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ภาคผนวก

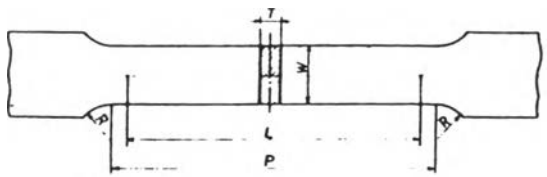
ข้อกำหนดตามมาตรฐานอุตสาหกรรมญี่ปุ่น

4. Form and Dimensions of Test Piece

4.1 The forms and dimensions of the test pieces Nos. 1 to 14 shall be as follows:

(1) No. 1 Test Piece The form and dimensions of this test piece shall conform to Fig. 1.

Fig. 1

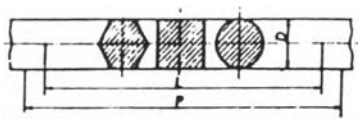


Unit: mm

Type of test piece	Width W	Gauge length L	Parallel length P	Radius of fillet R	Thickness T
1 A	40	200	220 approx.	25 min.	Thickness of material
1 B	25	200	220 approx.	25 min.	Thickness of material

(2) No. 2 Test Piece The form and dimensions of this test piece shall conform to Fig. 2.

Fig. 2

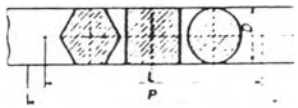


Dia. or width across flats D	Gauge length L	Distance between grips P
Size of material	8 D	(L + 2 D) approx.

Remark: This test piece shall be applied to bars of not more than 25 mm in nominal diameter (or width across flats).

(3) No. 3 Test Piece The form and dimensions of this test piece shall conform to Fig. 3.

Fig. 3



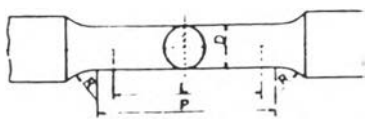
Dia. or width across flats D	Gauge length L	Distance between grips P
Size of material	4 D	(L + 2 D) approx.

Remarks 1. This test piece shall be applied to bars of over 25 mm in nominal diameter (or width across flats).

2. This test piece may be machined into the test piece with reduced parallel portion. In this case, the diameter of reduced parallel portion shall be not less than 25 mm and the length of the part P shall be approximately 4.5 D.

(4) No. 4 Test Piece The form and dimensions of this test piece shall conform to Fig. 4.

Fig. 4



Unit: mm

Diameter D	Gauge length L	Parallel length P	Radius of fillet R
14	50	60 approx.	15 min.

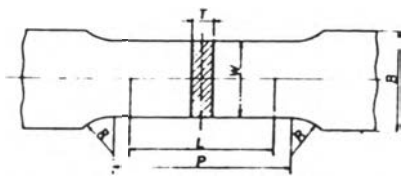
Remarks 1. The parallel portion of this test piece shall be machine-finished. However, that of malleable casting shall, as a rule, not be finished.

2. If the test piece of the dimensions as specified in Fig. 4 can not be obtained, the diameter of parallel portion and the gauge length may be determined in accordance with the formula $L = 4\sqrt{A}$ where A is the cross-sectional area of parallel portion.

รูปที่ 1 ขนาดของตัวอย่างชิ้นทดสอบความต้านแรงดึงตามมาตรฐานอุตสาหกรรมญี่ปุ่น

(5) No. 5 Test Piece The form and dimensions of this test piece shall conform to Fig. 5.

Fig. 5



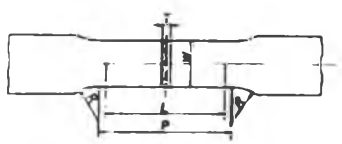
Unit: mm

Width W	Gauge length L	Parallel length P	Radius of fillet R	Thickness T
25	50	60 approx.	15 min.	Thickness of material

Remark: In the case of applying this test piece to steel sheets not more than 3 mm thick, the radius R of fillet shall be 20 to 30 mm, and the width B of gripped ends shall be 30 mm or over.

(6) No. 6 Test Piece The form and dimensions of this test piece shall conform to Fig. 6.

Fig. 6



Unit: mm

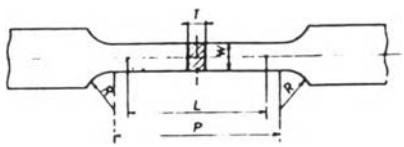
Width W	Gauge length L	Parallel length P	Radius of fillet R	Thickness T
15	$8\sqrt{A}$	L + approx. 10	15 min.	Thickness of material

A: cross-sectional area of parallel protion (W x T)

Remark: This test piece shall be applied to plates and shapes not more than 6 mm in thickness.

(7) No. 7 Test Piece The form and dimensions of this test piece shall conform to Fig. 7

Fig. 7



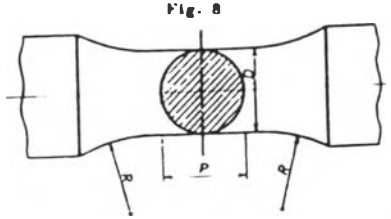
Unit: mm

Width W	Gauge length L	Parallel length P	Radius of fillet R	Thickness T
T min.	$4\sqrt{A}$	1.2 L approx.	15 min.	Thickness of material

A: cross-sectional area of parallel portion (W x T)

(8) No. 8 Test Piece This test piece shall be made from a test coupon cast to the dimensions specified in the following table by machine-finishing to the form and dimensions shown in Fig. 8.

Fig. 8



Unit: mm

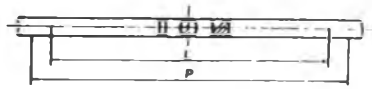
Type of test piece	Casting dimensions of test coupon (diameter)	Parallel length P	Diameter D	Radius of fillet R
8 A	13 approx.	8 approx.	8	16 min.
8 B	20 approx.	12.5 approx.	12.5	25 min.
8 C	30 approx.	20 approx.	20	40 min.
8 D	45 approx.	32 approx.	32	64 min.

Remark: This test piece shall be used for the tensile testing of the materials such as iron castings which do not require elongation values.

รูปที่ 1 (ต่อ) ขนาดของตัวอย่างชิ้นทดสอบความแข็งแรงดึงตามมาตรฐานอุตสาหกรรมญี่ปุ่น

(9) No. 9 Test Piece The form and dimensions of this test piece shall conform to Fig. 9.

Fig. 9

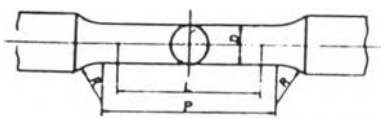


Unit: mm

Type of test piece	Gauge length L	Distance between grips P
9 A	100	150 min.
9 B	200	250 min.

(10) No. 10 Test Piece The form and dimensions of this test piece shall conform to Fig. 10.

Fig. 10

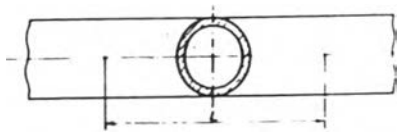


Unit: mm

Diameter D	Gauge length L	Parallel length P	Radius of fillet R
12.5	50	60 approx.	15 min.

(11) No. 11 Test Piece The form and dimensions of this test piece shall conform to Fig. 11.

Fig. 11

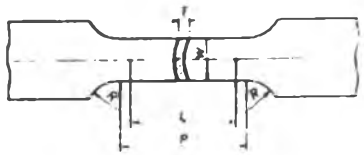


Gauge length L = 50 mm

Remark: The cross section of this test piece shall be as cut out from the tubular material, and the gripped ends shall be inserted with metal plugs or pressed flat by hammering.
In the latter case, the length of parallel portion shall be not less than 100 mm.

(12) No. 12 Test Piece This test piece shall be made from the tubular material by cutting out and then by finishing to the form and dimensions as shown in Fig. 12.

Fig. 12



Unit: mm

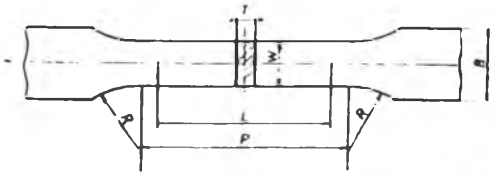
Type of test piece	Width W	Gauge length L	Parallel length P	Radius of fillet R	Thickness T
12 A	19	50	60 approx.	15 min.	Thickness of tube
12 B	25	50	60 approx.	15 min.	Thickness of tube
12 C	38	50	60 approx.	15 min.	Thickness of tube

Remark: The cross section of parallel portion of this test piece shall be of arc form as cut out of the tubular material. However, the gripped ends of test piece may be hammered flat at the room temperature.

รูปที่ 1 (ต่อ) ขนาดของตัวอย่างชิ้นทดสอบความแข็งแรงดึงตามมาตรฐานอุตสาหกรรมญี่ปุ่น

(13) No. 13 Test Piece The form and dimensions of this test piece shall conform to Fig. 13).

Fig. 13)



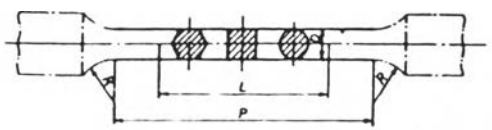
Unit: mm

Type of test piece	Width W	Gauge length L	Parallel length P	Radius of fillet R	Thickness T	Width of gripped portion B
13 A	20	80	120 approx.	20 to 30	Thickness of material	—
13 B	12.5	50	60 approx.	20 to 30	Thickness of material	20 min.

(14) No. 14 Test Piece

(a) No. 14 A Test Piece The form and dimensions of this test piece shall conform to Fig. 14 (A).

Fig. 14 (A)



Unit: mm

Gauge length L	Parallel length P	Radius of fillet R
$5.65\sqrt{A}$	5.5 D to 7 D	15 min.

A: cross-sectional area of parallel portion

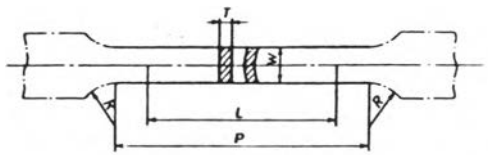
Remarks 1. The gauge length may be so determined that L = 5 D for circular cross section of parallel portion, that L = 5.65 D for square cross section, and that L = 5.26 D for hexagonal cross section.

2. The length P of parallel portion should be 7 D, as far as practicable.

3. The diameter of gripped portions of this test piece may be made same as that of the parallel portion. In this case, the distance between grips shall be so determined that $P \geq 8D$.

(b) No. 14 B Test Piece The form and dimensions of this test piece shall conform to Fig. 14 (B).

Fig. 14 (B)



Unit: mm

Width W	Gauge length L	Parallel length P	Radius of fillet R	Thickness T
8 T max.	$5.65\sqrt{A}$	$L + 1.5\sqrt{A}$ to $L + 2.5\sqrt{A}$	15 min.	Thickness of material

A: cross-sectional area of parallel portion

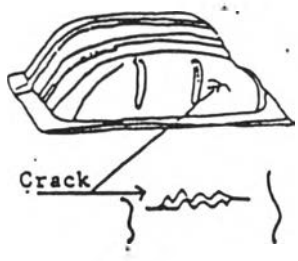
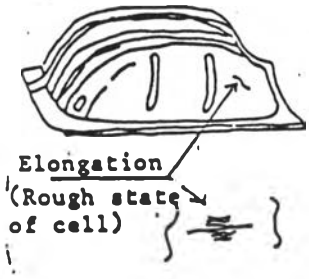
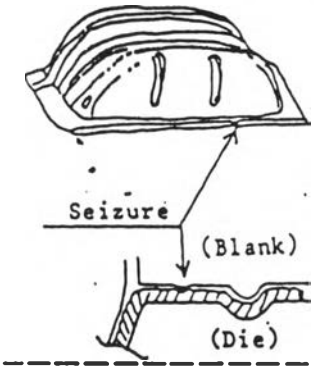
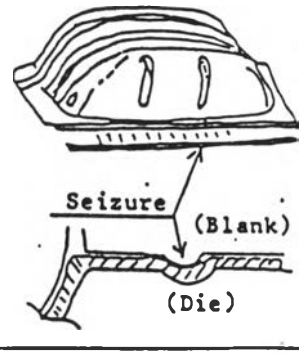
Remarks 1. The length of parallel portion should be so determined that $P = L + 2\sqrt{A}$, as far as practicable.

2. In the case of applying this test piece to the tensile test of tubes, the cross section of parallel portion shall be as cut out from the tube.

3. The width of gripped portion of this test piece may be made same as that of the parallel portion. In this case, the distance between grips shall be so determined that $P = L + 3\sqrt{A}$.

4. For the use of this type test pieces, it is advisable to unify their dimensions according to every reasonable range which covers varied plate thickness, as exampled in Table 3 (see 4.3 and 4.4.).

รูปที่ 1 (ต่อ) ขนาดของตัวอย่างชิ้นทดสอบความเค้นแรงดึงตามมาตรฐานอุตสาหกรรมญี่ปุ่น

Contents of defect		Cause of defect	Treatment
Crack		Caused by high pressure of the blank face and cushion, change of the die temperature (rising), seizure of the blank face and bend, and unevenness of materials.	Adjustment of the pressure Improvement of the die (Polishing) (Fitting depending on the case) Material check
Elonga-tion		Caused by high pressure of the blank face and cushion, change of the die temperature (rising), seizure of the blank face and bead, and unevenness of materials.	Adjustment of the pressure Improvement of the die (Polishing) Material check
(Drawing of blank face)		Mixture of dust and substances, scratch, burr, and deformation of the materials, excess pressure to be blank and cushion, wrinkles, changes of die temperature, and worn-out of the die	Complete control of materials, cleaning of materials, inspection and repair of the die, oiling, adjustment of pressure, and polishing and maintenance of the die
Seizure (Bead drawing)		Incorrect aperture Defective surface treatment	Complete surface treatment

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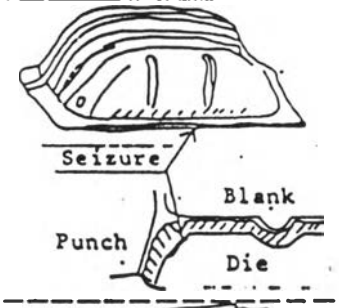
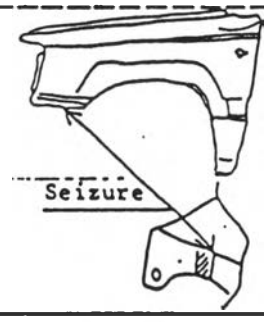
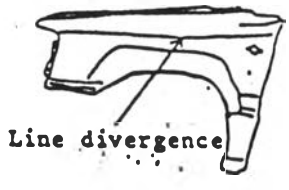
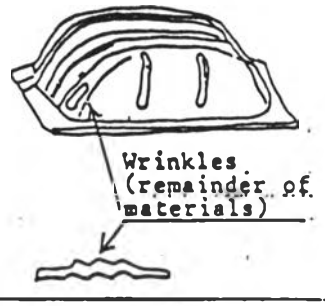
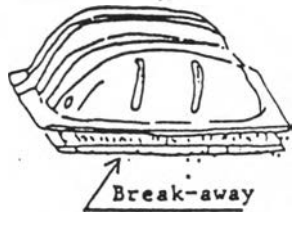
Contents of defect		Cause of defect	Treatment
(Die R drawing)		Mixture of dust and substances, worn-out of the die, wrinkles caused by crack, change of the die temperature, and excess pressure to the blank and cushion	Complete control of materials, cleaning of materials, inspection and maintenance of the die, adjustment of pressure, polishing of the die, and oiling
(Flange bent)		Mixture of dust and substances, worn-out of the die, insufficient (too narrow), break-away of plating, and wrinkles overlapping due to mis-insertion	Polishing of the die, inspection and maintenance of the die, oiling, insertion check, surface treatment
Line divergence		Unbalance of pressure to the blank and cushion Die worn-out	Adjustment of the pressure Repair of the die
Wrinkles		Unevenness of material characteristic value, unbalance of pressure to the blank and cushion, and die worn-out	Material check, replacement of materials, adjustment of the pressure, repair of the die, adhesion of materials, and oil quantity check
Break-away of surface treatment materials		Defective surface treatment (manufacturer), defective accuracy of the blank face and bead, and excess pressure to the blank and cushion	Material check, replacement of materials, polishing and repair of the die, and adjustment of the pressure

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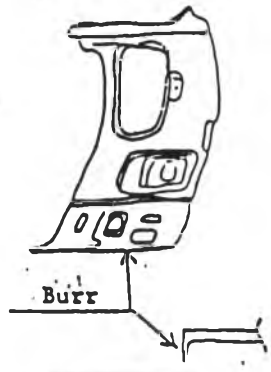
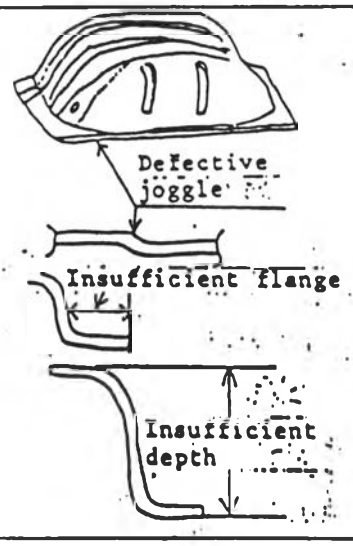
Contents of defect		Cause of defect	Treatment
Burr		Worn-out punch and die cutting edge, incorrect aperture	Repair of the die (Corrction of the aperture)
Defective setting-down		Insufficient pressure, defective stroke set, incomplete bottoming check, and incomplete checking of pressure gauge	Check completely the bottom dead center, bottoming mark, and pressure gauge.
Type difference		Incorrect switching position of the lever for switching type, incorrect position of slide, and incomplete check at the time of comparing with the type sample	Complete comparison with the type sample, as well as inspection, maintenance and improvement of type switching devices
Defective materials	Lamination, scab, scale, camber, meandering of coil, roll scratch and others	Defective steel materials At the time of BK and SH cutting off	Understand fully the contents of defection and defective part. Claim treatment is applied to the defective materials, and materials are replaced.

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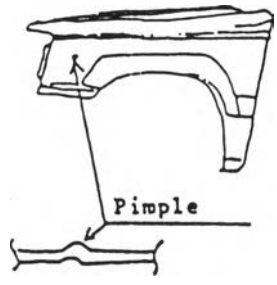
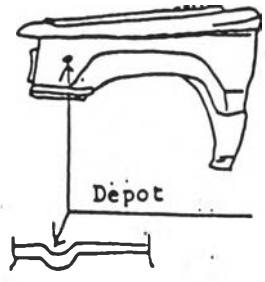
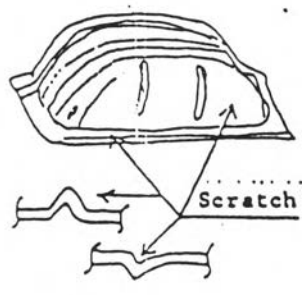
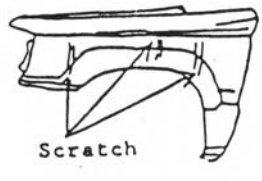
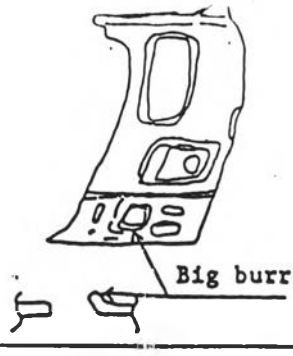
Contents of defect		Cause of defect	Treatment
Pimple		Mixture of substances including dust (caused by working gloves and conveyor) and refuse at the time of cutting, and dirt of the die (especially at the time of die repair)	Removal of substances by wiping and polishing, cleaning of materials and die, and inspection and maintenance of die
Depot			
Scratch caused by hit		Hit by the guide, cutter, and chute at the time of panel inspection or pulling out, fall of a panel, overlapping of panels. Incorrect setting of I/H lifter, and defective of rubber roller and buffer materials.	Re-guidance of operation method, removal of obstacles, repair, improvement, correction of process unbalance, correction of automatic devices, and inspection and maintenance of the die
Scratch		Caused by interference or overlapping of panels at the time of material transport by D/F, products transport by the conveyor and insertion of products.	Polishing, improvement and removal of the interferential section, correction of process unbalance, and stabilization of product insertion and pull-out.
Big burr		Worn-out of punch and die cutting edge, and incorrect aperture	Oiling and repair of the die (Correction of aperture and intrusion)

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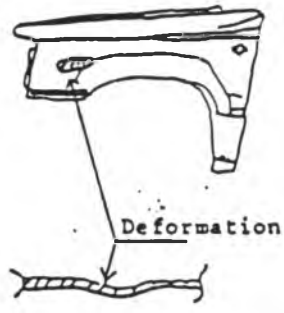
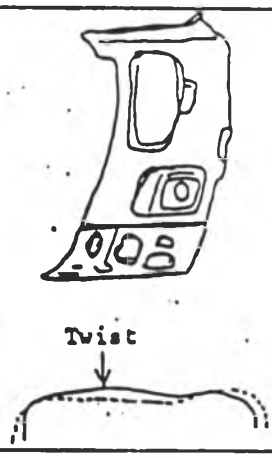
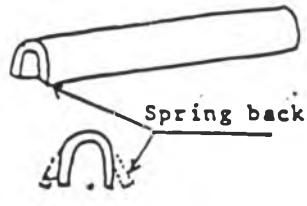
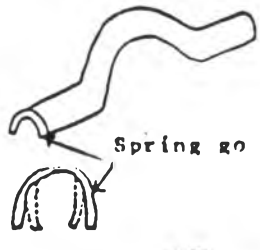
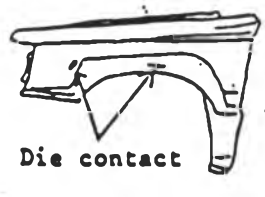
Contents of defect		Cause of defect	Treatment
Deformation		Dispersion of material characteristic values, camber of materials, oil adhesion to materials, insufficient pressure to the blank and cushion, and unbalance of the blank face	Material check, replacement of materials, re-cleaning, adjustment of pressure, and die fitting
Twist		Dispersion of material characteristic values, camber of materials, and unbalance of pat	Material check, replacement of materials, and inspection and maintenance of the die
Spring back		Die worn-out (too open), incorrect thickness of material (thin), and insufficient main pressure	Inspection and maintenance of the die, material check, replacement of materials, and adjustment of pressure
Spring go		Insufficient aperture of the die, and incorrect thickness of materials (too thick)	Inspection and maintenance of die, material check, and replacement of materials
Die contact		Looseness of pet, pat spring broken, looseness of inserted panel, incorrect position of panel, and error at the time of die repair	Inspection, maintenance and polishing of die

รูปที่ 2 (ต่อ) ลักษณะอาการเสียต่างๆของชิ้นส่วนรถยนต์จากการอัดขึ้นรูปโลหะ

ตารางที่ 1 ข้อกำหนดมาตรฐานญี่ปุ่นของแผ่นเหล็กที่ใช้ขึ้นรูปชิ้นส่วนรถยนต์

Specifications JIS (Japanese Industrial Standards) and Nippon Steel Standards

1. Mechanical Properties and Chemical Compositions (The chemical composition applies to that of porcelain enamelling sheets SPP.)

Type	Classification	Designation	Test: Nominal Thickness (mm)	Tension test: Yield Strength Max. Value N/mm²	Tensile Strength Min. Value N/mm²	Elongation Min. Value (%): 0.25 to 0.40 excl. (0.010 to 0.016)	0.40 to 0.60 excl. (0.016 to 0.024)	0.60 to 1.0 excl. (0.024 to 0.039)	1.0 to 1.6 excl. (0.039 to 0.063)	1.6 to 2.5 excl. (0.063 to 0.098)	2.5 and over (0.098 over)	Type and Direction of specimens	Bending test: Bending angle	Inside radius	Type and Direction of specimens	Erichsen test: Erichsen Min. Value (mm): 0.4 (0.016)	0.5 (0.020)	0.6 (0.024)	0.7 (0.028)	0.8 (0.031)	0.9 (0.035)	1.0 (0.039)	1.2 (0.047)	1.4 (0.055)	1.6 (0.063)
Standard cold rolled steel sheets and coils (JIS G 3141-1990)	Commercial quality	SPCC	3.6.4	–	(≥ 270)	(32)	(34)	(36)	(37)	(38)	(39)	JIS No. 5 Rolling direction	180°	Closing tightly	JIS No. 3 Rolling direction	(7.3)	(7.8)	(8.4)	(8.8)	(9.1)	(9.4)	(9.6)	(10.0)	(10.3)	(10.5)
		SPCCT	2.1	–	≥ 270	32	34	36	37	38	39					7.2	7.8	8.4	8.8	9.1	9.4	9.6	10.0	10.3	10.5
	Drawing quality	SPCD	5	–	≥ 270	34	36	38	39	40	41					7.8	8.2	8.6	8.2	9.5	9.8	10.0	10.4	10.7	10.8
	Deep drawing quality	SPCEN	5	–	≥ 270	36	38	40	41	42	43					8.0	8.6	8.2	9.6	9.8	10.2	10.4	10.8	11.1	11.3

Remarks:
1. In [illegible] tension test values are not apply to SPCC, but when required by the customer the values in the pa[illegible] thesis shall apply.
2. When tension test values or Erichsen values, or both, are guaranteed for SPCC in compliance with a customer's request, the suffix T shall be given to the designation SPCCT.
3. In principle the tension test shall be omitted to thicknesses less than 0.6 mm.
4. For SPCEN, non-aging shall be guaranteed for a period of 6 months from the date of shipment from the works. Non-[illegible] properties in which stretcher strain does not occur during working process. The bending test shall be omitted for standard tempering.

Remarks:
1. For intermediate nominal thickness from 0.4 to 1.6 mm inclusive not listed in the table, Erichsen values shall be obtained by interpolation and rounded off to one decimal place.
2. Values are the average values obtained from three test samples.
3. The Erichsen test shall not be conducted on thickness under 0.4 mm or over 1.6 mm.
4. ( ) Reference value.

JIS G 3131 ● Hot-Rolled Mild Steel Sheets and Strip

Designation	Chemical Composition, % P	S	Tensile Test: Tensile Strength N/mm²	Elongation % Thickness 1.2mm to 1.6mm excl.	Thickness 1.6mm to 2.0mm excl.	Thickness 2.0mm to 2.5mm excl.	Thickness 2.5mm to 3.2mm excl.	Thickness 3.2mm to 4.0mm excl.	Thickness 4.0mm and over	Test Piece	Bending Test: Bending Angle	Inner Diameter: Thickness Under 3.2mm	Thickness 3.2mm and over	Test Piece
SPHC	0.050 max.	0.050 max.	270 min.	27 min.	29 min.	29 min.	29 min.	31 min.	31 min.	No.5 Rolling Direction	180°	close overlap	0.5 t	No.3 Rolling Direction
SPHD	0.040 max.	0.040 max.	270 min.	30 min.	32 min.	33 min.	35 min.	37 min.	38 min.		180°	close overlap	close overlap	
SPHE	0.030 max.	0.035 max.	270 min.	31 min.	33 min.	35 min.	37 min.	39 min.	41 min.		180°	close overlap	close overlap	

Remarks 1. The C and Mn contents are not specified, but SPHC is manufactured from carbon steel having a C content of 0.15% or below and an Mn content of 0.60% or below. SPHD and SPHE are manufactured from carbon steel having a C content of 0.10% or below and a Mn content of 0.50% or below.

2. Mechanical test values do not apply to abnormal parts of at both ends steel strip (coils).

ตารางที่ 1 (ต่อ) ข้อกำหนดมาตรฐานญี่ปุ่นของแผ่นเหล็กที่ใช้ขึ้นรูปชิ้นส่วนรถยนต์

Classification and Designation

Sheets and coils shall be classified into 16 categories in the case of hot-rolled base metals and another 16 categories in the case of cold-rolled base metals. Their designations shall be as given in Tables 1 and 2.

Table 1 Classification and Designation

Designation of class	Nominal thickness mm	Application	
		Main use	Class designation of base metal in relevant JIS
SEHC	1.6 or over, up to and including 4.5	For commercial quality	SPHC
SEHD		For drawing quality	SPHD
SEHE	1.6 or over, up to and including 4.5	For deep drawing quality	SPHE
SEFH490	1.6 or over, up to and including 4.5	For forming quality	SPFH490
SEFH540			SPFH540
SEFH590			SPFH590
SEFH540Y	2.0 or over, up to and including 4.0	For improved forming quality	SPFH540Y
SEFH590Y			SPFH590Y
SE330	1.6 or over, up to and including 4.5	For general structural quality	SS330
SE400			SS400
SE490			SS490
SE540			SS540
SEPH310	1.6 or over, up to and including 4.5	For structural quality	SAPH310
SEPH370			SAPH370
SEPH400			SAPH400
SEPH440			SAPH440

Table 2 Classification and Designation

Designation of class	Nominal thickness mm	Application	
		Main use	Class designation of base metal in relevant JIS
SECC	0.4 or over, up to and including 3.2	For commercial quality	SPCC
SECD	0.4 or over, up to and including 3.2	For drawing quality	SPCD
SECE	0.4 or over, up to and including 3.2	For deep drawing quality	SPCE
SEFC340	0.6 or over, up to and including 2.3	For spinning quality	SPFC340
SEFC370			SPFC370
SEFC390	0.8 or over, up to and including 2.3	For forming quality	SPFC390
SEFC440			SPFC440
SEFC490			SPFC490
SEFC540			SPFC540
SEFC590			SPFC590
SEFC490Y	0.8 or over, up to and including 1.6	Lower yield ratio type	SPFC490Y
SEFC540Y			SPFC540Y
SEFC590Y			SPFC590Y
SEFC780Y	0.8 or over, up to and including 1.4		SPFC780Y
SEFC980Y			SPFC980Y
SEFC340H	0.6 or over, up to and including 1.6	Baked and hardening type	SPFC340H

Mechanical Properties

Table 6 Yield Point, Tensile Strength, and Elongation (in the case of hot-rolled base metal)

Designation of class	Yield point or proof stress (min.) N/mm²	Tensile strength (min.) N/mm²	Elongation (min.) %						Test piece
			1.6 mm or over, up to and excluding 2.0 mm in thickness	2.0 mm or over, up to and excluding 2.5 mm in thickness	2.5 mm or over, up to and excluding 3.15 mm in thickness	3.15 mm or over, up to and excluding 3.2 mm in thickness	3.2 mm or over, up to and excluding 4.0 mm in thickness	4.0 mm or over, up to and including 4.5 mm in thickness	
SEHC	–	270	29	29	29	29	31	31	No. 5 parallel to the rolling direction
SEHD	–	270	32	33	35	35	37	39	
SEHE	–	270	33	35	37	37	39	41	
SEFH490	325	490	22	23	24	24	25	25	No. 5 perpendicular to the rolling direction
SEFH540	355	540	21	22	23	23	24	24	
SEFH590	420	590	19	20	21	21	22	22	
SEFH540Y	295	540	–	24	25	25	26	26	
SEFH590Y	325	590	–	22	23	23	24	24	
SE330	205	330 to 430	26	26	26	26	28	28	No. 5 parallel or perpendicular to the rolling direction
SE400	245	400 to 510	21	21	21	21	21	21	
SE490	285	490 to 610	19	19	19	19	19	19	
SE540	400	540	16	16	16	16	16	16	
SEPH310	(185)	310	33	34	36	36	38	40	
SEPH370	225	370	32	33	35	35	36	37	
SEPH400	255	400	31	32	34	35	35	36	
SEPH440	305	440	29	30	32	33	33	34	

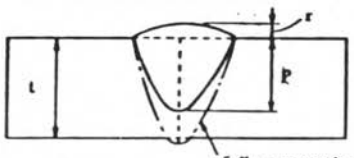
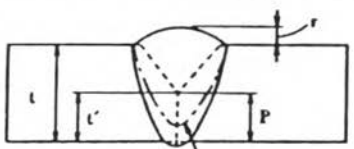
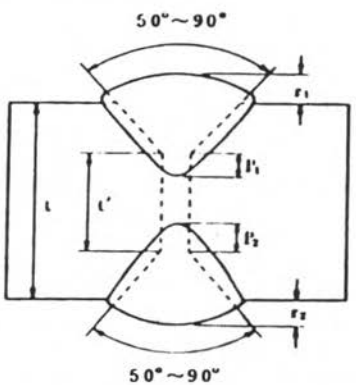
Table 7 Yield Point, Tensile Strength, Elongation, and Bake-hardening Property (in the case of cold-rolled base metal) (Applicable on and after January 1, 1990)

Designation of class	Yield point or proof stress (min.) N/mm²	Tensile strength (min.) N/mm²	Elongation (min.) %						Bake hardening value (min.) N/mm²	Test piece
			0.40 mm or over, up to and excluding 0.60 mm in thickness	0.60 mm or over, up to and excluding 1.0 mm in thickness	1.0 mm or over, up to and excluding 1.6 mm in thickness	1.6 mm or over, up to and including 2.3 mm in thickness	2.3 mm or over, up to and excluding 2.5 mm in thickness	2.5 mm or over in thickness		
SECC	–	(270)	(34)	(36)	(37)	(38)	(38)	(38)	–	No. 5 parallel to the rolling direction
SECD	–	270	36	38	39	40	40	41	–	
SECE	–	270	38	40	41	42	42	43	–	
SEFC340	175	340	–	34	35	35	–	–	–	No. 5 perpendicular to the rolling direction
SEFC370	205	370	–	32	33	33	–	–	–	
SEFC390	235	390	–	30	31	31	–	–	–	
SEFC440	265	440	–	26	27	27	–	–	–	
SEFC490	[illegible]	490		23	24	24	–	–	–	
SEFC540	325	540	–	20	21	21	–	–	–	
SEFC590	355	590	–	17	18	18	–	–	–	
SEFC490Y	225	490	–	24	25	25	–	–	–	
SEFC540Y	245	540	–	21	22	22	–	–	–	
SEFC590Y	265	590	–	18	19	19	–	–	–	
SEFC780Y	365	780	–	13	14	14	–	–	–	
SEFC980Y	490	980	–	6	7	7	–	–	–	
SEFC340H	185	340	–	34	35	35	–	–	30	

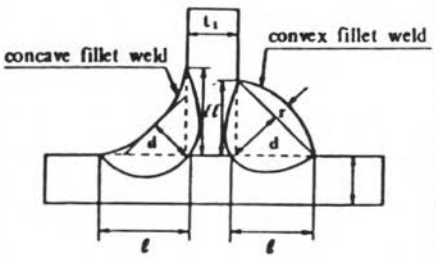
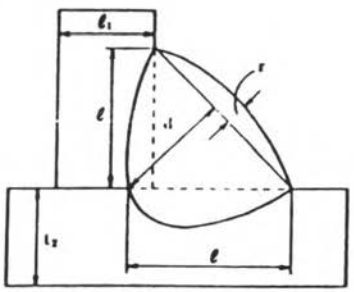
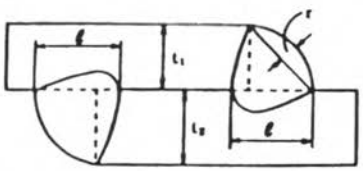
ตารางที่ 2 มาตรฐานการเชื่อมโลหะด้วย CO2 (การเชื่อมอัก)

Welding penetration of plate

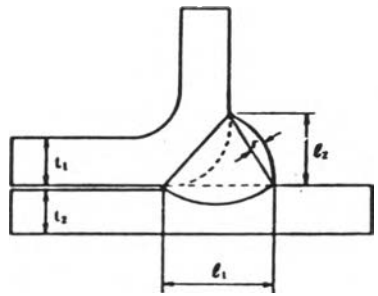
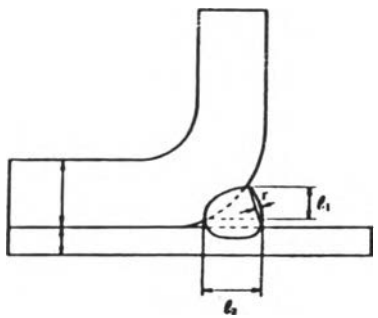
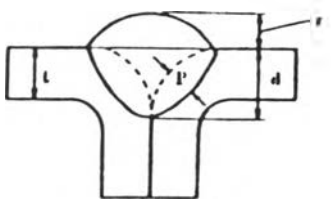
① penetration : P ④ throat : d
② leg length : l ⑤ thickness : t_1,…… tn
③ reinforcement : r ⑥ butt length : t′

shape of welding		thickness (t)	macroscopic shape		
			shape	penetration	reinforcement (reference)
But weld	I type	<2.3mm		unless drawing specified penetration shall beyond 70% penetration(%) = $\frac{P}{t} \times 100$	beyond base metal
	V type groove U type groove	2.3 ~ 9.0mm		unless drawing specified penetration shall be 100% penetration (%) = $\frac{P}{t'} \times 100$	① beyond base metal ② under 2t or under 10mm.
	groove weld	>6.0mm		unless drawing specified penetration shall be 100% penetration (%) = $\frac{P_1 + P_2}{t'} \times 100$	beyond base metal . reinforcement r_1, r_2 shall be under 2t.

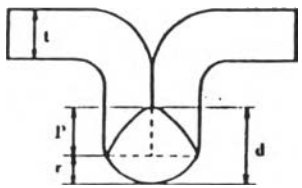
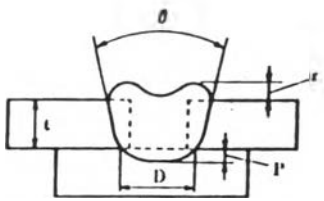
ตารางที่ 2 (ต่อ) มาตรฐานงานเชื่อมโลหะด้วย CO2 (การเชื่มลึก)

shape of welding	thickness (t)	macroscopic shape		
		shape	penetration	reinforcement (reference)
fillet weld (double)	< 12mm		① leg length shall be over drawing or within 150% of it. ② unless otherwise specify, it shall conform to following d >0.5X thickness l >0.7X thickness	r < 0.5 X l
fillet weld (single)	< 12mm		① leg length shall be over drawing or within 150% of it ② unless otherwise specify d >1.0 X thickness l >1.4 X thickness	
lap fillet weld	< 12mm		① it is same abone ② unless otherwise specify l >1.0 X thickness	

ตารางที่ 2 (ต่อ) มาตรฐานงานเชื่อมโลหะด้วย CO2 (การใช้มือ)

shape of weld	thickness (t)	macroscopic shape		
		shape	penetration	reinforcement (reference)
flare joint	< 12mm	 	① when $t_1 < t_2$ actual leg length l_1, $l_2 > t_1$ ② when $t_1 \geqq t_2$ actual leg length l_1 , $l_2 > t_2$	reinforcement shall be with in 50 percent of l_2.
edge joint	< 10mm		unless drawing specify. d > 1.0 x thickness P > 0.2 x thickness	reinforcement shall be beyond base metal

ตารางที่ 2 (ต่อ) มาตรฐานงานเชื่อมโลหะด้วย CO2 (การใช้งาน)

shape of weld	thickness (t)	macroscopic shape		
		shape	penetration	reinforcement (reference)
edge joint	< 10mm		unless drawing specify. d > 1.0 x thickness P > 0.5 x thickness	it is same above.
plug weld	< 20mm		when t < 3mm D = 6mm 30° ≦ θ ≦ 60° when t = 3 to 12mm D = 2t or over when t > 12mm D = 2t + 12 P > 0.2 x thickness	reinforcement shall be beyond base metal. center may become dented a bew. shall be careful to penetrate root.

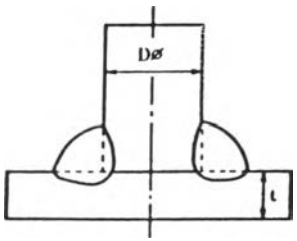
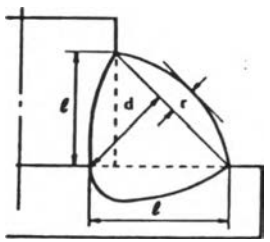
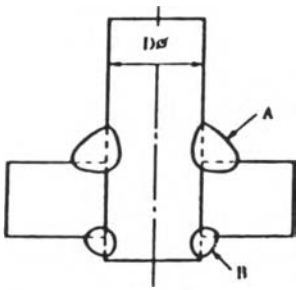
remarks (1) Root of but weld or fillet weld shall be penetrated.

(2) In case under 0.8mm thickness, welding shall conform to agreement of M.M.C

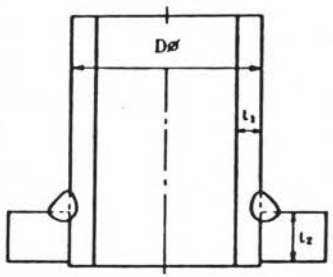
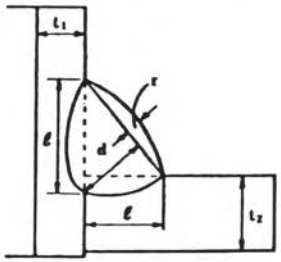
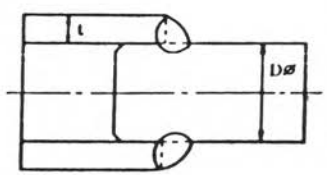
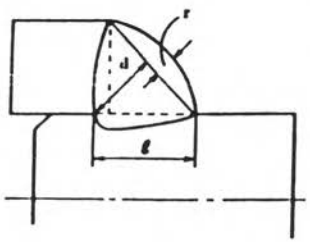
(3) Test methode shall be cut the bead at right angle and see after etching.

ตารางที่ 2 (ต่อ) มาตรฐานงานเชื่อมโลหะด้วย CO2 (การเชื่มลึก)

Bar and pipe welding penetration. D : diameter of bar.

shape of weld	shape	macroscopic shape	penetration	remarks
weld of bar and plate.			① leg length shall be drawing from −30% to +30% ② unless drawing specify when 1.4t ≦ 0.3D, l ≧ 1.4t. when 0.3D < 1.4t, l > 0.3D	r < 0.5 l
weld of bar and plate with pit.			A : it is same above. B : actual leg length shall be beyond 0.33t.	

ตารางที่ 2 (ต่อ) มาตรฐานงานเชื่อมโลหะด้วย CO2 (การชิมลึก)

shape of weld	shape	macroscopic shape	penetration	remarks
weld of pipe and plate			① leg length shall be drawing from 100% to 150% ② unless drawing specify $l > 1.4\,t_1$ $d > t_1$	$r < 0.2\,l$
weld of pipe and plate			① leg length shall be drawing from 100% to 150% ② unless drawing specify when $t \leqq 0.3\,D$ $l \geqq t$ when $0.3D < t$ $l > 0.3D$ $d > 0.7t$ or $0.3D$	$r < 0.2\,l$
remark (1) (2) (3)	it is same as Table 3.			

ตารางที่ 3 แผนการตรวจสอบชิ้นส่วนรถยนต์

Type of Inspection / Type of Part	Initial Stage		Mass Production Stage		Equipment			Comments
	Initial Parts Inspection	Initial Supervisory Inspection	Daily Inspection	Special Inspection	"Inspection Standards"	"Inspection Agreements"	"Inspection Tabulation"	
1. Safety Parts 2. Hysteresis Control Parts 3. Top Quality Parts	A	B	As per Table 1	A	Drawn up	Concluded	Drawn up	
1 General Parts 2 Particular parts in the 3 categories above specified by the head of quality control	A	B		A	Not drawn up	Not drawn up (in principle)	Not drawn up	
Comments	1. Whenever a goods delivery is to be undertaken, parts are inspected during this process until they pass 2. Parts clearing inspection at this stage subsequently move to the Initial Supervisory Inspection 3. "Initial Parts" include new parts, design changed parts and process changed parts.	1. Parts from Lot 3 or Lot 1 which have been passed are moved to Mass Production Inspection. However, should lots contain consistently substandard parts, an inspection of each individual lot will be carried out.	1. Should customer claims, line claims or failures of acceptance inspection occur, a change to Special Inspection will be undertaken.	1. Undertaken when abnormalities occur. Inspection will only be good for the said abnormalities. 2. If abnormalities are not found in three lots in succession, there will be no change to Mass Production Inspection.	1. General Parts are inspected using diagrams, while sections on "The Improvement of Inspection" and "Specially Tolerated Parts" have been drawn up 2. Rearrangement of similar parts is undertaken 3. It is also permissable to use the standards shown in "Inspection Agreements"	1. As a rule, agreements relating to safety, hysteresis control and top quality parts are all concluded.	1. As a rule this is not necessary for general parts but as part of the follow up to a special inspection it is permissable to make a simple tabulation if required.	

Rating	A	B	C	D	E	N
Inspection Rate	Per lot or once a day	Once a week	Once a month	Once every two months	Once every three months	Indirect Inspection

Sample Number	Initial Parts Pilot Sample	Initial Period	Daily or Special
	3	8	5

ตารางที่ 4 ตัวประกอบสำหรับคำนวณขอบเขตควบคุมคุณภาพ 3 σ

Number of Observations in Sample, n	Chart for Averages			Chart for Standard Deviations					Chart for Ranges					
	Factors for Control Limits			Factors for Cental Line	Factors for Control Limits				Factors for Central Line	Factors for Control Limits				
	A	A_1	A_2	c_2	B_1	B_2	B_3	B_4	d_2	d_3	D_1	D_2	D_3	D_4
2	2.121	3.760	1.880	0.5642	0	1.843	0	3.267	1.128	0.853	0	3.686	0	3.267
3	1.732	2.394	1.023	0.7236	0	1.858	0	2.568	1.693	0.888	0	4.358	0	2.575
4	1.500	1.880	0.729	0.7979	0	1.808	0	2.266	2.059	0.880	0	4.698	0	2.282
5	1.342	1.596	0.577	0.8407	0	1.756	0	2.089	2.326	0.864	0	4.918	0	2.115
6	1.225	1.410	0.483	0.8686	0.026	1.711	0.030	1.970	2.534	0.848	0	5.078	0	2.004
7	1.134	1.277	0.419	0.8882	0.105	1.672	0.118	1.882	2.704	0.833	0.205	5.203	0.076	1.924
8	1.061	1.175	0.373	0.9027	0.167	1.638	0.185	1.815	2.847	0.820	0.387	5.307	0.136	1.864
9	1.000	1.094	0.337	0.9139	0.219	1.609	0.239	1.761	2.970	0.808	0.546	5.394	0.184	1.816
10	0.949	1.028	0.308	0.9227	0.262	1.584	0.284	1.716	3.078	0.797	0.687	5.469	0.223	1.777
11	0.905	0.973	0.285	0.9300	0.299	1.561	0.321	1.679	3.173	0.787	0.812	5.534	0.256	1.744
12	0.866	0.925	0.266	0.9359	0.331	1.541	0.354	1.646	3.258	0.778	0.924	5.592	0.284	1.716
13	0.832	0.884	0.249	0.9410	0.359	1.523	0.382	1.618	3.336	0.770	1.026	5.646	0.308	1.692
14	0.802	0.848	0.235	0.9453	0.384	1.507	0.406	1.594	3.407	0.762	1.121	5.693	0.329	1.671
15	0.775	0.816	0.223	0.9490	0.406	1.492	0.428	1.572	3.472	0.755	1.207	5.737	0.348	1.652
16	0.750	0.788	0.212	0.9523	0.427	1.478	0.448	1.552	3.532	0.749	1.285	5.779	0.364	1.636
17	0.728	0.762	0.203	0.9551	0.445	1.465	0.466	1.534	3.588	0.743	1.359	5.817	0.379	1.621
18	0.707	0.738	0.194	0.9576	0.461	1.454	0.482	1.518	3.640	0.738	1.426	5.854	0.392	1.608
19	0.688	0.717	0.187	0.9599	0.477	1.443	0.497	1.503	3.689	0.733	1.490	5.888	0.404	1.596
20	0.671	0.697	0.180	0.9619	0.491	1.433	0.510	1.490	3.735	0.729	1.548	5.922	0.414	1.586
21	0.655	0.679	0.173	0.9638	0.504	1.424	0.523	1.477	3.778	0.724	1.606	5.950	0.425	1.575
22	0.640	0.662	0.167	0.9655	0.516	1.415	0.534	1.466	3.819	0.720	1.659	5.979	0.434	1.566
23	0.626	0.647	0.162	0.9670	0.527	1.407	0.545	1.455	3.858	0.716	1.710	6.006	0.443	1.557
24	0.612	0.632	0.157	0.9684	0.538	1.399	0.555	1.445	3.895	0.712	1.759	6.031	0.452	1.548
25	0.600	0.619	0.153	0.9696	0.548	1.392	0.565	1.435	3.931	0.709	1.804	6.058	0.459	1.541

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ประวัติผู้เขียน

นายบุญโรจน์ สิมะบวรสุทธิ์ เกิดเมื่อวันที่ 14 ธันวาคม พ.ศ. 2499 ที่กรุงเทพมหานคร สำเร็จการศึกษาปริญญาตรีอุตสาหกรรมศาสตรบัณฑิต จากคณะวิศวกรรมศาสตร์ สถาบันเทคโนโลยีพระจอมเกล้า พระนครเหนือ เมื่อปีการศึกษา 2525