CHAPTER VII

EVALUATION OF THE IMPROVEMENT AFTER FMEA IMPLEMENTATION

7.1 Introduction

In this thesis, quality as shipped (QAS) and customer complaint as the indicators for demonstrating the improvement after FMEA implementation. The comparison of QAS between before and after implementation are shown from figure 7.1 to figure 7.35. In August, September and October 1997 are the three months of before implementation. And in April, May and June 1998 are the three months after implementation.

For the improvement on customer complaint items in manufacturing area is shown in figure 7.36 Basically, comparison of customer complaint items in manufacturing area is between before and after FMEA implementation. From April 1997 to October 1997 was the period of before FMEA implementation. From April 1998 to October 1998 was the period of after FMEA implementation.

7.2 Quality as shipped (QAS)

Currently, Molex Thailand use QAS and part per million concept to measure the quality of product before they are shipped to the end customers. For QAS, sampling plan is applied to gather defects of the product in each lot at the final gate which is before packing process, then comparison with the number of detection is considered. For the whole month, Molex Thailand gather all information for both number of defects and number of detection to make a part per million in each month.

For each lot, if it is more than acceptance level at the final gate, Molex Thailand will sort 100% of that batch and then summarize the quantity of defects and then divided by the total number of detection. Molex Thailand use this concept for each type of defect and show in the table and demonstrate as a graph for the whole month as well.

7.3 Comparison QAS between before and after FMEA implementation

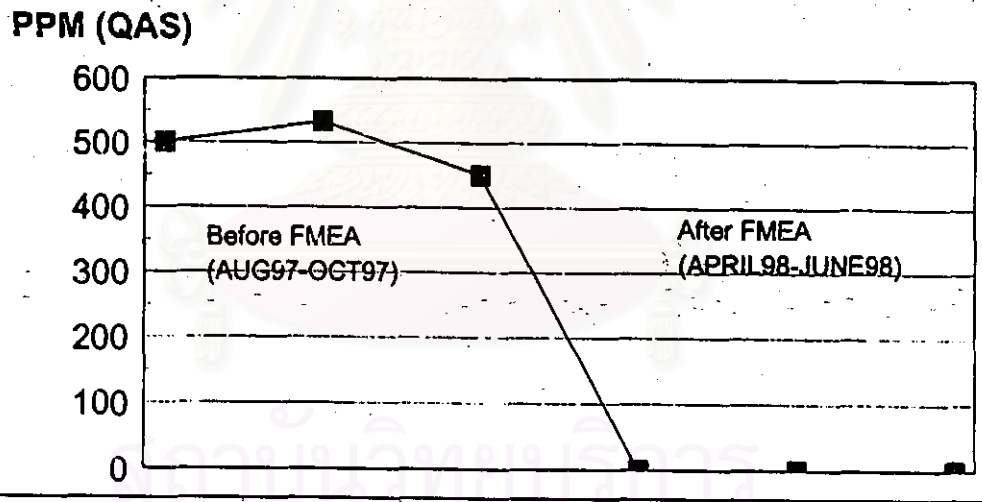
In this thesis, QAS comparison before and after FMEA implementation are shown as the following. From Chapter III, there are five part number which are selected to implement FMEA technique and they will be evaluated by using QAS.

7.3.1 Part 889-4941 for wrong color wire be assembled

From figure 7.2 to figure 7.4 show all significant QAS of quality criteria in August, September and October 1997 respectively. This period is before FMEA implementation. From figure 7.5 to figure 7.7 show all significant QAS of quality criteria in April, May and June 1998 respectively which is the period of after FMEA implementation.

In figure 7.1 show the comparison between before and after FMEA implementation in wrong color wire be assembled quality criteria for part 889-4941. Before FMEA implementation, QAS of wrong color wire be assembled are 500 ppm, 533 ppm and 450 ppm in August, September and October 1997 respectively. After FMEA implementation in April, May and June 1998, QAS of wrong color wire be assembled quality criteria are all zero.

Comparision between before and after FMEA implementation in "Wrong colour wire be assembled" issue for P/N 889-4941



Month	Aug 97	Sep 97	Oct 97	April 98	May 98	June 98
PPM	500	533	450	0	0	0

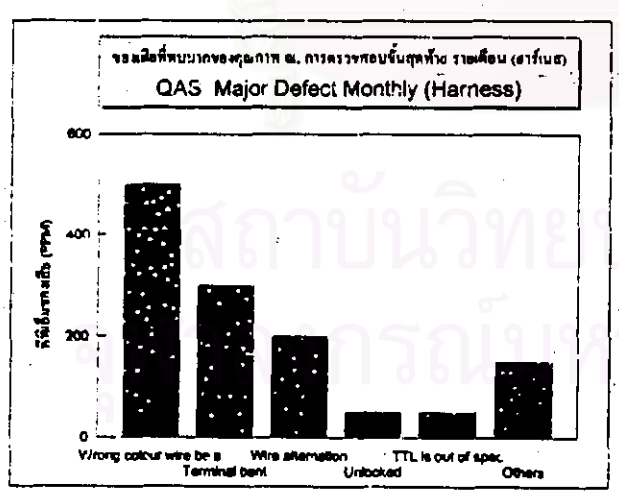
Figure 7.1- QAS comparison between before and after FMEA implementation for "wrong wire color be assembled" of Part number 889-4941

Criteria Defect (QAS)

	Harness	20,000	PPM
1.	Wrong colour wire be assy	10	500
2.	Terminal bent	6	300
3.	Wire alternation	4	200
4.	Unlocked	1	50
5.	TTL is out of spec	1	50
6.	Others	3	150

Criteria Defect (QAP)

		2,460,000	PPM
1.	Insul Over/Under Crimp	1,156	470
2.	Wrong colour wire be assy	1,017	413
3.	Wire alternation	604	246
4.	Strip length is out of spec	451	183
5.	Terminal bent	418	170
6	Extrude wire	311	126
7.	Lance height is out of spec	122	50
8.	TTL is out spec	50	20
9.	Others	300	122



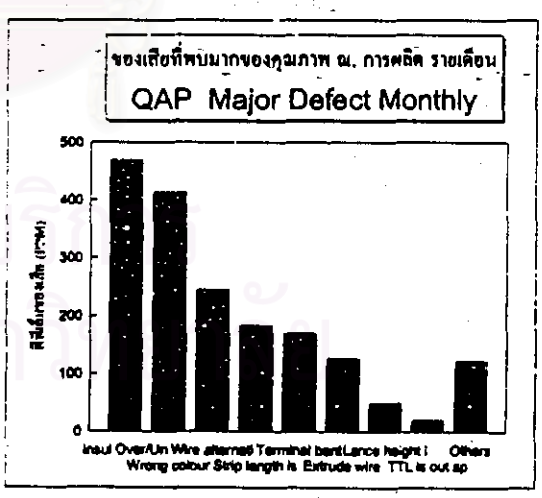


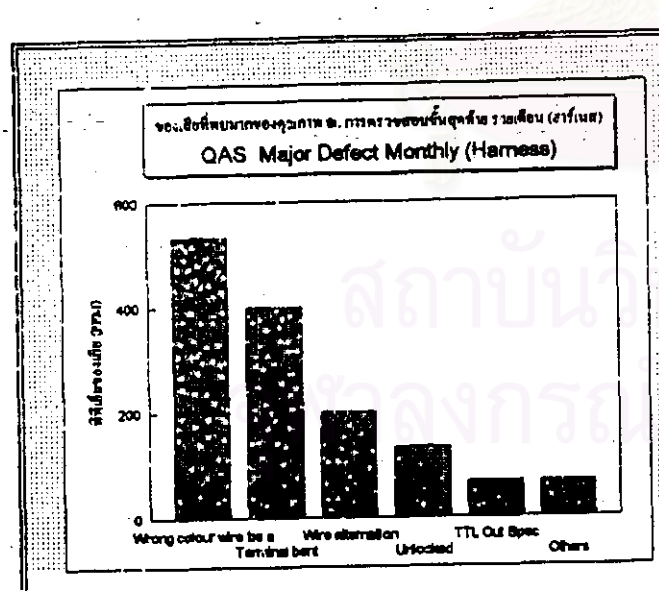
Figure 7.2- QAS of all quality criteria in August 1997 for 889-4941

Criteria Defect (QAS)

	Harness	15,000	PPM
1.	Wrong colour wire be assy	8	533
2.	Terminal bent	6	400
3.	Wire alternation	3	200
4.	Unlocked	2	133
5.	TTL Out Spec	1	67
6.	Others	1	67

Criteria Defect (QAP)

		1,845,000	PPM
1.	Insul Over/Under Crimp	974	528
2.	Wrong colour wire be assy	790	428
3.	Wire alternation	485	263
4.	Strip length is out of spec	330	179
5.	Terminal bent	300	163
6.	Extrude wire	180	98
7.	Lance height is out of spec	119	64
8.	TTL is out of spec	90	49
9.	Others	208	113



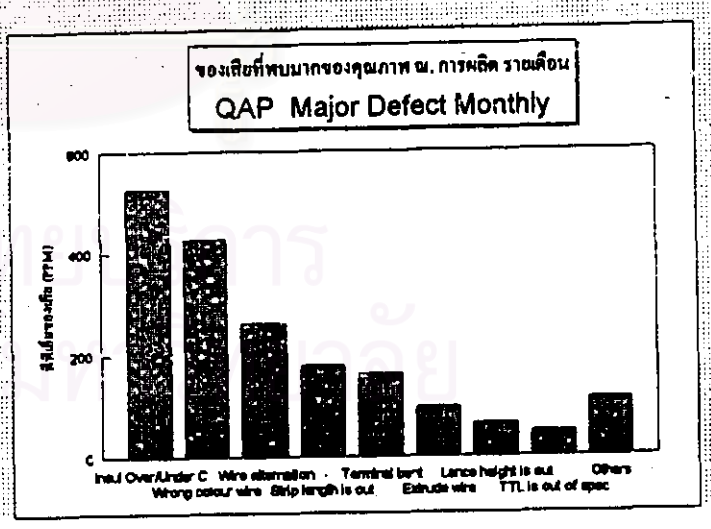


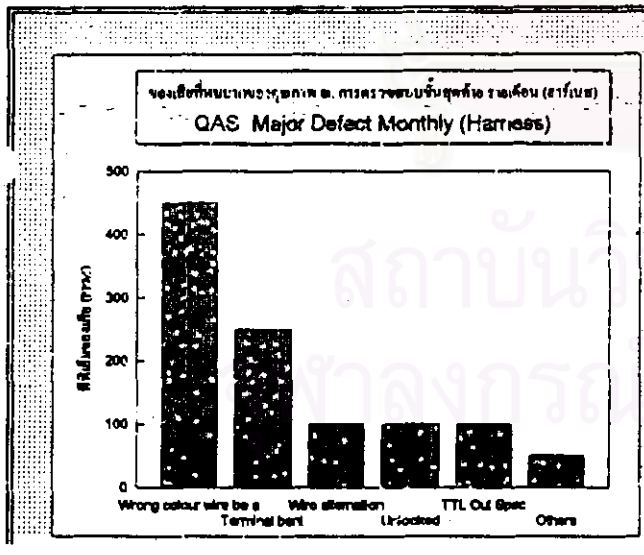
Figure 7.3- QAS of all quality criteria in September 1997 for 889-4941

Criteria Defect (QAS)

	Harness	20,000	PPM
1.	Wrong colour wire be assy	9	450
2.	Terminal bent	5	250
3.	Wire alternation	2	100
4.	Unlocked	2	100
5.	TTL Out Spec	2	100
6.	Others	1	50

Criteria Defect (QAP)

		2,460,000	PPM
1.	Insul Over/Under Crimp	1,502	611
2.	Wrong colour wire be assy	869	353
3.	Wire alternation	541	220
4.	Strip length is out of spec	470	191
5.	Terminal bent	426	173
6.	Extrude wire	248	101
7.	Lance height is out of spec	135	55
8.	TTL is out of spec	133	54
9.	Others	220	89



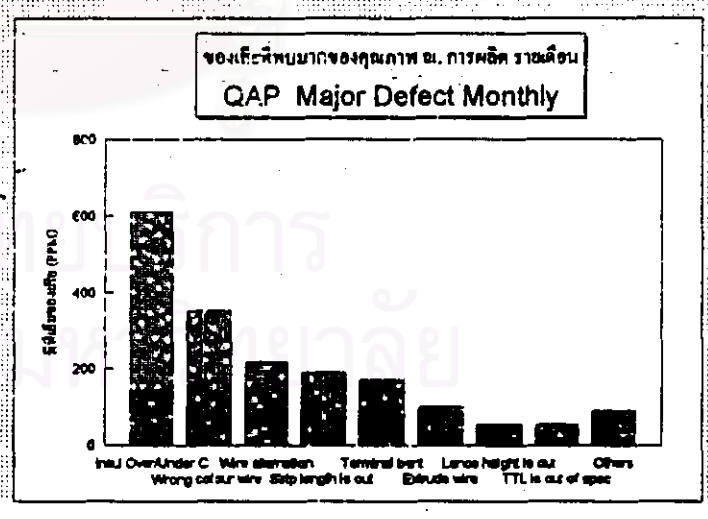


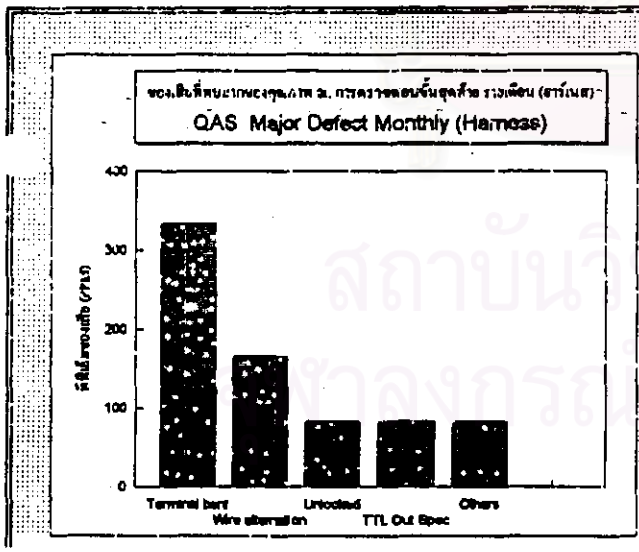
Figure 7.4- QAS of all quality criteria in October 1997 for 889-4941

Criteria Defect (QAS)

	Harness	12,000	PPM
1.	Terminal bent	4	333
2.	Wire alternation	2	167
3.	Unlocked	1	83
4.	TTL Out Spec	1	83
5.	Others	1	83
6.		0	0

Criteria Defect (QAP)

		1,476,000	PPM
1.	Insul Over/Under Crimp	754	511
2.	Strip length is out of spec	510	346
3.	Terminal bent	335	227
4.	Extrude wire	236	160
5.	Lance height is out of spec	145	98
6.	TTL is out of spec	89	60
7.	Wire alternation	40	27
8.	Wrong wire colour be away	10	7
9.	Others	45	30



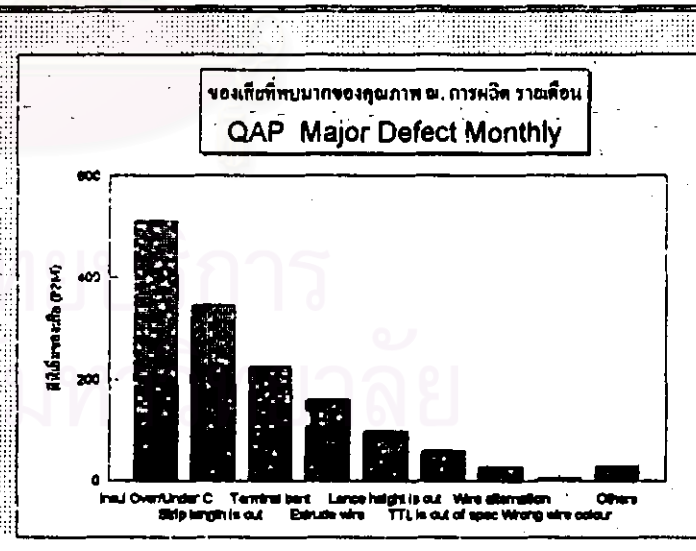


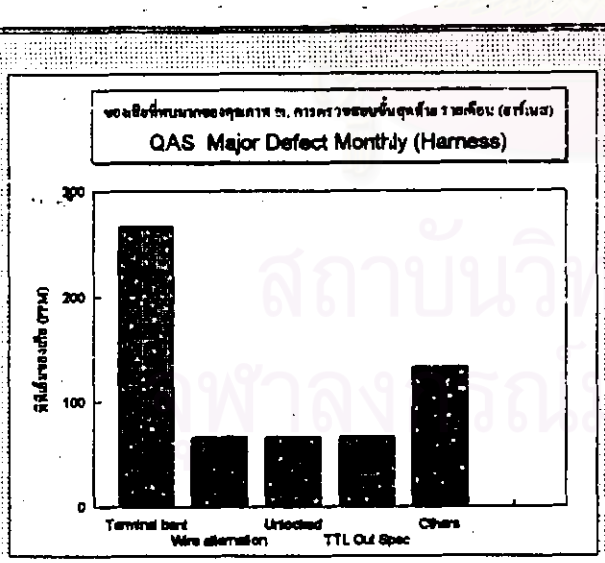
Figure 7.5- QAS of all quality criteria in April 1998 for 889-4941

Criteria Defect (QAS)

	Harness	15,000	PPM
1.	Terminal bent	4	267
2.	Wire alternation	1	67
3.	Unlocked	1	67
4.	TTL Out Spec	1	67
5.	Others	2	133
6.		0	0

Criteria Defect (QAP)

		1,845,000	PPM
1.	Insul Over/Under Crimp	945	512
2.	Strip length is out of spec	684	371
3.	Terminal bent	358	194
4.	Extrude wire	254	138
5.	Lance height is out of spec	168	91
6.	TTL is out of spec	71	38
7.	Wire alternation	38	20
8.	Wrong wire colour be easy	6	3
9.	Others	68	37



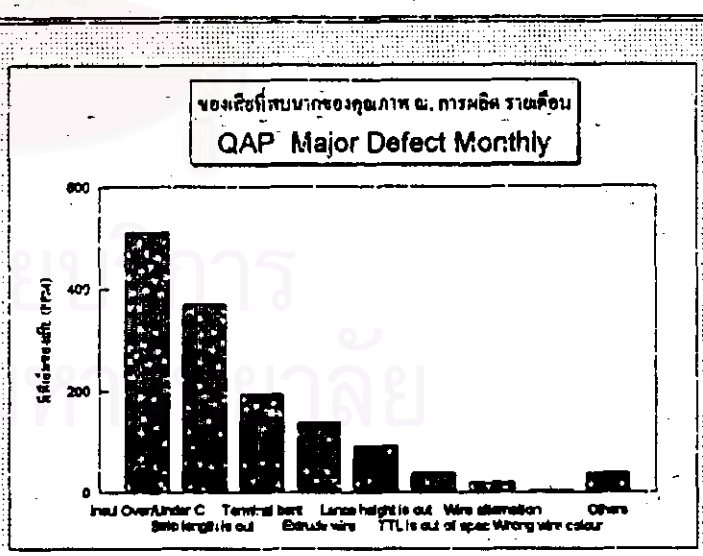


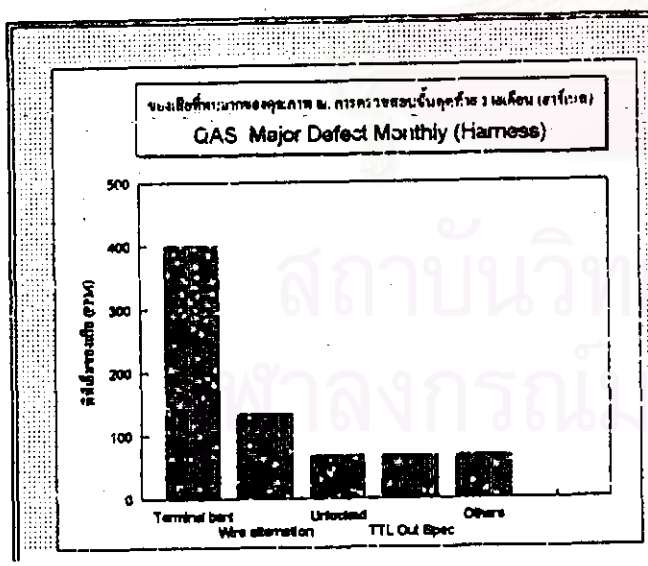
Figure 7.6- QAS of all quality criteria in May 1998 for 889-4941

Criteria Defect (QAS)

	Harness	15,000	PPM
1.	Terminal bent	6	400
2.	Wire alternation	2	133
3.	Unlocked	1	67
4.	TTL Out Spec	1	67
5.	Others	1	67
6.		0	0

Criteria Defect (QAP)

		1,645,000	PPM
1.	Insul Over/Under Crimp	861	467
2.	Strip length is out of spec	756	410
3.	Terminal bent	752	408
4.	Extrude wire	251	130
5.	Lance height is out of spec	239	130
6.	TTL is out of spec	116	63
7.	Wire alternation	101	55
8.	Wrong wire colour be assy	11	6
9.	Others	50	27



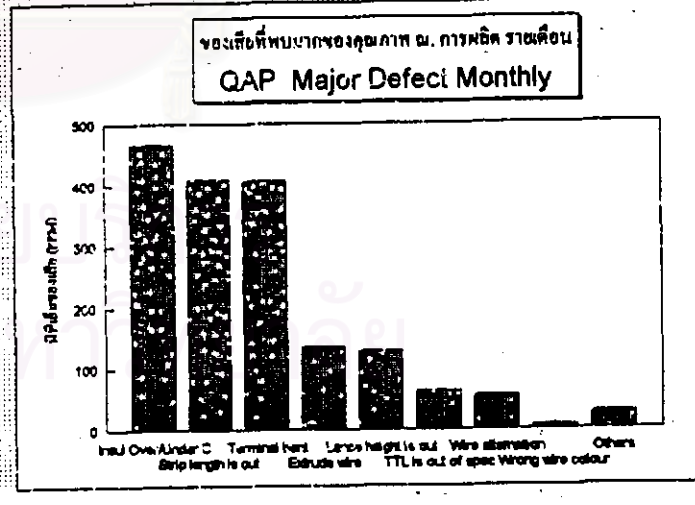


Figure 7.7- QAS of all quality criteria in June 1998 for 889-4941

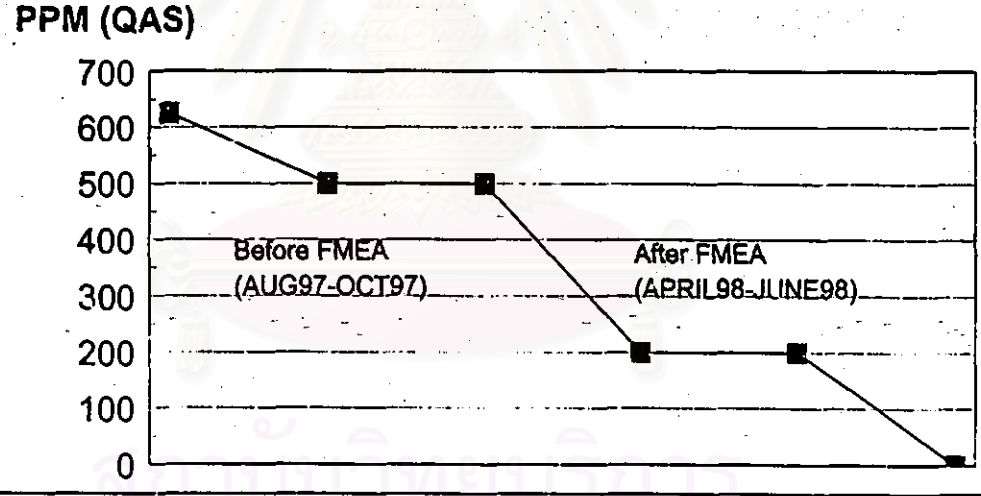
7.3.2 Part 889-4859 for wire alternation

From figure 7.9 to figure 7.11 show all significant QAS of quality criteria in August, September and October 1997 respectively. This period is before FMEA implementation. From figure 7.12 to figure 7.14 show all significant QAS of quality criteria in April, May and June 1998 respectively which is the period of after FMEA implementation.

In figure 7.8 show the comparison between before and after FMEA implementation in wire alternation quality criteria for part 889-4859. Before FMEA implementation, QAS of wire alternation are 625 ppm, 500 ppm and 500 ppm in August, September and October 1997 respectively. After FMEA implementation in April, May and June 1998, QAS of wire alternation quality criteria are 200 ppm, 200 ppm and 0 ppm respectively.

Comparision between before and after FMEA implementation

in"Wire alternation" issue for P/N 889-4859



Month	Aug 97	Sep 97	Oct 97	April 98	May 98	June 98
PPM	625	500	500	200	200	0

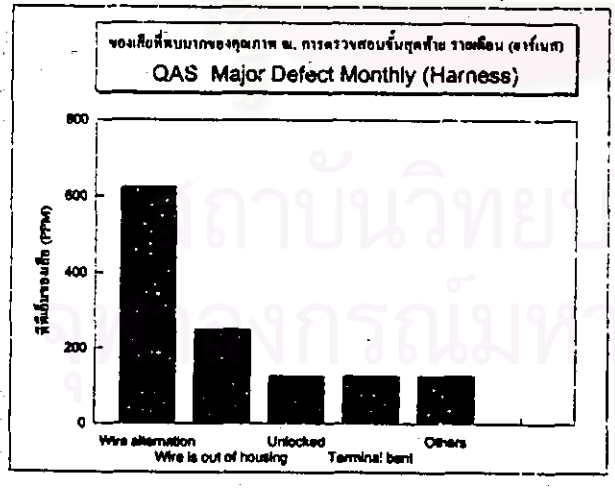
Figure 7.8- QAS comparison between before and after FMEA implementation for "wire alternation" of Part number 889-4859

Criteria Defect (QAS)

	Harness	8,000	PPM
1.	Wire alternation	5	625
2.	Wire is out of housing	2	250
3.	Unlocked	1	125
4.	Terminal bent	1	125
5.	Others	1	125
6.			0

Criteria Defect (QAP)

		320,000	PPM
1.	Insul Over/Under Crimp	257	803
2.	Wire alternation	176	547
3.	Terminal bent	141	441
4.	Strip length is out of spec	88	275
5.	Wrong colour be assy	40	125
6.	Extrude wire	24	75
7.	One side crimped	15	47
8.	TTL is out spec	5	16
9.	Others	45	141



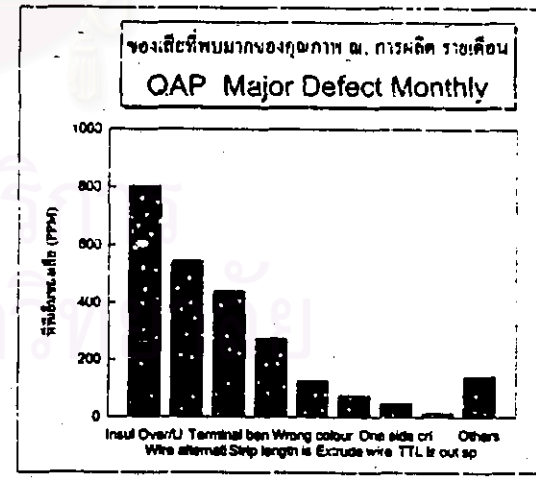


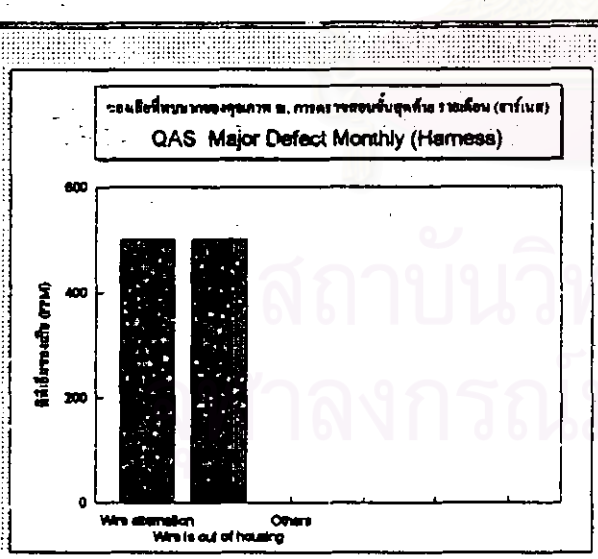
Figure 7.9- QAS of all quality criteria in August 1997 for 889-4859

Criteria Defect (QAS)

	Harness	2,000	PPM
1.	Wire alternation	1	500
2.	Wire is out of housing	1	500
3.	Others	0	0
4.		0	0
5.		0	0
6.		0	0

Criteria Defect (QAP)

		80,000	PPM
1.	Insul Over/Under Crimp	50	625
2.	Wire alternation	46	575
3.	Terminal bent	14	175
4.	Wrong colour be assy	11	138
5.	TTL is out of spec	4	50
6.	Others	34	425
7.		0	0
8.		0	0
9.		0	0



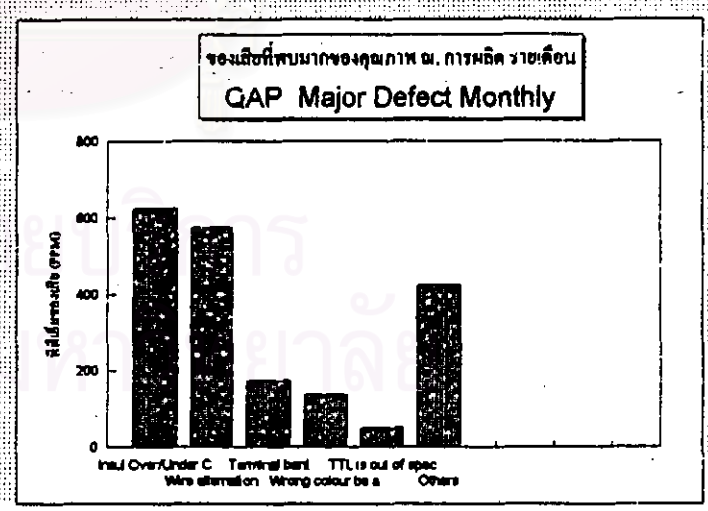


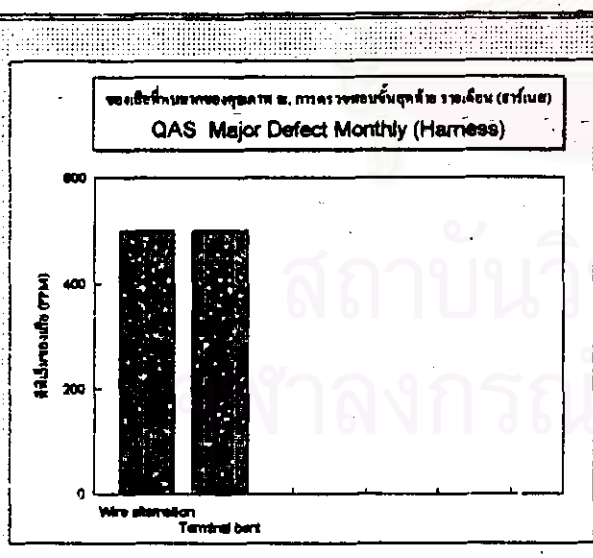
Figure 7.10- QAS of all quality criteria in September 1997 for 889-4859

Criteria Defect (QAS)

	Harness	2,000	PPM
1.	Wire alternation	1	500
2.	Terminal bent	1	500
3.		0	0
4.		0	0
5.		0	0
6.		0	0

Criteria Defect (QAP)

		80,000	PPM
1.	Insul Over/Under Crimp	35	438
2.	Wire alternation	33	413
3.	Terminal bent	26	325
4.	Wrong colour be assy	8	100
5.	TTL is out of spec	6	75
6.	Others	14	175
7.		0	0
8.		0	0
9.		0	0



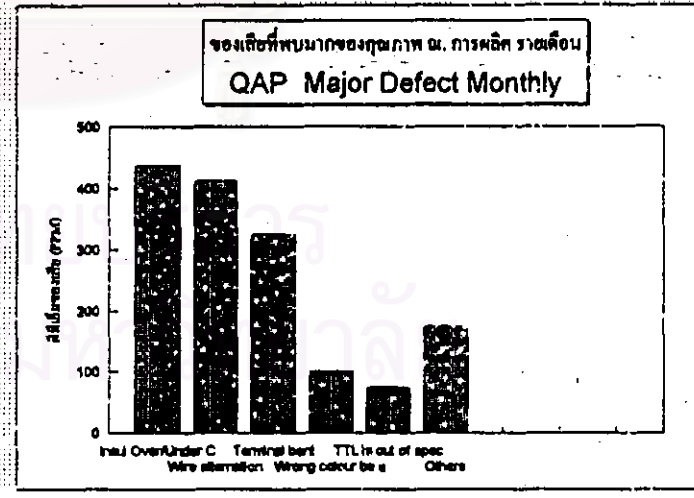


Figure 7.11- QAS of all quality criteria in October 1997 for 889-4859

Criteria Defect (QAS)

	Harness	5,000	PPM
1.	Wire is out of housing	2	400
2.	Terminal bent	1	200
3.	Wire alternation	1	200
4.		0	0
5.		0	0
6.		0	0

Criteria Defect (QAP)

		200,000	PPM
1.	Insul Over/Under Crimp	86	430
2.	Terminal bent	46	230
3.	Wrong colour be assy	27	135
4.	TTL is out of spec	14	70
5.	Wire alternation	3	15
6.	Others	16	80
7.		0	0
8.		0	0
9.		0	0

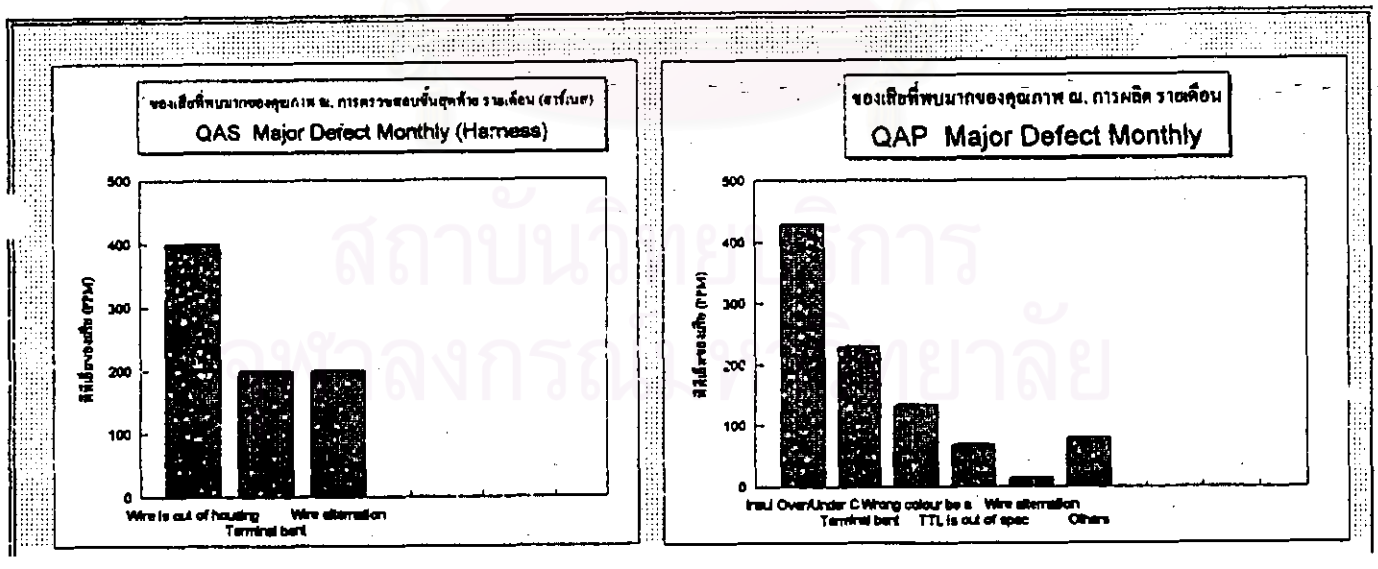


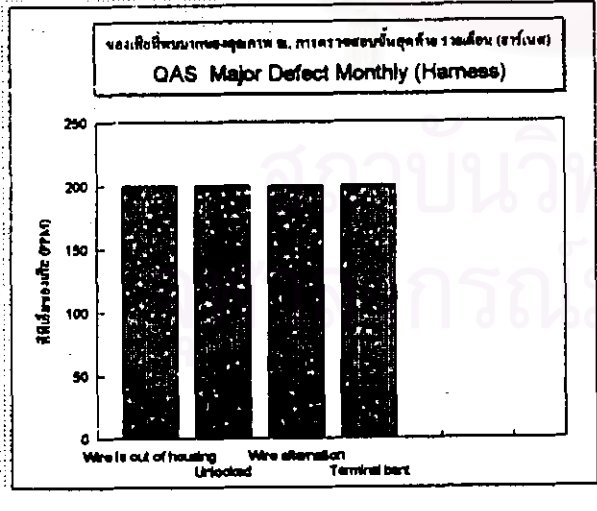
Figure 7.12- QAS of all quality criteria in April 1998 for 889-4859

Criteria Defect (QAS)

	Harness	5,000	PPM
1.	Wire is out of housing	1	200
2.	Unlocked	1	200
3.	Wire alternation	1	200
4.	Terminal bent	1	200
5.		0	0
6.		0	0

Criteria Defect (QAP)

		200,000	PPM
1.	Insul Over/Under Crimp	74	370
2.	Terminal bent	35	175
3.	Wrong colour be easy	28	140
4.	TTL is out of spec	15	75
5.	Wire alternation	3	15
6.	Others	12	60
7.		0	0
8.		0	0
9.		0	0



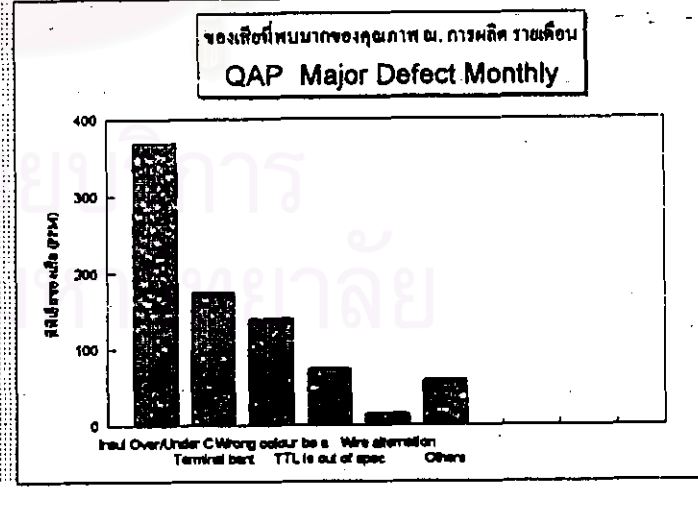


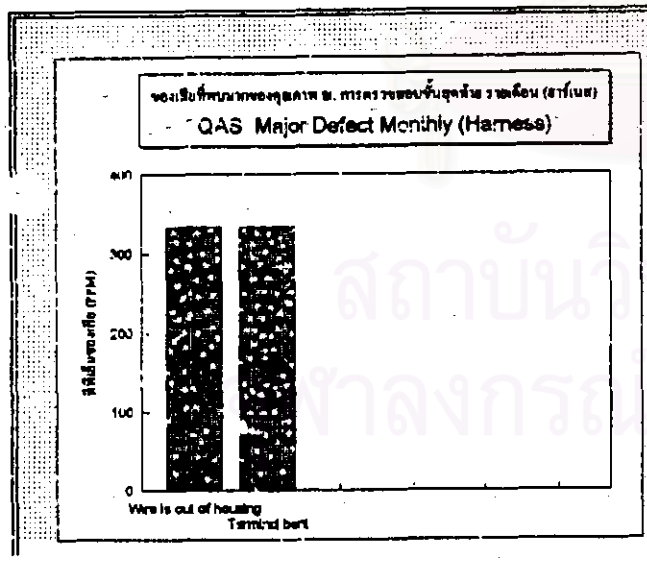
Figure 7.13- QAS of all quality criteria in May 1998 for 889-4859

Criteria Defect (QAS)

	Harness	3,000	PPM
1.	Wire is out of housing	1	333
2.	Terminal bent	1	333
3.		0	0
4.		0	0
5.		0	0
6.		0	0

Criteria Defect (QAP)

		120,000	PPM
1.	Insul Over/Under Crimp	56	467
2.	Terminal bent	49	408
3.	Wrong colour be assy	35	292
4.	TTL is out of spec	8	67
5.	Wire alternation	8	67
6.	Others	27	225
7.		0	0
8.		0	0
9.		0	0



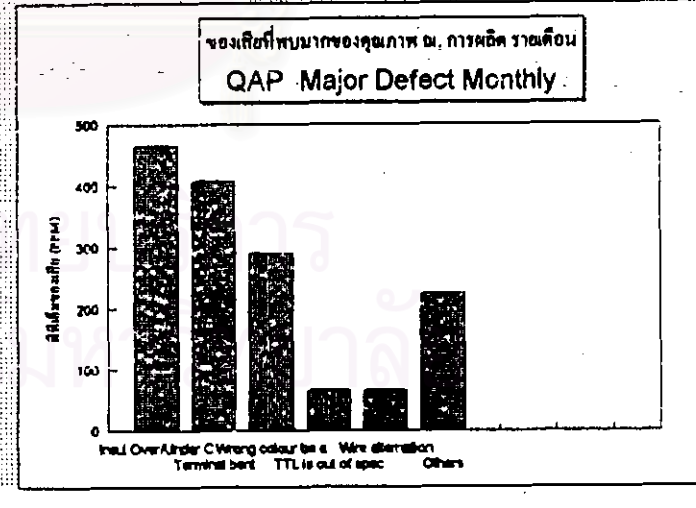


Figure 7.14- QAS of all quality criteria in June 1998 for 889-4859

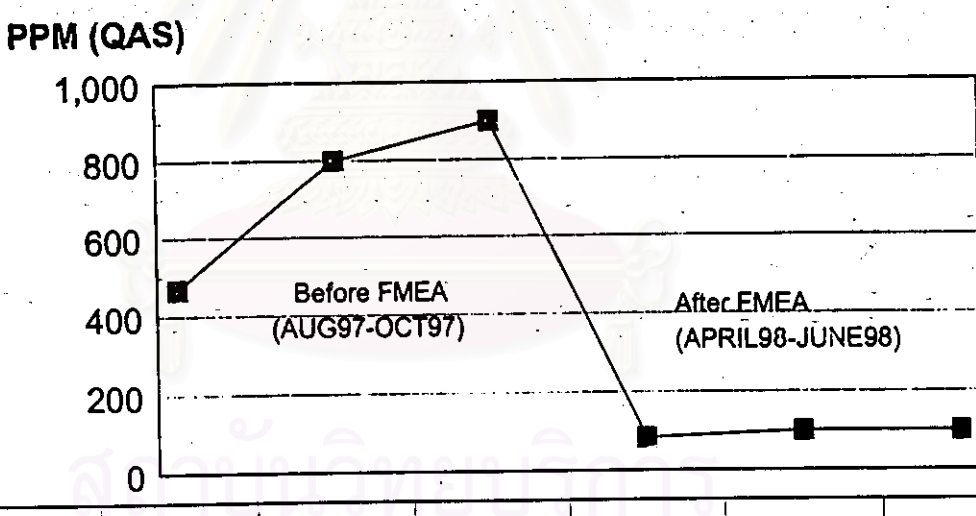
7.3.3 Part 889-5034 for terminal bent

From figure 7.16 to figure 7.18 show all significant QAS of quality criteria in August, September and October 1997 respectively. This period is before FMEA implementation. From figure 7.19 to figure 7.21 show all significant QAS of quality criteria in April, May and June 1998 respectively which is the period of after FMEA implementation.

In figure 7.15 show the comparison between before and after FMEA implementation in terminal bent quality criteria for part 889-5034. Before FMEA implementation, QAS of terminal bent are 467 ppm, 800 ppm and 900 ppm in August, September and October 1997 respectively. After FMEA implementation in April, May and June 1998, QAS of terminal bent quality criteria are 83 ppm, 100 ppm and 100 ppm respectively.

Comparision between before and after FMEA implementation

in"Terminal bent" issue for P/N 889-5034



Month	Aug 97	Sep 97	Oct 97	April 98	May 98	June 98
PPM	467	800	900	83	100	100

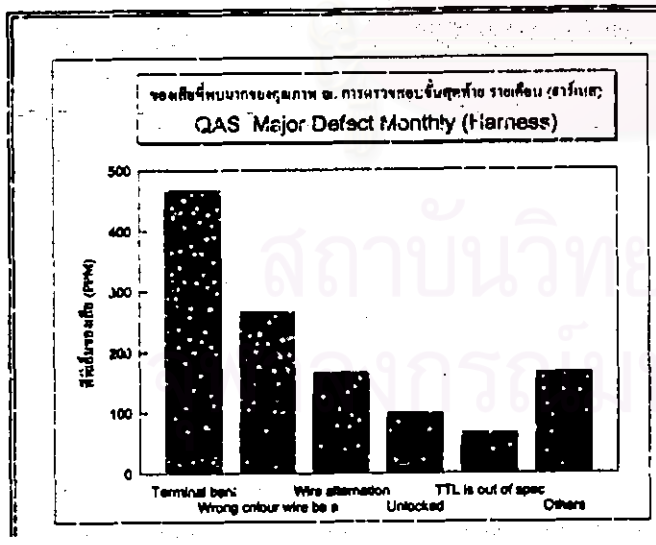
Figure 7.15- QAS comparison between before and after FMEA implementation for "terminal bent" of Part number 889-5034

Criteria Defect (QAS)

	Harness	30,000	PPM
1.	Terminal bent	14	467
2.	Wrong colour wire be assy	8	267
3.	Wire alternation	5	167
4.	Unlocked	3	100
5.	TTL is out of spec	2	67
6.	Others	5	167

Criteria Defect (QAP)

		3,720,000	PPM
1.	Insul Over/Under Crimp	1,459	392
2.	Wire alternation	1,074	289
3.	Wrong colour wire be assy	941	253
4.	Terminal bent	805	216
5.	Strip length is out of spec	500	134
6.	Extrude wire	348	94
7.	One side crimped	184	49
8.	TTL is out spec	68	18
9.	Others	147	40



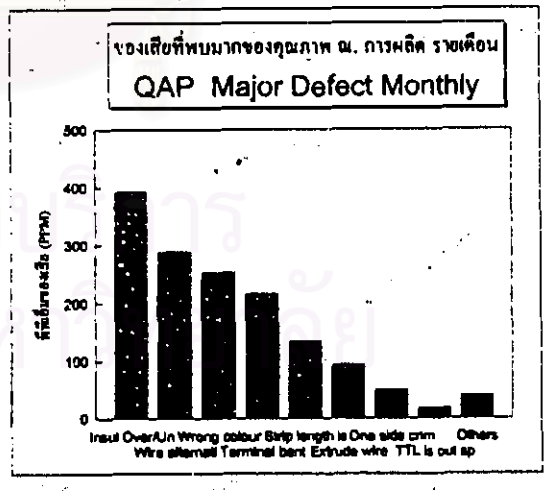


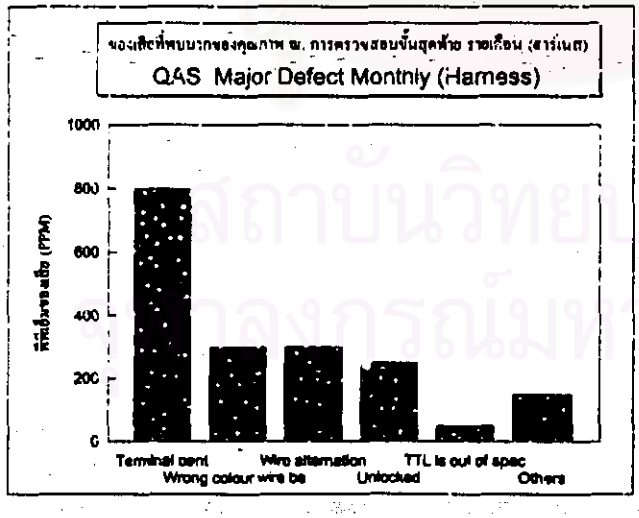
Figure 7.16- QAS of all quality criteria in August 1997 for 889-5034

Criteria Defect (QAS)

	Harness	20,000	PPM
1.	Terminal bent	16	800
2.	Wrong colour wire be assy	6	300
3.	Wire alternation	6	300
4.	Unlocked	5	250
5.	TTL is out of spec	1	50
6.	Others	3	150

Criteria Defect (QAP)

		2,480,000	PPM
1.	Insul Over/Under Crimp	1,022	412
2.	Wire alternation	800	323
3.	Terminal bent	621	250
4.	Strip length is out of spec	506	204
5.	Wrong colour wire be assy	307	124
6.	Extrude wire	243	98
7.	One side crimped	128	52
8.	TTL is out spec	46	19
9.	Others	102	41



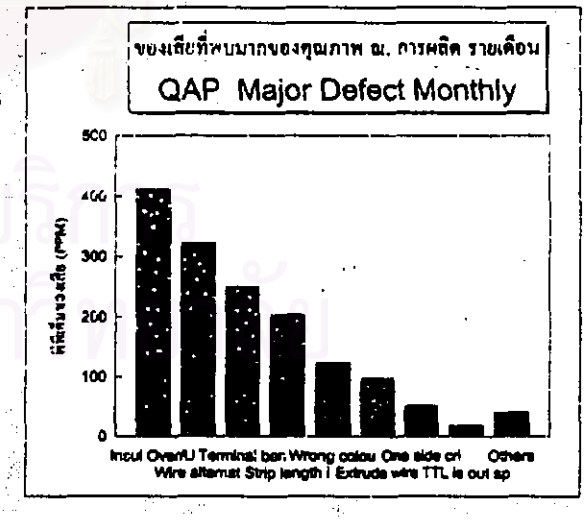


Figure 7.17- QAS of all quality criteria in September 1997 for 889-5034

Criteria Defect (QAS)

	Harness	20,000	PPM
1.	Terminal bent	18	900
2.	Wrong colour wire be easy	7	350
3.	Wire alternation	6	300
4.	Unlocked	6	300
5.	TTL Out Spec	2	100
6.	Others	2	100

Criteria Defect (QAP)

		2,460,000	PPM
1.	Insul Over/Under Crimp	1,200	484
2.	Wire alternation	981	396
3.	Terminal bent	746	301
4.	Strip length is out of spec	537	217
5.	Wrong colour wire be easy	314	127
6.	Extrude wire	278	112
7.	One side crimped	190	62
8.	TTL is out of spec	58	23
9.	Others	236	95

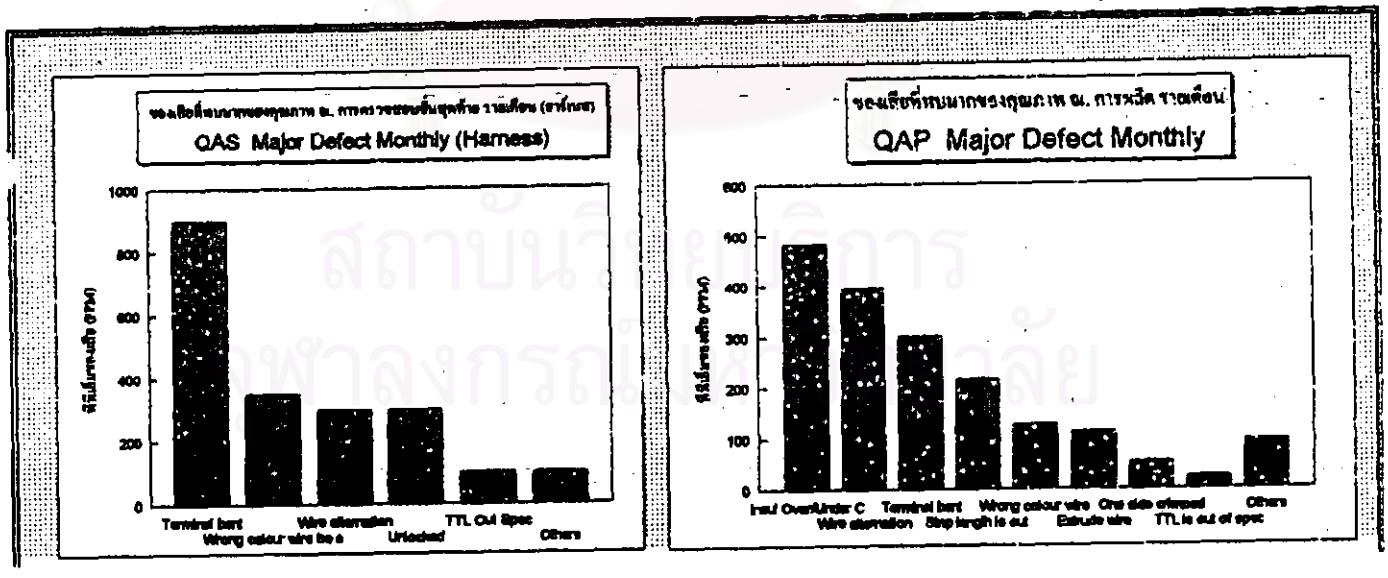


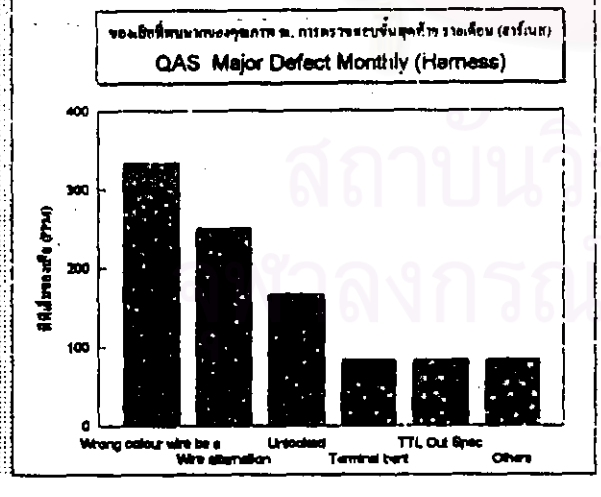
Figure 7.18- QAS of all quality criteria in October 1997 for 889-5034

Criteria Defect (QAS)

	Harness	12,000	PPM
1.	Wrong colour wire be assy	4	333
2.	Wire alternation	3	250
3.	Unlocked	2	167
4.	Terminal bent	1	83
5.	TTL Out Spec	1	83
6.	Others	1	83

Criteria Defect (QAP)

		1,488,000	PPM
1.	Insul Over/Under Crimp	651	438
2.	Wire alternation	529	356
3.	Strip length is out of spec	431	290
4.	Wrong colour wire be assy	237	159
5.	Extrude wire	116	78
6.	One side crimped	105	71
7.	Terminal bent	87	58
8.	TTL is out of spec	40	27
9.	Others	166	112



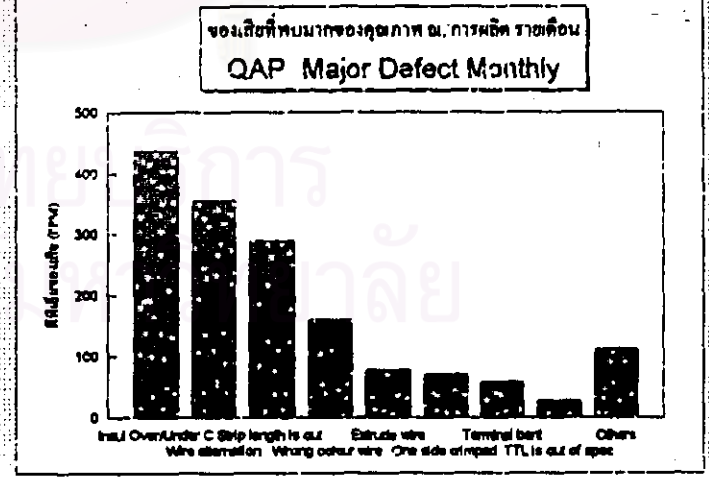


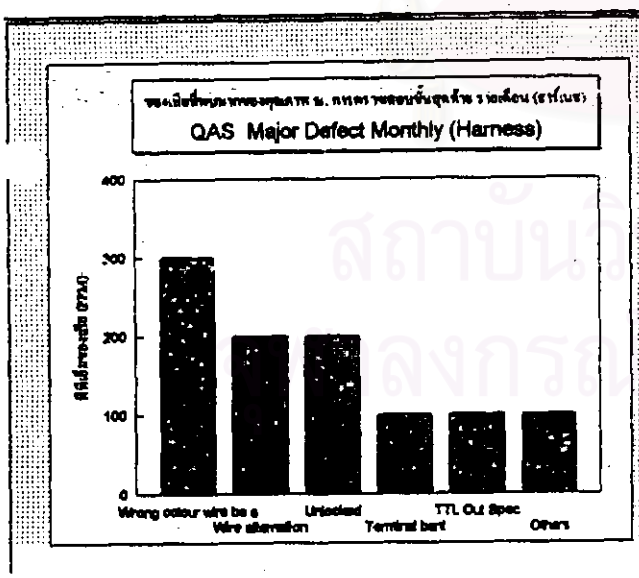
Figure 7.19- QAS of all quality criteria in April 1998 for 889-5034

Criteria Defect (QAS)

	Harness	10,000	PPM
1.	Wrong colour wire be assy	3	300
2.	Wire alternation	2	200
3.	Unlocked	2	200
4.	Terminal bent	1	100
5.	TTL Out Spec	1	100
6.	Others	1	100

Criteria Defect (QAP)

		1,240,000	PPM
1.	Insul Over/Under Crimp	557	449
2.	Wire alternation	468	377
3.	Strip length is out of spec	414	334
4.	Wrong colour wire be assy	251	202
5.	Extrude wire	107	86
6.	One side crimped	95	77
7.	Terminal bent	70	56
8.	TTL is out of spec	68	55
9.	Others	113	91



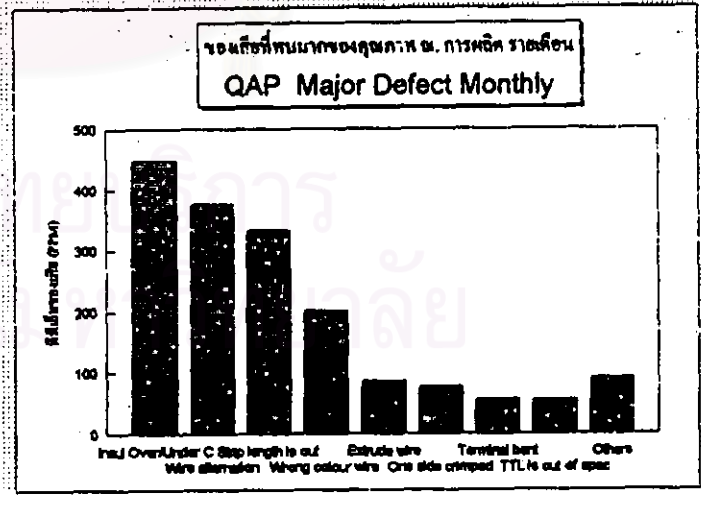


Figure 7.20- QAS of all quality criteria in May 1998 for 889-5034

Criteria Defect (QAS)

	Harness	10,000	PPM
1.	Wrong colour wire be assy	3	300
2.	Wire alternation	3	300
3.	Unlocked	2	200
4.	Terminal bent	1	100
5.	Others	1	100
6.		0	0

Criteria Defect (QAP)

		1,240,000	PPM
1.	Insul Over/Under Crimp	600	484
2.	Wire alternation	506	408
3.	Strip length is out of spec	372	300
4.	Wrong colour wire be assy	204	165
5.	Extrude wire	93	75
6.	One side crimped	71	57
7.	Terminal bent	48	39
8.	TTL is out of spec	40	32
9.	Others	63	51

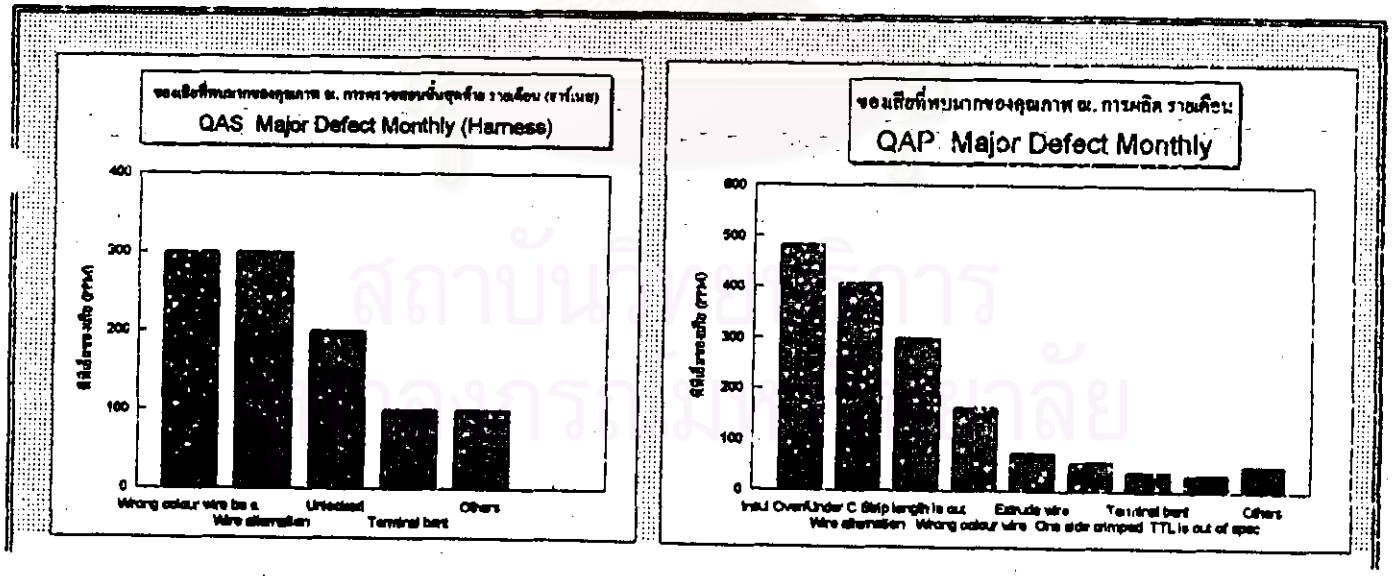


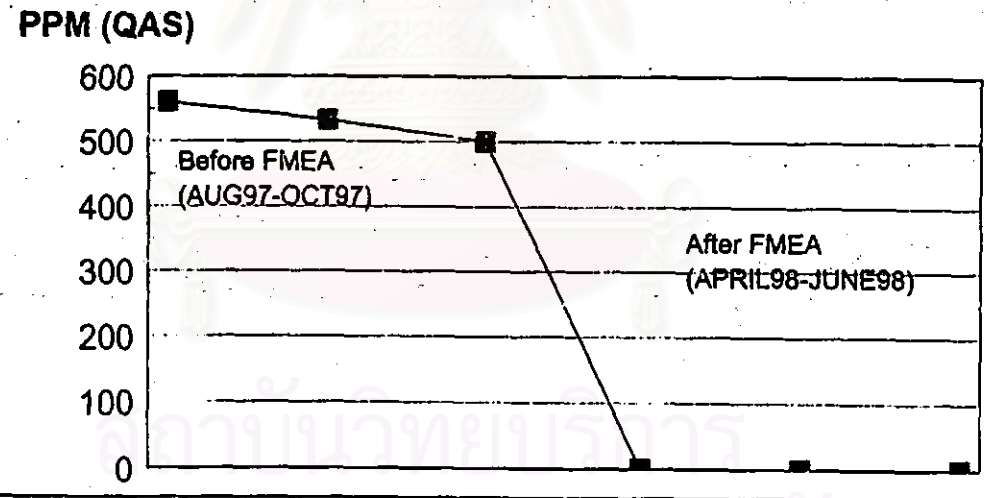
Figure 7.21- QAS of all quality criteria in June 1998 for 889-5034

7.3.4 Part 889-0692 for wire is out off housing

From figure 7.23 to figure 7.25 show all significant QAS of quality criteria in August, September and October 1997 respectively. This period is before FMEA implementation. From figure 7.26 to figure 7.28 show all significant QAS of quality criteria in April, May and June 1998 respectively which is the period of after FMEA implementation.

In figure 7.22 show the comparison between before and after FMEA implementation in wire is out off housing quality criteria for part 889-0692. Before FMEA implementation, QAS of wrong color wire be assembled are 600 ppm, 500 ppm and 500 ppm in August, September and October 1997 respectively. After FMEA implementation in April, May and June 1998, QAS of wire is out off housing quality criteria are all zero.

Comparision between before and after FMEA implementation in "Wire is out of housing" issue for P/N 889-0692



Month	Aug 97	Sep 97	Oct 97	April 98	May 98	June 98
PPM	560	533	500	0	0	0

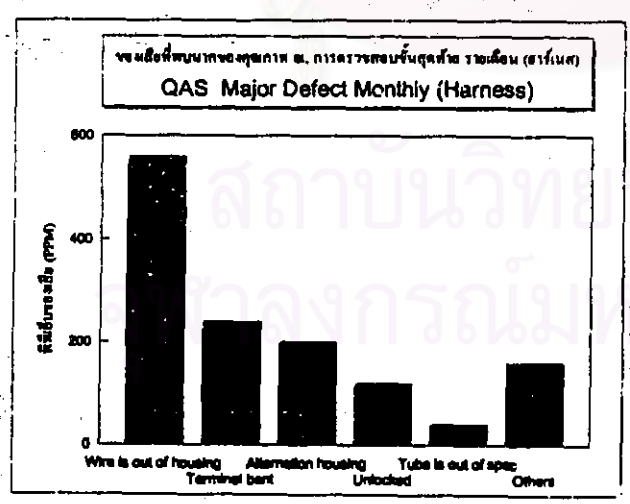
Figure 7.22- QAS comparison between before and after FMEA implementation for "wire is out off housing" of Part number 889-0692

Criteria Defect (QAS)

	Harness	25,000	PPM
1.	Wire is out of housing	14	560
2.	Terminal bent	6	240
3.	Alternation housing	5	200
4.	Unlocked	3	120
5.	Tube is out of spec	1	40
6.	Others	4	160

Criteria Defect (QAP)

		1,700,000	PPM
1.	Insul Over/Under Crimp	2,100	1,235
2.	One side crimped	438	258
3.	Alternation housing	422	248
4.	Terminal bent	390	229
5.	Lance height is out of spec	155	91
6.	Strip length is out of housing	131	77
7.	Tube is out of spec	24	14
8.	TTL is out spec	8	5
9.	Others	67	39



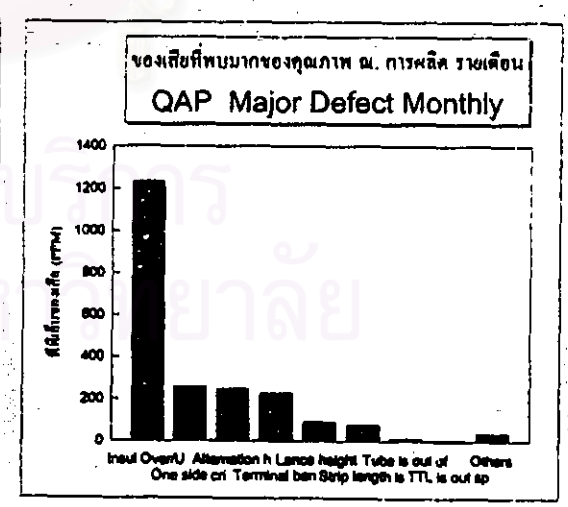


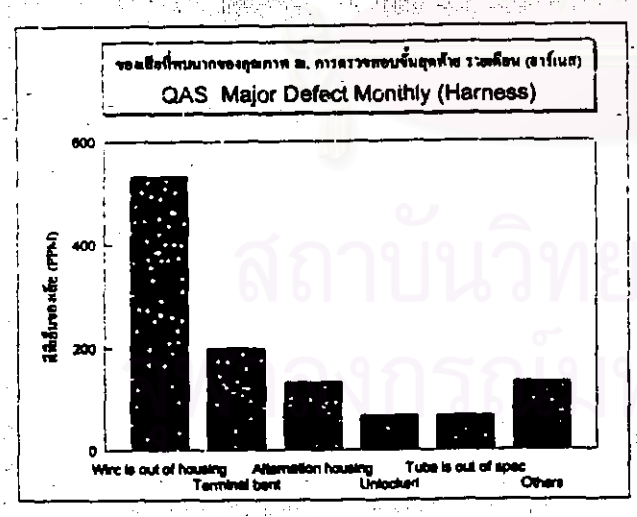
Figure 7.23- QAS of all quality criteria in August 1997 for 889-0692

Criteria Defect (QAS)

	Harness	15,000	PPM
1.	Wire is out of housing	8	533
2.	Terminal bent	3	200
3.	Alternation housing	2	133
4.	Unlocked	1	67
5.	Tube is out of spec	1	67
6.	Others	2	133

Criteria Defect (QAP)

		1,020,000	PPM
1.	Insul Over/Under Crimp	1,015	995
2.	One side crimped	327	321
3.	Alternation housing	286	280
4.	Terminal bent	250	245
5.	Lance height is out of spec	132	129
6.	Strip length is out of housing	60	59
7.	Tube is out of spec	16	16
8.	TTL is out spec	14	14
9.	Others	50	49



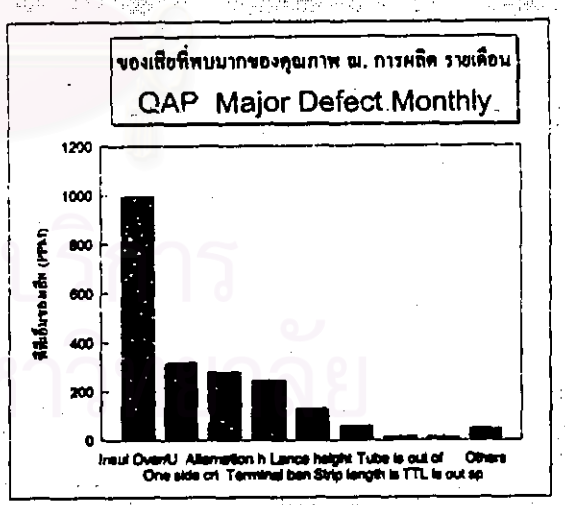


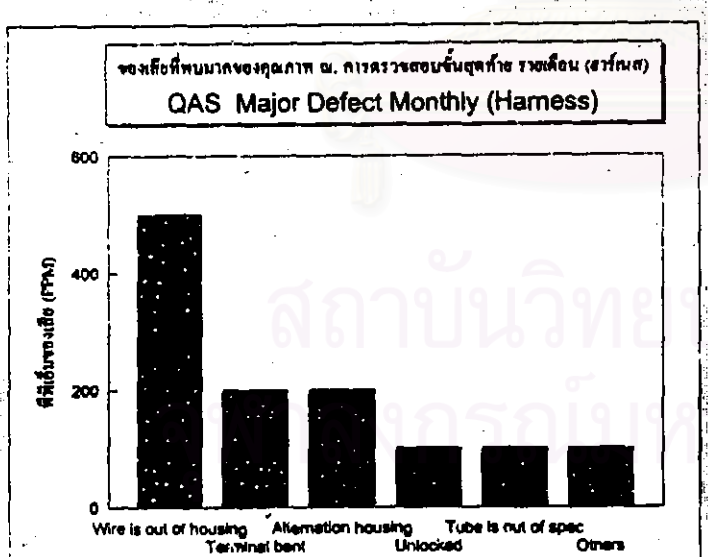
Figure 7.24- QAS of all quality criteria in September 1997 for 889-0692

Criteria Defect (QAS)

	Harness	10,000	PPM
1.	Wire is out of housing	5	500
2.	Terminal bent	2	200
3.	Alternation housing	2	200
4.	Unlocked	1	100
5.	Tube is out of spec	1	100
6.	Others	1	100

Criteria Defect (QAP)

		680,000	PPM
1.	Insul Over/Under Crimp	687	1,010
2.	One side crimped	260	382
3.	Terminal bent	251	369
4.	Alternation housing	126	185
5.	Lance height is out of spec	90	132
6.	Strip length is out of housing	35	51
7.	Tube is out of spec	21	31
8.	TTL is out spec	13	19
9.	Others	34	50



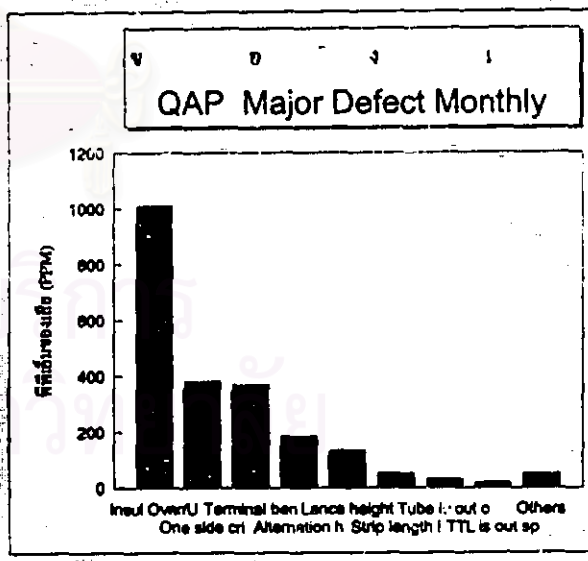


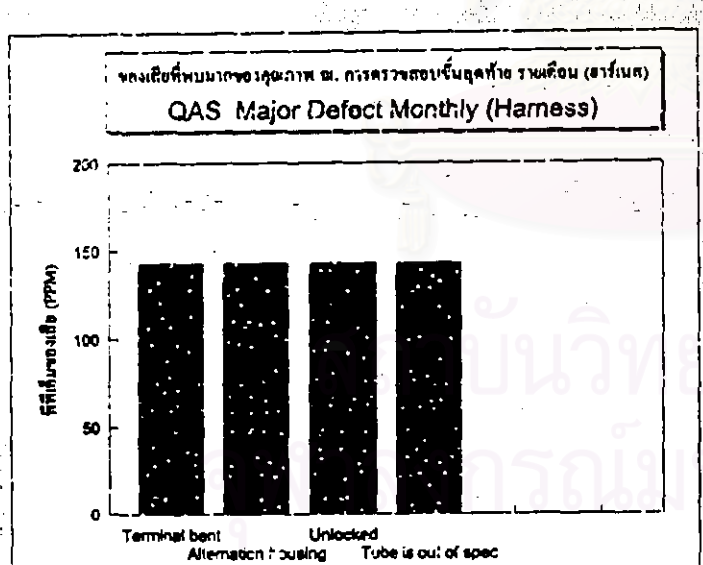
Figure 7.25- QAS of all quality criteria in October 1997 for 889-0692

Criteria Defect (QAS)

	Harness	7,000	PPM
1.	Terminal bent	1	143
2.	Alternation housing	1	143
3.	Unlocked	1	143
4.	Tube is out of spec	1	143
5.			0
6.			0

Criteria Defect (QAP)

		476,000	PPM
1.	Terminal bent	194	408
2.	One side crimped	176	370
3.	Lance height is out of spec	78	164
4.	Alternation housing	65	137
5.	Strip length is out of spec	42	88
6.	Insul Over/Under Crimp	40	84
7.	Tube is out of spec	13	27
8.	TTL is out spec	10	21
9.	Others	54	113



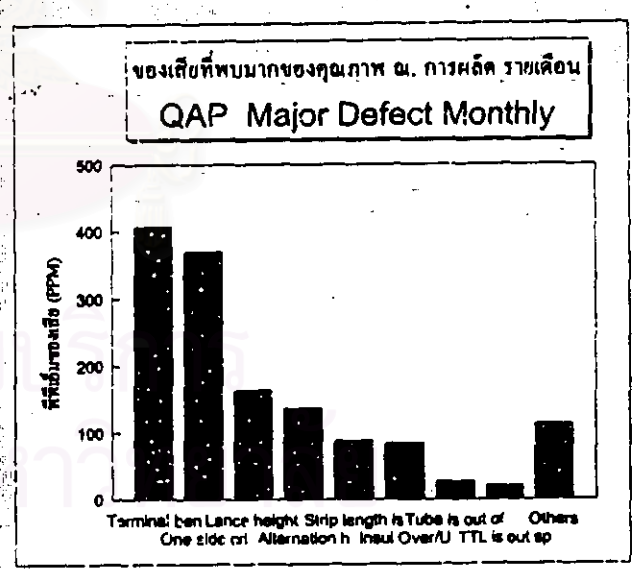


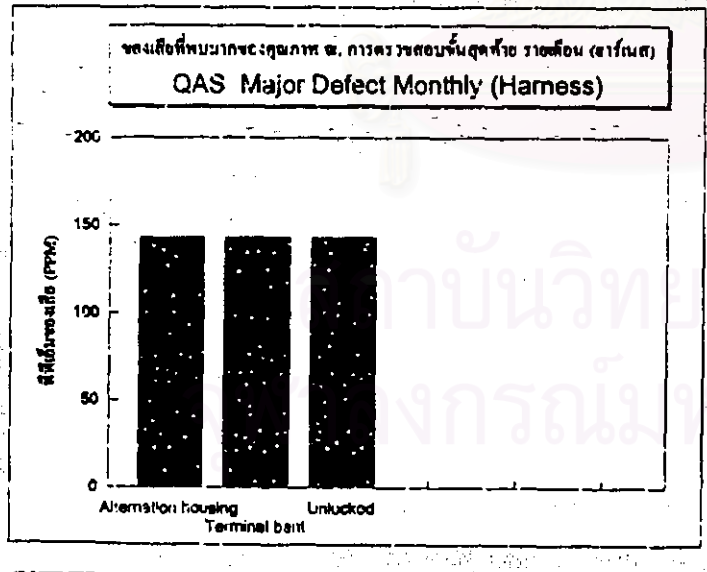
Figure 7.26 QAS of all quality criteria in April 1998 for 889-0692

Criteria Defect (QAS)

	Hamess	7,000	PPM
1.	Alternation housing	1	143
2.	Terminal bent	1	143
3.	Unlocked	1	143
4.			0
5.			0
6.			0

Criteria Defect (QAP)

		476,000	PPM
1.	Terminal bent	205	431
2.	One side crimped	157	330
3.	Lance height is out of spec	99	208
4.	Alternation housing	62	130
5.	Strip length is out of spec	44	92
6.	Insul Over/Under Crimp	40	84
7.	Tube is out of spec	30	63
8.	TTL is out spec	20	42
9.	Others	30	63



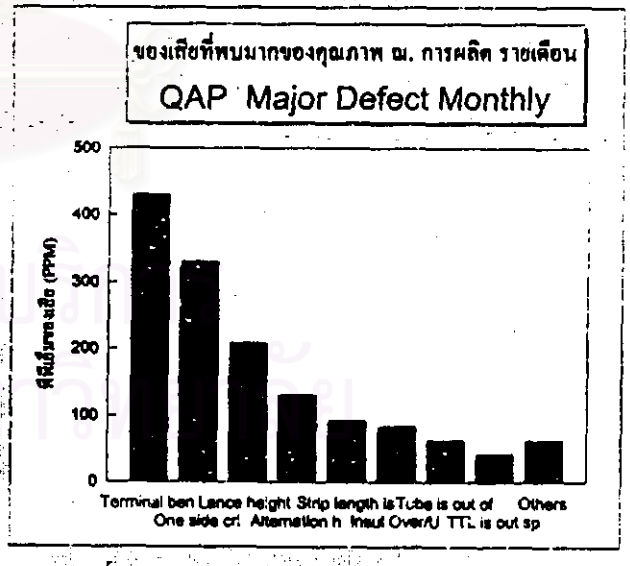


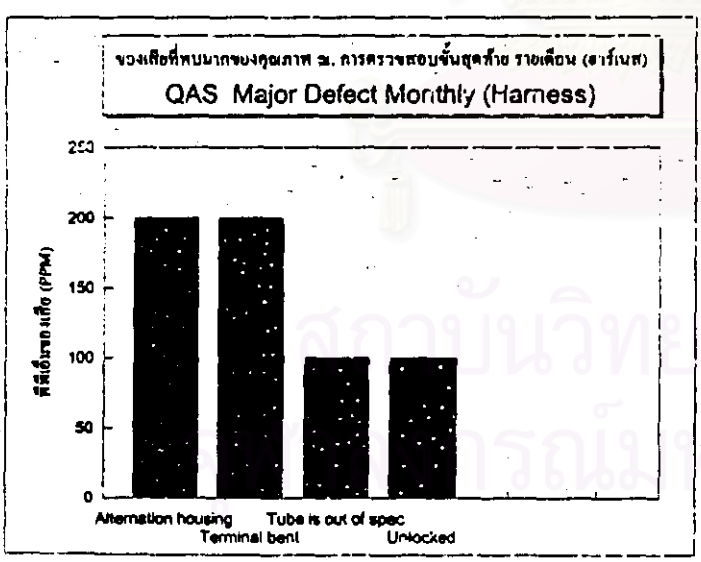
Figure 7.27- QAS of all quality criteria in May 1998 for 889-0692

Criteria Defect (QAS)

	Harness	10,000	PPM
1.	Alternation housing	2	200
2.	Terminal bent	2	200
3.	Tube is out of spec	1	100
4.	Unlocked	1	100
5.			0
6.			0

Criteria Defect (QAP)

		680,000	PPM
1.	Terminal bent	298	438
2.	One side crimped	234	344
3.	Lance height is out of spec	155	228
4.	Alternation housing	120	176
5.	Strip length is out of spec	70	103
6.	Insul Over/Under Crimp	67	99
7.	Tube is out of spec	16	24
8.	TTL is out spec	15	22
9.	Others	33	49



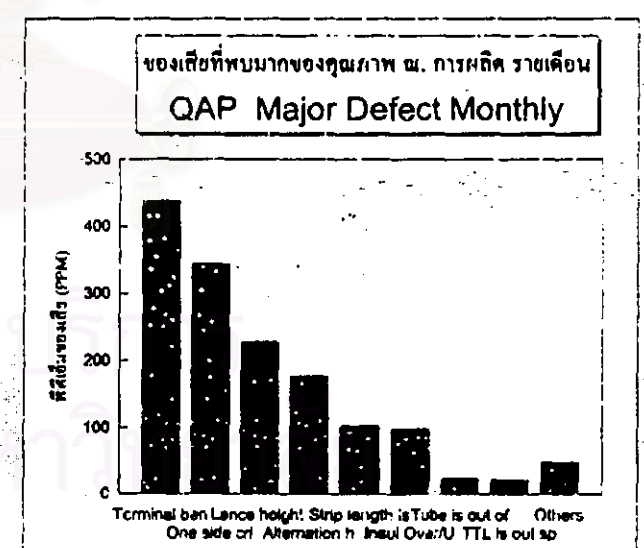


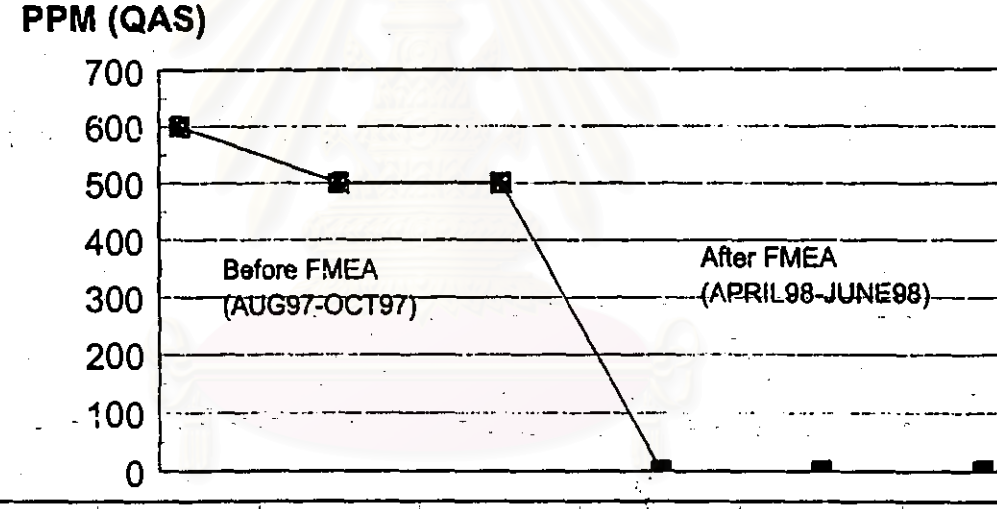
Figure 7.28- QAS of all quality criteria in June 1998 for 889-0692

7.3.5 Part 889-4529 for unlocked

From figure 7.30 to figure 7.32 show all significant QAS of quality criteria in August, September and October 1997 respectively. This period is before FMEA implementation. From figure 7.33 to figure 7.35 show all significant QAS of quality criteria in April, May and June 1998 respectively which is the period of after FMEA implementation.

In figure 7.29 show the comparison between before and after FMEA implementation for unlocked quality criteria for part 889-4529. Before FMEA implementation, QAS of unlocked are 600 ppm, 500 ppm and 500 ppm in August, September and October 1997 respectively. After FMEA implementation in April, May and June 1998, QAS of unlocked quality criteria are all zero.

Comparision between before and after FMEA implementation in"Unlocked" issue for P/N 889-4529



Month	Aug 97	Sep 97	Oct 97	April 98	May 98	June 98
PPM	600	500	500	0	0	0

Figure 7.29- QAS comparison between before and after FMEA implementation for "unlocked" of Part number 889-4529

Criteria Defect (QAS)

	Harness	20,000	PPM
1.	Unlocked	12	600
2.	Terminal bent	9	450
3.	Wire is out of housing	5	250
4.	Alternation housing	4	200
5.	Tube is out of spec	1	50
6.	Others	2	100

Criteria Defect (QAP)

		1,200,000	PPM
1.	Insul Over/Under Crimp	780	650
2.	Terminal bent	649	541
3.	Alternation housing	230	192
4.	Lance height is out of spec	105	88
5.	Strip length is out of spec	103	86
6.	Extrude wire	53	44
7.	Tube is out of spec	32	27
8.	TTL is out of spec	9	8
9.	Others	56	46

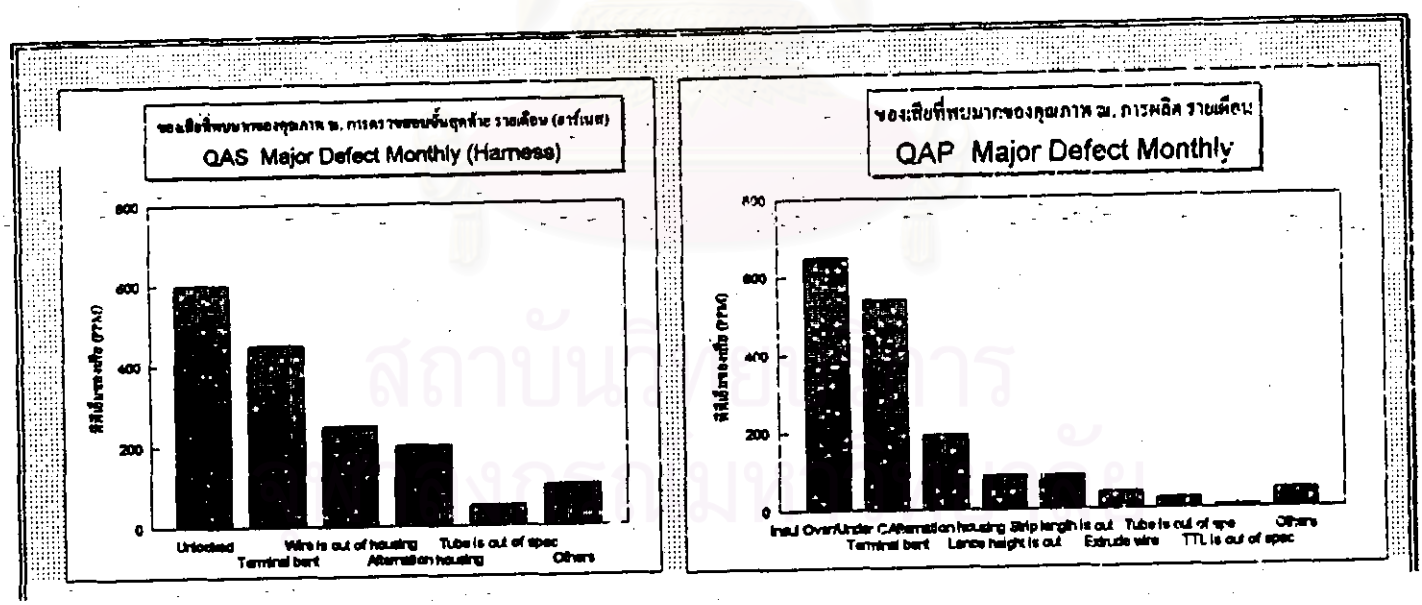


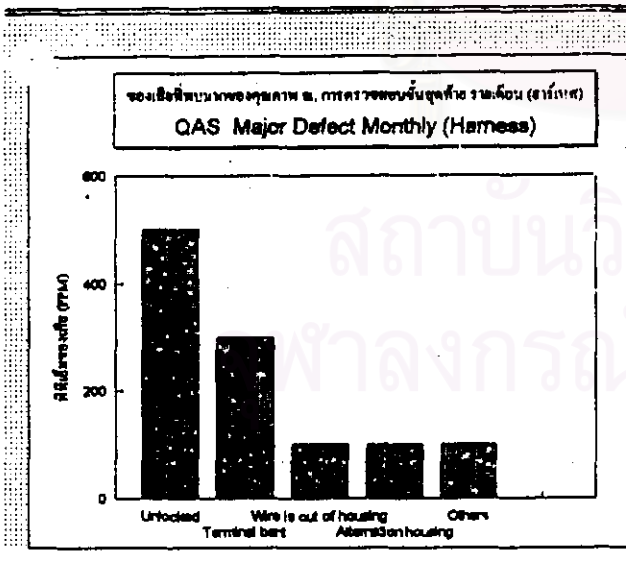
Figure 7.30- QAS of all quality criteria in August 1997 for 889-4529

Criteria Defect (QAS)

	Harness	10,000	PPM
1.	Unlocked	5	500
2.	Terminal bent	3	300
3.	Wire is out of housing	1	100
4.	Alternation housing	1	100
5.	Others	1	100
6.		0	0

Criteria Defect (QAP)

		600,000	PPM
1.	Insul Over/Under Crimp	400	667
2.	Terminal bent	344	573
3.	Alternation housing	125	208
4.	Extrude wire	117	195
5.	Strip length is out of spec	84	140
6.	Lance height is out of spec	51	85
7.	Tube is out of spec	16	27
8.	TTL is out of spec	3	5
9.	Others	24	40



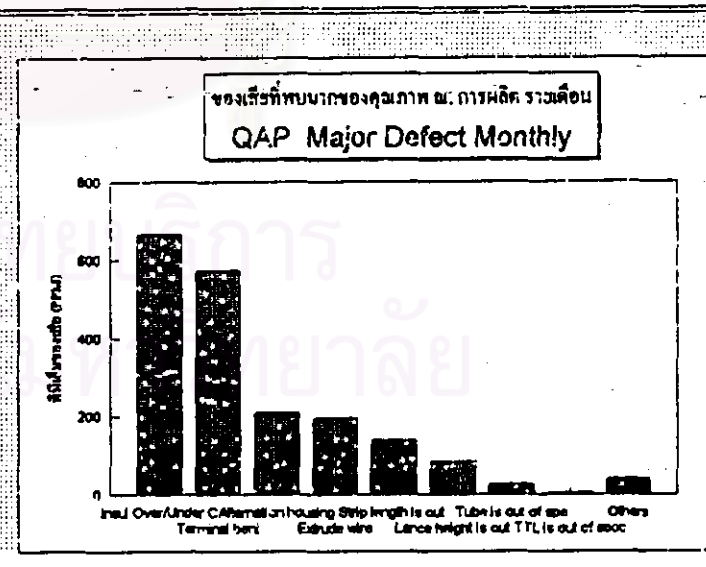


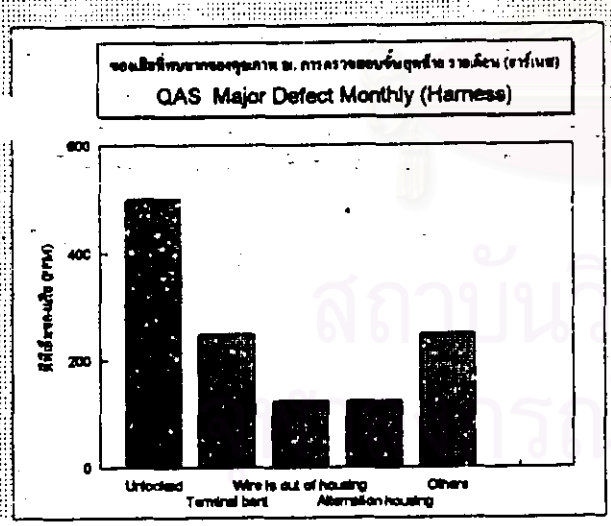
Figure 7.31- QAS of all quality criteria in September 1997 for 889-4529

Criteria Defect (QAS)

	Harness	6,000	PPM
1.	Unlocked	4	500
2.	Terminal bent	2	250
3.	Wire is out of housing	1	125
4.	Alternation housing	1	125
5.	Others	2	250
6.		0	0

Criteria Defect (QAP)

		480,000	PPM
1.	Insul Over/Under Crimp	335	698
2.	Terminal bent	294	613
3.	Alternation housing	108	225
4.	Extrude wire	94	196
5.	Strip length is out of spec	63	131
6.	Lance height is out of spec	44	92
7.	Tube is out of spec	15	31
8.	TTL is out of spec	3	6
9.	Others	20	42



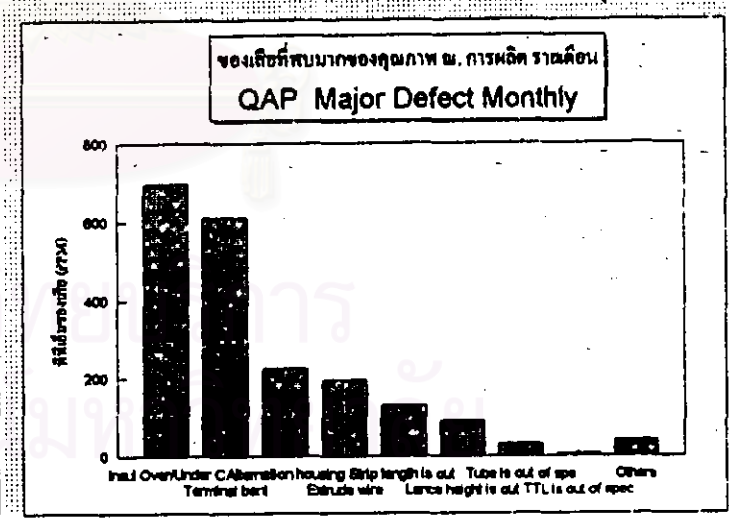


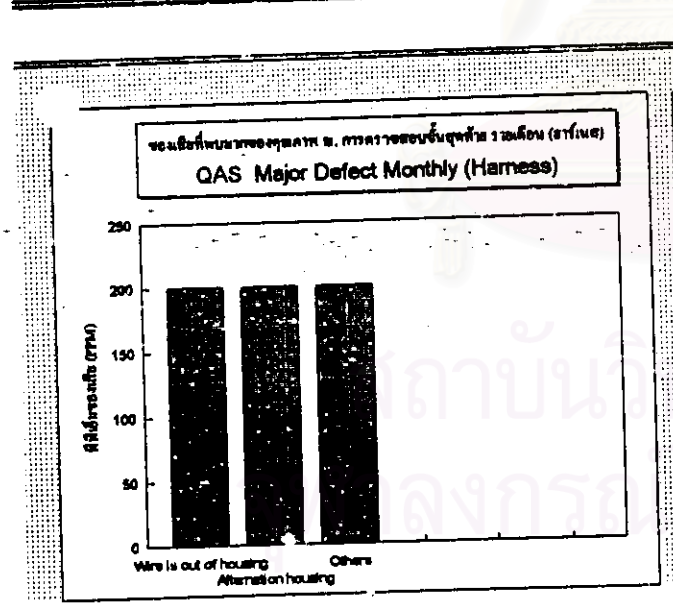
Figure 7.32- QAS of all quality criteria in October 1997 for 889-4529

Criteria Defect (QAS)

	Harness	5,000	PPM
1.	Wire is out of housing	1	200
2.	Alternation housing	1	200
3.	Others	1	200
4.		0	0
5.		0	0
6.		0	0

Criteria Defect (QAP)

		300,000	PPM
1.	Insul Over/Under Crimp	186	620
2.	Alternation housing	53	177
3.	Extrude wire	17	57
4.	Strip length is out of spec	16	53
5.	Terminal bent	11	37
6.	Lance height is out of spec	8	27
7.	Tube is out of spec	7	23
8.	TTL is out of spec	7	23
9.	Others	16	53



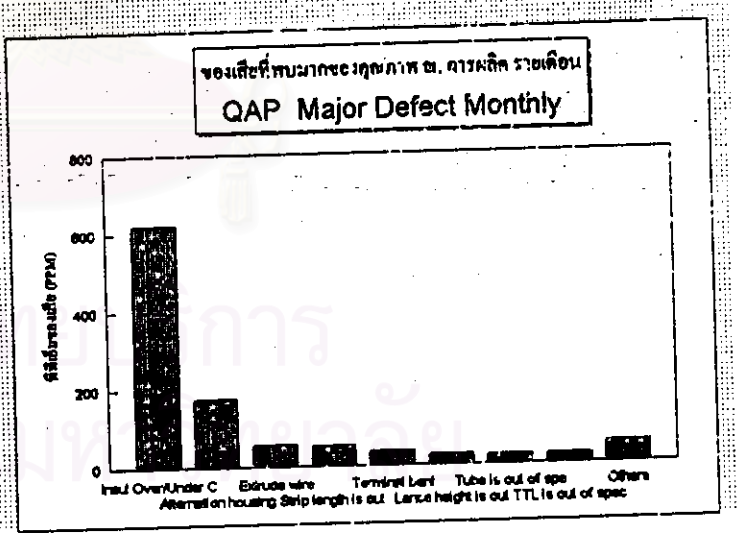


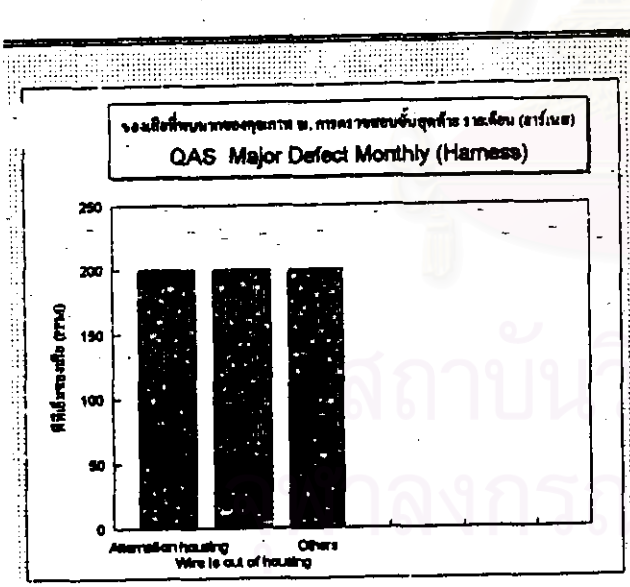
Figure 7.33- QAS of all quality criteria in April 1998 for 889-4529

Criteria Defect (QAS)

	Harness	5,000	PPM
1.	Alternation housing	1	200
2.	Wire is out of housing	1	200
3.	Others	1	200
4.		0	0
5.		0	0
6.		0	0

Criteria Defect (QAP)

		300,000	PPM
1.	Insul Over/Under Crimp	200	667
2.	Alternation housing	73	243
3.	Extrude wire	23	77
4.	Strip length is out of spec	15	50
5.	Terminal bent	8	27
6.	Lance height is out of spec	8	27
7.	TTL is out of spec	5	17
8.	Others	10	33
9.		0	0



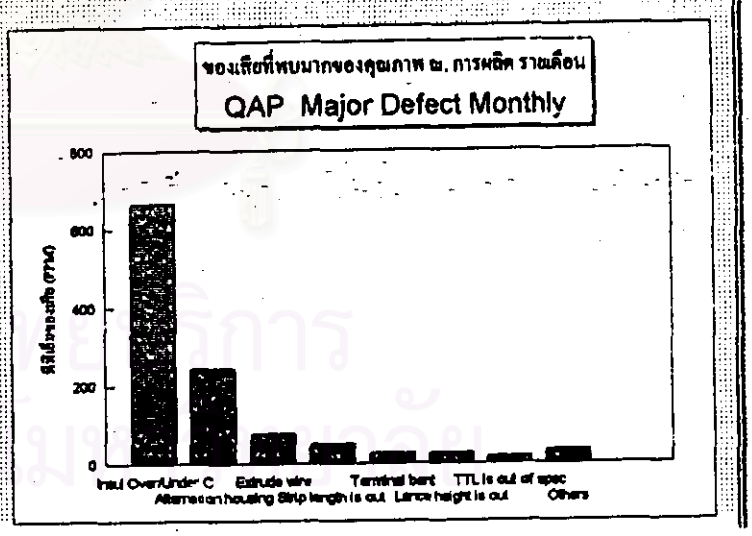


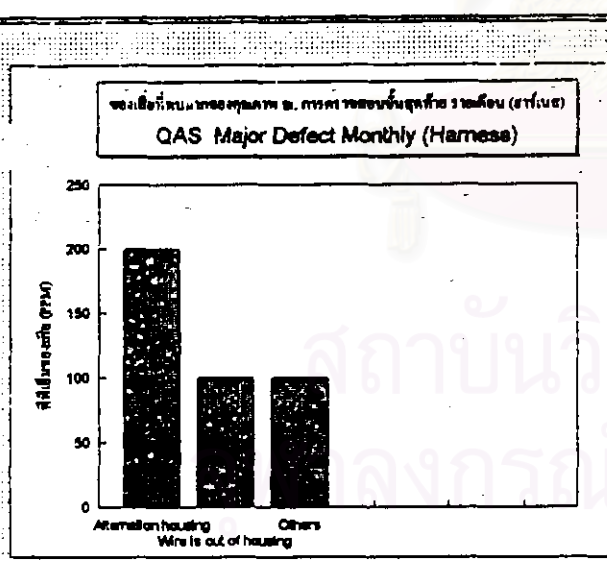
Figure 7.34- QAS of all quality criteria in May 1998 for 889-4529

Criteria Defect (QAS)

	Harness	10,000	PPM
1.	Alternation housing	2	200
2.	Wire is out of housing	1	100
3.	Others	1	100
4.		0	0
5.		0	0
6.		0	0

Criteria Defect (QAP)

		600,000	PPM
1.	Insul Over/Under Crimp	338	563
2.	Alternation housing	158	263
3.	Extrude wire	52	87
4.	Strip length is out of spec	26	43
5.	Terminal bent	15	25
6.	Lance height is out of spec	11	18
7.	TTL is out of spec	10	17
8.	Others	35	58
9.		0	0



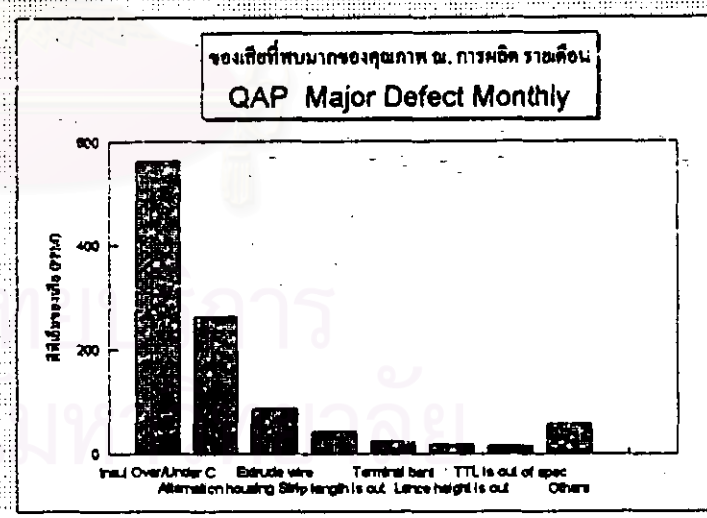


Figure 7.35- QAS of all quality criteria in June 1998 for 889-4529

7.4 Comparison customer complaint items in manufacturing area between before and after FMEA implementation

In this thesis, comparison between before and after FMEA implementation of customer complaint items in manufacturing is shown in figure 7.36. In this figure 7.36 show the customer complaint items in manufacturing area in 1997 and 1998.

In table 7.1 show the number of customer complaint items in manufacturing area in April, May, June, July, August, September and October 1997 against 1998 by monthly. In 1997 is the period of before FMEA implementation and in 1998 is the period of after FMEA implementation

Table 7.1- Customer complaint items in manufacturing area in 1997 against 1998

Monthly customer complaint items in manufacturing area	In 1997	In 1998
April	6.0	4.0
May	5.0	3.0
June	3.0	2.0
July	4.0	3.0
August	5.0	2.0
September	5.0	2.0
October	4.0	2.0
Total	32.0	18.0
Average	4.57	2.57
Percentage improvement is 43.76		

Source: The figure of customer complaint items in manufacturing in 1997 and 1998 are shown in Appendix E

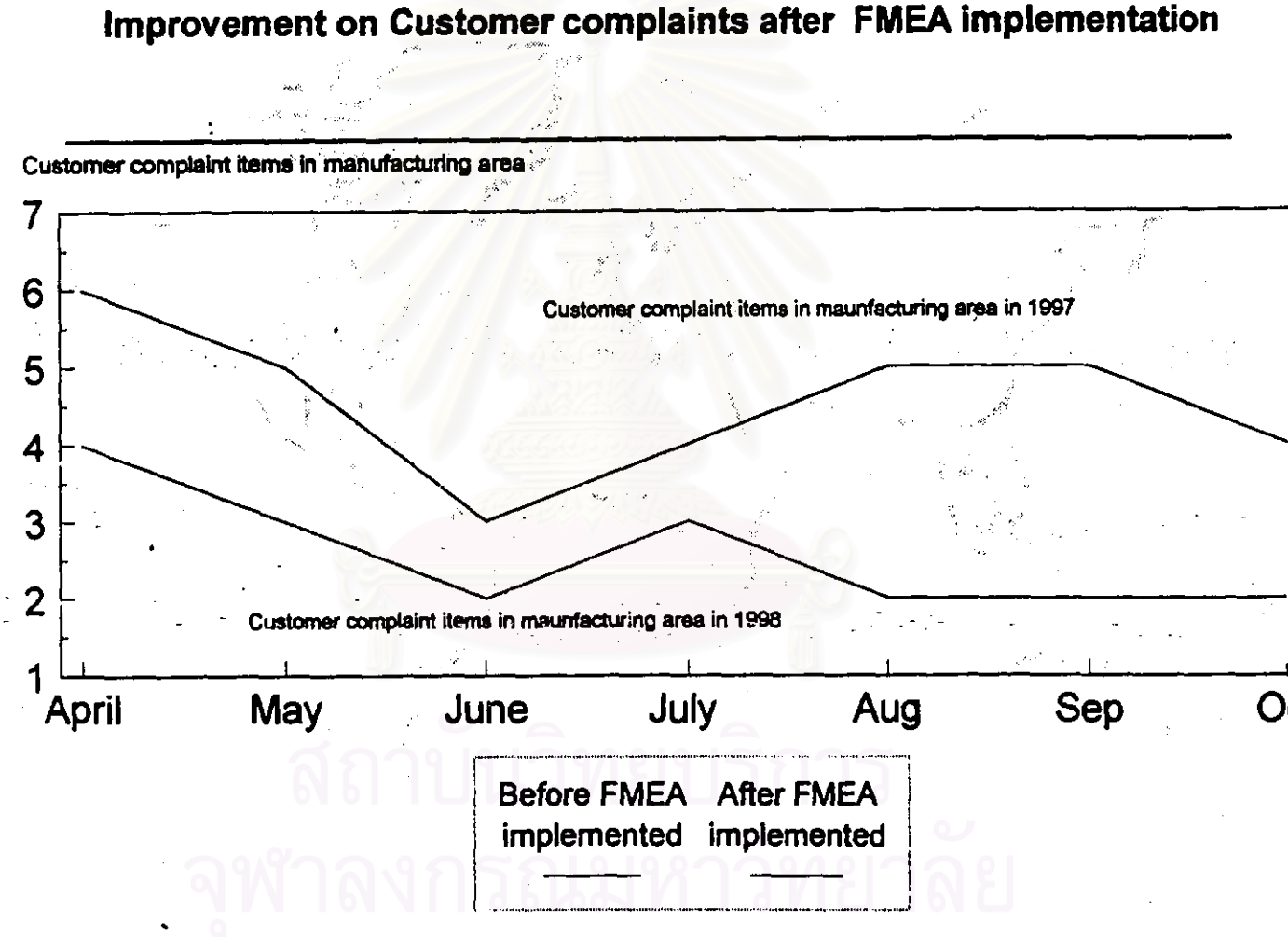


Figure 7.36- Comparison of customer complaint items in manufacturing area between before and after FMEA implementation

7.5 Standard procedure for product quality improvement

After FMEA implementation, FMEA team come out the standard procedure which have been described in seven cases as following

Case I: Standard procedure for setting up crimping machine
This standard procedure help to reduce the following quality criteria
1. Terminal bent
2. Wire is out off housing
3. Unlocked

Case II: Standard procedure for preventive maintenance level II and level III
This standard procedure help to reduce "Unlocked"

Case III: Standard procedure for crimping specification and tolerance analysis
This standard procedure help to reduce "Wire is out off housing"

Case IV: Standard procedure for tighten sampling plan and reduced sampling plan
This standard procedure help to reduce the following quality criteria
1. Wrong wire color be assembled
2. Terminal bent
3. Unlocked

Case V: Standard procedure for continuity test
This standard procedure help to reduce "Wire alternation"

Case VI: Standard procedure for color checker
This standard procedure help to reduce "Wrong wire color be assembled"

Case VII: Standard new carton
This standard procedure help to reduce "Terminal bent"

Case I: Standard procedure for setting up crimping machine
This standard can be applied to crimping process which is described as following.

1 Assembly the applicator on the bolster plate and lock by screws

2 Put the terminal to guide feed of applicator and lock it

3 Turn on power supply 220V and ensure pilot lamp is light

4 Start electric motor at output 300W and rotate fly wheel in the direction given by V-belt.

5 Push foot switch one time.

6 Check the punch, terminal and anvil are aligned

7 Insert wire and crimp terminal

8 Check with Molex specification. If the crimping is out off specification, turn the locked nut.

9 Adjust the crimping height by turning adjust dial with adjust handle 0.03 mm per scale. If crimping height is too low, adjust to the left. If crimping height is too height, adjust to the right

10 When crimping is under specification, lock the nut softly and fix screw at position "A" and "B" strongly

11 Then fix the locked nut strongly again

Case II: Standard procedure for peventive maintenance of level II and level III
FMEA team review level II and level III of preventive maintenance and come out the criteria which needed to be checked and inspected. Those criteria for both level II and level III of preventive maintenance are shown as following

1 Level II of preventive maintenance
There are five main things that must be checked for level II of preventive maintenance and they are listed out as following

1.1 Swivel arms and Grippes
There are ten things that needed to be inspected

1 Swivel cylinder
2 Bush holder

3 Swivel bush
4 Shock absorber
5 Rod eyes
6 Tie bar bush
7 Grooved ball bearings
8 Gripper finger
9 Lever
10 Tension of tooth belt

1.2 Measuring unit and cutter block
There are five things that needed to be checked

1 Knock out blades
2 Center cutter
3 Strippers
4 Measuring roller
5 Check proper function of piece counter

1.3 Pneumatic unit
There are four things that needed to be checked

1 Air regulator at 6 bar
2 Lubricator unit (oil level) 1 drop/5min
3 Pressure limit switch
4 Air filter

1.4 Electric parts

1 Clean magnetic contactor
2 Clean filter
3 Clean relay
4 Check all sensor

1.5 Others

1 Clean the entire machine
2 Lubricate all moving part

2 Level III of preventive maintenance

There are five main things that must be checked for level III of preventive maintenance and they are listed out as following

2.1 Swivel arms and grippers

There are eleven things that needed to be checked

1 Dismantle and clean the swivel arms and gripper
2 Check bush holder
3 Swivel bush
4 Shock absorber
5 Rod eyes
6 Tie bar bush
7 Swivel cylinder
8 Grooved ball bearings
9 Gripper finger
10 Lever
11 Tension of tooth belt

1.2 Measuring unit and cutter block

There are seven things that needed to be checked

1 Knock out blades
2 Center cutter
3 Strippers
4 Measuring roller
5 Check proper function of piece counter
6 Dismantle and clean the cutter block
7 Dismantle and clean measuring unit

1.3 Pneumatic unit

There are four things that needed to be checked

1 Air regulator at 6 bar
2 Lubricator unit (oil level) 1 drop/5min
3 Pressure limit switch
4 All control values

1.4 Electric parts

There are six things that needed to be checked

1 Clean magnetic contactor
2 Clean filter
3 Clean relay
4 Check all sensor
5 Check carbon bush of the drive motor
6 Clean drive motor

1.5 Others

1 Clean the entire machine
2 Lubricate all moving part

Case III: Standard procedure for crimping specification and tolerance analysis

This analysis can be a guideline to determine new crimping specification of any new terminal of harness wire assembly. Result of this analysis can be able to modify crimping specification when quality problem has been occurred. This analysis is to enhance determination of customer specification.

1 Crimp specification

There are two parts that needed to be analyzed for crimping specification. Firstly, it is the strip length and secondly, it is crimp height. Figure 7.37 show the picture of stripped wire and crimped wire.

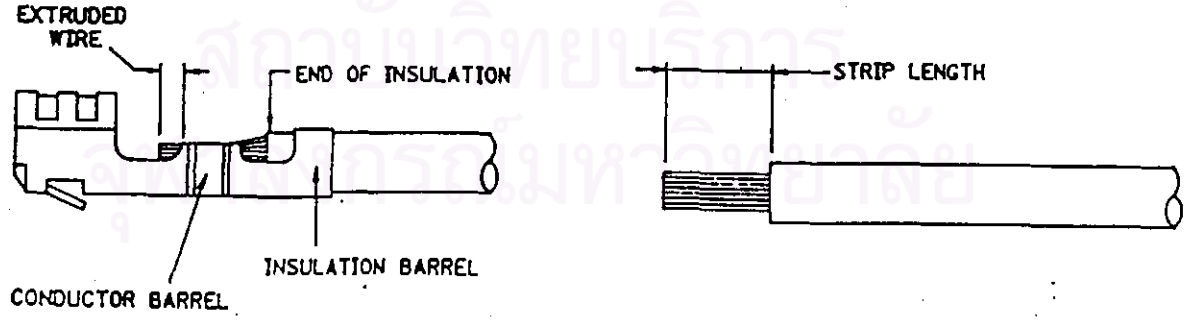


Figure 7.37- Stripped wire and crimped wire

1.1 Strip length for crimping terminal
In figure 7.37 show the picture of stripped wire.

1.1.1 Criteria that needed to be considered
1 Extrude wire from conductor barrel
2 Position of insulation end between conductor barrel and insulator barrel

1.1.2 Define the nominal strip length which considered from insulation end point. This end point should be located in the middle between conductor and insulator barrel. And the end of extrude wire should be in the middle between conductor barrel and end of mating zone. In figure 7.38 shows the position of insulation end and the position of extrude wire. In this figure 7.38 show the improperly crimped wire

1.1.3 Define the strip length's tolerance. Consideration of the range between conductor and insulator barrel is a must.

1.1.4 Cut and strip the wire according to the dimension and tolerance which was set in step 1.1.3 and 1.1.4 by using the upper limit number and lower limit number and then verify the strip length by practical crimping with wire so as to be able to adjust the tolerance again.

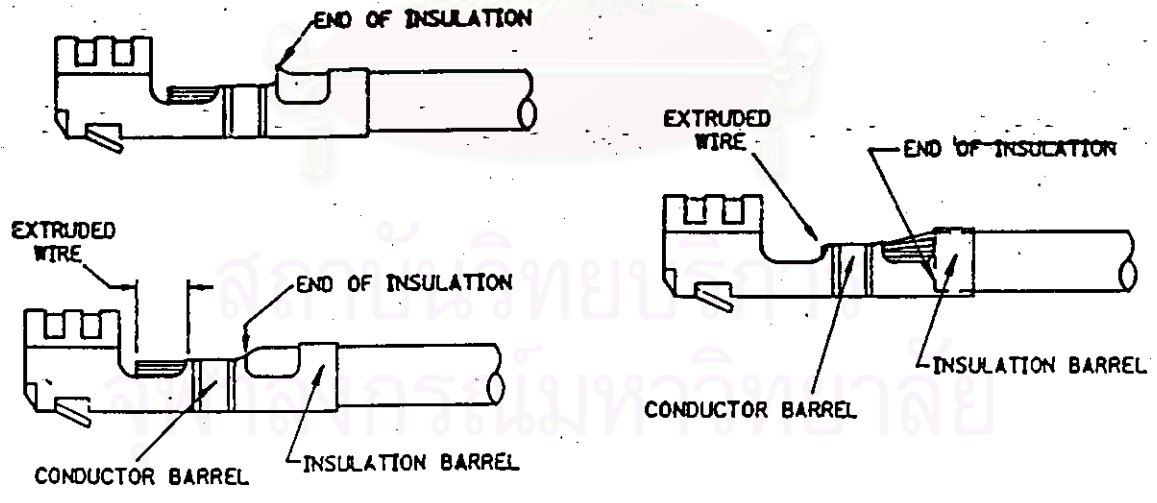


Figure 7.38- Example of improperly crimped wire

1.2 Crimp height
There are two type of improperly crimped wire.

1.2.1 Conductor crimped height

1 To evaluate the conductor crimp height, it is needed to refer to crimp strength of the terminal which has the same specification. For board-in terminal, it is needed to consider PCB hole as well because PCB hole is a part to limit the crimp height.

2 Prepare strip wire and then crimp the wire with different crimp height to test the crimp strength. Result of that the upper and lower specification of crimping specification can be identified.

3 After getting the middle value of crimp height, do insert into housing or print circuit assembly board (PCB) to test quality criteria.

1.2.2 Insulator crimped height

1 To evaluate insulator crimp height, type of wire and its application are the major thing to be considered. For example, UL 1015 has double insulator. UL 1617 is thicker than UL 1007. See figure 7.39. The thickness of insulator will limit the tolerance of insulator crimp height. In figure 7.39 show the cross section of wire and show the good crimped wire and bad crimped wire.

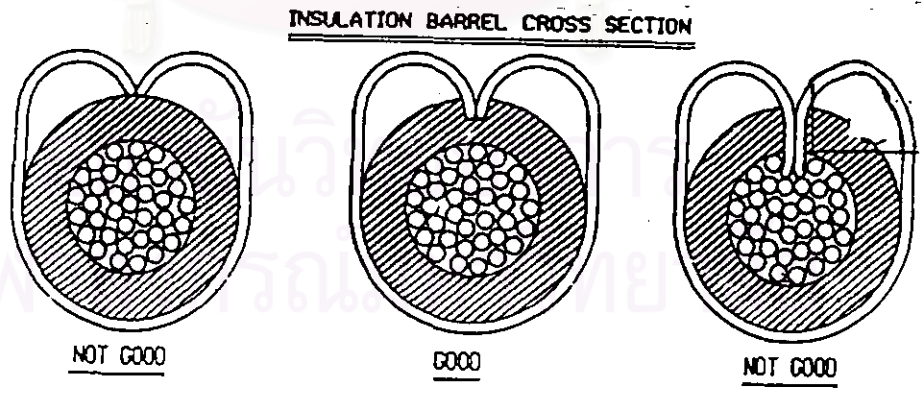


Figure 7.39- Insulator barrel cross section

2 To verify defined insulator crimp height specification, do adjust the tooling by using sample of crimped wire as an signal to adjust. Figure 7.40 show the maximum insulator crimp height and minimum insulator crimp height.

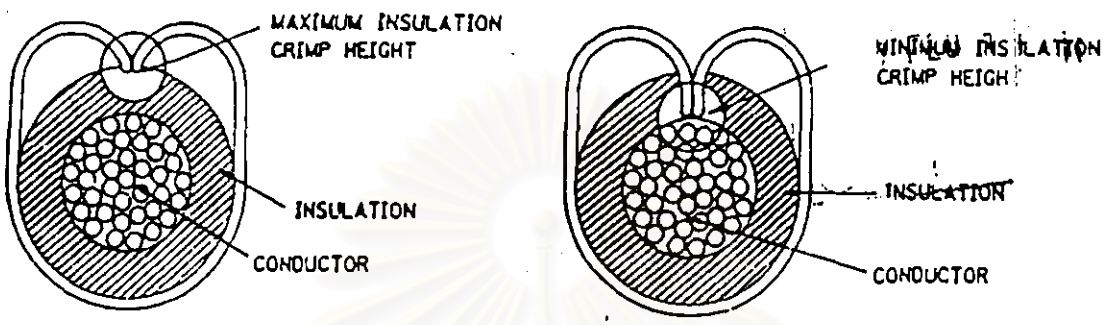


Figure 7.40- Insulator barrel cross section

3 After define insulator crimp height specification, do insert into housing or PCB to conform final specification or customer specification.

1.3 Analysis wire length's tolerance
There are two parts to be considered

1.3.1 Check the capability of cutting machine whether to be able to meet customer required specification or not

1.3.2 Consider the tolerance of the customer requirement specification and split the assembled part into components and add the tolerance of all components which has the same direction as follow

1 Crimping position tolerance
2 Strip length tolerance
3 Cut wire tolerance

When measure the wire length after insertion into housing, the wire need to be pulled a bit to get the lance hit the locking lance in the housing, so this tolerance will not be considered.

Case IV: Standard procedure for tighten sampling plan and reduced sampling plan

Samples must be taken randomly from the submitted lot according to the C=0 sampling plans with switching rule. Whenever the sampling plan was done and found only one reject part, Molex Thailand will reject the whole lot and Molex Thailand will sort the whole lot in house before that lot be shipped to customer.

1 The starting inspection point for any part number is normal level at AQL = 0.1 with C=0. See table 5.1 for sampling plan with C=0

2 Condition for normal level (AQL = 0.40 with C=0) to reduced level (AQL = 0.10 with C=0) This will be effective when the bellowing condition is exist.

2.1 Five consecutive lots are accepted

3 Condition for reduced level (AQL = 0.4 with C=0) to normal level (AQL = 0.1 with C=0) This will be effective when any one of the bellowing condition is exist.

3.1 Any lot was rejected

3.2 Irregular production

For example, there is no production in the last 10 consecutive working days

3.3 After ten lots was inspected

4 Condition for normal level (AQL = 0.1 with C=0) to tightened level (AQL = 0.04 with C=0) This will be effective when the bellowing condition is exist

4.1 Two of five consecutive lots was rejected

5 Condition for tightened level (AQL = 0.01 with C=0) to Normal level (AQL = 0.1 with C=0) This will be effective when the bellowing condition is exist

5.1 Five consecutive lots accepted

Case V: Standard procedure for continuity test

1 Choose the suitable continuity tester for the harness which will be tested

2 Connect the chosen continuity tester to power supply and check its function. This is to make sure that it is functional

3 Connect one end of harness with the mating connector and do the same thing with another end of harness

4 If the signal is active, that harness wire is accepted. But if the signal is not active, that harness will be rejected that needed to be reworked

Case VI: Standard procedure for color cable checker

1 Turn on color cable checker

2 Wait five minutes

3 Set number of wire to be checked

4 Press reset bottom

5 Press clear bottom to clear memory

6 Slide wire to the guide

7 Check the result with table 7.2

8 If the reject was found, it will has sound. Press reset bottom to stop that sound

9 When checking is completed as much as assigned , there will be Beep Beep sound

Table 7.2- Result of checking

Result	Light signal	Sound	Counter
accept	Green	Beep sound three times	auto count
reject color orientation	Red	Continue Beep sound high frequency	press reset
reject no of wire	Red	Continue Boo sound low frequency	press reset
Speed error for both good and defect part	Yellow	Continue Boo sound	press reset

Case VII: Standard new carton

Molex Thailand change the thickness of carton from three layers to five layers which are shown in figure 7.41 and 7.42 respectively

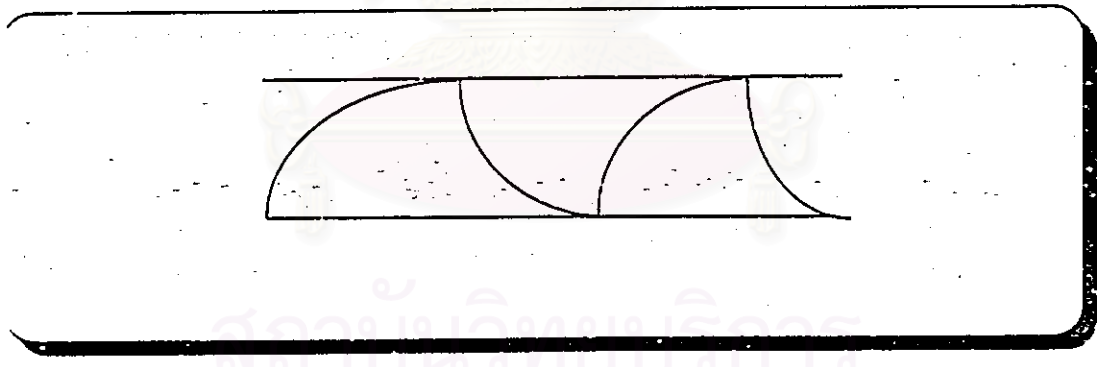


Figure 7.41- 3 layers carton

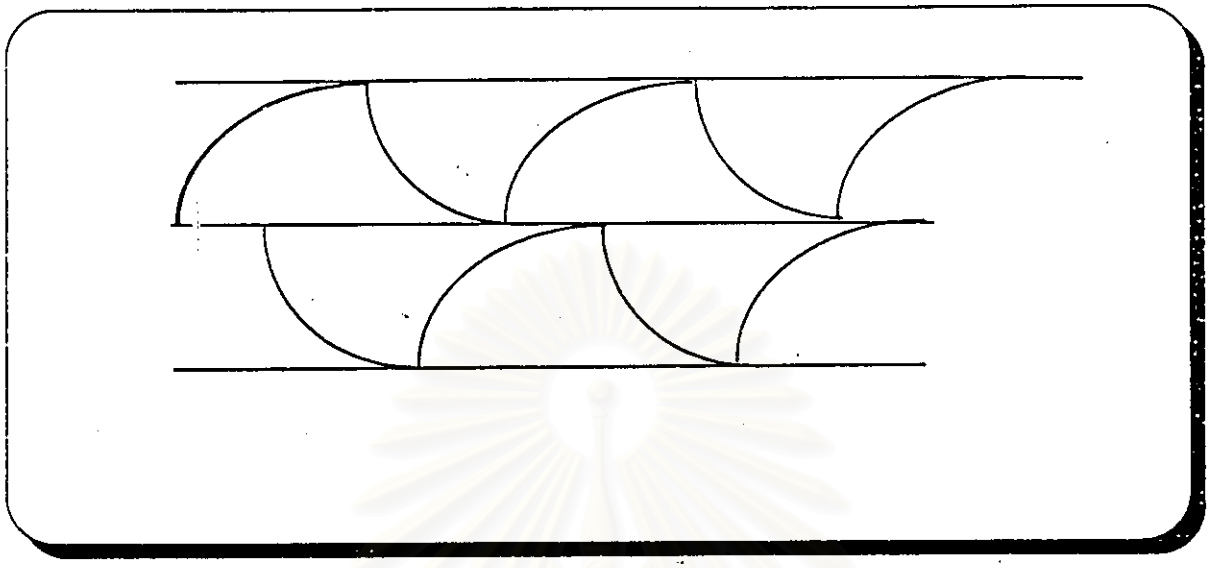


Figure 7.42- 5 layers carton