

**The Test result data of PVC Resin (straight type : TMC SG-5)
In WINDOW FRAME making**

1. Data Base of PVC : TMC SG-5

Items	Unit	standard	Result data	
			Control(P-1000)	TMC SG-5
Flow	sec	20 max.	12.80	21.75
Bulk density	g/cc	0.55 min.	0.651	0.631
particle(250 μ m)	%	95% pass	98.16	99.03
Impurities no.	ea/100g	10 max.	0	0
Water contents	%	0.3 max.	0.15	0.16
Color difference	Δ E	3.0 max.	2.06	2.02
		L	95.8	95.83
		a	-0.23	-0.11
		b	0.73	0.95

● Control → HANWHA PVC resin (P-1000)

● Test SAMPLE → TMC SG-5

2. the DATA of Extrusion Process

		Result DATA on several Extruder					
		Large sized E.		Middle sized E.		High speed E.	
Cylinder part (°C)	C1	185	185	170	169	179	180
	C2	188	188	178	177	190	190
	C3	185	1185	175	175	189	190
	C4	180	180	168	168	185	185
	C5	167	167	-	-	174	175
	C6	-	-	-	-	170	170
ADAP'TEMP(°C)		170	170	170	170	172	172
SCREW TEMP(°C)		145	145	144	145	-	-
RESIN TEMP(°C)		196	196	196	197	196	196
DIES(°C)	D1	195	195	195	195	198	198
	D2	195	196	197	197	195	195
	D3	195	195	195	195	190	190

	D4	193	194	193	193	195	195
MELT Pressure(bar)		204- 205	214- 218	191	201	246- 247	253- 254
Raw material Feed RPM		23.0	23.0	98.0	98.0	23.6	21.5
SCREW RPM		15.0	15.0	24.2	24.2	16.1	16.1
Extrusion LOAD(%)		51-52	52-53- 54	62-63	59-60	41-42	38-39
Speed (M/min)		2.68	2.68	1.62	1.55	1.89	1.80

※ Large sized Extruder : 180Kg/hr Paraller Screw

※ Middle sized Extruder : 100Kg/hr Conical Screw

※ High speed Extruder : 350Kg/hr Paraller Screw

3. Quality test DATA of Products

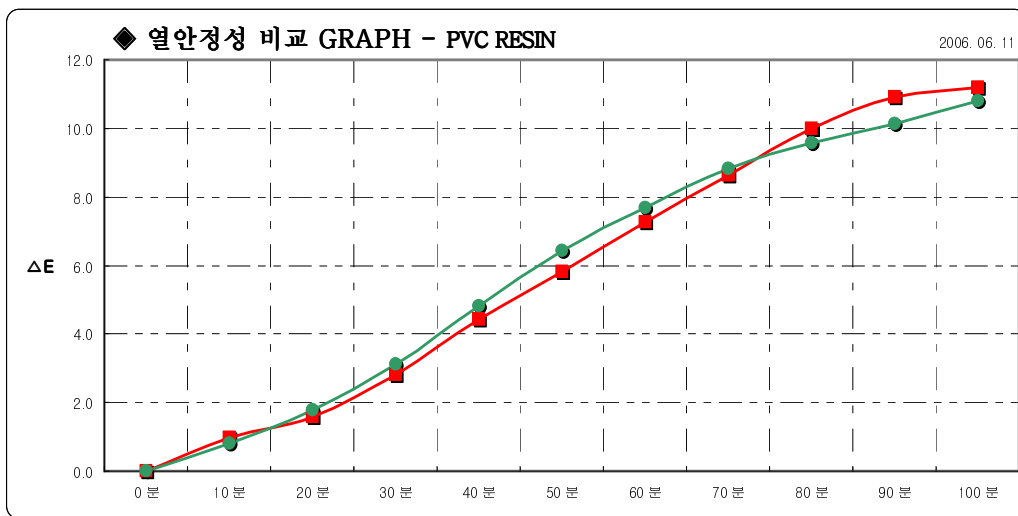
Test	Unit	Standard	Result	
			Control	TMC SG-5
Appearance	-	Smooth and without air bubble	good	good
Sizing	mm	Size As same as standard demand	good	good
Assembleing	-	Easy and tight assemble as drawing	good	good
Bending	mm	1mm max. at 1,000 mm center	good	good
Glossness	-	20 min.	41,9	29.3
weight	g/m	1,230±62	1,182	1,170
Color difference	ΔE	1.3 max.	0.94	0.85
		L	94.00	93.99
		a	-0.60	-061
		b	0.79	0.88

4. Physical properties of Products.

items	Unit	Standard	Result Data	
			Control	TMC SG-5
hardness	—	85 min.	103	104
Tensile strength	MN/m ²	36.8 min.	38.41	39.1
Elongation (Break)	%	100 min	169.2	167.3
Flexural Modulus	MN/m ²	1961 min	2499	2493
Low temp. Impact	—	not more than 2 Crack	no	no
Heat Deflection	—	no blowhole,crack,feeling-off	no	no
Burning-Resistant	—	Not burning	no	no
Charpy Impact(23'C)	KJ/m ²	12.7 min.	68.3	81.9
Charpy Imp. (-10'C)	KJ/m ²	4.9 max.	20.2	23.2
Heat elongation	%	2.5 min.	1.61	1.58
Low temp. shrinkage	%	0.2 min.	0.10	0.06

5. the Test of Heat Stability

Min (ΔE)	0	10	20	30	40	50	60	70	80	90	100
Control	0	0.97	1.59	2.8	4.44	5.83	7.28	8.62	9.99	10.91	11.19
TMC SG-5	0	0.81	1.79	3.13	4.81	6.42	7.69	8.82	9.57	10.13	10.8

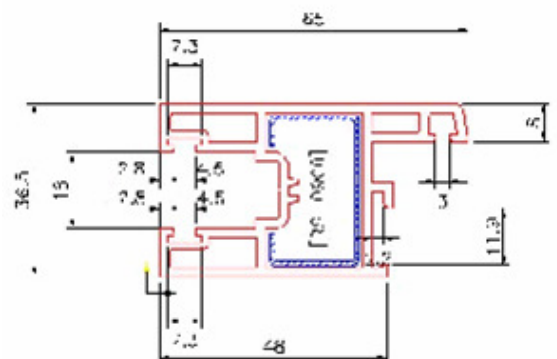


6. The Physical properties of WINDOW FRAME (WELDING STRENGTH)

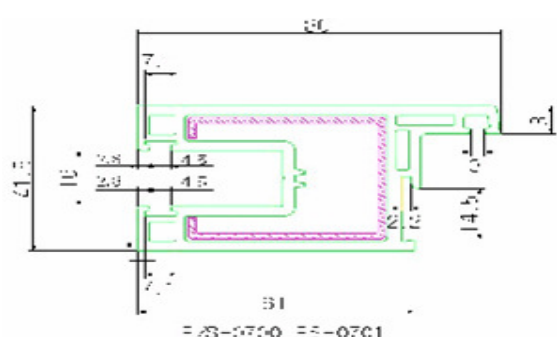
Test No		Unit	Standard	Result data	
				Control	TMC SG-5
Welding Strength	NO 1	N	1,500 min.	4253.2	4664.8
	NO 2			4027.8	3900.4
	NO 3			3645.6	3537.8
	NO 4			4390.4	5184.2
	NO 5			4370.8	3969.0
Average				4137.6	4251.2

7. Final result DATA sheets of Products (on several types of Extruder)

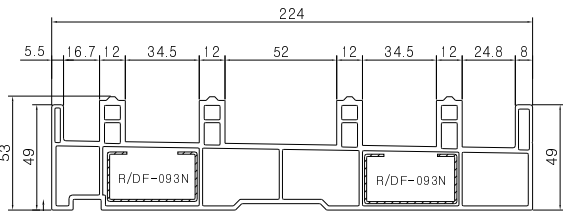
7-1 Large-sized Extruder (180Kg/hr Paraller Screw)

Process Monitor			Product size		result	Process Monitor		Product size		result					
Cylinder	C1	185	1	65.0±0.5	64.71	ScrewTemp	145	12	3.0±0.5	3.05					
	C2	188	2	48.0±0.5	48.50	Resin Temp	196	13	11.9±0.5	11.95					
	C3	185	3	36.5±0.5	36.71	Screw RPM	15.0	14	2.2±0.5	2.21					
	C4	180	4	16.0±0.5	15.89	%	53.0	(t)	2.0±0.5	2.15					
	C5	167	5	4.5±0.5	4.71	Feed RPM	23.0	Melt presure		214					
	C6		6	4.5±0.5	4.73	Ext.vacuum	110	result		Passed					
Dies	A1	170	7	2.8±0.5	2.74										
	D1	194	8	2.8±0.5	2.75										
	D2	195	9	7.3±0.5	7.03										
	D3	195	10	7.3±0.5	7.09										
	D4	193	11	8.0±0.5	8.11										
Cal 1		0.89		Cal 2		0.72		Cal 3		-	Cal 4		0.23		
Speed		2.68		Process		14						-			
Test Item					Standard				Test result				pass		
weight		g/m			780 ± 39				761.58				Pass		
bending		mm			1mm max. at 1,000 mm center				good				Pass		
glossness		-			20 min				41.1				Pass		
elongation		%			2.5 max				1.89 1.9 1.92 1.90				Pass		
Color difference		△E			1.3 max				0.24				Pass		
					L a b				93.86 -0.54 1.61						
Appreance		Crack, undulation			Good forming and smooth surface				good				Pass		
		Sink mark, carbonize							good						
		Weld line, break							good						
		impurites, air bubble							good						
		Mal-forming							good						
Assembl eing		IL-0930,GB-093N RS-0900/1 GASKET, MOHAIR				Tightly fit and easy assemble				good				Pass	

7-2 Middle-sized Extruder (100Kg/hr Conical Screw)

Process Monitor			Product size		result	Process Monitor		Product size		result	
Cylinder	C1	170	1	80.0±0.5	80.02	ScrewTemp	145	12	3.0±0.3	2.99	
	C2	178	2	61.0±0.5	61.12	Resin Temp	197	13	14.5±0.5	14.82	
	C3	175	3	41.5±0.5	41.65	Screw RPM	24.2	14	2.2±0.5	2.15	
	C4	168	4	16.0±0.5	15.96	%	59.0	(t)	2.8±0.2	2.81	
	C5	-	5	4.5±0.5	4.35	Feed RPM	98	Melt Pressure		201	
	C6		6	4.5±0.5	4.37	Ext.vacuum	160	Result		Passed	
Dies	A1	170	7	2.8±0.5	3.05						
	D1	195	8	2.8±0.5	3.09						
	D2	197	9	7.1±0.5	7.12						
	D3	195	10	7.1±0.5	7.16						
	D4	193	11	8.0±0.5	8.09						
Cal 1		0.89		Cal 2	0.60	Cal 3		-	Cal 4		0.30
Speed		1.55		process		12					-
Test item					standard			Test result		Pass	
weight		g/m			1,230±62			1,170.00		Pass	
bending		mm			1mm max. at 1,000 mm center			good		Pass	
glossness		-			20 min			29.3		Pass	
elongation		%			2.5 max			1.60 1.58 1.56 1.58		Pass	
Color difference		△E			1.3 max			0.85		Pass	
					L a b			93.99 -0.61 1.88			
Appreance		Crack, undulation			Good forming and smooth surface			good		Pass	
		Sink mark, carbonize						good			
		Weld line, break						good			
		impurites, air bubble						good			
		Mal-forming						good			
Assembl eing		IL-0700,GB-042N RS-0700/1			Tightly fit and easy assemble			good		Pass	

7-3 High-speed Extruder (350Kg/hr Paraller Screw)

Process Monitor			Product size		result	Process Monitor		Product size		result					
Cylinder	C1	180	1	224.±0.5	224.18	ScrewTemp	—	12	12.0±0.5	12.14					
	C2	190	2	53.0±0.5	53.21	Resin Temp	179	13	12.0±0.5	12.21					
	C3	190	3	49.0±0.5	48.99	Screw RPM	16.1	14	12.0±0.5	12.22					
	C4	185	4	49.0±0.5	48.93	%	38.2	15	8.0±0.5	2.81					
	C5	175	5	16.7±0.5	16.68	Feed RPM	21.5	(t)	2.4±0.2	2.31					
	C6	170	6	34.5±0.5	34.54	압출진공	150	Melt 압력		254					
Dies	A1	172	7	52.0±0.5	52.07										
	D1	198	8	34.5±0.5	34.33										
	D2	195	9	24.8±0.5	24.68										
	D3	190	10	5.5±0.5	5.57										
	D4	195	11	12.0±0.5	12.12										
Cal 1		0.75		Cal 2		0.54		Cal 3		—		Cal 4		0.27	
speed		1.80		process		15						—			
Test item					standard				Test result				Pass		
weight		g/m			2,746±62				2,630.00				Pass		
bending		mm			1mm max. at 1,000 mm center				good				Pass		
glossness		—			20 min				29.3				Pass		
elongation		%			2.5 max				1.35 1.38 1.37 1.37				Pass		
Color difference		△E			1.3 max				0.67				Pass		
					L a b				93.91 -0.61 1.07						
Appreance		Crack, undulation			Good forming and smooth surface				good				Pass		
		Sink mark, carbonize							good						
		Weld line, break							good						
		impurites, air bubble							good						
		Mal-forming							good						
Assembl eing		IL-0700,GB-042N RS-0700/1				Tightly fit and easy assemble				good				pass	

8. Appedix : detail data of physical properties (**TMC PVC SG-5**)

8-1-1 Sharpy Impact Strength (std. temp.23'C)

No.	Width	Thickness	Absorbed Energy	Resilience		Broken	read
	① mm	② mm	③ J	④ KJ/m²	⑤ Kgf cm/cm²		
1	9.75	2.52	2.176	87.9			81.9
2	9.75	2.52	1.908	77.0			
3	9.75	2.52	1.986	80.2			
4	9.75	2.52	1.932	78.0			
5	9.75	2.52	2.134	86.2			

8-1-2 Sharpy Impact Strength (low temp. -10'C)

No.	Width	Thickness	Absorbed Energy	Resilience		Broken	read
	① mm	② mm	③ J	④KJ/m²	⑤Kgf cm/cm²		
1	9.75	2.52	0.616	24.4		●	23.6
2	9.75	2.35	0.544	23.0		●	
3	9.75	2.52	0.536	21.2		●	
4	9.75	2.52	0.568	22.5		●	
5	9.75	2.52	0.672	26.7		●	

Calculation (Sharpy Impact strength))

$a_c N \text{ ④} = \frac{\text{③}}{\text{①} \times \text{②}} \times 10^3 = \frac{W}{h b_N} \times 10^3$	
W ③ : Absorbed Impact Energy (J) h ② : width of sample with notch(mm) b_N ① : Thickness of sample with notch(mm) Impact strength of sharpy : 4J	

8-2 Tensile , Yield Point and Elongation(break) (std. temp.23'C)

No.	Width	Thickness	Yield	Tensile	length		⑥	Elongation (%)
	① mm	② mm	③ Kgf cm/cm ²		④after (mm)	⑤before (mm)		
1	5.75	2.52	3.954		25	60.92	1.680	168.0
2	5.75	2.52	4.102		25	63.11	1.777	177.7
3	5.75	2.52	3.873		25	62.95	1.770	177.0
4	5.75	2.52	4.068		25	60.15	1.647	164.7
5	5.75	2.52	3.960		25	56.61	1.491	149.1
Avg.	5.75	2.52	3.991		25	60.73	1.673	167.3

$$\text{Elongation (break)} = \text{⑥} \times 100 = \{ (\text{⑤} \times 1.1 - \text{④}) / \text{④} \} \times 100$$

8-3 Flexural Modulus

No.	Length of Test point	Length of sample	Height of sample	weight	bias	Elongation (break)
	L	B	H	F	Y	Ef
1	40	24.75	2.52	12.65	2.0	255.6
2	40	24.75	2.52	12.62	2.0	254.9
3	40	24.75	2.52	12.51	2.0	252.7
4	40	24.75	2.52	12.57	2.0	253.9
5	40	24.75	2.52	12.60	2.0	254.5
평균	40	24.75	2.52	12.59	2.0	254.3

$$\text{Flexural Modulus } Ef = L^3 \div 4BH^3 \times F \div Y$$

$$\Rightarrow Ef \cdot 9.8 = \text{MN/m}^2$$

8-4 Burn-resistance test

		No. of sample					Avg.
		1	2	3	4	5	
time(sec)		0	0	0	0	0	0
length(mm)		10.96	11.03	11.12	11.18	11.24	11.11
types	Non flammable	o	o	o	o	o	Non Flammable
	Self extinguish						
	flammable						

8-5 Elongation/shrinkage test on temperature change(repeat)

		No. of sample					Avg.
		1	2	3	4	5	
length (mm)	before	450.00	450.00	450.00			450.00
	after	449.74	449.68	449.76			449.73
Result (%)		0.06	0.07	0.05			0.06

8-6 the strength against Falling ball at low temp.

	No. of sample										total
	1	2	3	4	5	6	7	8	9	10	
N / B	●/	●/	●/	●/	●/	●/	●/	●/	●/	●/	10/0

8-7 Hardness, Heat distortion

item	unit	No. of sample					Avg.
		1	2	3	4	5	
hardness	—	104.5	103.8	104.3	104.1	104.2	104.2
Heat distortion	—	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected

8-8 The Strength test after welding

