

Introduction to PAS 108

Specification for the production of tyre bales for use in construction



Material change for
a better environment



Introduction

A Publicly Available Specification, PAS 108, has been prepared by The British Standards Institution (BSI) in collaboration with WRAP (Waste & Resources Action Programme) to provide a specification for producing compact tyre bales of a consistent and verifiable quality and dimension.

The PAS was prepared following exhaustive consultation from a wide range of stakeholders from the secondary tyre industry. The expert contributions made by all organizations and individuals in the development of this PAS 108 are gratefully acknowledged.

Overview

The compression of these tyres into bales provides a means of reusing these tyres whilst at the same time, reducing the demand for primary aggregate materials in construction.

PAS 108 sets out to provide a specification that can be adopted by suppliers for producing tyre bales such that potential customers will be assured that they are procuring a construction material of consistent and verifiable quality. Thus the core of this document addresses the production, handling, storage, transport and placement of standardized tyre bales, the dimensions and properties of which are described in this PAS. In addition, guidance is given on engineering properties and typical construction applications.

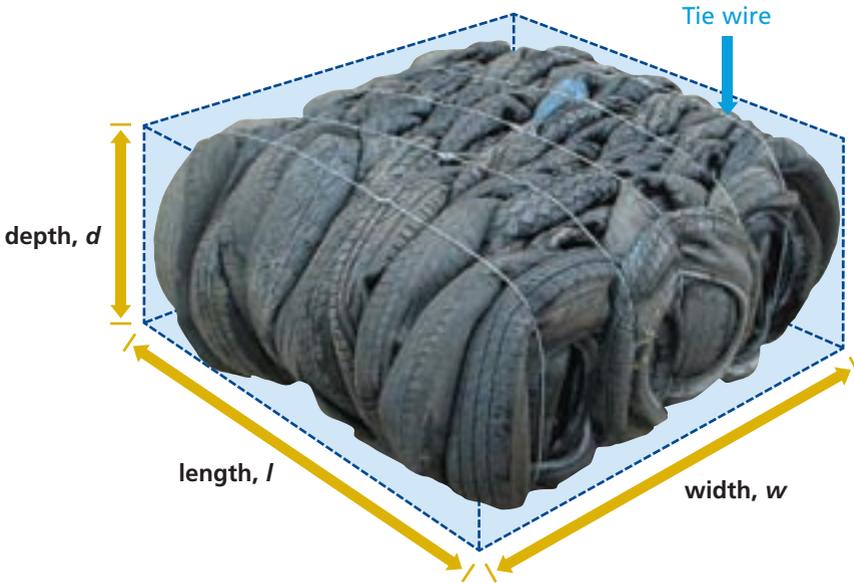
Tyre bales offer significant advantages in construction projects due to, the following features:

- Permeability comparable to gravel;
- High porosity;
- Low bulk density;
- Good frictional response and stiffness.

The specific use of bales (once manufactured) in construction is generally accepted by the waste regulators in the UK as a low risk activity. Regulators are not actively pursuing licensing applications for the use of tyre bales in construction; future amendments to regulations may introduce exemptions to cover this use.

“R4 Limited welcome the introduction of PAS 108. As a company with strict manufacturing and environmental standards to our business practices and products we look forward to operating to a new complimentary PAS 108 specification which will introduce greater product consistency to all manufacturers of tyre bales. We aim to promote our PAS108 adherence to our existing and potential customers so that they can reap the benefits of knowing that bales purchased from us will have been made from a standardised process generating a consistent sized bale with known engineering properties.” Lynn Kerr, R4 Limited

Figure 1 – Reference sketch of tyre bale



Specification

This specification is intended to assist manufacturers of bales of post-consumer tyres to produce a high quality, consistent and traceable material for use in construction by responsible and competent organizations. It is also intended to assist balers in demonstrating that their material is of a high and consistent quality via their Factory Production Control processes.

This specification is based on reference bales manufactured in a standard width baling machine. The length of bales produced in such machines can be varied from the reference length. In addition this specification permits the production of two prescribed alternative widths of bales, but it is important to be aware that baling machines to manufacture such modified-width bales may not be commercially available. Whilst the use of reference width bales is encouraged, alternative width bales may be useful in certain specialist applications.

PAS 108 has been prepared based on current UK practice within the industry and covers the bale sizes specified herein. However, in the future alternative and satisfactory rectilinear shapes of bales and/or forms of tying/wrapping of the bales may be developed to produce bales that are useful for construction purposes.

Guidance is given to assist construction professionals in formulating preliminary design and construction proposals. This guidance is not intended to cover all aspects of detailed design but to provide key information that could not be sourced from other engineering documents.

Table 1 – Engineering properties of reference tyre bales

Property	Value(s)
Length (of reference bale)	1.33 m (+ 0.08 m/- 0.06 m)
Width (of reference bale)	1.55 m (\pm 0.07 m)
Depth (of reference bale)	0.83 m (\pm 0.04 m)
Volume (of enclosing cuboid of reference bale)	1.70 m ³ (+ 0.24 m ³ /- 0.15 m ³)
Mass (of reference bale)	810 kg (\pm 35 kg)

Table 2 – Engineering properties of all PAS 108 tyre bales

Property	Value(s)	Comments
Nominal mass density	470 kg/m ³ (\pm 50 kg/m ³)	Mass density of the cuboid enclosing the tyre bale (see Annex B) ¹⁾ .
True mass density	500 kg/m ³ (\pm 70 kg/m ³)	Mass density of bale only (see Clause C.2.3) ¹⁾
Porosity	62 % (\pm 5 %)	
Shear strength: angle of inter-bale friction, ϕ'	35° to 36°	Tests performed on dry bales. Cohesion is small and can be ignored in design.
Stiffness (expressed as Young's Modulus), M	800 MPa to 1,000 MPa	Values increase within range with increasing degree of confinement. Values based on a preliminary interpretation of USA data for arrangements of two and three bales with no joint filling.
Total Creep (35 months)	Up to 1.1 %	Based on measurements of a bale stack in a beach at Pevensy. Measurements indicate creep process now substantially slower and long term creep not expected to exceed 1.5 %.
Permeability through depth (see Figure 1)	0.1 m/s to 0.2 m/s	
Permeability through length (see Figure 1)	0.02 m/s to 0.04 m/s	

1) These references refer to the full PAS 108 specification.

Table 3 – Typical dimensions of various bales

Bale type	Length, l	Width, w	Depth, d^1	Tie wires	
				Number	Length
Reference bale (REF)	1.27 – 1.41 m	1.48 – 1.52 m	0.79 – 0.87 m	5	3.5 m
Reduced length bale (RL)	0.6 m minimum	1.48 – 1.52 m	0.79 – 0.87 m	5	≈ 2.1 m (for 0.6 m long bale)
Full length reduced width bale (RW)	1.27 – 1.41 m	≈ 1.15 m	0.79 – 0.87 m	4	3.5 m
Reduced length reduced width bale (RL-RW)	To be specified	≈ 1.15 m	0.79 – 0.87 m	4	≈ 2.1 m (for 0.6 m long bale)
Full length increased width bale (IW)	1.27 – 1.41 m	≈ 1.95 m	0.79 – 0.87 m	6	3.5 m
Reduced length increased width bale (RL-IW)	To be specified	≈ 1.95 m	0.79 – 0.87 m	6	≈ 2.1 m (for 0.6 m long bale)

A typical tyre baler

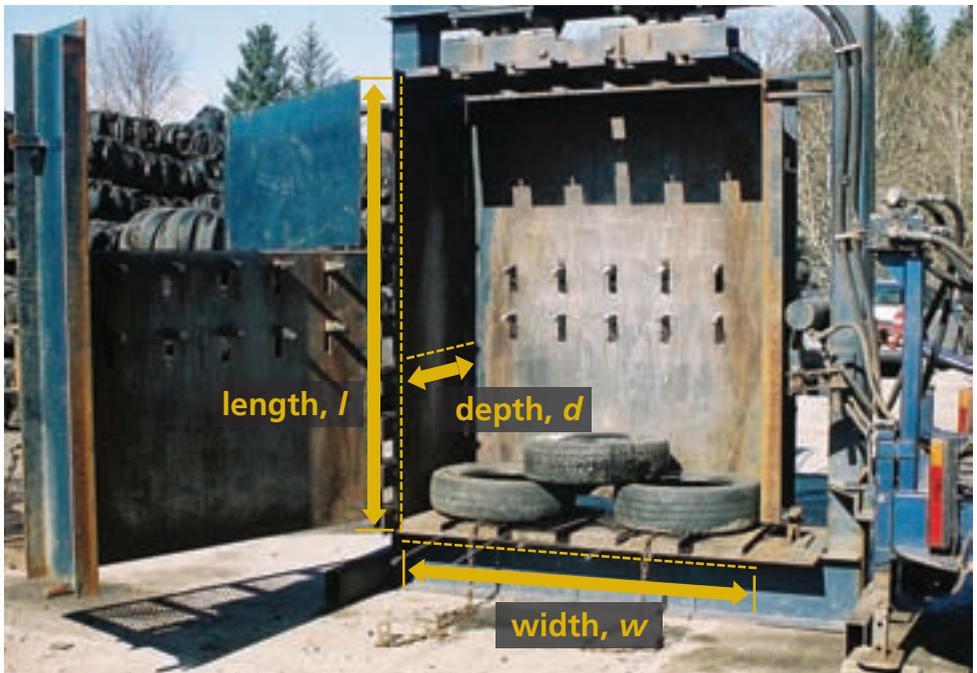


Table 4 – Structure of PAS 108

Key Element	Summary Description
Input	Minimum requirements for the receipt, inspection, cleaning, handling and storage of tyres intended for incorporation into bales
Process	The process of compressing and baling, handling and storage of tyre bales intended for use in construction.
Use	Minimum requirements for the transport, storage on site, and final placement of tyre bales into construction works.
Properties and their measurement	Procedures for the measurement of basic properties (dimensions, mass and density). Suggested methods of testing for other properties (porosity, permeability, shear strength, stiffness, creep).
Applications	General construction considerations (supply and production, patterns of placement, filling around and between bales, covering of bales, construction breaks). Specific applications: <ul style="list-style-type: none"> • Road foundations over soft ground. • Slope failure repairs. • Lightweight embankment fill. • Free-draining layers behind retaining walls. • Drainage layers, including landfill engineering applications. • Sustainable urban drainage systems.
General issues	A factory production control procedure for tyre bale manufacture; End of service life options.

Figure 2 – Schematic cross-section showing a typical layout of a slope failure repair

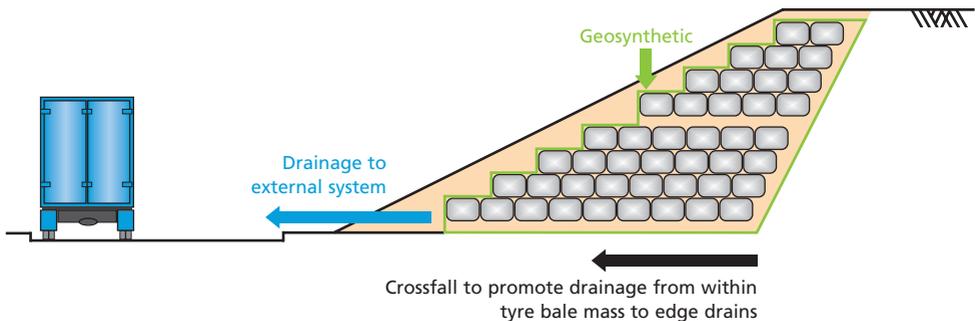


Figure 3 – Number of compressed tyres per cubic metre

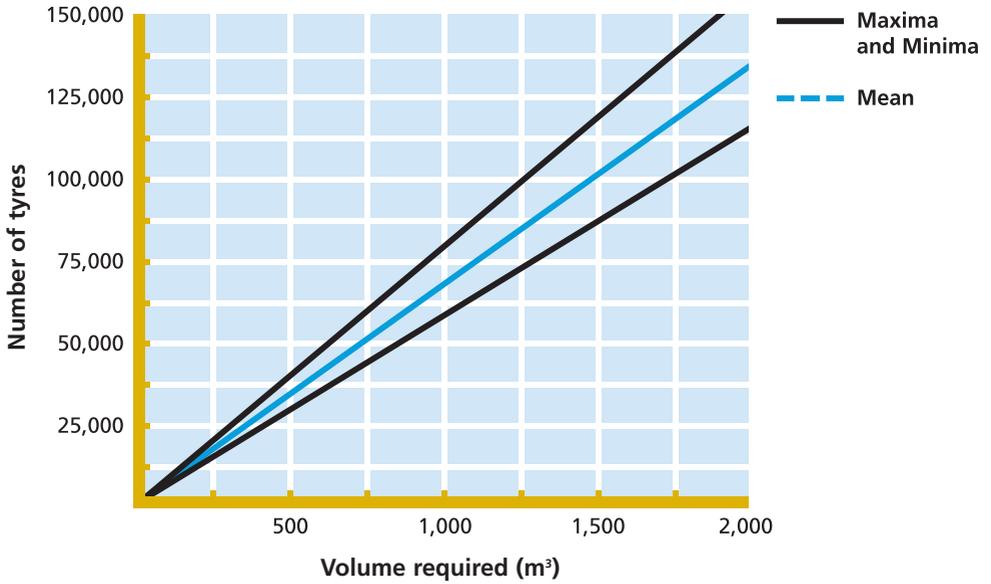
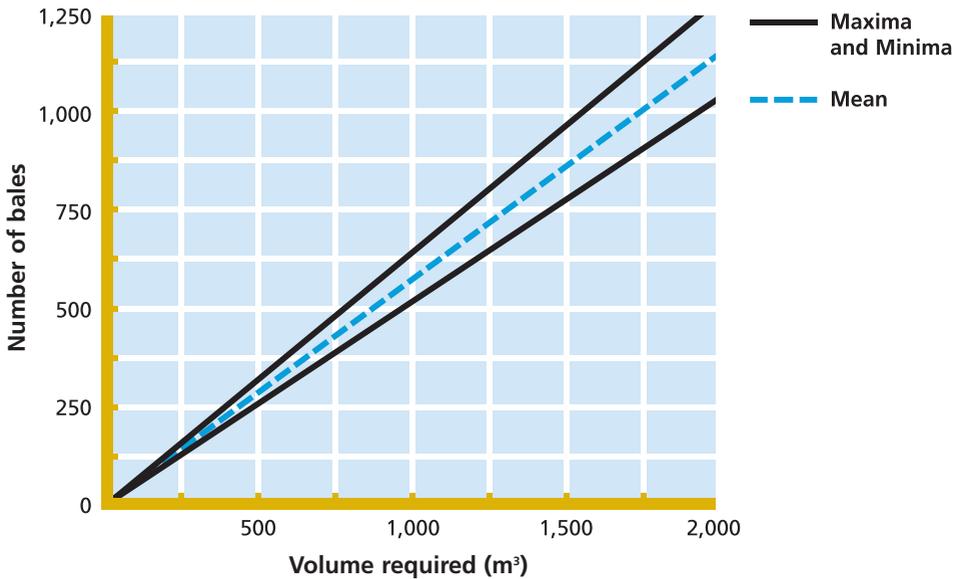


Figure 4 – Number of referenced bales per cubic metre



For more information online, visit our comprehensive website:

On the WRAP website you will find information on all aspects of tyres and tyre bales. Whether you're looking for a supplier, or you need detailed technical information – all the latest news, facts and guidance can be found at www.wrap.org.uk/tyres.

How to order a copy

Copies of PAS 108 can be obtained free of charge from WRAP.

E-mail: helpline@wrap.org.uk

Telephone: 0808 1002040

website: www.wrap.org.uk/tyres

Acknowledgements

This Publicly Available Specification (PAS) 108 has been developed by WRAP (Waste & Resources Action Programme) in collaboration with The British Standards Institution (BSI). It has been written by Jonathan Simm of HR Wallingford and Dr Mike Winter of TRL Limited, in collaboration with WRAP, BSI and a steering group of specialists. It takes account of consultation responses from the tyre baling, construction and related industries.

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