1. What is DOWLEX™ PE-RT?

DOWLEX™ Polyethylene of Raised Temperature Resistance (PE-RT) is an advanced type of polyethylene which benefits from the latest Dow technology (constrained geometry catalyst, polymerization solution technology and ethylene-octene comonomer) to add extra performance characteristics such as enhanced strength at high temperatures to the traditional properties of polyethylene. The family of DOWLEX™ PE-RT Resins has a proven track record of close to 30 years for delivering excellent performance in pipe applications. Over two million kilometers of pipes have been produced using DOWLEX™ PE-RT Resins.

2. What are the recommended uses for DOWLEX™ PE-RT?

Because of its enhanced mechanical properties at elevated temperature, PE-RT resins can be used in all hot water & heat distribution applications (ISO 10508 Service Conditions including Class V). PE-RT Type I is a suitable choice for underfloor heating applications, and PE-RT Type II is a material of choice for the more demanding applications like radiator heating and drinking water, either monolithic or as a multilayer pipe combined with aluminum.

In 2010, the hot and cold water pipe market is estimated at around 1.6 billion meters in Western Europe, with less than half of the materials used being the traditional materials such as copper - see Graph I for reference. Within the plastics that are used, PE-RT has a market share of 43% in Western Europe in 2010 (see Graph II).

3. Is DOWLEX™ PE-RT suitable for multilayer applications?

Yes. PE-RT is both used as a protective outside layer and as a stress carrying inside layer in five-layer plastic pipes (PE-RT/ adhesive/ EVOH/ adhesive/PE-RT) for underfloor heating systems. It can also be used in five-layer metal pipes in conjunction with Aluminum or Stainless Steel and AMPLIFY™ Functional Polymer adhesives to produce higher performing pipes for the more demanding applications.

4. What are the technical benefits of DOWLEX™ PE-RT resins?

As a leader in technology innovation, Dow employs around 5,800 R&D professionals in 41 major R&D sites and laboratories around the world. Having an annual R&D budget of well over $1 billion helped us develop DOWLEX™ PE-RT resins that have several technical benefits including excellent long term performance at high temperatures, greater flexibility than other materials and excellent organoleptics.

5. Is it true that choosing DOWLEX™ PE-RT resins is a cost effective option all along the value chain?

When customers choose to work with Dow, they can tap into competitive advantages of integration, global reach with a local presence, market knowledge and a depth of technological innovation and experience. That is why Dow can create a material such as DOWLEX™ PE-RT which has no need to crosslink or x-link, has excellent processability without processing aids, no loss of start up material as regrind can be reused, and easy installation in terms of flexibility and weldability.

6. What are the environmental and safety benefits of using DOWLEX™ PE-RT multi-layer pipes?

Producing sustainable products with environmental and safety benefits is a high priority for Dow because it is consistent with the values of our people and our values as a company, and also because it is a platform for unprecedented growth, profitability and competitiveness in the coming century. PE-RT in multi-layer pipe helps protect aluminum from corrosion. There are no chemicals for compounds used during the production of PE-RT pipe. DOWLEX™ PE-RT Resins have an environmentally friendly stabilization package and are compliant with most drinking water regulations worldwide. DOWLEX™ 2344 and DOWLEX™ 2388 have an excellent surface smoothness and meets food approval regulations including EU and FDA requirements.

7. Is it true that DOWLEX™ PE-RT pipes continue to exhibit excellent performance in ISO 9080 hydrostatic stress rupture curves at 10,000 hours?

We drive innovations that help meet major human challenges through rigorous testing and design excellence. That is why DOWLEX™ PE-RT resins exhibit excellent hoop stress performance at elevated temperatures, making them well suited for use in hot and cold water pipe systems. Independent hoop stress tests conducted on DOWLEX™ 2344 and DOWLEX™

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Graph I: Total Hot and Cold Water Pipe market in Western Europe (1.6 billion meters)  
Source: KWD and Dow data

Graph II: Polymer split - Heating & Plumbing Pipe Market in 2010  
Source: KWD and Dow data

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2388 PE-RT resin at 20°C, 80°C, 95°C and 110°C consistently show no knee in hydrostatic stress rupture curves before 10,000 hours.

8. Are DOWLEX™ PE-RT pipe systems eligible for CE marking?

Yes. In 2005, underfloor heating systems and radiator connections made from DOWLEX™ 2344 PE-RT Type I plastic pipes were awarded a European Technical Approval (“ETA”) - signified by the “CE” mark quality standard. This was the first time any pipe system had been awarded an ETA. It is also applicable for DOWLEX™ 2388 as Type II. The ETAs are based on the CUAPS (Common Understanding Assessment Procedure), which have been defined for both classes of PE-RT.

9. Where are DOWLEX™ PE-RT pipes available?

Dow has a remarkable history of product and technical innovation. As such, DOWLEX™ PE-RT resins are available globally from Dow. Monolithic and multilayer pipe made with DOWLEX™ PE-RT resins are available from leading pipe distributors. For a complete list of distributors or direct sales contact with Dow and for more information on the products, please contact Dow in Europe at 0800 3 694 6367 (tollfree) or +32 3 450 2240. You can also visit www.plasticpipes.com.

10. What are the classifications of the different DOWLEX™ PE-RT pipe resins?

- DOWLEX™ 2344 PE-RT Type I (ISO 24033 and ISO 22391)
- DOWLEX™ 2377 PE-RT Type II (ISO 24033 and ISO 22391), but it is targeted at industrial applications with project specific requirements, e.g. the expected lifetime might be less than 50 years - which results in a higher operating temperature (e.g. EN 15632-2 or ISO 15494).
- DOWLEX™ 2388 PE-RT Type II (ISO 24033 and ISO 22391)
DOWLEX™ 2388 (PE-RT Type II)

ISO 9080 – Evaluation

4-Parameter Model

\[
\log(t_f) = C_1 + C_2 \log(T_i) + C_3 + \frac{1}{T_i} + C_4 \log(\sigma_i) + C_5 \frac{\log(\sigma_i)}{T_i}
\]

Strength Values

- MRS (20°C, 50 years) 9.77 MPa
- CRS (60°C, 50 years) 6.51 MPa
- CRS (70°C, 50 years) 5.64 MPa

Miner’s Rule – ISO 13760

Balancing time required to make the service life equal to 50 years shall be at 20°C:

\[
\frac{1}{t_f} = \sum_i \left[ \frac{t_i}{t_f} \right] \left( \frac{1}{T_i} + C_5 \log(\sigma_i) \right)
\]

To see an enlarged version, visit the literature section at www.plasticpipes.com.
Operating Conditions
When extruding DOWLEX™ PE Resins specifically for pipe applications, the following heater settings are suggested for a 60 mm barrel extruder with six zones and using a conventional PE screw:

- Often, with DOWLEX™ Resins, it is advantageous to run a so-called “reverse temperature profile.” This is especially recommended when a screw with a high compression ratio (3 or above) is used. Example: 180-250-240-230-230-230°C (356-482-464-446-446-446°F).
- For DOWLEX™ 2388 Resin, the temperature profile can be reduced by 10°C.

Generally, if the melt exiting the die is not clear and transparent, the pipe will not have a glossy surface. The temperatures should then be gradually increased, though not beyond 240°C (464°F) melt temperature. Normally, the optimum melt temperature will be between 220°C and 240°C (428-464°F).

Although these temperature settings are considered typical, they may vary depending upon individual manufacturing circumstances such as extruder type and size, die design, particular type of screw design, and other processing conditions.

The equipment and extrusion conditions presented in this guide are known to be capable of extruding acceptable high performance pipe. Although other equipment and processing parameters may also produce quality pipe, final judgment must be made on each individual set-up and be confirmed by appropriate product testing.

Backpressure and Filter Packs
DOWLEX™ PE Resins are known to create higher backpressure than LDPE or HDPE. This is normal and to be expected because of the narrow molecular weight distribution.

A fine screen mesh filter pack (80 mesh) is suggested. The level of the obtained backpressure is dependent on the screw design and speed, but typical pressures observed are around 200 bar.

Die
DOWLEX™ PE Resins require a large die gap than do traditional polyolefins. A die gap 1.75x-2.5x of the final wall thickness of the pipe is suggested. A pin diameter of 1.3x-1.4x of the outside diameter of the finished pipe is also suggested.

Barrier Coatings
A number of countries specify the use of a barrier coating on hot water pipes. Ethylene-vinyl alcohol (EVOH) remains one of the most widely used products. EVOH, however, is moisture sensitive and has poor adhesion to all types of PE and, therefore, needs a tie layer coating to the pipe. Preferably, an outside protective coating of two to three layers of a DOWLEX™ Resin coextruded onto the pipe should also be considered.

Coloring
Ideally, color masterbatches should be based on the same DOWLEX™ Resin as specified in the application. Any pigments based with iron oxides, copper, or manganese must be avoided. Special care must also be taken with TiO2 (whitening agent); only rutile types, neutralized and coated, can be permitted.

Multilayer (Composite) Pipe
Multilayer coextrusion is standard practice in the pipe industry, typically using an adhesive polymer layer to tie inside and outside PE layers to a central aluminum tube. All DOWLEX™ Resins used for pipe applications are also very well suited for such composite pipe applications. Specifically, DOWLEX™ 2377 and DOWLEX™ 2388 Resins can provide excellent processing behavior.

Experts With Answers
For further information regarding DOWLEX™ Polyethylene Resins and their use in extruding pipe, you may contact your Technical Service and Development (TS&D) representative, or go online at www.dow.com, or use any of the additional contact information found on the back of this literature. In person, over the phone, or on the web, Dow has the experts with answers to assist you.
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