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REPORT
ON
THE FEASIBILITY STUDY OF SAFETY GLASS
IN
BURMA

May, 1981

Japan International Cooperation Agency
(JICA)

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INTRODUCTION

1. Background

The present feasibility study on the establishment of a safety glass plant was conducted as a result of the request made by the Ceramic Industries Corporation (hereinafter referred to as CIC) of the Socialist Republic of the Union of Burma for the dispatch of a safety glass specialist by the Japan International Cooperation Agency (hereinafter referred to as JICA). The background to the present feasibility study may be outlined as below.

1) Since the commencement of production by the CIC sheet glass plant in Bassein, southern Burma, in September, 1979, production of sheet glass has been extremely satisfactory, reaching its capacity production of 12,000 tons per year. Moreover, the highest standard of quality for sheet glass has been maintained.

   On the other hand, since the domestic demand is under 5,000 tons, the surplus is allocated to exports to sustain plant operation; but this still leaves some surplus, which is desired to effectively be used to produce tinted glass and mirrors as well as safety glass.

2) Since the commencement of vehicle assembly in Burma in 1962, domestic production of parts has been promoted except for safety glass for vehicle windows. Accordingly, domestic production of safety glass is to be promoted to prevent the drain on foreign currency reserves. Furthermore, only imported flat laminated glass is used for replacement to broken glass and it is difficult to obtain bent glass for windshield at present.

3) Improvement in the standard of living by supplying safety glass for vehicles, shipping and buildings is desirable and the acquisition of technical know-how is to be promoted.

Accordingly, the present feasibility study is intended to estimate the demand for safety glass for vehicles to be domestically produced and for replacement of existing vehicles and also for rolling stock, shipping and buildings and to ascertain the economic feasibility of an appropriate plant to produce safety glass from sheet glass produced in Bassein, studying, at the same time, the technical, quality and management aspects of the plant.

2. Survey Expert and Survey Activities

2-1. Survey expert

Masao OJIMA (Safety Glass Expert)

2-2. Survey period.

For a period of 29 days from March 14 (arrival in Rangoon) to April 11 (departure from Rangoon), 1981.

2-3. Major establishment visited

Ceramic Industries Corporation, Head Office.
Ceramic Industries Corporation, Bassein Sheet Glass Factory.
Ceramic Industries Corporation, Syriam Bottle Glass Factory.
Industrial Planning Department, Head Office.
Heavy Industries Corporation, Head Office.
Vehicle and Machinery Store Trade Corporation.
Road Transport Corporation.
Road Transport Administrative Department.
Construction Corporation, Head Office.
Inland Water Transport Corporation, Head Office.
Central Statistical Organization.
Burma Railway Corporation.
Foreign Economic Relations Department.
Embassy of Japan.

3. Summary and Conclusion

3-1. Estimate of demand for safety glass

1) Demand for safety glass for motor vehicles.

Domestic production of motor vehicles in Burma was started in 1962 with Japan's technical assistance. Now that Burma has come out of its long economic seclusion there is a strong domestic demand for cars, centering in Rangoon, and the importation of complete units has to be accepted under the present situation. Materials and parts necessary for car production are imported from Japan in considerable quantities and production is expected to be restricted for the time being because of the situation with the Overseas Assistance Funds. After visiting car related establishments including HIC and observing towns including Rangoon during the feasibility study, the present writer formed the view that though the car industry will no doubt expand eventually, the average rate of growth will be 5% for the next decade.

As regards the present situation of glass for replacement, it was found to be extremely difficult to estimate the demand unlike in the case of glass for car production. Since it was impossible to ascertain the past records and extremely difficult to compute the rate of damage to window glass, the present demand was estimated on the basis of purchase plans of various organizations for 1981.

Moreover, though the number of car holdings has been increasing in recent years under the above-mentioned circumstances, many of them are becoming obsolete and the number of cars to be scrapped is expected to increase. Since complete units are imported

in the light of the required transport volume, the number of car holdings was estimated to increase by 3.5% annually during the next decade or so and the demand for glass for replacement was estimated proportionately to the increase in car holdings.

The present writer saw, however, passenger cars with glass parts left damaged or repaired by methods unseen in other countries, e.g., strips of flat glass (sheet glass or flat laminated glass) secured with putty to replace a broken windshield or rear window with deep bending. In view of the leak of water in the wet season, damage to wipers, visibility and safety, it was understandable that the demand for domestic production of safety glass was increasing. The potential demand for bent glass seemed, therefore, to be fairly large; but it was estimated by taking account of restrictions on production.

However, annual car production of 2,200 units and the total holdings of 88,000 form too small a market for starting a safety glass enterprise and it was expected from the beginning that the demand from cars alone would not form an economic unit.

The demand for safety glass for motor vehicles during the period from 1981 to 1990 was finally estimated to increase by 4.2% annually on a quantity basis (m^2/year) from 6,720 m^2/year (28,750 sheets/year) in 1981 to 10,075 m^2/year (43,200 sheets/year) in 1990.

2) Estimated demand for safety glass for other uses.

Survey was thus conducted for the above reason to discover a possible demand for those other than motor vehicles, supported by the government's firm resolution to create demand even by setting up safety regulations as a government measures.

a) The most developed form of transportation in Burma is water transport with more than 3,000 vessels of various sizes transporting both people and goods. Since the government has been making every effort to export rice, cement, fertilizer, etc. in recent years, resulting in a marked increase in total tonnage to increase the transport capacity.

The Inland Water Transport Corporation, for instance, is troubled by broken windows during the wet season with a high rate of damage and strongly desires a change to tempered glass. However, since it was virtually impossible to conduct a survey on many vessels not belonging to the Corporation due to the lack of statistical data, the demand was estimated on the basis of vessel holdings by type. The potential demand for 1981 was thus estimated to be 5,900 sheets (2,466 m^2) with an annual rate of 5%.

b) Survey was also conducted on coach windows at the Burma Railway Corporation and at Rangoon Central Station. It was learned then that no window had glass except on some coaches recently imported from Japan and West Germany. Glass was taken off windows due to the fact that safety glass is not produced in Burma and that passengers were often injured as stones were thrown at raw glass. The BRC

officials and others saw the necessity of safety glass and were hoping to install it when the budget permits it. The potential demand was estimated to increase from 654 m^2 (1,160 sheets) in 1981 to 900 m^2 (1,600 sheets) in 1990.

c) It was most difficult to estimate the demand for safety glass for buildings. As it concerns the largest opening space, once generated, the demand will form a large sector. On the other hand, there is no urgency involved since they are not means of transport. The future prospects and estimated data were obtained on visits to the Construction Corporation to be used, together with construction data centering around Rangoon, to attempt an estimate.

As regards the current use of safety glass for buildings, though accurate data are not available, it does not seem to be in much use. Eventually, based on the view held by the Construction Corporation, it was concluded that the best step would be to institute Burma's own regulations, adopting part of the U.S. safety regulations on architectural glass. The CPSC is therefore quoted at the end of the present report for reference.

In view of the fact that safety glass accounts for 25% of all windows in the U.S., safety glass was estimated to account for 20% of thick sheet glass actually used in construction handled by the Construction Corporation. The annual growth rate of construction was estimated to be 10% on the basis of the data for the recent 3 ~ 4 years.

Since the data available for survey and estimate were inadequate, the potential demand in 1981 was estimated on the basis of views expressed by the top CIC officials to be 8,180 m^2/year, reaching about 19,000 m^2/year in 1990.

3) As regards the demand forecast, the central task of the present feasibility study, most of the survey period was allocated to this task, obtaining statistical data and information from abroad and exchanging views with the related agencies, to arrive at an estimate.

As a result, it was estimated to be 22,210 m^2/year (60,700 sheets/year) for 1984 when the proposed safety glass plant is due to commence production, increasing to 34,200 m^2/year (88,900 sheets/year) in 1990 at an annual growth rate of 6.2%, somewhat under Burma's GNP in recent years.

3-2. Production items and the manufacturing method.

Safety glass is available in two types: laminated glass and tempered glass.

Laminated glass is formed as a lamination of two or more sheets of glass or tempered glass bonded to an interlayer (polyvinyl butyral resin), producing merits for safety. However, it requires a long process involving surface treatment of glass and the interlayer, air-conditioning, vacuum condition, high temperature, high air pressure, etc. Accordingly, it needs much bigger plant and equipment investments than tempered glass.

In view of the investment efficiency against the demand for safety glass in Burma, laminated glass is obviously economically disadvantageous as it requires large investments and interlayers imported at high costs. Accordingly, production of tempered glass was recommended.

As regards the types of tempered glass, deep bent tempered glass is used for the front and the rear of the automobile, shallow bent tempered glass for a part of the side and flat tempered glass of non-rectangle for a part of the side and the rear. Flat tempered glass of rectangular shapes are normally used for coaches, vessels and buildings. They are to be produced in relatively small quantities in accordance with the demand estimated in 3-1, The Vertical Type Press Bending Furnace with 2 Heating Stages is recommended as the main facilities which can produce the above three types of tempered glass, making the investments economically most efficient. The plant capacity will thus be 140,000 sheets per year (50,000 m^2/year) for 300 working days on a 24-hour operation basis.

3-3. Raw materials and heat source

The only material required is flat glass. In general, float glass or polished glass are used for windshields and high-grade buildings and sheet glass for other purposes.

Since the sheet glass produced in Bassein has good quality in terms of waves, bubbles and inclusion materials, if the bubble standard is set in practical terms, it may be used for the windshield installed at an angle of more than 60° and safely used for other purposes. Therefore, apart from some imported float glass to be used for replacement for passenger cars, sheet glass produced in Bassein is to be used in most cases.

As regards the heat source for the tempering furnace, electricity is to be recommended because 1) it will be easy to control processing conditions, 2) it will be economical for intermittant operation and 3) stable supply to the Bassein Plant will be possible.

Though it will be necessary to depend on imports for most of the equipment and tools, gauges and processing materials, local production of these items will be advantageous in the future and is thus to be recommended.

It is believed that packing materials are obtainable locally as is sheet glass.

3-4. Location

Since safety glass is generally produced on order, it is desirable to construct the plant in the area where it is in demand. However, with improved communications, if transportation of products and materials can be improved, it may be possible to produce it with sheet glass under joint control. Accordingly, it was concluded that the plant should be located within the grounds of the present Bassein Plant situated in an advantageous position in terms of space, utility and various supplies.

3-5. Manpower

Since it will be incorporated into the organization of the Bassein Plant, sheet glass and safety glass will jointly be managed. The additional manpower required will be 56 ~ 58 persons including 10 on the managerial and technical staff, 3 for sales and 43 ~ 45 workers.

3-6. Time of establishment

It will be possible to commence production 18 months after the effectuation of the contract. If the decision can be made by the end of 1981 and the contract comes into effect in the middle of 1982, production can be commenced at the beginning of 1984.

3-7. Construction costs

The total investments are estimated to be ¥1,111.9 million with the breakdown figures as below.

1)	Imported goods:	¥442.2 million.
2)	Local costs:	¥545.6 million.
3)	Design fees:	¥26 million.
4)	Know-how charges:	¥50 million.
5)	Initial expenses:	¥48.1 million.
	Total:	¥1,111.9 million.

3-8. Profitability

As regards the estimate of selling prices of safety glass, since it will be produced locally, prices 20% off the import prices were adopted, deducting import expenses (freight, marine insurance and port charges).

As for safety glass for those other than automobiles, prices about 1.7 times those of sheet glass were adopted for income and expenditure accounting since the processing costs could be reduced compared with that for automobiles and it would be necessary to create a new demand.

As a result, as shown in Chart 9 in Chapter 7, profits after tax are to remain in the red for seven years after the commencement of production. If financing is arranged locally without a yen loan, even profits before tax will also be practically nil.

This is due to the fact that the scale of production is small for a safety glass enterprise and that the number of types to be produced is too large for the quantities, thus resulting in low yield and operation rates.

3-9 Technical training

Since safety glass will for the first time be produced in Burma, it was though necessary to provide four Burmese engineers with practical training for about two months at a safety glass

plant in Japan.

3-10. On-site supervision

In order to provide supervision on plant construction and production, it will be necessary to provide on-site supervision by Japanese mechanical, electrical and production engineers. Furthermore, on-site supervision by Japanese production engineers on several occasions will be effective during the first year of production.

3-11. Others

- The present report is based on the exchange rates at the beginning of April, 1981, as shown below.

  US $1 = KS6.6988 = 209.59 yen

  ¥100 = KS3.3 : 1 ks = 30.30 yen
- Economic computations are all based on current prices with no inflation considered.

CHAPTER 1. DEMAND ESTIMATE

1-1. Present vehicle production and holdings and future estimates

The history of automobile production in Burma goes back to 1962 when it was inaugurated with technical assistance provided by the Toyo Kogyo and the Hino Motors as an effective use of the reparation fund. Production has continued since then, purchasing parts from Japan with the Economic and Technical Cooperation Fund and the Overseas Economic Cooperation Fund. The production is currently under the management of the Heavy Industries Corporation belonging to the Second Ministry of Industry.

Automobile Production: 1971–80

Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Annual production	1504	1997	948	1077	817	1044	1145	1491	*1335	*1565

(Refer Chart I) Source: Report to the Phyithu Hluttaw 1980/81
*1979, 1980 HIC

In view of the strong demand for automobiles, the Government revised the customs duties in 1977 from 300% to 30% on commercial vehicles for those who are abroad on business for more than three months, facilitating the importation of automobiles. The domestic production has also been set at a higher level, planning to produce 2,220 units in 1981.

Since the industry relies on the OECF for the purchase of parts, production is expected to show only a slight increase for the time being. In the long run, however, production is expected to be increased because of the strong public demand. It seems appropriate to assume that it will increase by 5% annually during the next decade. (This view is shared by the HIC and others.)

Estimate of Automobile Production: 1981–90

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Annual production	2200	2300	2400	2550	2675	2800	2950	3100	3250	3420

Changes in Automobile Holdings: 1971–80

Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Holdings	62,697	64,336	66,022	75,651	76,849	78,233	79,872	82,194	84,958	87,942
Annual growth	3.2%	2.6	2.6	14.6	1.6	1.8	2.1	2.9	3.4	3.5

(Refer Chart I) Source: Road Transport Administration Department
Figures are as of year-end.
1974 figures are amended statistical figures.

As regards the estimate of holdings during the next decade, the average annual rate of increase was estimated to be 3.5%, assuming that the level in the recent two years will continue. This means that the growth rate of land transport will exceed the rate of increase of 2.5% in production (1981) and that the difference will have to be met with imports.

Estimate of Automobile Holdings: 1981–90

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Holdings	91.0	94.2	97.5	101.0	104.5	108.1	111.9	115.8	119.9	124.0

Unit: 1,000 units.
(Figures are as of year-end.)

(Chart I)

Burma Motor Vehicles Production and Registered Vehicles by Type (1967 - 1980)

Source Central Statiscal Organization
Road Transport Administration Department

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	
	unit														
A. Production	1,537	1,472	1,422	1,969	1,504	1,997	948	1,077	817	1,044	1,145	1,491	1,335	1,565	
B. Registered Vehicle	55,799	57,945	59,332	60,758	62,697	64,336	66,022	75,651	76,849	78,233	79,872	82,194	84,958	87,942	
Rangoon	29,272	31,228	32,649	34,058	35,930	37,421	38,964	39,773	41,302	42,335	43,628	45,314	47,251	48,997	56%
Other area	26,527	26,637	26,683	26,700	26,767	26,915	34,478	35,878	35,537	35,898	36,244	36,870	37,717	38,945	44%
1. Passenger Car	28,097	28,880	29,362	29,774	30,350	30,980	31,675	36,313	37,061	37,707	38,554	39,879	41,597	43,276	
a. Saloon Cars	14,186	14,536	14,932	15,230	15,671	16,036	16,385	17,271	17,723	18,110	18,691	18,824	19,105	19,384	
b. Jeeps	9,873	9,918	9,971	10,062	10,177	10,282	10,315	10,559	10,604	10,746	10,804	10,988	11,070	11,180	
c. Station Wagons	599	599	630	653	666	691	712	2,787	2,334	2,355	2,409	2,464	2,522	2,554	
d. Three Wheelers	2,122	2,122	2,122	2,122	2,122	2,123	2,125	2,173	2,175	2,178	2,180	2,204	2,204	2,195	
e. Others	1,317	1,705	1,707	1,707	1,714	1,848	2,138	4,023	4,225	4,318	9,514	5,399	6,696	7,963	
2. Commercial Cars	27,702	29,065	29,970	30,984	32,347	33,356	34,347	39,338	39,788	40,586	41,318	42,315	43,361	44,665	
a. Buses	6,331	6,498	6,716	6,923	7,015	7,134	7,321	7,382	7,498	7,608	7,684	7,729	7,955	8,104	
b. Truck	18,157	19,185	19,662	20,331	21,199	21,924	22,487	27,335	27,611	28,115	28,576	29,123	29,044	30,417	
c. Others	3,214	3,382	3,592	3,730	4,133	4,298	4,539	4,621	4,669	4,803	5,058	5,463	5,762	6,144	

1-2. Estimated demand for safety glass for motor vehicles

1) Seven models are currently produced in Burma and the production plan for 1981 is as shown below.

1.	B600 van	: 100 units	
2.	B600 pickup	: 300	
3.	E2000 truck	: 300	2-ton light truck
4.	X2000 jeep	: 400	
5.	TE21 truck	: 800	6.5-ton large truck
6.	KM410 truck	: 200	3.5-ton medium truck
7.	BM401 bus	: 100	Medium bus seating 25.
	Total	: 2,200	

Computation was made on the basis of the above ratios since they are not likely to change for the time being. Chart II shows the current consumption of safety glass for domestic production of automobiles and the future demand was estimated as shown in Chart III 1)-a (based on the data supplied by the HIC).

2) Estimate of demand for safety glass for replacement.

a) The HIC supplies safety glass for replacement for domestically produced automobiles to the Government agencies, mainly to the RTC. The demand in fiscal 1981 is expected to be 2,150 sheets/year (580 m^2/year) with bent glass (mainly for front) accounting for 20% and flat glass (for side and rear) 10% to the HIC production. (Data supplied by the Road Transport Corporation.)

b) As for replacement in the private sector, the Vehicle and Machinery Trade Corporation imports flat laminated glass and distributes them through its 24 sales agents in the country. Since the VMTC has imported 2,700 m^2 of flat laminated glass for 1981, 70% of the total, or 1,900 m^2/year, may be regarded as the demand which will be 7,900 sheets/year, assuming that the average size is 0.24 m^2 per sheet.

(Chart II)

Safety Glass Price List for Vehicle (FOB)

(Safety Glass Demand for 1981 Vehicle Production)

(Received from Heavy Industries Corp. on 7th April, 1981)

SY No.	Part No.	Nomenclature	Q'ty Unit	Kind of Glass	Dimension TxHxW	area m^2	Price FOB YEN/pc	area m^2/Y	Value YEN/Y
1. B-600 Van (100 units)									
1	0111 53 901	Front window	1	BL	7x446x1,040	0.464	9,609		
2	2783 73 351	Back "	1	T	5x310x 870	0.270	1,600		
3	2783 70 651	Side (Front)	2	T	5x410x 540	0.221	1,633		
4	2783 70 661	Side (Rear)	2	T	5x410x 575	0.236	1,633		
5	2778 58 221	Door	2	T	5x495x 415	0.205	1,336		
6	2783 58 461	Ventilator	2	T	5x195x 325	0.063	339		
	Total:		10			2.184m^2/u	21.091 YEN/u	218.4m^2	2.109.100
2. B-600 Pick up (300 units)									
1	0111 53 901	Front window	1	BL	7x446x1,040	0.464	9,609		
2	0111 53 911	Back window	1	T	5x270x 790	0.213	1,138		
3	2778 58 221	Door window	2	T	5x495x 415	0.205	1,336		
4	2783 58 461	Ventilator	2	T	5x195x 325	0.063	339		
	Total:		6			1.213m^2/u	14.097 YEN/u	363.9m^2	4.229.100
3. E-2000 Light Truck (300 units)									
1	0183 53 901	Front window	1	BL	7x485x1,410	0.684	13,890		
2	2525 57 711	Back window	1	T	5x275x1,035	0.285	2,780		
3	0183 58 221	Door window	2	T	5x590x 430	0.254	662		
4	0672 58 411A	Ventilator	2	T	5x155x 340	0.053	259		
	Total:		6			1.583m^2/u	18.512 YEN/u	474.9m^2	5.553.600
4. X-2000 JEEP (400 units)									
1	0647 53 691	Window (R)	1	L	7x415x685	0.285	4,163		
2	0647 54 691	Window (L)	1	L	7x415x685	0.285	3,939		
3	0647 58 411	Door (Front)	2	T	5x465x495	0.230	1,777		
4	0647 58 451	Door (Rear)	2	T	5x465x325	0.151	1,209		
	Total:		6			1.331m^2/u	14.074 YEN/u	532.4m^2	5.629.600

SY No.	Part No.	Nomenclature	Q'ty Unit	Kind of Glass	Dimension TxHxW	area m^2	Price FOB YEN/pc	area m^2/Y	Value YEN/Y
5.	TE21AZ Truck (800 units)								
1	4500 7001 00	Front LH	1	BL	5x488x888	0.434	24,000		
2	4500 7002 00	Front RH	1	BL	5x488x888	0.434	24,000		
3	4500 7004 00	Ventilator	2	T	5x550x172	0.085	720		
4	4500 7003 00	Door	2	T	5x422x522	0.220	2,400		
5	4500 7005 00	Rear window	4	T	5x240x312	0.075	830		
	Total:		10			1.797m^2/u	55.900 YEN/u	1.437.6m^2	44.720.000
6.	KM410 Truck (200 units)								
1	7941 1111 0A	Front window	1	BT	5x545x1,740	0.948	24,000		
2	7943 1111 0A	Back window	1	T	5x220x 920	0.202	2,250		
3	4503 3620 00	Ventilator	2	T	5x425x 190	0.081	810		
4	4503 3610 01	Door	2	T	5x500x 455	0.228	2,250		
	Total:		6			1.769m^2/u	32.370 YEN/u	353.7m^2	6.474.000
7.	BM401 Medium Bus (100 units)								
1	2104 1700 30	Front window (LH)	1	BL	5x652x1,190	0.776	37,000		
2	2104 1700 40	Front window (RH)	1	BL	5x652x1,190	0.776	22,000		
3	2104 1700 20	Rear window	1	BT	5x568x1,980	1.125	28,000		
4	2104 1305 10	A Front (LH)	2	T	5x580x 646	0.375	2,610		
5	2104 1305 20	A Rear (LH)	2	T	5x580x 646	0.375	2,610		
6	2104 1305 30	B Front (LH)	1	T	5x580x 700	0.406	2,840		
7	2104 1305 40	B Rear (LH)	1	T	5x580x 700	0.406	2,840		
8	2104 1305 90	Door window	1	T	5x525x 450	0.236	1,650		
9	2104 1306 00	Door window	1	T	5x525x 336	0.176	1,230		
10	2104 1305 70	F Front (LH)	1	T	5x580x 395	0.229	1,600		
11	2104 1305 80	F Rear (LH)	1	T	5x580x 395	0.229	1,600		
12	2104 1500 50	Door	4	T	5x505x 210	0.106	740		
13	2104 1306 30	A Front (RH)	2	T	5x580x 645	0.374	2,610		
14	2104 1306 40	Rear (RH)	2	T	5x580x 645	0.374	2,610		
15	2104 1306 10	E Front (RH)	1	T	5x580x 490	0.284	1,980		
16	2104 1306 20	E Rear (RH)	1	T	5x580x 370	0.215	1,500		
17	2104 1305 50	G Front (RH)	1	T	5x580x 270	0.157	1,100		
18	2104 1305 60	G Rear (RH)	1	T	5x580x 270	0.157	1,100		
	Total:		25			8.593m^2/u	128.280 YEN/u	859.3m^2	12.828.000
	Grand Total: (2.200 units/Y)18.700 pcs/Y							4.240.2m^2	81.543.400

(Unit Value for type and kind)

1. BT (Curved Temper)

a.	0.948 x 200 = 189.6m^2	24TY x 200 = 4,800TY	25,316Y/m^2
b.	1.125 x 100 = 112.5m^2	28TY x 100 = 2,800TY	24,889Y/m^2
ave.	302.1m^2	7,600TY	25,157Y/m^2

2. T (Flat Temper)

a.	1.720 x 100 = 172m^2	11,482Y x 100 = 1,148,200Y	6,676Y/m^2
b.	0.749 x 300 = 224.7m^2	4,488Y x 300 = 1,346,400Y	5,992 "
c.	0.899 x 300 = 269.7m^2	4,622Y x 300 = 1,386,600Y	5,141 "
d.	0.762 x 400 = 304.8m^2	5,972Y x 400 = 2,388,800Y	7,837 "
e.	0.930 x 800 = 744.0m^2	7,900Y x 800 = 6,320,000Y	8,495 "
f.	0.820 x 200 = 164.0m^2	8,370Y x 200 = 1,674,000Y	9,797 "
g.	5.916 x 100 = 591.6m^2	41,280Y x 100 = 4,128,000Y	6,978 "
ave.	2,470.8m^2	18,392,000Y	7,444Y/m^2

3. BL (Curved Laminate)

a.	0.464 x 400 = 185.6m^2	9,609Y x 400 = 3,843,600Y	20,709Y/m^2
b.	0.684 x 300 = 205.2m^2	13,890Y x 300 = 4,167,000Y	20,307 "
c.	0.867 x 800 = 693.6m^2	48,000Y x 800 =38,400,000Y	55,363 "
d.	1.552 x 100 = 155.2m^2	59,000Y x 100 = 5,900,000Y	38,015 "
ave.	1,239.6m^2	52,310,600Y	42,200Y/m^2

4. L (Flat Laminate)

0.569 x 400 = 227.6m^2 8,102Yx 400 = 3,240,800 14,239 Y/m^2

			m^2/pc	unit price
5. Curved Glass:	2,800 pcs/Y	1,541.7m^2/Y	0.551	38,860 YEN/m^2
6. Flat Glass :	15,900 pcs/Y	2,698.4m^2/Y	0.172	8,017 YEN/m^2
Grand Total:	18,700 pcs/Y	4,240.1m^2/Y	0.227	19,231 YEN/m^2

FOB Price

o	BT	24.889 - 25,316 YEN/m^2	ave. 25,157 YEN/m^2
	BL	20,307 - 55,303 "	ave. 42,200 "
o	T	5,141 - 9,797 YEN/m^2	ave. 7,444 YEN/m^2
	L	-	ave. 14,239 "

Total ave. 19,231 YEN/m^2

c) Accordingly, the demand for safety glass for replacement in 1981 is estimated to be (a) 2,150 + (b) 7,900 = 10,050 sheets/year. This is about 2% of the Total Holdings (91,000 units) x 6 sheets/car = 546,000 sheets, corresponding to the rate of damage estimated by the RTC and HIC.

As regards the supply to meet the demand for replacement glass, it may be outlined as below.

a. Demand for glass for domestic models can be met adquately and promptly with the stocks at sales agents. Accordingly, the average annual rate of increase of 5% was used for estimate as in the case of automobile production.

b. Demand for replacement on other vehicles. The registered vehicles in Burma are featured by the diversity of models in both European and Japanese makes for the number of holdings (though it was not possible to obtain statistical figures). Under such circumstances, replacement glass may be required in small and varied lots. As for the supply of bent glass for front and rear, therefore, standard glass for manufacturing tools and gauges will be necessary. At the same time, these tools and gauges will be costly unless there is a considerable demand, since they have to be manufactured for different items. In view of the situation, the rate of increase in demand was estimated to be 3.5%, close to that in vehicle holdings. As a result, an estimate of demand during the next decade was made as shown in Chart III 1)-b.

1-3. Estimated demand for safety glass for shipping, rolling stock and construction

As regards the demand in this category, since imports of safety glass are negligible at present and no import statistics are available, it was decided to make an estimate after consultation with the Government agencies concerned on the assumption that the demand will be created.

1-3-1. Demand for portholes, etc.

Detailed survey was conducted on vessels owned by the Inland Water Transport Corporation in charge of inland water transportation, providing the basis for estimate in other sectors.

a) IWTC.

- Number of vessels owned in 1981: 604 (including 49 newly constructed this year).
- Total number of portholes, etc.: 15,542 with sheet glass.
- Damage ratio: extremely high damage ratio due to gusts as they are of the swing type structure, registering 15% of the total portholes per year.
- Size and thickness: Both portholes and bridge windows are standardized to 36" x 18" with a thickness of 5 mm for the former and 8 mm for the latter for the convenience to replacement. (0.418 m^2/sheet.)
- Average annual rate of increase in vessels owned is 6.8% due to an increase in

imports, e.g., rice, cement, fertilizer, etc.

- Safety glass is desired even though it would cost more than double the prices of sheet glass.

Breakdown figures are given below. (Supplied by IWTC.)

- Powered vessels: passenger boats 193 averaging 52 portholes per vessel (A).
- Powered vessels: cargo boats 152 averaging 26 portholes per vessel (B).
- Non-powered vessels: barges, cargo boats 259 averaging 6 portholes per vessel (C).

Total: 604 vessels x 25.7 portholes/vessel = 15,542

b) Other vessel holdings.

	Holdings	Ave. portholes per vessel
• Five Star Corp.		
Ocean liners	11	208 (A x 4)
Coastal vessels	11	104 (A x 2)
• Oil barges and tugs	136	26 (B)
• Cooperative-owned		
Powered, non-powered and		
cargo boats	1,246	6 (C)
• Privately owned		
Powered, coastal	1,559	6 (C)
• Total	2,963 x 8.0 portholes/vessel = 23,798 portholes	

Holdings are based on the Report to the Pyithu Hluttaw 1980/81. Average number of portholes per vessel was estimated on the basis of the IWTC holdings.

c) Demand for replacement

(15,542 + 23,798) x 0.15 = 5,900 sheets/year:

2,466 m^2/year.

Though the rate of damage may fall by adopting tempered glass, in view of demand for change to the tempered glass to be added, the annual rate of increase during the next decade was estimated, assuming that the rate of incrase in safety glass will be 5% against that of 6.8% in vessel holdings. (Chart III-2)

1-3-2. Demand for rolling stock windows.

a) Changes in Burma Railway Corporation coach holdings:

1975/ Year-end	1976/ Year-end	1977/ Year-end	1978/ Year-end	1979/ Year-end	1980/ Year-end	
1203	1210	1280	1357	1357	1395	Annual rate of increase 3%

b) Coaches imported from Japan and West Germany are equipped with safety glass, accounting for about 15% of the total coaches. Thus,

Ordinary coaches: 18 windows/coach x 1,395 x 0.15 x 60/72 = 3,140

High-grade coaches: 28 windows/coach x 1,395 x 0.15 x 12/72 = 980

Total: 4,120 windows.

The rate of damage was estimated to be 1% per year and the annual rate of increase 3%.

c) The remaining 85% consisted of those whose bodies were produced in Burma in wood or steel without window glass. This is due to the fact that though sheet glass was installed initially, it had to be taken off because of numerous injury on the passenger caused by stone throwing. Accordingly, wooden shutters were installed for windows, resulting in dark and wet interior during the wet season. Therefore, if safety glass can be domestically produced, it is likely to be adopted. However, since it will be necessary to modify the window structure, it is expected to be adopted gradually at times of coach replacement. (Information supplied by the BRC.) Assuming that the service life of the coach is 20 years, we obtain

1,400 coaches/20 years = 70 coaches/year

As for ordinary coaches,

940 mm x 600 mm (5 mm in thickness) = 0.564 m^2/sheet, 16 windows/coach, thus,

70 x 16 sheets = 1,120 sheets/year (632 m^2/year)

constitutes the demand for renewance.

d) From 1984 onward, 1% per year is to be added as replacement to broken glass windows for coaches to be renewed.

e) The rate of increase in rolling stock is estimated to be 3% per year during the next decade as shown below.

1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
coaches									
1395	1437	1480	1525	1570	1620	1670	1720	1770	1825

f) Demand for coach windows.

b) + c) + d) = 1,650 sheets/year (931 m^2/year) in 1991. (Chart III-3.)

1-3-3. Demand for architectural glass

a) Construction statistics.

Year	1975	1976	1977	1978	1979	1979/1975
Built by Construction Corporation	971 housings	558 housings	1405 housings	1612 housings	1289 housings	1.32
Building investment	5.85 billion yen	6.36 billion yen	12.0 billion yen	12.24 billion yen	13.97 billion yen	2.39
		8.7%	88.8%	1.9%	14%	

Investments in buildings have rapidly increased in recent years at an average annual rate of more than 10%.

b) Major construction works either in progress or planned centering around Rangoon by the Construction Corporation include the National Assembly building (commenced),

Myama Foreign Economic Bank (foundation work commenced), Rangoon Hospital (planned), Museum (planned), plant buildings and Corporation buildings. They are scheduled to be completed around 1984 with the possibility of adopting safety glass and tinted glass. Since large scale structures have larger window areas, sheet glass may pose safety problems. Therefore, the U.S. safety standard for architectural glass may partially be adopted.

Example:

"In residential buildings, the first piece of operable or nonoperable glazing material adjacent to a door whose nearest vertical edge is within 12 inches (31 centimeters) of the door;"

"In all buildings other than residential buildings . . . The exposed glazing material in such panel exceeds 6 square feet (0.55 square meters) . . ."

-- Consumer Product Safety Commission: Architectural Glazing Materials Safety Standard.

c) In the U.S., safety glass accounts for 25% of the total architectural glass used. In Japan, there is no safety standard in force and safety glass has only recently begun to be used autonomously for schools, banks, hospitals, etc., accounting for about 2% of architectural glass.

d) The amount of glass used by the Construction Corporation is as shown below.

3 mm	3,000 c/s per year (27,870 m^2/year)
5 mm	4,000 c/s per year (37,160 m^2/year)
6 mm	400 c/s per year (3,716 m^2/year)
Total	15,700 cases converted to 2 mm per year 730 tons per year.

Maximum sizes

3 mm	36" x 24",	48" x 36"
5 mm	72" x 24",	72" x 30"
6 mm	72" x 42",	60" x 42"

(Supplied by the C.C.)

e) Assuming that the safety standard for architectural glass is applied to the window area of 0.55 m^2, if 20% of 5 mm and 6 mm thick glass of the buildings under construction by the C.C. are considered as object of the safety slandard, the demand for safety glass will be 8,180 m^2/year (104 t/year), equivalent to 2.5% of the total annual demand of 4,000 t/year for sheet glass in Burma. This is 1/10 of the U.S. ratio of 25% but roughly corresponds to the ratio in Japan. It will be affected by the adoption in the future of the safety standard in Burma, the trend in large scale construction and the prices of safety glass. Since the demand for architectural glass is greatly affected by the Government policy and measures, the estimate was made on the basis of the views expressed by the top management of the CIC.

f) Assuming the rate of increase in construction starts to be 10% per year during the next decade (estimate by the C.C.), the rate was applied to the demand for architectural safety glass.

As regards sheet glass, the domestic demand is estimated to reach about 9,400 t/year. Therefore, there will still be the remaining capacity of 2,600 t/year, capable of supplying raw material glass for safety glass without any difficulty.

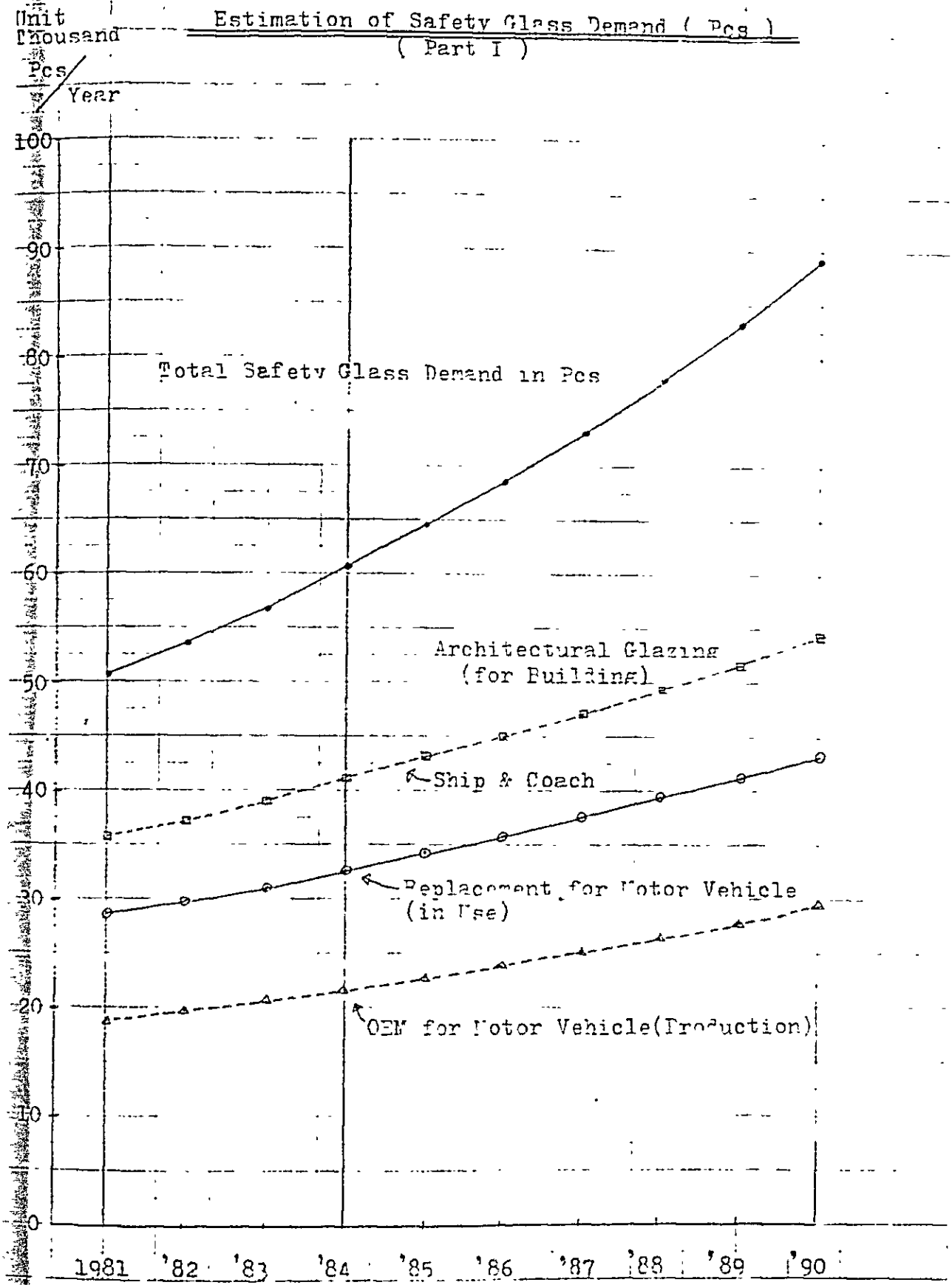
g) The average m^2 per sheet was estimated to be 0.557 m^2/sheet, as shown in Chart III-5. Fig. 1 shows the increase in demand for safety glass classified by use in terms of sheets/year and Fig. 2 in m^2/year.

(Chart III)

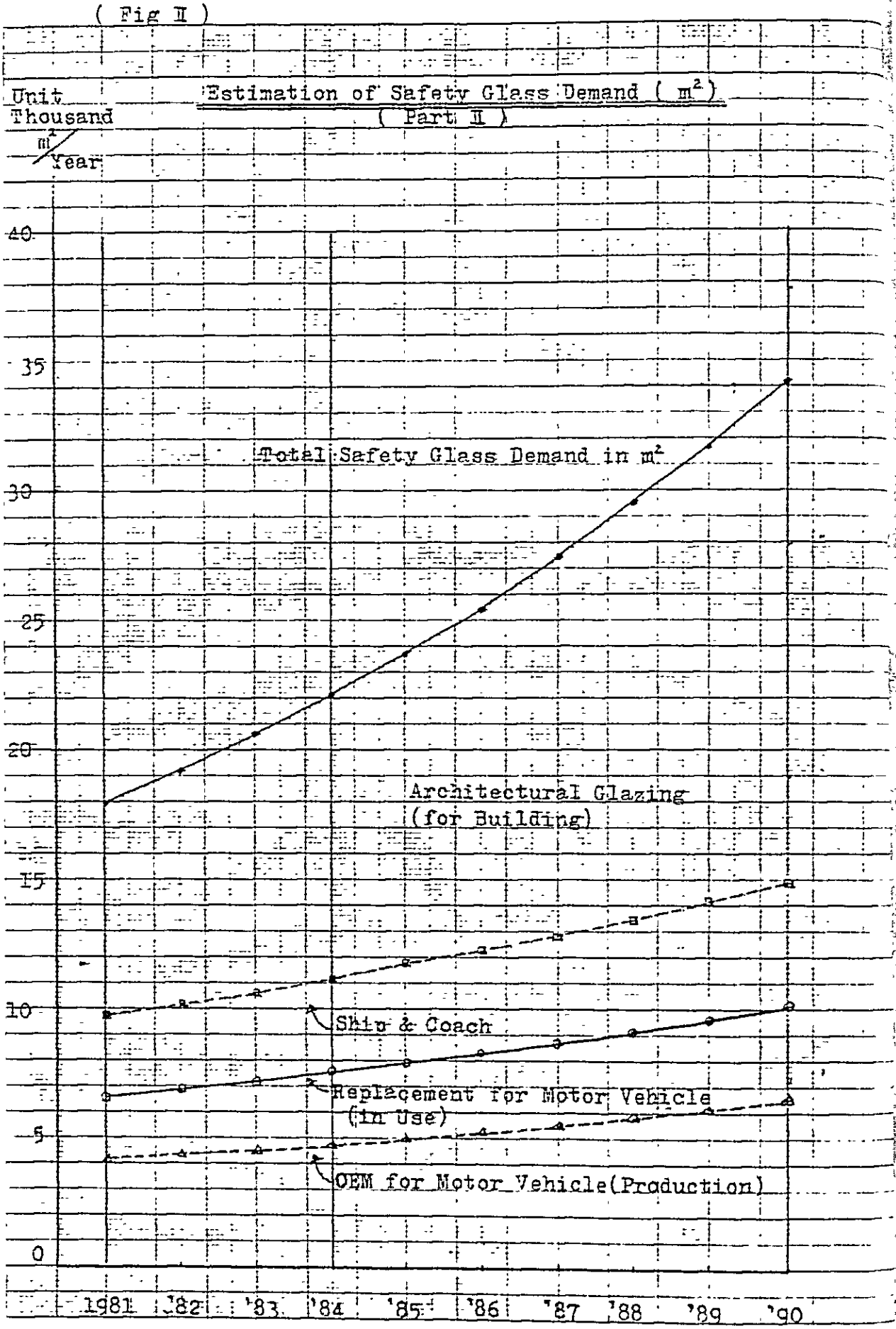
Estimation/Forecast of Safety Glass Demand and Production

Item		1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Growth Rate/year	Remark
Motor Vehicle													
Production in Burma	·Numbers	2,200 Nos	2,300	2,400	2,550	2,675	2,800	2,950	3,100	3,250	3,420	5%	(Motor Vehicle OEM)
Safety Glass for Prod	BT m^2	1,540 m^2	1,610	1,680	1,785	1,870	1,960	2,065	2,170	2,275	2,395	"	BT: 0.551 m^2/Pcs
	T m^2	2,700 "	2,820	2,950	3,130	3,280	3,440	3,620	3,800	3,990	4,190	"	T : 0.170 "
	BT+T Psc	18,700 Pcs	19,550	20,410	21,610	22,740	23,800	25,080	26,350	27,630	29,070	"	BT+T: 0.227 "
Replacement for Vehicle													
Number of Vehicle in use	·Numbers	88,000 Nos	91,000	94,200	97,500	101,000	104,500	108,100	111,900	115,800	119,900	3.5%	(Replacement for Motor Vehicle)
Safety Glass for Replacement	BT m^2	310 m^2	320	340	360	370	380	410	430	450	480		BT: 0.551 m^2/Pcs
	T m^2	2,170 "	2,250	2,340	2,420	2,510	2,600	2,690	2,800	2,900	3,010		T : 0.228 "
	BT+T Psc	10,050 Pcs	10,450	10,850	11,280	11,710	12,130	12,610	13,100	13,600	14,130	3.8%	
Ship IWTC	·No of Ship	604 Nos	646	692	740	792	847	906	970	1,038	1,110	7%	Replacement for ship window
Others	· "	2,963 "	3,082	3,206	3,333	3,467	3,606	3,750	3,900	4,056	4,218	4%	
Safety Glass for Ship	T m^2	(2,466 m^2)	(2,600)	(2,740)	2,880	3,030	3,190	3,360	3,540	3,730	3,930	5%	T = 0.418 m^2/Pcs
	" Psc	(5,900 pcs)	(6,220)	(6,550)	6,890	7,250	7,630	8,030	8,460	8,920	9,400	"	
Railway Coach	·No of Coach	1,395 Nos	1,437	1,480	1,525	1,570	1,620	1,670	1,720	1,770	1,825	3%	New fit for old Coach change and Partialy Replacement
Safety Glass for Coach	T m^2	(654 m^2)	(671)	(694)	711	744	773	807	835	869	897	3%	T = 0.564 m^2/Pcs
	" Pcs	(1,160 Pcs)	(1,190)	(1,230)	1,260	1,320	1,370	1,403	1,480	1,540	1,590	"	
(2)-(3) Ship & Coach	T m^2	(3,120 m^2)	(3,271)	(3,434)	3,591	3,774	3,963	4,167	4,375	4,599	4,827	5%	
	" Pcs	(7,060 Pcs)	(7,410)	(7,780)	8,150	8,570	9,000	9,460	9,940	10,460	10,990		
Building: Sheet Glass	Tons	4,000 Tons	4,400	4,840	5,324	5,856	6,442	7,086	7,795	8,575	9,431	10%	*Safety Regulation for Architectural Glazing
Safety Glass for Building	T m^2	(8,180 m^2)	(9,020)	(9,920)	10,920	11,980	13,200	14,540	16,000	17,500	19,330	"	T = 0.556 m^2/Pcs
	" Pcs	(14,700 Pcs)	(16,200)	(17,800)	19,600	21,500	23,700	26,100	28,700	31,500	34,700	"	
	" Tons	(102.2 Tons)	(112.7)	(124.0)	136.5	149.7	165.0	181.7	200.0	218.7	241.6	"	
G. Total BT (Vehicle)	m^2	1,850 m^2	1,930	2,020	2,145	2,240	2,320	2,475	2,600	2,725	2,875		
T (Vehicle)	"	4,870 "	5,070	5,290	5,550	5,790	6,040	6,310	6,600	6,890	7,200		
T (Others)	"	11,300 "	12,290	13,350	14,510	15,750	17,160	18,710	20,380	22,100	24,160		
Total	"	18,020 "	19,290	20,660	22,210	23,780	25,520	27,490	29,580	31,720	34,200		
"	Pcs	50,600 Pcs	53,700	56,900	60,700	64,500	68,600	73,300	78,100	83,200	88,900	6.2%	
"	Tons	227.1 Tons	243.2	260.7	280.1	300.1	322.1	347.0	373.4	400.5	432.3		

(Fig I)


Estimation of Safety Glass Demand (Pcs)
(Part I)
Unit
Thousand
Pcs
Year
100
90
80
70
60
50
40
30
20
10
0
Total Safety Glass Demand in Pcs
Architectural Glazing
(for Building)
Ship & Coach
Replacement for Motor Vehicle
(in Use)
OEM for Motor Vehicle(Production)
1981
'82
'83
'84
'85
'86
'87
'88
'89
'90

(Fig II)


Unit
Thousand
m²/Year
Estimation of Safety Glass Demand (m²)
(Part II)
40
35
30
25
20
15
10
5
0
Total Safety Glass Demand in m²
Architectural Glazing
(for Building)
Ship & Coach
Replacement for Motor Vehicle
(in Use)
OEM for Motor Vehicle(Production)
1981
'82
'83
'84
'85
'86
'87
'88
'89
'90

1-4. Composition of safety glass types and the establishment of maximum sizes.

1-4-1. Composition of glass types and uses.

After conducting a survey of demand for safety glass under the present feasibility study, the types and uses concerned may be summarized as below.

Form of tempering	Kind of tempering	Use / Thickness	Automobile			Architec-tural	Rolling stock	Ship-ping
			Front	Rear	Side			
Deep bending	Zone temper	5m/m 6m/m	○					
"	Temper	4m/m 5m/m		○				
Shallow bending	Temper	4m/m 5m/m			○			
Flat temper	Zone temper of rectangular shapes	5m/m 6m/m	○					
"	Non-rectangular temper	4m/m 5m/m		○	○			
"	Rectangular temper	4m/m 5m/m 6m/m		○	○	○	○	○

Judging from the present demand, annual demand may be estimated in three categories as shown in Chart III-6.

1) Deep bending (zone, even): BT (vehicle).
2) Flat temper (non-rectangular temper): T (vehicle).
3) Flat temper (rectangular temper): T (others).

1-4-2. Establishment of maximum sizes

As Chart II shows, the maximum size for motor vehicles is that for bus windscreens and rear windows of trucks, i.e., width 1,980 mm x height 652 mm, and the minimum size is that for front ventilation windows, i.e., width 155 mm x height 312 mm. Though those for architectural glass are width 1,830 mm x height 1,070 mm (72" x 42"), the maximum figures of width 2,000 mm x height 1,100 mm were adopted for designing.

1-5. Pricing of safety glass

According to the price list supplied by the Heavy Industries Corporation, local prices will be as shown below.

Chart II.

Local prices may be computed as follows:

CIF = FOB x 1.15 (Freight charge + Marine insurance)

Local price = CIF x 1.95 (Customs duty: 50%, Tax: 30%, Licence fee: 5%, Port and clearance: 5%. Inland transport: 5%)

1) Bent glass for front and rear: FOB 25,157 yen/m^2 x 1.15 x 1.95 = 56,414 yen/m^2.

2) Flat glass for side: FOB 7,444 yen/m^2 x 1.15 x 1.19 = 16,692 yen/m^2

It was thought to be appropriate, being local production, to deduct a total of 20% including Freight charge, Marine insurance and Port clearance from the price to set the local selling price. As regards the category T (other than automobiles), though it will mean a new demand without past import records, as it is rectangular in shape and can be produced in adequate lot sizes, thus reducing the costs, the price was set at 1.73 times that of sheet glass.

Accordingly, selling prices were set as follows:

1) Front and rear (automobile): 44,800 yen/m^2.
   Deep bent temper or zone temper.
2) Side (automobile): 12,800 yen/m^2.
   Shallow bent or non-rectangular flat temper.
3) Buildings, rolling stock and shipping: 5,600 yen/m^2.
   Flat temper of rectangular shapes.
   (As regards the local price of sheet glass: Factory price 8,446 ks/ton + Freight charge 75 ks/ton = 8,521 ks/ton
   107 ks/m^2 ≒ 3,230 yen/m^2 for 5 mm thick sheet glass
   Thus, ¥3,230 x 1,73 = ¥5,600 for 5 mm safety glass.)

The average annual prices under the present feasibility study will be as shown below.

1984	1987	1990
11,194 yen/m^2	10,791 yen/m^2	10,423 yen/m^2

These prices have no export competitiveness.

CHAPTER 2. SELECTION OF THE MANUFACTURING METHOD AND THE SCALE OF PRODUCTION

2-1. The main methods of manufacturing tempered glass to be covered by the present feasibility study may be outlined as below.

1) Gravity bending type tempering method
   This is to be used to produce deep bent glass for car windshields and rear window panels. The bending mold is installed on the transporter to heat and mold the sheet glass sheared by means of gravity. It is then taken out of the furnace at once to be wind cooled for tempering. As regards the furnace, from reciprocation type with one stage or penetration type with two stages to penetration type with four stages may be employed depending on the capacity.
2) Horizontal type press bending method tong type).
   This is to be used to produce relatively shallow bent glass for the rear and sides of

automobile or flat tempered glass. It is also used to produce glass of large scale for buildings. The sheet glass sheared is tonged by steel hanger and transported into a heating furnace. The glass is heated to the forming temperature and then taken out of the furnace to be pressed into the required shape by press (consisting of male and female parts). It is then cooled and tempered by blowing cooling air. As regards the furnace, one of those with more than penetration type furnace with one stage is used. The glass moves horizontally throughout the process, i.e., tong, heating, pressing, cooling and releasing.

3) Vertical type press bending method (tong type).

This method is capable of producing wide-ranging items and shapes, e.g., deep bent glass for car windshields and rear windows, shallow bent glass for sides and the rear, flat tempered glass, etc. It operates on the same principles as 2) above in tong, heating, pressing and cooling. However, it is taken out of the furnance vertically to be pressed and cooled for easy deep bending. As regards the furnace, at least two stages will be required.

2-2.

Under the present feasibility study, the vertical type press bending with two stages is recommended as tempering method because it will be efficient to produce wide-ranging items, e.g., deep bent tempered for automobiles (particularly the larger ones for bus and truck), shallow bent or flat tempered for sides of automobile and larger flat tempered glass for construction with one type of furnace in view of the size of the demand.

Alternatively, two types of furnace may be combined: the gravity bending furnace with one stage for deep bent glass for front and rear and the horizontal type press bending furnace with one stage (tong type) for flat tempering.

However, both are required large facilities because of large maximum sizes. Moreover, since the demand for deep bent items is small, the rate of operation of the gravity bending type furnace will be low against high construction costs. Therefore, this type is not recommended for adoption because of the low efficiency.

2-3. Production scale

In view of the demand outlined in the previous Chapter, the heating one stage furnace will not have a sufficient capacity to cope with the demand of 34,200 m^2/year (88,900 sheets/year) in 1990. For the vertical type, minimum requirements in terms of structure will be a two stage heating furnace.

Since the capacity of the furnace is 50,000 m^2/year (140,000 sheets/year), it will operate to 68% of the capacity in 1990, suggesting that the scale of production is appropriate taking account of new demand in the future.

CHAPTER 3. PROCUREMENT OF RAW MATERIALS, TOOLS AND UTILITY

3-1. Quality, quantities and prices of raw materials sheet glass

3-1-1. Quality of sheet glass

Chart IV shows both the Japanese standard (JASO) for raw materials sheet glass for automobiles and the standard used at the Bassein Factory. It also shows the results of inspection carried out on the quality of drawn sheets produced from March 19 to 24, 1980 and inventories during the period of February and March on a random basis. The results revealed the facts outlined below.

1) Bubbles and inclusion material are few for sheet glass:- Those of A quality are, therefore, adequate for sides and the rear; but they do not meet the float glass standard for windshields. It is, however, possible to use them by instituting the bubble standard for the width of less than 0.5 mm and the length of less than 5 ~ 10 mm, which will cause no problems in practice. Accordingly, it is necessary to institute the Burmese standard.
2) As regards distortion for windshield use, some ream and waves were noticed; but it will be possible to use them if they are installed on the cars with the installation angle of over 60° close to vertical so that drawing direction might be vertical. However, imported float glass will be necessary for those with the installation angle of less than 60° (imported passenger cars).
3) Those of AA quality are desirable for windshields; but those of A quality may be used if selected. It is, however, desirable to improve the distortion minimizer.
4) Though the tank condition will be favorable after 1.5 years from start-up, requisition is that the present quality be maintained until cold repair by means of maintenance and stable operation.

(Chart IV) Sheet Glass Quality Standard

1. JASO Glass Quality Standard for Motor Vehicle

	Sheet Glass	Float Glass	
		Central Region	Peripheral Region
(1) Bubble Transparent bubble	ℓ = 3.0 - 15.0 mm (width not over 1.0 mm)	ℓ = 1.0 - 2.0 mm	ℓ = 1.0 - 3.0 mm
White bubble	3.0 - 15.0 mm	1.0 - 7.0 mm	3.0 - 15.0 mm
Colored bubble	0.5 - 1.5 mm	0.5 - 1.0 mm	0.5 - 1.5 mm
Open bubble	3.0 - 15.0 mm	0.5 - 1.5 mm	0.5 - 2.5 mm
(2) Inclusion materials (stone, devitrification)	ℓ = 0.5 - 1.5 mm	ℓ = 0.5 - 1.0 mm	ℓ = 0.5 - 1.5 mm
(3) Aggregate of defects	Up to 5 aggregates shall be allowed within circle of 30 cm diameter. In case of serious defects (ℓ = 10 - 15 mm), upto 1 aggregate shall be allowed within a circle of 30 cm diameter.	Up to 3 aggregates shall be allowed within a circle of 30 cm diameter. In case of serious bubbles (ℓ=1.5 - 2.0 mm), upto 1 aggregate shall be allowed within a circle of 30 cm diameter.	Up to 5 aggregates shall be allowed within a circle of 30 cm diameter. In Case of serious bubbles (ℓ=2.0-3.0 mm), up to 1 aggregate shall be allowed within a circle of 30 cm diameter.
(4) Allowable number of defects on one sheet	(a) 24 defects shall be allowed on 1.16 m^2	(60" x 30") (3 defects if not over 0.1m^2)	
	(b) 9 defects shall be allowed on 0.39 m^2	(30" x 20")	
(5) Cords and waves	No distinct cords or waves should be found when glass surface is observed from the angle of 60°.	No distinct cords or waves should be found when glass surface is observed from the angle of 30°.	Light and fine cords or waves are permitted.

Judgement method for optical distortion of windshield (JIS or practical method)

(6) Judgement method for optical distortion of windshield	It shall accord with JIS 3211, JIS 3212 (a) 2nd Image Separate (b) Optical Distortion Please refer JIS3211, JIS3212 attached hereto
(7) Practical judgement method only used by Asahi (Distant view method)	(a) Set the glass at the rake angle of front glass on the real car (b) Locate the observer's eye 1.5 m backward from the glass (c) See through the glass lateral-striped grit board located 30 m forward from the glass or equivalent distant view. (d) Moving the observer's eye upward and downward, check whether the image distorts. (Compare with sample which shows limit of tolerance.)

(Chart IV)

2. Bassein Factory Quality Standard

based on JIS

	AA	A	B
(1) Closed bubble Open bubble	ℓ= 5.0-10.0mm no bubbles of the larger range shall be found within a circle of 40cm diameter	Allowed	In central region, bubbles under 25mm length shall be allowed In peripheral region, bubbles under 35mm length shall be allowed. Summed up length shall not exceed 100mm.
	ℓ= 10-15mm Upto 2 bubbles shall be allowed	No bubbles of the larger range shall be found within a circle of 40cm diameter	
	ℓ= 15.0mm over 0	0	
(2) Colored bubbles, stones, Inclusion materials	Under 1mm No inclusion materials shall be found within a circle of 40cm diameter	Allowed	Allowed
	1-2mm Upto 2 pcs. shall be allowed	No inclusion materials shall be found within a circle of 40cm diameter	Allowed
	Over 2mm 0	0	2.0-2.5mm upto 2 pcs. shall be allowed 2.5mm - 0
(3) Cords	No distinct cords shall be found when the glass is observed from 50cm distance and 30o angle	No distinct cords shall be found when the glass is observed from 50cm distance and 45° angle	No distinct cords shall be found when the glass is observed from 50cm distance and 90° angle
(4) Distortion {Zebra board {M102 inspection}	Deviation should be less than 30mm	Deviation should be less than 40mm	Deviation should be less than 70mm

Bassein Factory Thickness Standard

			Minimum thickness at present
2mm	1.90mm	± 0.20mm	1.85mm
3	3.00	± 0.30	2.85
4	4.00	± 0.30	3.85
5	5.00	± 0.30	4.85
6	6.00	± 0.30	5.85

Chart II-3

Bassein Sheet Glass Actual Inspection Result (19-24 March, 1981)

Defect	4 mm, 60" x 20" (Feb, 1981 No. 2 M/C prod., M/L = 100 days)			5 mm, 60" x 20" (Feb, 1981 No. 1 M/C prod., M/L = 100 days)			6 mm, 60" x 20" (March, 1981 No. 2 M/C prod., M/L = 140 days)		
	Number of defects	Sheet Glass Std.	Float Glass Std.	Number of defects	Sheet Glass Std.	Float Glass Std.	Number of defect	Sheet Glass Std.	Float Glass Std.
Transparent bubble (3-15 mm)	2 pcs (3.4mm, 8.0mm)	OK	NG	1 pc (5mm)	OK	NG	2 pcs (5.0mm, 8.5mm)	OK	NG
White bubble (3-15 mm)	0	OK	OK	0	OK	OK	0	OK	OK
Colored bubble (0.5-1.5 mm)	0	OK	OK	0	OK	OK	0	OK	OK
Open bubble (3-15 mm)	0	OK	OK	0	OK	OK	0	OK	OK
Stone (0.5-1.5 mm)	0	OK	OK	0	OK	OK	0	OK	OK
Devitrification (0.5-1.5 mm)	1 (0.6mm)	OK	OK	0	OK	OK	0	OK	OK
Number of defects one one sheet	3 pcs/sheet	OK if not exceed 24 pcs	NG	1 pc/sheet	OK if not exceed 24 pcs	NG	2 pcs/sheet	OK if not exceed 24 pcs	NG
Judgement	Judgement A			Judgement B			Judgement B		

Judgement by Distant View Method (for windshield use)

Mix angle	4 mm * horizontal	4 mm ** vertical	5 mm horizontal	5 mm vertical	6 mm horizontal	6 mm vertical
60°	OK	OK	OK	OK	NG	OK
40°	NG	OK	NG	OK	NG	NG
35°	NG	NG	NG	NG	NG	NG

It is usable as a windshield in case of vertical and more than 60°.

* Horizontal means the drawn glass to be cut so that drawing direction might be horizontal when it would be fixed as a windshield.

** Vertical means the drawn glass to be cut so that drawing direction might be vertical when it would be fixed as a windshield.

3-1-2. Required quantities

Required quantities at present for A quality and above:

	AA	A	B	A Quality
2 m/m	0	0	100%	0
3 m/m	0	10%	90%	415 ton/year
4 m/m	0	10%	90%	155 "
5 m/m	0	5%	95%	100 "
6 m/m	0	5%	95%	10 "
				Total 680 "

(CIC Basin Factory Data)

Year	1984	1985	1986	1987	1988	1989	1990
Safety glass product	280t/Y	300t/Y	328t/Y	347t/Y	373t/Y	400t/Y	432t/Y
Raw sheet glass	400	430	460	500	533	571	617t/Y

Installation angles of less than 60° do not apply to Burmese cars. They are required for a part of replacement of passenger cars and 10% of bent temper will have to rely on the importation of float glass.

3-1-3. Prices

Prices of sheet glass to be processed are to be set at prices eliminating tax and profit for the same factory.

8445.49 ks/ton (Factory selling price) – 1948.96 ks/ton (Goods service tax) – 599.28 ks/ton

Accordingly, 5897.25 ks/ton i.e. 737.16 ks/m^2 in case of 5 mm, equivalent to 2233 yen/m^2.

Prices of float glass are to be set assuming that they are imported from Japan as follows:

FOB price 0.77S/ft^2 x 1.15 x 1.7 = 1.7S/ft = 4200 yen/m^2

3-1-4. Replenishment and stocking

Request for raw material sheet glass is sent from Processing Section to Sheet Glass Section on the basis of demand forecast (tempered glass) made every three months. Those of popular sizes (sizes produced at fixed rates annually) are stocked up to three months' requirement. One year's supply of float is purchased and stocked. As regards the form of packing, the present feasibility study calculated on the basis of packing in wooden cases as with sheet glass. In practice, however, use of pallets (recycled) is recommended to reduce the costs.

The area for stocking raw material sheet glass was obtained as belows.

5 m/m: 48" x 36" containing 17 sheets: Box 1380 x 995 x 220: 18.58 m^2/0.303

(Product)
= 61.3 m^2/m^2 (Place)

5 m/m: 60" x 48" containing 10 sheets: Box 1682 x 1300 x 150: 18.58 m^2/0.252

(Product)
= 73.7 m^2/m^2 (Place)

Average 67.5 m^2/m^2

FL 495 m^2 + S 11.284 m^2 = 11.779 m^2 ÷ 67.5 m^2/m^2 = 175 m^2

175 m^2 ÷ 0.5 (Storage efficiency) = 350 m^2

Accordingly, a total storage area of 40 m x 21 m = 840 m^2 will be required to include products discussed later.

3-2. Procurement, manufacturing, materials and prices of tools

3-2-1. Inspection gauges

They are to be used to manufacture press head and to inspect curveture fitting of products. Mass produced types are to be imported from Japan on the commencement of production. Thereafter, replacements are to be produced locally. As regards the materials, the following, obtainable locally, will be required:

Pinewood 2,000 mm (ℓ) x 400 mm (W) x 50 mm (t) x 5 pcs./set

The price was estimated to be three times that for packing.

3-2-2. Press heads

1 set for every type of bent products will be required to be used exclusively.

- Special steel plate: convex 2.3 mm/t, concave 3.2 mm/t, 4' x 8' required (130 kg/set).
- Turn buckle: W 5/16 x 200 mmℓ = 70 pcs./set
- Square pipe: 30 mm x 60 mm x 2.3 mmt = 60 kg/set
- Steel plate: 3' x 6' x 6 mmt x 2 sheets = 160 kg/set

All materials are to be imported. Mass production types are to be imported from Japan on the commencement of production.

3-2-3. Cutting templates

Semi-automatic cutters are to be used for non-rectangular shapes of mass production types (for automobiles).

In this case, cutting templates for exclusive use for each type will be necessary. They will require steel materials obtainable locally as below.

12 mm/t steel 6' x 3': 160 kg/set

Mass production types are to be imported from Japan on the commencement of production.

3-2-4. Developed gauges

They are used to inspect the precision in cutting non-rectangular shapes (size, shape fitting) and also used as gauges for products in the case of flat tempered glass.

Material: tin-plate 0.3 mm/t 3' x 6' / set obtaintable locally.

Mass production types are to be imported from Japan on the commencement of production.

3-2-5. Equipment to be imported from Japan on the commencement of production

1. In addition to the above, 1 set of cooling blower for flat tempered glass and 8 sets for bent tempered glass will be prepared.
   They can be used for joint purposes except for special bent products.
2. Press head: 8 sets.
3. Inspection gauges: 8 sets.
4. Cutting templates: 48 sets.
5. Developed gauges: 48 sets.

(Based on BTZ 7 type BT 1 type T 40 type for the commencement of production.)

3-2-6. Local prices of tools and annual costs

Material costs (local procurements and local prices of import) + manufacturing cost

1. Inspection gauges: 62 thousand yen/set x 24 set/year = 1488 thousand yen/year
2. Press heads: 120 thousand yen/set x 24 set/year = 2880 thousand yen/year
3. Cutting templates. 40 thousand yen/set x 24 set/year = 960 thousand yen/year
4. Developed gauges. 2.4 thousand yen/set x 30 set/year = 72 thousand yen/year

Annual costs of tools: 5,400 thousand yen/year

Furthermore, cutting of those in small lots and those other than car parts are to be done manually with wooden cutting templates or in the same way as sheet glass. These costs were included in the repair costs.

3-3. Packing materials

3-3-1. Wood plates

a) Quality : Same as those used for sheet glass. Jungle wood.
   Thickness : 1/2" ~ 3".
   Width : 3" ~ 6"

b) Procurement:
   1) Upper Burma Sagaing Town (650 miles from Bassein. To be supplied by boat.)
   2) Supply from the Bassein area is expected to increase in the future.

c) Price: CIF Bassein. 1,200 ks/ton. Relative gravity 2.43 ton/m^3

d) Required quantity: 9.5 kg/product m^2
   211 ~ 325 ton/year

3-3-2. Straw

Since foam styrol and strapping materials are difficult to obtain in Burma, straws are to be used for cushioning in all cases (same as sheet glass).

a) Required quantity: 7.3 kg/product m^2 29–45 ton/year

b) Price: 242 ks/ton

3-3-3. Paper

a) Required quantity: 0.11 kg/product m^2 2,443 kg–3762 kg/year

b) Price: 6,670 ks/ton

c) Quality: same as those used currently for sheet glass.

3-3-4. Nails

a) Required quantity: 0.153 kg/product m^2 3,400 kg–5,230 kg/year

b) Price: 7,665 ks/ton

c) Sizes: same as those used currently for sheet glass.

3-3-5. Future rationalization

Wooden case may be disposed of after it has been used once for the time being. However, the use of reusable case and pallets are recommended for stable sales routes to reduce the costs.

3-4. Utility

3-4-1. Electricity

a) Though LPG, city gas, electricity, etc. may be used for the heating furnace for tempered glass, electricity is the most suitable source of power for the precision in temperature control and heating control and also for intermittent operation.

b) The Bassein Factory has the capacity to receive 2,500KVA in view of safety glass, mirror and frosted glass, using 550KVA for sheet glass at the maximum.
Since processing glass requires a total of about 350KVA to cover the furnace, cutting, washing and lighting, the remaining power will be sufficient.

c) Since the entire production process comes to a standstill in the event of power failure, no emergency generator will be required.

d) Electricity is supplied to the Bassein Factory from the Myan Aung Gas Turbine in 66,000V to be reduced to 6,600V at the Factory substation. It is further reduced to 400V or 200V at the sheet glass plant and the processing plant before use.

e) Cycle: 50HZ.

f) Voltage fluctuations and power failure.

The maximum fluctuation is 3% at 400V, thus causing no practical problem. Power failure occurs twice a month on average (but lasting less than 5 minutes).

The voltage falls fairly often.

g) Consumption:

25 kwH/product m^2 550 – 785 thousand kwH/year

h) Price:

Assuming that the electricity currently used will be consumed in addition, it will be 0.18 ks/kwh = 5.4 yen/kwh on the basis of actual price in case of sheet glass.

3-4-2. Water

a) Required quantity:

On the basis of full operation (day work), 11.000 t/ear (4.6 t/hr) will be consumed mainly for bevelling machine and for washing the cut and bevelled glass and also for cleaning, drinking and housing (increased portion).

b) Quality:

At Bassein, water taken from a nearby river goes through a water treatment system for sedimentation and filtering, showing the water quality as shown below.

	PH	Cl^- ppm	Hardness $CaCO_3$ ppm	Fe ppm	SO_4 ppm	SiO_2 ppm	Electricity conduction $\mu V/cm$
River water	8.4	7.9	82.0	1.25	2.47	46.7	198
Treated water	8.1	6.4	82.6	0.11	28.8	–	237
Replenishing water	8.2	5.9	3.1	nil	32.5	24.7	234
Circulaton water	8.6	7.9	7.0	0.03	41.6	–	237
Drink water	8.3	7.4	85.0	0.31	30.4	–	242

Replenishing water can be used to wash the sheets.

c) Water treatment capacity.

Water treatment facilities:

Original water 21 – 22 m^3/Hr Treated water 18 – 20 m^3/Hr

Drinking water 4 – 7 m^3/Hr (Average: 127 m^3/day)

Cycling water 155 – 170 m^3/Hr

Soft water system 7 – 8 m^3/Hr (Deep-well water used)

Supply of the maximum 4.6 t/hr for processing is possible.

d) Price:

Though the exact costs at Bassein were not ascertained, the drinking water charge of 4 ks/1000 gal in Rangoon was used to arrive at 1 ks/ton = 30 yen/ton.

3-5. Processing materials and consumption materials

a) See Chart V for details.

(Chart V)

Processing Materials: List of processing materials and consumption materials

1. Pre-process

1)	Hand cutter	9)	Mark stencil
2)	Cutting wheel	10)	Emery
3)	Cutter holder	11)	G.C dressing stone
4)	Kerosene	12)	Dressing oil
5)	G.C. stone	13)	Rib dresser
6)	Vacuum chuck for beveling machine	14)	Brush roll for washing machine
		15)	Rubber roll for washing machine
7)	Grinding wheel	16)	Sponge roll for washing machine
8)	Beveling belt		etc.

2. Tempering process

1)	Press hanger	8)	Boron nitride
2)	Tong screw	9)	Record chart
3)	Asbestos cloth	10)	Rech ocher
4)	Glass fiber cloth	11)	Pannel heater
5)	Cerium oxide	12)	Scratch polishing wheel
6)	Pine carbon powder		etc.
7)	Teflon tube		

3. Others

1)	Stainless steel rule	6)	Gloves
2)	Thickness gauge	7)	Apron
3)	Polarized film	8)	Hand cover
4)	Cotton yarn	9)	Glass pencil
5)	Cotton rope		etc.

Bevelling (Pre-process):	16 items
Tempering process:	12 items
Others:	9 items

b) See Chart VIII for the required quantities of main materials.

c) Prices: Main materials are imported. See Chart VIII.

d) Costs:

Imported processing materials 25 yen/m^2 + locally procured materials 10 yen/m^2 = 35 yen/m^2.

Others were included in maintenance costs.

CHAPTER 4. SELECTION OF PLANT SITE

The selection of a plant site may be made taking account of the availability of raw materials and utilities, employment of workers, transportation of products, land conditions, etc. On the other hand, since the method of production of safety glass is normally based on an order basis, it is subjected to the trends in demand. It is, therefore, advantageous to be near the place of demand when the aspect of distribution is considered. From the above points of view, the selection of the site will be confined to the Rangoon area and the Bassein area where a sheet glass plant is already located.

1) In the case of the Rangoon area.

The merits of the selection of the site in the Rangoon area are:

- Orders can be received without delay, thus making production planning easy.
- The lead time in transporting products is short, an advantage for delivery.
- It is easy to employ engineers.

On the side of demerits:

- After cutting in the shape of finished products, remaining glass (cullet) equivalent to 30% of raw material sheet glass have to be transported between Rangoon and Bassein.
- It is necessary to keep a considerable surplus of sheet glass in stock from the viewpoint of delivery.
- There are some problems in terms of power supply and its quality (voltage fluctuations).
- Construction of all joint plant facilities will be necessary, not to speak of land acquisition, resulting in larger investments compared with Bassein.

2) In the case of the Bassein Factory.

The merits of the selection of the site within the grounds of the Bassein Factory are:

- It is advantageous in supplying and transporting sheet glass.
- Thorough production is possible for diversified contents of orders from sheet glass to processing.
- Thus, yield of materials will be efficient, leading cost reduction.
- Transportation of materials to cover the yield can be kept to a minumum.
- It is easy to transport and treat the cullet.
- Land, utilities, etc. were already taken care of when the sheet glass plant was constructed. The control sector, the repair shop, the can plant, etc. can be jointly used, contributing to higher investment efficiency.
- Voltage fluctuations are small and stable supply of water of a good quality is possible, thus advantageous in terms of quality and yield.

The demerits are:

- In order to receive diversified contents of orders promptly, the distance from the place of demand is considerable.
- Since water transport has to be used, shipments will have to be made in certain lot sizes, delaying deliveries.

- Though the employment of workers will pose no problems, the employment and settlement of engineers may pose some problems.

When the two sites are compared, we find that in the light of the demand size conceivable at present, it is advantageous to construct the proposed plant at Bassein from the viewpoint of investment efficiency. However, it will be necessary to improve the information system for order control and the aspect of distribution such as the transportation of products.

According to the above conclusion, the present feasibility study was conducted, confining its scope to the case of construction within the grounds of the Bassein Factory.

CHAPTER 5. INSTALLATION OF THE PLANT

5-1. The capacity and size of the plant and manufacturing process

5-1-1. The capacity

The tempering furnace:

- A cycle of tempering: 100 seconds per piece of the glass, 5 mm thickness basis.
- Operation rate: 60%
- Selection yield of tempering: 90%.
- Average area per piece: 0.360 m^2.
- Annual operating days: 300 days.
- Annual capacity: 140,000 pcs, or 50,000 m^2.

5-1-2. Products –kinds, thickness and sizes

- Zone-tempered glass, deep bent: for windshields of cars.
- Tempered glass, deep bent: for side glass of cars.
- Zone-tempered glass, flat: for windshields of cars, specially for Jeeps.
- Tempered glass, flat and non-rectangular: for side and rear glass of cars.
- Tempered, flat and rectangular: for buildings, rolling stocks, ships, etc..

Maximum sizes of the products:

- 2,000 mm x 1,100 mm (2.2 m^2/PC) for 6 mm thick glass
- 2,000 mm x 750 mm (1.5 m^2/PC) for 5 mm thick glass
- 1,600 mm x 750 mm (1.2 m^2/PC) for 4 mm thick glass

5-1-3. The manufacturing method

Vertical type press bending furnace with two stages 1 set

pre-process: semi-automatic and manual cutting machine and manual bevelling machines.

5-1-4. Manufacturing yield, %

	Bent temper	Flat and non-rectangular temper	Flat and rectangular temper
Theoretical yield	80	85	90
Raw material glass selection yield	80	85	90
Cutting yield	95	95	98
Tempering yield	85	95	95
Total yield	58	65	75

5-2. The required area of the plant

Site area : 66 m x 48 m = 3,168 m^2

Buildings : Main building 40 m x 21 m = 820 m^2

Ware house 40 m x 21 m = 820 m^2

Total 1,640 m^2

Refer to attached Sheet 1.

5-3. Machinery and Equipment

(1) Tempered Glass Production Equipment

a)	Electric Furnace (Vertical Type Press Bending Furnace with 2 Heating Stages)	1 set
b)	Quenching Blower and Duct	1 set
c)	Transformer and Wiring Materials	1 set

(2) Pre-Process Equipment

a)	Semi-automatic Cutting Machine for Windshield & Backlite	1 set
b)	Semi-automatic Cutting Machine for Side Lite	1 set
c)	Cutting Table for Straight Cutting	1 set
d)	Bevelling & Grinding Machine	3 sets
e)	Washing Machine	1 set
f)	Grinding Machine with Cutter Wheel	1 set
g)	Dressing Machine for Bevelling & Grinding Wheel	1 set

(3) Testing Equipment

a)	Optical Distortion Test Equipment	1 set

b)	Impact Resistance Test Equipment	1 set
c)	Fragmentation Test Instrument	1 set
d)	Abrading Instrument	1 set

(4) Utility Equipment

a)	Equipment of Power Station	1 set
b)	Cable and Wiring Materials	1 set
c)	Illumination Equipment and Instrument	1 set
d)	Compressor	2 sets
e)	Pump for Industrial Water	2 sets
f)	Piping Materials	1 set

(5) Transporter, Operational Tools, Work Shop Equipment

a)	Cullet Box	6 sets
b)	Cart	20 sets
c)	Forklift	1 set
d)	Operational Tools and Work Shop Equipment	1 set

(6) Tools

a)	Press Molds	8 sets
b)	Blast Heads	9 sets
c)	Inspection Gauges	8 sets
d)	Cutting Template	48 pcs
e)	Developed Gauges	48 pcs
f)	Tongs	200 pcs

5-4. Buildings and Civil Works

(1) Warehouse for Raw Material Glass & Good (21 m x 40 m) — 1

Structure: Timber truss, Reinforced concrete
One-story house, Slate roof

(2) Main Factory for Tempered Glass (21 m x 40 m) — 1

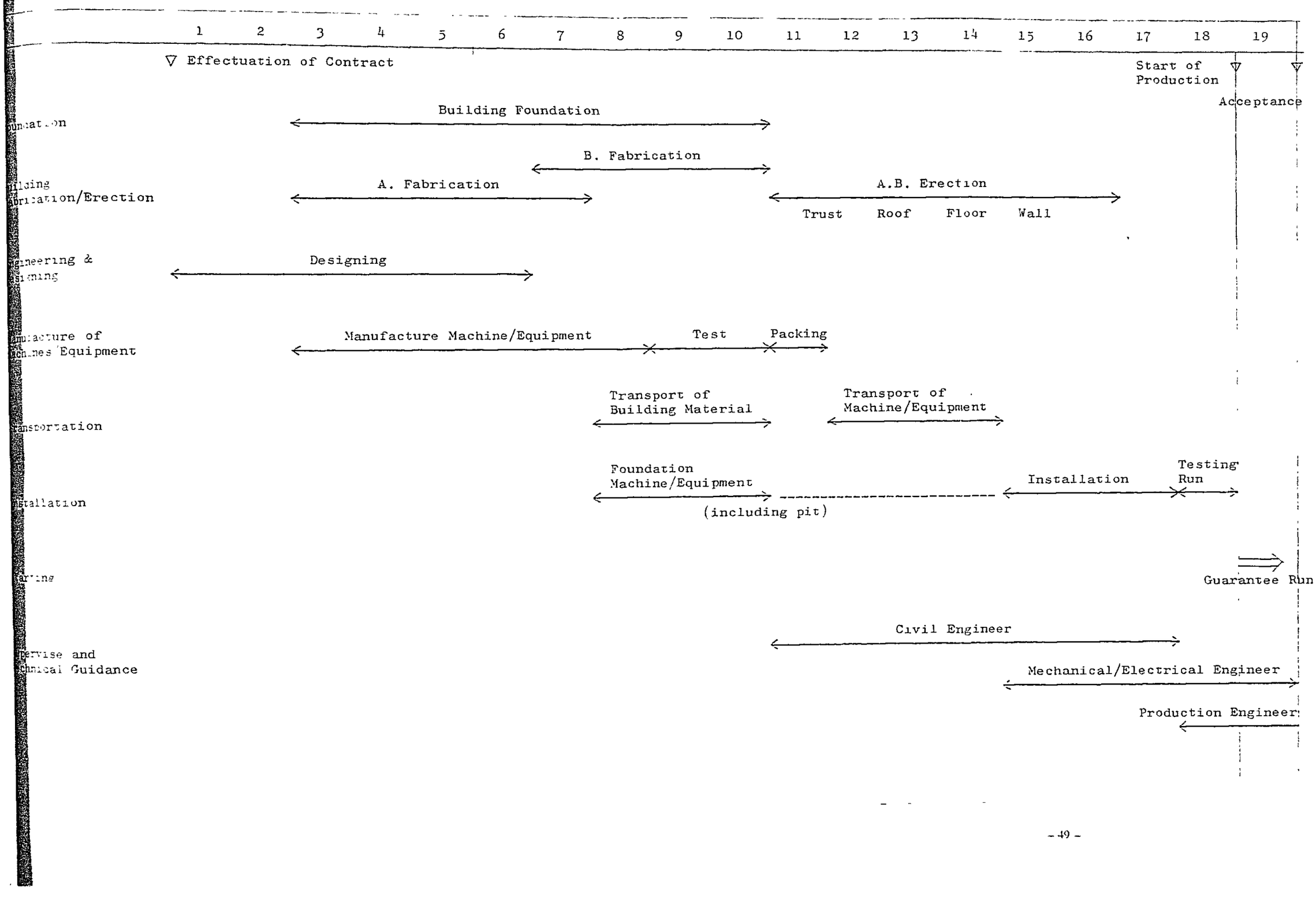
Steel structure, One-story house
Slate roof

(3) Roads and Drainages — 1 set

(4) Foundation Works — 1 set

(Chart VI)

Schedule of construction work



5-6. Construction Cost

		million yen
(1)	Machines and Equipment to be imported	442.2
(2)	Local Construction	545.6
	inclusive of: Marine freight, insurance, import duty and inland transportation on imported items	
	Supervisory fee	
	Training fee	
	Local procurement/construction expenses	
(3)	Engineering Fee	26.0
(4)	Know-How Fee	50.0
(5)	Initial Expenses	48.1
	Total	1,111.9 million yen

CHAPTER 6. OPERATION OF THE PLANT

(Chart 7)

Chapter 6. Operation of the Plant

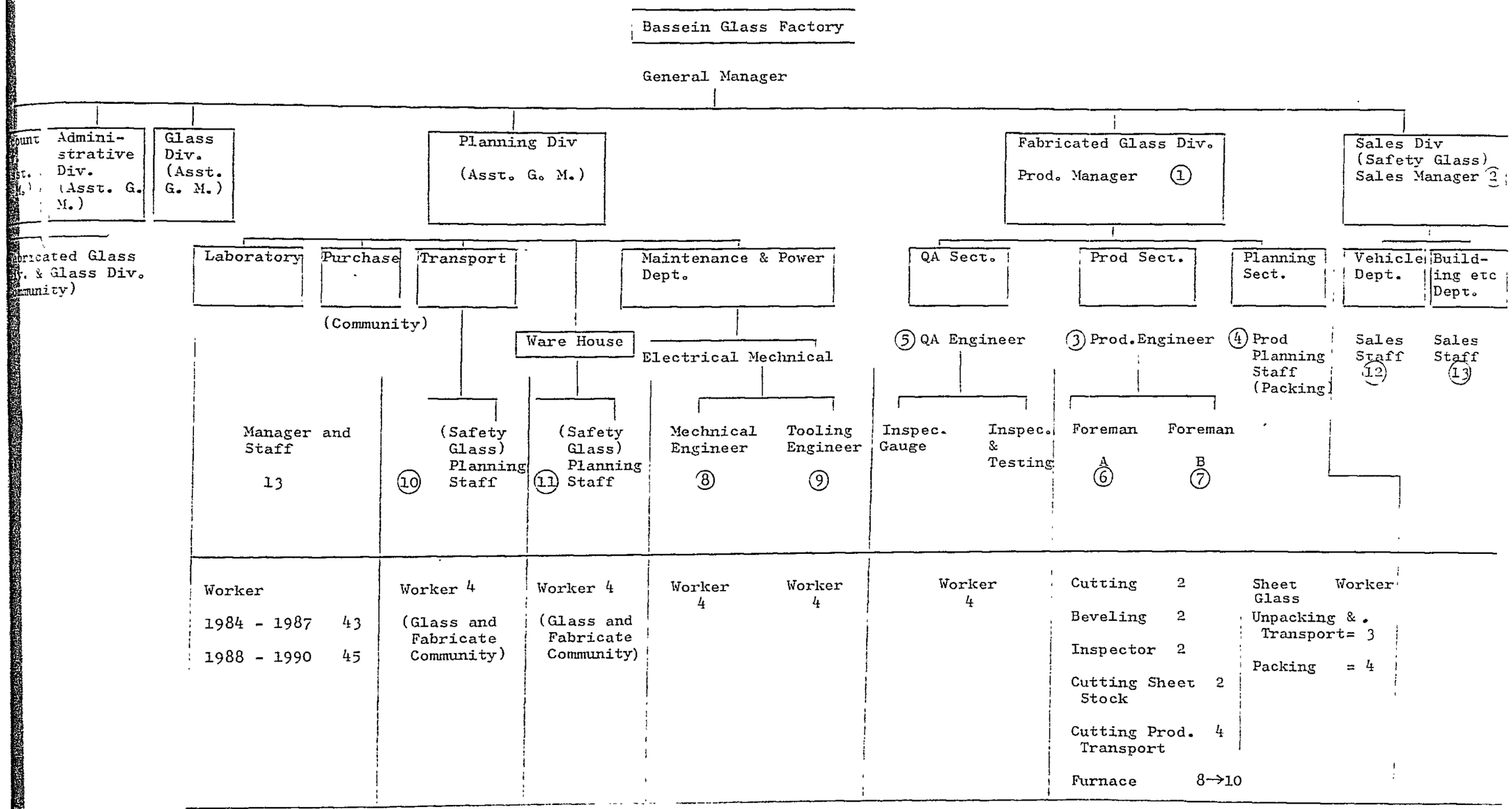
6-1: Quantity required of raw materials and utilities (Raw Materials, Utilities, Processing Materials, Packing Materials)

	Unit Price (Yen)	Unit	1984	1985	1986	1987	1988	1989	1990
1. Production Amount		m^2/Y	22,210	23,780	25,520	27,490	29,580	31,720	34,200
2. Raw Material									
Imported Float Glass FL5m/m	4,200/m^2	m^2/Y	370	385	400	430	450	470	495
Sheet Glass S5m/m	2,233/m^2	m^2/Y	31,720	33,975	36,460	39,270	42,260	45,615	48,860
" " "	178.640/t	t/Y	396.5	424.7	455.8	490.9	528.3	570.2	610.8
3. Utilities									
.Electric Power	5.4/KWH	thousand KWH/Y	544	576	610	650	692	734	784
1984 1,813KWH/D; 1990 2,613KWH/D									
.Water	30/Ton	TON/Y	7,500	8,000	8,500	9,000	9,500	10,000	10,500
1984 25 Ton/D; 1990 35 Ton/D									
4. Processing Materials									
Cutting wheel	2,480/pc	pcs/Y	11	12	13	14	15	16	17
GC stone	419/pc	"	22	24	26	28	30	32	35
Beveling wheel	133,300/pc	"	11	12	13	14	15	16	17
Beveling belt	3,565/pc	"	44	48	52	56	60	64	70
Mark stencil	4,185/pc	"	44	48	52	56	60	64	70
Emery	3,565/pc	"	22	24	26	28	30	32	35
5. Packing Materials									
Wooden Plate 9.5kg/m^2	36/kg	kg/Y	211,000	226,000	242,000	261,000	281,000	301,000	325,000
Nail 0.153kg/m^2	230/kg	"	3,400	3,640	3,900	4,210	4,530	4,850	5,230
Straw 1.3kg/m^2	7.3/kg	"	28,873	30,914	33,176	35,737	38,454	41,236	44,460
Paper 0.11kg/m^2	200/kg	"	2,443	2,616	2,807	3,024	3,254	3,489	3,762

(Chart 8)

6-2 : Required number of employees & employment cost

6-2-1 : Organization & Placement of New employees



6-2-2 Personel Cost

(A) Manager and Engineer and Staff

Prod. Manager	1
Prod. Engineer	1
Quality Assurance Engineer	1
Foreman	2
Planning Staff	3
Mechanical Engineer	1
Tooling Engineer	1
Sales Manager	1
Sales Staff	2
Total	13

(B) Worker

(Production)	23 - 25 men
1. Sheet Glass unpack carry	3
2. Cutting Bevelling Inspector	6
3. Cutting Sheet Stock	2
4. Furnace	
4 x 2 = 8 (1984 - 1987)	
5 x 2 = 10 (1988 - 1990)	
5. Cutting Sheet & Product Transport	
2 x 2 = 4	
(QA)	
1. Inspection & Testing	2
2. Gauge Preparation	2
(M & P)	
Tooling & Mechanical	8
(Ware House & Transport)	8
Total	43 - 45

Salary & Wages

(A) Average 19,500 Yen/Man month

13 x 12 x 19,500 = 3,042 T Yen/Year

(B) Average 10,500 Yen/Man month

43 x 12 x 10,500 = 5,418 T Yen/Year
1984 - 1987

45 x 12 x 10,500 = 5,670 T Yen/Year
1988 - 1990

(A + B) 1984 - 1987
8,460 T Yen/Year

1988 - 1990
8,712 T Yen/Year

6-3. Inventory of the raw material sheet glasses, finished products and other materials

6-3-1. Inventory of the raw material sheet glass as stated in 3-1-4

unit: m^2

Year	1984	1985	1986	1987	1988	1989	1990
FL5 One yr inv.	370	385	400	430	450	470	495
S5 2.8 mon. inv.	7310	7837	8413	9061	9754	10462	11284
Total 2.9 mon. inv.	7680	8222	8813	9491	10204	10932	11779
							unit: M yen
Capital for inv.	17895	19156	20551	22134	23063	25528	27520

It is necessary to provide area of 350 m^2 (A) for raw material sheet glass inventory.

6-3-2. Inventory of the finished products and other materials

(1) Though Inventory of the products with standard sizes for the domestically assembling cars, ships, rolling stocks and buildings shall be kept as low as possible, but it will still need the inventory in some extent. (inventory for tunover)

(2) The products, on which orders may be pressed repeatedly and regularly, should be stored at some level even though the amount of order may be small like replacement. Considering above, having the inventory of the products equivalent to two month production is recommended. Inventory of the other materials required for operation including packing materials and processing materials are needed to cover the products of one month.

Year	1984	1985	1986	1987	1988	1989	1990
A., m^2	3700	3963	4253	4582	4930	5287	5700
B., 1000 yen	34271	35910	37716	39787	41280	44258	46845

A. Products inventory, two months

B. Capital requirement, based on two month products inventory plus inventory of other materials to cover one month products.

6-3-3. Land area required for inventories of finished products and others

A. Area for products.

(1) Bent temper.

480 m^2 products ÷ 9.6 m^2 products/m^2 area = 50 m^2 area

(2) Flat temper

5,220 m^2 ÷ 34.5 m^2/m^2 = 151 m^2

(1) + (2) 50 m^2 + 151 m^2 = 201 m^2

201 m^2 ÷ 0.5 = 400 m^2 (B) is required for finished products inventory

Storage efficiency

Area to stock packing materials to be used for one month:

Wood 27t (11 m^3), Straw 3.7 tons, Paper 314 kgs, Total 50 m^2 is required (C)

(A) : Area for raw material sheet glasses is 350 m^2 as stated in 6-3-1.

Total required area becomes to:

(A) 350 m^2 + (B) 400 m^2 + (C) 50 m^2 = 800 m^2

So, one ware house for raw material glass and finished products of 21 m + 40 m as mentioned in 5-4 (1) is necessary.

6-4. Working capital

The working capital in this feasibility study was calculated from the condition of commodity trade in Burma that the purchasers always should pay for goods in cash at the time they receive the goods.

Unit: One million yen

Year	1984	1985	1986	1987	1988	1989	1990
Total operation fund	52.2	55.1	58.3	61.9	64.3	69.8	74.4

CHAPTER 7. MANUFACTURING COST AND PROFIT

7-1. Manufacturing cost

Refer to followings for the amounts, unit prices and concerned details.

6-1, chart VII for 1 Raw material glass
2 Processing materials
3 Packing materials
4 Utilities

6-2-2, chart VIII for 5 Personnel cost

3-2-6, for 7 Tools

7-1-1. Depreciation

Under the Burmese law, depreciation years are:

Machines and Equipments	20 years
Buildings in Industries	40 years
Electric facilities	20 years
Glass melting tanks (Refractories)	5 years

Depreciation years for tools were considered same as those of refractories of glass melting tanks, i.e. 5 years, in this feasibility study.

Annual depreciation is:

Investment x 0.9 ÷ Depreciation years

Calculation follows:

(1) Buildings:

Imported materials (24.1 million yen) + Local construction (106.6) + Design fee (0.8) = Total 131.5 million yen

131.5 x 0.9 ÷ 40 = 2,959 Myen/year

(2) Machines and Equipments

Imported Goods (323.5 million yen) + Installation at the site (359.5) + Design fee (25.2) = Total 708.5 million yen

708.5 x 0.9 ÷ 20 = 31,883 Myen/year

(3) Tools:

Imported (94.6 million yen) + Local manufacturing (79.5) = Total 174.1 million yen

174.1 x 0.9 ÷ 5 = 31,338 Myen/year

(1) + (2) + (3) = 66.166 Myen/year. Refer to 2–(6) in the chart IX.

Know how fee and Initial Expenses were allocated to each of 5 years in accordance with Japanese law due to lack of knowledge on the Burmese rule.

7-1-2. Maintenance cost

The 2% and 3% of the cost of buildings and machines/ equipments respectively were estimated as the maintenance cost from the experience at Basein Sheet Glass Factory.

131.5 x 0.02 + 708.5 x 0.03 = 23.876 Myen/year

MMyen MMyen

7-1-3. Fire insurance

The 0.5% of the cost of buildings and machines/equipments

(131.5 + 708.5) x 0.005 = 4.199 Myen/year

MMyen MMyen

7-1-4. Transportation cost

(1) Water transportation

Actual water transportation cost of sheet glass between Besein and Rangoon is 74.3 Kyats/ton so far. Packing measurement of tempered glass is one and half times as big as that of sheet glass and lot size on freight of the former is half of the latter. Therefore freight cost of tempered glass may be calculated as triple of freight cost of sheet glass per m^2.

74.3 ks/ton is converted to 0.93 ks/m^2 for 5 mm thick glass.

0.93 ks/m^2 x 3 = 28.2 yen/m^2 x 3= 85 yen/m^2

(2) Inland transportation (Truck freight)

Assuming freight cost in Burma as half of freight cost in Japan, 25 yen/m^2.

(1)+(2) = 85 + 25 = 110 yen/m^2

7-1-5. Initial payment

The cost of raw material glass (2540 m^2), utilities, labour and other materials, which would be spent during three months from the beginning of commissioning to the starting commercial operation and which cannot be accounted as cost of products, is estimated here as 48,080 Myen.

7-1-6. Capital raising and Interest Payment

(1) Yen credit (OECF): 30 year deferred payment, unredeemable for 10 years, 2.25% per year interest.

Imported goods	442.2 million yen
Engineering fee	26.0
Know How fee	50.0
Total	518.2

The annual interest will be 11,660 Myen.

The accumlated interest in seven years will be 81,620 Myen.

(2) Loan from Burmese banks for equipment cost: Short term loan within 5 years, 5% per year interest.

–Local construction, and

The charges of imported goods excluded from F.O.B. prices, 545.6 million yen

(36.6 million yen per year shall be reimbursed as a part of the depreciation.)

Tools expected to be invested in 1989 additionally

–Procuring domectically 79.5 million yen

–Importing 94.6 million yen

(reimbursement in 5 years, allocating to each year evenly)

–Initial expenses 48.1 million yen

(reinbursement in 5 years, allocating to each year evenly)

The interest against the total of 593.7 million yen in the first year, 1984, will be 29.685 Myen and the accumulated interest in 7 years from 1984 through 1990 will be 176.275 Myen.

(3) Loan from Burmese banks for working capital: Short term loan within 5 years, 8% per year interest. The interest in the first year, 1984, and the accumulated interest in 7 years from 1984 to 1990 will be 4,176 Myen and 34,880 Myen respectively.

(4) (1)+(2)+(3) are shown in the chart IX-(9).

Total interest accumulated in 7 years from 1984 to 1990 is:

1.	Yen loan	81.620 Myen 27.88%
2.	Domestic loan for the equipment cost	176.275 Myen 60.21%
3.	Domestic loan for the working capital	34.880 Myen 11.91%
Total		292.775 Myen 100.00%

7-2. Profitability

7-2-1. Sales value

Year	For motor cars		Others		Total	
	Myen	%	Myen	%	Total	%
1984	167,360	67.3	81,256	34.7	248,616	100
1987	191,872	64.7	104,776	35.3	296,648	100
1990	221,184	62.0	135,296	38.0	356,480	100
1990/1984	%	% per yr.	%	% per yr.	%	% per yr.
	132	5	167	9	143	6.2
Sales prices	Myen per m^2		Myen per m^2		Myen per m^2	
	21.7–21.9		5.6		11.2–10.4	

As seen in the table above, the ratio of the total sales in 1990 to those in 1984 is expected to be 143% and the annual average growth of the total sales is expected to be 6.2% which is almost at same level of GNP growth in Burma. It will be seen also from the table that the sales growth of 132% and the annual growth of 5% for motor cars are rather smaller than the sale growth for other usage with 167% growth and 9% annual growth. That makes the sales volume increment larger, but the sales value increment smaller causing less profit growth because of the smaller sales growth for motor cars where sales price is the higher. The contribution of the sales of each item of the deep bent windshields and rear glass for cars, flat and non-rectangular side glass for cars, flat temper for ships and rolling stocks and flat temper for buildings to the total sales are shown in Fig. III.

7-2-2. Profit and Loss

The "profit and Loss" situation on this feasibility study is shown chart 9.

(1) The net profit after tax seems to be in the red within the period from 1984 to 1990 and it will take a time to become "black figure" even after that time, even though amount of loss in 1984 would be reduced to half in 1990.

(2) The pre-tax profit will become positive before the end of the third year and the accumulated loss will have been compensated by the profit before the middle of the fifth year.

(3) The accumulated pre-tax profit will be 117 million yen at the end of the seventh year and only 10.5% to the invested capital of 1111.9 million yen.

7-2-3. Economic inquiry into the production of safety glass in Burma

From the profit and loss study, we can recognize that the net profit after tax in the red will be accumulated to 510 million yen during 7 years from 1984 to 1990 but the pre-tax profit will be totaled as positive 117 million yen.

Addition to above, following advantages can be expected from this project.

(1) Utilization of excess sheet glass.

2,455 tons of product safety glasses will be produced in the period of 1984 through 1990 and this is equivalent to 3,507 tons of raw material sheet glasses if 2,455 tons is devided by yield of 0.7.

(Refer to chart III-(6) in Chapter 1.)

(2) Saving of foreign currency of Burma.

The difference between the foreign currencies which will be paid for importation of safety glass and importation of the plant under study, may be saved.

Trial statement of profit and loss for safety glass production in Burma

(Chart 9)

(Unit, thousand yen)

	1984	1985	1986	1987	1988	1989	1990	Remarks
Sales Volume (m^2)	22,210	23,780	25,520	27,490	29,580	31,720	34,200	
1. Sales Value	248,616	262,664	277,344	296,648	315,088	334,256	356,480	
2. Cost of Goods Sold	202,706	208,627	215,183	222,622	227,760	228,813	238,165	
1) Raw Materials Glass	71,581	76,623	82,202	88,536	92,252	102,113	110,078	
2) Processing Materials	777	832	893	962	1,035	1,110	1,197	
3) Packing Materials	9,084	9,726	10,438	11,243	12,098	12,973	13,988	
4) Utilities	3,163	3,345	3,549	3,780	4,022	4,264	4,549	Electricity and Water
5) Personnel Expenses	8,460	8,460	8,460	8,460	8,712	8,712	8,712	Engineers and Administration: 13
6) Depreciation	66,166	66,166	66,166	66,166	66,166	66,166	66,166	Operators: 43 until 1987, 45 from 1988
7) Tools	5,400	5,400	5,400	5,400	5,400	5,400	5,400	
8) Maintenance Expenses	23,876	23,876	23,876	23,876	23,876	23,876	23,876	Building 2%, Equipment 3% (to investment)
9) Fire Insurance	4,199	4,199	4,199	4,199	4,199	4,199	4,199	Investment x 0.5%
10) Royalties	10,000	10,000	10,000	10,000	10,000	0	0	On the basis of 5 years depreciation
3. Sales Expenses	3,087	3,297	3,525	3,794	4,072	4,358	4,687	
1) Transportation Cost	2,465	2,640	2,832	3,052	3,284	3,522	3,796	
2) Transportation Insurance	622	657	693	742	788	836	891	Sales value x 0.25 %
4. General and Administrative Expenses	7,458	7,880	8,320	8,899	9,453	10,028	10,694	Sales value x 0.25 % (excluding personnel expenses)
5. Total Cost	213,251	219,804	227,028	235,315	241,285	243,199	253,546	
6. Initial Expenses	9,616	9,616	9,616	9,616	9,616	0	0	On the basis of 5 years depreciation
7. Total (5 + 6)	222,867	229,420	236,644	244,931	250,901	243,199	253,546	
8. Profit Including Interest	25,749	33,244	40,700	51,717	64,187	91,057	102,934	
9. Interest	45,521	43,443	41,399	39,372	37,254	44,094	41,692	
10. Pre-Tax Profit & Loss	Δ19,772	Δ10,199	Δ699	12,345	26,933	46,963	61,242	
11. Tax	74,585	78,799	83,203	88,994	94,526	100,277	106,944	Tax on Goods and Services, Sales Value x 30%
12. Net Profit & Loss	Δ94,357	Δ88,998	Δ83,902	Δ76,649	Δ67,593	Δ53,314	Δ45,702	

Chart 10

Component Ratio of Costs to Sales Value

Item	Total, 1984-1990	Ratio of each item to Sales Value	Ratio of each item to Cost of Goods Sold	Component Ratio of Proportional Expense
Sales Volume (m^2)	194,500 m^2			
. Sales Value	2,091,096,000 Yen	100 %		
2. Cost of Goods Sold	1,543,876,000 "	73.8 "	100 %	
(1) Raw Material Glass (P)	623,200,000 "	29.8 "	40.4 "	81.7 %
(2) Processing Materials (P)	6,806,000 "	0.3 "	0.4 "	0.9 "
(3) Packing Materials (P)	79,550,000 "	3.8 "	5.2 "	10.4 "
(4) Utilities (P)	26,672,000 "	1.3 "	1.7 "	3.5 "
(5) Personnel Expenses	59,976,000 "	2.9 "	3.9 "	
(6) Depreciation	463,162,000 "	22.2 "	30.0 "	
(7) Tools	37,800,000 "	1.8 "	2.5 "	
(8) Maintenance Expenses	167,132,000 "	8.0 "	10.8 "	
(9) Fire Insurance	29,393,000 "	1.4 "	1.9 "	
(10) Royalties	50,000,000 "	2.4 "	3.2 "	
(Total of Proportional Expenses)				100 % (763,100)
3. Sales Expenses (P)	26,820,000 "	1.3 "		3.5%
4. General and Administrative Expenses	62,733,000 "	3.0 "		
5. Total Cost	1,633,429,000 "	78.1 "	105.8 "	
6. Initial Expenses	48,100,000 "	2.3 "	3.1 "	
7. Total (5 + 6)	1,681,529,000 "	80.4 "	108.9 "	
8. Profit including Interest	409,567,000 "	19.6 "	26.5 "	
9. Interest	292,775,000 "	14.0 "	19.0 "	
10. Pre-tax Profit & Loss	116,792,000 "	5.6 "		
11. Tax	627,329,000 "	30.0 "		
12. Net Profit & Loss	△510,537,000 "	△24.4 "		

(Fig III)

Estimation of Gross Sales Values by Type and Total Cost(except Tax)

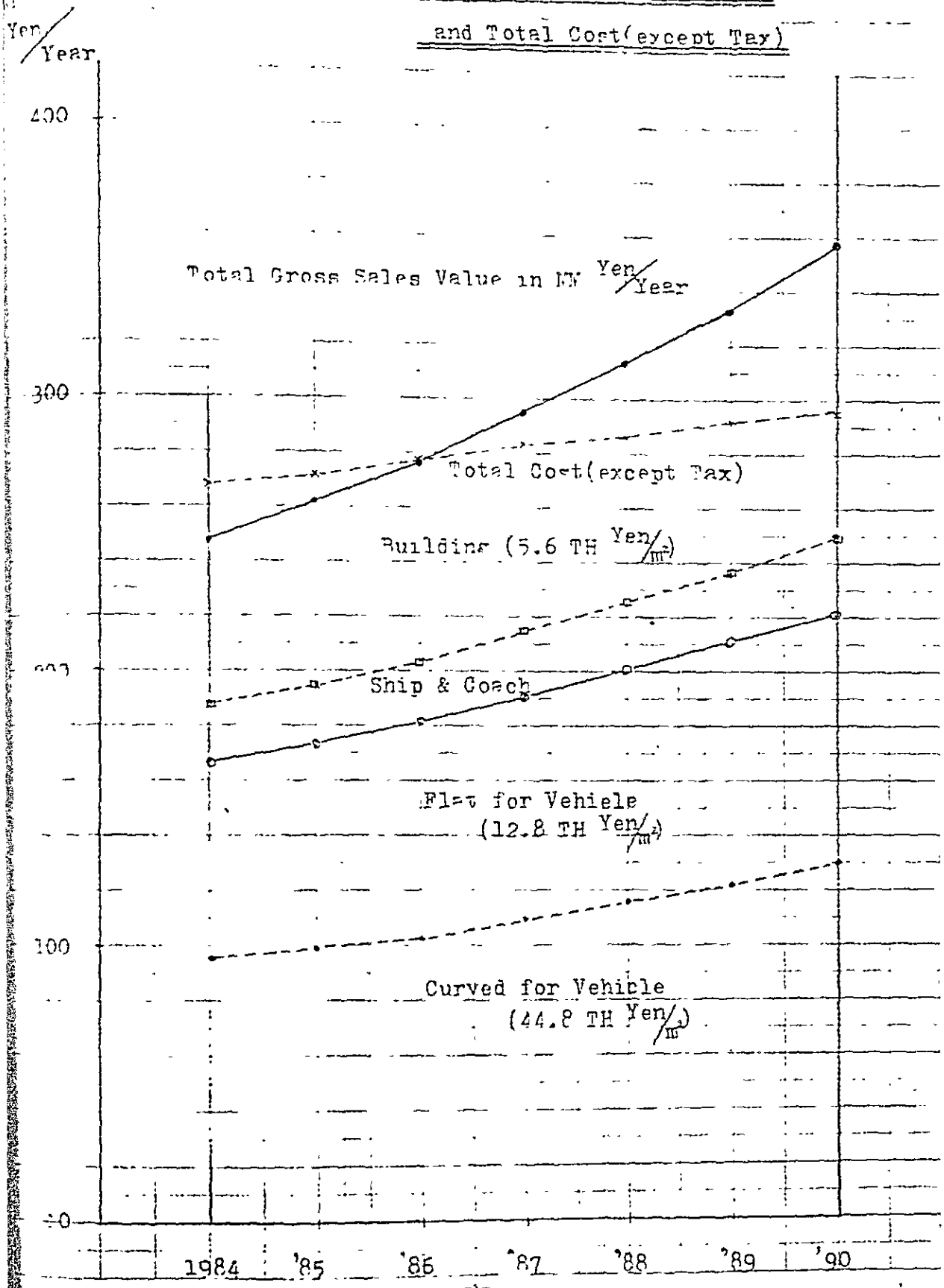


Chart 11

Fund Plan

1. Fund and Interest

	Interest	Amount (Million Yen)
a. Investment in Plant and Equipment For local construction, initial expense and the charges for imported goods excluded from FOB prices	5%/year	593.7
b. Working Capital	8%/year	
c. Yen Credit For FOB price of goods to be imported and technical assistance	2.25%/year	518.2
	Total	1,111.9

2. Fund Plan Statement

	1984	1985	1986	1987	1988	1989	1990
Investment in Plant and Equipment							
c. (Goods to be imported)	(442.2)						
Building	24.1						
Equipment	323.5						
Tools	94.6						
a. Tools						94.6	
a. (Local Construction)	(545.6)						
Building	106.6						
Equipment	359.5						
Tools	79.5					79.5	
c. (Engineering Fee)	(26.0)						
Building	0.8						
Equipment	25.2						
a. (Initial Expenses)	48.1						
c. (Royalties)	(50.0)						
Total	1,111.9					174.1	
b. Working Capital and Fund for Stock							
{Working Capital 1 month Stock of Finished Products 2 months Stock of Raw Material Glass 3 months}	52.2	55.1	58.3	61.9	64.3	69.8	74.4
Total	1,164.1	55.1	58.3	61.9	64.3	243.9	74.4

Reinvestment in Tools shall be made in the sixth year because depreciation of Tools completes in five years.

CHAPTER 8. TECHNICAL TRAINING AND SUPERVISION AT THE SITE

8-1. Technical training

Technical training of the personnel, for instance four people, from Burma at the safety glass manufacturing plant in Japan for some period, for instance two months, is necessary because this is the first production of safety glass in Burma. The personnel from Burma may be followings. Manufacturing, one engineer and two technicians. Mechanical, one engineer.

8-2. Supervision at the site

Having Japanese engineers in the fields of mechanics, electrics and manufacturing supervise the installation and production at the site is required.

Also, several visits and assistances by Japanese engineers in one year after the beginning of production will be effective.

CHAPTER 9. TECHNICAL INFORMATION

9-1. Principle of tempering of glass and safety nature of the tempered glass

The tempered glass is the sheet glass which is heated up to around 630–700°C, then quenched to form the layers having the residual compress stresses on its surfaces.

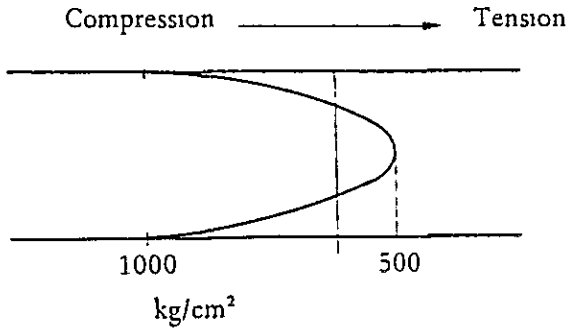


Fig. 4
Principle of Tempering

So, the composition does not change by tempering. The strength of the sheet glass depends on fire cracks on the glass surface. Strength of the glass varies significantly against tension and compression, and the breaking tensile stress may be considered around one tenth of the breaking compress stress.

Therefore the breakage of the sheet glass is generally caused by bending stress and the start-

ing point of breakage locates surely at the tensile side of the glass, and the breaking tensile stress is about 500kg/cm^2.

When the sheet glass is heated up to 600°C or more, it softens gradually, and it can be formed maintaining its smooth surfaces under the temperature range within 700°C. The heating and forming is done before quenching at the suitable temperature to tempering except for flat tempered glass.

The thin surface layers which have the thickness of 0.5–1mm will be cooled down to 500°C or less in one or several seconds after the beginning of the quench operation, so that the shape becomes rigid.

But the glass body which is more than 1mm under the surfaces is still at higher temperature and remain soft because the thermal conductivity of glass is rather low comparing to metals. The glass body will be cooled down and become rigid gradually after 10–20 seconds quenching and being left at a room temperature. The linear thermal expansion coefficient of sheet glass are 9–10x10^6/°C at the temperature less than 350°C and the cooling and contracting glass body will compress the surface layers of the glass producing a residual compress stress of about 1000kg/cm^2, and the center portion of the glass body will have a residual tensile stress of about 500kg/cm^2 contrally. (See Fig. 4.)

The bending breaking stress of glass is considered as about 500kg/cm^2, but this strength of glass depends much on the fine cracks on the glass surfaces as mentioned before. So, the residual tensile stress of 500kg/cm^2 at the center portion of the glass body does not cause any breakage of the glass. Becouse the breaking strength of the glass against compress stress is more than five times higher than the breaking surface tensile stress, the residual compress stress of 1000kg/cm^2 at the glass surfaces also does not cause any breakage of the glass.

Furthermore, this residual compress stress will act favourably to the strength of the glass compensating the tensile stress up to 1000kg/cm^2 when exposed under certain bending force. That means this tempered glass will have the apparent breaking tensile stress of 1500kg/cm^2, adding 1000kg/cm^2 to the original breaking tensile of 500kg/cm^2 which is three times as high as the breaking tensile strength of untempered glass is.

The tempered glass, a piece of glass sheet, contains much energy caused from the localized residual tensile and compress stresses which have been created by heat treatment and these tensile and compress stresses are balanced. Therefore, if this balance be lost, the sudden breakage would occur and the fracture fronts proceed rapidly at the center portion of the glass body branching without number to make numberless pieces of fragments instantly. This nature of the tempered glass makes the glass unable to fabricate, such as cut, drill etc after tempering it. The tempered glass has been recognised as a safety glass because of its favourable characteristics.

That is, the tempered glass is three times as strong as the untempered glass is, and breaks to the small perticles without any sharp edge which might hurt the people.

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9-2. Kinds of the tempered glass products

The tempered glass are classified into two kinds of glass depending on the shapes or sizes of the fragments when they are broken.

(1) Whole uniformly tempered: which break into the small perticles over whole area of the glass uniformly in case of breakage. They will be used as the side and rear glass of cars, buildings and other general purposes.

(2) Zone-tempered: which are controlled to break into fairly coarse perticles over some particular zones to maintain the sight or seeing-through area in case of breakage. They will be used as the windshields of cars.

9-3. Key characteristics of the tempered glass and their testing methods and standards

9-3-1 Strength

The impact resistance strength is standardized as the measurement of strength of the glass generally. The dropping steel ball of 227 g is the most common method in many countries. Each country has its own specification for measurement and even the easiest standard specifies 2 m as the lowest height from which the steel ball will hit the specimen without any fracture. (Refer to JIS R3211-4.10, JIS R3212-3.11.)

9-3-2. Safety

The key feature of the safety control of the tempered glass is the fragmentation. For the uniformly tempered glass, the impact points are specified and the specimens are broken in accordance with the specification. The maximum number of fragment within the frame of 5 cm x 5 cm and the weight of the maximum fragment are specified in the most cases. The acceptable standard values vary slightly from country to country.

For the zone-tempered glass, the sizes of the fragments in the area where seeing-through is possible are specified in full detail. (Refer to JIS R3211-4.11, JIS R3212-3.12.)

9-3-3. Durability

It is said that the tempered glass might release the residual stress gradually. But no trouble has been reported practically after more than 30 year use. And the tempered glass also have same durability, such as abrasion resistance, as the untempered glass have. (Refer to JIS R3211-4.5, JIS R3212-3.6.)

9-3-4. Optical Property

The optical distortion of the glass increases slightly by heat tempering. The increment of the optical distortion by heat tempering can be controlled and reduced to the level which is no problem in the practical uses, by the correct design of the quenching devices. Because

the optical distortion of the deep bent tempered glass and also those of the raw material sheet glass themselves may become to problem sometime, several kinds of the testing methods and standards are specified.

9-4. The standards and the applied regulations of the safety glass

(1) The safety glass of cars.

Application of JIS to the manufacturing of the safety glass in Burma is recommended and the copies of JIS are attached to this study report. Applied standard is explained in JIS R 3211 and testing method in JIS R 3212.

The inspection equipment and instruments requested in JIS are also included as a part of importing machines and equipment and listed in Chapter V-3-(3).

(2) Regulation of the architectural safety glass.

The regulation of the architectural safety glass has not been established in Japan. Recently the movement to promote use of the safety glass for school buildings has been active under the leader ship of the Plate Glass Association of Japan. The places where the safety glass should be used are clearly specified in the regulation in the U.S.A.. So, it is believed that the regulation like in the U.S.A. will be set also in Japan in near future. The copy of "Archtectural glazing materials, Consumer product safety commission Feb. 11, 1976" is attached to this study report.

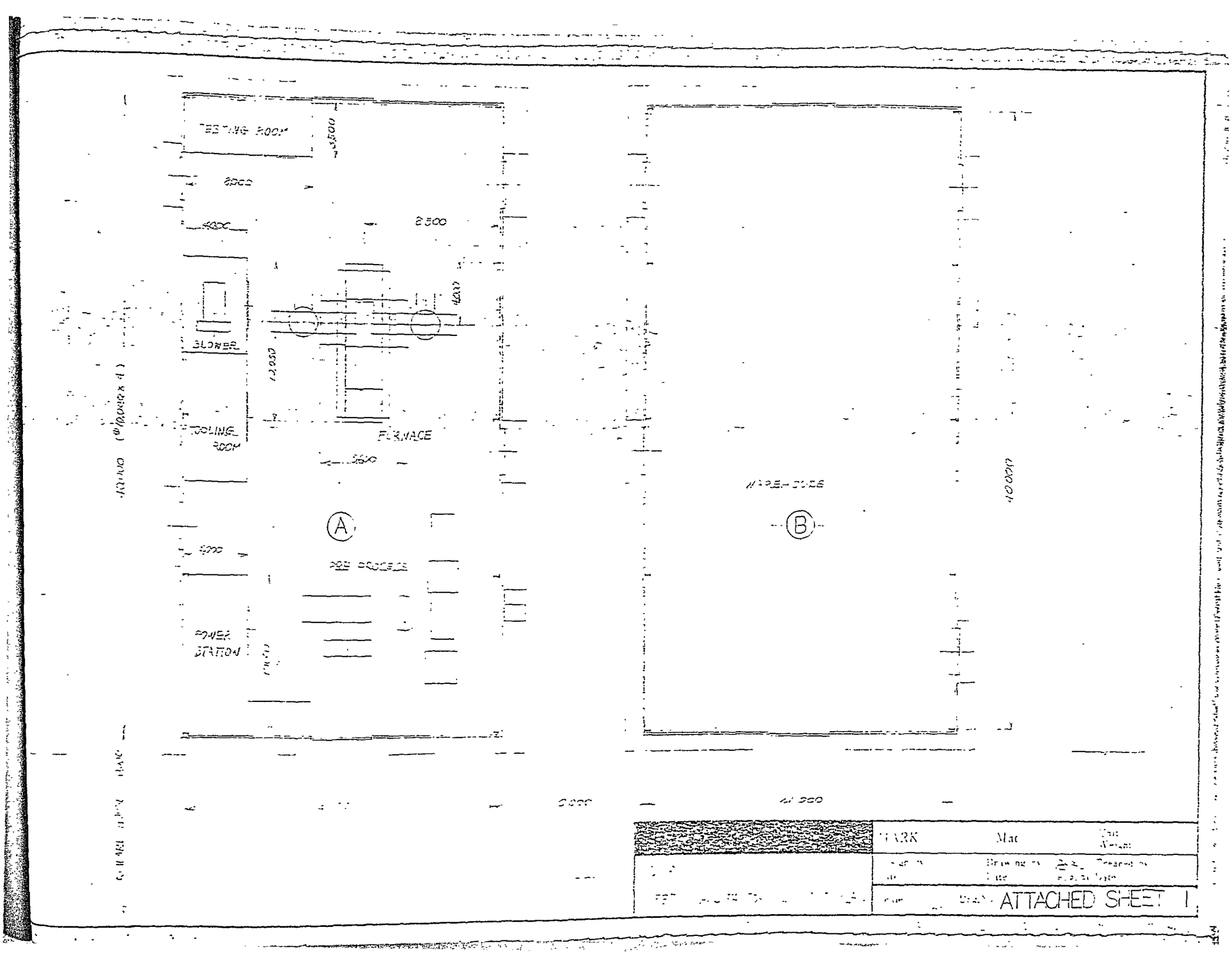
9-5. The manufacturing process of the tempered glass

The brief discription on the main operations and equipment or machines concerning the press type tempering process which we recommending in this feasibility study is shown in chart 12.

(Chart 12)
Process Description

GLASS FLOW

Process	Equipment and Operation
Raw glass	
loading to cutting machine	
cutting	Semi-automatic Cutting M/C or Hand Cutting table
trimming	Manually trimming
beveling	Manual bevelling M/C
loading to washing machine	
washing & drying	Automatic Washing Conveyor
unloading from washing machine	
inspection (Intermediate inspection)	
stock	
suspend the glass to tong	Manually hang on by tongs
heating	Electrical Heating Furnace
pressing	Automatic Press M/C and Press Head
quenching	Cooling Nozzle and Blower
unloading the glass from cart	
inspection (Final inspection)	
packing	


TESTING ROOM
BLOWER
COOLING ROOM
FURNACE
A
B
WAREHOUSE
POWER STATION
ATTACHED SHEET 1

UDC 656.155:629.111

JIS

JAPANESE INDUSTRIAL STANDARD

Safety Glasses for Road Vehicles

ⓙ JIS R 3211 -1979

Translated and Published

by

Japanese Standards Association

ⓒ

Printed in Japan

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Translation without guarantee
In the event of any doubt arising, the original
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JAPANESE INDUSTRIAL STANDARD J I S

Safety Glasses for Road Vehicles R 3211-197

1. Scope

This Japanese Industrial Standard specifies the safety glasses to be used mainly for windows of road vehicles, hereinafter referred to as the "safety glasses".

2. Definitions

Principal terms used in this standard are as defined below:

(1) Laminated Glass A glass consisting of two or more sheet glasses which have been adhered together with interlayer of plastics material, which allows, in the event of shattering by external force, a large part of fragments not to scatter.

(2) Toughened Glass A glass consisting of a sheet glass which has been subjected to heat treatment to form a tough compression-stressed layer, on the glass surface, to increase the strength against the action of external force and temperature change, and consequently to condition fragmentation after shattering in the event of shattering. This type is to be used for the window panes other than front windscreens.

(3) Zone-Toughened Glass A glass which is so treated as to condition so that, in the event of shattering, a part of fragments may shatter into somewhat larger fragments to secure field of vision necessary to driving. This type is to be used for the front windscreens of road vehicles.

3. Types and Notations

The types and notations thereof of the safety glasses shall be in accordance with Table 1.

Applicable Standards:

JIS R 3201-Sheet Glass

JIS R 3202-Float, Polished Plate Glass

JIS R 3208-Heat Absorbing Glass

JIS R 3212-Glass Roving

Table 1

Type	Notation	Division
Laminated glass A	L	Laminated glass using an interlayer of 0.76 mm thickness. Laminated glass using an interlayer of 0.38 mm thickness together with that of 0.76 mm thickness shall be included in this type.
Laminated glass B	L	Laminated glass using an interlayer of 0.38 mm thickness.
Zone-toughened glass	Z	
Toughened glass	T	

4. Quality

The safety glass shall prove itself to satisfy the requirements of 4.1 to 4.11, when subjected to the tests enumerated in Table 2 in accordance with JIS R 3212.

Requirements for the appearance, shape and dimensions, exclusive of thickness, of the safety glasses shall be subject to the agreement between the parties concerned.

Table 2

Test item		Item No. of quality specification				Item No. of test specified in JIS R 3212
		Laminated glass A	Laminated glass B	Zone-toughened glass	Toughened glass	
Thickness		4.1	4.1	4.1	4.1	3.2 *Measurement of thickness*
Visible light transmission		4.2	4.2	4.2	4.2	3.3 Visible light transmission test
Secondary image separation		4.3	4.3	4.3	—	3.4 Secondary image separation test
Optical distortion		4.4	4.4	4.4	—	3.5 Optical distortion test
Abrasion resistance		4.5	4.5	4.5	4.5	3.6 Abrasion resistance test
High temperature resistance		4.6	4.6	—	—	3.7 *High temperature resistance test*
Radiation resistance		4.7	4.7	—	—	3.8 *Radiation resistance test*
Head-form (human head manikin) impact resistance		4.8	—	4.8	—	3.9 Head-form (human head manikin) impact test
Penetration resistance		4.9	—	—	—	3.10 Penetration resistance test
Impact resistance		4.10	4.10	—	4.10	3.11 Impact resistance test
Condition of fragmentation	Zone-toughened glass	—	—	4.11.1	—	3.12.1 Fragmentation test for zone-toughened glass
	Toughened glass (5 mm and 6 mm thick.)	—	—	—	4.11.2	3.12.2 Fragmentation test for toughened glass, 5 mm and 6 mm thick.
	Toughened glass (3.5 mm and 4 mm thick.)	—	—	—	4.11.3	3.12.3 Fragmentation test for toughened glass, 3.5 mm and 4 mm thick.

Remarks 1. The secondary image separation test and optical distortion test for laminated glass A and laminated glass B apply to those to be used for front windscreens.

4.1 Thickness The thickness and tolerance thereon shall conform to Table 3.

Table 3

Unit: mm

Type	Nominal thickness	Thickness and tolerance
Laminated glass A Laminated glass B	Summed thickness of material sheet glass and interlayer	Nominal thickness(1) $\pm 0.3n$ (2)
Zone-toughened glass	5	5.0 ± 0.3
	6	6.0 ± 0.3
Toughened glass	3.5	3.5 ± 0.3
	4	4.0 ± 0.3
	5	5.0 ± 0.3
	6	6.0 ± 0.3

Notes (1) The nominal thickness of the laminated glasses shall be subject to an agreement between the parties concerned.

(2) The letter n indicates the number of the material sheet glass composing laminated glass.

4.2 Visible Light Transmission Three specimens shall be tested by the visible light transmission test, and all of the specimens shall meet the values specified in Table 4. This rule, however, does not apply to those for particular cars and the parts not impedimental to field of vision for driving.

Table 4

Type	Visible light transmission
Laminated glass A	70 % min.
Laminated glass B	
Zone-toughened glass	
Toughened glass	

4.3 Secondary Image Separation Three specimens shall be tested by the secondary image separation test, and all of the specimens shall satisfy the requirements given in Table 5. This rule, however, does not apply to the laminated glass A and laminated glass B not to be used for front windscreens.

Table 5

Type	Displacement of secondary image
Laminated glass A	The secondary image of the spot shall not be partially over the inside diameter line of the ring.
Laminated glass B	
Zone-toughened glass	

4.4 Optical Distortion Three specimens shall be tested by the optical distortion test, and all of the specimens shall satisfy the requirements specified Table 6. This rule, however, does not apply to the laminated glass A and laminated glass B not to be used for front windscreens.

Table 6

Unit: mm

Type	Permissible distortion of 8.0 dia. circle projected in the screen
Laminated glass A	± 2.3 in the test area I ± 6.9 in the test area II
Laminated glass B	
Zone-toughened glass	

4.5 Abrasion Resistance Three specimens shall be tested by the abrasion resistance test, and the mean value of three measurements shall satisfy the requirements specified in Table 7.

Table 7

Type	Haze value due to abrasion
Laminated glass A	2.0 % max.
Laminated glass B	
Zone-toughened glass	
Toughened glass	

4.6 High Temperature Resistance Three specimens shall be tested by the high temperature resistance test, and all of the specimens shall satisfy the requirements specified in Table 8.

Table 8

Type	Condition after boiling
Laminated glass A	It is permitted for the specimen to bring forth cracks, but neither bubble nor other defect shall be found beyond 15 mm from the edges or beyond 10 mm from the cracks. Where a specimen made by cutting out of a product is tested, cracks which have been brought forth beyond 25 mm from the newly made edges shall be permissible.
Laminated glass B	

4.7 Radiation Resistance Three specimens shall be tested by the radiation resistance test, and all of the specimens shall satisfy the requirements specified in Table 9.

Table 9

Type	Condition after exposed to ultraviolet ray
Laminated glass A	(1) $\frac{b}{a} \times 100\,\% \geqq 95\,\%$ (2) $b \geqq 70\,\%$ where a: visible light transmission(3) before exposed to ultraviolet ray b: visible light transmission(3) after exposed to ultraviolet ray
Laminated glass B	(3) There shall not be found any remarkable change in colour, any bubble and turbidity in the specimen, when inspected for a white background.

Note (3) Refer to 4.2.

4.8 Head-Form (Human Head Manikin) Impact Resistance Six specimens shall be tested by the head-form test. Where five or more specimens satisfy the requirements specified in Table 10, the safety glass shall be acceptable, but where three specimens or less pass, they shall be rejected.

Where four specimens pass, further six specimens shall be tested, and all of the specimens satisfy the requirements specified in Table 10, the safety glass shall be acceptable.

Table 10

Type	Condition after impact
Laminated glass A	Surface of specimen shall not be penetrated by the head-form.
Zone-toughened glass	The specimen shall fracture by head-form impact.

4.9 Penetration Resistance Six specimens shall be tested by the penetration resistance test. Where five specimens or more satisfy the requirements specified in Table 11, the safety glass shall be acceptable, but where three specimens or less fail, they shall be rejected.

Where four specimens pass, further six specimens shall be tested, and all of the specimens satisfy the rquirements specified in Table 11, the safety glass shall be acceptable.

Table 11

Type	Condition after impact
Laminated glass A	The surface of specimen shall not be penetrated by the steel ball.

4.10 Impact Resistance Six specimens shall be tested by the impact resistance test. Where five specimens or more satisfy the requirements specified in Table 12, the safety glass shall be acceptable, but where three specimens or less pass, they shall be rejected.

Where four specimens pass, further six specimens shall be tested, and where all of the specimens satisfy the requirements specified in Table 12, the safety glass shall be acceptable.

Table 12

Type	Condition after impact
Laminated glass A	(1) Surface of the specimen shall not be penetrated by the steel ball.
Laminated glass B	(2) The total mass of the fragments detached from the face opposite to the impacted face shall be not more than 20 g.
Toughened glass	The specimen shall not rupture.

4.11 Condition of Fragments

4.11.1 Condition of Fragments of Zone-Toughened Glass Four specimens shall be tested by the test for condition of fragments of zone-toughened glass. Where four specimens satisfy the requirements of Table 13, the safety glass shall be acceptable, but where one specimen or less passes, it shall be rejected.

Where three specimens pass, further one specimen shall be tested on the impact point same as that of the specimen which has failed, and if the specimen satisfies the requirements of Table 13, the safety glass shall be acceptable. Where two specimens pass, further four specimens shall be tested, and if all of the specimens satisfy the requirements of Table 13, the safety glass shall be acceptable.

Table 13

Divided area of specimen	Condition of fragments of zone-toughened glass	
Surrounding area	Number of fragments	40 to 400 specimens
	No. of slender fragments	5 specimens max.
Seeing-through area	Total area containing effective fragments	15 % min. of an area to be assessed(4)
	No. of fragments of 16 to 25 cm^2	3 specimens max. within an area of 100 mm radius centring impact point. 8 pieces max., in total seeing-through area.
	No. of fragments exceeding 25 cm^2	None
	No. of slender fragments	5 specimens max.
Intermediate area	Not coarser than fragments contained in seeing-through area.	

Note (4) A rectangular area of 400 x 200 mm shall be taken as an area to be assessed. If the requirements of Table 13 are not satisfied, the assessment shall be made for the area extending to the entire seeing-through area.

4.11.2 Condition of Fragments of Toughened Glass (5 mm and 6 mm thick.) Three specimens shall be tested by the test for condition of fragments of toughened glass of 5 mm and 6 mm thickness. Where all of the specimens satisfy the requirements of Table 14, the safety glass shall be acceptable, but where one or less fails, it shall be rejected. Where two specimens pass, further one specimen shall be tested for the impact point same as that of the specimen which has failed to pass, and where it satisfies the requirements of Table 14, the safety glass shall be acceptable.

Table 14

Condition of fragments of toughened glass (5 mm and 6 mm thick.)	
No. of fragments	40 to 400 specimens
No. of slender fragments	5 specimens max.

4.11.3 Condition of Fragments of Toughened Glass (3.5 mm and 4 mm Thick.) Five specimens shall be tested by the test for condition of fragments of the toughened glass in nominal thickness of 3.5 mm and 4 mm, and all of the specimens shall prove that the largest fragment is 4.2 g or less in mass.

5. Materials

5.1 The materials to be used for safety glass shall generally be in compliance with one of the standards enumerated below according to purpose of use.

(1) JIS R 3201

(2) JIS R 3202

(3) Heat absorbing ordinary sheet glass and heat absorbing float, polished plate glass specified in JIS R 3208.

5.2 The interlayer of the laminated glass shall be forced from polyvinyl butyral or plastics similar to it.

6. Inspection

The safety glass shall be inspected in accordance with the tests provided in 3. Testing Methods of JIS R 3212, and the results shall meet the requirements of 4.1 to 4.11 according to type.

The inspection items, however, may be partially omitted as required, subject to the agreement between the parties concerned.

7. Marking

The safety glass shall be clearly marked with the following particulars on each sheet by an indelible means.

(1) Type or notation thereof of safety glass

(2) Manufacturer's name or its abbreviation

R 3211-1979
Edition 1

Japanese Text

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JAPANESE INDUSTRIAL STANDARD

Test Method of Safety Glasses for Road Vehicles

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JAPANESE INDUSTRIAL STANDARD J I S

Test Method of Safety Glasses for Road Vehicles R 3212-1979

1. Scope

This Japanese Industrial Standard specifies the test methods of safety glasses for road vehicles, hereinafter referred to as the "safety glasses".

Remark: In this standard, units and numerical values given in { } are in accordance with the International System of Units (SI), and are given for reference.

2. Test Items

The test items shall be as enumerated below:

(1) Measurement of thickness

(2) Visible light transmission test

(3) Secondary image separation test

(4) Optical distortion test

(5) Abrasion resistance test

(6) High temperature resistance test

(7) Radiation resistance test

(8) Head-form (human head manikin) impact test

(9) Penetration resistance test

(10) Impact resistance test

(11) Fragmentation test

Applicable Standards:

JIS B 7502-Micrometer Callipers for External Measurement

JIS R 3211-Safety Glasses for Road Vehicles

JIS Z 8401-Rules for Rounding Off of Numerical Values

JIS Z 8701-Specification of Colour According to the CIE (1931) Standard Colorimetric System

JIS Z 8703-Standard Atmospheric Conditions for Testing

JIS Z 8722-Methods of Measurement for Colour of Materials Based on the CIE (1931) Standard Colorimetric System

Reference Standard:

JIS Z 8203-SI Units and the Use of Their Multiples and of Certain Other Units

3. Test Methods

3.1 Temperature of Test Specimen Unless otherwise specified, temperature of the test specimen shall be an ordinary temperature(1).

Note (1) This temperature means Class 4 standard temperature condition, (20 ± 15 °C) specified in JIS Z 8703.

3.2 Measurement of Thickness The measurement of thickness shall be carried out as described below:

(1) Purpose of Test The purpose of this test is to examine whether the product and test piece satisfy the requirements for the thickness specified in JIS R 3211.

(2) Objects to Be Tested The product or test piece measuring 100 x 100 mm, 300 x 300 mm, 1100 x 500 mm, etc. shall be furnished to the tests.

(3) Instrument to Be Used A micrometer capable of measuring to 0.01 mm specified in JIS B 7502, or an instrument equivalent or superior to it.

(4) Procedure Measure the thickness by employment of the micrometer specified in JIS B 7502, and round off the measured values to the first decimal place in accordance with the rule provided in JIS Z 8401.

3.3 Visible Light Transmission Test The visible light transmission test shall be carried out as described below:

(1) Purpose of Test The purpose of this test is to determine to what degree the safety glass has visible light transmission.

(2) Objects to Be Tested The objects to be tested shall be prepared by the methods described below according to the type of the safety glass.

(2.1) Laminated Glass A product or a test piece which has been cut out of the specimen shall be furnished to the test. A laminated glass which has been bonded after cutting the material, in advance, to the dimensions of the test piece may be used for the test.

(2.2) Zone-Toughened Glass and Toughened Glass Test piece which has been cut out of the same sheet glass as that of the product shall be furnished to the test.

(3) Apparatus to Be Used One of the apparatus given below shall be selected according to the varieties of test methods.

(3.1) Spectrometric Method The measurement shall generally be made on a spectrometer covering wavelength from 380 to 780 nm.

(3.2) Direct Method The measurement shall be made on an optical apparatus satisfying the requirements below:

(a) Light Source An incandescent lamp(2) lighting at a colour temperature of 2856 ± 50 K.

Note (2) Equivalent to the standard illuminant A specified in JIS Z 8701.

(b) Receiver The receiver shall have a sensitivity equivalent to the photopic function $\bar{y}(\lambda)$ based on the 2-degree visual field XYZ system given in JIS Z 8701. The section of the light beam shall be within 20 x 20 mm in area, and the direction of incidence be at right angles to the face of the specimen.

Reference: The photopic function $\bar{y}(\lambda)$ means the spectrum corresponding to the spectral sensitivity for the CIE (International Commission on Illumination: 1931) standard observer for photopic vision.

(4) Procedure The test shall follow one of the methods described below:

(4.1) Spectrometric Method Obtain spectrum transmission of the specimen in accordance with JIS Z 8722 and express the value of stimulus value Y in percentage under the standard illuminant A, which shall be taken as the visible light transmission.

(4.2) Direct Method Measure the transmitted light beam and the incident light beam of the specimen. Express the ratio of the two values in percentage, and take it as the visible light transmission.

3.4 Secondary Image Separation Test The secondary image separation test shall be made as described below:

(1) Purpose of Test The purpose of this test is to examine the condition of the secondary image separation of front windscreens for road vehicles.

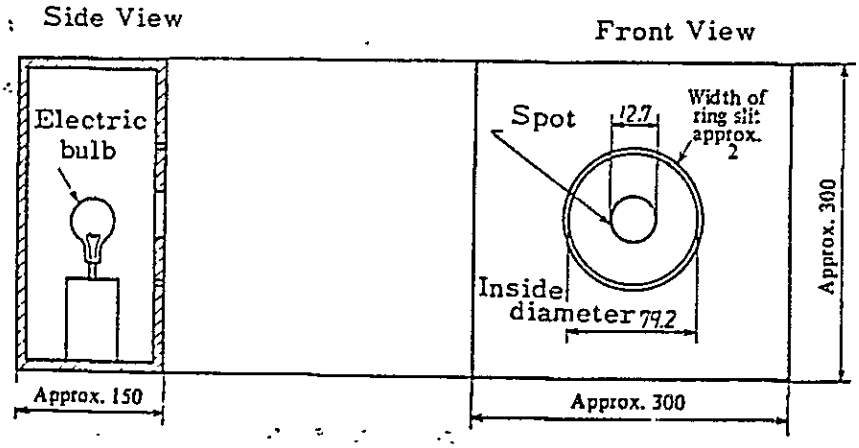
(2) Object to Be Tested A product as it is shall be furnished to the test.

(3) Apparatus and Instruments Used

(3.1) Light Box The light box shall be approximately 300 x 300 x 150 mm in size and its front face shall be coated with matte black paint. This light box shall contain a low-voltage bulb, and the ring slit and spot on its front shall be equipped with the orange colour filter (see Fig. 1).

Fig. 1

Unit: mm



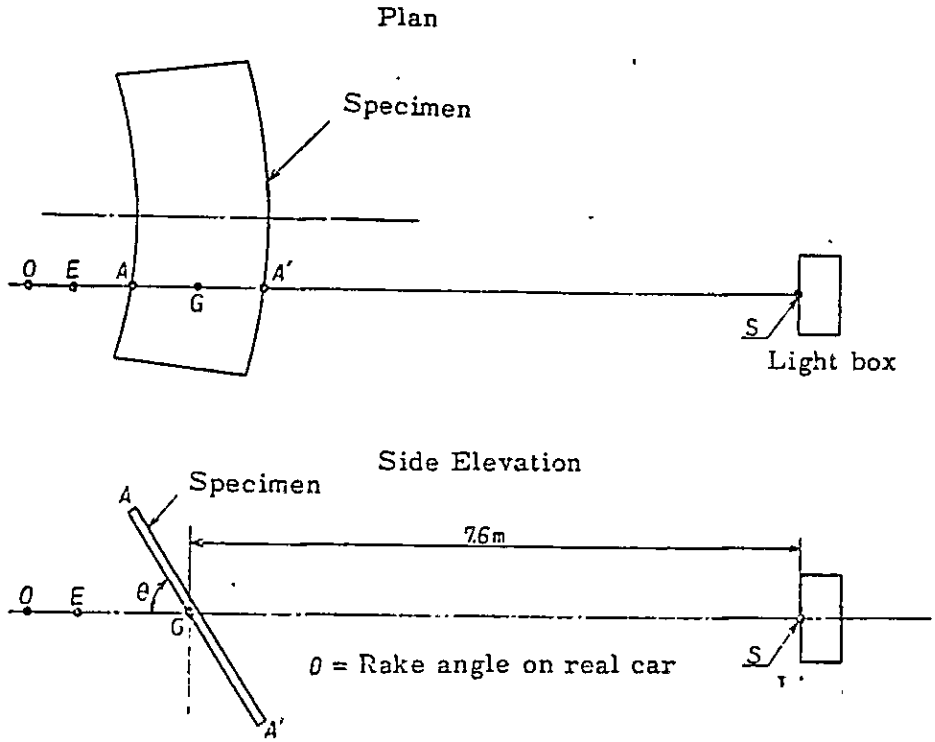
(3.2) Supporting Fixture The supporting fixture shall be capable of mounting a specimen at the rake angle of a real car, and also of rotating it in horizontal direction and shifting it in vertical direction round the eye point of the driver.

(3.3) Dark Room or Dark Place The apparatus shall be set in a semi-dark or dark place to enable the tester to find easily the presence of secondary image.

(4) Procedure

(4.1) Set the specimen as shown in Fig. 2.

Fig. 2



(4.1.1) Place G(3), a point on the surface of the test specimen, at a position, 7.6 m distant from the spot, on a horizontal straight line OS passing through the central point S of the spot. Let the section of the specimen along the vertical median plane in lengthwise direction of the car be in parallel with the vertical plane passing through the horizontal straight line OS.

Note (3) The point G shall be the position at the intersection of the specimen, which is set as if it is mounted to a real car, and a line passing through the driver's eye point E. which is horizontal and also in parallel with the vertical median plane along the lengthwise direction of the car.

(4.1.2) Set the specimen at the rake angle on the real car.

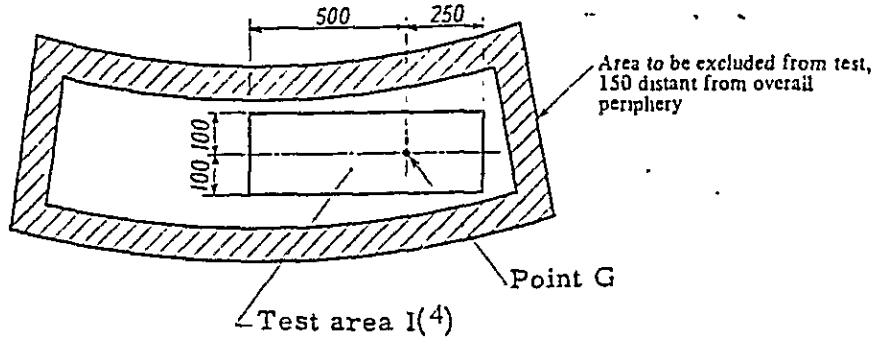
(4.2) Locate the observer's eye near the point E on the horizontal line OS.

(4.3) Check by viewing through the specimen whether the secondary image of the spot locating at the centre of the light box is over the inside edge of the ring.

(4.4) Rotating the specimen in horizontal direction and shifting it in vertical direction round the driver's eye point E, examine the condition of the secondary image appearing in the test area I shown in Fig. 3.

Fig. 3. Development

Unit: mm



Note (4) This test area shall extend from the point G to each 100 mm upperwards and downwards, to 250 mm in the direction of driver's seat, and to 500 mm in the direction of assistant driver's seat. If this test area thus settled makes inroads into the hatched area of 150 mm from the periphery, the portion of inroads is exempted from the application of this test.

3.5 Optical Distortion Test The optical distortion test shall follow the method described below:

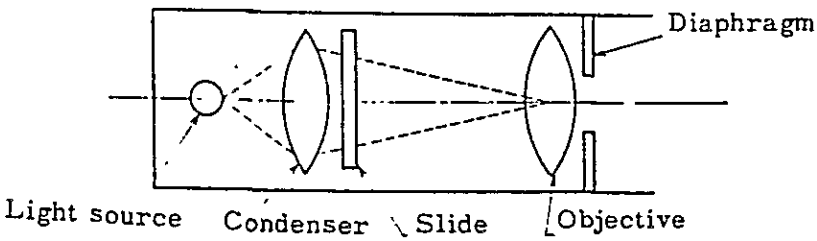
(1) Purpose of Test The purpose of this test is to examine the condition of the optical distortion of the front windpane for road vehicles.

(2) Object to Be Tested A product as it is shall be furnished to the test.

(3) Apparatus and Instruments Used

(3.1) Projector The projector shall have a light source of 150 to 250 W halogen lamp and an objective of focal length of 90 mm or more. A diaphragm to obtain sharp image may be attached as required (see Fig. 4).

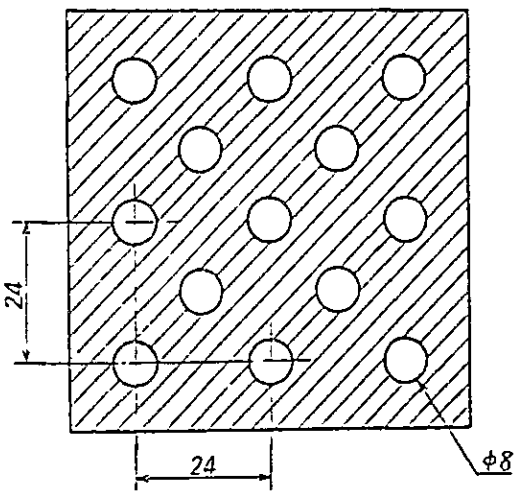
Fig. 4



(3.2) Slide The slide shall be capable of obtaining the image as shown in Fig. 5.

Fig. 5. Image Projected on the Screen after Passing through the Centre of Specimen

Unit: mm



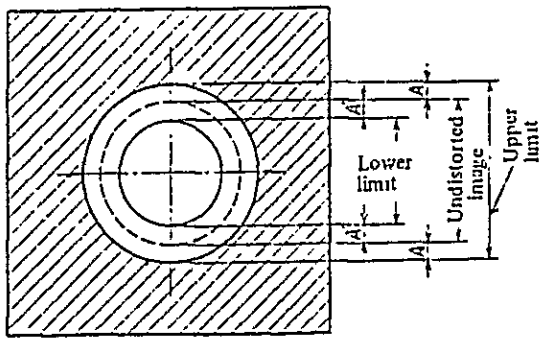
(3.3) Screen The screen shall be white and flat.

(3.4) Supporting Fixture The supporting fixture provided in 3.4 (3.2) shall be used.

(3.5) Dark Room or Dark Place The apparatus shall be set in a semi-dark or dark place to enable the tester to find easily the presence of optical distortion.

(3.6) Measuring Instrument The measuring instrument shall be capable of measuring the distortion of the shape of the bright circle projected on the screen after passing through the specimen. The checking template, as given in Fig. 6, may be used.

Fig. 6



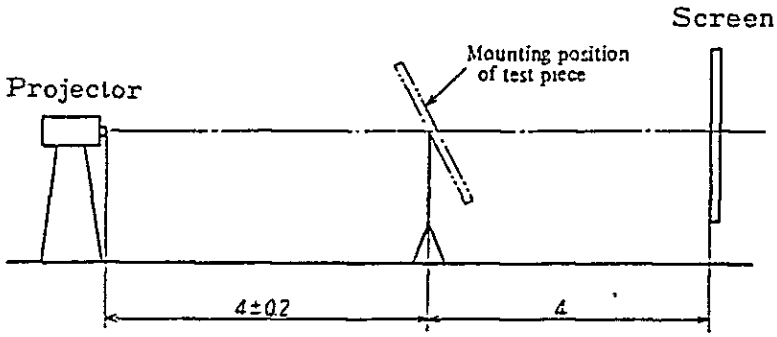
Remark: Dimensions A and A' are determined according to the specified value.

(4) Procedure

(4.1) Arrange the projector, support stand and screen as shown in Fig. 7.

Fig. 7

Unit: m

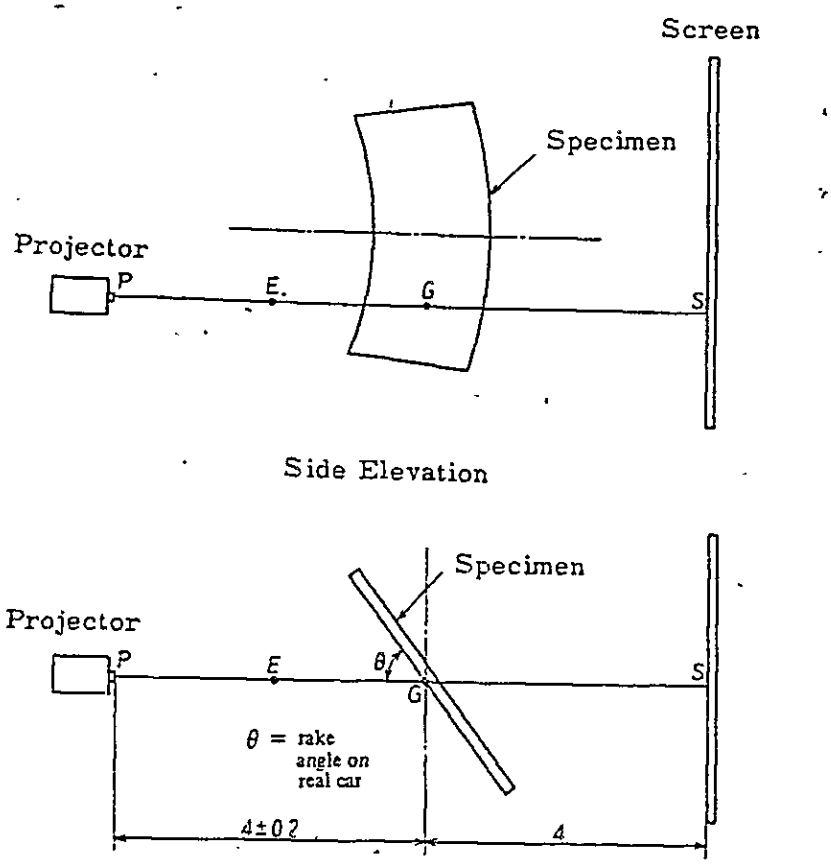


(4.2) In the absence of the specimen, ascertain that the circular shaped part projected on the screen is 8 mm in diameter.

(4.3) Set the specimen as shown in Fig. 8.

Fig. 8

Unit: m



(4.3.1) Locate the point $G^{(3)}$ on the specimen surface at a position, on the optical axis of the projector, 4 ± 0.2 m distant from the objective and 4 m away from the screen. The cross-section of the specimen along the vertical median plane in lengthwise direction of the car shall be in parallel with the optical axis.

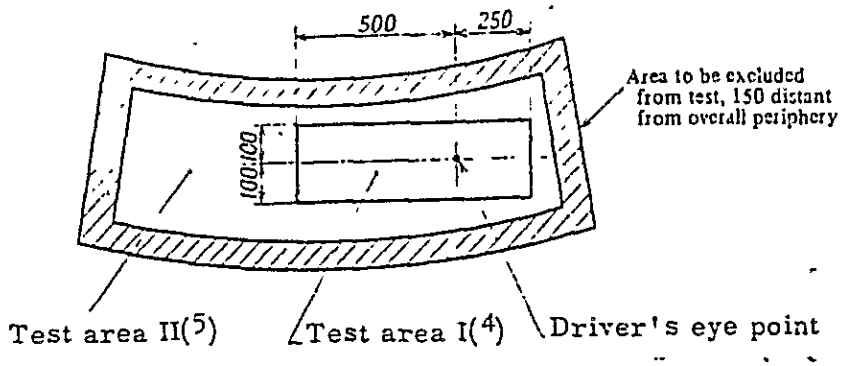
(4.3.2) Set the specimen at the rake angle on real car.

(4.4) Measure the degree of diametral deviation of the bright circle projected on the screen after passing through the specimen.

(4.5) Rotating the specimen in horizontal direction and shifting it in vertical direction round the position of the driver's eye point E, examine the test areas I and II shown in Fig. 9.

Fig. 9. Development

Unit: mm



Note (5) The test area II includes the area excluding the test area I and the hatched area of 150 mm from the periphery of the glass.

3.6 Abrasion Resistance Test The abrasion resistance test shall be made as described below:

(1) Purpose of Test The purpose of this test is to examine whether the safety glass has a certain minimum resistance to abrasion.

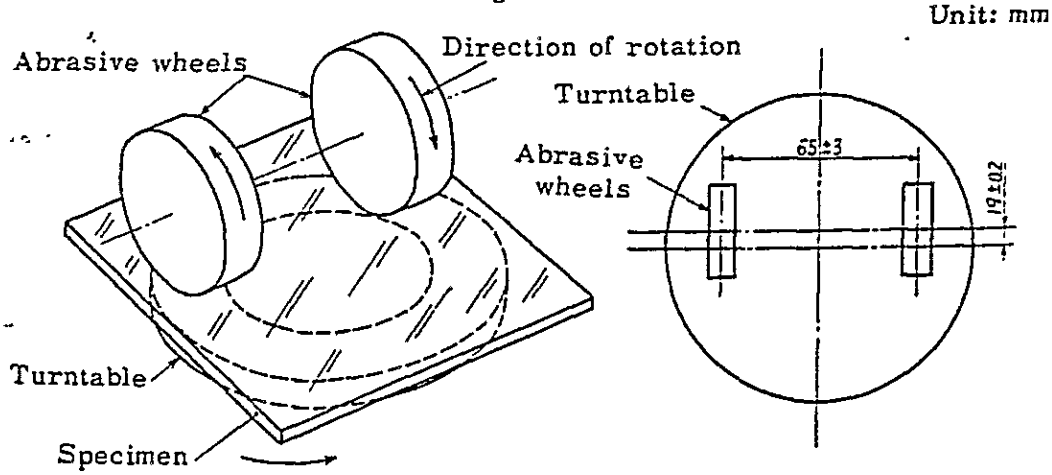
(2) Objects to Be Tested For the laminated glass, a flat test piece of approximately 100 x 100 mm manufactured by the same method as the product shall be furnished to the test. For the zone-toughened glass and toughened glass, a flat test piece of approximately 100 x 100 mm cut out of the same sheet glass as the product shall be furnished to the test.

(3) Apparatus to Be Used

(3.1) Abrading Instrument The abrading instrument shall be of Taber type, or equal to or superior to it in performance. The abrading instrument shown in Fig. 10 consists of a horizontal turntable which rotates at the rate of 70 ± 5 rpm and a pair of smoothly rotatable abrasive wheels which are fixed at a spacing of 65 ± 3 mm.

Fig. 10

Unit: mm



(a) Turntable The turntable shall rotate in one plane, and the load applied to the specimen by each abrasive wheel shall be 500 gf{4.90 N}.

(b) Abrasive Wheels The abrasive wheels, each 45 to 50 mm in diameter and 12.5 mm in thickness, are made of medium-hard rubber in which abrasives are imbedded, and they shall be so mounted as to cause no play in axial direction and rotational vibration. The hardness of the abrasive wheels shall be of hardness 72 ± 5 in IRHD.

References 1. The abrasive wheels of general use are No. CS-10F of Taber type.

2. The abbreviation IRHD is derived from International Rubber Hardness Degrees specified in ISO 48.

(3.2) Hazemeter The hazemeter shall consist of a light source part with an incandescent lamp as a source and a receiver with an integrating sphere, as shown in Fig. 11. It is to measure the diffusion of light caused by abrasion traces, and shall satisfy the requirements below:

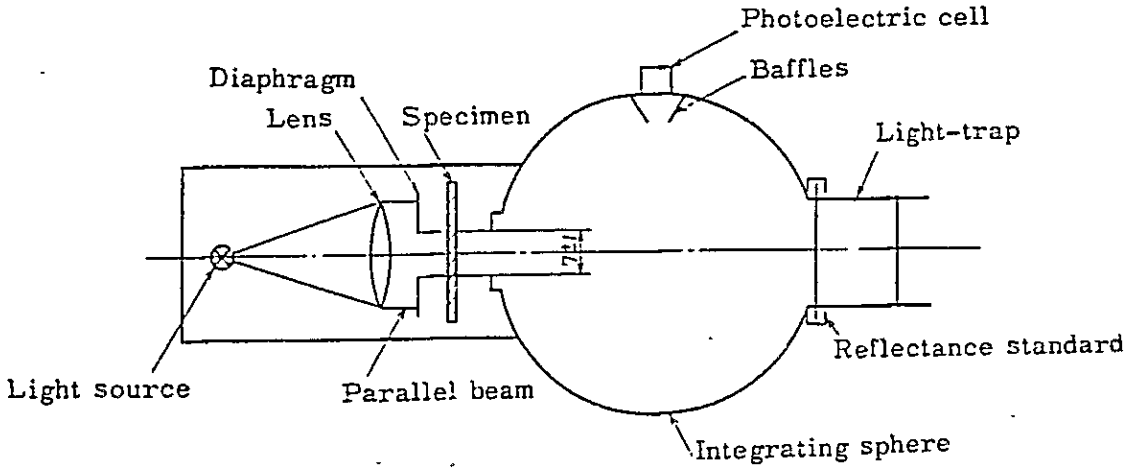
(a) Light Source The light source shall be an incandescent lamp lighting at a colour temperature of 2856 ± 50 K.

(b) Light Source Part It shall use anastigmatic lens to obtain sufficient parallel light beam of 7 ± 1 mm diameter.

(c) Receiver The receiver shall consist of a photoelectric cell, and an integrating sphere provided with a light-trap and reflectance standard.

Fig. 11

Unit: mm



(4) Procedure

(4.1) Clean the specimen.

(4.2) Calculate the haze values of the specimen before abrasion by the use of a hazemeter, at four equally spaced points of that area which will be a track of the abrasive wheels, and average the values thus obtained.

(4.3) Place the specimen on the turntable of the abrading instrument so that the peripheral sides of the wheels work as abrading faces, apply a load of 500 gf {4.90 N} to each abrasive wheel, and allow the specimen to be abraded by 1000 turn rotation.

(4.4) Clean the specimen after abraded.

(4.5) Calculate the haze values of the specimen after abrasion by the use of the hazemeter at four equally spaced points on the track of the abrasive wheels, and average the values thus obtained.
The abraded surface of the specimen shall face to the light source side.

(4.6) Calculate the haze value from the formula below after obtaining the measured values given in Table 1.

$$\text{Total transmission } T_t\,(\%) = \frac{T_2}{T_1} \times 100$$

$$\text{Diffuse transmission } T_d\,(\%) = \frac{T_4 - T_3 \times \frac{T_2}{T_1}}{T_1} \times 100$$

$$\text{Haze value } (\%) = \frac{T_d}{T_t} \times 100$$

Table 1

Classification of measured value	Condition of measurement		
	With specimen	With light-trap	With reflectance standard
Incident light T_1	No	No	Yes
Total light transmitted by specimen T_2	Yes	No	Yes
Light scattered by instrument T_3	No	Yes	No
Light scattered by instrument and specimen T_4	Yes	Yes	No

(4.7) Obtain the haze value when abraded by subtracting the haze value before abrasion from that after abrasion.

3.7 High Temperature Resistance Test The high temperature resistance test shall be made as described below:

(1) Purpose of Test The purpose of this test is to examine the durability of the laminated glass exposed to high temperatures over an extended period of time.

(2) Object to Be Tested A flat laminated glass measuring approx. 300 x 300 mm manufactured by the same process as that for the product or a laminated glass measuring approx. 300 x 300 mm cut out of a product shall be furnished to the test. When the test piece is made by cutting out of the product, it shall include an edge part of the product as its, at least, one edge.

(3) Apparatus and Instruments Used The apparatus consists of a scalding tank, preheating tank and supporter of the specimen.

(4) Procedure

(4.1) Mount the specimen on the supporter.

(4.2) Immerse the specimen into the hot water preheating tank of approx. 65 °C and hold it for three minutes.

(4.3) Transfer the specimen rapidly from the preheating tank to the scalding tank which contains boiling water, and hold it for two hours in nearly perpendicular position.

(4.4) Take out the specimen, and examine the condition of bubbles or other defects.

3.8 Radiation Resistance Test The radiation resistance test shall be made as described below:

(1) Purpose of Test The purpose of this test is to examine whether exposure of the laminated glass to the solar radiation over an extended period of time produces any change in colour and turbidity.

(2) Object to Be Tested A flat laminated glass measuring approx. 300 x 300 mm or approx. 300 x 100 mm manufactured by the same process as that for the product shall be furnished to the test.

(3) Apparatus and Instruments Used

(3.1) Ultraviolet Light Radiation Apparatus The ultraviolet light radiation apparatus shall have quartz glass mercury lamp of 750 ± 50 W, or a light source equivalent to it, and shall be capable of adjusting the temperature.

(3.2) One of the following instruments, specified in 3.3, shall be used:

(a) Spectrophotometer

(b) Optical apparatus for direct measurement

(4) Procedure

(4.1) Measure the visible light transmission of the specimen before exposure to ultraviolet light in accordance with the method of 3.3.

(4.2) Place the specimen in the apparatus keeping 45 ± 5 °C at a distance of 230 mm from the light source so that its exterior part, if mounted to the real car, faces the light source side.

(4.3) Expose the specimen to the ultraviolet light for 100 hours.

(4.4) Measure the visible light transmission of the specimen after exposure to the ultraviolet light in accordance with the method of 3.3.

(4.5) Examine the change in colour and turbidity of the specimen after exposure to the ultraviolet light with naked eye.

3.9 Head-Form (Human Head Manikin) Impact Test The impact test by head-form shall be made as described below:

(1) Purpose of Test The purpose of this test is to determine to what extent the laminated glass A behaves the penetration resistance against the impact of the head-form, and whether the zone-toughened glass gives too large impact to the head-form.

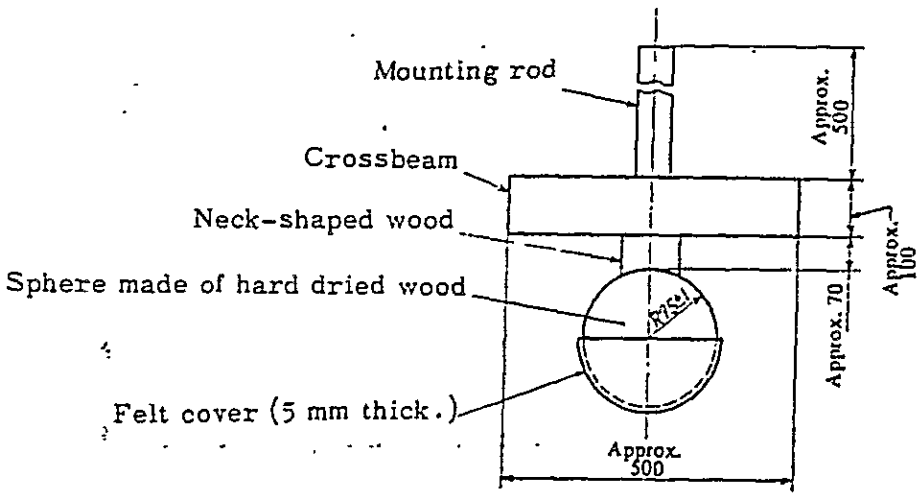
(2) Object to Be Tested A flat or curved specimen of approx. 1100 x 500 mm manufactured by the same method as that for the product shall be furnished to the test.

(3) Apparatus and Instruments Used

(3.1) Head-Form The head-form shall be 10 ± 0.2 kg in mass, and shall be so constructed as shown in Fig. 12.

Fig. 12

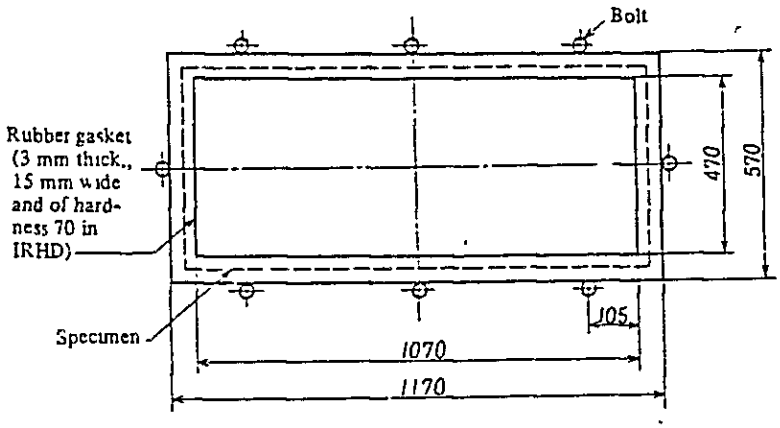
Unit: mm



(3.2) Supporting Fixture for Specimen The supporting fixture for the specimen shall be made of steel frames as shown in Fig. 13. The distance between the specimen and the floor shall be not less than 300 mm.

Fig. 13

Unit: mm



(3.3) Dropping Device The device shall be capable of dropping the head-form freely from a specified height.

(4) Procedure

(4.1) For the specimen of the laminated glass, keep it in a room of 23 ± 2 °C for at least four hours immediately preceding test.

(4.2) Place the specimen of which periphery is supported nearly uniformly with interposition of the rubber gasket on the supporting fixture placed horizontally, and put the pressing frame with rubber gasket upon it.

The specimen shall be placed so that its side which will be the interior part when set on the motor vehicle faces upwards.

(4.3) Fasten the pressing frame and supporting fixture with the bolts to prevent the specimen from being dislocated out of the frames at the time of impact of the head-form.

(4.4) Make the head-form as it is at a standstill, without being subjected to any impetus, to drop from a height given in Table 2 onto the centre of the specimen face. The point of impact shall be within 50 mm from the centre of the specimen face.

The impact given onto one specimen shall be limited to only once.

Table 2

Unit: m

Type of glass	Drop height of head-form(6)
Laminated glass A	4.0
Zone-toughened glass	2.0

Note (6) A height from the upper face of the specimen to the lowermost point of the head-form.

(4.5) Examine the condition of the specimen immediately after the head-form falls down to the face of the specimen.

3.10 Penetration Resistance Test The penetration resistance test shall be made as described below:

(1) Purpose of Test The purpose of this test is to determine whether the laminated glass A has a certain minimum penetration resistance.

(2) Object to Be Tested A flat laminated glass of approx. 300 x 300 mm manufactured by the same method as that for the product or that of approx. 300 x 300 mm cut out from the product shall be furnished to the test.

For the product of the curved laminated glass, the specimen shall be cut out of the flattest portion as possible.

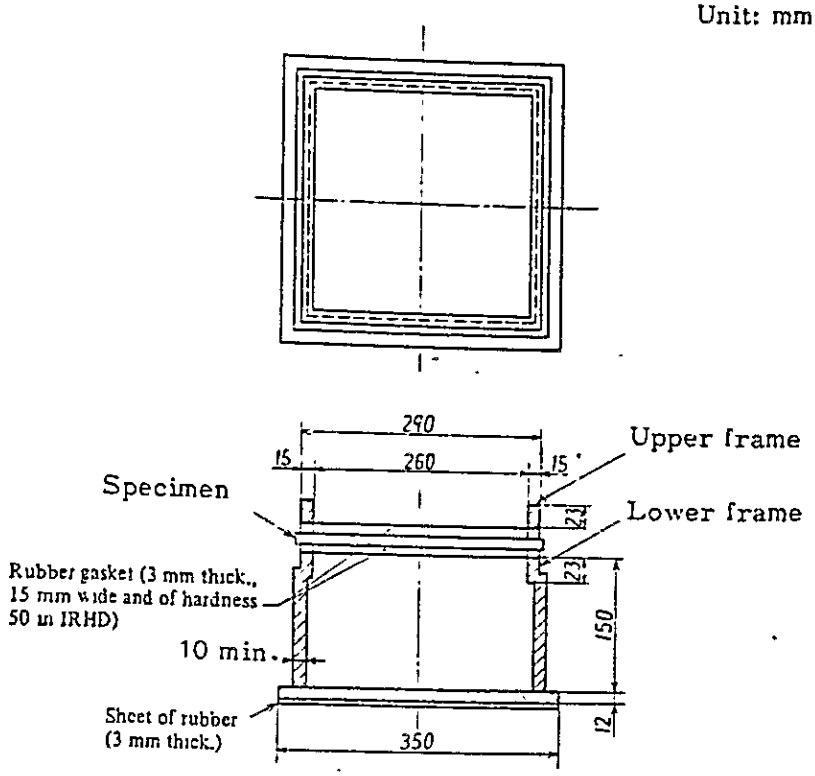
(3) Apparatus and Instruments Used

(3.1) The apparatus shall be capable of dropping the ball freely from the specified height.

(3.2) The steel frame shown in Fig. 14 shall be used.

Fig. 14

Unit: mm



(3.3) Steel Ball The steel ball used shall have smooth surface, and shall be 2260 ± 20 g in mass, and approx. 82 mm in diameter.

(4) Procedure

(4.1) Keep the specimen in a room of temperature at 23 ± 2 °C for at least four hours immediately preceding the test.

(4.2) Place the specimen in the supporting fixture supported horizontally, so that the face which represents the internal face of the vehicle faces upwards.

(4.3) Drop the steel ball as it is at a standstill, without being subjected to any impetus, from the height of 4 meters onto the centre of the specimen face. The point of impact shall be within 25 mm from the centre of the specimen face.

The impact given onto one specimen shall be limited to only once.

(4.4) Examine whether the specimen is penetrated.

3.11 Impact Resistance Test The impact resistance test shall be made as described in the following:

(1) Purpose of Test The purpose of this test is to examine whether the safety glass has a certain minimum cohesion or strength under impact from a flying small hard object.

(2) Object to Be Tested The specimen shall be a laminated glass or toughened glass, measuring approx. 300 x 300 mm, manufactured by the same process as that for the product.

(3) Apparatus and Instruments Used

(3.1) Device for Dropping Ball The device shall be capable of dropping a steel ball freely from the specified height.

(3.2) Supporting Frame The supporting frame, made of steel, shall be as specified in 3.10.

(3.3) Steel Ball The steel ball, 227 ± 2 g in mass and approx. 38 mm in diameter, shall have a smooth surface.

(4) Procedure

(4.1) For the specimen of laminated glass, keep it in a room of 23 ± 2 °C for at least four hours immediately preceding the test.

(4.2) Place the specimen in the supporting frame supported horizontally, so that the face which represents the external face of the real vehicle faces upwards.

(4.3) Drop the steel ball as it is at a standstill, without being subjected to any impetus, from a height given in Table 3 onto the centre of the specimen. The point of impact shall be within 25 mm from the centre of the specimen face for the toughened glass and be within 50 mm for the laminated glass.

The impact given onto one specimen shall be limited to only once.

Table 3

Unit: m

<table>
<tr><th colspan="3">Type of glass</th><th>Drop height of steel ball</th></tr>
<tr><td colspan="3">Laminated glass A</td><td rowspan="2">9.0</td></tr>
<tr><td colspan="3">Laminated glass B</td></tr>
<tr><td rowspan="4">Toughened glass</td><td rowspan="4">Nominal thickness</td><td>3.5 mm</td><td rowspan="2">2.0</td></tr>
<tr><td>4 mm</td></tr>
<tr><td>5 mm</td><td>2.5</td></tr>
<tr><td>6 mm</td><td>3.0</td></tr>
</table>

(4.4) For the laminated glass, examine whether it is penetrated and weigh the total mass of the fragments detached from the face opposite to the face having been struck. For the toughened glass, examine whether it has fractured.

3.12 Fragmentation Test

3.12.1 Fragmentation Test for Zone-Toughened Glass The fragmentation test for zone-toughened glass shall be made as described below:

(1) Purpose of Test The purpose of this test is to examine whether the condition of the fragments, in the event of fracture of the zone-toughened glass, can keep the necessary safety.

(2) Object to Be Tested Product as it is shall be furnished to the test.

(3) Apparatus and Instruments Used

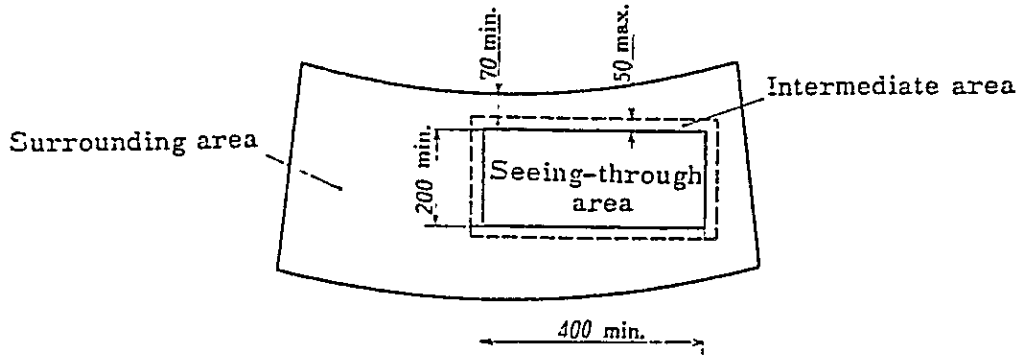
(3.1) A hammer or punch with a pointed end of 0.2 ± 0.05 mm in radius of curvature.

(3.2) A counting frame of 50 x 50 mm or 400 x 200 mm.

(4) Divided Area of Specimen The specimen shall be divided into three areas shown in Fig. 15.

Fig. 15. Development

Unit: mm



(4.1) Surrounding Area The surrounding area shall be such that 70 mm or more apart from the periphery of the glass.

(4.2) Seeing-Through Area The seeing-through area shall be that which locates at approximately front of the driver's seat and consists of a rectangular shape of horizontal side 400 mm or more and vertical side 200 mm or more.

(4.3) Intermediate Area The intermediate area shall be that which is within 50 mm from the periphery of the seeing-through area.

(5) Measuring Method of Fragments

(5.1) Surrounding Area

(5.1.1) Select two portions where the fragments are the coarsest and the finest in size, and count the number of fragments contained in each frame of 50 x 50 mm size.

Any fragment lying on a side of the counting frame shall be counted as 1/2 piece.

(5.1.2) Count the number of the slender fragments 75 mm or more long and 12 mm or less wide.

(5.1.3) Exclude the areas, within 20 mm from the periphery of the glass and within 75 mm in radius from a point of impact, from the measurements.

(5.2) Seeing-Through Area

(5.2.1) Count the fragments, 13 mm or more wide and 2 to 25 cm^2 in area, as effective.

(5.2.2) Take a rectangle of 400 mm in horizontal side and 200 mm in vertical side approximately in front of the driver's seat as the assessing area.

The seeing-through area as a whole may be taken as the assessing area.

(5.2.3) Calculate the total area of the effective fragments in the assessing area.

While, any fragment lying on the periphery of the assessing area shall be counted as an effective fragment, so far as it has an area of 2 cm^2 or more within the assessing area.

(5.2.4) Count the number of fragments exceeding 16 cm^2.

(5.2.5) Count the number of slender fragments 75 mm or more long and 12 mm or less wide. However, the fragments existing in an area within 100 mm in radius from the point of impact shall be excluded from the measurement.

(5.3) Intermediate Area Compare the condition of fragmentation in the intermediate area with the condition of those in the seeing-through area.

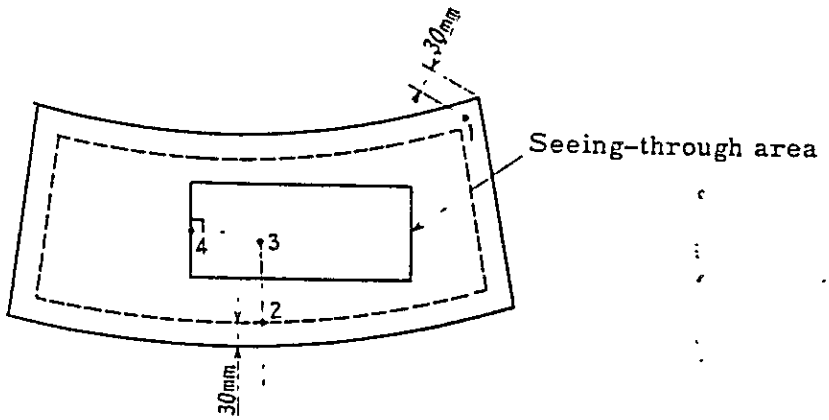
(6) Procedure

(6.1) Support the specimen so that the fragments can not scatter when it fractures.

(6.2) Break the specimen by striking the impact points of 1, 2, 3 and 4 shown in Fig. 16 with the hammer or punch.

Use one specimen for every impact.

Fig. 16. Development



Remarks 1. Point 1: 30 mm distant from the corner of the smallest angle on its bisecting line.

2. Point 2: 30 mm distant from centre of the longer side on a line passing the centre.

3. Point 3: approximately central point of the specimen.

4. Point 4: The centre of vertical side, far away from the driver's seat, of the seeing-through area.

(6.3) Immediately observe the condition of fragments and measure in accordance with 3.12.1 (5).

The measurement can be made by the aid of photographic papers.

3.12.2 Fragmentation Tests for Toughened Glass (5 mm and 6 mm Thick.) The fragmentation tests for toughened glass of 5 mm and 6 mm in nominal thickness shall be made as described below:

(1) Purpose of Test The purpose of this test is to examine whether the condition of the fragments, in the event of the fracture of the toughened glasses of 5 mm and 6 mm in thickness, can keep the required safety.

(2) Object to Be Tested Product as it is shall be furnished to the test.

(3) Instruments Used

(3.1) A hammer or a punch of which pointed end is 0.2 ± 0.05 mm in radius of curvature.

(3.2) A counting frame of 50 x 50 mm in size.

(4) Measuring Method of Fragments

(4.1) Select two portions where the fragments are the coarsest and the finest in size, and count the number of fragments existing in the counting frame of 50 x 50 mm in each portion. Any fragment lying on a side of the counting frame shall be counted as 1/2 piece.

(4.2) Count the number of the slender fragments of 75 mm or longer and 12 mm or narrower.

(4.3) Exclude the fragments contained in the areas, within 20 mm from the periphery of the glass and within 75 mm in radius from the impact point, from the measurement.

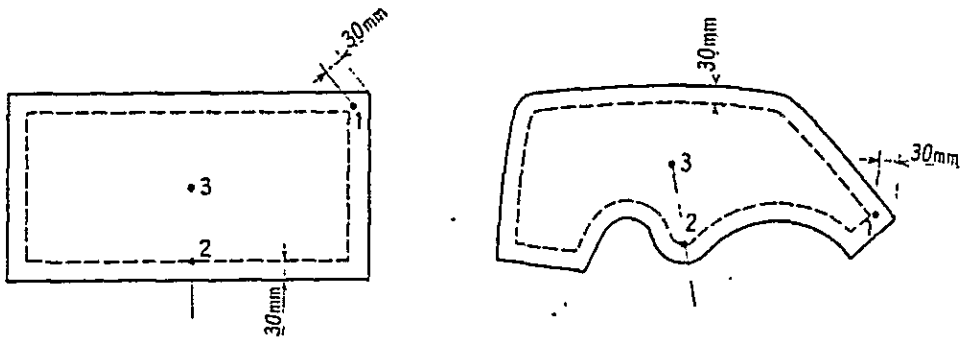
(5) Procedure

(5.1) Hold the specimen so that the fragments can not scatter when it fractures.

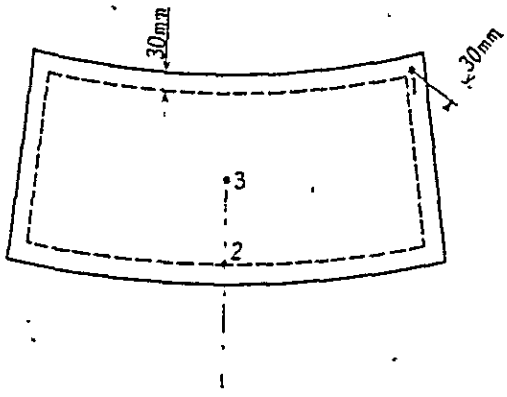
(5.2) Strike the impact points of 1, 2 and 3 of the specimen, shown in Fig. 17, with a hammer or a punch to break the specimen. Use one specimen for every impact onto one point.

Fig. 17. Shapes of Specimens

Flat Face or Single Curvature Face



Development of Double-Curvature Face



Remarks 1. Point 1: 30 mm distant from the corner of the smallest angle on its bisecting line.

2. Point 2: 30 mm distant from the centre of the longer side on a line passing the centre.

3. Point 3: approximately central point of the specimen.

(5.3) Immediately observe the condition of fragments and measure in accordance with 3.12.2 (4).

3.12.3 Fragmentation Tests for Toughened Glasses (3.5 mm and 4 mm Thick.)
The fragmentation test for the toughened glass of 3.5 mm and 4 mm in nominal thickness shall be made as described below:

(1) Purpose of Test The purpose of the test is to examine whether the condition of the fragments, in the event of fracture of the toughened glass of 3.5 mm and 4 mm in nominal thickness, can keep the required safety.

(2) Object to Be Tested The toughened glass 3.5 mm and 4 mm thick. used for the test of 3.11 shall be furnished to this test.

(3) Apparatus and Instrument Used

(3.1) The device for dropping the ball, supporting fixture and the steel ball used for the test of 3.11 shall be used in this test.

(3.2) A balance graduated at least 0.05 g in the minimum scale reading.

(4) Procedure

(4.1) Place the specimen in the supporting fixture supported horizontally so that the face which represents the external of real vehicle faces upwards.

(4.2) Drop the steel ball as it is at a standstill, without being subjected to any force, onto the centre of the specimen from a height of 3 m.

(4.3) Increase the height of ball by every 0.5 m until the specimen fractures.

(4.4) Immediately weigh the mass of the largest fragment of the fractured specimen.

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WEDNESDAY, FEBRUARY 11, 1976

PART III:

CONSUMER PRODUCT SAFETY COMMISSION

Architectural Glazing Materials

Proposed Safety Standard

CONSUMER PRODUCT SAFETY COMMISSION

[16 CFR Part 1201]

ARCHITECTURAL GLAZING MATERIALS

Proposed Safety Standard

The purpose of this document is to propose, pursuant to section 7(f) of the Consumer Product Safety Act (15 U.S.C. 2056(f)) (hereinafter referred to as CPSA or act)), a consumer product safety standard applicable to glazing materials used in certain architectural products. Written comment on the proposal is invited until March 14, 1976, and interested persons will have an opportunity to make an oral presentation of views on March 8, 1976, as described at the end of this notice.

In the proceedings leading to this proposal, the subject materials were referred to as "architectural glass." Commencing with this proposal, the name has been changed to "architectural glazing materials." This is consistent with the intent of the notice of proceeding and with the scope and definitions contained in the proposed standard. It recognizes that the materials covered by the standard can consist in whole or part of materials other than glass.

The proposed standard, 16 CFR Part 1201 below, prescribes safety requirements for the manufacture and construction of glazing materials for use in storm doors or combination doors, entrance/exit doors (both exterior and interior), shower and bathtub doors and enclosures, fixed glazed panels, and sliding or patio-type doors; the proposed standard also requires that the products enumerated which incorporate glazing materials must be constructed with glazing materials that meet the requirements of the standard. The proposed standard is designed for residential and certain nonresidential applications. It does not cover glazing materials used in the manufacture and construction of other architectural products such as (but not necessarily restricted to) prime windows, storm windows and certain glazed panels. After the effective date of the standard no person shall manufacture for sale, offer for sale, distribute in commerce or import into the United States glazing material subject to the standard which does not comply with the requirements of the standard. For purposes of this standard fabricators (persons who assemble or otherwise incorporate glazing materials into the architectural products identified) are considered to be manufacturers as the term manufacturers is defined in § 1201.4(b) (13) and (14) of the standard. Distributors and retailers of glazing materials (including persons cutting glazing materials to size) are also covered by the standard. The proposed effective date for the standard is 180 days after the issuance of a final standard in the FEDERAL REGISTER.

BACKGROUND

On June 20, 1973, the Consumer Safety Glazing Committee (CSGC), petitioned the Commission under section 10 of the act (15 U.S.C. 2059), to commence a proceeding for the development of a consumer product safety standard to address the hazards associated with architectural glass. CSGC is an ad-hoc group of industry, labor and general interest groups initially formed in 1968 for the purpose of drafting and lobbying for passage of a Model Safety Glazing bill in the various states.

On November 1, 1973, the Commission, on the basis of information submitted by the CSGC, consideration of injury data reported by the National Electronic Injury Surveillance System (NEISS), and review of data and information gathered by the National Commission on Product Safety, granted CSGC's petition.

Copies of all the documents, data, information relative to the CSGC petition, the Commission's decisions thereon and other documents mentioned in this notice may be seen in the Office of the Secretary, 10th Floor, 1750 K Street NW., Washington, D.C. 20207.

The Commission commenced a proceeding to develop a consumer product safety standard applicable to architectural glass under section 7 of the act by publishing a notice in the FEDERAL REGISTER of May 28, 1974 (39 FR 18502). In the notice of proceeding, the Commission preliminarily determined (1) that hazards associated with architectural glass present unreasonable risks of injury or death and (2) that one or more consumer product safety standards are necessary to eliminate or reduce those unreasonable risks of injury. Interested persons were invited to submit offers to develop a recommended safety standard, or to submit an existing standard as a proposed consumer product safety standard.

In the FEDERAL REGISTER of August 21, 1974 (39 FR 30191), the Commission announced its acceptance of a CSGC offer to develop a recommended standard. On November 1, 1974 (39 FR 38715), the Commission for good cause shown extended the time for developing the standard from October 25, 1974, to January 24, 1975, as requested by CSGC. The recommended standard was submitted by CSGC on January 24, 1975. Subsequently, on March 5, 1975 (40 FR 10227), the Commission extended to March 21, 1975, later corrected to March 25, 1975 (40 FR 13334), the period in which it must publish a proposed standard or withdraw the notice of proceeding. On March 26, 1975 (40 FR 13334), the Commission further extended this period to May 24, 1975.

On February 13 and February 18, 1975, the Commission staff completed briefing packages which evaluated the recommended standard submitted by CSGC. On April 9, 1975 Commission staff discussed the recommended standard at a public briefing before the Commission. CSGC submitted additional information in response to Commission requests on May 5, May 15, and May 29, 1975.

On the basis of the above information, the Commission determined that Commission staff should (1) convert CSGC's recommended standard to a performance standard to the degree practicable, (2) examine the recommended environmental tests to determine their relationship to safety and consider a single environmental test or the deletion of such testing, and (3) make procedural changes as necessary. In view of the foregoing, the Commission, in the FEDERAL REGISTER of July 23, 1975 (40 FR 30262), extended until October 29, 1975 the time in which it must either publish a proposed standard or withdraw the notice of proceeding. This was further extended until January 12, 1975 by notices in the FEDERAL REGISTER of November 6, 1975 (40 FR 51685) and December 2, 1975 (40 FR 55897).

In the FEDERAL REGISTER notice which commenced the proceeding (39 FR 18502, May 28, 1974) the Commission identified the nature of the risk of injury associated with architectural glass (architectural glazing materials) as the following:

1. Lacerations, contusions, abrasions and other injury or death resulting from walking into glass doors or panels believed to be open or mistaken as a means of egress, or pushing against glass panels in an attempt to open a door.

2. Lacerations, contusions, abrasions and other injury or death resulting from accidentally falling into or through glass doors, adjacent panels and windows, bathtub enclosures, and shower stalls.

3. Lacerations, contusions, abrasions and other injury or death resulting from opening, closing, washing or otherwise handling windows; and

4. Lacerations, contusions, abrasions and other injury or death resulting from the act of installing, replacing, storing or otherwise manipulating glass panels in doors, flat fixed panels or sidelites, windows, bathtub enclosures and shower stalls, or from broken glass in doors, fixed panels or sidelites, windows, bathtub enclosures and shower stalls.

The basic problem involves the use of panels of annealed glass in certain locations that create an unreasonable risk of lacerations, contusions, or abrasions. The inherent properties of most commonly used thicknesses of annealed glass that contribute to unreasonable risks of injury are the low impact strength of the material and the presence upon breakage of sharp points and edges which cause the lacerations, contusions, or abrasions.

CSGC's recommended standard directly addresses the first two risks of injury identified above. By attempting to reduce the incidence of hazardous breakage, the standard also addresses the fourth risk of injury.

Neither CSGC's recommended standard, nor the proposed standard contains provisions for glazing materials used in windows and storm windows. (The third risk of injury listed above.) The preliminary determination in the notice of proceeding was based solely upon the number, severity, and type of injuries associated with this use of glazing materials. However, the Commission now finds that there is insufficient evidence to show whether the effect on cost, utility, and

40

ailability of the products would be outighed by the benefits that any standd that is feasible at this time may con. Therefore, the Commission believes t a determination of unreasonable k of injury is unsupportable at this e. This conclusion is based upon the lowing:

1. If the requirements of this proposed ndard were applied to glazing maals for windows and storm windows, cost of compliance with such requireents could be prohibitive (see draft nomic impact analysis, discussed be, available for inspection at the ce of the Secretary).

2. According to tests conducted at the tional Bureau of Standards for the mmission, requirements involving er costs (e.g. the use of thicker anled glass) if applied to glazing maals used in windows and storm winrs could lead to fewer injuries, but ht also lead to more severe injuries. refore, it is not possible to determine ther there would be a reduction of risk of injury from proposing such irements.

he Commission will continue, to enage further efforts looking toward reduction of injuries associated with ng materials used in windows. The mission will keep under continuing ew all information available conng injuries associated with windows the technological practicability of loping a standard and may, in the re initiate a standard development eeding relative to glazing material in dows.

indicated above, CSGC's recomded standard has been the subject of neering analysis and laboratory test by CPSC to determine its adeby in eliminating or reducing unreable risk of injury. This review proed a number of technical concerns as e standard's adequacy and a gen concern regarding the standard's quality-control oriented rather performance oriented. Section 7(a) e act states that the requirements consumer product safety standard wherever feasible, be expressed in of performance requirements. The ges made by the Commission in t recommended standard are de: to remedy these inadequacies to gree practicable to reduce the unable risk of injury associated with materials.

The Proposed Standard

proposed standard set forth below gned to reduce or eliminate the onable risk of injury associated chitectural glazing materials by ing that the glazing materials used ain architectural products either break when impacted with a cer- y or break with characteristhat are less likely to cause an onable risk of injury. The proStandard is basically the standard has recommended by CSGC with revisions, additions, and dele- ade by the Commission's staff in response to the direction by the Commission discussed above. The major provisions and rationale for the proposed Part 1201, below, are:

1. *Impact Tests.* Affected products are defined and divided into two categories according to the expectation of high energy or low energy accident modes, as well as the opportunity for full body involvement (§ 1201.2(a) (3) and (4) below). Glazing material for products used in high risk areas or products subject to high impact energies (e.g., patio doors, bathtub and shower enclosures) are tested at 400 foot pounds, and glazing materials for other products (e.g., storm doors, entrance and exit doors) are tested at 150 food pounds. The impact requirements are designed to insure that glazing materials for each level of application will not break or will break with characteristics less likely to cause an unreasonable risk of injury. The Commission proposal would require a single impact at the specified energy level for each category. It differs from the CSGC recommended standard which would require glazing material for all products to be subjected to the same series of impact tests, regardless of the intended use of the product.

2. *Breakage Characteristics.* The proposed standard provides that glazing materials, when impacted as required by the standard, either do not break or break with one of a series of alternative acceptable breakage characteristics (§ 1201.4(e)(1) below). There are: (1) A requirement that the ten largest broken pieces not exceed a specified weight, (2) a requirement that a ball weighing 4 pounds and having a diameter of 3 inches shall not fall through the hole remaining in the glazing material after impact when the ball is placed on the material with the material held horizontally, or (3) a requirement that specimens have a modulus of elasticity (stiffness) less than 750,000 psi (5,170 megapascal) and a Rockwell hardness (M or R scale) less than 140. The first characteristic is the CSGC recommendation. The second characteristic differs from the CSGC recommendation which evaluates the hole while the glazing material is held vertically. The Commission believes the proposal which makes use of a 4 pound ball more adequately represents an evaluation of the likelihood of penetration and entrapment of a body part, because it will not allow a material to pass the test if a small scrap of remaining material is suspended in the opening or the hole closes after impact.

The third breakage criterion is also the criterion recommended by CSGC. The Commission recognizes that several further revisions of the stiffness/hardness criterion have been under consideration in the private sector, and the Commission solicits comments on what revisions might be included in the final standards.

This third breakage criterion is designed primarily to evaluate plastic glazing materials. The Commission understands that the requirement passes most plastics by virtue of their being plastics rather than establishing requirements based upon the hazard patterns associated with architectural glazing materials. Because of this, the Commission considered an internally developed requirement that plastic pieces no longer than two inches remaining in the frame be no sharper than 60 degrees. The Commission believes that such an included angle requirement might provide a criterion which differentiates materials that break into pointed or dagger-like pieces, which it believes might present an unreasonable risk of injury, from those pieces which break into more rounded patterns.

However, upon reviewing this new criterion further, the Commission decided to:

a. Propose those requirements for stiffness and hardness which were recommended by CSGC.

b. Determine if there is a correlation between any risk of injury associated with plastic glazing material and the degree of sharpness of the piece remaining in the frame after impact.

c. Determine whether an included angle criterion can be generalized to other glazing materials.

If these additional efforts lead to a criterion which is considered by the Commission to be acceptable either for plastics, or for other glazing materials, the new criterion will be proposed for comment and issuance in place of currently proposed criteria for stiffness and hardness (§ 1201.4(e)(1)(C)). If an included angle criterion is to be part of this standard, it will be proposed for comment prior to issuance of this standard in final form. In the event that an included angle criterion is not proposed prior to issuance of this standard, any further consideration would be part of an amendment process as described in section 9(e) of CPSA.

Because the included angle criterion is still under consideration, the Commission is hereby soliciting comment on the advantages and disadvantages of the criterion, including submission of any available quantitive technical data.

3. *Environmental Durability Tests.* The proposed standard requires that accelerated or simulated weathering tests be conducted periodically to insure maintenance of environmental durability of the glazing materials. These accelerated tests are essentially those recommended by CSGC with minor revisions.

4. *Fire Doors.* The proposed standard would require glazing used in fire doors to comply with this Part 1201. This changes the CSGC recommendation that fire doors be exempted from coverage. CSGC made their recommendation because currently marketed glazing materials meeting fire codes often do not meet impact test criteria. However, glazed products which must meet fire codes are often used in high risk locations, e.g. school corridors and emergency exits. The Commission has in-depth investigation reports which indicate that serious injuries have occurred in such

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locations associated with glazing materials meeting the fire codes. The Commission believes that glazing materials can be developed which will meet the requirements both of this standard and of the various fire codes.

5. *Procedural Changes to the CSGC Recommended Standard.* The proposed standard contains several minor procedural differences from those contained in the CSGC recommended standard. These have to do with construction of the test frame, handling of the impactor, provision for use of either a carbon arc or xenon arc lamp in accelerated environmental durability tests, changes in the relative humidity for the accelerated test for plastics for indoor use, and limiting of the applicability of an infrared spectrograph as a substitute for accelerated testing of plastics. The Commission staff developed these modifications during their evaluation of the recommended standard.

Rationales for the requirements of the standard including modification made by the Commission are available for review in the Office of the Secretary.

Other Considerations

Economic analysis. In its consideration of the proposed standard the Commission has taken into account the need of the public for the products and the probable effects of the standard upon the utility, cost, and availability of the consumer products to meet such need. These were among the factors the Commission weighed in developing an estimation of the economic impact of such a standard on consumers, on affected manufacturers of glazing materials used in architectural products subject to the standard and those other persons involved in the various marketing levels of the assembly, distribution, and sale process, and on other areas of the general economy. A draft economic analysis is available for inspection at the Office of the Secretary.

Environmental impact. After due deliberation, the Commission has determined that there are no potentially significant adverse environmental effects associated with the proposed standard. The factors considered in making this determination are contained in an environmental assessment that may be seen in the Office of the Secretary.

Findings. Prior to promulgating a consumer product safety rule, the Commission shall consider, and shall make appropriate findings for inclusion in such a rule: (1) the degree and nature of the risk of injury the rule is designed to eliminate or reduce; (2) the approximate number of consumer products, or types or classes thereof, subject to such rule; (3) the need of the public for the consumer products subject to such rule, and the probable effect of such rule upon the utility, cost, or availability of such products to meet such need; (4) any means of achieving the effect of the order while minimizing adverse effects on competition or disruption or dislocation of manufacturing and other commercial practices consistent with the public health and safety; (5) that the rule is reasonably necessary to eliminate or reduce an unreasonable risk associated with such product; and (6) that the promulgation of the rule is in the public interest (15 U.S.C. 2058(c)).

Stockpiling. Section 9(d)(2) of the act (15 U.S.C. 2058(d)(2)) authorizes the Commission to prohibit manufacturers from stockpiling a product subject to a consumer product safety standard between issuance of the final standard and its effective date. Stockpiling is defined as manufacturing or importing of a product during this time period at a rate significantly greater than the rate at which the product was produced or imported during a base period (set by rule) ending prior to the promulgation date.

A proposed antistockpiling rule (§ 1201.6 below) is included in the proposed standard to insure that the purposes of the standard, if promulgated, will not be circumvented. Section 1201.6 specifies that manufacturers, fabricators, and importers of certain architectural products who incorporate glazing material into those products shall not incorporate glazing materials which do not comply with the requirements of a final glazing material standard, into those products between the date the final standard is issued and the date the standard becomes effective, at a rate which is greater than the rate of production or importation during the base period plus ten percent. The base period is, at the option of the manufacturer or importer concerned, any period of 180 consecutive days beginning on or after January 1, 1974, and ending on or before July 1, 1975.

The Commission believes that permission of an 18 month period from which the 6-months base period may be selected is justified in this standard because of the large number of different products covered, the variety of seasonal production patterns, and the cyclical economic factors that have influenced production for the building industry in recent years. The allowance of an increase over the base period not to exceed 10% is consistent with normal growth rates within the architectural products industry, and therefore should not represent production or incorporation at a significantly greater rate than the base period.

The stockpiling provision in the proposed Standard is authorized by section 9(d)(2) of the Consumer Product Safety Act (15 U.S.C. 2058(d)(2)). Therefore, any amendment to the stockpiling provision would be governed by the Administrative Procedure Act (5 U.S.C. 553) rather than section 9(e) of the Consumer Product Safety Act.

Preemption. Section 26(a) of the act (15 U.S.C. 0275(a)) provides that whenever a consumer product safety standard issued under the act is in effect and applies to a risk of injury associated with a consumer product, no State or political subdivision of a State shall have any authority either to establish or to continue in effect any provision of a safety standard or regulation which prescribes any requirements as to the performance, composition, contents, design, finish, construction, packaging, or labeling of such products which are designed to deal with the same risk of injury associated with such consumer product, unless such requirements are identical to the requirements of the standard promulgated under the act. This means, in effect, that most State standards in existence will be completely or substantially preempted by the CPSC standard upon its effective date. Such State standards that address the same risk of injury dealt with by the Federal Standard must be identical to the Federal Standard to be enforceable. The Commission encourages all States to adopt this Federal Standard, when issued.

However, in conjunction with the above, section 26(c) of the act (15 U.S.C. 2075(c)) provides that upon application of a State or political subdivision thereof, the Commission may by rule, after notice and opportunity for oral presentation of views, exempt from the preemption provisions of section 26(a) (under such conditions as the Commission may impose) a proposed safety standard or regulation described in the application for exemption. In such cases, the applicant must establish that the proposed standard or regulation (1) imposes a higher level of performance than the standard promulgated under the act, (2) is required by compelling local conditions, and (3) does not unduly burden interstate commerce.

Certification and identification marking. Specific certification and identification marking requirements are not included in the standard, but will be issued in a separate rule developed under the authority of section 14 of the Consumer Product Safety Act. The rule on certification and identification marking will be proposed for public comment in accordance with the requirements of 5 U.S.C. 553 (Administrative Procedure Act), and the rule will be issued prior to the effective date of the standard. Its issuance and any subsequent amendment of such a rule will, therefore, be governed by the Administrative Procedure Act (5 U.S.C. 553) rather than section 14 of the Consumer Product Safety Act.

Manufacturers and private labelers are required to comply with the provisions of section 14(a)(1) of the Act (15 U.S.C. 2063(a)(1)) even in the absence of a regulation.

Reference standards. Certain voluntary standards have been referenced in this Part 1201. The referenecs pertain to the voluntary standards issued on the cited dates, and not to any prior or subsequent revisions. Revisions to those reference standards would not be incorporated into this Part 1201 unless Part 1201 itself is amended under section 9 of the CPSA to incorporate these revisions.

Metric conversions. This standard was developed using the English system of units. Metric equivalents have been included in the text of the standard.

nvenience. Metric equivalents have not en added to the figures. The conver-on factors to be used there are:

inch=2.54 centimeters
pound=.4536 kilograms

Conclusion and Proposal

Having considered CSGC's recom-ended standard for glazing materials ed in certain architectural products, e supportive material submitted there-ith, and other relevant information, the mmission concludes that the stand-d changed as described above and with ditional editorial changes, should be oposed as a consumer product safety ndard as set forth below.

Therefore, pursuant to provisions of e Consumer Product Safety Act (Pub. 92-573, sec. 7(f), 86 Stat. 1215; 15 C. 2056(f)), the Commission pro-es that Title 16, Chapter II, be ended by adding to Subchapter B a Part 1201 as follows:

RT 1201—A SAFETY STANDARD FOR ARCHITECTURAL GLASS

1 Scope and application.
1.2 Definitions.
1.3 General requirements.
1.4 Test procedures.
1.5 Certification and labeling requirements.
1.6 Prohibited stockpiling.

THORITY: Secs. 2, 3, 7, 9, 14, Pub. L. 92-86 Stat. 1212-17; 15 U.S.C. 2056, 2058.

1201.1 Scope and application.

(a) *Scope.* This Part 1201, a consumer duct safety standard, prescribes the ty requirements for glazing materials d in any of the following architec-l products:

(1) Storm doors or combination doors.
(2) Doors.
(3) Bathtub doors and enclosures.
(4) Shower doors and enclosures.
(5) Glazed panels.
(6) Sliding glass doors (patio-type).

lso requires that these products which rporate glazing materials be con-cted with glazing materials that the requirements of this part. The y requirements are designed to re-e or eliminate unreasonable risk of h or serious injury to consumers t glazing material is broken by an contact.

(b) *Application.* This Part 1201 shall r to glazing materials used in the itectural products listed in para-h (a) of this section and to those ucts if they are made with glazing rial when such glazing material products are manufactured for offered for sale, distributed in merce, or imported into the United s after the effective date of the rd and are sold to or for the al use consumption of en-ent of consumers in or around a anent or temporary household or idence or in recreational, school, pub-or other buildings or parts thereof. rposes of this standard, fabricators persons who assemble glazed panels considered to be manufacturers of the architectural products listed in § 1201.1(a) of this part.

(c) *Effective date.* The effective date shall be 180 days after publication of this Part 1201 in the Federal Register.

§ 1201.2 Definitions.

(a) As used in this Part 1201:

(1) "Annealed glass" means glass that has been subjected to a slow, controlled cooling process during manufacture to control residual stresses so that it can be cut or subjected to other fabrication. Regular polished plate, float, sheet, window, rolled, and patterned surface glasses are examples of annealed glass.

(2) "Bathtub doors and enclosures" means assemblies of panels and/or doors that are installed on the lip of or immediately surrounding a bathtub.

(3) "Category I products" means any of the following architectural products:

(i) Storm doors or combination doors that contain no single piece of glazing material greater than 6 square feet (0.55 or more square meters) in surface area of one side of the piece of glazing material.

(ii) Doors that contain no single piece of glazing material greater than 6 square feet (0.55 or more square meters) in surface area of one side of the piece of glazing material.

(iii) Glazed panels that contain no single piece of glazing material greater than 6 square feet (0.55 or more square meters) in surface area of one side of the piece of glazing material.

(4) "Category II products" means any of the following architectural products:

(i) Shower doors and enclosures.
(ii) Bathtub doors and enclosures.
(iii) Sliding glass doors (patio type).
(iv) Storm doors or combination doors that contain any piece of glazing material of 6 or more square feet (0.55 or more square meters) in surface area of one side of the piece of glazing material.
(v) Doors that contain any piece of glazing material of 6 or more square feet (0.55 or more square meters) in surface area of one side of the piece of glazing material.
(vi) Glazed panels that contain any piece of glazing material of 6 or more square feet (0.55 or more square meters) in surface area of one side of the piece of glazing material.

(5) "Distributor" means a person to whom a consumer product is delivered or sold for purposes of distribution in commerce, including persons cutting glazing material to size, except that such term does not include a manufacturer or retailer of such product.

(6) "Distribution in commerce" means to sell in commerce, to introduce or deliver for introduction into commerce, or to hold for sale or distribution after introduction into commerce.

(7) "Door" means an assembly that is installed in an interior or exterior wall; that is movable in a sliding, pivoting, hinged, or revolving direction; and that is used by consumers to produce or close off an opening for use as a means of human ingress or egress.

(8) "Fabricator" means any person who assembles or otherwise incorporates glazing materials into an architectural product listed in § 1201.1(a).

(9) "Glass" means a hard, brittle, amorphous substance produced by fusion, usually consisting of mutually dissolved silica and silicates that also contains soda and lime, which may be transparent, translucent, or opaque.

(10) "Glazed panel" means a glazing material used in any building listed in § 1201.1(b) that is:

(i) In residential buildings, the first piece of operable or nonoperable glazing material adjacent to a door whose nearest vertical edge is within 12 inches (31 centimeters) of the door; or

(ii) In all buildings other than residential buildings, any piece of operable or nonoperable glazing material adjacent to a door whose nearest vertical edge is within 48 inches (1.2 meters) of the door; or

(iii) In all buildings other than residential buildings, all panels not described in paragraph (a)(10)(ii) of this section where:

(A) The lowest edge of the glazing material is less than 18 inches (46 centimeters) above any floor or any walking surface; and

(B) The exposed glazing material in such panel exceeds 6 square feet (0.55 square meters); and

(C) There is a walking surface on both sides, either of which is within 36 inches (92 centimeters) of such panel and the horizontal planes of such walking surfaces are within 12 inches (31 centimeters) of each other.

(iv) Not included in the definition of glazed panels are:

(A) Panels where an intervening interior permanent wall is between the door and the panel(s) described in paragraph (a)(10)(ii) of this section;

(B) Panels described in paragraph (a)(10)(iii) of this section that have a horizontal member such as a piece of the framing or permanent chair rail no less than 1½ inches (4 centimeters) in width, which is located between 18 and 36 inches (46 and 91 centimeters) above the walking surface.

(11) "Glazing material" means glass, plastics, organic-coated glass, tempered glass, laminated glass, wired glass, or combinations thereof where these are used:

(i) In openings through the architectural products listed in § 1201.1(a), or

(ii) As the architectural products themselves, e.g. glazed panels or unframed doors.

(12) "Laminated glass" means glazing material composed of two or more pieces of glass bonded to an intervening layer or layers of resilient plastic material.

(13) "Manufacture" means to manufacture, produce or assemble.

(14) "Manufacturer" means any person who manufactures or imports a glazing material or architectural product listed in § 1201.1(a) that incorporates glazing material.

(43)

(15) "Mirror" means a treated, polished or smooth glazing material that forms images by the reflection of light.

(16) "Mobile home" means a structure transportable in one or more sections, which is eight body feet (2.4 body meters) or more in width and is thirty-two body feet (9.7 body meters) or more in length, and which is built on a permanent chassis and designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities.

(17) Other buildings or parts thereof" means buildings or parts thereof (other than residential, school, public, or recreational buildings) in which all or part of the building is open to the public with or without specific invitation. Included are buildings or parts thereof such as banks and recreational or retail facilities in a building and multiuse buildings that contain residential units.

(18) "Organic-coated glass" means a glazing material consisting of a piece of glass coated and bonded on one or both sides with an applied polymeric coating, sheeting, or film.

(19) "Patio door" (See "sliding glass doors (patio-type)" in paragraph (a) (29) of this section.

(20) "Permanent label" means a label that will remain permanently legible and visible after installation of the glazing material and that would be destroyed in attempts to remove it from the glazing material and includes (but is not limited to) sandblast, acid etch, hotstamp, and destructible polyester labels.

(21) "Plastic" means an organic transparent or translucent glazing material that consists of a single sheet of plastic material, a combination of two or more such sheets laminated together, or a combination of plastic material and reinforcement material in the form of fiber or flakes.

(22) "Private labeler" means an owner of a brand or trademark on the label of a consumer product which bears a private label, and includes any fabricator, distributor, or installer who cuts certified and permanently labeled glazing materials into smaller pieces.

(23) "Public building" means a building of public assembly or meeting including (but not limited to) a museum, place of worship, restaurant.

(24) "Recreational building" means a building used for recreational purposes including (but not limited to) a theater, stadium, gymnasium, amusement park building or library.

(25) "Residential building" means a structure, permanent or temporary, such as a single or multifamily residence, including (but not limited to) a house, apartment building, lodging home, dormitory, hotel, motel, hospital, sanitarium, mobile home (as defined in paragraph (a) (16) of this section), and nursing home, used as a dwelling for one or more persons or families. Public area of all residential buildings, such as lobbies and other common facilities, are included within the definition of "other buildings or parts thereof" in paragraph (a) (21) of this section.

(26) "Retailer" means a person to whom a consumer product is delivered or sold for purposes of sale or distribution by such person to a consumer, including a person who cuts glazing material to size.

(27) "School building" means a structure designed primarily for the conduct of educational instruction and includes the classrooms, libraries, administrative offices, auditoriums, eating and sanitary facilities, stadiums, and gymnasiums and all other structures associated with such buildings.

(28) "Shower door and enclosure" means an assembly of one or more panels installed to form all or part of the wall and/or door of a shower stall.

(29) "Sliding glass door (patio-type)" means an assembly of one or more panels, at least one of which is suitably movable for use as a means of human ingress or egress. The term includes the nonmovable and movable panels of such assembly.

(30) "Storm door (or combination door)" means a movable assembly, used in tandem with an exterior door to protect the door against weather elements and to improve indoor climate control.

(31) "Tempered glass" means a piece of specially heat treated or chemically treated glass that cannot be cut, drilled, ground, or polished after treatment without fracture. When fractured at any point, if properly tempered, the entire piece breaks into small granular pieces.

(32) "Wired glass" means a single piece of annealed glass that contains wire embedded in the body of the glass.

(33) "Commission" means the Consumer Product Safety Commission.

(b) Definitions given in the Consumer Product Safety Act, and not repeated in this section, are applicable to this Part 1201.

§ 1201.3 General requirements.

(a) All glazing materials used or intended for use in glazed architectural products listed in § 1201.1 (a) and defined in § 1201.2 shall meet the test requirements in § 1201.4, and shall be labeled in accordance with § 1201.5.

(b) Glazing materials used in architectural products not listed in § 1201.1 (a) are not subject to this Part 1201.

§ 1201.4 Test procedures.

(a) *Types of tests*—(1) *Impact test.* Specimens are struck as prescribed by paragraph (d) (1) of this section using equipment specified by paragraphs (b) (1) and (2) of this section. Results of the impact test are to be interpreted in accordance with paragraph (e) (1) of this section. The test specimens are to be selected in accordance with paragraph (c) (1) and (2) of this section.

(2) *Accelerated environmental durability tests.* Each manufacturer shall test or cause to be tested each of its different types of glazing material covered by this Part 1201 in accordance with the accelerated tests referenced in table I, "Accelerated Tests" of this section.

TABLE I.—*Accelerated tests (applicable paragraphs)*

Glazing material	Specimen	Test equipment	Exposure	Criteria for passing
Laminated glass	Sec. 1201.4(c)(1) and (c)(3)(i).	Sec. 1201.4(b)(3)(i)	Sec. 1201.4(d)(2)(i)	Sec. 1201.4(e)(2)(i).
Organic-coated glass	Sec. 1201.4 (c)(1) and (c)(3)(ii).	Sec. 1201.4(b)(3)(ii) or (b)(3)(iii) or (b)(3)(iv).	Sec. 1201.4(d)(2)(ii)	Sec. 1201.4(e)(2)(ii)(B).
Plastics	Sec. 1201.4 (c)(1) and (c)(3)(ii)	Sec. 1201.4 (b)(3)(ii) or (b)(3)(iii) or (b)(3)(iv).	Sec. 1201.4(d)(2)(ii)	Sec. 1201.4(e)(2)(ii)(A).
Plastics (indoor)	Sec. 1201.4 (c)(1) and (c)(3)(iii).	Sec. 1201.4(b)(3)(v)	Sec. 1201.4(d)(2)(iii)	Sec. 1201.4(e)(2)(ii)(C).
Tempered glass	Exempt			
New products	See sec. 1201.4(a)(2)			

(3) Separate testing is required for different glazing materials or for differences within a type of glazing material that could noticeably affect performance in the impact or environmental durability tests. Such differences could include (but are not limited to): nominal thickness or thicknesses, method of manufacture (in appropriate cases), types and amounts of additives, and composition of base materials and adhesives.

(b) *Impact test equipment*—(1) *Impact test frame and subframe. (See figures 1, 2, 3, and 4).* (i) The impact test frame shall be constructed to minimize movement and deflection of its members during testing. For this purpose, the structural framing and bracing members shall be steel angles (3 inches by 5 inches by ¼ inch—7.7 centimeters by 12.7 centimeters by 0.7 centimeters) or other sections and materials or equal or greater rigidity, except that impact test frames already in existence on the effective date of this Part 1201 that conform to the requirements of ANSI Standard 297.1–1972[1] and which are as rigid as the steel angle frame need not be modified to be specified steel angle construction.

[1] Entitled "Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings," January 20, 1972 approved and published by American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

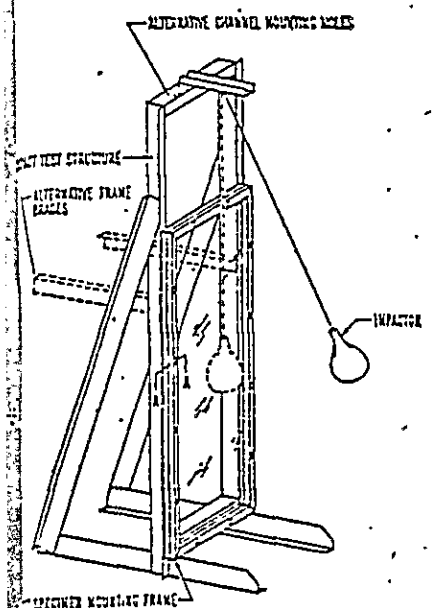

FIG 1-GLASS IMPACT TEST STRUCTURE

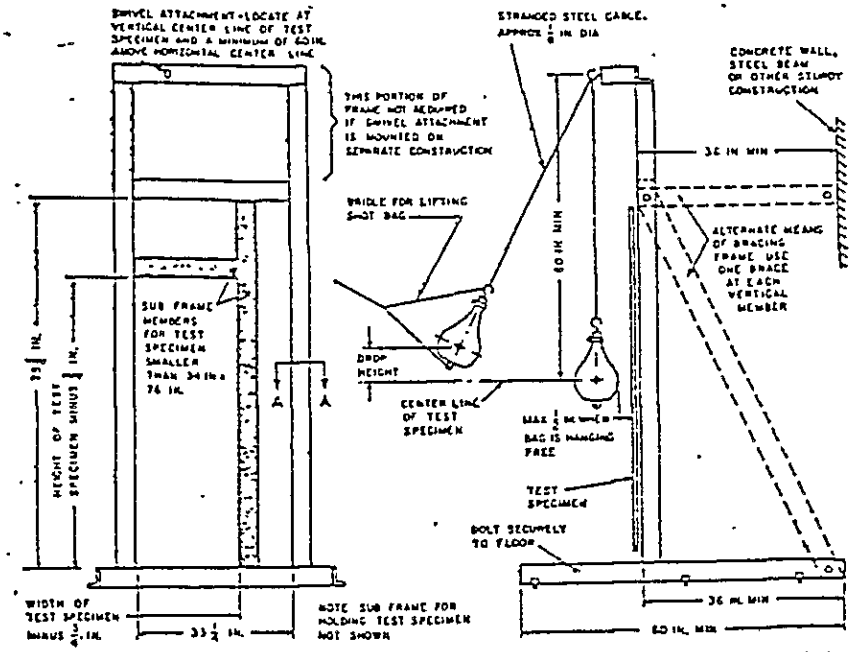

FIG 2-TEST FRAME

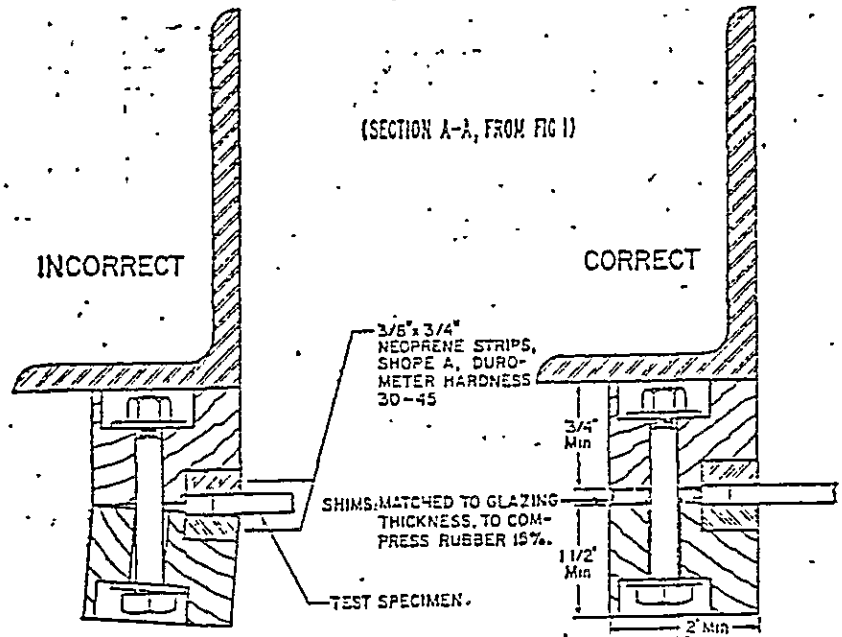

FIG 3-PROPERLY & IMPROPERLY CLAMPED TEST SPECIMEN(>1/8" THICK)

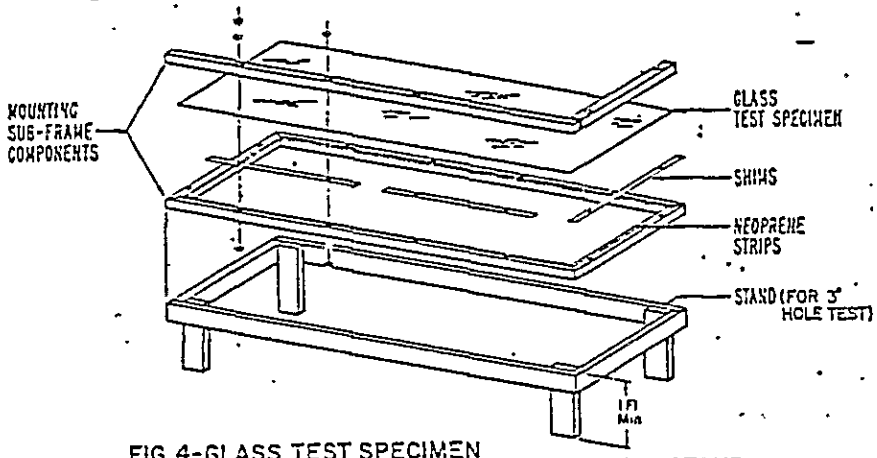

FIG 4-GLASS TEST SPECIMEN MOUNTING SUB-FRAME(EXPLODED) & STAND

(ii) The structural framing shall be welded or securely bolted at the corners and braced by one of the alternate methods shown in figure 1 and shall be securely bolted to the floor.

(iii) The subframe for securing the test specimen on all four edges shall be reinforced at each corner. The material is shown as wood in figure 3, but other materials may be used provided the test specimen will contact only the neoprene strips.

(iv) Any reasonable means may be used to secure the subframe to the test frame so long as the mounting is secure and the pressure on the glazing in the subframe is not significantly altered when the subframe is removed.

(v) Pressures on the test specimen shall be controlled but the compression of the neoprene strips shall not be more than 15 percent of the original thickness of the neoprene. Securing methods such as wing bolts and clamps shall be uniformly spaced no greater than 18 inches (45 centimeters) apart with no fewer than two on any edge. To limit the compression of the neoprene and prevent distortion of the subframe, metal shims of an appropriate thickness shall be used as shown in figures 3 and 4.

(2) *Impactor*—(i) The impactor shall be a leather punching bag as shown in figure 5 of this section. The bag shall be filled with No. 7½ chilled lead shot to a total weight of completed assembly of 100 pounds ± 4 ounces (45.36±0.11 kilograms). The rubber bladder shall be left in place and filled through a hole cut into the upper part. After filling the rubber bladder, the top should be either twisted around the threaded metal rod below the metal sleeve or pulled over the metal sleeve and tied with a cord or leather thong. Note that the hanging strap must be removed. The bag should be laced in the normal manner. The exterior of the bag shall be completely covered by ½-inch (1.3 centimeters) wide polyester glass fiber reinforced tape or equivalent (figure 5).

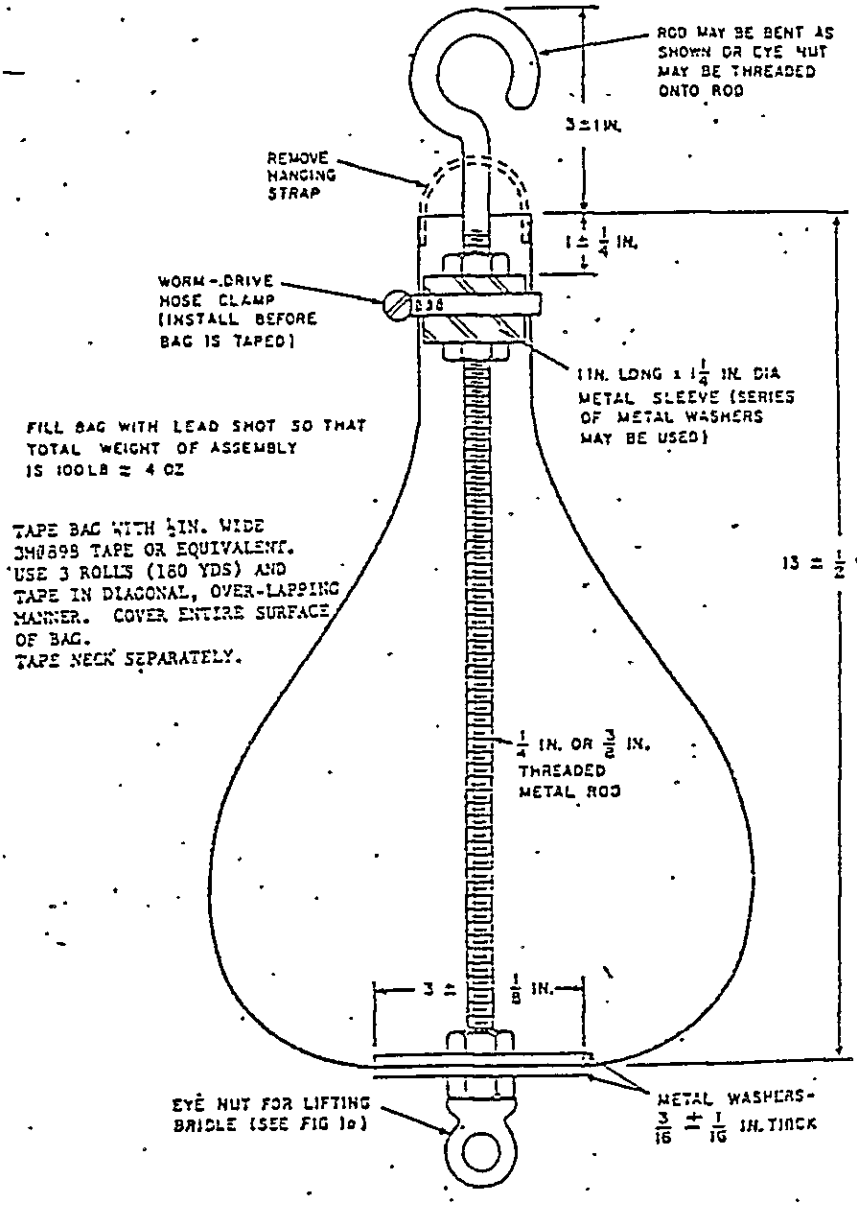

FIG 5-IMPACTOR

(ii) The impactor shall be supported as shown in figure 2. Provisions shall be made for raising the impactor to drop heights of up to 48 inches (1.22 meters). At its release it shall have been supported so that the pin going through its center was in line with the steel cable. The impactor shall not wobble or oscillate after its release.

(3) *Environmental durability test equipment*—(i) *Boil test.* Two containers of water shall be provided with means to maintain one at 150°±5° F (66°±2° C) and the second at a slow boil at atmospheric pressure. The containers shall be large enough to accept a rack holding three specimens, each 12 inches (30 centimeters) square, of the glazing material in a vertical position. The rack shall be positioned so that each specimen is surrounded by at least one inch (2.5 centimeters) of water.

(ii) *Simulated weathering test.* The equipment shall be the apparatus commercially known as a "Weatherometer" or its functional equivalent, incorporating a single or twin carbon arc or a xenon arc. Recorders shall monitor the energy reaching the specimens. The carbon-arc equipment, when used, shall be operated in accordance with ASTM G 23–69, "Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Nonmetallic Materials," March 21, 1969, as augmented for plastics by ASTM D 1499–64, "Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics," August 31, 1964. The xenon-arc equipment, when used, shall employ the borosilicate filter and be operated in accordance with ASTM G 26–70, "Operating Light- and Water-Exposure Apparatus (Xenon-Arc Type) for Exposure of Nonmetallic Materials," April 13, 1970, as augmented for plastics by ASTM D 2565–70, "Operating Xenon-Arc Type (Water-Cooled) Light- and Water-Exposure Apparatus for Exposure of Plastics," June 12, 1970, Procedure B. (ASTM methods are approved and published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa 19103.)

(iii) *Outdoor weathering test equipment.* Commercial outdoor exposure test racks shall face the specimens south and inclined skyward 45 degrees. The specimens shall be mounted so that at least 80 percent of each surface is fully exposed to the environment. The total amount of solar energy reaching the specimens shall be recorded.

(iv) *Intensified weathering test.* The Equatorial Mount with Mirrors for Acceleration with Water found at the Desert Sunshine Exposure Tests near Phoenix, Arizona, may be used with appropriate water spray cycle. The total solar energy reaching the specimens shall be monitored.

(v) *Indoor aging test.* A test chamber large enough to contain four specimens of size used in the impact test (see paragraph (c)(2) of this section) shall be used. Hangers shall be provided to support the specimens vertically with 4 inches (11 centimeters) of separation for air circulation. The chamber shall be capable of reaching 140° F (60° C) at 100 percent relative humidity.

(c) *Test specimens*—(1) *Condition of specimens.* All specimens shall be tested as supplied by the manufacturer, following removal of any temporary protective masking materials. No tests shall be commenced before the specimens have been stored in the laboratory for 4 hours. Specimens shall be arranged to permit free circulation of air to all surfaces during this period.

(2) *Impact specimens.* Impact specimens shall be of the largest size manufactured up to a maximum width of 34 inches (86 centimeters) and a maximum height of 76 inches (1.9 meters). Specimens shall be tested for each nominal thickness offered.

(3) *Environmental durability specimens*—(i) *Boil test.* Three pieces 12 inches by 12 inches (30 centimeters by 30 centimeters) with nominal thickness identical to those submitted for the impact test.

(ii) *Weathering tests*—(A) *Plastics.* Not less than 10 plastic specimens ½ inches by 5 inches (1.3 centimeters by 12.7 centimeters) by thickness identical to those submitted for the impact test.

(B) *Organic-coated glass.* Six organic-coated glass specimens 2 inches by 6 inches (5 centimeters by 15 centimeters) by thickness identical to those submitted for the impact test.

(iii) *Indoor service.* Four additional samples identical to those submitted for the impact test.

(d) *Test procedures*—(1) *Impact test procedure.* Each specimen shall be struck within 2 inches (5 centimeters) of its geometric center with the impactor dropped from a single height, designated according to the product category. Specimens for category I shall be impacted one time from a drop height of 18 to 18½ inches (458 to 470 millimeters). Specimens for category II shall be impacted one time from drop height of 48 to 48½ inches (1.22 to 1.23 meters). For all specimens that are not symmetric from surface to surface, an equal number of specimens shall be impacted on each side.

(2) *Environmental durability test procedures*—(i) *Boil test.* The specimens shall be immersed in the 150° F (66° C) water for 3 minutes. They shall then be quickly removed and immersed in the boiling water and left there for 2 hours. The specimens shall then be removed, cooled, and dried for examination as specified in § 1201.4(e)(2)(i) of this standard.

(ii) *Accelerated weathering test.* The specimens shall be retained in the selected equipment (paragraph (b)(3)(ii), (iii), or (iv) of this section) until exposed to 200,000±10,000 langleys (200.±10. kilo-calories per square centimeter) of radiation. Three organic-coated glass specimens shall be mounted with the coated surface away from the radiation; the other three specimens shall be kept in darkness at 73° F (23° C) for use as controls. Half of the number of the plastic specimens shall be exposed to radiation and half of the number of plastic specimens shall be kept in darkness for use as controls.

(iii) *Indoor aging test.* The specimens shall be hung in the test chamber for 10 complete cycles (480 hours). The procedure shall be in accordance with procedure A of ASTM D 756–56, "Test for Resistance of Plastics to Accelerated Service Conditioning," September 10, 1956, except that during the humid phase of the cycle the relative humidity shall be maintained at 100 percent.

(iv) *Identification of plastic and adhesive specimens.* Infrared spectrograms may be made of any initial plastic specimen. Replication of this spectrogram by samples taken from subsequent specimens shall identify the material as acceptable without repetition of the accelerated environmental durability test. In using this paragraph (d)(2)(iv) the manufacturer attests that each formulation is physically and chemically the same as that used for the initial qualification test. This paragraph (d)(2)(iv) may not be used to negate or supercede the results of any actual testing. This section may not be used for composites such as laminated glass or organic-coated glass.

(e) *Interpretation of results*—(1) *Impact test.* (i) A glazing material shall be judged to pass the impact test if the specimen tested meets any one of the criteria listed in paragraph (e)(1)(i)(A) through (D) of this section:

(A) When breakage occurs (numerous cracks and fissures may occur) no opening shall develop in the test sample through which a 3-inch (76 millimeters) diameter solid steel sphere, weighing 4 pounds ±3 oz (1.81±0.08 kilograms), passes when placed (not dropped) in the opening. For this criterion, the sample after being impacted shall be placed, while remaining in the subframe, in a horizontal, impact side-up position with a minimum of one foot (31 centimeters) of free space immediately beneath the specimen.

(B) When breakage occurs, the 10 largest crack-free particles selected within 5 minutes subsequent to the test shall weigh no more than the equivalent weight of 10 square inches (64 square centimeters) of the original specimen.

(C) The specimen has:

(*1*) A modulus of elasticity less than 750,000 psi (5,170 megapascal) when measured by ASTM D 790–71, "Standard Method of Test for Flexural Properties of Plastics," October 29, 1971, and

(*2*) A Rockwell hardness (M or R scale) less than 140 when measured by ASTM D 785–65 (Reapproved 1970), "Standard Method of Test for Rockwell Hardness of Plastics and Electrical Insulating Materials," August 31, 1965.

(D) The specimen shall not break but is not required to remain within the frame.

(ii) A glazing material may be qualified for both category I and category II, but in such case, specimens must be tested in accordance with the procedures for each category.

(2) *Environmental durability tests*—(i) *Boil test.* The glass itself may crack in this test, but no bubbles or other defects

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shall develop more than ½ inch (1... millimeters) from the outer edge of the specimen or from any crack that may develop. Any specimen in which the glass cracks to an extent that confuses the results shall be discarded and another specimen shall be tested in its stead.

(ii) *Accelerated weathering test*—(A) *Plastics.* (1) Plastic specimens shall be evaluated before and after exposure as described in Method B, "Simple Beam (Charpy-Type) Test," of ASTM D 256-73, "Test for Impact Resistance of Plastics and Electrical Insulating Materials," November 27, 1973 The exposed specimens shall be tested with the exposed surface subjected to tension. In the case of thin materials, the span of the specimens shall be reduced to 2 inches (50 millimeters) to avoid having the specimens bend enough to slip between the supports without breaking. For materials that will not break on this 2-inch (50 millimeters) span the specimens shall be notched across the ½-inch (12 millimeters) surface prior to exposure. The notch shall be a 45-degree angle and the radius at the bottom shall be 0.010±0.002 inch (0.25±0.04 millimeters). The thickness of the material beneath the notch shall be uniform within ±0.002 (±0.05 millimeters) inch for all specimens and shall not be less than 70 percent of the specimen thickness. During exposure the notch shall face the radiation source.

(2) Plastic material shall be acceptable for safety glazing if the impact strength is not reduced by more than 25 percent during exposure. Some discoloration is permissible, but defects other than this discoloration shall not be permissible. No bubbles or other noticeable decomposition shall be permissible in the irradiated portion.

(B) *Organic-coated glass.* Specimens shall be judged satisfactory if they pass both the adhesion test and the tensile test described in paragraphs (e) (2) (ii) (B) (*1*) and (2) of this section.

(*1*) *Adhesion test (organic-coated glass only—(i) Specimens.* The specimens for this test are the three 2-inch by 6-inch (5 centimeters by 15 centimeters) weathered specimens and the three control specimens. The specimens shall be conditioned just prior to the performance of the adhesion test at 73°±2° F (23°±1° C) and 50±2 percent relative humidity for 24 hours.

(*ii*) *Apparatus.* The test apparatus shall consist of a constant-rate-of-extension-type (CRE) tensile tester with the moving crosshead set to move at 12 inches per minute (5 millimeters per second) and load range such that the average peel force will fall at 30 to 50 percent of full scale. A cutter shall be used containing new razor blades for cutting 1-inch (25 millimeter) wide specimens of the organic coating on the glass. The razor blades shall be used one time only.

(*iii*) *Procedure.* Using the razor cutter, cut a straight, 1-inch (25 millimeter) wide strip of the organic coating in the lengthwise direction of the glass specimen along and within ¼ inch (6 millimeters) of one edge. Peel back, cleanly and evenly, about 2 inches (50 millimeters) of one end of the 1-inch (25 millimeters) wide organic strip. Attach a strip of reinforced pressure-sensitive tape to the side of the organic strip opposite the adhesive, to extend this free end to about 8 inches (200 millimeters) in length. Place the end of the glass panel from which the organic strip was removed in the lower clamp of the tensile tester and the free end of the tape in the upper clamp. Peel the remainder of the organic strip from the glass mechanically and obtain a record of the peel force value. Determine and record the average pull force value for each specimen from the chart. Weathered and control specimens are to be tested alternately.

(*iv*) *Interpretation of results.* The organic-coated glass adhesion shall be judged satisfactory if the average adhesion value for the three weathered specimens is no less than 90 percent of the average adhesion value for the three control specimens.

(2) *Tensile strength test (organic-coated glass only).* (*i*) The specimen for this test are the same six 2-inch by 6-inch (5 centimeter by 15 centimeter) specimens used in the adhesion test.

(*ii*) *Apparatus.* The CRE tensile tester shall be used with the moving crosshead set to move at 2 inches per minute (0.8 millimeter per second) and the load range such that the specimens will break at 30 to 60% of full scale. A cutter shall be used containing new razor blades for cutting ½-inch (12 millimeter) wide specimens of the organic coating on the glass. The razor blades shall be used one time only.

(*iii*) *Procedure.* Using the ½-inch (12 millimeter) razor cutter, cut a straight strip of the organic coating in the lengthwise direction of the glass specimen for the full 6-inch (15 centimeter) length. Carefully peel this strip from the glass panel and test it for breaking strength in the tensile tester.

(*iv*) *Interpretation of results.* The organic coating tensile strength shall be judged satisfactory if the average tensile value of the three weathered specimens is no less than 75 percent of the average of the three control specimens. Weathered and control specimens are to be tested alternately.

(C) *Plastic (indoor service).* Specimens shall be judged satisfactory if, after the indoor aging test (paragraph (d) (2) (iii) of this section), they again pass the impact test (paragraph (d) (1) of this section).

§ 1201.5 Certification and labeling requirements.

(a) Manufacturers and private labelers of glazing materials covered by this Part 1201 shall comply with the requirements of section 14 CPSA (15 U.S.C. 2063) and regulations issued under section 14.

(b) Any glazing material that meets only the requirements of § 1201.4(e) (2) (ii) (C) entitled "Plastic (indoor service" shall bear the statement "INDOOR USE ONLY" as part of a permanent label.

(c) Organic-coated glass that has been tested for environmental exposure from one side only must bear a permanent label on the coating stating "INSTALL WITH THIS SURFACE INDOORS" and shall bear in the central 50 percent of the surface area the following message in letters at least ¼-inch (7 millimeters) high: "SEE PERMANENT LABEL FOR IMPORTANT MOUNTING INSTRUCTION." The latter message shall be attached to either side of the glazing by any means which shall ensure the message will remain in place until installation.

(d) It shall be contrary to this Part 1201 for anyone other than the ultimate consumer to remove any permanent label required by this Part 1201 from glazing material subject to this Part 1201.

§ 1201.6 Prohibited stockpiling.

(a) *Stockpiling.* For the purposes of this section, the term "stockpiling" means manufacturing or importing the affected products between the date of promulgation of Part 1201 in the FEDERAL REGISTER and its effective date (180 days after promulgation) at a rate significantly greater (prescribed in paragraph (c) of this section) than the rate at which the affected products were produced or imported during a base period (prescribed in paragraph (c) (2) of this section).

(b) *Prohibited acts.* Manufacturers, including fabricators, and importers of architectural products specified in § 1201.1(a) who incorporate glazing material into those products shall not incorporate glazing materials which do not comply with the requirements of this Part 1201 into such products between the date of issuance of this Part 1201 in the FEDERAL REGISTER and 180 days thereafter at a rate greater than the rate of production or importation during the base period (defined in paragraph (c) (2) of this section) plus ten percent.

(c) *Definitions.* As used in this § 1201.6:

(1) "Rate of production (or importation)" means the total number of affected architectural products incorporating glazing material not complying with this Part 1201 manufactured or imported during a stated base period.

(2) "Base period" means, at the option of the manufacturer or importer, any period of 180 consecutive days beginning on or after January 1, 1974, and ending on or before July 1, 1975.

Interested persons are invited to submit, on or before March 12, 1976, written comments regarding any aspect of the proposed standard. The Commission is interested in receiving comment on the technical aspects of the standard as well as comments on the need of the public for the consumer products subject to the standard and the probable effects of the standard upon the utility, cost, or availability of the products to meet the need. In this connection, the Commission's draft economic analysis is available for review in the Office of the Secretary. Such comment should be accompanied, to the extent possible, by

supporting data or documentation. Requests for confidentiality of documentation will be handled in accordance with the Freedom of Information Act as amended, 5 U.S.C. 552; the Commission's interim regulations issued under that Act, (39 FR 30298, August 21, 1974); and the provisions of section 6(a)(2) of the CPSA (15 U.S.C. 2055(a)(2)).

Interested persons will be afforded an opportunity to make an oral presentation of data, views, or arguments on any aspect of the proposed standard on March 8, 1976. The proceedings for the oral presentation will be held at 10:00 a.m. at the 6th Floor Hearing Room, 1750 K Street, NW., Washington, D.C. The procedural regulations for oral presentations, 16 CFR Part 1109, promulgated October 14, 1975, (40 FR 48122), shall govern this proceeding.

All persons wishing to make an oral presentation should notify Richard Danca of the Office of the Secretary, 202-634-7700, no later than close of business February 26, 1976, for scheduling purposes. A summary or outline of each oral presentation should be filed with the Office of the Secretary at least 48 hours prior to the oral presentation.

Written submissions and any accompanying data or material should be submitted, preferably in five copies, addressed to the Secretary, Consumer Product Safety Commission, Washington, D.C. 20207. Comments may be accompanied by a memorandum or brief in support thereof. Received comments and other relevant material may be seen in the Office of the Secretary, 10th floor, 1750 K Street NW., Washington, D.C., during working hours Monday through Friday.

Dated: February 4, 1976.

SADYE E. DUNN,
Secretary, Consumer Product Safety Commission.

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