



**Plastic Pipes & Fittings Factory**  
**Yousif Khalid Al-Adasani Ent.**



**POLYBUTYLENE**  
**PIPING SYSTEM**





## POLYBUTYLENE (PB) PIPING SYSTEM

### MATERIAL :

Polybutylene is a polymer of Hydrocarbon Butylene ( $C_4 H_8$ )

### MANUFACTURING STANDARDS :

DIN 16968, DIN 16969, DIN 16831, DIN EN ISO/ BS EN ISO 15876

### MAJOR ADVANTAGES OF AL-ADASANI PB PIPES

- High chemical resistance
- Internal/ External corrosion resistance
- Non-toxic and resistant to microbiological attack
- Low friction loss
- Light weight end easy installation
- Has got good insulating properties (Low thermal conductivity)

### APPLICATION FIELD

- Drinking water systems
- Service Hot & Cold water systems
- Industrial projects
- Agricultural projects
- Central heating system
- House Connections

### GENERAL PROPERTIES OF PB MATERIAL

PROPERTIES	PB	UNIT
Density	$\approx 0.93$	$g/cm^3$
Mean Coefficient of Linear Thermal Expansion	$\approx 1.3 \times 10^{-4}$	$K^{-1}$
Thermal Conductivity	$\approx 0.22$	W/ K. M
Modulus of Elasticity	$\geq 350$	$N/mm^2$
Tenstile Strength	$\geq 20$	$N/mm^2$
Heat Reversion	$< 2\%$	-
Minimum required strength (MRS)	12.5	$N/mm^2$
Surface Resistance	$>10^{12}$	$\Omega$

\* Minimum required strength, MRS (i.e. the resistance to internal hydrostatic pressure) in water at 20°C for 50 years. (ref. DIN 16969 St.)

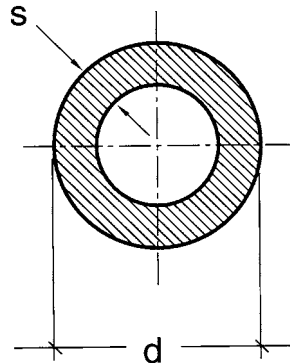


**PB PIPES :**

DIN 16968, DIN 16969, DIN EN ISO/ BS EN ISO 15876

OUT SIDE DIAMETER d, mm	PIPE SERIES , S		
	5	4	3.2
	SDR		
	11	9	7.4
	PN 16	PN 20	PN 25
	WALL THICKNESS ( mm )		
20	1.9	2.3	2.8
25	2.3	2.8	3.5
32	2.9	3.6	4.4
40	3.7	4.5	
50	4.6	5.6	
63	5.8	7.1	
75	6.8	8.4	
90	8.2	10.1	
110	10	12.3	
125	11.4	14.0	
160	14.6	17.9	
200	18.2		
225	20.5		

PN : Nominal Pressure in bar



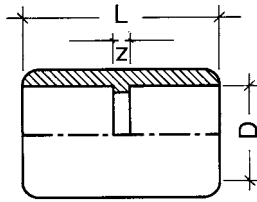
**d : outside diameter**  
**s : wall thickness**  
measurements in mm





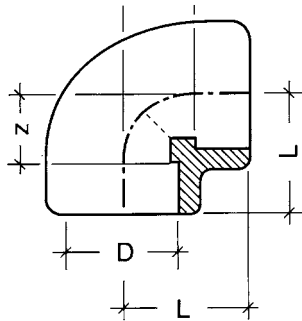
### AL-ADASANI PB PIPES FITTINGS

PN : 25 bar - DIN16831 - DIN EN ISO/ BS EN ISO 15876



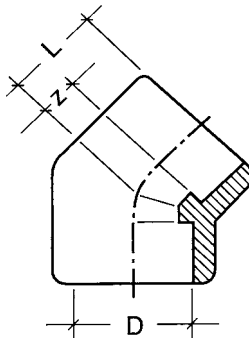
#### WELDING SOCKET (COPB)

D mm	L mm	Z mm
20	32	3
25	35	3
32	43	3
40	43	3
50	52	4
63	61	6
75	73	6
90	73	6
110	84	8



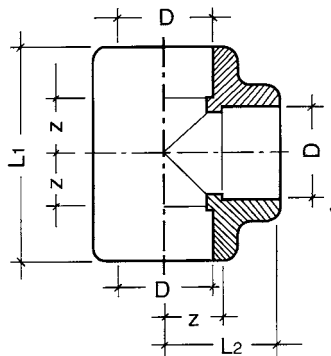
#### WELDING ELBOW (BEPB 90°)

D mm	L mm	Z mm
20	29	14
25	33	17
32	40	21
40	47	26
50	51	28
63	60	32
75	59	28
90	79	46
110	94	58



#### WELDING ELBOW (BEPB 45°)

D mm	L mm	Z mm
20	22	4
25	26	7
32	30	9
40	34	12
50	34	12
63	42	14
75	46	16
90	65	35
110	74	42

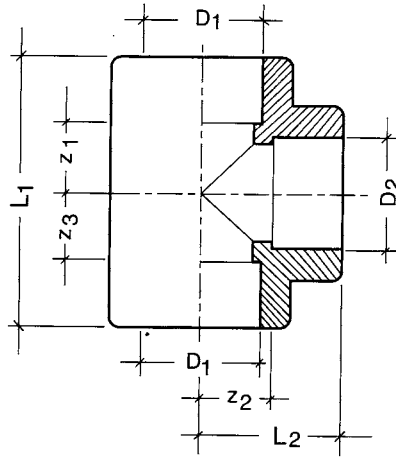


#### WELDING TEE (TEPB)

D mm	L <sub>1</sub> mm	L <sub>2</sub> mm	Z mm
20	54	27	12
25	63	31	13
32	75	38	16
40	86	44	21
50	105	52	26
63	122	62	33
75	139	70	39
90	159	82	49
110	179	94	59

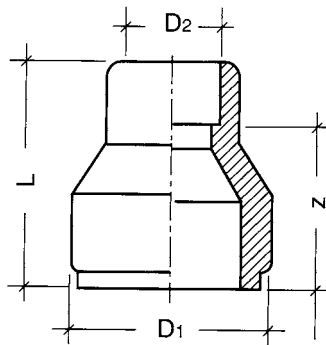


**REDUCED WELDING TEE  
(TRPB)**



D <sub>1</sub> mm	D <sub>2</sub> mm	L <sub>1</sub> mm	L <sub>2</sub> mm	Z <sub>1</sub> mm	Z <sub>2</sub> mm	Z <sub>3</sub> mm
25	20	62	31	13	13	13
32	20	75	38	17	22	17
32	25	75	38	17	20	17
40	20	86.5	40.0	21.4	21.0	21.4
40	25	86.5	38.25	21.4	21.25	21.4
40	32	86	44	21	25	21
50	20	104	42.8	25.5	26.8	25.3
50	25	105	52	33	35	33
50	32	105	52	33	33	33
63	25	126	49.5	34	31.5	34
63	32	126	55.5	34	36.4	34
63	40	126	54.5	34	31.5	34
63	50	126	57.5	34	32.5	34
75	25	144	58	39.5	38.5	39.5
75	32	144	60	39.5	38	39.5
75	40	145	59.5	40.0	35.0	40.0
75	50	144	62	39.5	35.0	39.5
75	63	144	65	39.5	34.5	39.5

**REDUCED WELDING SOCKET  
(REPB)**

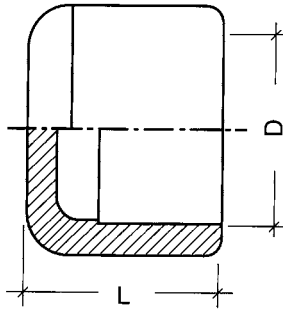


D <sub>1</sub> mm	D <sub>2</sub> mm	L mm	Z mm
25	20	39	23
32	20	42	26
32	25	43	26
40	20	50	30
40	25	50	30
40	32	50	30
50	20	55	35
50	25	55	35
50	32	55	37
50	40	54	34
63	25	65	48
63	32	65	45
63	40	65	44
63	50	72	45
75	32	65	45
75	40	67	45
75	50	68	43
75	63	72	44
90	40	65	41
90	50	76	51
90	63	79	51
90	75	82	52
110	63	88	60
110	75	92	60
110	90	95	63



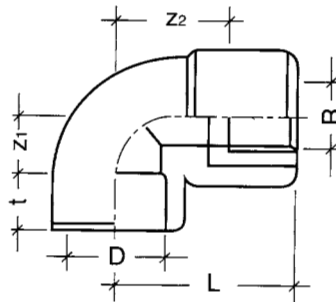


**WELDING END CAP  
(EPPB)**



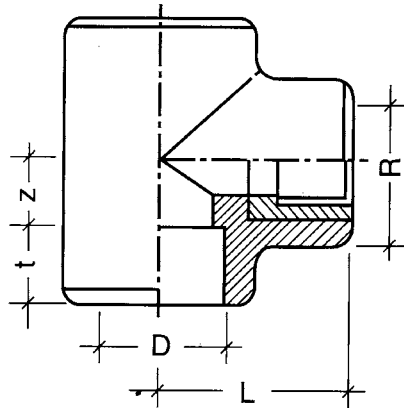
D mm	L mm
20	25
25	28
32	33
40	38
50	46
63	55
75	58
90	68

**WELDING ELBOW ADAPTOR,  
FEMALE THREAD (ABPB)**



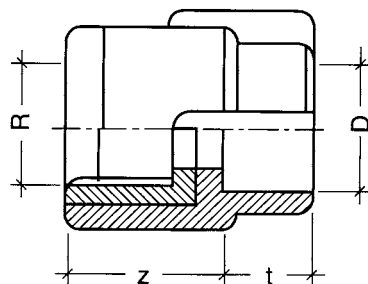
D mm	R Inch	T mm	Z <sub>1</sub> mm	Z <sub>2</sub> mm	L mm
20	1/2"	18	11	20	35
20	3/4"	18	17	24	39
25	1/2"	20	15	24	39
25	3/4"	20	15	24	39
32	3/4"	18	12	32	66
32	1"	18	12	32	66

**WELDING TEE ADAPTOR  
FEMALE THREAD (ATPB)**



D mm	R Inch	T mm	Z mm	L mm
20	1/2"	16	11	36
20	3/4"	18	14	40
25	1/2"	16	15	44
25	3/4"	18	14	40
32	1"	18	12	65

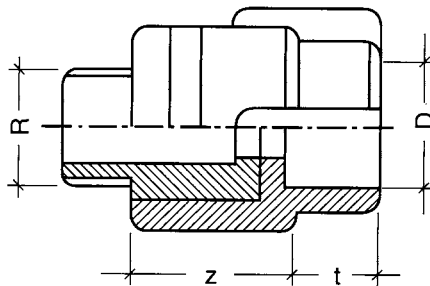
**FEMALE ADAPTOR  
(FAPB)**



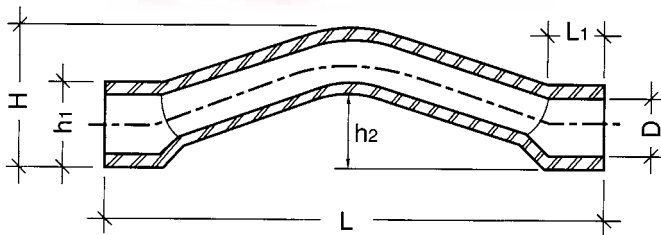
D mm	R Inch	T mm	Z mm
20	1/2"	16	25
20	3/4"	18	25
25	1/2"	16	26
25	3/4"	18	25
32	3/4"	20	40
32	1"	20	40
40	1 1/4"	20	46
50	1 1/2"	24	46
63	2"	28	48



**MALE ADAPTOR  
(MAPB)**



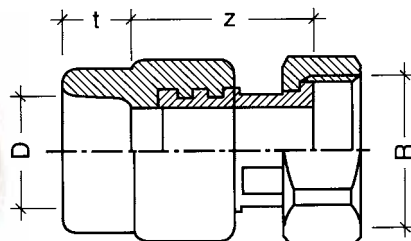
D mm	R Inch	T mm	Z mm
20	1/2"	16	25
20	3/4"	18	25
25	1/2"	16	26
25	3/4"	18	25
32	3/4"	20	37
32	1"	20	37
40	1 1/4"	20	45
50	1 1/2"	24	42
63	2"	28	52
75	2 1/2"	29	50



**STEP-OVER BEND  
(SOPB)**

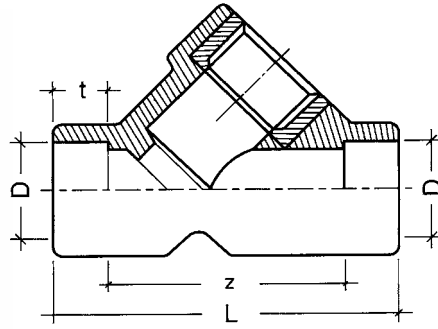
D mm	H mm	H <sub>1</sub> mm	H <sub>2</sub> mm	L <sub>1</sub> mm	L mm
20	46	28.2	24	15.5	160
25	58.0	35	32	22	201
32	66	43	34.5	22.5	172
40	82	53	43	21.5	240

**WELDING UNION PB TO BRASS  
(UBPB)**



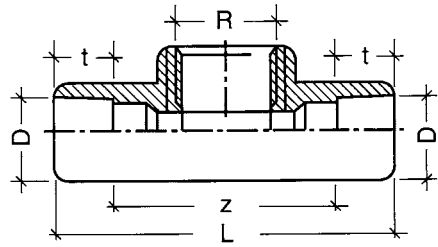
D mm	R Inch	T mm	Z mm
20	3/4"	16	44
25	3/4"	16	44
32	1"	19	45
40	1 1/4"	21	48
50	1 1/2"	24	54
63	2"	30	60





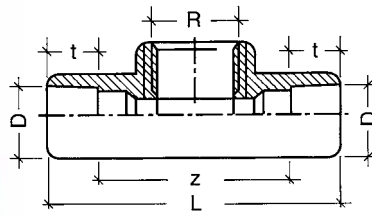
**SLANTED SEAT VALVE  
(GVPB)**

D mm	T mm	Z mm	L mm
25	16	86	118
32	18	82	118



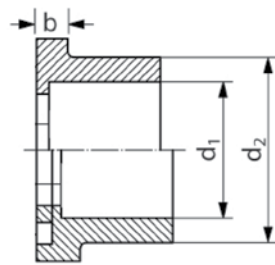
**CONCEALED / SHUT OFF VALVE  
(CVPB)**

D mm	R Inch	T mm	Z mm	L mm
20	3/4"	15	66	96
25	3/4"	16	64	96
32	1"	18	80	116
40	1"	21	73	115



**GATE VALVE  
(TGVP)**

D MM	R INCH	T MM	Z MM	L MM
20	3/4"	15	66	96
25	3/4"	16	64	96
32	1"	18	80	116
40	1"	21	73	115



**FLANGE ADAPTER, QPB**

PIPE OUT SIDE DIAMETER, MM	d <sub>1</sub>	d <sub>2</sub>	b
50	48.8	61	13
63	61.9	76.3	15
75	73.6	90	17.1
90	88.8	109.2	17.1
110	108.5	130	18



**BACKING RING, ODC**

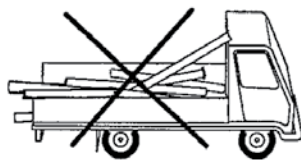
PIPE OUT SIDE DIAMETER, MM	NOMINAL FLANGE SIZE	d <sub>3</sub>	D	K	d <sub>4</sub>	NUMBER OF BOLTS
50	40	63	152	110	18	4
63	50	78	168	125	18	4
75	65	92	187	145	18	4
90	80	110	202.5	160	18	8
110	100	133	220	180	18	8

Note: The Backing Ring is made from C-PVC

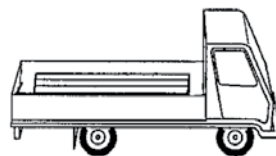


## HANDLING AND STORAGE

- Care should be exercised to avoid rough handling of PB pipes and fittings. They should not be dragged over sharp objects, stones or projections, dropped or have objects dropped upon them.
- Pipes and fittings should be stored on levelled ground which is free of any sharp objects.
- If different thickness classes are stacked together, the thickest pipe should be on bottom.
- The pipe should be protected from direct sunlight and stored in place with good venting and away from any heat sources, more care should be taken in holding pipes in cold weather.
- If the pipes are stored in racks, it should be continuously supported along their length. They should be stacked not more than 1.5 m height.
- Coils should be stored either on edge or stacked flat one upon another to maximum height of 1.5 m.
- Fittings must be stored in their original cartons to keep them free of dust and reduce the possibility of damage and must be stored inside doors.
- Vehicles with flat bed, which is free of any sharp objects, should be used for transporting pipe.



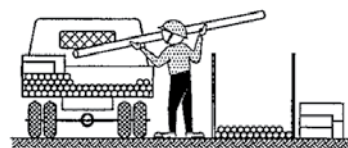
Incorrect way to load pipes



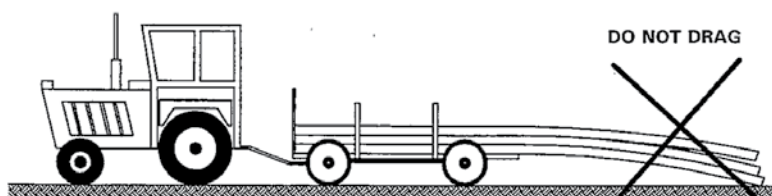
Correct way to load pipes



Incorrect way to off-load



Correct way to off-load



On-site transport



## JOINTING PROCEDURES

PB pipes can be jointed together or with fittings for different applications by means of three major methods: Socket fusion Electrofusion and Butt welding methods.

Before starting welding, make sure that all required parts of welding machine are available, clean and in good condition.

### 1- SOCKET FUSION JOINTING

in which the outer surface of pipe end and inside surface of the fitting are melted simultaneously then the two components are joined by inserting one into other to become one piece.

- Cut the pipe end squarely using proper cutter and remove the burrs or ridges
- Clean and dry the pipe end and fitting immediately before welding, both inside and outside surfaces, by wiping with clean paper towel or cloth..
- Switch on welding machine and set the temperature of the heating plate to about 250<sup>o</sup> C.
- When required temperature is reached , pipe & fitting will be inserted in heating unit ( plugs) simultaneously for heating for period shown in table (1).
- At the end of heating period , pipe and fitting will be removed from heating unit quickly and jointed together immediately , straight without rotating them and holding them for period shown in table (1).
- For PB pipes & fittings sizes up to 63mm welding machine fig.1 can be used while for sizes 75mm upto 125mm welding machine, fig 2 will be used for 160mm and above Butt welding methods will be used as per page 13.

### NOTES:

- Do not twist during and after jointing.
- precautions must be taken while dealing with pipes and fittings in low temperature (Close to Zero) to avoid knocks which may happen while handling.
- Mechanical joining can be done using mechanical fitting as flanges, screwed fitting, etc.





### Recommended welding time for PB pipes & fittings:

PIPE OUTSIDE DIAMETER, MM.	LENGTH OF MELTED SECTION, MM.	HEATING TIME/ SEC.	JOINTING TIME/ SEC.	COOLING TIME/ MIN.
16	13.0	5	4	2
20	14.0	5	4	2
25	15.0	7	4	2
32	16.0	8	6	4
40	18.0	12	6	4
50	20.0	18	6	4
63	24.0	24	8	6
75	26.0	30	8	6
90	29.0	40	10	8
110	31	50	12	10
125	32	60	15	13

### 2- ELECTRO FUSION JOINTING METHOD :

Electro fusion is a heat fusion jointing process where a heat source is an integral part of fittings, where electric current is applied, heat is produced, melting and jointing the component.

- Cut the pipe end squarely using proper cutter and remove the burrs or ridges.
- Clean and dry the pipe by wiping with clean paper towel or cloth..
- Remove the fitting from its packaging and check the bore of fitting is clean and dry.
- Insert the pipe ends into the fittings until the center stop.
- Secure the fitting and the pipe in place to prevent movement during the fusion and cooling cycles using clamps.
- Connect the machine output leads to the fitting terminals.
- Operate the machine in accordance with the operating instructions.
- The joints must be left for cooling time, although the terminal lead may be removed carefully without disturbing the joint



### 3 -BUTT WELDING METHOD

This method depends on the use of special butt welding machine, Fig. 1 .



Before starting welding, make sure that all parts of the machines are in good condition, hydraulic systems, milling cutter, heating element, pressure gauges and thermometers, the heater plate is clean and set at required temperature.

- 1- Place all parts of the machine on a firm surface.
- 2- Set the temperature of the heating plate to the required temperature, Annex-A.
- 3- Take the carriage apart as far as possible and insert the two pipes or the pipe and fitting to be jointed in the clamps and fasten them
- 4- Place the milling cutter between the parts or edges to be welded and bring the parts near each other and start the milling until the shaving looks homogeneous on both sides then open the carriage, Don't dirty nor touch the surfaces just milled.
- 5- Remove the loose shavings from the machine and parts ends.
- 6- Close the carriage and checks that there are no visible gaps between milling faces.
- 7- Check the temperature of the heating element, to be as specified in Annex-A and place the heating element between the parts edges.
- 8- Close the carriage so that the surfaces to be joined are touching the plate at pressure  $P_1$  and wait until the bead (A) reaches the height specified in Annex-A,
- 9- Discharge the pressure to value  $P_2$  and wait for period  $T_2$  then remove the heating element within the time  $T_3$  and bring the melted surfaces together,
- 10-Raise the pressure to  $P_5$  within the period  $T_4$  and maintain the pressure  $P_5$  for period  $T_5$  (minimum cooling time).
- 11- After this time the assembly can be removed from the machine, the joint should be checked for cleanliness and uniformity.

#### Annex-A PB ( Butt fusion)

D, mm	s, mm (wall thickness)	SDR	T C <sup>0</sup>	P <sub>1</sub> bar	A, mm (Bead)	P <sub>2</sub> ,Max bar	t <sub>2</sub> Sec	t <sub>3</sub> ,Max Sec	t <sub>4</sub> Sec	P <sub>5</sub> Bar	t <sub>5</sub> minuts
125	11,4	11	210	6	1	1	237	7	11	6	19
	14,0	9	210	7	1	1	268	8	13	7	23
160	14,6	11	210	10	1	1	277	8	13	10	24
	17,9	9	210	12	1	1	315	9	16	12	28
	21,9	7,4	210	14	1.5	1	359	10	19	14	34
200	18,2	11	210	16	1	2	320	9	16	16	29
225	20.5	11	210	20	1.5	2	345	10	18	20	32

Note: Butt welding method can be use for jointing PB pipes/ fitting of sizes 160 mm and above.



## EXPANSION/CONTRACTION LENGTH

PIPE LENGTH m	TEMP. DIFFERENCE							
	10	20	30	40	50	60	70	80
	CHANGE OF LENGTH, mm.							
1	1.3	2.6	3.9	5.2	6.5	7.8	9.1	10.4
2	2.6	5.2	7.8	10.4	13	15.6	18.2	20.8
3	3.9	7.8	11.7	15.6	19.5	23.4	27.3	31.2
4	5.2	10.4	15.6	20.8	26	31.2	36.4	41.6
5	6.5	13	19.5	26	32.5	39	45.5	52
6	7.8	15.6	23.4	31.2	39	46.8	54.6	62.4
7	9.1	18.2	27.3	36.4	45.5	54.6	63.7	72.8
8	10.4	20.8	31.2	41.6	52	62.4	72.8	83.2
9	11.7	23.4	35.1	46.8	58.5	70.2	81.9	93.6
10	13	26	39	52	65	78	91	104

TABLE(2)

### EXPANSION AND CONTRACTION

PB pipes undergo length changes as a result of temperature variations above and below the installation temperature. Change in pipe length depends on the coefficient of linear expansion, length of the pipe and temperature variations.

#### DETERMINATION OF LENGTH CHANGE

$$\Delta L = L \cdot \Delta T \cdot \delta$$

$\Delta L$  = Length change in mm

$L$  = Length of pipe in m

$\Delta T$  = Difference between installation temperature and maximum or minimum working temperature in  $^{\circ}\text{C}$

$\delta$  = Coefficient of linear expansion of the pipe in  $\text{mm}/\text{m} \cdot ^{\circ}\text{C} = 0.13^*$

#### EXAMPLE OF DETERMINING $\Delta L$

Length of pipe,  $L = 10$  m

Temperature difference  $\Delta T = 40$   $^{\circ}\text{C}$

$$\Delta L = 10 \times 40 \times 0.13 = 52 \text{ mm}$$

The expansion and contraction of the pipe should be considered in installing of hot lines which is not embedded in the wall. The relation between expansion/contraction of the pipe and its length and temperature difference shown in table (2).

### ALLOWING FOR LENGTH CHANGES

The length change in open placed installation are compensated for by one of two means:

1. Flexible section (deflection leg).
2. Expansion loops

#### 1-THE LENGTH OF FLEXIBLE SECTION CAN BE MEASURED BY THE FOLLOWING FORMULA:

$$a = c \cdot \sqrt{d \times \Delta L}$$

$a$  = length flexible section

$\Delta L$  = change of length due to expansion or contraction.

$d$  = outside diameter of pipe in mm.

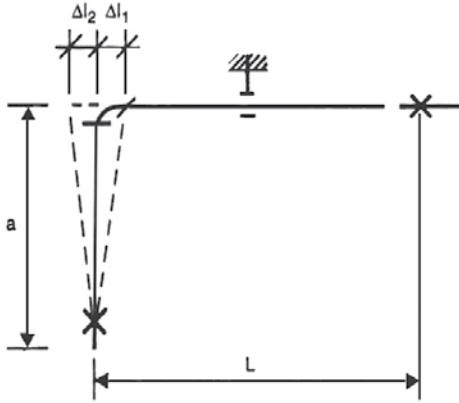
$c$  = material dependent constant for PB is 10



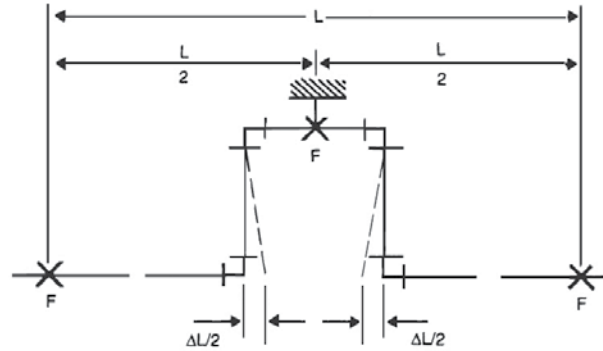


2- For expansion loop, the length of flexible section will be calculated by the following formula

$$a = C \sqrt{d \times \frac{\Delta L}{2}}$$



Flexible section



Expansion loop

### Insulation

Al-Adasani PB pipes have very low thermal conductivity, so no thermal insulation is required for cold lines bedded in the wall. For suspended hot lines, it is preferable to be thermally insulated. If the pipes are installed outdoor, they should be protected from direct sunlight.

### Pipe clamps

PB pipelines need to be supported at specific intervals, depending on the temperature of the fluid being transported, the diameter and wall thickness of the pipe. (Table 3)

PIPE OUTSIDE DIAMETER D, mm	COLD WATER	HOT WATER
	CLAMPS INTERVALS IN HORIZONTAL, L, cm	
20	80	50
25	85	60
32	100	65
40	110	80
50	125	100
63	140	120
75	150	145
90	165	150
110	190	160
125	220	170
160	250	185
200	290	195
225	330	210

Note: For vertical pipes L should be multiplied by 1.3

Table (3)



**\*ALLOWABLE WORKING PRESSURE FOR PB PIPES**

TEMPERATURE IN °C	YEARS OF SERVICE	ALLOWABLE WORKING PRESSURE, bar		
		SDR 11, PN 16	SDR 9, PN 20	SDR 7.4, PN 25
10	25	23.7	29.6	37.0
	50	23.3	29.1	36.4
	100	22.9	28.7	35.8
20	25	22.2	27.8	34.7
	50	21.8	27.3	34.1
	100	21.4	26.8	33.5
30	25	20.6	25.8	32.2
	50	20.2	25.2	31.6
	100	19.8	24.7	30.9
40	25	18.8	23.6	29.5
	50	18.4	23.0	28.8
	100	18.0	22.5	28.1
50	25	16.9	21.2	26.5
	50	16.5	20.6	25.8
	100	16.1	20.1	25.1
60	25	14.8	18.5	23.2
	50	14.4	18.0	22.5
70	25	12.6	15.7	19.6
	50	12.1	15.2	19.0
80	18	10.3	12.9	16.2
	25	10.1	12.7	15.8
95	5	7.1	8.9	11.2
	10	6.8	8.5	10.6

PN = Nominal Pressure

**PRESSURE TESTING**

- Hydrostatic pressure test will be carried out after completing the installation of a pipeline or a section of the pipeline.
- The pipeline should be suitable anchored at all changes of direction and at fixed points.
- The test shall be performed during periods of relatively stable atmospheric temperature, the temperature of the piping material will not exceed 40 °C during the last period of testing.
- Each pipeline or section shall be filled slowly with water from the lowest point avoiding surge pressures, all air shall be allowed to escape from the line through air vents or suitable cocks located at high points.
- After filling and before application of the test pressure, maintain the test section for standing period at least 2 hours, to achieve conditions as stable as possible for testing.
- If no leakage has been observed during the standing period, the pressure shall be raised slowly to the test pressure which shall be 1.5 operating pressure for 2 hours.
- The test pressure should not exceed the maximum working pressure (which related to the temperature) of the lowest rated component



## CHEMICAL RESISTANCE FOR PB MATERIAL

CHEMICALS	CONCENTRATION	TEMPERATURE	
		20° C	60° C
Acetic acid	80%	+	+
Acetic acid (glacial)	> 96%	(+)	-
Acetic anhydride	tg-l	+	+
Acetone	tg-l	+	+
Adipic acid	Sat.sol.	+	(+)
Allyl alcohol	tg-l	+	+
Alum (Aluminium Potassium Sulphate)	Sat.sol.	+	+
Aluminium chloride	Sat.sol.	+	+
Aluminium fluoride	Susp.	+	+
Aluminium Nitrate	Sat.sol.	+	+
Aluminium sulphate	Sat.sol.	(+)	-
Ammonia (liquid)	tg-l	+	(+)
Ammonia(aqueous)	Sat.sol.	+	+
Ammonia, dry, gas	tg-g		
Ammonium chloride	Sat.sol.	+	+
Ammonium fluoride	Sat.sol.	+	(+)
Ammonium nitrate	Sat.sol.	+	+
Ammonium phosphate	Sat.sol.	+	+
Ammonium sulphate	Sat.sol.	+	+
Amyl alcohol	tg-l	+	+
Aniline	tg-l	(+)	(+)
Antimony trichloride	Sat.sol.	+	+
Aqua regia (HCL / HN03)	3/1	-	-
Arsenic acid,	Sat.sol.	+	+
Barium carbonate	susp	+	+
Barium chloride	Sat. sol.	+	+
Barium hydroxide	Sat. sol.	+	+
Barium sulphate	Susp.	+	+
Benzaldehyde	tg-l	(+)	-
Benzene	tg-l	-	-
Benzoic acid	Sat. sol.	+	+
Borax	Sat. sol.	+	+
Boric Acid	Sat.sol.		+
Bromic acid	Sat. sol.	+	+
Bromine (liquid)	tg-l	-	-
Butane (gas)	tg-g	-	-
Butyl alcohol	tg-l	+	+

CHEMICALS	CONCENTRATION	TEMPERATURE	
		20° C	60° C
Butyric acid	tg-g	+	(+)
Calcium carbonate	Susp.	+	+
Calcium chlorate	Sat. sol.	+	+
Calcium chloride	Sat. sol.	+	+
Calcium hydroxide	Sat. sol.	+	+
Calcium hypochlorite	Sol.	+	+
Calcium nitrate	Sat. sol.	+	+
Calcium bisulphate	Sat. sol.	+	+
Calcium sulphate	Susp.	+	+
Carbon dioxide, dry & wet gas	Sat.sol., tg-g	+	+
Carbon monoxide, gas	tg-g	+	+
Carbon tetrachloride	tg-l	-	-
Chlorine (gas,dry, wet)	tg-g	-	-
Chlorine water	Sat. sol.	+	+
Chloro acetic acid	Sat. sol.	-	-
Chloroform	tg-l	(+)	-
Chromic acid	50%	+	
Citric acid	Sat. sol.	+	+
Copper chloride	Sat. sol.	+	+
Copper cyanide	Sat. sol.	+	+
Copper nitrate	Sat. sol.	+	+
Copper sulphate	Sat. sol.	+	+
Cyclohexanol	tg-s	+	(+)
Cyclohexanone	tg-l	-	-
Dextrin	Sol.	+	+
Diocetyl phthalate	tg-l	(+)	-
Diesel Fuel	work sol.	(+)	-
Ethanol	tg-l	+	+
Ethylene glycol	tg-l	+	+
Ethylene ether	tg-l	(+)	-
Ferric chloride	Sat. sol.	+	+
Ferric nitrate	Sat.sol.	+	+
Ferric sulphate	Sat. sol.	+	+
Ferrous chloride	Sat. sol.	+	+
Ferrous sulphate	Sat. sol.	+	+
Fluorine , gas, dry/wet	tg-g	(+)	-
Fluo silicic acid, aqu	Sat. sol.	+	+



## CHEMICAL RESISTANCE FOR PB MATERIAL

CHEMICALS	CONCENTRATION	TEMPERATURE	
		20° C	60° C
Formaldehyde	50%	+	
Formic acid	tg-l	+	+
Gasoline ( fuel)	work, sol.	-	-
Glucose	Sol.	+	+
Glycerine	tg-l	+	+
Glycolic acid	30%	+	+
Heptane	tg-l	-	-
Hexane	tg-l	-	-
Hexanol	tg-l	+	+
Hydrobromic acid	20%	+	+
Hydrochloric acid	conc.	+	+
Hydrocyanic acid	tg-l	+	+
Hydrofluoric acid	60%	+	+
Hydrogen peroxide	30%	+	+
Hydrogen peroxide	50%	-	-
Hydrogen sulphide (aqueous/dry gas)	Sat.sol., tg-g	+	+
Hydroquinone	Sat. sol.	+	+
Isopropyle Alcohol	tg-l	+	+
Lactic acid	28%	+	+
Lead acetate	Sat. sol.	+	+
Magnesium carbonate	Susp.	+	+
Magnesium chloride	Sat.sol.	+	+
Magnesium hydroxide	Sat. sol.	+	+
Magnesium nitrate	Sat. sol.	+	+
Mercury	tg-l	+	+
Mercuric chloride	Sat. sol	+	+
Mercurous nitrate	Sol	+	+
Methanol	tg-l	+	+
Milk		+	+
Nickel chlorirde	Sat. sol	+	+
Nitric acid	10%	(+)	-
Nitric acid	20%	-	-

CHEMICALS	CONCENTRATION	TEMPERATURE	
		20° C	60° C
Oxalic acid	Sat. sol	+	+
Phenol	tg-s	+	(+)
Phosphoric acid	50%	+	+
Phosphoric acid	50-75%	+	(+)
Propyl alcohol	tg-l	+	+
Potassium bicarbonate	Sat. sol	+	+
Potassium bichromate	Sat. sol	+	+
Potassium bisulphate	Sat. sol	+	+
Potassium bromide	Sat. sol	+	+
Potassium carbonate	Sat. sol	+	+
Potassium chlorate	Sat. sol	+	+
Potassium chloride	Sat. sol	+	+
Potassium chromate	Sat. sol	+	+
Potassium cyanide	Sol.	+	+
Potassium ferricyanide	Sat. sol	+	+
Potassium nitrate	Sat. sol	+	+
Potassium persulphate	Sat. sol	+	+
Potassium sulphate	Sat. sol	+	+
Potassium sulphide	Sat. sol	+	+
Propane (gas)	tg-g	+	
Salicyclic acid	Sat. sol	+	
Silver acetate	Sat. sol	+	+
Silver cyanide	Sat. sol	+	+
Silver nitrate	Sat. sol	(+)	-
sodium acetate	Sat.sol.	+	+
Sodium benzoate	Sat. sol	+	+
Sodium bicarbonate	Sat. sol	+	+
Sodium bromide	Sat. sol	+	+
Sodium carbonate	Sat. sol	+	+
Sodium chlorate	Sat. sol	+	+
Sodium chloride	Sat. sol	+	+
Sodium cyanide	Sat. sol	+	+



## CHEMICAL RESISTANCE FOR PB MATERIAL

CHEMICALS	CONCENTRATION	TEMPERATURE	
		20° C	60° C
Sodium ferricyanide	Sat. sol	+	+
Sodium fluoride	Sat. sol	+	+
Sodium hydroxide	Sat. sol	+	+
Sodium hypochlorite	20%	+	(+)
Sodium nitrate	Sol.	+	+
Sodium nitrite	Sat. sol	+	+
Sodium phosphate acidv	Sat. sol	+	+
Sodium sulphate	Sat. sol	+	+
Sodium sulphide	Sat. sol	+	
Sulphuric acid	50%	+	+
Sulphuric acid	75-90%	(+)	-
Sulphuric acid	95%	-	
Sulphuric acid	fuming	-	-
Sulphurous acid	30%	+	+
Tannic acid	Sol.	+	+
Tartaric acid	Sol.	+	+
Toluene	tg-l	-	-
Trichloroethylene	tg-l	-	-
Triethanolamine	tg-l	+	+
Urea	Sat.Sol.	+	+
Urine	-	+	+
Vinegar	-	+	+
Water	-	+	+
Xylene	tg-l	-	-
Zinc carbonate	Susp.	+	+
Zinc chloride	Sat. sol	+	+
Zinc oxide	Susp.	+	+
Zinc sulphate	Sat. sol	+	+

tg = At least technical - grade purity

Work Sol.= Work solution of concentration usually used in industry concerned

+ = Resistant, (+) = Limited Resistance, - = Not Resistant

Reference : ISO/TR 10358



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