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APPENDIX A

ULTRASONIC CLEANING MACHINE

Ultrasonic Cleaning Machine

1) Function of Ultrasonic Cleaning Machine

Ultrasonic cleaning Machine is the machine which use for cleaning by using solvent which heated until nearly boiling point in order to make molegular of solvent vibration to take out very small particals. Ultraosnic cleaning machine is shown in Figure.

2) Utilyze Ultrasonic Cleaning Machine for cable production

Ultrasonic Cleaning Machine has been used to clean printing roller. The printing roller has been taken out printing roller from printing unit and put in the ultrasonic baht which has solvent heated about 60 degree about 20 minutes. Then the cleaned printing roller is put into water for taking out solvent before checking with osiloscope.

3) The advantage of Ultrasonic Cleaning machine

It can used for cleaning printing roller out off production line. (At preparation step or when the machine running)

The efficiancy of cleaning is very good and very fast. Operator does not spend the time for cleaning. They only put printing roller into Ultrasonic baht and after 10-20 minutes, they take the clean printing roller into water for taking out solvent after that check and keep it in the printing roller box. While before improving to utilyze Ultrasonic, operators put printing roller into washing plate which contained solvent after that they used brush to clean it before taken into water. In this way, operators need to spend the time for cleaning and the cleaning quality was not sure. It was many times that was found the long set up time due to printing problem which caused from printing roller cleaning no good.

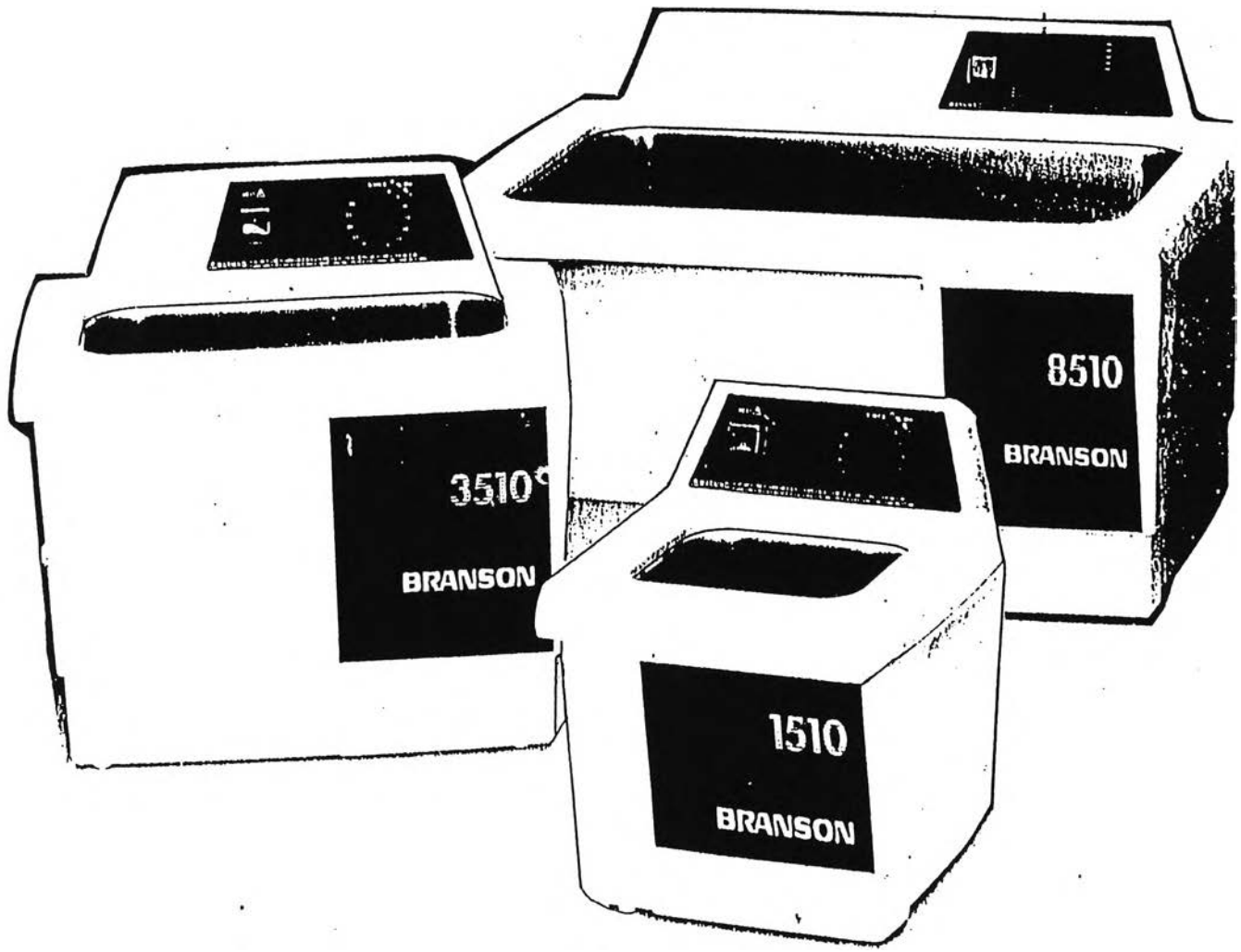

Figure 1 : Ultrasonic cleaning machine

APPENDIX B

CLEAN-SHOT CLEANING MACHINE

Clean-shot Cleaning Machine

1) Function of Clean-shot Cleaning Machine

Clean-shot cleaning Machine is the machine which use for cleaning by using small partical of sand to take out very small particals sticked on the objective by fast adbrasive. Clean-shot cleaning machine is shown in Figure.

2) Utilyze Clean-shot Cleaning Machine for cable production

Clean-shot Cleaning Machine is used for cleaning die, nipple, die holder, nipple holder, and breaker plate. The method of cleaning are as below. Die, die holder, nipple, nipple holder or breaker plate have been taken out from cross-head, The overflow valve of clean-shot machine is open to flow small sand with high speed in order to abrasive with the objective to take out compound which sticked on it before checking with osiloscope.

3) The advantage of Clean-shot Cleaning machine

Clean-shot cleaning machine can used for cleaning die, die holder, nipple, nipple holder or breaker plate out off production line. (At preparation step or when the machine running)

The efficiancy of cleaning is very good and very fast. Operators can do it very fast and can do it whenever they have free times such as during machine running. While before improving to utilyze Clean-shot, operators should clean die, die holder, nipple, nipple holder or breaker plate immedeatly after they took it out from cross-head because if it cooled down, compound had becomed to solid and sticked on it which was very difficult to clean so they need to spend more long time for cleaning and The cleaning quality was not sure. It was many times that was found long set up time due to such those parts problems which caused from cleaning no good.

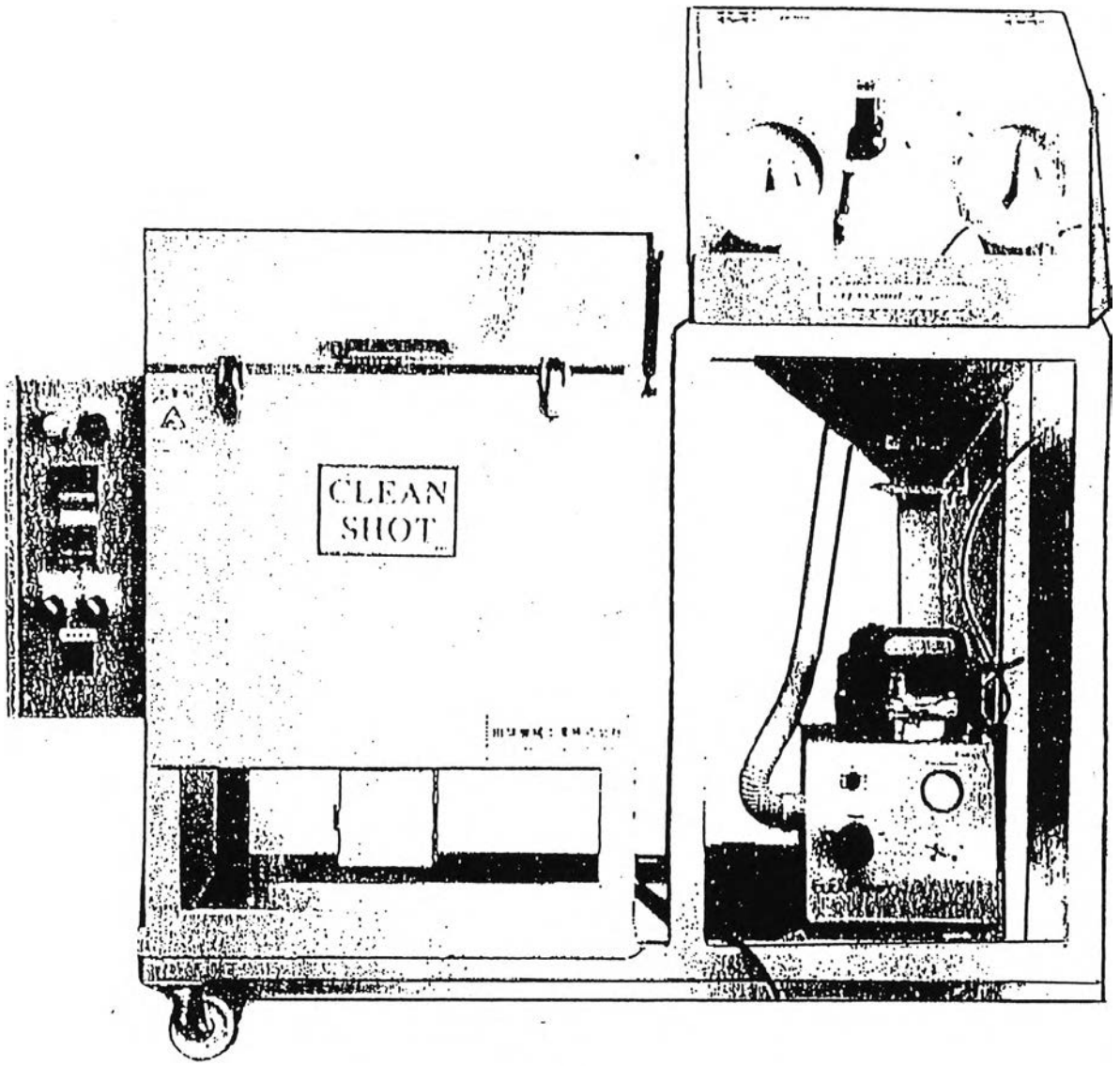

Figure 1 : Clean shot cleaning machine

APPENDIX C

CHECK-SHEET FORM

Check Sheet Form

1) Detail of check sheet

Check sheet is completed with 4 pages.

1. Page1 is called Operation condition. Operators write down all machine conditions compare between standard condition and actual condition such as pay-off and take-up tension, die, nipple, and screen mesh size, main and sub extruder temperature control, printing roller, line speed and all detector setting etc.

2. Page2 and page3 are called Quality control-1 and Quality control-2 respectively. Operators write down all products specification compare between specification and actual such as all dimensions, thickness, appearance, manufacturing lot no. of conductor and finished product.

3. Page4 is called compound check sheet. Operators write down compound lot no, name, color, vender name etc.

2) Method of input data in check sheet before improvement

Operators needed to prepare check-sheet, Process Operation Manual and Instruction sheet.

They have input data in page1 by separting into parts of machines such as pay-off, take-up, cross-head and cylinder and conductor spec. they inputed data when they set that parts for example that when they checked conductor, they was put conductor specification, when they set main and sub extruder temperature control, they inputed main and sub extruder temperature control. They inputed every specification until finish page1.

When operators finish to set up machine and after they could get the good product. They had begun to input data in check sheet page2 and page3 respectively. And they needed to check the quality of product in every bobbins and inputed data in check sheet in the detail of every bobbin together with sample attached until finished.

For page4 of check sheet, operators needed to input data after he checked compound lot no., quality of compound, date of manufacturing, compound name and color. Before compound was put into hopper.

3) Method of input data in check sheet after improvement

The method of input data in check sheet has been changed as following

1. Operators should prepare check sheet, Process Operation Manual and Instruction sheet at preparing step when they have free time or when machine running.
2. Operators should check conductor and compound quality and specification at preparing step when they have free time or when machine running after that input conductor specification in check sheet page1 and compound specification in check sheet page4.
3. Operators should input standard of machine condition specification at preparing step when they have free time or when machine running.
4. Operators should set all machine condition starting from pay-off until take-up after that they will input all actual machine conditions in the same time.

This new method can reduce set up time due to reduce transportation time of operator to pick up check sheet and input data in many times.

Figure 1 : Check sheet page 1

Jacketing Process Check Sheet (Operating Condition)

Order No. :	Machine	Date O Day O Night	Order quantity	Operator	S.OP.	PL / SV.
Product name :		Item No.	Design No.			
IS No.	TIS No.					

Operating condition

	Standard	Actual				
Pay-off tension	1)		Product	Test No.		
break or	2)			length (m)		
accumulator	3)		Talc	Level *(Above Min.)*		
			Powder	Coating (Can see powder)		
Die size (mm.)			Main Extruder	Master (%)		
				Temp. (C) C1		
Nipple size (mm.)				C2		
				C3		
Spacing (mm.)				C4		
				Neck		
Screen mesh				Head		
				Die		
Press roller shape				Current (A) / Load (%)		
				Revolution (RPM)		
Ink color			Sub Extruder	Temp. (C) C1		
				C2		
Ink viscosity (sec.)				C3		
				Adaptor		
Printing roller No.				Nozzle		
				Current (A) / Load (%)		
Printing roller appearance				Revolution (RPM)		
			Printing Unit	Level of ink *(Between min. and max.)*		
Take up tension				Level of solvent *(Above min.)*		
Line speed (m/min.)				Printing condition *(No line on marking roll No ink remained on cover)*		
Lump Detector	200 mm					
			Air wiper and blower	Printing		
				Accumulator		
				(No water remain on cord)		
			Spark tester (kV)			

Figure 2 : Check sheet page 2

Jacketing Process Check Sheet (Quality Control-1)

Order No. :	Machine	Date O Day O Night	Order quantity	Operator	S.OP.	PL / SV.
Product name :	Item No.	Design No.				
IS No.	TIS No.					

Specification

Input compound				Input core							Output cable											
Main compound		Stripe compound		No of wire	ire diamete		Insulation diameter		ore diamete		Thickness				Distance between conductor (mm)	Inspection (Length / time) / (Line speed)						
																Outer Diameter (mm)				Standard length (m)	Appearance	Printing	Strip Test
																Minor/Round		Major					
No.	Color	No.	Color		Min. (mm)	Max. (mm)	Min. (mm)	Max. (mm)	Min. (mm)	Max. (mm)	Min. (mm)	Avg. (mm)	Min above ground insulation	Min. Max.		Min.	Max.	Min.	Max.				

Actual

Input core

Conductor size	Bobbin No.	M/C No.	OP. Name	Length	Mark Joint	Test	Length (m)	Cause of bobbin changing	Thickness										Earth	Min. distance between conductors	Outer diameter				Appearance	Printing	Strip Test		Sample	Joint Sample
									Ridge side					Mark side							Minor/Round		Major								
									Min. (mm.)	Max. (mm.)		Min. Max.	Avg. (mm.)	Min. (mm.)	Max. (mm.)		Min. Max.	Avg. (mm.)	Min.above insulation (mm.)	(mm)	Min. (mm.)	Max. (mm.)	Min. (mm.)	Max. (mm.)						

Printing Roller code		Detail Read from P.O.M. (before start)	
T. No.	to	Detail Read by Actual (after start)	
		Sample of First bobbin (start side)	

Remarks : ◯ for Min. amd Max. Thickness

Figure 3 : Check sheet page 3

Jacketing Process : Check Sheet (Quality Control-2)

Order No. :	Machine	Date O Day O Night	Order quantity	Operator	S.OP.	PL / SV.
Product name :		Item No.	Design No.			
IS No.	TIS No.					

Actual

Input core

Conductor size	Bobbin No.	M/C No.	OP. Name	Length	Mark Joint	Test	Length (m)	Cause of bobbin changing	Thickness: Ridge side Min. (mm.)	Ridge side Max. (mm.)	Ridge side ○	Ridge side Min. Min. Max.	Ridge side Avg. (mm.)	Thickness: Mark side Min. (mm.)	Mark side Max. (mm.)	Mark side ○	Mark side Min. Min. Max.	Mark side Avg. (mm.)	Earth: Min. above insulation (mm.)	Min. distance between conductors (mm)	Outer diameter: Minor/Round Min. (mm.)	Minor/Round Max. (mm.)	Major Min. (mm.)	Major Max. (mm.)	Appearance	Printing	Strip Test		Sample	Joint Sample

Printing Roller code		Detail Read from P.O.M. (before start)	
T. No.	to	Detail Read by Actual (after start)	
		Sample of First bobbin (start side)	

Remarks : ○ for Min. amd Max. Thickness

Figure 4 : Check sheet page 4

Jacketing Process : Check Sheet (Compound)

Order No. :	Machine	Date O Day O Night	Order quantity	Operator	S.OP.	PL / SV.
Product name :		Item No.	Design No.			
IS No.	TIS No.					

Main compound	Test no.																
	Tag	Lot no.															
Stripe compound	Test no.																
	Tag	Lot no.															

Micrometer no.	Dial gauge no.	Pull gauge	Vernior caliper no.	Profile projector no.
Due date	Due date	Due date	Due date	Due date

PC DEPARTMENT

F 035-4-B

APPENDIX D

JACKET MACHINE HOPPER MODIFICATION

Hopper modification

1) Functional of hopper

Hopper is used for keeping compound before it flow into cylinder at cross-head when extrusion.

When it need to change type of compound, operator need to overflow old compound out of hopper and clean hopper before input new compound into hopper.

2) Shape of hopper before improvement

The shape of hopper before improvement made difficulty to clean because overflow area is in the middle of pipe. After operators overflowed old compound, they needed to clean the hopper by using air-gun to get rid of the remaining compound to make sure that it did not has any compound remained in hopper or pipe area. Sometimes operators did not enough cleaning hopper, it took a time to overflow compound at cross-head more long time.

3) Shape of hopper after improvement

The hopper is modified by moving overflow to the beginning of pipe and change pipe type to more smooth surface.

This modification made operator do shorter hopper cleaning time because of no remaining compound in hopper or pipe after overflow. It is not only effected to shorter hopper cleaning time but also effected to shorter cross-head overflow time and saved the overflow compound.

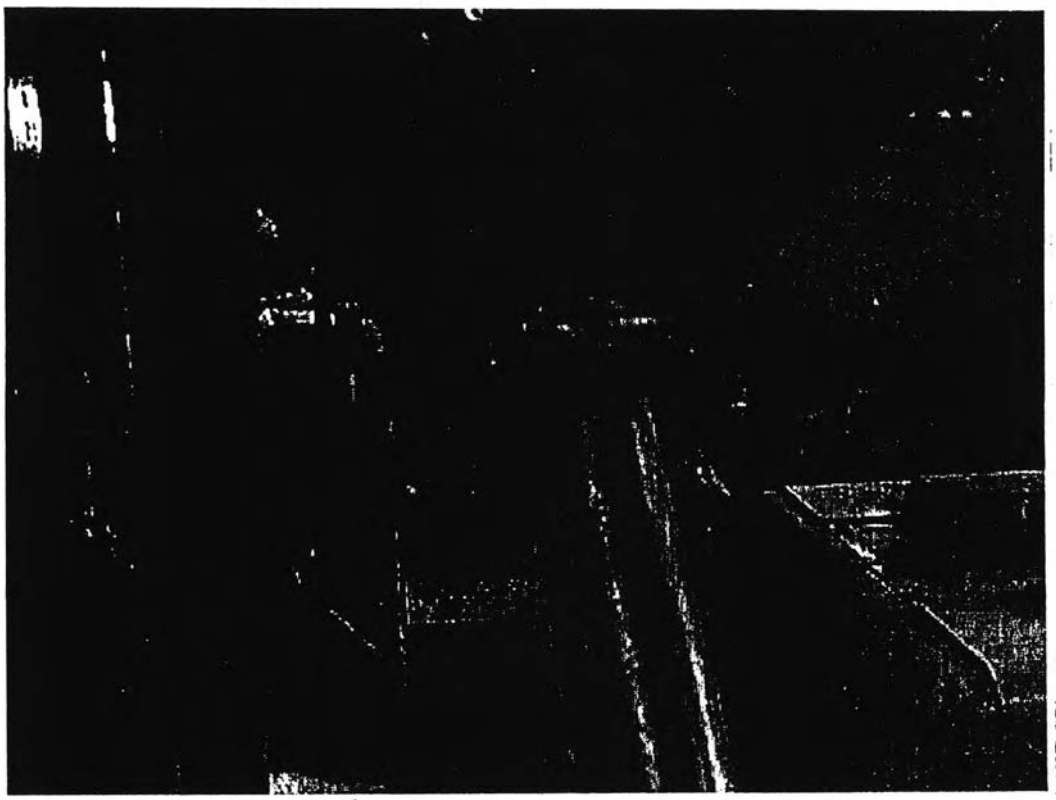

Figure 1 Hopper before improvement

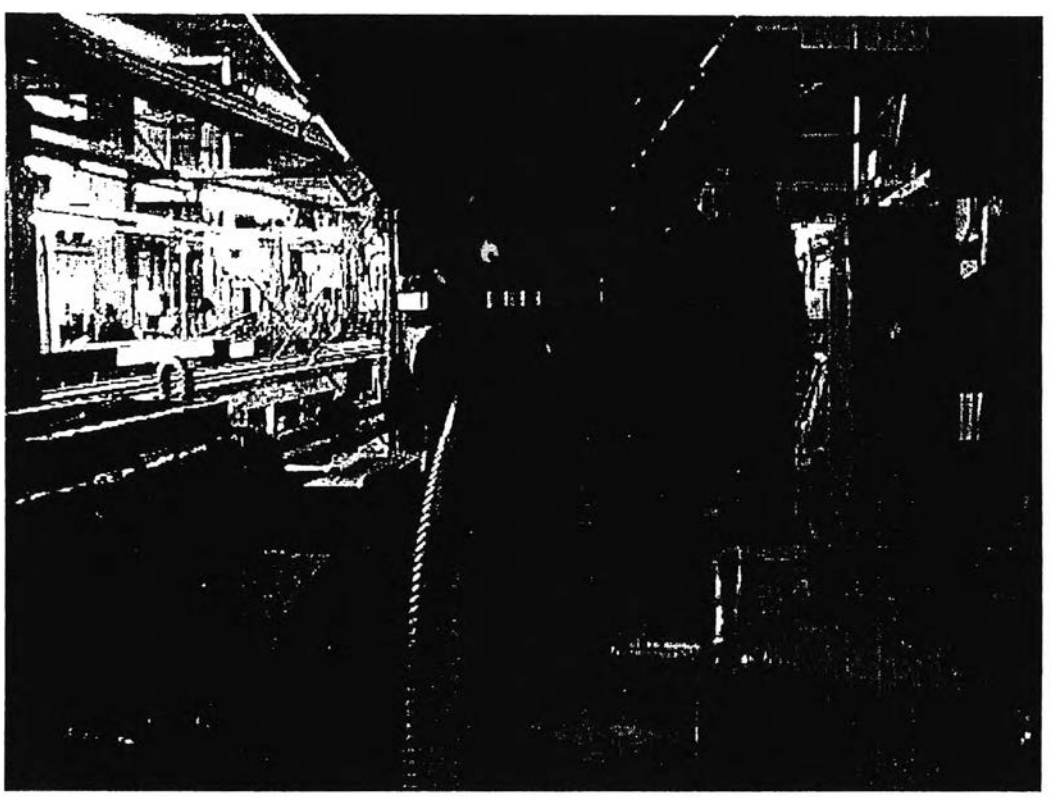

Figure 2 Hopper after improvement

APPENDIX E

PRINTING UNIT MODIFICATION

Printing Unit modification

1) Components of printing unit

Printing unit is composed of 5 components.

a. Ink bath, it uses for containing ink, solvent, blade, blade holder, ink viscosity checking, printing roller,shaft for controlling printing roller rotating speed. It is moveable. When operators want to change printing color, they need to clean it together with its parts by taking out from machine and cleaning with brush .

b. Blade, it composed of 2 blade which called front blade and side blade. Both of them is used to get rid of ink from printing roller and control the suitable ink quantity on printing roller. They made from Polyethelene. Operators need to change both front and side blade every 60 kms.

c. Blade holder, it composed of 2 blade holder which called front blade holder and side blade holder. The functional of blade holders are to hold front blade and side blade respectively.

d. Ink viscosity control unit, it uses for controlling ink viscosity. Normally ink was mixed together with solvent and checked viscosity of ink after mixing at starting. If its viscosity is too low, printing problems such as print blur, unreadable, ink splash etc will occure, so ink need to be added to increase its viscosity. If its viscosity is too high, printing problems also occure so solvent need to be added to decrease its viscosity. Standard ink viscosity value has been set. Operators have used it to set ink viscosity when starting. But after machine running, ink viscosity control unit is used for maintain viscosity value. This control unit check viscosity value and drop solvent when ink viscosity is higher than specification which had set.

e. Printing roller, it has been rotated by shaft roller to print charecteristics such as cable manufacturing companay, cable voltage and temperature rating specification etc. Operators need to install printing roller to fit with shaft roller.

f. Shaft roller, it uses for rotating printing roller. Operators can adjust shaft roller speed to synchonize printing roller speed with machine speed, unless he can get good printing.

2) Method of Setting Printing Unit before improvement

Operators had taken out printing roller, front and side blade, front and side blade holder,and shaft roller, after that they cleaned ink bath, printing roller, front and side blade, front and side blade holder and shaft roller. Then he set front blade with front blade holder and side blade with side blade holder before set marking roller with shaft roller. Finally he checked ink viscosity.

When machine started and when machine speed increasing, operators should check quality of printing. If printing quality was not good, they needed to adjust printing roller speed until can get good printing

3) Method of Setting Printing Unit after improvement

It is waste time for operator to clean all parts such as printing roller, front and side blade, front and side blade holder and shaft roller, so the spare printing unit is prepard another 1 set which is prepared by installed all parts except only printing roller with shaft roller . After operators take out the old printing unit, they can install new printing unit immediately by setting printing roller with shaft roller after that they dip all old printing unit parts into Ultrasonic cleaning machine when they have free times or during machine operating, finally they will only take those parts out from Ultrasonic cleaning machine and dip into water bath before checking and keeping.

Machine and roller speed have connected automation interlock automatically. Operators do not need to adjust printing roller speed when starting and when machine speed increasing.

Blade and blade holder design of both side blade and front blade are changed the design in order to reduce setting time.

Blade holder modification

1) Functional of blade holder

We use blade holder at printing unit. The functional of blade holder is to hold the blade at printing unit, while the functional of blade is to get rid of ink and control quantity of printing ink.

2) Blade holder before improvement

The shape of blade holder before improvement made difficulty to install because holdering area is small which effected to make blade bending after installation and difficult to adjust printing unit.

3) Blade holder after improvement

We improve the blade holder in order to make it easy when installation by extend the length of it and expand the arm of holdering.

The result showed that not only it is easy to install to reduce set up time of printing unit but also it can help to solve printing problem such as ink splash, printing uncompleted ect.

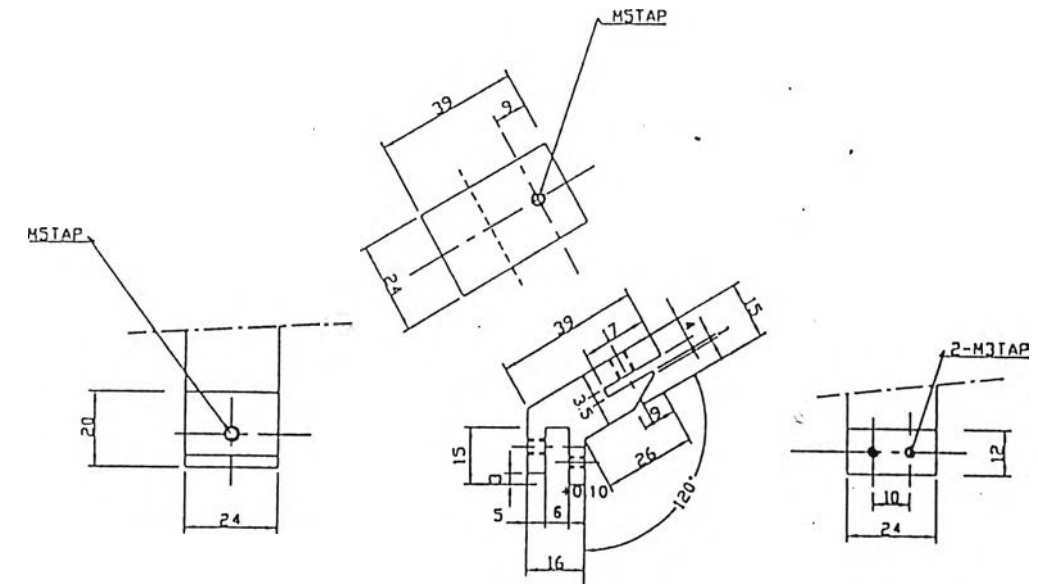

Figure 1 : Front blade holder before improvement

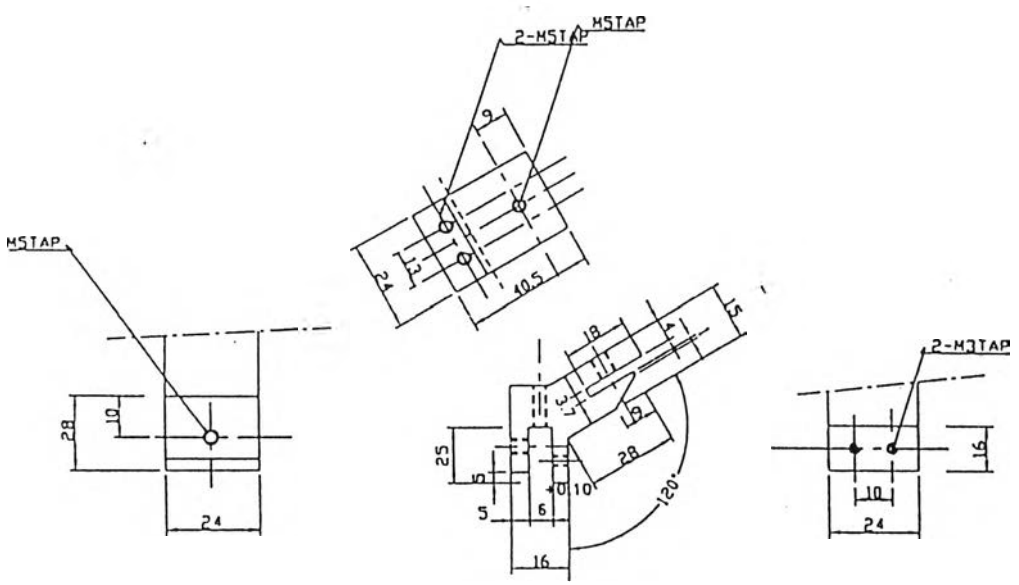

Figure 2 : Front blade holder after improvement

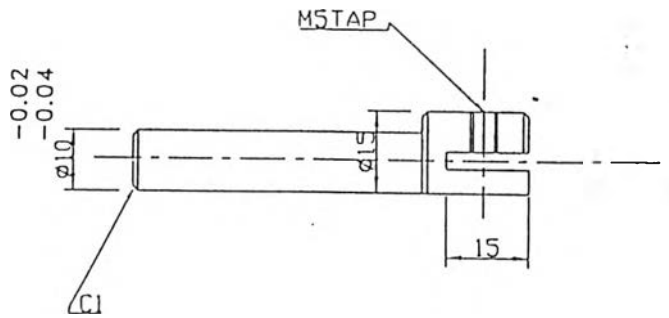

Figure 3 : Side blade before improvement

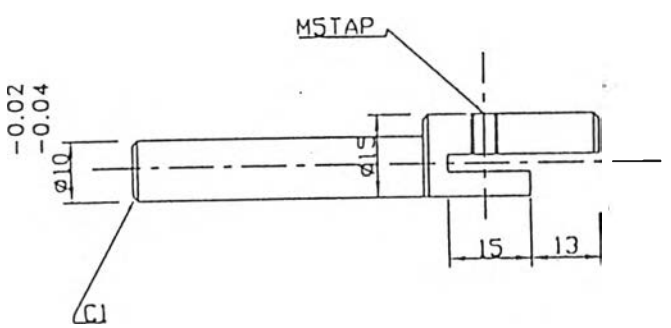

Figure 4 : Side blade after improvement

APPENDIX F

DATA OF SET UP TIME OF MAIN OPERATOR FOR MACHINE Ex-302

Table 1 : Data of set up time type A in July,1997 for main operator machine Ex-302 (Before Improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
JUL.4-N	A1	8	7	10	5	5	23	14	8	80
JUL.9-D	A2	6	5	7	5	4	16	12	5	60
JUL.9-N	A1	2	3	3	2	2	6	4	3	25
JUL.18-D	A1	5	4	6	4	4	22	12	8	65
JUL.20-D	A2	2	3	5	3	2	21	10	4	50
JUL22-D	A1	4	4	7	5	3	15	12	6	56
JUL29-D	A1	2	2	6	3	2	33	9	7	64
Average	A	5	4	6	4	3	19	10	6	57

Remark : D=day shift

N=night shift

Table 2 : Data of set up time type B in July,1997 for main operator machine Ex-302 (Before Improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
JUL.4-N	B1	5	5	6	0	5	23	11	7	62
JUL.8-D	B2	5	4	4	0	4	12	9	5	43
JUL.9-N	B1	4	4	6	0	4	24	10	6	58
JUL.10-D	B1	5	5	6	0	5	25	12	6	64
JUL.13-D	B1	4	3	4	0	3	15	8	4	41
JUL.13-N	B1	5	6	6	0	5	42	13	6	83
JUL.15-N	B1	4	4	5	0	4	19	11	5	52
JUL.18-D	B2	5	4	6	0	4	18	10	6	53
JUL.19-N	B1	5	4	6	0	4	24	9	5	57
JUL.24-D	B2	4	4	5	0	4	19	9	4	49
JUL26-D	B2	5	5	6	0	5	24	10	7	62
JUL27-N	B1	7	4	5	0	4	44	15	5	84
Average	B	5	4	5	0	4	24	11	6	59

Table 3 : Data of set up time type C in July,1997 for main operator machine Ex-302 (Before Improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
JUL.3-D	C2	5	4	6	5	0	15	12	7	54
JUL.5-D	C2	3	3	4	4	0	6	7	4	31
JUL.6-D	C1	3	3	4	4	0	8	8	5	35
JUL.6-N	C2	3	3	5	4	0	5	11	6	37
JUL.7-N	C1	3	3	6	4	0	6	11	5	38
Average	C	3	3	5	4	0	8	10	5	39

Table 4 : Data of set up time type D in July,1997 for main operator machine Ex-302 (Before Improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
JUL.14-N	D2	3	3	3	0	0	4	8	4	25
Average	D	3	3	3	0	0	4	8	4	25

Remark : D=day shift

N=night shift

Table 5 : Data of set up time type E in July,1997 for main operator machine Ex-302 (Before Improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
JUL.1-N	E1	4	5	5	4	0	19	11	8	56
JUL.2-D	E1	3	4	3	3	0	10	9	6	38
JUL.24-N	E1	4	5	4	5	0	23	14	5	60
JUL.27-D	E1	3	5	4	5	0	8	11	6	42
Average	E	4	5	4	4	0	15	11	6	49

Remark : D=day shift

N=night shift

Table 6 : Data of set up time type F in July,1997 for main operator machine Ex-302 (Before Improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
JUL.1-D	F1	3	0	4	0	0	17	10	5	39
JUL.2-D	F1	4	0	3	0	0	14	8	4	33
JUL.2-N	F1	3	0	3	0	0	11	9	4	30
JUL.5-N	F1	3	0	3	0	0	15	12	5	38
JUL.15-N	F1	3	0	3	0	0	11	10	6	33
Average	F	3	0	3	0	0	14	10	5	35

Table 7 : Data of set up time type G in July,1997 for main operator machine Ex-302 (Before Improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
JUL.9-D	G1	0	0	0	5	0	8	11	7	31
JUL.10-D	G1	0	0	0	5	0	9	9	5	28
JUL.11-D	G1	0	0	0	4	0	7	8	5	24
JUL.12-D	G1	0	0	0	6	0	7	12	5	30
JUL.12-D	G2	0	0	0	3	0	7	8	4	22
JUL.18-N	G1	0	0	0	5	0	11	13	6	35
JUL.19-D	G1	0	0	0	5	0	7	7	4	23
JUL.20-D	G2	0	0	0	6	0	8	7	7	28
JUL.20-N	G2	0	0	0	4	0	7	6	4	21
JUL.23-N	G1	0	0	0	4	0	8	10	5	27
JUL.25-D	G1	0	0	0	6	0	10	8	8	32
JUL.25-D	G1	0	0	0	3	0	7	5	4	19
JUL.29-D	G1	0	0	0	3	0	8	5	4	20
JUL.29-D	G2	0	0	0	4	0	7	8	5	24
JUL.29-N	G2	0	0	0	5	0	9	7	5	26
JUL.29-N	G1	0	0	0	4	0	9	5	4	22
JUL.30-N	G1	0	0	0	3	0	6	5	4	18
JUL.30-N	G1	0	0	0	4	0	7	5	6	22
Average	G	0	0	0	4	0	8	8	5	25

Remark : D=day shift N=night shift

Table 8 : Data of set up time type A in October,1997 for main operator machine Ex-302 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
OCT.1-N	A1	3	4	2	3	3	6	6	3	30
OCT.3-N	A1	3	3	1	2	2	6	8	3	28
OCT.5-D	A2	3	4	2	2	3	7	5	4	30
OCT.15-D	A2	4	4	3	2	4	7	6	4	34
OCT.17-N	A1	4	5	3	3	3	5	7	3	33
OCT.18-D	A2	4	4	1	2	3	6	5	4	29
OCT.30-D	A1	4	4	3	3	3	6	6	4	33
Average	A	4	4	2	2	3	6	6	4	31

Remark : D=day shift

N=night shift

Table 9 : Data of set up time type B in October,1997 for main operator machine Ex-302 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
OCT.2-N	B1	6	4	2	0	3	7	7	3	32
OCT.3-N	B1	6	5	3	0	3	7	6	4	34
OCT.7-N	B1	6	4	2	0	3	6	5	4	30
OCT.10-D	B1	4	5	2	0	3	9	6	4	33
OCT.10-N	B1	3	6	2	0	4	7	8	4	34
OCT.16-N	B2	5	5	2	0	1	6	7	5	31
OCT.18-N	B1	3	5	2	0	3	8	5	4	30
OCT.20-N	B2	3	3	2	0	3	7	5	6	29
OCT.26-D	B2	5	5	2	0	3	6	6	4	31
OCT.28-D	B2	4	3	2	0	2	8	6	4	29
OCT.28-N	B1	4	4	2	0	2	13	6	4	35
OCT.30-N	B1	3	5	3	0	2	7	8	3	31
Average	B	4	5	2	0	3	8	6	4	32

Remark : D=day shift

N=night shift

Table 10 : Data of set up time type C in October,1997 for main operator machine Ex-302 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
OCT.2-N	C1	3	4	2	2	0	5	7	3	26
OCT.3-D	C1	4	4	2	3	0	10	6	3	32
OCT.4-D	C2	4	5	2	3	0	6	6	4	30
OCT.5-D	C2	3	4	2	3	0	16	6	3	37
OCT.8-N	C2	5	5	3	3	0	8	6	3	33
OCT.9-D	C1	3	4	2	2	0	8	5	3	27
OCT.10-N	C2	3	3	3	3	0	7	5	3	27
OCT.12-N	C2	2	4	2	3	0	7	6	3	27
OCT.18-N	C2	3	4	2	2	0	10	6	4	31
OCT.20-D	C1	3	4	2	3	0	7	6	3	28
OCT.24-N	C2	3	3	2	2	0	10	5	3	28
Average	C	3	4	2	3	0	9	6	3	30

Remark : D=day shift

N=night shift

Table 11 : Data of set up time type D in October,1997 for main operator machine Ex-302 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
OCT.11-N	D1	4	4	3	0	0	10	7	4	32
OCT.16-N	D1	4	5	2	0	0	15	6	4	36
OCT.26-N	D2	4	4	3	0	0	8	7	5	31
OCT.28-N	D1	4	4	2	0	0	5	7	3	25
Average	D	4	4	3	0	0	10	7	4	31

Remark : D=day shift

N=night shift

Table 12 : Data of set up time type E in October,1997 for main operator machine Ex-302 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
OCT.5-D	E1	4	0	2	2	0	7	7	3	25
OCT.5-N	E1	4	0	2	2	0	6	7	5	26
OCT.8-D	E2	3	0	3	2	0	10	6	5	29
OCT.10-D	E1	5	0	3	2	0	10	7	4	31
OCT.10-N	E1	4	0	2	3	0	8	8	3	28
OCT.14-D	E2	5	0	2	2	0	7	7	5	28
OCT.20-D	E1	4	0	3	2	0	5	6	5	25
OCT.26-N	E2	3	0	3	1	0	7	7	5	26
Average	E	4	0	3	2	0	8	7	4	27

Remark : D=day shift

N=night shift

Table 13 : Data of set up time type F in October,1997 for main operator machine Ex-302 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2.	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
OCT.7-D	F1	5	0	2	0	0	6	6	5	24
OCT.10-N	F2	5	0	2	0	0	10	7	4	28
OCT.17-N	F2	5	0	3	0	0	7	6	4	25
OCT.25-D	F1	4	0	2	0	0	6	6	4	22
OCT.27-N	F1	4	0	3	0	0	11	6	5	29
Average	F	5	0	2	0	0	8	6	4	26

Remark : D=day shift

N=night shift

Table 14 : Data of set up time type G in October,1997 for main operator machine Ex-302 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
OCT.2-D	G1	0	0	0	3	0	7	6	5	21
OCT.4-N	G1	0	0	0	2	0	13	5	4	24
OCT.6-D	G2	0	0	0	2	0	6	6	4	18
OCT.8-D	G1	0	0	0	3	0	6	6	4	19
OCT.10-D	G1	0	0	0	3	0	4	6	4	17
OCT.10-N	G2	0	0	0	4	0	5	7	4	20
OCT.12-D	G2	0	0	0	3	0	9	7	4	23
OCT.13-D	G1	0	0	0	3	0	5	6	4	18
OCT.16-D	G1	0	0	0	2	0	6	6	3	17
OCT.19-D	G1	0	0	0	4	0	6	6	4	20
OCT.22-D	G2	0	0	0	3	0	5	5	5	18
OCT.24-D	G1	0	0	0	2	0	10	6	4	22
OCT.30-D	G2	0	0	0	3	0	5	6	4	18
OCT.30-N	G1	0	0	0	2	0	7	7	4	20
Average	G	0	0	0	3	0	7	6	4	20

Remark : D=day shift

N=night shift

Table 15 : Data of set up time type A in November,1997 for main operator machine Ex-302 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
NOV.2-N	A1	2	3	3	3	2	4	6	3	26
NOV.5-N	A1	2	4	1	2	2	4	4	4	23
NOV.8-D	A1	1	3	3	2	2	4	5	5	25
NOV.11-D	A1	3	4	3	1	3	6	4	2	26
Average	A	2	3	2	2	2	4	5	4	24

N=night shift

Table 16 : Data of set up time type B in November,1997 for main operator machine Ex-302 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
NOV.3-D	B1	3	2	2	0	2	4	4	3	20
NOV.6-D	B1	2	3	2	0	2	4	5	4	22
NOV.9-N	B1	2	3	3	0	1	6	4	3	22
NOV.10-N	B1	2	2	3	0	4	2	5	5	23
NOV.12-D	B2	3	4	2	0	3	8	5	3	28
NOV.14-N	B1	2	2	3	0	2	13	4	4	30
NOV.15-N	B1	2	2	2	0	3	5	4	4	22
NOV.16-N	B1	2	3	3	0	2	3	5	4	22
NOV.20-D	B2	3	3	2	0	3	2	6	3	22
NOV.22-D	B1	3	4	1	0	2	8	4	3	25
NOV.24-N	B1	1	4	3	0	2	4	5	5	24
NOV.26-D	B1	3	2	3	0	3	4	5	4	24
NOV.27-D	B2	3	2	4	0	1	4	5	5	24
NOV.28-N	B2	2	4	3	0	3	3	4	4	23
NOV.30-N	B1	2	3	2	0	3	5	5	5	25
Average	B	2	3	3	0	2	5	5	4	24

Remark : D=day shift

N=night shift

Table 17 : Data of set up time type C in November,1997 for main operator machine Ex-302 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
NOV.2-N	C2	2	2	2	2	0	8	6	3	25
NOV.5-D	C2	1	4	2	2	0	5	5	1	20
NOV.5-N	C2	1	4	2	3	0	7	5	2	24
NOV.6-D	C1	2	3	2	2	0	6	4	2	21
NOV.10-N	C2	3	4	2	1	0	6	4	2	22
NOV.16-D	C1	2	1	3	2	0	7	5	2	22
NOV.20-N	C2	1	3	3	2	0	6	5	2	22
NOV.26-N	C1	3	2	3	3	0	5	4	2	22
Average	C	2	3	2	2	0	6	5	2	22

Remark : D=day shift

N=night shift

Table 18 : Data of set up time type D in November,1997 for main operator machine Ex-302 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
NOV.3-N	D1	2	2	3	0	0	7	5	2	21
NOV.6-D	D1	2	2	2	0	0	7	5	2	20
NOV.9-D	D1	2	2	2	0	0	9	4	1	20
NOV.12-D	D1	1	4	3	0	0	4	4	2	18
NOV.16-N	D2	1	4	3	0	0	3	5	3	19
NOV.28-N	D1	1	3	3	0	0	5	5	3	20
Average	D	2	3	3	0	0	6	5	2	20

Remark : D=day shift

N=night shift

Table 19 : Data of set up time type E in November,1997 for main operator machine Ex-302 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
NOV.3-D	E1	1	2	3	2	0	4	5	5	22
NOV.5-D	E1	2	2	3	2	0	10	4	3	26
NOV.10-N	E2	2	1	2	3	0	4	5	6	23
NOV.18-D	E2	2	3	3	2	0	6	4	3	23
NOV.24-N	E1	3	2	3	2	0	4	5	2	21
NOV.30-N	E1	2	2	3	2	0	4	6	4	23
Average	E	2	2	3	2	0	5	5	4	23

Remark : D=day shift

N=night shift

Table 20 : Data of set up time type F in November,1997 for main operator machine Ex-302 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
NOV.5-D	F1	2	2	2	0	0	7	5	2	20
NOV.11-N	F1	2	3	2	0	0	5	5	2	19
NOV.17-N	F1	1	3	3	0	0	6	6	2	21
Average	F	2	3	2	0	0	6	5	2	20

Remark : D=day shift

N=night shift

Table 21 : Data of set up time type G in November,1997 for main operator machine Ex-302 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
NOV.2-D	G1	0	0	0	3	0	3	5	2	13
NOV.4-N	G1	0	0	0	2	0	2	4	4	12
NOV.6-D	G2	0	0	0	3	0	2	5	3	13
NOV.8-D	G1	0	0	0	3	0	3	6	2	14
NOV.10-D	G1	0	0	0	2	0	1	6	3	12
NOV.10-N	G2	0	0	0	1	0	4	6	2	13
NOV.12-D	G2	0	0	0	1	0	5	5	3	14
NOV.13-D	G1	0	0	0	3	0	5	7	3	18
NOV.16-D	G1	0	0	0	3	0	3	5	2	13
NOV.19-D	G1	0	0	0	2	0	3	6	3	14
NOV.22-D	G2	0	0	0	2	0	5	4	2	13
NOV.24-D	G1	0	0	0	2	0	6	6	3	17
NOV.25-N	G1	0	0	0	2	0	3	7	2	14
NOV.26-N	G1	0	0	0	2	0	2	5	3	12
NOV.27-D	G2	0	0	0	1	0	2	4	3	10
NOV.28-N	G2	0	0	0	2	0	3	5	3	13
NOV.29-D	G1	0	0	0	2	0	3	5	2	12
NOV.29-N	G1	0	0	0	2	0	4	4	3	13
NOV.30-D	G2	0	0	0	3	0	4	6	4	17
NOV.30-N	G1	0	0	0	2	0	2	5	4	13
Average	G	0	0	0	2	0	3	5	3	14

Remark : D=day shift

N=night shift

APPENDIX G

DATA OF SET UP TIME OF MAIN OPERATOR OF

MACHINE Ex-303

Table 1 : Data of set up time type A in October,1997 for main operator machine Ex-303 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
OCT.2-N	A1	3	1	3	2	6	5	3	7	30
OCT.17-D	A2	4	2	3	3	7	4	4	6	33
Average	A	4	2	3	3	7	5	4	7	32

Remark : D=day shift

N=night shift

Table 2 : Data of set up time type B in October,1997 for main operator machine Ex-303 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
OCT.2-D	B1	3	3	3	0	2	8	2	3	24
OCT.3-D	B1	3	2	4	0	2	9	2	3	25
OCT.6-D	B1	2	2	4	0	2	6	3	4	23
OCT.11-N	B1	2	2	3	0	1	7	3	3	21
OCT.15-N	B2	4	3	3	0	2	5	2	3	22
OCT.22-D	B2	3	2	4	0	1	9	3	4	26
OCT.26-D	B2	3	3	4	0	2	8	3	4	27
OCT.29-D	B1	3	2	4	0	2	6	3	4	24
Average	B	3	2	4	0	2	7	3	4	24

Remark : D=day shift

N=night shift

Table 3 : Data of set up time type C in October,1997 for main operator machine Ex-303 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
OCT.15-N	C2	2	3	.5	1	0	6	4	4	25
OCT.18-D	C1	2	2	6	2	0	6	4	5	27
OCT.25-N	C2	2	2	6	1	0	5	5	4	25
OCT.30-D	C1	2	2	4	2	0	6	4	4	24
Average	C	2	2	5	2	0	6	4	4	25

Remark : D=day shift

N=night shift

Table 4 : Data of set up time type D in October,1997 for main operator machine Ex-303 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
OCT.8-N	D2	3	2	5	0	0	5	4	4	23
OCT.11-N	D2	2	2	6	0	0	10	4	4	28
OCT.19-D	D2	1	1	6	0	0	4	5	3	20
OCT.29-N	D1	2	3	5	0	0	3	4	5	22
Average	D	2	2	6	0	0	6	4	4	23

Remark : D=day shift

N=night shift

Table 5 : Data of set up time type E in October,1997 for main operator machine Ex-303 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
OCT.1-D	E2	3	2	3	2	0	3	5	5	23
OCT.9-D	E1	3	2	2	1	0	4	4	4	20
OCT.16-N	E1	2	2	2	2	0	11	4	4	27
OCT.20-D	E2	3	2	2	1	0	3	4	4	19
OCT.26-D	E1	2	3	3	1	0	6	5	4	24
OCT.28-N	E2	4	1	2	1	0	6	5	4	23
Average	E	3	2	2	1	0	6	5	4	23

Remark : D=day shift

N=night shift

Table 6 : Data of set up time type F in October,1997 for main operator machine Ex-303 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
OCT.4-N	F2	3	2	3	0	0	7	5	4	24
OCT.10-N	F2	4	3	3	0	0	4	5	4	23
OCT.15-D	F1	3	2	3	0	0	4	4	4	20
OCT.19-N	F1	2	3	3	0	0	10	5	5	28
OCT.27-N	F1	4	3	3	0	0	3	5	3	21
Average	F	3	3	3	0	0	6	5	4	23

Remark : D=day shift

N=night shift

Table 7 : Data of set up time type G in October,1997 for main operator machine Ex-303 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
OCT.1-D	G1	0	0	0	2	0	2	4	4	12
OCT.2-D	G1	0	0	0	1	0	3	5	4	13
OCT.4-N	G2	0	0	0	1	0	2	4	5	12
OCT.6-D	G1	0	0	0	2	0	8	4	5	19
OCT.10-D	G1	0	0	0	2	0	3	5	4	14
OCT.11-D	G2	0	0	0	1	0	5	5	5	16
OCT.12-D	G2	0	0	0	2	0	3	4	4	13
OCT.13-N	G1	0	0	0	2	0	3	5	5	15
OCT.18-N	G1	0	0	0	2	0	9	4	5	20
OCT.19-D	G1	0	0	0	2	0	2	5	5	14
OCT.20-D	G2	0	0	0	2	0	5	4	4	15
OCT.26-D	G1	0	0	0	2	0	2	5	4	13
OCT.27-N	G1	0	0	0	2	0	2	5	5	14
OCT.28-N	G1	0	0	0	1	0	2	6	5	14
OCT.29-D	G2	0	0	0	2	0	4	5	5	16
OCT.30-N	G1	0	0	0	3	0	3	5	6	17
Average	G	0	0	0	2	0	4	5	5	15

Remark : D=day shift N=night shift

Table 8 : Data of set up time type A in November,1997 for main operator machine Ex-303 (After improvement)

DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
NOV.3-D	A1	3	2	2	1	2	5	3	4	22
NOV.15-D	A2	2	1	1	1	1	4	4	4	18
Average	A	2	1	1	1	2	5	4	4	20

Remark : D = day shift

N = night shift

Table 9 : Data of set up time type B in November,1997 for main operator machine Ex-303 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
NOV.1-D	B2	3	3	3	0	2	4	4	5	24
NOV.6-N	B2	2	2	4	0	2	6	5	5	26
NOV.10-D	B1	2	3	4	0	2	4	4	4	23
NOV.18-D	B1	3	2	3	0	1	11	5	4	29
NOV.24-N	B2	2	4	4	0	2	4	4	4	24
NOV.29-D	B1	1	3	3	0	1	7	4	5	24
Average	B	2	3	4	0	2	6	4	5	25

Remark : D=day shift

N=night shift

Table 10 : Data of set up time type C in November,1997 for main operator machine Ex-303 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
NOV.6-N	C1	2	2	4	1	0	4	4	4	21
NOV.16-D	C1	1	2	4	2	0	3	4	4	20
NOV.25-N	C2	2	2	4	1	0	3	3	5	20
NOV.26-D	C1	2	2	4	1	0	5	4	4	22
Average	C	2	2	4	1	0	4	4	4	21

Remark : D=day shift

N=night shift

Table 11 : Data of set up time type D in November,1997 for main operator machine Ex-303 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
NOV.4-D	D1	3	2	3	0	0	4	4	5	21
NOV.9-N	D1	3	2	2	0	0	5	4	5	21
NOV.10-D	D2	3	2	2	0	0	4	5	4	20
NOV.21-D	D2	2	1	3	0	0	3	5	6	20
NOV.23-N	D1	4	4	2	0	0	2	3	5	20
Average	D	3	2	2	0	0	4	4	5	20

Remark : D=day shift

N=night shift

Table 12 : Data of set up time type E in November,1997 for main operator machine Ex-303 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
NOV.3-D	E2	2	1	2	2	0	6	4	4	21
NOV.7-D	E2	2	2	3	2	0	7	4	4	24
NOV.11-D	E2	1	2	2	2	0	4	6	3	20
NOV.19-N	E2	2	3	2	3	0	4	5	4	23
NOV.24-N	E1	3	3	3	2	0	6	4	4	25
NOV.30-D	E2	2	3	2	2	0	6	3	5	23
Average	E	2	2	2	2	0	6	4	4	23

Remark : D=day shift

N=night shift

Table 13 : Data of set up time type F in November,1997 for main operator machine Ex-303 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
NOV.1-D	F1	2	2	2	0	0	4	4	4	18
NOV.4-N	F2	3	1	2	0	0	5	5	4	20
NOV.6-D	F2	2	2	2	0	0	11	4	3	24
NOV.10-N	F1	2	3	3	0	0	3	4	4	19
NOV.12-D	F1	3	2	2	0	0	5	4	4	20
NOV.17-N	F2	3	2	3	0	0	2	4	4	18
NOV.20-D	F1	2	2	2	0	0	4	5	4	19
NOV.26-N	F1	1	1	2	0	0	6	4	3	17
Average	F	2	2	2	0	0	5	4	4	19

Remark : D=day shift

N=night shift

Table 14 : Data of set up time type G in November,1997 for main operator machine Ex-303 (After improvement)

		Set up time (min)								
DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	STEP7	STEP8	TOTAL
NOV.1-N	G1	0	0	0	2	0	4	5	5	16
NOV.4-N	G1	0	0	0	2	0	3	5	5	15
NOV.5-N	G1	0	0	0	1	0	4	6	4	15
NOV.6-N	G1	0	0	0	1	0	2	5	5	13
NOV.7-N	G2	0	0	0	2	0	3	5	4	14
NOV.11-D	G2	0	0	0	1	0	3	4	4	12
NOV.12-D	G2	0	0	0	1	0	3	5	6	15
NOV.14-D	G2	0	0	0	2	0	4	5	4	15
NOV.15-N	G1	0	0	0	2	0	2	4	5	13
NOV.16-D	G1	0	0	0	1	0	2	5	5	13
NOV.17-D	G2	0	0	0	2	0	7	5	6	20
NOV.18-N	G1	0	0	0	1	0	4	4	5	14
NOV.21-N	G2	0	0	0	1	0	2	5	5	13
NOV.22-D	G1	0	0	0	1	0	3	5	5	14
NOV.23-D	G1	0	0	0	1	0	3	5	6	15
NOV.25-D	G2	0	0	0	1	0	2	6	5	14
NOV.27-D	G1	0	0	0	2	0	5	4	4	15
NOV.28-N	G1	0	0	0	2	0	2	5	5	14
NOV.29-N	G1	0	0	0	2	0	2	5	4	13
NOV.30-N	G2	0	0	0	2	0	9	4	4	19
Average	G	0	0	0	2	0	3	5	5	15

Remark : D=day shift N=night shift

APPENDIX H

DATA OF SET UP TIME OF SUB OPERATOR FOR MACHINE Ex-302

Table 1 : Data of set up time type A in July,1997 for Sub-operator machine Ex-302 (Before improvement)

DATE	TYPE	STEP1	STEP2	STEP3	STEP4	STEP5	STEP6	TOTAL
JUL.4-N	A1	19	1	17	16	14	13	80
JUL.9-D	A2	20	1	10	10	5	14	60
JUL.9-N	A1	8	1	3	3	5	5	25
JUL.18-D	A1	24	1	14	10	8	8	65
JUL.20-D	A2	16	1	7	8	10	8	50
JUL22-D	A1	17	1	8	11	8	11	56
JUL29-D	A1	19	1	14	11	7	12	64
Average	A	18	1	10	5	8	10	57

Table 2 : Data of set up time type A in October,1997 for sub-operator machine Ex-302 (After improvement)

DATE	TYPE	STEP1	STEP4	STEP5	STEP6	TOTAL
OCT.1-N	A1	2	16	7	5	30
OCT.3-N	A1	1	14	7	6	28
OCT.5-D	A2	2	16	7	5	30
OCT.15-D	A2	2	19	7	6	34
OCT.17-N	A1	2	17	8	6	33
OCT.18-D	A2	3	15	7	4	29
OCT.30-D	A1	3	16	7	7	33
Average	A	2	16	7	6	31

Table 3. : Data of set up time type A in November,1997 for Sub-operator machine Ex-302 (After improvement)

DATE	TYPE	STEP1	STEP4	STEP5	STEP6	TOTAL
NOV.2-N	A1	2	9	8	7	26
NOV.5-N	A1	2	8	7	6	23
NOV.8-D	A1	1	9	8	7	25
NOV.11-D	A1	1	9	8	8	26
NOV.14-D	A1	2	7	7	5	21
NOV.15-D	A2	2	11	6	3	22
NOV.17-D	A2	2	12	10	3	27
Average	A	2	9	8	6	24

APPENDIX I

DATA OF SET UP TIME OF SUB OPERATOR OF

MACHINE Ex-303

Table 1 : Data of set up time type A in October,1997 for sub operator machine Ex-303 (After improvement)

DATE	TYPE	STEP1	STEP4	STEP5	STEP6	TOTAL
OCT.2-N	A1	8	6	6	13	33
OCT.17-D	A2	12	7	8	3	30
Average	A	10	7	7	8	32

Table 2 : Data of set up time type A in November,1997 for Sub-operator machine Ex-303 (After improvement)

DATE	TYPE	STEP1	STEP4	STEP5	STEP6	TOTAL
NOV.3-D	A1	6	6	3	4	19
NOV.15-D	A2	6	5	4	6	21
Average	A	6	6	4	5	20

VITA

Chommanard Pornwattanakul was born on 19 November 1965. She graduated from Prince of Songkla University majored in Industrial Engineering in 1987. After graduated , she began to work as an Design Engineer. She has continued to pursue her graduate study in Engineering Management at The Regional Centre for Manufacturing Systems Engineering in 1996. Having some experiences of Design Engineering for Cable and Cable Assembly for 10 years and having some experiences of Cable Production Engineering for 1 year until today she is a manager of cable engineering department at Fujikura (Thailand) Ltd.