Prix à la consommation des produits pétroliers droits et taxes compris
Consumer prices of petroleum products inclusive of duties and taxes
Verbraucherpreise für Mineralölerzeugnisse einschließlich Abgaben und Steuern

Prix en vigueur au
Prices in force on
Preise geltend am

27/08/2012

In national currency					
	Euro-super 95 (I) 1000L	Gas oil automobile Automotive gas oil Dieselkraftstoff (I) 1000L	Gasoil de chauffage Heating gas oil Heizöl (II) 1000L	Fuel oil - Schweres Heizöl (III) Soufre <= 1% Sulphur <= 1% Schwefel <= 1% t	Fuel oil - Schweres Heizöl (III) Soufre > 1% Sulphur > 1% Schwefel > 1% t
Bulgaria (BGN)	2,612.40	2,596.80	1,952.40		
Czech Republic (CZK)	38,035.00	37,208.00	25,054.00	11,809.00	
Denmark (DKK)	13,270.00	11,530.00	11,632.00	8,188.00	
Hungary (HUF)	433,799.53	434,684.88	434,684.88	169,864.00	
Latvia (LVL)	1,022.00	982.00	717.01		
Lithuania (LTL)	5,077.34	4,749.20	3,157.00		1,847.96
Poland (PLN)	5,831.40	5,728.18	4,079.96	2,626.05	2,321.54
Romania (RON)	5,964.52	6,085.20	5,616.00	2,964.50	
Sweden (SEK)	15,345.00	14,741.00	12,626.00	9,921.00	
United Kingdom (GBP)	1,370.98	1,421.69	731.92		

European Commission - Energy Policy

Prix à la consommation des produits pétroliers droits et taxes compris
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Prix en vigueur au
Prices in force on
Preise geltend am

27/08/2012

En/In EURO

	Euro-super 95 (I) 1000L	Gas oil automobile Automotive gas oil Dieselkraftstoff (I) 1000L	Gasoil de chauffage Heating gas oil Heizöl (II) 1000L	Fuel oil - Schweres Heizöl (III) Soufre <= 1% Sulphur <= 1% Schwefel <= 1% t	Fuel oil - Schweres Heizöl (III) Soufre > 1% Sulphur > 1% Schwefel > 1% t
Austria	1,520.00	1,457.00	1,039.71	685.70	
Belgium	1,706.10	1,505.40	940.10	581.96	
Bulgaria	1,335.72	1,327.74	998.26		
Cyprus	1,361.79	1,386.23	1,062.90	703.57	
Czech Republic	1,530.89	1,497.61	1,008.41	475.31	
Denmark	1,781.61	1,548.00	1,561.70	1,099.31	
Estonia	1,419.00	1,405.00	1,070.00		
Finland	1,742.00	1,582.00	1,197.00		
France	1,648.20	1,459.20	996.10	645.54	
Germany	1,750.00	1,561.00	973.90		
Greece	1,838.00	1,597.00	1,480.43	697.30	
Hungary	1,562.40	1,565.59	1,565.59	611.79	
Ireland	1,647.38	1,561.02	1,159.91	933.88	
Italy	1,870.13	1,759.24	1,499.63	673.31	
Latvia	1,467.76	1,410.31	1,029.74		
Lithuania	1,470.50	1,375.46	914.33		535.21
Luxembourg	1,453.79	1,319.85	867.13		
Malta	1,449.00	1,350.00	1,035.00		
Netherlands	1,808.00	1,475.00	870.00	603.00	
Poland	1,429.97	1,404.65	1,000.48	643.96	569.28
Portugal	1,710.00	1,497.00	1,333.00	808.85	
Romania	1,334.94	1,361.95	1,256.94	663.50	
Slovakia	1,582.00	1,452.00		726.15	719.51
Slovenia	1,562.00	1,429.00	1,059.00	686.02	
Spain	1,512.62	1,422.83	985.57	608.08	
Sweden	1,862.33	1,789.02	1,532.34	1,204.05	
United Kingdom	1,730.07	1,794.07	923.63		
CE/EC/EG EUR 27 (IV) Moyenne pondérée Weighted average Gewichteter Durchschnitt	**1,701.22**	**1,548.30**	**1,059.45**	**723.79**	**551.74**
CE/EC/EG Euro Area 17 (€) (V) Moyenne pondérée € Weighted average € Gewichteter Durchschnitt €	**1,727.45**	**1,529.31**	**1,044.23**	**668.87**	**719.51**

Other petroleum products	In National Currency	In/En EURO

Lead Substitute Petrol (1000L) (I)

Czech Republic (CZK)	37,069.00	1,492.01
Greece (EUR)		1,901.00

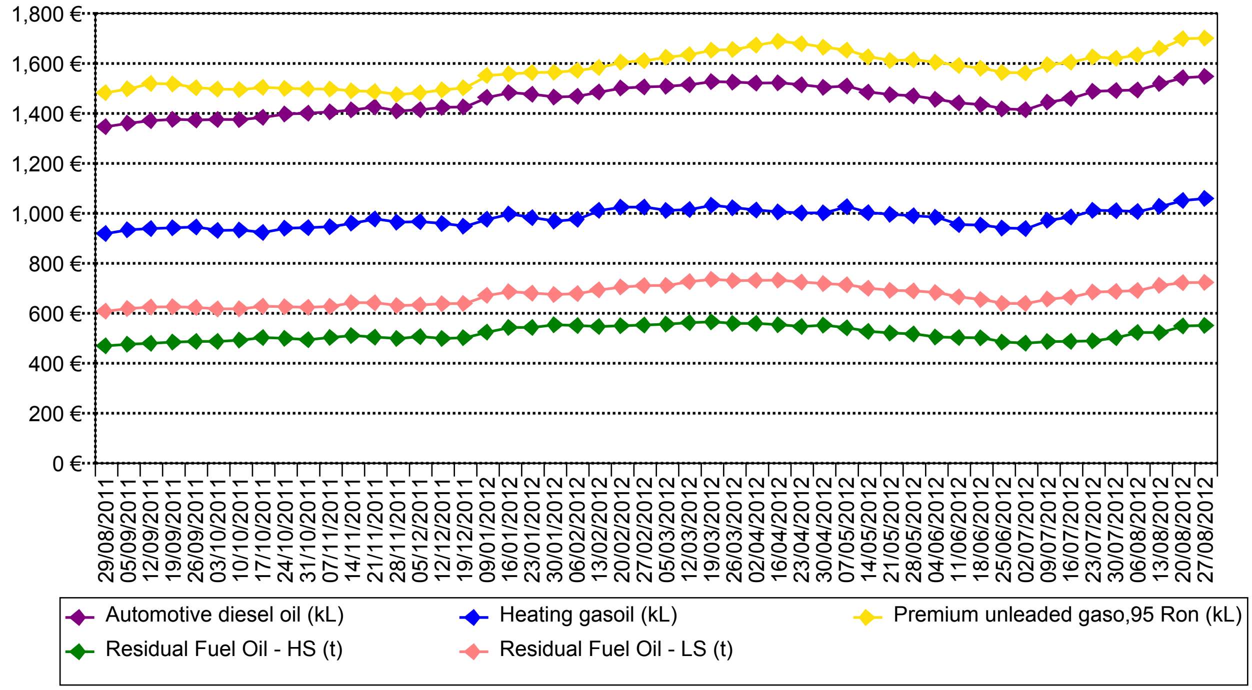
LPG - motor fuel (1000L) (I)

Belgium (EUR)		733.00
Bulgaria (BGN)	1,180.45	603.56
Czech Republic (CZK)	16,955.00	682.43
Estonia (EUR)		780.00
France (EUR)		868.90
Germany (EUR)		761.36
Hungary (HUF)	250,697.03	902.92
Italy (EUR)		789.36
Latvia (LVL)	431.00	618.99
Lithuania (LTL)	2,290.32	663.32
Luxembourg (EUR)		666.87
Netherlands (EUR)		752.00
Poland (PLN)	2,690.50	659.76
Portugal (EUR)		774.00
Romania (RON)	3,033.10	678.85
Slovakia (EUR)		730.00
Slovenia (EUR)		808.22
Spain (EUR)		741.62

Standard Grade Burning Oil UK (1000L) (II)

United Kingdom (GBP)	603.26	761.27

MOYENNE PONDEREE - EUR 27
WEIGHTED AVERAGE - EUR 27
GEWICHTETER DURCHSCHNITT - EUR 27



Euro exchange rate		
Bulgaria	BGN	1.95580
Czech Republic	CZK	24.84500
Denmark	DKK	7.44830
Hungary	HUF	277.65000
Latvia	LVL	0.69630
Lithuania	LTL	3.45280
Poland	PLN	4.07800
Romania	RON	4.46800
Sweden	SEK	8.23970
United Kingdom	GBP	0.79244

(I) Pump prices

(II) Delivered consumer prices for deliveries of 2 000 to 5 000 litres (for offtakes of less than 2 000 litres the industrial sector may be taken into consideration)

(III) Delivered consumer prices for offtakes of less than 2 000 tonnes per month or less than 24 000 tonnes per year (for Ireland, deliveries of 500 to 1 000 tonnes per month)

The prices inclusive of duties and taxes are VAT excluded

(IV) Average resulting from the weighting of the quantities consumed during the year 2010 (EUR 27/EUR 25)

(V) Average resulting from the weighting of the quantities consumed during the year 2010 (EUROLAND)

The prices communicated by the Member States are the prices most frequently charged, based on a weighted average.

Comparisons between prices and price trends in different countries shall be carefully made. They are of limited validity because of differences in product quality, in marketing practices, in market structures, and to the extent that standard categories are representative of the total sales of a given product.

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I. DISPOSICIONES GENERALES

MINISTERIO DE INDUSTRIA, ENERGÍA Y TURISMO

12197 *Resolución de 27 de septiembre de 2012, de la Dirección General de Política Energética y Minas, por la que se establece el coste de producción de energía eléctrica y las tarifas de último recurso a aplicar a partir del 1 de octubre de 2012.*

El Real Decreto 485/2009, de 3 de abril, por el que se regula la puesta en marcha del suministro de último recurso en el sector de la energía eléctrica establece en su artículo 7.2 que el Ministro de Industria, Turismo y Comercio, mediante orden ministerial, previo Acuerdo de la Comisión Delegada del Gobierno para Asuntos Económicos, dictará las disposiciones necesarias para el establecimiento de las tarifas de último recurso determinando su estructura de forma coherente con los peajes de acceso. A estos efectos el Ministro de Industria, Energía y Turismo podrá revisar la estructura de peajes de acceso de baja tensión para adaptarlas a las tarifas de último recurso y asegurar la aditividad de las mismas.

El artículo 7.3 del Real Decreto 485/2009, de 3 de abril, dispone que la Dirección General de Política Energética y Minas revisará al menos semestralmente el coste de producción de energía eléctrica aplicando la metodología establecida en el mismo. Este coste será el que de forma automática integrará la Dirección General de Política Energética y Minas en la revisión de las tarifas de último recurso a los efectos de asegurar su aditividad.

La Orden ITC/1659/2009, de 22 de junio, por la que se establece el mecanismo de traspaso de clientes del mercado a tarifa al suministro de último recurso de energía eléctrica y el procedimiento de cálculo y estructura de las tarifas de último recurso de energía eléctrica, con las modificaciones introducidas en la Orden ITC/1601/2010, de 11 de junio, por la que se regulan las subastas CESUR a que se refiere la Orden ITC/1659/2009, de 22 de junio, a los efectos de la determinación del coste estimado de los contratos mayoristas para el cálculo de la tarifa de último recurso, desarrolla las previsiones del citado artículo 7 del Real Decreto 485/2009, de 3 de abril, estableciendo la estructura de las tarifas de último recurso aplicables a los consumidores de baja tensión con potencia contratada hasta 10 kW, y sus peajes de acceso correspondientes.

Asimismo, fija el procedimiento de cálculo del coste de producción de energía eléctrica que incluirán las tarifas de último recurso y los costes de comercialización que le corresponden a cada una de ellas, de tal forma que se respete el principio de aditividad que exige la norma, posibilitando su revisión de forma automática conforme establece el artículo 7.3 del Real Decreto 485/2009, de 3 de abril.

En el capítulo IV de la citada Orden se determina la estructura de la tarifa de último recurso, constituida por un término de potencia que será el término de potencia del peaje de acceso más el margen de comercialización fijo y un término de energía que será igual a la suma del término de energía del correspondiente peaje de acceso y el coste estimado de la energía. De igual forma, se fija el procedimiento para determinar el coste estimado de la energía, que se calcula como suma del coste estimado en el mercado diario afectado, en su caso, de la prima por riesgo al que se encuentra sujeto el comercializador de último recurso de acuerdo con la política de compras de contratos, el sobrecoste de los servicios de ajuste del sistema y el pago por capacidad de generación correspondiente al consumo, todo ello afectado de los coeficientes de pérdidas estándares establecidos en la normativa para elevar a barras de central el consumo leído en el contador del consumidor.

En la disposición transitoria tercera de la citada Orden ITC/1659/2009, de 22 de junio, se fijan los valores iniciales del margen de comercialización fijo a aplicar en el cálculo de

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la tarifa de último recurso a partir de 1 de julio de 2009, siendo este valor el considerado en el cálculo de las tarifas para el suministro de último recurso en vigor durante el cuarto trimestre de 2012.

Por otro lado, el Real Decreto 647/2011, de 9 de mayo, por el que se regula la actividad de gestor de cargas del sistema para la realización de servicios de recarga energética, crea los peajes de acceso con una nueva modalidad de discriminación horaria que contempla el periodo supervalle. Por ello, en su disposición final primera modifica la mencionada Orden ITC/1659/2009, de 22 de junio, con el fin de incluir esta modalidad de discriminación horaria supervalle en la propia tarifa de último recurso, y realizar asimismo la adaptación necesaria en el procedimiento de cálculo del coste estimado de la energía para permitir su cálculo.

La Orden IET/3586/2011, de 30 de diciembre, por la que se establecen los peajes de acceso a partir de 1 de enero de 2012 y las tarifas y primas de las instalaciones del régimen especial, determina en su disposición adicional cuarta que la prima por riesgo (PRp) utilizada para la determinación del coste estimado de la energía en base a lo dispuesto en los artículos 9 y 13 de la Orden ITC/1659/2009, de 22 de junio, por la que se establece el mecanismo de traspaso de clientes del mercado a tarifa al suministro de último recurso de energía eléctrica y el procedimiento de cálculo y estructura de las tarifas de último recurso de energía eléctrica, tomará un valor nulo al aplicar el procedimiento de cálculo de las tarifas de último recurso que estén vigentes en cada momento a partir de 1 de enero de 2012.

Asimismo, el artículo 6.3 de la citada Orden IET/3586/2011, de 30 de diciembre, recoge la cuantía que los comercializadores que actúen en el ámbito del Mercado Ibérico de la Electricidad pagarán al Operador del Mercado, estableciéndola en 0,0244 euros por cada MWh que figure en el último programa horario final de cada hora.

Por su parte, en virtud de la habilitación otorgada por la disposición transitoria quinta del Real Decreto-ley 13/2012, de 30 de marzo, por el que se transponen directivas en materia de mercados interiores de electricidad y gas y en materia de comunicaciones electrónicas, y por el que se adoptan medidas para la corrección de las desviaciones por desajustes entre los costes e ingresos de los sectores eléctrico y gasista, la Orden IET/843/2012, de 25 de abril, por la que se establecen los peajes de acceso a partir de 1 de abril de 2012 y determinadas tarifas y primas de las instalaciones del régimen especial, establece en su disposición adicional octava que el Operador del Sistema se financiará a partir de los precios que cobre a los sujetos del sistema, fijando en 0,0665 euros por cada MWh que figure en el último programa horario operativo de cada hora la cuantía que tendrán que pagar al Operador del Sistema los comercializadores que actúen en el ámbito geográfico nacional, a partir de 1 de junio de 2012.

Vista la Orden IET/3586/2011, de 30 de diciembre, por la que se establecen los peajes de acceso a partir de 1 de enero de 2012 y las tarifas y primas de las instalaciones del régimen especial.

Vista la Orden IET/843/2012, de 25 de abril, por la que se establecen los peajes de acceso a partir de 1 de abril de 2012 y determinadas tarifas y primas de las instalaciones del régimen especial.

En el artículo 3 y anexo II de dicha orden se establecen los precios de los términos de potencia y energía activa de los peajes de acceso aplicables a partir de 1 de abril de 2012 a tensiones no superiores a 1 kV y con potencia contratada menor o igual a 10 kW denominados 2.0A (sin discriminación horaria), 2.0DHA (con discriminación horaria) y 2.0DHS (con discriminación horaria supervalle).

Visto el apartado 2 del artículo 9 de la Orden ITC/1659/2009, de 22 de junio, según la redacción dada por la disposición final segunda de la Orden IET/843/2012, de 25 de abril, en el que se especifica que en el cálculo del coste estimado de la energía se incluirán como términos las cuantías que correspondan al pago de los comercializadores para la financiación de la retribución del Operador del Mercado Ibérico de Energía, Polo Español y al Operador del Sistema, según la normativa de aplicación vigente en cada momento.

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Vistos los resultados de la subasta CESUR celebrada el día 25 de septiembre de 2012, validada por la Comisión Nacional de Energía, en la que el coste de los contratos mayoristas con entrega en el bloque de base para el cuarto trimestre de 2012 ha resultado de 49,25 Euros/MWh, y el coste de los contratos mayoristas con entrega en el bloque de punta para el cuarto trimestre de 2012 ha resultado de 54,25 Euros/MWh.

Vista la disposición adicional tercera de la Orden ITC/1659/2009, de 22 de junio, y la propuesta enviada por la Comisión Nacional de Energía en virtud de dicha disposición.

Esta Dirección General de Política Energética y Minas resuelve:

Primero.

Aprobar los precios del coste de producción de energía eléctrica que incluirán las tarifas de último recurso a partir de 1 de octubre de 2012, fijando sus valores en cada periodo tarifario, expresados en euros/MWh, en los siguientes:

a) Tarifa de último recurso sin discriminación horaria y con discriminación horaria de dos periodos:

– CE_0 = 76,58 Euros/MWh.
– CE_1 = 81,84 Euros/MWh.
– CE_2 = 55,62 Euros/MWh.

b) Tarifa de último recurso con discriminación horaria supervalle:

– CE_1 = 82,85 Euros/MWh.
– CE_2 = 65,97 Euros/MWh.
– CE_3 = 49,07 Euros/MWh.

Los parámetros utilizados para el cálculo de dichos valores son los recogidos en los anexos de la presente resolución.

Segundo.

Aprobar los precios del término de potencia y del término de energía activa de las tarifas de último recurso aplicables a partir del 1 de octubre 2012, fijando sus valores en los siguientes:

– Término de potencia:

TPU = 21,893189 Euros/kW y año.

– Término de energía: TEU.

• Modalidad sin discriminación horaria:

TEU_0= 0,145578 Euros/kWh.

• Modalidad con discriminación horaria de dos periodos:

TEU_1= 0,178438 Euros/kWh.
TEU_2= 0,059070 Euros/kWh.

• Modalidad con discriminación horaria supervalle:

TEU_1= 0,179448 Euros/kWh.
TEU_2= 0,070800 Euros/kWh.
TEU_3= 0,050795 Euros/kWh.

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Tercero.

Lo dispuesto en el apartado primero y segundo de la presente resolución será de aplicación para los consumos efectuados a partir de las cero horas del día 1 de octubre de 2012.

Cuarto.

Contra la presente Resolución cabe interponer recurso de alzada ante el Secretario de Estado de Energía, en el plazo de un mes, de acuerdo con lo establecido en la Ley 30/1992, de 26 de noviembre, de Régimen Jurídico de las Administraciones Públicas y del Procedimiento Administrativo Común, modificada por la Ley 4/1999, de 13 de enero, y en el artículo 14.7 de la Ley 6/1997, de 14 de abril, de Organización y Funcionamiento de la Administración General del Estado.

Madrid, 27 de septiembre de 2012.–El Director General de Política Energética y Minas, Jaime Suárez Pérez-Lucas.

ANEXO I

Tarifa de último recurso sin discriminación horaria y con discriminación horaria de dos periodos

1. Los valores tanto de los sobrecostes de apuntamiento para el consumo como de la energía suministrada en cada uno de los periodos tarifarios p y para cada tipo de horas (punta, valle) necesarios para el cálculo de los valores estimados del coste de la energía en el mercado diario con entrega en cada periodo tarifario p (CEMDp), se han obtenido según lo establecido en el artículo 10 de la Orden ITC/1659/2009, de 22 de junio, considerando como perfiles iniciales los aprobados por Resolución de 15 de diciembre de 2010, de la Dirección General de Política Energética y Minas, por la que se aprueba el perfil de consumo y el método de cálculo a efectos de liquidación de energía, aplicables para aquellos consumidores tipo 4 y tipo 5 que no dispongan de registro horario de consumo, así como aquellos que han pasado de ser tipo 4 a tipo 3, según el Real Decreto 1110/2007, de 24 de agosto, por el que se aprueba el Reglamento unificado de puntos de medida del sistema eléctrico, para el año 2011.

Los valores obtenidos son los que se señalan a continuación:

	Periodo 0	Periodo 1	Periodo 2
αp,valle	1,078673	1,191979	0,933362
αp,punta	1,000877	0,995479	0,991683
Ep,valle	0,162996349	0,036087446	0,20757135
Ep,punta	0,104699212	0,041306368	0,023033406

2. Los valores resultantes del coste estimado de la energía en el mercado diario con entrega en cada periodo tarifario p (CEMDp), calculados según lo dispuesto en el artículo 10 de la Orden ITC/1659/2009, de 22 de junio, son los siguientes:

Coste estimado de la energía en el mercado diario (Euros/MWh)	Periodo 0	Periodo 1	Periodo 2
CEMDp	51,75	54,64	44,4

Para el cálculo del número de horas de los contratos mayoristas en el bloque de base (NHbase) y de punta (NHpunta) utilizados para la obtención del coste de los contratos mayoristas con entrega en el bloque de valle (CCvalle) se han considerado como perfiles

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iniciales los aprobados por Resolución de 29 de diciembre de 2011, de la Dirección General de Política Energética y Minas, por la que se aprueba el perfil de consumo y el método de cálculo a efectos de liquidación de energía, aplicables para aquellos consumidores tipo 4 y tipo 5 que no dispongan de registro horario de consumo, así como aquellos que han pasado de ser tipo 4 a tipo 3, según el Real Decreto 1110/2007, de 24 de agosto, por el que se aprueba el Reglamento unificado de puntos de medida del sistema eléctrico, para el año 2012.

3. Los valores del sobrecoste de los servicios de ajuste del sistema asociados al suministro en el periodo tarifario p, calculados según lo establecido en el artículo 12 de la Orden ITC/1659/2009, de 22 de junio, son los siguientes:

Sobrecoste de los servicios de ajuste (Euros/MWh)	Periodo 0	Periodo 1	Periodo 2
SAp.	5,52	6,45	4,05

4. Los valores de la prima por riesgo asociado a cada periodo tarifario son los siguientes:

Prima de riesgo (%)	Periodo 0	Periodo 1	Periodo 2
PRp.	0,00	0,00	0,00

5. El valor del pago por capacidad de generación (CAPp) correspondiente al consumo en cada período tarifario p es el contemplado para las tarifas de acceso 2.0A (periodo 0) y 2.0 DHA (periodos 1 y 2) en la disposición adicional cuarta de la Orden ITC/3353/2010, de 28 de diciembre, por la que se establecen los peajes de acceso a partir de 1 de enero de 2011 y las tarifas y primas de las instalaciones del régimen especial:

Pago por capacidad (€/kWh b.c.)	Periodo 0	Periodo 1	Periodo 2
CAPp	0,009812	0,010110	0,001706

6. Los coeficientes de pérdidas estándares para elevar a barras de central el consumo leído en contador del consumidor en el periodo tarifario p, son los establecidos para las tarifas y peajes sin discriminación horaria (periodo 0) y con discriminación horaria (periodos 1 y 2) en el anexo V de la Orden IET/3586/2011, de 28 de diciembre, por la que se revisan los peajes de acceso a partir de 1 de enero de 2012 y las tarifas y primas de las instalaciones del régimen especial.

Coeficiente de pérdidas (%)	Periodo 0	Periodo 1	Periodo 2
PERDp	14	14,8	10,7

7. El coste estimado de la energía a partir de 1 de octubre de 2012 para cada periodo tarifario, calculado de acuerdo al artículo 9 de la Orden ITC/1659/2009, de 22 de junio, es el siguiente:

Coste estimado de la energía (Euros/MWh)	Periodo 0	Periodo 1	Periodo 2
CEp.	76,58	81,84	55,62

Dicho coste incluye la cuantía que corresponde al pago de los comercializadores para la financiación de la retribución del Operador del Mercado Ibérico de Energía, Polo

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Español para 2012, fijada en el apartado 3 del artículo 6 de la Orden IET/3586/2011, de 30 de diciembre, por la que se establecen los peajes de acceso a partir de 1 de enero de 2012 y las tarifas y primas de las instalaciones del régimen especial, que asciende a un valor de 0,0244 €/MWh, y la cuantía que corresponde al pago de los comercializadores para la financiación de la retribución del Operador del Sistema, fijada en la disposición adicional octava de la Orden por la que se establecen los peajes de acceso a partir de 1 de abril de 2012 y determinadas tarifas y primas de las instalaciones del régimen especial, que asciende a un valor de 0,0665 €/MWh.

ANEXO II

Tarifa de último recurso con discriminación horaria supervalle.

1. Los valores tanto de los sobrecostes de apuntamiento para el consumo como de la energía suministrada en cada uno de los periodos tarifarios p y para cada tipo de horas (punta o valle) necesarios para el cálculo de los valores estimados del coste de la energía en el mercado diario con entrega en cada periodo tarifario p (CEMDp), se han obtenido según lo establecido en el artículo 10 de la Orden ITC/1659/2009, de 22 de junio, considerando como perfiles iniciales los que figuran en el Anexo IV por la Resolución de 29 de septiembre de 2011 de la Dirección General de Política Energética y Minas, por la que se aprueba el perfil de consumo asociado a los peajes de acceso con discriminación horaria supervalle y el método de cálculo a efectos de liquidación de energía, aplicables para aquellos consumidores tipo 5 que no dispongan de registro horario de consumo, para el año 2011.

Los valores obtenidos son los que se señalan a continuación:

	Periodo 1	Periodo 2	Periodo 3
αp,valle	1,197335	1,059105	0,854771
αp,punta	1,007394	0,996375	0,000000
Ep,valle.	0,046192923	0,029160763	0,130705079
Ep,punta	0,0366902	0,018824433	0,000000000

2. Los valores resultantes del coste estimado de la energía en el mercado diario con entrega en cada periodo tarifario p (CEMDp), calculados según lo dispuesto en el artículo 10 de la Orden ITC/1659/2009, de 22 de junio, son los siguientes:

Coste estimado de la energía en el mercado diario (Euros/MWh)	Periodo 1	Periodo 2	Periodo 3
CEMDp.	55,19	51,1	39,71

Para el cálculo del número de horas de los contratos mayoristas en el bloque de base (NHbase) y de punta (NHpunta) utilizados para la obtención del coste de los contratos mayoristas con entrega en el bloque de valle (CCvalle) se han considerado como perfiles iniciales los aprobados por Resolución de 29 de diciembre de 2011, de la Dirección General de Política Energética y Minas, por la que se aprueba el perfil de consumo y el método de cálculo a efectos de liquidación de energía, aplicables para aquellos consumidores tipo 4 y tipo 5 que no dispongan de registro horario de consumo, así como aquellos que han pasado de ser tipo 4 a tipo 3, según el Real Decreto 1110/2007, de 24 de agosto, por el que se aprueba el Reglamento unificado de puntos de medida del sistema eléctrico, para el año 2012.

3. Los valores del sobrecoste de los servicios de ajuste del sistema asociados al suministro en el periodo tarifario p, calculados según lo establecido en el artículo 12 de la Orden ITC/1659/2009, de 22 de junio, son los siguientes:

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Sobrecoste de los servicios de ajuste (Euros/MWh)	Periodo 1	Periodo 2	Periodo 3
SAp.	6,78	4,17	4,02

4. Los valores de la prima por riesgo asociado a cada periodo tarifario son los siguientes:

Prima por riesgo (%)	Periodo 1	Periodo 2	Periodo 3
PRp.	0,00	0,00	0,00

5. El valor del pago por capacidad de generación (CAPp) correspondiente al consumo en cada período tarifario p es el contemplado para el peaje de acceso 2.0DHS (periodos 1, 2 y 3) en el Anexo I de la Orden ITC/2585/2011, de 29 de septiembre, por la que se revisan los peajes de acceso, se establecen los precios de los peajes de acceso supervalle y se actualizan determinadas tarifas y primas de las instalaciones del régimen especial, a partir de 1 de octubre de 2011:

Pago por capacidad (€/kWh b.c.)	Periodo 1	Periodo 2	Periodo 3
CAPp	0,010110	0,002303	0,001365

6. Los coeficientes de pérdidas estándares para elevar a barras de central el consumo leído en contador del consumidor en el periodo tarifario p, es el establecido para el peaje de acceso 2.0DHS (periodos 1, 2 y 3) en el anexo V de la Orden IET/3586/2011, de 28 de diciembre, por la que se revisan los peajes de acceso a partir de 1 de enero de 2012 y las tarifas y primas de las instalaciones del régimen especial.

Coeficiente de pérdidas (%)	Periodo 1	Periodo 2	Periodo 3
PERDp	14,8	14,4	8,6

7. El coste estimado de la energía a partir de 1 de octubre de 2012 para cada periodo tarifario, calculado de acuerdo al artículo 9 de la Orden ITC/1659/2009, de 22 de junio, es el siguiente:

Coste estimado de la energía (Euros/MWh)	Periodo 1	Periodo 2	Periodo 3
CEp.	82,85	65,97	49,07

Dicho coste incluye la cuantía que corresponde al pago de los comercializadores para la financiación de la retribución del Operador del Mercado Ibérico de Energía, Polo Español para 2012, fijada en el apartado 3 del artículo 6 de la Orden IET/3586/2011, de 30 de diciembre, por la que se establecen los peajes de acceso a partir de 1 de enero de 2012 y las tarifas y primas de las instalaciones del régimen especial, que asciende a un valor de 0,0244 €/MWh, y la cuantía que corresponde al pago de los comercializadores para la financiación de la retribución del Operador del Sistema, fijada en la disposición adicional octava de la Orden por la que se establecen los peajes de acceso a partir de 1 de abril de 2012 y determinadas tarifas y primas de las instalaciones del régimen especial, que asciende a un valor de 0,0665 €/MWh.

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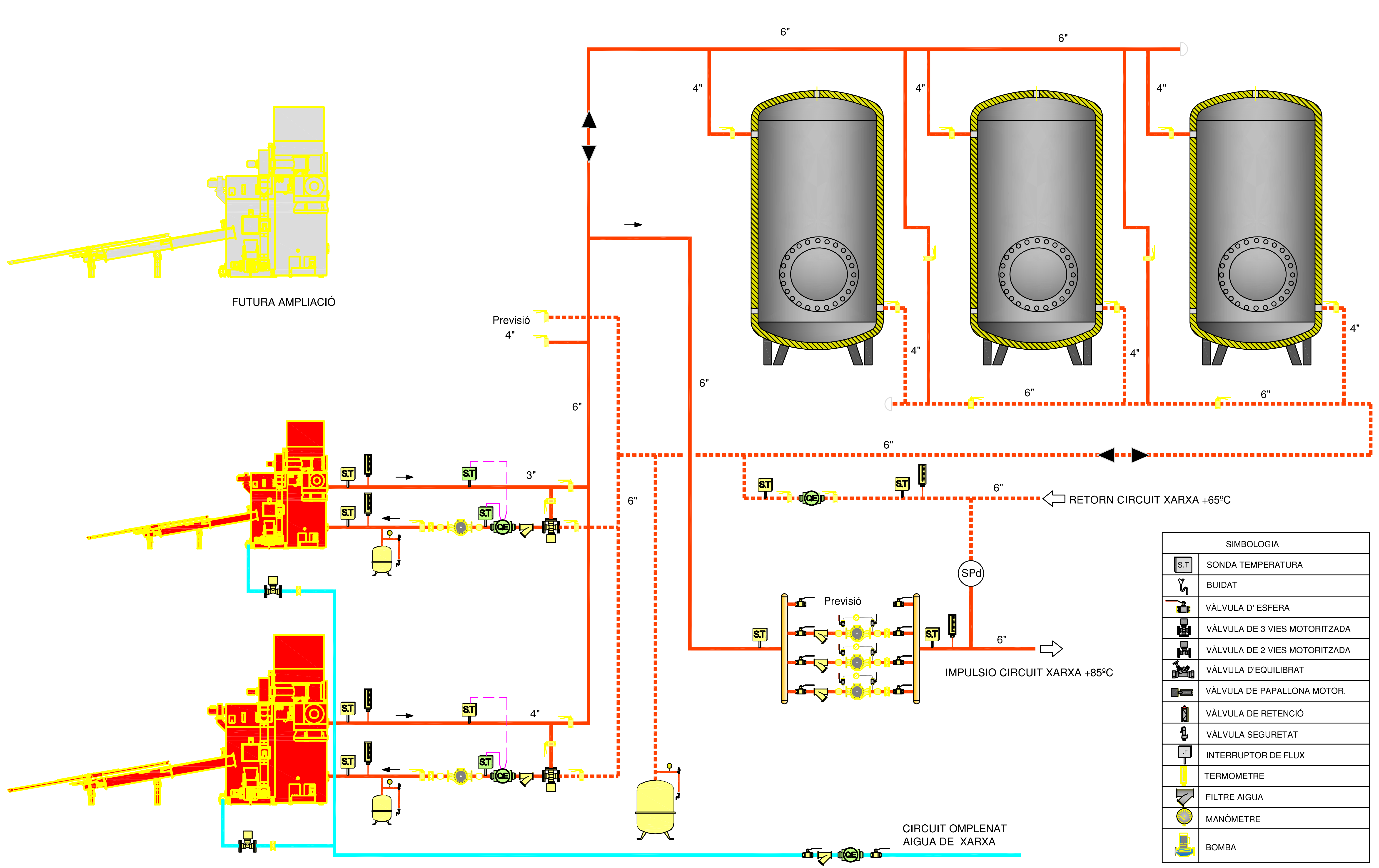

Agefred Grup Dalkia	Client: Ajuntament de RIBES DE FRESER	Assumpte: PRODUCCIÓ CENTRAL BIOMASA	Títol: ESQUEMA DE PRINCIPI	Projectat: C.BUDIA Dibuixat: J.OLIVÉ Revisat: C.BUDIA Data: MARÇ '12	Ref: 102806-07 Escala: 1/÷	Rev:

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FACTORES DE CONVERSIÓN A ENERGÍA PRIMARIA (EP) Y FACTOR DE EMISIÓN DE CO_2 PARA CARBURANTES, USOS TÉRMICOS Y ELECTRICIDAD - 2008

A.- CARBURANTES

FUENTE ENERGÉTICA	CONSUMO FINAL DIRECTO			ENERGÍA PRIMARIA		FACTOR DE EMISIÓN	FACTOR DE EMISIÓN
	tep	En volumen		tep	MWh	tCO_2/tep EF	tCO_2/tep EP
Gasolina	1	1.303	l	1,10	12,791	2,897	3,187
Gasóleo A y B	1	1.170	l	1,12	13,023	3,056	3,423
Gas natural (PCI)	1	960	Nm^3	1,07	12,442	2,345	2,509
Biodiesel	1	1.267	l	1,24	14,419	neutro	neutro
Bioetanol	1	1.971	l	1,70	19,767	neutro	neutro
GLP genérico	1	1.737	l	1,05	12,209	2,721	2,857
Butano	1	1.677	l	1,05	12,209	2,721	2,857
Propano	1	1.794	l	1,05	12,209	2,671	2,805
Keroseno	1	1.188	l	1,12	13,023	3,006	3,367
Keroseno aviación	1	1.188	l	1,12	13,023	3,006	3,367
Biogás	1	960	Nm^3	1,12	13,023	neutro	neutro

B.- COMBUSTIBLES

FUENTE ENERGÉTICA	PRODUCCIÓN DIRECTA			ENERGÍA PRIMARIA	FACTOR DE EMISIÓN	FACTOR DE EMISIÓN
	tep	unidades		tep	tCO_2/tep CFD	tCO_2/tep EP
Hulla	1	2,012	t	1,14	4,229	**4,805**
Lignito negro	1	3,137	t	1,14	4,163	**4,729**
Carbón para coque	1	1,446	t	1,14	4,396	**5,012**
Biomasa agrícola	1	3,330	t	1,25	neutro	**neutro**
Biomasa industria forestal	1	2,860	t	1,25	neutro	**neutro**
Coque de petróleo	1	1,351	t	1,42	4,116	**5,838**
Gas de coquerías	1	1,446	t	1,14	1,807	**2,060**
Gasóleo C	1	1.082	l	1,12	3,056	**3,423**
Fuelóleo	1	1.073	l	1,11	3,182	**3,532**
GN	1	960	Nm^3	1,07	2,345	**2,509**
GLP	1	1.737	l	1,05	2,721	**2,857**
Gas de refinería	1	0,870	t	1,12	2,303	**2,587**

C.- ELECTRICIDAD

TECNOLOGÍA	ENERGIA FINAL		ENERGÍA PRIMARIA				FACTOR DE EMISIÓN	
			EN BORNAS DE LA CENTRAL		EN PUNTO DE CONSUMO		EN BORNAS DE LA CENTRAL	EN PUNTO DE CONSUMO
	MWh	tep (10^7 Kcal)	MWh	Tep	MWh	tep	tCO_2/MWh	tCO_2/MWh
Hulla+ antracita	1,000	0,086	2,519	0,217	2,786	0,240	**0,993**	**1,098**
Lignito Pardo	1,000	0,086	2,681	0,231	2,965	0,255	**0,896**	**0,991**
Lignito negro	1,000	0,086	2,681	0,231	2,965	0,255	**0,965**	**1,067**
Hulla importada	1,000	0,086	2,519	0,217	2,786	0,240	**0,905**	**1,001**
Nuclear	1,000	0,086	3,030	0,261	3,351	0,288	**0**	**0,000**
Ciclo Combinado	1,000	0,086	1,927	0,166	2,131	0,183	**0,353**	**0,390**
Gas natural	1,000	0,086	2,500	0,215	2,765	0,238	**0,504**	**0,557**
Hidroeléctrica	1,000	0,086	1,000	0,086	1,106	0,095	**0**	**0**
Cogeneración motor Otto (60%REE)	1,000	0,086	1,667	0,143	1,764	0,152	**0,336**	**0,356**
Cogeneración TG (62% REE)	1,000	0,086	1,613	0,139	1,707	0,147	**0,325**	**0,344**
Cogeneración CC (67%REE)	1,000	0,086	1,493	0,128	1,579	0,136	**0,301**	**0,318**
Eólica,Fotovoltaica	1,000	0,086	1,000	0,086	1,106	0,095	**0**	**0**
Solar termoeléctrica	1,000	0,086	4,560	0,392	5,043	0,434	**0**	**0**
Biomasa eléctrica	1,000	0,086	4,425	0,381	4,893	0,421	**0**	**0**
Biogás	1,000	0,086	2,494	0,214	2,758	0,237	**0**	**0**
RSU (FORSU 24,88%) (vii)	1,000	0,086	4,019	0,346	4,445	0,382	**0,243**	**0,269**
Central de Fuel	1,000	0,086	2,519	0,217	2,786	0,240	**0,687**	**0,759**
Gas siderúrgico	1,000	0,086	2,857	0,246	3,160	0,272	**0,566**	**0,626**

E.E. Baja Tensión (Sector Doméstico)	1	0,086	0,178 tep primario/MWh generado neto 2,066 MWhprimario/MWh generado neto	0,212 tep primario/MWh final 2,466 MWh primario/ MWh final	0,323 t CO2/MWh generado neto 3,754 t CO2 /tep generado neto	0,385 t de CO2/MWh final 4,480 t CO2/tep final

FACTORES DE CONVERSIÓN DE CONSUMO O PRODUCCIÓN A ENERGÍA PRIMARIA (EP) Y FACTOR

FUENTE ENERGÉTICA	CONSUMO FINAL			ENERGÍA PRIMARIA		FACTOR DE EMISIÓN Energía Final [1]	FACTOR DE EMISIÓN Energía Primaria [2]
	tep	Densidad Energética		tep	MWh	tCO_2/tep	tCO_2/tep
Gasolina	1	1.290	l/tep	1,10	12,79	2,90	3,19
Gasóleo A y B	1	1.181	l/tep	1,12	13,02	3,06	3,42
Gas natural (GN)	1	910	Nm^3/tep	1,07	12,44	2,34	2,51
Biodiesel	1	1.267	l/tep	1,24	14,42	neutro	neutro
Bioetanol	1	1.968	l/tep	1,70	19,77	neutro	neutro
Gases Licuados de Petróleo (GLP)	1	1.763	l/tep	1,05	12,21	2,72	2,86
Butano	1	1.670	l/tep	1,05	12,21	2,72	2,86
Propano	1	1.748	l/tep	1,05	12,21	2,67	2,80
Queroseno	1	1.213	l/tep	1,12	13,02	3,01	3,37
Biogás	1	910	Nm^3/tep	1,12	13,02	neutro	neutro

COMBUSTIBLES

FUENTE ENERGÉTICA	CONSUMO FINAL			ENERGÍA PRIMARIA	FACTOR DE EMISIÓN Energía Final [1]	FACTOR DE EMISIÓN Energía Primaria [2]
	tep	Densidad Energética		tep	tCO_2/tep	tCO_2/tep
Hulla	1	2,01	t/tep	1,14	4,23	4,81
Lignito negro	1	3,14	t/tep	1,14	4,16	4,73
Carbón para coque	1	1,45	t/tep	1,14	4,40	5,01
Biomasa agrícola	1	3,34	t/tep	1,25	neutro	neutro
Biomasa forestal	1	2,87	t/tep	1,25	neutro	neutro
Coque de petróleo	1	1,29	t/tep	1,42	4,12	5,84
Gas de coquerías	1	1,08	t/tep	1,14	1,81	2,06
Gasóleo C	1	1.092	l/tep	1,12	3,06	3,42
Fuelóleo	1	1.126	l/tep	1,11	3,18	3,53
Gas Natural (GN)	1	910	Nm^3/tep	1,07	2,34	2,51
Gases Licuados de Petróleo (GLP)	1	1.763	l/tep	1,05	2,72	2,86
Gas de refinerías	1	0,85	t/tep	1,12	2,30	2,59

ELECTRICIDAD

FUENTE/TECNOLOGÍA ENERGÉTICA	CONSUMO FINAL		ENERGÍA PRIMARIA				FACTOR DE EMISIÓN	
			EN BORNAS DE CENTRAL		EN PUNTO DE CONSUMO (BT)		EN BORNAS DE CENTRAL	EN PUNTO DE CONSUMO (BT)
	MWh	tep	MWh	tep	MWh	tep	tCO_2/MWh	tCO_2/MWh
Hulla+antracita	1	0,086	2,52	0,22	2,87	0,25	1,06	1,21
Lignito Pardo	1	0,086	2,68	0,23	3,05	0,26	0,93	1,06
Lignito negro	1	0,086	2,68	0,23	3,05	0,26	1,00	1,14
Hulla importada	1	0,086	2,52	0,22	2,87	0,25	0,93	1,06
Nuclear	1	0,086	3,03	0,26	3,45	0,30	0	0
Ciclo Combinado	1	0,086	1,93	0,17	2,19	0,19	0,37	0,42
Hidroeléctrica	1	0,086	1,00	0,09	1,14	0,10	0	0
Cogeneración MCI	1	0,086	1,67	0,14	1,79	0,15	0,44	0,50
Cogeneración TG	1	0,086	1,61	0,14	1,74	0,15	0,36	0,41
Cogeneración TV	1	0,086	1,72	0,15	1,86	0,16	0,43	0,49
Cogeneración CC	1	0,086	1,54	0,13	1,66	0,14	0,34	0,39
Eólica, Fotovoltaica	1	0,086	1,00	0,09	1,14	0,10	0	0
Solar termoeléctrica	1	0,086	4,56	0,39	5,19	0,45	0	0
Biomasa eléctrica	1	0,086	4,88	0,42	5,55	0,48	0	0
Biogás	1	0,086	3,70	0,32	4,22	0,36	0	0
RSU (FORSU 24,88%)	1	0,086	4,02	0,35	4,57	0,39	0,25	0,29
Centrales de fuelóleo	1	0,086	2,52	0,22	2,87	0,25	0,74	0,85
Gas siderúrgico	1	0,086	2,86	0,25	3,25	0,28	0,72	0,82
E.E. Baja Tensión (Sector Doméstico)	**1**	**0,086**	**0,17** tep primario/MWh generado neto **2,00** MWh primario/MWh generado neto		**0,20** tep primario/MWh final **2,28** MWh primario/ MWh final		**0,31** t CO_2/MWh generado neto **3,56** t CO_2 / tep generado neto	**0,35** t de CO_2/MWh final **4,05** t CO_2/tep final

(1) Factor de emisión sin considerar pérdidas en las transformaciones para la obtención del combustible y/o carburante y transporte del mismo.
(2) Factor de emisión considerando pérdidas en las transformaciones para la obtención del combustible y/o carburante y transporte del mismo.
(3) Fracción Orgánica de Residuos Sólidos Urbanos del 24,88% (FORSU=24,88%).

Datos utilizados en los cálculos internos de IDAE.

30 noviembre 2010

FACTORES DE CONVERSIÓN ENERGÍA FINAL -ENERGÍA PRIMARIA y FACTORES DE EMISIÓN DE CO_2 - 2010

CARBURANTES

FUENTE ENERGÉTICA	CONSUMO FINAL DIRECTO			ENERGÍA PRIMARIA (1)		FACTOR DE EMISIÓN(2)
	tep	*Volumen específico*		*tep*	*MWh*	*tCO_2/tep*
Gasolina	1	1.290	l	1,10	12,79	2,90
Gasóleo A y B	1	1.181	l	1,12	13,02	3,06
Gas natural	1	910	Nm^3	1,07	12,44	2,34
Biodiesel	1	1.267	l	1,24	14,42	neutro
Bioetanol	1	1.968	l	1,70	19,77	neutro
Gases Licuados de Petróleo (GLP)	1	1.763	l	1,05	12,21	2,72
Queroseno	1	1.213	l	1,12	13,02	3,01

COMBUSTIBLES

FUENTE ENERGÉTICA	CONSUMO FINAL DIRECTO			ENERGÍA PRIMARIA (1)		FACTOR DE EMISIÓN(2)
	tep	*Volumen específico*		*tep*	*MWh*	*tCO_2/tep*
Hulla	1	2,01	t	1,14	13,21	4,23
Lignito negro	1	3,14	t	1,14	13,21	4,16
Carbón para coque	1	1,45	t	1,14	13,26	4,40
Biomasa agrícola	1	3,34	t	1,25	14,53	neutro
Biomasa industria forestal	1	2,87	t	1,25	14,53	neutro
Coque de petróleo	1	1,29	t	1,42	16,49	4,12
Gas de coquerías	1	1,08	t	1,14	13,26	1,81
Gasóleo C	1	1.092	l	1,12	13,02	3,06
Fuelóleo	1	1.126	l	1,11	12,91	3,18
Gas Natural	1	910	Nm^3	1,07	12,44	2,34
Gases Licuados de Petróleo (GLP)	1	1.763	l	1,05	12,21	2,72
Butano	1	1.670	l	1,05	12,21	2,72
Propano	1	1.748	l	1,05	12,21	2,67
Gas de refinería	1	0,85	t	1,12	13,07	2,30

ELECTRICIDAD

TECNOLOGÍA	ENERGIA FINAL		ENERGÍA PRIMARIA				FACTOR DE EMISIÓN		
			Bornas de central		En punto de consumo		En bornas de alternador (bruta)	En bornas de central (neta)	En punto de consumo
	MWh	*tep*	*MWh*	*Tep*	*MWh*	*tep*	*tCO_2/MWh*	*tCO_2/MWh*	*tCO_2/MWh*
Hulla+ antracita	1	0,086	2,52	0,22	2,73	0,24	1,13	1,17	1,27
Lignito pardo	1	0,086	2,68	0,23	2,91	0,25	0,90	0,93	1,01
Lignito negro	1	0,086	2,68	0,23	2,91	0,25	0,97	1,00	1,09
Hulla importada	1	0,086	2,52	0,22	2,73	0,24	0,90	0,94	1,02
Nuclear	1	0,086	3,03	0,26	3,29	0,28	0	0	0
Ciclo Combinado	1	0,086	1,93	0,17	2,09	0,18	0,34	0,35	0,38
Hidroeléctrica	1	0,086	1,00	0,09	1,09	0,09	0	0	0
Cogeneración MCIA (3)	1	0,086	1,67	0,14	1,74	0,15	0,37	0,38	0,42
Cogeneración TG (4)	1	0,086	1,61	0,14	1,69	0,15	0,33	0,34	0,37
Cogeneración TV (6)	1	0,086	1,72	0,15	1,80	0,16	0,41	0,42	0,46
Cogeneración CC (6)	1	0,086	1,54	0,13	1,61	0,14	0,31	0,32	0,35
Eólica y fotovoltaica	1	0,086	1,00	0,09	1,09	0,09	0	0	0
Solar termoeléctrica	1	0,086	4,56	0,39	4,95	0,43	0	0	0
Biomasa eléctrica	1	0,086	4,88	0,42	5,29	0,46	0	0	0
Biogás	1	0,086	3,70	0,32	4,02	0,35	0	0	0
RSU	1	0,086	4,02	0,35	4,36	0,38	0,24	0,25	0,27
Centrales de fuelóleo	1	0,086	2,52	0,22	2,73	0,24	0,71	0,73	0,79
Gas siderúrgico	1	0,086	2,86	0,25	3,10	0,27	0,64	0,69	0,75
Energía Eléctrica General	**1**	**0,086**	**0,17** tep /MWh neto **1,94** MWh primario/ MWh neto		**0,18** tep /MWh **2,11** MWh primario/ MWh final		**0,23** tCO_2/MWh bruto **2,63** tCO_2/tep bruto	**0,23** tCO_2/MWh neto **2,72** tCO_2/tep neto	**0,25** tCO_2/MWh final **2,95** tCO_2/tep final
Energía Eléctrica Baja Tensión (Sector Doméstico)	**1**	**0,086**	**0,17** tep /MWh neto **1,94** MWh primario/ MWh neto		**0,19** tep /MWh final **2,21** MWh primario/ MWh final		**0,23** tCO_2/MWh bruto **2,63** tCO_2/tep bruto	**0,23** tCO_2/MWh neto **2,72** tCO_2/tep neto	**0,27** tCO_2/MWh final **3,09** tCO_2/tep final

(1) Incluye las pérdidas en las transformaciones para la obtención del combustible y/o carburante y transporte del mismo.
(2) En punto de consumo
(3) MCIA: Motor de Combustión Interna Alternativo
(4) TG: Turbina de Gas
(5) TV: Turbina de Vapor
(6) CC: Ciclo combinado

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Automotive
Industry

RAUTHERMEX
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1 RAUTHERMEX
INTRODUCTION

In view of the increasing need to minimise CO_2 emissions as much as possible, local and district heating supply technology is becoming ever more important. With the number of new supply stations being set up, the requirements for a flexible and efficient local and district heating pipe system are also increasing. Pioneering technologies, combining optimum functionality with low energy losses, form the basis for the insulated pipe system RAUTHERMEX from REHAU.

1.1 System Advantages

- Flexible pipe system ensures cost-effective heat distribution
- High operating safety because the RAUTHERMEX pipes are made of corrosion-resistant material
- No linear expansion, as pipe layers are fully bonded together
- No need for expansion bellows or compensators
- Fully bonded pipe layers limit water penetration to absolute minimum
- System components for all applications

1.2 Scope

This Technical Information applies to the design, installation and use of the flexible RAUTHERMEX district heating pipe system, the REHAU compression sleeve joints and the REHAU insulating sleeve systems, T-couplings and jointing sleeves, Generation I and II.

1.3 Applications

RAUTHERMEX is a pre-insulated pipe system used predominantly below ground.

- Local and district heating supply
- Swimming pool technology
- Cooling technology
- Industry and agriculture
- Connection of external surface heating
- Geothermal applications

Villa Pompei, Italy

Biomass Plant, Germany

Biogas facility in Loorenhof, Switzerland

Pay attention when you see

Important Information for the safe and correct handling of this product

Abbreviation:
The following technical abbreviation terms are used in this Technical Manual:
PE-Xa = high pressure cross linked Polyethylene
PE-LD = Polyethylene - low density
PE-HD = Polyethylene - high density
EVOH = Ethylen-Vinyl-Alcohol-Copolymer
PU = Polyurethane

2 RAUTHERMEX
MAIN COMPONENTS

Fig. 1 RAUTHERMEX Pipe

2.1 RAUTHERMEX Pipe (Fig. 1)

RAUTHERMEX district heating pipes are made of coextruded, fully bonded layers, resulting in a system where water penetration along the pipe is reduced to a minimum and no movement between the individual layers is possible. The UNO and DUO variants comprise one and two carrier pipes respectively, made of high-pressure crosslinked polyethylene (PE-Xa) in accordance with DIN 16892/93, SDR 11 with an EVOH oxygen diffusion barrier in accordance with DIN 4726.
The thermal insulation is made of polyurethane (PU) and the outer jacket is made of polyethylene - low density (PE-LD).

Advantages

- No linear expansion in the pipe trenches thanks to fully bonded system
- Quick installation
- Small bending radii
- Excellent thermal insulation properties

2.2 REHAU Jointing Technique

Fig. 2 RAUTHERMEX Compression Sleeve Joint

2.2.1 REHAU Compression Sleeve (Fig. 2)

The jointing technique for a compression sleeve is a method developed and patented by REHAU for quick, safe and permanently leakproof connections between PE-Xa pipes. It comprises simply a fitting and the compression sleeve.
Additional sealing elements are not required, as the pipe itself acts as a seal. Four sealing ribs guarantee a completely secure connection, which also withstands the tough application conditions on construction sites. Specially designed ribs on the compression sleeves prevent the connection coming loose during operation.

Advantages

- Secure, permanently leakproof connection
- Practically no bore reduction, as carrier pipes are expanded to make the connection. The resulting pressure loss is negligible and there is no cavitation
- Quick installation
- Joints pressurised immediately
- Joints made under any weather conditions

2.2.2 RAUTHERMEX T-Shroud Set Generation II (Fig. 3)

REHAU offers the RAUTHERMEX T-shroud set, which makes reliable insulation of T-branches in RAUTHERMEX pipes with an outer diameter of up to 182mm considerably easier and quicker.

The RAUTHERMEX T-shroud Generation II comprises two half-shells, which are placed over the branch and simply pressed together with clamping clasps in accordance with the toggle lever principle.
The seal between the coupling and the pipe is carried out by means of an innovative sealing ring concept. Track grooves ensure that the coupling sits perfectly, while combined sealing and vent plugs also ensure quick and easy installation. Insulation is carried out in a similar way with the dual-component RAUTHERMEX coupler foam.

Fig. 3 RAUTHERMEX T-Shroud Set Generation II

Advantages

- Efficient and reliable insulation of T-branches on local and district heating pipelines
- Installation without tools
- Simple positioning via track grooves
- Quick adjustment to pipe dimensions thanks to flexible sealing ring system
- Strong ribbing guarantees stability even in the event of large static loads

RAUTHERMEX
PROPERTIES

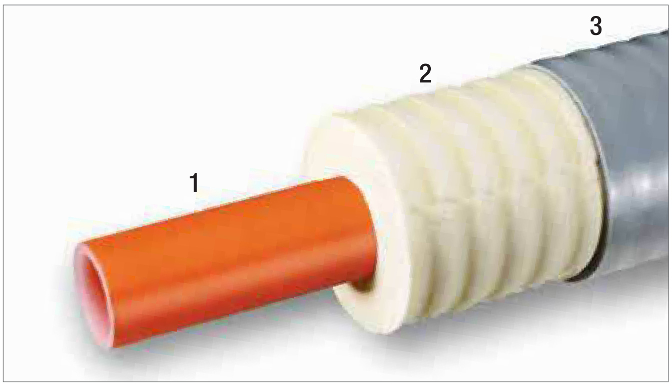


Fig. 4 RAUTHERMEX pipe main components

3.1 RAUTHERMEX pipe

The RAUTHERMEX pipes are made up of the following main components:
- Carrier Pipe (1)
- Pipe Insulation (2)
- Pipe Jacket (3)

These sub-areas are explained in detail below.

Fig. 5 Carrier Pipe SDR 11

3.1.1 Carrier Pipes

The carrier pipe is made of high-pressure crosslinked polyethylene PE-Xa (produced in accordance with DIN 16892 and DIN 16893). The carrier pipes are crosslinked via the addition of peroxide under high pressure and at a high temperature. This process bonds the macromolecules so that they form a network.

RAUTHERMEX Carrier Pipes SDR 11

The RAUTHERMEX SDR 11 pipes are predominantly used in heating and cooling circulation systems. For this reason, they have an additional oxygen diffusion barrier made of EVOH in accordance with DIN 4726. The colour of these pipes is orange.

Advantages of PE-Xa carrier pipes

- Excellent chemical resistance
- Extremely low friction coefficient (e = 0.007 mm at 60°C)
- No incrustation
- Permanently low pressure loss over entire service life
- SDR 11 pipes with special, orange-coloured EVOH oxygen diffusion barrier
- Corrosion-resistance
- Good aging behaviour
- Creep resistance
- Shape retention
- Temperature resistance
- Poor transmission of sound
- Pressure resistance
- Toxicologically and physiologically harmless
- Excellent notched impact strength

Properties of PE-Xa carrier pipe

Density	0.94 g/cm3
Average thermal longitudinal expansion coefficient in temperature range of 0°C to 70°C	1,5 10^{-4} K^{-1}
Thermal conductivity	0,38 W/mK
Modulus of elasticity	600 N/mm^2
Surface resistance	10^{12} Ω
Construction material class (DIN 4102)	B2 (normal entflammbar)
Surface friction coefficient	0,007 mm

Table 1 Properties of PE-Xa Carrier Pipe

Chemical Resistance

The RAUTHERMEX PE-Xa carrier pipe demonstrates excellent resistance to chemicals. The safety factors and temperature resistances are dependent on the medium. The resistances mentioned in DIN 8075, Supplement 1, generally also apply to PE-Xa. Often, because of its crosslinking, PE-Xa is even more resistant than non-crosslinked PE.

Pressure and temperature limits

The following temperature and pressure limits apply in accordance with DIN 16892/93 at continuous operating temperatures for RAUTHERMEX pipes. (Application: water; safety factor: 1.25)

RAUTHERMEX, SDR 11		
40 °C	11,9 bar	50 years
50 °C	10,6 bar	50 years
60 °C	9,5 bar	50 years
70 °C	8,5 bar	50 years
80 °C	7,6 bar	25 years
90 °C	6,9 bar	15 years
95 °C	6,6 bar	10 years

Table 2 Pressure and Temperature Limits SDR 11

For varying pressures and temperatures, the expected service life can be determined according to DIN 13760 “Miner’s rule”. The carrier pipes are designed for maximum operating temperatures of 95°C, but can tolerate excess temperatures of up to 110°C for short periods.

Approvals for RAUTHERMEX Pipe

Approvals SDR 11 (bis 110x10):

- Frankreich: Atec 14/04-890
- WRAS Approved (up to 63mm UNO & DUO)

Fig. 6 Exposed pipe layers

3.1.2 Pipe Insulation

The insulation of the RAUTHERMEX pipes SDR 11 is made of PU foam with Pentane as a blowing agent. The PU foam is therefore free from CFCs and HCFCs.

Advantages

- Extremely fine pores (up to 95% closed cells)
- High water vapour transfer coefficient, which means no moisture penetration during operation

Properties of PU pipe insulation

Thermal conductivity	≤ 0,0216 W/mK nach EN 253
GWP (global warning potential)	0,5
ODP (ozone depletion potential)	0
Density	≥ 65 kg/m^3
Compresion Strength	0,2 MPa
Water Absorption	≤ 5 % nach EN 253
Long-term temperature resistance	130 °C
Axial shear strength (EN 253)	≥ 90 kPa

Table 3 Properties of PU Pipe PU (Pentane-driven)

As an alternative to Pentane driven insulation, RAUTHERMEX pipes are also available with CO2-driven insulation on request.

Fig. 7 Pipe Outer Jacket

3.1.3 RAUTHERMEX Outer Jacket

The RAUTHERMEX pipes have a slightly corrugated outer jacket. This improves static properties, increases flexibility and enables low bending radii, particularly for pipe jacket diameters of 162 mm and 182 mm. To increase flexibility, the outer jackets of the RAUTHERMEX SDR 11 pipes are manufactured from the flexible material PE-LLD.

Advantages

- Very good bond with the PU foam
- Extruded seamlessly around the PU foam
- Ideal for gluing to heat-shrink sleeving in the sleeve sealing technique

Properties of outer jacket

Low-density polyethylene (PE-LD):

Thermal conductivity	0,33 W/mK
Crystallite melting range	122 °C
Density	0,92 g/cm^3
Modulus of elasticity	325 N/mm^2
Constriction material class (DIN 4102)	B2 (normal flammability)

Table 4 Properties of outer jacket

Fig. 8 Compression Sleeve Fitting

3.2 Jointing technique

In the case of below-ground pipe joints, the system operator must be able to rely on the jointing technique. Permanent watertightness of the pipe joints can only be ensured if the pipe joints are carried out using the REHAU compression sleeve jointing technique. Processing of the compression sleeve joint must be carried out using RAUTOOL tools.

3.2.1 Compression Sleeve

The compression sleeve fittings are made of dezincification-resistant special brass in accordance with BS EN 1254/3 (E) Class A, gunmetal or ST 37.0. Compression sleeves are made of annealed standard brass CuZn39Pb3 / F43 in accordance with DIN 17671 or gunmetal.

3.2.2 RAUTOOL Tools

To process the REHAU compression sleeve, there are various manual, hydraulic and electrohydraulic tools available:

RAUTOOL M1

Manual tool with double clamping jaw for 2 dimensions. Area of use is dimensions 16mm – 40mm. The M1 clamping jaws must only be used with the RAUTOOL M1. (Fig. 9)

Fig. 9 RAUTOOL M1

RAUTOOL A2

Electrohydraulic tool with power pack and double clamping jaw for 2 dimensions. It is driven via a power-pack-operated hydraulic unit located directly on the tool cylinder. Area of use is dimensions 16mm – 40mm. (Fig. 10)

Fig. 10 RAUTOOL A2

RAUTOOL G2

Tool for the dimensions 50mm – 110mm (optionally also available for dimension 40 mm). It is driven via a hydraulic foot pump or via an electrohydraulic unit. (Fig. 11)

Fig. 11 RAUTOOL G2

RAUTOOL G1 125/160

Tool for the dimensions 125mm – 160mm.It is driven by an electrohydraulic unit. (Fig. 12)

Fig. 12 RAUTOOL G1 125/160

3.3 REHAU Insulating Sleeve Systems

To insulate joints, two different systems are available, which are heat-insulating and, at the same time, protect against the penetration of moisture.

3.3.1 RAUTHERMEX Coupling Shroud (Generation I)

The RAUTHERMEX jointing sleeve is used to insulate couplings and end caps. Used for RAUTHEMEX 160/250 UNO pipe

The jointing sleeve set comprises

- 1 jointing sleeve, large or small
- 2 heat shrink sleeves
- 1 vent plug
- Installation instructions

Fig. 13 RAUTHERMEX Jointing Sleeve

Properties of Coupling System

High-density polyethylene (PE-HD):

Thermal conductivity	0,43 W/mK
Ctystallite nelting range	105 –110 °C
Density	0,93 g/cm^3
Modulus of elasticity	600 N/mm^2
Cpnstruction material class (DIN 4102)	B2 (normal flammability)

Table 5 Properties of Sleeve System Generation I

Heat-shrink Sleeving for Sleeve Set I

The heat-shrink sleeving is coated inside with a hot melt adhesive to seal the sleeve to the RAUTHERMEX pipe.

Material Properties of Heat-shrink sleeve

Tensile Strength	14 MPa
Max. Expansion	300 %
Density	1,1 g/cm^3
Water Absorption	< 0,1 %
Adhesive siftening temperature	80 – 90 °C
Construction material class (DIN 4102)	B2 (normal flammability)

Table 6 Material Properties of Heat-Shrink Sleeve

3.3.2 RAUTHERMEX T-Shroud Set Generation II

The newly developed RAUTHERMEX T-shroud set Generation II enables simple, safe and quick installation for RAUTHERMEX branches with an outer jacket diameter of up to 182 mm.

The T-Shroud Set comprises of;

- Coupling (2 half-shells) made of ABS (acrylnitril-butadiene-styrol)
- 3 plugs, orange, made of POM (polyoxymethylene)
- 16 brackets, orange, made of POM
- 1 Fast set Adhesive
- Installation instructions

Fig. 14 RAUTHERMEX T-Coupling II

Material Properties of ABS

Yield Stress	40 MPa
Tensile modulus	2200 MPa
Ultimate elongation	>15 %
Heat distortion temperature 1,8 MPa	94 °C
Flammability (UL 94; 1,6 mm)	HB

Table 7 Material Properties of ABS

For sealing purposes, an innovative sealing ring concept made of EPDM (ethylene-propylene diene monomer rubber) is used, which enable adjustment to the various pipe jacket diameters. For the three pipe outlets, an appropriately sized sealing ring is used in each case.

Material Properties of EPDM

Shore hardness ± 5	30 A
Density ± 0,02	1,16 g/cm^3
Ultimate tear strength	8 MPa
Ultimate elongation	600 %
Compression set 22h at 70 °C	18 %
Compression set 22h at 100 °C	50 %

Table 8 Material properties EPDM

3.4 RAUTHERMEX PU Foam

For thermal insulation of the couplings, RAUTHERMEX coupler foam is used. RAUTHERMEX sleeve insulation is made of dual-component PU foam.

The foam is supplied with the set and comprises of;

- 2 bottles
- 1 filler attachments
- Installation instructions

Fig. 15 Foam Set

Before using the foam products, the safety data sheets and the installation instructions supplied with the products must be read through carefully.

Technical Data for component A, Colour: brown

Flashpoint	> 200 °C
Vapour pressure (20 °C)	1 h Pa
Density (20 °C)	1,23 g/cm³

Table 9 Technical data for component A

Technical Data for component B, Colour: yellowish

Flashpoint	-5 °C
Vapour pressure (20 °C)	345 h Pa
Density (20 °C)	1,06 g/cm³

Table 10 Technical data for component B

Technical Data for Foam [measurement temperature 20 °C]

Mix. ratio for weight (A:B)	146:100
Mix. ratio for volume (A:B)	130:100
Start time	54 Sekunden
Thread time	335 Sekunden
Raw density (unrestricted foaming)	42 kg/m³
Raw density (core)	>60 kg/m³
Closed-cell factor	>88 %

Table 11 Technical data for foam

Recommended Processing Times depending on foam temperature

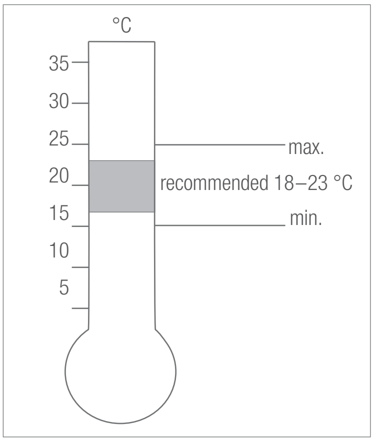
Temperature	Mixing/Shaking time	Processing time
25 °C	20 s	30 s
20 °C	25 s	40 s
15 °C	40 s	50 s

Table 12 Processing of foam components

Please read the safety regulations! To avoid the burst risk, the following points must be observed:

- During processing, RAUTHERMEX coupler foam temperature must be between 15°C and 25°C
- Shaking and processing times in accordance with the table below must be adhered to.

Caution: The RAUTHERMEX coupler foam is to be handled in accordance with the instructions for use.



3.5 RAUTHERMEX Pipe Sizes

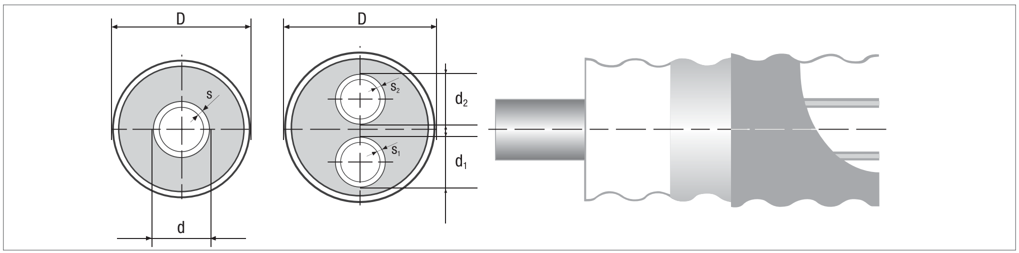


Fig. 16 RAUTHERMEX outline diagram

UNO Pipe, Pipe Series 1, SDR 11

Type	d [mm]	s [mm]	D* [mm]	Volume inner pipe [l/m]	Weight [kg/m]	Max. ring coil length [m] 2,8 m x 0,8 m	2,8 m x 1,2 m
25/91	25	2,3	93	0,327	1,20	377	560
32/91	32	2,9	93	0,539	1,34	377	560
40/91	40	3,7	93	0,835	1,84	377	560
50/111	50	4,6	113	1,307	1,97	271	380
63/126	63	5,8	128	2,091	2,60	192	280
75/162	75	6,8	164	2,961	4,11	92	144
90/162	90	8,2	164	4,256	1,56	92	144
110/162	110	10,0	164	6,362	6,37	92	144
125/182	125	11,4	185	8,120	7,22	-	86
160/250	160	14,6	250	13,430	11,43	12 m straight lengths	

Table 13 UNO Pipe, pipe series 1, SDR 11

DUO Pipe, pipe Series 1, SDR 11

Type	d1, d2 [mm]	s1, s2 [mm]	D* [mm]	Volume inner pipe [l/m]	Weight [kg/m]	Max. ring coil length [m] 2,8 m x 0,8 m	2,8 m x 1,2 m
25+25/111	25	2,3	113	2 x 0,327	1,73	271	380
32+32/111	32	2,9	113	2 x 0,539	1,87	271	380
40+40/126	40	3,7	128	2 x 0,835	2,45	192	280
50+50/162	50	4,6	164	2 x 1,307	3,96	92	144
63+63/182	63	5,8	185	2 x 2,07	5,28	-	86

Table 14 DUO Pipe, pipe series 1, SDR 11

* maximun outer diameter at the peak

4.1 General Information

With the flexible RAUTHERMEX pipes, both heating supply networks and connecting lines between two buildings can be achieved cost effectively. There are three different laying alternatives. Combinations are possible.

4.1.2 Branch Layout

With this method, buildings are connected via branches from a main line.

Advantages

- Flexible in design
- Easy installation even before buildings are constructed
- Branches can be connected to the main line at a later stage

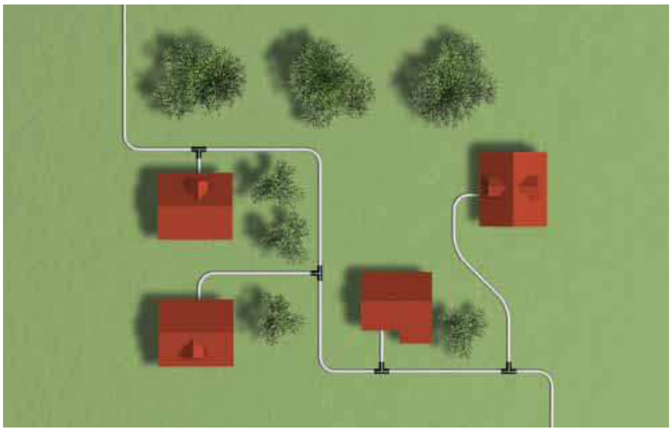


Fig. 17 Branch piping

4.1.3 Building to building ("Daisy chain") Layout

In many cases, the availability of long delivery lengths of RAUTHERMEX pipes allows for the complete elimination of below-ground connections or branches by laying the RAUTHERMEX pipes from one building to the next and back.

Advantages

- No connectections below ground

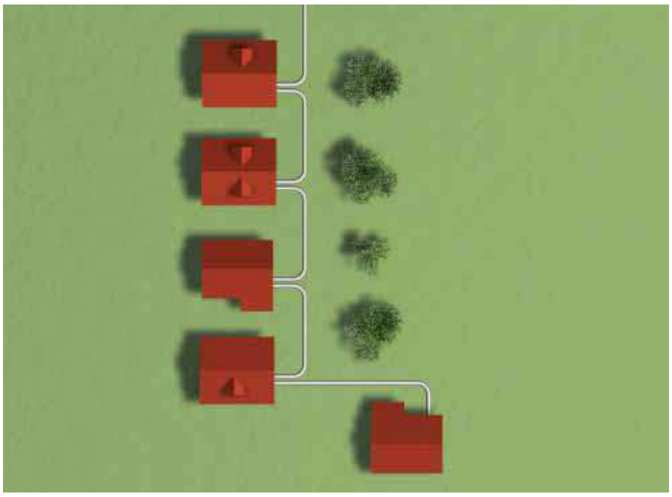


Fig. 18 Building-to-building ("Daisy Chain") piping

4.1.4 Branching off a plastic jacketed main line

Existing district heating networks can either be extended or tapped into for connections for future developments of properties, as long as the network can accommodate the increased load.

Advantages

- If the operating temperatures of the main line are too high, a secondary network with RAUTHERMEX pipes can be created via a network decoupling
- If the heat-carrying capacity, and therefore the volume flow of the main line, is too high for the RAUTHERMEX pipes, branches can be added without the need for any special precautions

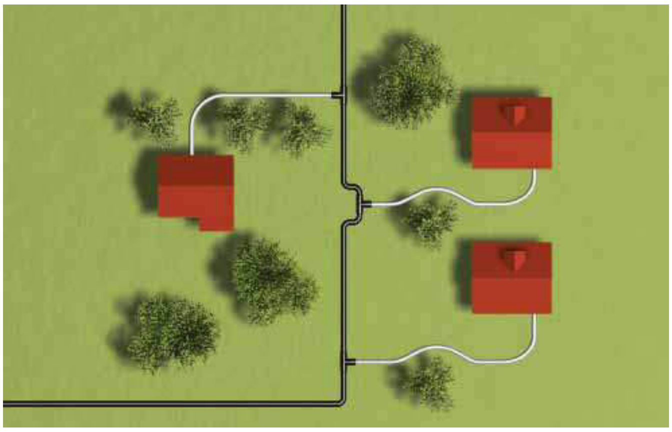


Fig. 19 Branching off a plastic jacketed main line

4.2 Design Guidance

From the heat demands plotted over one year, it is clear that full heat-carrying capacity is only required on a few days a year. Investment and running costs (due to higher energy losses) of district heating networks rise proportionally with the nominal pipe diameter. Therefore, the smallest possible pipe diameters should be designed for the pipe network. The low additional costs required to compensate for the increased pressure loss at full capacity are more than outweighed by the savings mentioned above. It may also be practical to use a second pump, which starts automatically when the primary pump is at full capacity and which otherwise serves as a back-up.

In connecting lines in particular, it may be a good idea to split the lines into three (two flow pipes and one return pipe) or into four pipes (two flow pipes and two return pipes). If the second lines are only switched on when the capacity of the first is exceeded, the network can indeed be operated with minimal energy losses for most of the year.

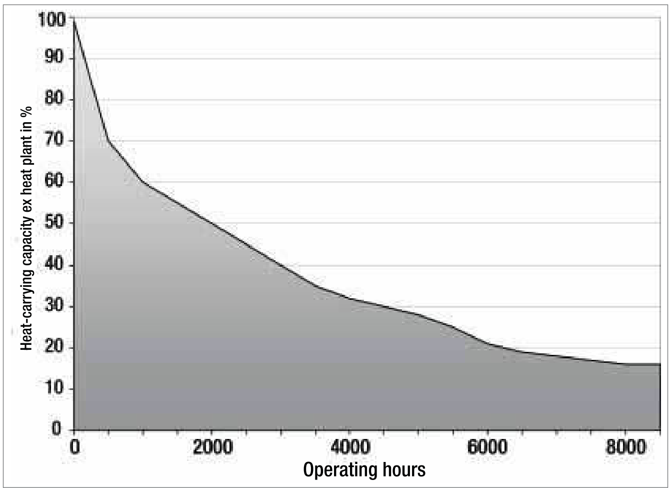


Fig. 20 Annual time curve

4.3 Pipe Sizing

The hydraulic performance of RAUTHERMEX pipes is considerably greater than that of steel pipes due to the lower pipe friction coefficient with the same inner diameter. For this reason, pressure-loss tables for steel pipes cannot be used for the pressure-loss calculation of RAUTHERMEX pipes. When sizing RAUTHERMEX pipes, we recommend comparing the energy losses and pump capacities. Since full pump capacity is usually only required on a few days of the year, reducing the pipe dimensions can lead to considerable savings in terms of energy loss and material used.

For sizing, the maximum carrying capacities must be calculated for the heating supply network. The charts on the following pages can be used for estimating pressure loss. As the inner diameters are different, various tables or charts are available for the pressure loss calculation for SDR 11 pipes (Fig. 22).

4.4 Pressure Loss

4.4.1 Pressure Loss Calculation for SDR 11 Pipes

To estimate pressure loss in a pipe section, the pipe routing must be known in order to determine the necessary section and therefore pipe length. The flow rate [l/s] or the heat-carrying capacity [kW] together with the design temperature drop [K] can be used for system design.

Calculation method using flow rate [l/s]: taking SDR 11 pipes as an example:

Flow rate:	0,65 l/s
Section length:	100 m
= Total pipe length:	200 m

Selecting a pipe size

First, start at 0.65 l/s and draw a straight line vertically upwards (red line). Where the straight line crosses the lines for each pipe size (circles), draw another horizontal straight line to the left axis Pressure loss drop (green line). This shows the relevant pressure loss drop [Pa/m] for the corresponding pipe size.

Selecting the flow speed

From the intersections (circles), draw a line diagonally upwards and left (blue line) to find the flow speed in the pipe.

Calculation using heat-carrying capacity [kW]

If the values for design temperature drop in K and heat-carrying capacity in kW are available, the capacity on the axis with the relevant temperature drop is used as a starting point.

Example:

Temperature drop:	30 K
Heat-carrying capacity:	80 kW
Length:	100 m

Selection

Starting at the 80 kW mark on the bottom axis (temperature drop 30 K), draw a line upwards (yellow line). All subsequent steps follow the same sequence as the previous process using the flow rate.

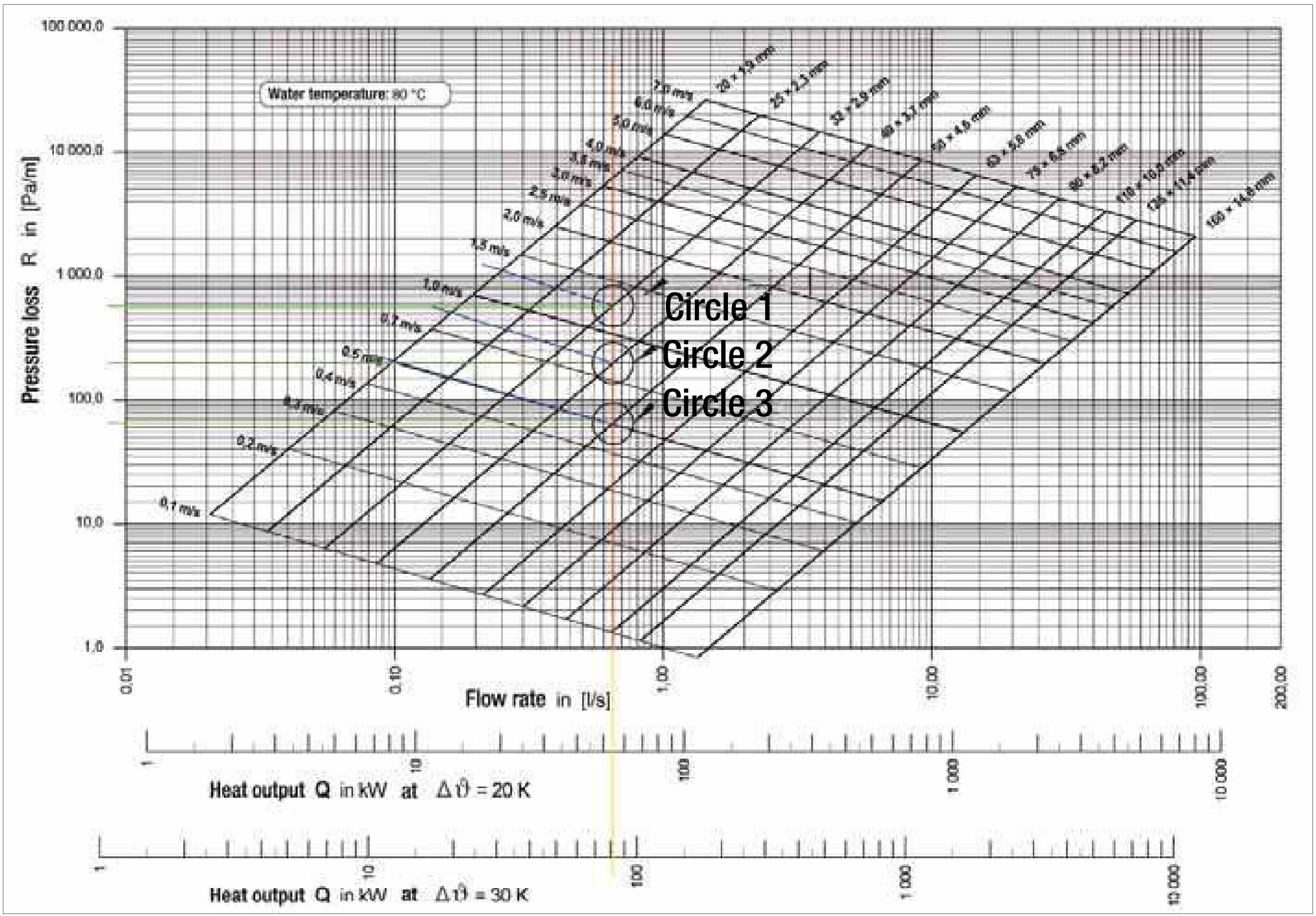


Fig. 21 Pressure loss diagram SDR 11

Alternatives

Circle 1 pipe size:	32 x 2,9
Green Line	
Pressure loss:	550 Pa/m
Total pressure loss:	550 Pa/m x 200 m
	= 110.000 Pa
	= 1,1 bar
Blue Line	
Flow speed:	1,3 m/s

Circle 3 pipe size:	50 x 5,7
Green Line	
Pressure loss:	65 Pa/m
Total pressure loss:	65 Pa/m x 200 m
	= 13.000 Pa
	= 0,13 bar
Blue Line	
Flow speed:	0,5 m/s

Circle 2 pipe size:	40 x 3,7
Green Line	
Pressure loss:	200 Pa/m
Total pressure loss:	200 Pa/m x 200 m
	= 40.000 Pa
	= 0,4 bar
Blue Line	
Flow speed:	0,8 m/s

Detailed pressure loss tables available on request

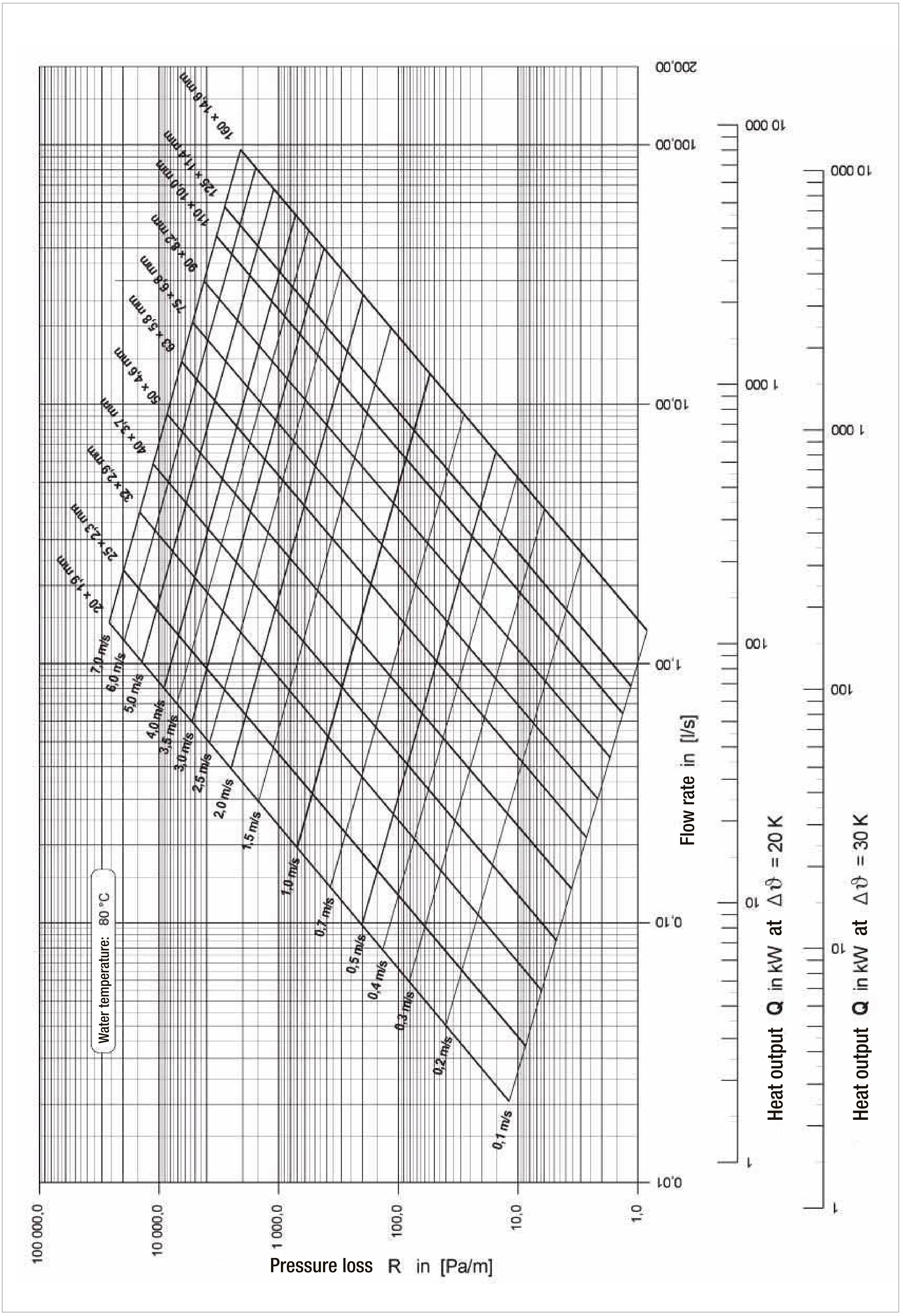


Fig. 22 Pressure loss diagram for SDR 11

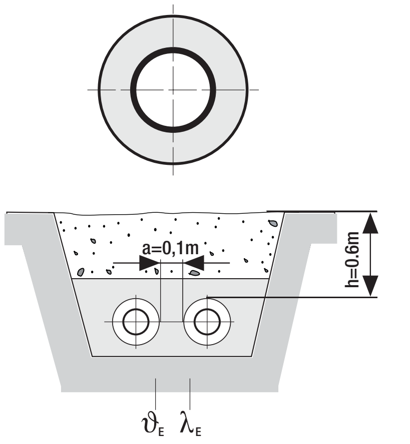


Fig. 23 RAUTHERMEX UNO SDR 11

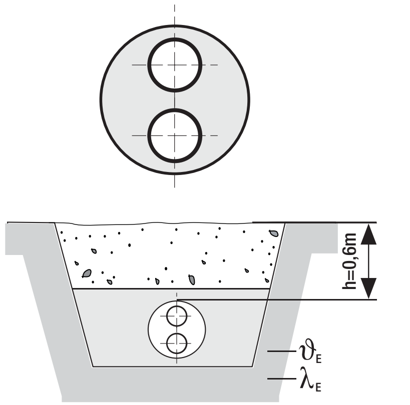


Fig. 24 RAUTHERMEX DUO SDR 11

4.5 Energy losses

4.5.1 Energy losses in SDR 11 pipes

With a soil temperature of 10°C, soil conductivity of 1.2 W/mK, depth of 0.6 m from the surface and (when using two UNO pipes) pipe spacing of 0.1 m, the following energy losses per metre of pipe can be expected at the average water supply temperature. The indicated energy losses apply to 1 m of RAUTHERMEX pipe.

Assumptions

UNO pipe: 2 pipes in trench below ground
DUO pipe: 1 pipe in trench below ground

For UNO pipes:	a = 0,1 m
Depth from surface:	h = 0,6 m
Ambient soil temperature:	ϑ_E = 10 °C
Soil conductivity:	λ_E = 1,2 W/mK
Cond. of PUR foam:	λ_{PU} = 0,0216 W/mK
Cond. of PE-Xa-pipes:	$\lambda_{PE\text{-}Xa}$ = 0,38 W/mK
Cond. of PE pipe jacket:	λ_{PE}= 0,33 W/mK

Energy losses during operation

$\boxed{Q = U\,(\vartheta_B - \vartheta_E)}$ **[W/m]**

U = thermal heat transfer coefficient [W/mK]
ϑ_B = average water supply temperature [°C]
ϑ_E = ambient soil temperature [°C]

Energy loss in UNO Pipe SDR 11

		Energy losses Q [W/m] Avergae water supply temperature ϑ_B					
RAUTHERMEX UNO	**U [W/mK]**	**40 °C**	**50 °C**	**60 °C**	**70 °C**	**80 °C**	**90 °C**
25/91	0,101	3,02	4,02	5,03	6,04	7,04	8,04
32/91	0,123	3,69	4,92	6,16	7,39	8,62	9,85
40/91	0,154	4,63	6,17	7,72	9,26	10,80	12,34
50/111	0,159	4,78	6,37	7,97	9,56	11,15	12,74
63/126	0,182	5,46	7,28	9,10	10,92	12,74	14,56
75/162	0,164	4,93	6,57	8,22	9,86	11,50	13,14
90/162	0,211	6,32	8,43	10,54	12,65	14,76	16,86
110/162	0,308	9,24	12,32	15,40	18,48	21,56	24,64
125/182	0,313	9,40	12,53	15,66	18,79	21,92	25,06
160/250	0,318	9,54	12,72	15,90	19,08	22,26	25,44

Table 15 Energy loss in UNO pipe SDR 11

Energy loss in DUO Pipe SDR 11

		Energy losses Q [W/m] Avergae water supply temperature ϑ_B					
RAUTHERMEX DUO	**U [W/mK]**	**40 °C**	**50 °C**	**60 °C**	**70 °C**	**80 °C**	**90 °C**
25+25/111	0,141	4,23	5,64	7,05	8,46	9,87	11,28
32+32/111	0,185	5,55	7,40	9,25	11,10	12,95	14,80
40+40/126	0,210	6,30	8,40	10,50	12,60	14,70	16,80
50+50/162	0,196	5,88	7,84	9,80	11,76	13,72	15,68
63+63/182	0,269	8,07	10,76	13,45	16,14	18,83	21,52

Table16 Energy loss in DUO pipe SDR 11

Instructions for Using Pipe Sizing and Energy Loss Tables

a) Pipe Sizing

- Using the heat load (KW) and temperature drop (DT) obtain flow in l/sec" from table 18
- Use the flow rate in Table 17 to select a suitable pipe size

b) Energy Loss and temperature Drop

- Using the selected pipe size and the mean water temperature, obtain the energy loss and temperature drop over 100m pipe lengths using tables 19 & 20.

Pressure losses are based on a mean water temperature of 70ºC

Flow rate	25 x 2.3		32 x 2.9		40 x 2.9		50 x 2.9		63 x 2.9	
(L/sec)	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec
0.1	64	0.31								
0.2	218	0.61	65	0.37						
0.3			135	0.56						
0.4			227	0.74	79	0.48				
0.5					118	0.60				
0.6					164	0.72				
0.7					216	0.84	73	0.5		
0.8					276	0.96	93	0.6		
0.9							115	0.7		
1.0							139	0.8		
1.5							291	1.1	95	0.72
2.5									241	1.20

Flow rate	75 x 6.8		90 x 8.2		110 x 10		125 x 11.4		160 x 14.6	
(L/sec)	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec
3	141	1.0								
3.5	187	1.2								
4	240	1.4								
4.5	298	1.5	123	1.06						
5			149	1.18						
5.5			178	1.29						
6			209	1.41						
6.5			242	1.53						
7			277	1.65	104	1.10				
7.5					118	1.18				
8					133	1.26				
8.5					148	1.34				
9					165	1.41				
9.5					182	1.49	98	1.16		
10					200	1.57	107	1.22		
15							228	1.83		
20									116	1.49
25									175	1.86
30									247	2.23

Table 17 Pipe sizing and pressure loss table

Heat Load	Temperature Drop (△T)				
kW	5K	10K	15K	25K	30K
10	0.48	0.24	0.16	0.10	0.08
20	0.96	0.48	0.32	0.19	0.16
30	1.44	0.72	0.48	0.29	0.24
40	1.91	0.96	0.64	0.38	0.32
50	2.39	1.20	0.80	0.48	0.40
60	2.87	1.44	0.96	0.57	0.48
70	3.35	1.67	1.12	0.67	0.56
80	3.83	1.91	1.28	0.77	0.64
90	4.31	2.15	1.44	0.86	0.72
100	4.78	2.39	1.59	0.96	0.80
200	9.57	4.78	3.19	1.91	1.59
300	14.35	7.18	4.78	2.87	2.39
400	19.14	9.57	6.38	3.83	3.19
500	23.92	11.96	7.97	4.78	3.99
600	28.71	14.35	9.57	5.74	4.78
700		16.75	11.16	6.70	5.58
800		19.14	12.76	7.66	6.38
900		21.53	14.35	8.61	7.18
1000		23.92	15.95	9.57	7.97
1100		26.32	17.54	10.53	8.77
1200		28.71	19.14	11.48	9.57
1300			20.73	12.44	10.37
1400			22.33	13.40	11.16
1500			23.92	14.35	11.96

Table 18 Flow rates for various heat loads and varying temperature drops . Flow rate in L/sec.

Pipe Size	Mean Water Temperature (°C) and Temperature Drop (△T)											
(mm)	40°C	△T	50°C	△T	60°C	△T	70°C	△T	80°C	△T	90°C	△T
25 x 2.3	0.30 kW	0.4 °C	0.40 kW	0.5 °C	0.50 kW	0.6 °C	0.60 kW	0.7 °C	0.70 kW	0.8 °C	0.80 kW	1.0 °C
32 x 2.9	0.37 kW	0.2 °C	0.49 kW	0.3 °C	0.62 kW	0.4 °C	0.74 kW	0.5 °C	0.86W	0.5 °C	0.98 kW	0.6 °C
40 x 3.7	0.46 kW	0.2 °C	0.62 kW	0.2 °C	0.77 kW	0.3 °C	0.93 kW	0.3 °C	1.08 kW	0.4 °C	1.23 kW	0.4 °C
50 x 4.6	0.48 kW	0.1 °C	0.64 kW	0.1 °C	0.80 kW	0.2 °C	0.96 kW	0.2 °C	1.12 kW	0.2 °C	1.27 kW	0.2 °C
63 x 5.8	0.55 kW	0.1 °C	0.73 kW	0.1 °C	0.91 kW	0.1 °C	1.09 kW	0.1 °C	1.27 kW	0.1 °C	1.46 kW	0.1 °C
75 x 6.8	0.49 kW	0.0 °C	0.66 kW	0.0 °C	0.82 kW	0.1 °C	0.99 kW	0.1 °C	1.15 kW	0.1 °C	1.31 kW	0.1 °C
90 x 8.2	0.63 kW	0.0 °C	0.84 kW	0.0 °C	1.05 kW	0.0 °C	1.26 kW	0.1 °C	1.48 kW	0.1 °C	1.69 kW	0.1 °C
110 x 10	0.92 kW	0.0 °C	1.23 kW	0.0 °C	1.54 kW	0.0 °C	1.85 kW	0.0 °C	2.16 kW	0.1 °C	2.46 kW	0.1 °C
125 x 11.4	0.94 kW	0.0 °C	1.25 kW	0.0 °C	1.57 kW	0.0 °C	1.88 kW	0.0 °C	2.19 kW	0.0 °C	2.51 kW	0.0 °C
160 x 14.6	0.95 kW	0.0 °C	1.27 kW	0.0 °C	1.59 kW	0.0 °C	1.91 kW	0.0 °C	2.23 kW	0.0 °C	2.54 kW	0.0 °C

Table 19 RAUTHERMEX UNO Energy Loss and Temperature Drop for 100m pipe length

Pipe Size	Mean Water Temperature (°C) and Temperature Drop (△T)											
(mm)	40°C	△T	50°C	△T	60°C	△T	70°C	△T	80°C	△T	90°C	△T
25 x 2.3	0.42 kW	0.5 °C	0.56 kW	0.7 °C	0.71 kW	0.8 °C	0.85 kW	1.0 °C	0.99 kW	1.2 °C	1.13 kW	1.3 °C
32 x 2.9	0.56 kW	0.3 °C	0.74 kW	0.5 °C	1.00 kW	0.6 °C	1.11 kW	0.7 °C	1.30 kW	0.8 °C	1.48 kW	0.9 °C
40 x 3.7	0.63 kW	0.2 °C	0.84 kW	0.3 °C	1.05 kW	0.4 °C	1.26 kW	0.4 °C	1.47 kW	0.5 °C	1.68 kW	0.6 °C
50 x 4.6	0.59 kW	0.1 °C	0.78 kW	0.1 °C	0.98 kW	0.2 °C	1.18 kW	0.2 °C	1.37 kW	0.3 °C	1.57 kW	0.3 °C
63 x 5.8	0.81 kW	0.1 °C	1.08 kW	0.1 °C	1.35 kW	0.1 °C	1.61 kW	0.2 °C	1.88 kW	0.2 °C	2.15 kW	0.2 °C

Table 20 RAUTHERMEX DUO Energy Loss and Temperature Drop for 100m pipe length

4.6 Pipe laying technicques

Thanks to the flexibility of RAUTHERMEX pipes, various pipe laying techniques can be used. The pipe laying technique must be adapted to suit the local conditions. The fully bonded RAUTHERMEX system is also ideal for bridging long distances with ploughing-in and horizontal directional drilling.

4.6.1 Open-cut technique

This is the most common laying method. RAUTHERMEX pipe trenches can be very narrow. Sufficient working space only has to be available at joints.

Advantages

- Flexible laying without special tools
- Simple and cost-effective
- Additional connections can be made at any time

Fig. 25 Open-cut technique

4.6.2 Pull-through technique

With the pull-through method, RAUTHERMEX pipes can be installed in disused channels, already laid pipes or in plastic pipe jackets requiring renovation.

Advantages

- Defective pipelines can be renovated easily
- Cost-effective laying through empty pipes that already exist or have been installed using horizontal directional drilling
- The fully bonded construction allows high pull forces to be used. This, in turn, allows large distances to be covered

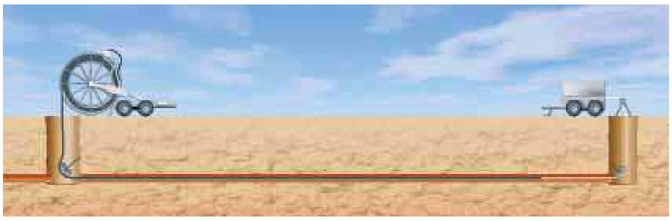


Fig. 26 Pull-through technique

4.6.3 Horizontal directional drilling technique

This method is also suitable for RAUTHERMEX.

Advantages

- High-quality surface structures can be bypassed cost effectively, it is even possible to cross under water
- In this case, the RAUTHERMEX pipes should be installed in a protective sleeve

Fig. 27 Horizontal directional drilling technique

4.6.4 Ploughing-in technique

In the ploughing-in technique, the pipes are laid quickly and without any great effort.
The ploughing-in method can be used for soils that are free of stones or when the ploughing-in method can guarantee that the pipe will be laid in a bed of sand.

Advantages

- No need for pipe trenches
- High insulation efficiency

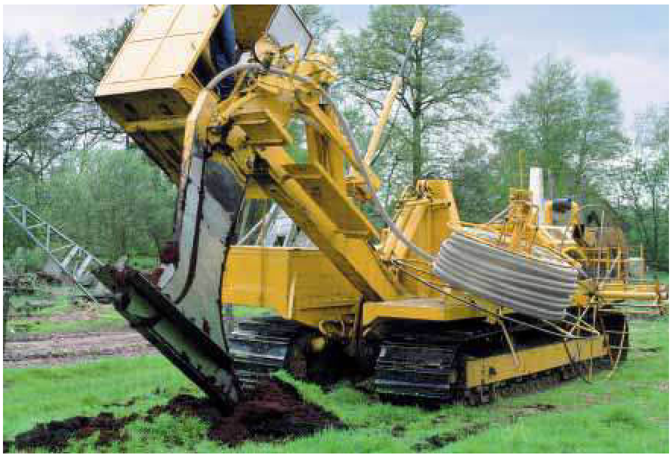


Fig. 28 Ploughing-in technique

4.7 Pipe Trenches

The dimensions of the pipe trench influence the level and distribution of the soil and traffic loads and therefore the load-bearing capacity of the pipeline. The width at the bottom of the trench depends on the outer diameter of the pipe and also whether or not additional accessible working space is required to lay the pipes. Sections underneath roads must comply with loading classifications SWL 30 or SWL 60 in accordance with DIN 1072. For loads greater than SLW 30 (e.g. SLW 60), a load-distributing surface structure in accordance with RStO 75 is necessary.

For RAUTHERMEX pipes, accessible working space is only required in jointing areas, as stipulated in DIN 4124. The minimum pipe cover for RAUTHERMEX pipes is 60 cm. The maximum cover is 2.6 m. More or less cover must be confirmed by means of a static load calculation. The trench bottom is to be constructed in such a way that it fulfils the width and depth specifications and the pipeline is in contact with it over its entire length.

For installations in groundwater and saturated ground, please discuss your project with REHAU first.

Fig. 29 Earthworks

The trench bottom should not be aerated. Before the pipes are laid, any aerated, cohesive soil is to be removed down to where the aerated soil begins and this is to be replaced with non-cohesive soil or a special pipe support. Aerated, non-cohesive soil is to be packed again.

Fig. 30 Trench base

4.7.1 Trench Widths

The figures show the required trench widths.

Sand of grade 0/4 must be used around the pipes and must be compacted manually in layers

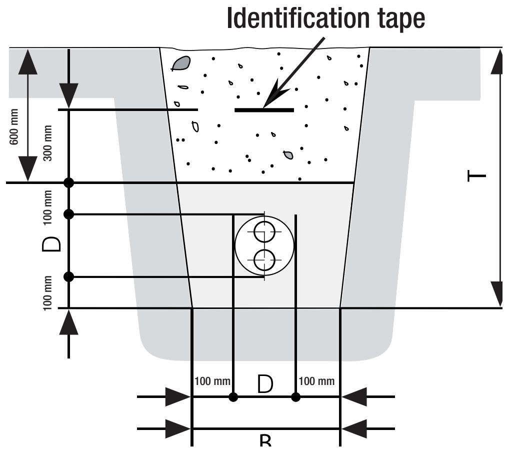


Fig. 31 DUO pipe trenches

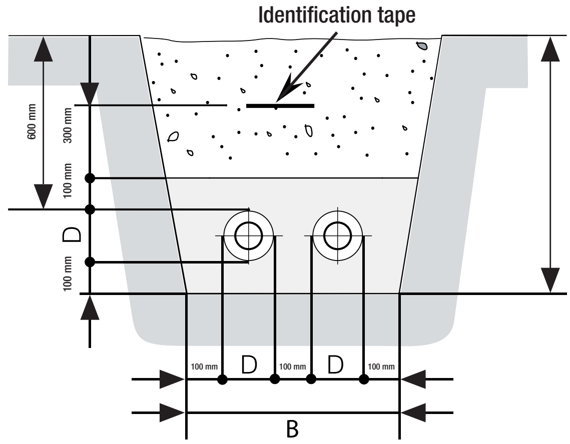


Fig. 32 Pipe system with UNO pipe

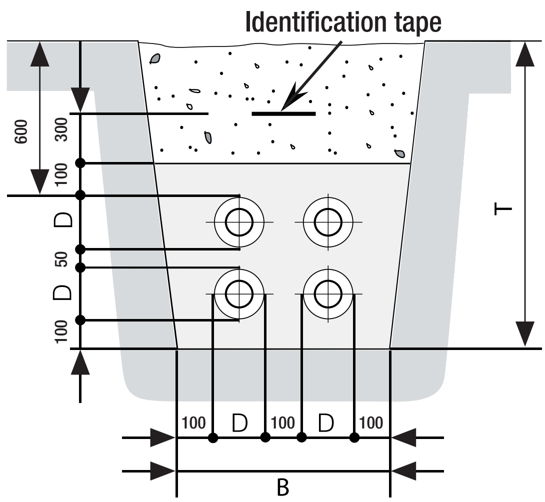


Fig. 33 Pipe system with UNO pipes laid above one another

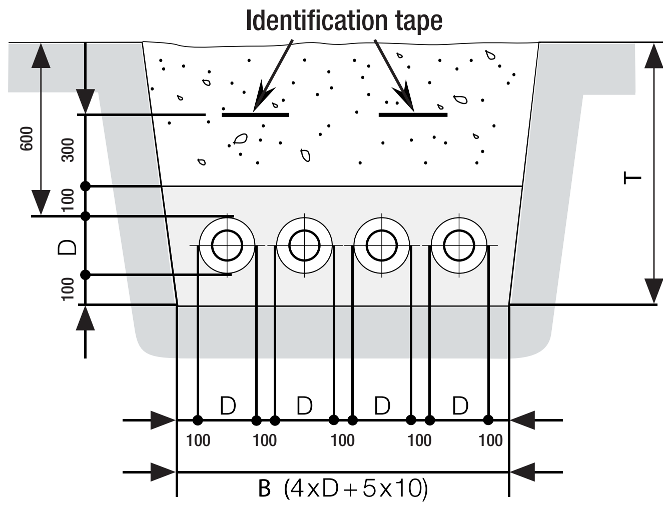


Fig. 34 Pipe system with UNO pipe laid next to one another

4.7.2 Proximity to other services

Minimum distances from other services must be observed (see Table 21). Drinking-water services adjacent to district heating pipes are to be separated by the minimum distance to prevent them from warming up above the temperature specified by the applicable standards. If this cannot be guaranteed by the distance, the drinking-water lines are to be insulated..

Other service	Parallel line <5 m or crossover	Parallel line >5 m
1-kV-, Signal-, sensor cablel	0,3 m	0,3 m
10-kV- or a 30-kV-cable	0,6 m	0,7 m
Several 30-kV-cables or cables 60 kV	1,0 m	1,5 m
Gas and Water services	0,2 m	0,4 m

Table 21 Distances from other services

4.7.3 Protecting the Pipes in Special Situations

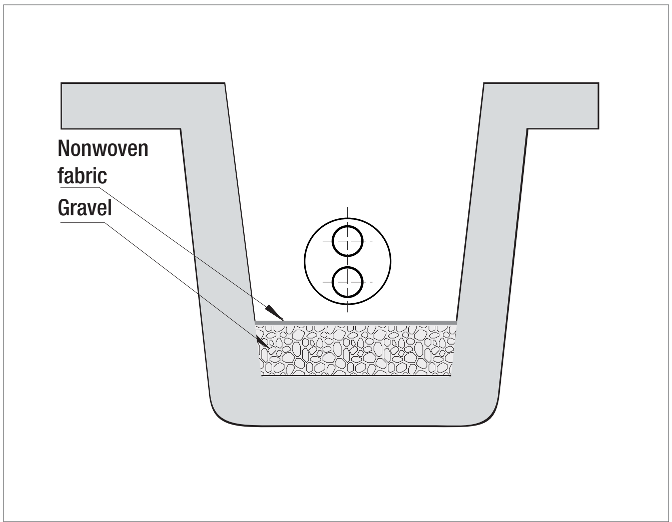


Fig. 35 Earthworks

Boggy conditions and marshland

If pipes are laid in boggy soil or marshland with a varying water table or underneath roads, solid obstructions that can affect the pipe support must be removed to a sufficient depth under the pipes.
In cases where the bottom of the trench is unstable or the soil is highly saturated, or where there are different soil layers of varying levels of stability, the pipes have to be secured through adequate construction measures, e.g. using non-woven fabric.

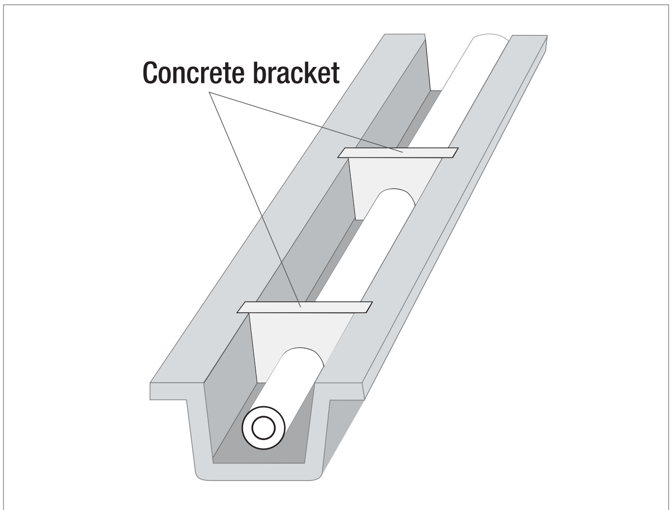


Fig. 36 Earthworks

Sloped trenches

On slopes, cross brackets are required to prevent the bedding from being washed away. In some cases, drainage may be needed.

RAUTHERMEX
INSTALLATION INSTRUCTIONS

Fig. 37 RAUTHERMEX pipes

5.1 Transport and Storage

Incorrect transportation or storage can result in damage to RAUTHERMEX pipes, accessories and fittings, which could affect the operational safety, particularly the excellent thermal insulation properties. Pipes and pipeline components should be checked for any transportation and/or storage damage before being placed in the trench. Damaged pipes and pipeline components must not be installed.

5.1.1 Storage time

To protect the pipes from dirt and the carrier pipe from UV radiation, the ends of the RAUTHERMEX pipes must be kept sealed at all times. Contact with potentially damaging substances (see Supplement 1 to DIN 8075) should be avoided. RAUTHERMEX pipes with a pipe jacket made of PE-LLD can only be stored in direct sunlight for a limited time. Experience has shown that, in Central Europe, pipes can be stored outside for up to 2 years after manufacture without this affecting the strength of the pipes. For prolonged periods of external storage or in areas with intense solar radiation, e.g. sea, in southern countries, or at altitudes over 1500 m, the pipes must be protected from direct sunlight. When covering with tarps, the UV resistance of the pipes must be taken into account and good ventilation of the pipes must be ensured to prevent any build-up of heat. Unlimited storage is possible if the pipes are protected from any light.

5.1.2 Transportation

Pipe coils are to be transported horizontally, lying completely flat on a load area, and must be secured to prevent shifting. The load area must be cleaned before loading up the pipe coils.

Fig. 38 Transportation

5.1.3 Lifting with a Digger

When lifting a pipe coil, ensure that the lower part of the coil, which is still touching the ground and carrying part of the total weight, is not dragged across the ground or load area. Take extra care when putting down the pipe coils: do not use ropes for lifting, only transport straps at least 50 mm wide.

Fig. 39 Lifting with a digger

5.1.4 Lifting with a Forklift

When using a forklift, ensure that the forks are covered with a soft material (cardboard or plastic tubes). Note: When using plastic pipes, make sure they are secured properly to prevent them from slipping off.

Fig. 40 Lifting with a forklift

5.1.5 Storage

We recommend storing pipe coils horizontally on wooden planks. This will largely avoid any pipe damage and allow easy lifting of the pipe coils when moved at a later stage. Under no circumstances are pipe coils to be stored on top of sharp-edged objects. Pipe coils should not be stored upright due to the risk of them falling..

Attention: Injury risk!

The small contact area between the ground and the coil would also allow objects to easily penetrate the outer jacket.

Fig. 41 Storage

Fig. 42 Cutting the coil straps

When undoing the bundled coil bindings, pipe ends can spring out! Always open bindings layer by layer.

Do not stand in the danger zone!

5.2 Laying Pipes

Cutting the straps

RAUTHERMEX pipes are supplied in coils with an outer diameter of up to 182 mm. When undoing the coil bindings, it is important to note that pipe ends can spring out.

Fig. 46

Fig. 43 Opening the coil layer by layer

Unwind coils layer by layer

Ensure that the uncoiled pipe section does not twist, as otherwise kinks may form. Another reason for cutting the straps layer by layer.

Fig. 44 Uncoiling

Uncoiling

For pipes with an outer diameter of up to 126 mm, the coils are usually uncoiled in an upright position. For larger pipe sizes, we recommend using a mechanical uncoiler. The coils can then, for example, be positioned horizontally on the uncoiler and uncoiled by hand or with a slow-moving vehicle.

Fig. 45 Laying a bend arean

Bend Radius

The high flexibility of the RAUTHERMEX pipes allows easy and quick laying. Obstacles can be bypassed and changes of direction in trenches are possible without the need for fittings. However, based on the pipe temperature, the minimum bending radii specified in the following table must be observed.

Bending radii

If the bending radii have to be achieved at lower pipe jacket temperatures, the bend area should be preheated with a low burner flame. For installation in frost conditions, the bend area of the pipe must always be preheated!

RAUTHERMEX Outer Diameter D	Minimum bending radius at 10 °C pipe jacket temperature
91 mm	0,8 m
111 mm	0,9 m
126 mm	1,0 m
142 mm	1,1 m
162 mm	1,2 m
182 mm	1,4 m

Table 22 Minimum bending radii for RAUTHERMEX

In view of the reduced pipe flexibility at low temperatures around freezing, the coil can be warmed up for a few hours in a heated building or a heated tent to facilitate installation.

Fig. 47 RAUTHERMEX pipes

Backfilling with sand

Fill pipe trench up to 100mm over the top of the pipes using sand of grade 0/4 and compact it by hand.

Fig. 48 Backfilling trenches with sand

Identification Tape

For better identification during future excavation work, identification tape should be laid 40 cm above the pipes. The identification tape should be labelled "Caution – District Heating Pipeline". For easier location of the installed pipeline, identification tape with metallic strips can be used

Fig. 49 Identification tape

5.3 Joining pipes with the compression sleeve technique

1 Cut pipe.

⚠ RAUTHERMEX pipe could spring back!

1

2

2 Expose lengths according to outer diameter of carrier pipe:

⚠ If the end of the pipe is not square, an extra approx. 2–4 cm should also be stripped so that the carrier pipe can be trimmed (see point 5)

Outer diameter	l
OD 20 - 40 mm	100 mm
OD 50 - 110 mm	125 mm
OD 125 - 160 mm	150 mm

Table 23 Exposing lengths

3 Cut the pipe jacket all the way round with a saw or pipe cutter and peel it off.

⚠ Take care not to damage the carrier pipe!

3

4

4 Remove the foam.

⚠ Take care not to damage the oxygen diffusion barrier!

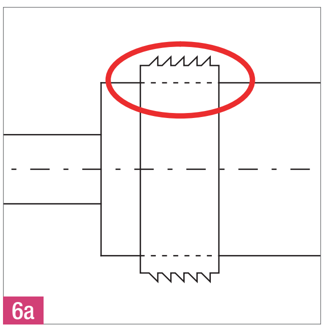
5 Cut the carrier pipe square, if required (see point 2).

5

6

6 Use sandpaper to remove the remaining RAUTHERMEX coupler foam from the carrier pipe.

6a Insert sealing rings, whilst making sure the ridges point away from the edge.



6a

6a

7 Slide compression sleeve on to the pipe.
Ensure that the square end faces toward the insulation and the chamfered end faces towards the joint.


7


8

8 Expand pipe twice, offset by approx. 30°.

Do not use expander in the area of the compression sleeve. Slide the compression sleeve right back to the insulation

9 Next, insert the fitting (REHAU T-piece for T-coupling or REHAU coupler for straight-coupling). Position the clamping jaws over the tool and clamp on to the joint. Note: For diameters above 63 mm, use REHAU lubricant on the carrier pipe in the area of the compression sleeve.

Before using the tool, read the operating instructions supplied with the tool very carefully!


9

10

10 If required for additional compression sleeve connection, cut out a recess to make room for the clamping tool. The insulation should then be removed as specified in the table.

Carrier pipe- Outer diameter	l Tool A1 oder M1	l Tool G1
20 - 40 mm	170 mm	------
40 - 110 mm	--------	270 mm

Table 24 Cutting a recess for tool

11 Clamp the second pipe. If you have selected a coupler as the pipe connection, the pipe connection is done.


11


12

12 When creating a T-branch, clamp the third pipe. If necessary, cut a recess to make room for the clamping tool. If these steps have already been carried out, the pipe connection is done.

5.3.1 Assembling the T-coupling set Generation II

13

13 Adjust the lower half-shell (without plug holes) and position the sealing rings.

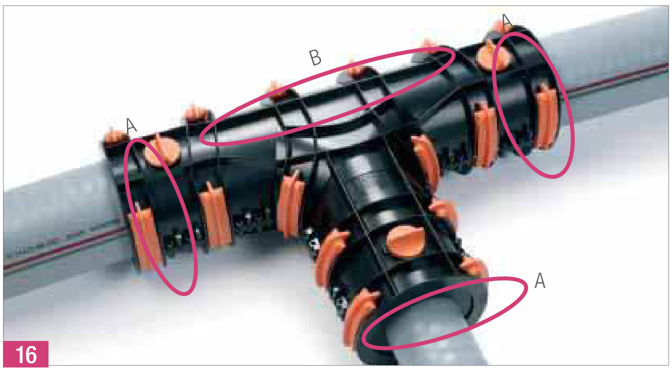
Check the positioning of the sealing rings along the entire circumference when the upper half-shell is placed on top.

14

14 Clean the bonding surfaces so that they are free from dirt and grease. Then apply the fast set adhesive supplied to the bonding surfaces of the shell, ensuring complete coverage.

15

15 Place the upper shell (with plug holes) on top and press on.



16

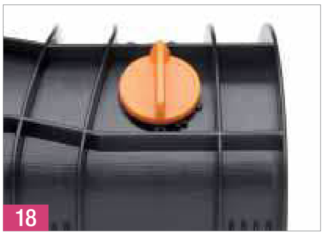
16 Mount the holding clips at the ends of the shells (see marking A). Next, do the same with the rest of the clips, starting with the long side of the T-piece (see marking B).

17

17 Apply adhesive generously to the two deeper-set plug holes.

Caution: The remaining highest-set plug hole is to be used later to fill the coupling with foam and to expel any air.

18 Insert the plug. Turn the bayonet fitting until it is vertical (= second notch and setting position). Use pliers if necessary. Wait 20 minutes until the adhesive has set.


18


18

19a Mix the foam components.


19a

19b Shake the foam bottle well (see Table 12, pg 11) and fill the coupling within the processing time.


19b

20 Fill with RAUTHERMEX coupler foam (for information about using foam, see 3.4) through remaining plug hole. Then cover or fill the sealing groove with the fast adhesive. Please ensure that the bonding surface is clean.


20

21 Turn the highest-set plug to the vent position (approx. 45°, first notch).

21 Turn the plug after venting (max. 4 minutes after filling with foam) to the closed position

Use pliers if the plug is stuck.

.

Assembly is complete.

5.3.2 Coupling Shroud (Generation I)

5.3.2.1 Assembling

1 Preparation
- Drill a vent hole and a foam hole
- Saw off the coupling ends in accordance with the dimensions of the RTX pipe jacket to be joined (see markings on the stepped ends).

2 Slide the Coupling Shroud with heat-shrink sleeves on to the pipes to be joined. Join up the carrier pipes (see 5.3 Joining pipes, point 7) Then position the shroud over the joint.

Fig. 50 To be used with RAUTHERMEX 160/250 UNO Pipe

5.3.2.2 Filling of the foam

Using the foam hole, fill the coupling shroud with RAUTHERMEX PU foam. You can find more information on using the RAUTHERMEX PU foam in point 5.3.3.

The vent hole must remain open until the air has escaped. Then fully insert the vent plug. Wait 60 minutes before continuing.

5.3.2.3 Heat shrinking of sleeves

Preparation
- Remove surplus foam after 60 minutes.
- Clean the areas on the socket and outer jackets where the sleeves will be fitted to remove foam, dirt, moisture and oils/grease and use sandpaper/abrasive cloth to rough up the areas where heat shrinking will be carried out. - Trim back the vent plug to make it flush with the socket.
- Preheat the area gently with a soft flame.
- The socket surface temperature must be at least 60°C and can be checked using the temperature indicator strips. At the correct temperature, the green area turns dark.

Jointing Heat Shrinking

1 Position the heat-shrink sleeves and shrink them with a soft flame. The heat-shrink sleeve should overlap the foam hole or the vent hole by approx. 5 cm.

5.4 Service connection pipes

5.4.1 Connecting through the basement

The RAUTHERMEX pipes should be routed in straight lines. If the RAUTHERMEX pipeline runs parallel to the building, the bend for entry into the building must have a bending radius of at least 2.5 x the value specified in Table 18. This protects the pipe from unnecessary stress where it penetrates the wall. If the spatial proportions are too small, prefabricated bends may also be used as a fall-back option.

In order to realise the connection inside the building, the pipes must project into the building by the amount specified in Table 29 (page 41).

5.4.2 Wall seals

Wall seals for sealing building inlets can be installed in core drill holes or in standard wall penetrations.
For core drill holes, Table 25 lists the recommended diameters for grouting the wall seals into place in the wall. For standard wall penetrations, a gap of at least 80mm between the outer pipe jacket and the wall must be ensured. For two pipes penetrating the wall, the dimensions are also listed in Table 25.

It is easier to push wall seals on to the outer pipe jacket when REHAU lubricant is used. The square end of the wall seal must face inwards and the stepped end must face towards the outer building wall. Insert the pipe with the wall seal into the core drill hole or standard wall penetration. The wall seal should be at least 80 mm from outside wall surface. Sealing is carried out using conventional expansive mortar.

Fig. 51 Wall seals

Outer diameter of pipe jacket D [mm]	Concrete core drill holes d [mm]	Wall penetration for 1 pipe h x l [mm]	Wall penetration for 2 pipes h x l [mm]
91	200	250 x 250	250 x 500
111	220	300 x 300	300 x 500
126	240	330 x 330	330 x 550
142	260	350 x 350	350 x 600
162	280	350 x 350	350 x 650
182	300	370 x 370	370 x 700
250	400	450 x 450	450 x 775

Table 25 Dimensions of wall penetrations

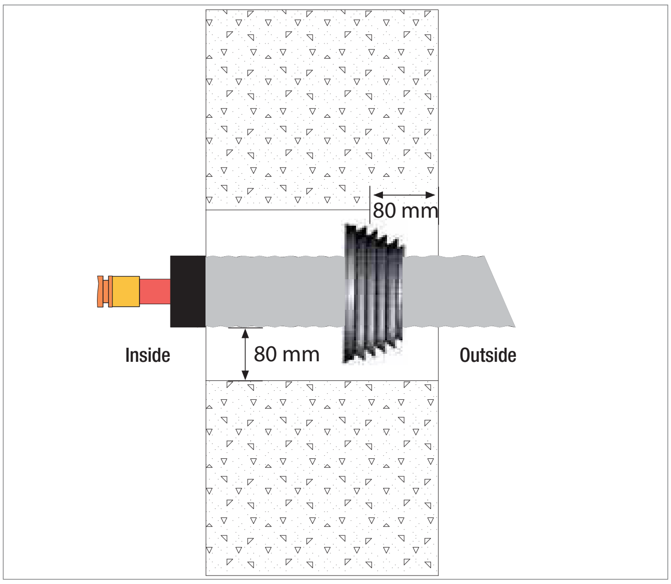


Fig. 52 Wall seal, side view, core drill hole

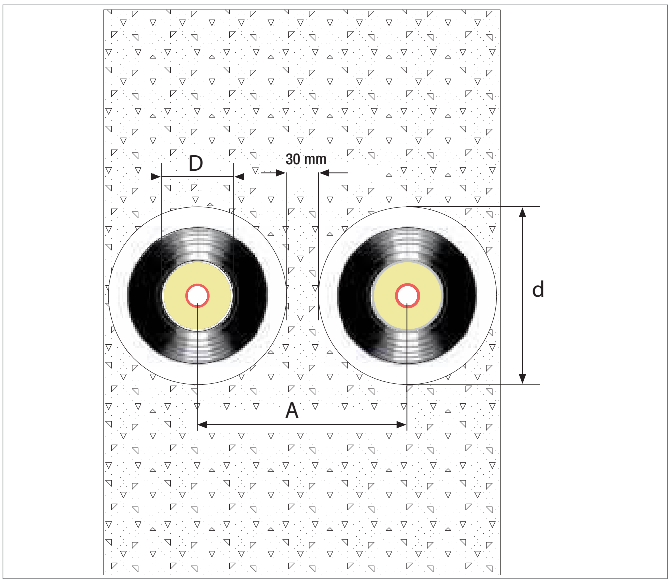


Fig. 53 Wall seal, front view, core drill hole

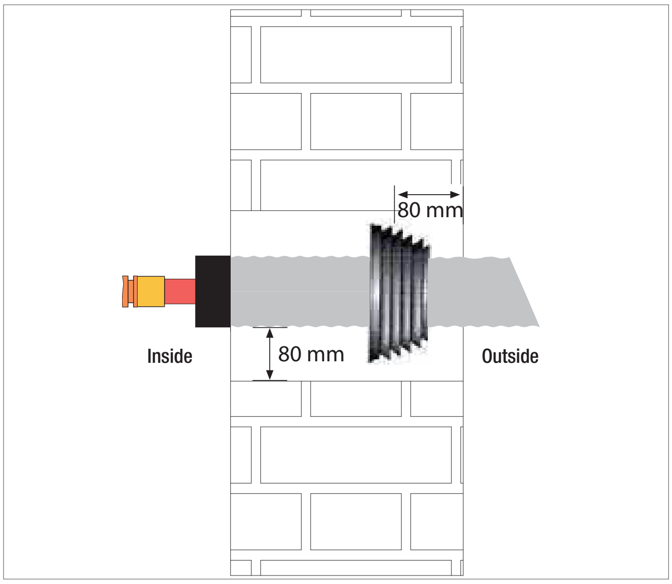


Fig. 54 Wall seal, side view, wall penetration

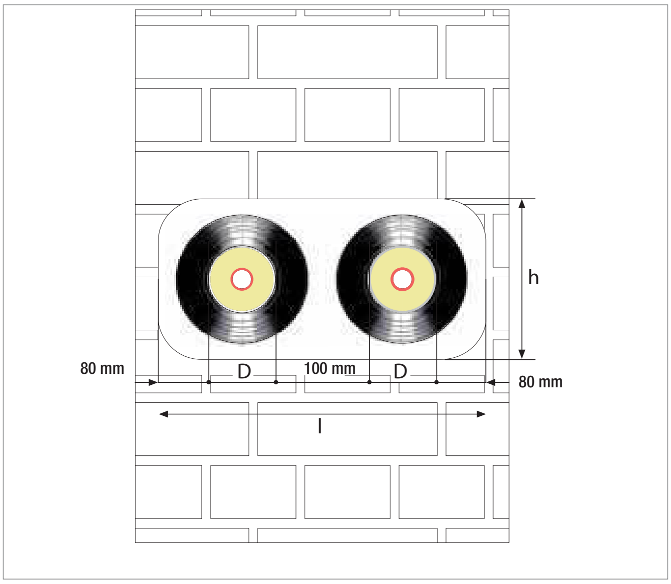


Fig. 55 Wall seal, front view, wall penetration

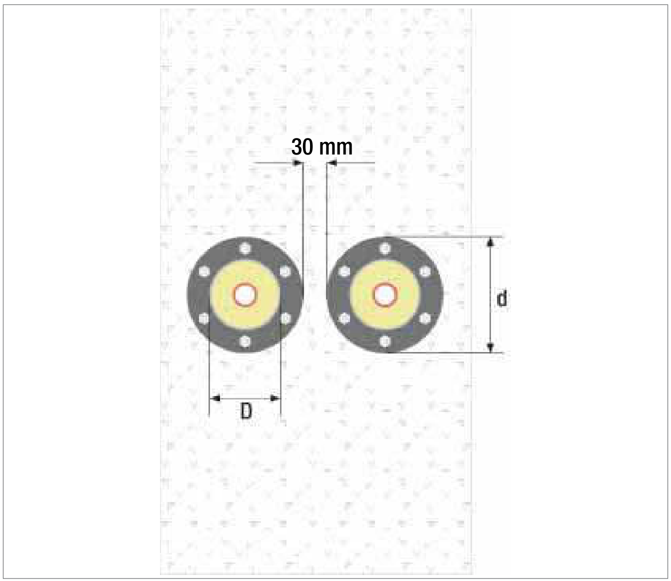


Fig. 56 Compression wall seal, front view

5.4.3 Compression wall seals

Compression wall seals should be used for sealing RAUTHERMEX pipes that are routed through the foundations, ceilings, etc. Sealing is carried out in a core drill hole or plastic wall sleeves. Where there are several wall penetrations next to one another, the distance between core drill holes or wall sleeves should be at least 30 mm.
The RAUTHERMEX pipes must have a maximum deviation of 7° in the drill hole. The position of the pipe in the wall sleeve or in the core drill hole must be secured.

When using plastic wall sleeves, we recommend using a wall sleeve bracket to fix and stabilise the wall sleeves. In the case of core drill holes, the entire drill hole wall should be sealed to seal any possible hairline cracks that occurred during drilling or construction work.

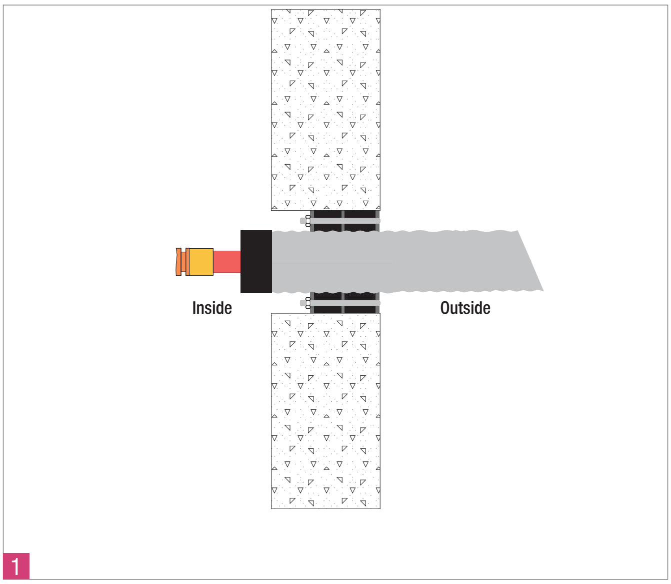


Fig. 57 Compression wall seal FA 80, single, for water under pressure, side view

5.4.4 Watertight compression wall seal FA 80 for pressures up to 1.5 bar

1 The FA 80 compression wall seal is to be used as a sealing element.

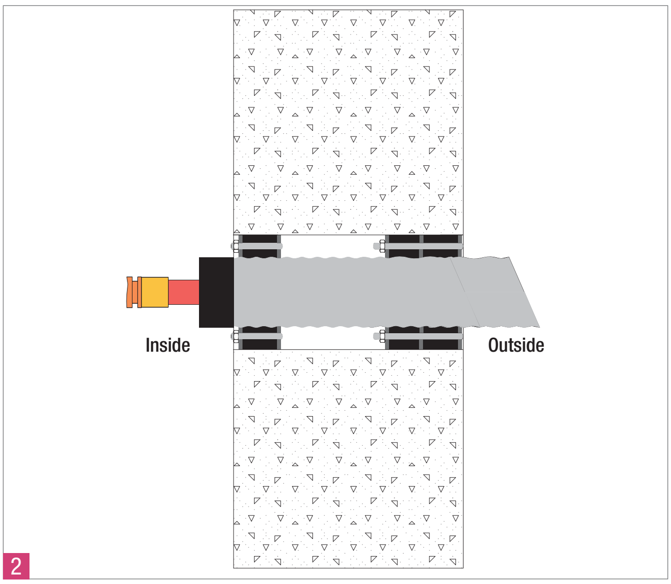


Fig. 58 ompression wall seal FA 80 and FA 40, water under pressure, side view

2 The FA 40 compression wall seal can also be used to stabilise the pipe in the drill hole (securing the position).

5.4.5 Compression wall seal FA 40 for water not under pressure

3 An FA 40 compression wall seal can be used for water not under pressure.

4 A second FA 40 compression wall seal can also be used to provide additional support (securing the pipe position).

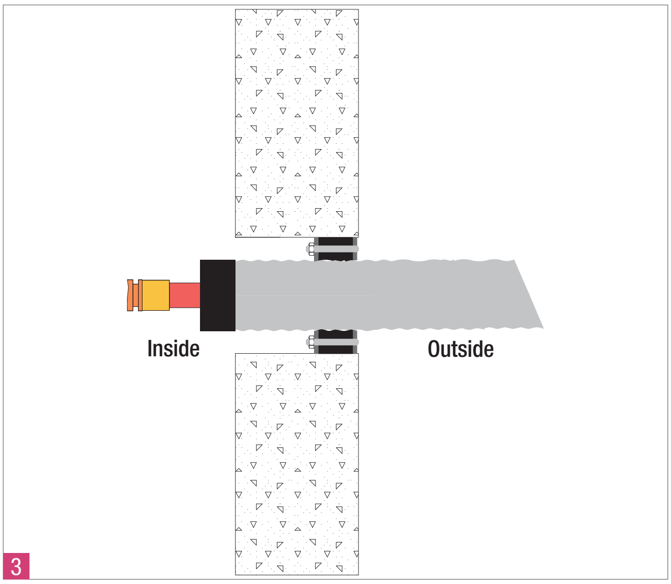


Fig. 59 Compression wall seal FA 40 single, for water not under pressure, side view

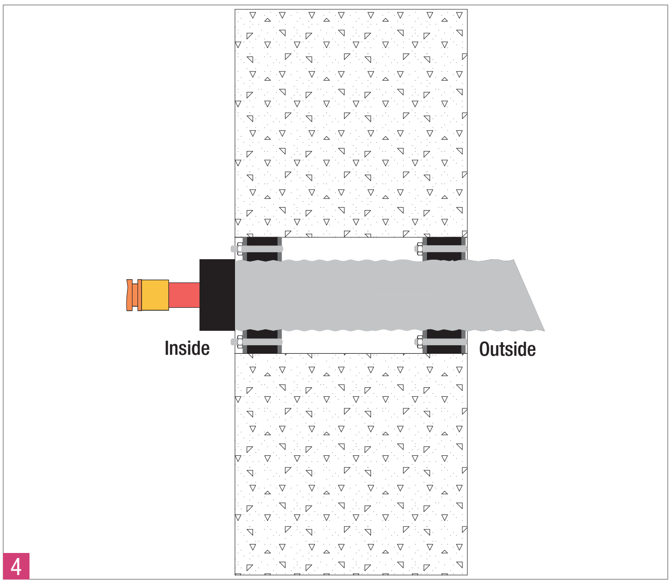


Fig. 60 Compression wall seal FA 40, water not under pressure, side view

Fig. 61 Compression wall seal

Installation

The RAUTHERMEX pipes must first be uncoiled. The pipe is then inserted into the wall penetration and properly secured in the pipe trench. Now insert the compression seal, align it and tighten the bolts with a torque wrench set as per Table 26.

RTX outer diameter D [mm]	Core drill hole/ wall sleeve inner diameter d [mm]	Bolts	Wrench size [mm]	Torque [Nm]
76	125 ± 2 mm	M 6	10	5
91	150 ± 2 mm	M 6	10	5
111	200 ± 2 mm	M 8	13	10
126	200 ± 2 mm	M 8	13	10
142	200 ± 2 mm	M 8	13	10
162	250 ± 2 mm	M 8	13	10
182	250 ± 2 mm	M 8	13	10
250	350 ± 3 mm	M 8	13	10

Table 26 Dimensions of compression wall seal

5.4.6 Pre-fabricated bends

The prefabricated RAUTHERMEX bends are used where the possible bending radius for routing into the building is smaller than required under 5.4.1. This is usually the case when installing pipes going into a building without a basement.

Installation

- Install wall seal and position prefabricated bend in the foundations
- The vertical end must be secured before the ground plate/foundations are laid

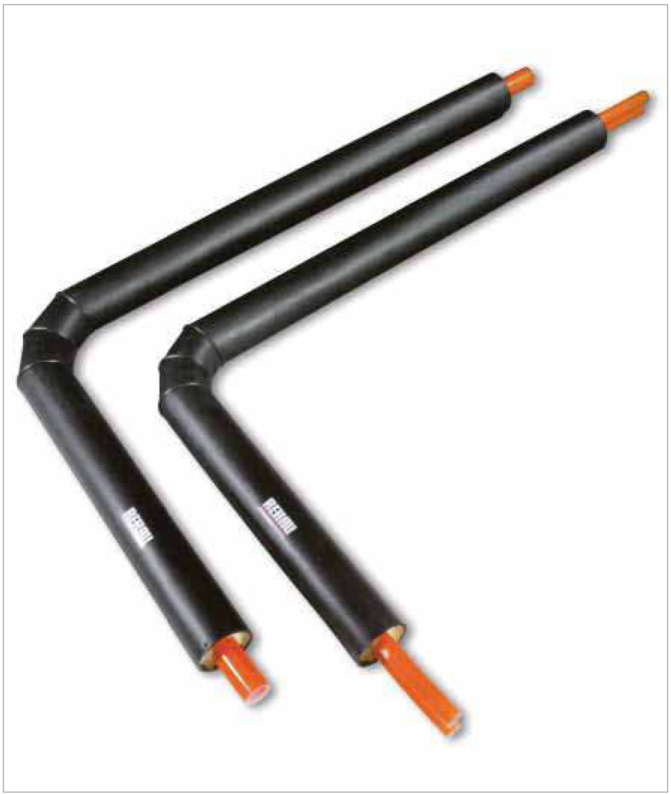


Fig. 62a Pre-fabricated bends for UNO and DUO pipes

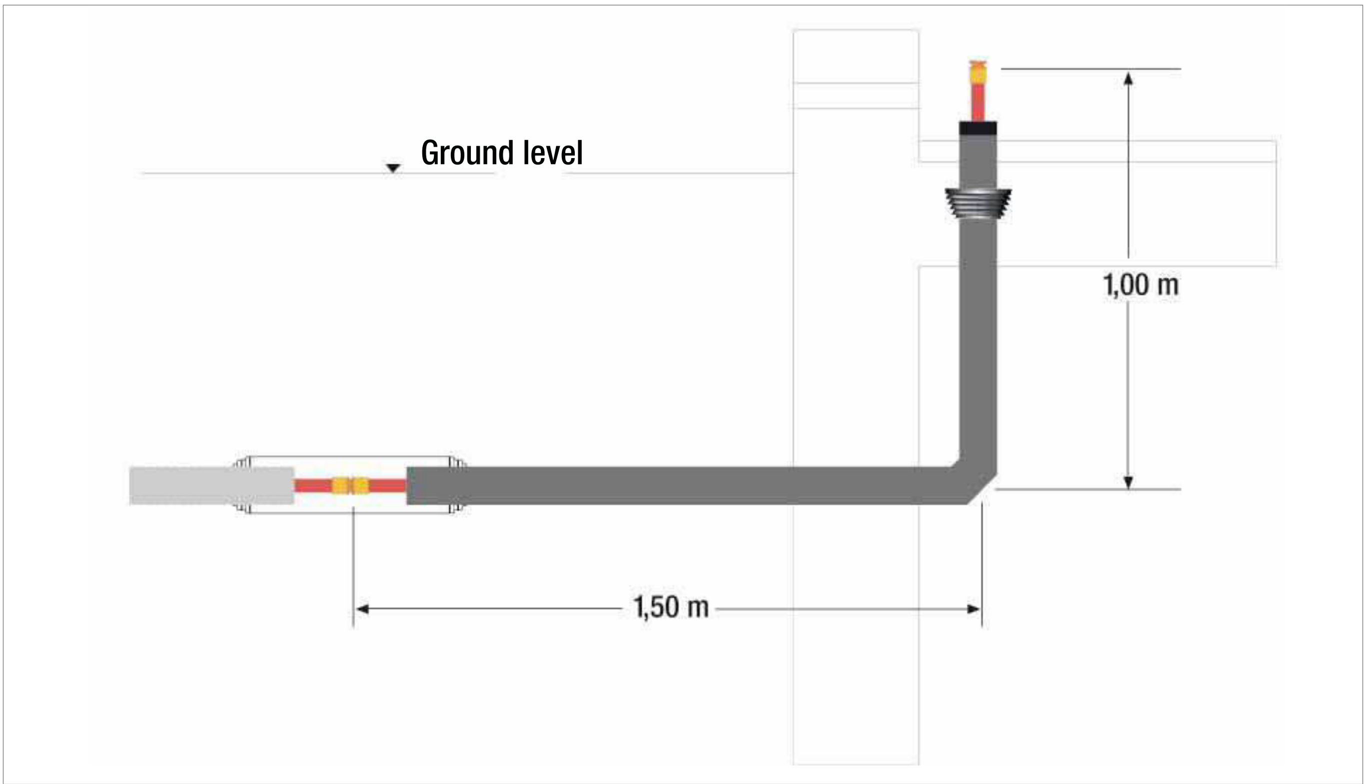


Fig. 62b Installing a pre-fabricated bend

Do not remove the protective end caps until the final connections have been made. If there is a danger of the unprotected carrier pipe ends becoming dirty or damaged by UV radiation, they must be protected with UV-resistant plastic film/tape.

5.4.7 Pre-fabricated Y- Pipe

The prefabricated RAUTHERMEX Y-Pipe is used to transition from UNO to DUO, available for dimensions upto 63mm.

Installation

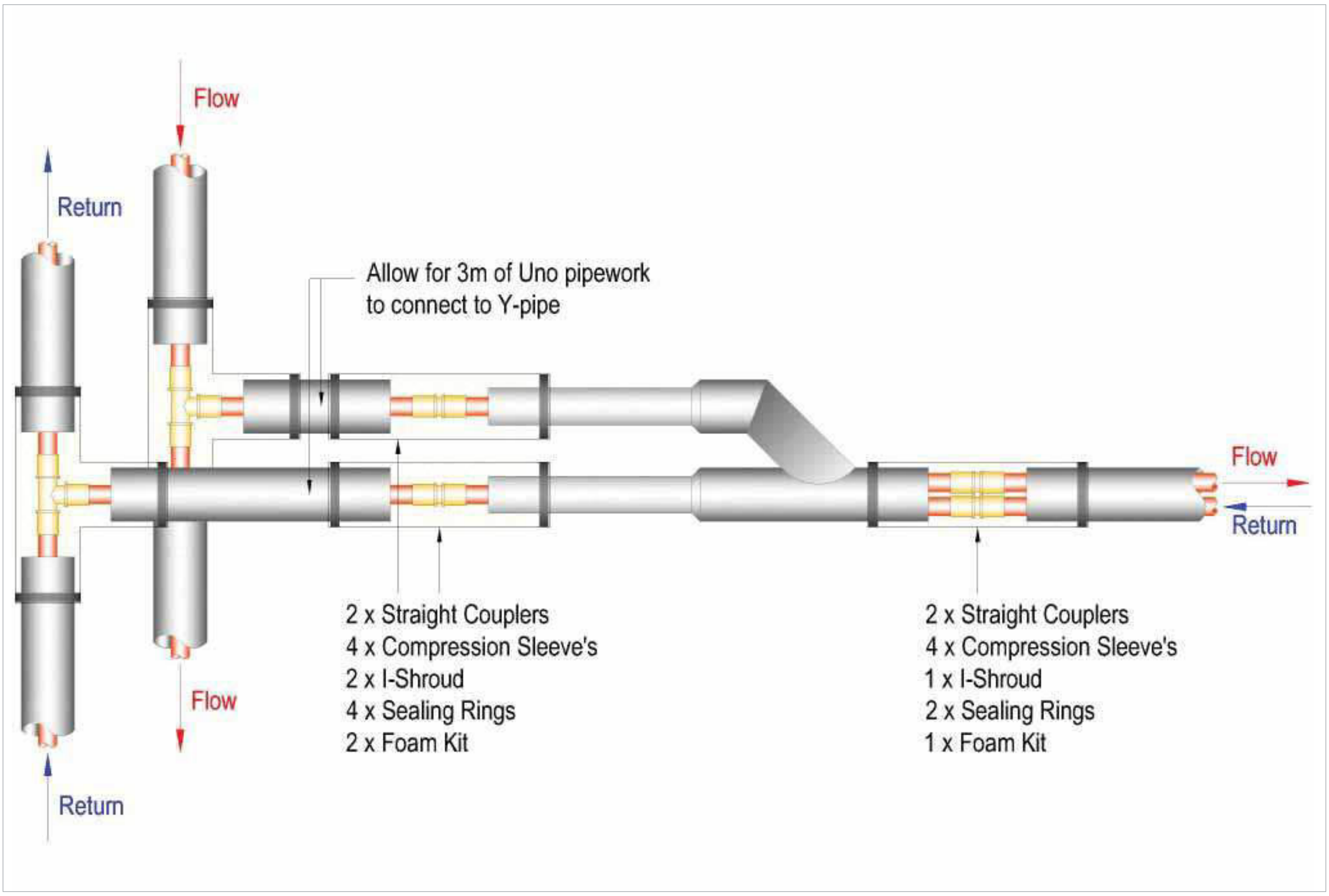


Fig. 63a Transition from UNO to DUO pipe using prefabricated Y-pipe

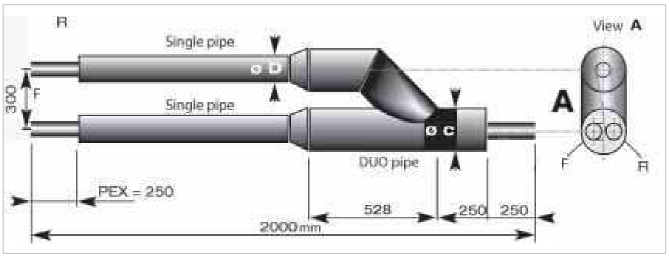


Fig. 63b Transition from UNO to DUO pipe using prefabricated Y-pipe

5.4.8 Exposed lengths with end caps

End caps are used to close off the pipes where they penetrate the building wall. If the end cap should be installed inside a wall, the pipe jacket must be stripped back before the RAUTHERMEX pipes are positioned in the trench. In this case, heat-shrink end caps must also be placed on the pipe ends beforehand. Otherwise, the pipes can be routed in first and stripped afterwards.

To carry out a compression sleeve joint with end caps, depending on the type of cap (heat-shrink end caps or push-on end caps), the exposed lengths shown in Tables 27 and 28 are required:

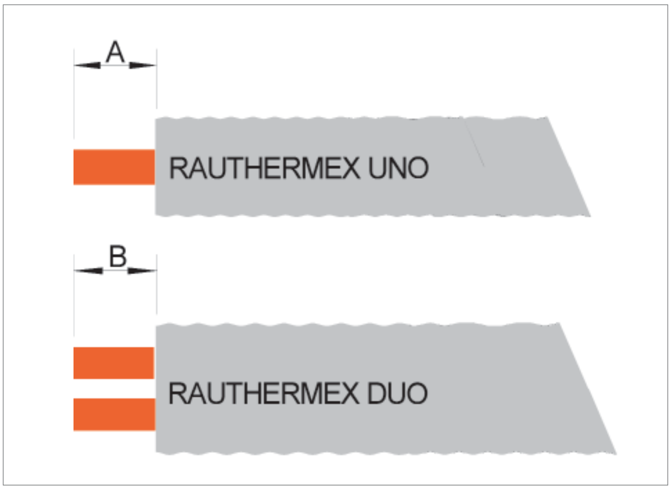


Fig. 64 Exposed lengths

Installing a heat-shrink end cap

- Expose RAUTHERMEX pipe in accordance with Table 24
- Rough up the heat-shrink area with an abrasive cloth and preheat it to over 60°C with a soft flame. Use temperature indicator strips to check the preheating temperature!
- Slide on heat-shrink end cap and shrink on using a soft flame
- Then complete the compression sleeve joint
- Danach Schiebehülsenverbindung erstellen

heat-shrink end cap dimensions	dimensions
RAUTHERMEX UNO	A
25 to 40 mm 50 to 110 mm 125 to 160 mm	150 mm 175 mm 200 mm
RAUTHERMEX DUO	B
25 to 40 mm 50 to 63 mm	150 mm 175 mm

Table 27 Exposed lengths, heat-shrink end caps (A, B)

Fig. 65 Heat-shrink end caps for UNO and DUO pipes

Installing push-on end caps

- Expose RAUTHERMEX pipe in accordance with Table 25
- Push-on end cap
- Then complete the compression sleeve joint

End cap	Dimensions
RAUTHERMEX UNO	A
25 to 40 mm 50 to 110 mm 125 to 160 mm	100 mm 125 mm 150 mm
RAUTHERMEX DUO	B
25 to 40 mm 50 to 63 mm	100 mm 125 mm

Table 28 Exposed lengths, push-on end caps

Fig. 66 Push-on end caps for UNO and DUO pipes

5.5 Linear thermal expansion during installation

5.5.1 Linear thermal expansion in trenches

No expansion bellows or compensators are required for RAUTHERMEX pipes when installed in trenches, as the friction between the pipe and the soil is greater than the expansion forces of the plastic pipe.

5.5.2 Linear thermal expansion when connecting to buildings

To keep the thermal expansion within acceptable limits when connecting to a building, RAUTHERMEX pipes should not extend more than the distances specified in Table 29 beyond the inner building wall into the building itself. If the push-on or heat-shrink end caps are inside the wall or extend into the core drill hole, the dimensions x can be reduced by 60 mm. The carrier pipe requires fixed brackets suitable for the forces listed in the table. Fixed brackets may be attached to the fitting body, but not to the compression sleeve.

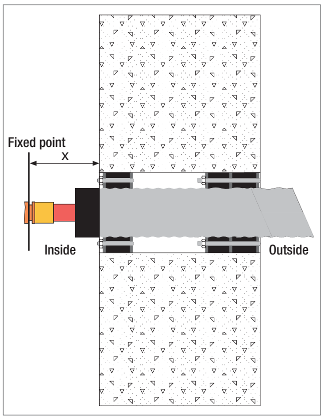


Fig. 67

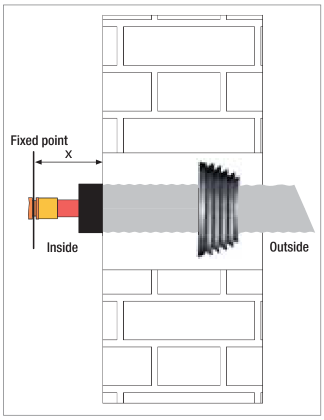


Fig. 68

5.6 Installation techniques

5.6.1 Pipe in sleeve system

For crossing underneath buildings or for areas with difficult access, a pipe-in-sleeve installation is possible with RAUTHERMEX. The inner diameter of the sleeve pipe must be at least 2 cm bigger than the outer diameter of the RAUTHERMEX pipe jacket. The RAUTHERMEX pipe can be pulled in using a winching cable and towing sock, ensuring the maximum winching forces are not exceeded. A lubricant applied to the RAUTHERMEX pipe jacket minimises the pipe friction. Changes in direction should only be made with the open-cut installation technique.

5.6.2 Installing during land development phase

To develop plots for connection to a heating network where buildings will be erected at a later date, dead legs can be laid and closed off with isolating valves (available on request). The ball valves can be insulated with the REHAU insulation kit for end caps.

5.6.3 Tapping into existing lines

The flexibility of the RAUTHERMEX pipes allows the subsequent installation of T-joints. The network section must be taken off line for this and the heating water must be cooled to 30°C. The usual contraction associated with polymer pipes installed above ground is not present with fully bonded RAUTHERMEX pipes. For this reason, the carrier pipes do not require any anchoring prior to separation of the through pipe.

Carrier pipe outer diameter x s [mm]	max. distance to wall from - to x min/max [mm]*	Max anchor forces per pipe [kN]
25 x 2,3	220 - 270	0,93
32 x 2,9	220 - 270	1,50
40 x 3,7	220 - 270	2,40
50 x 4,6	220 - 270	3,70
63 x 5,7	260 - 300	5,80
75 x 6,8	260 - 300	8,20
90 x 8,2	260 - 300	11,90
110 x 10	260 - 300	17,70
20 x 2,8	220 - 270	1,00
25 x 3,5	220 - 270	1,70
32 x 4,4	220 - 270	2,10
40 x 5,5	220 - 270	3,30
50 x 6,9	220 - 270	5,20
63 x 8,7	260 - 300	8,20

Table 29 Fixed points: distance to the wall and occurring forces

** To enable a fitting to be pressed in*

6 Commissioning

6.1 General information

The RAUTHERMEX pipes and joints must be pressure-tested before they are insulated or the trench is backfilled. The pressure test can be carried out immediately after completing the compression sleeve joints.

6.2 Pressure test with water

Test Procedure

- Visually imspect the District Heating pipe work to ensure that there is no post installation damage
- Flush the district heating circuit and allow for water to run clear of bubbles and any dirt/chippings that may have got into the pipeline
- Pressurise the system to test pressure of 6 bar (or) 1.5 x operating pressure, whichever is greater. Close the isolation valve on the inlet and outlet. Ensure there are no leaks from the connections
- The above step may need to be repeated several times before the pressure within the system stabilises at the test pressure. This is due to the inherent flexible properties of PE-Xa.
- When the pressure is stabilised in accordance to the graph below, remove the pressure pump and the pressure test is successful.

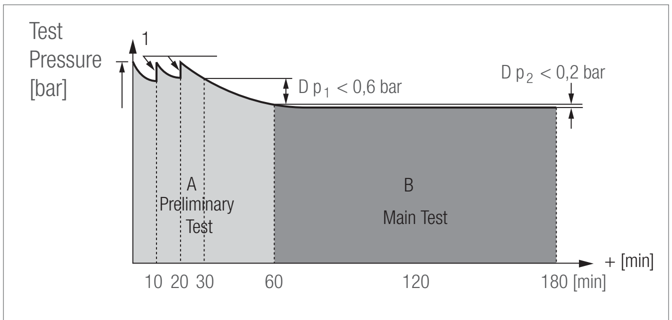


Fig 69 Pressure test diagram in accordance with DIN 1988

1 - Repumping
A - Pressure drop due to expansion of the pipe
B - Main Test

6.3 As installed drawings

The actually installed pipe lengths are to be recorded and entered into an as-installed drawing as per DIN 2425-2.

6.4 Corrosion Inhibitors

When using corrosion inhibitors or flow conditioners, confirmation of their compatibility with PE-Xa and the fitting materials used is to be obtained from the manufacturer. The requirements of VDI 2035 relating to the quality and treatment of the feed water should also be observed

6.5. Other applicable standards and guidelines

- DIN 2425 Part 2
  Plans for public supplies, for water engineering and for transmission lines; plans for pipe-systems for distant-heating

- DIN 16892: 2000
  Crosslinked polyethylene (PE-X) pipes
  - General requirements, testing

- DIN 16893: 2000
  Crosslinked polyethylene (PE-X) pipes
  - Dimensions

- DIN 13760 Miner's rule

- DIN 4726
  Warm water floor heating systems and radiator pipe connecting – Piping of plastic materials
  - General requirements

- DIN 4729
  Crosslinked polyethylene pipes for warm water floor heating systems
  - General requirements

- DVGW Worksheet W531
  Manufacture, quality assurance and testing of pipes made of PE-Xa for drinking-water installation

- DVGW Worksheet W534
  Compression joints for pipes made of PE-Xa

- DVGW Worksheet W534(E)
  Pipe connectors and pipe connections

- VDI 2035 Prevention of damage in water heating installations

- WRAS Approved up to 63mm for UNO and DUO pipe

6.6 Pressure Test Certificate

1. **Project Name** ....

2. **Installation Date**

Max. Operating Pressure ....
Max. Operating Temperature ....
Test Pressure: ....
Ambient Temperature: ....

3. **Pressure Test** **Completed**

a) Flush and fill the circuit ....
b) Pressureise to 6 bar (or) 1.5 times operating pressure whichever is greater ....
c) Pressure several times again in accordance with the pressure test diagram .... (Pipe expansion causes initial pressure loss)
d) Test Period for 3 hours ....
e) Pressure test is succesful, if-there are no leaks within the circuits - pressure has not fallen by more than 0.1 bar per hour ....

4. **Confirmation**

The Pressure Teststing was carried out in accordance with the above recommendations.
No leaks were deducted and no component showed a permanent deformation.

Location: ....

Date: ....

M & E Contractor/
Installer: ....

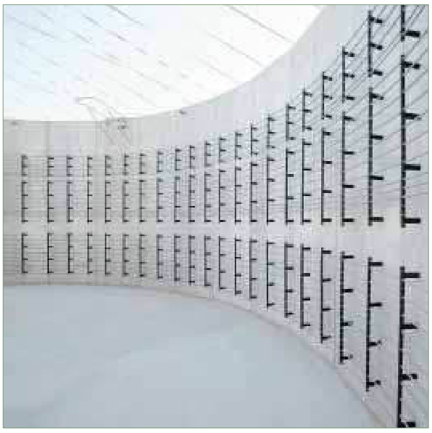
FURTHER REHAU PRODUCT RANGES

RAUVITHERM pre-insulated pipe

RAUGEO PE-Xa Probes

RAUGEO PE-RC & PE 100 Probes

RAUTOOLS



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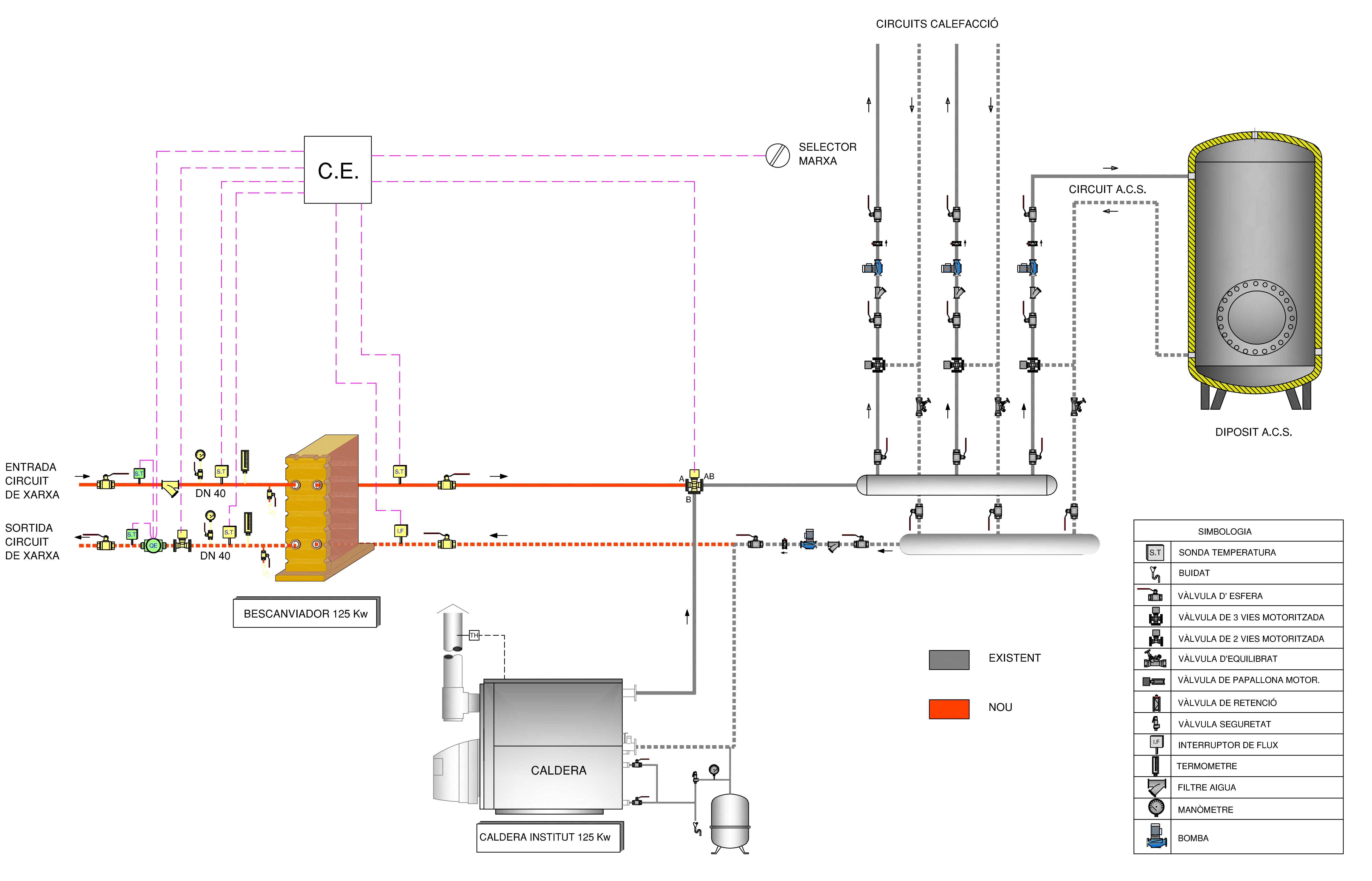

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