# Polyethylene pipe

## HDPE pipe

HDPE pipe (high density polyethylene pipe) is a type of flexible plastic pipe used for fluid and gas transfer and is often used to replace ageing concrete or steel mains pipe lines. Made from the thermoplastic HDPE (high density polyethylene pipe) its high level of impermeability and strong molecular bond make its suitable for high pressure pipe lines. HDPE pipe is used across the globe for applications such as water mains, gas mains, sewer mains, slurry transfer lines , rural irrigation , fire system supply lines, electrical and communications conduit, and storm water and drainage pipes.

## What are three types of polyethylene?

Polyethylene are classified mainly into three types, which include low-density PE(LDPE) with density ranging between (0.910 and 0.940 g/cm3), linear low-density PE(LLDPE) with density ranging between (0.910 and 0.920 g/cm3), and high-density PE(HDPE) with density ranging between (0.941 and 0.967 g/cm3)

## What is polyethylene LDPE used for?

Low-density polyethylene (LDPE) uses majorly revolve around manufacturing containers, dispending bottles, wash bottles, tubing, plastic bags for computer components, and various molded laboratory equipments. The most popular application of low-density polyethylene is plastic bags.

# Advantage of PE-HDPE piping system

1. Low weight
2. Security for 100 years
3. Trenchless advantageous piping because of high flexibility (coils).
4. Physiological harmless.
5. Excellent high resistance to chemical.
6. No corrosion.
7. Low abrasion.
8. No depositions or encrustations.
9. High performance security by welded pipe system.
10. Frost-proof.

# SDR (standard diameter ratio)

SDR is the ratio of the outer diameter to the thickness of the PE pipe which is one of the characteristics of the polyethylene pipe, and the pipes can be sorted according to the standard tables accordingly.

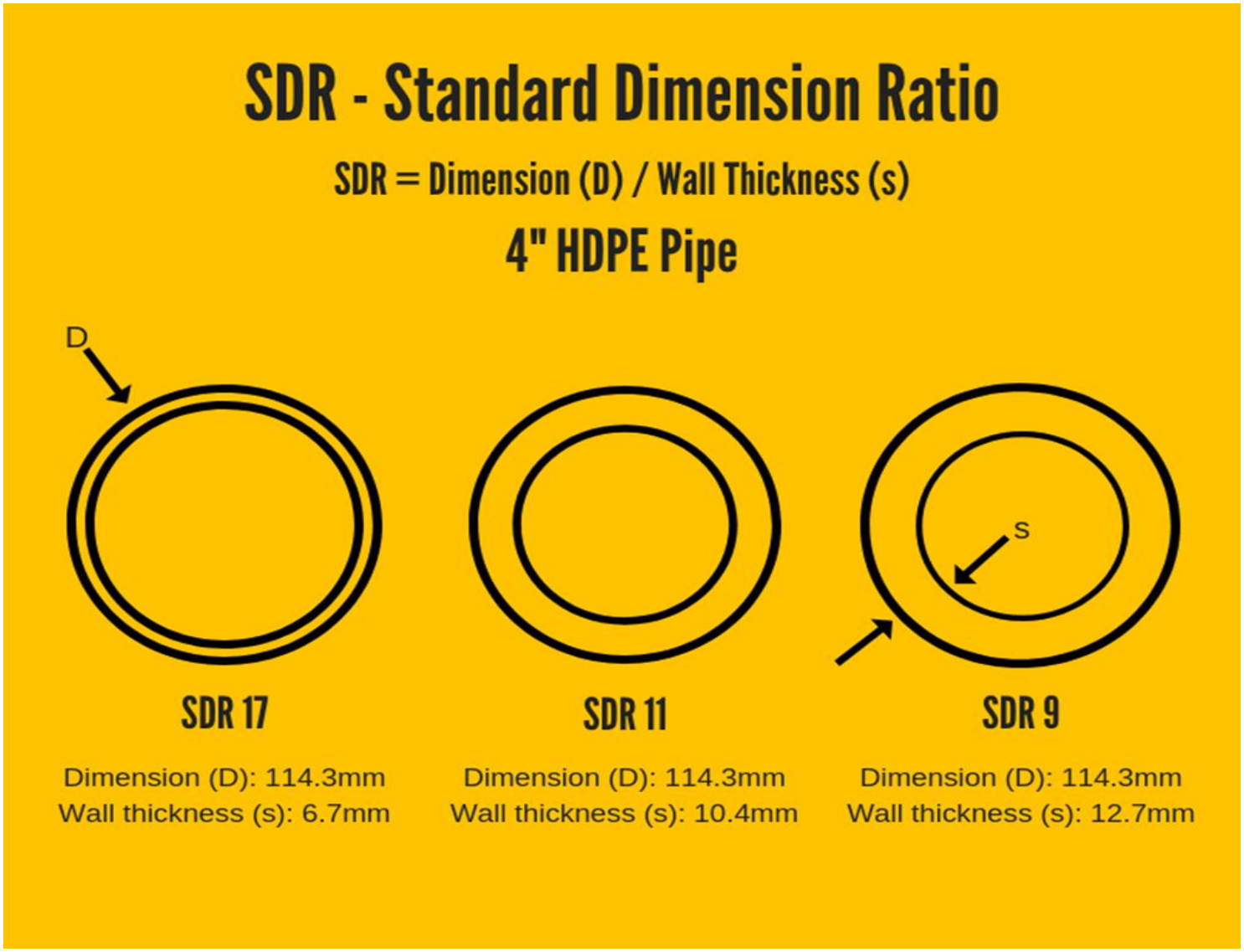
SDR is used as a method for rating a pipes durability against pressure .A high SDR ratio indicates that the pipe diameter , resulting in lower pressure rating.

# What is thickness of polyethylene?

Standard specification for polyethylene sheeting in thickness of (0.25mm, 0.010in.) and greater. This specification covers the requirements for extruded (cast or blown) and compression-molded sheeting made from low, medium, and high-density polyethylene and copolymers in specified thicknesses.

# What is SDR11 HDPE pipe used for?

So, what is SDR for HDPE pipe? SDR is used to pressure piping. Its an inverse relationship, though. The higher the SDR ,the lower the pressure rating.



## OUT SIDE DIAMETER (OD) &WEIGHTS PER METER

| | SDR26 | | SDR21 | | SDR17 | | SDR13.6 | | SDR11 | | SDR9 | | SDR7.4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PE100 | PN 6.3 | | PN 8 | | PN 10 | | PN 12.5 | | PN 16 | | PN 20 | | PN 25 | | PE100 |
| SIZE | MIN WALL | MEAN I.D. | MIN WALL | MEAN I.D. | MIN WALL | MEAN I.D. | MIN WALL | MEAN I.D. | MIN WALL | MEAN I.D. | MIN WALL | MEAN I.D. | MIN WALL | MEAN I.D. | SIZE |
| **20** | 1.6 | 16.7 | 1.6 | 16.7 | 1.6 | 16.7 | 1.6 | 16.7 | 1.9 | 16.1 | 2.3 | 15.2 | 2.8 | 14.2 | **20** |
| **25** | 1.6 | 21.7 | 1.6 | 21.7 | 1.6 | 21.1 | 1.9 | 21.1 | 2.3 | 20.2 | 2.8 | 19.2 | 3.5 | 17.7 | **25** |
| **32** | 1.6 | 28.7 | 1.6 | 28.7 | 1.9 | 28.1 | 2.4 | 27.0 | 2.9 | 26.0 | 3.6 | 24.5 | 4.4 | 22.8 | **32** |
| **40** | 1.6 | 36.7 | 1.9 | 36.1 | 2.4 | 35.0 | 3.0 | 33.8 | 3.7 | 32.3 | 4.5 | 30.6 | 5.5 | 28.5 | **40** |
| **50** | 2.0 | 45.9 | 2.4 | 45.0 | 3.0 | 43.8 | 3.7 | 42.3 | 4.6 | 40.4 | 5.6 | 38.3 | 6.9 | 35.6 | **50** |
| **63** | 2.4 | 58.0 | 3.0 | 56.8 | 3.8 | 55.1 | 4.7 | 53.2 | 5.8 | 50.9 | 7.1 | 48.1 | 8.6 | 45.1 | **63** |
| **75** | 2.9 | 69.1 | 3.6 | 67.6 | 4.5 | 65.7 | 5.5 | 63.6 | 6.8 | 60.9 | 8.4 | 57.5 | 10.3 | 53.6 | **75** |
| **90** | 3.5 | 82.8 | 4.3 | 81.1 | 5.4 | 78.8 | 6.6 | 76.3 | 8.2 | 72.9 | 10.1 | 68.6 | 12.3 | 64.5 | **90** |
| **110** | 4.3 | 101.2 | 5.3 | 99.1 | 6.6 | 96.4 | 8.1 | 93.2 | 10.0 | 89.3 | 12.3 | 84.4 | 15.1 | 78.6 | **110** |
| **125** | 4.8 | 115.3 | 6.0 | 112.8 | 7.4 | 109.8 | 9.2 | 106.0 | 11.4 | 101.4 | 14.0 | 96.0 | 17.1 | 89.5 | **125** |
| **140** | 5.4 | 129.1 | 6.7 | 126.4 | 8.3 | 123.0 | 10.3 | 118.8 | 12.7 | 113.8 | 15.7 | 107.5 | 19.2 | 100.2 | **140** |
| **160** | 6.2 | 147.5 | 7.7 | 144.4 | 9.5 | 140.6 | 11.8 | 135.8 | 14.6 | 129.9 | 17.9 | 123.0 | 21.9 | 114.7 | **160** |
| **180** | 6.9 | 166.2 | 8.6 | 162.6 | 10.7 | 158.2 | 13.3 | 152.7 | 16.4 | 146.2 | 20.1 | 138.4 | 24.6 | 129.1 | **180** |
| **200** | 7.7 | 184.5 | 9.6 | 180.5 | 11.9 | 175.7 | 14.7 | 169.8 | 18.2 | 162.4 | 22.4 | 153.6 | 27.3 | 143.4 | **200** |
| **225** | 8.6 | 207.7 | 10.8 | 203.1 | 13.4 | 197.6 | 16.6 | 190.9 | 20.5 | 182.7 | 25.1 | 173.0 | 30.8 | 161.3 | **225** |
| **250** | 9.6 | 230.7 | 11.9 | 225.9 | 14.8 | 219.8 | 18.4 | 212.2 | 22.7 | 203.2 | 27.9 | 192.3 | 34.2 | 179.2 | **250** |
| **280** | 10.7 | 258.6 | 13.4 | 252.9 | 16.6 | 246.2 | 20.6 | 237.8 | 25.4 | 227.7 | 31.3 | 215.3 | 38.3 | 200.7 | **280** |
| **315** | 12.1 | 290.7 | 15.0 | 284.7 | 18.7 | 276.9 | 23.2 | 267.4 | 28.6 | 256.1 | 35.2 | 242.2 | 43.0 | 226.1 | **315** |
| **355** | 13.6 | 327.8 | 16.9 | 320.9 | 21.1 | 312.0 | 26.1 | 301.5 | 32.2 | 288.7 | 39.6 | 273.2 | 48.5 | 254.6 | **355** |
| **400** | 15.3 | 369.3 | 19.1 | 361.3 | 23.7 | 351.7 | 29.4 | 339.7 | 36.3 | 325.2 | 44.7 | 307.6 | 54.6 | 287.0 | **400** |
| **450** | 17.2 | 415.5 | 21.5 | 406.5 | 26.7 | 395.6 | 33.1 | 382.1 | 40.9 | 365.8 | 50.3 | 346.0 | 61.5 | 332.8 | **450** |
| **500** | 19.1 | 461.7 | 23.9 | 451.7 | 29.6 | 439.7 | 36.8 | 424.6 | 45.4 | 406.5 | 55.8 | 384.7 | ... | ... | **500** |
| **560** | 21.4 | 517.2 | 26.7 | 506.1 | 33.2 | 492.4 | 41.2 | 475.6 | 50.8 | 455.5 | ... | ... | ... | ... | **560** |
| **630** | 24.1 | 581.8 | 30.0 | 569.5 | 37.2 | 554.1 | 46.3 | 535.2 | 57.2 | 512.3 | ... | ... | ... | ... | **630** |
| **710** | 27.2 | 655.6 | 33.9 | 641.6 | 42.1 | 624.3 | 52.2 | 603.1 | ... | ... | ... | ... | ... | ... | **710** |
| **800** | 30.6 | 738.8 | 38.1 | 723.0 | 47.4 | 703.2 | 58.8 | 680.0 | ... | ... | ... | ... | ... | ... | **800** |
| **900** | 34.4 | 829.5 | 42.9 | 813.8 | 53.5 | 791.6 | ... | ... | ... | ... | ... | ... | ... | ... | **900** |
| **1000** | 38.2 | 923.0 | 47.7 | 904.2 | 59.3 | 879.8 | ... | ... | ... | ... | ... | ... | ... | ... | **1000** |

# polyethylene pipe dimensions

| SDR | SDR | 7.4 | SDR | 9 | SDR | 11 | SDR | 13.6 | SDR | 17 | SDR | 21 | SDR | 22 | SDR | 26 | SDR | 33 | SDR | 41 | SDR | 51 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PE100 | PN | 25 | PN | 20 | PN | 16 | PN | 12.5 | PN | 10 | PN | 8 | PN | 7.5 | PN | 6.3 | PN | 5.0 | PN | 4.0 | PN | 3.2 |
| PE80 | PN | 20 | PN | 16 | PN | 12.5 | PN | 10 | PN | 7.5 | PN | 6.5 | PN | 6.0 | PN | 5.0 | PN | 4.0 | PN | 3.2 | PN | 2.5 |
| OD mm | s | kg/m | s | kg/m | s | kg/m | s | kg/m | s | kg/m | s | kg/m | s | kg/m | s | kg/m | s | kg/m | s | kg/m | s | kg/m |
| 20 | 3.0 | 0.162 | 2.3 | 0.132 | 2.0 | 0.116 | | | | | | | | | | | | | | | | |
| 25 | 3.5 | 0.240 | 2.8 | 0.199 | 2.3 | 0.170 | 2.0 | 0.148 | | | | | | | | | | | | | | |
| 32 | 4.4 | 0.387 | 3.6 | 0.327 | 3.0 | 0.278 | 2.4 | 0.231 | 2.0 | 0.194 | | | | | | | | | | | | |
| 40 | 5.5 | 0.603 | 4.5 | 0.510 | 3.7 | 0.429 | 3.0 | 0.355 | 2.4 | 0.293 | 2.0 | 0.245 | 1.9 | 0.235 | 1.8 | 0.224 | | | | | | |
| 50 | 6.9 | 0.940 | 5.6 | 0.790 | 4.6 | 0.666 | 3.7 | 0.549 | 3.0 | 0.452 | 2.4 | 0.372 | 2.3 | 0.358 | 2.0 | 0.310 | 1.8 | 0.283 | | | | |
| 63 | 8.6 | 1.479 | 7.1 | 1.263 | 5.8 | 1.054 | 4.7 | 0.875 | 3.8 | 0.720 | 3.0 | 0.577 | 2.9 | 0.560 | 2.5 | 0.491 | 2.0 | 0.395 | 1.8 | 0.359 | | |
| 75 | 10.3 | 2.107 | 8.4 | 1.774 | 6.8 | 1.472 | 5.6 | 1.239 | 4.5 | 1.016 | 3.6 | 0.826 | 3.5 | 0.806 | 2.9 | 0.672 | 2.3 | 0.547 | 1.9 | 0.451 | 1.8 | 0.430 |
| 90 | 12.3 | 3.019 | 10.1 | 2.559 | 8.2 | 2.133 | 6.7 | 1.775 | 5.4 | 1.461 | 4.3 | 1.185 | 4.1 | 1.136 | 3.5 | 0.975 | 2.8 | 0.787 | 2.2 | 0.634 | 1.8 | 0.518 |
| 110 | 15.1 | 4.524 | 12.3 | 3.803 | 10.0 | 3.164 | 8.1 | 2.630 | 6.6 | 2.174 | 5.3 | 1.778 | 5.0 | 1.674 | 4.2 | 1.432 | 3.4 | 1.171 | 2.7 | 0.937 | 2.2 | 0.779 |
| 125 | 17.1 | 5.822 | 14.0 | 4.904 | 11.4 | 4.105 | 9.2 | 3.389 | 7.4 | 2.774 | 6.0 | 2.272 | 5.7 | 2.170 | 4.8 | 1.844 | 3.9 | 1.513 | 3.1 | 1.229 | 2.5 | 0.996 |
| 140 | 19.2 | 7.313 | 15.7 | 6.162 | 12.7 | 5.116 | 10.3 | 4.244 | 8.3 | 3.482 | 6.7 | 2.846 | 6.4 | 2.732 | 5.4 | 2.328 | 4.3 | 1.878 | 3.5 | 1.541 | 2.8 | 1.240 |
| 160 | 21.9 | 9.520 | 17.9 | 8.024 | 14.6 | 6.716 | 11.8 | 5.540 | 9.5 | 4.545 | 7.7 | 3.732 | 7.3 | 3.559 | 6.2 | 3.053 | 4.9 | 2.428 | 4.0 | 1.996 | 3.2 | 1.629 |
| 180 | 24.6 | 12.037 | 20.1 | 10.153 | 16.4 | 8.489 | 13.3 | 7.032 | 10.7 | 5.749 | 8.6 | 4.690 | 8.2 | 4.495 | 6.9 | 3.802 | 5.5 | 3.073 | 4.4 | 2.485 | 3.6 | 2.045 |
| 200 | 27.4 | 14.892 | 22.4 | 12.555 | 18.2 | 10.469 | 14.7 | 8.625 | 11.9 | 7.095 | 9.6 | 5.812 | 9.1 | 5.540 | 7.7 | 4.716 | 6.2 | 3.850 | 4.9 | 3.055 | 3.9 | 2.451 |
| 225 | 30.8 | 18.820 | 25.2 | 15.890 | 20.5 | 13.250 | 16.6 | 10.952 | 13.4 | 8.998 | 10.8 | 7.344 | 10.3 | 7.038 | 8.6 | 5.925 | 6.9 | 4.793 | 5.5 | 3.867 | 4.4 | 3.123 |
| 250 | 34.2 | 23.235 | 27.9 | 19.531 | 22.7 | 16.297 | 18.4 | 13.492 | 14.8 | 11.028 | 11.9 | 8.987 | 11.4 | 8.648 | 9.6 | 7.342 | 7.7 | 5.945 | 6.2 | 4.845 | 4.9 | 3.839 |
| 280 | 38.3 | 29.134 | 31.3 | 24.551 | 25.4 | 20.431 | 20.6 | 16.905 | 16.6 | 13.854 | 13.4 | 11.345 | 12.8 | 10.851 | 10.7 | 9.157 | 8.6 | 7.435 | 6.9 | 6.004 | 5.5 | 4.837 |
| 315 | 43.1 | 36.881 | 35.2 | 31.058 | 28.6 | 25.863 | 23.2 | 21.425 | 18.7 | 17.545 | 15.0 | 14.257 | 14.4 | 13.743 | 12.1 | 11.666 | 9.7 | 9.421 | 7.7 | 7.542 | 6.2 | 6.139 |
| 355 | 48.5 | 46.759 | 39.7 | 39.443 | 32.2 | 32.829 | 26.1 | 27.162 | 21.1 | 22.329 | 16.9 | 18.102 | 16.2 | 17.426 | 13.6 | 14.743 | 10.9 | 11.914 | 8.7 | 9.595 | 7.0 | 7.809 |
| 400 | 54.7 | 59.395 | 44.7 | 50.037 | 36.3 | 41.682 | 29.4 | 34.448 | 23.7 | 28.222 | 19.1 | 23.084 | 18.2 | 22.051 | 15.3 | 18.696 | 12.3 | 15.173 | 9.8 | 12.163 | 7.9 | 9.863 |
| 450 | 61.5 | 75.039 | 50.3 | 63.354 | 40.9 | 52.782 | 33.1 | 43.634 | 26.7 | 35.755 | 21.5 | 29.193 | 20.5 | 27.908 | 17.2 | 23.639 | 13.8 | 19.108 | 11.0 | 15.337 | 8.8 | 12.361 |
| 500 | 68.3 | 92.778 | 55.8 | 78.068 | 45.4 | 65.129 | 36.8 | 53.841 | 29.7 | 44.179 | 23.9 | 36.018 | 22.8 | 34.454 | 19.1 | 29.161 | 15.3 | 23.567 | 12.3 | 19.094 | 9.8 | 15.284 |
| 560 | | | 62.5 | 98.008 | 50.8 | 81.588 | 41.2 | 67.547 | 33.2 | 55.344 | 26.7 | 45.077 | 25.5 | 43.173 | 21.4 | 36.552 | 17.2 | 29.660 | 13.7 | 23.775 | 11.0 | 19.186 |
| 630 | | | | | 57.2 | 103.375 | 46.3 | 85.379 | 37.4 | 70.096 | 30.0 | 56.944 | 28.7 | 54.630 | 24.1 | 46.315 | 19.3 | 37.417 | 15.4 | 30.079 | 12.3 | 24.191 |
| 710 | | | | | 64.5 | 131.404 | 52.2 | 108.468 | 42.1 | 88.981 | 33.9 | 72.505 | 32.3 | 69.318 | 27.2 | 58.873 | 21.8 | 47.555 | 17.4 | 38.277 | 13.9 | 30.518 |
| 800 | | | | | | | 58.8 | 137.691 | 47.4 | 112.781 | 38.1 | 91.901 | 36.4 | 87.984 | 30.6 | 74.563 | 24.5 | 60.241 | 19.6 | 48.537 | 15.7 | 39.105 |
| 900 | | | | | | | 66.1 | 174.193 | 53.3 | 142.664 | 42.9 | 116.282 | 41.0 | 111.385 | 34.4 | 94.307 | 27.6 | 76.306 | 22.0 | 61.221 | 17.6 | 49.313 |
| 1000 | | | | | | | | | 59.3 | 176.451 | 47.7 | 143.664 | 45.5 | 137.407 | 38.2 | 116.366 | 30.6 | 93.986 | 24.5 | 75.803 | 19.6 | 60.993 |
| 1200 | | | | | | | | | 71.1 | 253.678 | 57.2 | 206.778 | 54.6 | 197.800 | 45.9 | 167.601 | 36.7 | 135.204 | 29.4 | 109.123 | 23.5 | 87.726 |
| 1400 | | | | | | | | | | | | | | | 53.5 | 228.000 | 42.9 | 184.000 | 34.3 | 149.000 | | |
| 1600 | | | | | | | | | | | | | | | 61.2 | 298.000 | 49.0 | 241.000 | 39.2 | 194.000 | | |

# What is PE100 HDPE?

**(**HDPE,PE100) or polyethylene High Density(PEDH), also known as black poly or black poly in the industry is a polyethylene thermoplastic made from petroleum . The difference in strength exceeds the difference in density, giving HDPE a higher specific strength.

# Which is better PE80 and PE100?

PE100 offers additional long terms strength and performance over PE80 while allowing for thinner pipe walls for the same operating pressure. PE100 uses less polymer and provides for a larger bore and increased flow capacity.

# Why HPDE pipes are preferred?

HDPE pipe is flexible and ductile, not rigid. It has outstanding resistance to fatigue. Unlike other plastic pipes, it is designed and pressure rated to handle the kind of occasional and recurring surge events that are common in water distribution systems.

# Is HDPE pipe safe for drinking water?

Studies show that HDPE pipes are safe for potable water applications and WL plastics products are certified by NSF on an annual basis. Disinfectants such as chlorine and chloramine are approved for use in HDPE pipe.

# What is the best type of pipe for underground water line?

HDPE (High density polyethylene) pipes are a considered the best choice for underground water lines. What makes this type of piping so great? HDPE pipes are non-toxic, tasteless, and considered to be high crack and corrosion-resistant.

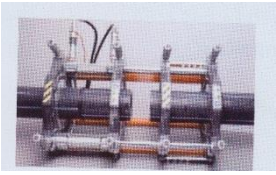
# Can polyethylene pipe be used for hot water?

Polyethylene pipe is ideal for most domestic hot and cold-water plumbing and heating system, offering exceptional durability and long-term performance.

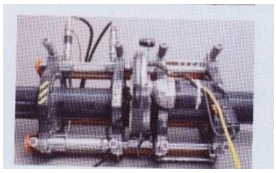
HDPE high density polyethylene plastic has an amazing temperature rang, and is considered safe for short periods up to 248F (120C) or for long periods up to 230F (110C). Since boiling water never gets above (100C), this means that anything boiling and below is safe for a food grade bucket.

# Two type for connection polyethylene pipe

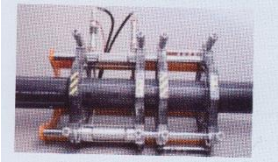
## 1. Butt fusion welding



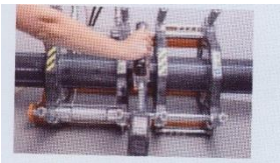
A. Pipe ends on the opposite to the welding zone, must be adequately sealed to avoid air currents during the welding time.



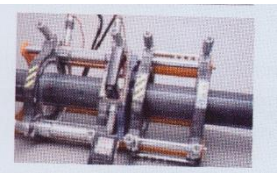
B. Shape and cut the ends of the pipe straight for perfect match of welding zone (milling).



C. Check the alignment after milling, 10% difference in wall thickness is allowed.



D. Preheating of pipes in the welding zone, so that the thermal extension of plastic is accomplished.

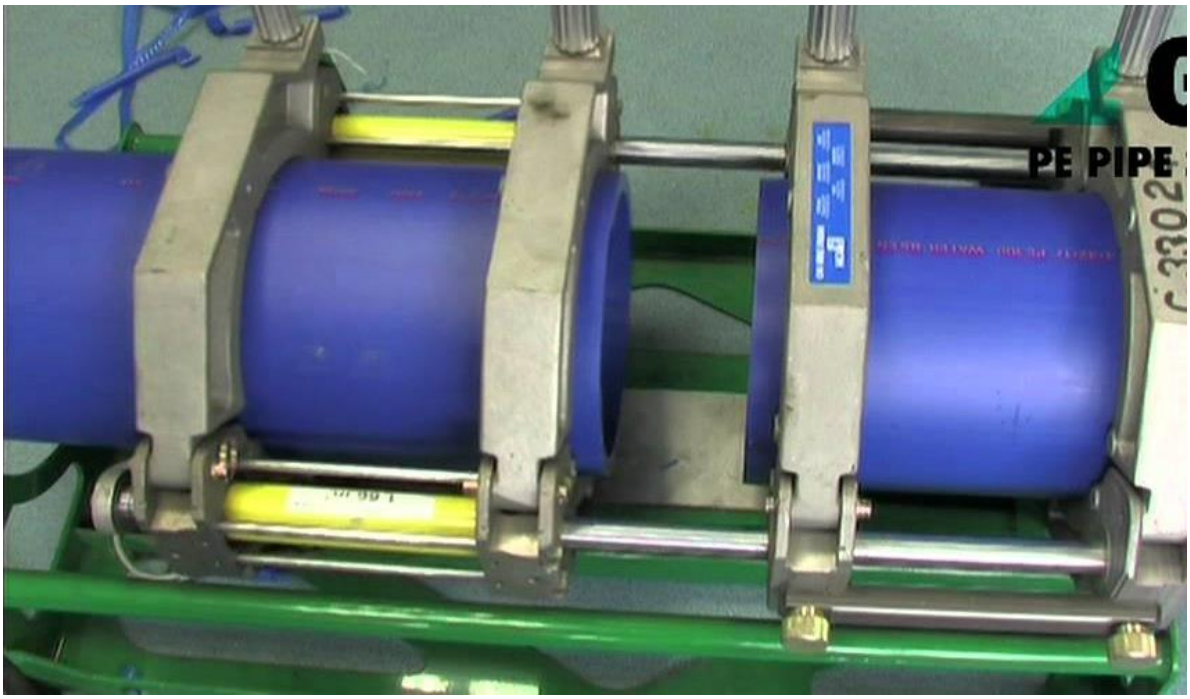


E. Heating of the welding zone at the end of both pipes. After finishing heating processes, the thermo element has to be removed fast and the pipe shall be joined together holding the joining pressure.

F. The weld seam should show a small turn over of the inner layer of the plastic pipe.

After cooling time is over, the pipe can be removed.

Butt fusion machine



Example for butt fusion welding

# 2. Electro fusion welding

The electro fusion machine for welding pipes and fittings is controlled by computer function. Data input is effected manually by reading pencil or by handheld scanner, also manual insertion of the barcode figure is possible. Our electro fusion units have all standard equipment with handheld scanners. (The process is exactly shown in the following picture).

The fusion processing and its controlling is performed fully automatic. The process is as follows.

A. For of an electro fusion joint, the oxide skin on the pipe surface in the welding zone has to be removed with a peeling tool/scanner. The PE pipe skin removed should be 0.2mm, which is already taken in consideration during production process by the outer diameter of pipes and fittings. When the oxide skin is not removed you will not have a pressurized connection.
B. The so scraped welding zone must stay clean .Any dirt, dust or oily substances should be truly avoided. It is recommended to clean the welding area with ethanol>90%.
C. The pipe ends/resp. Fitting have to be marked properly for the joint area to make sure, that the coupler will fit adequately on both ends of the connecting area.
D. To avoid tensions within the welding area, it is recommended to use pipe aligner.
E. Once the coupler is fasted, you have to take the reading pencil or handheld scanner and read the fitting code for the electro fusion machine. When the code is read you hear a peep. The machine now knows the exact melding time automatically (the welding machine has a temperature control device that adapts the welding time to the outer temperature).
F. When the specific product welding time has passed by the machine makes a peep again, so you know the cooling time starts. The welding zone is cooling down under the melting point. The cooling time is printed on each fitting/fitting code to ensure proper field installation.

G. The fitting and the pipe are now permanently jointed to each other and form a piping system which can now be pressurized and maintained for 100 years.


Contact, to be connected with the cable connector

# Welding produce electro fusion (Part 1)

1. Check your equipment and that you have the correct PE pipe diameter for the joint.

Pipe ends should be sealed during the welding process to avoid air currents a and straight sunlight.

2. The protective packaging should be intact and sealed, check diameter and SDR11 class, to make sure that you have the right fitting, the surface has to be smooth and uniform, coils (of wire) have to be regular.

3. The pipe should be right angles, clean and even, no kindling or splinter.

4. The welding area is the insertion part of the fitting,(when you have coupler, it is half size).

Mark the welding area, which must be sraped (remove the oxide skin of the pipe).

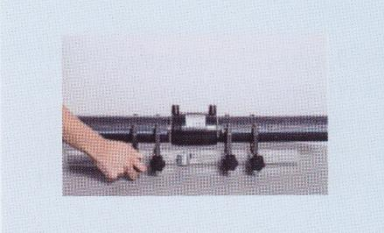
5.There is a variety of scraper tools-make sure that the scraper has the correct diameter range and that only a maximum of 2/10mm is scraped.

6.The PE cleaner has to be used to ensure that the welding area is clean, no grease or dust

The fluid of the cleaner is volatile, nevertheless do not pour cleaner directly on pipe or fitting, use tissues.

# Welding produce electro fusion (Part 2)

1.Make  sure, that the joining area of the fitting is marked properly.



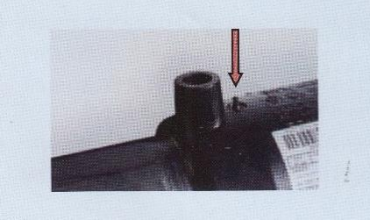
2. Aligner/fastener for the welding zone should keep parts tight and fixed during the welding

Aligner can be removed after cooling time is over.

3. Power generator and extension cable have to be sized properly-the fitting bar code contents all information required for the welding process and is ready by scanner.

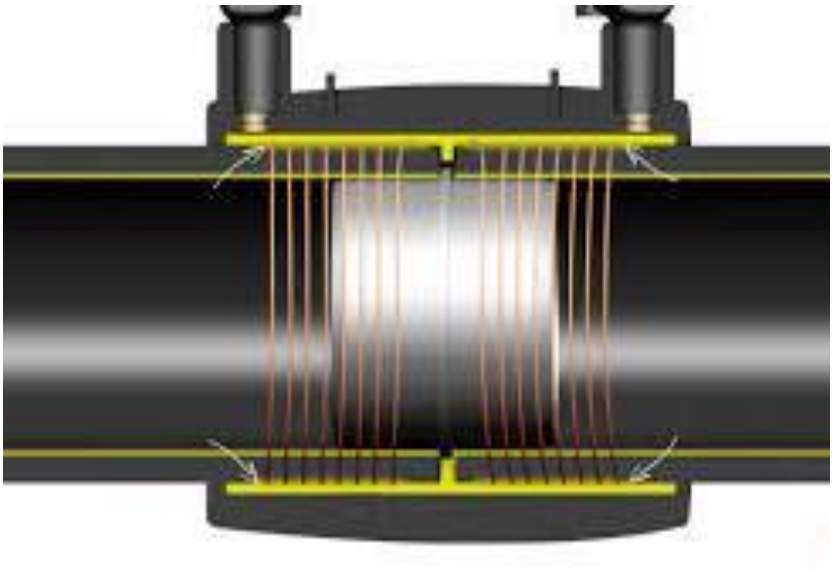
4.Performance the required controls initiated by the electro fusion machine and start the welding process.

5.During the welding process, fitting and pipe should not be removed, in case there is a power break down, wait until the fitting is cool again and then restart the process.



6.The fusion indicator regularly shows up to give you final control, that welding has occurred.


Elector fusion machine



Example for elector fusion welding