

## Definition of pixel faults tolerance for Belinea TFT monitors:

### What defines the standard ISO 13406-2?

The standard ISO 13406-2 is a component of the TUEV ergonomics examination and defines the LCD specific ergonomics standards. One of the quality criteria of the ISO standard is the pixel error tolerance. In the case of pixel faults it concerns one technologically and technically caused itself characteristic of LCD monitors. At a large number of cells, which have the current LCD of monitors, the possibility exists that individual cells can exhibit an fault and permanently switched on or off. The result is constantly bright or black pixels. The standard ISO 13406-2 provides here for transparency and gives the customer and the manufacturer a clearly defined and thus comparable warranty claim definition, in which the pixel fault classes are given. The number and positioning of pixel faults define the basis pixel faults of a warranty claim. An overview of the pixel fault classes and types offers the following excerpt from the standard ISO 13406-2. The table defines the maximal permissible number and kind of pixel faults per 1 million pixel.

Pixel defect category	The number of pixel defects is defined per 1 million pixel.		
	Defect <b>Typ 1</b> (constantly bright pixel)	Defect <b>Typ 2</b> (constantly dark pixel)	Defect <b>Typ 3</b> (defect subpixel, either constantly bright red, green, blue) or constantly dark)
I	0	0	0
<b>II</b>	<b>2</b>	<b>2</b>	<b>5</b>
III	5	15	50
IV	50	150	500

Additionally to the individual types of error the number and kind of errors are defined in the Pixelklaster in the standard ISO 13406-2. A Pixelklaster is a range form concentrated of 5 times 5 pixels in that the errors in to arise can. The following table defines the maximally permissible number and kind of the cluster faults per 1 million pixel.

Pixel defect category	The number of pixel defects in a cluster for 1 million pixel.	
	Typ 1 und Typ 2	Typ 3
I	0	0
<b>II</b>	<b>0</b>	<b>2</b>
III	0	5
IV	5	50

The following conditions must be fulfilled according to ISO 13406-2 for the correct measurement of the pixel errors:

- preheating phase of the monitor which can be tested > 1 hour,
- ambient temperature 25°C +/- 5°C
- relative air humidity 40-70%
- test must be accomplished in a dark area

**The pixel faults are defined in the following way:**

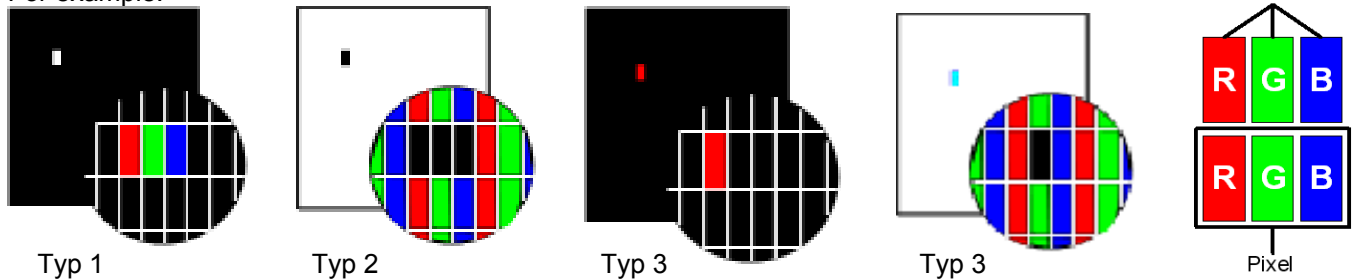
A pixel is a group of 3 assigned subpixels (red, green, blue). Each subpixel corresponds to a transistor.

Pixel fault Typ 1: constantly bright pixel

Pixel fault Typ 2: constantly dark pixel

Pixel fault Typ 3: defect subpixel, either constantly bright (red, green, blue or constantly dark)

For example:

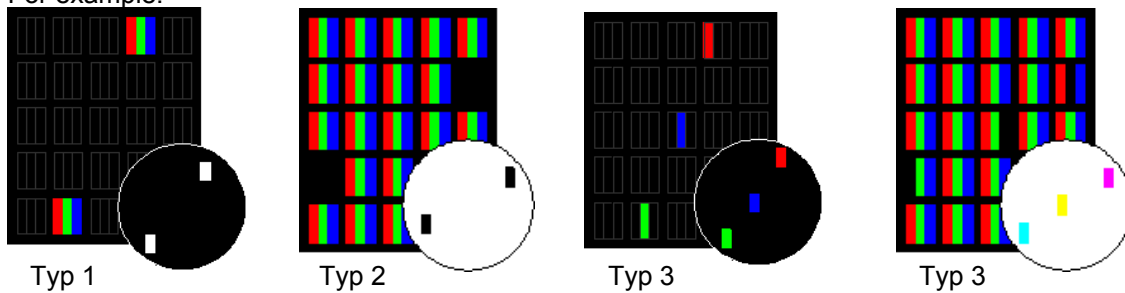


A cluster is an area of 5 x 5 pixel

Cluster pixel fault Typ 1 and Typ 2: constantly bright or dark pixels within the clusters

Cluster pixel fault Typ 3: defect subpixel, either constantly bright red, green, blue or constantly dark within the cluster.

For example:



The number of permissible pixel faults can be calculate with the following function:  
(number of errors = number of pixels of the physical resolution x number of errors in the pixel fault category / 1.000.000) with rounding up upward (there it no half errors gives). The following table defines the maximum permissible number of pixel faults for the respective resolution types validly for the pixel error class II.

Paneltyp	Physical Resolution	Amount of Pixel	Maximally permissible number of errors for the pixel error class II in accordance with ISO 13406-2				
			Typ 1	Typ 2	Typ 3	Cluster fault Typ 1 und Typ2	Cluster fault Typ 3
15" XGA	1024 x 768	768 432	2	2	4	0	2
17"-19" SXGA	1280 x 1024	1 310 720	3	3	7	0	3
20.1" UXGA	1600 x 1200	1 920 000	4	4	10	0	4

Based on the standard ISO 13406-2 the customer can use the tables explained above as basis for the evaluation of the pixel error tolerance. Excess of one of the specified border criteria leads to the entry into force of the warranty claim.