

# **Abrasion Wheel Feasibility Study Report**

September 5th & 6th, 2012  
Flat Glass Manufacturers Association of Japan

# Abrasion Wheel Feasibility Study Report

---

## 1. Reason for Addressing the Issue

During the Inf-G meeting, the following issue was raised:

When abrasion resistance tests were performed with the abrasion wheel, the standard value was exceeded in some cases, and there was wide dispersion of results. Therefore, some glazing was rejected even though it had abrasion resistance that would be satisfactory for practical use.

# Abrasion Wheel Feasibility Study Report

---

## 2. Discussion in the Inf-G Meeting

Relating to the problems with the abrasion wheel, changing the test method was discussed, and the following were proposed.

- 1) Evaluate based on sand drop test, and lower the standard value to 5%.
- 2) Possibility of Amtec Kistler Test
- 3) Start WG activity for researching the possibility of the wiper test.

# Abrasion Wheel Feasibility Study Report

---

## 3. Concerns with the Newly Proposed Methods

- 1) Evaluation methods for glass and plastics differ from each other, lacking consistency.
  - 2) As with GTR and other methods, evaluation by abrasion is standard practice, so it would be difficult to change the method for evaluating abrasion resistance.
- For continuing use of abrasion wheels, feasibility was studied of an abrasion wheel that will produce abrasion less than 2% even with plastics.

# Abrasion Wheel Feasibility Study Report

---

## 4. Investigation Direction

Given that plastic glazing products, which have been satisfactorily used in Germany, can be statistically proven to have no quality problems with abrasion:

- 1) Commissioned Daiwa Kasei Kogyo Co. Ltd to produce an abrasion wheel that satisfies an abrasion test standard of 2% with plastic glass.
- 2) Proved that there are no problems with reproducibility.

Feasibility would be achieved, if the reproducibility of the current abrasion wheel is increased and the standard is set at 5%. But, we do not commit ourselves to this solution at present.

# Abrasion Wheel Feasibility Study Report

---

## 5. Profile of Daiwa Kasei Kogyo Co., Ltd. (in charge of development)

- 1) Established in 1965
- 2) Specialty manufacturer of elastic grinding stones with resilient matrix of rubber
- 3) Principal Products
  - Grinding stones for aircraft jet engine blades
  - Grinding stones for nuclear power plant turbine blades  
(customers: HITACHI, TOSHIBA · W.H, IHI, MITSUBISHI)
  - Grinding stones for hairline finishing of timepiece dials
  - Abrasion wheels for glass, C180-0XF

# Abrasion Wheel Feasibility Study Report

---

## 6. Daiwa's Manufacturing Process of Abrasion Wheel

- 1) Mastication ·· Rubber molecules are shredded and plasticized
- 2) Mixing ······ Rubber, abrasive particles, and compounding agent are blended
- 3) Sheeting ···· Round sheet is stamped out of rubber
- 4) Casting ···· Heat and pressure are applied (cross linking of rubber polymers)
- 5) Dressing ···· Surface film is removed, finish to size

# Abrasion Wheel Feasibility Study Report

---

## 7. Current Abrasion Wheel Test Results

### 1) Taber & Daiwa Current Abrasion Wheel Feasibility Study Report

According to ISO Round Robin Test (2011.12) documents

For Plastics:

- At 500 revolutions,  $\Delta H$  exceeds 2%.
  - There is wide dispersion of results, and the abrasion with Taber wheel reaches an ultimate value at 500 revolutions.
- Research for feasibility of abrasion wheel that will be 2% or lower at 1000 revolutions



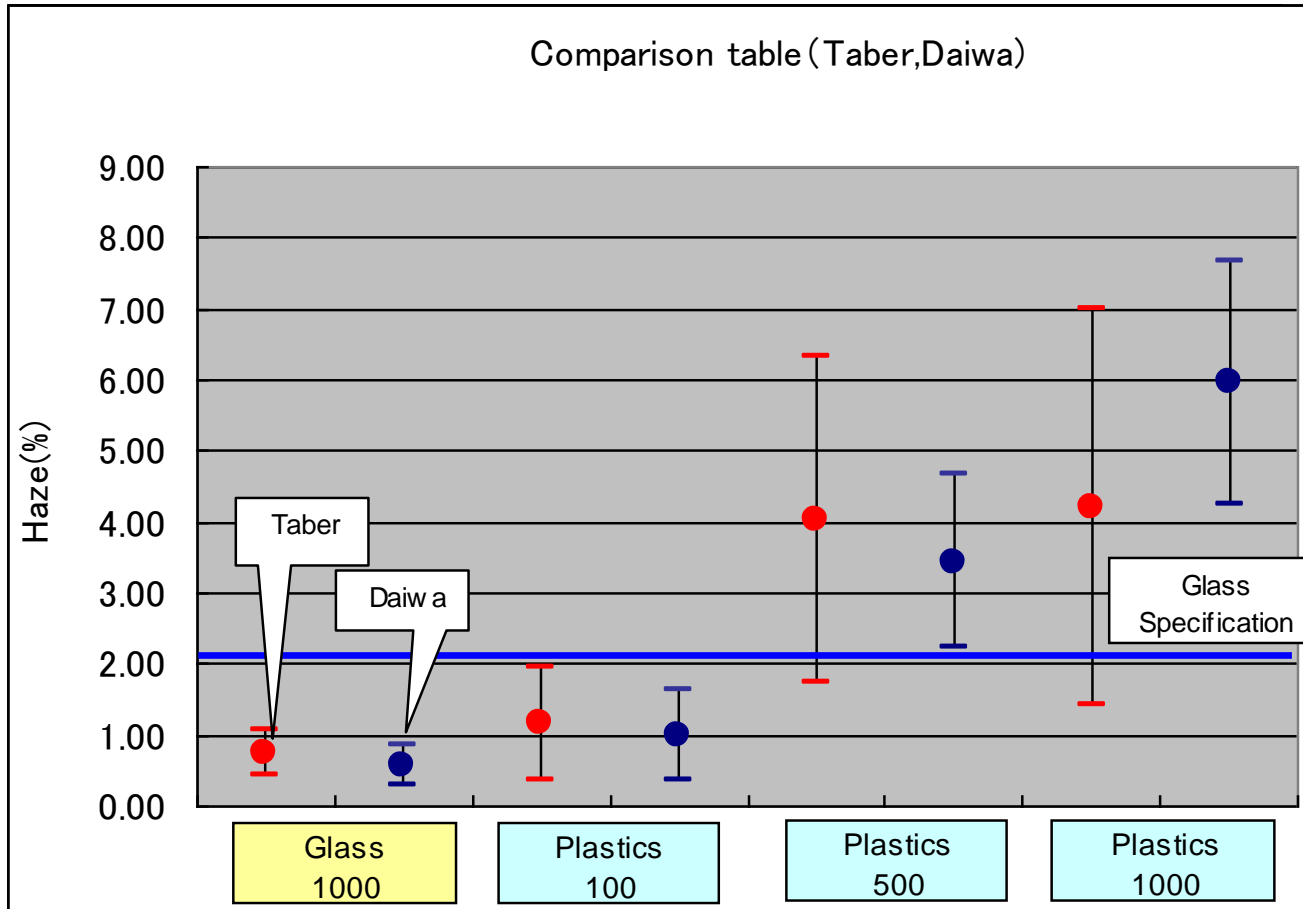
# Abrasion Wheel Feasibility Study Report

Results of Round Robin Test(Data from 2011.12.1,2 ISO meeting)

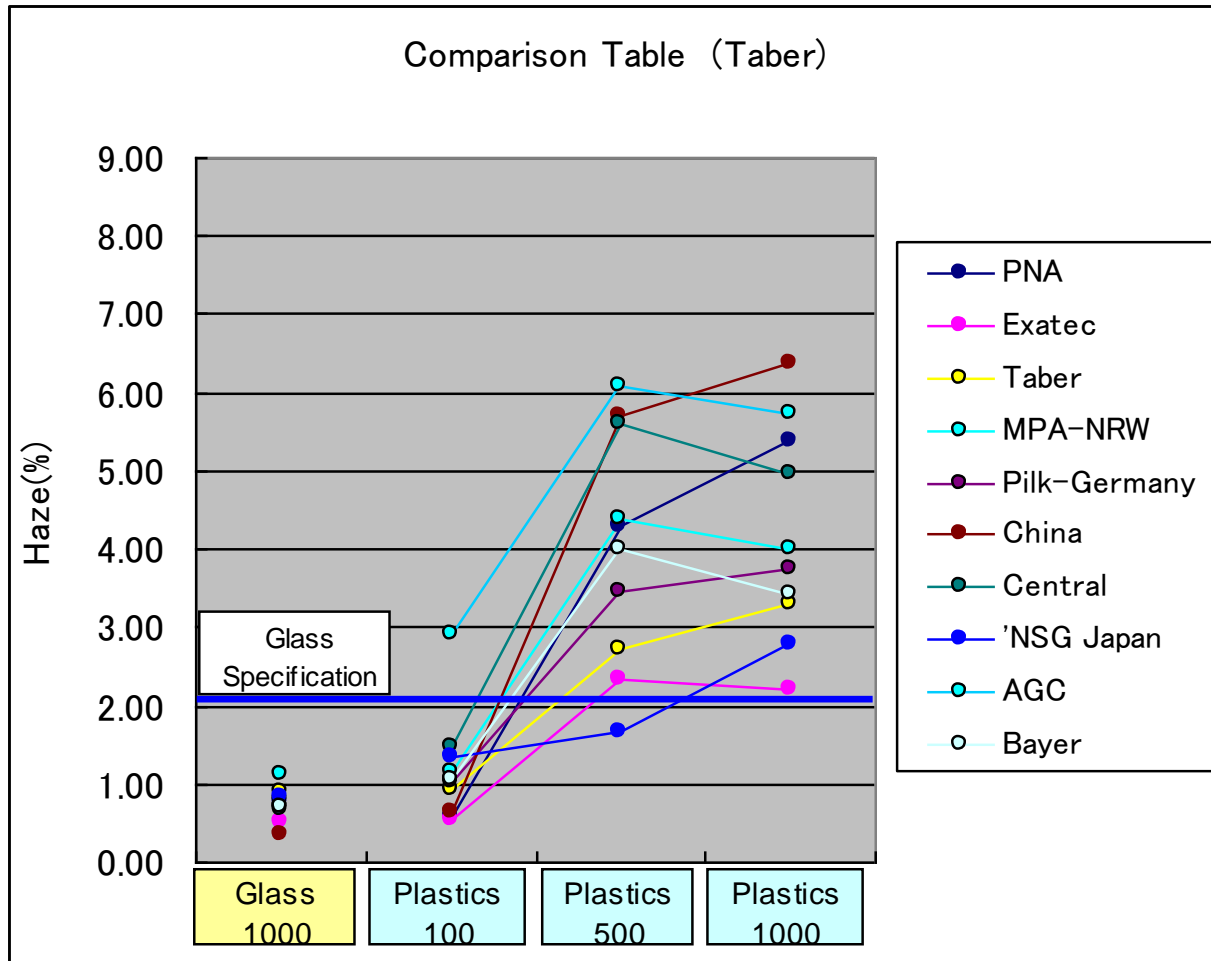
Very High result eliminated  
High and Low result included

Labs	1000 Cycles Glass				100 Cycles HC Plastic				+400 Cycles HC Plastic				1000 Cycles HC Plastic				
	Taber		Daiwa		Taber		Daiwa		Taber		Daiwa		Taber		Daiwa		
	Average	Std Dev	Average	Std Dev	Average	Std Dev	Average	Std Dev	Average	Std Dev	Average	Std Dev	Average	Std Dev	Average	Std Dev	
PNA	1	0.76	0.16	0.58	0.08	0.58	0.18	0.75	0.18	4.29	1.19	2.91	0.44	5.39	0.67	3.77	0.55
Exatec	2	0.50	0.11	0.50	0.10	0.53	0.08	0.77	0.08	2.33	0.19	3.57	0.22	2.20	0.26	5.43	0.69
Taber	3	0.89	0.25	0.62	0.20	0.93	0.16	0.85	0.39	2.73	0.42	4.03	0.83	3.30	0.46	5.51	0.54
MPA	4	0.67	0.09	0.77	0.09	1.17	0.08	0.87	0.06	4.40	0.37	2.87	0.10	4.00	0.70	4.53	0.37
Pilkington	5	0.80	0.04	0.66	0.05	1.03	0.31	0.94	0.04	3.45	0.69	3.00	0.12	3.76	0.67	6.34	0.40
China	6	0.35	0.04	0.24	0.03	0.63	0.18	0.47	0.08	5.69	0.62	3.56	1.00	6.38	0.49	5.92	0.22
Central	7	0.70	0.14	0.63	0.07	1.47	0.48	1.33	0.61	5.60	1.30	3.47	0.29	4.95	0.40	6.87	0.57
NSG	8*	0.83	0.08	0.17	0.09	1.33	0.36	1.00	0.26	1.67	0.36	1.50	0.19	2.80	1.25	4.95	0.40
AGC	9*	1.13	0.12	0.70	0.14	2.90	0.62	1.57	0.26	6.10	2.33	4.10	0.38	5.73	4.20	8.10	1.30
Bayer	10	0.71	0.05	0.76	0.09	1.06	0.20	1.28	0.12	3.99	0.13	5.40	0.46	3.42	0.18	8.08	0.64
AVG		0.73	0.11	0.56	0.09	1.16	0.27	0.98	0.21	4.02	0.76	3.44	0.40	4.19	0.93	5.95	0.57
			0.32		0.28		0.80		0.63		2.28		1.21		2.78		1.70
		0.41		0.28		0.37		0.35		1.74		2.23		1.41		4.25	
		1.06		0.85		1.96		1.61		6.31		4.65		6.98		7.65	

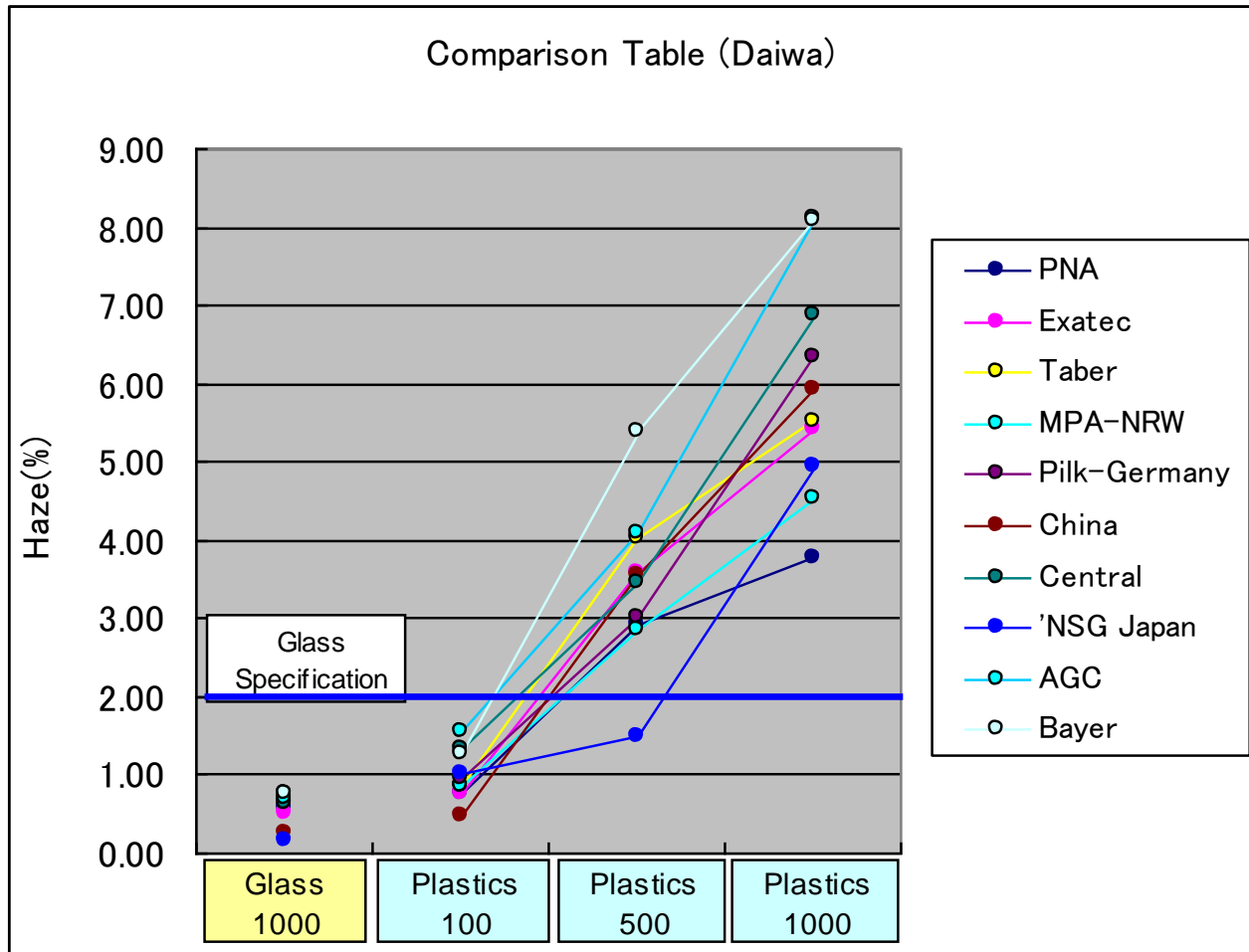
# Abrasion Wheel Feasibility Study Report



# Abrasion Wheel Feasibility Study Report



# Abrasion Wheel Feasibility Study Report



# Abrasion Wheel Feasibility Study Report

---

## 8. First Prototypes

Trial-1 Type-A: 1000 revolutions,  $\Delta H$  4%

Type-B: 1000 revolutions,  $\Delta H$  10%

The initial goal of  $\Delta H$  2% was not achieved

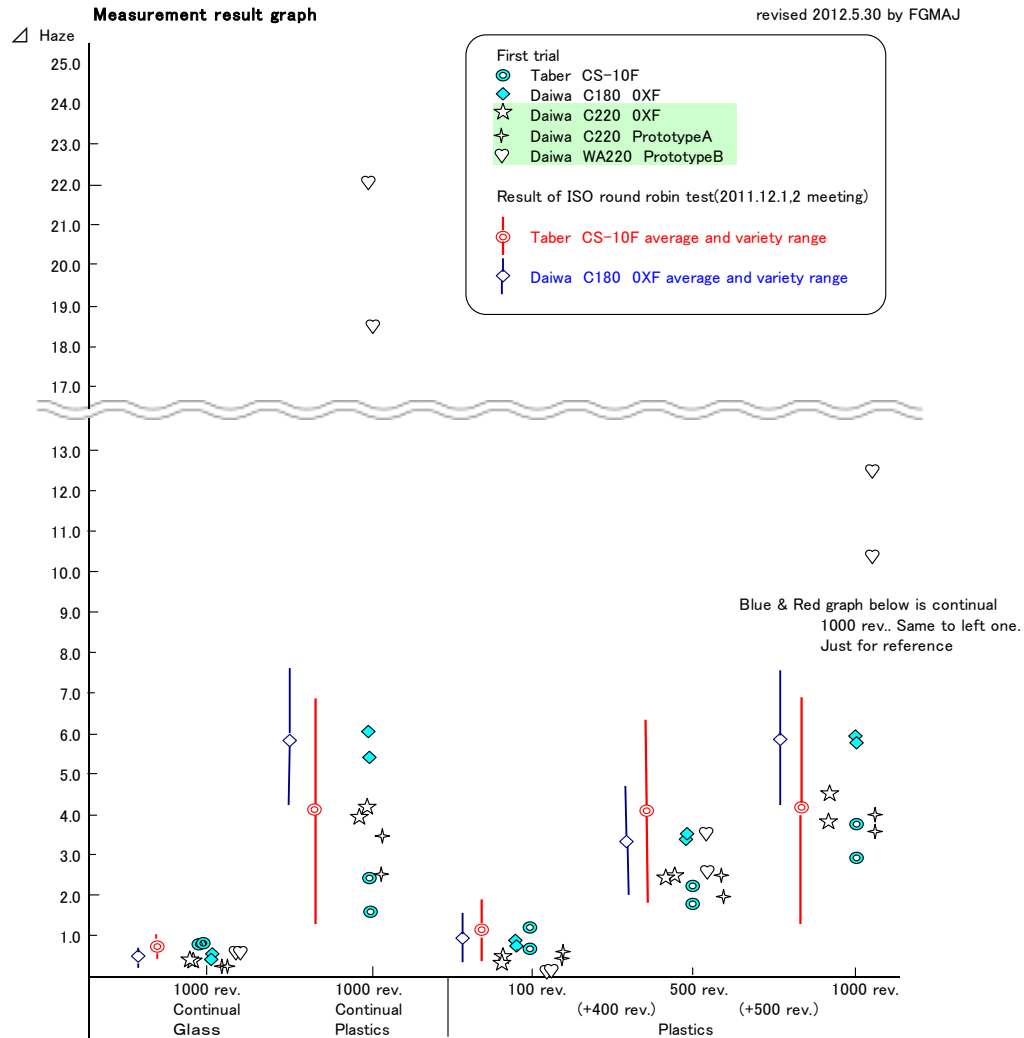
A second prototype will be made on the basis of Type-A

# Abrasion Wheel Feasibility Study Report

## (Document: First Prototype Inspection Results)

Measurement results with current and trial wheels			Glass: Central glass				Plastic: Courtesy by Bayer Germany				
Abrasion wheel	sample	revolutions	Haze				R	ave. $\Delta$ H	Figure No		
			results(1)	results(2)	results(3)	results(4)					
Current wheel	Taber	Glass-(1)	1000	0.9	0.8	1.0	0.9	0.2	0.8	3033	
		Glass-(2)	1000	0.7	1.0	0.9	0.8	0.3	0.8	3034	
	CS-10F(Gene.4)	Plastics-(1)	100	1.3	1.4	1.1	1.7	0.6	1.2	3039	
		Plastics-(1)	500(+400)	2.0	2.8	2.6	2.1	0.8	2.2	3041	
		Plastics-(1)	1000(+500)	3.2	3.9	4.6	3.8	1.4	3.7	3043	
		Plastics-(2)	100	0.8	1.0	0.7	1.0	0.3	0.7	3040	
		Plastics-(2)	500(+400)	1.8	2.2	1.9	2.2	0.4	1.8	3042	
		Plastics-(2)	1000(+500)	2.9	3.2	3.8	2.4	1.4	2.9	3044	
		Plastics-(3)	1000	1.9	1.6	1.3	2.2	0.9	1.6	3037	
		Plastics-(4)	1000	3.2	2.9	1.8	2.6	1.4	2.4	3038	
	Daiwa	Glass-(3)	1000	0.6	0.5	0.5	0.5	0.1	0.4	3035	
		Glass-(4)	1000	0.5	0.5	0.7	0.5	0.2	0.5	3036	
		C180-0XF	Plastics-(5)	100	1.3	1.0	0.9	1.0	0.4	0.9	3053
			Plastics-(5)	500(+400)	3.4	3.4	4.0	3.7	0.6	3.4	3056
			Plastics-(5)	1000(+500)	5.9	5.2	6.2	7.1	1.9	5.9	3058
			Plastics-(6)	100	1.1	0.6	0.9	1.1	0.5	0.7	3054
Plastics-(6)			500(+400)	3.8	3.9	3.8	3.7	0.2	3.6	3057	
Plastics-(6)			1000(+500)	6.8	5.8	5.2	6.2	1.6	5.8	3059	
Plastics-(7)	1000		6.5	5.7	6.4	6.4	0.8	6.1	3051		
Plastics-(8)	1000		5.2	5.7	6.0	5.3	0.8	5.4	3052		
Trial	Daiwa Trial-1	Glass-(5)	1000	0.4	0.4	0.4	0.4	0.0	0.3	3045	
		Glass-(6)	1000	0.4	0.4	0.4	0.4	0.0	0.3	3046	
	C220-0XF (Current product for other use)	Plastics-(9)	100	0.3	0.7	0.5	0.7	0.4	0.4	3060	
		Plastics-(9)	500(+400)	3.4	2.1	2.8	2.6	1.3	2.5	3062	
		Plastics-(9)	1000(+500)	3.7	3.5	4.1	4.6	1.1	3.8	3065	
		Plastics-(10)	100	0.7	0.7	0.4	0.3	0.4	0.3	3061	
		Plastics-(10)	500(+400)	2.1	1.6	3.1	3.8	2.2	2.5	3063	
		Plastics-(10)	1000(+500)	4.9	3.9	4.9	4.9	1.0	4.5	3066	
		Plastics-(11)	1000	4.1	3.6	4.2	4.3	0.7	3.9	3047	
		Plastics-(12)	1000	4.5	4.1	4.6	4.5	0.5	4.2	3048	
		Daiwa Trial-2	Glass-(7)	1000	0.3	0.3	0.3	0.3	0.0	0.2	3075
			Glass-(8)	1000	0.3	0.2	0.3	0.3	0.1	0.2	3076
	C220-PrototypeA		Plastics-(13)	100	0.6	0.6	0.7	0.6	0.1	0.4	3068
			Plastics-(13)	500(+400)	2.8	2.2	2.9	2.7	0.7	2.5	3070
			Plastics-(13)	1000(+500)	4.2	3.8	4.4	4.4	0.6	4.0	3073
			Plastics-(14)	100	0.8	0.9	0.6	0.7	0.3	0.6	3069
			Plastics-(14)	500(+400)	2.0	2.1	2.2	1.9	0.3	1.9	3071
			Plastics-(14)	1000(+500)	3.6	3.3	4.0	4.4	1.1	3.6	3074
	Daiwa Trial-3	Plastics-(15)	1000	3.6	3.7	3.9	3.6	0.3	3.5	3067	
		Plastics-(16)	1000	2.5	2.8	2.3	3.1	0.8	2.5	3072	
WA220-PrototypeB		Glass-(9)	1000	0.7	0.7	0.7	0.6	0.1	0.6	3050	
		Glass-(10)	1000	0.7	0.7	0.8	0.7	0.1	0.6	3077	
		Plastics-(17)	100	0.3	0.4	0.3	0.3	0.1	0.1	3078	
		Plastics-(17)	500(+400)	3.4	3.8	4.1	4.0	0.7	3.6	3080	
		Plastics-(17)	1000(+500)	12.0	12.4	13.9	12.4	1.9	12.5	3083	
		Plastics-(18)	100	0.3	0.3	0.3	0.3	0.0	0.1	3079	
	Plastics-(18)	500(+400)	3.0	2.5	2.6	3.1	0.6	2.6	3082		
	Plastics-(18)	1000(+500)	9.1	11.0	11.0	10.7	1.9	10.3	3084		
	Plastics-(19)	1000	22.6	23.1	20.1	23.3	3.2	22.1	3049		
	Plastics-(20)	1000	18.9	18.5	19.2	18.2	1.0	18.5	3081		

# Abrasion Wheel Feasibility Study Report



# Abrasion Wheel Feasibility Study Report

## WHEEL DATA

Wheel Type	LOT	Checked	Valid	Weight gr		ISO Reguration						Remarks
						Diameter 45mm~50mm		Width 12.5±0.5mm		Hardness 72±5 IRHD		
				R	L	R	L	R	L	R	L	
CS-10F Gene.IV	2011/10/3	2012/5/8	Oct-12			52.0	52.0	12.8	12.8	89	89	* Standard of Taber for glass * Hardness do not meet ISO criteria
Daiwa C180 OXF	2011/10/25	2012/5/8	-	45.5 * new wheel	45.5 * new wheel	46.1	45.6	12.5	12.5	74	74	* Standard of Daiwa Kasei for glass
Daiwa C220 OXF	2012/4/*	2012/5/9	-	44.0	44.0	50.2	50.2	12.5	12.5	77	77	* Prototype of Daiwa Kasei grain size of C180 OXF only changed (from 180 mesh to 220 mesh)
Daiwa C220 PrototypeA	2012/4/*	2012/5/9	-	45.0	45.0	50.1	50.1	12.5	12.5	79	79	* Prototype of Daiwa Kasei rubber of C220 OXF only changed
Daiwa WA220 PrototypeB	2012/4/*	2012/5/9	-	56.0	56.0	50.2	50.2	12.5	12.5	75	75	* Prototype of Daiwa Kasei grit grain and rubber of C220 OXF changed

## TESTING METHOD

GLASS(1000 rev.) G1~G10	Abrasive wheel reface (25 rev.) → 1000 rev. abrasion (continual)
PLASTIC(100 rev.) P1,P2,P5,P6,P9,P10 P13,P14,P17,P18	Abrasive wheel reface (25 rev.) → 100 rev. abrasion (continual)
PLASTIC(500 rev.) P1,P2,P5,P6,P9,P10 P13,P14,P17,P18	Abrasive wheel reface (25 rev.) → 100 rev. abrasion (continual) → Abrasive wheel reface (25 rev.) → 400 rev. abrasion (continual)
PLASTIC(1000 rev.) P1,P2,P5,P6,P9,P10 P13,P14,P17,P18	Abrasive wheel reface (25 rev.) → 100 rev. abrasion (continual) → Abrasive wheel reface (25 rev.) → 400 rev. abrasion (continual) → Abrasive wheel reface (25 rev.) → 500 rev. abrasion (continual)
PLASTIC(1000 rev.) P3,P4,P7,P8,P11,P12 P15,P16,P19,P20	Abrasive wheel reface (25 rev.) → 1000 rev. abrasion (continual)



# Abrasion Wheel Feasibility Study Report

---

## 9. Second Prototypes

Hardness :  $\approx 75$  IRHD

Particle size: test at three levels: #400, #600, #800



As the particle size decreases,  $\Delta H$  tends to be higher, failing to achieve the goal.

# Abrasion Wheel Feasibility Study Report

## FIRST TRIAL

(at CENTRAL GLASS May 2012)

Plastic samples were provided by courtesy of Bayer German

Abrasion Wheel	Sample No.	Rotation	Haze value						Pict. No.	
			initial	at 1	at 2	at 3	at 4	R		ΔH
Daiwa trial-1 C220-0XF (Current product for other use)	Glass-(5)	1000	0.1	0.4	0.4	0.4	0.4	0.0	0.3	3045
	Glass-(6)	1000	0.1	0.4	0.4	0.4	0.4	0.0	0.3	3046
	Plastics-(9)	100	0.2	0.3	0.7	0.5	0.7	0.4	0.4	3060
	Plastics-(9)	500(+400)	0.2	3.4	2.1	2.8	2.6	1.3	2.5	3062
	Plastics-(9)	1000(+500)	0.2	3.7	3.5	4.1	4.6	1.1	3.8	3065
	Plastics-(10)	100	0.2	0.7	0.7	0.4	0.3	0.4	0.3	3061
	Plastics-(10)	500(+400)	0.2	2.1	1.6	3.1	3.8	2.2	2.5	3063
	Plastics-(10)	1000(+500)	0.2	4.9	3.9	4.9	4.9	1.0	4.5	3066
	Plastics-(11)	1000	0.2	4.1	3.6	4.2	4.3	0.7	3.9	3047
	Plastics-(12)	1000	0.2	4.5	4.1	4.6	4.5	0.5	4.2	3048
Daiwa trial-2 C220-Prototype A	Glass-(7)	1000	0.1	0.3	0.3	0.3	0.3	0.0	0.2	3075
	Glass-(8)	1000	0.1	0.3	0.2	0.3	0.3	0.1	0.2	3076
	Plastics-(13)	100	0.2	0.6	0.6	0.7	0.6	0.1	0.4	3068
	Plastics-(13)	500(+400)	0.2	2.8	2.2	2.9	2.7	0.7	2.5	3070
	Plastics-(13)	1000(+500)	0.2	4.2	3.8	4.4	4.4	0.6	4.0	3073
	Plastics-(14)	100	0.2	0.8	0.9	0.6	0.7	0.3	0.6	3069
	Plastics-(14)	500(+400)	0.2	2.0	2.1	2.2	1.9	0.3	1.9	3071
	Plastics-(14)	1000(+500)	0.2	3.6	3.3	4.0	4.4	1.1	3.6	3074
	Plastics-(15)	1000	0.2	3.6	3.7	3.9	3.6	0.3	3.5	3067
	Plastics-(16)	1000	0.2	2.5	2.8	2.3	3.1	0.8	2.5	3072
Daiwa trial-3 WA220-Prototype B	Glass-(9)	1000	0.1	0.7	0.7	0.7	0.6	0.1	0.6	3050
	Glass-(10)	1000	0.1	0.7	0.7	0.8	0.7	0.1	0.6	3077
	Plastics-(17)	100	0.2	0.3	0.4	0.3	0.3	0.1	0.1	3078
	Plastics-(17)	500(+400)	0.2	3.4	3.8	4.1	4.0	0.7	3.6	3080
	Plastics-(17)	1000(+500)	0.2	12.0	12.4	13.9	12.4	1.9	12.5	3083
	Plastics-(18)	100	0.2	0.3	0.3	0.3	0.3	0.0	0.1	3079
	Plastics-(18)	500(+400)	0.2	3.0	2.5	2.6	3.1	0.6	2.6	3082
	Plastics-(18)	1000(+500)	0.2	9.1	11.0	11.0	10.7	1.9	10.3	3084
	Plastics-(19)	1000	0.2	22.6	23.1	20.1	23.3	3.2	22.1	3049
	Plastics-(20)	1000	0.2	18.9	18.5	19.2	18.2	1.0	18.5	3081

Note: "at 1..." in the table represents the haze value after abrasion at each point.

# Abrasion Wheel Feasibility Study Report

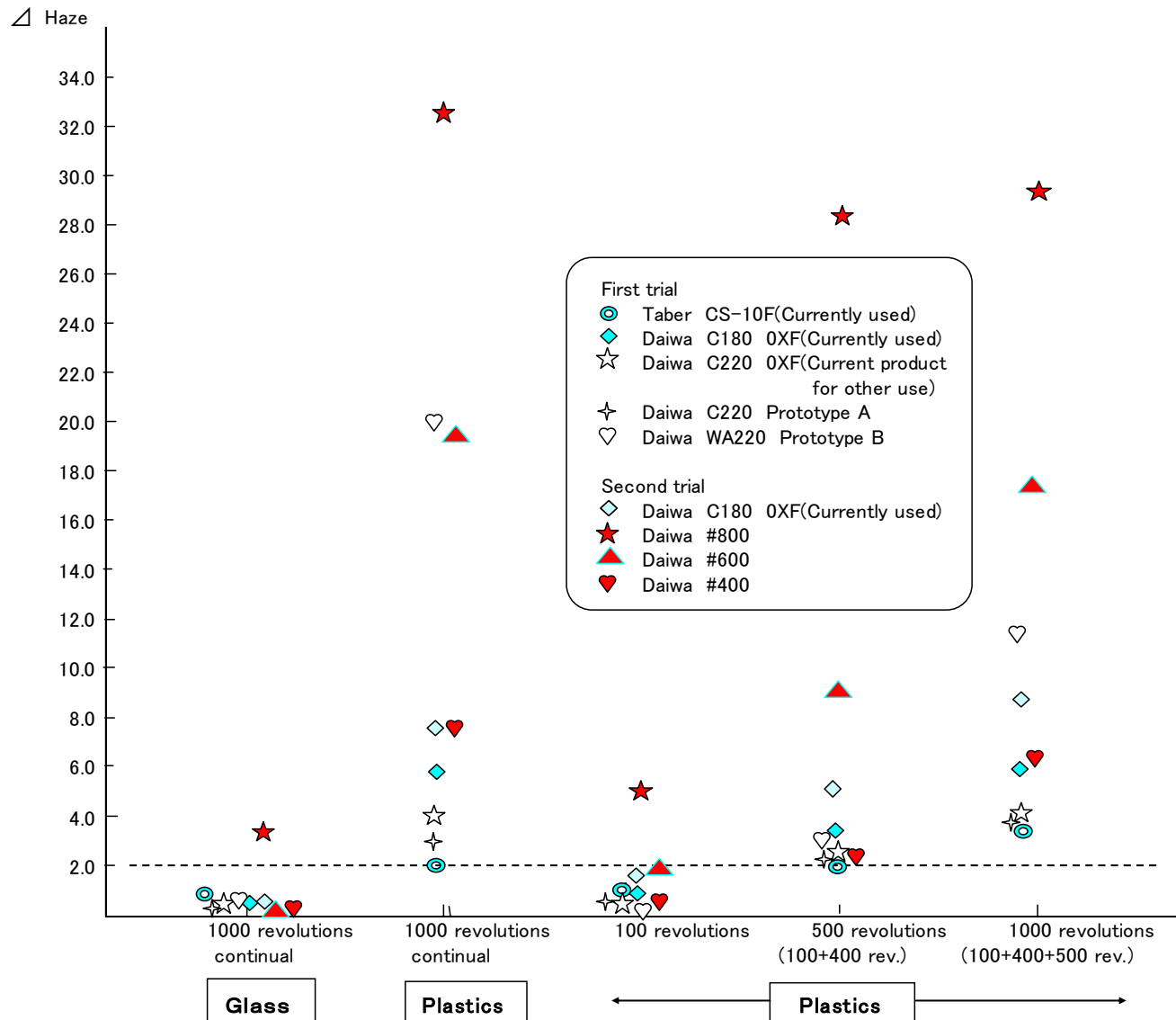
## SECOND TRIAL

(at CENTRAL GLASS August 2012)

Plastic samples were provided by courtesy of Bayer German:

Abrasion Wheel	Sample No.	Rotation	Haze value								R	ΔH	Pict. No.
			initial	at 1	at 2	at 3	at 4	average					
Daiwa trial-4 #800	Glass-(5)	1000	0.1	3.3	3.4	3.6	3.5	3.5	0.3	3.4	4061		
	Glass-(6)	1000	0.1	3.2	3.3	3.1	3.1	3.2	0.2	3.1	4124		
	Plastics-(9)	100	0.2	4.4	4.6	4.8	5.2	4.8	0.8	4.6	4123		
	Plastics-(9)	500(+400)	0.2	27.1	25.9	26.4	24.0	25.9	3.1	25.7	4068		
	Plastics-(9)	1000(+500)	0.2	34.2	3.4	30.3	33.2	25.3	30.8	25.1	4069		
	Plastics-(10)	100	0.2	5.6	5.6	5.3	5.4	5.5	0.3	5.3	4070		
	Plastics-(10)	500(+400)	0.2	30.5	32.5	30.7	30.8	31.1	2.0	30.9	4071		
	Plastics-(10)	1000(+500)	0.2	31.8	36.2	33.1	33.2	33.6	4.4	33.4	4073		
	Plastics-(11)	1000	0.2	28.0	30.2	27.8	29.1	28.8	2.4	28.6	4074		
	Plastics-(12)	1000	0.2	37.1	37.4	36.1	36.0	36.7	1.4	36.5	4075		
	Daiwa trial-5 #600	Glass-(7)	1000	0.1	0.5	0.4	0.4	0.4	0.4	0.1	0.3	4076	
		Glass-(8)	1000	0.1	0.4	0.4	0.4	0.3	0.4	0.1	0.3	4118	
Plastics-(13)		100	0.2	3.0	2.3	2.4	2.4	2.5	0.7	2.3	4125		
Plastics-(13)		500(+400)	0.2	9.0	10.1	9.3	10.0	9.6	1.1	9.4	4077		
Plastics-(13)		1000(+500)	0.2	13.5	18.6	16.0	16.7	16.2	5.1	16.0	4078		
Plastics-(14)		100	0.2	2.2	2.5	0.9	1.6	1.8	1.6	1.6	4080		
Plastics-(14)		500(+400)	0.2	5.4	9.9	10.0	10.1	8.9	4.7	8.7	4081		
Plastics-(14)		1000(+500)	0.2	18.2	19.8	18.8	20.7	19.4	2.5	19.2	4083		
Plastics-(15)		1000	0.2	21.3	19.3	18.7	19.6	19.7	2.6	19.5	4087		
Plastics-(16)		1000	0.2	20.3	20.5	19.0	19.5	19.8	1.5	19.6	4088		
Daiwa trial-6 #400		Glass-(9)	1000	0.1	0.4	0.4	0.4	0.4	0.4	0.0	0.3	4089	
		Glass-(10)	1000	0.1	0.3	0.3	0.4	0.4	0.4	0.1	0.3	4116	
	Plastics-(17)	100	0.2	0.6	0.8	0.6	0.6	0.7	0.2	0.5	4117		
	Plastics-(17)	500(+400)	0.2	2.2	3.2	1.8	3.2	2.6	1.4	2.4	4090		
	Plastics-(17)	1000(+500)	0.2	8.0	6.5	7.6	6.6	7.2	1.5	7.0	4091		
	Plastics-(18)	100	0.2	0.4	0.6	0.6	0.8	0.6	0.4	0.4	4093		
	Plastics-(18)	500(+400)	0.2	2.7	2.3	2.5	2.1	2.4	0.6	2.2	4097		
	Plastics-(18)	1000(+500)	0.2	5.5	5.9	6.1	5.2	5.7	0.9	5.5	4098		
	Plastics-(19)	1000	0.2	9.4	10.2	9.7	10.1	9.9	0.8	9.7	4112		
	Plastics-(20)	1000	0.2	5.5	5.2	5.8	6.5	5.8	1.3	5.6	4113		

# Abrasion Wheel Feasibility Study Report



# Abrasion Wheel Feasibility Study Report

FIRST TRIAL		(at CENTRAL GLASS May 2012)					Plastic samples were provided by courtesy of Bayer Germany						
Abrasion Wheel	Sample No.	Rotation	Haze value					R	ΔH	ΔH ave	photo No		
			initial	at 1	at 2	at 3	at 4						
Taber CS-10F(Gene.4)	Glass-(1)	1000	0.1	0.9	0.8	1.0	0.9	0.2	0.8	0.8	3033		
	Glass-(2)	1000	0.1	0.7	1.0	0.9	0.8	0.3	0.8		3034		
	Plastics-(1)	100	0.2	1.3	1.4	1.1	1.7	0.6	1.2		3039		
	Plastics-(2)	100	0.2	0.8	1.0	0.7	1.0	0.3	0.7		1.0	3040	
	Plastics-(1)	500(+400)	0.2	2.0	2.8	2.6	2.1	0.8	2.2		3041		
	Plastics-(2)	500(+400)	0.2	1.8	2.2	1.9	2.2	0.4	1.8		2.0	3042	
	Plastics-(1)	1000(+500)	0.2	3.2	3.9	4.6	3.8	1.4	3.7		3043		
	Plastics-(2)	1000(+500)	0.2	2.9	3.2	3.8	2.4	1.4	2.9		3.3	3044	
	Plastics-(3)	1000	0.2	1.9	1.6	1.3	2.2	0.9	1.6		3037		
	Plastics-(4)	1000	0.2	3.2	2.9	1.8	2.6	1.4	2.4		2.0	3038	
	Glass-(3)	1000	0.1	0.6	0.5	0.5	0.5	0.1	0.4		3035		
	Glass-(4)	1000	0.1	0.5	0.5	0.7	0.5	0.2	0.5		0.5	3036	
Daiwa C180-0XF	Plastics-(5)	100	0.2	1.3	1.0	0.9	1.0	0.4	0.9	0.8	3053		
	Plastics-(6)	100	0.2	1.1	0.6	0.9	1.1	0.5	0.7		3054		
	Plastics-(5)	500(+400)	0.2	3.4	3.4	4.0	3.7	0.6	3.4		3056		
	Plastics-(6)	500(+400)	0.2	3.8	3.9	3.8	3.7	0.2	3.6		3.5	3057	
	Plastics-(5)	1000(+500)	0.2	5.9	5.2	6.2	7.1	1.9	5.9		3058		
	Plastics-(6)	1000(+500)	0.2	6.8	5.8	5.2	6.2	1.6	5.8		5.9	3059	
	Plastics-(7)	1000	0.2	6.5	5.7	6.4	6.4	0.8	6.1		3051		
	Plastics-(8)	1000	0.2	5.2	5.7	6.0	5.3	0.8	5.4		5.8	3052	
	Glass-(5)	1000	0.1	0.4	0.4	0.4	0.4	0.0	0.3		3045		
	Glass-(6)	1000	0.1	0.4	0.4	0.4	0.4	0.0	0.3		0.3	3046	
Daiwa trial-1 C220-0XF (Current product for other use)	Plastics-(9)	100	0.2	0.3	0.7	0.5	0.7	0.4	0.4	0.4	3060		
	Plastics-(10)	100	0.2	0.7	0.7	0.4	0.3	0.4	0.3		3061		
	Plastics-(9)	500(+400)	0.2	3.4	2.1	2.8	2.6	1.3	2.5		3062		
	Plastics-(10)	500(+400)	0.2	2.1	1.6	3.1	3.8	2.2	2.5		2.5	3063	
	Plastics-(9)	1000(+500)	0.2	3.7	3.5	4.1	4.6	1.1	3.8		3065		
	Plastics-(10)	1000(+500)	0.2	4.9	3.9	4.9	4.9	1.0	4.5		4.2	3066	
	Plastics-(11)	1000	0.2	4.1	3.6	4.2	4.3	0.7	3.9		3047		
	Plastics-(12)	1000	0.2	4.5	4.1	4.6	4.5	0.5	4.2		4.1	3048	
	Glass-(7)	1000	0.1	0.3	0.3	0.3	0.3	0.0	0.2		3075		
	Glass-(8)	1000	0.1	0.3	0.2	0.3	0.3	0.1	0.2		0.2	3076	
	Daiwa trial-2 C220-Prototype A	Plastics-(13)	100	0.2	0.6	0.6	0.7	0.6	0.1		0.4	0.5	3068
		Plastics-(14)	100	0.2	0.8	0.9	0.6	0.7	0.3		0.6		3069
Plastics-(13)		500(+400)	0.2	2.8	2.2	2.9	2.7	0.7	2.5	3070			
Plastics-(14)		500(+400)	0.2	2.0	2.1	2.2	1.9	0.3	1.9	2.2	3071		
Plastics-(13)		1000(+500)	0.2	4.2	3.8	4.4	4.4	0.6	4.0	3073			
Plastics-(14)		1000(+500)	0.2	3.6	3.3	4.0	4.4	1.1	3.6	3.8	3074		
Plastics-(15)		1000	0.2	3.6	3.7	3.9	3.6	0.3	3.5	3067			
Plastics-(16)		1000	0.2	2.5	2.8	2.3	3.1	0.8	2.5	3.0	3072		
Glass-(9)		1000	0.1	0.7	0.7	0.7	0.6	0.1	0.6	3050			
Glass-(10)		1000	0.1	0.7	0.7	0.8	0.7	0.1	0.6	0.6	3077		
Daiwa trial-3 WA220-Prototype B	Plastics-(17)	100	0.2	0.3	0.4	0.3	0.3	0.1	0.1	0.1	3078		
	Plastics-(18)	100	0.2	0.3	0.3	0.3	0.3	0.0	0.1		3079		
	Plastics-(17)	500(+400)	0.2	3.4	3.8	4.1	4.0	0.7	3.6		3080		
	Plastics-(18)	500(+400)	0.2	3.0	2.5	2.6	3.1	0.6	2.6		3.1	3082	
	Plastics-(17)	1000(+500)	0.2	12.0	12.4	13.9	12.4	1.9	12.5		3083		
	Plastics-(18)	1000(+500)	0.2	9.1	11.0	11.0	10.7	1.9	10.3		11.4	3084	
	Plastics-(19)	1000	0.2	22.6	23.1	20.1	23.3	3.2	22.1		3049		
	Plastics-(20)	1000	0.2	18.9	18.5	19.2	18.2	1.0	18.5		20.3	3081	

Note: "at 1..." in the table represents the haze value after abrasion at each point.

# Abrasion Wheel Feasibility Study Report

## SECOND TRIAL

(at CENTRAL GLASS August 2012)

Plastic samples were provided by courtesy of Bayer Germany

Abrasion Wheel	Sample No.	Rotation	Haze value							R	ΔH	ΔH ave	photo No
			initial	at 1	at 2	at 3	at 4	average					
Daiwa C180-0XF	Glass-(3)	1000	0.1	0.5	0.6	0.6	0.5	0.6	0.1	0.5		4057	
	Glass-(4)	1000	0.1	0.7	0.7	0.7	0.7	0.7	0.0	0.6	0.6	4058	
	Plastics-(5)	100	0.2	1.7	2.1	1.7	1.9	1.9	0.4	1.7		4059	
	Plastics-(6)	100	0.2	1.7	1.9	1.7	1.9	1.8	0.2	1.6	1.7	4062	
	Plastics-(5)	500(+400)	0.2	5.6	5.9	5.6	5.9	5.8	0.3	5.6		4060	
	Plastics-(6)	500(+400)	0.2	5.1	5.7	4.2	4.5	4.9	1.5	4.7	5.2	4063	
	Plastics-(5)	1000(+500)	0.2	10.0	10.1	9.5	9.0	9.7	1.1	9.5		4061	
	Plastics-(6)	1000(+500)	0.2	8.1	7.9	7.8	9.1	8.2	1.3	8.0	8.8	4064	
	Plastics-(7)	1000	0.2	8.2	7.5	9.7	6.7	8.0	3.0	7.8		4066	
	Plastics-(8)	1000	0.2	8.6	7.0	7.9	7.4	7.7	1.6	7.5	7.7	4067	
Daiwa trial-4 #800	Glass-(5)	1000	0.1	3.3	3.4	3.6	3.5	3.5	0.3	3.4		4124	
	Glass-(6)	1000	0.1	3.2	3.3	3.1	3.1	3.2	0.2	3.1	3.3	4123	
	Plastics-(9)	100	0.2	4.4	4.6	4.8	5.2	4.8	0.8	4.6		4068	
	Plastics-(10)	100	0.2	5.6	5.6	5.3	5.4	5.5	0.3	5.3	5.0	4071	
	Plastics-(9)	500(+400)	0.2	27.1	25.9	26.4	24.0	25.9	3.1	25.7		4069	
	Plastics-(10)	500(+400)	0.2	30.5	32.5	30.7	30.8	31.1	2.0	30.9	28.3	4073	
	Plastics-(9)	1000(+500)	0.2	34.2	3.4	30.3	33.2	25.3	30.8	25.1		4070	
	Plastics-(10)	1000(+500)	0.2	31.8	36.2	33.1	33.2	33.6	4.4	33.4	29.3	4074	
	Plastics-(11)	1000	0.2	28.0	30.2	27.8	29.1	28.8	2.4	28.6		4075	
	Plastics-(12)	1000	0.2	37.1	37.4	36.1	36.0	36.7	1.4	36.5	32.6	4076	
Daiwa trial-5 #600	Glass-(7)	1000	0.1	0.5	0.4	0.4	0.4	0.4	0.1	0.3		4118	
	Glass-(8)	1000	0.1	0.4	0.4	0.4	0.3	0.4	0.1	0.3	0.3	4125	
	Plastics-(13)	100	0.2	3.0	2.3	2.4	2.4	2.5	0.7	2.3		4077	
	Plastics-(14)	100	0.2	2.2	2.5	0.9	1.6	1.8	1.6	1.6	2.0	4081	
	Plastics-(13)	500(+400)	0.2	9.0	10.1	9.3	10.0	9.6	1.1	9.4		4078	
	Plastics-(14)	500(+400)	0.2	5.4	9.9	10.0	10.1	8.9	4.7	8.7	9.1	4083	
	Plastics-(13)	1000(+500)	0.2	13.5	18.6	16.0	16.7	16.2	5.1	16.0		4080	
	Plastics-(14)	1000(+500)	0.2	18.2	19.8	18.8	20.7	19.4	2.5	19.2	17.6	4087	
	Plastics-(15)	1000	0.2	21.3	19.3	18.7	19.6	19.7	2.6	19.5		4088	
	Plastics-(16)	1000	0.2	20.3	20.5	19.0	19.5	19.8	1.5	19.6	19.6	4089	
Daiwa trial-6 #400	Glass-(9)	1000	0.1	0.4	0.4	0.4	0.4	0.4	0.0	0.3		4116	
	Glass-(10)	1000	0.1	0.3	0.3	0.4	0.4	0.4	0.1	0.3	0.3	4117	
	Plastics-(17)	100	0.2	0.6	0.8	0.6	0.6	0.7	0.2	0.5		4090	
	Plastics-(18)	100	0.2	0.4	0.6	0.6	0.8	0.6	0.4	0.4	0.5	4097	
	Plastics-(17)	500(+400)	0.2	2.2	3.2	1.8	3.2	2.6	1.4	2.4		4091	
	Plastics-(18)	500(+400)	0.2	2.7	2.3	2.5	2.1	2.4	0.6	2.2	2.3	4098	
	Plastics-(17)	1000(+500)	0.2	8.0	6.5	7.6	6.6	7.2	1.5	7.0		4093	
	Plastics-(18)	1000(+500)	0.2	5.5	5.9	6.1	5.2	5.7	0.9	5.5	6.3	4112	
	Plastics-(19)	1000	0.2	9.4	10.2	9.7	10.1	9.9	0.8	9.7		4113	
	Plastics-(20)	1000	0.2	5.5	5.2	5.8	6.5	5.8	1.3	5.6	7.7	4114	

# Abrasion Wheel Feasibility Study Report

## WHEEL DATA

### First trial

Wheel Type	LOT	Checked	Valid	Weight_gr		ISO Regulation						Remarks
						Diameter 45mm~50mm		Width 12.5±0.5mm		Hardness 72±5 IRHD		
				R	L	R	L	R	L	R	L	
CS-10F Gene.IV	2011/10/3	2012/5/8	Oct-12			52.0	52.0	12.8	12.8	89	89	*Taber's standard wheel for glass
Daiwa C180 0XF	2011/10/25	2012/5/8	-	45.5 *Before use	45.5 *Before use	46.1	45.6	12.5	12.5	74	74	*Daiwa's standard wheel for glass (Currently used)
Daiwa C220 0XF	2012/4/*	2012/5/9	-	44.0	44.0	50.2	50.2	12.5	12.5	77	77	*Daiwa's prototype C180 0XF, but its particle size was changed (220 mesh instead of 180 mesh)
Daiwa C220 Prototype A	2012/4/*	2012/5/9	-	45.0	45.0	50.1	50.1	12.5	12.5	79	79	*Daiwa's prototype C220 0XF, but its resilient material was changed
Daiwa WA220 Prototype B	2012/4/*	2012/5/9	-	56.0	56.0	50.2	50.2	12.5	12.5	75	75	*Daiwa's prototype C220 0XF, but its abrasive particles and resilient material were changed

### Second trial

Wheel Type	LOT	Checked	Valid	Weight_gr		ISO Regulation						Remarks
						Diameter 45mm~50mm		Width 12.5±0.5mm		Hardness 72±5 IRHD		
				R	L	R	L	R	L	R	L	
Daiwa C180 0XF	2012/8/10	2012/8/10		44.4	44.5	49.9	50.0	12.4	12.5	75	75	*Daiwa's standard wheel for glass (New)
Daiwa #800	2012/8/10	2012/8/10		47.1	47.3	50.2	50.1	12.5	12.5	75	75	*Daiwa's prototype C180 0XF, but its particle size was changed (800 mesh instead of 180 mesh)
Daiwa #600	2012/8/10	2012/8/10		43.8	43.6	50.1	50.1	12.8	12.8	75	75	*Daiwa's prototype C180 0XF, but its particle size was changed (600 mesh instead of 180 mesh)
Daiwa #400	2012/8/10	2012/8/10		44.2	44.2	50.0	50.0	12.7	12.7	75	75	*Daiwa's prototype C180 0XF, but its particle size was changed (400 mesh instead of 180 mesh)

### TESTING METHOD

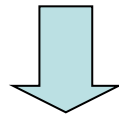
GLASS (1000 rev.)	Refacing (25 rev.) → 1000 rev. (continual)
PLASTICS (100 rev.)	Refacing (25 rev.) → 100 rev. (continual)
PLASTICS (500 rev.)	Refacing (25 rev.) → 100 rev. (continual) → Refacing (25 rev.) → 400 rev. (continual)
PLASTICS (1000 rev.)	Refacing (25 rev.) → 100 rev. (continual) → Refacing (25 rev.) → 400 rev. (continual) → Refacing (25 rev.) → 500 rev. (continual)
PLASTICS (1000 rev.)	Refacing (25 rev.) → 1000 rev. (continual)

# Abrasion Wheel Feasibility Study Report

---

## 10. Results and Future Plans

- 1) Review the particle size and rubber-to-abrasive particle ratio
- 2) Alter abrasive particle quality
- 3) Change the hardness and resin composition.



Evaluate the 4 third trial samples Daiwa made



**Thank you very much  
for your attention.**