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APPENDICES

APPENDIX A
SPECIFICATIONS OF PLASTIC (POLYPROPYLENE)

PROPERTIES	UNITS	TESTING METHODS	INJECTION MOLDING						FILM		FLAT YARN/SHEET		
			P400J	P700J	P721J	P702J	P750J	P851JO	P600F	P650F	P401S	P401S	P341S
TYPE	-	-	H*	H*	H*	H*	R*	R*	H*	H*	H*	H*	B*
MELT FLOW RATE	g/10 min.	ASTM D1238	3.5	12	12	12	12	20	10	10	3.5	2.4	1.8
DENSITY	g/cm³	ASTM D1505	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910
TENSILE STRENGTH AT YIELD	kg/cm²	ASTM D638	350	360	380	420	300	320	330	330	380	350	250
TENSILE STRENGTH AT BREAK	kg/cm²	ASTM D638	350	250	250	350	220	300	250	200	350	350	200
ELONGATION AT BREAK	%	ASTM D638	500	500	600	150	500	600	600	600	600	600	500
FLEXURAL MODULUS	kg/cm²	ASTM D790	13,500	15,500	16,500	17,000	12,000	12,000	17,000	17,500	16,000	16,500	11,500
IZOD IMPACT STRENGTH AT 23 °C	kg.cm/cm	ASTM D256	3.5	2.8	2.8	3	7	7	2.5	2.5	4	4	Not Break
IZOD IMPACT STRENGTH AT 0 °C	kg.cm/cm	ASTM D256	2.5	2	2	2	3	3	2	2	2.5	2.6	12
IZOD IMPACT STRENGTH AT -20 °C	kg.cm/cm	ASTM D256	-	-	-	-	2	-	-	-	-	-	8
ROCKWELL HARDNESS	R Scale	ASTM D785	100	108	105	115	90	90	105	105	100	100	76
HAZE	%	ASTM D1003	48**	47**	41**	20**	12**	9**	3***	2***	-	-	-
GLOSS	%	ASTM D2457	58**	51**	58**	68**	77**	84**	76***	80***	-	-	-
MELTING POINT	°C	ASTM D2117	-	160	160	160	150	150	160	-	162	160	160
VICAT SOFTENING POINT	°C	ASTM D1525	156	156	156	156	130	130	155	155	155	155	150
HEAT DEFLECTION TEMPERATURE													
AT 4.6 kg/cm²	°C	ASTM D648	110	110	110	115	90	100	110	110	110	110	100
AT 18.5 kg/cm²	°C	ASTM D648	60	65	65	67	50	-	60	60	60	60	58
FLAMABILITY	-	UL-94	-	HB	-	-	HB	-	-	-	-	-	-
APPLICATIONS			General purpose housewares, food containers, toys, medical instruments, infant articles, office accessories.	General purpose housewares, food containers, toys, medical instruments, infant articles, office accessories.	General purpose housewares, food containers, toys, medical instruments, infant articles, office accessories.	General purpose injection parts required high clarity and dimension stability such as food containers, toys and closure.	food containers, medical parts such as syringe, utensils and premium articles with excellent clarity.	Food containers, big size containers and medical parts household articles where transparency is requested.	Water quenched blown film. Suitable for food and clothes packaging, etc.	Used for water quench blown film. Suitable for blending with P600F for excellent clarity film such as food bag, garment bag, etc.	Stretched tape and monofilament for woven bags, woven sheet, ropes, strap and sheet	Stretched tape for jumbo woven sheet, monofilament for rope and sheet	Plastic shelf, corrugated sheet, appropriated for outdoor uses.
CHARACTERISTICS			High stiffness and gloss, and good processability, odorless and food contact.	High stiffness and gloss, high productivity and good processability, odorless and food contact.	High stiffness and gloss, high productivity and good processability, odorless and food contact.	High clarity, high stiffness, good processability and nucleated (except for capping applications) odorless and food contact.	Excellent clarity, productivity, good processability and stiffness, high gloss, odorless and food contact.	Excellent clarity, high productivity, high gloss, antistatic, nucleated and food contact.	Good optical property, High productivity and good operability.	Excellent optical property, high productivity.	High output, good mechanical properties.	Excellent mechanical properties.	High ultraviolet (UV) resistance, excellent impact strength.

* H = HOMOPOLYMER, R = RANDOM COPOLYMER, B = BLOCK COPOLYMER [illegible]
** Properties of specimen [illegible] mm
*** Properties of film [illegible]
[illegible]

Note: The typical property data contained in this catalog [illegible]

Specifications of plastic (polypropylene) for making finished products by way of injection moulding

APPENDIX B
QUOTATIONS FOR COMPUTER NUMERICAL CONTROL (CNC) MACHINES

CNC milling machines

	Table size	Spindle speed	Price (Baht)	Delivery time (days)
Supplier A	800 mm x 450 mm	8000 RPM *	2,000,000	75
Supplier A	1200 mm x 650 mm	8000 RPM	2,300,000	75
Supplier B	1100 mm x 600 mm	10000 RPM	2,700,000	90
Supplier C	1000 mm x 450 mm	8000 RPM	2,000,000	90

CNC lathes

	Chuck diameter	Spindle speed	Price (Baht)	Delivery time (days)
Supplier A	8"	4800 RPM	1,800,000	90
Supplier B	6"	6000 RPM	1,200,000	90

* *Revolutions per minute*

- Table size of a CNC milling machine should be related with size of a mould. In practice, the biggest size of steel plate that the company uses for mould fabrication is 550 mm x 450 mm. Thus, the minimum requirement for table size for a CNC milling machine is 800 mm x 450 mm.
- Chuck diameter of a CNC lathe machine should be related with size of a steel rod. In practice, the size of steel rod that the company uses is 6"-8". Thus, the minimum requirement for chuck diameter for a CNC lathe machine is 6".

APPENDIX C

CALCULATIONS OF THE MAN-HOURS

Man-hours available in one year

Where, There are 8 machinists in the mould shop.

Working days of the department were 6 days per week.

Regular working time is 8 hours per day.

Thus, Man-hours available in one year

= 8 hours × 26 days × 8 machinists × 12 months

= 19,968 man-hours

Fabrication of new moulds

Where, On average, the department has job orders to construct 12 moulds per year.

It normally requires 2 machinists and 3 months to fabricate one set of mould.

Working days of the department were 6 days per week.

Regular working time is 8 hours per day.

Thus, Man-hours for fabrication of new moulds

= 8 hours × 26 days × 3 months × 2 machinists × 12 moulds

= 14,976 man-hours

Remaining capacity for mould repairs = 19,968 − 14,976

= 4,992 man-hours

Capacity shortage

Where, There are an average of 40 jobs per month for repairing moulds and making replacement components.

It normally requires 28 man-hours per job.

Thus, Man-hours for repairing moulds and making replacement components

= 40 jobs × 28 man-hours × 12 months

= 13,440 man-hours

Capacity shortage = 13,440 − 4,992

= 8,448 man-hours

BIOGRAPHY

Pitak Lausangngam was born on 6 May 1982 in Bangkok. He graduated with a Bachelor's degree in Electro-mechanic Manufacturing Engineering from Kasetsart University in 2003. After graduation, he worked as a sales engineer for one and a half years for Amada (Thailand) Co., Ltd. Currently, he is employed by Plastech Industrial Co., Ltd. as an assistant manager of the mould department. In 2005, he enrolled as a part-time student working toward a Master's degree in engineering management at the Regional Centre for Manufacturing Systems Engineering, Chulalongkorn University.