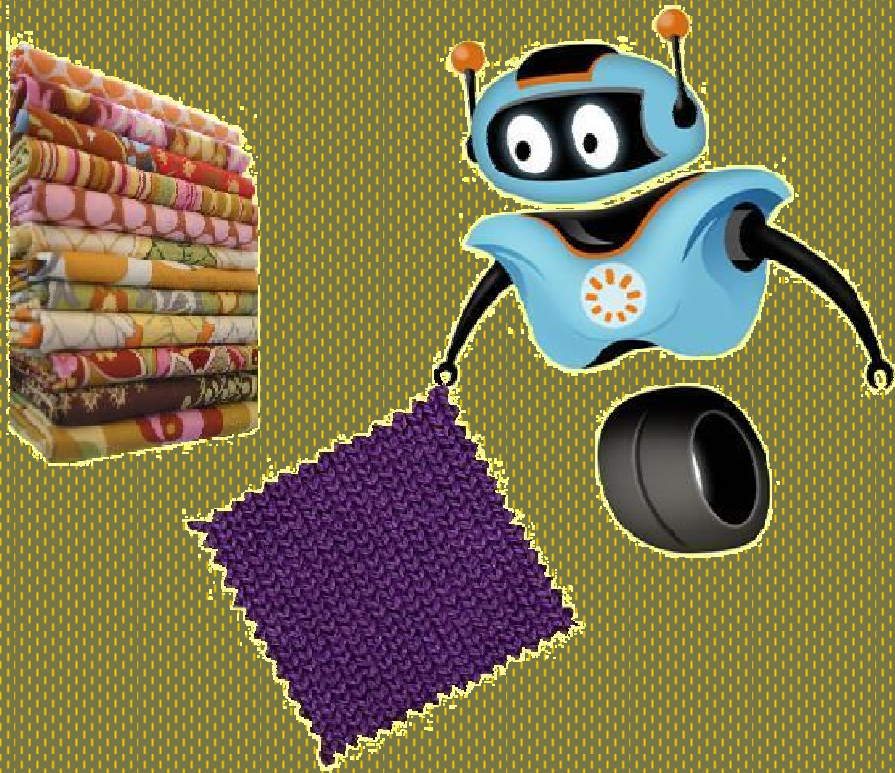


# Fabric Inspection System and Machines



**By: Parth Joshi and  
Aditya Trivedi**

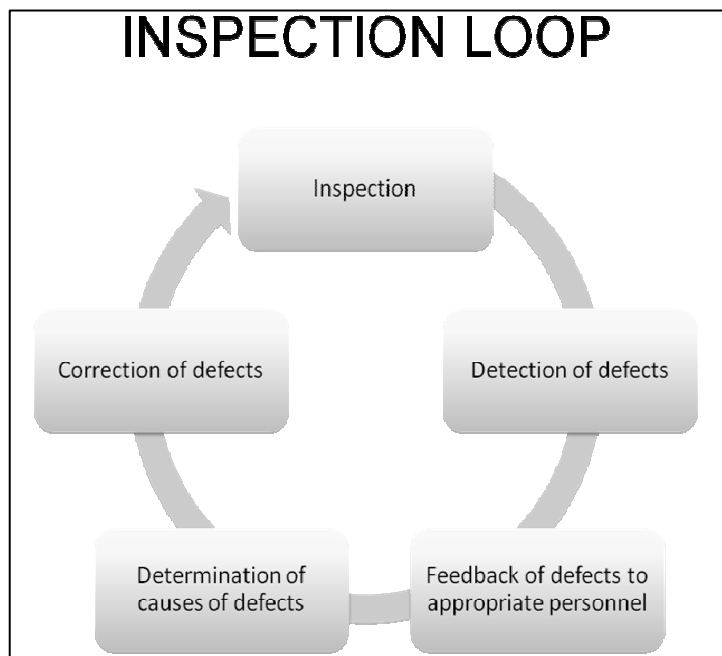
# Fabric Inspection System and Machines

By: Parth Joshi and Aditya Trivedi

## Fabric inspection systems

*Inspection:* Inspection in reference to the apparel industry can be defined as the visual examination or review of raw materials partially finished components of the garments. It also examines completely finished garments by measuring the garments to check if they meet the required measurements, in relation to some requirements, standards or specifications.

The main objective of inspection is the detection of the defects and nonconformance's as early as possible in the manufacturing process so that time and money are not wasted later on in either correcting the defect or writing off defective garments.



## Grading systems for fabric inspection

The quality of a final garment depends on the quality of a fabric when it is received as a roll. Defective materials cannot be compensated by even the most outstanding manufacturing methods.

They inspect 20% of the rolls that they receive and evaluate them based on different systems.

In this way, fabric related quality problems can be avoided before it is put into production.

So, for the fabric inspection to remove defects, we can use different types of systems, which are given below.

1. 4- point grading system
2. 10 point grading system
3. 6 point grading system
4. Graniteville "78" system
5. Dallas System.

### 1. 4 Point Grading System

It was published in 1959 by the National Association of Shirt Pajama Sportswear Manufacturers. It is widely used and adopted in knitted fabric.

### Amount to select

It inspects around 20% of the total rolls of the shipment.

### Selection of rolls

Select at least one roll of each color. Choose the additional roles in proportion to the total number of roles per color received, if more than one role must be selected.

Defects classification	
Size of defects in fabric	Points allotted (Penalty)
Up to 3"	1
Over 3" up to 6"	2
Over 6" up to 9"	3
Over 9"	4
Holes and opening (large dimensions)	
1" or less	2
Over 1"	4

The length of the defect is used to determine the penalty point. Defects that are major are only considered. Penalty points are not assigned to minor defects. (A major defect\* is any defect that would

cause a final garment to be considered a second.)

### \*Major Defects

- Mostly woven fabric defects include slubs, holes, missing yarns, yarn variation, end out, soiled yarns, and wrong yarn. But they are not limited to these.
- Major printing or dye defects are out of register, dye spots, machine stop, color out, color smear, or shading.

The total defect points per 100 square yard are calculated. The fabric rolls containing more than 40 points per 100 square yard are considered as "seconds". However, a garment may use more or less than 40 points per 100 square yards as an acceptance criteria.

Therefore points per 100

$$\text{Square yards (PPHSY)} = \frac{\text{Total points scored in the roll} \times 36 \times 100}{\text{Fabric width (in inches)} \times \text{total yards inspected}}$$

### Advantages

- 4 point system has not width limitation.
- Worker can easily understand it.

## 2. 6 Point Grading System

Defects classification	
Size of defects in fabric	Points allotted (Penalty)
Up to 25 cm	1
25 to 50 cm	2
50 to 74 cm	3
75 to 99 cm	4
100 to 124 cm	5
125 to 150 cm	6

The average of all pieces must not exceed the range of 34-36 points per 100 sqrm for it being considered as a fresh quality. However for individual pieces range of 30-32 points per 100 sqrm may be permissible.

### 3. 10 Point Grading System

In 1955, the 'ten point system for piece goods evaluation' was approved by the Textile distributors institute and the National Federation of Textile.

It is the earliest inspection system. It is designed to identify defects and to assign each defect a value based on severity of defect.

The system assigns penalty points to each defect depending on its length and whether it is in the warp (ends) or weft (fill) direction. It can get quite complicated in practical use, while sounding simple.

<b>Defects classification</b>	
<b>Size of defects in fabric</b>	<b>Points allotted (Penalty)</b>
<b>Warp defects</b>	
Up to 1"	1
Over 1" up to 5"	3
Over 5" up to 10"	5
Over 10" up to 36"	10
<b>Weft defects</b>	
Up to 1"	1
Over 1" up to 5"	3
Over 5" up to 1/2 width	5
Over 1/2 width	10

Deciding fabric quality  
For width less than 50"

First Quality = Total Defect Points < Total Yards inspected  
Otherwise it is second Quality.

For more than 50" width

First Quality = Total Defects X 1.1 Points < Total Yards Inspected  
Maximum defects allotted /yard = 10.  
Otherwise it is second quality.

#### Advantages

- It is the most used and oldest when it comes to woven finished fabric.
- It uses the length of fabric and along the length of warp and weft defects are identified.

#### Disadvantages

- It has width limitation.
- It is difficult in practical use

### 4. GRANITEVILLE "78" System

For the field of fabric grading, it was introduced in 1975. The system divided defects into major and minor types.

<b>Defects classification</b>	
<b>Size of defects in fabric</b>	<b>Points allotted (Penalty)</b>
Up to 9"	1
Over 9" up to 18"	2
Over 18" up to 27"	3
Over 27 up to 36"	4

The defect which was very obvious and leads the goods to second quality was the major defect.

The defect which may or may not have caused garment to second, depending on its location in the end use item was the minor defect.

- The principle was established in garment cutting piece, which the short length defects (less than 9") will normally be removed.
- The system tries to balance the importance of longer defects (over 9") and put less weight on 1-10" defects such as slub.
- The system also suggests the viewing distance of 9 foot instead of normal 3-foot viewing distance. It also tends to eliminate very small defects from the total penalty score.

#### **Disadvantages:**

As this system is used on cutting pieces according to one point of view it also increases the cost of production.

#### **5. DALLAS System**

- In 1970's, there was also a Dallas System published. That system was developed specifically for knits.
- According to this system, if any defect was found on a finished garment the garment would then be termed a second.
- In regard to fabric, this system defines a second as "more than one defect per ten linear yards, calculated to the nearest ten yards."

#### **Disadvantage**

- The defect is located after the garment is finished. As a result of this the cost of production increases.

#### **Types of Defects**

- *Bar* – Filling wise thin place, thick place, fine yarn or coarse yarn.
- *Bad Selvedge* – Raged, tight, loose, beaded, etc.
- *Broken End* – A warp yarn missing for a portion of its length
- *Chafe* – An area where the fabric has been damaged by abrasion or friction.
- *Coarse End Or Pick* – A warp or weft yarn having larger diameter or more plies than normally used in the fabric.
- *End Out* – A warp end missing from the entire length of the cloth.
- *Fine End* – A warp yarn having smaller diameter or less plies than normally used in the fabric.
- *Flat* – Two or more threads weaved as one and not meant to be a feature of the weave.
- *Float* – A thread that extend unwoven over the threads of the opposite set with which it should normally be interlaced.
- *Fly* – loose fibers not originating from the fabric or foreign mater that have been woven into the fabric.
- *Fuzz Balls* – Loose fibers originated from within the fabric that have formed balls and is woven into the fabric.
- *Hard Size* – An excessive quantity of size material.

- *Double Pick* – An extra pick dragged into shed with the correct pick for a portion of the width of the fabric
- *Kink (Snarl)* – A short length of yarn spontaneously doubled on itself.
- *Miss pick* – A pick woven in the wrong order with respect to the weave or color pattern.
- *Missing End* – A warp wise streak causing the improper spacing of the warp across the fabric.

## **Fabric inspection machine**

### ***Introduction***

Inspection is reference to quality control in apparel industry can be defined as the visual examination or the review of raw material partially finished component of garment in relation to some standard, specification or requirement, as well as measuring the garment to check if they meet required measurement.

- ☞ To trace the source of defect, so that appropriate measures can be taken to make use of the faulty fabrics.
- ☞ To minimize the future reoccurrence of the defect.
- ☞ To determine quality and hence the price of the fabric.
- ☞ To supply information to proper levels of management as to the qualities being produced.

### **Types of Machines**



### **I – TEX**

Manual operation such as second inspection, roll cutting or mending will be achieved more efficiently, faster and it's lower cost using I-TEX process.

It offers

- New dimensions of accuracy
- Reliability
- Cost effectiveness in fabric inspection

## **Types of I-TEX Machine**

1. I-TEX 1000
2. I-TEX 2000
3. I-TEX 2000D
4. Loom Tex

## **I-TEX 1000:**

**Greige & Industrial Fabric Automatic Inspection Machine :** The I-TEX 1000 is a computerized vision inspection system that automatically detects, locates, memorizes and further grades weaving defects on greige fabrics and process defects on several industrial fabrics. The system is based on a state of the heart technology of unique image understanding algorithms and structure that imitate the human visual mechanism.

## **Benefits**

- Continued fabric quality improvement
- Substantial saving on inspection and operation expenses
- Reliable and consistent quality standards
- Accurate and accessible quality data
- Reduced customer claims

## **The new I TEX1000 features**

- Modern and new human interface for easy operator training and user friendly system operation.
- New frame for a dust free environment. This enables maximum flexibility in cameras and illumination design.
- For higher inspection level, upgraded detection algorithms.
- Easy parameter setting and fabric styles.

I-TEX1000 inspects 100% of the fabric, at fabric speed up to 10-150 meters per minute. The system can detect defects as small as 0.5mm such as the following multiple Greige defect type.

- ↻ yarn and weaving faults
- ↻ holes
- ↻ oil stains
- ↻ missing threads
- ↻ starting marks
- ↻ broken yarns

I-TEX1000 can be configured and designed to fit your specific application and needs. Modularity of the system enables configuration that matches your demands in following categories: Fabric width, Fabric speed, desired resolution, grading standards.

External optional connecting devices: Seam detector, Length meter, Visual alarm, UV/IR ink marker, Metal label marker, Modem, Data interface by Ether link III communication and printer.

## **I-TEX2000**

**Finished Fabric Automatic Inspection System:** The I-TEX2000 is a computerized vision inspection system that automatically detects memorized, displays and further grades – yarn defects on fabrics, weaving, dyeing, finishing, and coating. The system is based on a state of the art technology of unique images understanding algorithms and structure that imitate the human visual mechanism.

### **Benefits:**

- ↪ Continued fabric quality improvement
- ↪ Substantial saving on inspection an operational expenses
- ↪ Reliable and consistent quality standards
- ↪ Accurate and accessible quality data
- ↪ Reduced customer claims

I-TEX2000 is the only proven industrial solution for an automatic fabric inspection in textile finishing and dyeing processes. It has the ability to automate the quality inspection process resulting in high inspection performances convinced leading textile manufactures to adapt the I TEX2000 solution and to continuously increase the number of I TEX2000 installations.

### ***I TEX2000 new model present new features for better performance and easier operation:***

1. User friendly system operation and a modern and new human interface for easy operator training and user friendly system operation.
2. Full integration with shade variation analyzer for the purpose of combing the fabric and shade defects into one output.
3. Up to 4 different lines of site and illuminations, for optimal detection performances.
4. For higher inspection level, upgraded detection algorithms.
5. Easy fabric styles and parameter setting.

I TEX2000 inspects 100% of the fabrics speed up to 150 meters per minute. Defects that is as small as 0.5mm can also be detected by the system. The following are some finishing defect types:

- ♣ Yarn and weaving faults
- ♣ Holes
- ♣ Oil stains
- ♣ Missing threads
- ♣ Starting marks
- ♣ Broken yarns
- ♣ Water and dyestuff stains
- ♣ Dyeing and finishing irregularities
- ♣ The system can detect any visible defect.

I TEX2000 can be configured and designed to fit your specific application and needs. The following are the categories in which the system's modularity enables configuration



that matches your demands: Fabric width, Fabric speed, desired resolution, grading standards.

External optional connecting devices: Seam detector, Length meter, Visual alarm, UV/IR ink marker, Metal label marker, Modem, Data interface by Ether link III communication and printer.

## **I-TEX 2000D**

**Denim Fabric Automatic Inspection Machine:** The I-TEX2000D is a dual surface computerized vision inspection system that automatically displays, memorizes, detects and further grades weaving and finishing defects on denim fabrics. The system is based on a state of the art technology of unique image understanding algorithms and structure that imitate the human visual mechanism.

The worldwide denim industry is continuously growing, as is the demand for denim quality. The I-TEX2000D inspection is specially designed to optimize the denim fabric inspection:

- ♣ Combines inspection results of front and back side of denim fabric.
- ♣ Up to 4 different lines of site and illuminations used for the performance of optimal detection.
- ♣ Typical fashion denim fabric defects detected by a special detection algorithm designed for it.
- ♣ Easy parameter setting and fabric styles.

User friendly system operation and a new and modern human interface for easy operator training.

At fabric speed up to 100 meters per minute, I-TEX2000D inspects 100% of the fabric. The system is also capable of inspecting the modern denim styles such as: cross denim, multi color, bicolor and more. Defects that is as small as 0.5mm can also be detected by the system. The following are some multiple denim defect types:

- Yarn and weaving faults
- Holes
- Oil stains
- Missing threads
- Starting marks
- Broken yarns
- The system can detect virtually any visible defect.

## **Loom Tex**

**On Loom Automatic Fabric Inspection System:** Inspects 100% of the fabric increase the yield of 1st choice fabrics eliminates manual inspection reduces the need to cut out running defects enables exact fabric length weaving, while considering the actual defect rate optimizes loom's assignment real time alarm informs of major defects stops the loom when warp and running defects are detected.

## **LOOM TEX modules:**

1. Full width fixed line video scanner
2. Integrated dual illumination module.
3. Each loom has its own dedicated image processing computer.
4. Monitoring Management done by a Central computer

LOOM TEX utilizes properties image acquisition and processing technologies, designed to fit with rough weaving condition:

- No moving parts
- Configured for on loom/ off take up
- Wide loom configuration up to 390cm
- Sealed electronic module
- Remote diagnostics

LOOM-TEX inspects 100% of the fabric and selvage, suitable for a wide range of application such as: Technical fabrics, silk, Apparel, shirting, Home Furnishing and more. Each loom performance can be viewed in real time, displaying defect images, roll defect's map and statically data.

**Detectable weaving defect type:**

- Broken pick
- Double pick
- Stop mark
- Double end
- Broken end
- Missing end
- Wrong draw
- Kinky filling
- Reed mark
- Density change and more

A communication network interface several LOOM TEX system in the weaving hall with the center computer which can be located at the control room and which receives from each loom its status and data

**Cyclops**

**Principle of operation:** The Cyclops on-loom inspection unit uses a moving image acquisition head installed on the off-loom take up or above the cloth roll. It consists of a camera and illumination unit.

An image of the fabric is taken and transferred to the image processing unit, at a number of pre-defined positions. To analyze the texture of the fabric and to detect deviations from standard, proprietary algorithms are applied. Any detected defect is signaled to the loom.

Cyclops system can be easily set up. The scanning range is self-adjusted to the fabric position and width by automatic detection of the fabric boundaries.

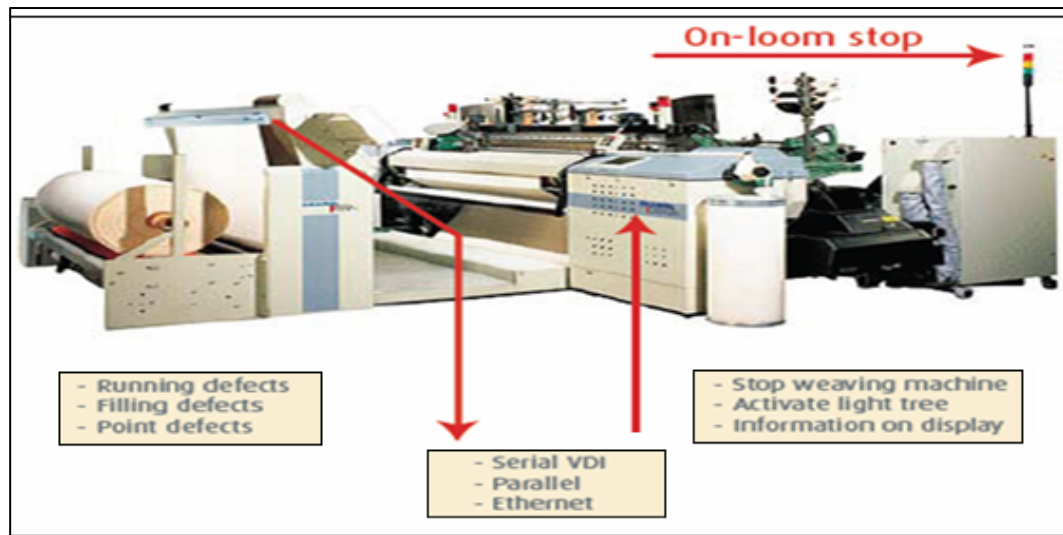
Illumination and camera settings are optimized by the calibration software module in relation to the optical characteristics of the fabric. Also, in order to calculate the algorithm parameters for optimal defect detection, the structure of the fabric is automatically identified.

### Interaction with the weaving machine

The on-loom inspection system communicates with the micro-processor of the weaving machine. The on-loom inspection system stops and holds the loom; in case a running defect is detected, preventing to continue the production of defective fabric. The weaver has to make a declaration, before the loom can be put back in production, confirming that the defect cause has been eliminated.

The weaver's declaration also allows to further specify the nature of the defect for which the loom has been stopped by the Cyclops on-loom inspection system.

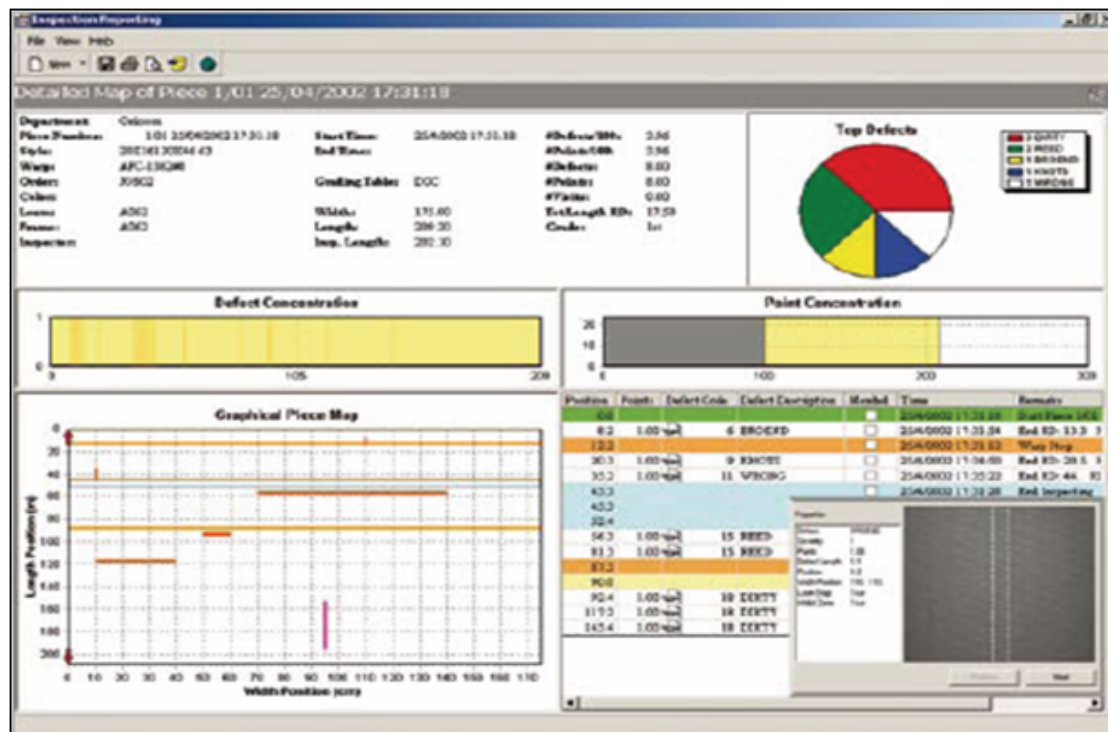
In order to help the weaver, a lamp in the loom's light tree is activated indicating the stop and a message on the loom's display informs the weaver that the loom is stopped because of a fabric defect.



The loom will be stopped for any detected running warp defect as well as for a too high concentration of weft or filling defects in a set length of fabric.

### Connection to the QualiMaster system

All detected defects are transmitted to the QualiMaster system. Each defect is marked with time, pick stamp and date, in order to complete the information. This allows locating the defect in the cloth roll. It also



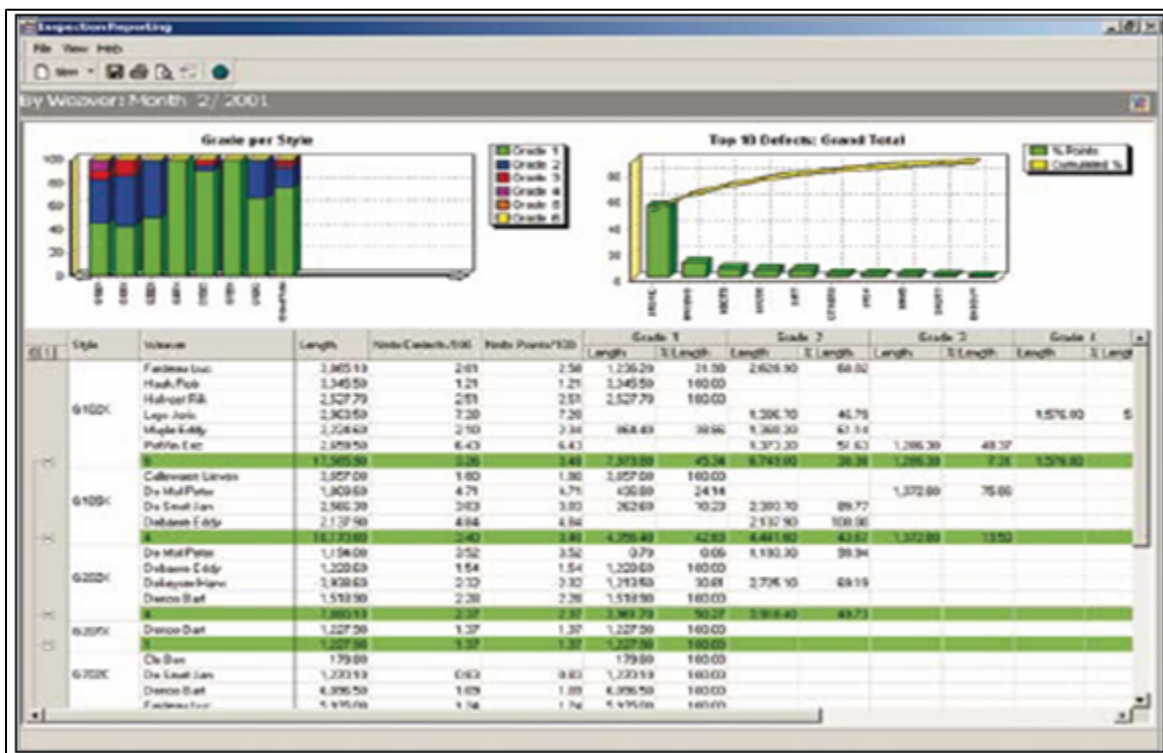
helps in generating quality reports by weaver, per shift, per style and many more.

A typical application of QualiMaster is the “by pass” software. The system formulates a fabric quality advice, at cloth roll doffing. In case the fabric is judged to be first grade, the system will indicate on the loom’s display that the cloth roll can pass the greige cloth inspection and can be sent on directly for further processing.

### Cyclops and double panel looms

For single panel looms (up to a maximum fabric width of 280 cm), Cyclops includes an image acquisition head with one single camera.

For double panel looms (up to max. 500 cm), Cyclops offers a double camera based image acquisition head. Each camera covers 50% of the fabric width. The panel separations do not disturb the operation of CYCLOPS.



### Benefits

- 100% detection of all running defects like reed , drawing-in defect, missing end
- 100% detection of all full width filling defects like missing pick, double pick, etc
- 100% detection of concentrations of point defects
- Real time defect detection allowing to stop the loom and prevent the production of defective fabric
- Independent of human perception
- Higher fabric quality, less second grade
- Lower work load in greige inspection department
- Investment not needed in automatic inspection of loom-state fabric

- QualiMaster system integration
- No maintenance require

### Specifications

- Camera: CMOS technology - 10 pixel/mm
- Single panel looms (max 280 cm)- single camera double panel looms (max 500 cm) - dual camera
- Illumination: infra red LED - option: blue LED allowing the detection of stains
- Scanning speed - standard version: 18 cm/sec, high speed version: 54 cm/sec
- Window: 60 x 45 mm
- Automatic calibration
- Communication with the loom: VDI, Ethernet, TCP/IP
- Integration with the QualiMaster system

### Cyclops detecting typical defects in fabric

