

## Recent progress of Ergonomics Studying in CRTs Design and Manufacturing

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### **Abstract**

*This paper analyzes some important achievements in Ergonomics field in CRT industry. After introducing principal regulatory requirements for CRTs, including ISO 9241 and TCO standards, the paper indicates some theoretical research in ergonomics of the display devices, such as new contrast parameter for appraising the display devices and effects of environment on visual performance at the ergonomic. Then, as the pivot of this paper, some practical progress, in the ergonomics field in CRT manufacturing, are described, such as vacuum sputtering process for advanced CRTs, new developed wet process for getting the multi-coating layers on surface of the panel.*

### **Keywords**

Ergonomics, CRTs, TCO, Surface process, AR /AS Coating .

### **1. Background**

The good designs with ergonomics is a key points to attract the consumers to buy electronics products in recent years. As the visual terminals, the displays' ergonomics issue is paid more and more attention, especially for mature and old CRTs. In order to enhance the CRTs' competitive power in the face of growing FPD technology, the ergonomics must be improved much more. So the ergonomics studying has been becoming among critical researches about CRT manufacturing just now.

It is well known, for the consumers, the environment harm at the time to use consumable must meet the minimum requirements in the ergonomics. If

some body enjoys the consumable in a bad environment conditions, it will cause health and safety problems for the consumer. In addition, some countries and organizations have established a series of ergonomics standards in the CRT manufacturing for the design criterion about the environment harm to regulate the manufacturing of the makers to conform. Indeed, these regulation requirements have become industry standards in the CRT manufacturing. So the ergonomics is becoming one of the fastest growing branches in the CRT development.

### **2. Current ergonomics regulatory requirements for the display terminals**

Because of its outstanding performance and lower cost, the CRT displays are occupying dominating status in today's display manufacturing. However, CRTs have some inherent disadvantages from the ergonomics aspect. In succession, so a few of regulations have been set down in allusion to CRTs' ergonomics requirements in the past ten years. Among of them, ISO 9241 series standards and TCO'95 & TCO'99 regulations which are constituted in 90's were most popular. In ISO-9241 standards, some Important Requirement terms for CRT displays including Character Size uniformity, Linearity, Orthogonality, Luminance Contrast, Color Uniformity, Color Misconvergence, Image Luminance Ratio with Reflections, Specular Reflection Luminance Ratio, etc have been regulated clearly. In later 90's, TCO standards have been established. Now, TCO

regulation has been adopted by more and more CRT manufacturers.

### 3. Recent progress in ergonomics studying of displays

In the past ten years, some researchers and engineers have done a lot of work to study the ergonomics of the display manufacturing, and many achievements have been realized. Among of them, a new ergonomic contrast theory has been found. Because the human eyes have a nonlinear characteristic between stimulus and the response, conventional Contrast Ratio is not enough to describe the image quality in the displays since conventional Contrast Ratio has a linear characteristic between luminance level and the parameter. Therefore, some researchers have suggested a new ergonomic contrast parameter— which is called “HVC” (Human Visual Contrast) to solve above problem.

Besides HVC parameter, in the CRTs' ergonomics field, there are some important results have been realized in the past years. Among of them, an interesting item is the effects of environment on visual performance have been studied deeply. Ambient lighting is one of the important factors of influence on the visual performance, now it is proved that CRT is inferior to TFT-LCDs under sunlight environment. Obviously, this conclusion is much valuable for CRT engineers to adopt some special measures to improve CRTs visual performance, especially in the bright environment.

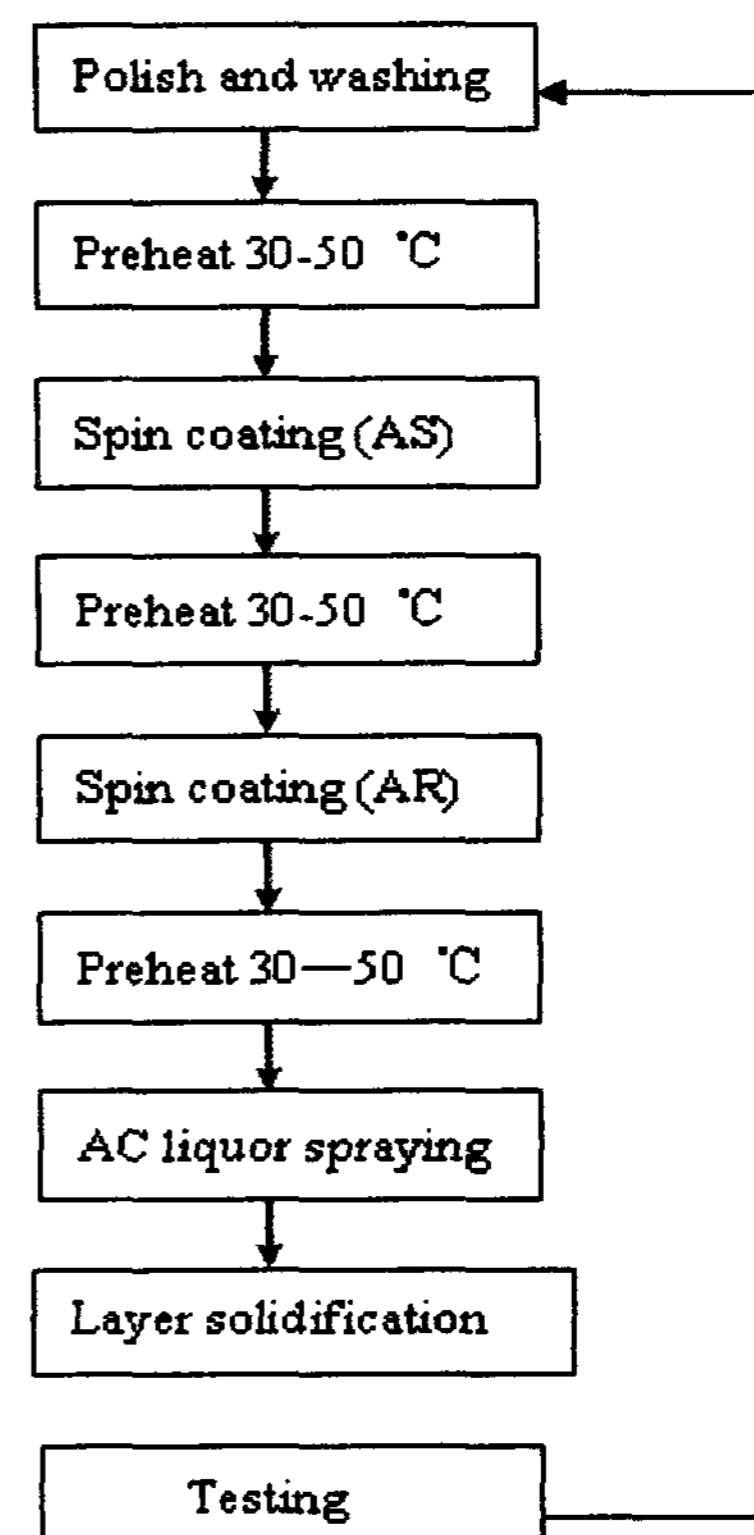
### 4. Some practical developments to improve ergonomics performance in CRTs

Compare with the FPDs, surface process is very necessary, especially for color monitor tubes (CDTs) and large-sized color TV tubes. Under this situation, AR (Anti-Reflecting), AS (Anti static electricity) and AG (Anti glaring) process is widely adopted in today's CRT manufacturing. At the present time, there are two ways to realize AR and AS process. Besides by direct

coating on the out surface of the screen, the new method by which AR and AS film is attached on the out surface of the screen has been developed in last three years, and now practically, it is adopted by some manufacturers. Certainly, it is still that the direct coating on the out surface of the screen is the dominant technology in the CRTs surface treatment process. With regard to surface coating ways, the wet coating method is used widely because of its maturity and lower cost.

It is well known the electromagnetism radiation in CRTs will become big if its surface resistance is large, so an important task for the ergonomics is to develop a new surface treatment process which can lead to a lower surface resistance. That is why double and three coating layers process has been developed in the past 2 years widely and widely.

#### Typical manufacturing process for Multi coating layers



**Various coating method in CRTs' surface treatment process and their characterizations**

	Coating method	Requirements	Surface resistance	Applied-material	Function
Single Layer	Spray coating		$10^9-10^{10} \Omega /cm^2$	ATO	AG, AS
Double Coating Layers	Spin coating / Spray coating	MPR II	$10^6-10^8 \Omega /cm^2$	ATO	AR, AS
	Spray / Spray coating	MPR II	$10^6-10^8 \Omega /cm^2$	ATO	AR, AS
	Spin / Spin coating	MPR II	$10^6-10^8 \Omega /cm^2$	ATO	AR, AS
	Spin / Spin coating	TCO 97	$10^3-10^5 \Omega /cm^2$	ITO	AR, EMS
	Spin / Spin coating	TCO 99	$10^2-10^3 \Omega /cm^2$	Metal	AR, EMS
Three Coating Layers	Spin / Spin / Spray coating	TCO 97	$10^3-10^5 \Omega /cm^2$	ITO	AR, EMS
	Spin / Spin / Spray coating	TCO 99	$10^2-10^3 \Omega /cm^2$	Metal	AR, EMS

In addition, concerning surface treatment process in CRT manufacturing, the coating efficiency and the cost is a very critical point. In order to enhance the rivaling to others, some novel and efficient coating machines have been developed and are used commendably in CRT manufacturing. A representative coating machine is the sputtering equipment, because of its high stability and productivity. Certainly, the improvement of coating liquor is also valuable because wet process is a mature surface treatment process with much cheap and easily controlled techniques parameter. Now, a new coating liquor, whose composition is 6% metal-salt, 39% isopropanol, 39% butyl alcohol, 14% water, and 2% conductive material, are developed, and are proved with perfect performance .

Besides the surface treatment process, X-Ray radiation in CRTs is also a challenge for CRT engineers, especially for CDTs. So some extra measures have been adopted to solve this problem, such as adjusting the ingredient of the bulbs, install degauss coils in CRTs , developing a rectangular

funnel and rectangular deflection yokes.

**5. Conclusions**

The ergonomics is an important field for the display devices manufacturing. New theory, new equipments, new process, new materials in the CRT ergonomics field have been discussed in this paper. However, since the ergonomics studying is attracting more and more, the engineers are expecting much more progress to be achieved in the near future. With these progresses, CRTs will still dominate the display world in a longtime.

**6.Reference:**

[1] TCO regulations: [www.tcodevelopment.com](http://www.tcodevelopment.com)  
 [2]Y.M. Teng, H.S. Tong, C.M. Hu, T.W. Wang, IDMC (2003) Proceeding  
 [3] D.G. Lee, J.H. Kil, M. C. Jeong, B. K. Oh, and W. Y. Kim, ASID (2003) Proceeding,  
 [4] Shuang Liu, Ke Xian, Technology of display devices, volume 82, p20-22