

AS 5204:2023



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Australia



Fibre-reinforced polymer bars



AS 5204:2023

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Preface

This document was prepared by the Standards Australia Committee BD-108, Fibre-Reinforced Polymer (FRP) bars.

This document sets out the criteria for the acceptable materials for the production, the minimum physical, mechanical, and durability properties of glass and basalt fibre reinforced polymer (FRP) bars used for internal and non-prestressed reinforcing concrete in the form of straight or bent bars.

This document only applies to glass and basalt FRP bars with a solid circular cross-section.

This document focuses on straight and bent FRP bars manufactured using the pultrusion or modified pultrusion methods.

This document is intended to be used in conjunction with relevant codes, Standards and best practices in FRP reinforced concrete design.

The terms “normative” and “informative” are used in Standards (and other publications) to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

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Introduction

This is the first edition of the Australian Standard (AS) for Fibre-Reinforced Polymer (FRP) Composite Bars. This document is developed to ensure structural quality and grade of FRP bars are met to satisfy the design requirements. The material standard requirements are developed using the best available collected and analysed data. This document will ensure that an Australian Standard developed for FRP bars will reflect the current best practices and will allow consistency with the international community.

This document sets the minimum properties of FRP bars to ensure their quality when used as internal and non-prestressed reinforcement in concrete structures. This material standard is valuable to bar suppliers and manufacturers, purchasing bodies, designers, engineers, asset owners, government organisations as well as research and academic institutions for quality assurance during manufacturing and qualification tests of FRP bars.

Australian Standard®

Fibre-reinforced polymer bars

1 Scope and general

1.1 Scope

This document was prepared by the Standards Australia Committee BD-108, Fibre-Reinforced Polymer (FRP) Bars.

This document sets out the criteria for the acceptable materials for the production, the minimum physical, mechanical, and durability properties of glass and basalt fibre reinforced polymer (FRP) bars used for internal and non-prestressed reinforcing concrete in the form of straight or bent bars.

This document only applies to glass and basalt FRP bars with a solid circular cross-section.

This document is intended to be used in conjunction with relevant codes, standards and best practices in FRP reinforced concrete design.

1.2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document:

NOTE Documents for informative purposes are listed in the Bibliography.

AS/NZS ISO 9001, *Quality management systems — Requirements*

AS ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 10406-1, *Fibre-reinforced polymer (FRP) reinforcement of concrete — Test methods — Part 1: FRP bars and grids*

ASTM D3171, *Standard Test Methods for Constituent Content of Composite Materials*

ASTM D4475, *Standard Test Method for Apparent Horizontal Shear Strength of Pultruded Reinforced Plastic Rods By the Short-Beam Method*

ASTM D570, *Standard Test Method for Water Absorption of Plastics*

ASTM D578/D578M, *Standard Specification for Glass Fiber Strands*

ASTM D7205/D7205M, *Standard Test Method for Tensile Properties of Fiber Reinforced Polymer Matrix Composite Bars*

ASTM D7337/D7337M, *Standard Test Method for Tensile Creep Rupture of Fiber Reinforced Polymer Matrix Composite Bars*

ASTM D7617/7617M, *Standard Test Method for Transverse Shear Strength of Fiber-reinforced Polymer Matrix Composite Bars*

ASTM D7705/D7705M, *Standard Test Method for Alkali Resistance of Fiber Reinforced Polymer (FRP) Matrix Composite Bars used in Concrete Construction*

ASTM D7913/7913M, *Standard Test Method for Bond Strength of Fiber-Reinforced Polymer Matrix Composite Bars to Concrete by Pullout Testing*

ASTM D792, *Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement*

ASTM D8448/D8448M, *Standard Specification for Basalt Fiber Strands*

ASTM E1131, *Standard Test Method for Compositional Analysis by Thermogravimetry*

ASTM E1356, *Standard Test Method for Assignment of the Glass Transition Temperatures by Differential Scanning Calorimetry*

ASTM E2160, *Standard Test Method for Heat of Reaction of Thermally Reactive Materials by Differential Scanning Calorimetry*

1.3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

1.3.1

batch

quantity of bar manufactured together in a single production lot

1.3.2

design values

values used for design purposes

1.3.3

grade

category of FRP bars based on the level of tensile modulus of elasticity

1.3.4

guaranteed tensile strength

average tensile strength minus three times the standard deviation

1.3.5

manufacturing cross-sectional area limits

values used for quality control purposes

1.3.6

nominal bar diameter

nominal bar diameter is for reference only and shows the approximate diameter of the bar

1.3.7

qualification testing

series of tests conducted to establish conformance with this document

1.3.8

temporary structures

structures with service life of less than 6 months

1.3.9

water absorption at saturation

capacity of the FRP bar to absorb moisture at the saturated state

2 Materials and manufacturing requirements

2.1 Materials

2.1.1 General

This section provides the types of acceptable materials for fibres, resin, additives, and sand coating.

2.1.2 Fibres

For glass fibre bars, the fibre type shall be E-Glass Corrosion Resistant (ECR) glass fibres, or boron free glass fibres in the form of unidirectional rovings in accordance with ASTM D578/D578M.

For basalt fibre bars, the fibre type shall be in the form of unidirectional rovings in accordance with ASTM D8448/D8448M.

Fibre types and grades shall not be blended.

Fibre coupling agents (sizing) shall be compatible with the fibre and resin type selected.

2.1.3 Matrix/polymers

For bars with a durability classification of Permanent, the resin matrix shall be vinylester or epoxy resin. The resin matrix shall not contain any other type of resin.

For bars with a durability classification of Temporary, the resin matrix may contain polyester, vinylester or epoxy resin.

2.1.4 Additives

Catalysts shall be compatible with the fibre type and resin system selected. Low profile (anti-shrink) additives are not permitted.

Other allowable additives include the following:

- (a) Pigments.
- (b) Release agents.
- (c) Initiators.
- (d) Promoters.
- (e) Inhibitors (anti-oxidants).
- (f) Coupling agents.
- (g) Wetting agents.
- (h) Anti-foaming chemicals.

2.1.5 Fillers

Fillers may be used. If used, these shall be inorganic.

2.1.6 Sand coating

For sand-coated bars, if used, the sand coating type shall be sourced from fine aggregates that are suitable for use in concrete. The sand coating shall be uniformly applied to the bars to ensure a proper bonding performance as per [Clause 3.3.7](#). The bonding agent for the sand coating shall use the same base resin as used within the resin matrix. The sand shall be clean, hard, durable and free from clay, dust, flaky particles, shale, salt, alkali, organic matter, soil. The sand shall consist of naturally occurring sands, or a combination of naturally occurring sands and manufactured sands.