Using Laboratory CNC for Making Samples of ISO 6259 ASTMD 638 , EN 527-3 , ISO 179-1 , ISO 180 & ASTM D256 (Feasibility Study)

Description

Laboratory CNC Milling

Laboratory CNC milling machine from AHP PLASTIK MAKINA has 3 version. Samples of up to 50mm thickness, 100mm thickness and higher than 100mm based on customer request.

In two first versions we have possibility of having spindles with two types of tool holder ER16 and ER 20.

ER16 collet has possibility of holding tools 2,3,4,5,6,7,8,9,10mm. ER20 collet can be used with tools of diameter range 2-13mm. Standard tools for sample preparation for laboratory purpose are 8,10,12mm in different cases. Let study sample shapes for mentioned standard:

Lets take a look at sample dimensions according to mentioned norms:

ISO 6259-2 includes 3 types of tensile sample piece as below:

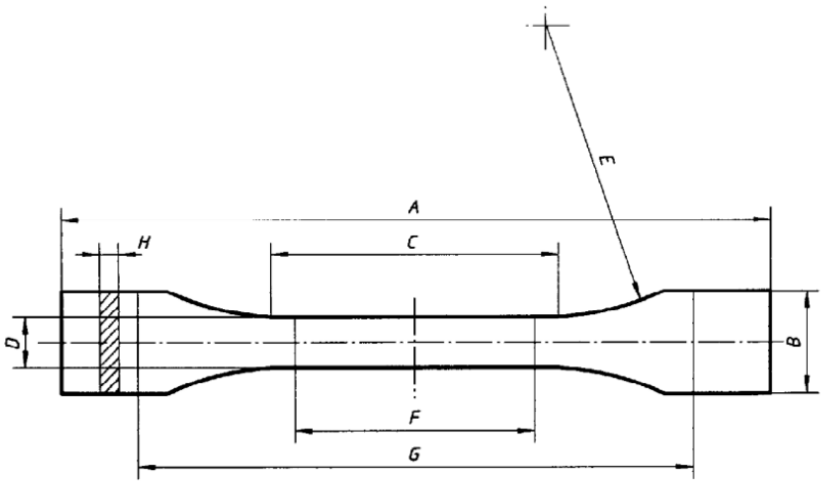


Figure 1 — Type 1 test piece

Table 1 — Dimensions of type 1 test pieces

Symbol	Description	Dimensions mm
A	Overall length (min.)	150
B	Width of ends	20 ± 0,2
C	Length of narrow, parallel-sided portion	60 ± 0,5
D	Width of narrow, parallel-sided portion	10 ± 0,2
E	Radius	60
F	Gauge length	50 ± 0,5
G	Initial distance between grips	115 ± 0,5
H	Thickness	That of the pipe

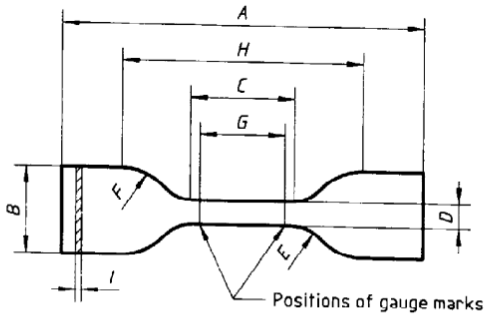


Figure 2 — Type 2 test piece

Table 2 — Dimensions of type 2 test pieces

Symbol	Description	Dimensions mm
A	Overall length (min.)	115
B	Width of ends	25 ± 1
C	Length of narrow, parallel-sided portion	33 ± 2
D	Width of narrow, parallel-sided portion	$6\ ^{+0,4}_{0}$
E	Small radius	14 ± 1
F	Large radius	25 ± 2
G	Gauge length	25 ± 1
H	Initial distance between grips	80 ± 5
I	Thickness	That of the pipe

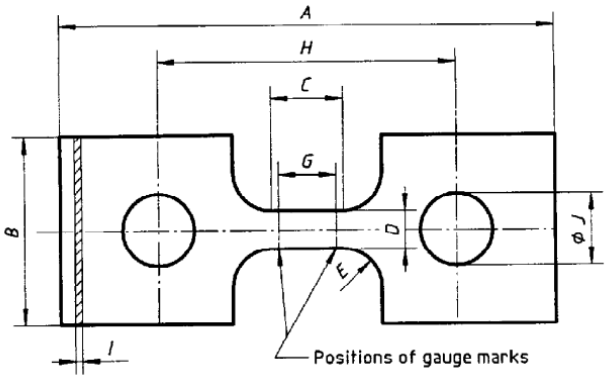


Figure 3 — Type 3 test piece

Table 3 — Dimensions of type 3 test pieces

Symbol	Description	Dimensions mm
A	Overall length (min.)	250
B	Width of ends	100 ± 3
C	Length of narrow, parallel-sided portion	25 ± 1
D	Width of narrow, parallel-sided portion	25 ± 1
E	Radius	25 ± 1
G	Gauge length	20 ± 1
H	Initial distance between centres of loading pins	165 ± 5
I	Thickness	That of the pipe
J	Diameter of hole	30 ± 5

Obviously with all of 8, 10 or 12 mm tool diameter tools, above 3 samples can be cut easily.

for ISO 6259-2 there are two tensile sample piece as below:

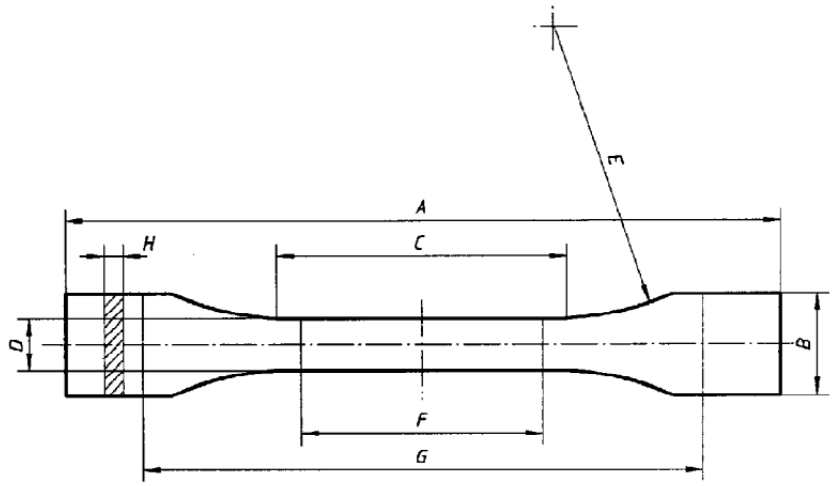


Figure 1 — Test piece obtained by machining (type 1)

Table 1 — Dimensions of test pieces prepared by machining

Symbol	Description	Dimensions mm
A	Minimum total length	115
B	Width of ends	⩾ 15
C	Length of narrow, parallel-sided portion	33 ± 2
D	Width of narrow, parallel-sided portion	$6\ ^{+0,4}_{0}$
E	Radius	14 ± 1
F	Gauge length	25 ± 1
G	Initial distance between grips	80 ± 5
H	Thickness	That of the pipe

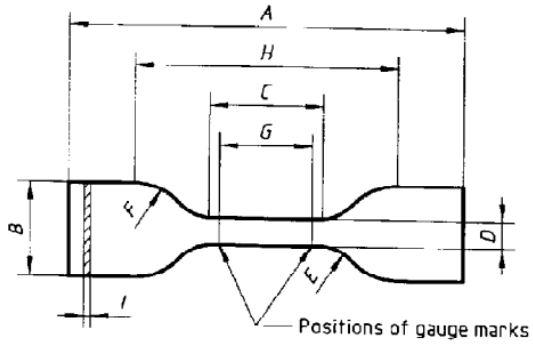


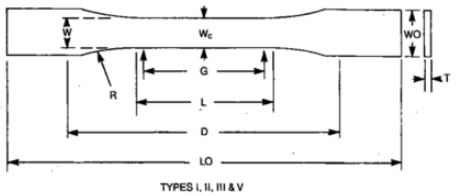
Figure 2 — Test piece obtained by die cutting (type 2)

Table 2 — Dimensions of test pieces obtained by die cutting

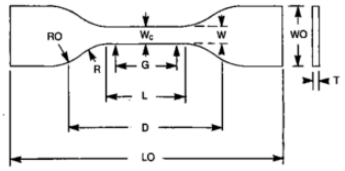
Symbol	Description	Dimensions mm
A	Minimum total length	115
B	Width of ends	25 ± 1
C	Length of narrow, parallel-sided portion	33 ± 2
D	Width of narrow, parallel-sided portion	$6\ ^{+0,4}_{0}$
E	Small radius of curvature	14 ± 1
F	Large radius of curvature	25 ± 2
G	Gauge length	25 ± 1
H	Initial distance between grips	80 ± 5
I	Thickness	That of the pipe

for the above two samples also there is no limitation for using 8, 10 or 12mm tool diameters.

ASTM D638 has 5 types of tensile sample piece as below drawing:



TYPES I, II, III & V

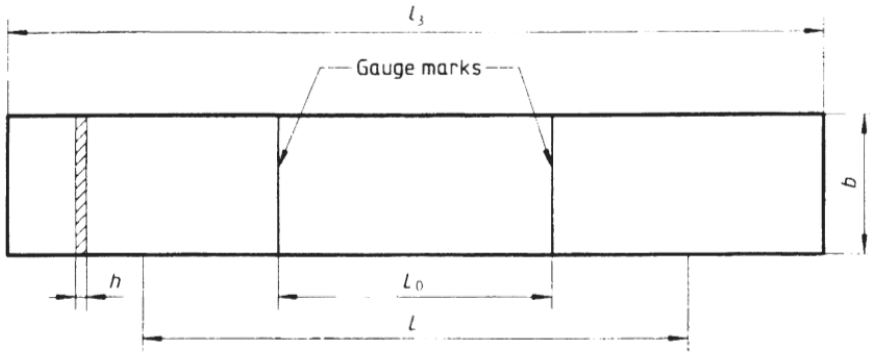


TYPE IV

Specimen Dimensions for Thickness, *T*, mm (in.)[A]

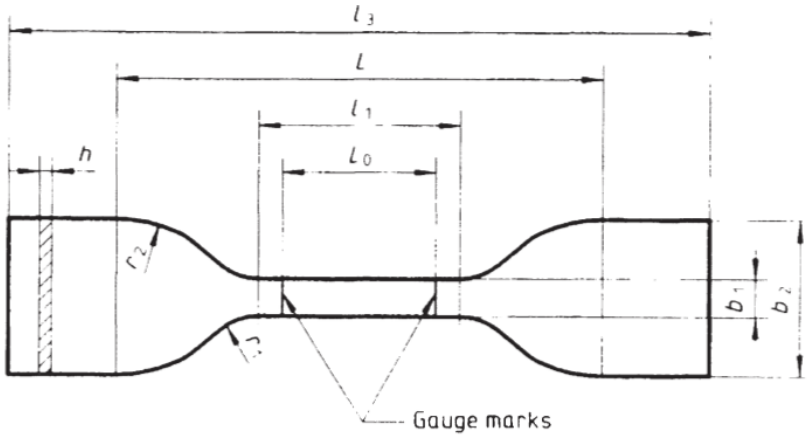
Dimensions (see drawings)	7 (0.28) or under		Over 7 to 14 (0.28 to 0.55), incl	4 (0.16) or under		Tolerances
	Type I	Type II	Type III	Type IV[B]	Type V[C,D]	
W—Width of narrow section[E,F]	13 (0.50)	6 (0.25)	19 (0.75)	6 (0.25)	3.18 (0.125)	±0.5 (±0.02)[B,C]
L—Length of narrow section	57 (2.25)	57 (2.25)	57 (2.25)	33 (1.30)	9.53 (0.375)	±0.5 (±0.02)[C]
WO—Width overall, min[G]	19 (0.75)	19 (0.75)	29 (1.13)	19 (0.75)	...	+ 6.4 (+ 0.25)
WO—Width overall, min[G]	...	...	...	...	9.53 (0.375)	+ 3.18 (+ 0.125)
LO—Length overall, min[H]	165 (6.5)	183 (7.2)	246 (9.7)	115 (4.5)	63.5 (2.5)	no max (no max)
G—Gage length[I]	50 (2.00)	50 (2.00)	50 (2.00)	...	7.62 (0.300)	±0.25 (±0.010)[C]
G—Gage length[I]	...	...	...	25 (1.00)	...	±0.13 (±0.005)
D—Distance between grips	115 (4.5)	135 (5.3)	115 (4.5)	65 (2.5)[J]	25.4 (1.0)	±5 (±0.2)
R—Radius of fillet	76 (3.00)	76 (3.00)	76 (3.00)	14 (0.56)	12.7 (0.5)	±1 (±0.04)[C]
RO—Outer radius (Type IV)	...	...	...	25 (1.00)	...	±1 (±0.04)

ISO 527-3 has 4 types of tensile sample piece as below drawings?



b	Width: 10 mm to 25 mm
h	Thickness: $\leqslant$ 1 mm
L_0	Gauge length: 50 mm $\pm$ 0,5 mm
L	Initial distance between grips: 100 mm $\pm$ 5 mm
l_3	Overall length: $\geqslant$ 150 mm

Figure 1 — Specimen type 2



b_1 Width of narrow parallel-sided portion: 6 mm ± 0,4 mm

b_2 Width at ends: 25 mm ± 1 mm

h Thickness: ≤ 1 mm

L_0 Gauge length: 25 mm ± 0,25 mm

l_1 Length of narrow parallel-sided portion: 33 mm ± 2 mm

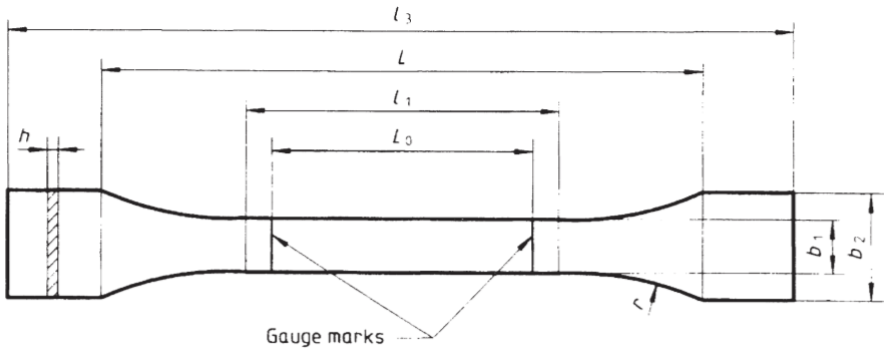
L Initial distance between grips: 80 mm ± 5 mm

l_3 Overall length: ≥ 115 mm

r_1 Small radius: 14 mm ± 1 mm

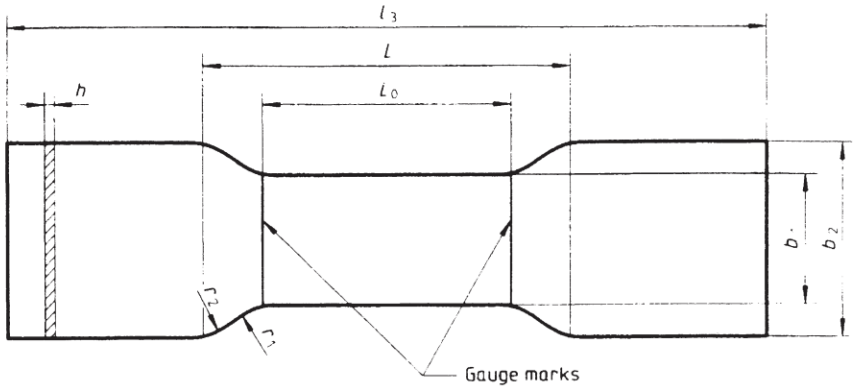
r_2 Large radius: 25 mm ± 2 mm

Figure 2 — Specimen type 5



b_1 Width of narrow parallel-sided portion: 10 mm ± 0,2 mm
b_2 Width at ends: 20 mm ± 0,5 mm
h Thickness: ⩽ 1 mm
L_0 Gauge length: 50 mm ± 0,5 mm
l_1 Length of narrow parallel-sided portion: 60 mm ± 0,5 mm
L Initial distance between grips: 115 mm ± 5 mm
l_3 Overall length: ⩾ 150 mm
r Radius: ⩾ 60 mm (recommended radius: 60 mm ± 0,5 mm)

Figure 3 — Specimen type 1B



b_1 Width of narrow parallel-sided portion: 25,4 mm ± 0,1 mm
b_2 Width at ends: 38 mm
h Thickness: ⩽ 1 mm
L_0 Gauge length: 50 mm ± 0,5 mm
L Initial distance between grips: 98 mm
l_3 Overall length: 152 mm
r_1 Small radius: 22 mm
r_2 Large radius: 25,4 mm

Figure 4 — Specimen type 4

For ISO 179-1 there are two types of sample piece, with notch and without notch. dimensions are as below:

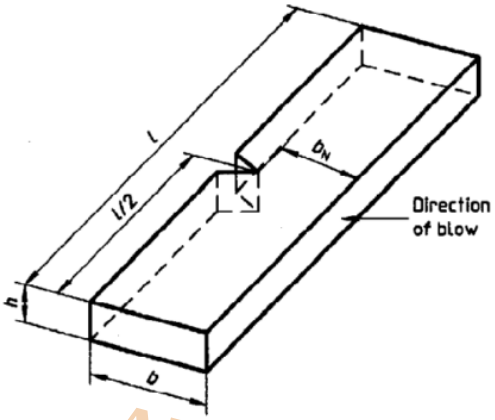


Figure 2 — Charpy edgewise impact (e), with single-notched specimen

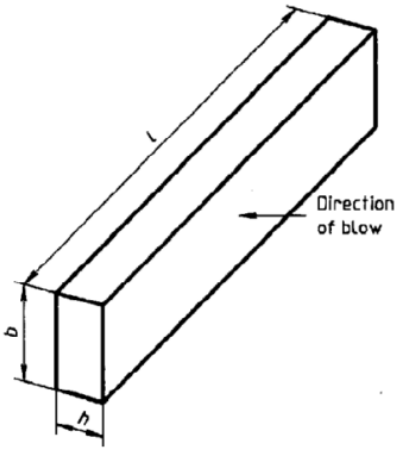


Figure 3 — Charpy flatwise impact (f)

Table 2 — Specimen types, dimensions and span (see figure 1)

Dimensions in millimetres

Specimen type[1]	Length[2] l	Width[2] b	Thickness[2] h	Span L
1	80 ± 2	10,0 ± 0,2	4,0 [3] ± 0,2	62 $^{+0,5}_{0}$
2 [4] 3 [4]	25 h (11 or 13) h	10 or 15 [5]	3 [3]	20 h (6 or 8) h

1) Attention is drawn to the changes in the specimen type numbers from those used in ISO 179:1982.

2) The specimen dimensions (thickness h, width b and length l) are defined according to: $h \leqslant b < l$.

3) Preferred thickness. If the specimen is cut from a sheet or a piece, h shall be equal to the thickness of the sheet or piece, up to 10,2 mm (see 6.3.1.2).

4) Specimen types 2 and 3 shall be used only for materials described in 6.3.2.

5) 10 mm for materials reinforced with a fine structure, 15 mm with a large stitch structure (see 6.3.2.2).

Table 3 — Method designations, specimen types, notch types and notch dimensions — Materials not exhibiting interlaminar shear fracture

Dimensions in millimetres

Method designation[1) 2)]	Specimen type[1)]	Blow direction	Notch type[1)]	Notch base radius r_N	Remaining width, b_N, at notch base
ISO 179/1eU [3)]	1	edgewise	unnotched		
			single notch		
ISO 179/1eA [3)]			A	0,25 ± 0,05	8,0 ± 0,2
ISO 179/1eB			B	1,00 ± 0,05	8,0 ± 0,2
ISO 179/1eC			C	0,10 ± 0,02	8,0 ± 0,2
ISO 179/1fU [4)]	1	flatwise	unnotched		

1) Attention is drawn to the changes in the specimen type number, notch type letter designations and method designation number from those used in ISO 179:1982,

2) If specimens are taken from sheet or products, the thickness of the sheet or product shall be added to the designation, and unreinforced specimens shall not be tested with their machined surface under tension.

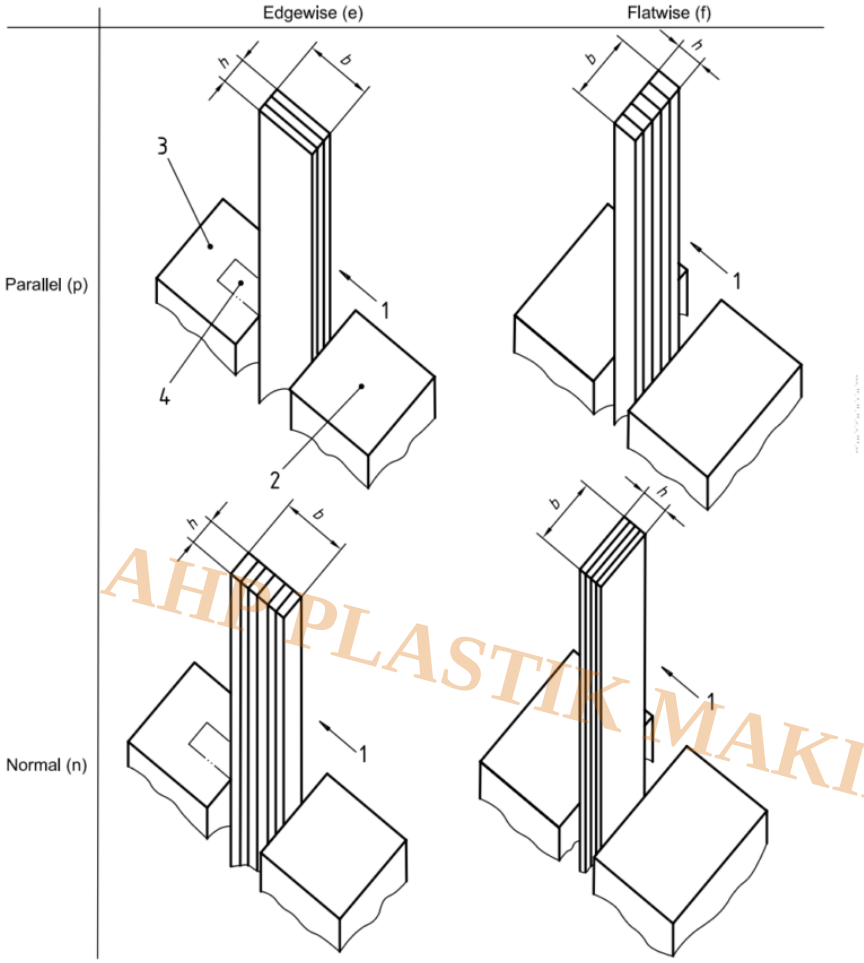
3) Preferred method.

4) Especially for study of surface effects (see 1.2 and 6.3.1.1.3).

Considering above drawings for Charpy impact test samples , sample cutting is possible by CNC milling machine but notches need special notch making device:

Notch Milling Machine

For ISO 180 , Izod test sample is as below dimensions:



Key

1	Direction of blow	3	Fixed vice jaw
2	Movable vice jaw	4	Optional groove

Edgewise (e) and flatwise (f) indicate the direction of the blow with respect to the specimen thickness h and specimen width b.
Normal (n) and parallel (p) indicate the direction of the blow with respect to the laminate plane.

The usual Izod test is "edgewise parallel". When $h = b$, parallel as well as normal impact testing is possible.

Figure 1 — Scheme of designations describing the direction of blow

Radius of notch base
r_N = 0,25 mm ± 0,05 mm

a) Type A

Radius of notch base
r_N = 1,00 mm ± 0,05 mm

b) Type B

Figure 2 — Notch types

Table 1 — Method designations, specimen types, notch types and notch dimensions

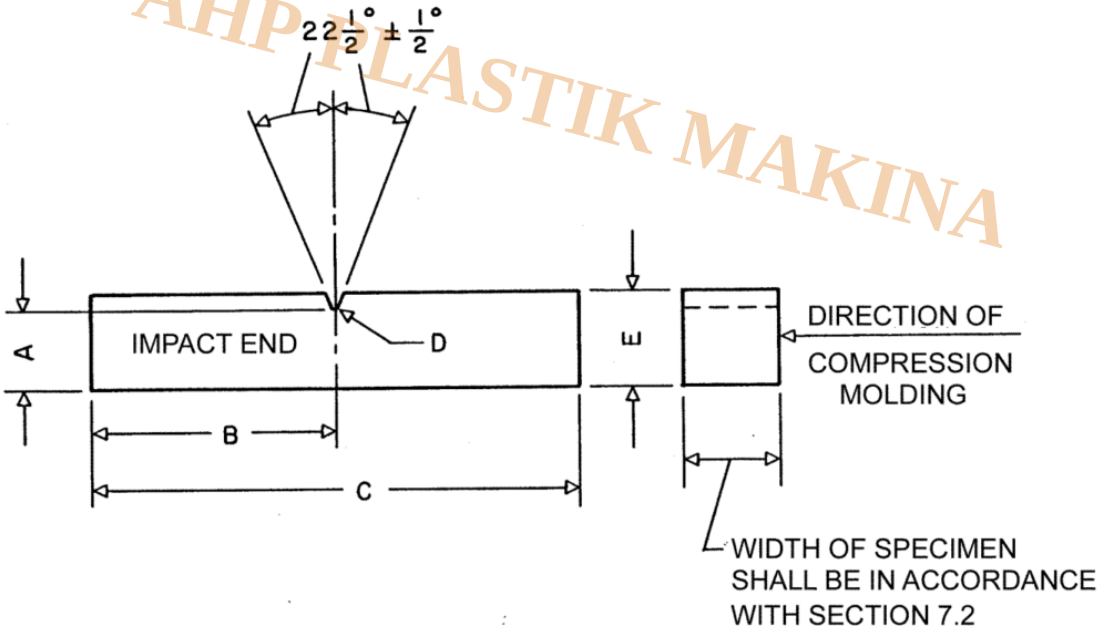
Dimensions in millimetres

Method designation[a,b]	Specimen	Notch type[a]	Notch base radius, r_N	Remaining width, b_N, at notch base
ISO 180/U	Length l = 80 ± 2 Width b = 10,0 ± 0,2 Thickness h = 4,0 ± 0,2	Unnotched	—	—
ISO 180/A		A	0,25 ± 0,05	8,0 ± 0,2
ISO 180/B		B	1,00 ± 0,05	

a If specimens are taken from sheet or products, the thickness h of the sheet or product shall be added to the designation. Unreinforced specimens shall not be tested with their machined surface under tension.

b If the sheet thickness h equals the width b, the direction of the blow (normal n, or parallel p) shall be added to the designation.

For ASTM D256 sample dimension is as below:



	mm	in.
A	10.16 ± 0.05	0.400 ± 0.002
B	31.8 ± 1.0	1.25 ± 0.04
C	63.5 ± 2.0	2.50 ± 0.08
D	0.25R ± 0.05	0.010R ± 0.002
E	12.70 ± 0.20	0.500 ± 0.008

FIG. 6 Dimensions of Izod-Type Test Specimen

As a brief, important parameters of CNC milling machine for making above sample types are as below:

- CNC milling is only suitable for hard materials like HDPE, PVC, â€¦.. It is not suitable for elastomeric and soft materials like rubber, â€¦.
- Thickness is limited to maximum thickness of selected type of CNC milling from AHP
- For samples of less thickness, it is important to use clamp both under and above sample piece lengthwise.
- For high thickness samples like Type 3 of ISO 6259 it is important to use clamp at the both ends of sample piece.

- For samples including holes, need to care about size of hole. hole diameter need to be more than minimum usable diameter of tool.
- Sample dimensions need to be in the range of XY travel of the CNC milling machine.
- Z travel of CNC milling machine is dependent on maximum thickness request from customer side.
- Machine need to have air cooling hosing and air inlet connection. This is important to repel milling chips from milling zone. unless it will cause excess heating of the tool.
- Some of above samples like Izod, Charpy have some notches with very small radius of edge. These notches need to be made by special notch milling machine.
- **All above samples can be prepared using CNC milling from AHP PLASTIK MAKINA.**

Category

1. Equipment for Standards
2. Standards