EB603 UNDERSTANDING TYPICAL VALUES, MARV & MVS

BACKGROUND

Much confusion still exists on the significance and statistical definitions of the terms "Minimum Average Roll Value" (MARV), "Typical Value", and "Minimum Value" (MV). Since geosynthetics are engineering materials, it is imperative that the terminology defining property values and how it applies to design and specification is clearly understood.

This engineering bulletin will help engineers, distributors, contractors, and owners in the geosynthetic industry understand these terms and their significance to the design and specification process. Additionally, since all Propex geosynthetics are manufactured according to the following definitions, this engineering bulletin will provide a greater understanding for how these terms apply to Propex products.

RELEVANCE TO MANUFACTURING QUALITY CONTROL (MQC)

All manufacturing processes inherently contain variation, to some extent or another. Additionally, all test methods used to quantify material properties further contribute to the variability. To properly account for this variation and accurately represent the material characteristics of these products, most manufacturers of geosynthetics publish properties as "MARV", "Typical", or "MV" values. These terms are defined in American Society for Testing and Materials (ASTM) D-4439, "Standard Terminology for Geosynthetics".

When a manufacturer develops a new product, a sufficient quantity of the material must be produced and tested to determine basic material properties and evaluate variation. Once a sufficient quantity of material is produced, the property MARVs, Typical Values, and MVs can be determined using simple statistics.

For example, say we are interested in determining the MARV, MV, and Typical Value for the grab tensile strength of a specific style of geotextile. All of the grab tensile strength test results for the production period under consideration are compiled and analyzed. The data is arranged on a frequency distribution plot (e.g. a histogram) and analyzed with standard statistical approaches. Figure 1 shows a histogram for grab tensile strength data from an example product, Propex's Geotex® 601 nonwoven geotextile. This data is considered "normally distributed".

As defined in ASTM D-4439, the MARV yields a 97.7 percentage

degree of confidence that any samples taken from quality assurance testing will exceed the value reported. For normally distributed data the MARV can be determined by subtracting two times the standard deviation from the average or Typical value. In the data in Figure 1 the MARV is 160 pounds.

The Typical Value is defined in ASTM D-4439 as the average or arithmetic mean of all historic test data points. On Figure 1, the Typical Value is 180 pounds.

Histogram Showing MARV and Typical Data
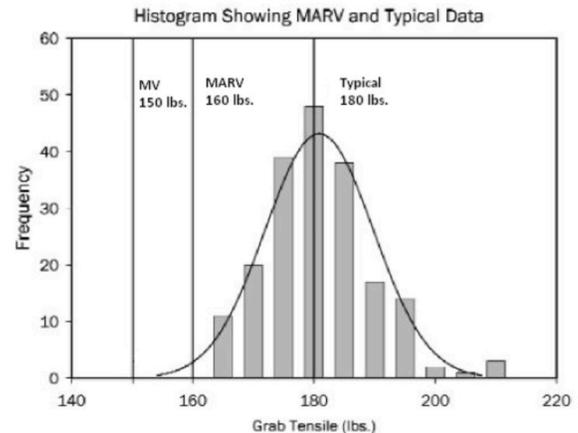
ULTRAVIOLET LIGHT DEGRADATION OF GEOTEXTILES

As defined in ASTM D-4439, the MARV yields a 97.7 percentage degree of confidence that any samples taken from quality assurance testing will exceed the value reported. For normally distributed data the MARV can be determined by subtracting two times the standard deviation from the average or Typical value. In the data in Figure 1 the MARV is 160 pounds.

The MV, as defined in ASTM D-4439, yields a 99.9 percentage degree of confidence that any sample taken from quality assurance testing will exceed the value reported. For normally distributed data the MV can be determined by subtracting three standard deviations from the average or Typical value. In the data in Figure 1 the MV is 150 pounds.

Once the MARVs, Typicals, and MVs are established and published, the manufacturer, through its standard manufacturing quality control program (MQC) continues to monitor, quantify, and document the properties of the geotextile to assure that the material stays within the

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published values. This is done by testing a specific frequency determined by the variability of the product and/or process and making process adjustments on-line when necessary.

MARV is the United States industry standard for published properties of geotextiles. The AASHTO and many other speci cations state their requirements in terms of MARV. The definition of MARV in ASTM D-4439 notes that the definition applies to strength properties but may not apply to properties such as apparent opening size, permittivity, and Ultraviolet (UV) stability. MARV is relevant to the manufacturer's quality control program and should not be calculated for a limited volume such as a truck load.

QUALITY ASSURANCE (QA) / CONFORMANCE RELEVANCE

Now that we have learned how these terms are applied by manufacturers, let's consider how they can be properly verified through conformance or quality assurance testing.

EXAMPLE ONE

Let's take a project site where a truckload of 175 rolls of the same style geotextile have been delivered. Although defined differently by each manufacturer, these 175 rolls constitute a single lot of material in this example. It is required in the project specifications that the Construction Quality Assurance (CQA) rm verify the delivered product is in conformance with the project specifications. One of the requirements of the project specifications is as follows:

Grab Tensile Strength ASTM D-4632, "Standard Test Method for Grab Breaking Load and Elongation of Geotextiles" of 160 lbs (MARV)

To properly determine if the delivered materials are in conformance with the specification the CQA representative refers to ASTM D-4354, "Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products (RECPs) for Testing". The first table in ASTM D-4354 indicates a sample, a full roll width by 3ft long, needs to be taken from a minimum of six (6) randomly selected rolls. These samples are then sent to a Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP) accredited testing laboratory. At the lab, ten (10) specimens are taken from each sample and tested as per ASTM D-4632. The data in Error! Reference source not found. is generated. In conformance with ASTM D-4759," Standard Practice for Determining the Specification Conformance of Geosynthetics", the ten (10) test results from the ten (10) test specimens from each sample are averaged, giving an average sample (e.g. average roll) value. The lowest of these average roll values

is 161 lbs. The 161 lbs is greater than the required project specification value of 160 lbs. Therefore, the entire truckload is acceptable.

Specimen	Sample (Roll) #					
	1	2	3	4	5	6
1	162	170	175	127	175	173
2	165	161	165	165	165	180
3	167	155	178	183	174	168
4	168	162	180	159	165	189
5	178	161	172	168	178	167
6	170	159	168	170	159	165
7	158	165	175	158	181	170
8	163	158	162	168	172	174
9	165	160	160	163	172	184
10	154	159	165	179	174	175
Average Roll Value	165	161	170	168	172	175

Table 1 - Sample Grab Tensile Strength Data

It is important to realize that even though nine individual specimen values were below the required 160 lbs, the truckload is acceptable per ASTM D-4759. If the lowest average roll value for the tested material was below 160 lbs, ASTM D-4759 states that the lot would be re-sampled and retested. This holds true except in the case where all of the individual average roll values are below the required value. In this case, ASTM D-4759 states the entire lot should be rejected without further sampling and testing.

EXAMPLE TWO

Let's now say that the average roll value for sample #3 and sample #5 were below 160 lbs. Following ASTM D-4759, roll #3 and roll #5 are not included in the re-sampling and are disposed of in a manner agreed upon by the purchaser and the seller. The remaining 173 rolls in the lot are randomly re-sampled and tested. The lot is accepted if the lowest average roll value of the re-sampled rolls is greater than or equal to 160 lbs. The entire lot does not pass if the lowest average roll value is below the specified value.

SUMMARY

Propex takes the quality of our products and how we represent them very seriously. We are committed to providing high quality products with solid documentation. We would be more than happy to provide you with historical data or statistical calculations that support our published values. For additional design support and installation consideration please contact Propex's Engineering Services at (423) 553-2450 or at:

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