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APPENDIX

APPENDIX A PRODUCTION COST ESTIMATION OF THE IN-HOUSE TCO GLASS

1. Assumptions and parameters

1.1	Cost of In-house TCO glass coating line	THB 87,500,000
1.2	Calculated depreciation (straight-line method)	5 years
1.3	Total TCO glass production capacity	150,000 pcs per year
1.4	Number of working days	313 days per year
1.5	Number of working hours	24 hours per day
1.6	Number of direct labor	3 persons
1.7	Cost of direct labor inc. over-time	THB 15,000/month
1.8	Electric power requirement	200 kW
1.9	Electricity cost	THB 3.50 per kWh
1.10	Cost of SiO_2 and ITO targets	THB 8,000,000 per year
1.11	Cost of process gases (N_2 and Ar)	THB 1,200,000 per year
1.12	Cost of maintenance and services	THB 600,000 per year
1.13	Production overhead	10 percent

2. Cost Estimation

2.1   Cost of 3.2 mm soda-lime glass = THB 100 per piece

2.2   Cost of depreciation of the equipment = 87,500,000 /5years = THB 17,500,000 per year or equals to 17,500,000/150,000 = THB 116.67 per piece

2.3   Cost of direct labor = 3shifts x 3persons x 15,000 THB/month x 12months = THB 1,620,000 per year or equals to 1,620,000/150,000 = THB 10.80 per piece

2.4   Cost of electricity = 200kW x313days x24hours x3.50THB/kWh = THB 5,258,400 per year or equals to 5,258,400/150,000 = THB 35.08 per piece

2.5   Cost of metallic targets = THB 8,000,000 per year or equals to 8,000,000/150,000 = THB 53.33 per piece

2.6   Cost of process gases = THB 1,200,000 per year or equals to 1,200,000/150,000 = THB 8.00 per piece

2.7   Cost of maintenance and services = THB 600,000 per year or equals to 600,000/150,000 = THB 4.00 per piece

3. Total production cost per piece

3.1 Total production cost without overhead = THB 100+116.67+10.80 +35.08+53.33+8.00+4.00 = THB 327.86 per piece

3.2 Cost contribution from production overhead = THB 327.88 x 10% = THB 32.78 per piece

3.3 Total production cost of in-house TCO glass = THB 327.86+THB 32.79 = THB 360.64
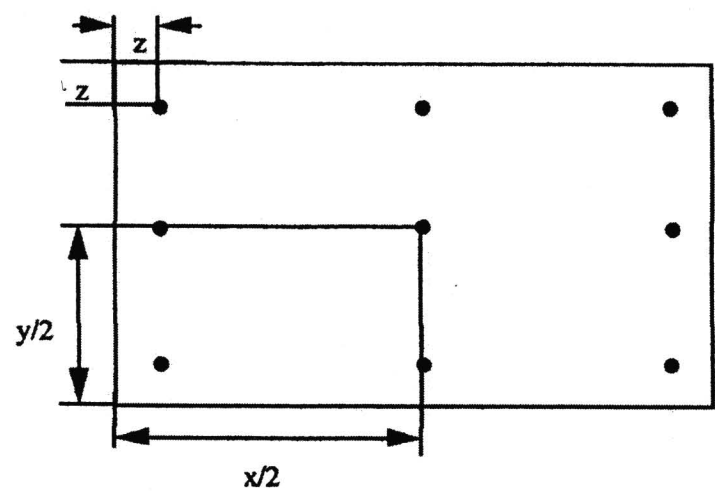
APPENDIX B EVALUATION OF ITO FILM PROPERTIES

1. Measuring Equipment

    1.1 Sheet resistivity with four-point probe

    1.2 Optical transmission with Gaertner ellipsometer

2. Location of Measurement Points on the TCO glass

    For distribution calculation of the film properties 9-15 points per substrate to be measured as illustrated below.

Measurement method	Distance z mm from the coating edge
Spectrophotometer	20 mm
Mechanical profilometer	20 mm
Four-point probe	20 mm

3. Calculation of Distribution

    Following formulas are applied for the calculation of the distribution of sheet resistance and thickness.

    3.1 Calculation of Distribution for one Carrier Holder.

$$U = \pm \frac{X_{max} - X_{min}}{2\bar{X}} \cdot 100 \quad [\%]$$

☐= deviation of measured values (%)

X_{max}= maximum value

X_{min} = minimum value

$\bar{X}$ = arithmetical average value of all X-values

3.2 Calculation of Distribution from Carrier to Carrier (Reproducibility).

$$R = \pm \frac{\bar{X}_{max} - \bar{X}_{min}}{2\bar{X}} \cdot 100 \quad [\%]$$

R= reproducibility from carrier to carrier (%)

$\bar{X}_{max}$= maximum arithmetical average value

$\bar{X}_{min}$= minimum arithmetical average value

$\bar{X}$ = arithmetical average value of all X-values

The calculation of $\bar{X}$ of a carrier is:

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

$\bar{X}$ = arithmetical average value of all X-values

☐= sum of X-values measured on a carrier

n= number of values measured on the carrier

BIOGRAPHY

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