

## **Visual Inspection and Grading of Fabrics**

In trade relationships between sellers of fabrics and their customers, a system of defect analysis or defect grading must be agreed upon and in use. At the core of any grading system is simplicity and accuracy. The system must be clearly stated and easy to execute. Of various systems used worldwide, the "4-point" and "10-point" systems are the most common. The actual method used in any relationship must be agreed upon by all parties as the standard. This discussion will cover these grading methods in a very fundamental manner, and these discussions should not be automatically adopted as a standard method. Various world standards organizations such as ASTM should be referred to for an actual standard method.

### **Defect Classifications (Major/Minor Defects)**

Defects depicted in this CD have been classified as "Major or Minor" defects and by category. These classifications are based upon the judgment and experience of fabric graders. It must be conceded that all "pointable" defects do not result in the determination of product (end item) seconds. Further, it must be understood that certain small or minor defects may be acceptable in certain areas of an end item (garment or home product) while being unacceptable in others, and that a large percent of small or minor defects are lost in the cutting and fabricating of end items. For these reasons, it seems logical that the quality of a fabric, represented by a point value, should be more reliable and correlative to end item quality and fabric utilization if these facts are taken into account.

It is known that across the industry almost all conditions exist, so that a minor defect to one end use may be a major to another and vice versa, but if the nature of the fabric and the demands of an end use are understood, there should be little problem relating quality determined by the major/minor concept. The definitions against which these defects have been classified are as follows:

#### **Major/minor defects defined:**

**Major-** A defect severe enough, if exposed, to place an end item in seconds.

**Minor** -An imperfection that may or may not cause a second, depending upon its location in the end item and/or its chance of being lost in fabrication.

In many agreements, a major defect may be severe enough that it carries a connotation of "*critical/H*". This means that this defect by itself would cause an entire roll to be rated as a second or worse. Where applicable, the purchaser and the supplier may agree upon the classification, location, maximum size of a fabric characteristic, and frequency of occurrence that shall not be counted as a

defect. In any case, the purchaser and the supplier must agree on a list of defects to be used in grading fabric as well as their severity.

The total shipment shall be rejected if the sample inspected exceeds the maximum acceptable defect level mutually agreed upon by the purchaser and supplier.

#### Defect Category Classification:

Defects depicted in this CD have been placed into categories based upon their similarity of appearance and effect upon visual quality, and general utilization of the fabric. For example, all defects that result in a fine vertical line are classified within a category. As a result of defect grouping, the use of these general classifications can serve to simplify inspection reports and still render useful information.

Definitions of categories are as follows:

- I. A narrow or fine-lined length or warpwise defect of a continuous or lengthy nature.
- II. A narrow or fine-lined width or fillingwise defect.
- III. Isolated defects, such as general unevenness, neppy, fuzz balls, oil spots, color fly, knots, slubs, etc.
- IV. Pattern defects such as miss-selection of pattern, color misdraw, broken color pattern, improper cover, etc.
- V. Finishing defects.
- VI. Printing defects.

It is important to remember that the number of points assigned to a specific defect will tend to further establish its size and nature.

### **System of Visual Quality Evaluation for Woven and Knitted Fabrics**

#### **Part 1 – Domestic System of Measurement**

##### **A. Inspection:**

Rolls or bolts of fabric are visually inspected and individually graded at an examination station using an agreed upon point system. Inspect and grade the total length of each roll or bolt sampled.

Fabrics shall be inspected full width and are passed longitudinally through

the inspection area at a visual inspection speed. Fabric may be stopped to grade when necessary to affirm marginal defects and for defects flagging (marking).

All defects visible at normal inspection speed and distance of one yard or one meter shall be counted.

Fabric is normally inspected and graded on one side only. Certain types of end use fabrics may be inspected and graded on both sides as agreed upon between the purchaser and supplier.

Detect and assign points to defects observed as agreed upon by all parties. Assign points to the defects based upon their length within the plane of the fabric according to one of the following options of assigning points, as agreed upon between the purchaser and the supplier.

**Apparatus:**

It is recommended that a suitable fabric inspection machine that provides a flat viewing area and a variable speed controlled fabric rewind with forward and reverse.

Direct overhead lighting should be provided.

**Lighting:**

The overhead direct lighting source shall be mounted parallel to the viewing surface to illuminate with direct perpendicular impinging light rays. The illumination of the surface should have a standard value expressed in "lux" (100 foot candles).

The lighting source should be cool white preheat rapid start fluorescent lamps having a correlated color temperature of 4100 to 4500 K with white reflectors and without baffles or glues, or other source by agreement between the purchaser and supplier.

Back lighting (transmitted) light may be used if agreed upon by the parties involved. Typically, backlighting would apply to only particular types of fabric.

**Conditioning:** Conditioning is not required.

**Sampling:** (recommendations)

With shipments which total 1000 yards (meters) or less, inspect and grade the total number of rolls or bolts.

For shipments exceeding 1000 yards (meters), select samples as agreed upon by the purchaser and supplier. Typically, 10% of the rolls or bolts are inspected. If there are less than the allowable points for each 100 yards

inspected, then this is an acceptable level. If more than the allowable points are found, then the roll is unacceptable. If 20% of the rolls inspected are defective, then the entire lot of rolls should be inspected.

For example, a lot of 100 rolls of 100 yards each is inspected using a 4-point system. Ten rolls (10% of total) are selected for inspection. Of these 7 are found to have less than 40 points or less and 3 are found to have more than 40 points. Since 3 of the 10 rolls are found defective (30%) then the entire lot has to be inspected.

#### **B. Defect Classification:**

Defects shall be classified in accordance with the nomenclature of this defect manual.

Defects shall further be classified as Major or Minor.

##### **1. Severity**

Major- A defect severe enough if exposed to place an end item in seconds.

Minor- An imperfection that may or may not cause a second, depending upon its location in the end item and/or its chance of being lost in fabrication.

##### **2. Point Value of Major and Minor**

Major- One point for each increment of nine inches or part thereof.

Minor- One-quarter point for each increment of nine inches or part thereof.

#### **C. Designation of Major and Minor:**

Major- Designated by an (X) on the inspection report- contiguous points grouped.

Example-	1 point major	-X
	3 point major	-XXX
	3 & 2 point major	-XXX XX

Minor- Designated by a (1) on the inspection report.

Example -	12 minors	- 4-1-44 4-1-44 11
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#### **D. Maximum Penalty Per Yard:**

Per linear yard – Determined by dividing the fabric width to the nearest whole increment of nine inches.

Per Square Yard -The nine inch increment assigned to a one-point defect establishes the maximum penalty at four points per square yard.

### **E. Computation of Inspection Results:**

Minors

- |        |  |
|--------|--|
| Step 1 | Divide by four to convert to whole points.   |
| Step 2 | Divide by hundreds-of-yards inspected to convert to points per 100 linear yards.               |
| Step 3 | Multiply by 36 over fabric width (to nearest 9 inches) to convert points per 100 square yards. |

Majors – Use steps two and three.

Example – 16 major and 40 minor points in 200 yards of 60 inch fabric.

	Step 1	Step 2	Step 3
Minors-	$\frac{40}{4} = 10$	$10 = 5$	$5 \times \underline{36} = 3.3$
	2	2	54

  

Majors-	$\frac{16}{2} = a$	,	$8 \times \underline{36} = 5.3$
	2	2	54

### **F. Reporting:**

Results to be reported as:

$$\text{Major} + \text{Minor} = \text{Total}$$

Using the above example:

$$5.3 + 3.3 = 8.6 \text{ points per 100 square yards}$$

## **Part 1A - Metric System of Measurement**

### **A. Adaptation:**

To adapt the described point evaluation to the Metric System of measure:

1. Determine the width of the fabric in centimeters.
2. Substitute 25 centimeters for the 9 inch increment of defect measure.
3. Calculate results in points per 100 square meters.

### **B. Comparison of Results:**

Theoretically, on a given fabric, the point values obtained from the Domestic and Metric Systems of measure should closely approximate each other; that is, 30 points per 100 square yards on the Domestic System should reflect the same quality level as 30 points on the Metric System.

### C. Conversion Formulas:

When it is desirable to convert the point value obtained by one of the systems to that of the other, the following formulas should be used:

1. Points per 100 square meters  $\times$  0.836 = points per 100 square yards.
2. Points per 100 square yards  $\times$  1.196 = points per 100 square meters.

## Part 2—Point Systems

Various point systems are in use worldwide. The most common are the "Four-Point" and "Ten-Point" systems. The following are brief summaries of these systems.

### The Four-Point System

Defect Length (minimum to maximum)

Points	Length greater than	Length less than
1 pt.	0 inches (0 mm)	3 inches (75 mm)
2 pts.	3 ins. (75 mm)	6 inches (150 mm)
3 pts.	6 ins. (150 mm)	9 ins. (230 mm)
4 pts.	9 ins. (230 mm)	

Assign no more than a total of 4 points to any one linear yard or meter of fabric, regardless of the number or size of the detected individual defects.

Assign 4 points to each consecutive linear meter or yard in which a continuous running defect exceeds 9 inches or 230 millimeters.

Assign 4 points to each linear meter or yard of fabric where the useable width is less than the minimum specified.

Assign 4 points to each seam or other full width defect or seam if applicable.

Calculate the total number of points expressed in points per 100 square yards or 100 square meters. Expressions for 100 linear yards or 100 linear meters can also be agreed upon. (See Part 1.)

### The Ten-Point System

#### A. Defect Length-Warp

Defect Length (minimum to maximum)

<u>Points</u>	<u>Length greater than</u>	<u>Length less than</u>
1 pt.	0 inches (0 mm)	1 inch (25 mm)
2 pts.	1 inch (25 mm)	5 inches (125 mm)
5 pts.	5 ins. (125 mm)	10 ins. (250 mm)
10 pts.	10 ins. (250 mm)	36 ins. (900 mm)

#### B. Defect Length - Filling

Defect Length (minimum to maximum)

<u>Points</u>	<u>Length greater than</u>	<u>Length less than</u>
1 pt.	0 inches (0 mm)	1 inch (25 mm)
3 pts.	1 inch (25 mm)	5 inches (125 mm)
5 pts.	5 ins. (125 mm)	up to Y. fabric width
10 pts.	Y. fabric width	to full fabric width

Defect Length (minimum to maximum)

<u>Points</u>	<u>Length greater than</u>	<u>Length less than</u>
1 pt.	0 inches (0 mm)	1 inch (25 mm)
2 pts.	1 inch (25 mm)	5 inches (125 mm)
5 pts.	5 ins. (125 mm)	10 ins. (250 mm)
10 pts.	10 ins. (250 mm)	36 ins. (900 mm)

Calculate the total number of points expressed in points per 100 square yards or 100 square meters. Expressions for 100 linear yards or 100 linear meters can also be agreed upon. (See Part 1.)