

Australian Standard®

AS 1334.13:2017

Methods of testing conveyor and elevator belting

Method 13: Determination of indentation rolling resistance of conveyor belting

PREFACE

This Standard was prepared by the Standards Australia Technical Committee RU-002, Conveyor and Elevator Belting.

This Standard was developed based on the needs of conveyor belting manufacturers, belt conveyor designers and operators, to measure the indentation rolling resistance of conveyor belts of a given specification, at various speeds, ambient temperatures, idler roll diameters and loads that are representative of operating conditions. This Standard is intended to be used by conveyor belting manufacturers, belt conveyor designers and operators.

This Standard contributes to the measurement of energy savings to the bulk materials handling industry through the optimization of conveyor belt materials and construction.

The term 'informative' has been used in this Standard to define the application of the appendix to which it applies. An 'informative' appendix is only for information and guidance.

METHOD

1 SCOPE

This Standard sets out a test method to measure the indentation rolling resistance of conveyor belting used for the transportation of bulk materials.

This Standard includes conveyor belts for bulk material handling applications supported by flat or troughed idler rolls in accordance with EN ISO 15236-1, EN ISO 15236-2, AS 1332 and AS 1333. This Standard does not include conveyor belts for bulk material handling used in slide beds or bucket elevators.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS	
1100	Technical drawing
1100.201	Part 201: Mechanical engineering drawing
1332	Conveyor belting—Textile reinforced

- 1333 Conveyor belting of elastomeric and steel cord construction
- 4035 Conveyor and elevator belting—Glossary of terms
- AS/NZS
- 4024 Safety of machinery
- 4024.3610 Part 3610:Conveyors—General requirements
- ISO
- 1940 Mechanical vibration—Balance quality requirements for rotors in a constant (rigid) state
- 1940-1 Part 1: Specifications and verification of balance tolerances
- 7500 Metallic materials—Calibration and verification of static uniaxial testing machines
- 7500-1 Part 1: Tension/compression testing machines—Calibration and verification of the force-measuring system
- EN ISO
- 15236 Steel cord conveyor belts
- 15236-1 Part 1: Design, dimensions and mechanical requirements for conveyor belts for general use
- 15236-2 Part 2: Preferred belt types

3 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 4035 and those below, apply.

3.1 Belt conveyor

Apparatus used to convey bulk material in which conveyor belting is a key component.

3.2 Carry cover

Protective elastomeric layer bonded to and protecting the carcass on the side which normally carries the bulk material.

3.3 Deflection ratio

The deflection caused by the deflection rolls, divided by the pitch of the deflection rolls, expressed as a percentage.

NOTE: See Figure 5.1.1.

3.4 Deflection rolls

Conveyor idler rolls used to deflect the test belt in order to apply the test load to the test idler roll.

3.5 Drive pulley

A pulley mounted on a drive shaft that transmits power to the conveyor belt.

3.6 Force transducer

An electronic device used to measure force.

3.7 Idler roll

A roller free to rotate and placed to support the conveyor belting in the required profile.

3.8 Indentation rolling resistance

Motion resistance force resulting from the hysteresis losses of the pulley cover as it travels over an idler roll.

3.9 Pulley cover

A protective elastomeric layer bonded to and protecting the carcass on the side which does not normally carry the bulk material.

3.10 Takeup pulley

A pulley mounted on a mechanical actuator that can apply tension to the conveyor belting.

3.11 Test belt

A representative sample of conveyor belting to be tested.

3.12 Test idler roll

Precision manufactured idler roll.

4 PRINCIPLE

A test belt is passed over a test idler roll whose shaft is prevented from rotating by a force transducer and that is also restrained horizontally and vertically by additional force transducers. The test belt is forced into contact with the test idler roll and is operated at one or more speeds while being subjected to a range of loads at one or more temperatures. The force transducer measurements are then used to calculate the indentation rolling resistance.

5 APPARATUS

5.1 Test machine

5.1.1 General

The test machine shall consist of the following components (see Figure 5.1.1):

- (a) An equally sized drive pulley and takeup pulley whose diameters shall be equal to, or larger than, 1000 mm. The pulley shall not be crowned or tapered.
- (b) A drive mechanism capable of maintaining a constant test belt speed between 1 m/s and 12 m/s under all test conditions fitted to the drive pulley.
- (c) An actuator to provide and vary the test belt tension fitted to the takeup pulley.
- (d) A number of idler rolls that provide adequate support for the test belt.
- (e) A set of idler rolls to track the test belt.
- (f) A test frame (see Clause 5.1.2 and Figure 5.1.2).
- (g) Two deflection rolls located on either side of the test idler roll (see Clause 5.3.3) and equidistant from the test idler roll (see Clause 5.3.3) such that they can deflect the test belt in the direction of loading. The deflection rolls shall be adjustable in the horizontal and vertical directions and shall be capable of deflecting the test belt by at least 2% of the distance between the two deflection rolls.
- (h) A non-contact type thermometer to measure the test belt cover temperature.
- (i) An encoder wheel in contact with a flat section of test belt to measure speed.

The test apparatus shall be designed and operated in accordance with AS/NZS 4024.3610.

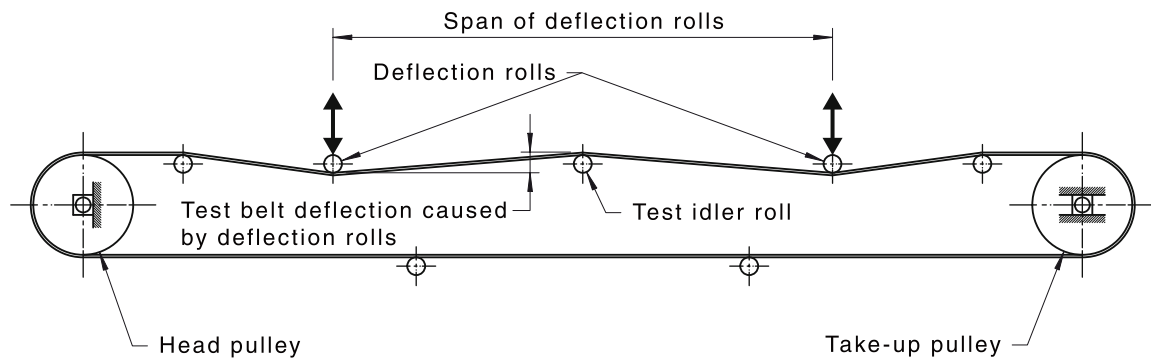


FIGURE 5.1.1 TEST MACHINE ARRANGEMENT

5.1.2 Test frame

A frame, from which the test idler roll may be suspended, shall include the following items:

- (a) Force transducers to measure the vertical load applied to the test idler roll.
- (b) A force transducer to measure the torque applied to the shaft of the test idler roll.
- (c) A force transducer to measure the horizontal force applied to the shaft of the test idler roll.

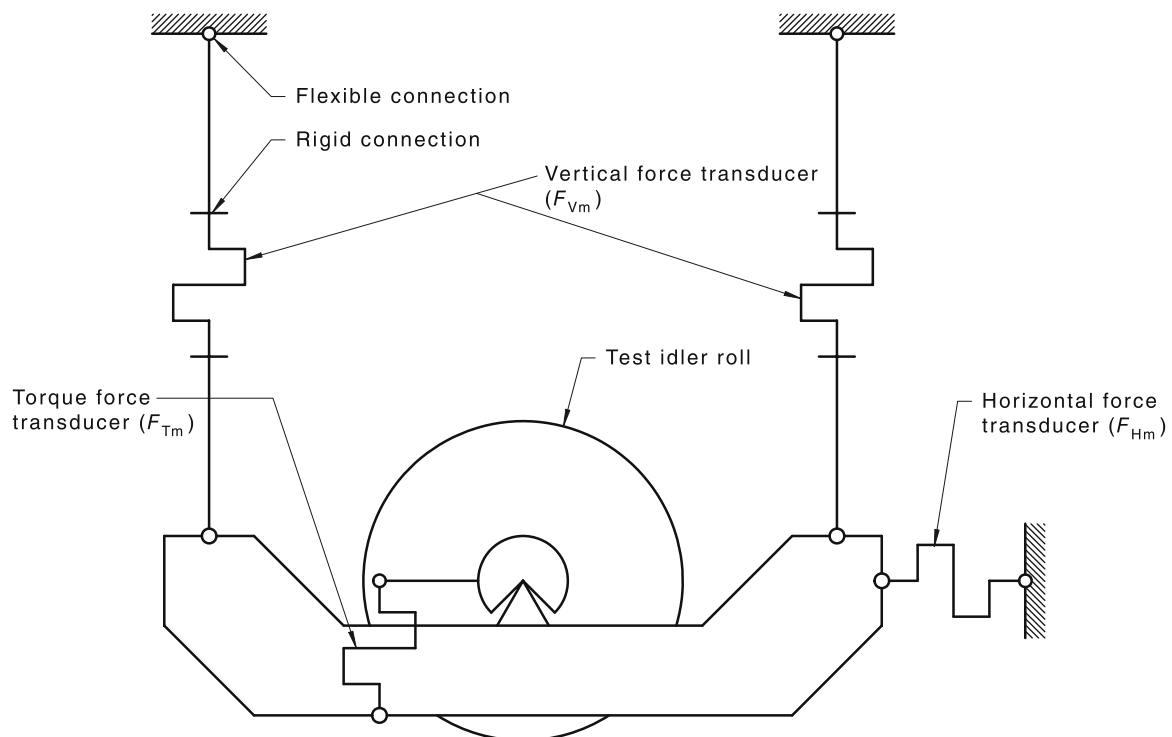


FIGURE 5.1.2 TEST FRAME ARRANGEMENT

5.1.3 Test idler rolls

Test idler rolls shall conform with the following criteria:

- (a) A maximum surface roughness of 1.6 μm in accordance with AS 1100.201.
- (b) A shell runout not greater than 0.05 mm when mounted on its shaft and bearings.
- (c) Test idler rolls longer than the test belt width.

5.2 Alignment

The drive pulley, takeup pulley, idler rolls and test idler roll shall—

- (a) support the test belt in a horizontal plane to a vertical tolerance of ± 0.5 mm; and
- (b) be adjusted such that they are perpendicular to the axis of the test belt.

5.3 Balancing

5.3.1 General

Balancing of all rotating components shall be conducted in accordance with ISO 1940-1.

5.3.2 Drive pulley and takeup pulley

The drive pulley and takeup pulley shall be statically balanced to be within an out of balance limit of 2.7 Nm.

5.3.3 Test idler roll

The test idler roll shall be balanced to a grade of G2.5.

5.3.4 Support idler rolls and deflection rolls

The support idlers rolls and the deflection rolls shall be balanced to a grade of G6.3.

6 BELT SAMPLES

6.1 Sampling

Test belt samples for indentation rolling resistance testing may either be—

- (a) cut from full width conveyor belt; or
- (b) specially manufactured with one or more materials incorporated into the pulley and carry covers.

6.2 Preparation

The test belt shall be prepared to a minimum width of 400 mm with a tolerance of ± 5 mm. The test belt sample shall be formed into a loop and spliced to form a loop that shall be an appropriate length for the intended test machine.

The test belt shall be smooth to avoid damaging the force transducers. The test belt shall not be mechanically spliced.

The test belt sections shall have a uniform thickness with a tolerance of ± 0.5 mm.

6.3 Conditioning

6.3.1 General

The test belt shall be conditioned prior to testing. The test belt shall not be tested prior to 5 days after manufacture.

NOTE: Conditioning may occur during this time.

6.3.2 Controlled temperature environment

The test belt shall be conditioned at each test temperature for a period of not less than 16 h immediately prior to testing.

6.3.3 Uncontrolled ambient temperature environment

The test belt shall be conditioned by operating at the highest intended test speed for a period of 15 min. The test belt surface temperature recorded at the end of the conditioning procedure shall be the test temperature.

7 PROCEDURE

7.1 General

Indentation rolling resistance testing may be conducted to match a specific set of field conditions or extended to determine the test belt's indentation rolling resistance performance over a range of operating parameters.

7.2 Test machine preparation

The test machine shall be prepared as follows:

- (a) The test machine force transducers calibrated according to ISO 7500-1.
- (b) The test belt installed on the test machine.
- (c) The test machine shall be adjusted until the slope of the plotted horizontal force (N) to the vertical load (kg) is less than 1×10^{-5} N/kg. Conformity with Clause 7.2(c) requires the test to be conducted only in one direction.

The adjustment shall be made by applying mass to the test idler frame while the belt is not in contact with the test idler roll.

- (d) The deflecting rolls shall be equidistant to the test idler roll to within ± 1 mm and shall be in the same vertical position to within a maximum tolerance of ± 0.25 mm.

NOTE: The operator should monitor the offset value for the vertical force transducers (F_{Vo}), the test idler roll shaft torque force transducer (F_{To}) and the horizontal force transducer (F_{Ho}) while the test belt is not moving and is not in contact with the test idler roll, at regular intervals during testing.

7.3 Temperature testing

Testing may be conducted in a temperature controlled environment or under ambient laboratory conditions. The test temperature shall be the surface temperature of the test belt. The test belt's surface temperature shall not exceed $\pm 2^\circ\text{C}$ of the desired test temperature. If the acceptable test belt temperatures are exceeded during testing the test belt shall be reconditioned in accordance with Clause 6.3 before testing may resume.

7.4 Test loads

A series of indentation rolling resistance measurements shall be conducted at a minimum of four different loads for each combination of test belt surface temperature, test belt speed and test idler roll diameter.

Test idler roll loads shall be varied by adjusting the position of the belt tension pulley to change the test belt tension.

7.5 Belt speeds

Indentation rolling resistance testing shall be carried out at any test belt speed or range of test belt speeds specified by the relevant parties.

7.6 Recording results

The following shall be recorded at a rate greater than or equal to 100 Hz:

- (a) Vertical load (F_{Vm}).
- (b) Horizontal force (F_{Hm}).
- (c) Test idler roll shaft torque force (F_{Tm}).

The output of the test idler roll shaft torque force shall be the direct output of the force transducer in newtons (N).

NOTE: This is not a torque measurement.