Bhavi Plast

FRP & THERMOPLASTIC PROCESS EQUIPMENT · EST. 1977

ENGINEERING REFERENCE

Design code summary

The standards Bhavi Plast designs, fabricates and tests to — what each one covers, what it requires, and which equipment it governs.

DOCUMENT	REVISION	ISSUED	CODES
BP-ENG-DCS-01	00	October 2026	10 design · 4 test

01

Why the code matters

A design code is the difference between equipment that is engineered and equipment that is simply made. It fixes the loads that must be considered, the safety margins that must be applied, the materials that may be used and the tests that must be passed.

Fibre-reinforced plastics and thermoplastics behave very differently from steel. FRP does not yield before it fails, its strength depends on how much glass it contains and how the fibres run, and both FRP and thermoplastics lose strength with temperature and over time. The codes in this summary exist to account for exactly those behaviours.

When a Bhavi Plast drawing or data sheet states that equipment is *designed to* a code, it means the design calculations, material selection, fabrication and testing follow that code's rules, and the documentation shows it. The edition applied on a project is stated in that project's design documentation.

02

At a glance

CODE	TITLE	GOVERNS
BS EN 13121	GRP tanks and vessels for use above ground (Parts 1 – 4)	Design, materials, fabrication and installation of FRP tanks and vessels
ASME Section X	Fiber-Reinforced Plastic Pressure Vessels	FRP vessels under internal pressure
ASME RTP-1	Reinforced Thermoset Plastic Corrosion-Resistant Equipment	FRP vessels from atmospheric pressure to 15 psig, and vacuum
EN 12573	Welded static non-pressurised thermoplastic tanks (Parts 1 – 4)	Design and workmanship of thermoplastic tanks
DVS 2205	Calculation of tanks and apparatus made of thermoplastics	Wall, rib and band design of thermoplastic tanks and equipment
AD 2000-Merkblatt N 1	Pressure vessels of glass-fibre-reinforced thermosetting plastics	FRP pressure equipment, where specified
IS 4894	Centrifugal fans — specification	Construction and performance testing of centrifugal fans
BS 848-1	Fans for general purposes — performance testing	Fan performance measurement
ACGIH	Industrial Ventilation: A Manual of Recommended Practice for Design	Hood, duct and exhaust system design
BS 4994	Design and construction of vessels and tanks in reinforced plastics	Legacy reference — withdrawn, replaced by BS EN 13121

03

FRP and dual-laminate codes

BS EN 13121

CURRENT · EUROPEAN STANDARD

GRP tanks and vessels for use above ground

What it covers. The European standard for glass-reinforced plastic tanks and vessels, in four parts: raw materials (Part 1), composite materials and chemical resistance (Part 2), design and workmanship (Part 3), and delivery, installation and maintenance (Part 4). It replaced BS 4994.

What it requires.

- Design against every load case: hydrostatic head, internal pressure and vacuum, wind, seismic, nozzle, support and lifting loads.
- Safety margins built from influence factors that penalise manufacturing method, chemical environment, temperature, long-term ageing and cyclic loading.
- A strain limit that keeps the corrosion barrier free of microcracks; the barrier is not counted as load-bearing.
- A formal chemical resistance assessment of the laminate for the stored medium.
- Qualified materials, controlled fabrication, visual acceptance criteria, cure verification and a hydrostatic test.

Where we apply it. Chemical storage tanks, FRP and dual-laminate scrubbers, reactors and vessels, PPC/FRP rectangular tanks.

ASME Boiler and Pressure Vessel Code, Section X

CURRENT · AMERICAN CODE

Fiber-Reinforced Plastic Pressure Vessels

What it covers. Rules for the design, fabrication, inspection and testing of FRP vessels operating under internal pressure. Class I vessels are qualified by destructive testing of a prototype; Class II vessels follow mandatory design rules with acceptance testing by acoustic emission; Class III covers high-pressure gas vessels.

What it requires.

- Qualification of the design, by prototype test or by rules, before production.
- Documented laminate procedures and qualified fabrication personnel.
- Pressure testing, and acoustic emission examination where the class requires it.

Where we apply it. FRP and dual-laminate pressure vessels, designed up to 10 kg/cm² internal pressure.

ASME RTP-1

CURRENT · AMERICAN STANDARD

Reinforced Thermoset Plastic Corrosion-Resistant Equipment

What it covers. Stationary FRP vessels for corrosive service, from atmospheric pressure up to 15 psig internal pressure, and external pressure and vacuum. It is the principal American standard for corrosion-resistant FRP tanks and process vessels.

What it requires.

- Design by rules or by stress analysis, including vacuum and buckling checks.
- A defined corrosion-resistant barrier construction and laminate requirements.
- A documented quality control programme, inspection and test before shipment.

Where we apply it. Reactors and vessels, particularly vacuum and agitated service.

AD 2000-Merkblatt N 1

CURRENT · GERMAN CODE

Pressure vessels of glass-fibre-reinforced thermosetting plastics

What it covers. Part of the German AD 2000 pressure vessel code, setting rules for FRP pressure equipment.

What it requires.

- Material, design and manufacturing requirements for FRP pressure parts.
- Testing and documentation for pressure-rated equipment.

Where we apply it. Pressure-rated FRP equipment where a customer or export specification calls for it.

04

Thermoplastic codes

EN 12573

CURRENT · EUROPEAN STANDARD

Welded static non-pressurised thermoplastic tanks

What it covers. The European standard for welded thermoplastic tanks operating at atmospheric pressure, in four parts: general principles (Part 1), calculation of vertical cylindrical tanks (Part 2), design and calculation of single-skin rectangular tanks (Part 3), and design and workmanship of joints (Part 4).

What it requires.

- Wall thickness and reinforcement calculated for the liquid, the head and the operating temperature, using long-term material values.
- Reduction factors for chemical exposure and for weld strength.
- Requirements for welding, joint design and workmanship.

Where we apply it. Thermoplastic tanks, rectangular process tanks and thermoplastic scrubbers.

DVS 2205

CURRENT · GERMAN GUIDELINE

Calculation of tanks and apparatus made of thermoplastics

What it covers. The German Welding Society (DVS) guideline series for the structural calculation of thermoplastic tanks and equipment, including characteristic material values, vertical cylindrical tanks and rectangular tanks.

What it requires.

- Design on long-term creep strength at the operating temperature, so the tank is sized for its full service life.
- Chemical reduction factors and weld factors applied to the material strength.
- Rib, band and frame design to control wall deflection.

Where we apply it. Thermoplastic tanks, rectangular process tanks, thermoplastic scrubbers and strainers. Welded joints are tested in house.

05

Fan and ventilation standards

IS 4894

CURRENT · INDIAN STANDARD

Centrifugal fans — specification

What it covers. The Indian Standard for centrifugal fans, covering construction requirements and the methods for testing fan performance.

What it requires.

- Performance — airflow, pressure, power and efficiency — measured by a defined test method.
- Construction and tolerance requirements.

Where we apply it. Every Bhavi Plast blower is performance-tested on our in-house test rig built to IS 4894, and the measured curve is supplied with the fan.

BS 848-1

REFERENCE · SUPERSEDED BY BS EN ISO 5801

Fans for general purposes — performance testing using standardised airways

What it covers. The British standard for fan performance testing. It has been superseded by BS EN ISO 5801 but is still widely cited in specifications.

What it requires.

- Standardised test airways and measurement methods for fan performance.

Where we apply it. Centrifugal blowers, where a specification cites it.

ACGIH Industrial Ventilation

CURRENT · INDUSTRY MANUAL

A Manual of Recommended Practice for Design

What it covers. The reference manual of the American Conference of Governmental Industrial Hygienists for local exhaust ventilation: hood design and capture velocities, duct design and system static pressure.

What it requires.

- Capture velocity and hood design for each source.
- Duct velocity, balancing and static pressure calculation for the full system.

Where we apply it. Hoods, ducting, dampers and stacks; dust collection systems; and system resistance before every blower selection.

06

Which code governs which equipment

The governing code follows the material and the duty. Where a customer specification calls up a different code, we design to the specified code and state it on the design documentation.

EQUIPMENT	BS EN 13121	ASME SEC X	ASME RTP-1	EN 12573	DVS 2205	AD 2000	IS 4894	BS 848	ACGIH
Wet scrubbing systems	●	·	·	●	●	·	·	·	·
Chemical storage tanks	●	·	·	·	·	·	·	·	·
Centrifugal blowers	·	·	·	·	·	·	●	●	·
Reactors and vessels	●	●	●	·	·	·	·	·	·
Rectangular process tanks	●	·	·	●	●	·	·	·	·
Thermoplastic tanks	·	·	·	●	●	·	·	·	·
Thermoplastic strainers	·	·	·	·	●	·	·	·	·
Dust collection systems	·	·	·	·	·	·	·	·	●
Ducting and exhaust systems	·	·	·	·	·	·	·	·	●
Pressure-rated FRP, where specified	·	·	·	·	·	●	·	·	·

Scrubbers built fully or partly in thermoplastic are designed to EN 12573 and DVS 2205; FRP and dual-laminate scrubbers to BS EN 13121. Rectangular tanks in PPC/FRP are designed to BS EN 13121. Steel base frames and supports use IS 2062 structural steel.

07

Legacy codes in specifications

BS 4994

WITHDRAWN · REPLACED BY BS EN 13121

Design and construction of vessels and tanks in reinforced plastics

What it covers. For decades the reference standard for FRP vessels, and still frequently quoted in Indian specifications. It introduced design by unit loading — strength per unit width per unit mass of glass — and a high overall design factor built from separate risk factors.

What it requires.

- Design by unit loading and a laminate schedule for every zone of the vessel.
- An overall design factor of not less than 8.
- A strain limit to protect the corrosion barrier.

Where we apply it. Where a specification calls up BS 4994, we design to BS EN 13121, its successor, and show how the design meets the intent of the specification.

08

Test standards we apply

STANDARD	TEST	PURPOSE
ASTM D2583	Barcol hardness	Confirms the degree of cure of FRP laminates
ASTM D2584	Ignition loss (resin burn-off)	Measures glass content against the laminate schedule
IS 4894	Fan performance test	Measured performance curve for every blower
Hydrostatic test	Per the governing code	Proves tanks and vessels before despatch
Spark test	High-voltage holiday test	Detects pinholes in thermoplastic and fluoropolymer liners
Weld tests	Destructive and non-destructive	Verifies thermoplastic weld strength and integrity

> **What you receive with a code-designed unit:** the design calculation showing loads and design factors, the laminate or wall schedule for each zone, the material and resin selection with its reasoning, the quality plan with acceptance criteria, and the test certificates after manufacture.

This summary describes the scope of each code in general terms for information. It is not a substitute for the codes themselves. The governing code, edition and any deviations for a specific project are stated in that project's design documentation. © Bhavi Plast Pvt Ltd. 603 Dev Corpora, Cadbury Junction, Khopat, Thane (W) 400 601, Maharashtra, India.