

Tanks, Vessels & Silos

GRP COMPOSITES



FORBES



PLASTICS TANKS AND
ENVIRONMENTAL TECHNOLOGIES

Tanks, Vessels & Silos GRP COMPOSITES

- In a GRP single laminate composite the glass/resin structure is protected from chemical attack by a contact surface with resin rich corrosion barrier.
- A wide choice of resin systems permits specification of the laminate to suit the required duty.
- Automated manufacture provides low cost products
- The design, manufacture, installation and operation of GRP tanks are covered by the comprehensive standard BS 4994:1987
- Although light and easy to handle, the substantial strength achievable with GRP permits structures to be designed with integral steelwork such as ladders, handrailing, platforms and bridges.
- It is straightforward to include side access manways when building dual laminate GRP tanks.

A QUALITY COMPANY

We are an independent privately owned business, soundly managed by a tightly knit team and with strong technical and financial bases. We are dedicated to supplying our customers with high quality products at competitive prices without jeopardising the well-being of our staff, the public at large, or the environment.

Forbes stands by its products – you will find our after sales service second to none.

We strive towards continual company improvement and aspire to provide standards of excellence, efficiency and service that make Forbes a comfortable organisation to deal with.



BS4994:1987

THE DESIGN AND CONSTRUCTION OF VESSELS AND TANKS IN GLASS REINFORCED PLASTICS

High quality production has always been vital for Forbes as so many of the company's products are dedicated to specialised and hazardous duties. For many years we have been producing tanks and pressure vessels to this demanding standard which describes various categories of production in great detail – even prescribing working conditions and the structure of fittings. Forbes is approved by leading inspection and insurance companies to manufacture to all categories of the standard.

The broad compass and thoroughness of BS4994 make it an invaluable aid to those preparing risk assessments and safety plans.

BS4994 covers the design, manufacture, transport and installation of tanks and vessels in GRP (glassfibre reinforced plastic) materials. It is a very thorough and stringent standard. IT DOES NOT deal with any aspect of the manufacture of tanks in other materials such as metals or freestanding thermoplastics. For advice talk to Forbes on +44(0)1366 388941.

DVS 2205 There is still no universal standard for the design of thermoplastics tanks although a European (CEN) standard is in preparation. In the meantime some manufacturers have been drawn to this German standard. Critics have pointed out that some aspects of DVS 2205 are basic and that in several crucial areas it refers inappropriately to metal design codes. To help specifiers evaluate DVS 2205 against BS 4994 we have prepared some guidance notes, please ask our sales department for a complimentary copy. Please also ask for a copy of our leaflet 'Thermoplastics Tanks'.

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GRP

Glass fibres have excellent tensile strength, are non-combustible and chemically resistant, yet lack rigidity and form on their own. They are however an ideal reinforcing material when combined with thermosetting resins.

Modern glassfibre technology dates from the 1930s but the material began to be properly exploited in the 1950s with the advent of synthetic resins which led to the development of modern polyester and vinylester resin systems.

The intense research and development of GRP into a predictable engineering material was driven above all by the aerospace industry where its light weight was of course its main attraction.

In the chemical and process industries, corrosion resistance has been the prime benefit and plastics materials are now the materials of choice for many applications, particularly storage and processing tanks, gas scrubbers and other chemical plant.

BS4994, introduced in 1973, revised and expanded in 1987, covers the design and fabrication of GRP tanks and vessels in substantial detail (see P3) and has been the bedrock of Forbes progress as the leading UK manufacturer of custom-designed tanks and vessels.

The corrosion barrier/contact surface of a GRP tank or other fabrication may be a resin rich layer or a thermoplastic inner shell, forming a dual laminate. The choice of manufacturing process depends very much on the duty for which the product is designed.

GRP structures have excellent strength to weight performance and are very versatile, but the most economical configuration for dual laminate tanks is as self supporting vertical cylinders. Manual fabrication, including hand lay up of the GRP, allows substantial variation of the height and diameter of a tank – a very useful consideration when a site has limited space.

RESIN SYSTEMS

There are many resins available for GRP fabrication, by no means all of them suitable for high specification applications. Orthophthalic polyester resins are perhaps most widely used. NPG isophthalic polyesters offer increased chemical resistance and higher temperature performance. Bisphenols and vinyl esters are generally employed for particularly demanding tasks. While specifying the resin for an application the design engineer also determines the suitable grade of glass reinforcement.

IMPARTIALITY

We are equipped to manufacture in a wide range of materials and will always endeavour to offer objective solutions to your requirements.



CHOP-HOOP WINDING

Traditional manual layup of GRP is labour intensive and effective quality management involves a great deal of detail. Cylindrical GRP tanks would seem to be a prime target for automated production and there have been various approaches, most based around the technique known as 'filament winding'.

Conscious that filament winding techniques do not produce ideal glass/resin ratios for process plant applications and determined that any automated production should match or improve on our existing standards, Forbes invested in a massive installation for the production of cylindrical GRP shells by chop-hoop winding. At the time of its installation it was thought to be the largest plant of its kind in the world and it has been much extended and improved since then.

Automated controls constantly monitor the rate of deposition of both glass and resin and provide detailed quality records. The laminate is particularly strong and economical and combines the advantages of winding and spraying techniques, notably considerable multidirectional strength and enhanced interlaminar shear when compared to filament winding.

Chop-hoop wound tanks with standard glass/resin combinations can economically handle many duties requiring chemical resistance. Water, corrosive liquids including sewage sludge, general effluent, liquid fertiliser, brine, and chemical storage are typical applications.

Specialised resins such as the higher performance isophthalic polyesters and the sophisticated bisphenol and vinyl ester resins are suitable for very demanding applications.

Some environments may require an enhanced performance glass reinforcement and in these circumstances special grades are used.

Chop-hoop winding is also a most efficient process for the production of silos for the bulk storage of dry materials such as PDV salt, plastics granules and animal feed.

POST CURING

The principle of post-curing GRP tanks and vessels to achieve maximum performance from the laminate is well known and is referred to in BS4994.

Curing, by linking free styrene monomers and other organic residuals within the laminate ensures optimum physical and chemical properties and reduces the possibility of taint in higher temperature, taste-sensitive, applications.

Resin manufacturers specifications outline the time and temperature requirements for post-curing their products. Without post-curing, laminates can in some demanding applications suffer from chemical degradation or the risk of taint. Also because of the lower ultimate tensile strength of the laminate increased safety factors in the design of the tank would result in greater wall thickness to achieve the required strength.

Our massive post-curing oven, fitted with a calibrated chart recorder, is over 5 metres in diameter and 13 metres long. It is capable of sustaining temperatures in excess of 100°C over long periods.

Customers can benefit when post-curing is specified by improved chemical resistance, increased strength, and avoidance of taint.

RANGE OF MANUFACTURE

We manufacture storage tanks in various materials from 200 to 200,000 litres capacity. All our products are custom designed and manufactured but where appropriate we will suggest an adaption of a standard design to minimise costs and lead times.

NON TANK PRODUCTS

The technologies we use to build tanks are directly transferable to many other items of process plant and we design and manufacture a wide range of custom and standard products such as Salt Saturators, Silos, Scrubbing and Stripping Towers (see page 8) in a variety of materials.

We also apply our substantial experience in process plant in the manufacture of complex one-off fabrications, in skid and container mounted modules and by offering a full turnkey supply, installation and commissioning service.

ECONOMICAL STANDARD DESIGNS FOR CHOP-HOOP GRP TANKS

SERIES 2	MODEL	Capacity (litres)	Diameter (mm)	Nominal Wall Height (mm)*	Approximate Weight (kg)
	PVT 5/2	5000	2000	2180	250
PVT 7.5/2	7500	2000	2980	300	
PVT 10/2	10,000	2000	3775	350	
PVT 12.5/2	12,500	2000	4570	420	
PVT 15/2	15,000	2000	5365	480	
PVT 20/2	20,000	2000	6960	600	

* Includes 390mm dish height

SERIES 2.4	MODEL	Capacity (litres)	Diameter (mm)	Nominal Wall Height (mm)*	Approximate Weight (kg)
	PVT 10/2	10,000	2400	3000	330
PVT 15/2	15,000	2400	4100	400	
PVT 20/2	20,000	2400	5200	570	
PVT 25/2	25,000	2400	6300	680	
PVT 30/2	30,000	2400	7400	800	

* Includes 600mm dish height

SERIES 3	MODEL	Capacity (litres)	Diameter (mm)	Nominal Wall Height (mm)*	Approximate Weight (kg)
	PVT 20/3	20,000	3050	3540	620
PVT 30/3	30,000	3050	4910	820	
PVT 40/3	40,000	3050	6280	1000	
PVT 50/3	50,000	3050	7650	1200	
PVT 60/3	60,000	3050	9020	1400	

* Includes 600mm dish height

SERIES 3.5	MODEL	Capacity (litres)	Diameter (mm)	Nominal Wall Height (mm)*	Approximate Weight (kg)
	PVT 30/3.5	30,000	3500	4000	850
PVT 40/3.5	40,000	3500	5040	1050	
PVT 50/3.5	50,000	3500	6080	1200	
PVT 60/3.5	60,000	3500	7120	1400	
PVT 70/3.5	70,000	3500	8160	1600	
PVT 80/3.5	80,000	3500	9200	1800	
PVT 90/3.5	90,000	3500	10,240	2000	
PVT 100/3.5	100,000	3500	11,280	2250	

* Includes 680mm dish height

SERIES 4	MODEL	Capacity (litres)	Diameter (mm)	Nominal Wall Height (mm)*	Approximate Weight (kg)
	PVT 50/4	50,000	4111	4770	1400
PVT 60/4	60,000	4111	5530	1600	
PVT 70/4	70,000	4111	6290	1800	
PVT 80/4	80,000	4111	7050	2000	
PVT 90/4	90,000	4111	7810	2150	
PVT 100/4	100,000	4111	8570	2350	
PVT 110/4	110,000	4111	9330	2600	
PVT 120/4	120,000	4111	10,090	2900	
PVT 130/4	130,000	4111	10,850	3100	
PVT 140/4	140,000	4111	11,610	3350	
PVT 150/4	150,000	4111	12,370	3650	
PVT 160/4	160,000	4111	13,130	3950	

* Includes 770mm dish height



Silo diameter 2.4m
Dome height 0.6m
Cone depth 1.95m
Cone angle 60°

Silo diameter 3.05m
Dome height 0.6m
Cone depth 2.64m
Cone angle 60°

Leg length
(L) 3.1m
(H) 4.75m

Outlet height above ground
(L) 1.15m
(H) 2.8m

SILOS

- One piece body with smooth interior assures complete emptying
- Smooth knuckle with no internal crevices
- Translucent shell permits visual contents check against integral calibration

INDUSTRIAL AND AGRICULTURAL SILOS

MODEL	CAPACITY CUBIC M.	CAPACITY, TONNES		HEIGHT, METRES	
		BULK DENSITY 600 KG/M ³	BULK DENSITY 1200 KG/M ³	L-LOW LEG	H-HIGH LEG
PCS 24.06	6	3.6	7.2	4.51	6.16
PCS 24.10	10	6	12	5.48	7.13
PCS 24.12	12	7.2	14.4	5.97	7.62
PCS 24.15	15	9	18	6.70	8.35
PCS 24.20	20	12	24	7.91	8.56
PCS 24.25	25	15	30	9.13	10.78
PCS 24.30	30	18	36	10.34	11.99
PCS 24.34	34	20.4	40.8	11.32	12.97
PCS 24.38	38	22.8	45.6	12.29	13.94
PCS 30.20	20	12	24	6.55	-
PCS 30.25	25	15	30	7.30	-
PCS 30.30	30	18	36	8.05	-
PCS 30.35	35	21	42	8.80	-
PCS 30.50	50	30	60	11.05	-

If you require a larger silo we can also offer 3.50m and 4.14m diameters. Please ask us to quote.

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SAFETY MATTERS

Health and safety issues are high on the agenda in all enterprises, especially as legislation has continued to focus the attention of safety officers on avoidable problem areas. During installation the Construction (Design and Management) Regulations detail the responsibilities of the client to appoint a supervisor to manage safety. Once commissioned the plant safety officer must have risk assessments and method statements in place for day-to-day operations.

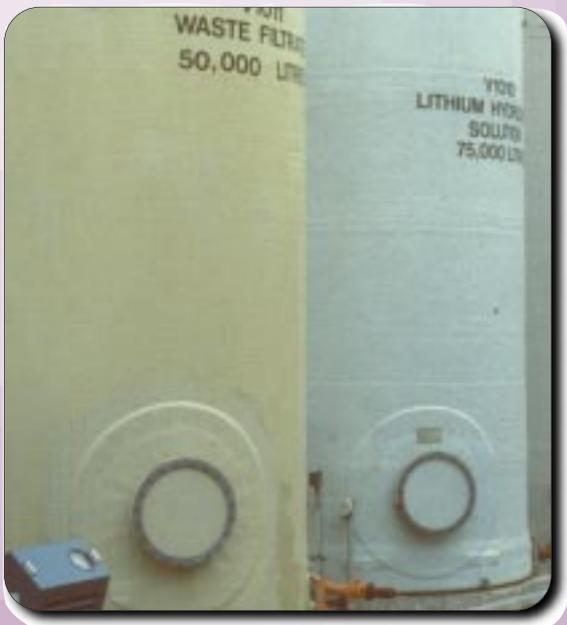
Tanks have to be entered to satisfy planned maintenance schedules. Awareness of the hazards involved in confined space working has grown, especially in the light of several well-publicised tragedies. It has become more common for safety procedures to demand breathing apparatus, winches and back-up staff – but even 600mm diameter top-mounted manways are too small to winch an inert colleague through.

SIDE ACCESS MANWAYS

The safest and most practical aid to entering tanks, and providing emergency backup, is the provision of side access manways. The small initial cost is quickly recovered by operational savings, let alone the substantial contribution to safer working practices.

The Health & Safety Commission document L101(section 95) states 'top openings to vessels, tanks etc. should be avoided due to difficulty of access and rescue. Bottom or low manholes are preferable.' The document also states that the minimum size of opening should be 575mm. The implementation of the Confined Space Regulation (CSR) which is now mandatory further emphasises this requirement. It is further suggested that all vertical tanks and vessels with a wall height in excess of 2.4 metres should be fitted with a side mounted access manway no more than 1.3 metres above the base.

It is straightforward to build side manways in GRP tanks during manufacture – design and construction are thoroughly covered by BS 4994.



PRODUCT RANGE

- ◆ Thermoplastics Tanks
- ◆ Tanks, Vessels & Fabrications
GRP/THERMOPLASTICS DUAL LAMINATES
- ◆ Tanks, Vessels & Silos
GRP COMPOSITES
- ◆ MINIBULK® Chemical Storage Systems
- ◆ Sectional Tanks
- ◆ Silos FOR SOLIDS & LIQUIDS
- ◆ Salt Saturators
- ◆ Pressure and Vacuum Vessels

- ◆ Fume and Odour Scrubbing Systems
- ◆ Vent Scrubbers
- ◆ CO₂ Degassers
- ◆ Stripping Towers
- ◆ Carbon Adsorption Units
- ◆ Bio Treatment Systems

- ◆ Ancillary Steelwork
- ◆ Skid Mounted Modules
- ◆ Turnkey Projects

For further information visit our website at: www.forbesgroup.co.uk



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