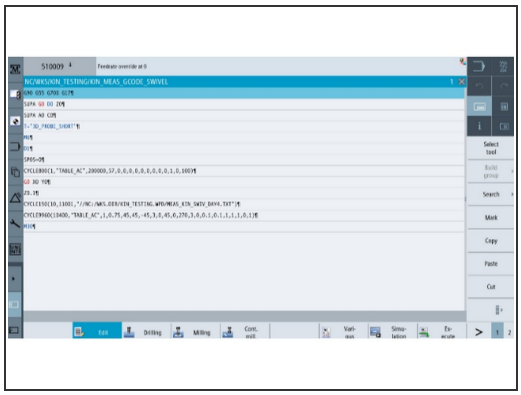
Step 8 — Horizontal Kinematic Measuring Set-Up

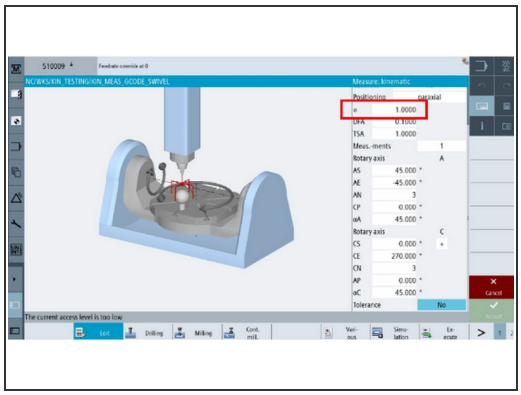


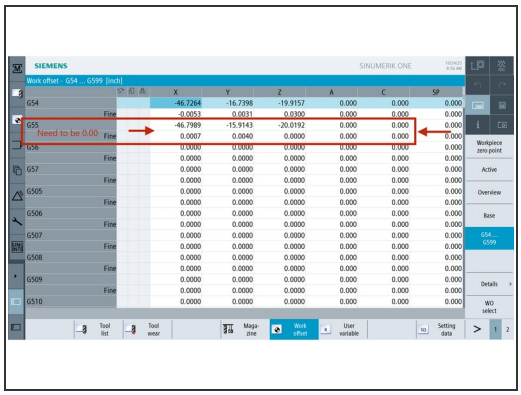
- Set Manufacture Password.
- Ensure the A-Axis and C-Axis positions are set to 0.
- Position the ball of the calibration sphere at the 3 o'clock position (X-positive direction) on the C-axis (rotary) as shown in the picture.
- Place the probe approximately at the center of the ball and about ¼" above it.
- Set the work offset from the **[T, S, M]** screen for all axes at this point.
- Navigate to the **[Work Offset (WO)]** menu and select **G55** as the active work offset.
- Use the **[Set Actual Position]** function to store the measured position as X = 0, Y = 0, Z = 0.

ⓘ If the probe tip fails to follow the calibration sphere correctly when the A-axis rotates, repeat Steps 4, 5, and 6. Pay close attention to Step 5 (Z-axis offset calculation).

Step 9 — Run Kinematic Measuring Program







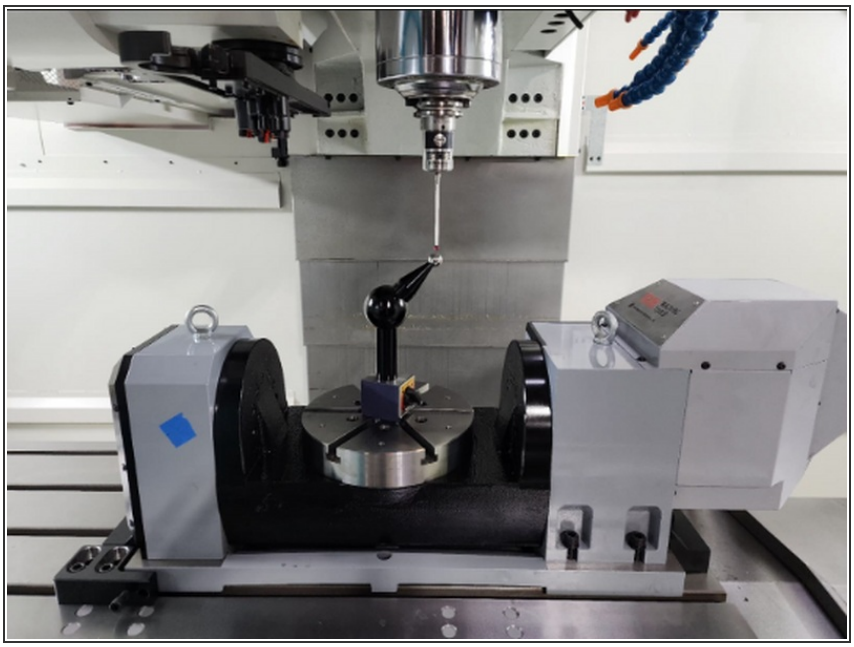
- Open **[Program Manager]** and navigate to **[Trunnion Directory]**.
- Select **KIN_MEAS_GCODE_SWIVEL** from the work directory.
- In **Cycle9960**, set Kinematic to **Meas. Only**.
- Using a micrometer, verify the calibration sphere diameter is 1.000 inch.
- Enter 1.000 into the program field for sphere size.
- Run the program to execute the kinematic measurement cycle. (Must be in Manufacture Level Access)

ⓘ If you run into *Error 61426: Block N699065; Some of the active offsets does not equal zero-error code: %*

  ⓘ Go to **[Offsets]** → **[Work Offsets]** and make sure no offset is applied to **G55**.

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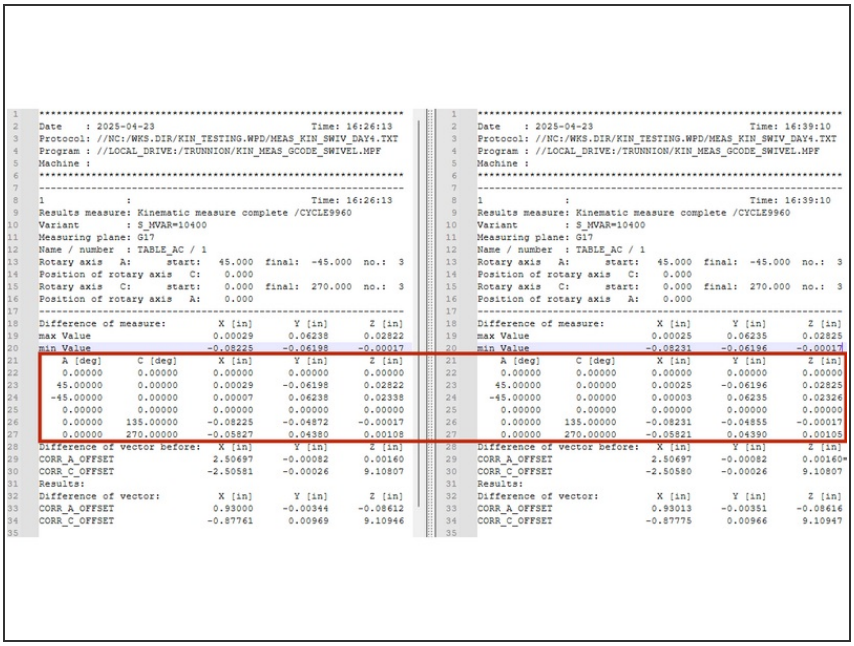
Step 10 — Vertical Kinematic Measuring Set-Up



⚠ VMCsi 7 & 10 use 50mm Probe Stylus for Trunnion Calibration.

- Position the calibration sphere with a magnetic base **vertically** at the 3 o'clock position (X-positive direction).
- Repeat **Step 8** and **9** to run the kinematic measuring cycle again.

Step 11 — Determine Skew Measurement



```
Date    : 2025-04-23                                Time: 16:26:13
Protocol: //NC:/WKS.DIR/KIN_TESTING.WPD/MEAS_KIN_SWIV_DAY4.TXT
Program : //LOCAL_DRIVE:/TRUNNION/KIN_MEAS_GCODE_SWIVEL.MPF
Machine :
*****************************************************************
-----------------------------------------------------------------
1                :                                  Time: 16:26:13
Results measure: Kinematic measure complete /CYCLE9960
Variant        : S_MVAR=10400
Measuring plane: G17
Name / number  : TABLE_AC / 1
Rotary axis   A:      start:   45.000  final:  -45.000  no.:  3
Position of rotary axis   C:    0.000
Rotary axis   C:      start:    0.000  final:  270.000  no.:  3
Position of rotary axis   A:    0.000
-----------------------------------------------------------------
Difference of measure:          X [in]       Y [in]       Z [in]
max Value                      0.00029      0.06238      0.02822
min Value                     -0.08225     -0.06198     -0.00017
    A [deg]      C [deg]       X [in]       Y [in]       Z [in]
    0.00000      0.00000      0.00000      0.00000      0.00000
   45.00000      0.00000      0.00029     -0.06198      0.02822
  -45.00000      0.00000      0.00007      0.06238      0.02338
    0.00000      0.00000      0.00000      0.00000      0.00000
    0.00000    135.00000     -0.08225     -0.04872     -0.00017
    0.00000    270.00000     -0.05827      0.04380      0.00108
Difference of vector before:    X [in]       Y [in]       Z [in]
CORR_A_OFFSET                  2.50697     -0.00082      0.00160
CORR_C_OFFSET                 -2.50581     -0.00026      9.10807
Results:
Difference of vector:           X [in]       Y [in]       Z [in]
CORR_A_OFFSET                  0.93000     -0.00344     -0.08612
CORR_C_OFFSET                 -0.87761      0.00969      9.10946
```

```
Date    : 2025-04-23                                Time: 16:39:10
Protocol: //NC:/WKS.DIR/KIN_TESTING.WPD/MEAS_KIN_SWIV_DAY4.TXT
Program : //LOCAL_DRIVE:/TRUNNION/KIN_MEAS_GCODE_SWIVEL.MPF
Machine :
*****************************************************************
-----------------------------------------------------------------
1                :                                  Time: 16:39:10
Results measure: Kinematic measure complete /CYCLE9960
Variant        : S_MVAR=10400
Measuring plane: G17
Name / number  : TABLE_AC / 1
Rotary axis   A:      start:   45.000  final:  -45.000  no.:  3
Position of rotary axis   C:    0.000
Rotary axis   C:      start:    0.000  final:  270.000  no.:  3
Position of rotary axis   A:    0.000
-----------------------------------------------------------------
Difference of measure:          X [in]       Y [in]       Z [in]
max Value                      0.00025      0.06235      0.02825
min Value                     -0.08231     -0.06196     -0.00017
    A [deg]      C [deg]       X [in]       Y [in]       Z [in]
    0.00000      0.00000      0.00000      0.00000      0.00000
   45.00000      0.00000      0.00025     -0.06196      0.02825
  -45.00000      0.00000      0.00003      0.06235      0.02326
    0.00000      0.00000      0.00000      0.00000      0.00000
    0.00000    135.00000     -0.08231     -0.04855     -0.00017
    0.00000    270.00000     -0.05821      0.04390      0.00105
Difference of vector before:    X [in]       Y [in]       Z [in]
CORR_A_OFFSET                  2.50697     -0.00082      0.00160
CORR_C_OFFSET                 -2.50580     -0.00026      9.10807
Results:
Difference of vector:           X [in]       Y [in]       Z [in]
CORR_A_OFFSET                  0.93013     -0.00351     -0.08616
CORR_C_OFFSET                 -0.87775      0.00966      9.10947
```

- Every time **KIN_MEAS_GCODE_SWIVEL** is executed, a new entry is added to

the MEAS_KIN_SWIV_DAY4 file. New entries added to the bottom.

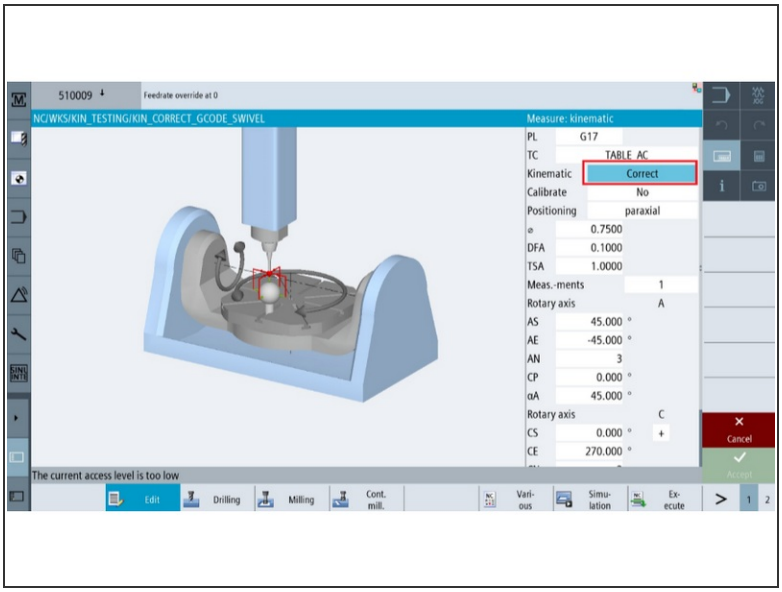
- This can be found in **[Program Manager] → [Workpieces] → [Kin Testing] → [MEAS_KIN_SWIV_DAY4]**
- Compare measured results from both **horizontal** and **vertical** calibration sphere placements.

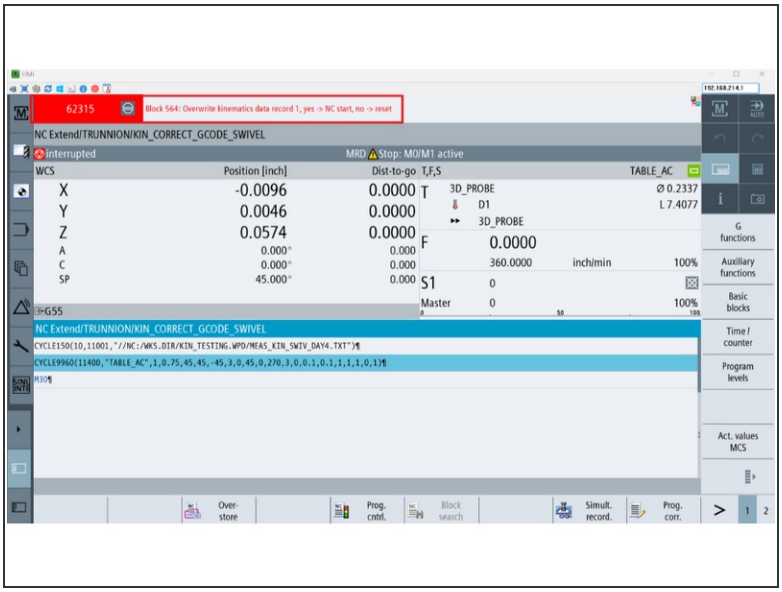
ⓘ The image shows a side-by-side comparison of the horizontal and vertical measurement results.

- Check the "**Difference of measure**" section in both results. The values, highlighted in the red box, should be within **0.008**” (8 thou, not eight-tenths) of each other to confirm proper alignment and eliminate skew.
- If any value exceeds 0.008”, the alignment is incorrect. Restart the calibration and verify your setup.

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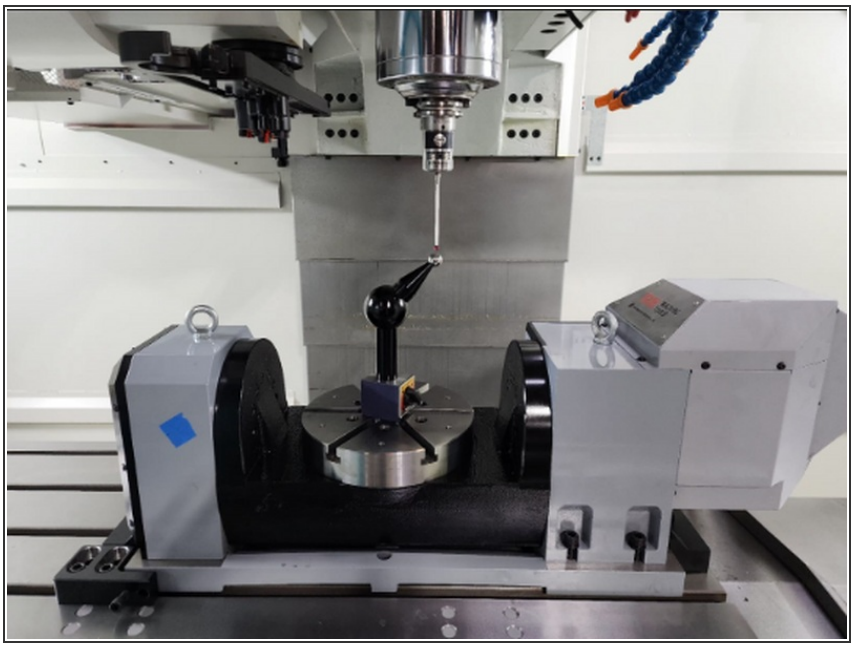
Step 12 — Run Kinematic Correction Program





- ⓘ Only continue on Step 12 if skew from Step 14 was within 0.008”
- Select the "**KIN_CORRECT_GCODE_SWIVEL**" program from the work directory.
- In Cycle9960, set Kinematic to "**Correct**" if it is currently set to "Meas. Only".
- ⓘ Using a micrometer, measure the diameter (in inches) of the calibration sphere to confirm its size. The sphere should be 1 inch.
- Run the program as performed in **Step 14** with the calibration sphere **vertically standing up**.
- After the program completes, message (62315) will pop up.
- Press **[NC Start]**, all kinematic data will be overwritten.

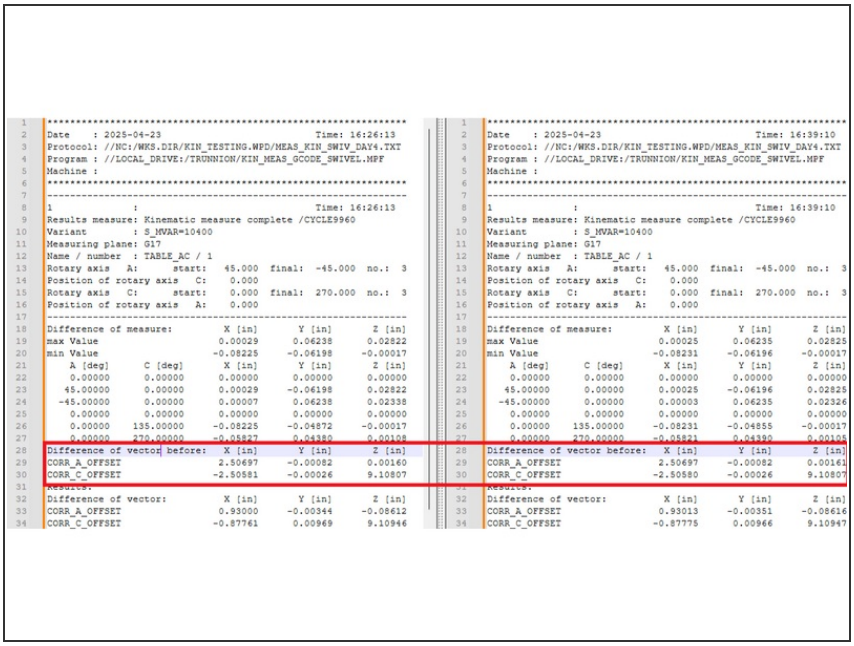
Step 13 — Vertical Kinematic Measuring Set-Up



⚠ VMCsi 7 & 10 use 50mm Probe Stylus for Trunnion Calibration.

- Position the calibration sphere with a magnetic base **vertically** at the 3 o'clock position (X-positive direction).
- Repeat **Step 9** to run the kinematic measuring cycle again.
  - ⓘ Measuring Cycle, not Correction Cycle.

Step 14 — Verification of Correction Offsets



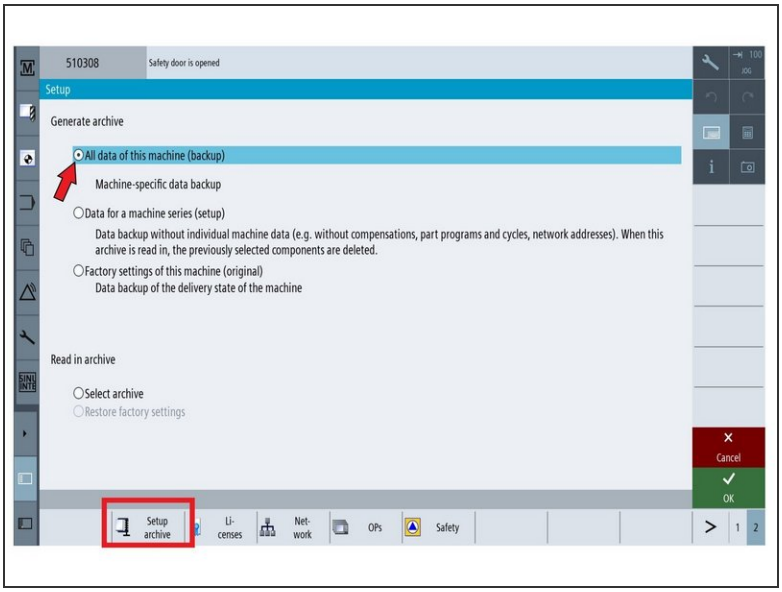
```
Date    : 2025-04-23                                Time: 16:26:13
Protocol: //NC:/WKS.DIR/KIN_TESTING.WPD/MEAS_KIN_SWIV_DAY4.TXT
Program : //LOCAL_DRIVE:/TRUNNION/KIN_MEAS_GCODE_SWIVEL.MPF
Machine :
*********************************************************************
--------------------------------------------------------------------
1            :                                  Time: 16:26:13
Results measure: Kinematic measure complete /CYCLE9960
Variant      : S_MVAR=10400
Measuring plane: G17
Name / number  : TABLE_AC / 1
Rotary axis   A:      start:   45.000  final:  -45.000  no.:  3
Position of rotary axis   C:    0.000
Rotary axis   C:      start:    0.000  final:  270.000  no.:  3
Position of rotary axis   A:    0.000
--------------------------------------------------------------------
Difference of measure:          X [in]       Y [in]       Z [in]
max Value                      0.00029      0.06238      0.02822
min Value                     -0.08225     -0.06198     -0.00017
    A [deg]      C [deg]       X [in]       Y [in]       Z [in]
    0.00000      0.00000      0.00000      0.00000      0.00000
   45.00000      0.00000      0.00029     -0.06198      0.02822
  -45.00000      0.00000      0.00007      0.06238      0.02338
    0.00000      0.00000      0.00000      0.00000      0.00000
    0.00000    135.00000     -0.08225     -0.04872     -0.00017
    0.00000    270.00000     -0.08227      0.04150      0.00108
Difference of vector before:    X [in]       Y [in]       Z [in]
CORR_A_OFFSET                  2.50697     -0.00082      0.00160
CORR_C_OFFSET                 -2.50581     -0.00026      9.10807
Results:
Difference of vector:           X [in]       Y [in]       Z [in]
CORR_A_OFFSET                  0.93000     -0.00344     -0.08612
CORR_C_OFFSET                 -0.87761      0.00969      9.10946
```

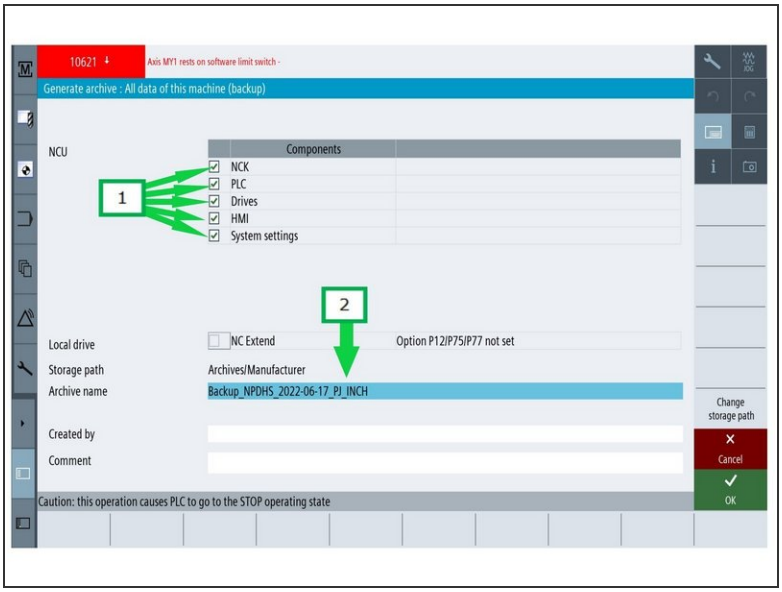
```
Date    : 2025-04-23                                Time: 16:39:10
Protocol: //NC:/WKS.DIR/KIN_TESTING.WPD/MEAS_KIN_SWIV_DAY4.TXT
Program : //LOCAL_DRIVE:/TRUNNION/KIN_MEAS_GCODE_SWIVEL.MPF
Machine :
*********************************************************************
--------------------------------------------------------------------
1            :                                  Time: 16:39:10
Results measure: Kinematic measure complete /CYCLE9960
Variant      : S_MVAR=10400
Measuring plane: G17
Name / number  : TABLE_AC / 1
Rotary axis   A:      start:   45.000  final:  -45.000  no.:  3
Position of rotary axis   C:    0.000
Rotary axis   C:      start:    0.000  final:  270.000  no.:  3
Position of rotary axis   A:    0.000
--------------------------------------------------------------------
Difference of measure:          X [in]       Y [in]       Z [in]
max Value                      0.00025      0.06235      0.02825
min Value                     -0.08231     -0.06196     -0.00017
    A [deg]      C [deg]       X [in]       Y [in]       Z [in]
    0.00000      0.00000      0.00000      0.00000      0.00000
   45.00000      0.00000      0.00025     -0.06196      0.02825
  -45.00000      0.00000      0.00003      0.06235      0.02326
    0.00000      0.00000      0.00000      0.00000      0.00000
    0.00000    135.00000     -0.08231     -0.04855     -0.00017
    0.00000    270.00000     -0.08231      0.04190      0.00105
Difference of vector before:    X [in]       Y [in]       Z [in]
CORR_A_OFFSET                  2.50697     -0.00082      0.00161
CORR_C_OFFSET                 -2.50580     -0.00026      9.10807
Results:
Difference of vector:           X [in]       Y [in]       Z [in]
CORR_A_OFFSET                  0.93013     -0.00351     -0.08616
CORR_C_OFFSET                 -0.87775      0.00966      9.10947
```

- Navigate to **[Program Manager] → [Workpieces] → [Kin Testing] → [MEAS_KIN_SWIV_DAY4]**
- Compare results from both **vertical measurement** and **vertical correction**.
- Check the "**Difference of vector before**" section in both results. The values, highlighted in the red box, should be within **0.008**" of each other to confirm proper alignment and eliminate skew.
- If any value exceeds **0.008"**, the alignment is incorrect. Restart the calibration and verify your setup.

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Step 15 — Backup Manufacturer Archive





- Press **[E-Stop]**.
- Go to **[Setup]** → **[2nd Page]** → **[Setup Archive]** → **[All data of this machine]** → **[Ok]**
- **(1)** Make sure all boxes are checked.
- **(2)** Select the **[Archive name]** data field. Name the file: Backup_NPDHS-YYYY-MM-DD_**TRUNNION_ENABLED**. Press **[OK]**.
  - ⓘ Note: YYYY-MM-DD is the current date (e.g., June 26, 2023, is written as 2023-06-26 in the archive name).
- The default storage path should be **[Archives/Manufacturer]**. If the storage path is anything other than the default, change it by pressing **[Change storage path]** → **[Archive/Manufacturer]** → **[OK]**.

⚠ **Please send copy of updated archive to TRAKMT Support.**