TIGRE

Hot Water Line

Technical Catalog and Products

Grupo TIGRE

A TOMORROW BETTER FOR EVERYONE. THIS IS OUR BRAND IN TH WORLD.

Each of our actions or our products has a single goal: to build a better world for all.

Better for our professionals who, united and guided by solid values, create innovative solutions to transform reality and people's lives.

Better for our customers, who receive the technology and trust that only a market-leading brand for decades can offer.

And better for the planet, which has every drop of its most precious natural resource respected and preserved with all affection.

Today, we are an admired multinational worldwide, with 24 manufacturing units (10 in Brazil and 14 abroad), present in more than 40 countries. All this done by more than 5,000 dedicated and passionate employees.

These numbers fill us with pride, but what really inspires us is knowing that a better world is at work.

And if it depends on Tigre, he will be better and better for everyone.

Our solutions

When it comes to building or renovating, count on Tigre! More than 75 years of history and innovation with a complete line of products for each stage of your project. After all, as important as a pioneering and transformative stance, it is to bring to the homes of millions of Brazilians solutions that guarantee tranquility and comfort. Whether for home renovation, collective, industrial and building works, real estate and artistic painting, sanitary metals, drainage projects, basic sanitation, agriculture, mining, among other applications, Tigre products guarantee innovative solutions ranging from infrastructure to finishing. And the best part: they are easy to install and very safe.

- **Water**
- **Sewage**
- **Drainage**
- **Accessories**
- **Electrical**
- **Painting Tools - Real Estate**
- **Painting Tools - Artistic**
- **Industry**
- **Irrigation**
- **Infrastructure**
- **Fire Fighting System**
- **Residential Gas**

Sumário

ClicPEX

ÁGUA QUENTE

1. ClicPEX

A melhor e mais moderna solução flexível para condução de água quente e fria em instalações hidráulicas prediais. Isso é o ClicPEX.

Os tubos da linha ClicPEX são fabricados em PEX (polietileno reticulado), um material que possui maior resistência à temperatura, a reações químicas e à deformação, além de ter excelente desempenho hidráulico. Todos esses diferenciais se traduzem em benefícios como durabilidade e qualidade elevadas.

Já as conexões, apresentam um conceito totalmente inovador e foram projetadas para dispensar o uso de ferramentas de montagem durante a instalação, tornando o trabalho mais simples e fácil. Fabricadas em CPVC, elas asseguram o pleno desempenho para condução de água quente.

Outro importante destaque são os tubos comercializados em bobinas de 50 m e 100 m, formatos que facilitam a aquisição, o transporte, o assentamento e a armazenagem do sistema na obra. Ele pode ser feito pelo método de distribuição tradicional, ou seja, coluna, ramal e sub-ramal, ou pelo método ponto a ponto, que são ramais de água com traçados diretos e sem derivações, partindo de um distribuidor até os pontos de consumo e reduzindo o uso de conexões.

A linha ClicPEX TIGRE é composta por tubos de PEX e conexões de CPVC e metálicas, que atendem às especificações normativas de performance de cada material indicado.

Todos esses benefícios fazem da linha ClicPEX a solução perfeita para instalações de água quente e fria.

1.1. Função/Aplicação

A linha flexível ClicPEX tem alto desempenho garantido na condução de água quente e fria em instalações hidráulicas prediais. E ainda pode ser utilizada com segurança e qualidade em sistemas de refrigeração.

1.2. Benefícios e Diferenciais

Instalação muito mais rápida
As inovadoras conexões ClicPEX dispensam o uso de ferramentas ou adesivos para realizar a união entre o tubo e a conexão. O sistema é intuitivo e a instalação é feita em um encaixe.

Maior retorno financeiro
Graças à flexibilidade do tubo e das conexões por simples encaixe, economia de tempo e mão de obra em até 50% (se comparado com os sistemas de crimpagem ou por anel deslizante).

Manutenção facilitada
Como dispensa o uso de ferramentas, facilita eventuais manutenções corretivas, incluindo mudança de direções no próprio tubo, reduzindo a necessidade de conexões.

Perda zero de material
Os tubos fornecidos em bobinas podem ser cortados em qualquer tamanho. O sistema por simples encaixe das conexões permite a sua reutilização em casos de manutenção ou alteração de configuração do sistema.

Maior durabilidade
Tubos de PEX e conexões de CPVC não sofrem corrosão, garantindo maior vida útil ao sistema.

Versatilidade
A instalação pode ser efetuada em diferentes locais e em diferentes configurações, seja ponto a ponto ou em kits.

Melhor performance hidráulica e térmica
As paredes internas lisas dos tubos proporcionam excelente desempenho hidráulico. A baixa condutividade térmica garante maior isolamento, conservando a temperatura da água por muito mais tempo.

1.3. Características Técnicas

Material: Os tubos são fabricados em Polietileno Reticulado (PEX) com grande flexibilidade e durabilidade. Não são afetados por aditivos derivados do cimento.

Cor: branco.

Propiedades: De acordo com Danieletto (2007), o polietileno reticulado é obtido por meio da transformação do polietileno em um material parcialmente termofixo. Quanto maior o grau de reticulação, maior a resistência à temperatura.

Em função do tubo adquirir características similares ao de material termofixo, o processo de soldagem acaba sofrendo restrições, por isso a principal forma de união com conexões é por meio mecânico.

Bitolas: O Sistema ClicPEX está disponível nos diâmetros de 16, 20 mm (bobinas de 100 m) e 25, 32 mm (bobinas de 50 m).

Aplicação: Para sistemas de água quente e água fria.

Tabela 1 - Propiedades do Tubo

ITEM	VALOR	UNIDADE
Coeficiente de dilatação	1,4x10-4	K-1
Temperatura de serviço	70	°C
Temperatura máxima do projeto	80	°C
Pressão de serviço (70°C)	6	kgf/cm²
Condutividade térmica	0,38	W/mk

A seguir, veja a relação de normas de referência que regem a fabricação do Sistema ClicPEX e que asseguram excelente desempenho, proporcionando um alto grau de segurança às instalações.

NORMAS TÉCNICAS DE REFERÊNCIA	
NBR 15884,	Sistemas de tubulações plásticas para instalações prediais de água quente e fria — Policloreto de vinila clorado (CPVC).
NBR15939	Sistemas de tubulações plásticas para instalações prediais de água quente e fria — Polietileno Reticulado (PEX)

1.3.1. Dilatação Térmica

Devido à variação de temperatura na instalação de água quente, o tubo pode ser submetido a processos de dilatação-contração.

Em toda a instalação, para compensar a dilatação, deve-se considerar os seguintes pontos:

- Instalação embutida na parede.
- Instalação sobre elementos em cima na parede, instalação à vista no teto.

A dilatação do tubo depende do comprimento do tubo (L) e da diferença da temperatura (Δt).

Em todas as variedades de montagem, tem que se considerar a dilatação do Tubo PEX.

Se os tubos estiverem instalados na parede, debaixo do reboco ou pavimento, a dilatação é compensada com o isolamento instalado (tubo bainha).

O coeficiente da dilatação do PEX é:

$$\alpha = 0{,}025$$

A dilatação é calculada da seguinte forma:

$$\Delta L = \alpha \cdot L \cdot \Delta t$$

Onde:

ΔL= dilatação (mm)

α= coefieciente de dilatação (0,025mm/m.°C)

L= comprimento do tubo (m)

Δt= diferença de temperatura (°C)

Dilatação térmica em instalações abertas

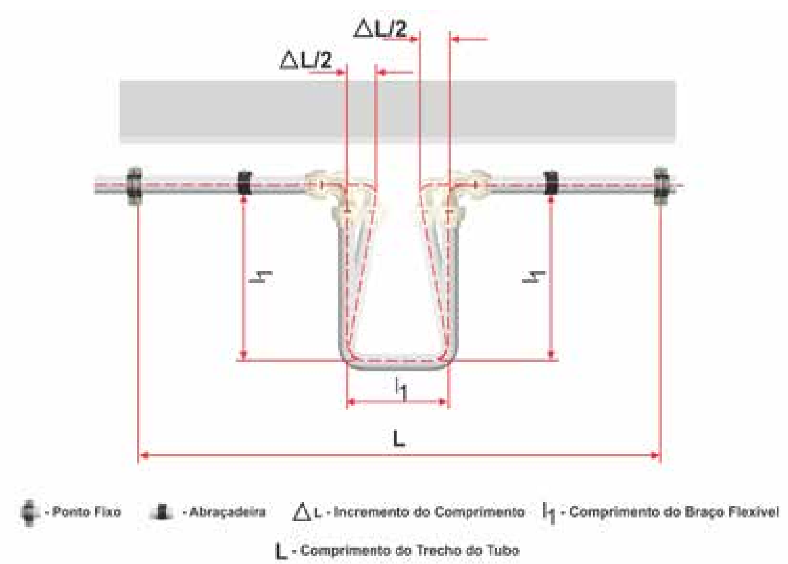
Em instalações abertas, não embutidas nas paredes, as fixações dos Tubos PEX devem ser feitas a uma distância máxima de 1,6 metro (veja exemplo na página 19).

Nessas instalações, raramente será necessário fazer uma compensação da expansão térmica do PEX (lira). Nesses casos, o procedimento abaixo deverá ser seguido.

Nas instalações abertas, não é possível fazer uma instalação fixa ou móvel. A dilatação do tubo terá que ser compensada. A compensação tem que ser sempre entre dois pontos fixos (FP) e nas mudanças de direção (trecho de absorção BS).

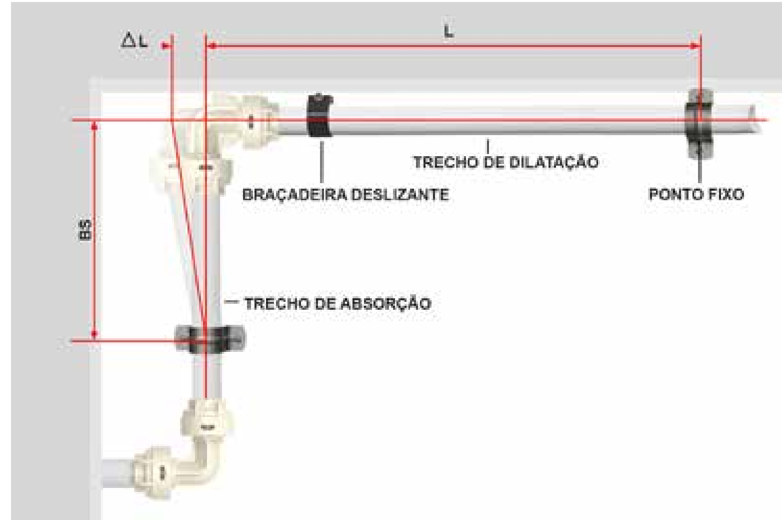
Na sequência, temos um exemplo de instalação que permite a expansão por meio de um trecho flexível e de uma lira.

INSTALAÇÃO COM EXPANSÃO **POR MEIO DE LIRA**



INSTALAÇÃO COM EXPANSÃO **POR MEIO DE UM TRECHO FLEXÍVEL**.

$$BS = 30 \times \sqrt{DA \times (\Delta T \times \alpha \times L)}$$



Onde:

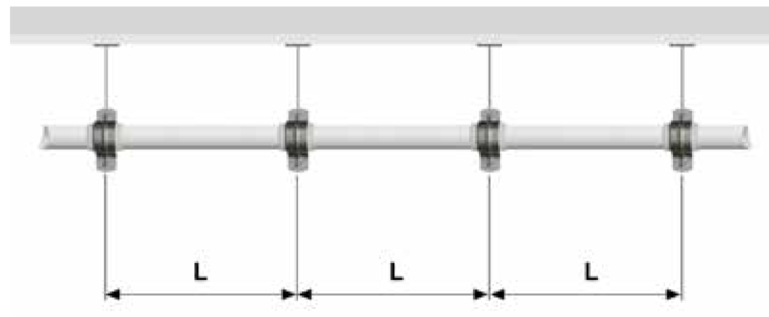
DA= Diâmetro exterior

L= comprimento do trecho de dilatação

BS= comprimento do trecho de absorção

α= coefieciente de dilatação (0,025mm/m.°C)

Δt= diferença de temperatura (°C)



Exemplo:
Calcular o comprimento do trecho de absorção e o alongamento de dilatação do tubo para uma simulação de aquecimento em um trecho flexível, considerando os seguintes parâmetros:

Temperatura no momento da instalação = 20°C
Temperatura em serviço = 60°C
Comprimento do trecho de dilatação (L) = 25m
Diâmetro do tubo (DA) = 32mm

$\Delta L = \alpha \times L \times \Delta t$

$\Delta L = 0{,}025 \times 25 \times 40$

$\Delta L = 25m$

$BS = 30 \times \sqrt{(DA \times (\Delta t \times \alpha \times \Delta t))}$

$BS = 30 \times \sqrt{(32 \times (25))}$

$BS = 848{,}5\ mm$

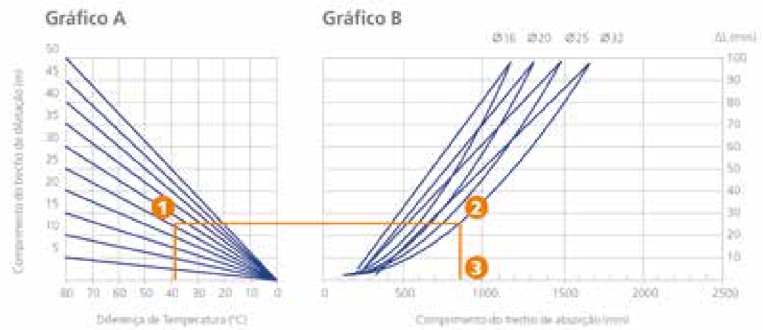
Obs.: para cálculo em trechos com liras, a TIGRE indica que a lira seja tal que

$$l_2 = \frac{l_1}{2}$$

Deve-se fazer o cálculo de maneira similar ao modelo anterior, tendo em conta que

$$L_B = l_1 + l_1 + l_2$$

CÁLCULO DO COMPRIMENTO **DO TRECHO DE DILATAÇÃO**



Utilizando os gráficos acima, também é possível estimar o comprimento do trecho de absorção (BS), seguindo as etapas sinalizadas no gráfico:

1 Partindo do eixo X no gráfico A, sabendo a variação da temperatura, trace uma reta no sentido vertical até o comprimento do trecho de dilata-ção.

2 Trace uma reta horizontal no sentido do gráfico B, até encontrar a curva
do diâmetro do tubo que você irá utilizar.

3 Desenhe um traço vertical, descendo até o eixo X, em que você conseguirá identificar o comprimento do trecho de absorção (BS).

1.3.2. Transporte e Estocagem

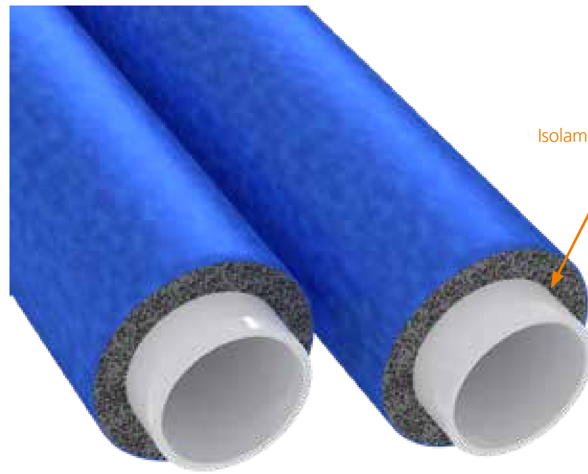
- Os tubos ClicPEX são fornecidos em bobinas de 50 m ou 100 m de comprimento.
- Tantos os tubos quanto as conexões não podem sofrer quedas ou impactos sob risco de serem danificados.
- Evite exposição ao sol, pois a radiação ultravioleta (luz solar) pode afetar os tubos durante o armazenamento e a instalação.
- Armazene os tubos e as conexões na embalagem original até a utilização.
- Evite que os produtos à base de óleo, solventes, tintas e fitas adesivas entrem em contato com os tubos.

O empilhamento máximo é de 6 bobinas, independentemente do comprimento delas.

1.3.3. Isolamento Térmico do Sistema

O isolamento térmico é indicado em condições em que a troca de tem-peratura com o meio externo é elevada, como em regiões mais frias, por exemplo.

O isolamento térmico deve ser utilizado de acordo com a necessidade/distância entre o ponto de utilização e o ponto de aquecimento de água. Para isso, a TIGRE indica materiais como poliuretano expandido, EPS ou lã de vidro para fazer o isolamento.



1.4. Instalação

A linha ClicPEX TIGRE tem na facilidade de instalação o seu principal dife-rencial diante dos produtos do mercado.

As conexões de engate rápido TIGRE foram projetadas para dispensar o uso de adesivos ou ferramentas de fixação, como alicates, por exemplo.

O conceito utilizado no produto agiliza o processo de instalação, pois as etapas são otimizadas, reduzindo consideravelmente o tempo gasto para tal, quando comparado a outros sistemas tradicionais do mercado.

1.4.1. Ferramentas

É fundamental utilizar as ferramentas adequadas para cada tipo de insta-lação, bem como é imprescindível utilizar ferramentas TIGRE para os seus acessórios, uma vez que é a única forma de assegurar que a união será realizada com pressão suficiente.

As ferramentas necessárias para a instalação da linha ClicPEX são as apre-sentadas a seguir.

Cortador de tubos

Calibrador/ chanfrador

Curvador

Expansor de tubos 16-32

Alicate de montagem anel deslizante 16-32

É imprescindível utilizar ferramentas Tigre para os seus acessórios. Essa é a única forma de assegurar que a união das peças será realizada de forma adequada e com a pressão suficiente

1.4.2. Procedimento de Instalação

1 Corte o tubo na medida necessária para sua aplicação de forma perpendicular, deixando a ponta sempre reta.

2 Insira o calibrador/chanfrador no tubo até o limite da ferramenta e gire no sentido horário para fazer o chanfro no interior do tubo.

O chanfro feito pelo calibrador/chanfrador facilita o encaixe do tubo na conexão.

3 Verifique se o acoplador está encaixado na conexão

Obs.: O sistema das conexões ClicPex foi desenvolvido para que ocorra um encaixe perfeito entre tubo, conexão e vedação. Durante a introdução do tubo à conexão, confira para que as partes estejam lineares no mesmo nível, para evitar avarias ou deslocamento do anel de vedação.

4 Insira o tubo na conexão e, por meio do espião, certifique-se de que o tubo foi introduzido até o final da peça. Durante o movimento, garanta que o encaixe das partes esteja linear, para evitar avarias.

Obs.: Se a ponta do tubo não estiver visível no espião significa que a junta foi mal executada e poderão ocorrer vazamentos.

Nota: Consulte nossa ficha técnica para obter detalhes sobre o passo a passo de instalação do anel deslizante.

1.4.3. Curvatura em Tubos

Raio mínimo de curvatura do Tubo PEX

Quando é feita uma instalação com Tubos PEX, existe um raio mínimo a ser respeitado para não colapsar o tubo. (Veja tabela ao lado).

Os tubos também podem ser dobrados com o auxilio do curvador. Essa ferramenta permite que os tubos sejam dobrados, evitando problemas de colapso. É importante que os tubos sejam curvados antes de fixados nas conexões para que não ocorra o tensionamento nos componentes, que possam ocasionar desgastes prematuros do sistema.

Para dobrar com a Mola Curvadora, deve-se introduzi-la por fora do tubo até chegar ao local desejado. Uma vez situada no ponto a curvar, dobramos com a mão, respeitando os raios indicados na tabela.

Tabela 2 - Raios mínimos de dobragem, em mm (em função do utensílio)

Dimensão do Tubo	Raio com Curvatura
16	65
20	100
25	120
32	160

1.4.4. Comprimento entre Conexões

Nas instalações da linha ClicPEX, sempre deve existir uma distância mínima de tubo entre as conexões. A tabela de comprimentos mínimos deve ser respeitada nas instalações.

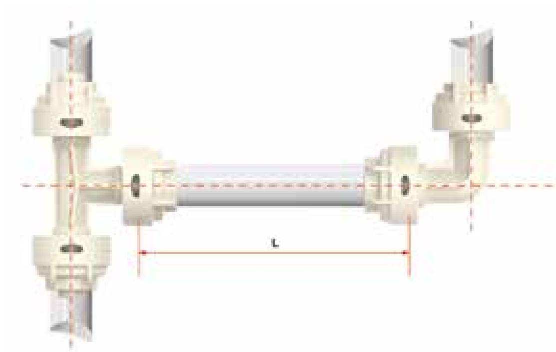


Tabela 3 - Comprimentos mínimos

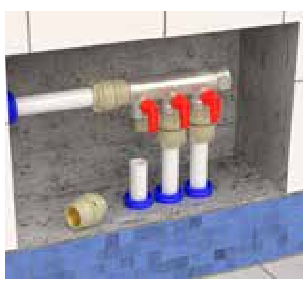
Diâmetro do tubo (mm)	Comprimento mínimo do tubo (LR) mm
16	160
20	160
25	170
32	170

1.4.5. Instalação em Casos Especiais

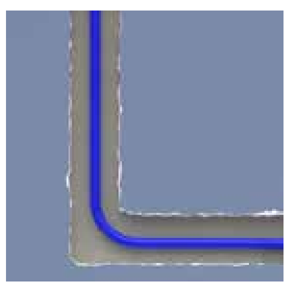
Instalação embutida (utilizando os tubos bainha).

Quando instalamos os Tubos PEX embutidos em alvenaria, é obrigatório o uso de tubos de bainha. Esse procedimento garante livre movimentação das tubulações condutoras de água por não estarem solidárias ao concreto, e também diminui o ruído, já que atua como isolante acústico contra a condensação de água.

Esse simples procedimento permite, quando utilizado em uma instalação ponto a ponto (com distribuidor), a fácil substituição de um tubo sem precisar quebrar a parede. Basta desligar o tubo conector (o distribuidor) e retirá-lo pela saída do ponto de água, podendo ser substituído por um novo trecho de tubo.



Desconecte a conexão do distribuidor para instalação ponto a ponto



Exemplo de instalação de tubo bainha

Recomendações Gerais

Para facilitar tanto o trabalho de retirar, quanto o de introduzir um tubo no tubo bainha embutido na parede, recomenda-se que as curvas ao longo da instalação tenham um raio mínimo igual a oito vezes o diâmetro do tubo que está sendo utilizado.

Tabela 4 - Raios de curvatura do tubo bainha

Diâmetro do tubo	Raio (mm)
DN 20	128
DN 25	160
DN 32	200

Também deve-se cuidar, durante a instalação, quanto à introdução de cimento entre o Tubo PEX TIGRE Monocamada e o tubo bainha, o que dificultará, e muitas vezes inviabilizará, a troca do tubo condutor.

Para facilitar a inserção do Tubo PEX ao interior do tubo bainha, utilize pasta lubrificante ao longo de todo o tubo.

Nesses casos, não é necessário considerar a dilatação térmica, basta fixar os tubos nas extremidades da parede ou do piso.

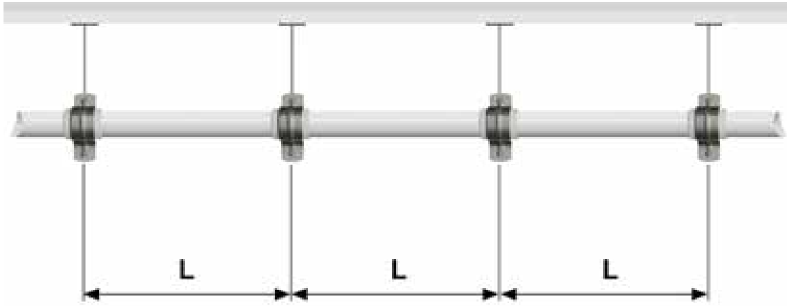
Em uma instalação ponto a ponto, as saídas dos distribuidores são tantas quanto os pontos de uso. A TIGRE possui distribuidores modulares de 2 a 3 saídas. Portanto, em instalações que tenham mais pontos de uso que saídas de um distribuidor, basta conectar outro até que a quantidade de saídas seja suficiente para abastecer todos os pontos da instalação, como mostra a figura a seguir.

Passagem por elementos estruturais, vigas, pilares, laje e instalações aéreas.

Apesar das tubulações PEX terem pequenas dilatações com a variação de temperatura, elas devem ter passagem livre em elementos estruturais, como vigas e pilares, bem como em passagem de laje. Para tanto, devem ser previstas passagens para as tubulações. Dessa forma, é garantida sua livre movimentação, como mostram as ilustrações na sequência.

Tubos passando por uma viga

Tubos passando por uma laje



Para instalações aéreas, com fixação no teto, utilizar abraçadeiras com distância entre pontos conforme tabela abaixo.

Importante: Após a abraçadeira instalada o tubo deve correr livre sem interferência da abraçadeira. As abraçadeiras devem ser do tipo D, com cunha ou parafuso.

A instalação da primeira abraçadeira após encaixe do tubo na conexão deverá ter distância mínima de 5cm e máxima 10cm.

Tabela 5 - Relação de distancias entre abraçadeiras

DN (mm)	Espaçamento "L"entre suportes horizontais (cm)		Espaçamento entre suportes verticais (cm)	
	20ºC	80ºC	20ºC	80ºC
16	57,8	45,1	75,1	58,6
20	64,4	50,3	83,7	65,4
25	74,2	57,9	96,5	75,3
32	87,1	68,0	113,2	88,4

1.4.6. Interface com Outros Sistemas (prumadas)

As alimentações principais de cada andar são feitas a partir das prumadas. Para derivar os ramais de distribuição, pode-se usar dois métodos principais em diferentes tipos de prumadas.

Prumada água fria soldável

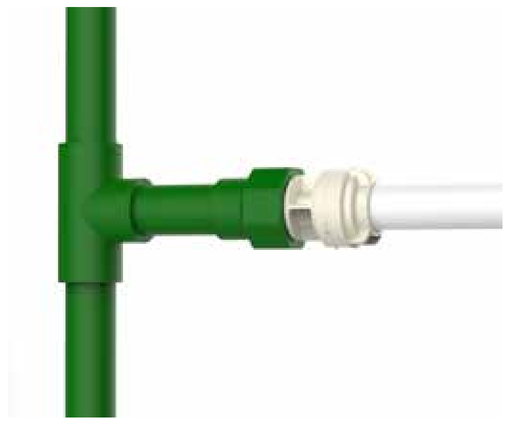
1) Derivação com Te + Luva Soldável com Rosca

Prumada CPVC – Aquatherm®

2) Derivação com Te Aquatherm® + Luva de Transição

Prumada PPR termofusão

3) Derivação com Te Normal PPR + Conector Fêmea



1.4.7. Instalação em Kits ou Paredes Drywall

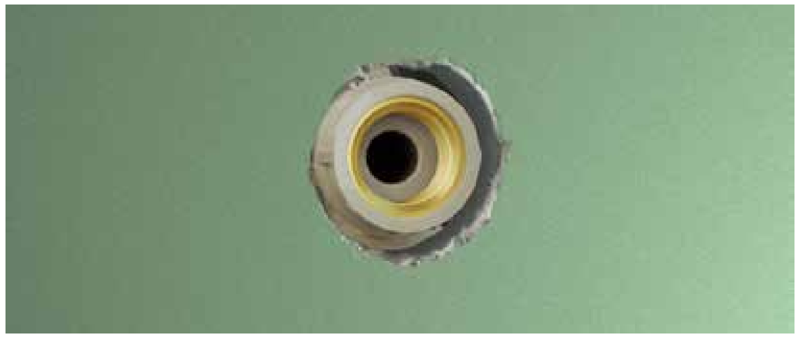
O sistema flexível para condução de água, além de ter um conceito de produto inovador, acompanha as tendências da construção civil. A proposta pode ser aplicada em paredes drywall ou em sistemas construtivos que utilizam estruturas de kits para a instalação da rede hidráulica.

Nesses casos, o principal benefício está ligado à produtividade da obra, que tem como objetivo dar agilidade durante a montagem e tornar os preços mais competitivos.

1.4.7.1. Instalação em drywall

Para uso em drywall, recomenda-se que o ponto de uso seja instalado da seguinte forma.

Obs.: O joelho deverá ser fixado no montante com dois conjuntos de porcas, parafusos e arruelas.



Recomendações gerais:

Para facilitar tanto o trabalho de retirar, quanto o de introduzir um tubo no tubo bainha embutido na parede, recomenda-se que as curvas ao longo da instalação tenham um raio mínimo igual a oito vezes o diâmetro do tubo que está sendo utilizado.

Tabela 6 - Raio de curvatura do tubo bainha

Diâmetro do tubo	Raio (mm)
DN 16	128
DN 20	160
DN 25	200

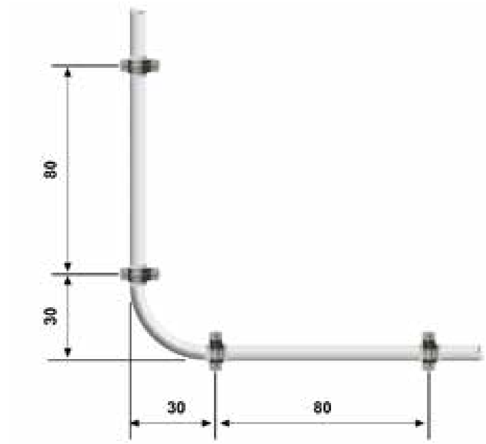
Para facilitar a inserção do Tubo PEX ao interior do tubo bainha, utilize pasta lubrificante ao longo de todo tubo.

Nesses casos, não é necessário considerar a dilatação térmica, basta fixar os tubos nas extremidades da parede ou do piso.

Em uma instalação ponto a ponto, as saídas dos distribuidores são tantas quanto os pontos de uso. A TIGRE possui distribuidores modulares de 2 a 3 saídas. Portanto, em instalações que tenham mais pontos de uso que saídas de um distribuidor, basta conectar outro até que a quantidade de saídas seja suficiente para abastecer todos os pontos da instalação.

Fixação no piso

Deve existir uma distância de manutenção entre os pontos de fixação de 80cm. Caso tenham curvas, deve-se fixar o tubo a uma distância de 30m.



Nota: Lembre-se de que, se o tubo atravessar paredes ou lajes, deve-se levar em conta que ele não passe por cantos vivos que possam danificá-lo.

1.4.7.2. Montagem de kits

Produtividade e eficiência têm sido atributos essenciais nas solicitações dos sistemas construtivos atuais, e um dos meios que contribuem diretamente com esses pontos é o uso de kits hidráulicos.

Os kits normalmente são formados por estruturas metálicas em que os tubos e as conexões são fixados conforme a configuração desejada para o local onde ele será aplicado.

Os kits hidráulicos podem ser utilizados em diferentes aplicações, que vão desde paredes convencionais até sistemas drywall.

A principal vantagem para o construtor é a agilidade durante a montagem, pois basta posicioná-lo e fixá-lo no local de uso.

Além disso, outros fatores importantes como padronização de instalação e organização na obra dão vantagem a esse conceito.

VEJA ABAIXO EXEMPLO DE **APLICAÇÃO DO KIT**

1. Posicionamento do kit no local.

2. Fixação do kit nos pontos de apoio.

3. Interligar o kit no sistema hidráulico.

4. Aplicar acabamento sobre o kit.

1.5. Manutenção

1.4.8. Manutenção e Desmontagem

Um dos principais benefícios da linha ClicPEX TIGRE é a possibilidade de manutenção. O conceito das conexões permite removê-las do tubo sem que ocorra o descarte do material.

Para realizar a manutenção e reutilizar as conexões da instalação, basta seguir as seguintes etapas:

1. Gire o acoplador no sentido anti-horário para destravar o click.

   Nota: As conexões podem ser retiradas para uma possível manutenção ou alteração, e reutilizadas de acordo com a necessidade do usuário.

2. Puxe o tubo juntamente com o acoplador para soltar a conexão.

3. Separe a parte da conexão com a parte do tubo e o acoplador.

4. Remova o acoplador do tubo, empurrando o tubo no sentido do acoplador, até a trava metálica ser expelida do tubo.

Obs.: Após instalado, se houver necessidade de manutenções futuras, recomenda-se a troca das vedações na conexão que será reutilizada.

5 Encaixe a trava metálica dentro do acoplador e posicione-o na extremidade da conexão girando o acoplador no sentido horário até ocorrer o click.

1.4 9. Manutenção corretiva

Este procedimento destina-se a instalações feitas com Tubos PEX, quando não é utilizada a instalação com tubo bainha manifold.

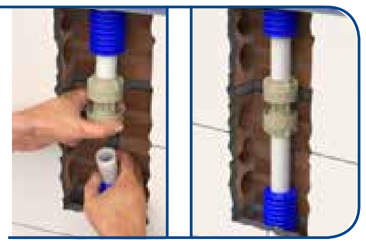
Quando o tubo é danificado, deve-se seguir o procedimento indicado:

1 Identifique o local onde ocorreu o dano.

2 Abra uma visita na área danificada.

3 Retire o trecho danificado cortando-o. Caso seja um trecho pontual (um furo, por exemplo) retire apenas o comprimento necessário para a instalação de uma luva.

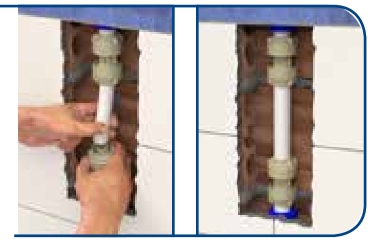
4 Proceda com a instalação de uma luva.



5 Caso o dano tenha sido mais extenso, será necessário o uso de duas luvas e mais um trecho de tubo.

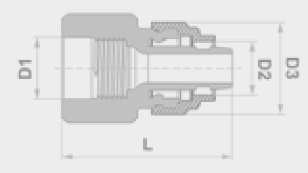
6 Corte um trecho do tubo danificado equivalente ao tamanho de duas luvas mais o trecho do tubo a ser utilizado.

7 Faça a instalação das duas luvas conforme indicado no procedimento de instalação no tópico 1.4.2.



1.6. Itens da Linha ClicPEX

• Conexão Fêmea



DIMENSÕES (MM)

CÓDIGO	BITOLA	D1	D2	D3	L
100019140	16X1/2"	1/2"	16	32,7	45,2
100019141	20X1/2"	1/2"	20	36,6	48,1
100019142	20X3/4"	3/4"	20	36,6	50,1
100019143	25X3/4"	3/4"	25	43,9	54,7

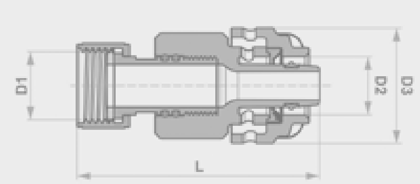
• Conexão Macho

DIMENSÕES (MM)

CÓDIGO	BITOLA	D1	D2	D3	L
100019144	16X1/2"	1/2"	16	32,7	55,8
100019145	20X1/2"	1/2"	20	36,6	60,7
100019147	20X3/4"	3/4"	20	36,6	62,2
100019148	25X3/4"	3/4"	25	43,9	67,8
100019146	25X1"	1"	25	43,9	73,3
300000745*	32X1"				

***** Produto metálico em anel deslizante. Detalhes na página 31

• Conexão Móvel

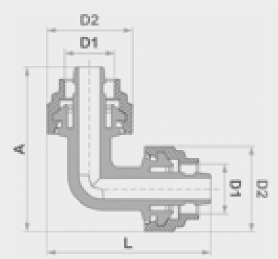


DIMENSÕES (MM)

CÓDIGO	BITOLA	D1	D2	D3	L
100019149	16X1/2"	1/2"	16	32,7	68,9
300000746*	16 X 3/4"				
300000747*	20 X 1/2"				
300000748*	20 X 3/4"				
300000749*	25 X 3/4"				

***** Produto metálico em anel deslizante. Detalhes na página 31

• Joelho 90º



DIMENSÕES (MM)

CÓDIGO	BITOLA	D1	D2	A	L
100019150	16	16	32,7	61,5	61,5
100019151	20	20	36,6	71	71
100019152	25	25	43,9	85	85
300000750*	32				

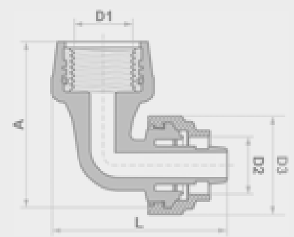
***** Produto metálico em anel deslizante. Detalhes na página 31

• Joelho Base Fixa

DIMENSÕES (MM)

CÓDIGO	BITOLA	D1	D2	D3	A	L
100019153	16x1/2"	1/2"	16	32,7	62	72,3
100019154	20x1/2"	1/2"	20	36,6	64,3	78,5
100019155	20x3/4"	3/4"	20	36,6	70,5	78,5
100019156	25x3/4"	3/4"	25	43,9	72,6	84,3

• Joelho Terminal Fêmea



DIMENSÕES (MM)

CÓDIGO	BITOLA	D1	D2	D3	A	L
100019157	16x1/2"	1/2"	16	32,7	55,5	55,8
100019158	20x1/2"	1/2"	20	36,6	62,1	61,9
300000754*	25x1"					
300000755*	32x1"					

***** Produto metálico em anel deslizante. Detalhes na página 32

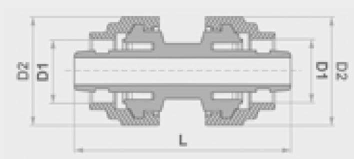
• Joelho Terminal Macho

DIMENSÕES (MM)

CÓDIGO	BITOLA	D1	D2	D3	A	L
100019159	16x1/2"	1/2"	16	32,7	66,1	51,3
100019160	20x1/2"	1/2"	20	36,6	70,7	57,5
300000756*	20x3/4"					
300000757*	25x3/4"					

***** Produto metálico em anel deslizante. Detalhes na página 32

• Luva



DIMENSÕES (MM)

CÓDIGO	BITOLA	D1	D2	L
100019161	16	16	32,7	62,6
100019162	20	20	36,6	71
100019163	25	25	43,9	81,6
300000758*	32			

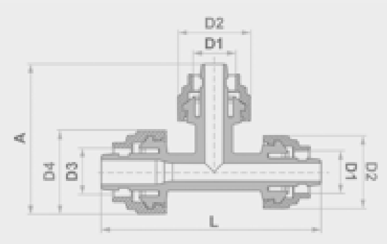
***** Produto metálico em anel deslizante. Detalhes na página 32

• TE

	DIMENSÕES (MM)				
CÓDIGO	**BITOLA**	**D1**	**D2**	**A**	**L**
100019164	16	16	32,7	62,8	92
100019166	20	20	36,6	68,8	101
100019165	25	25	43,9	79,5	115
300000762*	32				

* Produto metálico em anel deslizante. Detalhes na página 33

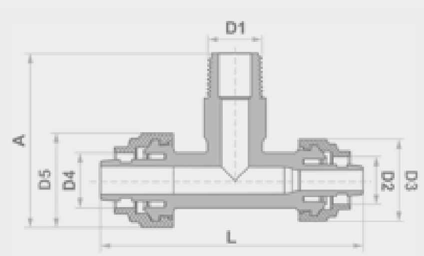
• TE Redução



	DIMENSÕES (MM)						
CÓDIGO	**BITOLA**	**D1**	**D2**	**D3**	**D4**	**A**	**L**
100019168	20x16x16	16	32,7	20	36,6	64,8	94,5
100019167	25x20x20	20	36,6	25	43,9	73,5	107
300000764*	16x20x16						
300000765*	20x16x20						
300000766*	20x20x16						
300000767*	25x16x20						
300000768*	25x16x25						
300000769*	25x20x25						

* Produto metálico em anel deslizante. Detalhes na página 33

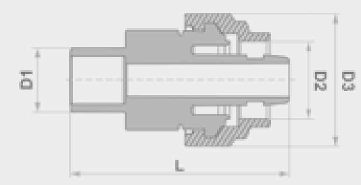
• TE Macho



	DIMENSÕES (MM)							
CÓDIGO	**BITOLA**	**D1**	**D2**	**D3**	**D4**	**D5**	**A**	**L**
100019169	16x1/2"	1/2"	16	32,7	16	32,7	64,3	92
100019171	20x1/2"	1/2"	20	36,6	20	36,6	70	101
100019170	20x3/4"	3/4"	20	36,6	20	36,6	71,5	101
100019172	20x1/2"x16	1/2"	16	32,7	20	36,6	67	100,5
300000763*	25x3/4"							

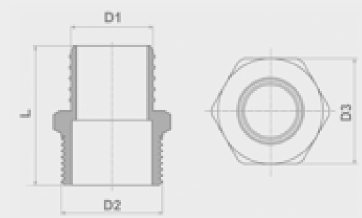
* Produto metálico em anel deslizante. Detalhes na página 33

• Conexão de Transição



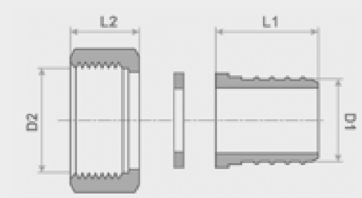
	DIMENSÕES (MM)				
CÓDIGO	**BITOLA**	**D1**	**D2**	**D3**	**L**
100019173	15X16	15	16	32,7	51,6
100019174	22X20	22	20	36,6	61,5

• Conexão Macho Anel Deslizante



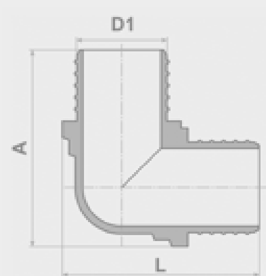
	DIMENSÕES (MM)			
CÓDIGO	**BITOLA**	**D1**	**D2**	**L**
300000745	32X1"	32	1"	45

• Conexão Móvel Anel Deslizante



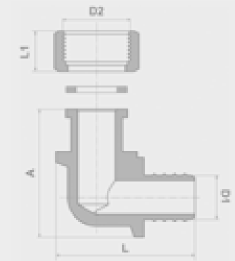
	DIMENSÕES (MM)				
CÓDIGO	**BITOLA**	**D1**	**D2**	**L1**	**L2**
300000746	16X3/4"	16	3/4"	20	14
300000747	20X1/2"	20	1/2"	20	13
300000748	20X3/4"	20	3/4"	20	14
300000749	25X3/4"	25	3/4"	26	14

• Joelho 90° Anel Deslizante



	DIMENSÕES (MM)			
CÓDIGO	**BITOLA**	**D1**	**A**	**L**
300000750	32	32	57	57

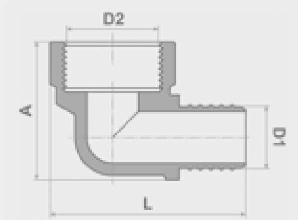
• Joelho Rosca Móvel Anel Deslizante



DIMENSÕES (MM)

CÓDIGO	BITOLA	D1	D2	A	L	L1
300000751	16x1/2"	16	1/2"	38	41	13
300000752	20x3/4"	20	3/4"	41	45	14
300000753	25x3/4"	25	3/4"	44	51	14

• Joelho Terminal Fêmea Anel Deslizante



DIMENSÕES (MM)

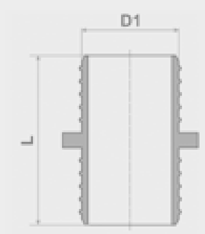
CÓDIGO	BITOLA	D1	D2	A	L
300000754	25X1"	25	1"	52	63
300000755	32X1"	32	1"	56	64

• Joelho Terminal Macho Anel Deslizante

DIMENSÕES (MM)

CÓDIGO	BITOLA	D1	D2	A	L
300000756	20X3/4"	3/4"	20	42	47
300000757	25X3/4"	3/4"	25	44	52

• Luva Anel Deslizante



DIMENSÕES (MM)

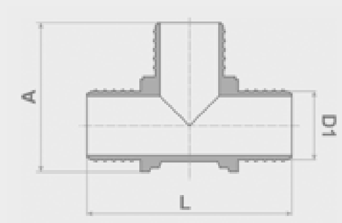
CÓDIGO	BITOLA	D1	D2
300000758	32	32	44,5

• Luva de Redução Anel Deslizante

DIMENSÕES (MM)

CÓDIGO	BITOLA	D1	D2	L
300000759	20X16	16	20	33,5
300000760	25X20	20	25	39
300000761	32X25	25	32	46

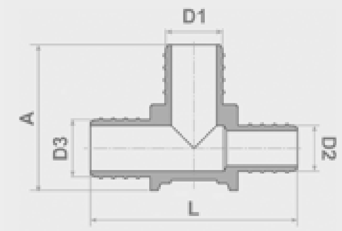
• TE Anel Deslizante



DIMENSÕES (MM)

CÓDIGO	BITOLA	D1	A	L
300000762	32	32	59	80

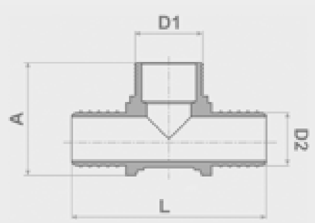
• TE Redução Anel Deslizante



DIMENSÕES (MM)

CÓDIGO	BITOLA	D1	D2	D3	A	L
300000764	16x20x16	20	16	16	40	56
300000765	20x16x20	16	20	20	40	55
300000766	20x20x16	20	16	20	40	55
300000767	25x16x20	16	20	25	45	67
300000768	25x16x25	16	25	25	45	73
300000769	25x20x25	20	25	25	45	73

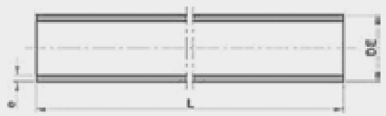
• TE Macho Anel Deslizante



DIMENSÕES (MM)

CÓDIGO	BITOLA	D1	D2	A	L
300000763	25X3/4"	3/4"	25	34	75

• Tubo Flexível PEX Monocamada



CÓDIGO	DIMENSÕES (MM)				
	BITOLA	DN	DE	e	L
300000774	16	16	16	1,8	100000
300000775	20	20	20	1,9	100000
300000776	25	25	25	2,3	50000
300000777	32	32	32	2,9	50000

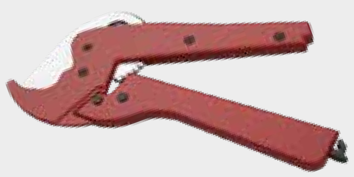
• Distribuidor Manifold 2 saídas

CÓDIGO	DIMENSÕES (MM)				
	BITOLA	D1	D2	D3	A	L
300001502	1x3/4	1″	1″	3/4″	75	100

• Distribuidor Manifold 3 saídas

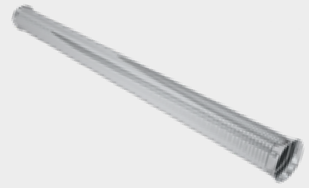
CÓDIGO	DIMENSÕES (MM)					
	BITOLA	D1	D2	D3	A	L
300001503	1x3/4	1″	1″	3/4″	75	145

• Cortador de tubos



CÓDIGO	DESCRIÇÃO
37427110	Modelo Único

• Curvador



CÓDIGO	MODELO
37430234	DN 16
37430242	DN 20
37430250	DN 25
37430269	DN 32

• Calibrador/chanfrador

CÓDIGO	MODELO
37430218	DN 16-20-25
37430226	DN 32

• Expansor de Tubos PEX

CÓDIGO	DESCRIÇAO
300001425	Para tubos de diâmetros 16mm, 20mm, 25mm e 32mm. Acompanha bocais

• Ferramenta para anel deslizante PEX

CÓDIGO	DESCRIÇAO
300001423	Para tubos de diâmetros 16mm, 20mm, 25mm e 32mm.

CPVC Aquatherm®

HOT WATER

2. CPVC Aquatherm®

The CPVC Aquatherm® line guarantees the user the desired comfort and efficiency when thinking about hot water. The line is ideal for projects that aim at performance during use and practicality during installation. It dispenses with thermal insulation and the use of tools, providing greater speed and economy in the work.

2.1. Function/Application

Conduction of hot water and cold water in different construction models, ensuring the lowest temperature loss in the installation and using a simple adhesive welding method.

2.2. Benefits and Differentials

Easy to install
The line dispenses with the use of tools to join the pipe to the connection. The installation is carried out in a few steps, with the use of Adhesive.

Increased durability and performance
Because it is manufactured in CPVC, the line does not suffer from oxidation and is free of fouling inside the pipe and connections, improving the performance of the water flow.

Complete line of pipes and connections
It allows to meet any project/work of building installations of hot water, both for individual and collective heating.

Increased safety
The line has expansion joints that ensure greater safety in the installation to support the thermal expansions of the network.

Maximum comfort at high temperatures
Recommended to operate at the service temperature of 80°C, conducting water under pressure of 60 m.c.a.

Greater thermal efficiency
Aquatherm® CPVC Pipes and Connections have low heat loss in hot water building installations, keeping the water temperature much longer. Dispenses any type of thermal insulator in piping stretches up to 20 meters long.

2.3. Technical Characteristics

Material: The raw material used for the manufacture of the Aquatherm® System is CPVC Poly(chlorinated vinyl chloride), which is a material with all the properties inherent to PVC, adding to the resistance to the conduction of liquids under pressures at high temperatures.

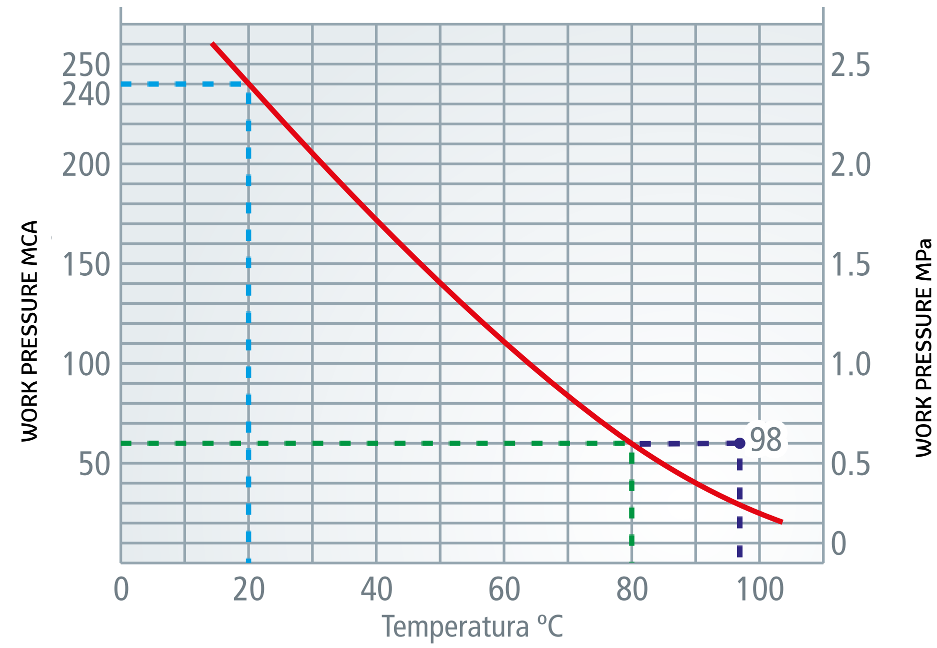
Color: beige.

Dimensioning: The CPVC Aquatherm® System complies with a rational criterion, based on the requirements of the international standard ASTM (American Society for Testing and Materials) D-2846, providing a high degree of safety to the facilities, even when subjected to extreme conditions of pressure and temperature.

Gauges: The CPVC Aquatherm® System is available in diameters of 15, 22, 28, 35, 42, 54, 73, 89 and 114 mm.

Working pressure
- 6.0 kgf/cm² or 60 m.c.a. conducting water at 80°C.
- 24.0 kgf/cm² or 240 m.c.a. conducting water at 20°C.

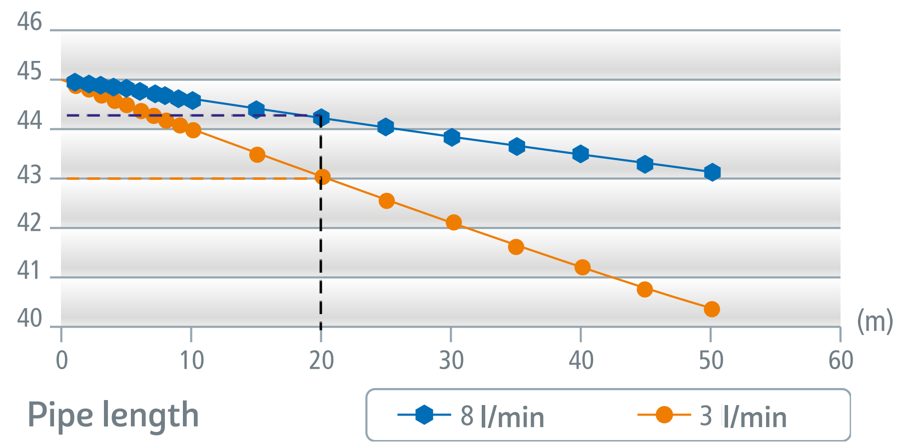
The following graph shows the service pressure variation of the Aquatherm® System as a function of temperature, and can also be consulted for other working ranges.



Note: Recommended for settlement lines in large buildings. Supports up to 240 m.c.a. at 20°C.

The following text presents the thermal loss in uninsulated CPVC pipelines.

Thermal loss in CPVC pipelines without insulation



See in the graph that the temperature loss in a 20-meter pipeline with a flow rate of 8 liters/minutes is only 0.7°C. To evaluate the thermal losses of the CPVC pipes, tests were carried out at the Brazilian Center for the Development of Thermal Solar Energy (GREEN Solar), headquartered at PUC Minas.

Next, see the list of reference standards that govern the manufacture of the Aquatherm® System and that ensure excellent performance, providing a high degree of safety to the facilities.

REFERENCE TECHNICAL STANDARDS	
ABNT NBR 15884/2010	Plastic piping systems for hot and cold water building installations — Chlorinated vinyl chloride (CPVC).
ASTM D2846	Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems.
ASTM F439	Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Connections, Schedule 80. (For diameters 73 to 114 - for connections).
ASTM F442	Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR). (For diameters 73 to 114 - for pipes).
ABNT NBR 7198	Design and execution of hot water building installations.

2.4. Instructions

2.4.1. Execution of Weldable Joints

Make a quick check before starting the welding operation and observe the adjustment between the pipe tip and the connection bag. It is necessary that there is an interference between the parts, as welding is not established if there is no pressure between the surfaces that are being joined.

1 Using a brush, apply Aquatherm® Adhesive to the connection and then to the tip of the pipe

2 Fit at once the trains to be welded, give ¼ turn and keep the joint under manual pressure for approximately 30 seconds, until the adhesive acquires resistance.

Notes

1) Any excess adhesive should be removed with a tow.
2) Do not interfere with the welded joint for the first 15 minutes. Wait for 24 hours to do the pressure test.

2.4.2. Execution of Threadable Joints

In a hot water installation with the Aquatherm® System, it will be necessary to interconnect with metal parts, such as drawer, pressure, ball registers, terminal points of use, inlets and outlets of heaters, etc. In these cases it will be necessary to make threaded joints.

See the following installation example, where the Aquatherm® Connector, a Pressure Base Register and the Aquatherm® Transition Mixer Tee are being coupled:

1 Apply the tape in the direction of the thread.

2 After applying the sealing material, thread the parts.

Important:

- Always clean the surfaces of the threads before applying the product, leaving them dry and free of grease and oxidation.
- The TIGRE Thread Sealing Tape supports a maximum temperature of 250°C, so it can be used for both cold and hot water, PVC or metal threads.

2.4.3. Aquatherm® Mixers

For connections where it is necessary to promote the mixing of hot and cold water, the Transition Mixer Tee or the Weldable CPVC Mixer Tee must be used.

The Transition Mixer Tee must be installed between the cold and hot water pressure registers to promote water mixing, using Thread Sealing Tape on the metal threads.

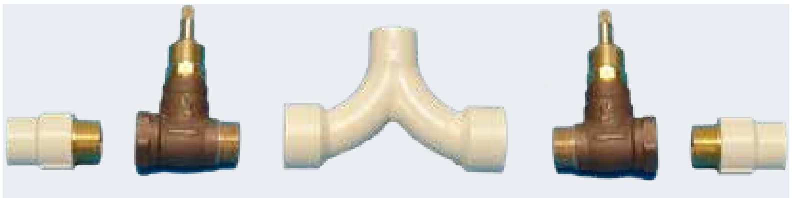
The Weldable CPVC Mixer Tee only takes adhesive on the joints to make the welding, however on both sides of the Weldable CPVC Mixer Tee, the CPVC record for hot water must be used.

At the cold water inlet point of the Tee Mixer (both) there must be a stretch of at least one meter long CPVC pipe.

Grade
The CPVC section installed before the Tee Mixer aims to protect the cold water installation from a possible return of hot water.

2.4.4. Assembly/Installation Scheme

With Tee Transition Mixer



With Weldable CPVC Mixer Tee

Thermal insulation:

- The use of thermal insulation in other types of pipes is necessary to reduce the effect of heat exchange of the pipes with the environment, consequently maintaining the temperature of the heated water for a longer time.
- In the case of Aquatherm® products, these heat exchanges reach minimum values, due to the low thermal conductivity * of the CPVC.
- In installations performed with Aquatherm® pipes and connections, hot water arrives faster at the point considered, due to the small heat loss along the piping.

For residences:

- The use of thermal insulation in the CPVC is generally recommended in cases where the distances between the heater and the point of consumption are above 20 meters "especially" in the open or apparent air and in situations where the loss may be more significant (e.g., passage through cooling chambers), but always at the discretion of the responsible designer.
- For use with central heating, the entire line must be isolated, avoiding heat loss.

***CPVC Thermal Conductivity = 9.6 x 10-5 cm² x s x °C (number of calories per second that crosses a board 1 cm thick and 1 cm² in area, when the temperature difference between the faces is 1°C).

The following is the formula for calculating Temperature Loss in CPVC Piping without insulation:

$$T = \frac{(69{,}67 \times Q \times Ti) - [F/2 \times L \times (Ti - 2 \times Tamb.)]}{F/2 \times L + 69{,}67 \times Q}$$

Where:

T (°C) = Consumption point

temperature **Ti (°C)** = Heater

temperature **Tamb. (°C)** = Ambient temperature

Q (l/min) = Flow Rate

F m-1 = Diameter factor

L (m) = Pipe length

Table 1 - Diameter factor

Diameter	Diameter Factor
15 (½")	0,60
22 (¾")	0,77
28 (1")	0,89
35 (1 ¼")	1,04
42 (1 ½")	1,17
54 (2")	1,35
73 (2 ½")	1,63
89 (3")	1,86
114 (4")	2,16

Thermal expansion and contraction
All materials are subject to the effects of thermal expansion, expanding when heated and contracting when cooled.

In most embedded installations this movement is absorbed by the pipeline layout due to the large number of connections used.

In apparent installations, long straight stretches between fixed points should be avoided. Where this is not possible it is recommended to use the exclusive Aquatherm® Expansion Joint or Liras.

2.4.5. Aquatherm® TIGRE Expansion Joint

The Aquatherm® Expansion Joint was developed to absorb pipe length variations (expansion and contraction) caused by temperature variations, minimizing stresses due to the transmission of efforts to the pipe and connection system.

Calculation of CPVC Aquatherm® Expansion Joints

The following is the sequence for calculating the thermal expansion of the piping, the number of expansion joints and the piston mounting position.

Example:

Given a hot water installation in a building supplied by a central heating system, located at the bottom of the building, with a height of 43m, calculate the number of expansion joints required to absorb the expansion of the vertical piping, as well as the length of the initial position of the piston.

It is known that the ambient temperature during installation is 28°C and that the maximum and minimum temperature that will reach the water conducted inside the pipe is, respectively, 68°C and 20°C.

Step 1: CPVC Thermal Expansion Calculation

To calculate the pipe length variation as a function of the thermal expansion of the CPVC, the following formula is used:

$$e = 0{,}06 \times \Delta T \times L$$

Where:

e = thermal expansion (axial displacement in mm)

ΔT = difference between highest and lowest pipe temperature (°C)

L = pipe length (m)

Notes: The temperature variation (ΔT) is the difference between the maximum temperature of the hot water supplied by the heater and the minimum temperature that the piping will reach.

Example:

e = 0,06 x ΔT x L	**ΔT = 68°C - 20°C = 48°C**
e = 0,06 x 48 x 43	**L = 43 m**

e = 123,84 mm ⟶ 12,38 cm pipe length variation for the established conditions

Step 2: Calculation of the number of Aquatherm® TIGRE Expansion Joints

$$N = \frac{e}{90}$$

Where:

N = number of expansion joints

e = thermal expansion (axial displacement in mm)

90 = maximum piston length (mm)

Example:

$$N = \frac{e}{90}$$

$$N = \frac{123{,}84}{90}$$

N= 1.376 joints round to 2 joints

Step 3: Piston mounting position

The piston of the Aquatherm® TIGRE Expansion Joint is installed partially extended, depending on the ambient temperature at the time of installation. The initial mounting position of the piston is calculated using the following formula:

$$P = \frac{(Tmax. - Tamb.) \times 90}{Tmax. - Tmin.}$$

Where:

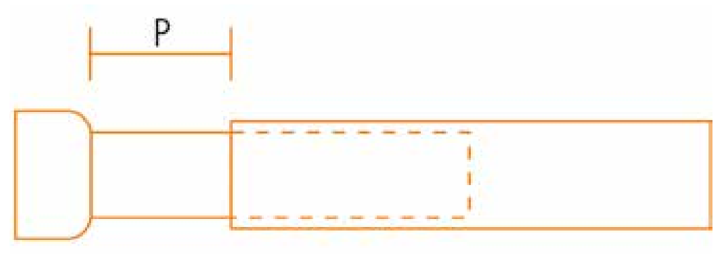
P = initial installation position of expansion joint piston (mm)

Tmax. = maximum temperature piping will reach

Tamb. = ambient temperature during installation

Tmin. = minimum temperature piping will reach

In order to facilitate the designer's task, we provide in the table below the values of P (piston mounting position), calculated considering that the piping will be subjected to a maximum temperature of 80°C and a minimum temperature of 10°C, that is, a DT of 70°C.



Example:

$$P = \frac{(Tmax. - Tamb.) \times 90}{Tmax. - Tmin.}$$

P= 75 mm

Conclusion

For the situation presented, we will have:

- Thermal expansion (e) = 123.84 mm
- Number of expansion joints (N) = 2
- Piston mounting position (P) = 75 mm

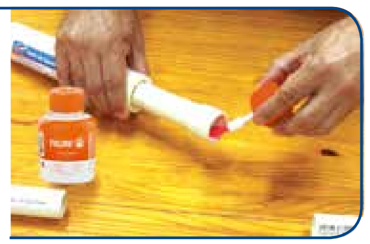
2.4.5.1. CPVC Aquatherm® Expansion Joint Installation

1 The Aquatherm® TIGRE Expansion Joint is already lubricated. Before installing it, move the entire piston stroke to distribute the lubricant.

2 The Aquatherm® TIGRE Expansion Joint must be installed with the piston partially extended. Mark the length according to the illustration of the piston position and table 3 (also on the Aquatherm® TIGRE Expansion Joint.)

3 Position the Aquatherm® TIGRE Expansion Joint with the piston properly extended in the place where it will be installed. Make the cut marks of the piping in the places coincident with the bottom of the bags of the Aquatherm® TIGRE Expansion Joint.

4 Apply Aquatherm® Adhesive to the bags of the Aquatherm® Expansion Joint and install it on the horizontal or vertical pipe section.



5 Weld both ends of the Aquatherm® Expansion Joint into the tubing. Install two supports near the joint to facilitate free movement of the piston.

2.4.6. Use of lira

If you prefer to use liras or changes of direction, perform them according to table 2:

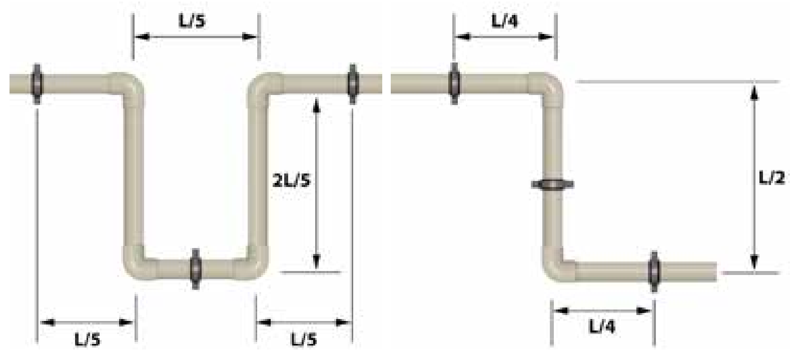


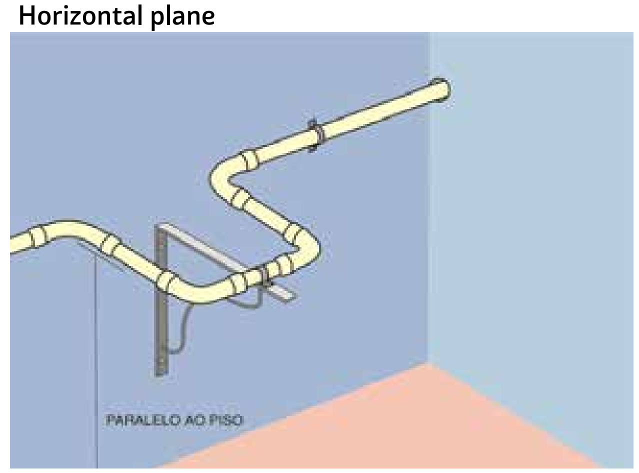
Table 2 - Lira Toral Length

DN (m/m)	Section Length (m)				
	6,0	12,0	18,0	24,0	30,0
	Total Lyre Length "L" (m)				
15	0,56	0,79	0,97	1,12	1,30
22	0,66	0,94	1,17	1,32	1,48
28	0,76	1,07	1,32	1,52	1,78
35	0,84	1,19	1,45	1,68	1,88
42	0,91	1,30	1,57	1,84	2,05
54	1,04	1,47	1,80	2,10	2,31
73	1,11	1,56	1,92	2,21	2,47
89	1,22	1,73	2,12	2,44	2,73
114	1,38	1,95	2,39	2,76	3,09

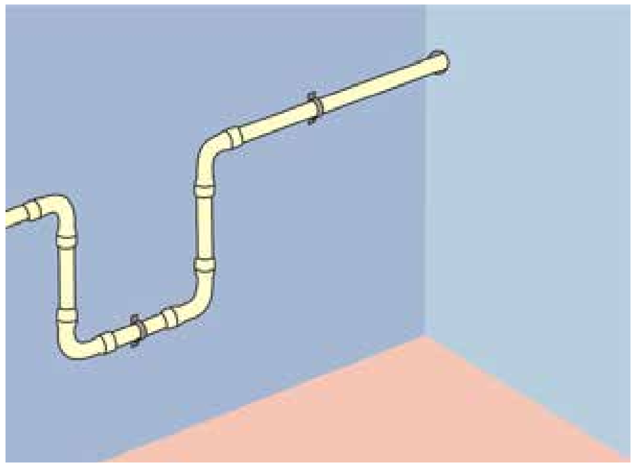
Grade

In horizontal pipes, the lyres should preferably be installed in the horizontal plane, that is, parallel to the floor. If they have to be installed in the vertical plane (wall plane), it is recommended to position them as U. Never install with U upside down, that is, as an inverted siphon. This would favor the accumulation of air at the highest point, making it difficult for water to flow. See the illustrations:

Horizontal plane



Vertical plane



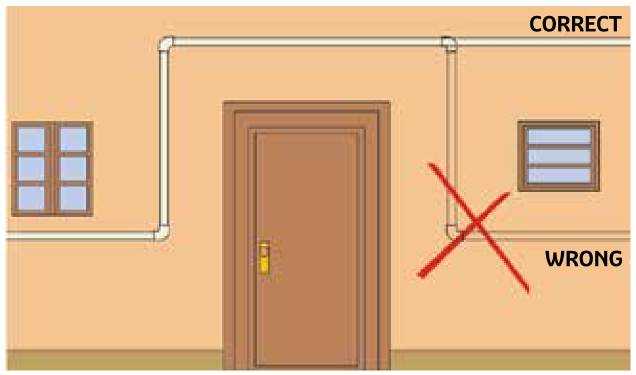


Table 2 was calculated for an average temperature differential of 40°C and a coefficient of expansion of the CPVC = 6.12 x 10-5/ °C (average).

Calculation of Lira

Equation 1: thermal expansion (e)

$$e = Lp \times C \times \Delta T$$

Where:

Lp = length of pipe, in m

C = coefficient of thermal expansion, in m/m °C

ΔT = temperature variation, in °C

For CPVC, C = 6.12 x 10-5/°C

Equation 2: developed length (L)

$$L = \sqrt{\left[\frac{3 \times E \times DE \times e}{S}\right]}$$

Where:

E = modulus of elasticity (from table 5), in Pa

DE = external pipe diameter (from p. 23), in mm

e = thermal expansion (from equation 1), in m

S = allowable stress (from table 5), in Pa

Modulus of elasticity and allowable stress for CPVC

Table 3 - Modulus Values of Elasticity and Allowable Stress According to Temperature

Temperature (°C)	Modulus of Elasticity (Pa)	Allowable Voltage (Pa)
20	2.982.238.410	14.352.920
30	2.796.931.910	12.564.127
40	2.611.625.410	10.775.333
50	2.426.318.910	8.986.540
60	2.241.012.409	7.197.746
70	2.055.705.909	5.408.953
80	1.870.399.409	3.620.159

Exemplo:
Calculate the lyre length for a 20 m long CPVC pipe with a 22 mm diameter pipe for a temperature rise from 25°C to 70°C.

From equation 1:

e = Lp x C x ΔT

e = 20 x (6,12 x 10-5) x (70 – 25)

e = 0, 05508 m

From equation 2:

$$L = \sqrt{\left[\frac{3 \times E \times DE \times e}{S}\right]}$$

$$L = \sqrt{\left[\frac{3 \times (2.055.705.909) \times 0{,}022 \times 0{,}05508}{5.408.953}\right]}$$

L = 1,38 m,it is recommended to round to 1.40 to be exact multiple of 5

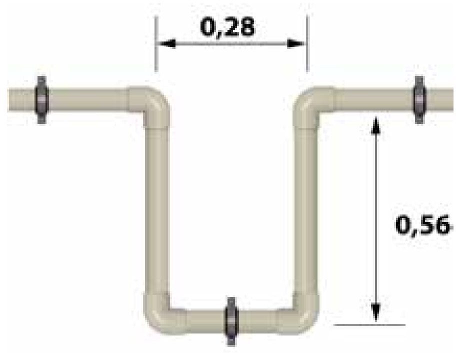
- The length of the 1.20 m lyre (L) calculated here is consistent with the L values reported in the table.
- As the lyre is composed of 3 pipe segments and four elbows 90°, we will have:

2 pipe segments:

$$\frac{L}{5} = \frac{1,40}{5} = 0,28 \text{ m}$$

1 pipe segment:

$$\frac{2L}{5} = \frac{(2x1,40)}{5} = 0,56 \text{ m}$$

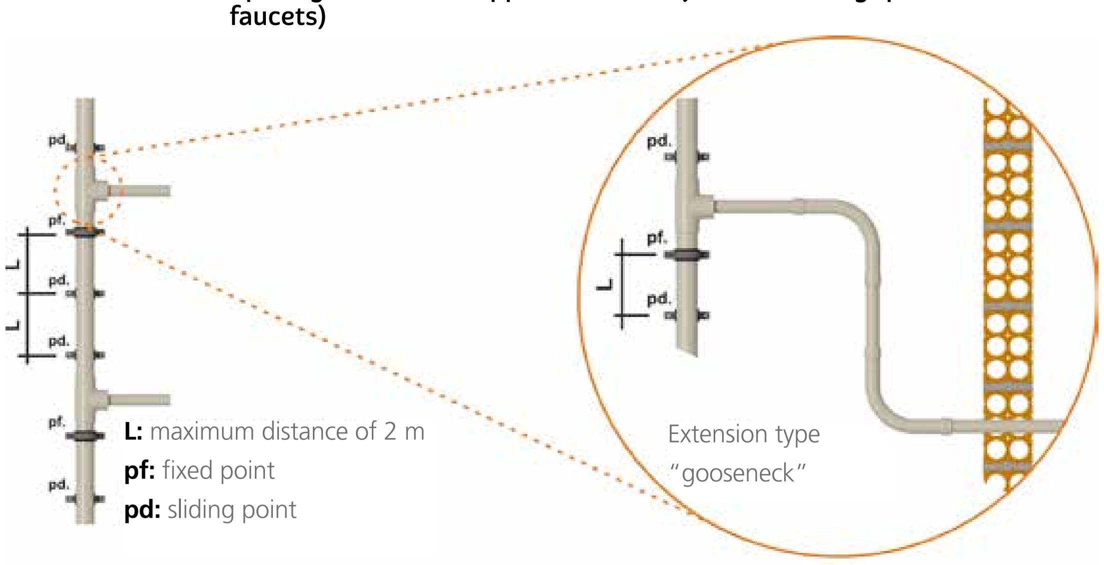


2.4.7. Apparent vertical and horizontal installations

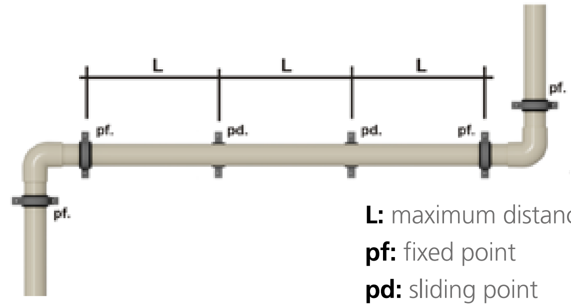
- The fixing of the piping must be done through brackets, clamps or perforated tape.
- The supports used to fix the pipes must be circular in shape, with a minimum width of 0.75 x D (D = diameter).
- Only one of them may be fixed, the other supports must allow the free movement of the pipe, caused by thermal expansion.
- When changes of direction occur, the connections used must be anchored in order to avoid unwanted displacement of the installation.
- According to the length of the stretch between 2 connections, there must be an expansion joint or liras to absorb the thermal expansion of this stretch.
- When there are concentrated weights due to the presence of 114 mm registers or connections, they must be supported and anchored regardless of the pipe system.
- In the case of vertical pipes, a maximum spacing of 2 meters between supports must be adopted. In the case of buildings, the ideal is to adopt 1 support for each floor.

In the shunt where the column does not have the fixed point next to the shunt connection, the tension relief in this connection can be achieved using the "gooseneck" type device, as shown in the diagram below.

Spacing between supports vertically (with sliding points on faucets)



Spacing between supports horizontally (with fixed points on the derivations)



L: maximum distance according to table 4
pf: fixed point
pd: sliding point

Table 4 - Maximum Spacing between Horizontal Supports

Spacing Between Supports - Horizontal (meters)				
Maximum Water Temperature				
DN	20°C	38°C	60°C	80°C
½")	1,2	1,2	1,1	0,9
22 (3/4")	1,5	1,4	1,2	0,9
28 (1")	1,7	1,5	1,4	0,9
35 (1 ¼")	1,8	1,6	1,5	1,2
42 (1 ½")	2,0	1,8	1,7	1,2
54 (2")	2,3	2,1	2,0	1,2
73 (2 ½")	2,4	2,3	2,0	1,2
89 (3")	2,4	2,4	2,1	1,2
114	2,7	2,7	2,3	1.4

Nota
For hot water, always consider the maximum temperature of 80ºC.

2.4.8. 1.4.8. Embedded facilities

Masonry walls

In the case of Aquatherm® pipes embedded in masonry, the openings in the walls must be made in such a way as to allow the placement of tension-free pipes and connections. Do not bend or force the pipes to a new position after assembly. This can cause extra stress on the connections, leading them to break.

Structural elements

1- In the case of inlays in concrete structures, free spaces should be provided for their installation. In the passage of beams and slabs, spaces must already be provided for the pipes. In this way, its free movement is guaranteed.

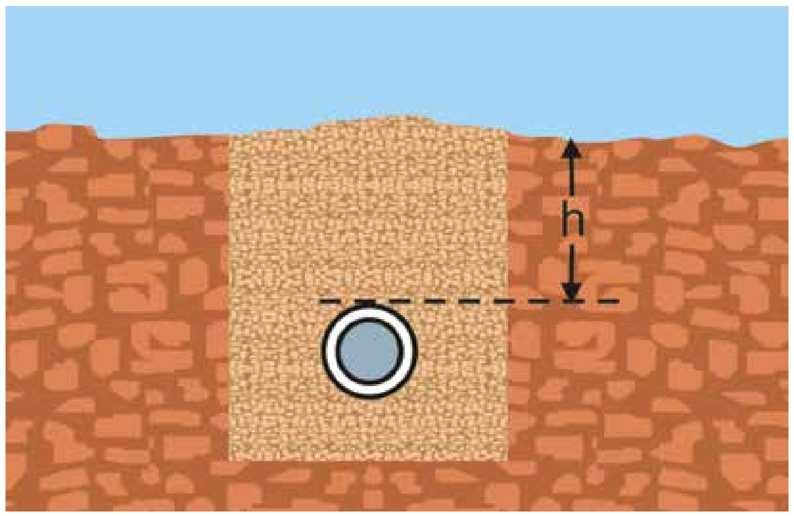
2- Aquatherm® piping does not present complications for the use of embedded form, but the use of some material that has the capacity to absorb any thermal expansions or even the jacketing of the pipe, especially next to the connections, is a good technique to improve the conditions of the piping inside the masonry.

3- The ideal is to install Aquatherm® pipes passing through the walls, but if it is inevitable to pass through the subfloor (mortar applied on the slab), the piping should have a small space to "work", not being supportive to the structure.

2.4.9. 1.4.9. Buried Facilities

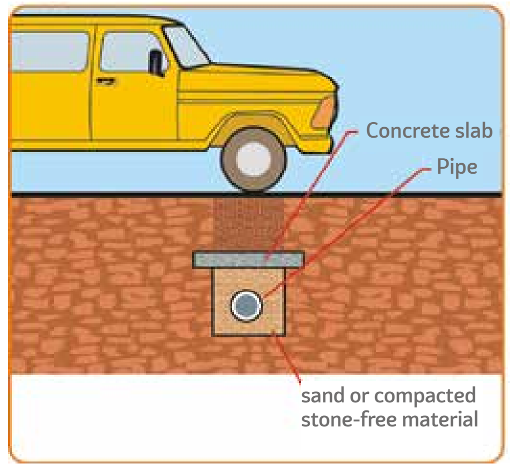
In situations where the Aquatherm® System has to be buried, follow the recommendations below:

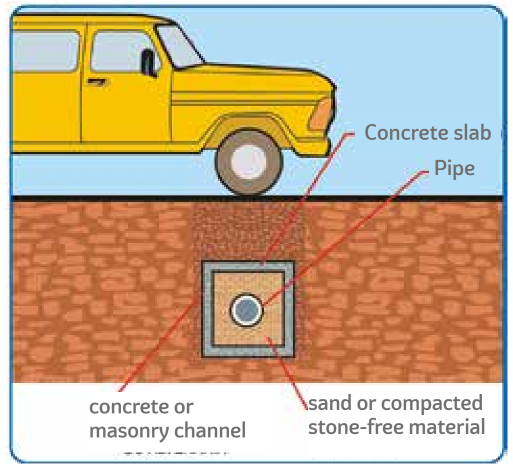
Buried Aquatherm® pipes must be seated on sturdy ground or on an appropriate base, free of debris or sharp materials. The minimum coverage should be 30 cm.



- **Minimum Settling Depth**
- Under railroad traffic = 150 cm
- Under heavy traffic = 120 cm
- Under vehicular traffic in street beds = 80 cm
- Under rides = 60 cm
- No traffic = 30 cm

If it is not possible to perform this minimum coverage of 30 cm, or if the pipes are subject to wheel load, strong compressions or even located in a built-up area, there must be adequate protection using slabs or channels that prevent the action of these efforts on the plumbing. See the following figures.





2.4.10. Installation Protection

For Aquatherm® pipelines installed apparent and exposed to the weather, even if the CPVC compound has incorporated anti UV additives, it is recommended to use expanded insulators or rubber tape for protection and maintenance of its mechanical properties. In such cases, materials such as: expanded polyurethane, EPS and glass wool can be used.

2.4.11. Installation of Heaters

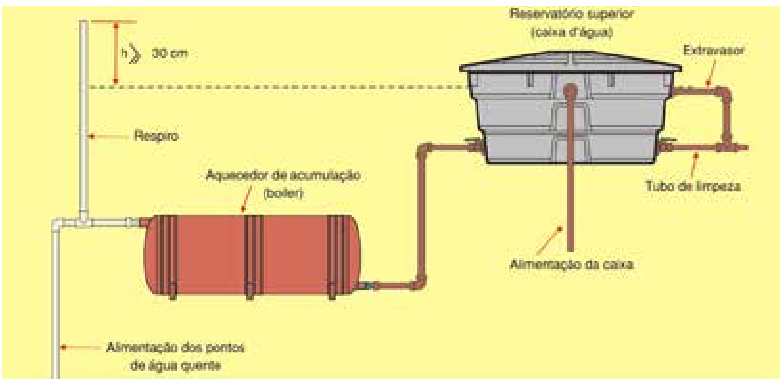
The following are some comments on the Brazilian standard NBR 7198 (Design and execution of hot water building installations):

Item 5.1.3 - Withdrawn from NBR 7198

The installation of storage heaters must comply with the following conditions:

Point c: : "the outlet of the hot water pipe must be provided with a vent". This solution is indicated in homes where the supply of the distribution network is made through an upper reservoir (by gravity).

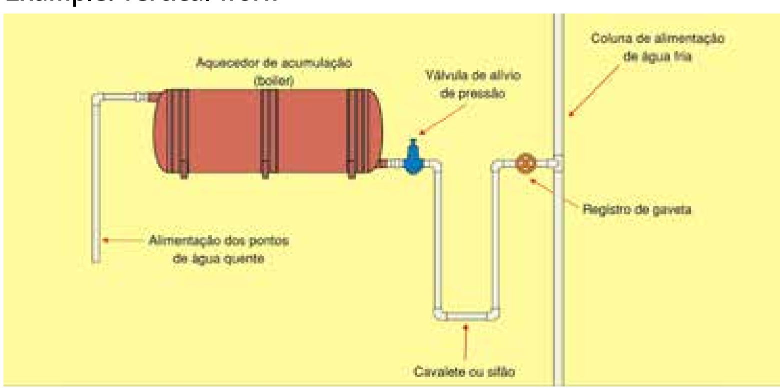
Exemplo: obra horizontal



Point d: "when the vent is not of practical execution, it must be replaced by a device of identical performance".

This means that, in buildings, the use of collective vent is prohibited (item h). In this case, it is recommended to use pressure relief valve. Several build-up heater manufacturers recommend using this pressure relief valve on the cold water inlet and a siphon to make it difficult for hot water to return to the cold water branch and facilitate valve opening.

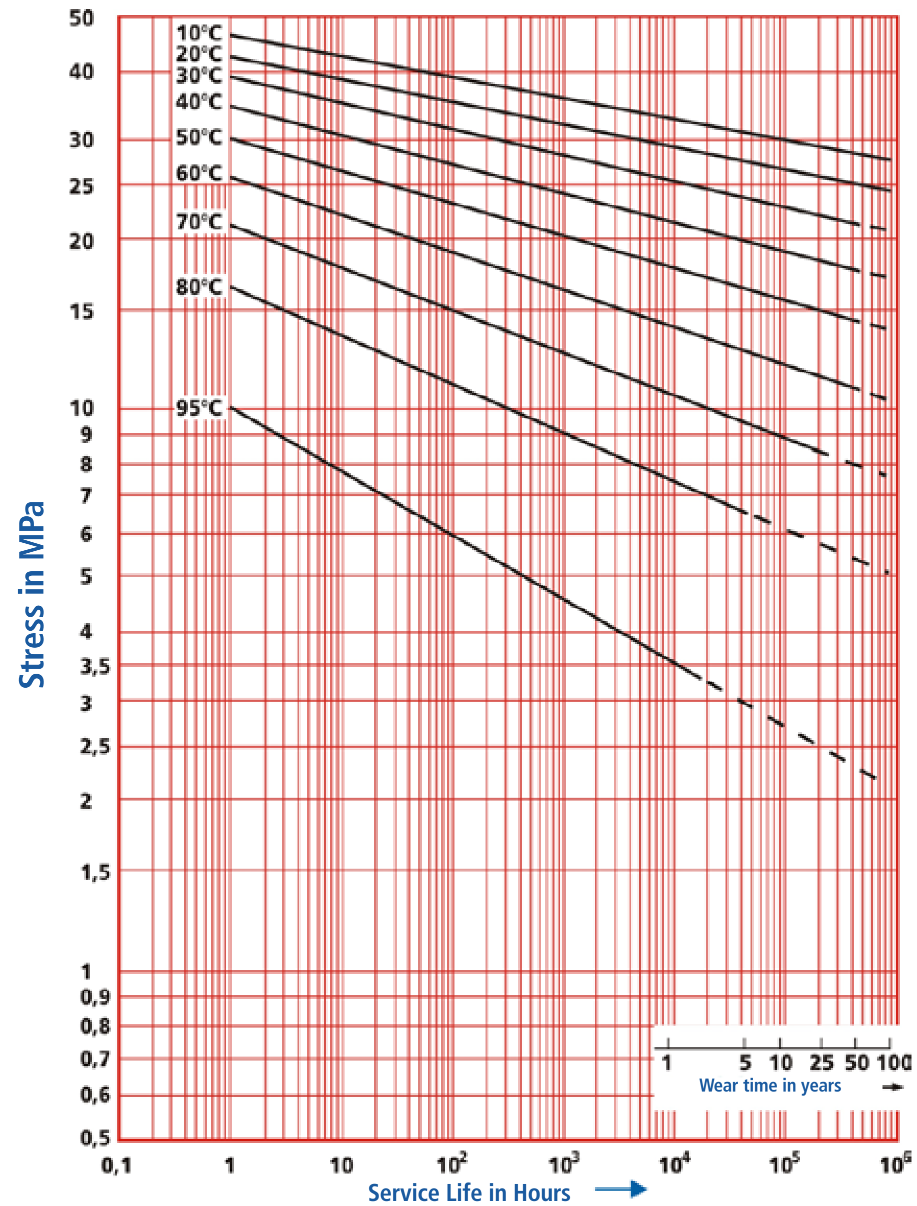
Example: vertical work



Point f: "the cold water supply pipe must be made of material resistant to the maximum permissible temperature of the hot water".

2.4.12. Durability of Aquatherm®

The graph of the regression curve demonstrates that, over 50 years, CPVC maintains its temperature and pressure resistance characteristics at excellent levels for use in hot water conduction systems.



Example of using the regression curve

Consider the piping of the Aquatherm® DN 54 line, an expected pipe durability in 50 years and an operating temperature of 80ºC. Through the graph of the regression curve we can obtain the value of the voltage (δ) of the pipe, through the intersection of the vertical line of the 50-year durability with the regression curve that indicates the temperature, which in this case is 80ºC.

In this example the value obtained is 6.0 MPa. This specification is achieved by bringing a horizontal line that starts from the intersection point already mentioned, proceeding to the value of the voltage (δ) of the pipe.

With this value, we can obtain the maximum allowable pressure (Pmax.) using the following formula:

$$\text{Pmáx.} = \frac{2 \times e \times \delta}{DE - e}$$

Where:
δ = tangential stress (of the regression curve)
e = Aquatherm® pipe wall thickness
DE = Aquatherm® pipe external diameter
t = operating temperature

Where:
δ = 5,3 Mpa
e = 4,9 mm
DE = 54 mm
t = 80°C

Then:

$$\text{Pmáx.} = \frac{2 \times 4{,}9 \times 5{,}3}{54 - 4{,}9} = \frac{58{,}8}{49{,}1} = 1{,}06 \text{ MPa}$$

Transforming to meters of water column, we will have 120 m.c.a. This result obtained corresponds to the maximum permissible pressure. To obtain the maximum working pressure (Pms) value, it is necessary to divide this pressure calculated by the safety coefficient (f) of Aquatherm®

$$\text{Pms} = \frac{\text{Pmáx.}}{f}$$

Where:
Pmáx. = maximum allowable pressure
f = safety coefficient

Where:
Pmáx. = 120 m.c.a.
f = 1,7

Then:

$$\text{Pms} = \frac{112}{1{,}7} = 66 \text{ m.c.a. ou } 6{,}4 \text{ kgf/m}^2$$

Conclusion:
This calculation proves that Aquatherm® can be perfectly used at a pressure of 60 m.c.a., at a temperature of 80°C for a period of 50 years.
Notes: The applied safety factor is 1.7, according to DIN 8079.3.

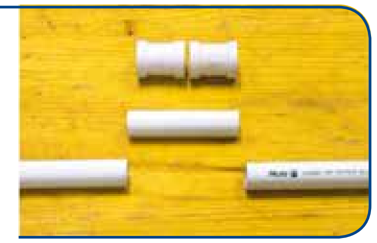
1.4.13. Maintenance

The Aquatherm® System does not require a maintenance plan as long as it is used correctly according to the standard.

In case of accidental hole in the piping, the weldable sleeves must be used, or the Aquatherm® TIGRE Running Sleeve.

1 Once the hole location is located, remove the damaged section in a length corresponding to that of the Aquatherm® TIGRE Running Lights.

2 Cut a new pipe segment to the same size as the defined section that was removed.



3 Use two Aquatherm® TIGRE Running Sleeves and install them at the ends of the new stretch of pipe. Complete the repair by sliding the Aquatherm® TIGRE Running Sleeves and joining them to the rest of the tubing.

2.5. Load Loss in Aquatherm® Pipes

The circulation of water or other fluids through a pipeline suffers pressure loss due to friction called Load Loss. The main factors are:

- Pipe length
- Roughness of the inner surface of the material
- Quantity and forms of changes of direction
- Piping diameters
- Water viscosity
- Water density
- Flow type (laminar or turbulent)

$$h = 10{,}643 \times Q^{1{,}85} \times C^{-1{,}85} \times D^{-4{,}87}$$

Where:
h = load loss (m/m)
Q = flow rate (m3/s)
C = 150
D = pipe inner diameter (m)

This equation was used to calculate water velocities, head losses and pressure drops as a function of water flows for 9 CPVC pipe diameters (CTS)*. The results are given in the table
5. The procedure for establishing a limiting or maximum flow, which is applicable for any material, is not well defined. For some materials, velocities may exist that can create abrasion or erosion, but there is no evidence that this occurs with CPVC under any operating condition.

An investigation of some CPVC systems revealed that velocities of 2 to 5 m/s could be developed under the maximum flow conditions. Based on both practical experience and laboratory studies, a maximum fluid velocity of 3 m/s can be used in CPVC system designs.

*Copper Tube Size

Table 5 - Load Loss in CPVC Pipelines

Flow (m3/s)	Flow rate l/s	15 V (m/s)	1/2" PL (m.c.a./m)	22 V (m/s)	3/4" PL (m.c.a./m)	28 V (m/s)	1" PL (m.c.a/m)	35 V (m/s)	1 1/4" PL (m.c.a/m)	42 V (m/s)	1 1/2" PL (m.c.a/m)	54 V (m/s)	2" PL (m.c.a/s)	73 V (m/s)	2 1/2" PL (m.c.a/m)	89 V (m/s)	3" PL (m.c.a/m)	114 V (m/s)	4" PL (m.c.a/m)
0,00005	0,05	0,46	0,027	0,20	0,003	0,12	0,001	0,08	0,000	0,06	0,000	0,03	0,000	0,02	0,000	0,01	0,000	0,01	0,000
0,00010	0,10	0,91	0,098	0,39	0,013	0,24	0,004	0,16	0,001	0,11	0,001	0,07	0,000	0,04	0,000	0,02	0,000	0,01	0,000
0,00015	0,15	1,37	0,207	0,59	0,027	0,36	0,008	0,24	0,003	0,17	0,001	0,10	0,000	0,05	0,000	0,04	0,000	0,02	0,000
0,00020	0,20	1,83	0,353	0,79	0,045	0,48	0,014	0,31	0,005	0,22	0,002	0,13	0,001	0,07	0,000	0,05	0,000	0,03	0,000
0,00030	0,30	2,74	0,748	1,18	0,096	0,72	0,029	0,47	0,010	0,34	0,005	0,20	0,001	0,11	0,000	0,07	0,000	0,04	0,000
0,00040	0,40	3,66	1,274	1,57	0,163	0,96	0,049	0,63	0,017	0,45	0,008	0,26	0,002	0,14	0,000	0,10	0,000	0,06	0,000
0,00050	0,50	4,57	1,925	1,96	0,246	1,20	0,075	0,78	0,026	0,56	0,012	0,33	0,003	0,18	0,001	0,12	0,000	0,07	0,000
0,00060	0,60	5,49	2,697	2,36	0,345	1,44	0,105	0,94	0,037	0,67	0,016	0,39	0,004	0,21	0,001	0,14	0,000	0,09	0,000
0,00070	0,70			2,75	0,459	1,68	0,139	1,10	0,049	0,78	0,022	0,46	0,006	0,25	0,001	0,17	0,000	0,10	0,000
0,00080	0,80			3,14	0,587	1,93	0,178	1,25	0,063	0,90	0,028	0,52	0,007	0,28	0,002	0,19	0,001	0,12	0,000
0,00090	0,90			3,54	0,730	2,17	0,221	1,41	0,078	1,01	0,034	0,59	0,009	0,32	0,002	0,21	0,001	0,13	0,000
0,00100	1,00			3,93	0,887	2,41	0,269	1,57	0,095	1,12	0,042	0,65	0,011	0,35	0,003	0,24	0,001	0,14	0,000
0,00120	1,20			4,72	1,243	2,89	0,377	1,88	0,133	1,35	0,059	0,78	0,016	0,42	0,004	0,29	0,001	0,17	0,000
0,00140	1,40			5,50	1,654	3,37	0,501	2,19	0,176	1,57	0,078	0,91	0,021	0,49	0,005	0,33	0,002	0,20	0,001
0,00160	1,60					3,85	0,642	2,51	0,226	1,79	0,100	1,04	0,027	0,56	0,006	0,38	0,002	0,23	0,001
0,00180	1,80					4,33	0,798	2,82	0,281	2,02	0,124	1,17	0,033	0,63	0,007	0,43	0,003	0,26	0,001
0,00200	2,00					4,81	0,970	3,14	0,341	2,24	0,151	1,30	0,040	0,71	0,009	0,48	0,003	0,29	0,001
0,00220	2,20					5,30	1,157	3,45	0,407	2,47	0,180	1,43	0,048	0,78	0,011	0,52	0,004	0,32	0,001
0,00240	2,40							3,76	0,478	2,69	0,211	1,56	0,056	0,85	0,013	0,57	0,005	0,35	0,001
0,00260	2,60							4,08	0,554	3,91	0,245	1,69	0,065	0,92	0,015	0,62	0,006	0,37	0,002
0,00280	2,80							4,39	0,636	3,14	0,281	1,82	0,075	0,99	0,017	0,67	0,006	0,40	0,002
0,00300	3,00							4,70	0,723	3,36	0,319	1,96	0,085	1,06	0,019	0,71	0,007	0,43	0,002
0,00325	3,25							5,09	0,838	3,64	0,370	2,12	0,099	1,15	0,022	0,77	0,008	0,47	0,003
0,00350	3,50							5,49	0,961	3,92	0,425	2,28	0,113	1,23	0,025	0,83	0,010	0,50	0,003
0,00375	3,75									4,2	0,483	2,44	0,139	1,32	0,029	0,89	0,011	0,54	0,003
0,00400	4,00									4,48	0,544	2,61	0,145	1,14	0,033	0,95	0,012	0,58	0,004

2.6. General Information about Aquatherm®

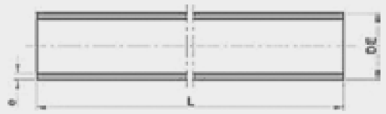
The Aquatherm® System of CPVC pipes and connections is more efficient than the other materials used for hot water building installations. Here's why:

Table 6 - Aquatherm® General Information

CHARACTERISTICS	AQUATHERM® TIGRE (CPVC)
Presence in most resales of throughout Brazil building materials in the country	More than 18,000 resellers spread
Complete solution of pipes and connections	Yes
Need for special equipment and tools	Não necessita de equipamentos e ferramentas especiais
Cost	Lowest cost among all solutions (procurement, installation and maintenance)
Possibility of theft in the work	Minimum
Installation process	The simplest and easiest to install and widely known by professionals
Power generator	It does not require any type of energy, as the execution of the joints is by simple fitting with Aquatherm® Adhesive
Possibility of joint execution failures	Practically null, as the weldable joint through adhesive performs a highly resistant and watertight fusion
Resistance to the effects of water hammer	Low, an inherent characteristic of plastic
Resistance to corrosion of chemical reagents and chlorinated water	High strength, characteristic of the material (see chemical resistance table)
Aggression by low pH of water	None, regardless of pH of water
Temperature resistance	Meets ABNT standards
Heat retention of hot water	Elevada capacidade de reter calor, devido à baixa condutividade térmica do CPVC: 0,14 W/mK
Need for thermal insulation	Up to 20 meters is dispensable. Studies carried out by the PUC of Minas Gerais (Energy Study Group) prove that, in a 20-meter pipe at a flow rate of 8 l/min, the temperature loss is only 0.7°C
Corrective maintenance	Made easy thanks to adhesive weldable joint and sliding sleeve
Technical assistance with national coverage	Yes, for technical guidance and complaint response via 0800 and face-to-face through ATs and TRs

2.7. CPVC Aquatherm® Line Items

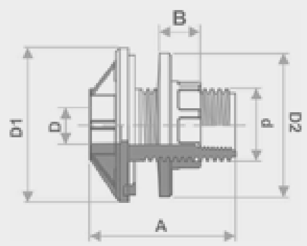
• Aquatherm® Pipe



DIMENSIONS (MM)

CODE	GAUGE	DE	e	L
17000152	DN 15	15,9	1,8	3000
17000225	DN 22	22,2	2,1	3000
17000284	DN 28	28,6	2,6	3000
17001086	DN 35	34,9	3,2	3000
17001108	DN 42	41,3	3,8	3000
17001132	DN 54	54	4,9	3000
17001515	DN 73	73,1	6,6	3000
17001531	DN 89	89	8,1	3000
17001558	DN 114	114,4	10,4	3000

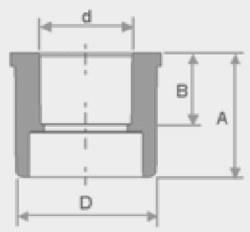
• Aquatherm® Water Tank Adapter



DIMENSIONS (MM)

CODE	GAUGE	A	B	D	D1	D2	d
22855816	22	61,2	18	15,25	64,3	60	30
22855824	28	64	21	28,3	79,4	74	44

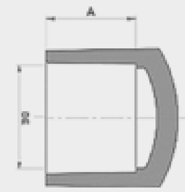
•Aquatherm® Reduction Bushing



DIMENSIONS (MM)

CODE	GAUGE	A	B	D	d
22850300	DN 22 x 15	18	13	22	15
22850202	DN 28 x 15	27	13,2	28,1	15
22850350	DN 28 x 22	23	18	28	22
22850210	DN 35 x 15	32	13,2	34,9	15
22850229	DN 35 x 22	32	18,2	34,9	22
37420840	DN 35 x 28	31	23	35	28
22850237	DN 42 x 22	37	18,2	41,3	22
22850245	DN 42 x 28	37	23,2	41,3	28
37420646	DN 42 x 35	36	28	42	35
22850253	DN 54 x 28	47,3	23,2	54	28
22850385	DN 54 x 35	48	28	54	35,2
37420654	DN 54 x 42	46	33	54	42
22850270	DN 73 x 35	50,8	28,2	73,1	35
37424668	DN 73 x 54	65,3	38,1	73	54
22850288	DN 89 x 54	53,4	43,8	89	54
37424676	DN 89 x 73	60,1	44,4	89,3	73,4
37424684	DN 114 x 73	74,6	44,4	114,8	73,4
37424692	DN 114 x 89	74,6	47,6	114,8	89,31

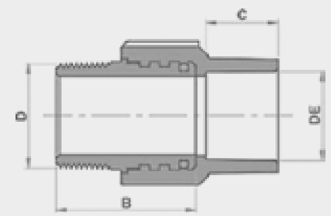
• Cap Aquatherm®



DIMENSIONS (MM)

CODE	GAUGE	A	DE
22850504	DN 15	13	15
22850555	DN 22	18	22
22850601	DN 28	23	28
37420662	DN 35	28	35
37420670	DN 42	33	42
37420689	DN 54	43	54
37424706	DN 73	44,4	73,4

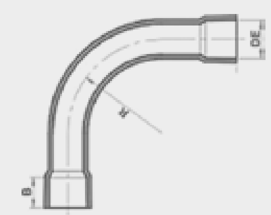
• Aquatherm® Connector



DIMENSIONS (MM)

CODE	GAUGE	B	C	D	DE
22850610	DN 15 x 1/2”	32	12,6	1/2”	15,25
22850628	DN 22 x 1/2”	32,6	18	1/2”	22,25
22850636	DN 22 x 3/4”	35	18	3/4”	22,25
100021062	DN 28 x 1”	39,5	23	1”	28,3
100021061	DN 35 x 1.1/4”	47,25	26,4	1.1/4”	35,2
100021058	DN 42x1.1/2”	49,7	33,5	1.1/2”	41,64
100021059	DN 54 x 2”	62,7	43,5	2”	54,3
100021060	DN 73x2.1/2”	75,7	44,5	2.1/2”	73,3
100021069	DN 89 x 3”	87,8	47,6	3”	89,3
100021070	DN 114 x 4”	99,0	55,2	4”	114,6

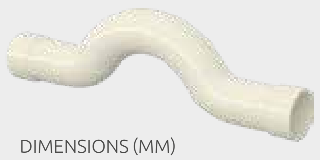
• 90° curve Aquatherm®

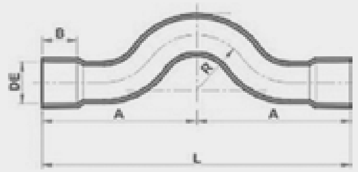


DIMENSIONS (MM)

CODE	GAUGE	B	DE	R
22852701	DN 15	13	15,25	38,00
22852728	DN 22	18	22,25	53,00
22852744	DN 28	23	28,30	70,00

• Aquatherm® Transposition Curve

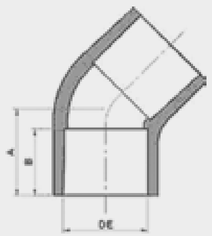




DIMENSIONS (MM)

CODE	GAUGE	A	B	DE	L	R
22852850	DN 15	66,90	13,00	15,25	133,80	16
22852876	DN 22	79,50	18,00	22,25	159,00	18

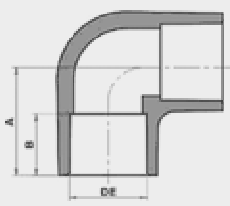
• Aquatherm® 45° Elbow



DIMENSIONS (MM)

CODE	GAUGE	A	B	DE
22850709	DN 15	23	13	15
22850750	DN 22	31	18	22
22850806	DN 28	39	23	28
37420727	DN 35	47	28	35
37420735	DN 42	55	33	42
37420743	DN 54	72	43	54
37424730	DN 73	82,6	44,4	73,4
37424749	DN 89	93,6	47,6	89,3
37424755	DN 114	115,8	58,7	114,8

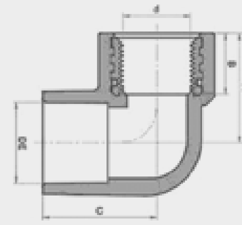
• Aquatherm® 90° Elbow



DIMENSIONS (MM)

CODE	GAUGE	A	B	DE
22850903	DN 15	23	13	15
22850954	DN 22	31	18	22
22851004	DN 28	39	23	28
37420751	DN 35	47	28	35
37420760	DN 42	55	33	42
37420778	DN 54	72	43	54
37424765	DN 73	82,6	44,4	73,4
37424773	DN 89	93,6	47,6	89,3
37424781	DN 114	115,8	58,7	114,8

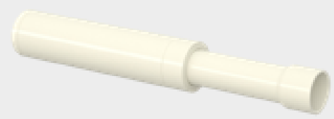
• 90° Elbow Transition Aquatherm®



DIMENSIONS (MM)

CODE	GAUGE	A	B	C	d	DE
22851187	DN 15 x 1/2"	27	17,2	26,5	1/2"	15
22851209	DN 22 x 1/2"	30,5	18	31,5	1/2"	22
22851225	DN 22 x 3/4"	32	18,5	31,5	3/4"	22
100021071	DN 28 x 1"	38,2	21,1	37	1"	28

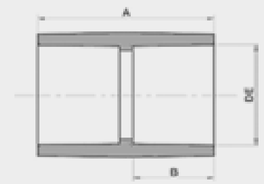
• Expansion Joint Aquatherm®



DIMENSIONS (MM)

CODE	GAUGE	D	L
22853716	DN 28	28,3	329
22853732	DN 35	35	348
22853759	DN 42	41,7	363
22853775	DN 54	54,4	403

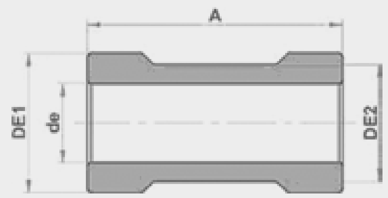
• Aquatherm® Sleeve



DIMENSIONS (MM)

CODE	GAUGE	B	C	D
22851403	DN 15	29	13	15
22851454	DN 22	39	18	22
22851500	DN 28	49	23	28
37420786	DN 35	59	28	35
37420794	DN 42	69	33	42
37420808	DN 54	89	43	54
37424790	DN 73	93,7	44,4	73,4
37424803	DN 89	100,1	47,6	89,3
37424811	DN 114	122,2	58,7	114,8

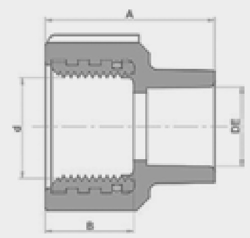
• Aquatherm® Running Sleeve



DIMENSIONS (MM)

CODE	GAUGE	A	de	DE1	DE2
22851314	DN 15	50	15,4	27,2	22,8
22851330	DN 22	55	22,4	33,6	29,1
22851357	DN 28	60	28,4	40,0	35,5

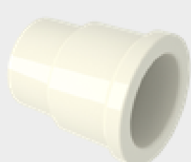
• Aquatherm® Transition Sleeve

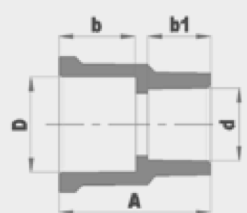


DIMENSIONS (MM)

CODE	GAUGE	B	C	D	DE
22851608	DN 15 x 1/2″	33	17	1/2″	15
22851632	DN 22 x 1/2″	37,5	17	1/2″	22
22851659	DN 22 x 3/4″	40	19	3/4″	22
22851675	DN 28 x 3/4″	44,5	21,5	3/4″	28
100021057	DN 28 x 1″	64	39	1″	28
100021064	DN 35 x 1 1/4″	78	25	1.1/4″	35
100021065	DN 42x1.1/2″	83	25	1.1/2″	42
100021066	DN 54 x 2″	93	25	2″	54

• Aquatherm® x Weldable Transition Sleeve

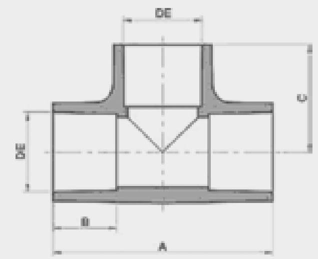




DIMENSIONS (MM)

CODE	GAUGE	A	b	b1	D	d
22854020	15 x 20	31,95	16,2	13,25	19,95	15,35
22854062	22 x 25	39	18,25	18,25	24,95	22,35

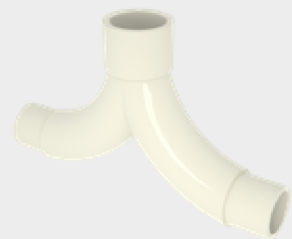
• Aquatherm® Tee

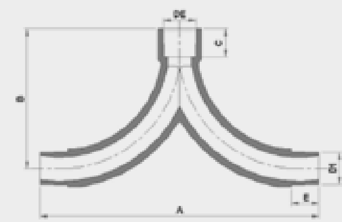


DIMENSIONS (MM)

CODE	GAUGE	A	de	DE1	DE2
22851900	DN 15	46	13	23	15
22851950	DN 22	62	18	31	22
22852000	DN 28	79	23	39	28
37420816	DN 35	95	28	47	35
37420824	DN 42	111	33	55	42
37420832	DN 54	144	43	72	54
37424820	DN 73	165	44,4	82,5	73,4
37424838	DN 89	187.3	47,6	93,6	93,6
37424846	DN 114	234,8	58,7	117,4	114,8

• Mixer Tee Aquatherm®

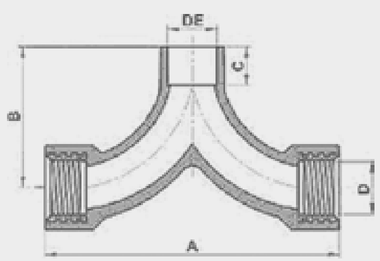




DIMENSIONS (MM)

CODE	GAUGE	A	B	C	D1	DE	E
22855018	DN 15	132	65,8	13,25	15,1	15,35	13,25
22855026	DN 22	132	65,75	18,25	22,1	22,35	18,25

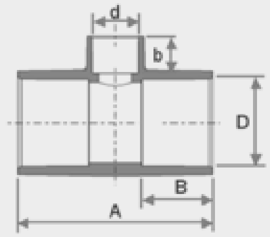
• Mixer Tee Aquatherm® transition



DIMENSIONS (MM)

CODE	GAUGE	A	B	C	D	DE
22852078	DN 15 x 1/2″	132	65,5	13	1/2″	15,25
22852043	DN 22 x 3/4″	132	65,5	18	3/4″	22,25

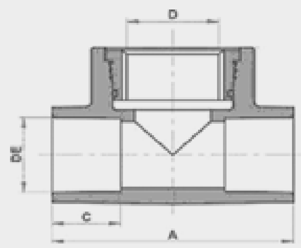
• Aquatherm® 90° Reduction Tee



DIMENSIONS (MM)

CODE	GAUGE	A	B	b	D	d
22854526	DN 22 x 15	58	18,2	13,2	22,3	15,3
22854542	DN 28 x 15	68	23,2	13,2	28,4	21,2
22854550	DN 28 x 22	74	23,2	18,2	28,4	22,3
22854577	DN 35 x 22	84,5	28,2	18,2	35,2	22,3
22852205	DN 35 x 28	89	26	23	35,2	28,3
22854615	DN 42 x 22	96	33,7	18,2	41,6	22,3
22852221	DN 42 x 28	101	33,5	23	41,64	28,3
22854623	DN 42 x 35	107	33,7	28,2	41,6	35,2
22854640	DN 54 x 22	117,6	43,8	18,2	54,4	22,3
22852248	DN 54 x 28	123	43,5	23	54,36	28,3
22854674	DN 73 x 54	152,6	47,3	43,8	73,3	54,4

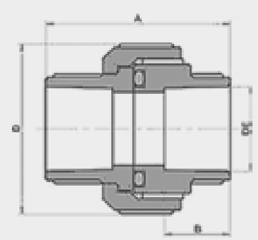
• Aquatherm® Transition Tee



DIMENSIONS (MM)

CODE	GAUGE	A	C	DE	D
22851780	DN 15 x 1/2"	52	13,2	15,3	18,6
22851810	DN 22 x 1/2'	63	18	22,25	18,63
22851837	DN 22 x 3/4"	63	18	22,25	24,2

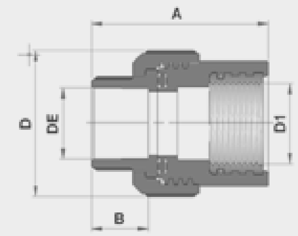
• Aquatherm® Union



DIMENSIONS (MM)

CODE	GAUGE	A	B	D	DE
22852400	DN 15	42	13	53,5	15
22852450	DN 22	46	18	44,2	22
22852507	DN 28	56	23	37,5	28
22852515	DN 35	68,6	28	69,5	35,2
22852523	DN 42	85	33,5	79,5	41,64
22852531	DN 54	101	43,5	101	54,36
37424854	DN 73	110,8	44,4	73,4	103,9
37424862	DN 89	127,5	47,6	156,5	89,3

• Aquatherm® Mixed Union



DIMENSIONS (MM)

CODE	GAUGE	A	B	D	D1	DE
22854836	DN 22 x 25"	55,6	18	46,2	3/4"	22,25

• Aquatherm® Pipe Adhesive

INFORMATION

CODE	DESCRIPTION
53010423	Adesivo Aquatherm® Bisnaga 17g
53010431	AdesivoAquatherm® Bisnaga 75g

• Aquatherm® Adhesive Bottle

INFORMATION

CODE	DESCRIPTION
53010407	Adesivo Aquatherm® Frasco 175g
53010415	Adesivo Aquatherm® Frasco 850g

• Thread Sealing Tape

DIMENSIONS (MM)

CODE	MEASUREMENTS
54501854	18 mm x 10 m
54501900	18 mm x 25 m
54501951	18 mm x 50 m

2.8. Warranty Certificate

TIGRE WARRANTY CERTIFICATE

AQUATHERM® TIGRE

To (Name of Builder)

TIGRE S.A. Tubos e Conexões, a manufacturer of pipes and connections for use in hot water in CPVC, provides this Warranty to its products of the Aquatherm® and DryFix® Hot Water lines in accordance with the terms established in this Certificate.

Aquatherm® TIGRE and DryFix® Hot Water TIGRE products are manufactured in accordance with ABNT NBR 15884/2010 and ASTM 2846 (American Society for Testing and Materials) standards, in addition to having the TIGRE quality standard.

TIGRE guarantees its Aquatherm® and DryFix® Hot Water products for a period of 50 years, counted from the date of purchase of the product, due to manufacturing failures. The validity of this warranty is linked to the correct handling, installation and use of the product, in accordance with Brazilian standards.

TIGRE reserves the right to introduce improvements and/or change specification of its products, at any time, not incurring such procedure in responsibility or obligation to the customer, dealer or third parties.

TIGRE

Effective quality, innovation, service and Technical Assistance are characteristics that are part of TIGRE's history and that have made it an absolute leader in all the markets where it operates.

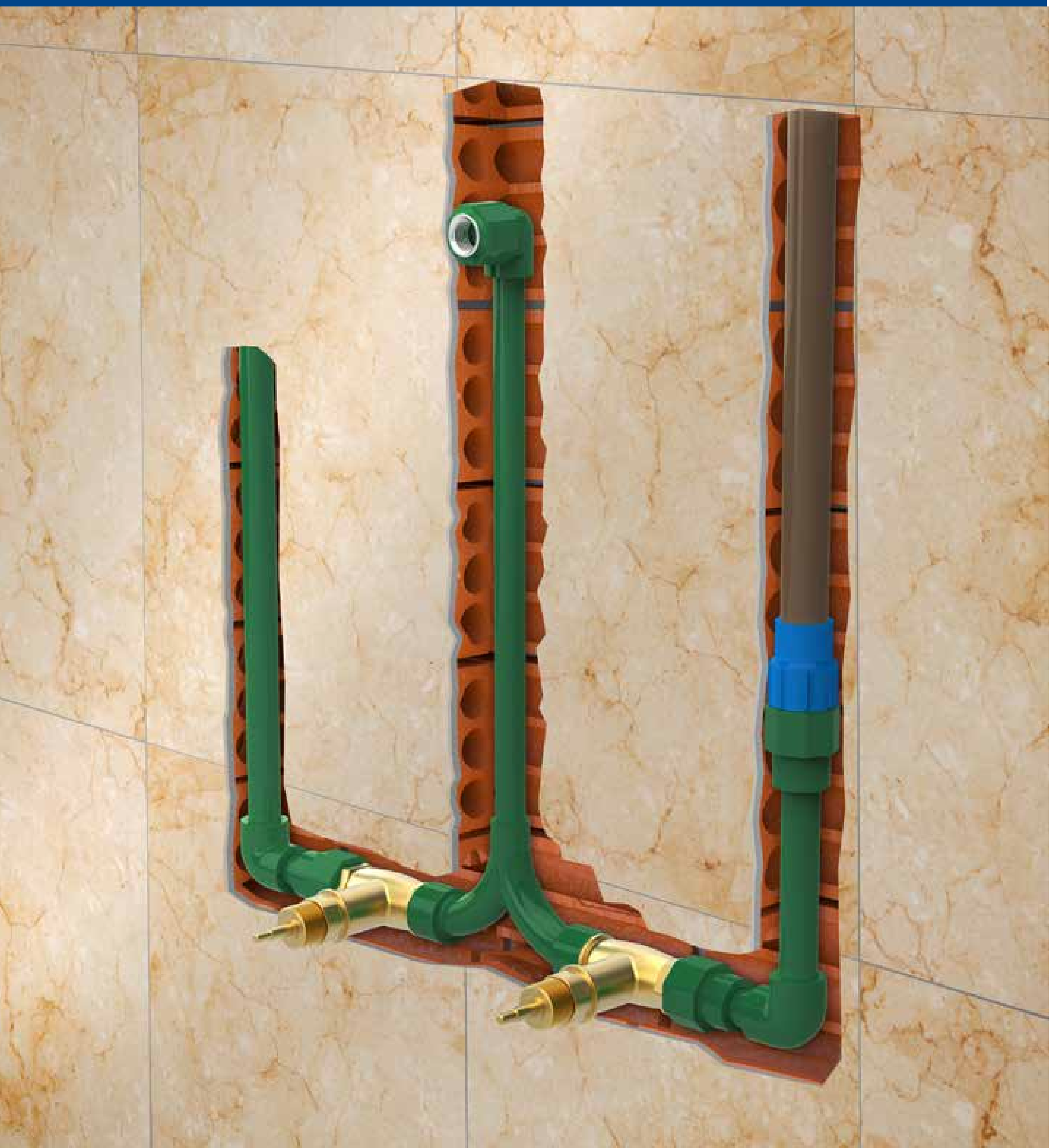
In addition to the services already provided through the Technical Assistance teams, TeleTigre, Tigre Resolve and Portal Tigre, we offer you a Warranty Certificate, which ensures the perfect operation of the Aquatherm® System for 50 years, provided that it is installed in accordance with the technical specifications of NBR 7198.

Ensuring for half a century serves to prove that "Whoever does with A TIGRE does it forever".

Notes

PPR THERMOFUSION

HOT WATER



3. 2. PPR Thermofusion

Tigre's PPR Thermofusion line offers the customer all the confidence and guarantee of a high quality product, which is already present in the most different countries. With high resistance to temperature and pressure, it provides the best cost benefit for compact works.

3.1. Function/Application

Cold and hot water conduction with high performance and durability requirement. The line is used in homes, hotels, clubs, hospitals, in heating systems and in naval and industrial facilities.

3.2. Benefits and Differentials

Cost benefit
The line made of polypropylene offers the best beneficial cost for small works.

Security Against Leaks
Thermofusion welding between the pipe and the connection provides leakage protection.

High durability
Made of PP, the line does not suffer from oxidation inside the pipe and connections, reducing the maintenance index and fouling in the network.

Easy operation and travel
Lighter products that facilitate the installation and transportation of parts.

Excellent thermal insulation
Better heat loss compared to metallic materials, ensuring the optimum temperature for the user.

3.3. Technical Characteristics

Raw material: The raw material used for the manufacture of the System is o PPR (Polypropylene Random Copolymer).

Color: Green.

Diameters: 20, 25, 32, 40, 50, 63, 75 and 90 mm.

Pressure class: PN 12 (12 kgf/cm2), PN 20 (20 kgf/cm2) and PN 25 (25 kgf/cm2).

Characteristics	Measurement Method	Units	Values
Fluidity Index (230°C/2.16kg)	ISO 1133	G / 10 MIN	0,3
Density	ISO 1183	g/cm^3	0,9
Melting Temperature	Microscope polarization	°C	140 - 150
Modulus of Elasticity and Bending 23°C	ISO 178	Mpa	830
Tensile Strength at Elastic Limit	ISO 527-2	Mpa	25
Stretching at the Elastic Limit	ISO 527-2	%	11
Short D Hardness	ASTM D2240	—	70
Charpy Impact Strength w/e at 23°C	ISO179	KJ/m^2	50
Charpy Impact Strength w/e at 0°C	ISO179	KJ/m^2	5
Melting Point	Internal method	°C	136,5 - 142,5
Thermal Conductivity at 23°C	DIN 8078	W/mk	0,23
Volume Resistivity at 20°C	—	Ω cm	>1x1016

Next, see the list of reference standards that govern the manufacture of the PPR Thermofusion System and that ensure excellent performance, offering a high degree of safety to the facilities.

REFERENCE TECHNICAL STANDARDS	
IRAM 13470	Polypropylene pipe systems for thermo-merger. Polypropylene pipes for transporting liquids under pressure. Measurements and nominal pressures.
IRAM 13471	Polypropylene pipes for hot melt joining intended for the transport of liquids at low pressure. Requirements.
IRAM 13472	Polypropylene pipes. Polypropylene connections, for thermofusion joining, with pipes of the same material, for the conduction of liquids at low pressure (parts 1 and 2).
DIN 2000	Drinking water directives and requirements. Study, construction and operation of the facilities.
DL/S 2203	Proof of connections to be cast in thermoplastic materials.
DVS 2207	Welding for thermoplastic materials.
DVS 2208	Machines and equipment suitable for thermofusion.
DIN 2999	Connection with metallic joint.
DIN 8076	Thermoplastic pipes under pressure.
DIN 8077	PP polypropylene pipes, dimensions.
DIN 8078	Polypropylene pipes. General quality requirements - tests, specifications and test methods.
UNI 9182	Power system and engineering system for hot water and cold water distribution.
DIN 16960	Welding of thermoplastic materials - principles.
DIN 16962	Polypropylene (PP) pipes and connections - dimensions and tests for connections
DIN 16774	Thermoplastic mass: polypropylene (PP).
DIN 53735	Tests of plastic materials: determination of the melt index of thermoplastics.

3.3.1. The Molecular Structure of PPR

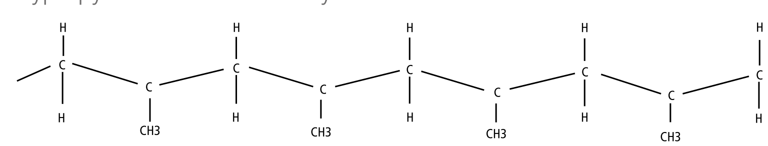
Polypropylene is a polyolefin resin, composed mainly of petroleum, and was developed by Europeans in 1954. Chemical derivations, as below, generate the rupture of the molecular chains giving rise to polypropylene. In order to reach the latest generation of polypropylenes, it was deep development is needed, as below:

Type 01 - Polipropileno homopolímero
-P-P-P-P-P-P-P-....-P-P-P-P-P-P-P

Type 02 - Polipropileno block
(P-P-P-...P) + (P-P-E-E-E-E-P-P-E-E-E-P-P-)

Type 03 - Polypropylene Random Copolymer
-P-P-P-E-P-P-P-E-P-...-P-P-P-E-P-P-P

Polypropylene Production - Polymer Chain



Polypropylene Random Copolymer – Type 3 – needs to add high temperature resistance to high pressure resistance. Therefore, currently few global petrochemical companies have the technology to manufacture it. This green colored raw material in small granules is subjected to several tests, according to the standards:

ISO/R 527 - Breaking stress
ISO 1133 - Creep index
ISO/R 1183 - Density and volumetric mass
ISO 1191 - Viscosity coefficient
ISO 2039 - Penetration hardness

Countries such as Germany, Turkey, Italy and Argentina have been using this solution for hot water conduction successfully for more than 30 years, proving its applicability after being subjected to the most severe conditions of use and tests in renowned laboratories.

3.3.2. Diameter Comparison

Table 7 - Comparison of PPR, Weldable, Threadable and Aquatherm® Diameters

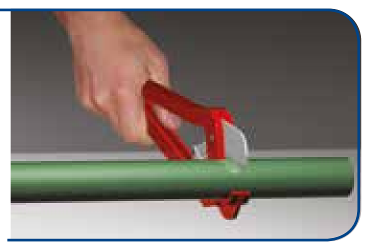
PPR PN 12		PPR PN 20		PPR PN 25		Soldável		Roscável		Aquatherm®	
DN	DI	DN	DI	DN	DI	DN	DI	DN	DI	DN	DI
20	16,2	20	14,4	20	13,2	20	17	1/2''	7,5	15	12,2
25	20,4	25	18	25	16,6	25	21,6	3/4''	13,25	22	18
32	26,2	32	23,2	32	21,2	32	27,8	1''	18,4	28	23,4
40	32,6	40	29	40	24,6	40	35,2	1 1/4''	24,35	35	28,5
50	40,8	50	36,2	50	33,2	50	44	1 1/2''	30,1	42	33,7
60	48,4	60	45	60	42	60	53,4	2''	41,4	54	44,2
75	61,4	75	54,4	75	50	75	66,6	2 1/2''	54,1	73	60
90	73,6	90	65,4	90	60	90	80,6	3''	66,6	89	74,1
110	90	110	79,8	110	73,4	110	97,8	4''	91,6	114	93,9

3.4. Instructions

3.4.1. Joint Execution

1 Before starting the thermofusion process, it is essential to clean the nozzles of the socket fusion tool with a cloth soaked in alcohol and check their correct adjustment on the equipment board.

2 It is recommended to cut the pipes with scissors to avoid burrs.



3 Wipe the tip of the pipe and the inside of the nozzle with an alcohol wipe.

4 Mark the injection depth at the tip of the pipe, conform to the measurement specified in table 8, according to the diameter.

5 Simultaneously insert the pipe and the connection into their respective nozzles, perpendicular to the socket fusion tool board.

Notes: The connection must be fitted to the end of the male nozzle. The pipe must not exceed the mark of the depth previously made.

6 Remove the pipe and the connection of the socket fusion tool after the minimum time determined for the melting has passed, according to table 9.

7 Immediately proceed to union. Stop the introduction of the pipe into the connection when the two visible rings that are due to the movement of the material are joined.

Notes: For 3 seconds, it is possible to align the connection or rotate it no more than 15°.

8 It is recommended to leave the joint at rest until it reaches full cooling, as specified in table 9.

9 Once the installation is completed, properly store the molder after cooling the board.

Table 8 - Insertion Depths

Diameter (pipe and connection)	Depth of Insertion in the Nozzle - P(MM)
20	12
25	13
32	14,5
40	16
50	18
63	24
75	26
90	29

Table 9 - Times for Thermofusion

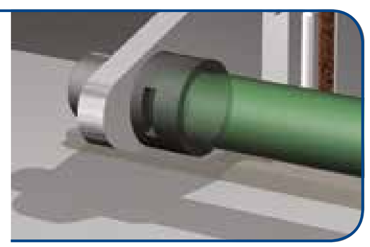
Diameter (pipe and connection)	Minimum Heating Time (seconds)	Maximum interval for coupling (seconds)	Cooling time (minutes)
20	5	4	2
25	7	4	2
32	8	6	4
40	12	6	4
50	18	6	4
63	24	8	6
75	30	8	6
90	40	8	6

Notes: Increase by 50% when the ambient temperature is less than 10°C.

3.4.2. Execution of Joints with Grooved Nozzles

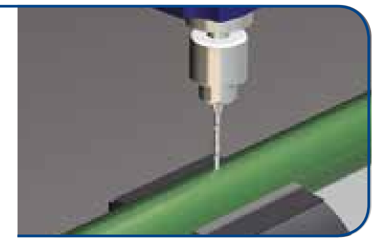
1 If grooved nozzles are used, it is not necessary to mark the depth of the pipes, since the groove serves as a visual mark for the correct insertion of the pipe.

2 Insert the pipe until it reaches the beginning of the nozzle groove.

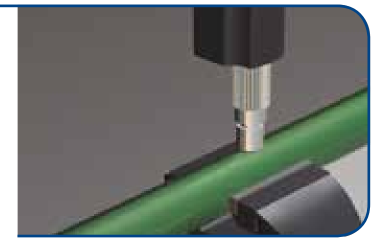


3.4.3. Bypass Fitting Installation

1 Drill the pipe with a 12 mm drill bit in the place where the shunt will be made.



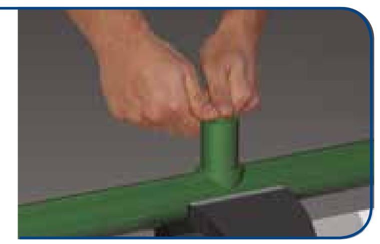
2 Use the drill with drill for faucet connections.



3 Place the nozzles for shunt saddles in the socket fusion tool. Use the concave nozzle to heat the pipe, and the convex one for the faucet. Heat the pipe for 30 seconds until a ring forms around the nozzle.

4 Then heat the fitting during 20 seconds, but without removing the nozzle from the pipe (total pipe heating: 50 seconds).

5 Quickly remove the thermofuser and press the fitting for 30 seconds. Next, allow the joint to cool for 10 minutes.



Important:
This procedure must be respected in each of its steps and must be done with the indicated tooling in order to ensure the success of the merger.

The bypass saddles of the TIGRE Thermofusion system are connections specifically developed to accompany and complete the line of reduction "tees". Its use is simple and with excellent results if the indications are followed and the corresponding tools are used. The pipe where the fitting is fused must be perfectly clean and dry. In the case of adding a fitting to an existing piping, check that it is free of water and dry at the place where the melting will take place. Carry out the operations with the drilling machine in the perpendicular position in relation to the pipe to prevent the hole from being decentralized.

3.4.4. Use of the Socket Fusion Tool

The Socket Fusion Tool is a manual equipment with thermal contact element, used in welding by thermofusion between pipes and connections of Polypropylene Random - Type 3.
This equipment has a temperature regulation device to reach the melting point (260ºC) of the material. Before installing the Socket Fusion Tool, carefully read the instructions contained in the manual that comes with the product and the information below.

Important:

- The operator of the socket fusion tool must read the manual before starting to operate the equipment.
- Ensure the length of the safety measures informed in the manual and technical catalogs to avoid accidents such as electric shocks, injuries and fires.
- Use the socket fusion tool only for the purposes described in this manual.
- The contents of the equipment, the images and illustrations, as well as the information contained in this manual, may change without prior notice, in order to improve the quality and operation of the product, or even due to changes in safety rules.
-

Caution
Below are some procedures that must be followed when handling the socket fusion tool. Such situations may present dangers of death, serious injury or material damage to the user.

1- Make sure that you will use the correct voltage for the equipment (110 V or 220 V). If the voltage is different, it may burn the equipment, in addition to facilitating the formation of fire or fire.
2 - Only connect the socket fusion tool to the mains after it has been fixed to the bracket.
3 - Do not handle the equipment with wet hands.
4 - Do not use the socket fusion tool in conditions of contact with water, under rain, in humid or wet environments.
5 - Do not use the equipment near flammable gases or fluids, such as gasoline or turpentine, as it may cause explosions or fires.
6 - Keep the place where you will use the socket fusion tool clean and illuminated.
7 - Do not overload the socket fusion tool, only use it under the conditions for which it was manufactured.
8 - Do not handle the power cord dangerously and never disconnect it from the outlet by pulling on the cord.
9 - Regularly inspect the power cord. If it is damaged, request repair in order to avoid electric shocks and accidents.
10 - In the face of unusual odor, vibrations or noise in the equipment, turn it off immediately and contact the local representative or distributor.

Equipment Description
Application: Intended to perform thermofusion welding between pipes and PPR connections.
Models: T-63 (for pipes up to DN 63 mm) and T-110 (for pipes up to DN 110 mm)

Parts nomenclature:

1 - Metal case	2 - Allen key
3 - Reinforced wrench	4 - Screws
5 - Table support	6 - Manual support

7 - Set of nozzles (does not come with the product)

3.4.4.1. Technical Characteristics

Model T-63

Voltage: 230 V
Rated Power: 800 W
Frequency: 50/60 Hz
Working range: 20 mm to 63 mm
Working temperature: 260º
Dimensions: 37 x 5 x 13.5 cm
Weight: 1.8 Kg

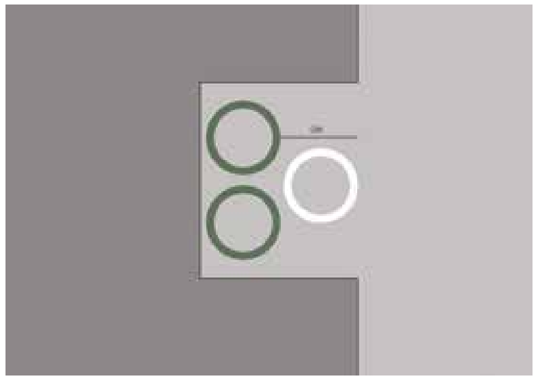
Model T-110

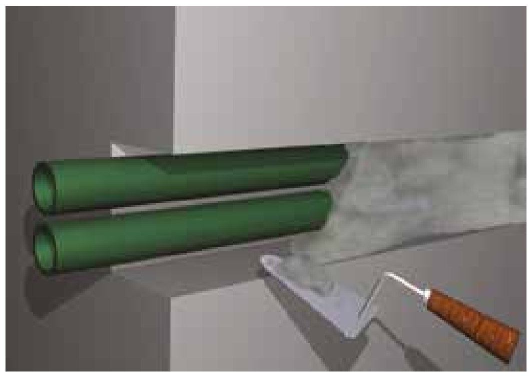
Voltage: 230 V
Rated Power: 1200 W
Frequency: 50/60 Hz
Working range: 20 mm to 110 mm
Working temperature: 260º
Dimensions: 38 x 6 x 15.5 cm
Weight: 2.0 Kg

Notes: Products with 1 year warranty from the date of purchase.

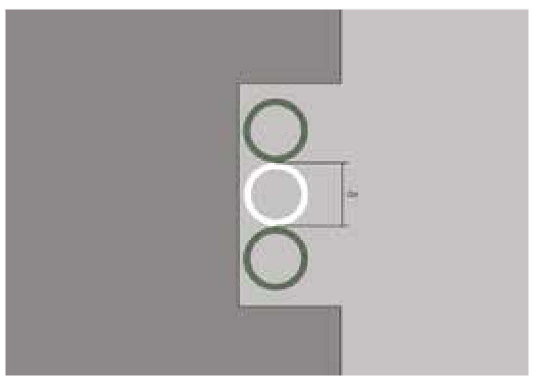
3.4.5. Embedded Facilities

To embed the TIGRE Thermofusion system, in the case of a deep wall, the piping must be at a minimum depth equal to the diameter of the piping, covering it with mortar as shown in the figures below. High strength mortar is not required to close the channel.





In case of narrow walls and passage of cold and hot water piping through the same channel, its width must be increased in order to separate both pipes by a distance equivalent to the diameter of the piping as shown in the following image.



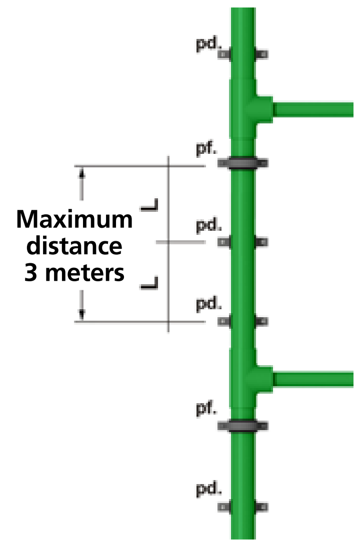
3.4.6. Apparent Installations

Apparent pipes must be installed in such a way as to allow natural thermal expansion of the system. They must be installed by means of clamps, interspersed between fixed points and sliding points.

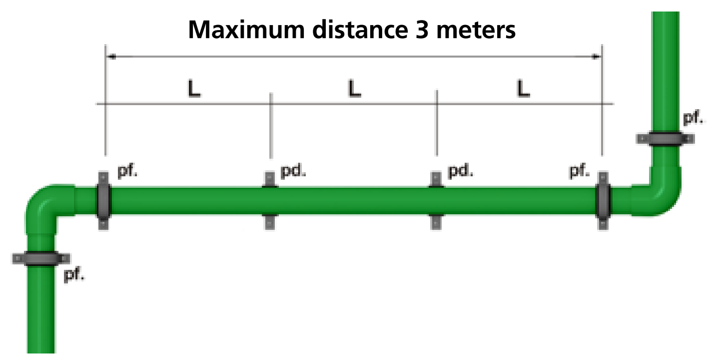
Fixed Points
They must be positioned at all changes of direction of the hydraulic installation (Tees, Elbows, etc.), preventing the thermal expansion forces of the piping from being discharged onto the exposed piping. The distance between fixed supports should not be greater than 3 meters.

Sliding Points
They are supports that allow the axial displacement of the piping, and must be installed according to the table of maximum distance between fixed points:

Vertical Installation – distance between fixed and sliding points:



Horizontal Installation – distance between fixed and sliding points:



Specifications for Clamps
The normally used clamps are metallic, coated with material that prevents their direct contact with the pipes (rubber), avoiding damage to the piping surface.

The following values of maximum distance between supports should be considered:

Table 10 - Maximum Distance Between Supports

Maximum Distance Between Supports (in cm) for PN 12, PN 20 and PN 25										
Pipe type		Service Temperature C°								
		0 C	10 C	20 C	30 C	40 C	50 C	60 C	70 C	80 C
PN 12	20	65	60	50	50	45				
	25	75	70	60	60	50				
	32	90	85	80	70	65				
	40	100	100	90	80	75				
	50	125	110	100	95	85				
	63	145	130	120	100	100				
	75	160	150	135	120	115				
	90	180	170	150	140	130				
PN 20	20	75	70	60	55	50	50	45	40	40
	25	85	80	70	65	60	55	50	50	40
	32	100	90	80	75	70	65	60	55	50
	40	120	100	100	90	80	75	70	65	60
	50	135	120	110	100	95	90	80	75	70
	63	160	140	130	120	110	100	95	85	80
	75	180	160	150	130	125	115	100	100	90
	90	200	180	165	150	140	130	120	110	100
PN 25	20	80	70	60	60	50	50	45	40	40
	25	90	80	70	70	60	60	50	50	45
	32	100	90	90	80	70	70	60	60	50
	40	120	110	100	90	85	80	70	65	60
	50	140	130	120	100	100	90	80	80	70
	63	160	150	135	120	115	100	100	90	80
	75	180	170	150	140	130	120	110	100	90
	90	200	190	170	160	150	130	125	115	100

This table indicates the maximum permissible distances between consecutive horizontal supports. For vertical installations, the distance can be increased by 30%.

Thermal Expansion

In the same way as all the materials of the work, the TIGRE Thermofusion pipes suffer the effects of contraction and expansion. The strength characteristics of the pipes and connections do not require any special protection for this purpose, but it is convenient to create a free space between the pipe and the plaster, which can be obtained by wrapping the pipe in material such as cardboard, in order to prevent the formation of cracks in the masonry.

In apparent installations greater than 40 meters in length, linear expansion should be considered before starting the project. The layout of the piping must be in such a way as to allow the free movement of the piping.

Linear dilation is calculated with the following formula

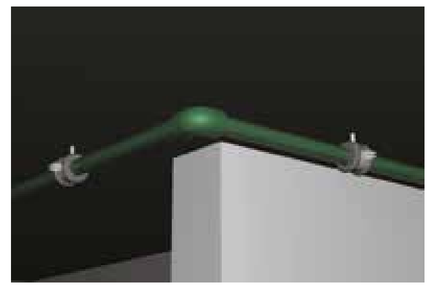
$$\Delta L = \Delta T \times L \times \alpha$$

Where:
ΔL = linear expansion - pipe length variation (mm)
α = coefficient of linear expansion of the pipe (0.15 mm/m°C)
L = pipe length (m)
ΔT = temperature variation (Tt -Tm): °C Cálculo do T:

$$T = Tt - Tm$$

Where:
Tt = working temperature (°C)
Tm = mounting temperature (°C)

To compensate for the variations in length caused by thermal expansion, changes in direction or liras can be used, as follows:



A) Direction changes
Formula for calculating the length of the bending arm:

$$LB = \sqrt{C \times DE \times \Delta L}$$

Where:
LB = Larm length (mm)
C = PPR specific constant (15)
DE = External pipe diameter (mm)
ΔL = Linear expansion of tubing (mm)

B) Expansion lyres, formed by 4 curves at 90°, function as a double sliding arm. The length of the lyre (LC) should be at least 10 times the diameter of the pipe. The length of the sliding arm (LB) is calculated by the previous formula.

Thermal Insulation

In the case of central hot water installations for the uprights, returns and distribution pipelines and in individual hot water installations with large extension piping, it is recommended to cover the piping with thermal protections in order to optimize the performance of the equipment.

3.4.7. Execution of Repairs

1 Make a perpendicular cut in the damaged section of the pipe. Pull the ends out of the wall opening, resting them on wooden shims.

2 Heat the ends of the pipes and sleeve.

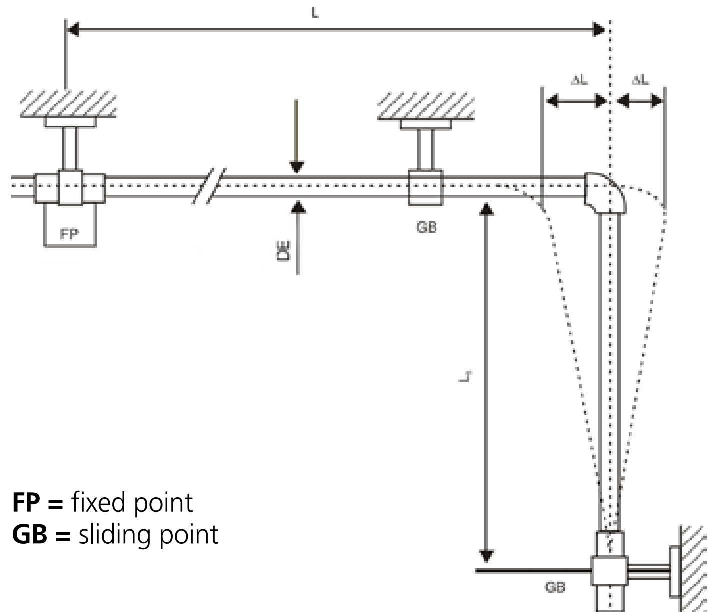
Notes: The heating time of the sleeve should be twice the time used for the pipe.

3 Immediately proceed to the union, removing the shims so that the piping returns to its normal position.

3.4.8. Execution of Elastic Arms

$$L_s = \sqrt{C \times DE \times \Delta L}$$

Where:
L_s = elastic arm length (mm)
DE = external pipe diameter (mm)
ΔL = linear pipe expansion (mm)
C = constant for PPR (30)



FP = fixed point
GB = sliding point

3.4.9. Transport/Storage

- Transport the pipelines carefully stacked.

- Do not store pipes outdoors or in piles larger than 1.50 meters.

- Do not undergo thermofusion to movements during the cooling phase.
- Do not interrupt the thermofusion process due to an error in the choice of parts. When finishing the wrong thermofusion, the segment must be cut and stored to use it again.

- Do not change hot nozzles with any tool – use special tweezers provided by the equipment manufacturer.
- Do not leave any part of the installation exposed to the sun without protection (nor in regions of very low temperature).
- Do not perform thermofusion in the presence of water.
- Do not use ordinary drill bits in place of the faucet fitting drills.
- Protect the pipes from impacts on the work site.

Protection from the Sun's Radiation

All synthetic materials are attacked, to a greater or lesser extent, by the sun's rays (especially ultraviolet radiation). This attack manifests itself as a gradual degradation of the product from the outside to the inside, which is observed as a shell.

So that this problem does not arise in the pipes, the recommendation is to protect the installation exposed to the sun from the moment of transport until its assembly.

For this, the market has the offer of expanded polyethylene sheaths, very advisable as protection against UV rays, and also has ironed tapes from different sources, which must be strong to resist in themselves the degrading action of UV and also aluminum tapes that act as protection against UV rays.

Hydraulic Test

The hydraulic pressure and tightness test for the TIGRE Thermofusion PPR Pipes must be carried out at a pressure of 1.5 times the working pressure, for pipes up to 100 m away. For larger sections, we recommend subdividing into smaller sectors, with a maximum of 100 meters.

In building installations, the hydraulic test should be performed only 1 hour after the last thermofusion. If the gauge pressure exceeds 40 m.c.a., a Pressure Reducing Valve must be installed. A pressure gauge measured close to the point to be tested must be used.

The pressure gauge will inform the normal static pressure of the pressurized tubing. With the aid of the Pressure Reducing Valve, increase the static pressure in an interval of 10 minutes. After the test, adjust the Pressure Reducing Valve, returning to the original situation.

3.4.10. General Information

Welding

The pipes and connections to be welded must always be well cleaned, and the thermostat of the Socket Fusion Tool must indicate the appropriate temperature (green light).

Avoid twisting the welded parts during welding as well as after the procedure.

Connections with Metallic Insert

When PPR connections that have metal inserts are used, tightening the joints should be avoided and excessive amounts of Thread Sealing Tape should not be used.

Contact with Cutting Bodies

Unintentional contact with sharp products can cause damage to the external surface of the pipes and may cause ruptures later. It is essential to pay attention to this during storage, transportation or installation.

Condensation

In installations of refrigeration systems, the phenomenon of condensation occurs, where the internal temperature of the piping is lower in relation to atmospheric pressure and relative humidity of the air in the place. For this, it is recommended to cover the piping with a thermal insulator such as expanded polyurethane, glass wool or EPS.

3.5. Load Loss for PPR Pipes

Table 11 - Load Loss for PPR Pipes - PN20

De	Thickness	Di	Vel (m/s)	Flow Rate		Load Loss		
				L/h	l/s	mmca/m	Pa/m	mbar/m
20	2,8	14,4	0,4	234,5	0,07	19,23	192,35	1,92
25	3,5	18	0,4	366,4	0,1	14,34	143,45	1,43
32	4,5	23	0,4	598,3	0,17	10,42	104,22	1,04
40	5,6	28,8	0,4	938,1	0,26	7,79	77,92	0,78
50	6,9	36,2	0,4	1482,1	0,41	5,81	58,1	0,58
63	8,7	45,6	0,4	2351,7	0,65	4,33	43,29	0,43
75	10,4	54,2	0,4	3322,4	0,92	3,48	34,78	0,35
90	12,5	65	0,4	4778,4	1,33	2,77	27,66	0,28
20	2,8	14,4	0,6	351,8	0,1	38,55	385,48	3,85
25	3,5	18	0,6	549,7	0,15	28,86	288,6	2,89
32	4,5	23	0,6	897,4	0,25	21,05	210,51	2,11
40	5,6	28,8	0,6	1407,1	0,39	15,79	157,93	1,58
50	6,9	36,2	0,6	2223,1	0,62	11,81	118,14	1,18
63	8,7	45,6	0,6	3527,6	0,98	8,83	88,3	0,88
75	10,4	54,2	0,6	4983,6	1,38	7,11	71,09	0,71
90	12,5	65	0,6	7167,5	1,99	5,67	56,66	0,57
20	2,8	14,4	0,8	469	0,13	63,53	635,31	6,35
25	3,5	18	0,8	732,9	0,2	47,68	476,79	4,77
32	4,5	23	0,8	1196,6	0,33	34,86	348,64	3,49
40	5,6	28,8	0,8	1876,1	0,52	26,21	262,13	2,62
50	6,9	36,2	0,8	2964,1	0,82	19,65	196,49	1,96
63	8,7	45,6	0,8	4703,4	1,31	14,71	147,14	1,47
75	10,4	54,2	0,8	6644,8	1,85	11,86	118,63	1,19
90	12,5	65	0,8	9556,7	2,65	9,47	94,68	0,95

De	Thickness	Di	Vel (m/s)	Flow Rate		Load Loss		
				L/h	l/s	mmca/m	Pa/m	mbar/m
20	2,8	14,4	1	586,3	0,16	93,95	939,47	9,39
25	3,5	18	1	916,1	0,25	70,63	706,27	7,06
32	4,5	23	1	1495,7	0,42	51,74	517,36	5,17
40	5,6	28,8	1	2345,2	0,65	38,96	389,57	3,9
50	6,9	36,2	1	3705,2	1,03	29,24	292,44	2,92
63	8,7	45,6	1	5879,3	1,63	21,93	219,3	2,19
75	10,4	54,2	1	8306	2,31	17,7	176,98	1,77
90	12,5	65	1	11945,9	3,32	14,14	141,39	1,41
20	2,8	14,4	1,2	703,6	0,2	129,64	1296,45	12,96
25	3,5	18	1,2	1099,3	0,31	97,59	975,89	9,76
32	4,5	23	1,2	1794,9	0,5	71,58	715,81	7,16
40	5,6	28,8	1,2	2814,2	0,78	53,96	539,62	5,4
50	6,9	36,2	1,2	4446,2	1,24	40,55	405,53	4,06
63	8,7	45,6	1,2	7055,1	1,96	30,44	304,42	3,04
75	10,4	54,2	1,2	9967,2	2,77	24,59	245,87	2,46
90	12,5	65	1,2	14335,1	3,98	19,66	196,56	1,97
20	2,8	14,4	1,4	820,8	0,23	170,51	1705,15	17,05
25	3,5	18	1,4	1282,5	0,36	128,48	1284,85	12,85
32	4,5	23	1,4	2094	0,58	94,34	943,42	9,43
40	5,6	28,8	1,4	3283,3	0,91	71,18	711,85	7,12
50	6,9	36,2	1,4	5187,3	1,44	53,54	535,43	5,35
63	8,7	45,6	1,4	8231	2,29	40,23	402,27	4,02
75	10,4	54,2	1,4	11628,4	3,23	32,51	325,09	3,25
90	12,5	65	1,4	16724,3	4,65	26,01	260,06	2,6
20	2,8	14,4	1,6	938,1	0,26	216,48	2164,78	21,65
25	3,5	18	1,6	1465,7	0,41	163,25	1632,54	16,33
32	4,5	23	1,6	2393,1	0,66	119,98	1199,75	12
40	5,6	28,8	1,6	3752,3	1,04	90,59	905,94	9,06
50	6,9	36,2	1,6	5928,3	1,65	68,19	681,9	6,82
63	8,7	45,6	1,6	9406,8	2,61	51,27	512,66	5,13
75	10,4	54,2	1,6	13289,6	3,69	41,45	414,5	4,14
90	12,5	65	1,6	19113,4	5,31	33,17	331,75	3,32
20	2,8	14,4	1,8	1055,3	0,29	267,47	2674,74	26,75
25	3,5	18	1,8	1649	0,46	201,85	2018,53	20,19
32	4,5	23	1,8	2692,3	0,75	148,45	1484,47	14,84
40	5,6	28,8	1,8	4221,3	1,17	112,16	1121,63	11,2
50	6,9	36,2	1,8	6669,3	1,85	84,48	844,76	8,45
63	8,7	45,6	1,8	10582,7	2,94	63,55	635,47	6,35
75	10,4	54,2	1,8	14950,8	4,15	51,4	514	5,14
90	12,5	65	1,8	21502,6	5,97	41,15	411,55	4,12
20	2,8	14,4	2	1172,6	0,33	323,45	3234,55	32,35
25	3,5	18	2	1832,2	0,51	244,24	2442,43	24,42
32	4,5	23	2	2991,4	0,83	179,73	1797,33	17,97
40	5,6	28,8	2	4690,4	1,3	135,87	1358,73	13,59
50	6,9	36,2	2	7410,4	2,06	102,39	1023,85	10,24
63	8,7	45,6	2	11758,5	3,27	77,06	770,57	7,71
75	10,4	54,2	2	16612	4,61	62,35	623,49	6,23
90	12,5	65	2	23891,8	6,64	49,94	499,39	4,99

De	Thickness	Di	Vel (m/s)	Flow Rate		Load Loss		
				L/h	l/s	mmca/m	Pa/m	mbar/m
20	2,8	14,4	2,5	1465,7	0,41	484,98	4849,79	48,5
25	3,5	18	2,5	2290,2	0,64	366,64	3666,37	36,66
32	4,5	23	2,5	3739,3	1,04	270,12	2701,24	27,1
40	5,6	28,8	2,5	5863	1,63	204,42	2044,19	20,44
50	6,9	36,2	2,5	9263	2,57	154,19	1541,92	15,42
63	8,7	45,6	2,5	14698,1	4,08	116,16	1161,59	11,62
75	10,4	54,2	2,5	20765	5,77	94,05	940,52	9,41
90	12,5	65	2,5	29864,8	8,3	75,39	753,85	7,54
20	2,8	14,4	3	1758,9	0,49	677	6769,98	67,7
25	3,5	18	3	2748,3	0,76	512,24	5122,42	51,22
32	4,5	23	3	4487,1	1,25	377,74	3777,36	37,77
40	5,6	28,8	3	7035,6	1,95	286,08	2860,77	28,61
50	6,9	36,2	3	11115,5	3,09	215,95	2159,47	21,59
63	8,7	45,6	3	17637,8	4,9	162,8	1627,98	16,28
75	10,4	54,2	3	24917,9	6,92	131,88	1318,83	13,19
90	12,5	65	3	35837,7	9,95	105,76	1057,61	10,58
20	2,8	14,4	3,5	2052	0,57	899,23	8992,29	89,92
25	3,5	18	3,5	3206,3	0,89	680,84	6808,45	68,08
32	4,5	23	3,5	5235	1,45	502,41	5024,15	50,24
40	5,6	28,8	3,5	8208,2	2,28	380,73	3807,31	38,07
50	6,9	36,2	3,5	12968,1	3,6	287,56	2875,64	28,76
63	8,7	45,6	3,5	20577,4	5,72	216,91	2169,08	21,69
75	10,4	54,2	3,5	29070,9	8,08	175,79	1757,87	17,58
90	12,5	65	3,5	41810,7	11,61	141,03	1410,27	14,1

Table 12 - Load Loss for PPR Pipes - PN25

De	Thickness	Di	Vel (m/s)	Flow Rate		Load Loss		
				L/h	l/s	mmca/m	Pa/m	mbar/m
20	3,4	13,2	0,4	197,1	0,05	21,58	215,8	2,16
25	4,2	16,6	0,4	311,7	0,09	15,95	159,51	1,6
32	5,4	21,2	0,4	508,3	0,14	11,59	115,86	1,16
40	6,7	26,6	0,4	800,2	0,22	8,63	86,33	0,86
50	8,4	33,2	0,4	1246,6	0,35	6,49	64,91	0,65
63	10,5	42	0,4	1995	0,55	4,81	48,06	0,48
75	12,5	50	0,4	2827,4	0,79	3,85	38,52	0,39
90	15	60	0,4	4071,5	1,13	3,06	30,59	0,31
20	3,4	13,2	0,6	295,6	0,08	43,18	431,8	4,32
25	4,2	16,6	0,6	467,5	0,13	32,05	320,48	3,2
32	5,4	21,2	0,6	762,5	0,21	23,37	233,72	2,34
40	6,7	26,6	0,6	1200,3	0,33	17,48	174,77	1,75
50	8,4	33,2	0,6	1869,9	0,52	13,18	131,82	1,32
63	10,5	42	0,6	2992,6	0,83	9,79	97,93	0,98
75	12,5	50	0,6	4241,2	1,18	7,87	78,65	0,79
90	15	60	0,6	6107,3	1,7	6,26	62,61	0,63

De	Thickness	Di	Vel (m/s)	Flow Rate		Load Loss		
				L/h	l/s	mmca/m	Pa/m	mbar/m
20	3,4	13,2	0,8	394,1	0,11	71,09	710,95	7,11
25	4,2	16,6	0,8	623,3	0,17	52,9	529	5,29
32	5,4	21,2	0,8	1016,6	0,28	38,68	386,78	3,87
40	6,7	26,6	0,8	1600,5	0,44	28,99	289,87	2,9
50	8,4	33,2	0,8	2493,2	0,69	21,91	219,08	2,19
63	10,5	42	0,8	3990,1	1,11	16,31	163,08	1,63
75	12,5	50	0,8	5654,9	1,57	13,12	131,17	1,31
90	15	60	0,8	8143	2,26	10,46	104,56	1,05
20	3,4	13,2	1	492,7	0,14	105,06	1,050,59	10,51
25	4,2	16,6	1	779,1	0,21	78,31	783,14	7,83
32	5,4	21,2	1	1270,8	0,35	57,36	573,62	5,74
40	6,7	26,6	1	2000,6	0,55	43,06	430,56	4,31
50	8,4	33,2	1	3116,5	0,86	32,59	325,89	3,26
63	10,5	42	1	4987,6	1,39	24,29	242,93	2,43
75	12,5	50	1	7068,6	1,96	19,56	195,59	1,96
90	15	60	1	10178,8	2,82	15,61	156,07	1,56
20	3,4	13,2	1,2	591,2	0,17	144,9	1449,03	14,49
25	4,2	16,6	1,2	935	0,25	108,16	1081,6	10,82
32	5,4	21,2	1,2	1524,9	0,42	79,33	793,32	7,93
40	6,7	26,6	1,2	2400,7	0,66	59,62	596,16	5,96
50	8,4	33,2	1,2	3739,8	1,03	45,17	451,72	4,52
63	10,5	42	1,2	5985,1	1,67	33,71	337,11	3,37
75	12,5	50	1,2	8482,3	2,35	27,16	217,62	2,18
90	15	60	1,2	12214,5	3,38	21,69	216,91	2,17
20	3,4	13,2	1,4	689,7	0,18	190,5	1905,04	19,05
25	4,2	16,6	1,4	1090,8	0,3	142,35	1423,51	14,24
32	5,4	21,2	1,4	1779,1	0,49	104,52	1045,21	10,45
40	6,7	26,6	1,4	2800,8	0,78	78,62	786,16	7,86
50	8,4	33,2	1,4	4363,1	1,21	59,6	596,23	5,96
63	10,5	42	1,4	6982,6	1,94	44,53	445,33	4,45
75	12,5	50	1,4	9896	2,75	35,9	359,04	3,59
90	15	60	1,4	14250,3	3,96	28,69	286,89	2,87
20	3,4	13,2	1,6	788,2	0,22	241,77	2417,74	24,18
25	4,2	16,6	1,6	1246,6	0,35	180,82	1808,2	18,08
32	5,4	21,2	1,6	2033,2	0,56	132,88	1328,83	13,29
40	6,7	26,6	1,6	3200,9	0,89	100,03	1000,29	10
50	8,4	33,2	1,6	4986,4	1,39	75,91	759,13	7,59
63	10,5	42	1,6	7980,1	2,22	56,74	567,41	5,67
75	12,5	50	1,6	11309,7	3,14	45,77	457,69	4,58
90	15	60	1,6	16286	4,52	36,59	365,9	3,66
20	3,4	13,2	1,8	886,8	0,25	298,64	2986,44	29,86
25	4,2	16,6	1,8	1402,4	0,39	223,52	2235,15	22,35
32	5,4	21,2	1,8	2287,4	0,64	164,38	1643,8	16,44
40	6,7	26,6	1,8	3601	1	123,82	1238,18	12,38
50	8,4	33,2	1,8	5609,7	1,56	94,02	940,22	9,4
63	10,5	42	1,8	8977,7	2,49	70,32	703,18	7,03
75	12,5	50	1,8	12723,5	3,53	56,75	567,45	5,67
90	15	60	1,8	18321,8	5,09	45,38	453,84	4,54

De	Thickness	Di	Vel (m/s)	Flow Rate		Load Loss		
				L/h	l/s	mmca/m	Pa/m	mbar/m
20	3,4	13,2	2	985,3	0,27	361,06	3610,62	36,11
25	4,2	16,6	2	1557,3	0,43	270,4	2703,99	27,04
32	5,4	21,2	2	2541,5	0,71	198,98	1989,84	19,9
40	6,7	26,6	2	4001,2	1,11	149,96	1499,65	15
50	8,4	33,2	2	6233	1,73	113,93	1139,34	11,39
63	10,5	42	2	9975,2	2,77	85,25	852,53	8,53
75	12,5	50	2	14137,2	3,93	68,82	688,22	6,88
90	15	60	2	20357,5	5,65	55,06	550,63	5,51
20	3,4	13,2	2,5	1234,6	0,34	541,11	5411,1	54,11
25	4,2	16,6	2,5	1947,8	0,54	405,73	4057,31	40,57
32	5,4	21,2	2,5	31769	0,88	298,94	2989,4	29,89
40	6,7	26,6	2,5	5001,4	1,39	225,54	2255,39	22,55
50	8,4	33,2	2,5	7791,3	2,16	171,52	1715,2	17,15
63	10,5	42	2,5	12469	3,46	128,47	1284,71	12,85
75	12,5	50	2,5	17671,5	4,91	103,78	1037,84	10,38
90	15	60	2,5	25446,9	7,07	83,09	830,94	8,31
20	3,4	13,2	3	1478	0,41	755,09	7550,9	75,51
25	4,2	16,6	3	2337,4	0,65	566,69	5666,88	56,67
32	5,4	21,2	3	3812,3	1,06	417,91	4179,11	41,79
40	6,7	26,6	3	6001,7	1,67	315,55	3155,49	31,55
50	8,4	33,2	3	9349,5	2,6	240,15	2401,49	24,01
63	10,5	42	3	14962,8	4,16	180,01	1800,08	18
75	12,5	50	3	21205,8	5,89	145,49	1454,95	14,55
90	15	60	3	30536,3	8,48	116,55	1165,5	11,66
20	3,4	13,2	3,5	1724,3	0,48	1002,69	10026,85	100,27
25	4,2	16,6	3,5	2726,9	0,76	753,03	7530,32	75,3
32	5,4	21,2	3,5	4447,7	1,24	555,72	5557,24	55,57
40	6,7	26,6	3,5	7002	1,95	419,87	4198,66	41,99
50	8,4	33,2	3,5	10907,8	3,03	319,72	3197,22	31,97
63	10,5	42	3,5	17456,6	4,86	239,79	2397,92	23,98
75	12,5	50	3,5	24740	6,87	193,9	1938,95	19,39
90	15	60	3,5	35625,7	9,9	155,86	1553,86	15,54

3.6. Localized Load Loss

Localized load losses are caused by connections, valves, meters, etc., which, due to the shape and arrangement, increase turbulence, thus causing friction and particle shocks.

Table 13 - Localized Resistance Coefficient (R)

Symbol	Illustrations	Description	Coefficient
—		Single Sleeve F/F – PPR	0,25

Symbol	Illustrations	Description	Coefficient
		M/F Reduction Bushing – PPR (up to 2")	0,55
		90º Elbow F/F – PPR	2
		45º Elbow F/F – PPR	0,6
		Tee F/F/F - PPR Tee F/F/F 1.3	1,8
		Central Reduction F/F/F Tee – PPR	2,6
		Tee F/F/F	4,2
		Central Reduction F/F/F Tee – PPR	2,6
		Tee F/F/F - PPR	4,2
		Central Reduction F/F/F Tee – PPR	9
		Tee F/F/F – PPR	2,2
		Central Reduction F/F/F Tee – PPR	5

Symbol	Illustrations	Description	Coefficient
		F/F/F Tee with Metallic Center Thread – PPR	0,8
		Male Connector	0,4
		90º Elbow with Metallic Insert - PPR	2,2
		90º Elbow Metallic Insert and Reduction – PPR	3,5

Total Load Loss Calculation (Jt):

Jt = Lt . Ju

Where:

Jt = total load loss in (m)
Lt = total length in (m)
Ju = unit load loss in m.c.a./m*

Lt = Lr + Leq

Where:

Lr = actual pipe length (m)
Leq = equivalent length of connections (m)

Leq = SR. V^2 / 2.g

Where:

SR = sum of the resistance coefficient for PPR connection (Localized Resistance Coefficient Table - R)
V = average fluid velocity in m/s

***** We removed from the table (Loss of Load per Pipe Meter) the loss of unit load as a function of diameter, flow velocity and service temperature.

Example:
- Pipeline PN 25 with diameter of 50 mm.
- Speed chosen for calculation: 2.0 m/s.
- Water temperature: 80 °C.
- Actual pipe length: 60 m.
- Existing connections in the section:

  10 sleeves

  2 90° elbows

  3 tes 90°

$$Jt = Lt \,.\, Ju$$

$$Lt = Lr + Leq$$
$$Lr = 60\ m$$

$$Leq = SR.\left(\frac{V2}{2g}\right)$$

$$SR = 10\ sleeves = 10 \times 0{,}25 = 2{,}50$$
$$2\ elbows\ 90^0 = 2 \times 2{,}200 = 4{,}00$$
$$3\ tes\ 90^0 = 3 \times 1{,}80 = 5{,}40$$

Then:

$$SR = 11{,}90$$

$$Leq = 11{,}90.\left(\frac{2{,}0^2}{2.9{,}81}\right)$$

Where:

Leq = 2,43 m of piping

Lt = 60 + 2,43

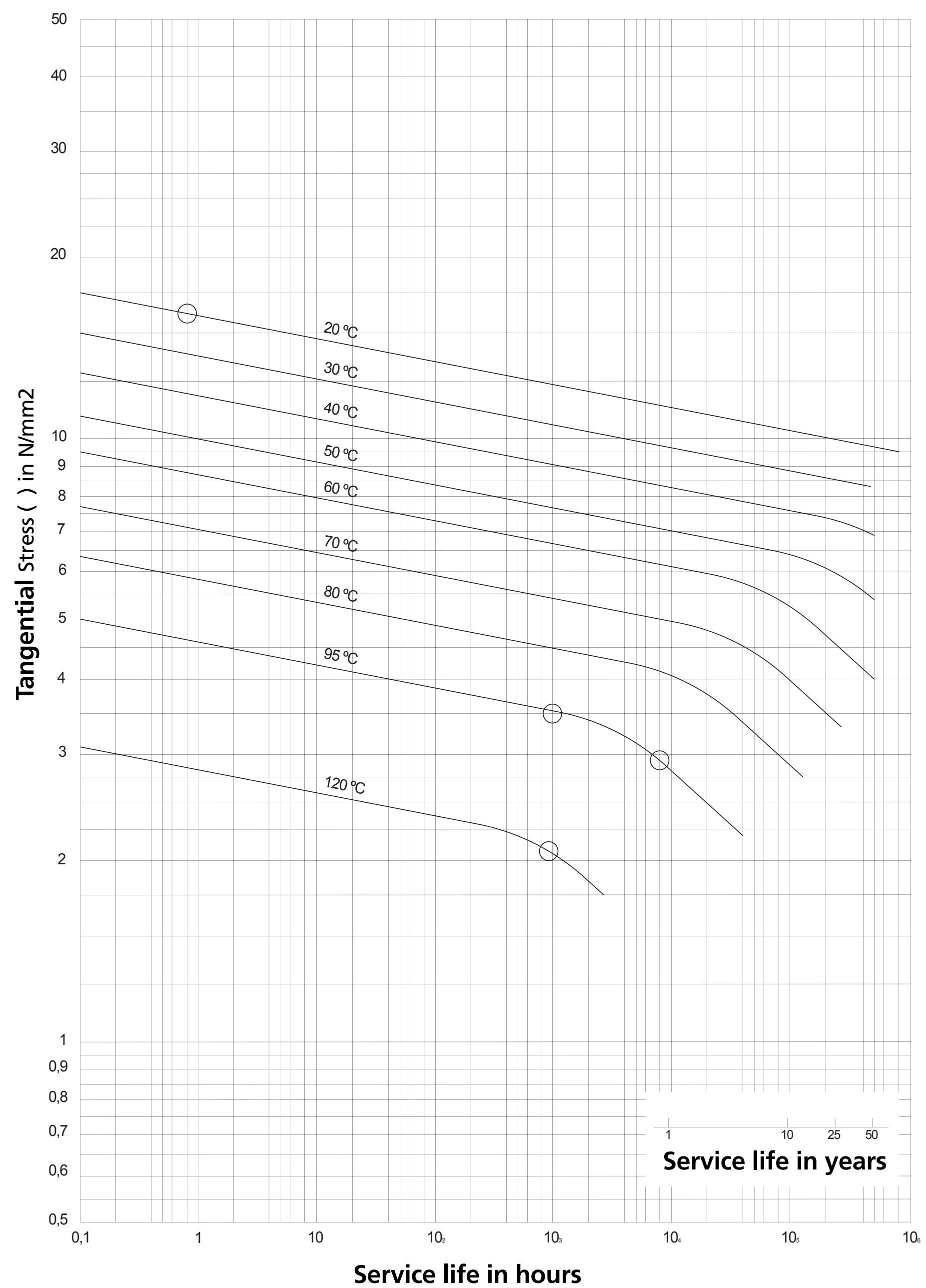
Lt = 62,43 m

Ju = 0,112 m.c.a./m

Jt = 62,43 m . 0,112 m.c.a./m

Regression Curve according to DIN 8078

The regression curve relates tangential stress, temperature, and pipe durability. This regression curve is obtained based on tests carried out in specialized laboratories and which are part of international standards. They allow to relate the conditions of use of the piping (pressure and temperature) to durability.



Attention: the regression curves refer to the polypropylene raw material, regardless of the pressure class.

Indications for Reading the Regression Curves:

Example:
Let us consider the expected durability of the pipe in 50 years and the exercise temperature of 70ºC. We can calculate the equivalent request a = δ, which will be obtained through the intersection of the vertical line that represents the durability and the regression curve that indicates the temperature (in this example, the obtained value is 3.23). This specification is obtained by bringing a horizontal line that starts from the intersection point already mentioned, proceeding to the value of the request. According to the Abacus above, Regression Curve.

To obtain the maximum allowable pressure (Pmax), we take the following formula:

$$\textbf{Pmáx} = \frac{20 \times e \times \delta}{de - e}$$

Where:
δ = Tangential stress (regression curve)
e = PPR pipe wall thickness
de = PPR pipe external diameter
t = Exercise temperature

Where:
δ = 3,2 kgf/cm²
e = 3,4 mm
de = 20 mm
t = 70ºC

Then:

$$\textbf{Pmáx} = \frac{20 \times 3{,}4 \times 3{,}2}{20 - 3{,}4} = 13{,}1 \text{ kgf/cm2}$$

The result obtained corresponds to the maximum allowable pressure. To obtain the value of the maximum working pressure, divide the value of the maximum allowable pressure by the safety coefficient, which, in this case, is 1.5. Therefore, following the example mentioned, the value of the maximum working pressure is equal to:

$$\textbf{Pe máx} = \frac{Pmáx}{f}$$

Where:
Pmáx = Maximum allowable pressure
f = Safety coefficient

Where:
Pmáx = 13,1 kgf/cm²
f = 1,5

Then:

$$\textbf{Pe máx} = \frac{13{,}1}{1{,}5} = 8{,}7 \text{ kgf/cm2}$$

Conclusion: the PPR class PN 25 pipe admits operating at a maximum working pressure of 8.7 kgf/cm2 at a constant temperature of 70ºC for 50 years, already considering the safety coefficient of 1.5, as provided for in the European standard DIN 8078.

Table 14 - Maximum Allowable and Service Pressure at Different Temperatures

TEMPERATURE (°C)	LENGTH OF SERVICE (YEARS)	MAXIMUM ALLOWABLE PRESSURE (kgf/cm²)	SAFETY COEFFICIENT	MAXIMUM WORKING PRESSURE (PN 25 kgf/cm²)
10	10	48,8	1,5	32,5
	25	47,1	1,5	31,4
	50	46	1,5	30,6
	100	47,2	1,5	31,5
20	10	41,3	1,5	27,6
	25	39,9	1,5	26,6
	50	38,9	1,5	25
	100	37,9	1,5	29,3
40	10	29,7	1,5	19,8
	25	28,5	1,5	19
	50	27,8	1,5	18,5
60	10	25	1,5	16,6
	25	24,1	1,5	16
	50	23,3	1,5	15,5
70	10	17,7	1,5	11,8
	25	15,4	1,5	10,2
	50	13,1	1,5	8,7
80	10	12,3	1,5	8,2
	25	9,9	1,5	6,6
	50	9	1,5	6
95	5	11,6	1,5	5,3
	10	7,8	1,5	4,4
	20	6,7	1,5	3,8

The maximum allowable pressure should not be considered for design, as it does not include the safety coefficient of 1.5, as provided for in European standard DIN 8078.

3.7. PPR Working Pressure

In order to simplify the calculations of the regression curve, the internal pressure resistance values of the PPR pipelines can be taken from the following table:

Table 15 - Working Pressure at Different Temperatures

Temperature (C°)	Duration (years)	PPR (bar)
10	1	27.8
10	5	26.4
10	10	25.5
10	25	24.7
10	50	24.0
20	1	23.8
20	5	22.3
20	10	21.7
20	25	21.1
20	50	20.4
30	1	20.2
30	5	19.0
30	10	18.3
30	25	17.7
30	50	17.3
40	1	17.1
40	5	16.0
40	10	15.6
40	25	15.0
40	50	14.5
50	1	14.5
50	5	13.5
50	10	13.1
50	25	12.6
50	50	12.2
60	1	12.2
60	5	11.4
60	10	11.0
60	25	10.5
60	50	10.1
70	1	10.3
70	5	9.5
70	10	9.3
70	25	8.0
70	50	6.7
80	1	8.6
80	5	7.6
80	10	6.3
80	25	5.1
95	1	6.1
95	5	4.0

According to DIN 8078, with a safety coefficient of 1.25.

3.8. Thermal Loss in PPR Pipes

When the temperature of the water circulating through a pipe is higher than the ambient temperature, the hot water loses heat to the environment.

The amount of heat lost by water depends, among other factors, on the temperature difference (fluid circulation temperature – room temperature) and the thermal conductivity coefficient of the material, polypropylene. When the pipeline has a fluid with a lower temperature than the environment, it is the environment that will give heat to the fluid. Below we present a table that gives us values of thermal loss at different temperatures, given in Watt/meter of pipe (W/m):

Table 16 - Thermal Loss at Different Temperatures

External Diameter	Temperature Difference in °C (Fluid Temperature – Ambient Temperature)								
	10	20	30	40	50	60	70	80	90
20	6.0	11.9	17.9	23.8	29.8	35.7	41.7	47.7	53.6
25	7.2	14.5	21.7	28.9	36.1	43.4	50.6	57.8	65.1
32	8.9	17.8	26.7	35.6	44.5	53.5	62.4	71.3	80.2
40	10.7	21.4	32.0	42.7	53.4	64.1	74.7	85.4	96.1
50	12.7	25.4	38.1	50.8	63.5	76.2	88.9	101.6	114.3
63	15.1	30.1	45.2	60.2	75.3	90.3	105.4	120.4	135.5
75	17.0	34.0	51.0	68.0	84.9	101.6	118.9	135.9	152.9
90	19.1	38.3	57.4	76.6	95.7	114.9	134.0	153.2	172.3
100	21.7	43.3	65.0	86.6	108.3	129.9	151.6	173.2	194.9

Although the aforementioned values do not present large heat losses, the components of an installation must have thermal insulation with a minimum thickness when presenting fluids at temperature:

Lower than the environment: the insulation will serve to prevent the formation of condensation.

More than 40 °C: located in places without heating, among which corridors, galleries, engine rooms and the like must be considered.

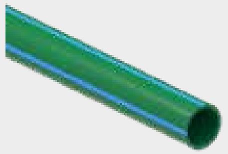
3.9. Physical, Chemical and Thermal Properties of PPR

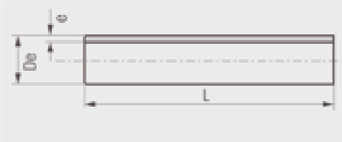
Table 17 - PPR Properties

PROPERTIES	PROOF METHOD	UN. MEASURE	AMOUNT
MFI creep index 190°C / 5 Kg	ISO 1133	g/10 min	0,55
MFI creep index 230°C / 5 Kg	ISO 1133	g/10 min	0,3
Índice de fluência MFI 230°C / 5 Kg	ISO 1133	g/10 min	1,3
Density at 23°C	ISO 1183	g/cm^3	0,909
Melting zone	DIN 53736 B2	°C	150 - 154
Breaking load elongation at break	ISO R 527 / DIN 53455	N/mm^2	>20
Modulus of elasticity	ISO R 527 / DIN 53457	N/mm^2	>800
Coefficient of linear thermal expansion	VDE 0304 Part 1ß4	MM/M°C	0,15
Condutividade térmica a 20°C (~)	DIN 52612	W/m K	0,24
Specific temperature at 20°C	Adiabatic calorimeter	Kj/Kg K	2
Impact test at 23°C with notche	ISO 180/1A	Kj/m^2	30
Impact test at 0°C with notch	ISO 180/1A	Kj/m^2	3
Impact test at -30°C with notch	ISO 180/1A	Kj/m^2	1,8
Viscosity coefficient	ISO 1191	cm^3/g	430
Tensile strength	ISO R 527	N/mm^2	40
Penetration hardness	ISO 2039	N/mm^2	45

3.10. PPR Thermofusion Line Items

• Pipe - PPR PN 12.5

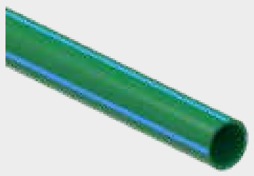




DIMENSIONS (MM)

CODE	GAUGE	e	DE	L
17010565	DN 32	3	32	3000
17010581	DN 40	3.7	40	3000
17010603	DN 50	4.6	50	3000
17010620	DN 63	5.8	63	3000
17010646	DN 75	6.9	75	3000
17010670	DN 90	8.2	90	3000
17010689	DN 110	10	110	3000

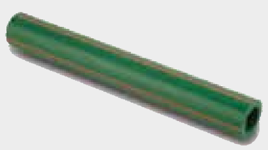
• Pipe - PPR PN 20

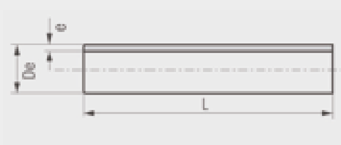


DIMENSIONS (MM)

CODE	GAUGE	e	DE	L
17010026	DN 20	2.8	20	3000
17010042	DN 25	3.5	25	3000
17010069	DN 32	4.5	32	3000
17010085	DN 40	5.6	40	3000
17010107	DN 50	6.9	50	3000
17010123	DN 63	8.7	63	3000
17010140	DN 75	10.4	75	3000
17010174	DN 90	12.5	90	3000
17010182	DN 110	15.1	110	3000

• Pipe - PPR PN 25

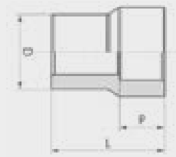




DIMENSIONS (MM)

CODE	GAUGE	e	DE	L
17010328	DN 20	3.4	20	3000
17010344	DN 25	4.2	25	3000
17010360	DN 32	5.4	32	3000
17010387	DN 40	6.7	40	3000
17010409	DN 50	8.4	50	3000
17010425	DN 63	10.5	63	3000
17010441	DN 75	12.5	75	3000
17010476	DN 90	15	90	3000

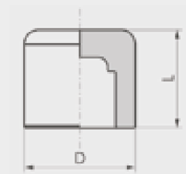
• PPR Reduction Bushing



DIMENSIONS (MM)

CODE	GAUGE	D	P	L
22326520	DN 25 x 20	30	15.25	38
22326554	DN 32 x 20	36	15.25	40
22326562	DN 32 x 25	36	16.75	43
22326724	DN 40 x 25	43	16.75	46.5
22326732	DN 40 x 32	43	18.75	46.5
22326830	DN 50 x 32	55.2	18.75	51.5
22326848	DN 50 x 40	55.2	21.25	54.5
22326945	DN 63 x 40	66.15	21.25	64.5
22326953	DN 63 x 50	66	24.25	64.5
22327054	DN 75 x 50	75.25	24.25	68.5
22327062	DN 75 x 63	84.3	28.25	72.5
22327267	DN 90 x 63	90.3	28.25	79.5
22327275	DN 90 x 75	106.5	30.75	82
22327291	DN 110 x 75	89,6	31,8	82
22327283	DN 110 x 90	110.5	37.75	85.25

• PPR Cap



DIMENSIONS (MM)

CODE	GAUGE	D	L
22325507	DN 20	30	26.5
22325523	DN 25	36	30
22325531	DN 32	43	34
22325540	DN 40	55.2	36.5
22325558	DN 50	66.1	41
22325566	DN 63	84.2	48
22325574	DN 75	106.5	58
22325590	DN 90	126.5	64
22325116	DN 110	140.5	37,75

• Female connector A PPR

DIMENSIONS (MM)

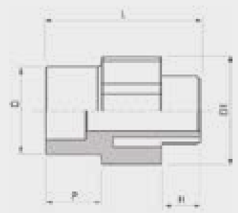
CODE	GAUGE	D	D1	P	L	H
22327500	DN 20 x 1/2″	30	44	15,25	51	16
22327518	DN 20 x 3/4″	30	44	15,25	51	18
22327526	DN 25 x 1/2″	35.7	44	16.75	51	18
22327534	DN 25 x 3/4″	35.7	44	16.75	51	18
22327569	DN 32 x 3/4″	43	57.8	18.75	47.5	16
22327577	DN 32 x 1″	43	57.8	20	47.5	22.5

• Connector Female PPR


DIMENSIONS (MM)

CODE	GAUGE	D	D1	P	L	H
22327631	DN 40 x 1.1/4"	55	70	21.25	68.5	29
22327690	DN 50 x 1.1/2"	66	81.5	24.25	71.5	29
22327755	DN 63 x 2"	84	91	28.25	76.5	34
22327860	DN 75 x 2.1/2"	100	115	30.75	64	25
22327976	DN 90 x 3"	120	134	33.75	67	25

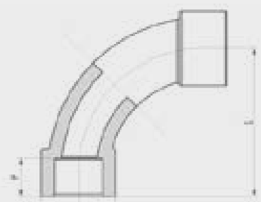
• PPR Male Connector

DIMENSIONS (MM)

CODE	GAUGE	D	D1	P	L	H
22328000	DN 20 x 1/2"	28,13	37,5	17	53,2	13,2
22328018	DN 20 x 3/4"	28,13	44	17	56,5	14,5
22328026	DN 25 x 1/2"	36	44	23	64,2	13,2
22328034	DN 25 x 3/4"	34,95	44	20	59,5	14,5
22328069	DN 32 x 3/4"	43	45	20	64,5	14,5
22328077	DN 32 x 1"	43	50	20	66,8	16,8
22328131	DN 40 x 1.1/4"	53,65	58,15	22	87,5	34
22328247	DN 50 x 1.1/2"	66.2	81,5	25	94,5	34
22328352	DN 63 x 2"	83,55	106,8	33	104	40
22328468	DN 75 x 2.1/2"	100,8	61	32	113	45
22328573	DN 90 x 3"	126,5	130,5	36,5	126	50
22328581	DN 110 x 4"	140,5	147,5	61	147,25	61

• 90º PPR curve

DIMENSIONS (MM)

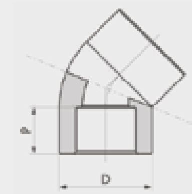
CODE	GAUGE	D	P	L
22321706	DN 20	30	15.25	60
22321722	DN 25	36	16.75	70
22321730	DN 32	43	18.75	80

• PPR Transposition Curve


DIMENSIONS (MM)

CODE	GAUGE	D	P	L
22322001	DN 20	20	21	360
22322028	DN 25	25	26	360
22322036	DN 32	32	33	360

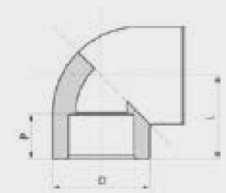
• 45º Elbow PPR

DIMENSIONS (MM)

CODE	GAUGE	D	P
22320505	DN 20	30	15
22320521	DN 25	36	16.75
22320530	DN 32	43	18.75
22320548	DN 40	56	21.25
22320556	DN 50	67.1	24.25
22320564	DN 63	85.3	28.25
22320572	DN 75	106.5	30.75
22320599	DN 90	126.5	33.75
22320726	DN 110	140.5	33.75

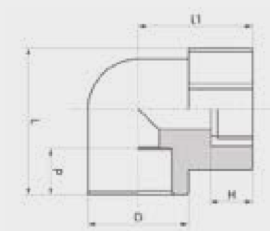
• 90º Elbow PPR

DIMENSIONS (MM)

CODE	GAUGE	D	P	L
22320807	DN 20	30	15.25	26.5
22320823	DN 25	36	16.75	30
22320831	DN 32	43	18.75	34
22320840	DN 40	55.2	21.25	36.5
22320858	DN 50	66.1	24.25	41
22320866	DN 63	84.2	28.25	48
22320874	DN 75	106.5	30.75	58
22320890	DN 90	126.5	33.75	64
22320700	DN 110	140.5	37.75	97.8

• PPR Female Threaded 90 ° Elbow

DIMENSIONS (MM)

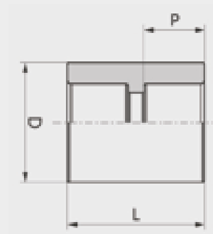
CODE	GAUGE	D	D1	P	L	L1	H
22321005	DN 20 x 1/2"	30	37	15.25	45	35	16
22321021	DN 25 x 1/2"	36	44	16.75	53	41	15
22321030	DN 25 x 3/4"	36	44	16.75	53	41	16
22321056	DN 32 x 1/2"	43	56.5	18.75	65.8	44.6	16
22321048	DN 32 x 3/4"	43	56.5	18.75	65.8	44.6	16
22321064	DN 32 x 1"	43	56.5	18.75	65.8	44.6	20

• 90º Elbow with Male Thread PPR

DIMENSIONS (MM)

CODE	GAUGE	D	D1	P	L	L1	d
22321218	DN 20 x 1/2"	30	37	15.25	45.5	48	20
22321226	DN 25 x 1/2"	36	44	16.75	53	56	25
22321234	DN 25 x 3/4"	36	44	16.75	53	57	25
22321269	DN 32 x 1"	42.95	56.5	18.75	74	60.6	32

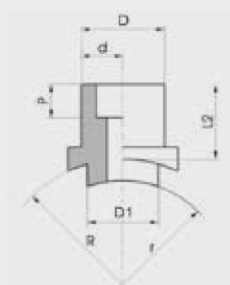
• PPR sleeve



DIMENSIONS (MM)

CODE	GAUGE	D	P	L
22325000	DN 20	30	15.25	26.6
22325027	DN 25	35.95	16.75	30.85
22325035	DN 32	43	18.75	37
22325043	DN 40	55.2	21.25	43
22325051	DN 50	66.15	24.25	51
22325060	DN 63	84.3	28.5	61.5
22325078	DN 75	106.5	30.75	67
22325094	DN 90	126.5	33.75	74
22325205	DN 110	140.5	37.75	82

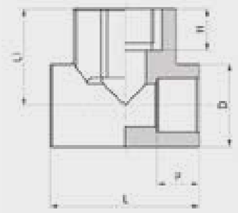
• PPR Bypass Fitting



DIMENSIONS (MM)

CODE	GAUGE	D	D1	P	L	L1	H
37645516	DN 63 x 25	35	25	16.75	32	34	28
37645524	DN 63 x 32	35	25	16.75	32	34	28
37645540	DN 75 x 25	35	25	16.75	38	34	28
37645559	DN 75 x 32	42	32	18.75	31	37	30

• PPR Female Center Threaded Tee



DIMENSIONS (MM)

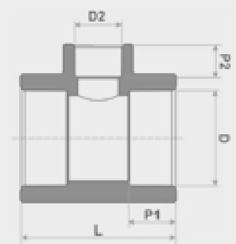
CODE	GAUGE	D	D1	P	L	L1	H
22324500	DN 20 x 1/2"	30	37	15.25	54	35	15
22324527	DN 25 x 1/2"	36	44	16.75	62	43	16
22324535	DN 25 x 3/4"	36	44	16.75	62	43	16.5
22324543	DN 32 x 1/2"	43	56.5	18.75	74	48.6	16
22324551	DN 32 x 3/4"	43	56.5	18.75	74	48.6	16.5
22324578	DN 32 x 1"	43	56.5	18.75	74	48.6	22

• PPR Male Center Threaded Tee

DIMENSIONS (MM)

CODE	GAUGE	D	D1	P	L	L1	H
22324802	DN 20 x 1/2"	36	37	15.25	54	50	15
22324829	DN 25 x 1/2"	36	44	16.75	62	56	12.5
22324837	DN 25 x 3/4"	36	44	16.75	62	57.5	14.5

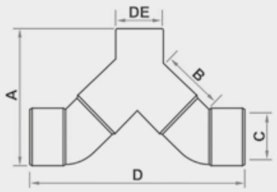
• PPR Central Reduction Tee



DIMENSIONS (MM)

CODE	GAUGE	D	D2	P1	P2	L
22323032	DN 25 x 20 x 25	24.35	19.35	16.75	15,25	58.1
22323067	DN 32 x 25 x 32	31.3	24.35	18.75	16,75	74.6
22323253	DN 40 x 25 x 40	39.25	24.35	21.25	16,75	77.8
22323261	DN 40 x 32 x 40	39.25	31.3	21.25	18,75	77.8
22323431	DN 50 x 25 x 50	49,2	24,35	24,25	16,75	80
22323440	DN 50 x 32 x 50	49.2	31.3	24.25	18,75	83.8
22323458	DN 50 x 40 x50	49.2	39.25	24,25	21,25	92
22323652	DN 63 x 40 x 63	62.15	39.25	26.25	21,25	123
22323660	DN 63 x 50 x 63	62.15	49.2	28.25	24,25	123
22323857	DN 75 x 50 x 75	74.6	49.2	30.75	24,25	140
22323865	DN 75 x 63 x 75	74.6	62.15	30.75	28,25	140
22324063	DN 90 x 63 x 90	89.6	62.15	33.75	29,00	161
22324071	DN 90 x 75 x 90	89.6	74.6	33.75	29,00	161
22324179	DN 110 x 75 x 110	109,7	74,6	42,5	32	166,5
22324187	DN 110 x 90 x 110	109,7	89,6	42,5	36,5	205

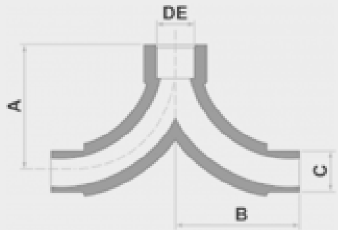
• PPR Mixer Tee



DIMENSIONS (MM)

CODE	GAUGE	A	B	C	D	De
22322702	DN 25 x 3/4"	597	46	3/4"	150	34

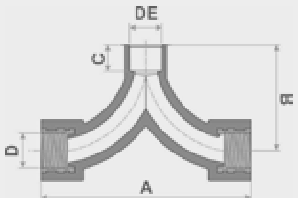
• FMM PPR Mixer Tee



DIMENSIONS (MM)

CODE	GAUGE	A	B	C	DE
22322737	DN 25 x 25	25	25	20	20

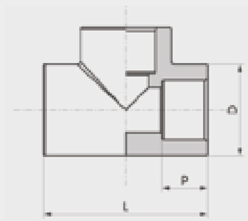
• FFF PPR Mixer Tee



DIMENSIONS (MM)

CODE	GAUGE	A	B	C	D	DE
22322710	DN 20 x 1/2"	124	62	15,25	1/2"	19,35

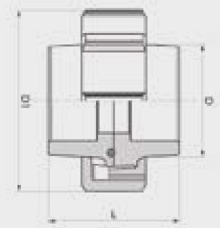
• PPR Tee



DIMENSIONS (MM)

CODE	GAUGE	D	P	L
22322508	DN 20	30	15.25	54
22322524	DN 25	36	16.75	62
22322532	DN 32	42.95	18.75	74
22322540	DN 40	55.2	21.25	86
22322559	DN 50	66.1	24.25	102
22322567	DN 63	84.3	28.25	128
22322575	DN 75	106.5	30.75	140
22322591	DN 90	126.5	33.75	161
22322800	DN 110	138.8	37.75	195.5

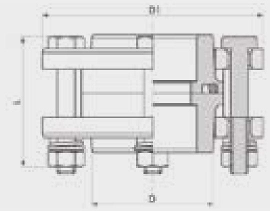
• PPR Double Union



DIMENSIONS (MM)

CODE	GAUGE	D	L	D1
22325701	DN 20	30	46	44
22325728	DN 25	36	47	54
22325736	DN 32	44	50	50

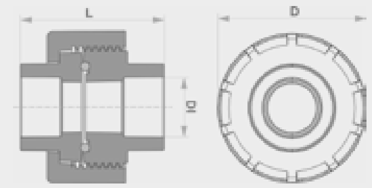
• Double Union with PPR Screws



DIMENSIONS (MM)

CODE	GAUGE	D	L	D1
22326040	DN 40	60	60	98
22326058	DN 50	70	65	113.5
22326066	DN 63	88	67	122
22326074	DN 75	110	76	154
22326090	DN 90	130	80	180

• PPR Plastic Union



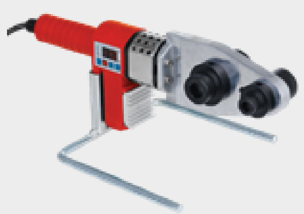
DIMENSIONS (MM)

CODE	GAUGE	D	L	D1
100002647	DN 25	62	58	24,35
100002648	DN 32	72	62	31,3

• PPR Pipe Scissors

CODE
37427110

• T-63 Socket Fusion Tool



CODE	
37427004	For pipes up to DN 63 mm

• T-110 Socket Fusion Tool

CODE	
37428981	For pipes up to DN 110 mm

• Thermofusion Nozzle *

CODE	DIMENSIONS (MM) DESCRIPTION
37427020	20
37427039	25
37427047	32
37427055	40
37427063	50
37427071	63
37427080	75
37427098	90
37429007	110

* Available upon request of deadline

Notes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