

HUITEX[®] Geomembrane

Manufacturing Quality Control & Quality Assurance Manual

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1 · Introduction

HuiKwang Corporation (HKC) has been serving the world since 1965. We understand environmental management is an important issue; therefore, we dedicate ourselves to manufacture the highest quality geomembrane to meet the requirements of lining application and to protect the environment of the world.

This manual provides HKC's manufacturing quality assurance policies and procedures. We suggest you to maintain contact with your HKC representative or our quality assurance staff to confirm the validity of this manual. HKC reserves the right to change the content herein without notice.

2 · HKC's Quality Manifest

The objective of HKC quality assurance policy is to provide the highest quality products and services to satisfy customers' requirements.

HKC is dedicated to the continuous quality commitment, and the quality program covers from the highest quality and meeting the HKC's specification raw material receipt, geomembrane manufacturing and superior product supply to customer satisfaction.

3 · Manufacturing Quality Assurance Overview

A strict quality assurance program is established to achieve the above statement. All the procedures of the program are carried out effectively, and the frequent review and adjustment are implemented to meet the application requirement and the improvement demands.

The Manufacturing Quality Assurance organization consists of quality control professionals in the lab and technicians on manufacturing site. The Quality Assurance Department is charged by the President to assure that only products meeting both HKC's and the customer's requirements are released for shipment. The Quality Assurance personnel are directly responsible for monitoring testing and providing feedback to the manufacturing department to ensure the production of the specified product quality. All staff are well trained. Regular training and meetings are held to ensure staff having the up-to-date quality control information.

We use, and only use the raw materials with highest quality. All manufacturing facilities are state-of-the-art and maintained carefully and regularly.

The Quality Control Laboratory of HKC is capably equipped to perform a wide range of conformance testing on geomembrane products.

All laboratory instruments are checked and calibrated regularly to ensure precise operating conditions.

4 · Manufacturing Quality Control and Quality Assurance Program

4.1 Raw Material

4.1.1 Two types of raw materials, natural resin and masterbatch of the concentrated carbon black along with the other additives, are used for the manufacturing of Geomembrane.

4.1.2 Natural resin is the main material of the geomembrane products. The raw material suppliers provide the certificate of analysis (COA) to confirm that the material meets the HKC's specification requirement.

The certificate shows the following properties:

- Density
- Melt Index
- Carbon Black Content (only the carbon black materbatch)

4.1.3 Masterbatch contains carbon black, stabilizer, anti-oxidant, and UV-absorber, and is mixed with the natural resin at an appropriate proportion during the manufacturing.

4.1.4 When the raw material is received, samples are taken and sent to the laboratory to verify the properties. The raw material shall not be accepted except all testing results meet the HKC's and customer's specification.

4.1.5 Testing frequency for the natural resin:

Property	Test Method	Testing Frequency
Density	ASTM D792	Each Lot
Melt Index	ASTM D1238(190°C;5.00Kg)	

4.1.6 Testing frequency for the masterbatch:

Property	Test Method	Testing Frequency
Density	ASTM D792	Each Lot
Carbon Black Content	ASTM D1603	

4.1.7 Minimum properties for the raw materials:

Property	HDPE	LLDPE	Masterbatch of Carbon Black
Density, g/cm ³	≥0.932	≤0.926	≥1.0
Melt Index, g/ 10 min.(5kg)	< 1.0	< 2.0	—
Carbon Black Content, %	—	—	32~60

4.1.8 If all the test results of raw material meet the HKC's specification, the resin is normally pumped into the silo, the masterbatch is stored in stock room to prevented damage or deterioration, the raw material doesn't meet the HKC's specification shall be reject.

4.2 Geomembrane Products

4.2.1 Manufacturing Process and Quality Control

Geomembrane products are produced by the continuous co-extrusion blown film process with the state-of-art three layers blown film extruder. The nature resin and masterbatch are fed and mixed above the hopper automatically according to the setting ratio to maintain a consistency in products according to the formulation.

An IBC (Internal Bubble Cooling) system is used to maintain consistent bubble diameter, and before winding, the sheet products pass through a calender system with hot roller heated by oil to eliminate the waving.

All the process conditions have been optimized and controlled precisely throughout the entire production.

If the operating parameter exceeds the permitted range, the products manufactured must be hold until the process is under control. Further inspection and test are required for these products. If all the testing results pass the specification, products will be released to stock, or they will be discarded.

4.2.2 On-line Quality Assurance

The geomembrane products are continuously monitored by visual inspection (for the holes, spots, scratches, etc.) and dimensional measurement (thickness, width, length, etc.) during manufacturing. Products will be discarded if any defect failed to meet the HKC's specification requirement is found. Thickness of each roll shall be measured with gauge at least 45 points along the 7m width. All the on-line test data are reviewed by quality control manager to confirm if they meet the HKC's specification.

4.2.3 Product Identification and Labeling

After a roll has been manufactured, it must be assigned a unique roll number, labeling with self adhesive stickers, and retained for a final product testing.

The label identifies:

- | |
|---------------------------|
| A. Product identification |
| B. Roll number |
| C. Thickness |
| D. Length |
| E. Width |
| F. Weight |

4.2.4 Storage and Shipment

The storage area must be flat and free of sharp objects that could damage the products. The document shall be verified against the information on the roll label before loading for shipment. The machine used to lift or move the products shall not damage the roll.

Two fabric straps are attached to the roll for unloading at the site. When the products are shipped, the Quality Assurance Department records the labels for Certificate of Analysis.

4.3 The Final Product Testing

4.3.1 The laboratory test samples are cut at least 700cm (width) × 40 cm (length) following the quality assurance program from the production line. 5 pieces of small samples, 30 cm × 30 cm in size, are taken from the cut sample across the width (7m) of the roll for the specimen preparation. Machine direction and transverse direction specimens need to be prepared from each sample.

4.3.2 The following tests are performed on geomembrane product as the standard quality testing of Huitex

Properties	Test Method	Minimum Test Frequency
Appearance Smooth Products : No holes, spots, scratches and surface defects. Textured Products : With uniform texturing appearance, no holes, free from agglomerated texturing material.	Visual determination	per roll
Thickness For Smooth Products(200kPa) For Textured products(0.56N)	ASTM D5199 ASTM D5994	per roll per roll
Density	ASTM D792	per 20,000 kg
Asperity Height	ASTM D7466	every second roll
Width & Length		per roll
Melt Flow Rate(190°C,5 kg)	ASTM D1238	per 60,000 kg
Tensile Properties Yield Strength Yield Elongation(gage length for yield:33mm) Break Strength Break Elongation(gage length for break:50mm)	ASTM D6693 Type IV Specimen (50mm/min)	per 9,000 kg
2% Modulus(only LLDPE products)	ASTM D5323	per formulation
Axi-Symmetric Break Resistance(only LLDPE products)	ASTM D5617	per formulation
Tear Resistance	ASTM D1004	per 20,000 kg
Puncture Resistance	ASTM D4833	per 20,000 kg
Dimensional Stability	ASTM D1204(100°C, 1 hour)	per formulation
Carbon Black Content(600°C,N₂,1.7L/min)	ASTM D1603	per 9,000 kg
Carbon Black Dispersion	ASTM D5596/3015	per 20,000 kg
std-OIT(200°C,1atm,O₂)	ASTM D3895	per 90,000 kg
Environment stress crack Resistance	ASTM D5397 (App.)	per formulation

4.3.3 All the specimens are cut by die to ensure uniformity, specimens that don't meet the requirement are rejected.

4.3.4 When the test is completed, and all the results meet the specification requirement, the data will be reviewed by the quality control manager, and filed in database to be used for the product certificate.

4.3.5 Non-Conformance

If the product doesn't meet the HKC's specifications or customer's requirements, the product shall be discarded, can't be released to storage or shipment.

The quality control manager of the independent quality control department is charged to assure the final products meet the HKC's specification and customer's requirement.

4.3.6 Test Reports

The raw material and geomembrane product test reports are maintained according to the program at least 10 years in the quality assurance laboratory.

5. Reference Test Methods

5.1 American Society for Testing Material (ASTM)

ASTM D638	Test Method for Tensile Properties of Plastics
ASTM D792	Specific Gravity (Relative Density) and Density of Plastic by Displacement
ASTM D1004	Test Method for Initial Tear Resistance of Plastics Film and Sheeting
ASTM D1238	Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D1434	Standard test method for determining gas permeability characteristics of plastic film and sheeting
ASTM D1505	Test Method for Density of Plastics by Density-Gradient Technique
ASTM D1603	Test Method for Carbon Black in Olefin Plastics
ASTM D1693	Test Method for Environmental Stress-Cracking of Ethylene Plastics
ASTM D3015	Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds
ASTM D3895	Test Method for Oxidative Induction Time of Polyolefins by Differential Scanning Calorimetry
ASTM D4833	Test Method for Index Puncture Resistance of Geotextiles, Geomembrane and Related Products
ASTM D5199	Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
ASTM D5323	Practice for Determination of 2% Secant Modulus for Polyethylene Geomembranes
ASTM D5397	Test Method for Evaluation of Stress Crack of Polyolefin Geomembranes Using Notched Constant Tensile Load Test Appendix: Procedure to Perform a Single Point Notched Constant Tensile Load (SP-NCTL) Test
ASTM D5596	Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
ASTM D5617	Test Method for Multi-Axial Tension Test for Geosynthetics
ASTM D5721	Practice for Air-Oven Aging of Polyolefin Geomembranes
ASTM D5895	Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
ASTM D6693	Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembrane

5.2 Geosynthetic Research Institute (GRI)

GM10	The Stress Crack Resistance of HDPE Geomembrane Sheet
GM11	Accelerated Weathering of Geomembranes Using a Fluorescent UVA Device
GM12	Asperity Measurement of Textured Geomembranes Using a Depth Gage
GM13	Test Properties, Test Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Geomembranes
GM17	Test Properties, Test Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes