Technical specification

Filament winding fiberglass (GRP) pipes

Product code: FW

Manufacturing process: Filament winding

Application field: Civil / Industry

Index

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1. Scope

The present document describes the main characteristics of filament winding fiberglass (GRP) pipes manufactured by NSguassero S.p.A.

2. References

Standards:

- UNI 9032
- EN 1796, EN 14364
- ASTM D2996, ASTM D3262, ASTM D3517, ASTM D3754
- AWWA C950, AWWA M45
- ISO 14692

Documents:

- Technical/commercial offer (contains specific information concerning the proposed pipes as resin type, rating, length, thickness, weight and joining systems).

3. Product certifications

- FM (Factory Mutual);
- KIWA (certification for drinking water also available).

4. Product certifications

- FM (Factory Mutual);
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5. Application field

FW series pipes are used in civil and industrial fields for many applications such as: thermoelectric and hydroelectric power plants, chemical and petrochemical industry, civil works (sewage systems, waterworks, drainages, irrigation plants), waters treatment, fumes treatment, fire fighting systems and desalination plants.
These piping systems convey pressure or gravity fluids and can be installed aboveground, underground and submerged.

6. Product description

5.1 Pipe wall structure

FW pipes wall consists of three layers: inner liner, structural wall and external liner (figure 1).

- The inner liner provides chemical corrosion resistance properties and acts as an anti-diffusion barrier towards the conveyed fluid.
  This resin rich layer is manufactured with "C" glass *surfacing mat* and "E" glass *mat* as reinforcements and has a nominal thickness of 1,3 mm (higher thickness and different glass or synthetic tissues are available for specific applications).

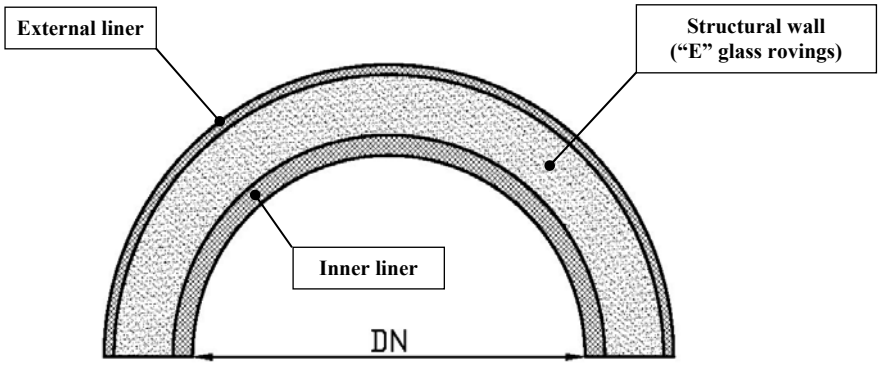

Figure 1: FW pipes wall section.

- The structural wall provides the mechanical resistance to withstand the stresses acting on the pipe (internal and external pressure, thermal loads, dead weight, external static and dynamics loads, etc..). The reinforcing material consists of specific weight "E" glass rovings. Wall thickness is function of diameter and design data.
- The external liner is the superficial finishing layer and protects the pipe from external agents and U.V. rays. It consists of a low weight synthetic veil and it is particularly rich of resin.

5.2 Manufacturing process

Pipes are manufactured with computer aided machines by the "*dual helical filament winding"* process where continuous "E" glass rovings, impregnated with resin, are wound on a rotating mandrel with a fixed angle and under controlled tension, up to reach the required thickness.

5.3 Impregnating resin

Glass fibers impregnating resin (orthophthalic, isophthalic, bisphenolic or vinylester) depends on the composite material chemical and physical resistance required (conveyed fluid and temperature).

5.4 Raw materials

	Inner liner *(anti-corrosion)*	***Inner liner*** *(anti-diffusion)*	***Structural wall***	***External liner*** [(1)]
Impregnating resin	Orthophthalic, isophthalic, bisphenolic or vinylester			
Resin characteristics	standard, anti-abrasive, fire resistant or electrical conductive			
Pigments / Additives	--		--	U.V. protection [(2)]
Type of reinforcing tissue	surfacing mat [(4)]	mat	rovings	superficial veil [(3)]
Materials	"C" glass [(4)]	"E" glass	"E" glass	synthetic tissue [(3)]
Weight	33 g/m^2	375 - 450 g/m^2	2400 tex	10 g/m^2
Nominal resin content	70%		35%	90%
Nominal reinforcement content	30%		65%	10%
Nominal thickness	1,3 mm [(5)]		note (6)	0,2 mm [(5)]

Notes:
[(1)] the indicated data are referred to standard external liner (see also par. 5.1);
[(2)] if required;
[(3)] external liner can be reinforced with glass tissues;
[(4)] inner liner can be reinforced with synthetic tissues;
[(5)] liners can be manufactured with higher thickness;
[(6)] wall thickness is function of design data (DN, PN and SN).

5.5 Rating and dimensions

Pipes are identified by a set of parameters (rating) such as nominal diameter (DN), nominal pressure (PN) and if applicable (usually for underground installation) the transversal stiffness class (SN).
Standard products range available is indicated in table 1.

Parameter	***Symbol [Unit]***	***Value***
Nominal (inner) diameter	DN [mm]	DN25 ÷ DN2400
Nominal pressure	PN [bar]	PN4 ÷ PN20
Stiffness class	SN [Pa]	SN500 ÷ SN10000

Table 1: FW pipes standard product range.

For intermediate values of the indicated parameters reference can be made to the applicable product standards. Different or higher diameters, pressure and stiffness classes are available on demand.
Pipes thickness is calculated on the basis of the design data using the main dimensioning criteria stated in the applicable standards (UNI, EN, ASTM, AWWA, ISO, etc..).
Pipes standard length is 4,5 m up to DN32, 6 m up to DN125 and 12 m for greater diameters.

5.6 Joining systems

The proposed joining systems for FW pipes can be divided in two categories:

- Axial restrained joint: bell & spigot with double O-ring gasket and key-lock, flanged, butt & strap welding and glued conical;
- Non axial restrained joint: bell & spigot with double O-ring gasket and sleeve with double lip gasket.

Pipes can be joined also with mechanical coupling such as Helden, Reka, Straub, Teekay, Gibault, etc..
Joint type selection depends on design data, technical specifications, installation requirements and customer requests.

5.7 Physical and mechanical properties

GRP laminate has exceptional chemical resistance, mechanical strength values similar to steel but with a specific weight about 4 times lower, low electrical conductivity, low thermal conductivity, optimal abrasion resistance and low surface roughness that reduces pressure losses.
Table 2 reports values of some physical and mechanical properties.

Characteristics	***Mean nominal value***	
Superficial roughness	30 µm / 150 HW	
Winding (roving) angle	55°	63°
Tensile elastic modulus axial (E_a) / hoop (E_h)	11000 / 22000 MPa	7000 / 27000 MPa
Allowable tensile axial stress	27,5 ÷ 36,7 MPa	17,5 ÷ 23,3 MPa
Allowable tensile hoop stress	55,0 ÷ 73,3 MPa	67,5 ÷ 90,0 MPa
Poisson coefficient in case of hoop stress (υ_{hl})	0,5 ÷ 0,6	
Poisson coefficient in case of axial stress (υ_{lh})	$\upsilon_{lh} = \upsilon_{hl} \times (E_a/E_c)$	
Thermal expansion coefficient	$18 \div 20 \times 10^{-6}$ 1/°C	
Thermal conductivity	0,26 W/mK	
Specific heat	1,26 J/gK	
Electrical resistivity	1000 MΩ/m	
Specific weight	1,85 kg/dm^3	

Table 2: FW pipes physical and mechanical properties.