REFERENCES

Brinto, B. Michell. Semiconductor Pulse Circuit . Hott: Rinchart and Winston, 1970.

Boger, D. V. ; Walters, K . Rheologigal Phenomena in Focus, Series 4, Netherlands: Elsevier Science Publishers , 1993 .

Daniel, S. Babb . Pulse Circuits: Switching and Shaping, Prentice-Hall, 1964.

Eugene, A. Avallone. Theodore Baumeister III, Standard Handbook for Mechanical Engineers, McGraw-Hill, 1996.

Hermann, R. ; Wilhelm , M. Maschinen Elemente , 7 Auflage. Braunschweig: Vieweg Verlag, 1996.

Harold, A. Rothbart. "Mechanical Design system Handbook" , 2 nd ed. McGraw-Hill, 1986.

Hassul, M.; Zimmerman, D. Electronic Devices and Circuits, New Jersey: Prentice-Hall, 1997.

Intravongsa, W. Report on Food Processing : Foi-tong, Petchaboon, 1985.

Katsuhiko , Ogata. Modern Control Engineering : Process Control System . Englewood Cliffs : Prentice-Hall , 1970.

Niyomwit, N; Uthaipanich, A. Technology of Cooking .Bangkok: Kasetsart University, 1985.

Paul Tullis, J. Hydraulics of pipeline . Canada: John Willey &Sons, 1989.

Suban, J. Thai food and dessert .Bangkok: Mitsampan Grafic ,1974.

Waren E, Stewart; R. Byron Bird ; Edwin N. Lightfoot . Transport Phenomena , John Willey & Sons, 1960.

William, S. Janna, Fluid Thermal Systems. PWS-KENT Publisher, 1993.

Warren , I. McCabe; Julian C. Smith; Harriot, P. Unit operations of Chemical Engineering : Fluid flow Phenomena, 5th. Singapore: Mc.Graw Hill , 1987.

Wenham, E. J. ; Dorlina, G. W.; Snell; Taylor . Physics: concepts and models , 2 nd ed. Addison-Wesley publishers, 1984 .

APPENDIX A

APPENDIX A

Data collection sheet

Test No.			Test No.			Test No.		
	dia.[mm.	t.[N/cm]		dia.[mm.	t.[N/cm]		dia.[mm.	t.[N/cm]
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		

Test No.			Test No.			Test No.		
	dia.[mm.	t.[N/cm]		dia.[mm.	t.[N/cm]		dia.[mm.	t.[N/cm]
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		

Test No.			Test No.			Test No.		
	dia.[mm.	t.[N/cm]		dia.[mm.	t.[N/cm]		dia.[mm.	t.[N/cm]
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		

Test No.			Test No.			Test No.		
	dia.[mm.	t.[N/cm]		dia.[mm.	t.[N/cm]		dia.[mm.	t.[N/cm]
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		

Data collection sheet

Test No.			Test No.			Test No.		
	dia.[mm.	**t.[N/cm]**		**dia.[mm.**	**t.[N/cm]**		**dia.[mm.**	**t.[N/cm]**
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		

Test No.			Test No.			Test No.		
	dia.[mm.	**t.[N/cm]**		**dia.[mm.**	**t.[N/cm]**		**dia.[mm.**	**t.[N/cm]**
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		

Test No.			Test No.			Test No.		
	dia.[mm.	**t.[N/cm]**		**dia.[mm.**	**t.[N/cm]**		**dia.[mm.**	**t.[N/cm]**
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		

Test No.			Test No.			Test No.		
	dia.[mm.	**t.[N/cm]**		**dia.[mm.**	**t.[N/cm]**		**dia.[mm.**	**t.[N/cm]**
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		

APPENDIX B

APPENDIX B

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
DIAMETER * Speed * pressure * height	135	100.0%	0	.0%	135	100.0%

Report

DIAMETER

Speed50	low03	height100	Mean	1.4933
			N	3
			Std. Deviation	.1007
			Minimum	1.40
			Maximum	1.60
			Range	.20
		height115	Mean	1.2400
			N	3
			Std. Deviation	.1100
			Minimum	1.13
			Maximum	1.35
			Range	.22
		height130	Mean	1.1333
			N	3
			Std. Deviation	.1026
			Minimum	1.02
			Maximum	1.22
			Range	.20
		Total	Mean	1.2889
			N	9
			Std. Deviation	.1839
			Minimum	1.02
			Maximum	1.60
			Range	.58
	middle06	height100	Mean	1.8033
			N	3
			Std. Deviation	.1518
			Minimum	1.64
			Maximum	1.94
			Range	.30
		height115	Mean	1.6700
			N	3
			Std. Deviation	.1323
			Minimum	1.52
			Maximum	1.77
			Range	.25
		height130	Mean	1.4300
			N	3
			Std. Deviation	.1054
			Minimum	1.32
			Maximum	1.53
			Range	.21

Report

DIAMETER

Speed50	middle06	Total	Mean	1.6344
			N	9
			Std. Deviation	.1994
			Minimum	1.32
			Maximum	1.94
			Range	.62
	high09	height100	Mean	1.8967
			N	3
			Std. Deviation	5.132E-02
			Minimum	1.84
			Maximum	1.94
			Range	.10
		height115	Mean	1.8267
			N	3
			Std. Deviation	.1429
			Minimum	1.67
			Maximum	1.95
			Range	.28
		height130	Mean	1.2967
			N	3
			Std. Deviation	.1692
			Minimum	1.11
			Maximum	1.44
			Range	.33
		Total	Mean	1.6733
			N	9
			Std. Deviation	.3060
			Minimum	1.11
			Maximum	1.95
			Range	.84
	Total	height100	Mean	1.7311
			N	9
			Std. Deviation	.2059
			Minimum	1.40
			Maximum	1.94
			Range	.54
		height115	Mean	1.5789
			N	9
			Std. Deviation	.2859
			Minimum	1.13
			Maximum	1.95
			Range	.82
		height130	Mean	1.2867
			N	9
			Std. Deviation	.1707
			Minimum	1.02
			Maximum	1.53
			Range	.51
		Total	Mean	1.5322
			N	27
			Std. Deviation	.2872
			Minimum	1.02
			Maximum	1.95
			Range	.93

Report

DIAMETER

Speed60	low03	height100	Mean	1.4733
			N	3
			Std. Deviation	.1790
			Minimum	1.32
			Maximum	1.67
			Range	.35
		height115	Mean	1.1633
			N	3
			Std. Deviation	.1159
			Minimum	1.04
			Maximum	1.27
			Range	.23
		height130	Mean	.9333
			N	3
			Std. Deviation	7.506E-02
			Minimum	.86
			Maximum	1.01
			Range	.15
		Total	Mean	1.1900
			N	9
			Std. Deviation	.2605
			Minimum	.86
			Maximum	1.67
			Range	.81
	middle06	height100	Mean	1.4000
			N	3
			Std. Deviation	.3079
			Minimum	1.14
			Maximum	1.74
			Range	.60
		height115	Mean	.9533
			N	3
			Std. Deviation	9.713E-02
			Minimum	.87
			Maximum	1.06
			Range	.19
		height130	Mean	1.1067
			N	3
			Std. Deviation	.2043
			Minimum	.96
			Maximum	1.34
			Range	.38
		Total	Mean	1.1533
			N	9
			Std. Deviation	.2741
			Minimum	.87
			Maximum	1.74
			Range	.87
	high09	height100	Mean	1.6967
			N	3
			Std. Deviation	.1595
			Minimum	1.52
			Maximum	1.83
			Range	.31

Report

DIAMETER

Speed60	high09	height115	Mean	1.3533
			N	3
			Std. Deviation	9.018E-02
			Minimum	1.26
			Maximum	1.44
			Range	.18
		height130	Mean	1.3867
			N	3
			Std. Deviation	.2715
			Minimum	1.22
			Maximum	1.70
			Range	.48
		Total	Mean	1.4789
			N	9
			Std. Deviation	.2318
			Minimum	1.22
			Maximum	1.83
			Range	.61
	Total	height100	Mean	1.5233
			N	9
			Std. Deviation	.2366
			Minimum	1.14
			Maximum	1.83
			Range	.69
		height115	Mean	1.1567
			N	9
			Std. Deviation	.1944
			Minimum	.87
			Maximum	1.44
			Range	.57
		height130	Mean	1.1422
			N	9
			Std. Deviation	.2637
			Minimum	.86
			Maximum	1.70
			Range	.84
		Total	Mean	1.2741
			N	27
			Std. Deviation	.2873
			Minimum	.86
			Maximum	1.83
			Range	.97
Speed70	low03	height100	Mean	.7900
			N	3
			Std. Deviation	.2211
			Minimum	.54
			Maximum	.96
			Range	.42
		height115	Mean	.8267
			N	3
			Std. Deviation	9.292E-02
			Minimum	.72
			Maximum	.89
			Range	.17

Report

DIAMETER

Speed70	low03	height130	Mean	.8667
			N	3
			Std. Deviation	.3147
			Minimum	.68
			Maximum	1.23
			Range	.55
		Total	Mean	.8278
			N	9
			Std. Deviation	.2006
			Minimum	.54
			Maximum	1.23
			Range	.69
	middle06	height100	Mean	1.3300
			N	3
			Std. Deviation	.3360
			Minimum	.98
			Maximum	1.65
			Range	.67
		height115	Mean	1.5767
			N	3
			Std. Deviation	.2754
			Minimum	1.31
			Maximum	1.86
			Range	.55
		height130	Mean	1.4400
			N	3
			Std. Deviation	.2402
			Minimum	1.17
			Maximum	1.63
			Range	.46
		Total	Mean	1.4489
			N	9
			Std. Deviation	.2703
			Minimum	.98
			Maximum	1.86
			Range	.88
	high09	height100	Mean	1.3433
			N	3
			Std. Deviation	.2065
			Minimum	1.20
			Maximum	1.58
			Range	.38
		height115	Mean	.8500
			N	3
			Std. Deviation	1.000E-01
			Minimum	.75
			Maximum	.95
			Range	.20
		height130	Mean	1.3100
			N	3
			Std. Deviation	.6537
			Minimum	.70
			Maximum	2.00
			Range	1.30

Report

DIAMETER

Speed70	high09	Total	Mean	1.1678
			N	9
			Std. Deviation	.4207
			Minimum	.70
			Maximum	2.00
			Range	1.30
	Total	height100	Mean	1.1544
			N	9
			Std. Deviation	.3548
			Minimum	.54
			Maximum	1.65
			Range	1.11
		height115	Mean	1.0844
			N	9
			Std. Deviation	.4000
			Minimum	.72
			Maximum	- 1.86
			Range	1.14
		height130	Mean	1.2056
			N	9
			Std. Deviation	.4624
			Minimum	.68
			Maximum	2.00
			Range	1.32
		Total	Mean	1.1481
			N	27
			Std. Deviation	.3953
			Minimum	.54
			Maximum	2.00
			Range	1.46
Speed80	low03	height100	Mean	.9567
			N	3
			Std. Deviation	.3677
			Minimum	.64
			Maximum	1.36
			Range	.72
		height115	Mean	1.5233
			N	3
			Std. Deviation	.1484
			Minimum	1.36
			Maximum	1.65
			Range	.29
		height130	Mean	1.0133
			N	3
			Std. Deviation	.1762
			Minimum	.87
			Maximum	1.21
			Range	.34
		Total	Mean	1.1644
			N	9
			Std. Deviation	.3466
			Minimum	.64
			Maximum	1.65
			Range	1.01

Report

DIAMETER

Speed80	middle06	height100	Mean	1.2233
			N	3
			Std. Deviation	.1518
			Minimum	1.06
			Maximum	1.36
			Range	.30
		height115	Mean	1.6633
			N	3
			Std. Deviation	.1234
			Minimum	1.56
			Maximum	1.80
			Range	.24
		height130	Mean	1.1467
			N	3
			Std. Deviation	.1443
			Minimum	.98
			Maximum	1.23
			Range	.25
		Total	Mean	1.3444
			N	9
			Std. Deviation	.2703
			Minimum	.98
			Maximum	1.80
			Range	.82
	high09	height100	Mean	.9400
			N	3
			Std. Deviation	.2762
			Minimum	.65
			Maximum	1.20
			Range	.55
		height115	Mean	1.1900
			N	3
			Std. Deviation	.3601
			Minimum	.80
			Maximum	1.51
			Range	.71
		height130	Mean	.9767
			N	3
			Std. Deviation	.2739
			Minimum	.68
			Maximum	1.22
			Range	.54
		Total	Mean	1.0356
			N	9
			Std. Deviation	.2897
			Minimum	.65
			Maximum	1.51
			Range	.86
	Total	height100	Mean	1.0400
			N	9
			Std. Deviation	.2786
			Minimum	.64
			Maximum	1.36
			Range	.72

Report

DIAMETER

Speed80	Total	height115	Mean	1.4589
			N	9
			Std. Deviation	.2934
			Minimum	.80
			Maximum	1.80
			Range	1.00
		height130	Mean	1.0456
			N	9
			Std. Deviation	.1942
			Minimum	.68
			Maximum	1.23
			Range	.55
		Total	Mean	1.1815
			N	27
			Std. Deviation	.3193
			Minimum	.64
			Maximum	1.80
			Range	1.16
Speed90	low03	height100	Mean	.7367
			N	3
			Std. Deviation	.1501
			Minimum	.59
			Maximum	.89
			Range	.30
		height115	Mean	1.5233
			N	3
			Std. Deviation	.1914
			Minimum	1.32
			Maximum	1.70
			Range	.38
		height130	Mean	1.3467
			N	3
			Std. Deviation	.1721
			Minimum	1.21
			Maximum	1.54
			Range	.33
		Total	Mean	1.2022
			N	9
			Std. Deviation	.3873
			Minimum	.59
			Maximum	1.70
			Range	1.11
	middle06	height100	Mean	1.0967
			N	3
			Std. Deviation	.1767
			Minimum	.98
			Maximum	1.30
			Range	.32
		height115	Mean	1.3067
			N	3
			Std. Deviation	.6860
			Minimum	.52
			Maximum	1.78
			Range	1.26

Report

DIAMETER

Speed90	middle06	height130	Mean	1.3133
			N	3
			Std. Deviation	.2554
			Minimum	1.11
			Maximum	1.60
			Range	.49
		Total	Mean	1.2389
			N	9
			Std. Deviation	.3913
			Minimum	.52
			Maximum	1.78
			Range	1.26
	high09	height100	Mean	1.6333
			N	3
			Std. Deviation	8.622E-02
			Minimum	1.54
			Maximum	1.71
			Range	.17
		height115	Mean	.9900
			N	3
			Std. Deviation	.2088
			Minimum	.85
			Maximum	1.23
			Range	.38
		height130	Mean	.8900
			N	3
			Std. Deviation	.3005
			Minimum	.60
			Maximum	1.20
			Range	.60
		Total	Mean	1.1711
			N	9
			Std. Deviation	.3967
			Minimum	.60
			Maximum	1.71
			Range	1.11
	Total	height100	Mean	1.1556
			N	9
			Std. Deviation	.4099
			Minimum	.59
			Maximum	1.71
			Range	1.12
		height115	Mean	1.2733
			N	9
			Std. Deviation	.4378
			Minimum	.52
			Maximum	1.78
			Range	1.26
		height130	Mean	1.1833
			N	9
			Std. Deviation	.3081
			Minimum	.60
			Maximum	1.60
			Range	1.00

Report

DIAMETER

Speed90	Total	Total	Mean	1.2041
			N	27
			Std. Deviation	.3775
			Minimum	.52
			Maximum	1.78
			Range	1.26
Total	low03	height100	Mean	1.0900
			N	15
			Std. Deviation	.3895
			Minimum	.54
			Maximum	1.67
			Range	1.13
		height115	Mean	1.2553
			N	15
			Std. Deviation	.2920
			Minimum	.72
			Maximum	1.70
			Range	.98
		height130	Mean	1.0587
			N	15
			Std. Deviation	.2362
			Minimum	.68
			Maximum	1.54
			Range	.86
		Total	Mean	1.1347
			N	45
			Std. Deviation	.3175
			Minimum	.54
			Maximum	1.70
			Range	1.16
	middle06	height100	Mean	1.3707
			N	15
			Std. Deviation	.3195
			Minimum	.98
			Maximum	1.94
			Range	.96
		height115	Mean	1.4340
			N	15
			Std. Deviation	.4057
			Minimum	.52
			Maximum	1.86
			Range	1.34
		height130	Mean	1.2873
			N	15
			Std. Deviation	.2210
			Minimum	.96
			Maximum	1.63
			Range	.67
		Total	Mean	1.3640
			N	45
			Std. Deviation	.3226
			Minimum	.52
			Maximum	1.94
			Range	1.42

Report

DIAMETER

Total	high09	height100	Mean	1.5020
			N	15
			Std. Deviation	.3746
			Minimum	.65
			Maximum	1.94
			Range	1.29
		height115	Mean	1.2420
			N	15
			Std. Deviation	.3915
			Minimum	.75
			Maximum	1.95
			Range	1.20
		height130	Mean	1.1720
			N	15
			Std. Deviation	.3765
			Minimum	.60
			Maximum	2.00
			Range	1.40
		Total	Mean	1.3053
			N	45
			Std. Deviation	.3989
			Minimum	.60
			Maximum	2.00
			Range	1.40
	Total	height100	Mean	1.3209
			N	45
			Std. Deviation	.3945
			Minimum	.54
			Maximum	1.94
			Range	1.40
		height115	Mean	1.3104
			N	45
			Std. Deviation	.3690
			Minimum	.52
			Maximum	1.95
			Range	1.43
		height130	Mean	1.1727
			N	45
			Std. Deviation	.2955
			Minimum	.60
			Maximum	2.00
			Range	1.40
		Total	Mean	1.2680
			N	135
			Std. Deviation	.3593
			Minimum	.52
			Maximum	2.00
			Range	1.48

APPENDIX C

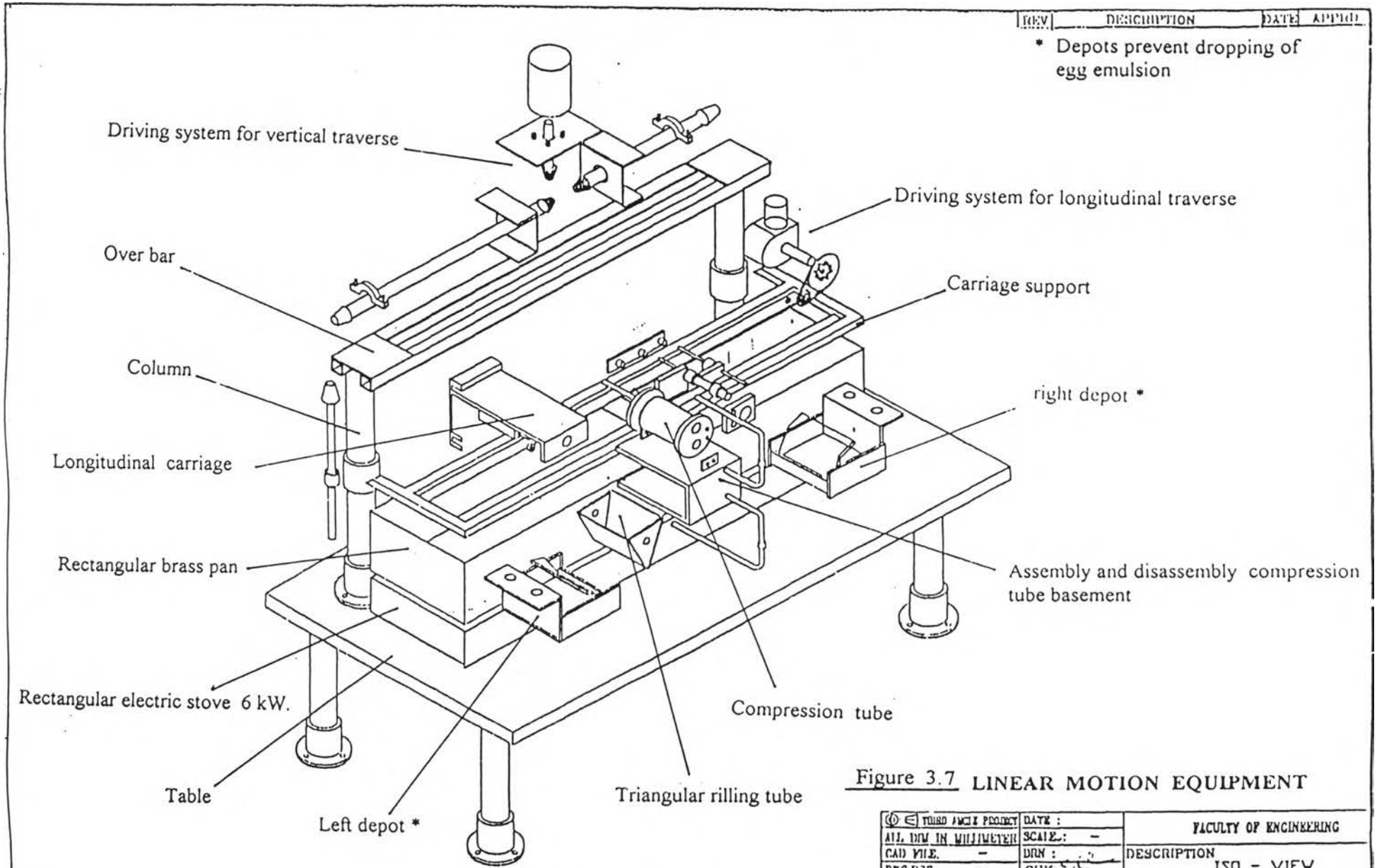
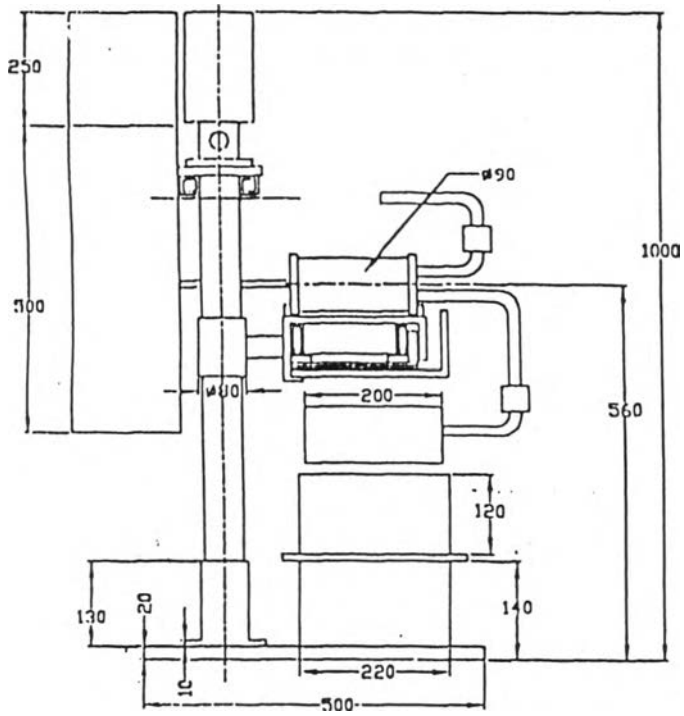
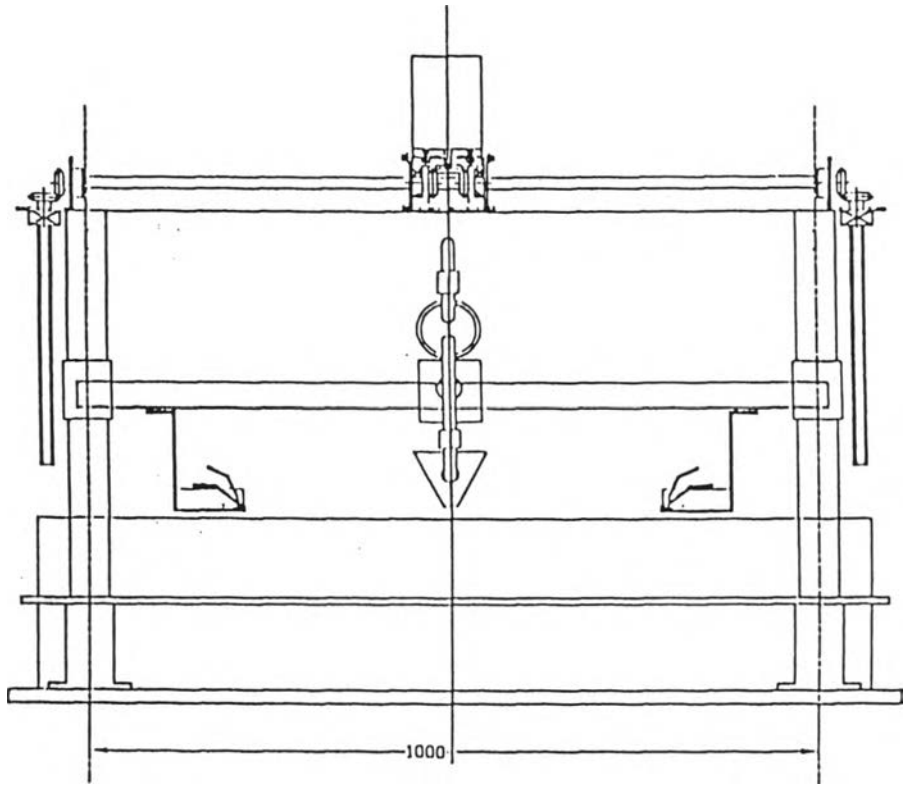


Figure 3.7 LINEAR MOTION EQUIPMENT

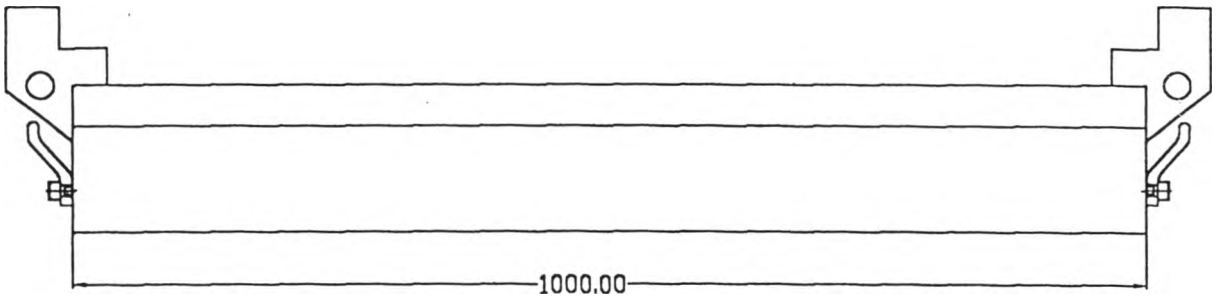
REV	DESCRIPTION	DATE	APPRD

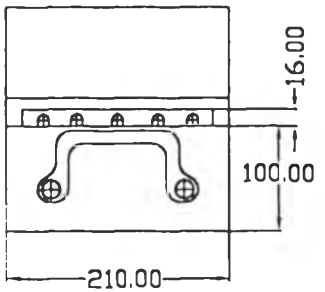




THIRD ANGLE PROJECT	DATE :	FACULTY OF ENGINEERING
ALL DIM IN MILLIMETERS	SCALE : –	
CAD FILE. –	DRN :	DESCRIPTION *Machine assy*
DWG.REF. –	CHK:	
IF IN DOUBT ASK.	APV :	MATERIAL : SHEET

REV	DESCRIPTION	DATE	APPRD



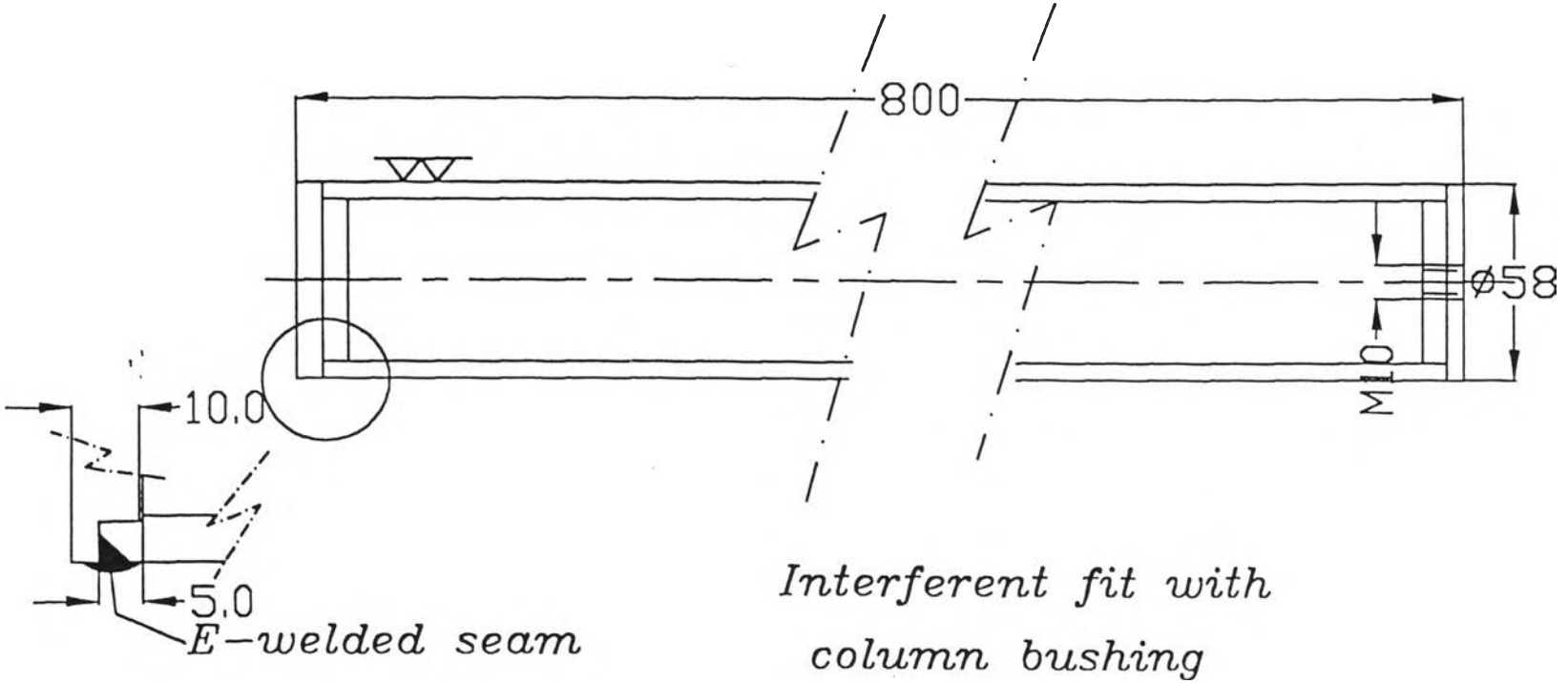


Heating Range
R1 = 2 kw
R2 = 4 kw
R3 = 6 kw

ELECTRIC STOVE

THIRD ANGLE PROJECT	DATE :	FACULTY OF ENGINEERING	
ALL DIM IN MILLIMETER	SCALE : -		
CAD FILE -	DRN :	DESCRIPTION *Electrical Stove*	
DWG.REF. -	CHK:		
IF IN DOUBT ASK	APV :	MATERIAL :	SHEET

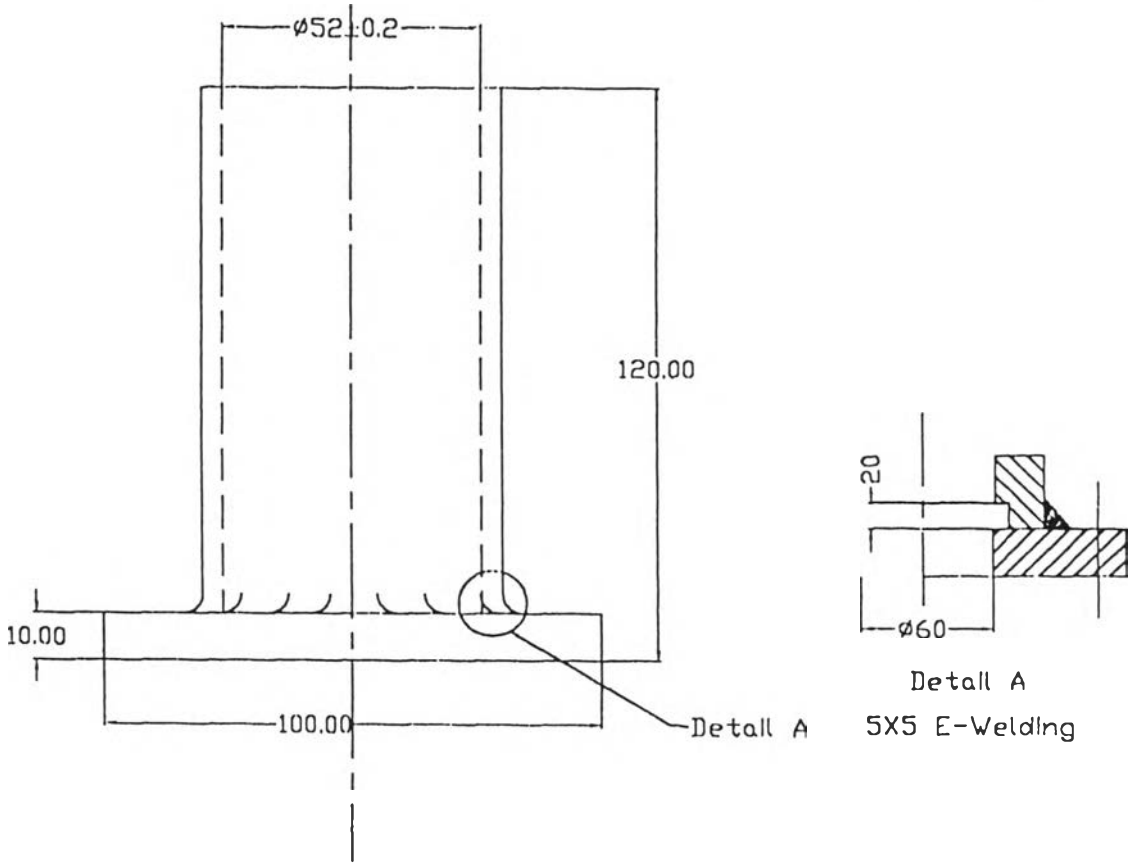
REV	DESCRIPTION	DATE	APPRD



COLUMN

THIRD ANGLE PROJECT	DATE :	FACULTY OF ENGINEERING
ALL DIM IN MILLIMETER	SCALE : –	
CAD FILE. –	DRN :	DESCRIPTION
DWG.REF. –	CHK: S.	
IF IN DOUBT ASK.	APV :	MATERIAL : SHEET

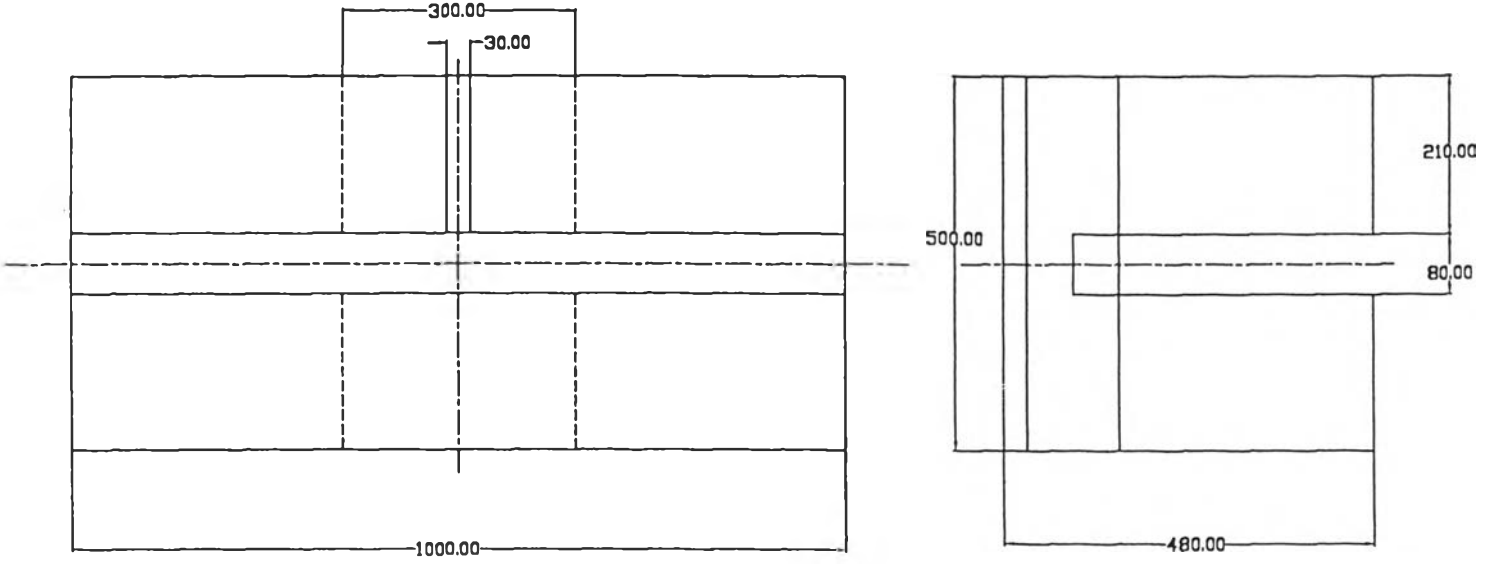
REV	DESCRIPTION	DATE	APPRD

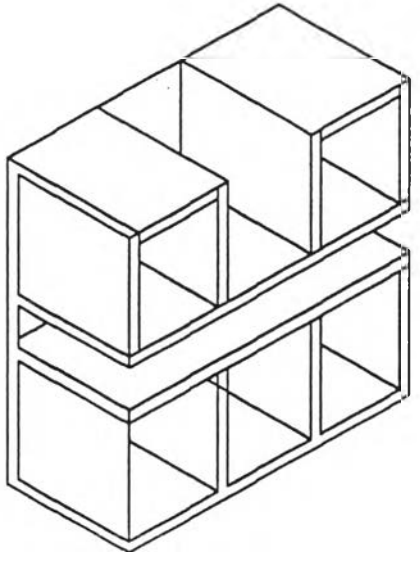


Footing sleeve (for column)

THIRD ANGLE PROJECT	DATE :	FACULTY OF ENGINEERING
ALL DIM IN MILLIMETER	SCALE : -	
CAD FILE. -	DRN :	DESCRIPTION
DWG.REF. -	CHK:	
IF IN DOUBT ASK.	APV :	MATERIAL : SHEET

REV	DESCRIPTION	DATE	APPRD

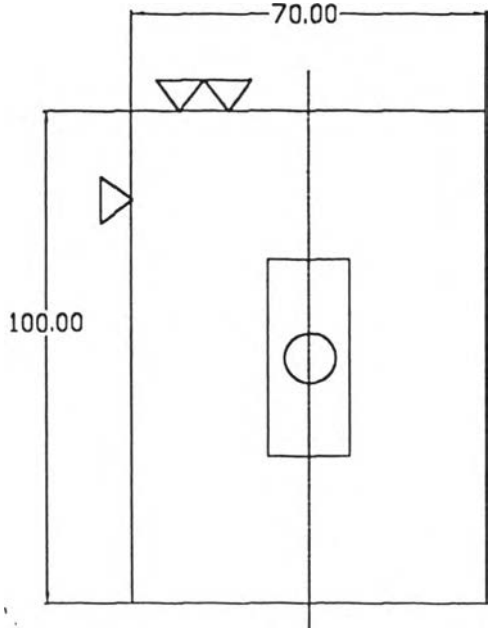


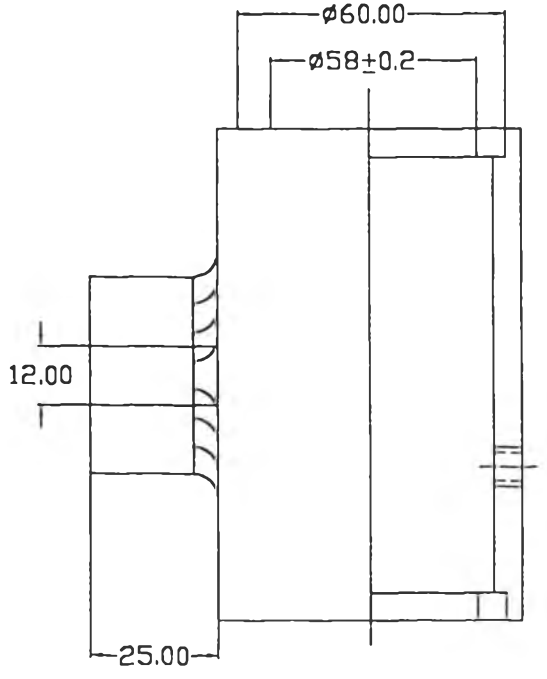


CONTROL CABINET

THIRD ANGLE PROJECT	DATE :	FACULTY OF ENGINEERING
ALL DIM IN MILLIMETER	SCALE : –	
CAD FILE. –	DRN :	DESCRIPTION
DWG.REF. –	CHK:	Control Cabinet
IF IN DOUBT ASK.	APV :	MATERIAL : SHEET

REV	DESCRIPTION	DATE	APPRD

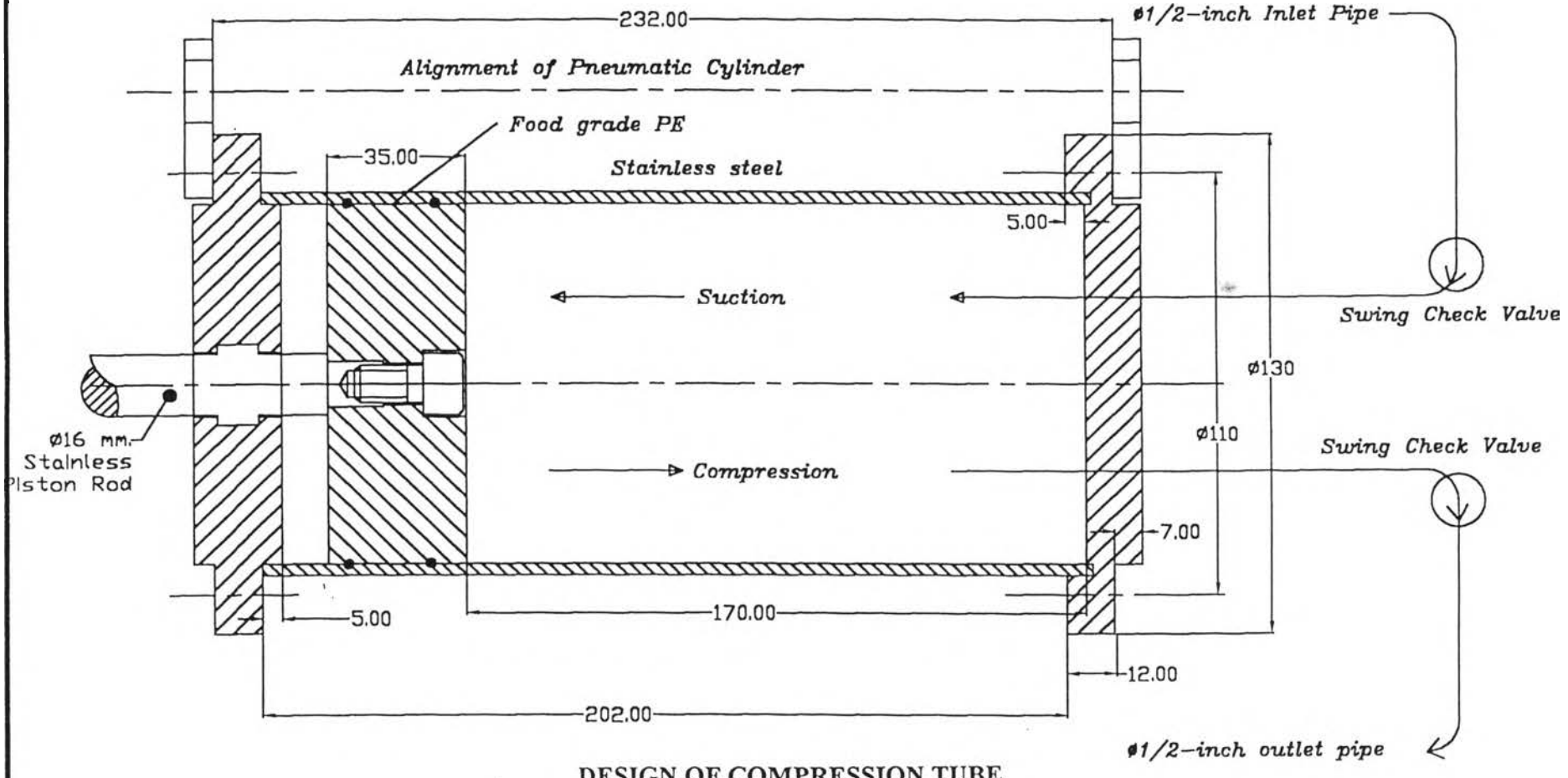




Column Bushes

THIRD ANGLE PROJECT	DATE :	FACULTY OF ENGINEERING
ALL DIM IN MILLIMETER	SCALE : –	
CAD FILE. –	DRN :	DESCRIPTION
DWG.REF. –	CHK: S.C.	
IF IN DOUBT ASK.	APV :	MATERIAL : SHEET

REV	DESCRIPTION	DATE	APPRD

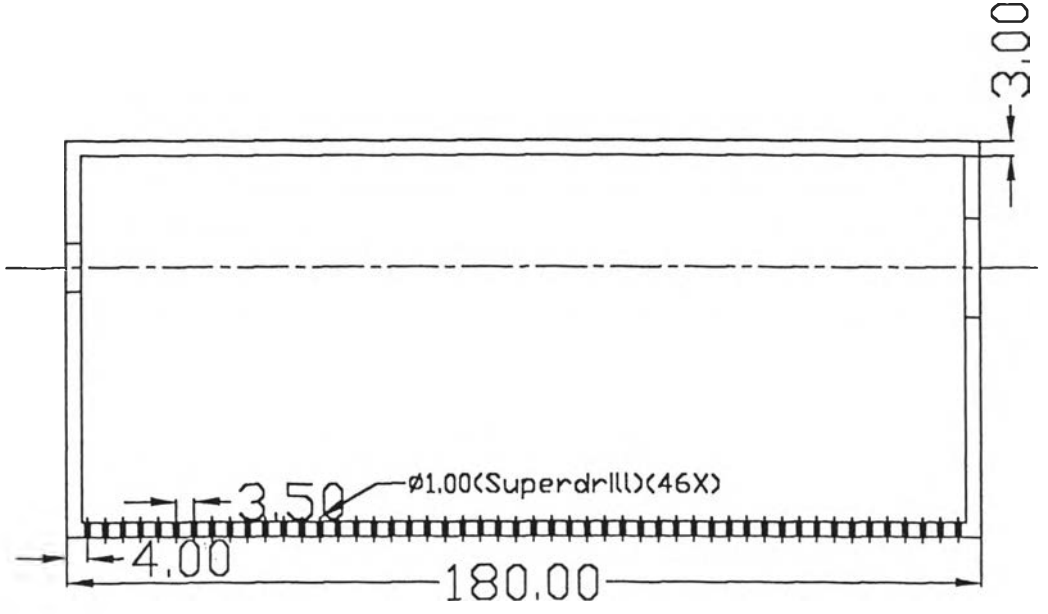


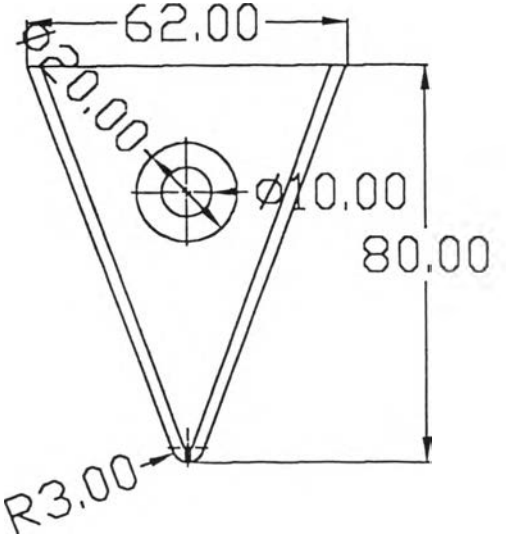
DESIGN OF COMPRESSION TUBE

All Material : Stainless Steel

THIRD ANGLE PROJECT	DATE :	FACULTY OF ENGINEERING
ALL DIM IN MILLIMETER	SCALE : -	
CAD FILE -	DRN :	DESCRIPTION *Compression Cylinder*
DWG.REF. -	CHK:	
IF IN DOUBT ASK	APV :	MATERIAL : SHEET

REV	DESCRIPTION	DATE	APPRD





RILLING CUP WITH THROUGH HOLES

THIRD ANGLE PROJECT	DATE :	FACULTY OF ENGINEERING	
ALL DIM IN MILLIMETER	SCALE : –		
CAD FILE. –	DRN :	DESCRIPTION	*Rilling Cup*
DWG.REF. –	CHK:		
IF IN DOUBT ASK.	APV :	MATERIAL :	SHEET

APPENDIX D

APPENDIX D

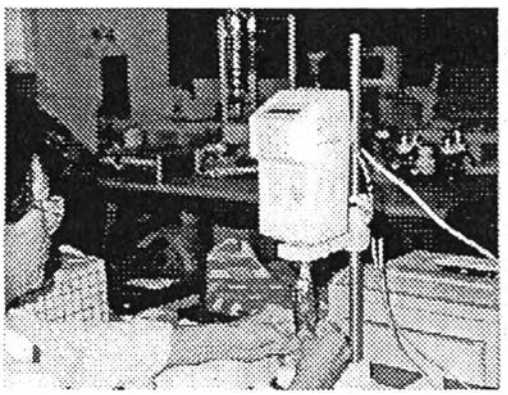


Figure D1 Preparation for viscosity test

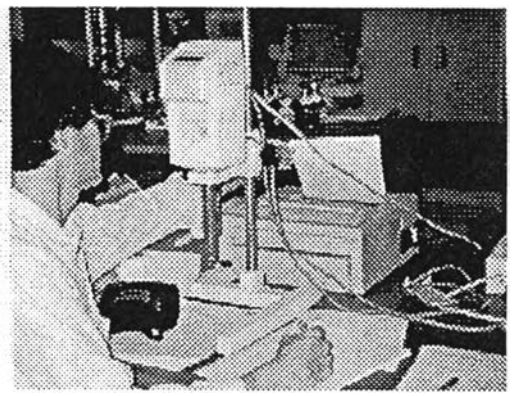


Figure D2 Viscosity test

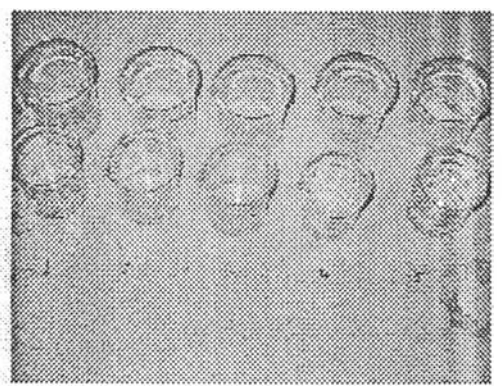


Figure D3 Syrup resistance test

Figure D4 Syrup preparation by weight

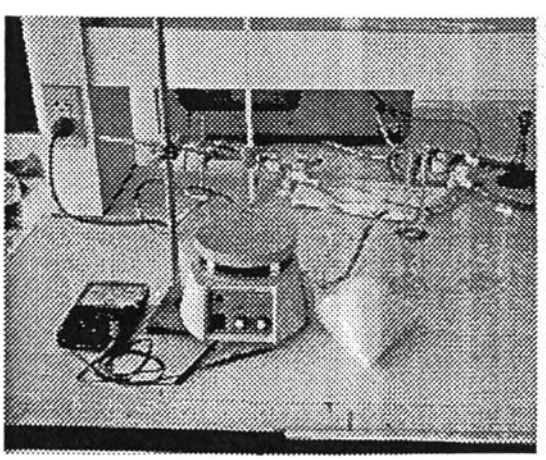


Figure D5 Laboratory equipment for resistance test

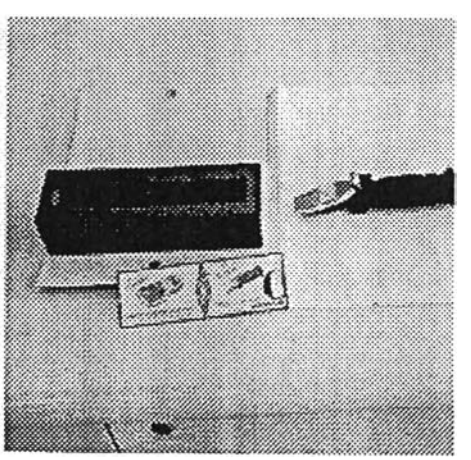


Figure D6 Reflectometer for testing the syrup concentration (60%)

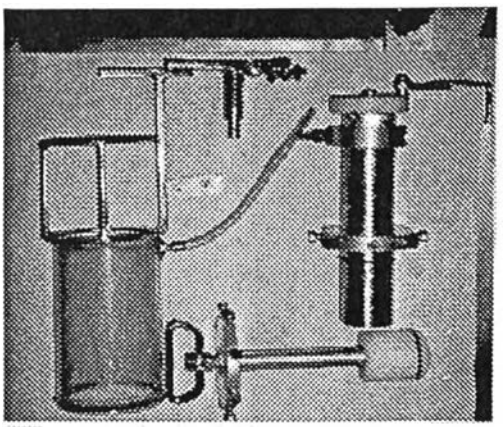


Figure D 7 Components of Figure D8

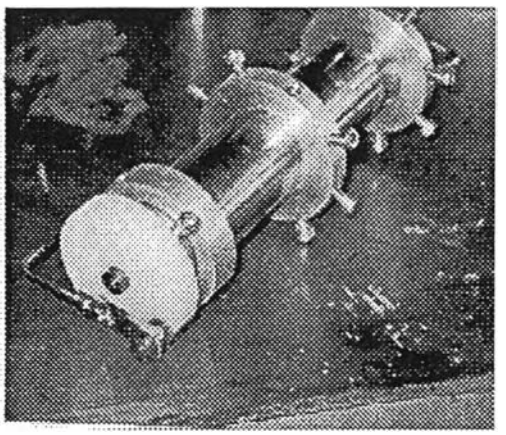


Figure D8 Compression tube for circular motion equipment

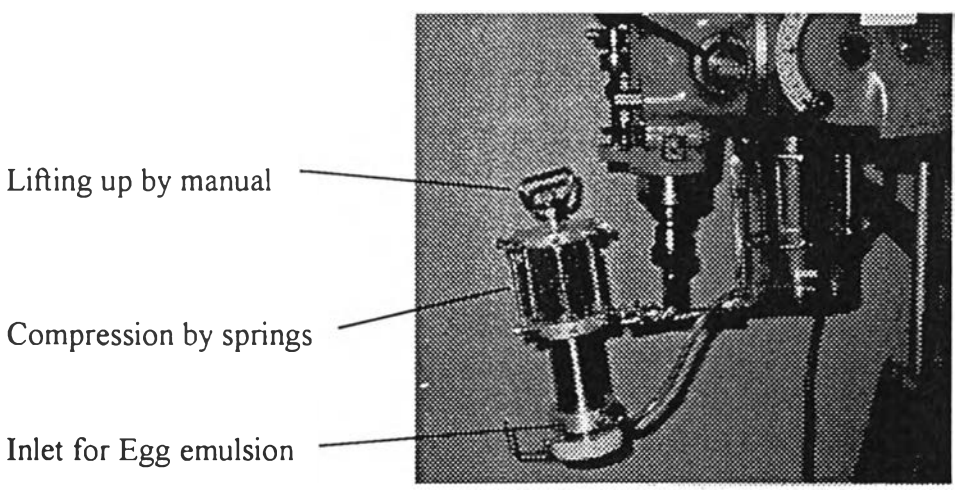


Figure D9 Circular motion equipment

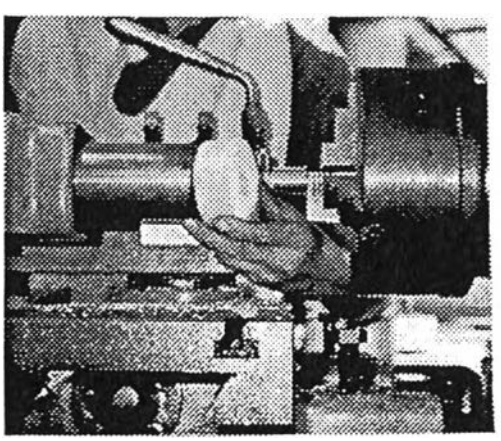


Figure D10 PE- piston for compression tube

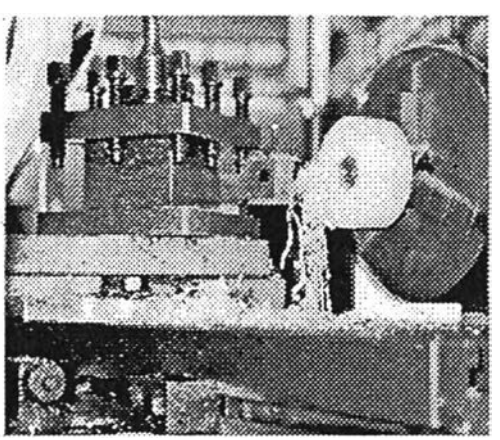


Figure D11 Facing of PE- piston

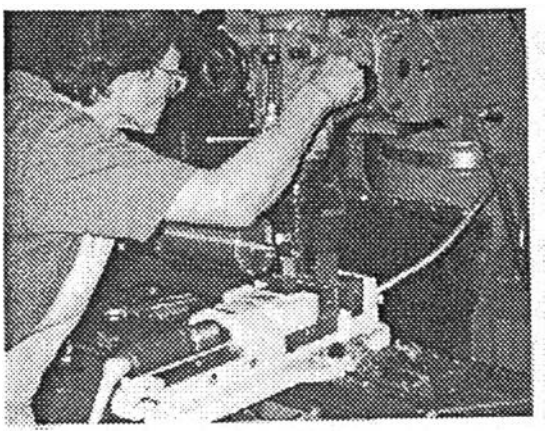


Figure D12 Machining of connecting part

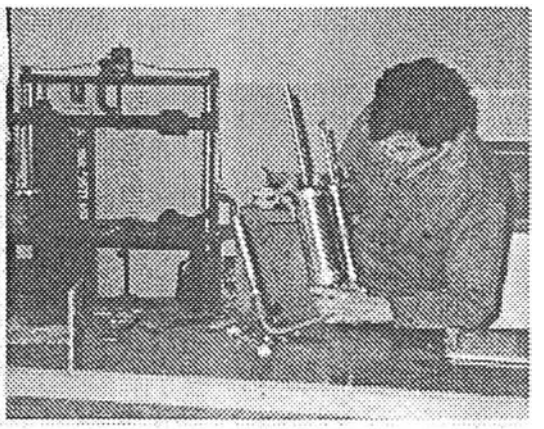


Figure D13 Assembly of commpression tube

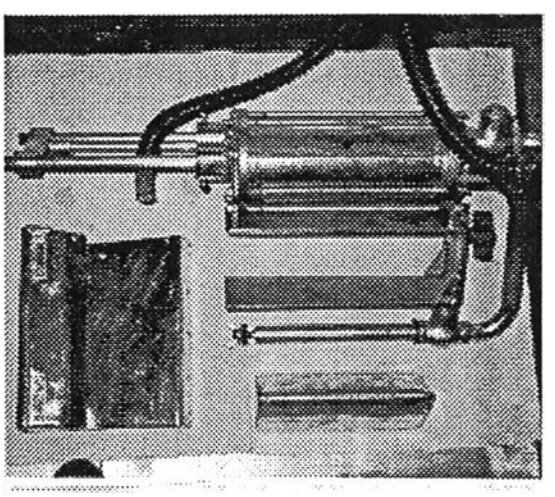


Figure D14 The components of compression tube

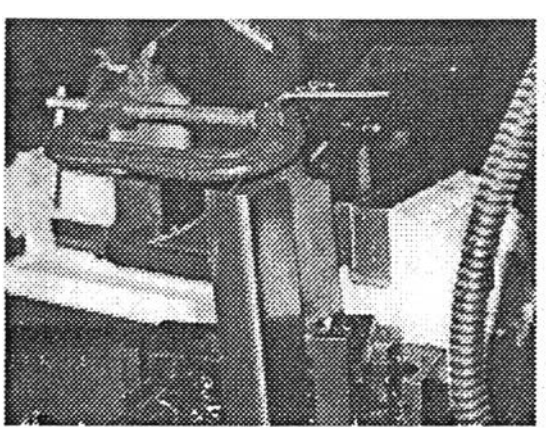


Figure D 15 Machining of the rilling cup

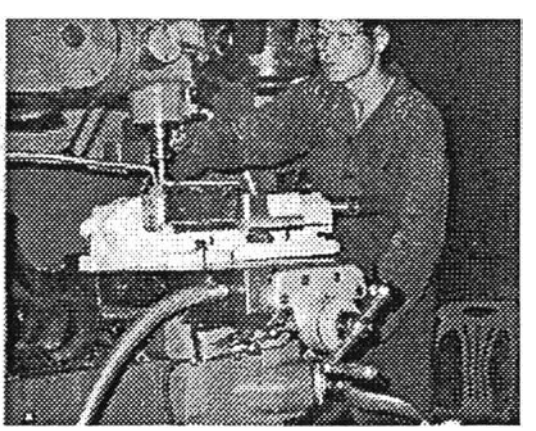


Figure D16 Surface milling of the rilling cup

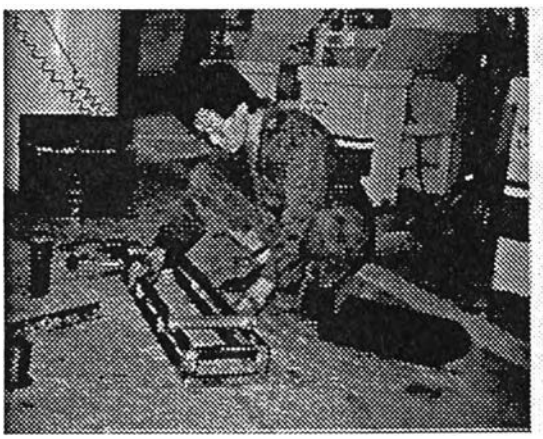


Figure D17 Stove basement

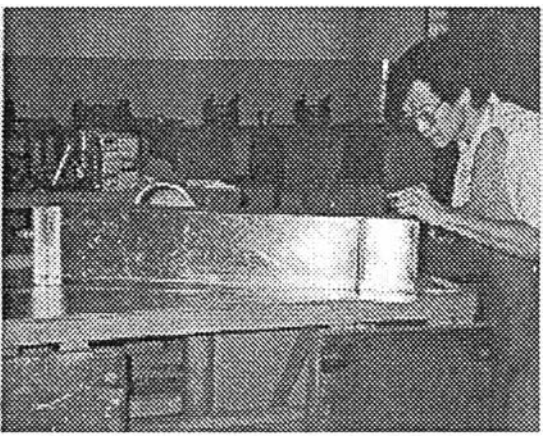


Figure D18 Rectangular brass pan for linear motion

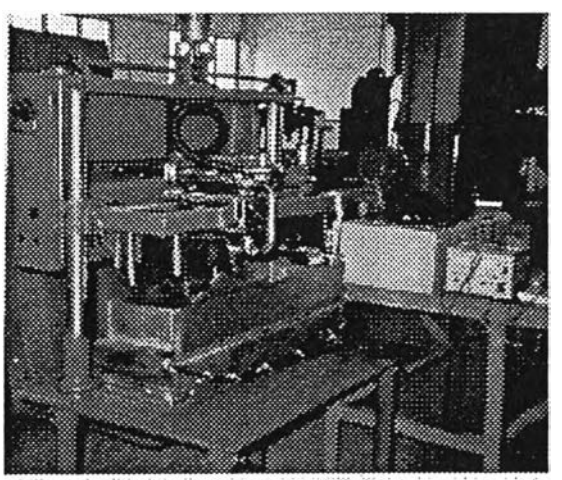


Figure D19 Complete assembly of the linear motion equipment

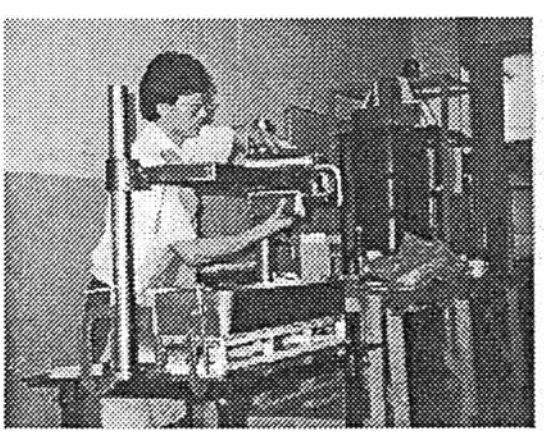


Figure D20 Installation of compression tube

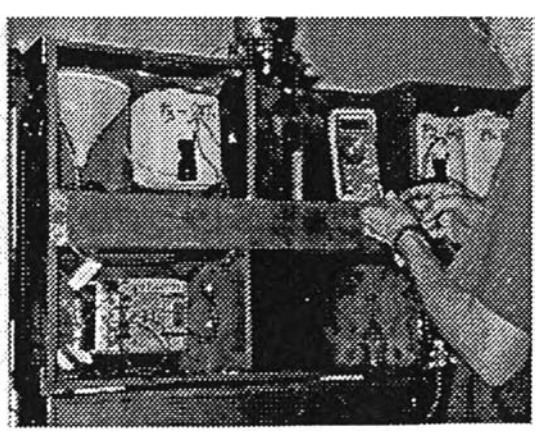


Figure D21 Installation of control system

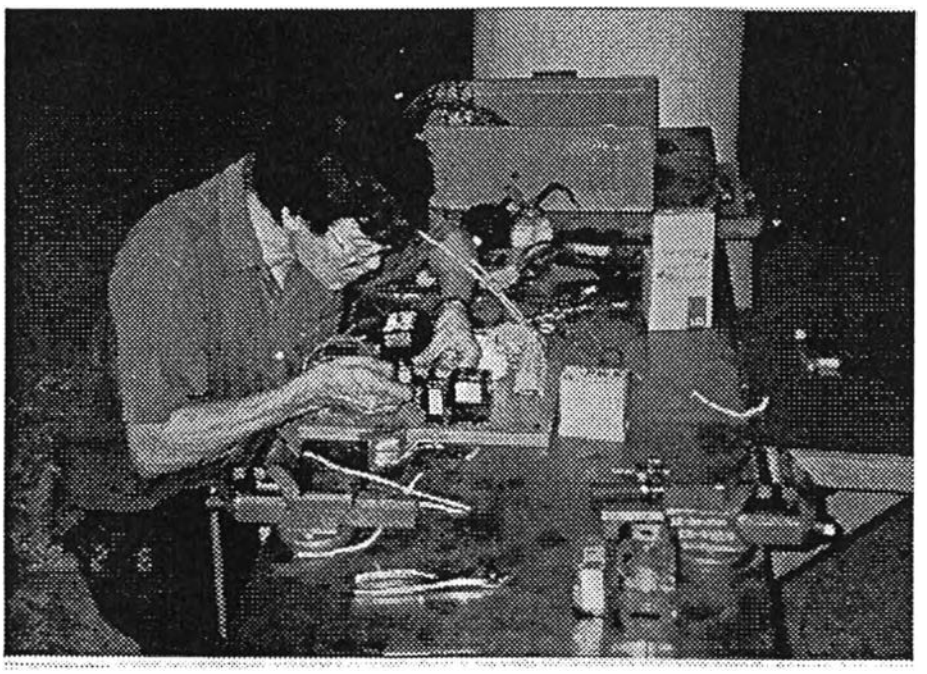


Figure D22 Installation of electrical circuit board for linear motion equipment

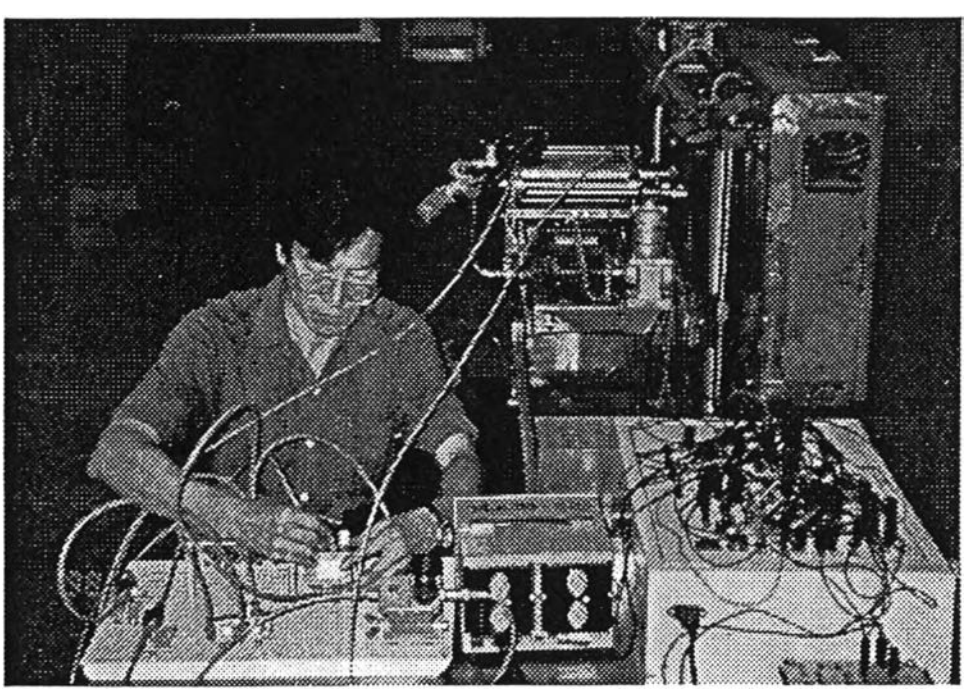


Figure D23 Pneumatic and electric control circuit for linear motion type

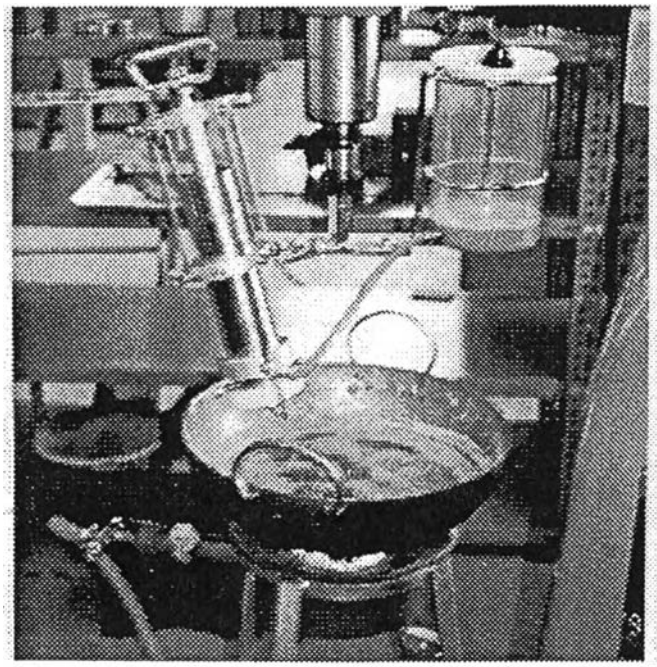


Figure D24 Foi-tong cooking by circular motion equipment

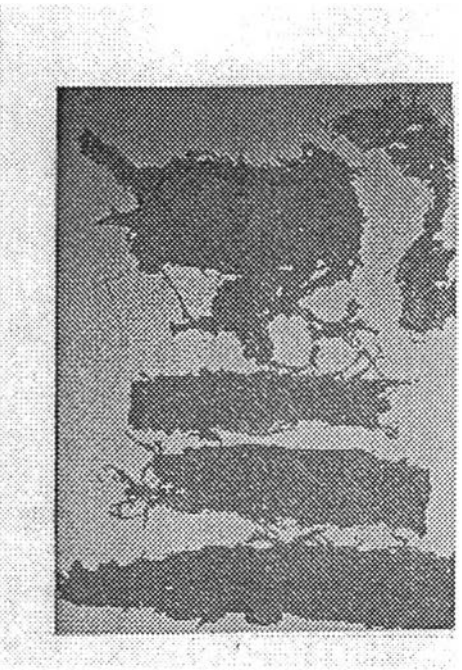


Figure D25 Foi-tong strings

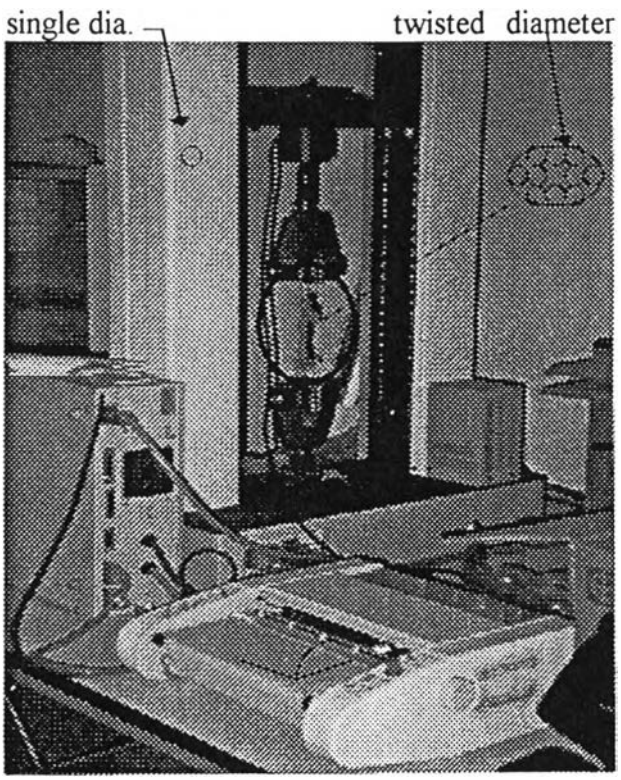


Figure D27 Diameter test by Profile Projector

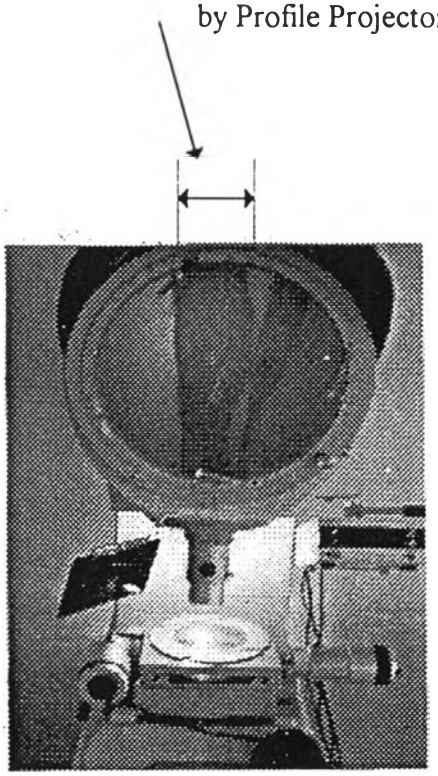


Figure D26 Tensile test for the case of foi-tong measured the extension in Kg / cm on the cross sectional area of 78.5 mm2 (10 mm. twisted diameter)

BIOGRAPHY

Mr.Somsak Chueakittisak was born on February 7, 1953 in Roi-Ed, Thailand. He obtained his Bachelor Degree in Machine Tools Design (Konstruktion Werkzeug-maschinen) from Advance Specialized College of Cologne. (Fachhochschule-Koeln), Germany in 1982 . In May, 1982 he started working for the government sector as a lecturer for technical colleges within Department of Vocational Education , in Education Ministry. Since June , 1992 he has been working for Engineering Faculty of Thammasat University on the Rang-sit campus, Bangkok In academic year 1996 he has been registered as a full-time student and continued to pursue his graduate study in Engineering Management Program of Chulalongkorn University and in Manufacturing Systems Engineering of The University of Warwick at the Regional Centre for Manufacturing Systems Engineering , Chulalongkorn University, Thailand.