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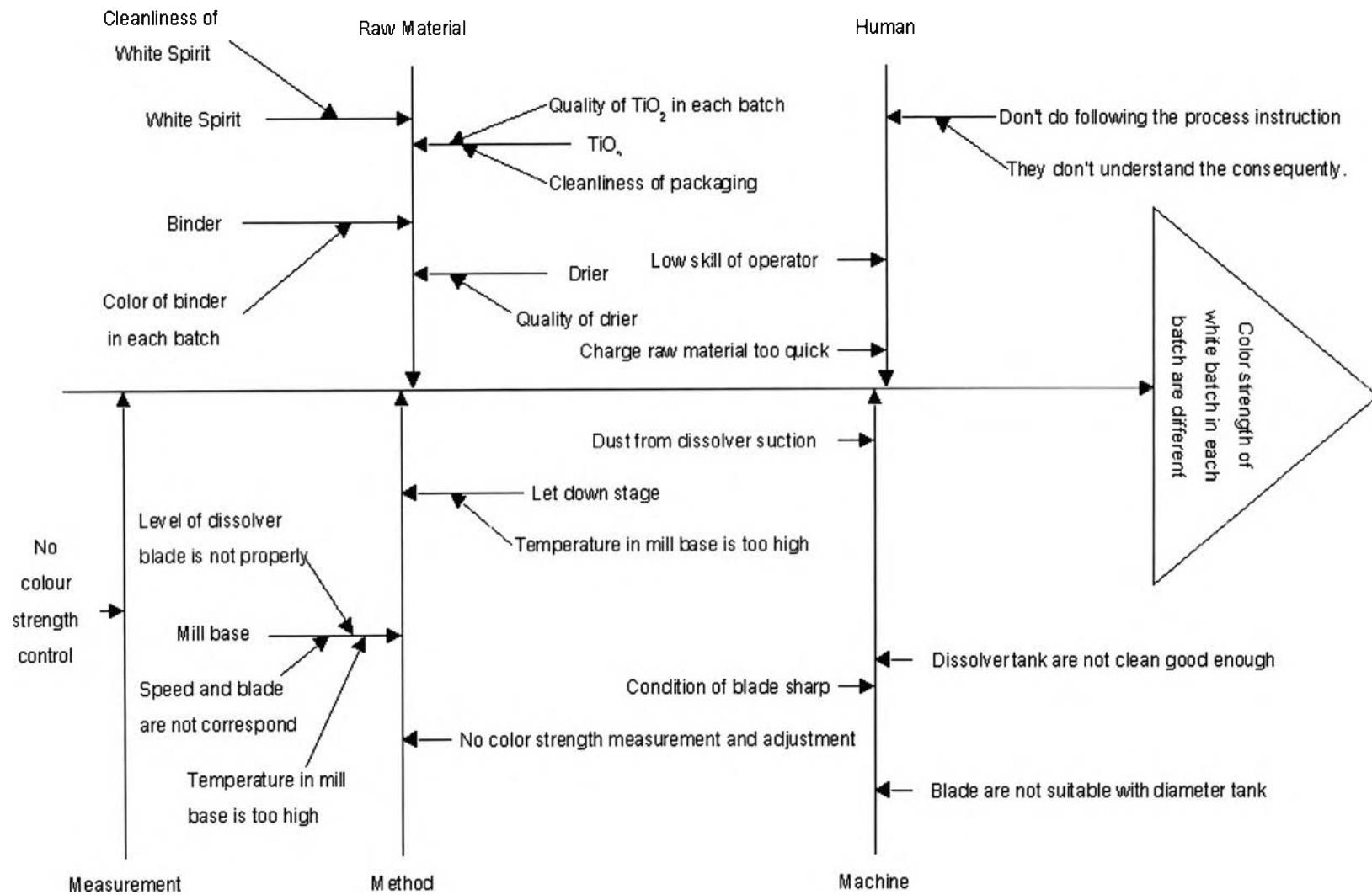
Warwick Module Note (2002) Quality Management and Technique. Coventry : University of Warwick. United Kingdom.

Appendices

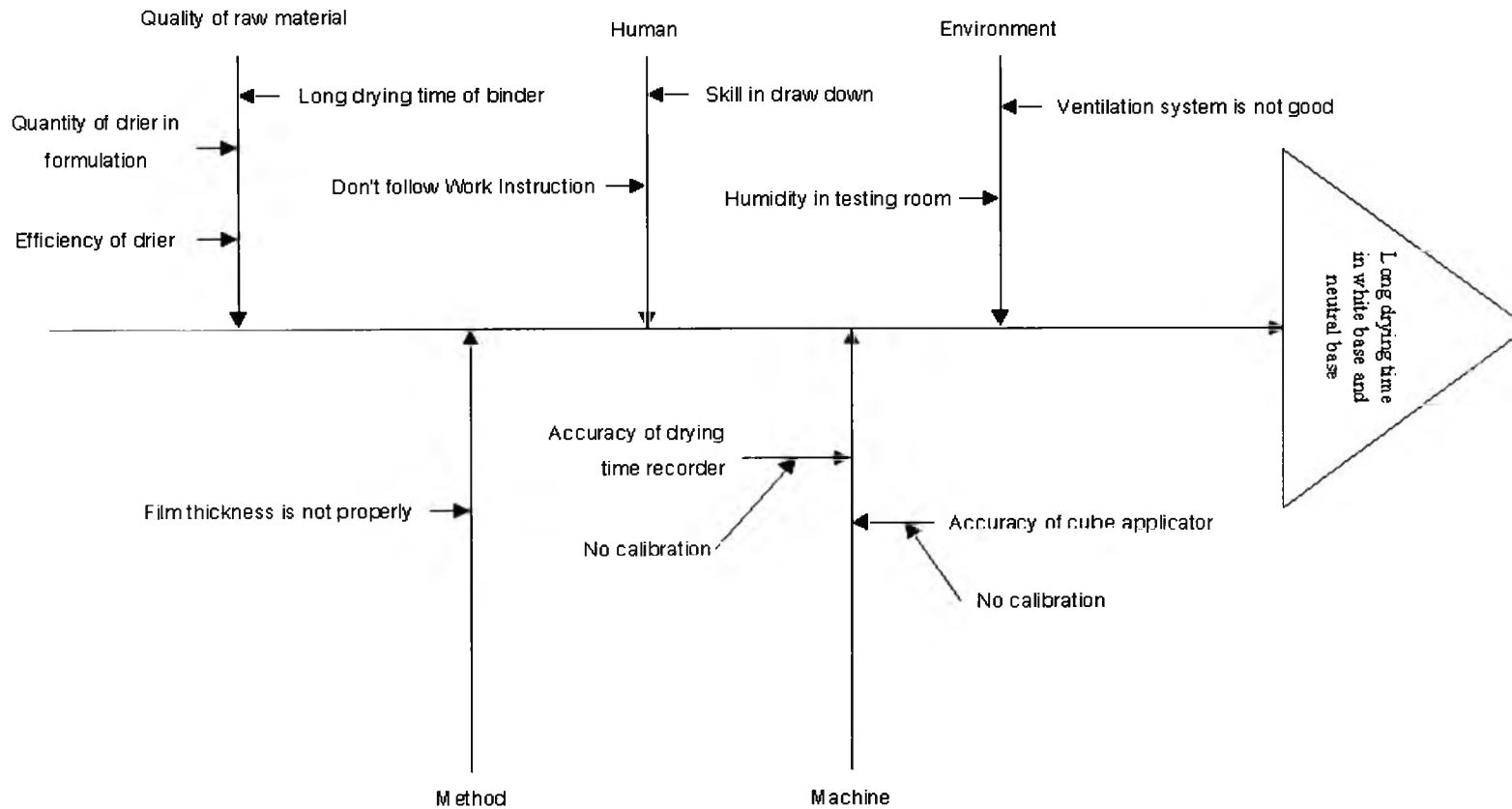
Appendix I

Fish bone diagram
For
Tinting section in Alkyd tinted products

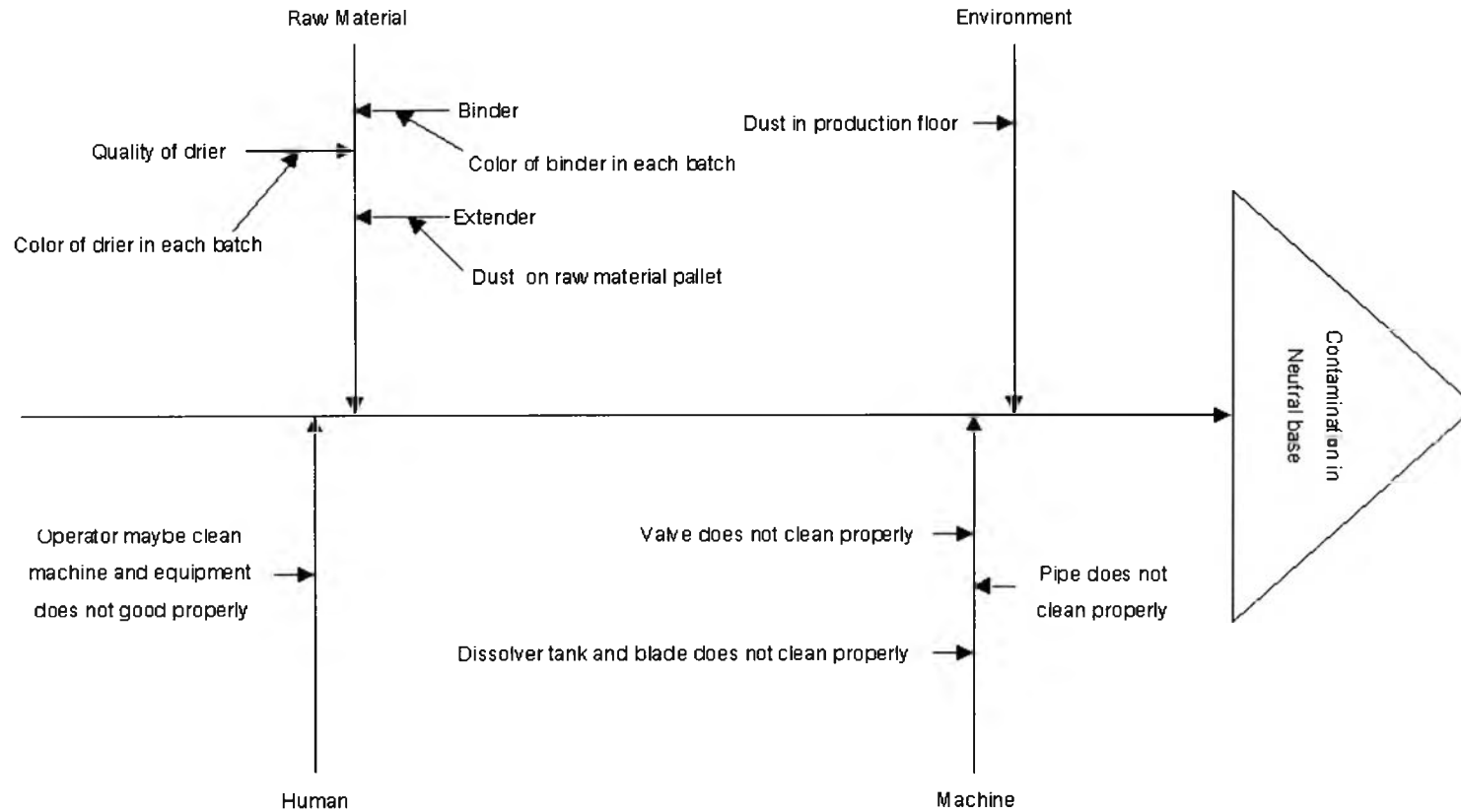
Fish Bone Diagram for Cause and Effective Analysis : Color strength of white base in each batch are different



Fish Bone Diagram for Cause and Effective Analysis : Long drying time in white base and neutral base

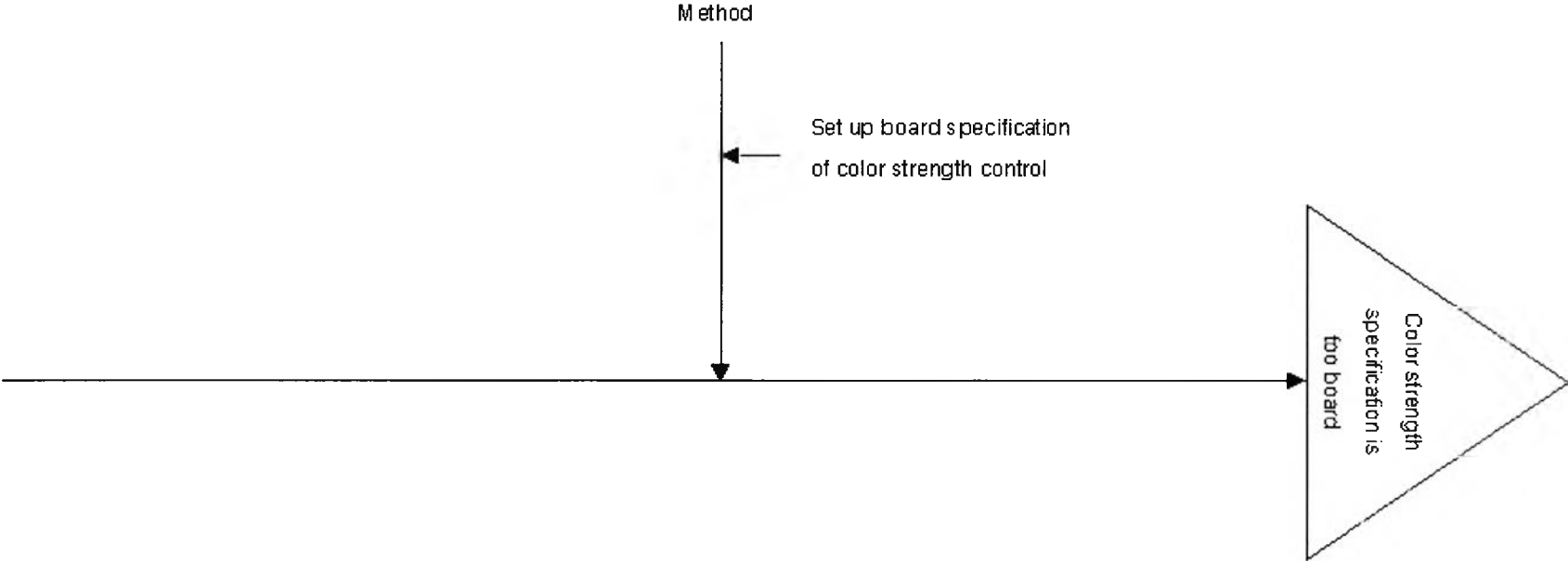


Fish Bone Diagram for Cause and Effective Analysis : Contamination in Neutral Base

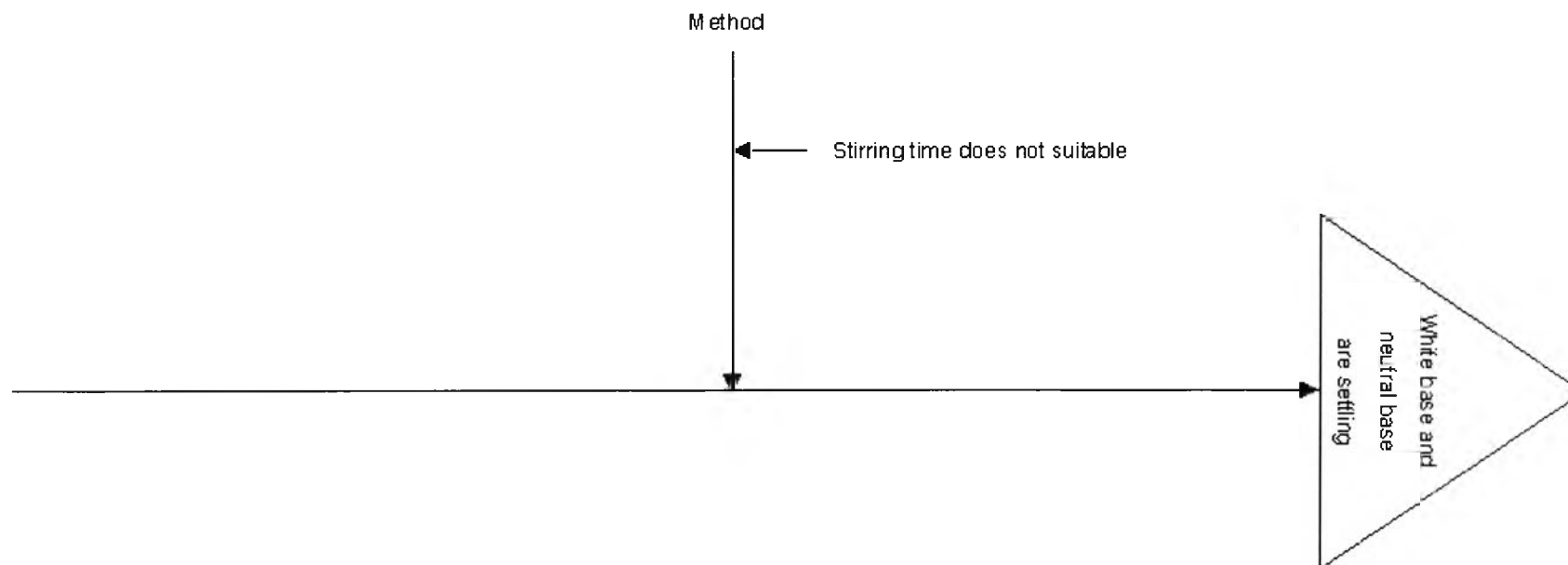


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12.6.02

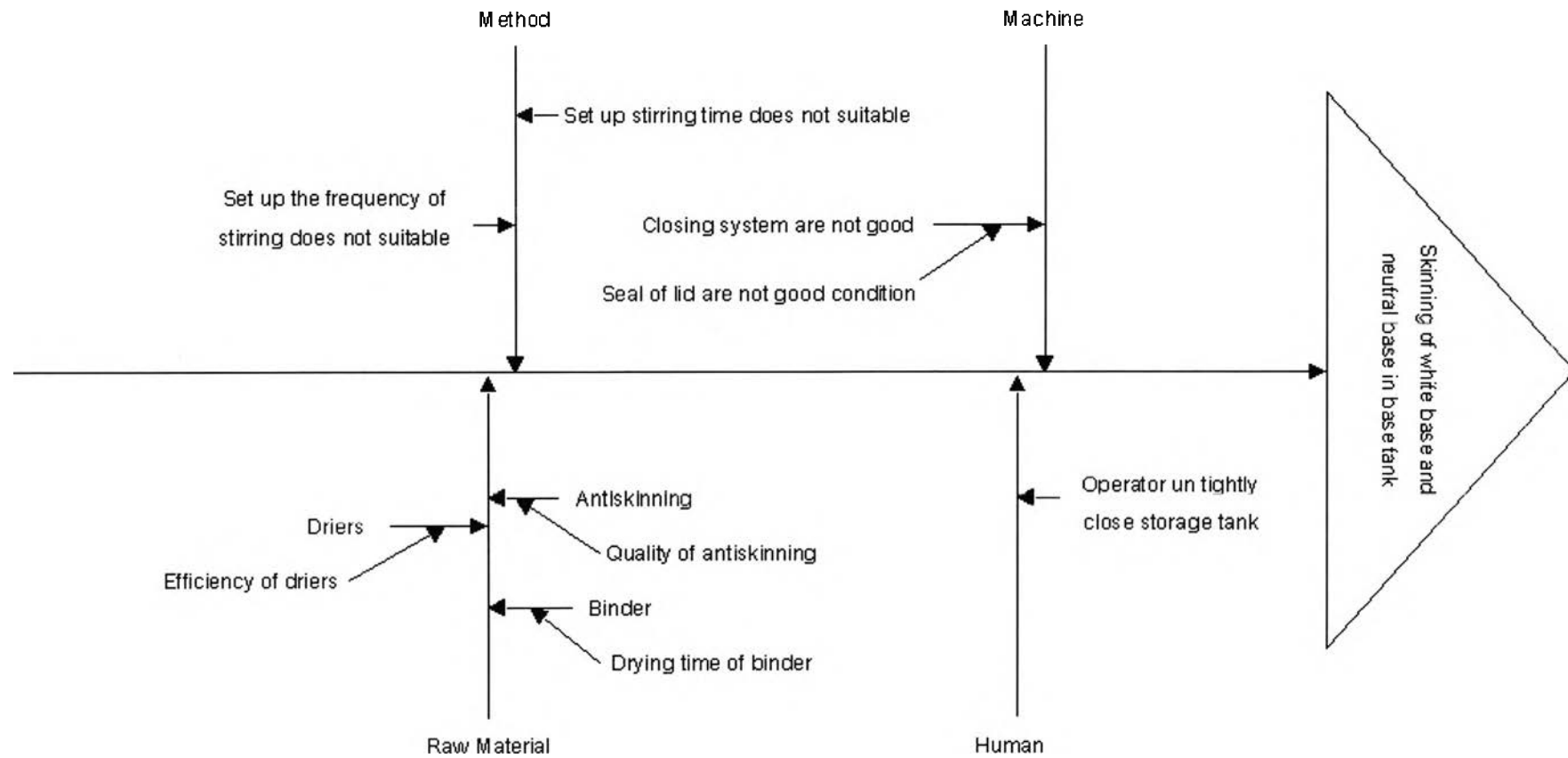
Fish Bone Diagram for Cause and Effective Analysis : Color strength specification is too board



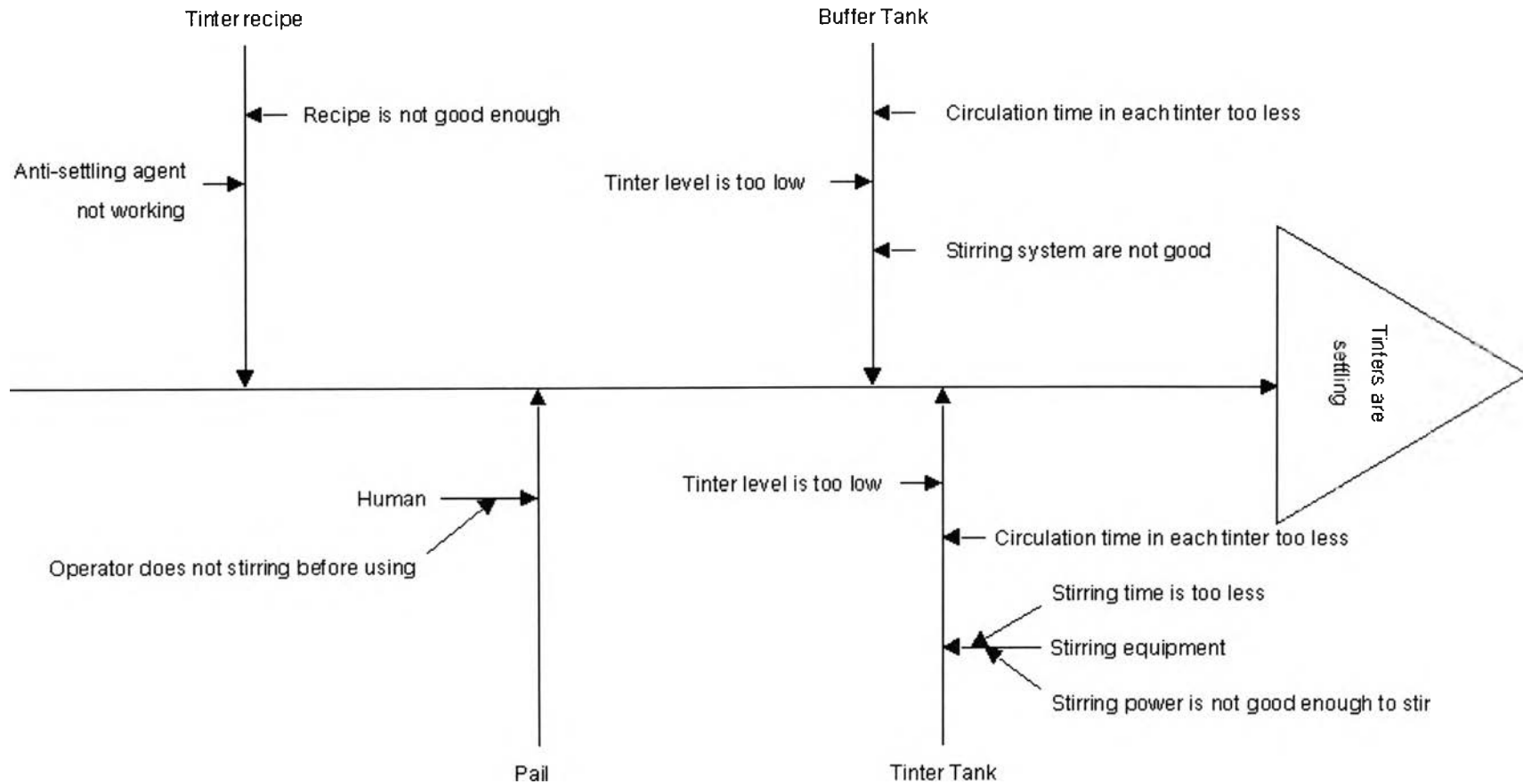
Fish Bone Diagram for Cause and Effective Analysis : White base and neutral base are settling



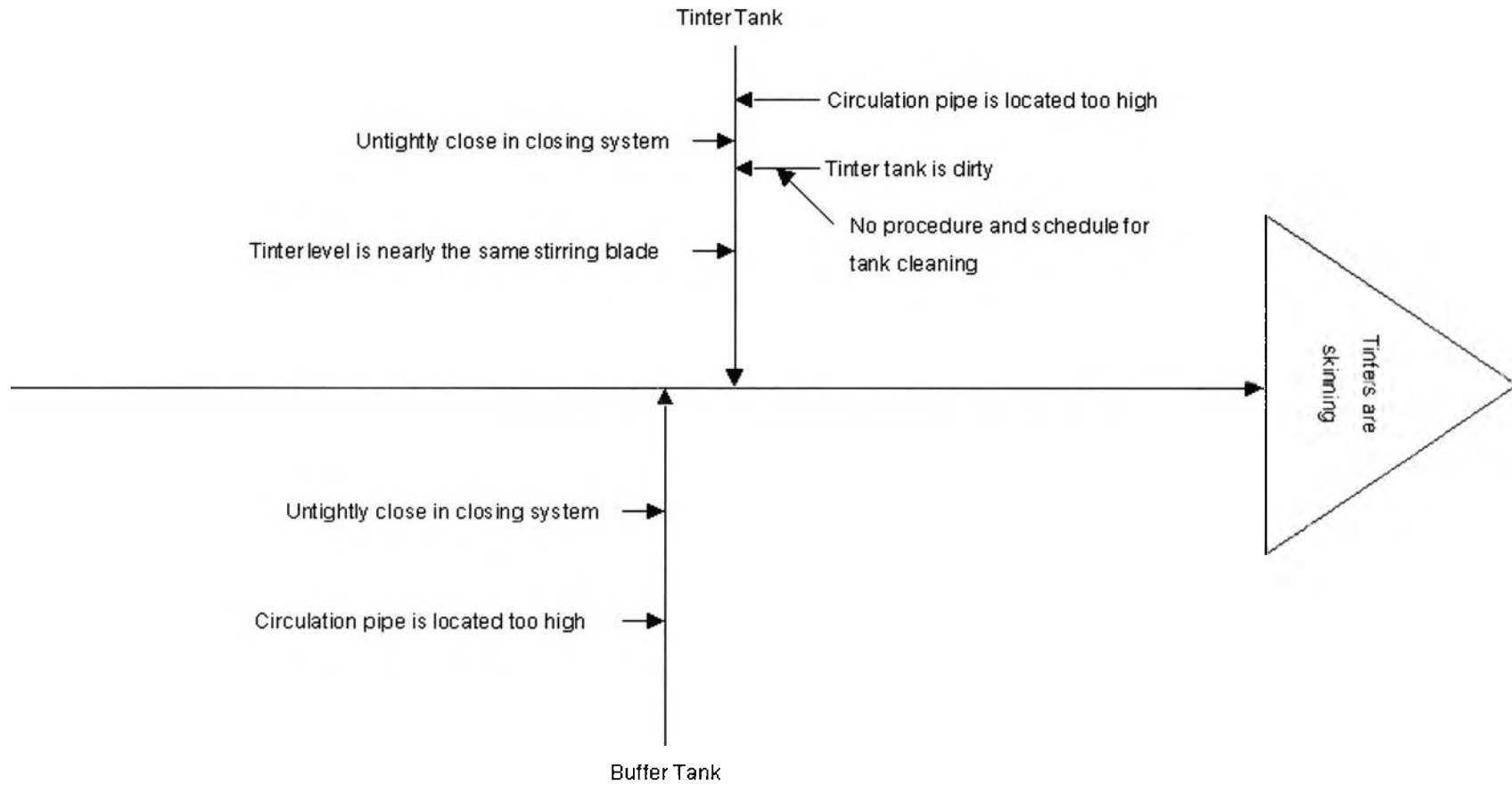
Fish Bone Diagram for Cause and Effective Analysis : Skinning of white base and neutral base in base tank



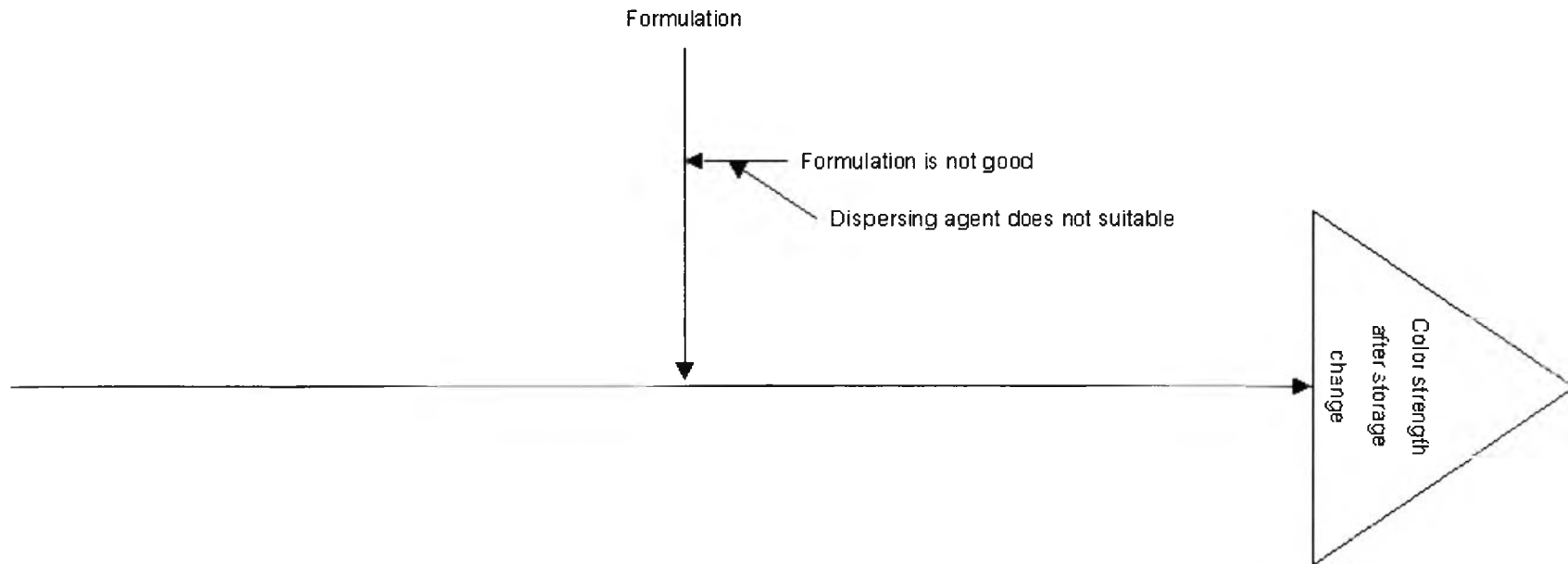
Fish Bone Diagram for Cause and Effective Analysis : Tinters are settling



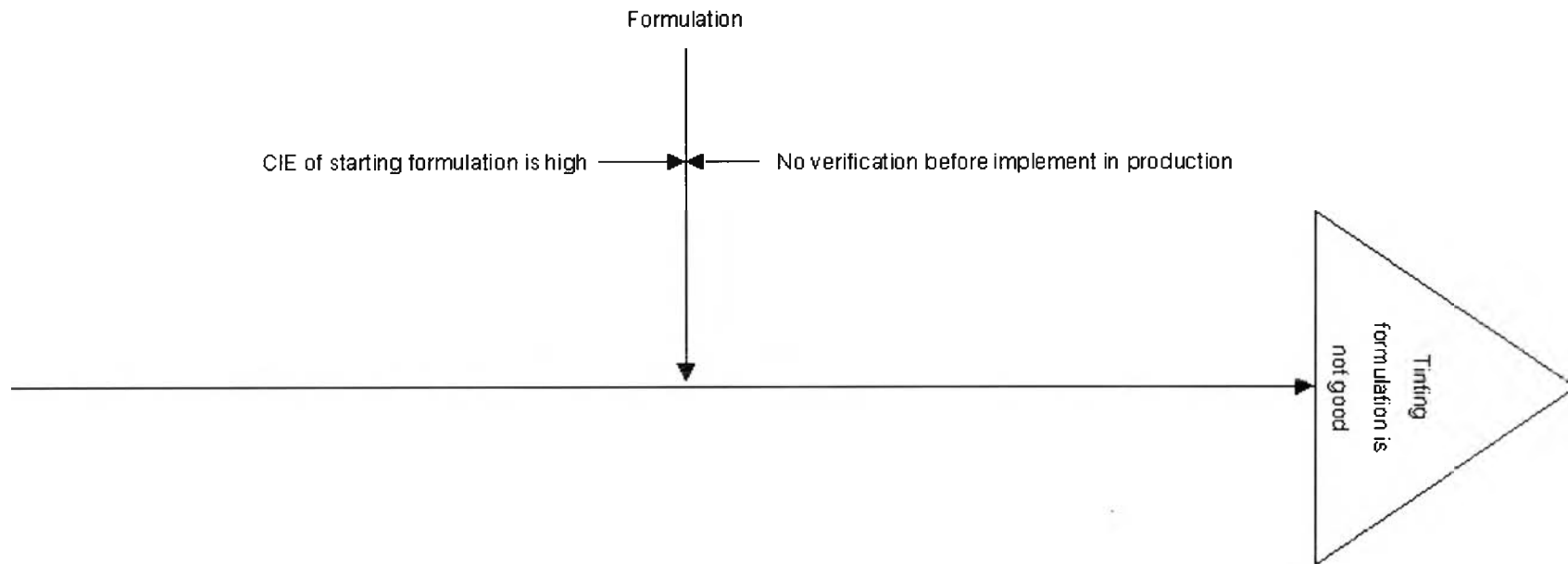
Fish Bone Diagram for Cause and Effective Analysis : Tinters are skinning



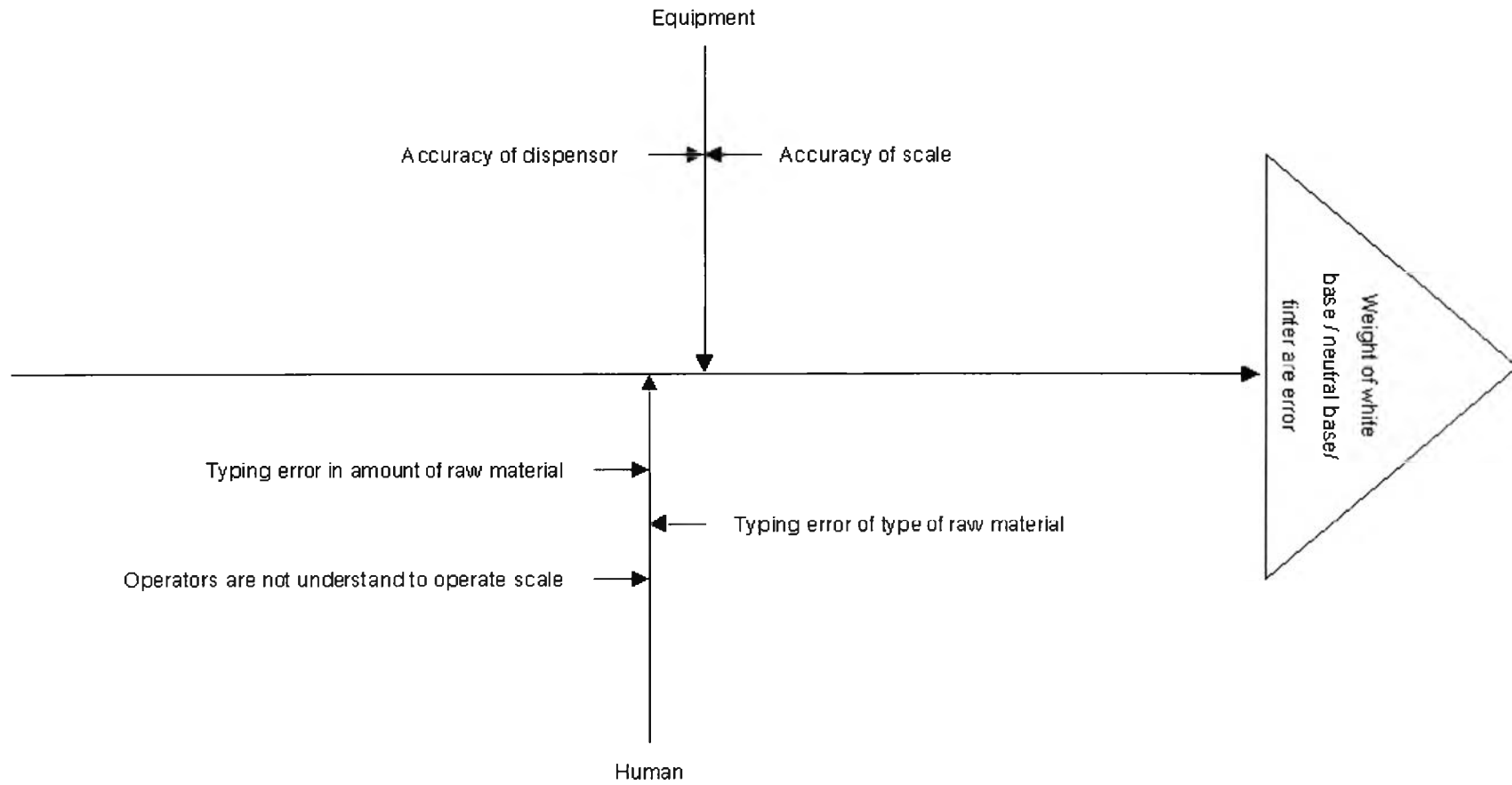
Fish Bone Diagram for Cause and Effective Analysis : Color strength changing after storage



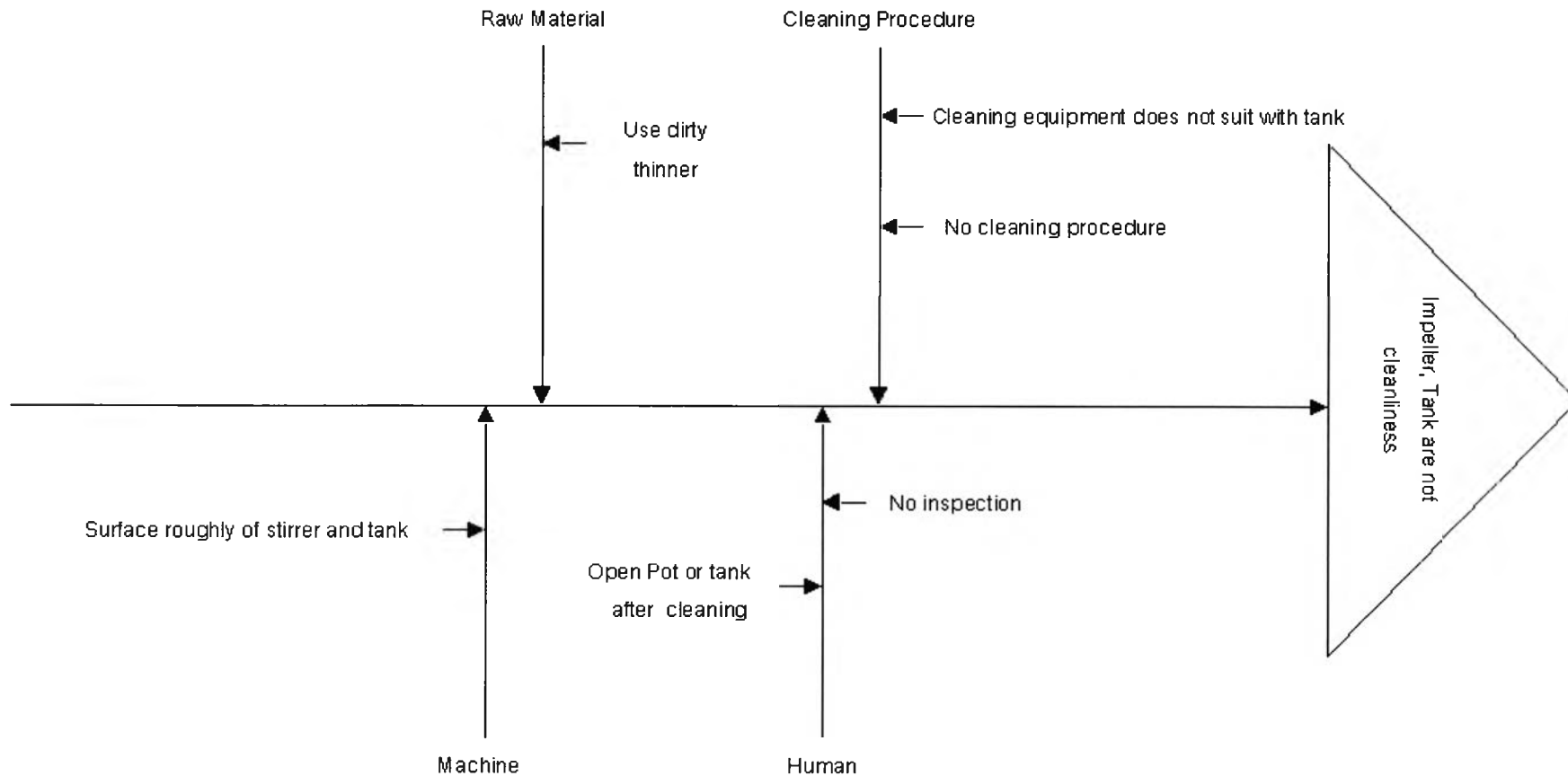
Fish Bone Diagram for Cause and Effective Analysis : Tinting formulation is not good



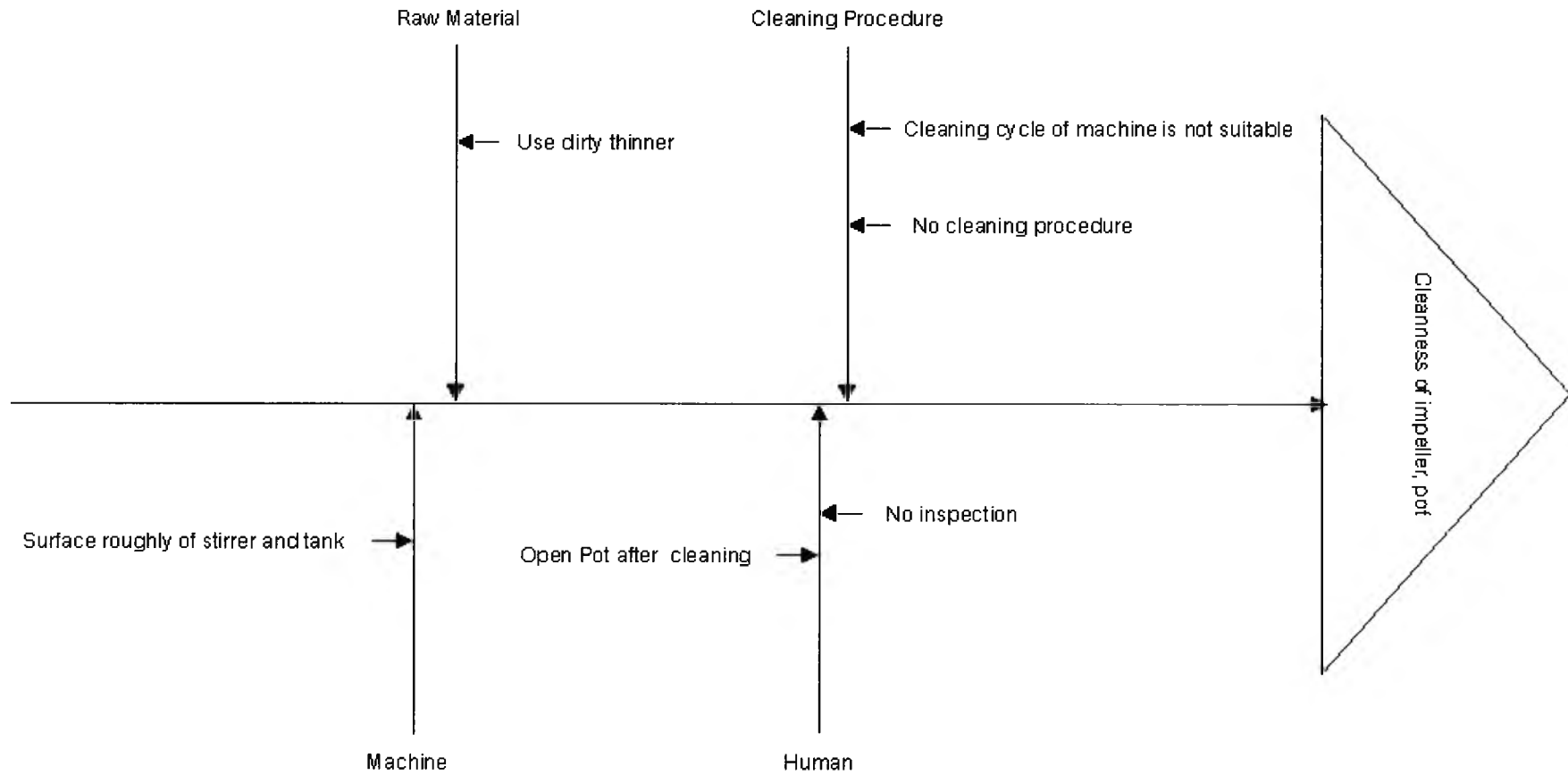
Fish Bone Diagram for Cause and Effective Analysis : Weight of white base, neutral base and tinter are error



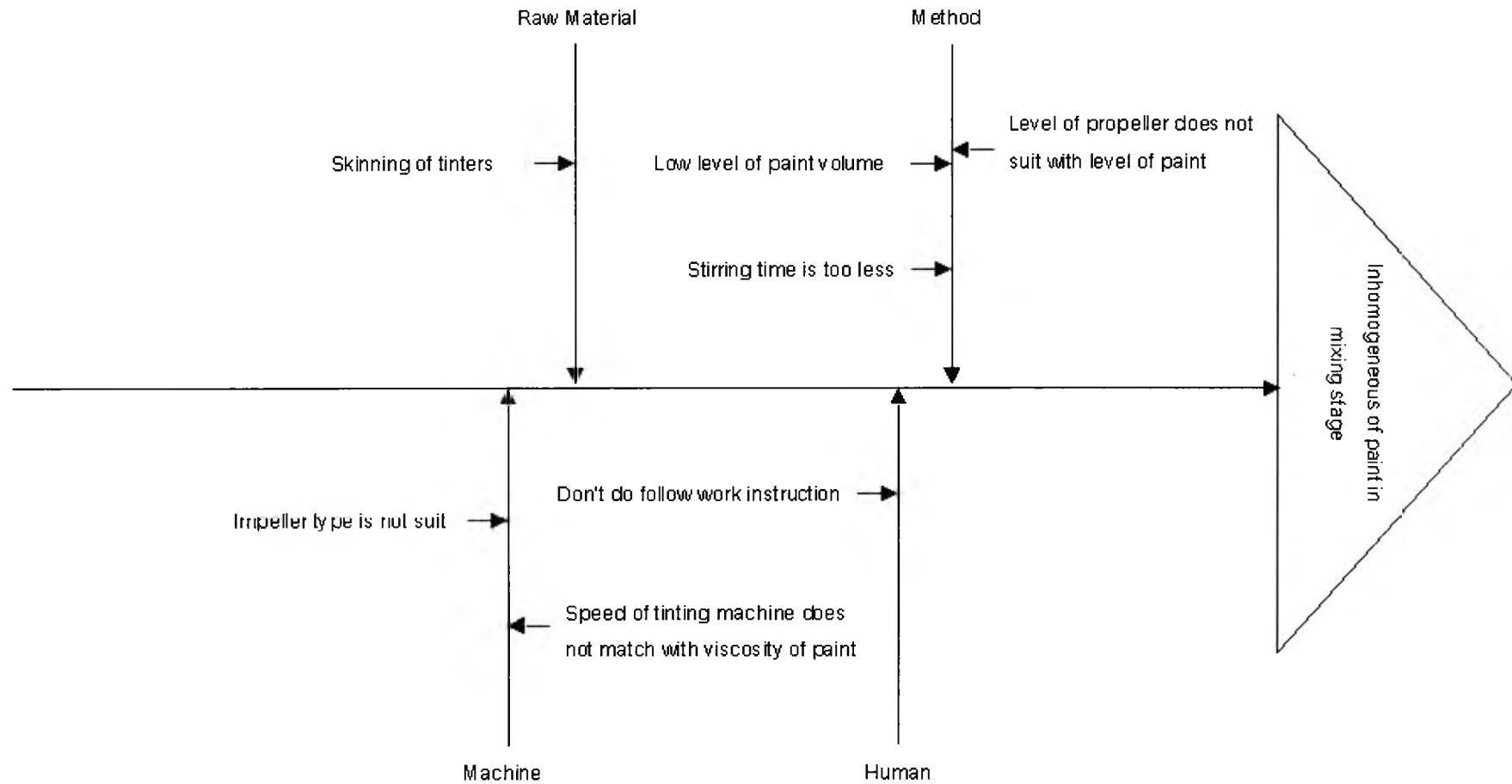
Fish Bone Diagram for Cause and Effective Analysis : Cleanness of impeller, tank



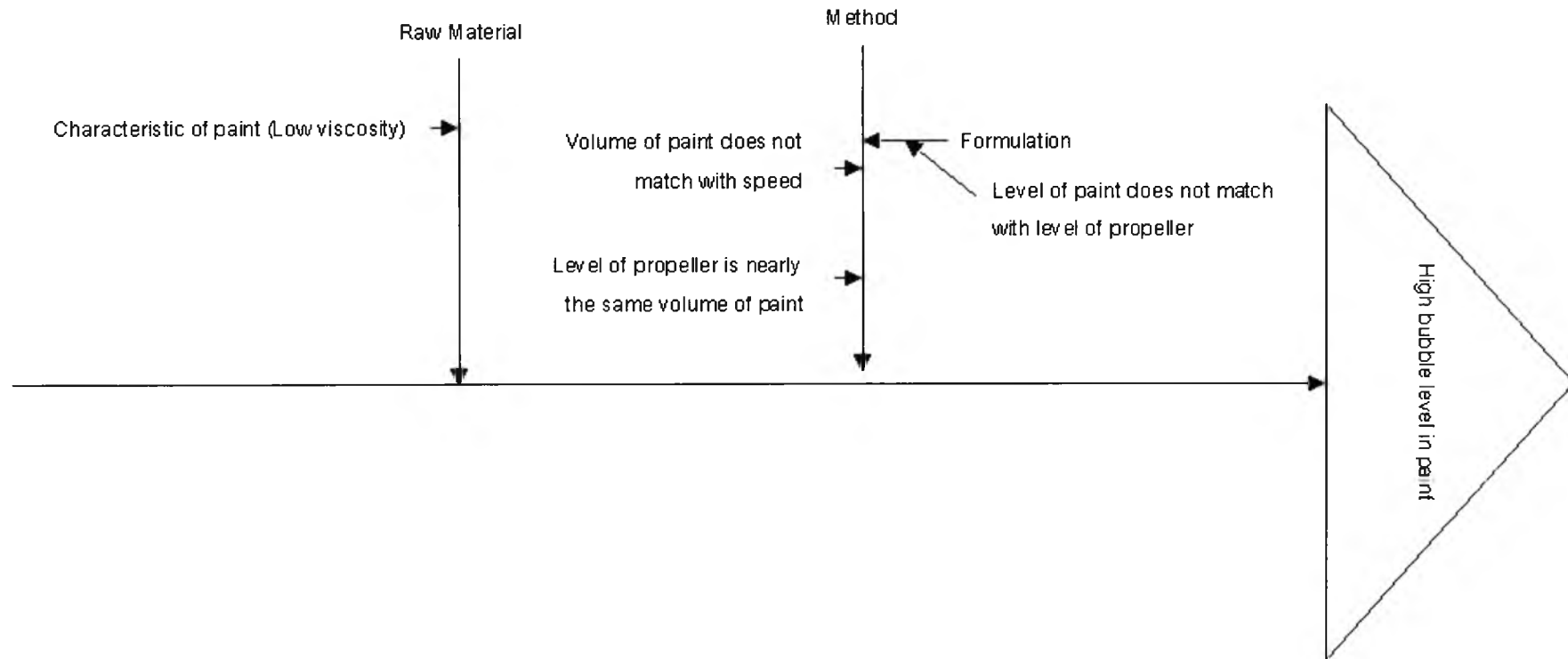
Fish Bone Diagram for Cause and Effective Analysis : Cleanness of impeller, pot



Fish Bone Diagram for Cause and Effective Analysis : Inhomogeneous of paint in mixing stage

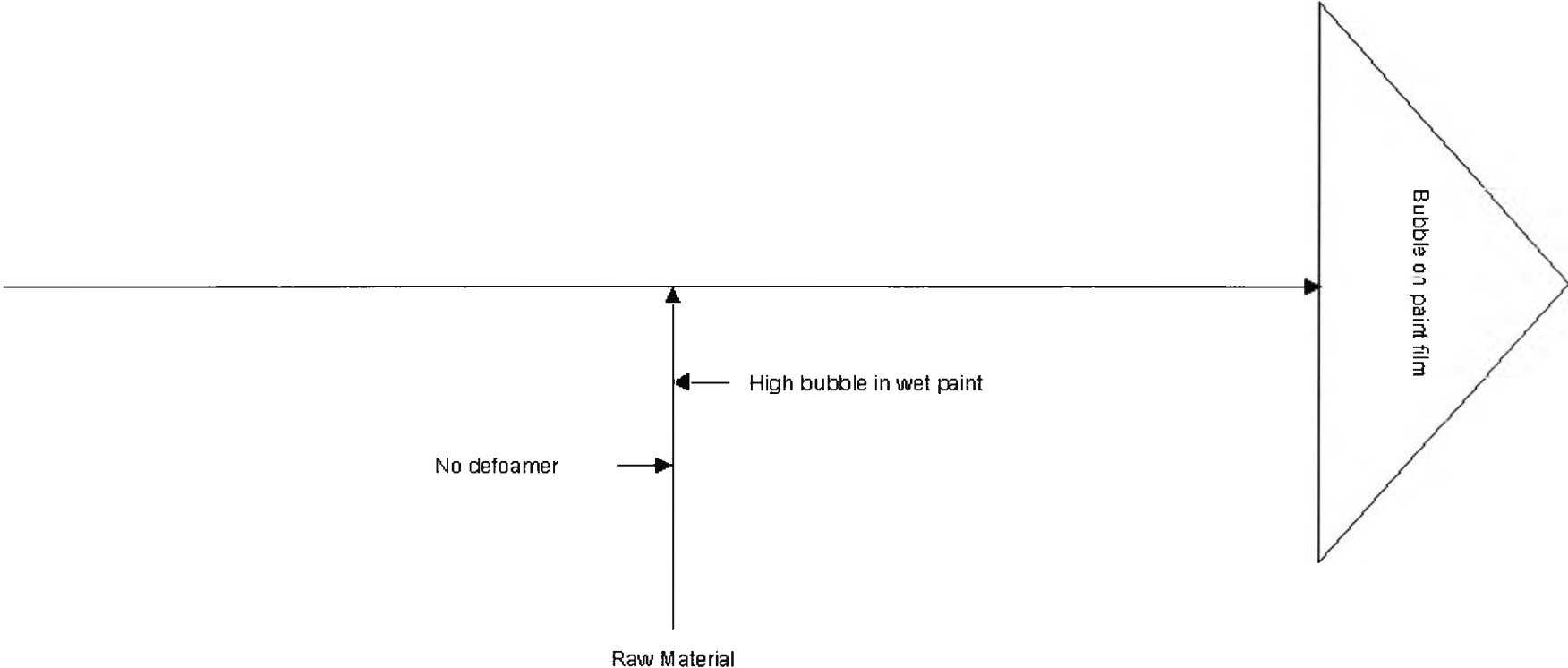


Fish Bone Diagram for Cause and Effective Analysis : High bubble in paint



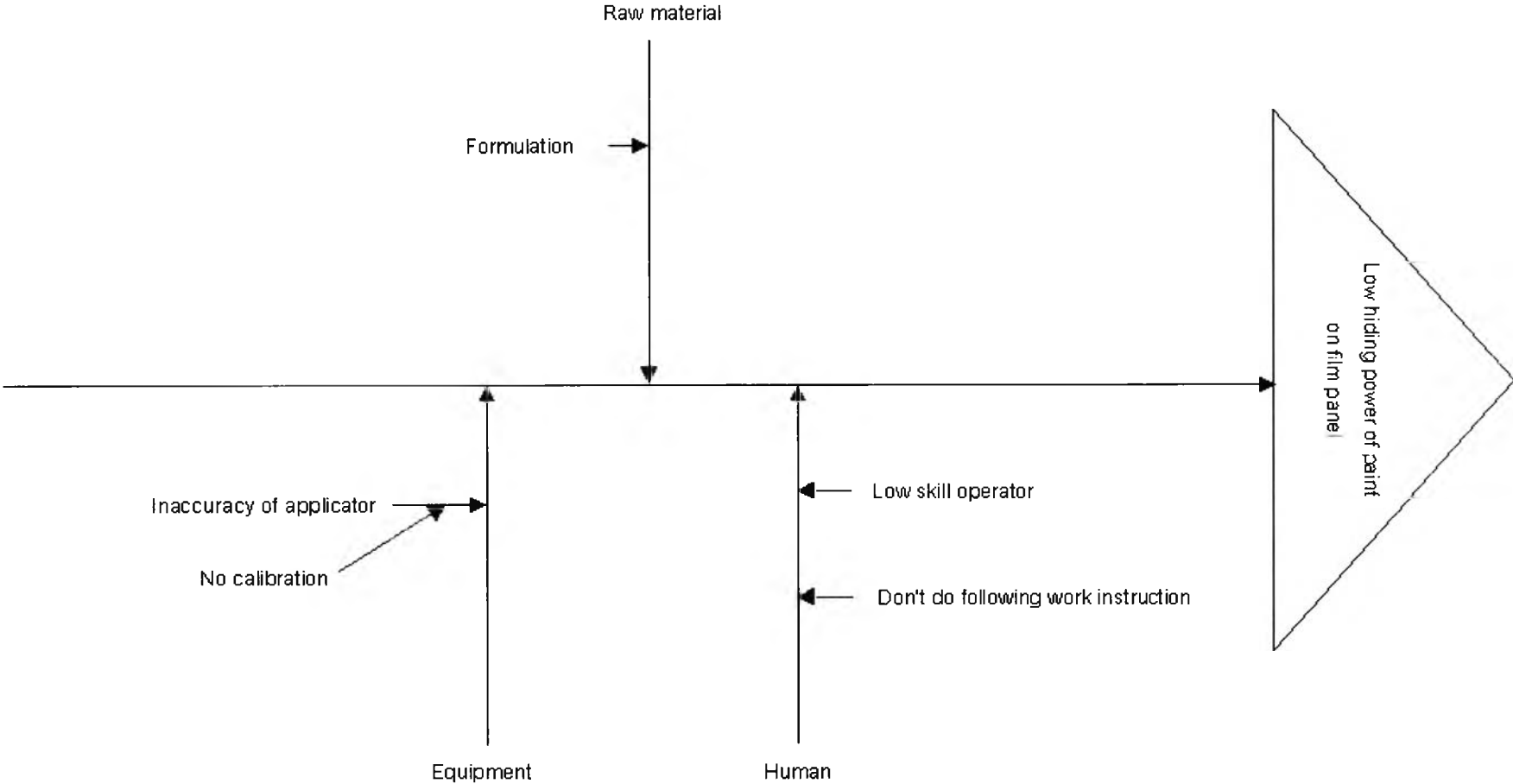
Color Panel Preparation: Make the draw down panel as following as specification

Fish Bone Diagram for Cause and Effective Analysis : High bubble on paint film



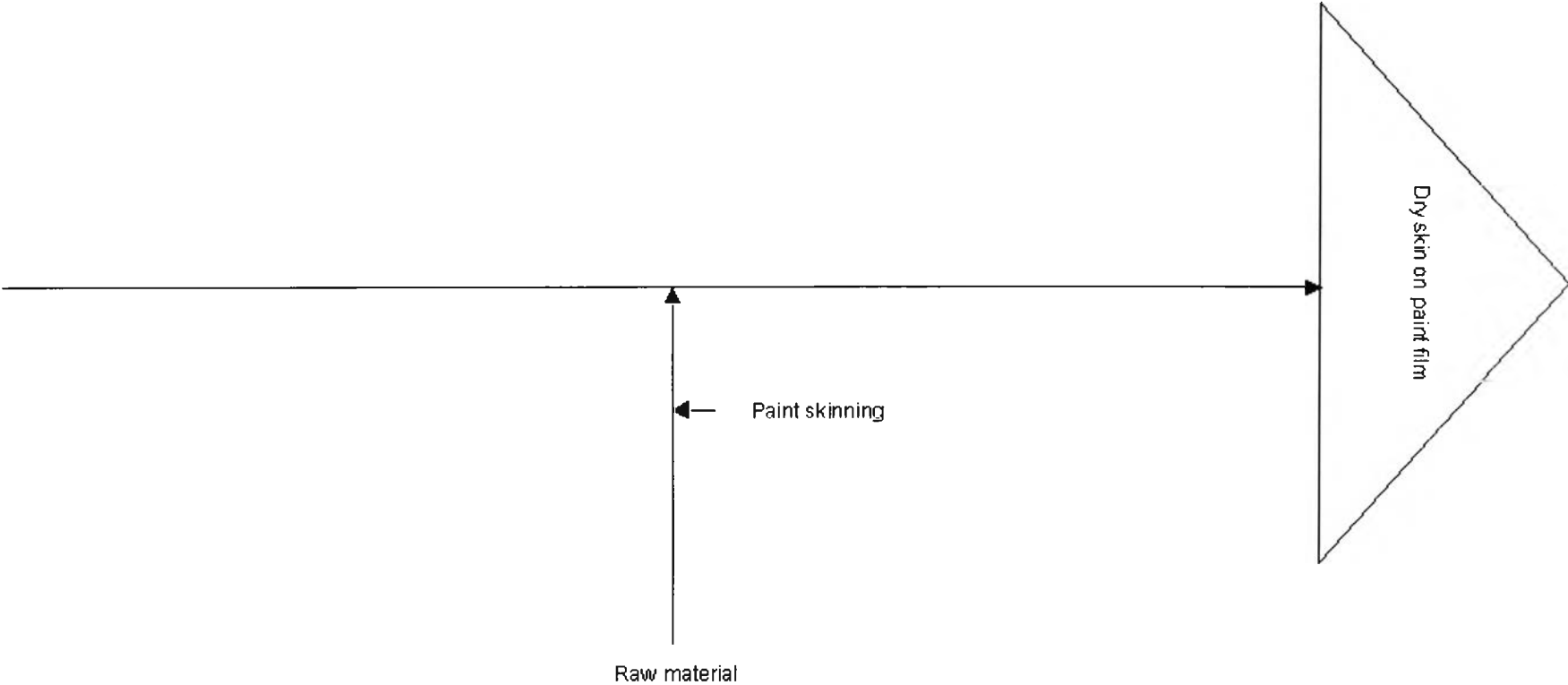
Color Panel Preparation : Make the draw down panel as following as specification

Fish Bone Diagram for Cause and Effective Analysis : Low hiding power of paint on film panel



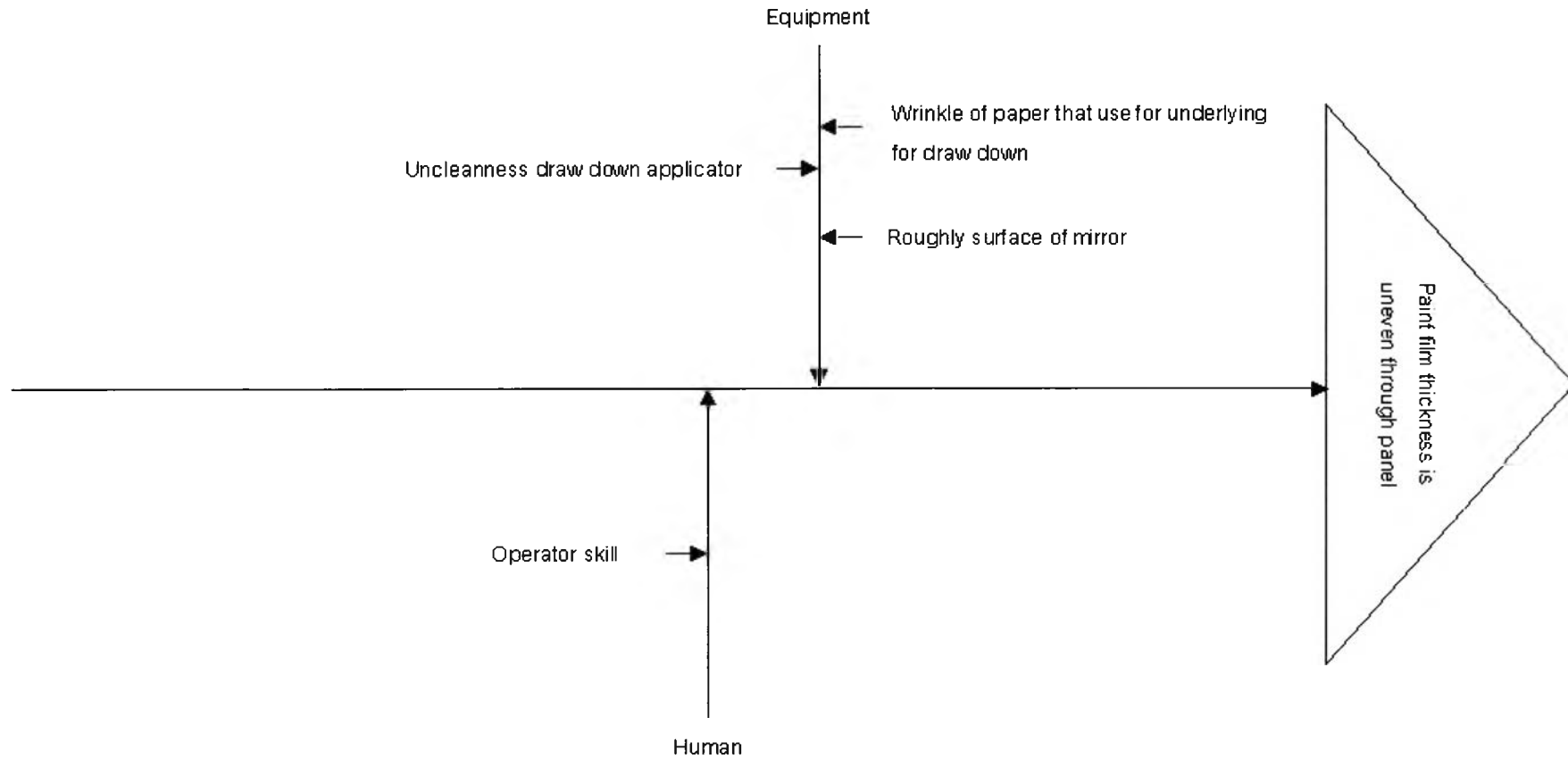
Color Panel Preparation : Make the draw down panel as following as specification

Fish Bone Diagram for Cause and Effective Analysis : Dry skinning on paint film



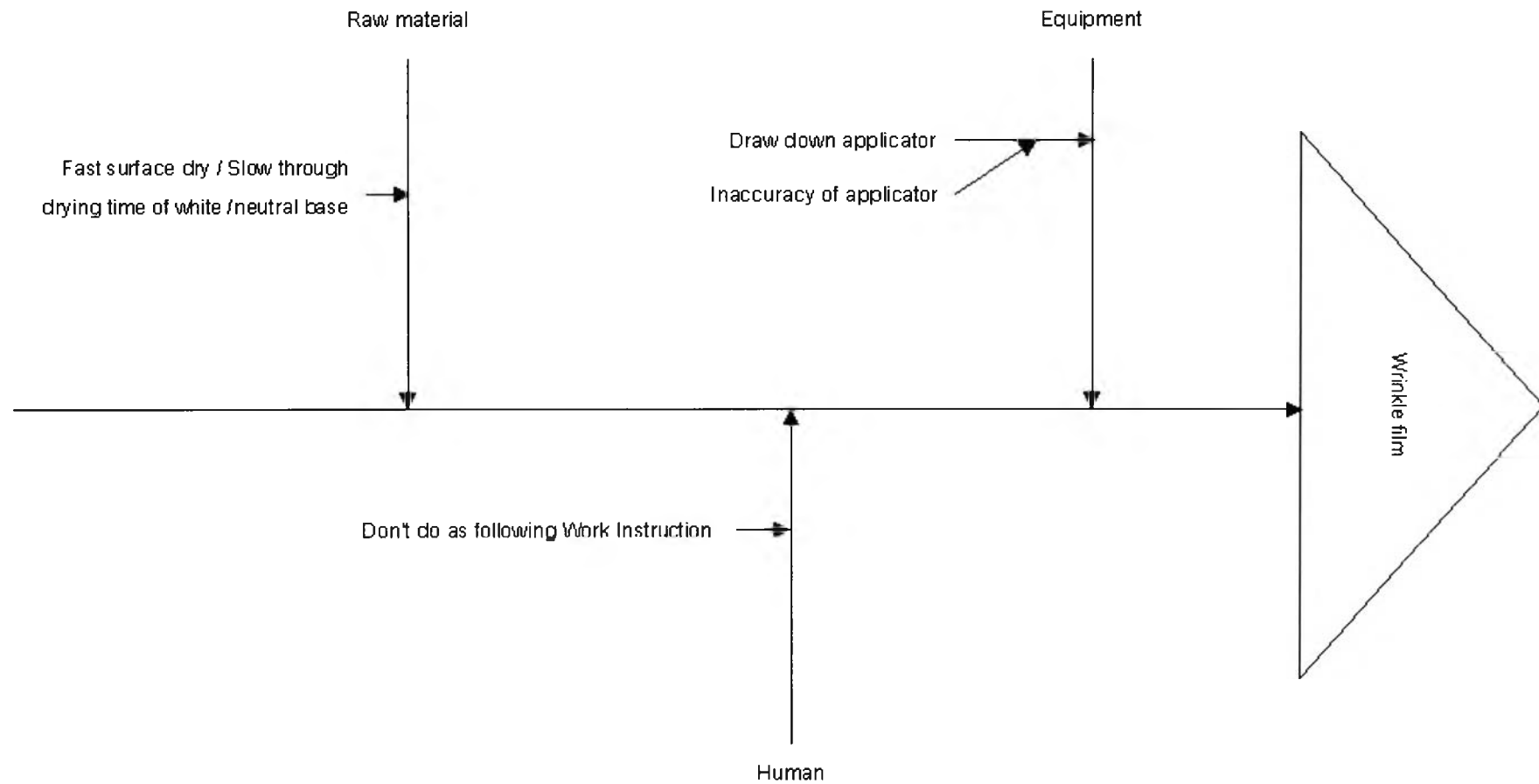
Color Panel Preparation: Make the draw down panel as following as specification

Fish Bone Diagram for Cause and Effective Analysis : Paint film thickness is uneven through panel



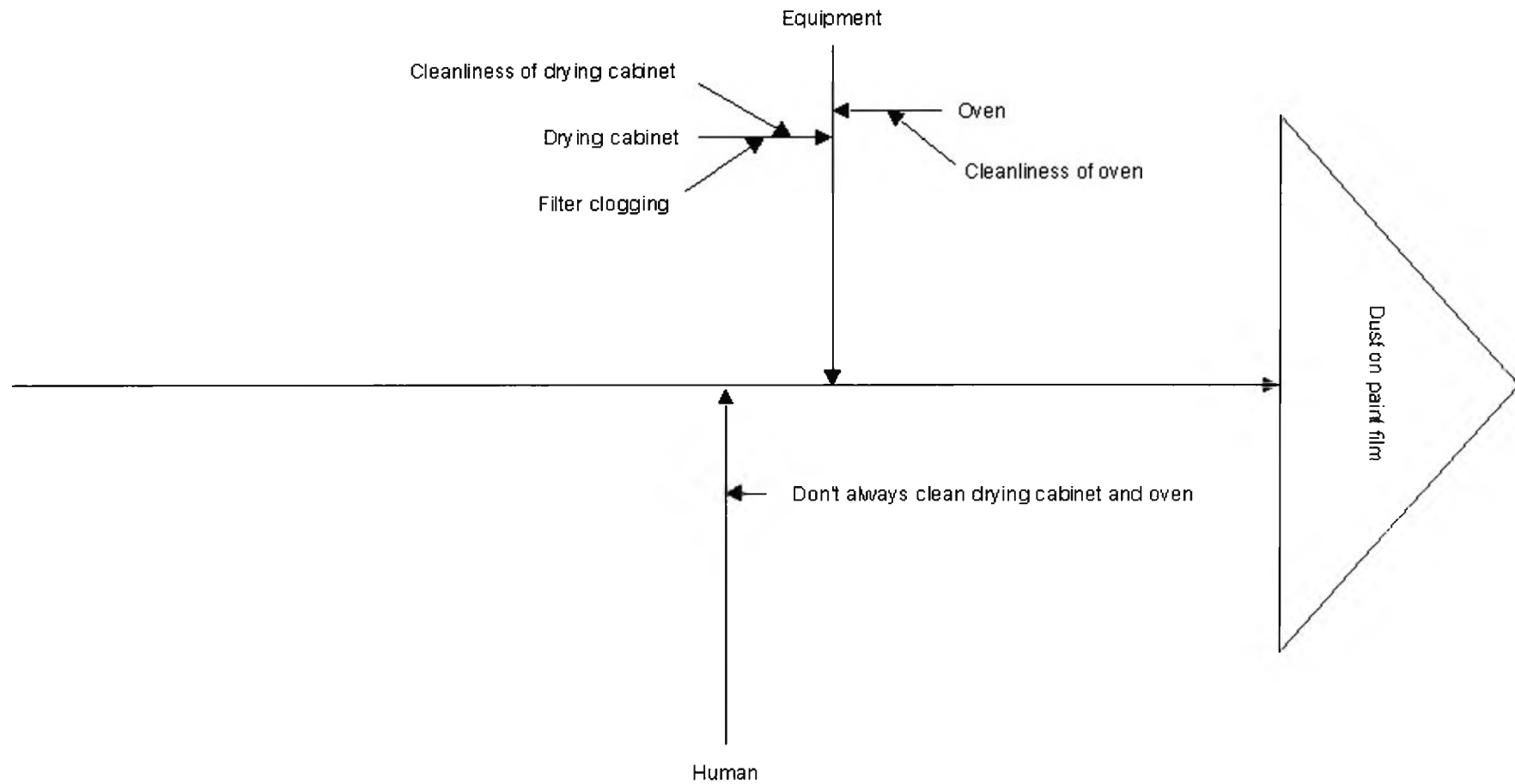
Color Panel Preparation : Make the draw down panel as following as specification

Fish Bone Diagram for Cause and Effective Analysis : Film is wrinkle



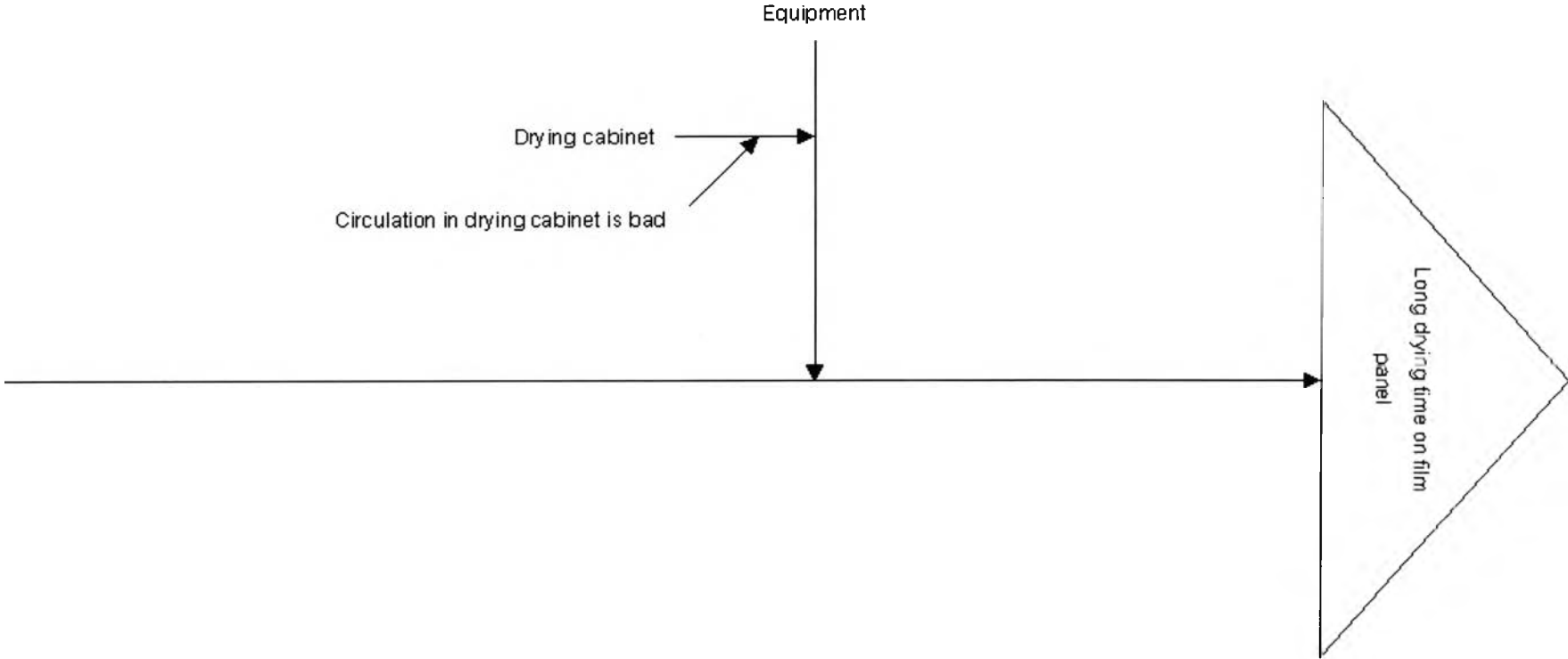
Color Panel Preparation : Keep in drying cabinet

Fish Bone Diagram for Cause and Effective Analysis : Dust on film panel

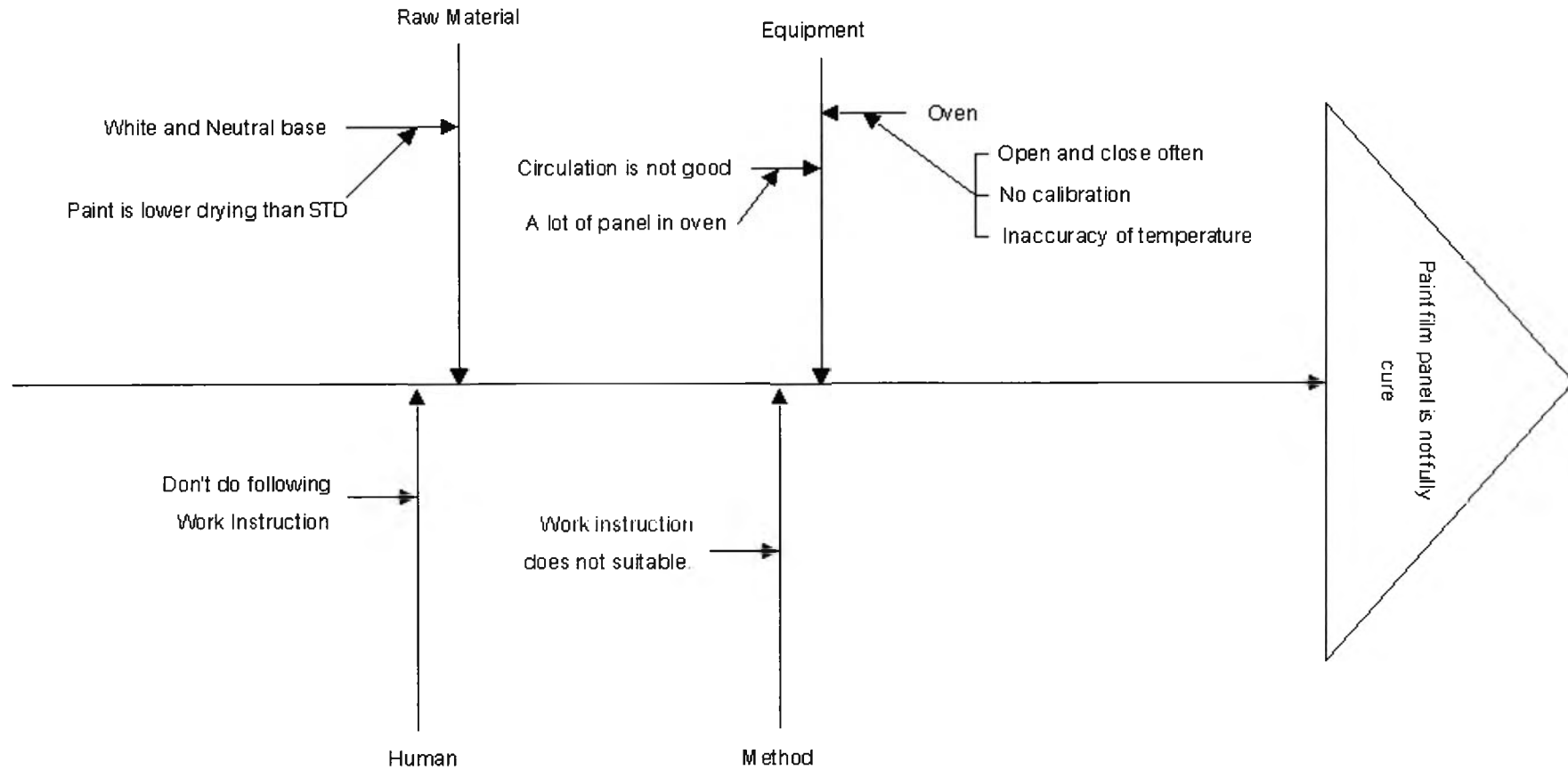


Color Panel Preparation : Keep in drying cabinet

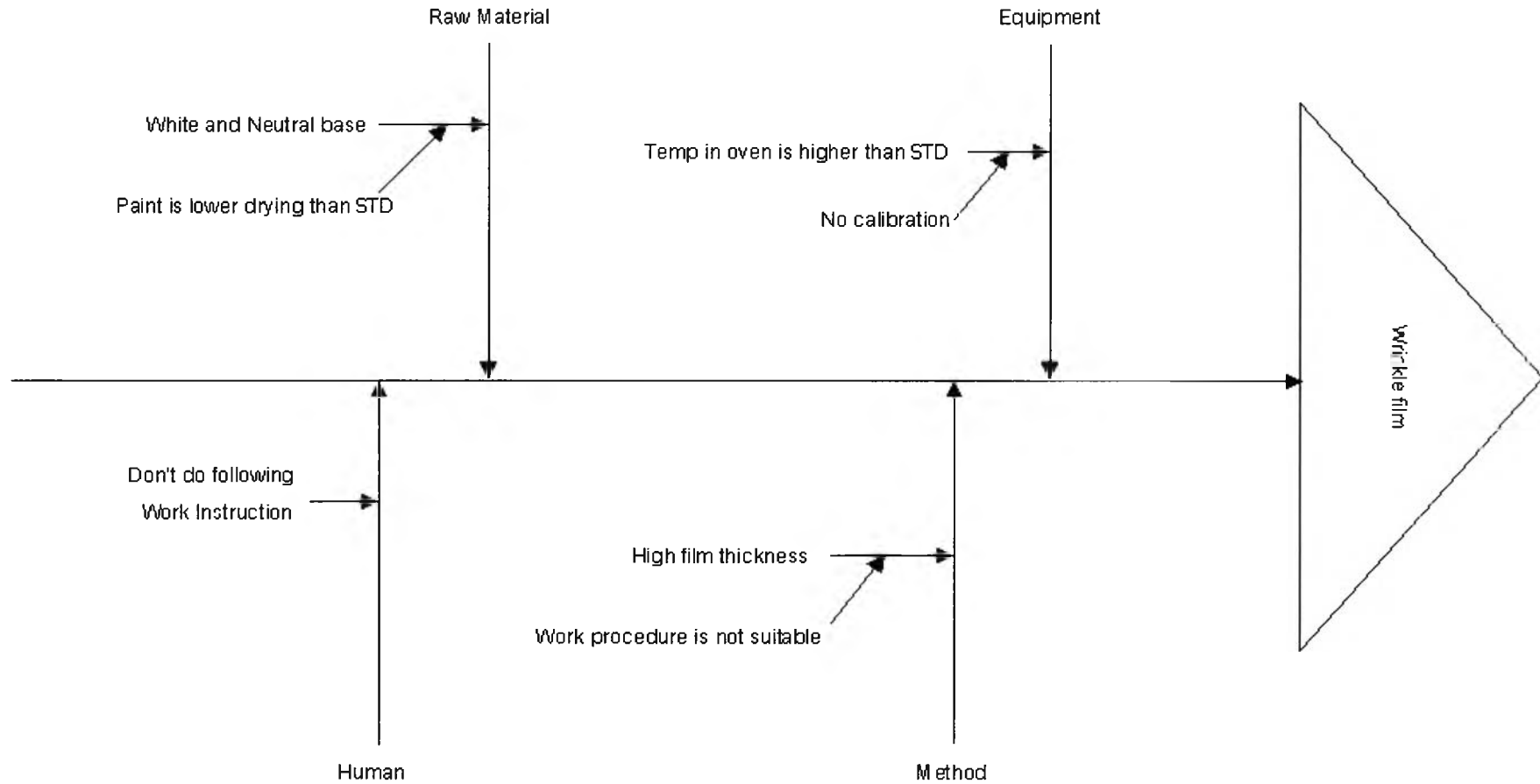
Fish Bone Diagram for Cause and Effective Analysis : Long drying time on film panel



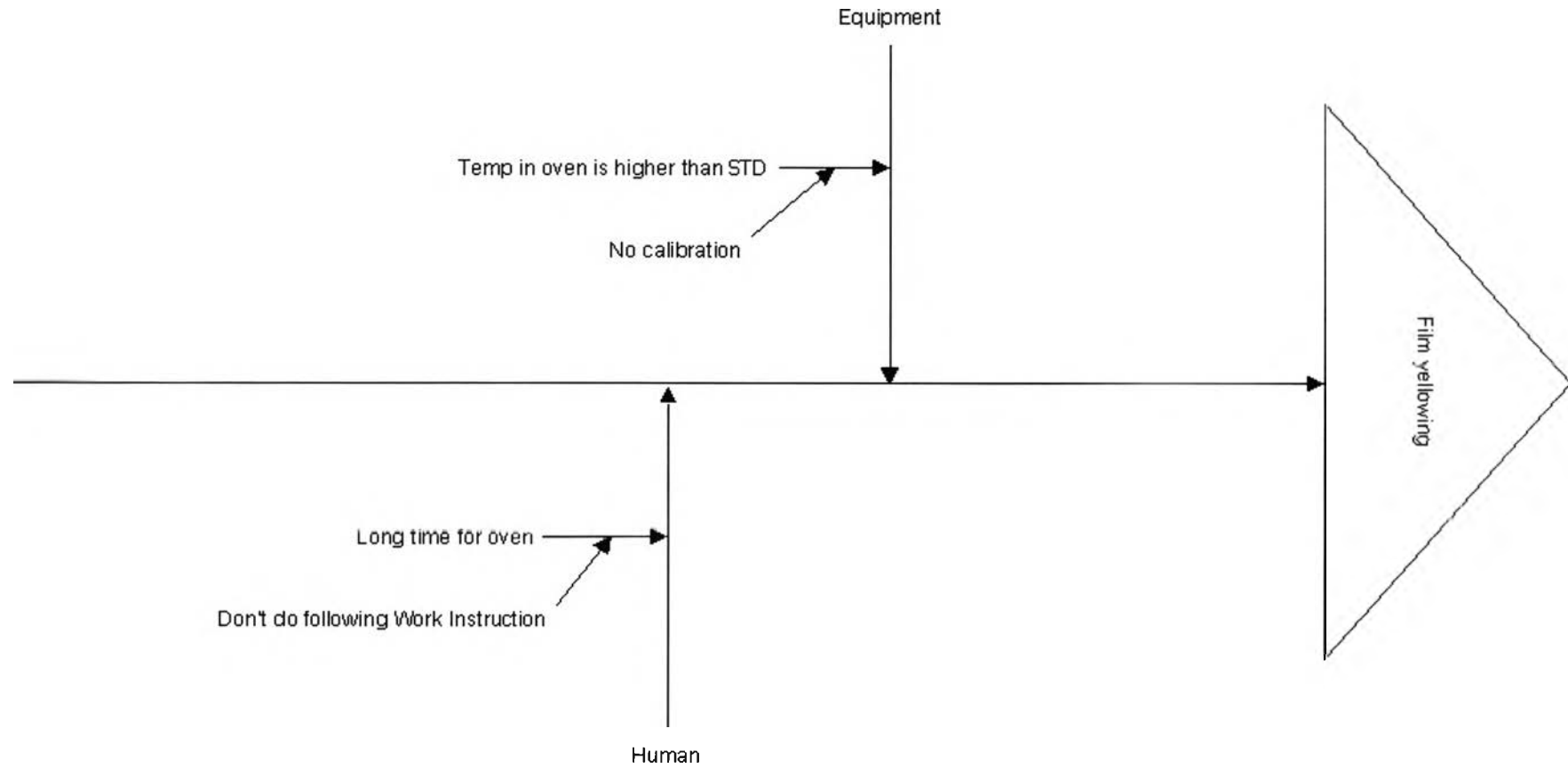
Fish Bone Diagram for Cause and Effective Analysis : Long drying time on film panel



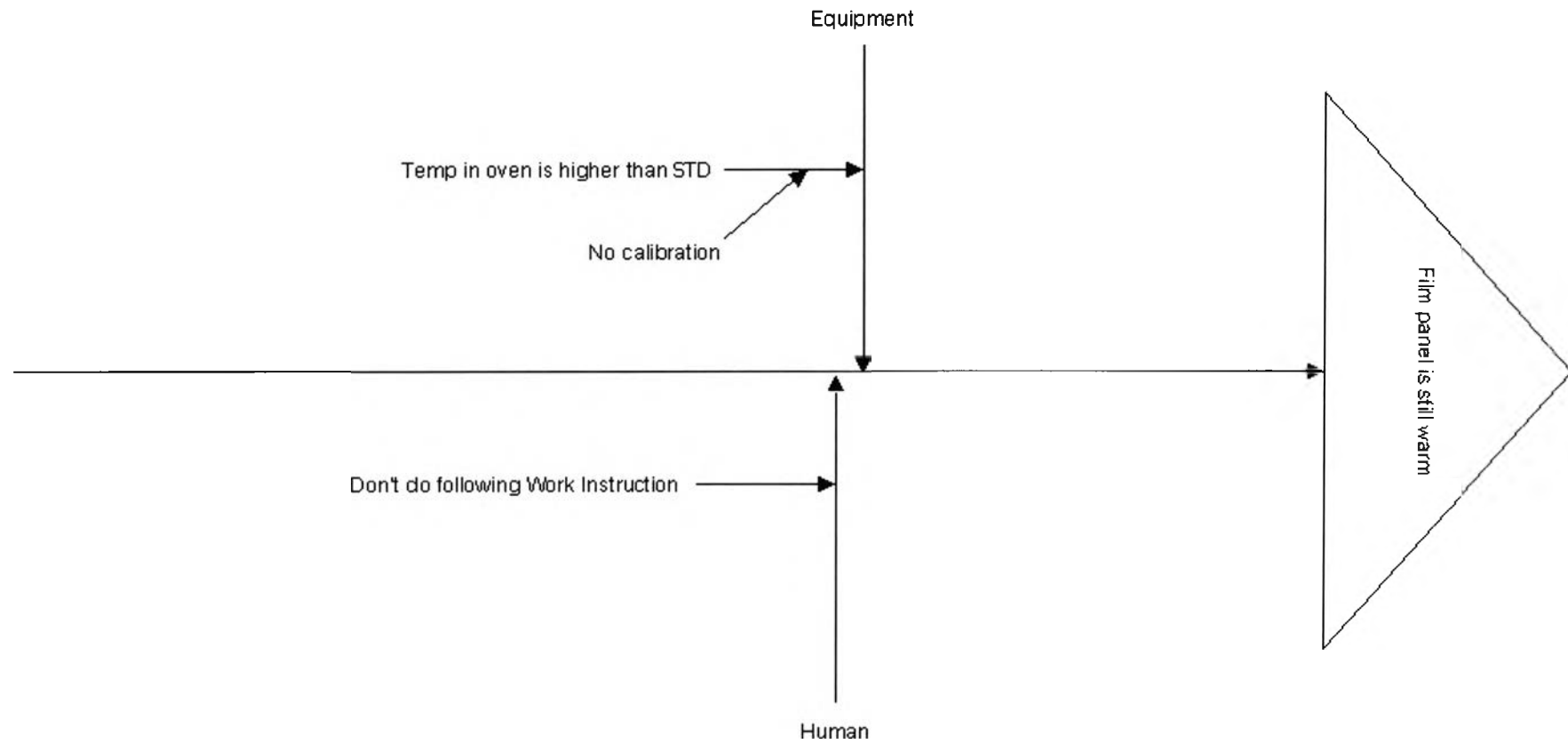
Fish Bone Diagram for Cause and Effective Analysis : Film is wrinkle



Fish Bone Diagram for Cause and Effective Analysis : Film is yellowing

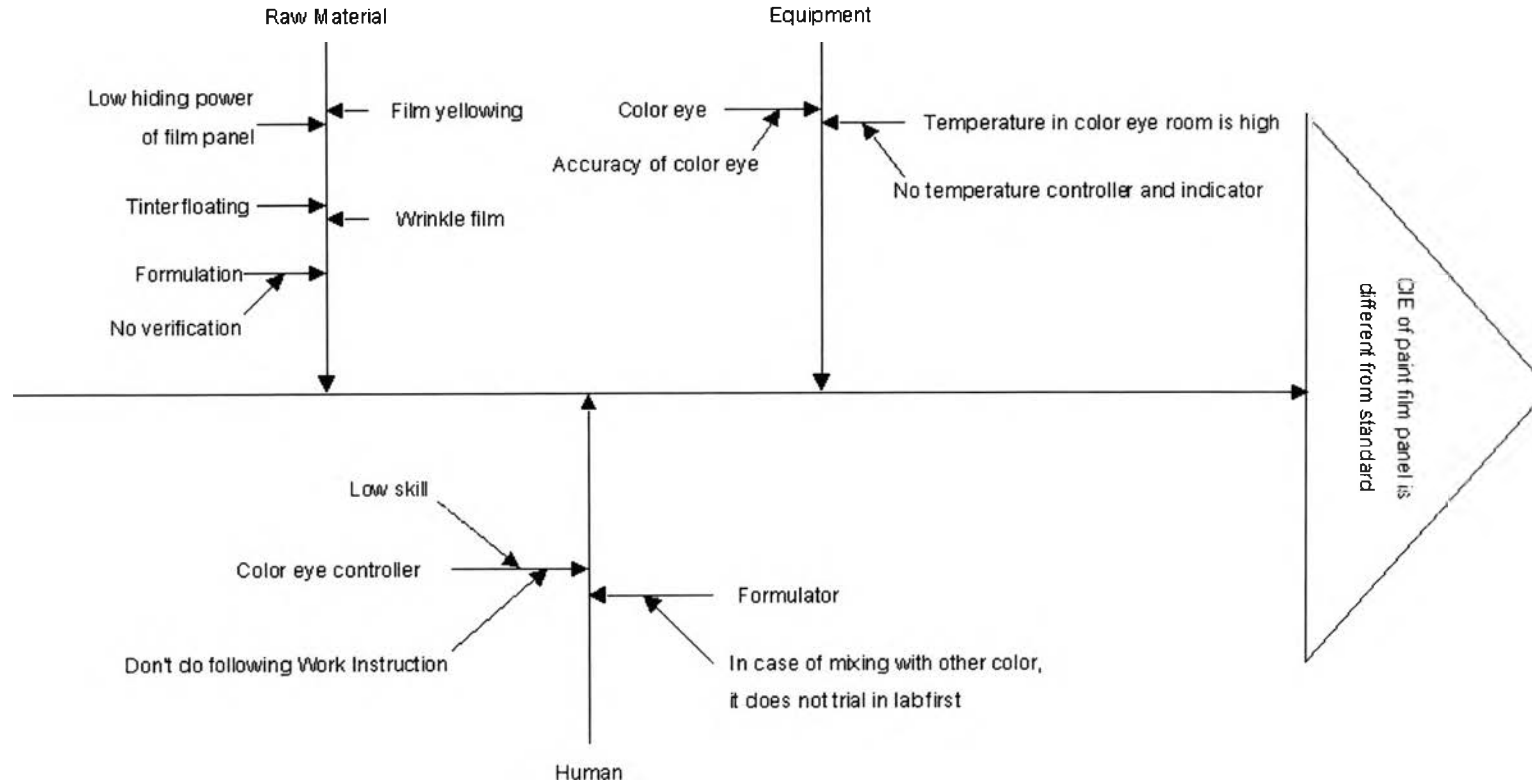


Fish Bone Diagram for Cause and Effective Analysis : Paint film is still warm



Color Panel Preparation : Drying at ambient

Fish Bone Diagram for Cause and Effective Analysis : CIE of paint film panel is different from standard



Piyawat R.

12.6.02

Appendix II

Failure Mode and Effect Analysis Form For Tinting section in Alkyd tinted products

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Raw material preparation** Supplied by : **Grinding section** PFMEA Number : **02/001**
 Product Name : **Alkyd** Received by : **Tinting section** FMEA Date (Orig.) : **5/4/2002**
 Responsible person : **Process Engineer** Documented by : **Piyawat R.** FMEA Date (Rev.) : _____
 Approved by : **Lab Manager** Approved date : **6/7/2002** Page 1 of 23
 Team : **Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.**

Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
White base preparation	Color strength of white base is deviation from batch to batch	Color deviation	7	Quality of white spirit (Color, Purity)	1	Raw material inspection with investigate COA from supplier	1	7	-	-	No action				
			7	Quality of alkyd binder (Color, Purity)	1	Raw material inspection with investigate COA from supplier	1	7	-	-	No action				
			7	Quality of TiO ₂ (%TiO ₂ , Purity, whiteness)	4	Only check COA from supplier (This raw material was specified as our specification)	4	112	Revise formulation by using only TiO ₂ TR 92	Process Eng. (13/9/02)	Specify TR-92 in recipe	7	2	2	28
			7	Cleanliness of TiO ₂ packing and pallet that use for transport raw material	1	No inspection	9	63	-	-	No action				
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : Raw material preparation Product Name : Alkyd Responsible person : Process Engineer Approved by : Lab Manager Team : Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wirotth S., Chokchai N.	Supplied by : Grinding section Received by : Tinting section Documented by : Piyawat R. Approved date : 6/7/2002	PFMEA Number : 02/001 FMEA Date (Orig.) : 5/4/2002 FMEA Date (Rev.) : _____ Page 2 of 23
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Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
White base preparation	Color strength of white base is deviation from batch to batch	Color deviation	7	Weight of each TiO ₂ packaging	2	No inspection but it was guarantee by Supplier	9	126	Random checking	Raw Material (10/9/02)	Set up WI and random checking (WI Doc2)	7	2	2	28
			7	Production operators don't follow as formulation	2	Process time and temp record	2	28	Training to make them understand to consequent	Process Eng (13/9/02)	As the recommend				
			7	Temperature in grinding higher than standard	2	Specific temp in formulation and record	4	56	-	-	No action				
			7	Level of impeller blade is not suit with mill base level	2	No control	3	42	-	-	No action				
			7	Cleanliness of dissolver	2	-Visual inspection -Delicate process line	4	56	-	-	No action				
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : Raw material preparation	Supplied by : Grinding section	PFMEA Number : 02/001
Product Name : Alkyd	Received by : Tinting section	FMEA Date (Orig.) : 5/4/2002
Responsible person : Process Engineer	Documented by : Piyawat R.	FMEA Date (Rev.) : _____
Approved by : Lab Manager	Approved date : 6/7/2002	Page 3 of 23
Team : Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.		

Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
White base preparation	White base that color strength deviate from standard	Color deviation	7	Dust from dust suction	3	Visual inspection	8	168	Set PM plan in dust suction pipe	Maintenance (10/9/02)	As the recommend (PM Plan)	7	2	2	28
			7	No color strength control for white base	9	No control	9	567	1. Set up work instruction for color strength control	QC (10/9/02)	As the recommend (WI Doc3)	7	2	2	28
									2. Specific color strength of white base in 20-25%	Process Eng. (10/9/02)	As the recommend	7	2	2	28
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Raw material preparation** Supplied by : **Grinding section** PFMEA Number : **02/001**
 Product Name : **Alkyd** Received by : **Tinting section** FMEA Date (Orig.) : **5/4/2002**
 Responsible person : **Process Engineer** Documented by : **Piyawat R.** FMEA Date (Rev.) : _____
 Approved by : **Lab Manager** Approved date : **6/7/2002** Page 4 of 23
 Team : **Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wirot S., Chokchai N.**

Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
White base preparation	Long drying time of white base	Color deviation	7	Quality of binder (long drying time of binder)	7	No control	8	392	Set up work instruction to investigate before using	QC (10/9/02)	As the recommend (WI Doc1)	7	2	2	28
			7	Quality of driers	2	Check COA from supplier	2	28	-	-	No action				
			8	Formulation and process instruction	2	Trail in lab before releasing to scale up	1	16	-	-	No action				
			8	Production operators don't follow as formulation	2	Process time and temp record	1	16	Training to make them understand to consequent	Process Eng. (10/9/02)	As the recommend				
			7	Low skill of QC inspector for draw down film checking for drying time	2	Use the cube applicator to make the film (Control film Thickness)	4	56	Set training course	QC (10/9/02)	As the recommend				
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : Raw material preparation	Supplied by : Grinding section	PFMEA Number : 02/001
Product Name : Alkyd	Received by : Tinting section	FMEA Date (Orig.) : 5/4/2002
Responsible person : Process Engineer	Documented by : Piyawat R.	FMEA Date (Rev.) : _____
Approved by : Lab Manager	Approved date : 6/7/2002	Page 5 of 23
Team : Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.		

Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
White base preparation	Long drying time of white base	Color deviation	7	Inaccuracy of cube applicator	6	No calibration	8	224	1. Set up work instruction for calibration	Process Eng. (13/9/02)	As the recommend (WI Doc8)	7	4	2	56
									2. Set up calibration schedule	Process Eng. (13/9/02)	As the recommend	7	2	2	28
			7	Inaccuracy of drying time recorder	3	No calibration	9	189	1. Set up work instruction for calibration	Process Eng. (13/9/02)	As the recommend (WI Doc9)	7	4	2	56
									2. Set up calibration schedule	Process Eng. (13/9/02)	As the recommend	7	2	2	28
			7	Ventilation system in drying cabinet is not good	6	No inspection and control	8	336	1. Check flow rate 2. Set PM for ventilation	Maintenance (13/9/02)	As the recommend (PM Plan)	7	2	2	28
			7	No re inspection after adjusting drying time	6	Specify in work instruction	4	168	Set training Course	QC (10/9/02)	As the recommend	7	2	2	28
Score				S= Severity			O= Occurrence			D= Detection		RPN= SxOxD			

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Raw material preparation** Supplied by : **Grinding section** PFMEA Number : **02/001**
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 Team : **Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.**

Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result					
											Action	S	O	D	RPN	
Neutral base preparation	Contaminate of neutral base	Color deviation	7	Quality of alkyd binder (Color, Purity)	2	Raw material inspection with investigate COA from supplier	2	28	-	-	No action					
			7	Color of driers	1	Only check COA from supplier	2	7	-	-	No action					
			7	Cleanliness of dissolver	2	-Visual inspection -Delicate process line	4	56	-	-	No action					
Score			S= Severity			O= Occurrence			D= Detection			RPN= SxOxD				

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Raw material preparation**
 Product Name : **Alkyd**
 Responsible person : **Process Engineer**
 Approved by : **Lab Manager**
 Team : **Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroteh S., Chokchai N.**

Supplied by : **Grinding section**
 Received by : **Tinting section**
 Documented by : **Piyawat R.**
 Approved date : **6/7/2002**

PFMEA Number : **02/001**
 FMEA Date (Orig.) : **5/4/2002**
 FMEA Date (Rev.) : _____
 Page 7 of 23

Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
Neutral base preparation	Contaminate of neutral base	Color deviation	7	Cleanliness of valve, pipe	4	-Visual inspection -Delicate process line	3	84	-	-	No action				
	Long drying time of neutral base	Color deviation		The same as long drying time in white base		The same as long drying time in white base			The same as long drying time in white base						
Tinter preparation	Color strength of Tinters are too board (±10%)	Color deviation	7	Specification of color strength control are too board	10	Control by formulation	8	560	Revise specification for controlling from +/-10% to ±5%	Process Eng. (13/9/02)	As the recommend	7	2	2	28
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Raw material preparation** Supplied by : **Grinding section** PFMEA Number : **02/001**
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 Team : **Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.**

Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
White base and neutral base storage	Settling of white base	Color deviation and quality of paint	7	Stirring time of white base tank is too less.	2	Set up and control at PLC (stirring every 3 hr. for 15 min)	2	28	-	-	No action				
	Skinning of white and neutral base	Quality of Paint in terms of fineness	7	Stirring time of white and neutral base are less than drying time of paint	2	Set up and control at PLC (stirring every 3 hr. for 15 min)	2	28	-	-	No action				
			7	Frequency of Stirrer	2	Set up and control at PLC (Frequency = 15min/ 3Hr)	2	28	-	-	No action				
			7	Closing system for storage tank is low efficiency	2	No control	9	126	1. Set up preventive maintenance	Production (13/9/02)	As the recommend (PM Plan)	7	3	2	42
									2. Training	Production (13/9/02)	As the recommend	7	3	2	42
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Raw material preparation** Supplied by : **Grinding section** PFMEA Number : **02/001**
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Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
White base and neutral base storage	Skinning of white and neutral base	Quality of Paint in terms of fineness	7	Leakage of seal of the lid	2	No control	8	112	1. Set up preventive maintenance	Production (13/9/02)	As the recommend	7	3	2	42
									2. Training	Production (13/9/02)	As the recommend	7	3	2	42
	Skinning of white and neutral base	Quality of Paint in terms of fineness	7	Un tight close of Storage tank lid	2	-Visual check air damper of ventilation -PM Plan	2	28	-	-	No action				
			7	Quality of anti Skinning	2	Only check COA from supplier	2	28	-	-	No action				
			7	Drying properties of driers	2	Only check COA from supplier	2	28	-	-	No action				
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Raw material preparation** Supplied by : **Grinding section** PFMEA Number : **02/001**
 Product Name : **Alkyd** Received by : **Tinting section** FMEA Date (Orig.) : **5/4/2002**
 Responsible person : **Process Engineer** Documented by : **Piyawat R.** FMEA Date (Rev.) : _____
 Approved by : **Lab Manager** Approved date : **6/7/2002** Page 10 of 23
 Team : **Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.**

Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
Tinter storage	Settling of tinter	Color deviation	7	Tinter level is lower than level of impeller	3	No control	9	189	Set up the min. level of tinter in buffer tank	Process Eng (13/9/02)	As the recommend (WI Doc6)	7	4	2	56
Buffer tank			7	Circulation time of tinter is not suitable	5	Set up and control at PLC	4	140	Revise to Stirring every 20 min	Maintenance (13/9/02)	As the recommend	7	2	2	28
Tinter tank			7	Stirring system is not good enough to stir tinter	7	No control	10	490	Set up the min. level of tinter in buffer tank	Process Eng. (13/9/02)	As the recommend (WI Doc6)	7	4	2	56
Tinter storage pail	Settling of tinter	Color deviation	7	Operator does not stir before using	2	No control	9	126	Set up the work Instruction	Production (13/9/02)	As the recommend (WI Doc7)	7	2	2	28
									Training tinting operators	Process Eng. (13/9/02)					
			7	Recipe is not good enough	2	Approved by corporate	1	14	-	-	No action				
			7	Anti-settling agent is not working	2	Test in lab scale before approval	1	14	-	-	No action				
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : Raw material preparation	Supplied by : Grinding section	PFMEA Number : 02/001
Product Name : Alkyd	Received by : Tinting section	FMEA Date (Orig.) : 5/4/2002
Responsible person : Process Engineer	Documented by : Piyawat R.	FMEA Date (Rev.) : _____
Approved by : Lab Manager	Approved date : 6/7/2002	Page 11 of 23
Team : Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.		

Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
Tinter storage Buffer tank	Skinning of tinter	Color deviation and quality of Paint in terms of fineness	7	Un tight close of storage tank lid	4	Visual check	3	84	-	-	No action				
Tinter tank			7	Level of tinter is nearly the same level of impeller	3	Set up minimum stock of tinter at PLC	9	189	Set up the min level of tinter in buffer tank	Process Eng (13/9/02)	As the recommend (WI Doc6)	7	4	2	56
			7	Circulation pipe is too high	9	No control	8	504	1. Modify pipe pipe extension	Maintenance	Set new min. level of tinter (WI Doc6)	7	4	2	56
									2. Set new min. stock	Process Eng. (13/9/02)					
			7	Tank is dirty from dry skin of tinter	4	No control	9	252	Set up cleaning procedure	Production (13/9/02)	As the recommend (WI Doc12)	7	3	2	42
									Set up cleaning schedule	Production (13/9/02)					
Tinting formulation	Starting formulation is not good	CIE of color is high	7	No verification before implement in production	9	No control	9	567	Revise new formulation sheet with verification	Color Eng. (13/9/02)	As the recommend (WI Doc13)	7	2	2	28
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Raw material preparation** Supplied by : **Grinding section** PFMEA Number : **02/001**
 Product Name : **Alkyd** Received by : **Tinting section** FMEA Date (Orig.) : **5/4/2002**
 Responsible person : **Process Engineer** Documented by : **Piyawat R.** FMEA Date (Rev.) : _____
 Approved by : **Lab Manager** Approved date : **6/7/2002** Page 12 of 23
 Team : **Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.**

Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
White and neutral base Weighing	Wrong weighing of white, neutral tinter	Color deviation	7	Typing error of amount weight	2	Set up work instruction	2	28	Set up training Operator	Production (13/9/02)					
			7	Select wrong raw material code	2	Set up work instruction	2	28	Set up training Operator	Production (13/9/02)					
			7	Operators does not understand scaling procedure	2	No control	2	28	Set up training Operator	Production (13/9/02)					
			7	Accuracy of scale	2	Calibration	2	28	-	-	No action				
Tinter weighing	Error of tinter weigh	Color deviation	7	Accuracy of dispenser in Full machine	7	No control	8	392	Create short form for calibration during loading Tinter into tank	Process (13/9/02)	As the recommend (WI Doc11)	7	2	2	28
			7	Low skill operator	4	Training	2	56	Set up training course for tinting operator	Production (13/9/02)					
			7	Typing wrong amount of tinter	3	Control by formulation sheet	2	42	Set up training course for tinting operator	Production (13/9/02)					
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Mixing** Supplied by : **Tinting section**
 Product Name : **Alkyd** Received by : **Tinting section**
 Responsible person : **Production Supervisor** Documented by : **Piyawat R.**
 Approved by : **Lab Manager** Approved date : **6/7/2002**
 Team : **Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.**

PFMEA Number : **02/001**
 FMEA Date (Orig.) : **5/4/2002**
 FMEA Date (Rev.) : _____
 Page 13 of 23

Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
Tinting m/c container preparation	Uncleanness of tinting m/c	Color deviation	7	Cleaning procedure is not suitable	2	Visual inspection	4	56	-	-	No action				
			7	Tank and impeller surface are rough	2	1. Visual inspection 2. Delicate line	5	70	-	-	No action				
			7	Brush for cleaning is not suitable	6	Visual inspection	3	126	Modify the equipment to match with cleaning	Production (13/9/02)	As the recommend	7	2	2	28
	Uncleanness of pot	Color deviation	7	Cleaning circle is not suitable	4	Control by setting program	2	56	-	-	No action				
			7	Valve is dirty	6	1. Manual cleaning 2. Delicate valve 3. Visual Inspection	2	84	-	-	No action				
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : Mixing	Supplied by : Tinting section	PFMEA Number : 02/001
Product Name : Alkyd	Received by : Tinting section	FMEA Date (Orig.) : 5/4/2002
Responsible person : Production Supervisor	Documented by : Piyawat R.	FMEA Date (Rev.) : _____
Approved by : Lab Manager	Approved date : 6/7/2002	Page 14 of 23
Team : Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.		

Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
Mixing	Inhomogeneous paint in mixing stage	Color deviation	7	Level of impeller does not match with level of paint	2	Control by setting the level of paint in each container/tank	4	96	-	-	No action				
			7	Stirring time does not suitable	3	Specify into the formulation	7	147	Revise Work Instruction	Color Eng. (13/9/02)	As the recommend (WI Doc4)	7	3	2	42
			7	Skimming of tinter	2	Visual checking	4	96	-	-	No action				
			7	Stirring speed does not suit with paint volume	3	Indicate in work instruction	3	63	-	-	No action				
			7	Production operators don't follow formulation	3	Process Instruction in Formulation sheet	4	84	Training to make them understand the consequent	Color Eng. (13/9/02)					
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Color panel preparation** Supplied by : **Tinting section**
 Product Name : **Alkyd** Received by : **Tinting section**
 Responsible person : **Color Engineer** Documented by : **Piyawat R.**
 Approved by : **Lab Manager** Approved date : **6/7/2002**
 Team : **Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.**

PFMEA Number : **02/001**
 FMEA Date (Orig.) : **5/4/2002**
 FMEA Date (Rev.) : _____
 Page 16 of 23

Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
Making draw down panel as following specification	Bubble on paint film	Color deviation	7	Film is too thick	7	WI does not suit with paint system	9	441	Revise WI	Color Eng. (13/9/02)	As the recommend (WI Doc4)	7	3	2	42
	Low hiding power of paint film	Color deviation	7	Formulation	3	Trail in lab scale before releasing into production	2	42	-	-	No action				
			7	Inaccuracy of applicator	2	No calibration	9	126	1.Set up work instruction for calibration	Process Eng. (13/9/02)	As the recommend (WI Doc8)	7	4	2	56
									2. Set up calibration schedule	Process Eng. (13/9/02)	As the recommend	7	2	2	28
			7	Production operators don't follow instruction	2	Work instruction	4	56	Training to make them understand the consequent	Color Eng. (13/9/02)					
			7	Low skill operator	3	Training	5	105	Set up training	Color Eng. (13/10/02)	As the recommend	7	2	2	28
Score				S= Severity		O= Occurrence			D= Detection		RPN= SxOxD				

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : Color panel preparation	Supplied by : Tinting section	PFMEA Number : 02/001
Product Name : Alkyd	Received by : Tinting section	FMEA Date (Orig.) : 5/4/2002
Responsible person : Color Engineer	Documented by : Piyawat R.	FMEA Date (Rev.) : _____
Approved by : Lab Manager	Approved date : 6/7/2002	Page 17 of 23
Team : Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.		

Process Function and Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
Making draw down panel as following specification	Some skinning on color panel	Color deviation	7	Skimming of paint	2	Visual checking	2	28	Set up training	Color Eng. (13/9/02)					
	Film is uneven through panel	Color deviation	7	Uneven of underlying mirror	2	Visual check	2	28	Set up training	Color Eng. (13/9/02)					
			7	Wrinkle of underlying paper	2	Visual check	2	28	Set up training	Color Eng. (13/9/02)					
			7	Uncleanness of applicator, mirror	2	Visual check	2	28	Set up training	Color Eng. (13/9/02)					
			7	Low skill operator	2	Training	2	28	Set up training	Color Eng. (13/9/02)					
	Wrinkle color panel	Color deviation	7	Inaccuracy of applicator	2	No calibration	9	126	1.Set up work instruction for calibration	Process Eng. (13/9/02)	As the recommend (WI Doc8)	7	4	2	56
									2. Set up calibration schedule	Process Eng. (13/9/02)	As the recommend	7	2	2	28
			7	Production operators don't follow formulation	3	Work instruction	3	63	Training to make them understand the consequent	Color Eng. (13/9/02)					
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Color panel preparation**
 Product Name : **Alkyd**
 Responsible person : **Color Engineer**
 Approved by : **Lab Manager**
 Team : **Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.**

Supplied by : **Tinting section**
 Received by : **Tinting section**
 Documented by : **Piyawat R.**
 Approved date : **6/7/2002**

PFMEA Number : **02/001**
 FMEA Date (Orig.) : **5/4/2002**
 FMEA Date (Rev.) : _____
 Page 18 of 23

Process Function and Requirement	Potential Failure Mode	Potential Effect (s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
Keep it into drying cabinet	Dust on paint film	Color deviation	7	Cleanness of drying cabinet	7	No Control	9	441	Set up schedule for cleaning	Color Eng. (10/09/02)	As the recommend	7	2	2	28
			7	Ventilation fan without filter	6	No control	9	504	Install the new ventilation fan with filter	Maintenance (13/09/02)	As the recommend	7	2	2	28
	Long drying time of panel	Color deviation	7	Short time in drying cabinet	2	Work instruction	2	28	Set up training	Color Eng. (13/9/02)					
			7	Ventilation system in drying cabinet is not good	6	No inspection and control	8	336	1.Check flow rate 2.Set PM for ventilation	Maintenance (13/09/02)	As the recommend (PM Plan)	7	2	2	28
			Score	S= Severity		O= Occurrence			D= Detection		RPN= SxOxD				

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Color panel preparation** Supplied by : **Tinting section** PFMEA Number : **02/001**
 Product Name : **Alkyd** Received by : **Tinting section** FMEA Date (Orig.) : **5/4/2002**
 Responsible person : **Color Engineer** Documented by : **Piyawat R.** FMEA Date (Rev.) : _____
 Approved by : **Lab Manager** Approved date : **6/7/2002** Page 19 of 23
 Team : **Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.**

Process Function and Requirement	Potential Failure Mode	Potential Effect (s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
Curing film in oven	Film is not fully cure	Color deviation	7	In accuracy temperature in oven	4	No control	9	252	1.Set up work instruction for calibration	Process Eng. (13/9/02)	As the recommend (WI Doc10)	7	4	2	56
									2. Set up calibration schedule	Process Eng. (13/9/02)	As the recommend	7	2	2	28
			7	Amount paper panel in oven is too much	4	Internal inform	7	196	Internal training	Color Eng. (13/9/02)	As the recommend	7	3	2	42
			7	White/neutral base are long drying time	2	Checking quality before using	1	14	-	-	No action				
			7	Production operators don't follow instruction	2	Work instruction	4	56	Training to make them understand the consequent	Color Eng. (13/9/02)					
			1	More often open and close oven	6	No control	9	54	Set up training	Color Eng. (13/9/02)					
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Color panel preparation** Supplied by : **Tinting section**
 Product Name : **Alkyd** Received by : **Tinting section**
 Responsible person : **Color Engineer** Documented by : **Piyawat R.**
 Approved by : **Lab Manager** Approved date : **6/7/2002**
 Team : **Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.**

PFMEA Number : **02/001**
 FMEA Date (Orig.) : **5/4/2002**
 FMEA Date (Rev.) : _____
 Page 20 of 23

Process Function and Requirement	Potential Failure Mode	Potential Effect (s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
Curing film in oven	Wrinkle film	Color deviation	7	Temperature in oven is higher than standard	2	No control	9	126	1.Set up work instruction for calibration	Process Eng. (13/9/02)	As the recommend (WI Doc10)	7	4	2	56
									2. Set up calibration schedule	Process Eng. (13/9/02)	As the recommend	7	2	2	28
	Wrinkle film	Color deviation	7	White/neutral base are long drying time	2	Checking quality before using	1	14	-	-	No action				
			7	Production operators don't follow instruction	2	Work instruction	4	56	Training to make them understand the consequent	Color Eng. (13/9/02)					
			4	Work procedure is not suitable	2	Work instruction	7	56	Revise work instruction	Color Eng. (13/9/02)					
	Film yellowing	Color deviation	7	Production operators don't follow instruction	2	Work instruction	4	56	Training to make them understand the consequent	Color Eng. (13/9/02)					
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : Color panel preparation	Supplied by : Tinting section	PFMEA Number : 02/001
Product Name : Alkyd	Received by : Tinting section	FMEA Date (Orig.) : 5/4/2002
Responsible person : Color Engineer	Documented by : Piyawat R.	FMEA Date (Rev.) : _____
Approved by : Lab Manager	Approved date : 6/7/2002	Page 21 of 23
Team : Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.		

Process Function and Requirement	Potential Failure Mode	Potential Effect (s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
Curing film in oven	Film yellowing	Color deviation	7	Temperature in oven is higher than standard	2	No control	9	126	1.Set up work instruction for calibration	Process Eng. (13/9/02)	As the recommend (WI Doc10)	7	4	2	56
									2. Set up calibration schedule	Process Eng. (13/9/02)	As the recommend	7	2	2	28
			Score	S= Severity		O= Occurrence			D= Detection		RPN= SxOxD				

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Color panel preparation** Supplied by : **Tinting section** PFMEA Number : **02/001**
 Product Name : **Alkyd** Received by : **Tinting section** FMEA Date (Orig.) : **5/4/2002**
 Responsible person : **Color Engineer** Documented by : **Piyawat R.** FMEA Date (Rev.) : _____
 Approved by : **Lab Manager** Approved date : **6/7/2002** Page 22 of 23
 Team : **Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.**

Process Function and Requirement	Potential Failure Mode	Potential Effect (s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result				
											Action	S	O	D	RPN
Drying at ambient	Film panel is still warm	Color deviation	7	Color eye controller doesn't follow instruction	2	Work instruction	1	14	1.Training to make them understand the consequent	Color Eng. (13/9/02)					
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD					

PROCESS FMEA (Potential Failure Mode and Effect Analysis in process)

Process Name : **Color measurement** Supplied by : **Tinting section**
 Product Name : **Alkyd** Received by : **Tinting section**
 Responsible person : **Color Engineer** Documented by : **Piyawat R.**
 Approved by : **Lab Manager** Approved date : **6/7/2002**
 Team : **Piyawat R., Watcharin S., Surin P., Sawitree L., Sukanya P., Wiroth S., Chokchai N.**

PFMEA Number : **02/001**
 FMEA Date (Orig.) : **5/4/2002**
 FMEA Date (Rev.) : _____
 Page 23 of 23

Process Function and Requirement	Potential Failure Mode	Potential Effect (s) of Failure	S	Potential cause(s)/ Mechanism(s) of Failure	O	Current process controls	D	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Result					
											Action	S	O	D	RPN	
Color measurement	CIE of color panel is different from standard	Color deviation	7	Temperature in color eye room is high	2	Control by thermometer	1	14	-	-	No action					
			7	Accuracy of color eye	2	Calibration	1	14	-	-	No action					
			7	Low skill of color eye controller	2	Training	1	14	-	-	No action					
				Low hiding power of film panel		See in color panel preparation					See in color panel preparation					
				Film yellowing		See in color panel preparation					See in color panel preparation					
				Wrinkle film		See in color panel preparation					See in color panel preparation					
			7	In case of mixing with other color formulator does not test first	3	Compensate and adjust the formulation	4	84	-	-	No action					
Score				S= Severity		O= Occurrence		D= Detection		RPN= SxOxD						



Appendix III

Work Instruction For

Tinting section in Alkyd tinted products

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 1 Drying time measurement procedure for alkyd resin	Rev. : 0
Operator : Raw Material Controller	Rev. Date : 13/9/02
	Page : 1 of 3

1. PURPOSE

This is the method for drying time measurement of alkyd resin.

2. SCOPE

This document uses for controlling the drying time of alkyd resin as the raw material specification in Work Instruction No. TH-420-06-02

3. DEFINITION/ABBREVIATION

4. REFERENCES

Quality Manual No. 11.0.11.G.010 Approved by ABC corporate
Work Instruction No. TH-420-02-19

5. EQUIPMENT/MATERIAL

1. Alkyd resin
2. White Spirit (Raw Material Code 02000)
3. Ca drier (Raw Material Code 01261)
4. Combi drier (Raw Material Code 01567)
5. Glass plate size 2x30 centimeters
6. Cube Applicator
7. Tin cup size 250 milliliters
8. Stirring machine
9. Spoon

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 1	Rev. : 0
Drying time measurement procedure for alkyd resin	Rev. Date : 13/9/02
Operator : Raw Material Controller	Page : 2 of 3

10. Analytical Balance (Readability = 0.01 gram)

11. Drying time recorder

6. SAFETY CAUTION

Install the appropriate safety and health device such as rubber glove mask, goggles, safety shoe, and safety helmet.

7. INSTRUCTION

7.1 Sample preparation

7.1.1 Weighing raw material to 1.0 mg in tin can size 250 ml. as following:

- 80.00 g of Alkyd resin
- 18.60 g of White spirit
- 0.60 g of Ca drier
- 0.80 g of Combi drier

7.1.2 Stir the sample from 7.1.1 with power stirrer at 750 RPM for 5 min.

7.2 Drawdown sample by cube applicator at 120 μ wet film on glass panel size 2X30 cm

7.3 Place the test panel into Beck Koller Recorder to check drying time by place pin of Beck Koller Recorder on the top of test panel. Run Beck Koller Recorder until the test panel to be dry.

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 1	Rev. : 0
Drying time measurement procedure for alkyd resin	Rev. Date : 13/9/02
Operator : Raw Material Controller	Page : 3 of 3

7.4 The drying time is read as the paint where no scratch is visible in the film.

8. QUALITY RECORDS

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9. APPENDIX

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The ABC Company, LTD. Work Instruction	ABC Company
Document No. 2 Sampling Weight Raw Material (Titanium Dioxide)	Rev. : 0
Operator : Raw Material Operator	Rev. Date : 13/9/02
	Page : 1 of 2

1. PURPOSE

This document is generated to random checking the weight of Titanium Dioxide and control the its weight to ensure the consistency of color strength in white base.

2. SAFETY CAUTION

Install the appropriate safety and health device such as rube glove, mask, goggles, safety shoes, safety helmet.

3. INSTRUCTION

- Raw material operator receives he Titanium Dioxide and storage at quarantine area. Then inform to the Bagslitter operator
- Bagslitter operator random checking the raw material as the following table 1

:

No. of incoming raw material (Pallet)	Sampling size (Pallet)
1 to 10	1
11 to 40	2
41 to 90	3
91 to 160	4
161 to 250	5
>251	6

Remark : The % error is acceptable at level $\pm 1.5\%$

- Bagslitter operator transfer raw material as the following table 1 from quarantine area to the raw material preparation zone.

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 2 Sampling Weight Raw Material (Titanium Dioxide)	Rev. : 0
Operator : Raw Material Operator	Rev. Date : 13/9/02
	Page : 2 of 2

- Use the vacuum Bag lift the raw material bag from the pallet bag by bag (Weight of each bag is approximately 25 Kg), Then put it on the scale.
- Record the weight of raw material in each bag into the Raw Material Weighing Record Sheet
- Send the Raw Material Weighing Record Sheet to the Raw Material Foreman to calculate the error of each batch
- In case of weight of raw material is out of standard, The Raw Material Foreman generate the request to Laboratory department to investigate and recommend for handling in the production.

Raw Material Sampling Record Form

Bag No.	STD Weight (Kgs)	Actual Weight (Kgs)	Net Weight	Result (OK/Fail)
	25 ± 0.37			
	25 ± 0.37			
	25 ± 0.37			
	25 ± 0.37			
	25 ± 0.37			
	25 ± 0.37			
	25 ± 0.37			
	25 ± 0.37			
	25 ± 0.37			
	25 ± 0.37			
	25 ± 0.37			
	25 ± 0.37			
	25 ± 0.37			
	25 ± 0.37			
	25 ± 0.37			
	25 ± 0.37			
Average				

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 3 Color strength control of Alkyd White Base for tinted products procedure	Rev. : 0
	Rev. Date : 13/9/02
Operator : Finished Goods Inspector	Page : 1 of 11

1. PURPOSE

This process is carried out to control the color strength of alkyd white base to reduce color deviation in tinting process.

2. SCOPE

This instruction is applicable to make the sample preparation, evaluation of color strength, and color strength adjustment in alkyd white base.

3. DEFINITION/ABBREVIATION

- Color eye : It is the computer that uses for measuring the strength of color by using the UV lamp as the light source for different visible wavelength. It consists of PC and spectrophotometer.
- Color strength : It is measurements of the coloring effect of white pigment that are in the literature described as “lightening power”
- %R : It is reflectance value of visible wavelength in color shade that measures by Color eye.
- Standard Black Tinter : It is standard black tinter that controlled by special process from the ABC corporate. It uses for color strength measurement.

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 3 Color strength control of Alkyd White Base for tinted products procedure	Rev. : 0
Operator : Finished Goods Inspector	Rev. Date : 13/9/02
	Page : 2 of 11

4. REFERENCES

Quality manual No. 10.230.37.E150 Approved by ABC corporate

5. EQUIPMENT/MATERIAL

1. Alkyd white base
2. Standard Black Tinter
3. Tint can size 250 ml
4. Pyknometer
5. Analytical balance (Readability = 1.0 mg)
6. Paper panel (Black/White) size 10x15 cm.
7. Drying cabinet
8. Oven
9. Shaking machine
10. Color eye

6. SAFETY CAUTION

- Install the appropriate safety and health device such as rubber glove, mask, goggles, safety shoe, safety helmet.

7. INSTRUCTION

- 7.1 Quality control inspector

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 3 Color strength control of Alkyd White Base for tinted products procedure	Rev. : 0 Rev. Date : 13/9/02
Operator : Finished Goods Inspector	Page : 3 of 11

7.1.1 Sample preparation

- Weighing the specific gravity of Alkyd white base by using the Pyknometer at precision 0.001 gram.
- Calculate the weight of Alkyd white base by equation :

$$\text{Weight of Alkyd white base} = \text{Specific gravity} * 180 \text{ ml}$$

- Weighing the Alkyd white base as calculation from step 2 into the tin cup size 250 ml.
- Weighing the standard black tinter = 5 gram into the can
- Close the lid and turn the can upside down to wet the internal part of the containers completely with paint.
- Shaking by shaking machine for 3 minute.

7.1.2 Color panel preparation and measurement

- Take some sample to make the draw down on paper panel at 200 micron wet film applicator.
- The color panel from the stage 1 will be kept in the drying cabinet for 20 minute.
- Then move it into the oven at 50 °C to cure the paint film for 30 minute.
- Finally, color panel will be exposure at ambient to make the panel cool for 3 minute prior to perform color measurement by Color eye controller.

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 3 Color strength control of Alkyd White Base for tinted products procedure	Rev. : 0
Operator : Finished Goods Inspector	Rev. Date : 13/9/02
	Page : 4 of 11

7.1.3 Color measurement

- Inspect the quality of color panel prior to perform color measurement.
- Insert the color panel on the slit of spectrophotometer.
- Draw the circle on the measurement area.
- Perform color measurement
 1. Select the “User Menu”
 2. Select Program 02 (Measure/Read)
 3. Select No.17 (ABC-R-Value) file for Color eye No. 3000, or N0.18 (ABC-R-Value) file for Color eye No. 3001
 4. Press F1 for reading the % R, then %R of sample measurement will be shown on the monitor at wavelength 400-700 nm.
 5. Read %R at wavelength 540 nm, and calculate the color strength as following
- Color strength calculation

Example : %R of white base at 540 nm is 32.745, How much the color strength value of this white base?

1. Read %R at 540nm, From the example it is 32.745
2. Compare with the standard %R at 540 nm for color strength measurement of white base is 33.2 nm.

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 3 Color strength control of Alkyd White Base for tinted products procedure	Rev. : 0 Rev. Date : 13/9/02
Operator : Finished Goods Inspector	Page : 5 of 11

Please see the Appendix 1 : K/S value at different %R, and different wavelength from 400-700 nm (Refer to ISO 787/24-1985(E))

1. Calculation

- Calculate K/S value at %R = 32.745 at 540 nm by interpolate between %R at 32.7 with 32.8

K/S Value at %R = 32.7 is 0.168955.....

(1)

K/S Value at %R = 32.8 is 0.167765.....

(2)

At the different of %R = 0.1, The different of K/S = equation (1) – equation (2)

So the different of K/S = 0.168955 – 0.167765 = 0.001220

- Compare the measured value of %R that is 32.745 with %R at 32.70. It is equal

$$32.745 - 32.70 = 0.045$$

- From the previous stage, We can calculate the K/S at %R = 32.745 as following :

$$\begin{array}{l} \Delta \%R = 0.1, \quad \Delta K/S = 0.001220 \\ \text{If } \Delta \%R = 0.045, \quad \Delta K/S = \frac{0.001220}{0.1} * 0.0045 \end{array}$$

$$\Delta K/S = 0.000549$$

∴ K/S at %R = 32.745 is different between %R at 32.7 deduct from 0.000549

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 3 Color strength control of Alkyd White Base for tinted products procedure	Rev. : 0
Operator : Finished Goods Inspector	Rev. Date : 13/9/02
	Page : 6 of 11

It is equal to $0.168955 - 0.000549$
 $= 0.168406$

- K/S of white base sample at %R = 32.745 is equal to 0.168406

Standard K/S at %R = 33.2 is equal to 0.162950

Color strength equation = (K/S of sample/ Standard K/S) – 1

$$= \left[\frac{0.168406}{0.162950} \right] - 1$$

$$= 0.0335$$

Convert into % = $0.0335 * 100$
 $= 3.35\%$

Interpret the value of calculation

- In case of color strength value is plus value, it means that white base sample is weaker than standard.
- In case of color strength value is minus value, it means that white base sample is stronger than standard.

Compare the Color strength from stage 4 with the standard of Alkyd white base

- In case of color strength of Alkyd white base is out of standard, The quality control inspector adjust as the following :

Color strength	Adjust by adding (by TWT)	
	White tinter	Alkyd neutral base
Weaker 1%	1.0	-
Stronger 1%	-	0.5

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 3 Color strength control of Alkyd White Base for tinted products procedure	Rev. : 0
	Rev. Date : 13/9/02
Operator : Finished Goods Inspector	Page : 7 of 11

8. QUALITY RECORD

8.1 Quality control inspector

- Record the color strength of Alkyd white base into the Production Formulation Sheet :

9. APPENDIX

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 3	Rev. : 0
Color strength control of Alkyd White Base for tinted products procedure	Rev. Date : 13/9/02
Operator : Finished Goods Inspector	Page : 8 of 11

Appendix 1 : K/S value at different %R, and different wavelength from 400-700 nm (Refer to ISO 787/24-1985(E))

ISO 787/24-1982 (E)

Annex B

K/S values as a function of measured reflectivity R_{∞}

(The table is valid if the reflectivity is measured when excluding the gloss of a high gloss sample, see annex A.)

100 R_{∞}	K/S	100 R_{∞}	K/S	100 R_{∞}	K/S	100 R_{∞}	K/S
0,1	191,301 468	5,5	2,956 856	11,0	1,167 677	16,5	0,634 444
0,2	95,302 643	5,6	2,795 623	11,1	1,152 900	16,6	0,628 256
0,3	63,303 925	5,7	2,736 571	11,2	1,138 399	16,7	0,622 150
0,4	47,305 222	5,8	2,679 591	11,3	1,124 170	16,8	0,616 125
0,5	37,706 482	5,9	2,624 577	11,4	1,110 206	16,9	0,610 178
0,6	31,307 755	6,0	2,571 429	11,5	1,096 498	17,0	0,604 309
0,7	26,737 595	6,1	2,520 057	11,6	1,083 038	17,1	0,598 516
0,8	23,310 287	6,2	2,470 374	11,7	1,069 823	17,2	0,592 798
0,9	20,644 882	6,3	2,422 301	11,8	1,056 846	17,3	0,587 154
1,0	18,512 817	6,4	2,375 760	11,9	1,044 100	17,4	0,581 581
1,1	16,768 631	6,5	2,330 679	12,0	1,031 580	17,5	0,576 080
1,2	15,315 344	6,6	2,286 995	12,1	1,019 278	17,6	0,570 648
1,3	14,085 828	6,7	2,244 645	12,2	1,007 192	17,7	0,565 285
1,4	13,032 135	6,8	2,203 569	12,3	0,995 314	17,8	0,559 988
1,5	12,119 089	6,9	2,163 712	12,4	0,983 641	17,9	0,554 759
1,6	11,320 328	7,0	2,125 018	12,5	0,972 166	18,0	0,549 594
1,7	10,615 692	7,1	2,087 443	12,6	0,960 885	18,1	0,544 493
1,8	9,989 471	7,2	2,050 938	12,7	0,949 795	18,2	0,539 455
1,9	9,429 295	7,3	2,015 459	12,8	0,938 890	18,3	0,534 478
2,0	8,925 260	7,4	1,980 965	12,9	0,928 165	18,4	0,529 563
2,1	8,469 336	7,5	1,947 412	13,0	0,917 616	18,5	0,524 707
2,2	8,054 968	7,6	1,914 772	13,1	0,907 240	18,6	0,519 910
2,3	7,676 740	7,7	1,883 001	13,2	0,897 033	18,7	0,515 170
2,4	7,330 125	7,8	1,852 069	13,3	0,886 990	18,8	0,510 488
2,5	7,011 335	7,9	1,821 942	13,4	0,877 109	18,9	0,505 861
2,6	6,717 152	8,0	1,792 594	13,5	0,867 384	19,0	0,501 289
2,7	6,444 851	8,1	1,763 991	13,6	0,857 813	19,1	0,496 772
2,8	6,192 079	8,2	1,736 110	13,7	0,848 393	19,2	0,492 308
2,9	5,956 818	8,3	1,708 921	13,8	0,839 120	19,3	0,487 896
3,0	5,737 318	8,4	1,682 400	13,9	0,829 990	19,4	0,483 536
3,1	5,532 049	8,5	1,656 526	14,0	0,821 002	19,5	0,479 226
3,2	5,339 687	8,6	1,631 273	14,1	0,812 151	19,6	0,474 967
3,3	5,159 047	8,7	1,606 623	14,2	0,803 435	19,7	0,470 756
3,4	4,989 097	8,8	1,582 551	14,3	0,794 850	19,8	0,466 595
3,5	4,828 927	8,9	1,558 041	14,4	0,786 395	19,9	0,462 480
3,6	4,677 715	9,0	1,536 074	14,5	0,778 066	20,0	0,458 413
3,7	4,534 738	9,1	1,513 630	14,6	0,769 861	20,1	0,454 392
3,8	4,399 342	9,2	1,491 693	14,7	0,761 777	20,2	0,450 416
3,9	4,270 945	9,3	1,470 246	14,8	0,753 812	20,3	0,446 485
4,0	4,149 022	9,4	1,449 275	14,9	0,745 963	20,4	0,442 598
4,1	4,033 100	9,5	1,428 763	15,0	0,738 228	20,5	0,438 755
4,2	3,922 750	9,6	1,408 697	15,1	0,730 605	20,6	0,434 955
4,3	3,817 581	9,7	1,389 061	15,2	0,723 091	20,7	0,431 197
4,4	3,717 244	9,8	1,369 843	15,3	0,715 684	20,8	0,427 480
4,5	3,621 411	9,9	1,351 032	15,4	0,708 382	20,9	0,423 804
4,6	3,529 794	10,0	1,332 613	15,5	0,701 184	21,0	0,420 168
4,7	3,442 120	10,1	1,314 576	15,6	0,694 086	21,1	0,416 573
4,8	3,358 141	10,2	1,296 908	15,7	0,687 088	21,2	0,413 016
4,9	3,277 634	10,3	1,279 601	15,8	0,680 186	21,3	0,409 498
5,0	3,200 388	10,4	1,262 642	15,9	0,673 380	21,4	0,406 018
5,1	3,126 211	10,5	1,246 021	16,0	0,666 667	21,5	0,402 575
5,2	3,054 929	10,6	1,229 731	16,1	0,660 046	21,6	0,399 170
5,3	2,986 375	10,7	1,213 759	16,2	0,653 515	21,7	0,395 800
5,4	2,920 398	10,8	1,198 099	16,3	0,647 072	21,8	0,392 467
		10,9	1,182 741	16,4	0,640 715	21,9	0,389 169

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 3 Color strength control of Alkyd White Base for tinted products procedure	Rev. : 0 Rev. Date : 13/9/02
Operator : Finished Goods Inspector	Page : 9 of 11

787/24-1982 (E)

100 R ₁₀₀	K/S	100 R ₁₀₀	K/S	100 R ₁₀₀	K/S	100 R ₁₀₀	K/S
22.0	0,385 906	28,0	0,239 338	34,0	0,153 822	40,0	0,100 513
22.1	0,382 677	28,1	0,237 527	34,1	0,152 720	40,1	0,099 808
22.2	0,379 482	28,2	0,235 732	34,2	0,151 628	40,2	0,099 109
22.3	0,376 321	28,3	0,233 953	34,3	0,150 543	40,3	0,098 415
22.4	0,373 192	28,4	0,232 189	34,4	0,149 468	40,4	0,097 725
22.5	0,370 097	28,5	0,230 441	34,5	0,148 400	40,5	0,097 041
22.6	0,367 033	28,6	0,228 708	34,6	0,147 341	40,6	0,096 361
22.7	0,364 000	28,7	0,226 990	34,7	0,146 290	40,7	0,095 686
22.8	0,360 999	28,8	0,225 288	34,8	0,145 246	40,8	0,095 016
22.9	0,358 029	28,9	0,223 599	34,9	0,144 211	40,9	0,094 350
23.0	0,355 089	29,0	0,221 926	35,0	0,143 184	41,0	0,093 690
23.1	0,352 179	29,1	0,220 267	35,1	0,142 165	41,1	0,093 033
23.2	0,349 299	29,2	0,218 622	35,2	0,141 154	41,2	0,092 382
23.3	0,346 448	29,3	0,216 991	35,3	0,140 150	41,3	0,091 735
23.4	0,343 625	29,4	0,215 374	35,4	0,139 154	41,4	0,091 093
23.5	0,340 831	29,5	0,213 771	35,5	0,138 165	41,5	0,090 455
23.6	0,338 065	29,6	0,212 182	35,6	0,137 184	41,6	0,089 821
23.7	0,335 326	29,7	0,210 606	35,7	0,136 210	41,7	0,089 192
23.8	0,332 615	29,8	0,209 043	35,8	0,135 244	41,8	0,088 568
23.9	0,329 931	29,9	0,207 494	35,9	0,134 285	41,9	0,087 948
24.0	0,327 273	30,0	0,205 958	36,0	0,133 334	42,0	0,087 332
24.1	0,324 641	30,1	0,204 434	36,1	0,132 389	42,1	0,086 720
24.2	0,322 036	30,2	0,202 924	36,2	0,131 451	42,2	0,086 113
24.3	0,319 455	30,3	0,201 426	36,3	0,130 521	42,3	0,085 509
24.4	0,316 901	30,4	0,199 941	36,4	0,129 597	42,4	0,084 910
24.5	0,314 370	30,5	0,198 468	36,5	0,128 681	42,5	0,084 316
24.6	0,311 865	30,6	0,197 007	36,6	0,127 771	42,6	0,083 725
24.7	0,309 384	30,7	0,195 559	36,7	0,126 868	42,7	0,083 138
24.8	0,306 926	30,8	0,194 122	36,8	0,125 972	42,8	0,082 556
24.9	0,304 493	30,9	0,192 698	36,9	0,125 082	42,9	0,081 977
25.0	0,302 082	31,0	0,191 285	37,0	0,124 200	43,0	0,081 403
25.1	0,299 695	31,1	0,189 884	37,1	0,123 323	43,1	0,080 832
25.2	0,297 331	31,2	0,188 494	37,2	0,122 453	43,2	0,080 265
25.3	0,294 989	31,3	0,187 116	37,3	0,121 590	43,3	0,079 703
25.4	0,292 669	31,4	0,185 749	37,4	0,120 733	43,4	0,079 144
25.5	0,290 371	31,5	0,184 393	37,5	0,119 882	43,5	0,078 589
25.6	0,288 095	31,6	0,183 048	37,6	0,119 037	43,6	0,078 037
25.7	0,285 841	31,7	0,181 715	37,7	0,118 199	43,7	0,077 490
25.8	0,283 607	31,8	0,180 392	37,8	0,117 367	43,8	0,076 946
25.9	0,281 394	31,9	0,179 079	37,9	0,116 541	43,9	0,076 406
26.0	0,279 202	32,0	0,177 778	38,0	0,115 721	44,0	0,075 870
26.1	0,277 031	32,1	0,176 487	38,1	0,114 907	44,1	0,075 337
26.2	0,274 879	32,2	0,175 206	38,2	0,114 099	44,2	0,074 808
26.3	0,272 748	32,3	0,173 936	38,3	0,113 296	44,3	0,074 283
26.4	0,270 636	32,4	0,172 676	38,4	0,112 500	44,4	0,073 761
26.5	0,268 543	32,5	0,171 426	38,5	0,111 709	44,5	0,073 242
26.6	0,266 470	32,6	0,170 186	38,6	0,110 925	44,6	0,072 728
26.7	0,264 415	32,7	0,168 955	38,7	0,110 146	44,7	0,072 217
26.8	0,262 380	32,8	0,167 735	38,8	0,109 372	44,8	0,071 709
26.9	0,260 363	32,9	0,166 524	38,9	0,108 604	44,9	0,071 204
27.0	0,258 364	33,0	0,165 323	39,0	0,107 842	45,0	0,070 703
27.1	0,256 383	33,1	0,164 132	39,1	0,107 085	45,1	0,070 206
27.2	0,254 420	33,2	0,162 950	39,2	0,106 333	45,2	0,069 712
27.3	0,252 475	33,3	0,161 777	39,3	0,105 587	45,3	0,069 221
27.4	0,250 548	33,4	0,160 614	39,4	0,104 847	45,4	0,068 733
27.5	0,248 637	33,5	0,159 459	39,5	0,104 111	45,5	0,068 249
27.6	0,246 744	33,6	0,158 314	39,6	0,103 381	45,6	0,067 768
27.7	0,244 868	33,7	0,157 178	39,7	0,102 657	45,7	0,067 290
27.8	0,243 008	33,8	0,156 050	39,8	0,101 937	45,8	0,066 815
27.9	0,241 165	33,9	0,154 931	39,9	0,101 222	45,9	0,066 344

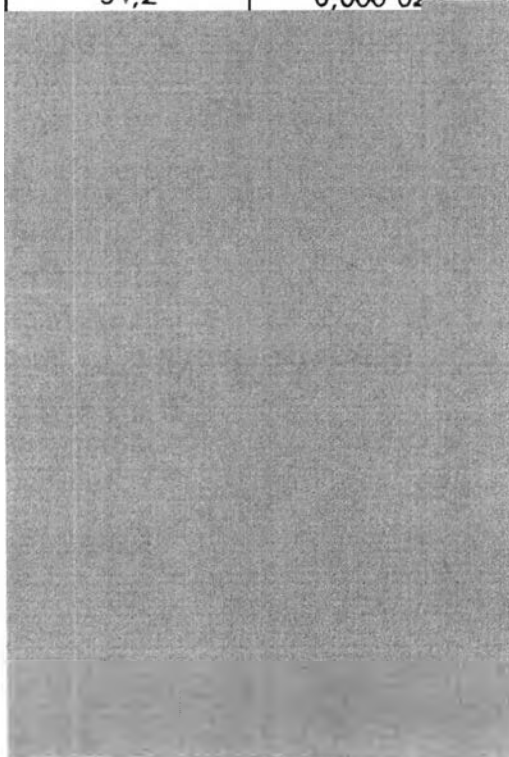
The ABC Company, LTD.	ABC Company
Work Instruction	
Document No. 3	Rev. : 0
Color strength control of Alkyd White Base for tinted products procedure	Rev. Date : 13/9/02
Operator : Finished Goods Inspector	Page : 10 of 11

ISO 787/24-1982 (E)

100 R ₁₀₀	K/S	100 R ₁₀₀	K/S	100 R ₁₀₀	K/S	100 R ₁₀₀	K/S
46.0	0.065 876	52.0	0.042 794	58.0	0.027 209	64.0	0.016 667
46.1	0.065 411	52.1	0.042 481	58.1	0.026 998	64.1	0.016 524
46.2	0.064 949	52.2	0.042 171	58.2	0.026 787	64.2	0.016 382
46.3	0.064 490	52.3	0.041 862	58.3	0.026 578	64.3	0.016 241
46.4	0.064 035	52.4	0.041 555	58.4	0.026 371	64.4	0.016 101
46.5	0.063 582	52.5	0.041 251	58.5	0.026 164	64.5	0.015 962
46.6	0.063 132	52.6	0.040 948	58.6	0.025 959	64.6	0.015 824
46.7	0.062 686	52.7	0.040 647	58.7	0.025 756	64.7	0.015 687
46.8	0.062 242	52.8	0.040 349	58.8	0.025 553	64.8	0.015 551
46.9	0.061 801	52.9	0.040 052	58.9	0.025 352	64.9	0.015 416
47.0	0.061 363	53.0	0.039 757	59.0	0.025 153	65.0	0.015 281
47.1	0.060 929	53.1	0.039 464	59.1	0.024 954	65.1	0.015 148
47.2	0.060 497	53.2	0.039 173	59.2	0.024 757	65.2	0.015 015
47.3	0.060 068	53.3	0.038 884	59.3	0.024 561	65.3	0.014 883
47.4	0.059 641	53.4	0.038 597	59.4	0.024 367	65.4	0.014 753
47.5	0.059 218	53.5	0.038 311	59.5	0.024 174	65.5	0.014 623
47.6	0.058 797	53.6	0.038 028	59.6	0.023 982	65.6	0.014 494
47.7	0.058 380	53.7	0.037 746	59.7	0.023 791	65.7	0.014 365
47.8	0.057 965	53.8	0.037 466	59.8	0.023 601	65.8	0.014 238
47.9	0.057 552	53.9	0.037 188	59.9	0.023 413	65.9	0.014 112
48.0	0.057 143	54.0	0.036 912	60.0	0.023 226	66.0	0.013 986
48.1	0.056 736	54.1	0.036 637	60.1	0.023 040	66.1	0.013 861
48.2	0.056 332	54.2	0.036 364	60.2	0.022 855	66.2	0.013 737
48.3	0.055 931	54.3	0.036 093	60.3	0.022 672	66.3	0.013 614
48.4	0.055 532	54.4	0.035 824	60.4	0.022 490	66.4	0.013 492
48.5	0.055 136	54.5	0.035 557	60.5	0.022 309	66.5	0.013 371
48.6	0.054 742	54.6	0.035 291	60.6	0.022 129	66.6	0.013 250
48.7	0.054 351	54.7	0.035 027	60.7	0.021 950	66.7	0.013 130
48.8	0.053 963	54.8	0.034 765	60.8	0.021 772	66.8	0.013 011
48.9	0.053 577	54.9	0.034 504	60.9	0.021 596	66.9	0.012 893
49.0	0.053 194	55.0	0.034 245	61.0	0.021 421	67.0	0.012 776
49.1	0.052 813	55.1	0.033 988	61.1	0.021 247	67.1	0.012 659
49.2	0.052 435	55.2	0.033 732	61.2	0.021 074	67.2	0.012 544
49.3	0.052 059	55.3	0.033 478	61.3	0.020 902	67.3	0.012 429
49.4	0.051 686	55.4	0.033 226	61.4	0.020 731	67.4	0.012 314
49.5	0.051 315	55.5	0.032 975	61.5	0.020 562	67.5	0.012 201
49.6	0.050 947	55.6	0.032 726	61.6	0.020 393	67.6	0.012 089
49.7	0.050 581	55.7	0.032 479	61.7	0.020 226	67.7	0.011 977
49.8	0.050 217	55.8	0.032 233	61.8	0.020 060	67.8	0.011 866
49.9	0.049 856	55.9	0.031 989	61.9	0.019 894	67.9	0.011 755
50.0	0.049 497	56.0	0.031 746	62.0	0.019 730	68.0	0.011 646
50.1	0.049 141	56.1	0.031 506	62.1	0.019 567	68.1	0.011 537
50.2	0.048 787	56.2	0.031 265	62.2	0.019 406	68.2	0.011 429
50.3	0.048 435	56.3	0.031 027	62.3	0.019 245	68.3	0.011 322
50.4	0.048 085	56.4	0.030 791	62.4	0.019 085	68.4	0.011 215
50.5	0.047 738	56.5	0.030 556	62.5	0.018 926	68.5	0.011 110
50.6	0.047 393	56.6	0.030 323	62.6	0.018 768	68.6	0.011 005
50.7	0.047 050	56.7	0.030 091	62.7	0.018 612	68.7	0.010 900
50.8	0.046 710	56.8	0.029 860	62.8	0.018 456	68.8	0.010 797
50.9	0.046 372	56.9	0.029 632	62.9	0.018 301	68.9	0.010 694
51.0	0.046 036	57.0	0.029 404	63.0	0.018 148	69.0	0.010 592
51.1	0.045 702	57.1	0.029 178	63.1	0.017 995	69.1	0.010 490
51.2	0.045 370	57.2	0.028 954	63.2	0.017 844	69.2	0.010 390
51.3	0.045 041	57.3	0.028 731	63.3	0.017 693	69.3	0.010 290
51.4	0.044 714	57.4	0.028 509	63.4	0.017 543	69.4	0.010 190
51.5	0.044 388	57.5	0.028 289	63.5	0.017 395	69.5	0.010 092
51.6	0.044 065	57.6	0.028 070	63.6	0.017 247	69.6	0.009 994
51.7	0.043 744	57.7	0.027 853	63.7	0.017 101	69.7	0.009 897
51.8	0.043 426	57.8	0.027 637	63.8	0.016 955	69.8	0.009 800
51.9	0.043 109	57.9	0.027 422	63.9	0.016 810	69.9	0.009 704

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 3 Color strength control of Alkyd White Base for tinted products procedure	Rev. : 0 Rev. Date : 13/9/02
Operator : Finished Goods Inspector	Page : 11 of 11

$100 R_{\infty}$	<i>K/S</i>
94,0	0,000 036
94,1	0,000 032
94,2	0,000 029



The ABC Company, LTD. Work Instruction	ABC Company
Document No. 4 (Tinting Process Procedure)	Rev. : 0
Operator : Tinting Operator : Finished Goods Controller : Coloreye Controller	Rev. Date : 13/9/02 Page : 1 of 8

1. PURPOSE

This process is carried out to ensure that alkyd tinted product conform the ABC specification.

2. SCOPE

This instruction is applicable to control quality in terms of color shade of alkyd tinted products in solvent base.

3. DEFINITION/ABBREVIATION

- Production Formulation : It is the document used for controlling the processed and raw materials used and the process details for producing each batch of paint. The master file of the Production formulation is approved by the Laboratory department and is accessible for use (but not for modification) from the computer net work.
- Filling Slip : It is the document use to control the packaging and labeling each batch of paint.
- Base : It is the group of semiproducts that use as the media for tinted products. They are white base, neutral base, and color base.
- Tinter : It is high concentration of color pigment that use for shading in tinted products to conform the standard color.

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 4 (Tinting Process Procedure)	Rev. : 0
Operator : Tinting Operator : Finished Goods Controller : Coloreye Controller	Rev. Date : 13/9/02 Page : 2 of 8

- Color eye : It is the computer that uses for perform color matching. It consists of PC and spectrophotometer.
- Full machine : It is automatic dispenser machine that uses for loading and weighing the tinters.

4. REFERENCES

Work Instruction No. TH-410-02 Production Process Control

5. EQUIPMENT/MATERIAL

1. Pot size 200-600 liter
2. Tinting tank size 3000 or 6000 liter
3. Tinting machine
4. Full machine
5. Film applicator gab size 100-400 micron
6. Draw down paper (Black and White)
7. Drying cabinet
8. Oven
9. Color eye
10. Base
11. Tinter

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 4 (Tinting Process Procedure)	Rev. : 0
Operator : Tinting Operator : Finished Goods Controller : Coloreye Controller	Rev. Date : 13/9/02 Page : 3 of 8

6. SAFETY CAUTION

- Install the appropriate safety and health device such as rubber glove, mask, goggles, safety shoe, safety helmet.
- Connect the ground line on the pot/tinting machine to prevent the electrostatic.

7. INSTRUCTION

7.1 Raw material preparation

7.1.1 Tinting operator

- Inspect the cleanliness of tinting pot/tinting tank, and tinting machine by visual prior to start the process.
- Record tinting machine, pot No./Tinting Tank No. into the Production Formulation.
- Check type and volume of base and tinter that use in each batch.
- Transfer base from base tank as following the Production Formulation into the pot/tinting tank. Record the actual weight of base into the Production Formulation by red pen.
- Stir mixture of base with tinting machine at speed No. 12-13 for 15 minute to homogenous

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 4 (Tinting Process Procedure)	Rev. : 0
Operator : Tinting Operator : Finished Goods Controller : Coloreye Controller	Rev. Date : 13/9/02 Page : 4 of 8

- Weight and loading all of tinters as the following Production Formulation in the vessel. Record the actual weight of each tinter into the Production Formulation by red pen.
- Transfer to the pot/tinting tank.

7.2 Mixing Process

7.2.1 Tinting operator

- Stir the mixture of base and tinter at medium speed (No. 12-13) for 20 mins
- Takes some of paint sample into 250 ml tin can to prepare the color panel for color measurement.

7.3 Color panel preparation

7.3.1 Tinting operator

- Take some sample from 7.2 to make the draw down on paper panel.
- The color panel from the stage 1 will be kept in the drying cabinet.
- Then move it into the oven at 50 °C to cure the paint film.
- Finally, color panel will be exposure at ambient to make the panel cool for 3 min prior to perform color measurement by Color eye controller

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 4 (Tinting Process Procedure)	Rev. : 0
Operator : Tinting Operator : Finished Goods Controller : Coloreye Controller	Rev. Date : 13/9/02 Page : 5 of 8

Table 1 : The specification for color panel preparation for tinted alkyd products

Color shade	Film thickness from applicator	Drying time in drying cabinet (minute)	Curing time in oven at 50 °C	Cooling time for panel exposure at ambient
Pale	200	20	30	3
Medium-Dark	300	20	30	3

7.4 Color measurement

7.4.1 Color eye controller

- Inspect the quality of color panel prior to perform color measurement.
- Insert the color panel on the slit of spectrophotometer.
- Draw the circle on the measurement area.
- Perform color measurement
- Record the color different value (CIE) into the Color Matching Sheet.

The outcome of color measurement categorize into 2 cases :

1. In case of CIE less than standard value, It means color shade conform the standard color.
 - Cut some sample of color shade and enclosed with the filling slip to prevent the error in filling line.
 - Send the formulation to Quality Controller to check other properties that specify into Production Formulation.

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 4 (Tinting Process Procedure)	Rev. : 0
Operator : Tinting Operator : Finished Goods Controller : Coloreye Controller	Rev. Date : 13/9/02 Page : 6 of 8

2. In case of CIE higher than standard value, It means color shade does not conform the standard color. It needs to be color adjustment.
 - Color eye controller adjust the color by adding some of tinter or base that read from Color Eye
 - Tinting operator perform the step by step from 7.1 to 7.4.
 - In case of color shade can not adjust as normal, Color eye controller must be inform Color Engineer to correct the batch.

8. QUALITY RECORDS

- Production Formulation will be collected for 2 years

9. APPENDIX

- Example of Production Formulation Sheet
- Example of Filling Slip

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 4 (Tinting Process Procedure)	Rev. : 0
Operator : Tinting Operator : Finished Goods Controller : Coloreye Controller	Rev. Date : 13/9/02 Page : 7 of 8

Appendix 1 : Example of Production Formulation Sheet

ITEM	DESCRIPTION	UNIT	QTY	PRICE	TOTAL
001	DESK	ALUM	1000	1.50	1500.00
002	DESK	ALUM	1000	1.50	1500.00
003	DESK	ALUM	1000	1.50	1500.00
004	DESK	ALUM	1000	1.50	1500.00
005	DESK	ALUM	1000	1.50	1500.00
006	DESK	ALUM	1000	1.50	1500.00
007	DESK	ALUM	1000	1.50	1500.00
008	DESK	ALUM	1000	1.50	1500.00
009	DESK	ALUM	1000	1.50	1500.00
010	DESK	ALUM	1000	1.50	1500.00
011	DESK	ALUM	1000	1.50	1500.00
012	DESK	ALUM	1000	1.50	1500.00
013	DESK	ALUM	1000	1.50	1500.00
014	DESK	ALUM	1000	1.50	1500.00
015	DESK	ALUM	1000	1.50	1500.00
016	DESK	ALUM	1000	1.50	1500.00
017	DESK	ALUM	1000	1.50	1500.00
018	DESK	ALUM	1000	1.50	1500.00
019	DESK	ALUM	1000	1.50	1500.00
020	DESK	ALUM	1000	1.50	1500.00
021	DESK	ALUM	1000	1.50	1500.00
022	DESK	ALUM	1000	1.50	1500.00
023	DESK	ALUM	1000	1.50	1500.00
024	DESK	ALUM	1000	1.50	1500.00
025	DESK	ALUM	1000	1.50	1500.00
026	DESK	ALUM	1000	1.50	1500.00
027	DESK	ALUM	1000	1.50	1500.00
028	DESK	ALUM	1000	1.50	1500.00
029	DESK	ALUM	1000	1.50	1500.00
030	DESK	ALUM	1000	1.50	1500.00
031	DESK	ALUM	1000	1.50	1500.00
032	DESK	ALUM	1000	1.50	1500.00
033	DESK	ALUM	1000	1.50	1500.00
034	DESK	ALUM	1000	1.50	1500.00
035	DESK	ALUM	1000	1.50	1500.00
036	DESK	ALUM	1000	1.50	1500.00
037	DESK	ALUM	1000	1.50	1500.00
038	DESK	ALUM	1000	1.50	1500.00
039	DESK	ALUM	1000	1.50	1500.00
040	DESK	ALUM	1000	1.50	1500.00
041	DESK	ALUM	1000	1.50	1500.00
042	DESK	ALUM	1000	1.50	1500.00
043	DESK	ALUM	1000	1.50	1500.00
044	DESK	ALUM	1000	1.50	1500.00
045	DESK	ALUM	1000	1.50	1500.00
046	DESK	ALUM	1000	1.50	1500.00
047	DESK	ALUM	1000	1.50	1500.00
048	DESK	ALUM	1000	1.50	1500.00
049	DESK	ALUM	1000	1.50	1500.00
050	DESK	ALUM	1000	1.50	1500.00
051	DESK	ALUM	1000	1.50	1500.00
052	DESK	ALUM	1000	1.50	1500.00
053	DESK	ALUM	1000	1.50	1500.00
054	DESK	ALUM	1000	1.50	1500.00
055	DESK	ALUM	1000	1.50	1500.00
056	DESK	ALUM	1000	1.50	1500.00
057	DESK	ALUM	1000	1.50	1500.00
058	DESK	ALUM	1000	1.50	1500.00
059	DESK	ALUM	1000	1.50	1500.00
060	DESK	ALUM	1000	1.50	1500.00
061	DESK	ALUM	1000	1.50	1500.00
062	DESK	ALUM	1000	1.50	1500.00
063	DESK	ALUM	1000	1.50	1500.00
064	DESK	ALUM	1000	1.50	1500.00
065	DESK	ALUM	1000	1.50	1500.00
066	DESK	ALUM	1000	1.50	1500.00
067	DESK	ALUM	1000	1.50	1500.00
068	DESK	ALUM	1000	1.50	1500.00
069	DESK	ALUM	1000	1.50	1500.00
070	DESK	ALUM	1000	1.50	1500.00
071	DESK	ALUM	1000	1.50	1500.00
072	DESK	ALUM	1000	1.50	1500.00
073	DESK	ALUM	1000	1.50	1500.00
074	DESK	ALUM	1000	1.50	1500.00
075	DESK	ALUM	1000	1.50	1500.00
076	DESK	ALUM	1000	1.50	1500.00
077	DESK	ALUM	1000	1.50	1500.00
078	DESK	ALUM	1000	1.50	1500.00
079	DESK	ALUM	1000	1.50	1500.00
080	DESK	ALUM	1000	1.50	1500.00
081	DESK	ALUM	1000	1.50	1500.00
082	DESK	ALUM	1000	1.50	1500.00
083	DESK	ALUM	1000	1.50	1500.00
084	DESK	ALUM	1000	1.50	1500.00
085	DESK	ALUM	1000	1.50	1500.00
086	DESK	ALUM	1000	1.50	1500.00
087	DESK	ALUM	1000	1.50	1500.00
088	DESK	ALUM	1000	1.50	1500.00
089	DESK	ALUM	1000	1.50	1500.00
090	DESK	ALUM	1000	1.50	1500.00
091	DESK	ALUM	1000	1.50	1500.00
092	DESK	ALUM	1000	1.50	1500.00
093	DESK	ALUM	1000	1.50	1500.00
094	DESK	ALUM	1000	1.50	1500.00
095	DESK	ALUM	1000	1.50	1500.00
096	DESK	ALUM	1000	1.50	1500.00
097	DESK	ALUM	1000	1.50	1500.00
098	DESK	ALUM	1000	1.50	1500.00
099	DESK	ALUM	1000	1.50	1500.00
100	DESK	ALUM	1000	1.50	1500.00
TOTAL			1000	1.50	1500.00

Handwritten signature

24 719 2548

 251
 252
 253
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 260

ต้นฉบับ หน้าขาดหาย

ต้นฉบับ หน้าขาดหาย

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 4 (Tinting Process Procedure)	Rev. : 0
Operator : Tinting Operator : Finished Goods Controller : Coloreye Controller	Rev. Date : 13/9/02 Page : 7 of 8

Appendix 2 : Example of Filling Slip-Sheet

*** JOTUN THAILAND LIMITED (PVT) ***
Filling & Transfer Slip

W0170
15.58.10

LABORATORY

P/O Name: JOTAGLOSS : PIXIE BLUE P/O Shop Order No.: 169168
 P/O Code: 000000 Spec. Gravity: _____
 Date: _____
 Std. Filling Weight: 3.785LT

Product Code		Pack Size	Std. Tolerance Filling weight	Sampling Weight	Filling Weight	Label Quality
018RS51VA		1 G	0.1	0.1	0.1	
			0.2	0.2	0.2	
			0.3	0.3	0.3	
			0.4	0.4	0.4	
			0.5	0.5	0.5	
			0.6	0.6	0.6	
			0.7	0.7	0.7	
			0.8	0.8	0.8	
			0.9	0.9	0.9	
			1.0	1.0	1.0	

Inspector Approved by: _____ Date: _____
 Supervisor Approved by: _____ Date: _____

LABORATORY

Product Code	Pack Size	Std. Tolerance Filling weight	Authorized Shop Order No.	Operational No. / Packs	Fill	Transfer
018RS51VA	1 G	3.785LT	169168	169168A		

Product For Authorized: _____ Date: _____
 Supervisor Authorized: _____ Date: _____



The ABC Company, LTD. Work Instruction	ABC Company
Document No. 5 (Minimum and maximum batch size for tinting section)	Rev. : 0
Operator : Senior Production Planning Supervisor	Rev. Date : 13/9/02
	Page : 1 of 2

1. PURPOSE

This document is generated to prevent the bubble and inhomogeneous problem in tinting product.

2. SCOPE

This instruction is applicable to scaling up and down in tinting section both of water base and solvent base.

For water base

Tank size (Ltr) Tank No.	Min. starting volume (Ltr/Gal)	Preferable for starting volume (Ltr/Gal)	Max. starting volume (Ltr/Gal)	Remark
Pot 200 Ltr	75/30	-	170/45	75-170Ltr
Pot 400 Ltr	110/50	-	340/90	110-340Ltr
Pot 600 Ltr	265/70	-	550/140	265-550Ltr
Tank size = 3000 Ltr				
Tank No. 230-233	795/210	1130/300	2800/240	1 blade
Tank No. 238-241	795/210	1130/300	2800/240	1 blade
Tank size = 12000 Ltr				
Tank No. 221-222				
-It has 2 blade for stirring	4000/1000 9800/2600	5700/1500 9800/2600	6000/1500 10000/2650	-For 1 st blade -For 2 nd blade
Remark: 223 slide down the 2 nd impeller to 6000 ltr				

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 5 (Minimum and maximum batch size for tinting section)	Rev. : 0
Operator : Senior Production Planning Supervisor	Rev. Date : 13/9/02
	Page : 2 of 2

For Solvent base

Tank size (Ltr) Tank No.	Min. starting volume (LtrGal)	Preferable for starting volume (Ltr/Gal)	Max. starting volume (Ltr/Gal)	Remark
Pot 200 Ltr	75/30	-	170/45	75-170Ltr
Pot 400 Ltr	110/50	-	340/90	110-340Ltr
Pot 600 Ltr	265/70	-	550/140	265-550Ltr
Tank size = 3000 Ltr				
Tank No. 230-235	795/210	1130/300	2700/720	1 blade
Tank No. 240-245	795/210	1130/300	2700/720	1 blade
Tank size = 6000 Ltr				
Tank No. 226-228	1900/500	2650/700	5300/1400	1 blade

Remark : 1 Gal. = 3.785 Ltr.

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 6 (Minimum and maximum volume of S/I tinter in tinter tank)	Rev. : 0
	Rev. Date : 13/9/02
Operator : Tinting Operator	Page : 1 of 2

1. PURPOSE

This document is generated to control consistency of color strength in S/I tinter that storage in tinter tank.

2. SCOPE

This instruction is applicable to tinter tank in solvent base.

Document No. 6	Rev. : 0
(Minimum and maximum volume of S/I tinter in tinter tank)	Rev. Date : 13/9/02
Operator : Tinting Operator	Page : 2 of 2

The Maximum and Minimum level of S/I tinter in tinter tank

Tank No.	Code No.	Name	Sp. gr.	STD batch size (Kg)	Minimum Level (Kg)	Maximum Level (Kg)
008-380-00	007279	SI Tinter 279 : Green No. 7	1.14	568	100	800
008-381-00	007236	SI Tinter 236 : Blue	1.10	567	100	780
008-382-00	007243	SI Tinter 243 : Chrome Middle	1.85	983	100	1000
008-383-00	007232	SI tinter 232 : Black	1.21	602	100	580
008-384-00	007233	SI Tinter : Yellow Oxide	1.57	800	100	1000
008-385-00	007234	SI Tinter : Red Oxide	1.89	900	100	1000

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 7 (Tinter pail handling)	Rev. : 0
	Rev. Date : 13/9/02
Operator : Tinting Operator	Page : 1 of 1

1. PURPOSE

This document is generated to control consistency in terms of color strength of S/I tinters that use in tinted solvent base products.

2. SCOPE

This instruction is applicable to S/I tinters that contained into the pail prior to use in tinting process.

3. EQUIPMENT/MATERIAL

Manual stirring equipment

4. SAFETY CAUTION

Install the appropriate safety and health device such as rubber glove, mask, goggles, safety shoes, safety helmet.

5. INSTRUCTION

Tinting operator

- Open the lid of the tinter pail
- Use the manual stirring equipment stir for 5 min prior to use in tinting process.
- After using, the pail should be close properly to prevent the skinning problem that caused by contacting with air.

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 8 (Cube Applicator calibration procedure)	Rev. : 0
Operator : Process Assistant	Rev. Date : 13/9/02
	Page : 1 of 3

1. PURPOSE

To ensure the precision of Cube Applicator that use for making film for drying time measurement.

2. SCOPE

This document specifies method for calibration drying time Cube Applicator in the laboratory.

3. DEFINITION/ABBREVIATION

Cube Applicator : It is the equipment that uses for drawdown film.

Comb Gauge : It is the wet film measurement equipment.

4. REFERENCES

-

5. EQUIPMENT/MATERIAL

1. Comb Gauge
2. Cube Applicator
3. Alkyd White Base
4. Glass plate size 2x30 centimeters
5. Stirring Machine
6. Tin can size 250 ml

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 8 (Cube Applicator calibration procedure)	Rev. : 0
Operator : Process Assistant	Rev. Date : 13/9/02
	Page : 2 of 3

6. SAFETY CAUTION

Install the appropriate safety and health device such as rubber glove mask, goggles, safety shoe, safety helmet.

7. INSTRUCTION

7.1 Check & clean Cube Applicator

Take sample of Alkyd white base 100 gram into 250 tin can, then stir with stirring machine at 750 RPM for 2 minute.

7.3 Place Glass panel on the table.

7.4 Place Cube Applicator on the top of glass panel (7.3)

7.5 Drop Alkyd white base sample from 7.2 in block of Cube Applicator about 5 gram.

7.6 Slide Cube Applicator on the glass panel.(Film coat on glass panel amount a haft of gap of Cube Applicator)

7.7 Measure thickness of coating by Comb Gauge.

7.8 Record result.

If they differ by more than $\pm 10\%$, then the Cube Applicator is not applicable.

8. QUALITY RECORDS

Please see the Appendix 1

9. APPENDIX

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 9 (Drying time recorder calibration procedure)	Rev. : 0
Operator : Process Assistant	Rev. Date : 13/9/02
	Page : 1 of 3

1. PURPOSE

To ensure the precision of Drying Time Recorder that measure drying time of paints.

2. SCOPE

This document specifies method for calibration oven in the laboratory.

3. DEFINITION/ABBREVIATION

Drying Time Recorder Type 6 is the drying time recorder that has the drying tester rack amount 6 racks.

Drying Time Recorder Type 10 is the drying time recorder that has the drying tester rack amount 6 racks.

Time ruler is the scale that uses for time measurement.

4. REFERENCES

-

5. EQUIPMENT/MATERIAL

- 5.1 Stop watch (Master)
- 5.2 Drying Time Recorder
- 5.3 Ruler
- 5.4 White paper size 2*30 cm.

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 9 (Drying time recorder calibration procedure)	Rev. : 0
Operator : Process Assistant	Rev. Date : 13/9/02
	Page : 2 of 3

6. SAFETY CAUTION

Install the appropriate safety and health device such as rubber glove mask, goggles, safety shoe, safety helmet.

7. INSTRUCTION

- 7.1 Check & clean Drying Time Recorder
- 7.2 Check & clean pins of Drying Time Recorder.
- 7.3 Stick white paper on Drying Time Recorder nearby the first drying time by means of edge of white paper starting line is coinciding.
- 7.4 Set pins of Drying Time Recorder at start point, then take the switch on.
- 7.5 Measure time by stopwatch.
- 7.6 Every 1 hour uses the ruler mark line from pins to white paper
- 7.7 Take scale of the white paper compare with time ruler.
- 7.8 Record result
- 7.9 If they differ by more than ± 8 min.(1/8 hour), the Drying Time Recorder should be judged faulty and be repaired

8. QUALITY RECORDS

Please see in the Appendix 1

9. APPENDIX

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 9 (Drying time recorder calibration procedure)	Rev. : 0
Operator : Process Assistant	Rev. Date : 13/9/02
	Page : 3 of 3

Appendix 1 : Drying time recorder report form

The ABC Company Calibration record		
Calibration record for Cube Applicator No.....		
Calibration Date/...../.....		
Equipment Serial No. :		
Location :		
Calibration period :		
Standard Equipment		
Result		
Time scale (Hour)	Time scale on white paper (Hour)	Error (minute)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
Conclusion ()Pass ()Fail		

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 10 (Oven Calibration Procedure)	Rev. : 0
Operator : Process Assistant	Rev. Date : 13/9/02
	Page : 1 of 3

1. PURPOSE

To ensure the precision of oven that use for making film to dry.

2. SCOPE

This document specifies method for calibration oven in the laboratory.

3. DEFINITION/ABBREVIATION

-

4. REFERENCES

-

5. EQUIPMENT/MATERIAL

- 5.1 Stop watch (Master)
- 5.2 Glass thermometer (Master)
- 5.3 Oven

6. SAFETY CAUTION

Install the appropriate safety and health device such as rubber glove mask, goggles, safety shoe, and safety helmet.

7. INSTRUCTION

- 7.1 Check & clean oven
- 7.2 Place glass thermometer in to the oven.

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 10 (Oven Calibration Procedure)	Rev. : 0
	Rev. Date : 13/9/02
Operator : Process Assistant	Page : 2 of 3

- 7.3 Switch on & set temperature of oven at 60 °C.
- 7.4 Close oven door.
- 7.5 Measure time 60 min. by stopwatch.
- 7.6 Open oven door, read temperature of glass thermometer & compare the temperature with temperature that set on the oven.
- 7.7 Record result.
- 7.8 Set temperature of oven at 100 °C.
- 7.9 Operate to 7.4 – 7.7

If they differ by more than $\pm 2^{\circ}\text{C}$, the oven should be judged faulty and be repaired

8. QUALITY RECORDS

Please see the Appendix 1

9. APPENDIX

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 10 (Oven Calibration Procedure)	Rev. : 0
Operator : Process Assistant	Rev. Date : 13/9/02
	Page : 3 of 3

Appendix 1

Oven recorder report form

The ABC Company Calibration record		
Calibration record for Cube Applicator No.....		
Calibration Date/...../.....		
Equipment Serial No. :		
Location :		
Calibration period :		
Standard Equipment		
Result		
Set point (° C)	Actual value (° C)	Different value (° C)
60		
100		
Conclusion	() Pass	() Fail

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 11 (Calibration sheet for Full machine)	Rev. : 0
	Rev. Date : 13/9/02
Operator : Solvent Base Foreman	Page : 1 of 2

1. PURPOSE

This document is generated to control the accuracy of tinter that use from Full machine.

2. SCOPE

This calibration sheet is applicable to Full machine in solvent base when load new tinter batch into canister or tinting tank.

3. INSTRUCTION

- 3.1 After tinter is loaded into the canister or tinting tank, Full machine is calibrated to ensure the accuracy of Full machine.
- 3.2 Solvent Base Foreman inspect the accuracy of Full machine by means of dispense the tinter as follow the set point weight. It should start from Superfine level, Fine level, Medium level, and Coarse level respectively. If the error is higher than 1%, they need to adjust.

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 11 (Calibration sheet for Full machine)	Rev. : 0
Operator : Solvent Base Foreman	Rev. Date : 13/9/02
	Page : 1 of 2

Calibration sheet for Full machine

Tinter	Fine (Kg)				Superfine (Kg)			
	Setting Point	Test Point	Actual	%Error	Setting Point	Test Point	Actual	%Error
	1.35	1.40			0.89	0.95		
	Fine (Kg)				Superfine (Kg)			
	Setting Point	Test Point	Actual	%Error	Setting Point	Test Point	Actual	%Error
	0.3	0.4			0.045	0.50		

Tested by :

Date :

Approved by :

Date :

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 12 (Cleaning instruction for tinter tank)	Rev. : 0
Operator : Tinting operator	Rev. Date : 13/9/02
	Page : 1 of 2

1. PURPOSE

This process carried out to prevent the dry skinning from tinter tank.

2. SCOPE

This instruction is applicable for cleaning the S/I tinter in solvent base.

3. DEFINITION/ABBREVIATION

-

4. REFERENCES

-

5. EQUIPMENT/MATERIAL

- 5.1 Riobeer (Cleaning machine)
- 5.2 Brush
- 5.3 Thinner No. 17
- 5.4 Solvesso 100 (RM 02110)

6. SAFETY CAUTION

- 6.1 Install the appropriate safety and health device such as rubber glove, mask, goggles, safety shoe, safety helmet.
- 6.2 Connect the ground line on the pot/tinting machine to prevent the electrostatic.

The ABC Company, LTD. Work Instruction	ABC Company
Document No. 12 (Cleaning instruction for tinter tank)	Rev. : 0
	Rev. Date : 13/9/02
Operator : Tinting operator	Page : 1 of 2

7. INSTRUCTION

- 7.1 Investigate the tinter level from PLC monitor, and record the level.
- 7.1 Contact with maintenance department to set up the minimum level of tinter volume at level zero. Then turn off the stirrer, and recirculate pump.
- 7.3 Empty tinter tank
- 7.4 Close the bottom valve, then cleaning as the following
- 7.3 Use the old thinner No. 17 clean the tank by means of spraying the entire tinter wall.
- 7.6 Then use the brush cleans the tinter wall until dry skin tinter leave from the tinter wall.
- 7.7 Use fresh thinner No. 17 clean the tinter wall again by means of using the Riobeer cleaning machine. Spray fresh thinner No. 17 around the tinter wall. Then drain the waste thinner pass through draining pipe.
- 7.8 Inspect the cleanliness of tinter tank by visual. If tank is not good clean enough, repeat the step 7.4.2 until tank is clean.
- 7.9 Empty tinter tank, then transfer tinter into the tank. Run pump and re circulation of the tinter for 30 min before using the tinter.
- 7.10 Contact maintenance department to set up the normal minimum level. Turn switch of stirrer on.

8. QUALITY RECORDS

The ABC Company, LTD.	ABC Company
Document No. 13 (Formulation Sheet for color development)	Rev. : 0
Operator : Color Engineer	Rev. Date : 13/9/02
	Page : 1 of 1

Product Name : _____	Product Code : _____
CE Code : _____	New Color No : _____
Date : _____	

Base/Tint	Score	CORR 1	CORR 2	CORR 3	Total	Utility
Neutral Base						
White Base						
CE						
Clay						

Product Name : _____	Product Code : _____
CE Code : _____	New Color No : _____
Date : _____	

Base/Tint	Score	CORR 1	CORR 2	CORR 3	Total	Utility
Neutral Base						
White Base						
CE						
Clay						

Appendix IV

Preventive Maintenance Plan

Machine No.	Location	Detail	Responsible Person	Due Date
008-304-01	Solvent base (Grinding)	Cleaning the dust suction of Dissolver	Maintenance	Monthly
-	Laboratory	Inspection and cleaning the ventilation system in drying cabinet	Maintenance	Monthly
008-343 008-345 008-456	Solvent base (Grinding)	Inspect the closing system of storage tank	Maintenance	Monthly
008-343 008-345 008-456	Solvent base (Grinding)	Inspect the condition of lid seal of storage tank	Maintenance	Monthly

BIOGRAPHY



Mr. Piyawat Rattanasupar was born on 23 October 1972 at Nakornsrihammarat, Thailand. He graduated a Bachelor Degree in Textile Chemical Engineering with the second class honor (Silver Medal Award for the outstanding Engineering student) from Rajamangala Institute of Technology (RIT) since 1996. He joined with the Jong Stit Dyeing factory as the Laboratory Supervisor and Coordinator with Hong Kong technician to develop the new products for 2 years. In 1995, He worked as the lecturer assistant in Textile Chemical Department at RIT. In 1996, He joined with Ciba Geigy as Technical Sale Representative for 1 year. In 1997 to present, He has joined with Jotun Thailand Limited, Paint manufacturing, as a Process Engineer. He has experienced in paint manufacturing, process design and optimization, production and process control for 6 years till now (2003).