AKBOR

AKBOR Boru Sanayi ve Ticaret Ltd Şti
AKBOR Pipe Industry and Trade Inc

Quality Control Manual

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I N D E X

1 Quality Plan

QUALITY PLAN			
	Control	**Frequency**	**Reference Standard/Specification**
Raw materials	Polyester Resin	For each batch	ISO 2535,OSO 2555
	Sand	For each batch	ISO 565
	Hoop/Chop	For each batch	ISO 1887,ASTM D 2584
	Gasket/Stopper	For each batch	ISO 7619
Visual inspection	Visual inspection of pipe	For each pipe	ASTM D 3754
	Visual inspection of Coupling	For each coupling	ASTM D 3754
	Visual inspection-Fitting	For each fitting	ASTM D 3754
Dimensional control	Pipe ID control	At production start	ASTM D 3567
	Pipe OD control	For each pipe	ASTM D 3567
	Thickness control	For each pipe	ASTM D 3567
	Chamfering and calibration	For each pipe	Internal standard
	Pipe length	For each pipe	Internal standard
	Measurement of coupling grooves	For each coupling	Internal standard
	Dimensional control of fittings (Angle, length)	For each fitting	Internal standard
Product performance	Stiffness Test	One per day or per 50 pipes	EN 1228,ISO 7685,ASTM D 2412
	Failure control at inner surface under load	One per day or per 50 pipes	ASTM D 3754
	Delamination control under load	One per day or per 50 pipes	ASTM D 3754
	Longitudinal tensile strength	One per day or per 50 pipes	ASTM D 638, ISO 527
	Circumferential tensile strength	One per day or per 50 pipes	ASTM D 2290
	Surface hardness	For each pipe	ASTM D 2583
	Pipe leak Tightness	For each pipe	AWWA C 950
	Loss on ignition test	One per day or per 50 pipes	ASTM D 2584
	Impact resistance	One per shift	BS 5480
	Joint performance test	At production start	ASTM D 4161
Long term performance type test	Long term strain corrosion test	Type test	ASTM D 3681, ASTM D 3262
	Hydrostatic design basis	Type test	ASTM D2992
	Long term ring bending strain (under construction)	Type test	ASTM D 5365
	Long term specific ring stiffness (under construction)	Type test	EN 1225

2 Test Equipment List

2.1 Acceptance Tests

- **Viscosimeter :** For determining the viscosity of resin
- **Reactivity Test Equipment:** For determining reactivity properties of polyester resin and other chemicals.
- **Incubator:** For determining for moisture in glass fiber products, sand filler and polymer contents of resin
- **Burning oven:** For determining loss of ignition of glass fiber and sand filler.
- **Thermometer:** For measuring heat of sand and resin .
- **Weighers :** For determining weights of several material and chemicals.
- **Sieves:** For determining of particle size distribution of sand.
- **Calipers:** For measuring gasket and stoper dimensions.
- **Angle meter:** For controlling angular specifications of gaskets and stoper.
- **Shoremeter:** For measuring hardness of EPDM gaskets and stoper.
- **Zahn Cup:** For determining the viscosity of resin

2.2 Product Tests

- **Universal Test Equipment:** For determining of axial tensile strength properties of pipe.
- **Hoop Tensile Strength Equipment:** For determining of hoop tensile strength of pipe.
- **Stiffness Tester:** For determining the initial stiffness of a pipe.
- **Hydrostatic Tester:** For determining leaking properties of pipe under pressure.
- **Impact resistant Apparatus:** To determine of impact resistant of pipe.
- **Barcol impressor:** For determining of hardness of finished product and raw materials.
- **ID micrometer:** For measuring the inner diameter (ID) of pipe.
- **Circometer:** For measuring the outer diameter (OD) of pipe..
- **Caliper:** For measuring thickness, chamfering, coupling grooves etc.
- **Micrometer:** For thickness measurement
- **Band Meter:** For length of pipe and fittings.
- **Angle meter:** For controlling angles of fittings.

2.3 Long-Term Tests

- **Strain Corrosion Performance:** Long term
- **Ring Bending Strain:** Long term
- **Specific Ring Stiffness:** Long term
- **Hydrostatic Design Basis:** Long term

2.4 Device List

AKBOR GRP FACTORY - LABORATORY EQUIPMENT LIST					
No	CALIBRATION CODE	USED AREA	DEVICE TYPE	CALIBRATION RANGE	CALIGBARTION FREQUENCY
1	I8G339	LABORATORY	MESH	0,125	1 Year
2	I8G340	LABORATORY	MESH	0,18	1 Year
3	I8G341	LABORATORY	MESH	0,3	1 Year
4	I8G342	LABORATORY	MESH	0,5	1 Year
5	I8G343	LABORATORY	MESH	0,71	1 Year
6	J8640	LABORATORY	HUMIDITY MEASUREMENT	0-100	1 Year
7	J8E009	LABORATORY	CHRONOMETER	10 h	1 Year
8	I8G355	LABORATORY	ANGLE MEASUREMENT	0-180	1 Year
9	I8G352	LABORATORY	DIGITAL CALIPER	0-150mm	1 Year
10	I8G350	LABORATORY	MECHANICAL CALIPER	0-150mm	1 Year
12	I8G354	LABORATORY	METER (30m)	0-30000mm	2 Years
13	J8S028	LABORATORY	LAB. THERMOMETER	_30± 50 ºC	2 Years
14	J8S029	FRONT OF WIND Mach	LAB. THERMOMETER	_30± 50 ºC	2 Years
16	J8S037	LABORATORY	LAB. THERMOMETER	_10± 110 ºC	2 Years
17	I8U018	LABORATORY	CIRCOMETER	700/1100mm	2 Years
19	A56933	LABORATORY	VISCOSİMETER		1 Year
20	I8T110	LABORATORY	SCALE	620gr	1 Year
21	I8T111	MECH LABORATORY	SCALE	300KG	1 Year
22	I8S165	LABORATORY	OVEN	300ºC	1 Year
23	I8S164	LABORATORY	OVEN	1100ºC	1 Year
24	H8F027	LABORATORY	SHORE-A	0-100	1 Year
25	L8U034	LABORATORY	CIRCOMETER	1100-1500	2 Years
26	L8U035	LABORATORY	CIRCOMETER	1500-1900	2 Years
27	L8U036	LABORATORY	CIRCOMETER	1900-2300	2 Years
28	E8B541	LABORATORY	MANOMETER	0-100bar	1 Year
29	J8S070	LABORATORY	DIGITAL TEMP.MEASUREMENT	_50± 200 ºC	2 Years
30	D8G704	LABORATORY	INNER DIAMETER MICROMETER	100mm-2100mm	1 Year
31	J9F006	MECH LABORATORY	STIFFNESS TEST	1-20kN	1 Year
32	J9F005	MECH LABORATORY	TENSILE STRENGTH TEST	1-200kN	1 Year
33	I9U013	LABORATORY	CIRCOMETER	300/700mm	2 Years
36	I9U016	LABORATORY	CIRCOMETER	1100/1500mm	2 Years
37	I9U017	LABORATORY	CIRCOMETER	700/1100mm	2 Years
38	I9U018	LABORATORY	CIRCOMETER	700/1100mm	2 Years
39	I9S317	LABORATORY	RESIN TEST DEVICE	0-300	1 Year
41	I9G336	PRODUCTION LINE	DIGITAL CALIPER	0-150mm	1 Year
42	J9G327	LABORATORY	ANGLE MEASUREMENT	0-180	1 Year
43	J9G469	LABORATORY	DIGITAL CALIPER	0-150mm	1 Year
44	J9G468	COUPLING ROOM	MECHANICAL CALIPER	0-150mm	1 Year
45	J9G469	LABORATORY	MECHANICAL CALIPER	0-150mm	1 Year
46	J9G468	LABORATORY	MECHANICAL CALIPER	0-150mm	1 Year

3 Raw Materials

3.1 Resin Receiving Inspection Test

Gel Time, Viscosity, Reactivity, Solid Content-Styrene Level

TEST-1 Physical Gel Time of Unsaturated Polyester Resin

1- Scope

This method covers determination of gel time of unsaturated polyester resin at room temperature.

2- Reference

This test is based on portions of ISO 2535-1997

3- Requirements

10-20 min @ 25^{o}C and 300 cps

4- Frequency and Number of Samples

One sample for each batch

5- Apparatus

250 ml PP (polypropylene) tri-pour beakers or paper cups (plastic lined or wax lined)

Thermocouple or thermometer

Stainless steel spatula or stirrer

(Optional) Sunshine gel time meter

6- Reagents

1% cobalt octoate solution

Butanox M60 MEKP (methylethylketone peroxide)

Resin to be tested (viscosity as delivered)

7- Procedure

Weigh out 100 g resin into a PP beaker or paper cup

Add 1 g 1% cobalt octoate solution and mix well with stainless steel spatula.

Temper resin to 25^{o}C.

Place PP beaker or paper cup into another stackable PP beaker or paper cup such that the resin is now insulated from ambient temperature or lab counter surface.

Add 1.1 g MEKP M50 or 1.0 g MEKP M60 (methylethylketone peroxide) to the resin which has been Tempered at 25oC (0.5°C),   record starting time and mix well for 30 seconds.

Peroxide temperature must be within 20-25^{O}C temperature range.
(Optional). Position gel tester over resin such that the 6 mm glass rod is centred in the resin and about 10 mm from the bottom of the cup or beaker.

Do not check for gelation until 10 minutes have passed. After 10 minutes, check for gelation every 30 seconds by **moving the stick up and down in the centre of the cup until the resin sticks to the rod.**

Record the time from when mixing of the peroxides begins, until gelation occurs.

Accuracy of 2 consecutive tests should be within 0.5 minute.

TEST-2 Determination of Viscosity

1- Scope

This method covers determination of viscosity of polyester resin measured by Brookfield Viscometer.

2- Reference

This test is based on ISO 2555, ASTM D 2196

3- Requirements

Viscosity as received @ 25 ^{O}C : 350-550 cps

4- Frequency and Number of Samples

One sample for each batch

5- Apparatus

· Brookfield Viscometer type: RVT or LVT

· 400 ml propylene beaker, Ø dIA~80 mm

· Thermometer

· Spindle # 3

6- Procedure

- Fill the 400 ml beaker full with resin.

- Temper the resin to 25°C ± 0.5 C

- The spindle is attached to the viscometer by screwing it onto the lower shaft.

- Note that the spindles have a left-hand thread. The lower shaft should be held in one hand and lifted up. The spindle should be screwed to the left.

- Insert and center spindle in the test material until the fluid’s level is at the immersion groove on the spindle’s shaft. Avoid trapping air bubbles beneath the disk by first immersing the spindle at an angle, and then connecting it to the viscometer.

- Adjust the speed to 50 rpm.

- Turn the motor ‘ON’. The spindle must rotate at least 5 times before readings are taken. Depress the clutch and turn off the motor, with the red pointer in view.

7- Calculation

The reading has to be multiplied with a factor varying with type of spindle and speed. For spindle #3 and speed 50 rpm, the factor is 20.

The result is given in centipoise.

TEST-3 Determination of reactivity of unsaturated polyester resin

1- Scope

This method is used to determine the reactivity of unsaturated polyester resin used in AKBOR pipe.

2- References

This test method is partially based on ISO 584

3- Requirements

CURING PROPERTIES (Resin diluted with styrene monomer to 300 +/- 25 cps)

Property	**Specification**
25 - 35°C (a)	12 - 24 min
65 - Exotherm peak (b)	< 40 min
Exotherm peak	145 - 185°C
b/a	2-3

4- Frequency and Number of Samples

One sample for each batch

5- Apparatus

Test tubes, 18 mm nominal O.D. (outside diameter), wall thickness 1.2mm +/- 0.2 mm, length by 150 mm. Longer test tubes may be used as long as thermocouple is centered properly.

Foam Block (details listed below)

J type thermocouple

Temperature recorder/meter (compatible with type J thermocouple)

Centering device (polyethylene)

6- Reagents

Butanox M60 MEKP (methylethylketone peroxide) for high reactivity resins or Butanox LPT MEKP for low reactivity resins.

Cobalt-octoate, (1 % Co)

Resin to be tested -as received - 300 cps

7- Procedure

Weigh out 100 g resin into a PP beaker or paper cup.

Add 1 g (1% cobalt octoate solution) and mix well with stainless steel spatula.

Temper resin to 25°C.

Place PP beaker or paper cup into another stackable PP beaker or paper cup such that the resin is now insulated from ambient temperature, lab counter surface, or operators hand.

Make certain that thermocouple has a very light coating of silicone grease. Care should be taken to ensure that test tube & thermocouple assembly is also tempered to 25^{O}C. This can be done by immersing tube in a 25^{O}C water bath for a minute, then wiping of water without transferring heat from the hand to the lower part of the test tube. Test tube and thermocouple assemble should rest in foam block for 5 minutes to ensure that the assembly measures 25^{O}C +/- 0.5^{O}C.

Add 1.0 g Butanox M60 (methylethylketone peroxide) to the resin which has been

tempered at 25^{O}C
(+/- 0.5^{O}C), record starting time and mix well for 30 seconds.

Peroxide temperature must be within 20-25^{O}C temperature range.

Pour resin into test tube to a height of 75mm.

Place thermocouple in the test tube using the centering device so that the end of the probe is positioned in the center of the resin mixture.

Place test tube into foam block.

Record the time it takes to reach each temperature event.

Both the resin and foam block should be at 25°C. It is important that the foam block is conditioned at 25°C for at least an hour. This time can be shortened if 25°C or cooler compressed air is used to cool the hole in the foam block. This would be required when running multiple tests. The test tube assembly is placed into the foam block and the time to reach the various temperature events is recorded. The start time for the test is the moment the peroxide is mixed into the resin. See below for other temperature events. A chart recorder can be convenient to monitor the temperature of the resin as it reacts. If multiple tests are to be run, cool the hole or make multiple foam blocks (see specifications below).

Foam Block:
The polyurethane foam block density is 30-50 kg/m^3 (2-4 lb/ft^3). A multi-cavity block will have the following dimensions: Length/width/height = 300mm/100mm/170mm. Circular holes in the foam block are 22mm diameter and 120mm deep in the middle of the block with a minimum distance of 50mm from the center of one hole to the center of another hole and 50mm from the center of a hole to the edge of the block. A smaller single cavity block may be 100mm/100mm/170mm.

TEST-4 Determination of solids content (styrene level) of liquid polyester resin

1- Scope

This method covers determination of solids content of liquid polyester resin (the monomer usually is monostyrene).

2- Reference

ISO 3251

3- Requirements
Solid Content min. 55 %

Styrene Level max. 45%
4- Frequency and Number of Samples

One sample for each batch

5- Apparatus

Tin box lid, diameter approx. 60 mm

Balance with 0,01 g accuracy

Heating cabinet

6- Procedure

Weigh the empty lid and weigh out 2 g of resin (viscosity 300 +/- 25 mPa·s/25 ^{O}C) into it.

Place the lid with polyester resin in a heating cabinet at 150^{O}C for 1 hours

Take the lid out of the heating cabinet and cool down in a desiccator and weigh again.

Calculation

PERCENT SOLIDS = (B/A) . 100 %

A=weight of resin before drying
B= weight of resin after drying

After finding the solid content, the rest of it is styrene level.

3.2 TM-02 sand Receiving Inspection Test

TEST-1 Particle Size Distribution on Sand Filler

1- Scope

This method covers the determination of particle size distribution of sand within the range of 0-1 mm.

2- Reference

ISO 565 & Internal Standards

3- Requirements

Micron	>=710	500-710	300-500	180-300	0-180
% Acceptable	0-1	0-6	40-62	30-53	0-7

4- Frequency and Number of Samples

For each batch

5- Apparatus

Standard Sieves (ISO 565): 710, 500, 300, 180 micron

Shaking apparatus

Weight sensitive to 0,10 g.

6-Procedure

-Weigh each sieve.

-Put the whole series of sieves together according to increasing numbers and mount them in the shaking apparatus.

-Weigh out exactly 1000 g of the sand and pour it onto the upper sieve.

-Shake for 6 minutes.

-Weigh each of the sieves again and calculate the sand residue on each of them.

-The cumulative percentage of sand is to be plotted on a graph.

TEST-2 Moisture Content in Inorganic Fillers

1. Scope

This method covers determination of moisture in inorganic fillers like sand, quarts etc.

2- Reference

AKBOR Internal standards

3- Requirements

Max: 0,1 %

4- Frequency and Number of Samples

For each batch

5- Apparatus

Porcelain cup (d = 75 mm)

Desiccator

Balance sensitive to 0,1 mg Heating cabinet

6- Procedure

-Make the porcelain cup dry by putting it into the heating cabinet at 150°^{o}C + 3°^{o}C for 20 minutes. Cool it down in a desiccator.

-Weigh out exactly approx. 50 g of the filler into the cup.

-Put the cup with the filler into a heating cabinet at 150°^{o}C + 3°^{o}C and leave it there for 1 hours. Cool down in desiccator.

-Weigh again and calculate the loss of weight during drying as % moisture.

-Run at least 4 parallel tests and calculate the average.

TEST-3 Wetting Properties of Sand Filler

1. Scope

This method gives relative values for the wetting properties of sand fillers. The method compares one or more sand types with a known sand type. Use the same resin for all samples, making sure temperature and viscosity are according to the procedure below.

The method can also be used for comparing wetting properties of different polyester resins, and to establish a reference base and acceptance level for local raw materials.

2- Reference

AKBOR Internal standards

3- Requirements

Max: 3,5 min.

4- Frequency and Number of Samples

For each batch

5- Apparatus

Cup with a diameter of approx. 60 mm and a depth of 6 mm (i.e. a 1/4 l tin lid).

Weight sensitive to 0,01 g

6- Procedure

-Adjust the temperature of cup, sand and polyester solution to 25 ^{o}C +/-± 1°^{o}C.

-Adjust the resin viscosity to 250 cps.

-Overfill the cup with sand and cut off the excess with a spatula.

-Place the filled cup on the weight and add 3 ± 0,1 g of the polyester solution in the centre of the cup.

-Note the time elapsed from the polyester solution is added until all the polyester solution is absorbed into the sand.

-Run 3 parallel tests and calculate the average.

TEST-4 Determination of loss on ignition of inorganic fillers

1- Scope

This method covers determination of loss on ignition of inorganic fillers like sand, quarts etc.

2- References

AKBOR Internal Standards

3- Requirements

Max: 0,5 %

4- Frequency and Number of Samples

For each batch

5- Apparatus

· Porcelain cup (d=75 mm)

· Desiccator (drying apparatus)

· Balance sensitive to 0,1 mg

· Electric muffle furnace

6- Procedure

- Make the porcelain cup free of organic material by putting it in the muffle furnace for 30 min. Cool down in a desiccator. To avoid extreme temperatures in desiccator the porcelain cup can be pre-cooled in a heating cabinet at 105oC.

- Weigh out approx. 50 g of the filler into the cup. The filler is pre-dried according to moisture content test .

- Put the cup with the filler in the muffle furnace at 610oC +/-10oC for 30 minutes. Cool down in a desiccator as described in step 1.

- Weigh again and calculate the loss of weight as loss on ignition.

- Run at least 4 parallel tests and calculates the average.

3.3 TM-03 glassfiber products Receiving Inspection Test

Hoop, chop & other glassfiber products

TEST-1 Moisture content of glass fiber products

1- Scope

This method covers determination of moisture in glass fiber products like roving and strand mats.

2- Reference

ISO 1887, ASTM D 2584

3- Requirements

Chop Max: 0.07 %

Hoop Max: 0.15 %

4- Frequency and Number of Samples

For each batch

5- Apparatus

· Porcelain cup

· Desiccator

· Balance sensitive to 0,1 mg

· Heating cabinet

6- Test Specimen

Glass fibre roving

The following table gives the quantity of roving to take as function of the linear density of the roving.

Linear density	Length of roving samples
tex	meters
50 < Tex < 200	100
200 < Tex < 500	50
500 < Tex < 1000	20
1000 < Tex < 2500	10
2500 < Tex < 5000	5

Strand mats

Each specimen shall have a mass of not less than 5 g.

7- Procedure
- Make the porcelain dry by putting it into the heating cabinet at 105 ^{o}C + 3 ^{o}C for 30 minutes. Cool it down in a desiccator.
- Weigh out exactly the specimen into the cup and put it in the heating cabinet for 3 hours. Cool down in a desiccator.
- Weigh again and calculate the loss of weight during drying as % moisture.
- Run at least 4 parallel tests and calculate the average.

TEST-2 Loss on ignition - glass fiber products

1- Scope

This test determines the loss on ignition of glass fiber roving and mats. The loss on ignition is equal to the content of size and finish on the glass fiber.

2- Reference

ISO 1172, ISO 3374, ASTM D 2584

3- Requirements

Chop Max: 1.8 %

Hoop Max: 0.75 %

4- Frequency and Number of Samples

For each batch

5- Apparatus

· Porcelain cup

· Desiccator

· Balance sensitive to 0,1 mg

· Electric muffle furnace

6- Test Specimen

Glass fiber roving
The following table gives the quantity of roving to take as a function of the linear density of the roving.

Strand mats
Each specimen shall have a mass of not less than 5 g.

7- Procedure

- Dry the specimen in a heating cabinet

- Make the porcelain cup free of organic material by putting it in the muffle furnace for 30 min. Cool down in a desiccator. To avoid extreme temperatures in dissector, the porcelain cup can be pre-cooled in a heating cabinet at 105 ^{0}C.

- Weigh out exactly the specimen into the cup and put the cup in the muffle furnace at 610°^{0}C +/- 10°^{0}C for 30 minutes. Cool down in a desiccator.

- Weigh again and calculate the loss of weight as loss on ignition.

- Run at least 4 parallel tests of each glass type.

3.4 TM-04 gasket/stopper hardness

1- Scope

This test method specifies a method for the determination of the indentation hardness of elastomeric products (gasket, center register, hydrotester seals etc.)

2- Reference

ISO 7619 (1997) Rubber- Determination of indentation hardness by means of pocket hardness meters.

En 681-1 elastomeric seals –materials requirements for pipe joint seals used in the water and drainage
Applications

3- Requirements

Gasket: 55 +/- 5 Shore A

Stopper: 80 +/- 5 shore a

4- Frequency and Number of Samples

For each batch

5- Apparatus

Shore-type durometer: Type A (Shoremeter)

6- Test Specimen

1- For the determination of hardness by pocket hardness meters, the thickness of the piece shall be at least 6 mm.

For sheets thinner than 6 mm, a test piece may be composed of not more than three layers, none of which shall be than 2 mm, to obtain the necessary thickness, but determinations made on such test pieces may not agree with those made on single-thickness pieces.

2- Place the test piece on a hard, rigid surface. Hold the hardness meter in position with the centre of the indentor at least 12 mm from the edges of the test piece. Apply the pressure foot to the test piece as rapidly as possible, keeping the foot parallel to the surface of the test piece and ensuring that the indentor is normal to the rubber surface.

Apply just sufficient force to obtain firm contact between the pressure foot and the test piece. Unless otherwise specified, take the reading within 1 s after the pressure foot is in firm contact with the test piece. When a reading after another time-interval is specified, hold the pressure foot in contact with the test piece without change in position and pressure and take the reading after the specified time.

3- Make five measurements of hardness at different positions on the test piece at least 6 mm apart and determine the mean value.

3.5 TM-05 gasket/stopper dimensional control

1- Scope

This method specifies the method of gasket and stopper dimensional check.

2- Reference

Internal Standard

3- Requirements

For Gasket:

Property	**Dimension**	**EPDM**
Profile tolerance	mm	±0,5
Length tolerance	%	± 1.0%
Weight tolerance	%	± 1,5%

For Stopper:

Property	**Dimension**	**Specification**
Profile tolerance	mm	±4
Length tolerance	%	± 1

4- Frequency and Number of Samples

For each batch

5- Apparatus

· Calliper accurate to within 0.1 mm

· Meter Tape +/- 1 mm

· Angle measurement device +/- 0.5 degree

6- Procedure

- To measure the length of gasket/stopper, cut the gasket/stopper and place it to straight and rigid plate longitudinally.
- Fix the tape meter from one end of sample and directly measure the length from the other end.
- Use calliper to measure the profile dimensions for gasket/stopper.
- Use the angle measuring device to measure the angular dimension for gasket/stopper or angular value of the quality report from supplier can be referred for income tests.
- Make all the measurements twice and write them to the related forms.

4 Visual inspection

4.1 TM-06 visual inspection of pipe and couplings

1- Scope

This test method specifies a method for the visual inspection of pipe and coupling products.

2- Reference

ASTM D 3754

3- Requirements

For all products: Each product shall be free from all defects including indentations, delaminations, bubbles, pinholes, cracks, pits, blisters, foreign inclusions and resin-starved areas due to their nature, degree or extent detrimentally affect the strength and serviceability of the pipe.

4- Frequency and Number of Samples

All products shall be tested.

5- Procedure

Visual Inspection - Inner/Outer Surface of Pipe

Look at inner/outer surface and both ends of pipe/coupling pipe carefully. Control if there is any nonconformity causes by process, impact, transport etc.

If it's OK;

-Mark OK box at related form for pipe,

-Write OK and sign at the Q/C inspector box at related form for coupling pipe,

-If there is any nonconformity that can be corrected by repairing for pipe, write repair request and repair code and control after repairing,

-There is no need to repair for coupling pipe inner surface as the coupling pipe will be milled at coupling milling machine.

Visual inspection – Coupling Inner /Outer Surface and Grooves

Look at inner surface and both ends of coupling carefully. Control if there is any nonconformity causes by process, impact, transport, milling etc.

If it is OK, mark and sign Q/C Visual Inspection OK box at related form

5 Dimensional control

5.1 TM-07 pipe id (inner diameter) control

1- Scope

This test method specifies a method for the measurement of Pipe/Coupling ID

2- References

ASTM D 3567 ASTM D 3754

3- Requirements

Dependent on pipe type

4- Frequency and Number of Samples

For each pipe

5- Apparatus

Inner Micrometer

6- Procedure

- Adjust the ID micrometer according to ID needed.

- Measure the ID from six different points by 60º^{o} angles.

- Calculate the average of six measurements and write all the measurement made to the FPR-01/06_ADP

5.2 TM-08 pipe od (outer diameter) control

1- Scope

This test method specifies a method for the measurement of Pipe/Coupling OD

2- References

ASTM D 3567 ASTM D 3754

3- Requirements

Dependent on pipe type

4- Frequency and Number of Samples

For each pipe

5- Apparatus

▪-Tape

6- Procedure

- Choose the correct ▪-Tape to measure accordance with OD needed
- Measure the OD from pipe ends and take care of placement of ▪-Tape to right measurement.

- Write values measured to related form

5.3 TM-09 wall thickness control

1- Scope

This test method specifies a method for the measurement of Pipe/Coupling thickness.

2- References

ASTM D 3567

3- Requirements

Dependent on pipe type

4- Frequency and Number of Samples

For each pipe

5- Apparatus

-Calliper

-Micrometer

-Thickness Calliper

For this test method; calliper, micrometer, thickness calliper can be used for measurement of thickness.

6- Procedure

1- When micrometer is used, get into tips of micrometer to the inside of pipe.

2- After ensuring " the tips are parallel", tight the micrometer bolt and read value.

3- When calliper is used, get into tipps of calliper to the inside of pipe.

4- When the tips are parallel, read the value.

5- Apply 3- and 4- when the thickness callipper is used.

6- Make measurements six times (6 x 60°) for each pipe and write the values to related form.

5.4 TM-10 Chamfering and Calibration-DOS Control of Pipe

1- Scope

This test method specifies a method for pipe chamfering and calibration control.

2- References

Internal Standard

3- Requirements

DOS and chamfering parameters shall meet AKBOR internal requirements.

4- Frequency and Number of Samples

For each pipe

5- Apparatus

··-Tape
Calliper

6- Procedure

- To check the OD after calibration (DOS)
- Use calliper to measure chamfering parameters.
- For each pipe ends , make 6 x 60° measurements and calculate average.
- Write the values calculated to related form.

5.5 TM-11 Length Control

1- Scope

This test method specifies a method for pipe/coupling length control

2- References

ASTM D 3754

3- Requirements

12000 +/- 25 (mm)

4- Frequency and Number of Samples

For each pipe

5- Apparatus

Tape (20 m & 5m)

6- Procedure

-Pipe Length Control: Use 20 meter tape to measure pipe length. Fix the tape at one end of pipe.
Tighthen the tape and fix at the other end. Read Value write to related form.

- Coupling Length Control: Use 5 meter tape to measure coupling length. Fix the tape at one end of coupling. Tighthen the tape and fix at the other end. Read Value write to related form.

5.6 TM-12 measurement of coupling grooves

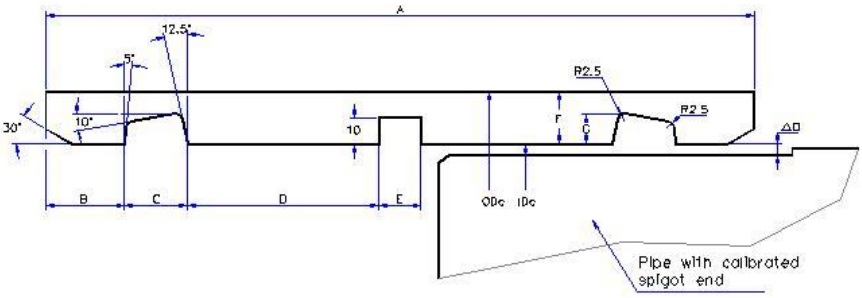
1- Scope

This test method specifies the measurement of coupling grooves

2- References

Internal Standard

3- Requirements



Diameters >= 600 mm

A 330 +3/-3
B 40 +1/-1
C 34 +1/-0.5
D 83 +1/-1
E 16 +1/-0.5
G 14,5 +0.5/-0.5

4- Frequency and Number of Samples

For each coupling

5- Apparatus

Calliper

6- Procedure

Measure for coupling

- Depth of both gasket channel
- Width of both gasket channel
- Depth of stopper channel
- Width of stopper channel

6 Technical parameters

6.1 TM-13 Ring stiffness

1- Scope

This test determines the initial stiffness of a pipe using a parallel-plate loading device at a short length of pipe. This method also covers the ring deflection properties
2- References

ASTM D 2412, EN 1228, ISO 7685

3- Requirements

Standard Stiffness classes 2500,5000,10000 (Pa), But it is possible to produce according to customer requirements

4- Frequency and Number of Samples

One per day or one per 50 pipes (whichever comes first)

5- Apparatus

Parallel-plate loading stiffness tester (STIS tester)

6- Test Specimen

Test specimens shall be cut from the pipe to be tested. The test specimen length shall be 300 mm.
Permissible deviation is +/- 15 mm (5%). The ends of specimens shall be cut square and shall be free of burrs and jagged edges. ISO 7685 requires the specimen to be conditioned 0.5 h at the test temperature prior to testing.

7- Procedure

- Measure the thickness at 6 places 60° apart along the circumference (± 0.2 mm) on both sides of the pipe. Calculate the average thickness of these 12 measurements.
- Measure the inner (or external) diameter with an accuracy of 0.5 mm. The mean diameter to be used in the STIS calculations is equal to inner diameter + pipe thickness (or, alternatively: external diameter
- pipe thickness). If measuring the diameter with a pair of callipers, take 6 measurements 60° apart and calculate the average. Enter the mean diameter on the STIS tester terminal.

- Measure the average pipe ring length (± 0.2 mm, 6 places 60° apart) and enter it on the STIS tester
terminal.
- The specimen is placed in the testing equipment with the two parallel plates aligned 180° apart. ISO
7685 specifies a deflection of (3 +/- 0.5)% of the mean diameter.

- Enter 3% as Max. deflection on the STIS tester display. Lower the top plate to just touch the pipe and reset the display to zero load and zero deflection. To compensate for the inherent slack in the STIS tester and the uneven pipe surface (see note 2), compress the pipe sample 1% of the mean diameter.
For pipes DN300-500 deflection-measurement must be done using a micrometer, record the inner diameter of the pipe.
- On the STIS tester terminal, reset to zero deflection and zero load. This is important before deflecting the sample the additional 3 % for measuring the STIS.

- Apply compression to the specimen at a constant rate and observe the deflection measurements.
Cease applying the compression force when the required deflection is reached. ISO 7685 specifies 60 +/- 10 sec to reach the specified 3% deflection
- Allow the test specimen to stabilise at the maximum deflection for 2 minutes. Read the STIS, the maximum force and the deflection at maximum force .
- For the tests where the STIS value is within 5% of specified, the test needs to be carried out two more times on the sample. The test shall be done on locations evenly distributed around it's circumference
(60° and 120° from the first location). Calculate the average of the three values to obtain the STIS of the test sample.

STIS Calculation
Standard Tangential Initial Stiffness

Calculate the Standard Tangential Initial Stiffness (STIS) from the formula below:

STIS= (f x F)/(L x y)

The STIS is expressed in N/m².
F = force (N) used to give the test specimen a deflection of 2.5 - 3.5 %, based on mean diameter.
F = deflection coefficient (see below).
L = average ring length (m)
y = deflection (in meters) of the ring at maximum force

The deflection coefficient can be calculated from the formula:

f= 0,0186 + [(0,025 x y)/D]

D = mean diameter of the ring (m)

The STIS is explained by the formula:

STIS = E x I / D^3

Modulus of elasticity

Calculate the modulus of elasticity from the formula below using data from stiffness test:

ESTIS = STIS x 12 x D^3 / t^3

STIS = The calculated STIS value from the test (N/m²)
D = mean diameter of the ring (m)
L = average ring length (m)
t = average thickness of the pipe (m)

6.2 TM-14 Failure and delamination control at deflected position

1- Scope

This test method specifies method of pipe inspection under deflection.

2- References

ASTM D 2412, ASTM D 3754, ASTM D 3517

3- Requirements

No crack and No delamination

4- Frequency and Number of Samples

One per day or one per 50 pipes (whichever comes first)

5- Apparatus

STIS tester

6- Procedure

To determine the full laminate hoop load capacity, the test ring is to be tested according to certain deflection levels. The test ring is deflected according to the table enclosed, and has to meet the listed specifications.

Level A:

When deflected to this ratio the test ring shall have no surface cracks. The surface cracks will appear in areas with the highest strains - 6 and 12 o'clock at the inner surface, 3 and 9 o'clock at the outer surface.

The surface cracks will be visible to an unaided eye, but a penetrating liquid may be used.

The test ring shall not have any delamination.

Level B:

When deflected to this ratio the test ring shall have no failure. Failure is defined as structural failures as delamination and rupture. Cracks in the surface is not failure.

Stiffness psi (kpa)	9(62)	18(124)	36(248)	72(496)
Stiffness N/m2	1250	2500	5000	10000
Level A	%18	%15	%12	%9
Level B	%30	%25	%20	%15

Calculation for non-standard STIS values.

According to ISO 7685

Force to be applied in theory can be calculated as

STIS = (f x F) / (L x y)

F = (L x y x STIS)/f

Where

f is the deflection coefficient, given by the equation,

$f = [1860 + (2500 \times y/dm)] \times 10^{-5}$

L is the average length of the test piece, expressed in meters;

F is the applied load, expressed in newtons;

y is the deflection, expressed in meters;

dm is the mean diameter, expressed in meters.

After calculating F from this equation, according to ASTM D 2412 Pipe Stiffness (PS) is calculated as follows

PS = (F) /(L x y)

PS is expressed Pa

According to ASTM D 3517 Level A and Level B can be calculated.

Convert PS value from Pa to psi.

% Level A = (72 / PS) 0.33 x 9

% Level B = % Level A / 0.6

6.3 TM-15 longitudinal tensile strength test

1- Scope

This method covers determination of tensile strength of laminates made on filament winding machines or cut-outs from spray up laminates and hand lay-ups.

2- References

ASTM D 638, ISO 527

3- Requirements

Minimum Longitudinal Tensile Strength (kN/m) Ref:ASTM D 3754

From 300 to 2400 1,6,10,12,16,20,25,32 2500-5000-10000 See attached list of Longitudinal Tensile Strength

4- Frequency and Number of Samples

One per day or one per 50 pipes (whichever comes first)

5- Apparatus

Test machine - Universal test machine
Micrometer suitable for measuring the dimensions within +/- 0.01 mm

6- Test Specimen

The width of the test specimen shall be 25 mm as standard. The width of the specimen may be reduced if the laminate is so thick that the tensile force is out of range of the test machine.

The number of test pieces shall be at least five. When testing spray-up laminates or hand lay-ups, test pieces shall be cut out from the two main directions, lengthways and crosswise. At least five test pieces from each direction shall be tested. Length of test specimens shall be 300mm. Other test pieces may be used, but shall be remarked in test report.

7- Procedure

Preparation
The testing equipment shall be set to the suitable range for the specific type of test specimen, and according to operation manual for the testing equipment. The distance between the grips shall be 170 mm. Fix test specimen in the grips, aligned to prevent oblique tension. The testing speed should be set to 10 mm/min.

Result
-Read the maximum tensile force at rupture.
-Measure the average width and average thickness of the test specimen nearest possible to the rupture. -
-Note that the dimensions of the test specimen may have changed due to fibre pull-out.

Calculate the tensile strength from the formula below

Longitudinal Tensile Strength (Mpa) = F / (b x h)
F=maximum force in Newton
b = width of the test specimen in mm
h = mean thickness of the test specimen in mm
Those specimens that break within 10 mm from the grips shall not be considered as valid. New specimens shall in these cased be tested.

6.4 TM-16 circumferential tensile strength test

1- Scope

Split Disk Method: This method covers determination of hoop tensile properties (circumferential
strength). The test specimen is a ring 20 mm wide cut out from a pipe. The test procedure is adapted to split disc hydraulic equipment.

Coupon Method: For this test method, ring samples are cut from the pipe and notched. The samples are tested as coupons placed directly in the grips of a standard tensile testing machine.

This coupon test method is applicable for all pipes larger than DN600, and gives the best tolerance of measurement compared to the Split Disk method.

2- Reference

ASTM D 2290, (also EN1394, test report)

3- Requirements
Minimum Hoop Tensile Strength, Ref:ASTM D 3754 (kN/m)

From 300 to 2400 1,6,10,12,16,20,25,32 2500, 5000, 10000 See attached list of Hoop Tensile Strength

4- Frequency and Number of Samples

One per day or one per 50 pipes (whichever comes first)

5- Apparatus

Test machine
Micrometer suitable for measuring the dimensions within +/- 0.01 mm

6- Test Specimen

Cut out sample from the cylinder to be tested. The samples shall be cut in the circumference, perpendicular to the cylinder axis with a uniform width of 20 mm.

The test ring shall be machined with two reduced cross-sections located at the point of minimum wall thickness and at 180°.The reduced cross-section shall have a width of 10 mm (notches are 10 mm in radius).

- Select a testing speed of 10 mm/min and start the machine (so that rupture can be reached between 1 min and 3 min after initial loading).

- Record the ultimate load carried by the specimen and the time to failure.

Calculation

Calculate the apparent tensile strength from this formula:

・ = F / 2 x w

・ = apparent tensile strength expressed in N/mm
F = load in N
w = ring width in mm (w is measured in the reduced cross-section)

Coupon Method

Test Specimen
Cut out five samples from the pipe to be tested. The samples shall be cut in the circumferential direction, perpendicular to the axis of the pipe. The samples shall be cut 20 mm wide.
The test coupon shall be an arc (part of a pipe ring) of length 150 mm and shall be machined with a reduced cross section at mid length. The reduced section shall have a width according to table 1 and shall be formed by two 10 mm diameter holes

Procedure

- Measure the width at the reduced section of the test specimen (+/- 0.1 mm). Use the average of outside and inside measurements.
- Load the test specimen in the jaws of the testing machine so that the sample is gripped across its width i.e. across the 20 mm dimension It is important that the faces of the test specimen in contact with the grips shall be smooth and perpendicular to the axis of the pipe.
- To prevent shear failure, the sample shall be gripped in the jaws of the machine so that the distance between the grips is 15・5 mm (Lg). The total sample length of the test specimen shall be adjusted to suit the grip arrangement.
- Test the specimen at a speed of 5 mm/min and record the ultimate load carried by the test specimen.
- After failure, inspect the test specimen and check that cracking occurred at the reduced section and in a direction perpendicular to the applied load.

In the event of failure occurring by delamination without rupture in the reduced cross section or by grip crushing of the specimen, repeat the test using specimens made with a reduced section width of 5 mm

7-Procedure

- Measure the width of the test specimen at the location of the reduced cross-section (± 0.1 mm). Use the average of outside and inside measurements.

- Place the test ring in the test fixture with the reduced cross-section approximately 10° away from the split in the fixture.
- Lubricate the inside of the ring to avoid friction between the test ring and the fixture.

6.5 TM-17 surface hardness

1- Scope

This method covers determination of reinforced and non-reinforced rigid plastics using a Barcol impressor (type 934-1).

2- Reference

ASTM D 2583

3- Requirements

Min. 40 Barcol

4- Frequency and Number of Samples

For all pipe

5- Apparatus

The apparatus used for this test is an Barber-Coleman indentor with calibration alloy discs supplied by the manufacturer.

6- Test Specimen

The test specimen can be a pipe or a section from the products. Test specimens shall be large enough to ensure a minimum distance of 3 mm in any direction from the indentor point to the edge of the specimen. Test specimen shall be free from mechanical damage.

7- Test preparation

The indentor shall be calibrated using the supplied alloy discs. The indentor must be placed perpendicular to the test specimen on a solidly supported surface.

8- Procedure

Set the point sleeve on the surface to be tested. Grasp the instrument firmly between the legs and point sleeve. Apply quickly by hand, increasing force on the case until the dial reaches a maximum value.
Read the maximum value.
Because of variations caused by difference in hardness between resin and filler materials in contact with the indentor, the reported value shall be the average of 6 readings. (For each pipe ends 3 x 120°)

6.6 TM-18 pipe leak tightness

1- Scope
This method covers the determination of the behaviours of pipe under the hydro-pressure.

2- Reference
ASTM D 3754

3- Requirements
No leaking , weaping or fracture of structural wall at 2 times of nominal pressure

4- Frequency and Number of Samples
for all pipe

7- Procedure
Place the pipe in a hydrostatic pressure testing machine that seals ends and exerts no end loads.
Fill the pipe with water after deaeration.
Apply to pipe 2 times of PN
Maintain this pressure minimum 30 sec.
Make the visual inspection " Is there nonconformity – leaking, weaping or fracture of structural wall.

6.7 TM-19 coupling leaktightness

1- Scope
This method covers the determination of the behaviours of coupling under the hydro-pressure.

2- Reference
ASTM D 3754

3- Requirements
No leaking , weaping or fracture of structural wall at 2 times of nominal pressure

4- Frequency and Number of Samples for all coupling

7- Procedure
Place the coupling in a hydrostatic pressure testing machine that seals ends and exerts no end loads.
Fill the coupling with water after deaeration.
Apply to the coupling 2 times of PN
Maintain this pressure minimum 30 sec.
Make the visual inspection " Is there nonconformity – leaking, weaping or fracture of structural wall –

6.8 TM-20 raw material composition test

1- Scope

This method covers determination of composition of laminates as to resin, glass fiber and filler content.

2- References

ASTM D 2584

3- Requirements
Dependent on pipe type
4- Frequency and Number of Samples

One per day or one per 50 pipes (whichever comes first)

5- Apparatus
Porcelain cup (dia 75 mm)
Balance with an accuracy of 0,1 mg
Electric muffle furnace
Sieve - Mesh 30

6- Procedure

- Cut out 5 test specimens from the laminate in axial direction. Each specimen should be 40 x 40 mm.
The edges of the cuts should be smooth and free of dust.

- Weigh each specimen separately in a porcelain cup. Note also the weight of the empty cup.
- Ignite the specimens as follows: Muffle furnace temperature: 610 +/- 10°. Place 2 samples in the muffle furnace (only one sample at the time if the laminate thickness is more than 6 mm), and leave it there until the flame ceases. Then remove the samples and put in another 2 samples. At last the 5th sample is placed in the furnace together with the 4 already burned out samples.
Leave all samples in the furnace for 30 min. (45 min. if the laminate thickness is more than 6 mm).
- Remove the samples from the furnace and place them on an asbestos plate at room temperature for cooling.
-. Weigh each cup with residue.
- Separate the sand from the glass fiber by tapping the residue on a sheet of paper.
- Separate the small pieces of chop roving from the sand by sieving it.
- Separate the hoop roving from the chop roving by using a pair of tweezers.
- Weigh each material.
- As a check, calculate the sum of each material's weight plus the weight of the cup and see that it equals the weight of residue + cup from step 6.

Calculation
P = (m2 - m 3 / m2 - m1) x 100
GH = (m4 - m1 / m2 - m1) x 100
GC = (m5 - m1 / m2 - m1) x 100
S = (m6 - m1 / m2 - m1) x 100

Check that the sum of percentages is 100.

If the sum is less than 99% or more than 101%, check weights and calculations. If the error is not found, conduct the test again.

P = % polyester resin
GH = % hoop roving
GC = % chop roving
S = % sand
m1 = mass of porcelain cup
m2 = initial total mass of cup plus specimen
m3 = mass of cup, hoop roving, chop roving and sand
m4 = mass of cup and hoop roving
m5 = mass of cup, chop roving and glass surface mat
m6 = mass of cup and sand

7 Tests Forms

7.1 Polyester Resin

7.2 Silica Sand

7.3 Glassfiber Hoop Roving

7.4 Glassfiber Chop Roving

7.5 EPDM Gasket

7.6 Stiffness, Behaviour Under Deflection, Hardness Circumferential Strength Test Sheet

7.7 Tensile Strength

7.8 Quality Control

7.9 Process Material Tracking