

COMMENTARY TO AG:PT/T211 - VERIFICATION PROCEDURE FOR A "GYROPAC" GYRATORY COMPACTOR

PREFACE

This verification procedure was prepared by the Asphalt Research Reference Group on behalf of Austroads. Representatives of ARRB Group, the Australian Asphalt Pavement Association and Austroads Member authorities have been involved in the development and review of this test method. .

FOREWORD

This document has been prepared to assist users to verify that a 'Gyropac' gyratory compactor is operating correctly. Users are advised to also check the requirements set out in the NATA Policy Circular No. 8. Where differences between this document and the NATA document exist, the NATA document takes precedence.

SCOPE

Asphalt characterisation tests require equipment that is well maintained and correctly adjusted. The procedures described in this document will provide a means of verifying that a Gyropac gyratory compactor is in a suitable working condition to comply with the requirements of AS 2891.2.2 'Sample preparation – Compaction of asphalt test specimens using a gyratory compactor'. The procedures are advisory rather than mandatory.

FURTHER DEVELOPMENT

There are no further developments planned for this document.

VERIFICATION PROCEDURE FOR A “GYROPAC” GYRATORY COMPACTOR

1 REFERENCED DOCUMENTS

The following documents are referred to in this test method:

AS /NZS

AS 2891.2.2 Sample preparation – Compaction of asphalt test specimens using a gyratory compactor.

NATA

NATA Policy Circular No. 8 – Calibration requirements for AS 2891 Method 2.2: Sample Preparation – Compaction of asphalt test specimens using a gyratory compactor.

2 APPARATUS

The following apparatus is required:

- (a) Gyratory compaction device conforming to AS2891.2.2
- (b) Timer
- (c) Gauge block approximately 4.5 mm in thickness.
- (d) Temperature measuring device capable of measuring temperatures to 0.1°C over the range 15 to 35°C.
- (e) Force measurement device capable of measuring loads in the range 1 to 5 kN readable to the nearest 0.1 kN.

3 PRE-CALIBRATION PREPARATION

Ensure that the mould and gyratory compactor are clean and that all detritus is removed from the mould locking assembly. Any routine maintenance tasks should be performed before calibration.

4 PROCEDURE

Care should be taken in the calibration of the equipment with regard to possible electrocution and danger from the use of pneumatic components. All manufacturers instructions should be thoroughly understood before commencing and appropriate personal protective safety apparatus should be worn.

Where the test outputs are processed from automatic recording equipment, it is the processed information which has to be checked against actual values.

4.1 Gyratory Compactor

Rate of Gyration: Locate and mark the cam shaft (item 1 in fig. 1) of gyratory compactor prominently such that when operating, the mark is easily visible. Typing correction fluid is often used to mark the cam shaft.

Use a timing device accurate to 0.1 seconds that has been checked against Telstra time signal (within last 6 months).

The pressure regulator (item 8 in fig. 1) should be adjusted to zero so that the vertical loading arm does not lower during verification of the items in section 4.1.

Rate of Revolution Check: The purpose of the revolution check is to ensure that the speed of rotation at any time during compaction is accurate and not fluctuating. This must be done at discrete points rather than using an "accumulative" test procedure.

- a. Following the manufacturers' instruction start the compactor.
- b. After approximately ten cycles start the stop watch when the mark on the cam shaft is aligned and count the number of revolutions over approximately a one minute period.
- c. Record the number of revolutions you have counted and the time to the nearest 0.1 second.
- d. Following the manufacturers' instruction stop the compactor.
- e. Repeat steps a) to d) after approximately ten minutes.
- f. From the revolutions counted over each of the two one minute periods calculate the revolution rate.
- g. Compare with the tolerance given in the standard (i.e. 60 ± 5 rpm).

Cycle Counter Check:

- a. Following the manufacturers' instructions zero the cycle counter (item 3 in Fig. 1) and start the machine.
- b. Count the revolutions using the mark on the cam shaft.
- c. After approximately 250 cycles, record the counter reading and the number of actual revolutions counted.
- d. Compare the 'counter' with the number of actual revolutions.

Preset Check:

- a. Set the compactor to stop at 50 cycles.
- b. Following the manufacturers' instructions zero the cycle counter and start the machine.
- c. Using the mark on the cam shaft count the number of revolutions.
- d. Repeat steps a) to c) with the "preset" set at 250 cycles.

- e. Compare the results against the tolerance specified in the standard (i.e. ± 1 revolution).

Slack in Yoke Check: The slack in the yoke must be checked on a regular basis (at least every 6 months). Check that with the digital angle gauge is reading on one arm of the yoke, twisting the yoke to the extremes of movement, both clockwise and anti-clockwise, does not cause an apparent angle of more than 0.3° .

4.2 Gyratory Angle

AS 2891.2.2 requires that the gyratory angle be adjusted and set to within ± 0.1 degrees. However the "Gyropac" cannot be adjusted with the existing angle setting mechanism to this accuracy. As a consequence laboratories may:

- use the "Gyropac" at an angle that has been set and calibrated by an external agency along with an endorsed report or alternatively;
- use the Gyratory angle calibrator (see Fig. 2) to adjust the equipment to the desired angle as detailed below. Assurance is gained through the use of the gyratory angle calibrator that the angle of gyration will be consistently and accurately set relative to all other laboratories who use a calibrator .

The gyratory angle calibrator is used to:

- Check the angle set as marked on the gyratory compactor, either 2 or 3 degrees;
- Set a gyration angle other than the two marked angles.

The gyratory angle calibrator uses a dial gauge to measure the deflection of the yoke. The geometry is such that the "mm" reading on the dial gauge display relates directly to the angle to be set in degrees.

i.e. 1 mm (displayed by the dial gauge) = 1° (gyratory angle applied to sample)

The gyratory angle calibrator is used in the following manner:

- (a) Disconnect the air supply and the mains power to the Gyropac.
- (b) Remove the bottom platen and clean any material away from the surface of the bottom pivot mounting plate.
- (c) Insert the gyratory angle calibrator so that the recess in the base of the calibrator engages with the raised annulus of the bottom pivot. The magnets in the base of the calibrator will hold it in position.
- (d) Insert a 6 mm Allen key in the end of the motor shaft (item 7 in Fig. 1) and rotate clockwise slowly until the crankshaft locking screws (item 6 in fig. 1) are vertical.
- (e) Ensure that the arm of the calibrator is parallel to the front face of the mould carrier (item 10 in Fig. 1) and facing to the right.
- (f) Visually ensure that the rocker arm (item 9 in Fig. 1) is approximately horizontal.

- (g) Adjust the dial gauge to the middle of its range (typically the position of the dial gauge within the carrier is not altered and will normally be correctly adjusted).
- (h) Zero the gauge.
- (i) Rotate the motor shaft clockwise slowly. Record the most positive and negative displayed angle.
- (j) Subtract the smaller from the larger, and halve.

e.g. + 1.5 and -2.5 gives $4.0/2 = 2.0$ degrees
- (k) If the desired angle has not been achieved remove angle calibrator. Adjust gyratory compactor according to the manufacturer's instructions. Repeat steps (c) through (j).

4.3 Force Measuring

Endorsed reports are required that indicate that the system meets grade C requirements of AS 2193. The endorsed report must note the pressure gauge reading that corresponds to 1.89 kN and 4.24 kN (i.e. a pressure of 240 kPa for 100 mm and 150 mm diameter specimens respectively). If other loads are to be used then reports must reflect these additional loads as well.

The force indicator (pressure gauge) shall be readable to at least 0.1 kN (or 10 kPa).

For pneumatic force measuring systems that use a Bourdon tube or diaphragm gauge, the period between successive calibrations is six months.. For those Gyropacs fitted with a digital pressure gauge the period between successive calibrations is two years.

- a. Place the endorsed force measuring apparatus within the yoke and ensure that it is located centrally and will come in contact with the yoke during operation. It may be necessary to manufacture a jig that positions the force measuring apparatus relative to the raised annulus of the bottom pivot.
- b. The pressure regulator (item 8 in fig. 1) should be adjust to zero.
- c. Following the manufacturers' instruction start the compactor.
- d. The pressure regulator should be used to slowly increase the pressure until the loading ram lowers and engages the top of the force measuring system.
- e. Increase the pressure using the pressure regulator until the force loading systems registers an applied load of 1.89 kN. Record the pressure gauge reading.
- f. Continue increasing the pressure until the force loading systems registers an applied load of 4.24 kN. Record the pressure gauge reading.
- g. Following the manufacturers' instruction stop the compactor.

4.4 Gyratory Angle Calibrator

The gyratory angle calibrator consists of a support stand, rocker arm and dial gauge (figure 2). The geometry of the calibrator is critical in order to ensure accurate setting of the compaction angle. The probe tip of the calibrator must not be adjusted following calibration.

If other 'calibrators' are to be used these must be approved by NATA as being suitable prior to their use.

It is recommended that the gyratory angle calibrator be calibrated by an appropriate calibration authority and a NATA endorsed calibration certificate obtained. Alternatively the gyratory angle calibrator may be checked in-house but as a consequence a lower level of assurance is provided.

Each report must be critically assessed to determine whether the indicated calibration must be applied or whether the device can be used and read as 1 mm being equal to 1 degree. The difference between the reference value and the reading from the gauge should not be greater than 0.1°.

A gauge block shall be used to check the gyratory angle calibrator. A gauge block (approximately 4.50 mm) must be used which corresponds to the equivalent angle of 3°. Additional blocks may be required for other angles depending on the compaction angles used. The gauge blocks used to perform the check must have a current NATA endorsed report associated.

The angle indicated by the gyratory angle calibrator is given by:

$$\text{Gyratory angle} = \frac{a \sin\left(\frac{G}{122}\right)}{0.7}$$

where G is the thickness in mm of the gauge block.

- a. First set the gyratory angle on the gyratory compactor to 3°. Position the mould carrier so that it is at its maximum angle. Check the error associated with the fit between the calibrator and the bottom pivot mounting plate by locating the calibrator hard up against the left side of the pivot mounting plate and then hard up against the right side of the pivot mounting plate and comparing the two readings. The difference shall be no more than a one fifth of the allowable error. (i.e. less than 0.02 degrees).
- b. Insert the gauge block between the yoke (set at the lowest point) and the probe tip.
- c. Using the above equation calculate the expected angle for the gauge block used.

The difference between the measured value and the calculated value shall be less than 0.05 degrees.

The geometry of the calibrator must also be checked (ie. dimensions 82 and 122 mm, see Fig. 2)..

4.5 Mould Assembly

Each mould assembly in use must be able to produce specimens that meet the tolerances for diameter stated in method AS 2891.2.2 (table 1). The diameter of the specimen shall be measured as described in AS 2891 Part 13.1 , Section 7.1.

In addition each mould shall be checked to ensure that the internal faces of the mould are parallel.

4.6 Wearing Disks

In the normal usage the wearing disks tend to become pitted, particularly at the circumference of the disk. Pits and scuffing of the faces of the disks is expected and does not require consideration. However, burrs on the circumference can bind to the mould and thus affect the compaction process. These burrs need to be removed so that the wearing disks easily fits within the moulds.

The thickness of the wearing disks can affect the height of the finished sample. Wearing disks are typically used as a set:

- 100 mm diameter set
- 150 mm diameter set.

The thickness of any wearing disk in use should not vary by more than 0.2 mm from the mean thickness of all wearing disks in a set.

5 CALIBRATION REPORT

The report should include the following information:

- (a) Date and time of calibration
- (b) Name of the person undertaking the calibration
- (c) Identification of gyratory compaction device being calibrated
- (d) Identification of all apparatus used in undertaking the calibration including:
 - Timer
 - Gauge block(s)
 - Calibrated temperature measuring device
 - Force measurement apparatus
 - Gyratory angle calibrator
- (e) Rate of gyration, incorporating
 - rate of revolution check to the nearest rpm
 - cycle counter check to the nearest whole number
 - preset check to the nearest cycle.
- (f) Gyratory angle to the nearest 0.1°
- (g) Pressure gauge value corresponding to a load of 1.89 kN and 4.24 kN.
- (h) The angle related to the play in the seating of the gyratory angle calibrator.
- (i) Statement describing the temperature at which the work was undertaken.

(j) Mould assembly identification and dimensions.

(k) Wearing plate identification and dimensions

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|------------------------------|------------------------------|-------------------|
| 1. Cam shaft | 5. Yoke | 9. Rocker arm |
| 2. Gyrotary angle calibrator | 6. Crankshaft locking screws | 10. Mould carrier |
| 3. Cycle counter | 7. Motor shaft | 11. Probe up |
| 4. Dial gauge | 8. Pressure gauge | |

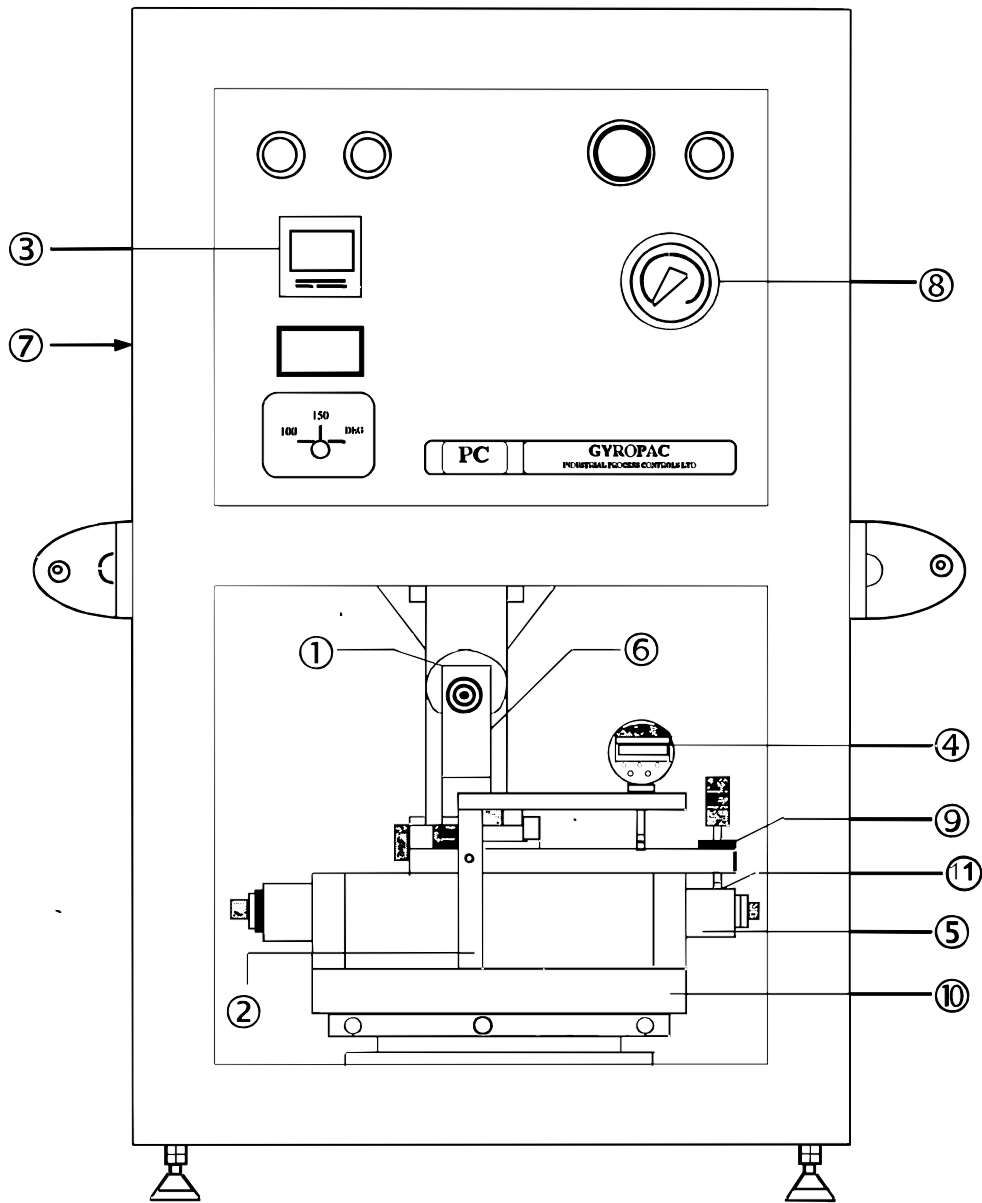


Fig. 1 Gyrotary compactor with angle calibrator installed

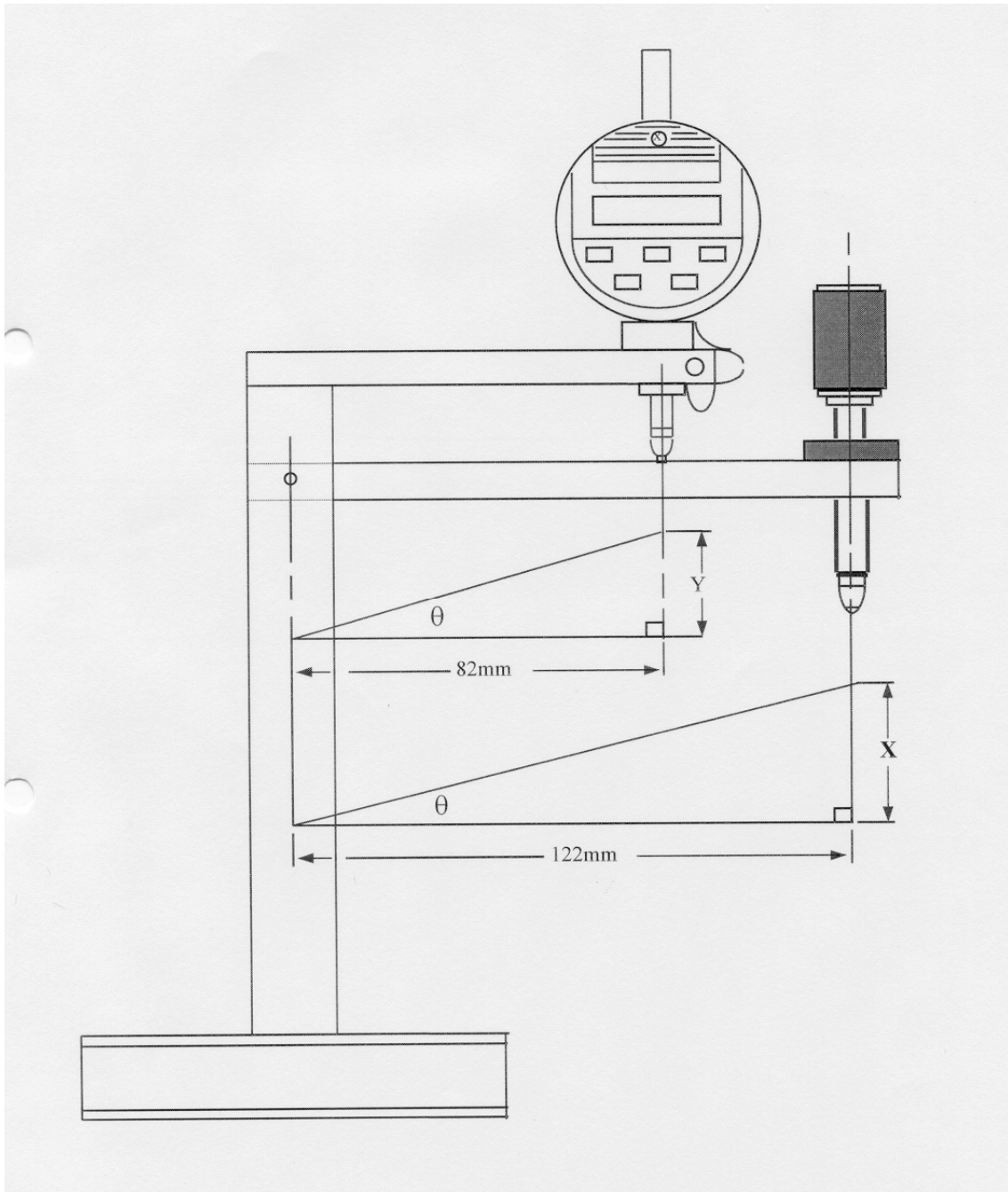


Fig. 2 Gyrotory angle calibrator

Fig. 3 Schematic representation of gyratory compactor

CHECKLIST
Calibration requirements for as 2891.2.2 - Gyratory compactor

Item	Maximum Period Between Successive Calibrations or Checks	Calibration Procedures and Comments
Rate of Gyration	Initial or whenever compactor is moved, then 6 monthly.	In-house check of revolution rate, counter and preset
Gyratory Angle	Check angle before and after each series of compactions (ie. change of angle) on a daily basis.	Use the Gyratory angle calibrator to set/verify angle.
Force Measuring		AS 2193, Grade C.
Gyratory Angle Calibrator	Initial, then 2 yearly.	
Steel Wearing Discs	Initial then 12 monthly depending on the amount of use.	Visual check prior to using. Check against another 'unused' but calibrated set or check piece.
Gauge blocks	Initial then 5 yearly.	Endorsed report required
Mould Assembly	Initial	
Balance	*	
Thermometer	*	
Ovens	*	
Timer	*	

- refer to NATA 's 17025 Application Document: Supplementary requirements for accreditation in field of construction materials testing – Section 4.

AMENDMENT RECORD

Amendment No.	Clauses amended	Action	Date
1	Commentary Page	New	10th May 2005
	Footer and header	Format	
	Applied revised test method number	Format	
	Applied new styles	Format	
	Clause 4.3	New	
	Various editorial	Substitution	
	Clause 4.6	New	

Key

Format	Change in format
Substitution	Old clause removed and replaced with new clause
New	Insertion of new clause
Removed	Old clauses removed