SEPMA

شركة صناعة الأنابيب المحدودة ش.م.م

Composite Pipes Industry L.L.C.

QA/QC BROCHURE

LEADERS IN MANUFACTURING FIBERGLASS PIPES

44 Years Experience

www.cpioman.com

CONTENT

INTRODUCTION

To enable distribution and manufacturing oriented businesses, CPI Quality Control module will help you automate the quality control processes and tests for serialized, lot or batch tracked inventory items as well as for non-inventory items such as environmental or laboratory metrics.

CPI QA/QC is fully equipped with all the resources required to comply with International Standards and Customer Requirements.

CPI is accredited by TUV Nord for ISO 9001 & ISO 14001 Certification for quality management and environmental systems.

Also successfully undergone audits and product testing and acquired product approval from FM 1614, NSF/ANSI 61, API 15 HR and API 15 LR.

NB: For product approvals refer official websites for the listing and latest product information.

CPI obtained various customer approvals through stringent audits and product qualifications, testing and complete compliance to the customer specification. Listed as approved vendor from major clients such as PDO, BP, Saudi Aramco, KNPC, KOC, EIL, ONGC and Haya Water.

We have trained, experience and enthusiastic personnels working as a team to ensure customer satisfaction through routine monitoring and adherence to Quality Management System.

PRODUCTION CONTROLS

a. Receipt of Materials and Services

Materials received by CPI shall be subjected to the incoming inspection as per the approved inspection & test plans and procedures as applicable which include raw material, Ancillaries and customer properties.

Inspection will verify and accomplish the following:
- The amount received against the quantity ordered.
- Visual inspection for damage in shipment or handling.
- Chemical analysis, physical properties, compliance to certificates and Dimensions Checks.

b. In Process Controls

All the in process checks are carried out as per customer approved manufacturing and inspection Test plans and procedures for each stage of manufacturing.

All work is being performed by qualified Forman's and supervised 100% by trained and well experienced supervisors. Additionally being monitored by the dedicated process controllers. The shop process real time data is being recorded in the birth certificate for each item being produced are the medium for setting up manufacturing operations in consecutive sequence and for establishing the points of inspection within a group of operations.

With the process sheet, the drawings, specifications an applicable SOP's, the QC process controller will inspect the work at various pre-determined points of manufacture.

Suitable corrective and preventive action being ensured as the outcome of failure analysis if any.

c. Final Quality Inspection

Upon completion of item, being inspected with a frequency of 100 % product sampling for visual and dimensional checks.

Critical dimensions, mechanical properties, STHP test, LOI test and Tg tests are being performed lot wise as per the required specification and applicable ITP.

d. Storage and Shipping

All handling, packaging and storage will be performed as per applicable standards in such a manner as to protect the manufactured items while in loading, unloading, storage and during transit as specified by the purchase order and approved method statements.

QUALITY ASSURANCE CONTROLS

a) Time-saving & flexible tests, classifications and automatic tracking

Each test is designed to describe the test measure being assessed and these tests are assigned to a Test classification as a means to logically group, view and perform related tests. For example in GRE manufacturing industry, test classifications may include, Project, Product Identification, Inspection test plans, physical and Mechanical property tests etc. You can define as few or as many tests as you require to be performed within each classification. Once tests have been classified and assigned to a project specific serialized, lot or batch tracked, their progress can be automatically tracked through the quality control process.

b) Ensure compliance and traceability

Each CPI process for receipting an item, such as a Purchase Order or Factory Order receipt can be set to a user defined status, eg. Quarantined or QC in Progress, and are assigned their defined tests and test specifications as per the customer approved inspection and Test plans. This saves time and effort. As test are performed, results from each test specification is being recorded along with who tested, the date and unlimited notes required to elaborate on the test procedure or results added. This provides flexibility for subjective tests such as visual inspection, dimensional checks, Mill hydro test, in-process checks etc. CPI Quality Control / Quality Assurance system will allow you to easily trace all items sold either by unique identification number or from a particular batch or lot, further can be traced for Raw material used with complete testing details till dispatch.

c) Tool, Gage, and Test Equipment's Calibration

All standard measuring instruments such as micrometers, Verniers, Height Gages, Depth Micrometer, Pressure Gauges, Laboratory instruments and equipment's etc., is being inspected and assigned to a unique identification number upon receipt. Further it will be part of calibration plan at set frequency with calibration status fixed on each and every instrument, tool and equipment. The gage and instruments will be inspected in a manner consistent with good practices as per the calibration schedule.

DEFECTIVE MATERIAL CONTROL

When an item does not meet the specification requirements and it cannot be repaired, it will be submitted to the Material Review Board. This Board will consist of the GM, Quality Control Manager and Engineering Manager. No rework, repair, or replacement is to be made until a request for deviation is approved by the customer. Suitable preventive and corrective action shall be implemented.

Checks and controls ensure defective items are never released for use or sale.
Items that fail quality control tests are automatically assigned a user definable status that will ensure they are unavailable for sale or use. You have the reassurance of knowing that faulty items will never be inadvertently distributed or sold to our customers. Products that pass are automatically made available for distribution and sale, QC IRN will be issued for released items. Checks and balances at every critical point in the process ensure you have complete control on the quality.

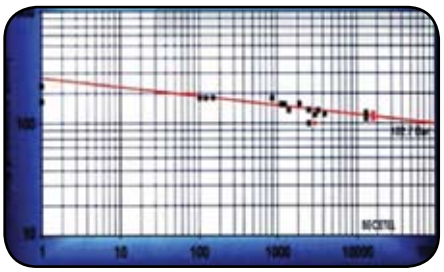
QUALIFICATION TESTING

Sr. No.	Test Details	International Standard
a)	Long Term Hydrostatic strength test - Regression Test	ASTM D 2992
b)	Product Sector Qualification / 1000 hrs.	ASTM D 1598
c)	Flange Qualification Test	ASTM D 4024
d)	Beam Deflection Test	ASTM D 2925
e)	Joint Integrity Test	ASTM D 4161
f)	Collapse Pressure Test	ASTM D 2924

a) Long Term Hydrostatic Strength Test-Regression Test

The Long Term Regression test is the primary and essential information for the design of fiberglass pipes and fittings. The hydrostatic design basis (HDB) is obtained by evaluating strength regression data as per ASTM D 2992, Procedure B. Minimum 18 pipe spools with joint at center are tested at rated constant temperature and different pressure level in-order to fulfil the failure criteria as given in ASTM standard.

Hours to Failure	Failure Points
10 to 1000	At least 4
1000 to 6000	At least 3
After 6000	At least 3
After 10000	At least 1
Total samples	At least 18



b) Product Sector Qualification / 1000 hrs. Test

The design validation is done by subjecting the pipes and fitting to a hydrostatic test pressure of approx. 2.4 times the design pressure for duration of 1000 hours as per ASTM D 1598. The test specimen is prepared by joining the components to form a spool which is enclosed using un-restrained ends. The spool is then conditioned in oven at design temperature and pressurized to required test pressure.

The temperature and pressure is continuously monitored for the entire duration of 1000 hrs. Pressure is recorded using continuous chart recorder. The design is considered to be validated if the spool successfully withstand the test pressure for a duration of 1000 hours without any leak or weep.

c) Flange Qualification Test

The flanges manufactured by CPI undergoes stringent qualification tests as per ASTM D 4024. As per ASTM standard the flanges are subjected to sealing test, short-term rupture strength test and maximum bolt torque test. In addition to above standard requirement CPI can also carry out cyclic test based on customer requirement to ensure integrity of flange to withstand cyclic load.

Sealing Test

The flanged joint connection is hydro tested at a pressure of 1.5 times the design pressure for a duration of 168 hours. The spool shall withstand the test pressure without any weep or leak. The sealing test qualifies the flange as well as the gasket/O-ring.

Short-Term Rupture Strength Test

The flanged joint connected spool is tested as per ASTM D 1599 until failure of flange occurs. To qualify, the flange shall withstand a hydrostatic load of at at least 4 times the design pressure without any damage to the flange.

Maximum Bolt Torque Test

The flange shall withstand a bold torque of 1.5 times the recommended value without any visible sign of damage.

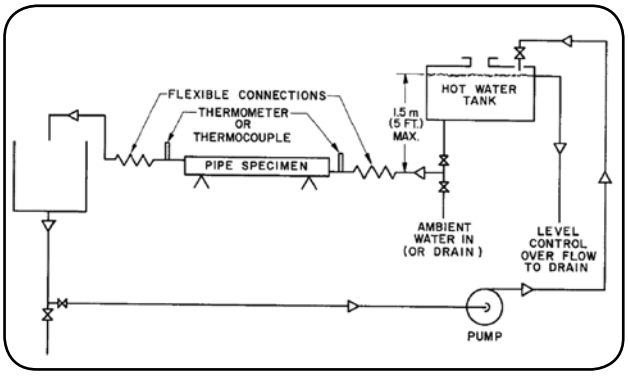
Cyclic Test

Cyclic test is performed to verify the performance of the flange system to withstand variations in pressure during the operations and testing.

The test spool is subjected to 10 pressure cycles, each cycle starts at 0 and rises to 1.5 times design pressure hold for 10 minutes and then reduces to 0. After completion of test there shall be no sign of any cracks or de-lamination.

d) Beam Deflection Test

Pipes manufactured at CPI are tested with the Beam deflection qualification test as per ASTM D 2925. The test method is used to evaluate the influence of span length on mid-span deflections at differing temperatures under full bore flow. This test method covers measurement of the deflection as a function of time for pipe specimen supported on a flat non-arced support as a simple beam under full bore flow of water at elevated temperatures. The deflection at the center of the span is measured at specific intervals for a minimum duration of 1000 hours.



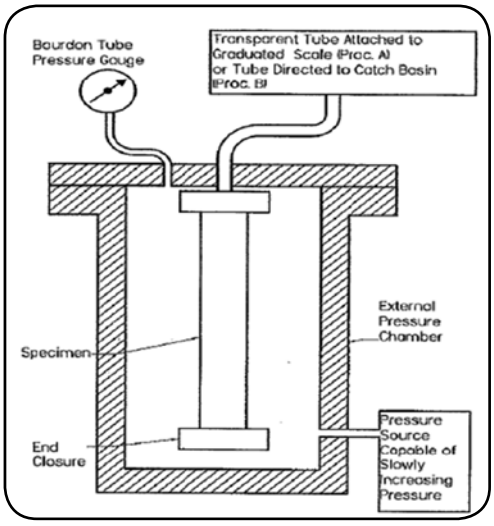
The data is used to calculate the long term beam bending modulus of elasticity at different temperatures. The value of elastic modulus is used to calculate maximum allowable unsupported span length of pipe.

e) Joint Integrity Test

Joint integrity test is performed to determine the integrity of joints as per ASTM D4161. The test is performed by subjecting the pipe to shear load and performing the hydro test and vacuum pressure test.

f) Collapse Pressure Test

The collapse pressure test is performed to determine the resistance of pipe to withstand external pressure. The test is performed as per ASTM D2924. The test method consists of loading a specimen to failure in a short time interval by means of continuously increasing external fluid pressure at a controlled constant temperature. Fluid is also maintained inside the pipe and changes in the inside volume is monitored with as fluid level tube.



QUALITY CONTROL INSPECTION AND TESTING

Quality Control Test on GRE Product

a.	Hydro Static Pressure Test	ASTM D 1598
b.	Short Term Hydro Static Pressure Test	ASTM D 1599
c.	Axial Tensile Test	ASTM D 638 & ASTM D 2105
d.	Hoop Tensile Test	ASTM D 2290
e.	Pipe Stiffness	ASTM D 2412
f.	Shear Strength Test	ASTM D 638
g.	Glass Transition Temperature Test	ISO 11357-2
h.	Loss on Ignition (Glass Content)	ASTM D 2584
i.	Water Absorption Test	ASTM D 570
j.	Density	ASTM D 792
k.	Hardness Test (GRE)	ASTM D 2583
l.	Visual and Dimensional Inspection	ASTM D 3567/ASTM D 2563

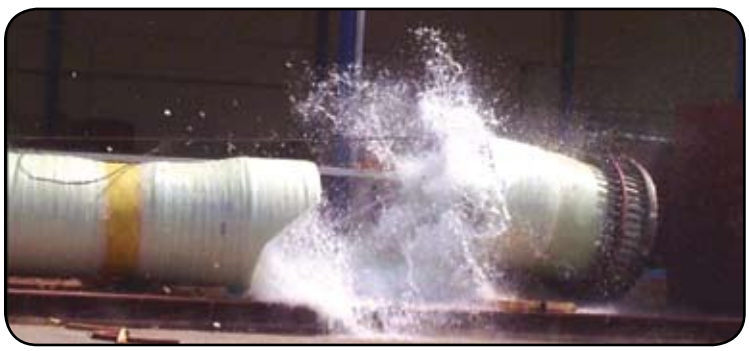
Raw Material Inspection

m.	Viscosity	ASTM D 2196
n.	Gel Time and Peak Exothermic Temperature	ASTM D 4473
o.	Liner Density of DR, WR and surface veil	ISO 1889
p.	Moisture Content Test	ISO 3344
q.	Hardness Test (Ancillary Items – Rubber)	ISO 7619
r.	Visual and Dimensional Inspection for ancillary items	Standard /Project Specific Drawings

i) Short Time Hydraulic Pressure Test (STHP)

STHP test is performed as per ASTM D 1599 to determine the failure pressure of pipes and fittings. The specimen is subjected to increasing internal pressure so as to obtain failure beyond 60 seconds. Free-end closure is used so that internal pressure produces longitudinal tensile stresses in addition to hoop stress.

The burst value obtained by this test method can be used to determine the ultimate short term hoop stress for pipes or short term pressure capability for fittings.



ii) Stiffness Test

Pipe Stiffness is an important property as far as burial depth is concerned. The test is performed as per ASTM D 2412. A section of pipe specimen is subjected to compression load using parallel plates. Load at 5% deflection is recorded and used for calculation of pipe stiffness as per ASTM standard. The specimen is further deflected and observed for any crack, crazing, inter laminar separation or structural damage.

iii) Axial Tensile Strength Test

The axial tensile strength of the pipe is determined as per ASTM D 2105 for the pipe diameter up to 150 mm and ASTM D 638 for diameter beyond ND 150 mm.

The test is performed by taking a section of pipe along the longitudinal direction and subjecting it to axial tensile load up to failure.

The ultimate axial tensile strength is determined by calculation as per respective standard.

As per ASTM D 638

As per ASTM D 2105

iv) Hoop Tensile Test

The strength of the pipe in the hoop direction is determine by subjecting a cut section of pipe to a hoop load using tensile testing machine as per ASTM D 2290. The specimen is subjected to tensile load using split disc. The maximum load sustained by the specimen is used to compute the hoop tensile strength of pipe.

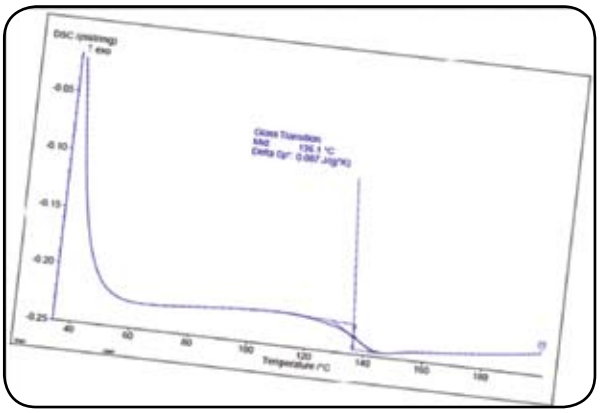
v) Hydrostatic Pressure Test

CPI is equipped with all sort of hydro test facility i.e pipe hydro test machines which can test up to 12 meter length pipes up to the diameter range of DN 1200 mm and fitting hdyrotest machine can accommodate fittings up to DN 600 mm with various degree and radius. All the CPI manufactured Pipes and Fittings are hydro tested as per ASTM D 1598 and customer specifications. The component is connected to re-strained ends using O-ring and pressure head. The component shall hold the test pressure of 1.5 times the design pressure for duration of 2 minutes without any leak or weep.

Spools with flanged end can also be hydro tested as per above standard.

vi) Glass Transition Temperature Test

Glass Transition Temperature (Tg) is a temperature at which transition in phase of the material will take place. The test is performed as per ISO11357-2 using Differential Scanning Calorimeter which determines the change in specific heat with change in temperature.



A small cut piece of cured product is taken at 3 locations 120 deg. apart and is placed inside the DSC chamber. The DSC machine will heat the material beyond its transition temperature and capture change in specific heat.

A sudden change in heat flow determines a transition phase of material. For a cured product the Tg shall be 30degree more than the maximum design temperature.

vii) Loss on Ignition Test (Glass Content)

Glass content test is performed as per ASTM D2584 to determine the percentage of glass content in the structure of the product. A small section of product is placed inside the muffle furnaces and heated until the entire resin has evaporated, the percentage difference in initial and final weight will give the glass content.

viii) Visual and Dimensional Inspection

Visual and Dimensional inspection check is done for each and every pipes and fittings as per ASTM D2563 and ASTM D3567. Components which fully confirms to the customer requirement are tagged with a green sticker and released from QC for delivery.

ix) Inspection of Threaded Pipes and Fittings

Visual and Dimensional inspection for threaded pipes is performed as per API 15 HR and API 5B.

Following inspections are done to ensure threads are manufactured as per standard requirement.

Thread Taper: The taper angle for threaded pipe is measured using taper gauge. The gauge provides the difference in diameter measured at an inch distance throughout the length of thread. The measure values are compared with standard dimensions mentioned on API 5B.

Thread Height: The height of the tread is measured using thread height gauge. Standard block is used to set the height gauge to zero position.

Lead: Thread lead is measured using lead gauge. Standard lead block is used to set gauge to zero position.

Stand-off: The standoff for pipes and fittings is measured using ring and plug gauge.

x) Density

The density of product is determined as per ASTM D792. Density kit is use to determine the density of product which is based on the Archimedes principle. The density of specimen is calculated by measuring the weight of small cut section of pipe in air and in water.

xi) Hardness

The hardness determines the extent to which the component is cured. It is measured using Barcol hardness tester as per ASTM D2583.

xii) Viscosity

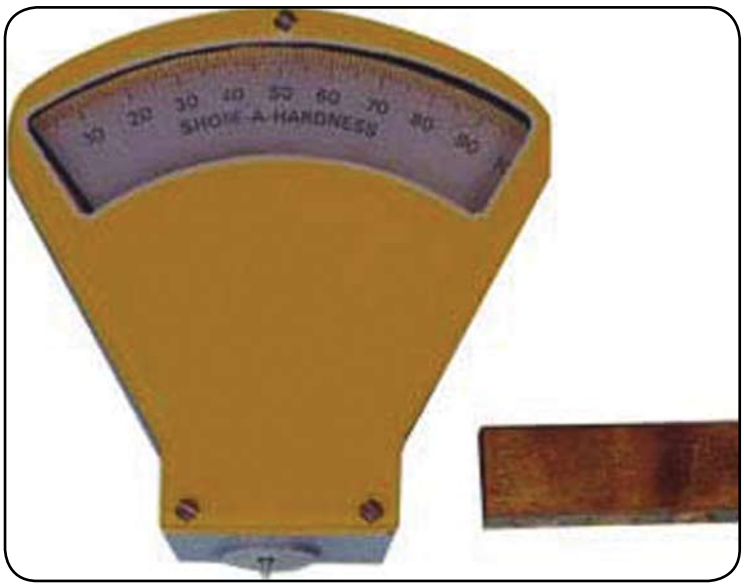
Every batch of resin is tested for viscosity as per ASTM D2196. The test is performed at 25° C using elcometer. System take the input from the elcometer and plots the graph between viscosity and temperature. Measure value is compared with the technical supply specification.

xiii) Gel Time and Peak Exothermic Temperature

Gel time and Peak exothermic temperature is determined as per ASTM D 4473. The test is performed by heating resin hardener mixture at elevated temperature and checking the time taken to start the gel formation and maximum temperature attend by the mixture due to exothermic reaction. Measure value is compared with the technical supply specification.

xiv) Shore 'A' Hardness Test (for Rubber items)

For gaskets, O-rings and other rubber items the hardness is checked using Shore A hardness tester as per ISO 7619. Standard block is used to calibrate the hardness tester before use. Measure value is compared with the technical supply specification.



Manufacturing and Testing of GRE Pipes and Fittings is performed as per International as well as customer specific standards such as:

- ISO 14692-2: GRP Qualification and manufacturing.
- ASTM D 2996: Specification for Filament Wound Fiberglass Pipes.
- AWWA C 950: Standard for Fiberglass Pressure Pipes.
- API 15 HR: Specification for High Pressure Fiberglass Line Pipe.
- API 15 LR: Specification for Low Pressure Fiberglass Line Pipe.
- DEP 31.40.10.19: (Shell) GRP Pipeline and Piping Systems.
- SP 2092-1: (PDO) GRP Specification for Qualification and Manufacturing.
- 01-SAMSS-034: (Saudi Aramco) Material System Specification for RTR Pressure Pipe and Fittings.
- KZ01-MT-SPE-14-0018: (BP) Specification for GRE Line Pipe, Flanges and Fittings.

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