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## **APPENDICE**

**APPENDIX A**  
**CONTRACT REVIEW FORM**

### APPENDIX A: Contract Review Form

Salesperson ..... Date ..... Ref.No. ....

Customer Name ..... Quantity .....

Tel : ..... Fax : ..... Delivery Date .....

Round Type ( Mobile )  
  Round Type (Industry)  
  Square Type (Tie Rod )  
  International Standard.....

Item	Description	Requested Data	Item	Description	Requested Data
1	Barrel dia. I.D.	_____ mm.	7	Max. working pressure	_____ bar
2	Barrel dia. O.D.	_____ mm.	8	Max. temperature	_____ degree ceisius
3	Rod dia.	_____ mm.	9	Max. speed	_____ m/sec
4	Working stroke	_____ mm.	10	Cylinder displacement	_____ lpm
5	Extend stroke pin to pin	_____ mm.	11	Port thread <input type="checkbox"/> NPT <input type="checkbox"/> BSP.....	_____ size
6	Retract stroke pin to pin	_____ mm.	12	Rod thread	_____

**Rod End Mounting**

Front flange (dimension .....)  
 Rod eye (dimension .....)  
 Rod clevis (dimension ..... )

**Blind End Mounting**

Rear flange (dimension .....)  
 Eye mounting (dimension .....)  
 Clevis mounting (dimension ..... )

**Between Cover Mounting**

Foot mounting (dimension .....)  
 Intermediate trunnion (dimension ..... )

**OFF-STANDARD DRAWING and APPLICATION CYLINDER**

Prepared by .....

Approved by .....

Date.....

Date.....

**APPENDIX B**  
**EXAMPLE OF CALCULATION SHEET**

**Calculation Sheet**

วันที่ 11/4/1948

JOB NO. HC0087/4/48AL

เล่มที่ / เลขที่ ใบสั่งงานช่าง 046/37 BORE 80 MM ROI 50 MM STORK 200 MM  
MOUNTING -

**ตรวจสอบความแข็งแรงเกลียวของ Piston**

Barrel ID Ø 80 mm Piston Rod Ø 50 mm Maximum Working Pressure 210 Bar

PULL FORCE (F2) 6.43 Tons Piston Material S 45 C Yield Strength 343 N/mm<sup>2</sup>

ทำเกลียว M 30 x 2.00 mm เกลียวที่ Piston สามารถรับแรงได้

จากสูตร

Yield Strength

$$\frac{\text{maximum load}}{\text{cross-sectional area (As)}}$$

$$As = \left[ \frac{d^2}{4} \right] - \frac{1}{4} \left[ \frac{(d2+d3)^2}{2} \right]$$

$$\begin{aligned} d2 &= d - 0.6495 P \\ &= 30.00 - (0.6495 \times 2.00) \\ &= 28.70 \end{aligned}$$

$$\begin{aligned} d3 &= d - 1.2269 P \\ &= 30.00 - (1.2269 \times 2.00) \\ &= 27.55 \end{aligned}$$

$$\begin{aligned} &= \left[ \frac{28.70 + 27.55}{2} \right]^2 \\ &= 790.94 \end{aligned}$$

$$= \left[ \frac{d^2}{4} \right] - \left[ \frac{790.94}{4} \right]$$

$$\therefore \text{พื้นที่รับแรงของเกลียว} = 2,827.43 - 621.20 = 2,206.23 \text{ mm}^2$$

$$343 \text{ N/mm}^2 = \frac{\text{maximum load}}{2,206.23 \text{ mm}^2}$$

$$\begin{aligned} \text{maximum load} &= 343 \text{ N/mm}^2 \times 2,206.23 \text{ mm}^2 \\ &= 756,737.93 \text{ N} \end{aligned}$$

$$\therefore \text{มีค่าความปลอดภัย} = \frac{756,737.93 \text{ N}}{6.43 \times 1000 \times 9.81 \text{ (N)}} = 11.99 \text{ เท่า}$$

สรุปค่าความปลอดภัย ผ่าน

Calculation Sheet

วันที่ 11/4/2548 ชื่อลูกค้า JOB NO. HC0087/4/48AL  
 เล่มที่ / เลขที่ ใบสั่งงานช่าง 046/37 BORE 80 MM ROI 50 MM STORK 200 MM  
 MOUNTING

ตรวจสอบความยาวเกลียวปลายแกนของ Piston Rod

จากสูตร  $L = \frac{F}{\pi d_1 \tau}$

$F = 6.43 \text{ Tons (Barrel 80 Roc 50 Max Working Pressure 210 Bar)}$

$d_1 = d - 1.0825 P$

$= 38 - 1.0825 \times 12$

$= 25.11 \text{ mm}$

$\tau = 0.577 \sigma \quad (\sigma = 343 \text{ N/mm}^2) = 197.91$

$= \frac{63,101.95}{\pi \times 25.11 \times 197.91} = 4.04 \text{ mm}$

Barrel 80 x Piston Rod 50 Max Working Pressure 210 Bar Piston Rod Material S 45 C ทำเกลียว  
 M 38 x 12 มีความยาวเกลียวอย่างน้อย = 4.04 mm  
 การออกแบบกำหนดให้เกลียวยาว = 50.00 mm ∴ มีค่าความปลอดภัย = 12.37 เท่า  
 สรุปค่าความปลอดภัย ผ่าน

ตรวจสอบความแข็งแรงช่วงตกร่องเกลียวของ Piston Rod

จากสูตร

Yield Strength		$\frac{\text{maximum load}}{\text{cross-sectional area (As)}}$
As	$= \frac{\pi D^2}{4}$	
D	$= 25.1$	
	$= \frac{\pi \times 25.1^2}{4} = 494.81 \text{ mm}^2$	
Yield Strength	$= 343 \text{ N/mm}^2 \times 494.81 \text{ mm}^2$	
	$= 169,719.38 \text{ N}$	
∴ มีค่าความปลอดภัย	$= \frac{169,719.38 \text{ N}}{6.43 \times 1000 \times 9.81 \text{ (N)}}$	$= 2.69 \text{ เท่า}$

สรุปค่าความปลอดภัย ผ่าน

ผู้ทบทวน

ผู้ทวนสอบ

ผู้รับรองผลการออกแบบ

.....  
...../...../..........  
...../...../..........  
...../...../.....



Calculation Sheet

วันที่ 11/1/2548 ชื่อลูกค้า

JOB NO. HC0087/4/48AL

เดิมที / เลขที่ ใบสั่งงานช่าง 046/37 BORE 30 MM ROI 50 MM STORK 200 MM MOUNTING -

ตรวจสอบความแข็งแรงเกลียวของ Piston Rod คำนวณที่ยึดกับลูกสูบ

Barrel ID Ø 80 mm Piston Rod Ø 50 mm Maximum Working Pressure 210 Bar

PULL FORCE (F2) 6.43 Tons Piston Rod Material S 45 C Yield Strength 343 N/mm<sup>2</sup>

ทำเกลียว M 30 x 2.00 mm เกลียวที่ Piston Rod สามารถรับแรงได้

จากสูตร

Yield Strength  $\frac{\text{maximum load}}{\text{cross-sectional area (As)}}$  (สูตร คำนวณแรงดึง)  $\frac{P}{A}$

As =  $\frac{\pi}{4} \left( \frac{d2+d3}{2} \right)^2$  เส้นผ่าศูนย์กลางของเกลียว

d2 = d - 0.6495 P  
 = 30.00 - (0.6495 x 2.00)  
 = 28.70 เส้นผ่าศูนย์กลางของเกลียว

d3 = d - 1.2269 P  
 = 30.00 - (1.2269 x 2.00)  
 = 27.55

=  $\left( \frac{28.70 + 27.55}{2} \right)^2$

= 790.94

=  $\frac{\pi}{4} \times 790.94$

∴ พื้นที่รับแรงของเกลียว = 621.20 mm<sup>2</sup>

343 N/mm<sup>2</sup> =  $\frac{\text{maximum load}}{621.20 \text{ mm}^2}$

maximum load = 343 N/mm<sup>2</sup> x 621.20 mm<sup>2</sup>  
 = 213,071.73 N

∴ มีค่าความปลอดภัย =  $\frac{213,071.73 \text{ N}}{6.43 \times 1000 \times 9.81 \text{ (N)}}$  = 3.38 เท่า

สรุปค่าความปลอดภัย ผ่าน

### Calculation Sheet

วันที่ 11/4/2548 ชื่อลูกค้า หุอิติ

JOB NO. HC0087/4/48AL

เล่มที่ / เลขที่ ใบสั่งงานช่าง 046/37 BORE 80 MM ROI 50 MM STORK 200 MM  
MOUNTING -

#### ตรวจสอบความแข็งแรงของแนวเชื่อม Foot Mounting

Barrel ID 250 mm Maximum Working Pressure 210 Bar PUSH FORCE (F1) 103.08 Tons

ลวดที่ใช้เชื่อม Foot Mounting ใช้ SS 41 จุดกลางตัว 235 N/mm<sup>2</sup>

ความกว้างของฐาน Foot Mounting (L) 385.00 mm ระยะ T (ความหนา) ของ Foot Mounting 125.00 mm

ระยะลดคมแนวเชื่อม C ของ Foot Mounting = 140.00 mm พื้นที่รับแรงของแนวเชื่อมสามารถรับแรงได้

จากสูตร

$$\tau = \frac{F}{0.707hl}$$

$$\tau = \text{shear stress N/mm}^2 \quad ( 235 \text{ N/mm}^2 )$$

$$F = \text{load (N)} \quad ( 1,011,249.22 \text{ N} )$$

$$h = \text{throat (MM)}$$

$$l = \text{length of the weld (MM)} \quad ( L \times T )$$

$$F = [ 0.707 \times 140.00 \times ((( 385.00 \times 2 ) + ( 125.00 \times 2 )) \times 2) \text{ mm}^2 ] \times \tau$$

$$F = 2E+05 \text{ N/mm}^2 \times \tau \text{ N/mm}^2$$

$$F = 2E+05 \text{ N/mm}^2 \times 235 \text{ N/mm}^2$$

$$1,011,249.22 \text{ N} = 47,451,012.00 \text{ N}$$

$$\therefore \text{มีค่าความปลอดภัย} = \frac{47,451,012.00 \text{ N}}{1,011,249.22 \text{ N}} = 46.92 \text{ เท่า}$$

สรุปค่าความปลอดภัย ผ่าน

ผู้ทบทวน

ผู้ทวนสอบ

ผู้รับรองผลการออกแบบ

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Calculation Sheet

วันที่ 11/4/2548 ชื่อลูกค้า JOB NO. HC0087/4/48AL  
 เล่มที่ / เลขที่ ใบสั่งงานช่าง 046/37 BORE 80 MM ROI 50 MM STORK 200 MM  
 MOUNTING -

ตรวจสอบความแข็งแรงเกลียวปลายแกนของ Piston Rod ( external thread )

Barrel ID 80 mm Piston Rod 50 mm Maximum Working Pressure 210 Bar  
 PULL FORCE (F2) 6.43 Tons Piston Rod Material S 45 C Yield Strength 343 N/mm<sup>2</sup>  
 ทำเกลียว M 38 x 12 mm เกลียวที่ Piston Rod สามารถรับแรงได้

จากสูตร

Yield Strength

maximum load

cross-sectional area (As)

$$\begin{aligned}
 A_s &= \frac{\pi}{4} \left( \frac{d_2 + d_3}{2} \right)^2 \\
 d_2 &= d - 0.6495 P \\
 &= 38.10 - (0.6495 \times 12) \\
 &= 30.31 \\
 d_3 &= d - 1.2269 P \\
 &= 38.10 - (1.2269 \times 12) \\
 &= 23.38 \\
 &= \left( \frac{30.31 + 23.38}{2} \right)^2 \\
 &= 720.47 \\
 &= \frac{\pi}{4} 720.47
 \end{aligned}$$

$$\begin{aligned}
 \therefore \text{พื้นที่รับแรงของเกลียว} &= 565.86 \text{ mm}^2 \\
 343 \text{ N/mm}^2 &= \frac{\text{maximum load}}{565.86 \text{ mm}^2} \\
 \text{maximum load} &= 343 \text{ N/mm}^2 \times 565.86 \text{ mm}^2 \\
 &= 194,088.54 \text{ N} \\
 \therefore \text{มีค่าความปลอดภัย} &= \frac{194,088.54 \text{ N}}{6.43 \times 1000 \times 9.81 \text{ (N)}} = 3.08 \text{ เท่า}
 \end{aligned}$$

Calculation Sheet

วันที่ 11/4/2548 ชื่อลูกค้า JOB NO. HC0087/4/48AL  
 เติมที่ / เลขที่ ใบสั่งงานช่าง 046/37 BOR 80 MM ROI 50 MM STORK 200 MM  
 MOUNTING

ตรวจสอบความยาวเกลียวปลาตแกนของ Piston Rod ด้านที่ยึดกับลูกสูบ

จากสูตร  $L = \frac{F}{\pi d_1 \tau}$  *ตรวจสอบหน้าที่ยึด Pull force*

$F = 6.43$  Tons ( Barrel 80 Rod 50 Max Working Pressure 210 Bar )

$d_1 = d - 1.0825 P$  *เส้นผ่านศูนย์กลางเกลียวปลาต*

$= 30 - 1.0825 \times 2.00$

$= 27.84$  mm

$\tau = 0.577 \sigma$  ( $\sigma = 343$  N/mm<sup>2</sup>) = 197.91

$= \frac{63,101.95}{\pi \times 27.84 \times 197.91} = 3.65$  mm

Barrel 80 x Piston Rod 50 Max Working Pressure 210 Bar Piston Rod Material S 45 C ทำเกลียว M 30 x 2.00 มีความยาวเกลียวอย่างน้อย = 3.65 mm  
 การออกแบบกำหนดให้เกลียวยาว = 28.00 mm ∴ มีค่าความปลอดภัย = 7.68 เท่า  
 สรุปค่าความปลอดภัย ผ่าน

ตรวจสอบความแข็งแรงช่วงตกร่องเกลียวของ Piston Rod ด้านที่ยึดกับลูกสูบ

จากสูตร

Yield Strength	<u>maximum load</u>	
	cross-sectional area (As)	
As =	$\frac{\pi D^2}{4}$	<i>cross-sectional area (As) &lt;math&gt;\frac{\pi D^2}{4}&lt;/math&gt;</i>
D =	27.00	
	$= \frac{\pi \times 27.00^2}{4}$	= 572.56 mm <sup>2</sup>
Yield Strength =	$343$ N/mm <sup>2</sup> x $572.56$ mm <sup>2</sup>	
	= 196,386.45 N	
∴ มีค่าความปลอดภัย =	$\frac{196,386.45}{6.43 \times 1000 \times 9.81}$ N	= 3.11 เท่า
	สรุปค่าความปลอดภัย ผ่าน	

ผู้ทบทวน	ผู้ทวนสอบ	ผู้รับรองผลการออกแบบ
.....	.....	.....

**APPENDIX C**  
**SUPPLIER EVALUATION FORM**

**APPENDIX C: Supplier Evaluation Form**

Product Type.....

Supplier Name .....

Evaluation : No. ....

Period.....

P/O No.	Product Description	Delivery Date in P/O	P/O Value	Delivery Date	Delivery Time(30)		Quality(40)		Quantity(30)	
					On-time	Late	Pass	No	Yes	No
<b>Total Score</b>		Total Score								
>90 = Grade A		Percent								
80 - 8 = Grade B		Ave.								
69-79 = Grade C		Total in %			Grade		/			
<60 = Grade D										
Checked by.....				<input type="checkbox"/> Passed <input type="checkbox"/> Not passed Purchasing Officer						
...../...../.....				Approved by...../...../.....						

**APPENDIX D**

**RAW MATERIALS INSPECTION FORM**

**APPENDIX D: Raw Materials Reception Form**

No.	Description	Grade	Quantity	Sampling Quantity	QC Result		Reasons	Supplier	Invoice No.	LOT No.	Remarks
					Passed	Not Passed					

Checked by .....

Date.....

Approved by .....

Date.....



**APPENDIX E**

**HYDRAULICS CYLINDER PRODUCTION PLAN**

**APPENDIX E: HYDRAULIC CYLINDER PRODUCTION PLAN**

Hydraulic Cylinder Production Plan		No. of Revision	Ref. No.			
Division		Date		Page		
Prepared by:		Approved by:				
	Procedure	Control Point		QC		Correction Plan
		QC Criteria	QC Point	Quantity	Method/Tool	
	1. RM Reception					
	2. RM inspection (Sampling method)	RM specification according to Purchase Order	RM Stock Room	Sampling test	Vernier Metre casket Gauge	Contact supplier for RM return
	3. Metal cutting (AMADA and HERO machine)	Quality of metal after cutting Size according to RM Ordering Form	RM Stock Room	All	Vernier Metre casket Sight	For further use of a smaller size
	4. Milling	Size according to design	M C	All	Vernier	For further use
	5. Lathing by CNC Machine	Size according to design	M C	All	Vernier Gauge	Dispose
	6. Drilling	Size according to design	M C	All	Vernier - JIG	Dispose
	7. TAP	Thread according to design	M C	All	- Thread Gauge	Dispose
	8. Bend	Size according to design	M C	All	Vernier	Rework
	9. Welding	Size according to design	Assembling	All	Sight	Rework
	10. WIP inspection	Size according to design	M C	All	Vernier Gauge	Rework Dispose
	11. Assembly	Assembly Plan	Assembling	All		Rework
	12. Final Inspection	Production Plan	Assembling	All	- Pressure Gauge Vernier Metre casket	Rework
	13. Painting	Colour standard	Painting	All	Sight	Rework
	14. Final Inspection	Overall condition	Painting	All	Sight	Rework
	15. Name Plate Attach		Plate attachment	All	Sight	Rework
	16. UTT	Size/condition of cylinder	Painting	All	Sight	Rework
	17. Wait for delivery					

Remarks Work Move Inspection

**APPENDIX F**  
**POSTPONEMENT FOR LATE DELIVERY**  
**OF MERCHANDISE FORM**

**APPENDIX F: POSTPONEMENT FOR LATE DELIVERY OF MERCHANDISE FORM**

Item	Product Type	JOB No.	Customer	M/L Date	M/L Delivery Date	Factory Delivery Date	Problem and Cause of Problem

Prepared by ..... Date.....

Approved by: .....Date.....

Attention to:

Agree for the postponement

Not agree for the postponement

Reasons:

Salesperson.....Date.....

Approved by ..... Date.....

**APPENDIX G**  
**FINAL INSPECTION FORM**

**APPENDIX G: Final Inspection Form**

Customer Name .....

Hydraulic Cylinder Size .....

JOB No. : ..... Type  Square Type  Mobile Or Round Type  Industrial Type

Item	Description	Tools	STANDARD	Inspection Amount										Remarks	
				1	2	3	4	5	6	7	8	9	10		
1	STROKE	Vernier, metre casket	± mm.												
2	Maximum Distraction	Vernier, metre casket	± mm.												
3	Thread Largeness	Thread Ring Gauge	Passed/Not Passed												
4	Thread Length	Vernier, metre casket	± mm.												
5	Pressure	Pressure Gauge	± PSI												
6	Holding Time	Timer	Minute												
7	<input type="radio"/> PUSH <input type="radio"/> PULL	Design	Design												
8	<input type="radio"/> OK <input type="radio"/> Leaked Seal	Sight	-												
9	Joint	Sight	Good condition												
10	Painting	Sight	Good condition												
11	Result		Passed Not Passed												
12	SERIAL No.:														

Inspected by.....  
Date.....

Approved by .....  
Date.....

**APPENDIX H**  
**CUSTOMER QUESTIONNAIRE**

**APPENDIX H-1: CUSTOMER QUESTIONNAIRE****CUSTOMER SURVEY ON IMPLEMENTATION****DATE:** **Before** **After**

Please write x in an appropriate rating.

1. What is your opinion on our quality of product?  
[5] Very good  
[4] Good  
[3] Moderate  
[2] Bad  
[1] Very bad
2. What is your opinion in receiving the right product as ordered?  
[5] Very good  
[4] Good  
[3] Moderate  
[2] Bad  
[1] Very bad
3. What is your opinion on quality of product design?  
[5] Very good  
[4] Good  
[3] Moderate  
[2] Bad  
[1] Very bad
4. What is your opinion on durability of product?  
[5] Very good  
[4] Good  
[3] Moderate  
[2] Bad  
[1] Very bad
5. What is your opinion on on-time delivery?  
[5] Very good  
[4] Good  
[3] Moderate  
[2] Bad  
[1] Very bad
6. What is your opinion on product ordering lead time? (Period from placing order until receiving product)  
[5] Most appropriate  
[4] Very appropriate



[3] Appropriate

[2] Less appropriate

[1] Not acceptable

7. What is your opinion on design time?

[5] Most appropriate

[4] Very appropriate

[3] Appropriate

[2] Less appropriate

[1] Not acceptable

8. Will you continue to purchase our product?

[5] Certainty

[4] Very likely to purchase

[3] Likely to purchase

[2] Unlikely to purchase

[1] Definitely not

9. Will you introduce your friends to purchase our product?

[5] Certainty

[4] Very likely to introduce

[3] Likely to introduce

[2] Unlikely to introduce

[1] Definitely not

10. How would you rate company for the effort in trying to improve quality of product and delivery time?

[5] Very good

[4] Good

[3] Moderate

[2] Bad

[1] Very bad



### APPENDIX H-3: RESULT OF QUESTIONNAIRE (AFTER) AND MEAN RATING CALCULATION

Customer	1	2	3	4	5	6	7	8	9	10
1	3	4	4	3	5	5	4	5	4	5
2	5	4	5	4	5	4	4	4	3	5
3	5	4	3	4	4	3	4	4	4	3
4	4	3	3	4	5	4	4	4	4	5
5	4	4	3	3	5	3	3	4	4	5
6	3	1	3	4	4	5	5	4	3	3
7	5	4	4	3	5	3	3	3	3	3
8	5	4	4	3	5	4	4	5	4	5
9	3	4	3	4	4	3	3	3	3	4
10	3	2	4	4	5	3	4	3	3	4
11	4	3	4	3	4	4	3	3	3	4
12	3	4	5	3	4	3	4	4	4	5
13	5	2	3	4	5	3	4	3	2	3
14	3	3	4	3	4	4	5	5	3	3
15	4	3	2	3	3	3	3	3	3	3
16	4	4	5	4	5	3	3	4	4	5
17	4	3	3	3	4	3	3	4	4	5
18	4	3	4	3	4	4	4	4	4	4
19	3	4	3	3	4	2	2	3	3	4
20	3	3	4	3	4	4	4	3	3	4
21	3	3	3	2	3	2	3	4	3	3
22	4	4	3	3	4	3	3	4	3	3
23	4	4	4	3	4	3	4	4	2	4
24	3	3	3	3	4	3	2	3	2	3
25	3	3	3	2	5	5	3	3	2	3
<b>Total</b>	93	83	89	81	108	86	88	93	80	98
<b>Mean</b>	3.72	3.32	3.56	3.24	4.32	3.44	3.52	3.72	3.2	3.92

Mean Mean 3.596



## BIOGRAPHY

Chutchanun Tanomvorsin was born on December 24, 1967 in Bangkok, Thailand. He obtained his Bachelor's Degree in Mechanics Engineering from Siam University in 1990. After graduated, he has joined TAEC since 1993, as the Marketing Manager. He enrolled and pursuit for a Master of Sciences in Engineering Management at the Regional Centre for Manufacturing Systems Engineering at Chulalongkorn University and University of Warwick (UK).