Technical manual for Aqua-Plus Pipes and Fittings


interplast

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01

COMPANY PROFILE

Interplast produces high quality plastic pipes and fittings used in plumbing, heating and sewage systems, covering a wide range of applications in the construction field, major technical projects and industrial facilities.

Plastic pipes and fittings are manufactured in an industrial unit of 40.000m^2, located in the city of Komotini, Thrace. The sales department for Northern Greece and the departments of engineering applications and exports are all located in Thessaloniki.

Brass fittings are produced in an industrial unit of 6.000m^2, located in Menidi, Attica.

Interplast is the market leader in plastic pipes for plumbing and heating systems in Greece and exports to 55 countries around the world.

Due to the company's highly experienced staff and their constant motivation for creativity and innovation, the company has seen a dynamic and rapid expansion over the last years. An expansion that was neither fortuitous nor transitory.

Constantly orientated towards high-quality and technology, Interplast steadily managed to secure a place among the leading European plastic pipes manufacturers for plumbing, heating and sewage systems.

The company's main goal is full knowledge of the market, following the latest developments, and carrying out systematic research on new and improved products that meet the customer needs.

Interplast staff work at their best to cover their clients' needs, offering great after-sale support, establishing excellent relations based on trust.

Manufacturing process verticalization and highly strict controls guarantee top quality. Komotini industrial unit produces PP-R pipes and fittings to be used in plumbing, heating, and cooling systems, as well as in industry. While, Interplast subsidiary company, ELVIOM S.A., produces the brass inserts of the mixed components (male and female couplings, tees, etc.).
Aqua-Plus pipes and fittings are produced following international standards and are certified by the strictest American and European Institutes.

Exporting to more than 55 countries
Interplast is also highly active outside the area of Greece, exporting to 55 countries around the world. Quality, innovation, vision, and creativity render the company a leader in the field of plumbing, heating and air conditioning worldwide.

QUALITY ASSURANCE CERTIFICATES

Interplast follows all International regulations regarding production, quality control, packaging, storage and handling processes. Furthermore, in recent years, special attention has been given to the terms of International Organizations concerning the protection of the environment.

Since its establishment, our company has been synonymous with green energy and sustainability and meets all the prerequisites set by International Organizations with absolute respect towards the environment and mankind.

EPD®

THE INTERNATIONAL EPD® SYSTEM


TÜV NORD

ΠΙΣΤΟΠΟΙΗΤΙΚΟ

DIN EN ISO 9001 : 2015

INTERPLAST GROUP
1. INTERPLAST A.E.
2. ΕΛΒΙΟΜ Α.Β.Ε.Ε.

ELVIOM


IQNet

THE INTERNATIONAL CERTIFICATION NETWORK

CERTIFICATE

INTERPLAST S.A.

ELOT EN ISO 14001:2015

Registration Number :
GR-MIRTEC1-01-7209CER11.2022000400


IQNet

THE INTERNATIONAL CERTIFICATION NETWORK

CERTIFICATE

INTERPLAST S.A.

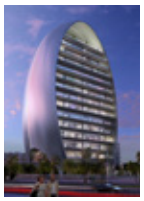
ELOT EN ISO 50001:2018

Registration Number : MIRTEC1-01-7209CER11.6072000475

REFERENCE LIST AQUA-PLUS

Building Facilities – Industries

- Hellenic Embassy, Austria
- Rex Bank, Vienna, Austria
- Intersport Store, Plovdiv, Bulgaria
- Arwa Tower, Doha, Qatar
- Butj Al Mana Tower, Qatar
- Lexus showroom and Offices, Qatar
- Naval Base, Qatar
- Imam Abdul Wahhab Mosque, Qatar
- Qatar Main Electricity Building, Qatar
- Saida Mall, Tyre, Lebanon
- DAMAC Tower by Versace, Lebanon
- Malta Currency Museum, Malta
- Ministry of Housing, Bahrein
- RPK Bio Pharma, Pharmaceutical Company, Portugal
- Airport City Belgrade, Office Complex, Belgrade, Serbia
- Coficab, Cable Industry, Tunisia

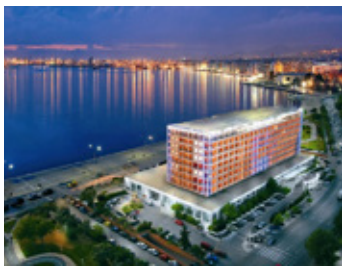

- Adelco S.A., Pharmaceutical Company, Moschato, Athens
- “City Plaza”, Mall, Glyfada, Athens
- Golden Union, Office Building, Athens
- Leroy Merlin Kifisou Ave., Athens
- Leroy Merlin Ampelokipoi, Athens
- Logistics Village, Elefsina, Athens
- Metro Cash & Carry, Super Market, Agios Ioannis Renti, Athens
- NOVO Norbix, Pharmaceutical Company, Agia Paraskevi, Athens
- Philip Morris - Papastratos, Tobacco Industry, Aspropyrgos, Athens
- SYMETAL Aluminium Foil Factory, Mandra, Athens
- STANDALONE Restaurant, Asteras Vouliagmeni, Athens
- “The Mall”, Entertainment – Shopping Center of Marousi, Nerantziotissa, Athens
- Uni-Pharma, Pharmaceutical Company, Athens
- IASIS, Pharmaceutical Company, Koropi, Athens
- ION, Chocolate Factory, Koropi, Athens
- Head Office of the Agricultural Bank of Greece, Syggrou Ave., Athens
- Penteliko Estate-Erithreas and Tatoi, Varimpompi, Athens
- Vailer Building-Administration Building of the Acropolis Museum, Athens
- EOF Building (National Organization for Medicines), Holargos, Athens
- Vass. Sofia 112 Building, Athens
- Eurobank Office Building, Neos Kosmos, Athens
- Terra Nord Office Building, Kifisia, Athens
- Ethniki Asfalistiki Office Building, Syggrou Ave., Athens
- VIOPOL Factory Office Building, Schimatari, Athens
- AUBERGE Office Building, Tatoi, Athens
- Ethniki PANGAIA Office Building, Chrisospiliotissis, Athens
- Papastratos Office Building 1, Piraeus, Athens
- Papastratos Office Building 2, Piraeus, Athens
- Papastratos Office Building 3, Piraeus, Athens
- Bioiatriki Stores, Athens
- Museum of Modern Art, Athens
- Office Complex Nerantziotissa 115, Marousi, Athens
- Ministry of Interior, Athens
- Attica Bank, Thessaloniki
- “Mediterranean Cosmos”, Entertainment – Shopping Center, Thessaloniki

- Hondos Center Store, Thessaloniki
- Waste Treatment Unit (WTU), Thiva
- Household Waste Treatment Unit of the Region of Epirus, Ioannina
- Barbouni Restaurant, Costa Navarino, Kalamata
- Selecta Hellas, Floriculture Unit, Kavala
- Court House of Pieria, Katerini
- Aquarium “Thalassokosmos”, Heraklion, Crete
- Heraklion Cultural Center, Heraklion, Crete
- Golf Course Crete, Heraklion, Crete
- Ethniki Trapeza (National Bank), Komotini
- Motor Oil Site, Agioi Theodoroi, Korinthos
- Agia Sofia Church, Mykonos
- Thrace Greenhouses, Thrace
- Thrace Plastics, Xanthi

Hotels

- Al Aar Hotel 5*, Qatar
- Al Asmakh Tower, Qatar
- Boutique Soup Waqif Hotel 5*, Qatar
- Brook Tower, Qatar
- Holiday Inn Hotel 4*, Qatar
- Mozoon Tower 5*, Doha, Qatar
- Rotana Arwa Tower, Qatar
- Seef Lusail Towers 5*, Qatar
- St. Regis Hotel & Residential Towers, Doha, Qatar, Luxury Hotels
- Sheraton Hotel 5*, Qatar
- Viva Bahriya Towers, Qatar
- Aphrodite Intercontinental 5*, Cyprus
- Chrysomare Hotel 5*, Cyprus
- Del Mar 5*, Nicosia, Cyprus
- Lydra Marriott 5* (Thalassoteraphy sector), Nicosia, Cyprus
- Murex Hotel 5*, Lebanon
- Belgrade Waterfront 5*, Belgrade, Serbia
- Skyline Towers, Belgrade, Serbia
- Grand Bretagne, Athens, Luxury Hotels
- Academias Autograph Collection 5*, Athens
- Athens Choice 2*, Athens

- Amanzoe Resort, Kranidi, Argolida
- Blend Hotel 4*, Athens
- Boss Boutique Athens 5*, Athens
- Capri Hotel 2*, Athens
- Electra Metropolis 5*, Athens
- Grand Hyatt 5*, Syggrou, Athens
- Grecotel Imperial 5*, Karaiskaki sq., Athens
- Holiday Inn 5*, Attika Avenue, Athens
- Hotel Coco-mat BC 5*, Athens
- Ibis Style Athens Routes 4*, Athens
- King's Palace 5*, Syntagma, Athens
- Mati Hotel 4*, Nea Makri, Athens
- NLH Athens, Neighborhood Lifestyle Hotel, Athens
- President Hotel 5*, Athens
- Selina Athens 3*, Theatrou sq., Athens
- Sofitel Athens Airport 5*, Spata, Athens
- Asteras Vouliagmenis Hotel 5*, Athens
- Thraki Palace 5*, Alexandroupoli
- Amalia Hotel 3*, Kourouta, Amaliada
- President Hotel 3*, Zante
- Tsamis Zante Suites 5*, Tragaki, Zante
- White Olive Elite Laganas, Laganas, Zante
- Aldemar Royal Olympian 5*, Pyrgos, Ilia
- Olympian Village 5*, Ilia
- Ilion Mare 5*, Thasos
- Thasos Grand Resort 5*, Thasos
- Makryammos Bungalows 4*, Thasos
- Vathi Cove Luxury Resort & Spa 5*, Vathi, Thasos
- Makedonia Palace 5*, Thessaloniki
- Electra Palace 5*, Thessaloniki
- Grand Serrai 5*, Ioannina
- Acharavi Beach Hotel 4*, Corfu
- Aldemar Knossos Royal 5*, Crete
- Aldemar Royal Mare 5*, Crete
- Apollonia 5*, Heraklion, Crete



- Arina Beach Hotel 4*, Heraklion, Crete
- Atermono Boutique Resort 5*, Rethymno, Crete
- Bella Mare 3*, Rethymno, Crete
- Domes of Elounda, Elounda, Crete, Luxury Hotels
- Elounda Breeze Hotel 5*, Crete
- Euphoria Beach Resort 5*, Chania, Crete
- Grand Hotel Holiday Resort 4*, Hersonissos, Crete
- Ibis Style Herakleion Central 4*, Crete
- Minos Mare Royal 5*, Rethymno, Crete
- Rethymno Palace 5*, Rethymno, Crete
- The Syntopia of Orion Hotel 4*, Adelianos Kampos, Crete
- Theartemis Hotel 4*, Rethymno, Crete
- Grecotel Olympia Riviera 5*, Killini
- Zorbas 5*, Tigaki, Kos
- Blue Lagoon Ocean 4*, Kos
- Blue Oceanic 4*, Kos
- Gaia Palace 5*, Mastihari, Kos
- Gaia Royal Hotel 4*, Mastihari, Kos
- Gaia Village Hotel 3*, Tigaki, Kos
- Smy Princess of Kos 4*, Mastihari, Kos
- Iberostar Astir Odysseus 5*, Tigaki, Kos
- Lakithira Resort & Village 5*, Kardamaina, Kos
- Mitsis Norida Beach Hotel 5*, Kardamaina, Kos
- Mitsis Summer Palace Beach Hotel 5*, Kardamaina, Kos
- Mitsis Blue Domes Resort & Spa 5*, Kardamaina, Kos
- Mitsis Family Village Beach Hotel 5*, Kardamaina, Kos

- Mitsis Ramina Beach Hotel, 5*, City of Kos, Kos
- Porto Galini Seaside Resort & SPA 4*, Nikiana, Lefkada
- Captain Stavros Hotel 4*, Nidri, Lefkada
- Camvillia Resort 5*, Koroni, Messinia
- K. Savvidis S.A. Hotel, Rocari Chora Mykonos, Mykonos
- Porto Plomari Hotel 5*, Mytilene
- Calypso Beach 4*, Faliraki, Rhodes
- Belair Beach Hotel 4*, Rhodes
- Lindosbay 5*, Lindos, Rhodes
- Lindos Mare, Lindos, Rhodes
- Paradise 5*, Kallithea, Rhodes
- Ixian Grand 5*, Ialisos, Rhodes
- Adriana Princess Hotel 5*, Rhodes
- Capsis 5*, Rhodes
- Hotel Amada Colossos 4*, Rhodes
- Rasisson Blu Zaffron Resort 4*, Kamari, Santorini
- Palirroia 5*, Chalkida
- Antigoni Beach Resort 4*, Ormos Panagias, Chalkidiki
- Ekies All Senses Resort 4*, Vourvourou, Chalkidiki
- Lagomandra Beach Hotel 4*, Sithonia, Chalkidiki
- Blue Lagoon Princess Hotel 5*, Chalkidiki
- Mellton-Porto Karras 5*, Chalkidiki

Residences

- German Sports Tower, Dubai Sports City, United Arab Emirates (UAE)
- 505 Villas – Uptown, Emirates City, United Arab Emirates (UAE)
- 14 Villas (Westar Prop), Jumeirah Village, Dubai, United Arab Emirates (UAE)
- Villa Rashidiya, Dubai, United Arab Emirates (UAE)
- Villa Ras Al Khor, Dubai, United Arab Emirates (UAE)
- Bab Al Rayyan 400 - Village Villas, Doha, Qatar
- Green Hills, Building Complex, Kenya
- Montave, Building Complex, Kenya
- Palm Valley, Building Complex, Kenya
- 5* Paradise, Building Complex, Kenya
- Amchit Bay Villas Resorts, Lebanon
- Retro 67 Residences, Lebanon
- B Chez Moon Residences, Lebanon
- Garden View, Sin El Fil, Lebanon
- Raoucheh residence, Verdun, Lebanon
- Chalet Ziad Mohsen Dalloul - Faqra, Lebanon

• Villa Karageuzian - Faqra, Lebanon
• Villa Badro - Faqra, Lebanon
• Jawad & Jaffer Villa, Bahrein
• Riyad Villa, Bahrein
• Alawi Villa, Bahrein
• Alia Apartments, Budapest, Romania
• Green Lake Residences, Bucharest, Romania
• West Park, Bucharest, Romania
• Monaco Towers, Bucharest, Romania
• Vile Curtea Domneasca, Bucharest, Romania
• Houses, Housing Complex, Uppsala, Sweden
• Goulandris Villa, Porto Heli, Athens
• Social Housing, Tayros, Athens
• Social Housing, Agios Ioannis Renti, Athens
• Housing of earthquake victims Ano Liosia, Athens
• Multi-Use Facility ELPEN, Spata, Athens
• Student Accomodations, Zografou, Athens
• Social Housing, Thessaloniki
• Housing Unit, Ministry for the Environment and Public Works, Thessaloniki
• Social Housing, Komotini

Hospitals – Rehabilitation Centers

• Dialysis Center, Doha, Qatar
• Hospital Al Salam, Tripoli, Lebanon
• Al Arcoub Hospital, Tyre, Lebanon
• Medrar Medical Center, Lebanon
• Mediterraneo Hospital, Glyfada, Athens
• Euroclinic of Athens, Ampelokipoi, Athens
• IASO ICU for Adults, Marousi, Athens
• IATRIKO OF ATHENS - PSICHICO, Psichico, Athens
• IATROPOLIS Diagnostic Center, Halandri, Athens
• IATROPOLIS Diagnostic Center, Patisia, Athens
• IATROPOLIS Diagnostic Center Tatoi and Anagenniseos, Metamorfosi, Athens
• Metropolitan General Private Clinic, Piraeus, Athens
• Central Clinic of Athens, Athens
• Center for People with Special Needs «Hara», Pallini, Athens
• Elderly Care Center of Zante, Zante
• General Hospital of Igoumenitsa, Igoumenitsa
• 424 Military Hospital, Thessaloniki
• Recovery & Rehabilitation Center ARMONIA, Thessaloniki
• Obstetric Clinic Genesis, Thessaloniki
• Private Clinic Galinos, Thessaloniki
• General Hospital of Kavala, Kavala
• Hospital of Karpathos, Karpathos
• Venizelio Hospital, Heraklion, Crete
• Creta InterClinic, Private Clinic, Heraklion, Crete
• Private Clinic Medical Sea, Ornos, Mykonos
• Vostanio Hospital, Mytilene
• Elderly Care Center of Terpni Serres, Serres

Olympic Projects
• Olympic village, Athens
• Athens Airport “El. Venizelos”, Spata
• Athens Metro, Athens
• Olympic Rowing Center, Sxinias
• Weightlifting Center, Nikaia
• Olympian Press Center, Marousi
• Olympian Beach Volley Stadium, S.E.F., N. Faliro
• Indoor Gym of Gymnastics and Table Tennis, Galatsi
• Peace and Friendship Stadium, N. Faliro
• Journalist’s Village of the Municipality of Pallini, Athens
• Journalist’s Village of the Municipality of Zografou, Athens
• Journalist’s Village of the Municipality of Marousi, Athens
• Basketball & Fencing stadium facilities, Elliniko
• Baseball, Softball & Hokey Stadium Facilities, Elliniko
• Building facilities of the start of the Marathon road, Marathonas

Educational Institutions
• University Facilities (Laboratories), Nicosia, Cyprus
• Aley Technical School, Lebanon
• Children Village, Tripoli, Lebanon
• School Al Salam Akkar / Akroum, Tripoli, Libanon
• University of Malta, Msida, Malta
• St’ Catherine’s British School College, Kifisia, Athens
• American Farm School, Thessaloniki
• Tsanakleios, Komotini
• Hellenic Open University of Patra, Patra
• Bioclimatic School Buildings of Ialysos, Afandou and Kremastis of Rhodes, Rhodes

Airports
• Athens International Airport “El. Venizelos” (ATH), Athens
• Aktion International Airport (PVK), Aktion
• Alexandria Heliport, Imathia
• Thessaloniki Airport Makedonia (SKG), Thessaloniki
• Kavala Airport “Alexander the Great” (KVA), Kavala
• Kefalonia International Airport “Anna Pollatou” (EFL), Kefalonia
• Chania International Airport “Ioannis Daskalogiannis” (CHQ), Crete
• Kos Island International Airport “Hippokrates” (KGS), Kos
• Paros Airport (PAS), Paros
• Samos International Airport “Aristarchos o Samios” (SMI), Samos

Wineries
• Kintonis Winery, Aigio, Achaia
• Kanakaris Winery, Aigio, Achaia
• Oinoforos Winery, Aigio, Achaia

REFERENCE LIST AQUA-PLUS PRINS



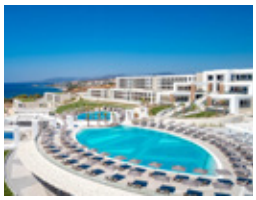
Hotels
- Kuda Villingili Resort 5*, Maldives
- Iveagh Gardens Hotel 4*, Dublin, Ireland
- Tribe Hotel 5*, Kenya
- Riverview Hotel 3*, Kenya
- Ayia Napa Marina, Ayia Napa, Cyprus
- Adams Beach 5*, Ayia Napa, Cyprus
- Aliathon Hotel 5*, Pafos, Cyprus
- Atlantica Mare Village Ayia Napa 5*, Ayia Napa, Cyprus
- Atlantica Mare Village Pafos 5*, Pafos, Cyprus
- Chrysomare Beach Hotel 5*, Ayia Napa, Cyprus
- Cypria Maris Beach Hotel 4*, Pafos, Cyprus
- Melpo Antia Hotel 4*, Ayia Napa, Cyprus
- Le Meridien 5*, Limassol, Cyprus
- Radisson Blu 5*, Limassol, Cyprus
- Radisson Larnaca Beach Hotel 5*, Larnaka, Cyprus
- Hotel Butrinti 5*, Sarande, Albania
- Arethusa Boutique Hotel 4*, Athens
- Ever Eden Beach Resort 4*, Anavissos, Athens
- HapiMag Resort 4*, Porto Heli, Athens
- MGallery Collection - Athens Capital Hotel 5*, Athens
- The Stanley 4*, Karaiskaki Sq., Athens
- Linden Apartments, Potos, Thasos
- Hyatt Regency Thessaloniki 5*, Thessaloniki
- Regina Mare Hotel Club 5*, Perdika, Thesprotia
- Epirus Palace Hotel Congress & Spa 5*, Ioannina
- Limneon Resort & Spa 5*, Kastoria
- Ikos Dassia 5*, Dassia, Corfu
- MarBella Corfu 5*, Agios Ioannis Peristeron, Corfu
- Cactus Beach 5*, Stalida, Crete
- Domes of Elounda, Luxury Hotel 5*, Elounda, Crete
- Lyttos Beach 4*, Hersonissos, Crete
- Nana Imperial Hotel 5*, Hersonissos, Crete
- The Royal Blue Resort 5*, Rethymno, Crete
- Robinson Club 5*, Ierapetra, Crete
- Atlantica Porto Bello Beach 4*, Kardamaina, Kos
- Blue Lagoon City Hotel 5*, City of Kos, Kos
- Caravia Beach Hotel 4*, Marmari, Kos
- Ikos Aria 5*, Kefalos, Kos
- Robinson Club Daidalos 4*, Fortress of Antimachia, Kos
- Horizon Beach Resort 4*, Mastihari, Kos
- Aleomandra, Luxury Villa, Ornos, Mykonos
- Sunset Hotel 5*, Mykonos
- Punda Beach Resort 5*, Punda, Paros
- Amathus Beach 5*, Ixia, Rhodes
- Atlantica Imperial Resort 5*, Kolymbia, Rhodes
- Atlantica Sensatori Resort 5*, Gennadi, Rhodes
- Atlantica Princess Hotel 4*, Ixia, Rhodes
- Atlantica Aegean Blue Resort 5*, Kolymbia, Rhodes
- Lindos Princess Beach Hotel 4*, Lardos, Rhodes
- Mayia Exclusive Resort & Spa 5*, Kiotari, Rhodes
- Lindian Village 5*, Lardos, Rhodes
- Olympic Palace Hotel 5*, Ixia, Rhodes
- Rodos Palace 5*, Ixia, Rhodes
- Rodos Palladium Leisure & Wellness 5*, Faliraki, Rhodes
- Sunwing Kallithea Beach 4*, Kallithea Ave., Rhodes
- Sun Beach Resort 4*, Ialisos, Rhodes
- The Ixia Grand Hotel 5*, Ixia, Rhodes
- Olympic Palace 5*, Ixia, Rhodes
- Virginia Family Resort 3*, Kallithea, Rhodes
- Kassadra Bay Resort 5*, Vasilias, Skiathos
- Xenia Hotel 5*, Koukounaries, Skiathos
- Antigoni Beach Resort 4*, Ormos Panagias, Halkidiki
- Anthemus Sea Beach 5*, Elia, Halkidiki
- Eagles Palace 5*, Ouranopoli, Halkidiki
- Ikos Oceania Resorts 5*, Nea Moudania, Halkidiki
- Lagomandra Beach Hotel 4*, Nikiti, Halkidiki
- Porto Carras Resort 5*, Porto Karras, Halkidiki
- Sani Club 5*, Halkidiki
- Sani Dunes 5*, Halkidiki
- Sani Beach Hotel 5*, Halkidiki

Prefabricated Buildings
- Refugee Hot Spot, Thiva

Airports
- Airport of Mykonos (JMK), Mykonos
- Rhodes International Airport “Diagoras” (RHO), Rhodes
- Skiathos International Airport “Alexandros Papadiamantis” (JSI), Skiathos

Wineries & Breweries
- Domain Analiontas, Nicosia, Cyprus
- Konstantinopoulos Winery (AMPELAKI), Marathia, Amaliada
- Kostas Lazaridis Estate, Adriani, Drama
- Macedonian Brewery, Drama
- Aslanis Estate, Nea Mixaniona, Thessaloniki
- Giannis Boutaris Winery, Naoussa Imathias
- Tsantiris Winery, Ano Proespera, Ikaria
- Ampeloes Winery, Nea Peramos, Kavala
- Vivlia Xora Estate, Kokkinoxori, Kavala
- Charalampaki Estate, Heraklion, Crete
- Zafeiraki Estate, Tyrnavos, Larissa

• D. Migas Estate, Tyrnavos, Larissa
• Vourvoukelis Estate, Avdira, Xanthi
• Santo Wines, Pyrgos, Santorini
• Vassaltis Winery, Vourvoulos, Santorini
• Giannis Boutaris Winery, Amyntaio, Florina
• Amyntaio Agricultural Cooperative Winery, Amyntaio, Florina
• Chios Distillery, Chios


Packaging – Dry Aging
• Argo Merchants, Packaging plant and Preservation chambers, Dublin, Ireland
• Fruit Packaging plant, Argos
• PAPADAKIS, Cooling chambers of Dry Aging of Bananas, Crete
• ALKYON, Fruit packaging plants, Industrial Area of Kavala
• ANATOLI, Fruit packaging plant, Imathia
• BOURAKIS, Preservation chambers, Anchialos, Thessaloniki
• TSAKIRIS FAMILY S.A., Food Industry, Neochorouda, Thessaloniki
• Wonderplant, Tomato Hydroponics Greenhouse, Petrousa, Drama
• Escarcom, Processing of Frozen Fruits and Vegetables, Skydra, Pella
• PROTOFANOUSIS A.E., Fruit Preservation, Nea Efesos, Pieria

Schools
• Simplex, Data Center, Limassol, Cyprus
• Deree College, Agia Paraskevi, Athens
• Theodoropoulou Private School, Korakies Chanion, Crete
• Democritus University of Thrace, Xanthi

Hospitals
• Marousi Medical Center, Marousi, Athens
• Peristeri Medical Center, Peristeri, Athens
• Papanikolaou Hospital, Thessaloniki
• Thessaloniki Psychiatric Hospital, Office building, Stavroupoli, Thessaloniki

Industries
• Esti Foods, Food Industry, New Jersey, USA
• Allergan Pharmaceuticals, Pharmaceutical Industry, Dublin, Ireland
• Coca Cola, Cyprus
• Genepharm, Pharmaceutical Industry, Pallini, Athens
• Style Glass, Glass Industry, Industrial Area of Thessaloniki, Thessaloniki
• Tsakiris Family S.A., Food Industry, Neochorouda, Thessaloniki
• Thrace Plastics
• Ellinika Lipasmata, Kavala
• Tomas, Animal Food Production Industry, Karitsa, Katerini
• 3P, Food Industry, Karditsa
• KOLIOS S.A., Milk Industry, Kilkis
• TORRE COOPERLAT, Ice Cream Industry, Kilkis
• SEKAP, Tobacco Industry, Xanthi
• Vitalic, Pharmaceutical Industry, Portugal
• Biodiesel Production Plant, Serres

Public & Private Buildings
• Al Wathba Stable Compound, Abu Dhabi, United Arab Emirates (UAE)
• Tent Majlis, Camel Farm, Abu Dhabi, United Arab Emirates (UAE)
• Paphos District Court, Paphos, Cyprus
• Areeba, Office Building, Beirut, Lebanon
• Residence Complex, Mauritius
• Residence Complex, Uppsala, Sweden
• Konaki Mount Athos, Romanian skete of Great Lavra, Mount Athos
• M-MARITIME, Shipping Company Offices, Athens
• Ilioupoli District Court, Athens
• Office Building Polyeco S.A., Aspropyrgos, Athens
• OTE TV Building, Kifisia, Athens
• Obstetrics Clinic MITERA, Marousi, Athens
• International Olympic Academy Building, Ancient Olympia, Ilia
• Esperides Villa, Residence complex, Koutouloufari, Heraklion, Ilia
• Private District Heating Network, Kozani
• Luxurious Villa of 2.500m^2, Lefkada
• Luxurious residence 2.000m^2, Mykonos
• Navarino Bay, Construction Site, Pylos, Messinia

02

GENERAL INFORMATION ON POLYPROPYLENE RANDOM

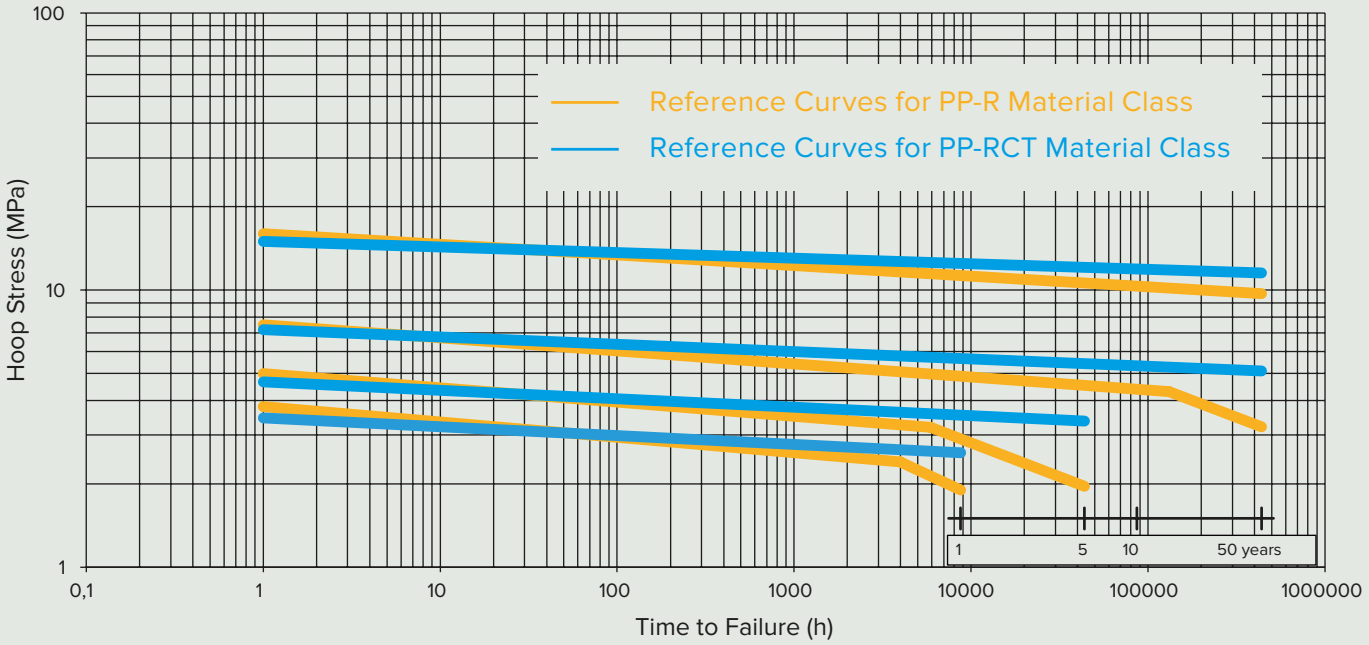
PP-R was first introduced as a piping systems material by Hüls company almost 40 years ago.
Its properties' advantages made it one of the most rapidly accepted materials in the world market with applications in central piping used to connect radiators, hot and cold water piping systems, as well in floor heating. The DIN standards applied to PP-R were the first to be established back in 1989, while the other national and international standards followed.
PP-R's special composition makes it suitable not only for the production of pipes (extrusion) but also for injected fittings. The material's properties allow the creation of a mono-material system with many advantages.
These pipings systems' reputation lies in the particular properties of Type-3 Polypropylene Random. The material's quality guarantees the system's long lifespan, which is estimated at least over 50 years, with excellent resistance to chemical corrosion. Another significant advantage is its low heat permeability in comparison with conventional systems, a characteristic that has a significant effect on operational savings of hot water. Furthermore, another important feature is that polypropylene pipes and connections do not degrade the quality of drinking water.

PP-RCT
THE FUTURE OF PLASTIC PIPES

Introduced by Borealis in 2004 through the RA7050 material series, it is considered a milestone in the evolution of PP pressure piping systems. The PP-RCT material classification was included in 2013 in EN ISO 15874, the global standard for polypropylene piping systems for hot and cold water pipe installations.

PP-RCT (Secondary Core Random Polymerization Propylene which increases the crystallization rate and temperature) is a material classification used to describe the second generation of PP-R materials.

Comparison of reference curves PP-R and PP-RCT in accordance with ISO 15874



AQUA-PLUS POLYPROPYLENE SYSTEM

Interplast produces Random polypropylene pipes and fittings (PP-R / PP-RCT) with dimensions ranging from 20mm to 450mm. Aqua-Plus pipes are produced in green color, in aligned segments of 4m each up to the 125mm dimension, 5.8m for dimensions of 160mm to 450mm and, upon request, in lengths of 11.6m. There is also the capability of 100m rollers in 20mm dimension.

Aqua-Plus pipes bear a printing per meter, indicating the trade name, outer diameter, wall thickness, operating pressure, pipe manufacturing specifications (EN, DIN, UNE, ASTM), certifying institutes and the code number stating the date and time of their production.

APPLICATIONS

- PLUMBING
- HEATING
- HVACR
- INDUSTRY
- SHIP BUILDING INDUSTRY
- FIRE PROTECTION
- GEOTHERMAL
- CHEMICALS FLUIDS
- COMPRESSED AIR

SDR PRODUCTION CAPABILITY by Interplast

PRODUCED DIMENSIONS	
SDR 6	20mm - 110mm
SDR 7,4	20mm - 250mm
SDR 9	32mm - 355mm
SDR 11	32mm - 450mm
SDR 17	125mm - 450mm

03

PHYSICAL, MECHANICAL AND ELECTRICAL PROPERTIES OF AQUA-PLUS SYSTEM

	PP-RCT single layer (SL)			PP-RCT multilayer with fiberglass (GF)		
Technical properties	**Value**	**Unit**	**Test method**	**Value**	**Unit**	**Test method**
Melt flow index (190°C / 5 Kg)	0,5	gr/10 min	ISO 1133	0,5	gr/10 min	ISO 1133
Melt flow index (230°C / 2,16 Kg)	0,3	gr/10 min	ISO 1133	0,3	gr/10 min	ISO 1133
Density	905	Kg/m^3	ISO 1183	925	Kg/m^3	ISO 1183
Modulus of elasticity	900	MPa	ISO 527	1200	MPa	ISO 527
Yield stress (50mm/min)	25	MPa	ISO 527-2	30	MPa	ISO 527-2
Impact strengh (Charpry) (23°C)	no break	KJ/m^2	ISO 179/1eU	no break	KJ/m^2	ISO 179/1eU
Impact strengh (Charpry) (0°C)	no break	KJ/m^2	ISO 179/1eU	no break	KJ/m^2	ISO 179/1eU
Impact strengh (Charpry) (-20°C)	50	KJ/m^2	ISO 179/1eU	50	KJ/m^2	ISO 179/1eU
Linear thermal expansion coefficient (0°C to 70°C)	0,07	K-1	DIN 53752	0,03	K-1	DIN 53752
Heat conductivity (λ)	0,24	W/m·K	DIN 52612	0,24	W/m·K	DIN 52612
Heat capacity	2,0	J/Kg·K	Calorimeter	2,0	J/Kg·K	Calorimeter
Coefficient of friction in pipes	0,007	mm	-	0,007	mm	-
Relative permittivity	2,3	in case of 1MHZ	VDE 0303-21	2,3	in case of 1MHZ	VDE 0303-21
Dielectric strength	52	kV/mm-1	VDE 0303-21	52	kV/mm-1	VDE 0303-21
Specific resistance	>1012	Ohm	DIN 53482	>1012	Ohm	DIN 53482
Fire resistance	B2	-	DIN 4102	B2	-	DIN 4102
Chemical resistance	Fulfilled	-	DIN 8075	Fulfilled	-	DIN 8075

	PP-R single layer (SL)			PP-R GF multilayer with fiberglass (GF)		
Technical properties	**Value**	**Unit**	**Test method**	**Value**	**Unit**	**Test method**
Melt flow index (190°C / 5 Kg)	0,5	gr/10 min	ISO 1133	0,5	gr/10 min	ISO 1133
Melt flow index (230°C / 2,16 Kg)	0,25	gr/10 min	ISO 1133	0,3	gr/10 min	ISO 1133
Density	905	Kg/m^3	ISO 1183	1004	Kg/m^3	ISO 1183
Modulus of elasticity	900	MPa	ISO 527	1200	MPa	ISO 527
Yield stress (50mm/min)	27	MPa	ISO 527-2	38	MPa	ISO 527-2
Impact strengh (Charpry) (23°C)	no break	KJ/m^2	ISO 179/1eU	no break	KJ/m^2	ISO 179/1eU
Impact strengh (Charpry) (0°C)	no break	KJ/m^2	ISO 179/1eU	no break	KJ/m^2	ISO 179/1eU
Impact strengh (Charpry) (-20°C)	50	KJ/m^2	ISO 179/1eU	50	KJ/m^2	ISO 179/1eU
Linear thermal expansion coefficient (0°C to 70°C)	0,07	K-1	DIN 53752	0,03	K-1	DIN 53752
Heat conductivity (λ)	0,24	W/m·K	DIN 52612	0,24	W/m·K	DIN 52612
Heat capacity	2,0	J/Kg·K	Calorimeter	2,0	J/Kg·K	Calorimeter
Coefficient of friction in pipes	0,007	mm	-	0,007	mm	-
Relative permittivity	2,3	in case of 1MHZ	VDE 0303-21	2,3	in case of 1MHZ	VDE 0303-21
Dielectric strength	52	kV/mm-1	VDE 0303-21	52	kV/mm-1	VDE 0303-21
Specific resistance	>1012	Ohm	DIN 53482	>1012	Ohm	DIN 53482
Fire resistance	B2	-	DIN 4102	B2	-	DIN 4102
Chemical resistance	Fulfilled	-	DIN 8075	Fulfilled	-	DIN 8075

04

PROPERTIES-BENEFITS OF AQUA-PLUS SYSTEM

Lifespan
The pipes have been designed for a lifespan of over 50 years, for temperatures up to 95°C and operating pressures ranging from 6 to 26 bar. Temperature peaks of 110°C at a 4 bar operating pressure do not affect the Aqua-Plus system.

Exceptional hydraulic shock behavior
High pressures generated by hydraulic shocks do not affect the Aqua-Plus system, which can withstand pressures greater than 100 bar at ambient temperature.

Shorter installation time
Compared to other conventional systems, Aqua-Plus can offer a 30% reduction in installation time.

Low thermal conductivity
PP-R's thermal conductivity is very low, making it possible to reduce heat loss in hot water networks. This means that only a minimum temperature drop will occur between the hot water supply and the delivery points, resulting in energy savings and lower insulation costs.

Thermal conductivity of Aqua-Plus and metals commonly used in heating and plumbing fields:

Aqua-Plus	λ = 0,17	W/mk
Steel	λ = 45-60	W/mk
Iron	λ = 45-60	W/mk
Copper	λ = 300-400	W/mk

The low value of thermal conductivity causes a drastic reduction of condensates on the outside of the pipe, a problem that often occurs in metal pipes under certain conditions of temperature and humidity.
Plus, water does not freeze so quickly when the outside temperature is extremely low.

Chemical resistance
The material is resistant to most chemicals, even at high temperatures, which is why it is used in industrial networks.

Mechanical strength
The Aqua-Plus system displays excellent behavior against mechanical stress. Its high mechanical strength, combined with its elasticity, even at low temperatures, make the system suitable for all climatic conditions.

Corrosion resistant
The Aqua-plus system displays exceptional resistance to corrosion, even in areas with very hard water, remaining unaltered over the course of time. Unlike metal pipes, it does not show any signs of electrochemical corrosion. Consequently, it can be used with materials employed in the construction field such as lime or cement, without requiring any special protection. Moreover, the high water velocity does not cause corrosion. Lastly, in the Aqua-Plus system, there is no metal inset, since even brass male inserts' interior is covered with PP-R.

Low frictional coefficient
The material structure and its smooth surface texture ensure low friction losses resulting in low resistance and low pressure drop in the piping. Therefore, they make the system more economical, as pipes of smaller dimension and lower PN 30 wattage pumps can be used for the same quantity of water. At the same time, Interplast distributes fittings with a considerably lower local resistance coefficient than that of the usual PN20 fittings, resulting in the improved flow of the system.

Fire protection
Aqua-Plus pipes and fittings meet all flammability specifications and are classified as B2 based on DIN 4102. Moreover, the burning of polypropylene does not give off any harmful substances such as dioxin or hydrochloric acid.

Noise-free
The material used significantly reduces the noise generated and limits its transition through the pipes. This makes it possible to transfer larger quantities of fluids with smaller dimension pipes, increasing the flow speed of the network and, consequently, the heat load.

Clean and non-toxic
The Aqua-Plus system is free of toxic substances. Sanitary and toxicological analyses have ensured its suitability for drinking water. The pipes are regularly tested by official institutes for the taste and the odor of water, the development of microorganisms, the extraction of substances and metals dangerous for public health (cadmium, arsenic, etc.).

Certified
The pipes are regularly tested for their mechanical strength and their suitability for drinking water by official institutes.

Guaranteed
Interplast's Aqua-Plus system carries a 10 years warranty covered by the Generali insurance company against damages caused by faulty pipe and fitting production up to a sum of €500.000 per incident and up to a maximum of €3.000.000 within a year.

POLYPROPYLENE VS METAL PIPES

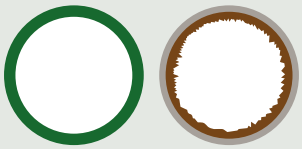
The structure of Polypropylene and its smooth surface texture ensure low friction losses resulting in low resistance and low pressure drop. It also has high resistance to hard water and a long lifespan.

On the other hand, metal pipes are very difficult to use in installations where the water has a high salt content and high oxidation reduction potential (ORP). In addition, metal network installations have a high probability of electrolysis occurring.

AVERAGE ROUGHNESS OF THE PIPES ON THE MARKET

PIPE MATERIAL	PIPE ROUGHNESS VALUE (mm)
Steel, Commercial or Welded	0.046
Cast iron	0.26
Galvanized iron	0.15
Asphalted cast iron	0.12
Copper, Light metals	0.013+0.015
Concrete	0.3+3.0
Ceramic	-0.07
Plastic	0.006

Corrosion and calcium carbonate deposition can reduce the internal dimension of a metal network by 2-3% per year, reducing efficiency by up to 10%.



As a result of the above, plastic pipes of smaller dimension are used for the same amount of transported water.

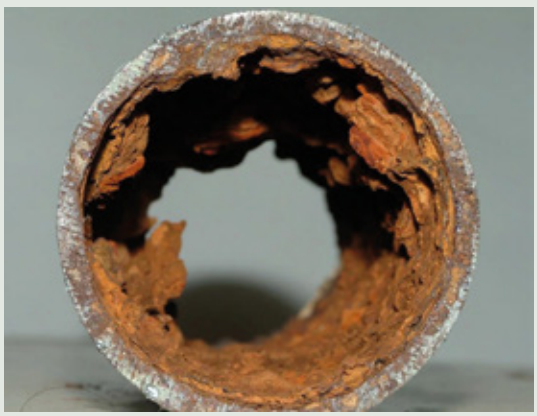
The correspondence among the Aqua-Plus polypropylene pipes, copper pipes and iron pipes is shown in the following table:

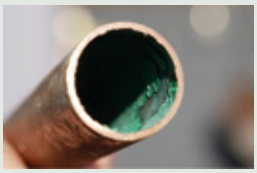
COMPARATIVE PIPE DIMENSIONS

Metal pipes	Copper pipes	Aqua-Plus
1/2″	18 x1,0mm	20
3/4″	22 x 1,0mm	25
1″	28 x 1,5mm	32
1 1/4″	32 x 1,5mm	40
1 1/2″	42 x 1,5mm	50
2″	54 x 2,0mm	63
2 1/2″	64 x 2,0mm	75
3″	76,1 x 2,0mm	90
4″	88,9 x 2,0mm	110
5″	108 x 2,5mm	125
6″	-	160
8″	-	200
10″	-	250
12″	-	315
14″	-	355
16″	-	400
18″	-	450

COMPARISON TABLE

CHARACTERISTICS	PP-R + PP-RCT	METAL PIPES
CORROSION RESISTANCE	+	-
MAINTENANCE	+	-
LIFESPAN	+	-
THERMAL LINEAR EXPANSION	-	+
INSULATION CAPACITY	+	-
CONDENSATION ISSUES/PROBLEMS	+	-
INSTALLATION COST	+	-
INSTALLATION SET UP TIME	+	-
WEIGHT	+	-
FLOW – LOW PRESSURE DROP	+	-
DIMENSION AVAILABILITY	+	-
ENVIRONMENTALLY FRIENDLY MATERIAL	+	-
NATURAL SOUND INSULATION	+	-
PIPELINE CHEMICAL CLEANING	+	-





Plastic pipes are recommended worldwide as the appropriate solution for drinking water installations by designers, institutes and non-governmental organizations. The following table has been published online by Greenpeace.

INDICATIVE EXAMPLES OF OPTIONS IN CONSTRUCTION PRODUCTS

Application	1st choice	2nd choice	3rd choice	Not recommended
Wall insulation	Cork Cellulose Wool Biofiber	Rock wool	Expanded polystyrene (EPS) Fiberglass	Extruded polystyrene (XPS) Polyurethane
Internal drainage pipes	Ceramic pipes	Polyethylene (PE) Polypropylene (PP)	—	PVC
Water pipes	Polypropylene (PP) Polyethylene (PE) Polybutylene	Stainless steel	Copper	PVC
External doors	Certified hard timber of sustainable management Conifer timber without preservatives	Conifer timber with borates implants Plywood timber of sustainable management	Aluminium Conifer timber without preservatives	Non certified tropical timber PVC

PIPE SERIES AND APPLICATIONS

Fields of application. The following list describes the application fields that are suitable for different material structures:

		STRUCTURE OF THE SYSTEM		FIELDS OF APPLICATION											
Brand Name	SDR	Raw Material Type	Structure of the pipe	Water Supply	Irrigation & Drainage	HVACR	Chemical Fluids	Compressed Air	District cooling & heating	Swimming Pools [1]	Geothermal applications	Shipbuilding Industry	Industrial Cooling	Fire Protection
Aqua Plus	6	PP-R 100	SL	●	●		●		●	●	●			
Aqua Plus	7,4	PP-R 125	SL	●	●	■	●	●	●	●	●	■	■	
Aqua Plus UV	7,4	PP-R 125	SL+UV	●	●	■	●		●	●	●	■		
Aqua Plus AL	7,4	PP-R 125	AL	●		■	●		●	●	●	■		
Aqua Plus	7,4	PP-R 125	GF	●		■	●	■	●	●	●	■	■	
Fire Fighter Plus	7,4	PP-R 125	GF+HI											●
Aqua Plus	7,4	PP-RCT	SL	●		■	●	●	●	●	●	●	■	
Aqua Plus	7,4	PP-RCT	GF	●		●	●	■	●	●	●	●	■	
Aqua Plus OT	7,4	PP-R 125	GF+OT			●	■		●	●	●	■	■	
Aqua Plus	9	PP-R 125	SL	●	●	■	●	●	●	●	●	■	●	
Aqua Plus	9	PP-R 125	GF	●		●	●	■	●	●	●	■	●	
Aqua Plus	9	PP-RCT	SL	●		■	●	●	●	●	●	●	●	
Aqua Plus	9	PP-RCT	GF	●		●	●	■	●	●	●	●	●	
Aqua Plus Clima	11	PP-R 125	SL		●	■	●	●	●	●	●	■	●	
Aqua Plus Clima	11	PP-R 125	GF			●	●	■	●	●	●	■	●	
Aqua Plus Clima	11	PP-RCT	SL			■	●	●	●	●	●	●	●	
Aqua Plus Clima	11	PP-RCT	GF			●	●	■	●	●	●	●	●	
Aqua Plus OT	11	PP-R 125	GF+OT			●	●		●	●	●	■	●	
Aqua Plus	17	PP-R 125	SL			■	●	●	●	●	●	■	■	
Aqua Plus	17	PP-R 125	GF			●	●	■	●	●	●	■	■	
Aqua Plus	17	PP-RCT	SL			■		●	●	●	●	●	■	
Aqua Plus	17	PP-RCT	GF			●	●	■	●	●	●	●	■	
Aqua Plus Prins	7,4	PP-R 125	GF+INS	●		●	●		●	●	●	■	●	
Aqua Plus Prins	9	PP-RCT	GF+INS	●		●	●		●	●	●	●	●	
Aqua Plus Prins	11	PP-R 125	GF+INS			●	●		●	●	●	■	●	
Aqua Plus Prins	17	PP-RCT	GF+INS			●	●		●	●	●	●	●	

SL	Single Layer
AL	Composition with aluminum foil
GF	Composition with a middle layer of glass fiber
OT	Oxygen barrier with EVOH film
HI	Hardly flammable fire-retardant material
UV	Protection against sunlight
INS	PUR polyurethane insulation with M-PVC housing
	PUR polyurethane insulation with PE housing
	The product can be produced with M-PVC and PE housing upon request
PP-R	Polypropylene random copolymer
PP-RCT	Polypropylene of random polymerization of high crystallinity with β-beta type nucleation

● The system is recommended for its technical advantages

■ The application of the system is suitable

[1] The application concerns closed heating systems of swimming pools. Use in chlorine networks is not recommended.

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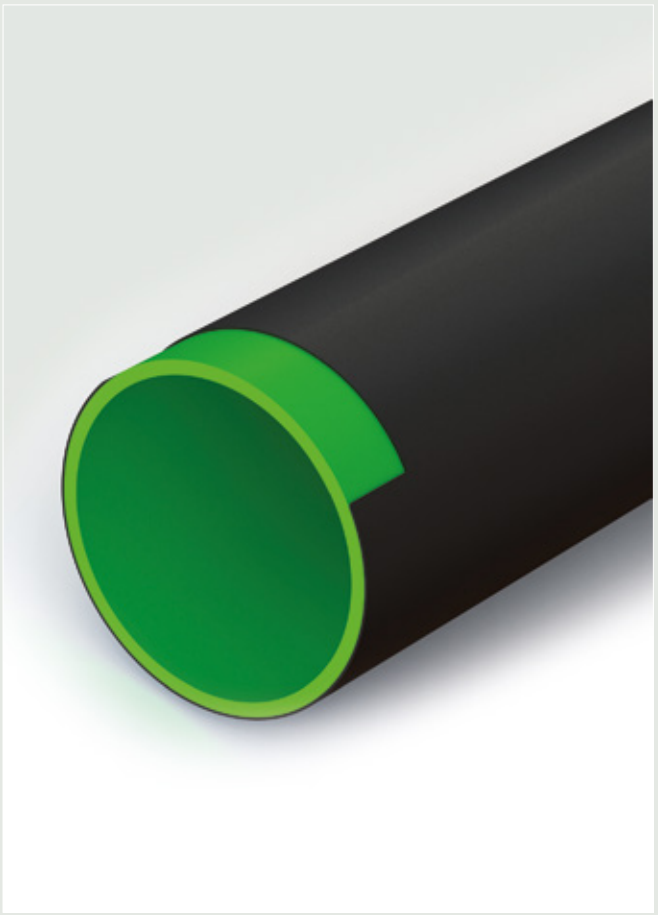
PIPES



AQUA-PLUS SDR 6

SDR 6 pipes are produced from PP-R 100, which is a different raw material from the initial PP-R 80 that was used in the past, thus improving the technical characteristics and the overall strength of the system.

ADVANTAGES

—High resistance of pipes and fittings against hydraulic shocks (Breaking pressure over 130 bar at room temperature)
—Lifespan of over 50 years, in temperatures ranging from 20°C to 90°C and operating pressures from 6 to 26 bar.
—Temperature peaks of 110°C at an operating pressure of 4 bar do not affect the Aqua-Plus system.
Excellent corrosion resistance. Very good behavior in areas with very hard water.
—Metal deactivators
—UV stabilizers

AQUA-PLUS SDR 7,4 with UV protection

Interplast adds a stabilizer for UV radiation to all types of pipes and fittings (UV protected), so they can remain exposed to the sun for up to 5 years depending on the climatic conditions of each area.
For applications where the pipes will be exposed for a longer period of time, Interplast offers pipes with a special black UV layer made of polypropylene.

TIP:

The welding of this pipe is done with the same tools and, more importantly, there is no need to peel (scratch) before welding.

NOTE:

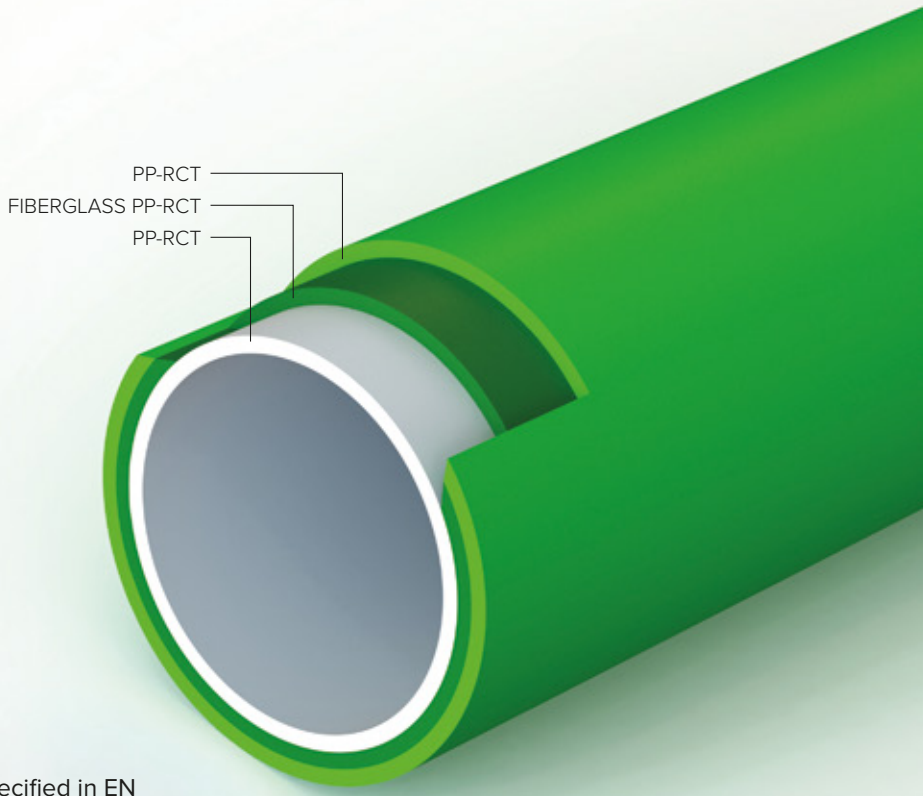
—In any case, for a much longer lifespan, the pipes and fittings should be protected.
—Upon request, they can be produced with glass fiber.

Aquaplus

AQUA-PLUS SDR 7,4 made of PP-R 125

Interplast, with its constant passion for upgrading its products, presents the newest generation of PP-R 125 polypropylene pipes. The new type of pipe upgrades the highly successful pipe series made of PP-R 112 of the last decade.
The resistance of the new pipes made of MRS 12,5 to temperatures, pressures and technical characteristics is much higher than the ordinary pipes made of MRS 8,0 (PP-R 80) that are available on the market.
The new Aqua-Plus 125 pipes are designed, produced and tested for their quality according to the EN15874 and DIN 8077/78 standards.

ADVANTAGES
—Increased mechanical strength
—Increased chemical resistance of the pipe against corrosion
—Larger amount of transported water
—Fewer pressure drops
—Lighter pipe
—Larger lifespan
—Metal deactivators
—UV stabilizers



AquaplusPP-RCT

AQUA-PLUS SDR 9 made of PP-RCT

Interplast, with its constant innovation, strategically produces and promotes the latest generation of PP-RCT polypropylene pipes, which can be described as "The future of plastic piping systems". PP-RCT is a polypropylene with a random polymerization structure with a modified dual-core crystallinity.

ADVANTAGES

—Higher durability than the classic PP-R, as specified in EN 15874 and DIN 8077 (especially at high temperatures).
—PP-RCT, according to European standards, does not show any transitions and change of inclination in the logarithmic diagrams of hydraulic resistance, due to its excellent aging behavior.
—Excellent behavior in chlorine.
—Smaller wall thickness with greater durability.
—More amount of transported water and optimized pressure drops compared to SDR 6 & 7,4.
—Higher hydraulic efficiency of networks.
—Can be used in demanding district heating installations, even when the supply temperature is 100°C.
—Metal deactivators
—UV stabilizers

EXAMPLE

According to DIN 8077, PP-R at 80°C in combination with SDR 7,4 for 25 years will be able to withstand a pressure of up to 6.2 bar, while PP-RCT at 80°C in combination with SDR 9 for 25 years will be able to withstand a pressure of up to 8.6 bar.

IMPORTANT NOTES

—PP-RCT pipes are certified for their mechanical strength by Mirtec EVETAM and the ICC of USA. They have also been certified by NSF and WRAS for potable water networks.
—The three layers must be made of PP-RCT. Pipes, where only the inner layer is made of PP-RCT, cannot be certified.
—Production capability of SDR 17 125mm - 450mm.

AquaplusClima

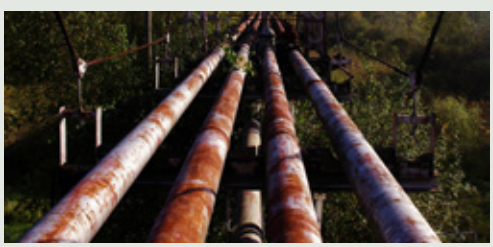
AQUA-PLUS Clima SDR 11 made of PP-R 125

The Aqua-Plus Clima system is an excellent choice for air conditioning and hot-cold water transmission networks, as well as for industrial applications. In addition, the use of PP-R 125 achieves much better behavior and durability than pipes made of PP-R 100 or PP-R 112 in the same SDR.
This type of pipe has been installed all over the world, in hotels, offices, schools, public buildings, private buildings, etc.

Especially in air conditioning networks, polypropylene solves the major problems of corrosion in the outer surface of the metallic pipes (galvanic effect), offering a guaranteed longer life.

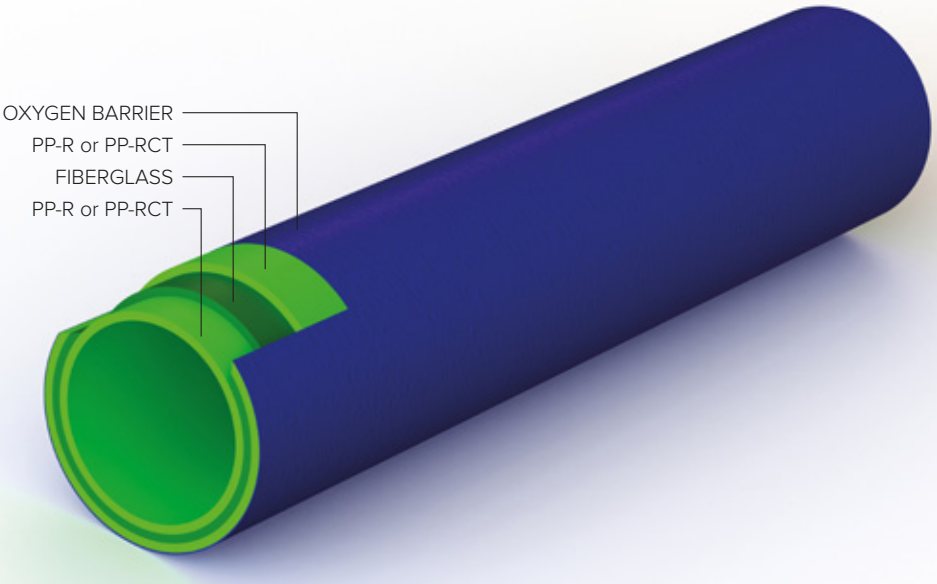
APPLICATIONS

—Cooling towers
—Air conditioning networks
—Transfer of hot and cold water
—Industrial applications
—Connection to central collectors



ADVANTAGES

—Fusion welding
—Corrosion resistance
—Zero scaling
—High abrasion resistance
—Frost resistance
—Limited heat losses
—Low noise
—Increased hydraulic efficiency of networks
—High resistance to electricity
—Lighter pipe
—High strength
—Much larger amount of transported water
—Metal deactivators
—UV stabilizers



AquaplusOT

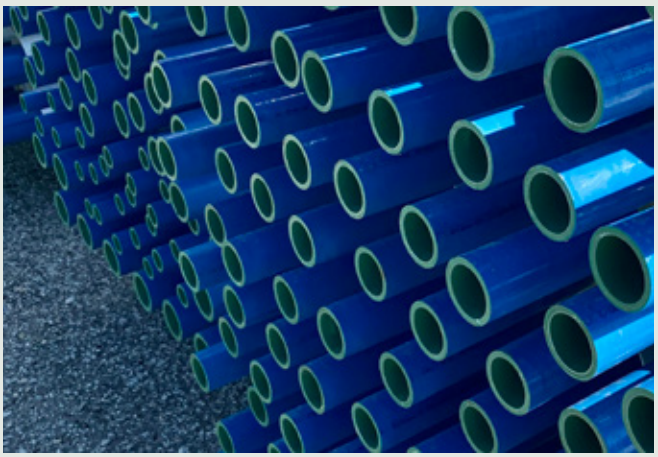
AQUA-PLUS SDR 7,4 / 11 made of PP-R 125 with 5-layer GLASS FIBERS with Oxygen Barrier (OT)

Interplast introduces the new PP-R OT system with glass fibers that does not allow oxygen (and other gases) to enter inside the closed circuits. As a result, the corrosion of the metal parts of the installation is drastically reduced.
This specific type meets the requirements of EN ISO 21003 and was tested according to EN ISO 17455 for the impermeability of polypropylene plastic systems with oxygen block.

APPLICATIONS
—Air conditioning systems (heating – cooling)
—Liquid transfer
—Heating systems
—Industry
—Ship building industry

ADVANTAGES
—Oxygen impermeability with diffusion barrier (colored EVOH layer)
—Absolute resistance to corrosion and scale build-up
—Suitable material for closed water circuits
—Resistance to chemicals
—Sound insulation properties
—Ecological product
—Low linear expansions
—Metal deactivators

NOTES
—Pipes with dimensions ranging from 20 mm to 160 mm have an oxygen blocking layer (OT). For dimensions ranging from 200 mm to 450 mm, the pipes include special additives which do not allow oxygen to enter the system, in combination with the wall thickness and the geometry of the pipe.
—On the above pipes "Oxygen Tight" is printed, as required by EN 21003, and they are certified by KIWA of the Netherlands.
—Complete equipment is provided for the cleaning of the edges (peeling of the barrier layer) which is necessary for the safe process of thermal welding.



AquaplusGF

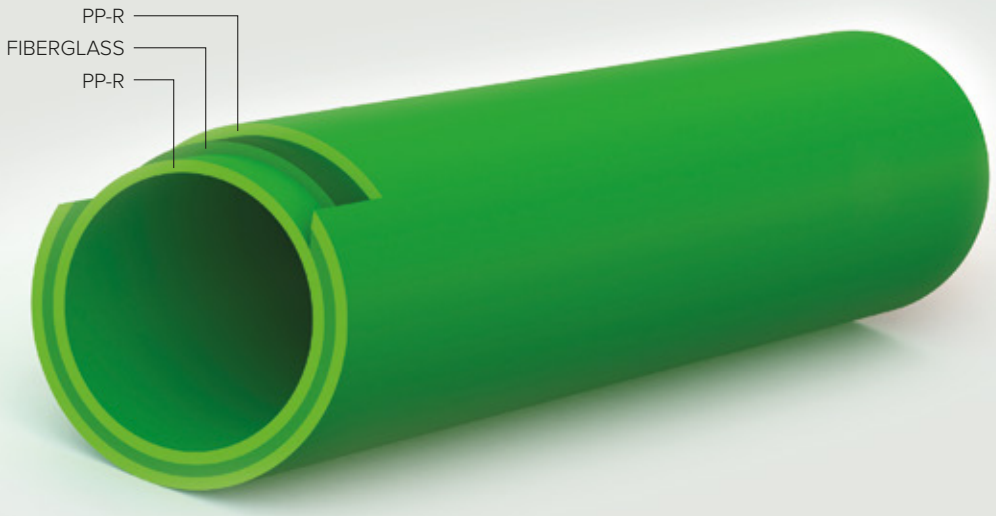
AQUA-PLUS PIPES with GLASS FIBER (GF) MADE OF PP-R 125

Interplast produces three-layered polypropylene pipes with the addition of glass fiber to the middle layer. This offers mechanical reinforcement and an increase in the overall quality of the system.

The support used in visible networks will be much thinner than in pipes that do not contain glass fibers. If glass fiber (GF) pipes are installed in an underground network, the linear expansions will be extremely less.

ADVANTAGES
—Smaller linear expansions
—Thinner support of about 40% compared to pipes that do not contain glass fibers
—Greater stability and service life in temperature changes
—High stiffness
—Bigger flow due to the smaller wall thickness

NOTE
—The heat sealing of glass fiber pipes with fittings is done with the same ease as with classic pipes
—No additional tools needed for the joints
—Production capability of SDR 7,4 - 9 - 11 - 17 and in dimensions ranging from 20mm to 450mm



DESIGN AND STUDY OF COMPRESSED AIR APPLICATIONS

In designing and studying systems for compressed air applications, the following operating pressures must be followed.

Aqua-Plus SDR 11	12,5 bar
Aqua-Plus SDR 7,4	20 bar

The above pressures apply for temperatures ranging from 10°C to 40°C. For different temperatures and conditions, you should contact our Technical Support Department.

WARNING:
The failure of a compressed gas system (air or inert gas) can be extremely violent and dangerous. In a compressed gaseous system, energy is applied to compress the gaseous media in addition to the system pressure. If damage occurs and both energies are released suddenly, they can be extremely dangerous.

The pipes must also be protected against exposure to ultraviolet (UV) radiation, chemical effects, temperature and oxidation.

Interplast recommends that thermoplastic pipes intended for the transport of compressed air or other compressed gases be installed underground, with a housing made of durable material or other suitable means to prevent or minimize the possibility of mechanical damage.
The danger must be eliminated for people near compressed air systems, complying with applicable national and international regulations on installation, accident prevention and safety.

AquaplusAL

AQUA-PLUS with aluminum made of PP-R 125

Interplast also produces three-layered polypropylene-aluminum-polypropylene pipes made of PP-R 125.

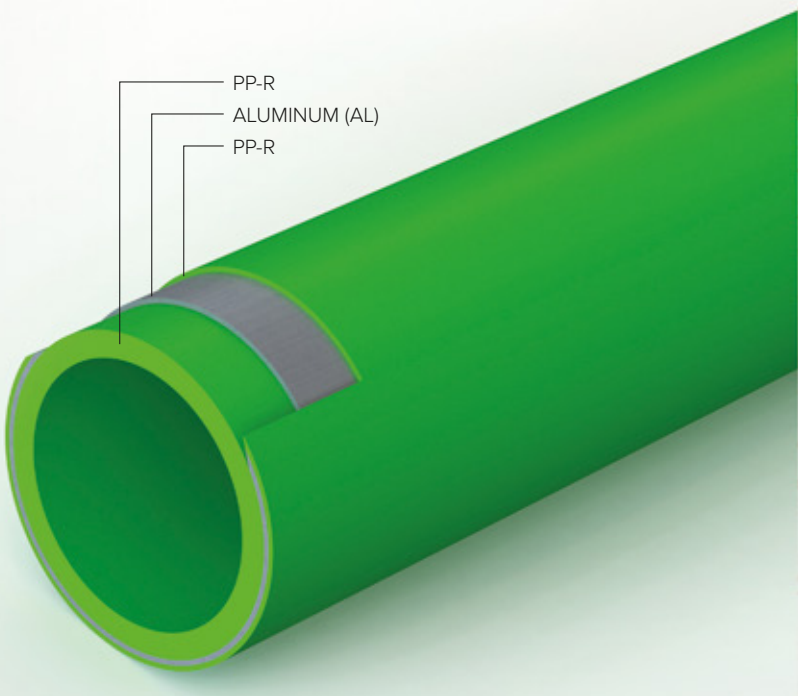
The new pipes are designed, manufactured and tested for their quality according to the standards that apply to ordinary polypropylene pipes.

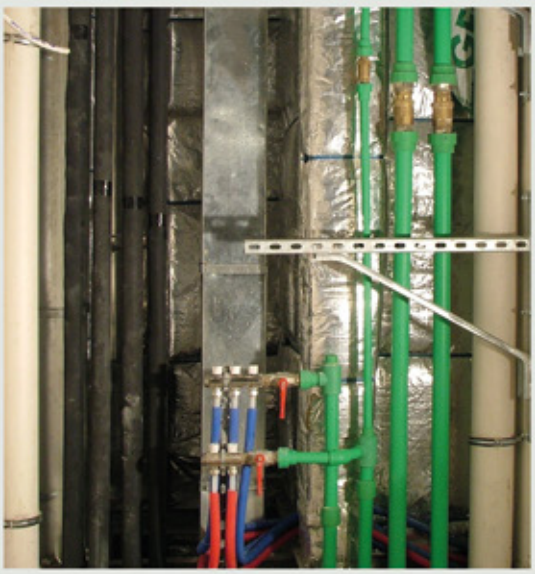
Aqua-Plus-AL pipes are classified in the same class as ordinary Aqua-Plus pipes: Class 2/10 bar (safety factor Sf = 1,5), which means that they are designed for the transport of drinking water with the possibility of continuous operation for more than 50 years with a network pressure of 10 bar and a water temperature of 70°C, while, alternatively, they can operate continuously at a pressure of 20 bar at 20°C (PN20) for the same time.

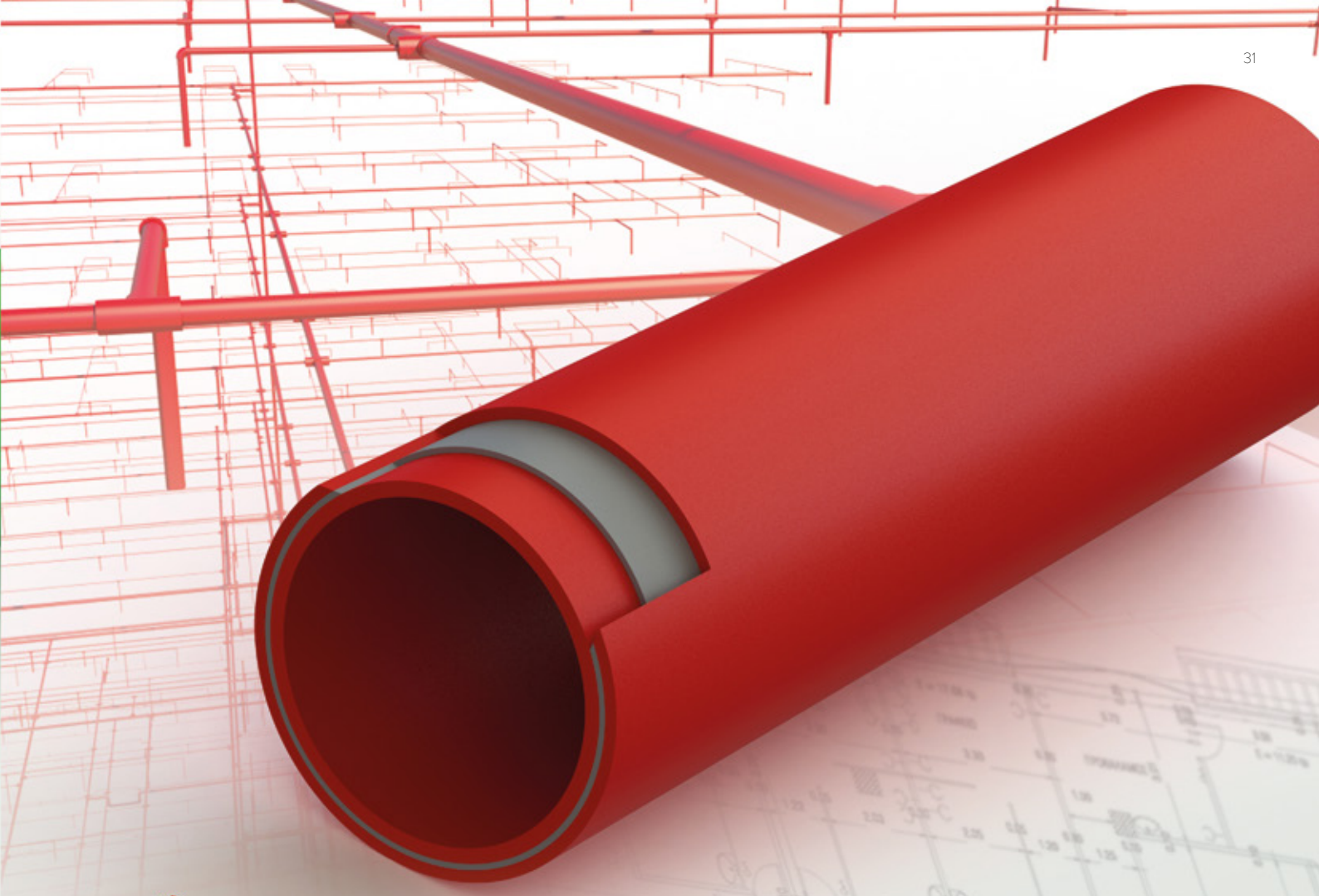
ADVANTAGES

—Reduced linear thermal expansion (0,025mm/m/°C) compared to ordinary polypropylene pipes
—Increased mechanical resistance of the pipe against external shocks
—Increased mechanical resistance of the pipe against internal hydraulic pressures
—Oxygen impermeable

The thermal welding of the new pipes with polypropylene fittings is done with the same way as the ordinary PP-R pipes, after scraping aluminum layer with scrapper at the welding points.







fireproof

FIREFIGHTER PLUS

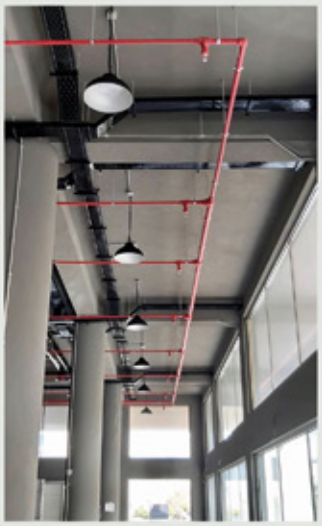
PLASTIC PIPING (GF) AND FITTINGS SYSTEM MADE OF PP-R 125 WITH HIGH FIRE RESISTANCE

Interplast offers a complete range of polypropylene pipes and fittings for firefighting systems, with the name FireFighter Plus.
The pipe consists of three layers, of which, the intermediate layer is a special synthetic glass material that shows high mechanical strength and great fire resistance.

The system follows the standards: EN ISO 13501, EN ISO 12845, EN ISO 13823, EN ISO 11925, EN ISO 15874, EN 21003, NFPA 13, UL 1821, DVS 2207.

APPLICATIONS in
—Hotels
—Malls
—Residences
—Parking
—Warehouses
—Ships
—Industry (as defined by EN)

Interplast uses state-of-the-art materials to offer a system that is difficult to ignite. During a fire, the FireFighter system does not produce flaming particles, droplets and smoke which are harmful to the body.
The system is categorized as **C-s1, d0 according to EN 13501**, occupying an excellent polymer classification against fire.



"Designed for at least 50 years of continuous operation"

CATEGORIZATION OF MATERIALS BY THEIR FIRE RESISTANCE ACCORDING TO EN 13501 AND CORRELATION WITH DIN 4102

Instruction Sheet
"Fire prevention – European classification of building products" 2017

European classification of building products

Building authority designation	DIN 4102	DIN EN 13501	Additional requirements: Smoke production	Additional requirements: Flaming particles/droplets
Non-combustible	A1	A1	no/hardly	no drips/droplets
Non-combustible	A2	A2 – s1, d0	no/hardly	no drips/droplets
Difficult to ignite	B1	A2 – s1, d1	no/hardly	limited drips/droplets
Difficult to ignite	B1	A2 – s1, d2	no/hardly	many drips/droplets
Difficult to ignite	B1	A2 – s2, d0	limited	no drips/droplets
Difficult to ignite	B1	A2 – s2, d1	limited	limited drips/droplets
Difficult to ignite	B1	A2 – s2, d2	limited	many drips/droplets
Difficult to ignite	B1	A2 – s3, d0	unlimited	no drips/droplets
Difficult to ignite	B1	A2 – s3, d1	unlimited	limited drips/droplets
Difficult to ignite	B1	A2 – s3, d2	unlimited	many drips/droplets
Difficult to ignite	B1	B – s1, d0	no/hardly	no drips/droplets
Difficult to ignite	B1	B – s1, d1	no/hardly	limited drips/droplets
Difficult to ignite	B1	B – s1, d2	no/hardly	many drips/droplets
Difficult to ignite	B1	B – s2, d0	limited	no drips/droplets
Difficult to ignite	B1	B – s2, d1	limited	limited drips/droplets
Difficult to ignite	B1	B – s2, d2	limited	many drips/droplets
Difficult to ignite	B1	B – s3, d0	unlimited	no drips/droplets
Difficult to ignite	B1	B – s3, d1	unlimited	limited drips/droplets
Difficult to ignite	B1	B – s3, d2	unlimited	many drips/droplets
Difficult to ignite	B1	C – s1, d0	no/hardly	no drips/droplets
Difficult to ignite	B1	C – s1, d1	no/hardly	limited drips/droplets
Difficult to ignite	B1	C – s1, d2	no/hardly	many drips/droplets
Difficult to ignite	B1	C – s2, d0	limited	no drips/droplets
Difficult to ignite	B1	C – s2, d1	limited	limited drips/droplets
Difficult to ignite	B1	C – s2, d2	limited	many drips/droplets
Difficult to ignite	B1	C – s3, d0	unlimited	no drips/droplets
Difficult to ignite	B1	C – s3, d1	unlimited	limited drips/droplets
Difficult to ignite	B1	C – s3, d2	unlimited	many drips/droplets
Normal combustibility	B2	D – s1, d0	no/hardly	no drips/droplets
Normal combustibility	B2	D – s1, d1	no/hardly	limited drips/droplets
Normal combustibility	B2	D – s1, d2	no/hardly	many drips/droplets
Normal combustibility	B2	D – s2, d0	limited	no drips/droplets
Normal combustibility	B2	D – s2, d1	limited	limited drips/droplets
Normal combustibility	B2	D – s2, d2	limited	many drips/droplets
Normal combustibility	B2	D – s3, d0	unlimited	no drips/droplets
Normal combustibility	B2	D – s3, d1	unlimited	limited drips/droplets
Normal combustibility	B2	D – s3, d2	unlimited	many drips/droplets
Normal combustibility	B2	E		
Normal combustibility	B2	E – d2		many drips/droplets
Easily ignited	B3	F		

The following conditions apply at the NürnbergMesse site (acc. to DIN EN 13501:
- unrestricted approval
- approved up to 2.50 m wall construction/not approved over people (d1)
- not approved (D, E, F, s3 or d2)

Key to building product classes: to DIN 4102
A1 = non-combustible (without combustible components)
A2 = non-combustible (with combustible components to a minor extent)
B1 = difficult to ignite
B2 = normal combustibility
B3 = easily ignited

Key to building product classes: to DIN EN 13501
A1 = non-combustible (without combustible components)
A2 = non-combustible (with combustible components to a minor extent)
B,C = difficult to ignite
D,E = normal combustibility
F = easily ignite
s1 = no/hardly any smoke production
s2 = limited smoke production
s3 = unlimited smoke production
d0 = no drips/droplets
d1 = limited drips/droplets
d2 = many drips/droplets

ADVANTAGES

—Certified system by AENOR according to EN 13501
—Quick and easy installation
—No accumulation of residues phenomena occurring due to corrosion, resulting in a trouble-free Sprinkler operation
—Low weight
—Easy transportation
—Reduced labor cost
—Painting of the pipes is not required, as in the respective metal ones
—No corrosion phenomena shown
—The connections of pipes and fittings are done in the same way as in the corresponding PP-R. The welding equipment remains the same.
-Ideal for installation in systems in the ground, even in shallow trenches

IMPORTANT NOTE

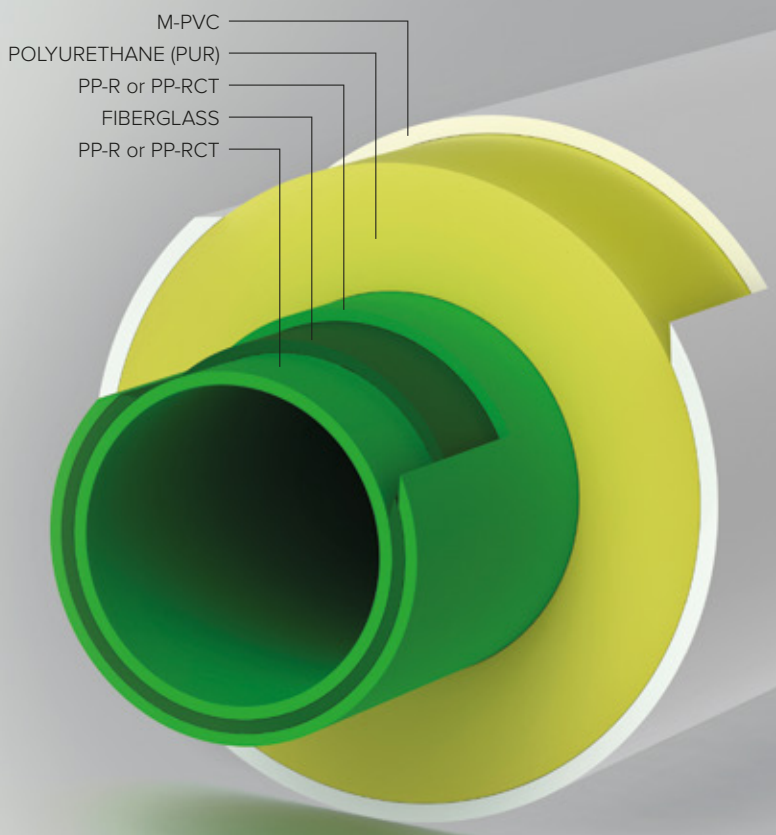
The only European standard for products' fire classification is EN 13501 (according to the fire protection regulation of Greece-PD 41/2018) which refers to flame transmission, flue gas emission and fall of flaming droplets. The DIN 4102 is not an acceptable standard for various countries which have harmonized with EN 13501 and EN 13823. Its categorization is completely different from the corresponding European standard. For example, products starting from A2-s1-d0 to C-s3-d2 belong to category B1.

FireFighter Plus was awarded for the two years 2020-2021 by the Hellenic Academy of Marketing as the most innovative Greek product. FireFighter Plus is a complete system for low and medium risk installations (Low & Ordinary Hazard) which ensures the smooth operation of firefighting networks.

PROBLEMS OF METAL PIPES IN FIREFIGHTING INSTALLATIONS

COMPARISON OF SYSTEMS' INSTALLATION TIME

	Metal	Plastic
Connection method	Mechanical tightening	Fusion welding
Personnel needed	At least 2 persons	1 person
Average installation time for 1 connection	10-20min	30s-2min



AquaplusPrins

PRE-INSULATED SYSTEM AQUA-PLUS PRINS made of PP-R or PP-RCT

Interplast, with its passion for innovation, produces a complete certified system of pre-insulated polypropylene pipes and fittings.
Aqua-Plus Prins is the epitome of the pre-insulation of water networks and industrial energy transmission networks. It offers certified uninterrupted energy savings and the elimination of linear expansions, ending costly insulation maintenance and energy-intensive network operations while showing great resistance against extreme weather, corrosive chemicals and fire.

PRODUCTION and DELIVERY INFORMATION

The length of the insulated pipes is 4 meters from ø20 mm to ø125 mm and 5.8 meters from ø160 mm to ø450 mm. The production of SDR 7,4 - 9 - 11 and 17 pipes is possible, with or without the additional layer of glass fiber.

Upon special request, our company can produce pipes with external polyethylene HDPE housing in straight lengths of 4-5.8 and 11.6 meters.

TEMPERATURE OPERATION LIMITS OF SYSTEM
—External ambient temperature -40°C to +80°C
—Fluid temperature for PP-R or PP-RCT pipes -15°C to +100°C

The system has been awarded the Gold Medal of Innovation and the Silver Medal of Industrial Excellence by the Hellenic Academy of Marketing.
These distinctions derive from the company's efforts to constantly invest in human resources and modern equipment for research towards innovation.
These awards do not belong only to us.
They also belong to all those who choose our products and support our efforts throughout the company's operation, promoting along with us innovation and high-quality, with respect towards people and the environment.

SUITABLE FOR
—Underground networks
—External networks
—Internal networks
—New constructions
—Reconstructions

APPLICATIONS
—Air conditioning and cooling towers
—Heating
—Hot water for use
—District heating and cooling networks
—Underground hot and cold water transport network
—Industrial cooling networks
—Food industry and more
—Shipbuilding industry
—Geothermal fields
—Transport of liquid chemical
—The Aqua-Plus Prins pipe is externally insulated with uniform insulation of hard closed-cell polyurethane. Polyurethane foam exceeds the quality characteristics defined by EN 253
—The outer housing (case pipe) is made of U-PVC with a special composition, which meets the quality characteristics of EN 1329

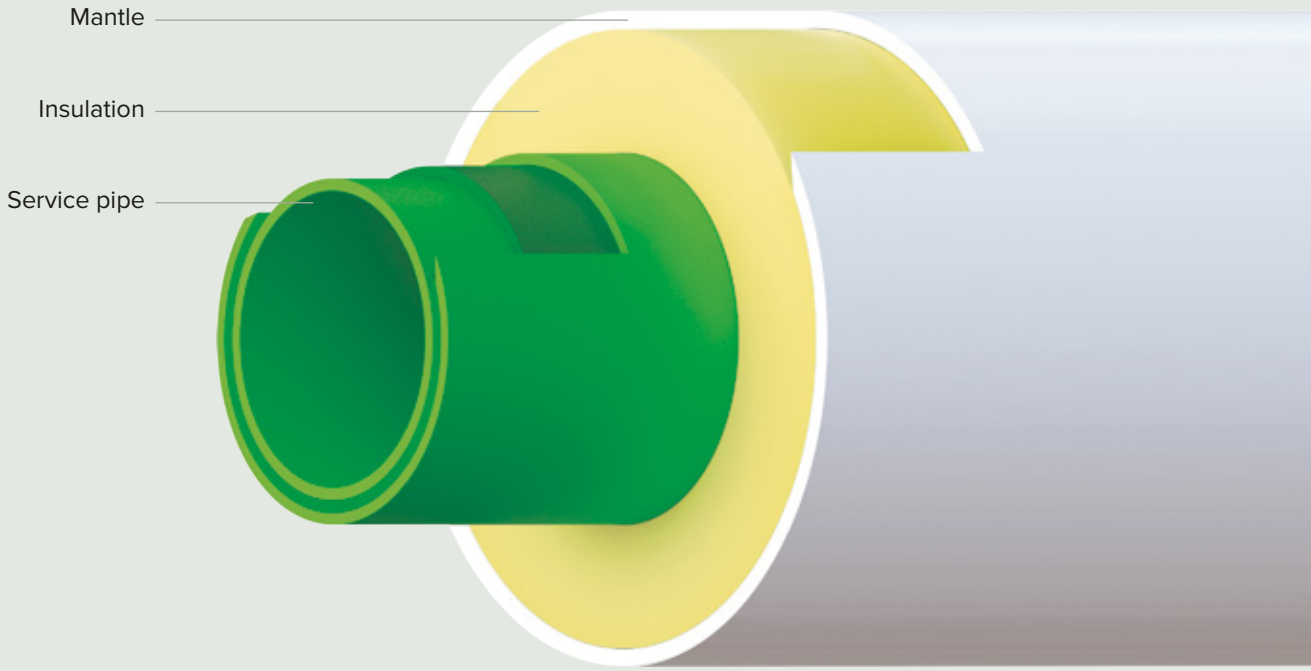
ADVANTAGES
—Reduction of energy losses by 70% compared to the classic types of insulation
—Zero maintenance
—Long lifespan
—Constant λ (lambda value in W/mK) over time
—Guaranteed insulation quality
—Total filling of all surfaces so that no gaps are left, thus liquefaction and air trapping phenomena are avoided
—Resistance to extreme weather conditions (rain, snow, etc.)
—Wide and simple support due to the minimal expansions and the small bending arrow of the pre-insulated pipes
—Lower linear expansion compared to copper
—Increased mechanical strength
—Zero liquefaction
—Faster installation time compared to conventional insulation systems
—High resistance to external stress
—Impermeable material
—UV protection
—Fire resistant (B-s2, d0)
—Oxygen barrier
—Thickness of wall insulation compliant with ASHRAE standards
—Extremely fast investment payback

U–VALUE

SYSTEM ANALYSIS

AQUA-PLUS PRINS | System's technical data

Thermal operating condition	-40°C to +80°C
Fluid temperature limits	-10°C to +100°C
Linear expansion coefficient of system PPR / PUR / M-PVC	=0,016mm/m K
European classification of building products according EN 13501-1	B-s2, d0
Certification for oxygen tight (KIWA) according to EN ISO 17455	1,34mg O_2 / m^2 * day at 80°C



TRANSMISSION PIPE | Technical data of Aqua-Plus multilayer (GF) transmission pipe

DESCRIPTION	VALUE	STANDARDS
Multilayer polypropylene	PP-R & PP-RCT	EN 15874, EN 21003, DIN 8077-78
Thermal conductivity	0,17 [W/m·K]	ISO 3146
Thermal conductivity	0,24 [W/m·K]	EN 8497
Producing length	4,0 [m]	-
	5,8 [m]	-
	11,6 [m]	-
Modulus of elasticity	900-1200 [N/mm^2]	ISO 527
Tensile strength	38 [N/mm^2]	ISO 527-2
Tensile stress at break	> 430 [%]	ISO 527-2
Coefficient of linear expansion	0,030 [mm/m ·K]	DIN 53752

INSULATION | Technical data of insulating foam

PUR RIGID FOAM PROPERTIES	VALUE	STANDARDS
Thermal conductivity insulation	0,028 [W/m·K]	EN 15632, EN 253
Density	60 [Kg/m^3]	EN 253
Closed cell	> 94 [%]	EN 8497
Water absorption	< 10 [%] Vol	EN 15632-1, EN 489
Shearing resistance	> 0,12 [N/mm^2]	-
Tangent shearing resistance	> 0,20 [N/mm^2]	-
Compression strength 10% deformation	> 0,3 [N/mm^2]	-

CASING (JACKET) | Technical data of sleeve

DESCRIPTION	VALUE	STANDARDS
Modified Poly-vinyl Cloride	M-P.V.C	EN 1401, EN 1329
Thermal conductivity of casing pipe	0,23 [W/m·K]	EN 8497
Modulus of elasticity	3000 [N/mm^2]	-
Density	1,43 [g/cm^3]	ISO 527-2
Coefficient of linear expansion	0,06 [mm/m·K]	-

From 01/01/2015, the produced M-PVC pipes do not contain lead (Pb-free). Organic stabilizers (OBS) or calcium/zinc stabilizers (Ca/Zn) replaced lead stabilizers as their components are categorized as environmentally friendly and are not on the “REACH” regulation list of to-be-removed materials.

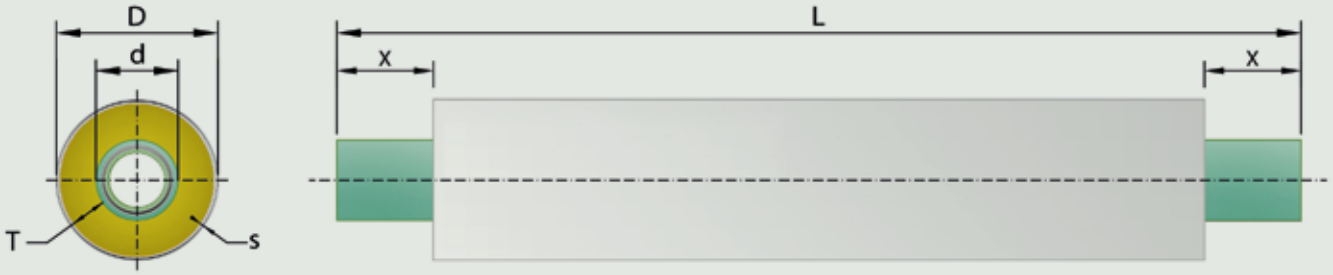
SYSTEM DIMENSIONS

Aqua-Plus Prins EERB section

EERB (Greek law) - Prins

DIMENSIONS							WEIGHT				WATER CONTENT			
Size	d PP [mm]	D PVC [mm]	s PVC [mm]	T Insulation [mm]	x Free [mm]	L system [m]	SDR 7,4 [Kg/m] Α	SDR 9 [Kg/m] Β	SDR 11 [Kg/m] Γ	SDR 17 [Kg/m] Δ	SDR 7,4 [lt/m] Α	SDR 9 [lt/m] Β	SDR 11 [lt/m] Γ	SDR 17 [lt/m] Δ
20/63	20	63	2,2	19,3	150	4,0	0,96	-	-	-	0,163	-	-	-
25/63	25	63	2,2	16,8			1,03	-	-	-	0,254	-	-	-
32/63	32	63	2,2	13,3			1,14	1,08	1,03	-	0,423	0,483	0,539	-
40/75	40	75	2,2	15,3			1,53	1,44	1,36	-	0,661	0,754	0,835	-
50/90	50	90	2,2	17,8			2,09	1,95	1,83	-	1,029	1,182	1,307	-
63/100	20	100	2,5	16			2,85	2,64	2,45	-	1,647	1,869	2,075	-
75/125	25	125	2,5	22,5	225		3,57	3,26	2,98	-	2,324	2,659	2,961	-
90/140	32	140	3,2	21,8			5,03	4,59	4,19	-	3,359	3,825	4,254	-
110/160	40	160	3,2	21,8			7,32	6,64	6,04	-	5,001	5,725	6,362	-
125/200	50	200	3,5	34			10,26	9,19	8,42	-	6,475	7,386	8,203	-
160/225	20	225	4,5	28		5,8	14,93	13,51	12,27	10,05	10,605	12,109	13,437	15,614
200/250	25	250	4,5	20,5			14,93	18,09	16,11	12,69	16,559	18,908	21,021	24,383
250/315	32	315	6	26,5			14,93	-	25,82	20,47	-	-	32,878	38,151
315/400	220	400	8,2	34,3			14,93	-	42,34	33,86	-	-	52,198	60,493

Table of insulation sizes according to the requirements of EERB.
PUR insulation specifications comply with the requirements of EN 253.
-Sizes or combinations not produced.
The sum of the columns, e.g. A+A or B+B on the respective lines, equals the total weight (Prins + water).



Aqua-Plus Prins + EN 253 section

EN 253 Prins

DIMENSIONS							WEIGHT				WATER CONTENT			
Size	d PP [mm]	D PVC [mm]	s PVC [mm]	T Insulation [mm]	x Free [mm]	L system [m]	SDR 7,4 [Kg/m] **A**	SDR 9 [Kg/m] **B**	SDR 11 [Kg/m] **Γ**	SDR 17 [Kg/m] **Δ**	SDR 7,4 [lt/m] **A**	SDR 9 [lt/m] **B**	SDR 11 [lt/m] **Γ**	SDR 17 [lt/m] **Δ**
20/90	20	90	2,2	32,8	150	4,0	1,49	-	-	-	0,163	-	-	-
25/90	25	90	2,2	30,3			1,55	-	-	-	0,254	-	-	-
32/90	32	90	2,2	26,8			1,66	1,61	1,56	-	0,423	0,483	0,539	-
40/100	40	100	2,2	22,5			2,18	2,09	2,01	-	0,661	0,754	0,835	-
50/100	50	100	2,2	22,5			3,07	2,93	2,81	-	1,029	1,182	1,307	-
63/100	63	125	2,5	28,5			3,48	3,27	3,08	-	1,647	1,869	2,075	-
75/140	75	140	2,5	28,5	225		4,8	4,48	4,2	-	2,324	2,659	2,961	-
90/160	90	160	3,2	31,8			6,16	5,72	5,32	-	3,359	3,825	4,254	-
110/200	110	200	3,5	41,5			9,05	8,37	7,77	-	5,001	5,725	6,362	-
125/225	125	225	4,5	45,5			12,29	11,21	10,45	-	6,475	7,386	8,203	-
160/250	160	250	4,5	40,5		5,8	16,18	14,76	13,52	11,3	10,605	12,109	13,437	15,614
200/315	200	315	6	51,5			25,96	23,74	21,76	18,34	16,559	18,908	21,021	24,383
250/400	250	400	6	51,5			-	-	31,91	26,56	-	-	32,878	38,151
315/450	315	450	10	57,5			-	-	50,31	41,82	-	-	52,198	60,493

Table of preinsulated system. Insulation sizes and insulation properties are according to EN 253 requirements.
-Non produced sizes or combinations.
The sum of the columns, e.g. A+A or B+B on the respective lines, equals the total weight (Prins + water).

ENERGY LOSSES IN COOLING & HEATING

Underground networks KENAK PRINS
The following tables show the thermal energy losses per system size at the listed fluid and subsoil temperatures.

For different values (fluid – subsoil) use equation (1) and the total heat transfer coefficient [U] as follows:

$$(1) \qquad \Phi = U \cdot (T_F - T_S) \quad [W/m]$$

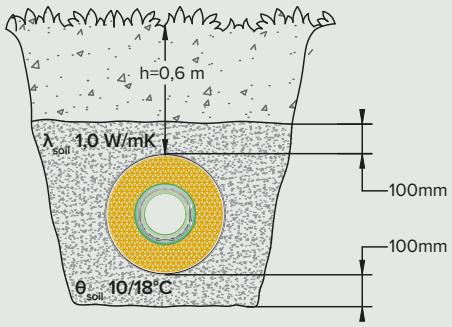
Where:
U [W/m·K]: Total heat transfer coefficient
T_F [°C]: Fluid temperature (supply)
T_S [°C]: Subsoil temperature

Assumptions for the calculation of the U-Value coefficient:
Thermal conductivity of subsoil λ_{soil}: 1,0 [W/m·K]
Pipe depth h: 0,6 [m]

Underground installation EERB PRINS | Heat losses according to EN ISO 8497:1996

Heating			Soil temperature T_{Soil}: 10°C			
			Heating energy loss Φ [W/m]			
d_{PPR} [mm]	D_{PVC} [mm]	U-Value [W/m·k]	θ_{water} 50°C [W/m]	θ_{water} 60°C [W/m]	θ_{water} 70°C [W/m]	θ_{water} 80°C [W/m]
SDR 7,4 PP-R GF (1) & PP-RCT GF (2)						
20	63	0,138	5,5	6,88	8,25	9,63
25	63	0,168	6,72	8,4	10,8	11,76
32	63	0,223	8,91	11,14	13,37	15,6
40	75	0,236	9,44	11,81	14,17	16,53
50	90	0,245	9,79	12,24	14,68	17,13
63	100	0,308	12,3	15,38	18,46	21,53
75	125	0,281	11,23	14,04	16,84	19,65
90	140	0,322	12,88	16,1	19,32	22,54
110	160	0,368	14,7	18,38	22,06	25,73
125	200	0,305	12,2	15,25	18,3	21,35
160	225	0,405	16,19	20,24	24,28	28,33
200	250	0,561	22,46	28,07	33,68	39,3
SDR 9 PP-RCT GF (1) & PP-R GF (2)						
32	63	0,225	9	11,25	13,5	15,75
40	75	0,239	9,56	11,95	14,34	16,73
50	90	0,252	10,08	12,6	15,12	17,64
63	100	0,312	12,48	15,6	18,72	21,84
75	125	0,284	11,36	14,2	17,04	19,88
90	140	0,327	13,08	16,35	19,62	22,89
110	160	0,374	14,96	18,7	22,44	26,18
125	200	0,309	12,36	15,45	18,54	21,63
160	225	0,428	17,12	21,4	25,68	29,96
200	250	0,567	22,68	28,35	34,02	39,69
SDR 11 PP-R GF (1) & PP-RCT GF (2)						
32	63	0,227	9,08	11,35	13,62	15,89
40	75	0,241	9,64	12,05	14,46	16,87
50	90	0,254	10,16	12,7	15,24	17,78
63	100	0,315	12,6	15,75	18,9	22,05
75	125	0,287	11,48	14,35	17,22	20,09
90	140	0,33	13,2	16,5	19,8	23,1
110	160	0,379	15,16	18,95	22,74	26,53
125	200	0,313	12,52	15,65	18,78	21,91
160	225	0,418	16,72	20,9	25,08	29,26
200	250	0,587	23,48	29,3	35,22	41,09
250	315	0,586	23,44	29,3	35,16	41,02
315	400	0,587	23,48	29,35	35,22	41,09
SDR 17 PP-RCT GF (1) & PP-R GF (2)						
160	200	0,427	17,08	21,35	25,62	29,89
200	250	0,605	24,2	30,25	36,6	42,35
250	315	0,604	24,16	30,2	36,24	42,28
315	400	0,604	24,16	30,2	36,24	42,28

Heating energy losses. Subsoil temperature 10°C.
(1) Basic type of main propylene pipe production. (2) Optional polypropylene type upon request.



Underground installation EERB PRINS | Cooling losses according to EN ISO 8497:1996

Cooling			Soil temperature T_{Soil}: 18°C			
			Cooling energy loss Φ [W/m]			
d_{PPR} [mm]	D_{PVC} [mm]	U-Value [W/m·k]	θ_{water} -6°C [W/m]	θ_{water} 0°C [W/m]	θ_{water} 7°C [W/m]	θ_{water} 12°C [W/m]
SDR 7,4 PP-R GF (1) & PP-RCT GF (2)						
20	63	0,138	3,3	2,48	1,51	0,83
25	63	0,168	4,03	3,02	1,85	1,01
32	63	0,223	5,35	4,01	2,45	1,34
40	75	0,236	5,67	4,25	2,6	1,42
50	90	0,245	5,87	4,4	2,69	1,47
63	100	0,308	7,37	5,54	3,38	1,85
75	125	0,281	6,74	5,05	3,09	1,68
90	140	0,322	7,73	5,8	3,54	1,93
110	160	0,368	8,82	6,62	4,04	2,21
125	200	0,305	7,32	5,49	3,36	1,83
160	225	0,405	9,71	7,28	4,45	2,43
200	250	0,561	13,47	10,11	6,18	3,37
SDR 9 PP-RCT GF (1) & PP-R GF (2)						
32	63	0,225	5,4	4,05	2,48	1,35
40	75	0,239	5,74	4,3	2,63	1,43
50	90	0,252	6,06	4,54	2,77	1,51
63	100	0,312	7,49	5,62	3,43	1,87
75	125	0,284	6,82	5,11	3,12	1,7
90	140	0,327	7,85	5,89	3,6	1,96
110	160	0,374	8,98	6,73	4,11	2,24
125	200	0,309	7,42	5,56	3,4	1,85
160	225	0,428	10,27	7,7	4,71	2,57
200	250	0,567	13,61	10,21	6,24	3,4
SDR 11 PP-R GF (1) & PP-RCT GF (2)						
32	63	0,227	5,45	4,09	2,5	1,36
40	75	0,241	5,78	4,34	2,65	1,45
50	90	0,254	6,1	4,57	2,79	1,52
63	100	0,315	7,56	5,67	3,47	1,89
75	125	0,287	6,89	5,17	3,16	1,72
90	140	0,33	7,92	5,94	3,63	1,98
110	160	0,379	9,1	6,82	4,17	2,27
125	200	0,313	7,51	5,63	3,44	1,88
160	225	0,418	10,03	7,52	4,6	2,51
200	250	0,587	14,09	10,57	6,46	3,52
250	315	0,586	14,06	10,55	6,45	3,52
315	400	0,587	14,09	10,57	6,46	3,52
SDR 17 PP-RCT GF (1) & PP-R GF (2)						
160	200	0,427	10,25	7,69	4,7	2,56
200	250	0,605	14,52	10,89	6,66	3,63
250	315	0,604	14,5	10,87	6,64	3,62
315	400	0,604	14,5	10,87	6,64	3,62

Cooling energy losses. Subsoil temperature 18°C.
(1) Basic type of main propylene pipe production. (2) Optional polypropylene type upon request.

Calculation of heat losses in outdoor networks

The calculation of heat losses for an outdoor network is different compared to an underground network. The energy loss Φ [W/m] of the pre-insulated pipe is calculated by the equation:

$$\Phi = U \cdot (T_M - T_A) \qquad [W/m]$$

Where:
U [W/m·K]: Total heat transfer coefficient
T_M [°C]: Fluid temperature
T_A [°C]: Air temperature

Outdoor installation EERB PRINS | Heat losses according to EN ISO 8497:1996

Heating			Ambient temperature $T_{Ambient}$: -7°C			
			Heating energy loss Φ [W/m]			
d_{PPR} [mm]	D_{PVC} [mm]	U-Value [W/m·k]	θ_{water} 50°C [W/m]	θ_{water} 60°C [W/m]	θ_{water} 70°C [W/m]	θ_{water} 80°C [W/m]
SDR 7,4 PP-R GF (1) & PP-RCT GF (2)						
20	63	0,115	6,57	8,01	9,44	10,92
25	63	0,137	7,82	9,51	11,19	12,93
32	63	0,173	9,9	12,01	14,09	16,24
40	75	0,190	10,87	13,2	15,5	17,88
50	90	0,208	11,86	14,42	16,95	18,56
63	100	0,257	14,64	17,76	20,85	24,04
75	125	0,248	14,12	17,19	20,22	23,37
90	140	0,287	16,37	19,92	23,42	27,05
110	160	0,333	18,99	23,1	27,14	31,33
125	200	0,287	16,36	19,98	23,54	27,25
160	225	0,385	21,97	26,97	31,49	36,38
200	250	0,543	30,98	37,66	44,17	50,89
SDR 9 PP-RCT GF (1) & PP-R GF (2)						
32	63	0,175	9,98	12,1	14,21	16,38
40	75	0,192	10,97	13,31	15,64	18,05
50	90	0,210	11,98	14,56	17,12	19,77
63	100	0,259	14,8	17,96	21,09	24,32
75	125	0,250	14,29	17,93	20,46	26,65
90	140	0,291	16,59	20,18	23,73	27,41
110	160	0,338	19,29	23,46	27,58	31,85
125	200	0,290	16,58	20,24	23,86	27,63
160	225	0,392	22,37	27,25	32,07	37,07
200	250	0,557	31,78	38,62	45,32	52,24
SDR 11 PP-R GF (1) & PP-RCT GF (2)						
32	63	0,176	10,05	12,18	14,3	16,49
40	75	0,194	11,04	13,4	15,75	18,17
50	90	0,211	12,07	14,67	17,25	19,92
63	100	0,262	14,94	18,13	21,29	24,56
75	125	0,253	14,42	17,55	20,66	23,88
90	140	0,294	16,77	20,4	23,99	27,72
110	160	0,342	19,53	23,75	27,93	32,26
125	200	0,294	16,76	20,45	24,12	27,94
160	225	0,398	22,68	27,64	32,54	37,62
200	250	0,569	32,44	39,42	46,27	53,36
250	315	0,587	33,46	40,73	47,88	55,29
315	400	0,624	35,41	43,17	50,79	58,69
SDR 17 PP-RCT GF (1) & PP-R GF (2)						
160	225	0,406	23,16	28,22	33,24	38,45
200	250	0,586	33,42	40,59	47,68	55,02
250	315	0,605	34,5	41,99	49,4	57,08
315	400	0,642	36,58	44,58	52,49	60,7

Heating energy losses. Subsoil temperature -7°C.
(1) Basic type of main propylene pipe production. (2) Optional polypropylene type upon request.

Heating			Ambient temperature $T_{Ambient}$: 7°C			
			Heating energy loss Φ [W/m]			
d_{PPR} [mm]	D_{PVC} [mm]	U-Value [W/m·k]	θ_{water} 50°C [W/m]	θ_{water} 60°C [W/m]	θ_{water} 70°C [W/m]	θ_{water} 80°C [W/m]
SDR 7,4 PP-R GF (1) & PP-RCT GF (2)						
20	63	0,119	5,1	6,53	7,96	9,46
25	63	0,142	6,11	7,8	9,5	11,26
32	63	0,181	7,81	9,94	12,08	14,29
40	75	0,198	8,54	10,89	13,24	15,67
50	90	0,216	9,29	11,85	14,42	17,08
63	100	0,267	11,5	14,66	17,81	21,08
75	125	0,256	10,99	14,05	17,11	20,29
90	140	0,297	12,76	16,3	19,84	23,51
110	160	0,344	14,8	18,91	23	27,25
125	200	0,293	12,63	16,18	19,73	23,44
160	225	0,396	17,03	21,78	26,52	31,44
200	250	0,562	24,19	30,88	37,48	44,32
SDR 9 PP-RCT GF (1) & PP-R GF (2)						
32	63	0,183	7,87	10,02	12,18	14,42
40	75	0,200	8,62	10,99	13,36	15,82
50	90	0,218	9,38	11,97	14,57	17,27
63	100	0,270	11,64	14,03	18,03	21,34
75	125	0,258	11,12	14,22	17,32	20,54
90	140	0,300	12,93	16,52	20,11	23,84
110	160	0,349	15,05	19,22	23,38	27,71
125	200	0,297	12,8	16,4	20,01	23,77
160	225	0,403	17,34	22,19	27,02	32,05
200	250	0,577	24,84	31,69	38,49	45,54
SDR 11 PP-R GF (1) & PP-RCT GF (2)						
32	63	0,184	7,93	10,09	12,27	14,52
40	75	0,202	8,68	11,06	13,46	15,94
50	90	0,220	9,45	12,06	14,68	17,41
63	100	0,273	11,75	14,97	18,21	21,55
75	125	0,261	11,23	14,35	17,49	20,75
90	140	0,304	13,08	16,7	20,34	24,12
110	160	0,354	15,24	19,46	23,69	28,08
125	200	0,300	12,94	16,58	20,23	24,04
160	225	0,409	17,6	22,51	27,43	32,54
200	250	0,590	25,37	32,37	39,33	46,55
250	315	0,604	25,99	33,22	40,42	47,9
315	400	0,636	27,38	35,03	42,65	50,58
SDR 17 PP-RCT GF (1) & PP-R GF (2)						
160	225	0,418	17,98	23	28,03	33,28
200	250	0,608	26,17	33,37	40,58	48,06
250	315	0,624	26,83	34,28	41,74	49,5
315	400	0,658	36,2	44,12	44,12	52,36

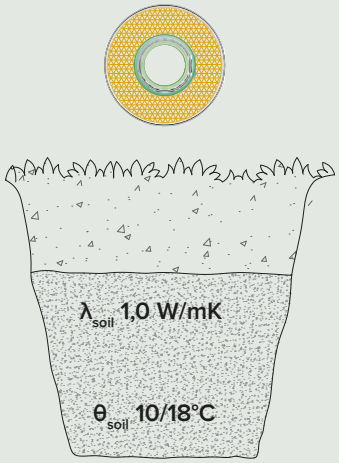
Heating energy losses. Subsoil temperature 7°C.
(1) Basic type of main propylene pipe production. (2) Optional polypropylene type upon request.

AquaplusPrins

Outdoor installation EERB PRINS | Cooling losses according to EN ISO 8497:1996

Cooling			Ambient temperature $T_{Ambient}$: 40°C			
			Cooling energy loss Φ [W/m]			
d_{PPR} [mm]	D_{PVC} [mm]	U-Value [W/m·k]	θ_{water} 0°C [W/m]	θ_{water} 7°C [W/m]	θ_{water} 12°C [W/m]	θ_{water} 18°C [W/m]
SDR 7,4 PP-R GF (1) & PP-RCT GF (2)						
20	63	0,105	4,22	3,48	2,95	2,32
25	63	0,127	5,08	4,19	3,55	2,79
32	63	0,167	6,66	5,49	4,66	3,66
40	75	0,18	7,21	5,95	5,05	3,97
50	90	0,194	7,75	6,4	5,43	4,26
63	100	0,243	9,71	8,01	6,8	5,34
75	125	0,226	9,03	7,45	6,32	4,97
90	140	0,263	10,51	8,67	7,36	5,78
110	160	0,305	12,2	10,06	8,45	6,71
125	200	0,253	10,12	8,35	7,08	5,57
160	225	0,345	13,79	11,38	9,65	7,58
200	250	0,271	10,84	8,95	7,59	5,96
SDR 9 PP-RCT GF (1) & PP-R GF (2)						
32	63	0,168	6,73	5,55	4,71	3,7
40	75	0,182	7,3	6,02	5,11	4,01
50	90	0,196	7,85	4,48	5,5	4,32
63	100	0,246	9,85	8,13	6,9	5,42
75	125	0,229	9,16	7,56	6,41	5,04
90	140	0,267	10,68	8,81	7,48	5,88
110	160	0,311	12,44	10,27	8,71	6,84
125	200	0,257	10,28	8,48	7,2	5,66
160	225	0,352	14,09	11,63	9,86	7,75
200	250	0,276	11,03	9,1	7,72	6,07
SDR 11 PP-R GF (1) & PP-RCT GF (2)						
32	63	0,17	6,79	5,6	4,75	3,74
40	75	0,184	7,36	6,07	5,15	4,05
50	90	0,198	7,93	6,54	5,55	4,36
63	100	0,249	9,97	8,23	6,98	5,48
75	125	0,232	9,27	7,65	6,49	5,1
90	140	0,271	10,83	8,93	7,58	5,96
110	160	0,316	12,63	10,42	8,84	6,95
125	200	0,26	10,41	8,59	7,29	5,73
160	225	0,358	14,34	11,83	10,04	7,88
200	250	0,28	11,18	9,23	7,83	6,15
250	315	0,531	21,22	17,51	14,85	11,67
315	400	0,552	22,06	18,2	15,44	12,14
SDR 17 PP-RCT GF (1) & PP-R GF (2)						
160	225	0,368	14,71	12,13	10,3	8,09
200	250	0,548	21,9	18,07	15,33	12,05
250	315	0,551	22,03	18,18	15,42	12,12
315	400	0,574	22,94	18,93	16,06	12,62

Cooling energy losses. Ambient temperature 40°C.
(1) Basic type of main propylene pipe production. (2) Optional polypropylene type upon request.



Cooling			Ambient temperature $T_{Ambient}$: 25°C			
			Cooling energy loss Φ [W/m]			
d_{PPR} [mm]	D_{PVC} [mm]	U-Value [W/m·k]	θ_{water} 0°C [W/m]	θ_{water} 7°C [W/m]	θ_{water} 12°C [W/m]	θ_{water} 18°C [W/m]
SDR 7,4 PP-R GF (1) & PP-RCT GF (2)						
20	63	0,105	4,22	3,48	2,95	2,32
25	63	0,127	5,08	4,19	3,55	2,79
32	63	0,167	6,66	5,49	4,66	3,66
40	75	0,18	7,21	5,95	5,05	3,97
50	90	0,194	7,75	6,4	5,43	4,26
63	100	0,243	9,71	8,01	6,8	5,34
75	125	0,226	9,03	7,45	6,32	4,97
90	140	0,263	10,51	8,67	7,36	5,78
110	160	0,305	12,2	10,06	8,45	6,71
125	200	0,253	10,12	8,35	7,08	5,57
160	225	0,345	13,79	11,38	9,65	7,58
200	250	0,271	10,84	8,95	7,59	5,96
SDR 9 PP-RCT GF (1) & PP-R GF (2)						
32	63	0,168	6,73	5,55	4,71	3,7
40	75	0,182	7,3	6,02	5,11	4,01
50	90	0,196	7,85	4,48	5,5	4,32
63	100	0,246	9,85	8,13	6,9	5,42
75	125	0,229	9,16	7,56	6,41	5,04
90	140	0,267	10,68	8,81	7,48	5,88
110	160	0,311	12,44	10,27	8,71	6,84
125	200	0,257	10,28	8,48	7,2	5,66
160	225	0,352	14,09	11,63	9,86	7,75
200	250	0,276	11,03	9,1	7,72	6,07
SDR 11 PP-R GF (1) & PP-RCT GF (2)						
32	63	0,17	6,79	5,6	4,75	3,74
40	75	0,184	7,36	6,07	5,15	4,05
50	90	0,198	7,93	6,54	5,55	4,36
63	100	0,249	9,97	8,23	6,98	5,48
75	125	0,232	9,27	7,65	6,49	5,1
90	140	0,271	10,83	8,93	7,58	5,96
110	160	0,316	12,63	10,42	8,84	6,95
125	200	0,26	10,41	8,59	7,29	5,73
160	225	0,358	14,34	11,83	10,04	7,88
200	250	0,28	11,18	9,23	7,83	6,15
250	315	0,531	21,22	17,51	14,85	11,67
315	400	0,552	22,06	18,2	15,44	12,14
SDR 17 PP-RCT GF (1) & PP-R GF (2)						
160	225	0,368	14,71	12,13	10,3	8,09
200	250	0,548	21,9	18,07	15,33	12,05
250	315	0,551	22,03	18,18	15,42	12,12
315	400	0,574	22,94	18,93	16,06	12,62

Cooling energy losses. Ambient temperature 25°C.
(1) Basic type of main propylene pipe production. (2) Optional polypropylene type upon request.

THEORY AND CALCULATIONS

The energy loss of the pre-insulated system is proportional to the installation location of the pipe (underground or outdoor), the ambient temperature, the fluid temperature, the installation depth, the distance between the pipes, the temperature and the velocity of air, the material emission coefficient as well as the total heat transfer coefficient of the system layers (composition of materials with different conductivity coefficient).
Interplast, for the calculation of energy losses, carried out laboratory measurements at the German institute **FFI FERNWARME**, following European standards: EN ISO 13941, EN ISO 8497, EN ISO 15632-2 and EN 253.

Calculation of energy losses in underground networks

The energy loss Φ [W/m] for a pre-insulated pipe is calculated by equation (1), while for pipe pairs it is calculated by equation (2):

$$(1) \qquad \Phi = U\cdot(T_F - T_S) \qquad [W/m]$$

$$(2) \qquad \Phi = U\cdot(T_F - T_R)-2\cdot T_S$$

Where:
U [W/m·K]: Total heat transfer coefficient
T_F [°C]: Fluid temperature (supply)
T_R [°C]: Fluid temperature (return)
T_S [°C]: Subsoil temperature

The total heat transfer coefficient U [W/m·K] is calculated by equation (3):

$$(3) \qquad U = \frac{1}{(R_{PUR} + R_P + R_C + R_S + R_H)} \quad [W/m\cdot K]$$

Where:
R_{PUR} [m·K/W]: Thermal resistance of PUR insulator
R_P [m·K/W]: Thermal resistance of PP pipe
R_C [m·K/W]: Thermal resistance of PVC shell
R_S [m·K/W]: Thermal resistance of subsoil
R_H [m·K/W]: Thermal resistance of the medium

The individual thermal resistances R [m·K/W] are calculated by equations (4):

$$(4.1) \qquad R_{PUR} = \frac{1}{(2\cdot\pi\cdot\lambda_{PUR})} \cdot ln \frac{D_i}{d}$$

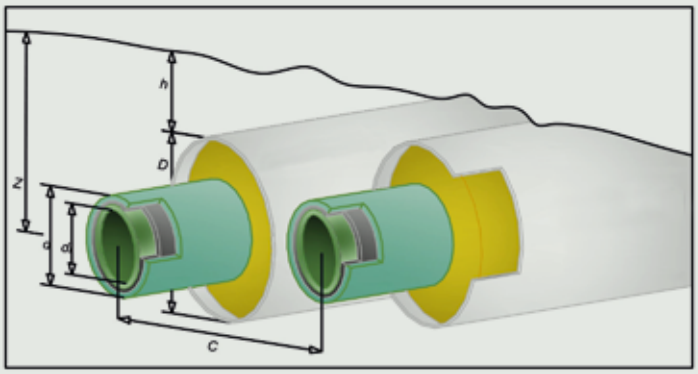
$$(4.2) \qquad R_P = \frac{1}{(2\cdot\pi\cdot\lambda_P)} \cdot ln \frac{d}{d_i}$$

$$(4.3) \qquad R_C = \frac{1}{(2\cdot\pi\cdot\lambda_C)} \cdot ln \frac{D}{D_i}$$

$$(4.4) \qquad R_S = \frac{1}{(2\cdot\pi\cdot\lambda_S)} \cdot ln \left[\frac{4\cdot(z+0{,}0685\cdot\lambda_S)}{D} \right.$$

$$(4.5) \qquad R_H = \frac{1}{(2\cdot\pi\cdot\lambda_{PUR})} \cdot ln \left[1+ \frac{(2\cdot(z+0{,}0685\cdot\lambda_S)^2}{C^2} \right.$$

Where:
D_i [m]: Inner diameter of PVC mantle
D [m]: Outer diameter of PVC mantle
d_i [m]: Inner diameter of PP pipe
d [m]: Inner diameter of PP pipe
λ_{PUR} [W/m·K]: Heat conductivity coefficient of PUR insulator
λ_P [W/m·K]: Heat conductivity coefficient of PP pipe
λ_C [W/m·K]: Heat conductivity coefficient of PVC mantle
λ_S [W/m·K]: Heat conductivity coefficient of subsoil
Z [m]: Depth of installation in the pipe's axis
C [m]: Distance between axes of pipe pairs
R_O [m^2·K/W]: (0,0685) Surface Transition Coefficient



Calculation of energy losses in outdoor networks

The calculation of energy losses for an outdoor network is different compared with the calculation for an underground network. The energy loss Φ [W/m] for a pre-insulated pipe is calculated by equation (5):

$$(5) \qquad \Phi = U \cdot (T_M - T_A) \qquad [W/m]$$

Where:
U [W/m·K]: Total heat transfer coefficient
T_M [°C]: Fluid temperature
T_A [°C]: Air temperature

The total heat transfer coefficient U [W/m·K] is calculated by equation (6):

$$(6) \qquad U = \frac{1}{(R_{PUR} + R_P + R_C + R_A)} \qquad [W/m \cdot K]$$

Where:
R_{PUR} [m·K/W]: Thermal resistance of PUR insulator
R_P [m·K/W]: Thermal resistance of PP pipe
R_C [m·K/W]: Thermal resistance of PVC shell
R_A [m·K/W]: Thermal resistance of air

The individual thermal resistances R[m·K/W] are calculated by equations (7):

$$(7.1) \qquad R_{PUR} = \frac{1}{(2 \cdot \pi \cdot \lambda_{PUR})} \cdot ln \frac{D_i}{d}$$

$$(7.2) \qquad R_P = \frac{1}{(2 \cdot \pi \cdot \lambda_P)} \cdot ln \frac{d}{d_i}$$

$$(7.3) \qquad R_C = \frac{1}{(2 \cdot \pi \cdot \lambda_C)} \cdot ln \frac{D}{D_i}$$

$$(7.4) \qquad R_A = \frac{1}{(\pi \cdot h \cdot D)}$$

Where:
D_i [m]: Inner diameter of PVC mantle
D [m]: Outer diameter of PVC mantle
d_i [m]: Inner diameter of PP pipe
d [m]: Outer diameter of PP pipe
λ_{PUR} [W/m·K]: Heat conductivity coefficient of PUR insulator
λ_P [W/m·K]: Heat conductivity coefficient of PP pipe
λ_C [W/m·K]: Heat conductivity coefficient of PVC mantle
λ_A [W/m·K] : Heat conductivity coefficient of air
h [W/m²·K]: Heat transfer coefficient of air

The heat transfer coefficient of air h [W/m²·K] is defined by equation (8):

$$(8) \qquad h = h_C + h_R$$

Where:
h_C [W/m²·K]: Convective heat transfer coefficient of air
h_R [W/m²·K]: Radiation coefficient

The convective heat transfer coefficient of air h_C [W/m²·K] is calculated by equation (9):

$$(9) \qquad h_C = 0{,}023 \cdot \frac{[V^{0,8} \cdot k^{0,6} \cdot (\rho \cdot C_P)^{0,4}]}{(D^{0,2} \cdot v^{0,4})}$$

Where:
V [m/s]: Air velocity
K [W/m·K]: Thermal conductivity of air
ρ [Kg/m³]: Air density
C_P [W/m²·K]: Specific heat of air
D [m]: Outer diameter of PVC mantle
ν [m²/s]: Kinematic viscosity of air

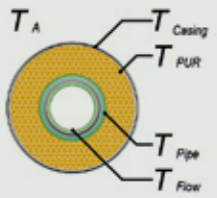
The radiation coefficient for a material hR [W/m²·K] is calculated by equation (10):

$$(10) \qquad h_R = 4 \cdot \varepsilon \cdot \sigma \cdot T^3$$

Where:
ε [-]: Emission coefficient of material (mantle)
σ [W/m²·K⁴]: Stefan – Bolzmann Constant $5{,}67 \cdot 10^{-8}$
T [K]: Air temperature in Kelvin

THEORY AND CALCULATIONS

Temperature calculation



The calculation of the temperature in the outer part of the service pipe is calculated by equation (11):

$$(11) \qquad T_{PIPE} = T_F - \frac{(T_F - T_A)\cdot R_P}{R_{TOTAL}} \qquad [C°]$$

The calculation of the temperature of the insulator is calculated by equation (12):

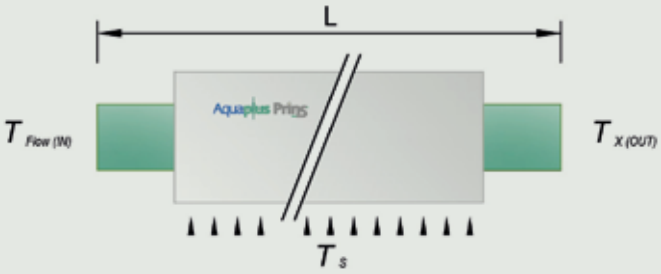
$$(12) \qquad T_{PUR} = T_{PIPE} - \frac{(T_F - T_A)\cdot R_{PUR}}{R_{TOTAL}} \qquad [C°]$$

The calculation of the surface temperature in the mantle housing is calculated by equation (13):

$$(13) \qquad T_{Casing} = T_{PUR} - \frac{(T_F - T_A)\cdot R_C}{R_{TOTAL}} \qquad [C°]$$

Where:
T_{Flow} [°C]: Temperature of fluid internally
T_{Pipe} [°C]: Temperature of service pipe externally
T_{PUR} [°C]: Temperature of insulator
T_{Casing} [°C]: Temperature of mantle externally
T_A [°C]: Temperature of air/subsoil
R_{PUR} [m·K/W]: Heat resistance of PUR insulator
R_P [m·K/W]: Heat resistance of PP pipe
R_C [m·K/W]: Heat resistance of PVC shell
R_{TOTAL} [m·K/W]: Total heat resistance

NOTE:
The total resistance R_{TOTAL} in the case of underground installations can be calculated by the sum of the equation (3), while for outdoor installations can be calculated by the sum of equation (7).



The outlet temperature of the fluid T_X in an extended network under constant ambient temperature is defined by equation (14):

$$(14) \qquad T_X = \Delta T \cdot Exp\left(\frac{-U\cdot L}{m\cdot C_P}\right) + T_C$$

Where:
ΔT [C°]: Temperature difference between the fluid and the ambient temperature of the pipe
Exp ή e^x: Euler Irrational number
U [W/m·K]: Total heat transfer coefficient
L [m]: Pipe length
M [Kg/s]: Fluid mass
C_P [J/Kg·K]: Specific heat of fluid in constant pressure
T_S [C°]: Ambient temperature

The fluid mass is defined by equation (15):

$$(15) \qquad m = \left(\frac{\frac{Q}{1000}\cdot \rho_m}{m\cdot C_P}\right)$$

Where:
Q [l/h]: Fluid supply
ρm [Kg/m^3]: Fluid density

INSULATION SPECIFICATIONS ACCORDING TO ASHRAE STANDARDS

The wall thickness of the insulation of Aqua-Plus Prins is fully compatible with the standards 90.1-2010 & 2012 of ASHRAE, which is a prerequisite for acquiring the LEED building certification.

ANSI/ASHRAE/IES Standard 90.1 - 2010 & 2012 IECC

Pipe Insulation Requirements in Commercial Buildings

Table 6.8.3A Minimum Insulation Thickness Heating and Hot Water Systems

Fluid Operating Temperature Range (°C) and Usage	Insulation Conductivity		Nominal Pipe or Tube Size (mm)				
	Conductivity W/(m°C)	Mean Rating Temperature, (°C)	<25	25 up to <40	40 up to <100	100 up to <200	≥ 200
			Insulation Thickness (mm)				
41 - 60 °C	0.032 - 0.040	38	25	25	40	40	40

Table 6.8.3B Minimum Insulation Thickness Cooling Systems

Fluid Operating Temperature Range (°C) and Usage	Insulation Conductivity		Nominal Pipe or Tube Size (mm)				
	Conductivity W/(m°C)	Mean Rating Temperature, (°C)	<25	25 εως <40	40 εως <100	100 εως <200	≥ 200
			Insulation Thickness (mm)				
4 - 16°C	0.030 - 0.039	24	15	15	25	25	25

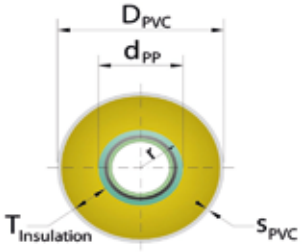
a For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows: $T = r\{(1 + t/r)^{K/k} - 1\}$ where T = minimum insulation thickness (mm), r = actual outside radius of pipe (mm), t = insulation thickness listed in this table for applicable fluid temperature and pipe size, K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (W / m ° C) and k = the upper value of the conductivity range listed in this table for the applicable fluid temperature.

b These thicknesses are based on energy efficiency considerations only. Issues such as water vapor permeability or surface condensation sometimes require vapor retarders or additional insulation.

§ a special wall thickness calculation

$$T = r\{(1 + t / r)^{K/k} - 1\}$$

Where :



T = measured minimum wall thickness of insulation in mm
r = outer pipe radius $d_{PP}/2$ in mm
t = suggested insulation wall thickness according to tab.6.8.3A & tab. 6.8.3B in mm
k = higher value of conductivity area according to tab.6.8.3A & tab. 6.8.3B in W/m°C
λ or K_{PUR} = coefficient of polyurethane conductivity W/m°C in accordance with EN ISO 8497: 1996

tab.1 manufacturing features of Aqua Plus Prins
tab.2 equivalent allowance wall thickness of insulation for λ=0,021 W/m°C
in accordance with tab.6.8.3.A&B **§ a**

Manufacturing features K.Ev.A.K Prins

Size	d_{PP}	D_{PVC}	S_{PVC}	$T_{Insulation}$
	mm			
20/63	20	63	2,2	**19,3**
25/63	25	63	2,2	**16,8**
32/63	32	63	2,2	**13,3**
40/75	40	75	2,2	**15,3**
50/90	50	90	2,2	**17,8**
63/100	63	100	2,5	**16,0**
63/110	63	110	2,5	**21,0**
75/125	75	125	2,5	**22,5**
90/140	90	140	3,2	**21,8**
110/160	110	160	3,2	**21,8**
125/200	125	200	3,5	**34,0**
160/225	160	225	4,5	**28,0**
200/250	200	250	4,5	**20,5**
250/315	250	315	6,0	**26,5**
315/400	315	400	8,2	**34,3**

tab.1

Wall thickness according to: tab.6.8.3.A & tab. 6.8.3

$T_{calculated}$ $\lambda_{0,021}$	
41-60 °C	4 - 16 °C
mm	
9,3	6,4
9,8	6,6
10,2	6,8
10,6	7,0
16,3	11,3
	11,7
16,9	
17,4	11,9
17,8	12,1
18,3	12,3
18,5	12,4
19,0	12,6
19,3	12,8
19,6	12,9
19,9	13,0

tab.2

GUARANTEED ENERGY LOSSES by INTERPLAST

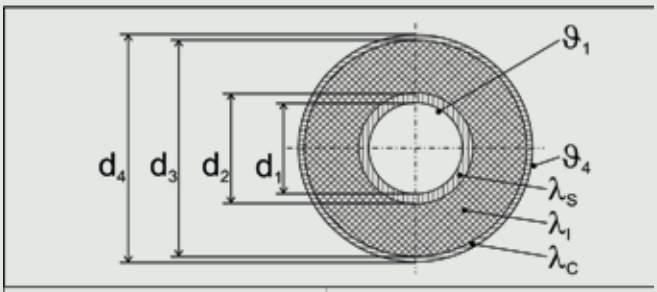
After the system's evaluation by the German FFI Institute, we can accurately guarantee the energy losses of the Aqua-Plus Prins system.
The reduction achieved compared to conventional insulation systems ranges from 55% to 70%.

It is worth noting that in a Ø75 pipe with an outer housing made of PVC Ø125, we achieved fewer losses compared to a Ø75 pipe with an outer housing made of HDPE Ø140 (heat flow rate /2 the meters of the specimen).

That is due to Polyurethane's high quality and the outer housing made of M-PVC with a special composition.

FFI FERNWÄRME FORSCHUNGSINSTITUT

Thermal conductivity of pre-insulated pipe systems according to EN ISO 8497:1996

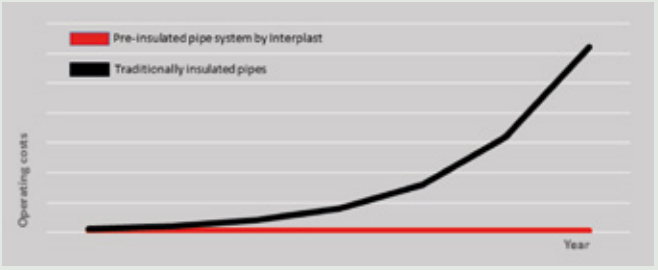


specimen № – order №		**4831 – 5340**			
orderer		**Interplast S.A.**			
label (imprint on casing)		Aqua Plus Prins Ø125 PPR/PUR/ECO U -PVC Free PB- UV Protection DIN 4102 B1- PATENDED 0407181414 -3-			
pipe assembly diameter nominal	[mm]×[mm]/[mm]		75×10,3/125		
test section length	L	[m]	2,000		
inner diameter of service pipe	d_1	[mm]	53,0		
outer diameter of service pipe	d_2	[mm]	75,5		
thermal conductivity of service pipe	λ_S	[W·m⁻¹·K⁻¹]	0,24		
thermal conductivity of casing	λ_C	[W·m⁻¹·K⁻¹]	0,23		
inner diameter of casing	d_3	[mm]	120,0		
outer diameter of casing	d_4	[mm]	125,1		
test temperature level	$\vartheta_{1,set}$	[°C]	60	70	80
heat flow rate	Φ	[W]	19,8	26,17	32,54
ambient temperature	ϑ_{amb}	[°C]	23,3	23,2	23,2
temperature of service pipe inner surface	ϑ_1	[°C]	60,0	70,0	79,9
temperature of casing outer surface	ϑ_4	[°C]	30,3	31,9	33,8
mean temperature of the insulation	ϑ_{av}	[°C]	44,1	50,9	56,8
thermal conductivity of pipe system	λ_{Sav}	[W·m⁻¹·K⁻¹]	0,0455	0,0469	0,0482
thermal resistance of pipe system	R_{Sav}	[m·K·W⁻¹]	3,0014	2,9115	2,8333
thermal conductivity of thermal insulation	λ_I	[W·m⁻¹·K⁻¹]	0,0269	0,0278	0,0287
thermal conductivity of pipe system at ϑ_{av} = 50 °C	λ_{Sav}	[W·m⁻¹·K⁻¹]	0,047		
thermal resistance of pipe system at ϑ_{av} = 50 °C	R_{Sav}	[m·K·W⁻¹]	2,924		
thermal conductivity of thermal insulation at ϑ_{av} = 50 °C	λ_{50}	**[W·m⁻¹·K⁻¹]**	**0,028**		
test period:	13.08.2018-16.08.2018				
testing engineer:	Kraft				

CONVENTIONAL INSULATIONS VS AQUA-PLUS PRINS

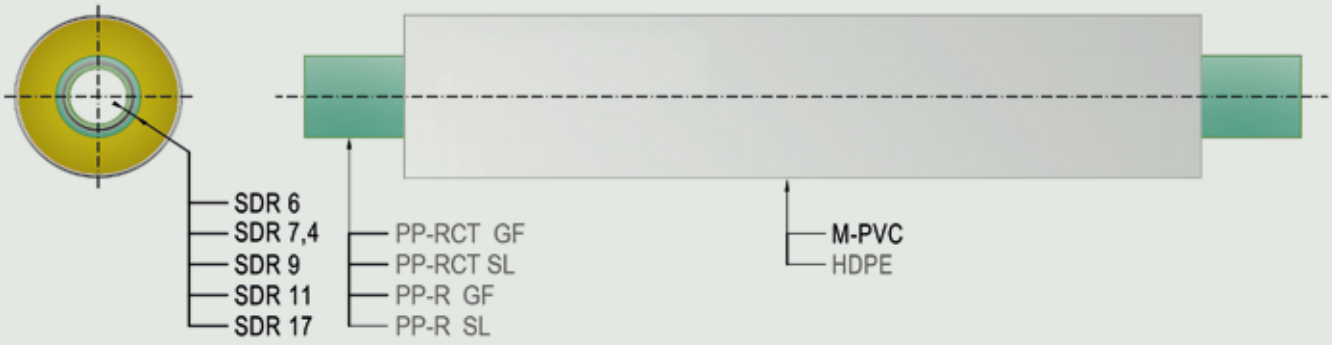
Aqua-Plus Prins is an industrial product.
Therefore, its original properties remain unchanged. In non-industrial network insulation, installation processes may change the insulator's properties and lifespan, thus increasing energy consumption. With Aqua-Plus Prins, due to the low coefficient of thermal conductivity λ = 0.028 W/mK, which remains steady over time, the smooth operation of the networks is ensured.

ADVANTAGES
—The shell, made of M-PVC with a special composition, and the complete filling of the voids ensure durability over time without any maintenance requirement
—In conventional insulation systems, liquefaction, observed due to air entrapment phenomena between the insulator and the pipe, drastically reduces the insulating properties
—Faster installation speed
—Long lifespan with constant insulation properties
—Does not allow the infiltration of insects, rodents and birds
—The support cannot damage the housing of the Aqua-Plus Prins system



For all the above, Interplast is certified for the quality of the polyurethane of the Aqua-Plus Prins system.

PRODUCED SYSTEM COMBINATIONS



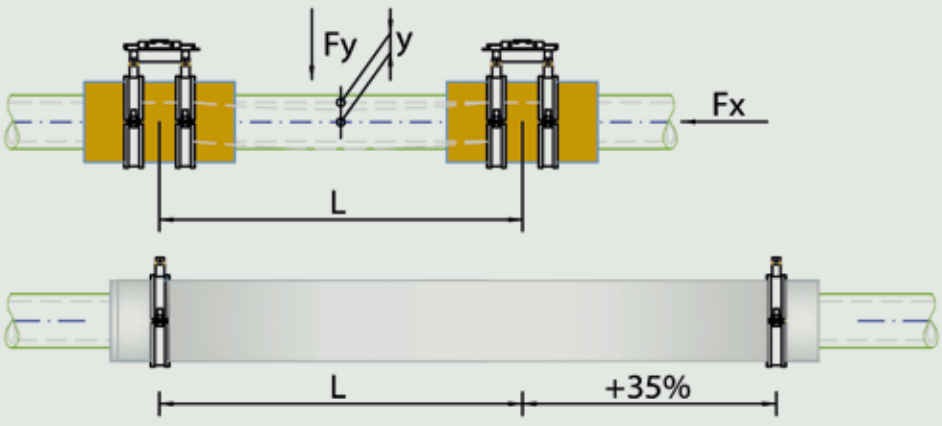
Support

The Aqua-Plus Prins compact structure allows increasing the distances between each support from +35% to +45% on each condition.

That is due to the small bending arrow, which does not change substantially from the fluid-ambient temperature difference.

Furthermore, the product provides thermal energy dissipation between pipe support and a structural element without using polyurethane thermal insulation cases (shells) or the need to use a special type of split support.

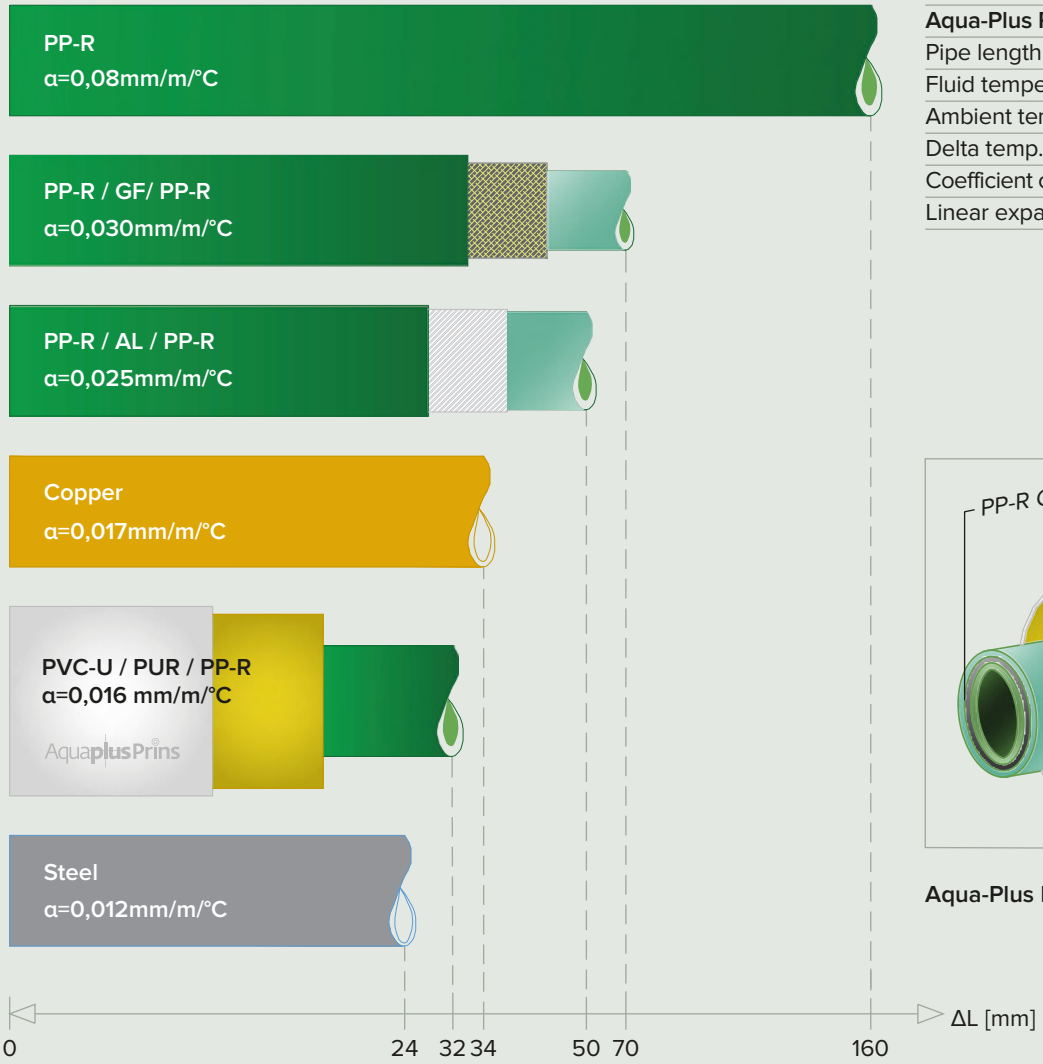
For information on intended distances and on how to support them, please consult the product installation manual.



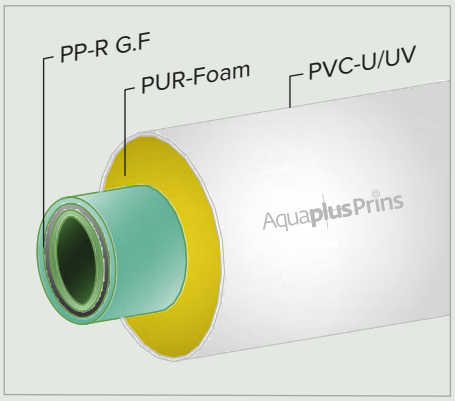
LINEAR EXPANSION AND SUPPORT OF AQUA-PLUS PRINS

LOWER LINEAR EXPANSION COMPARED TO COPPER
55% lower linear expansions than a fiberglass pipe and marginally lower than a copper pipe (PRINS linear expansion coefficient, α = 0.016 mm/m/C°).

The Aristotle University of Thessaloniki performed the measurement. In addition, Interplast Laboratory performed extensive factory tests on network models.



Aqua-Plus Prins comparison data	
Pipe length L	50m
Fluid temperature θ_w	50°C
Ambient temperature θ_a	10°C
Delta temp. $\Delta\theta=\theta_a-\theta_w$	40°C
Coefficient of thermal expansion α	mm/m/°C
Linear expansion / contraction ΔL	mm



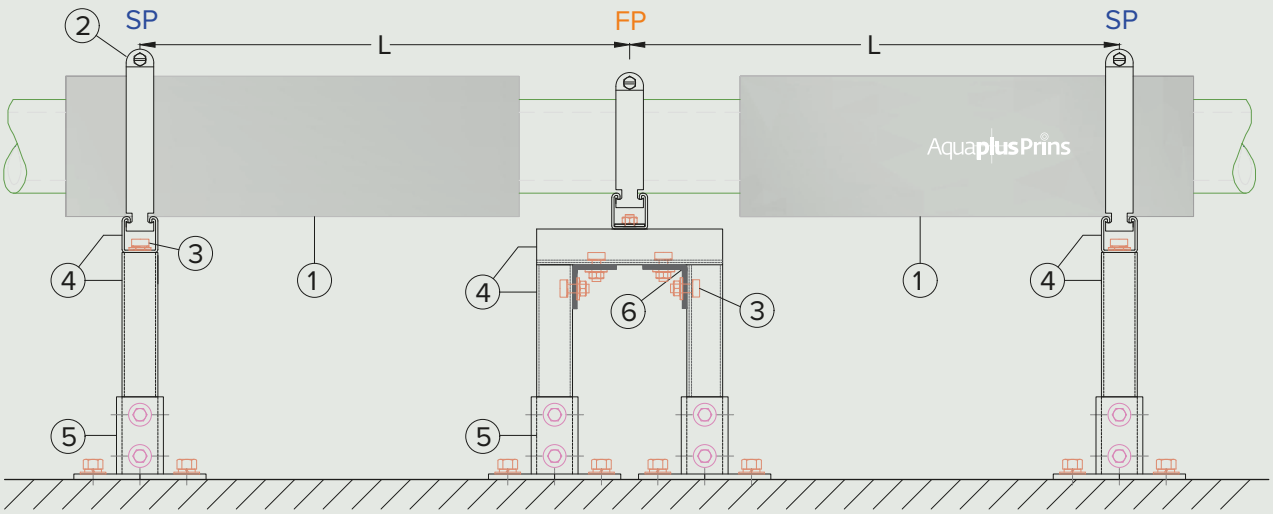
Aqua-Plus Prins structure

CONCLUSIONS
—Simpler structures to support piping networks made by PP-R/PUR/PVC-U pre-insulated system
—Lower support cost
—Faster and easier installation
—Simple design than design offices
—In the pre-insulated system, a support step 35-45% larger than the support step used for the non-pre-insulated pipe can be used

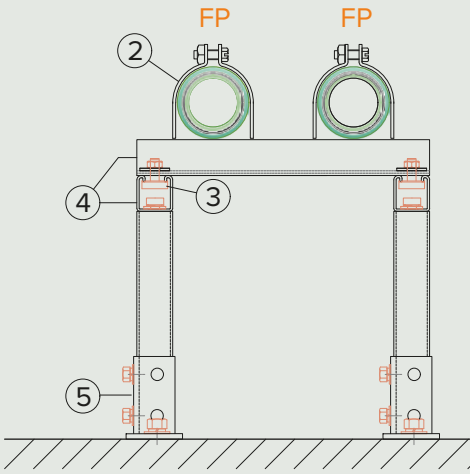
EXAMPLE
In a horizontal network of 50 meters, it is enough to use only rails and collars to support the pipe, without the need for fixed points and sliding fittings.

SUPPORT

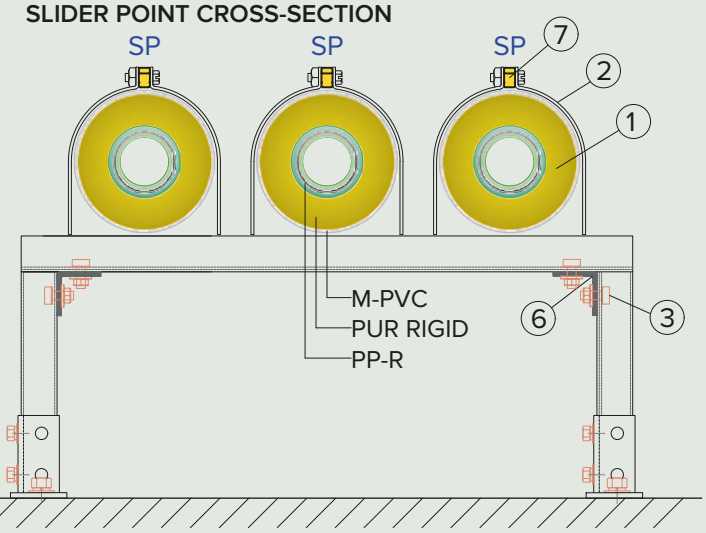
HORIZONTAL INSTALLATION WITH ANCHORING OF BASES ON CONCRETE SLABS: SIDE VIEW

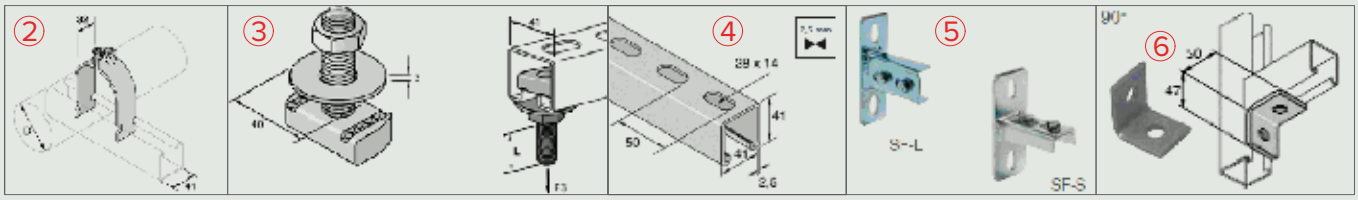


FIX POINT CROSS-SECTION



SLIDER POINT CROSS-SECTION





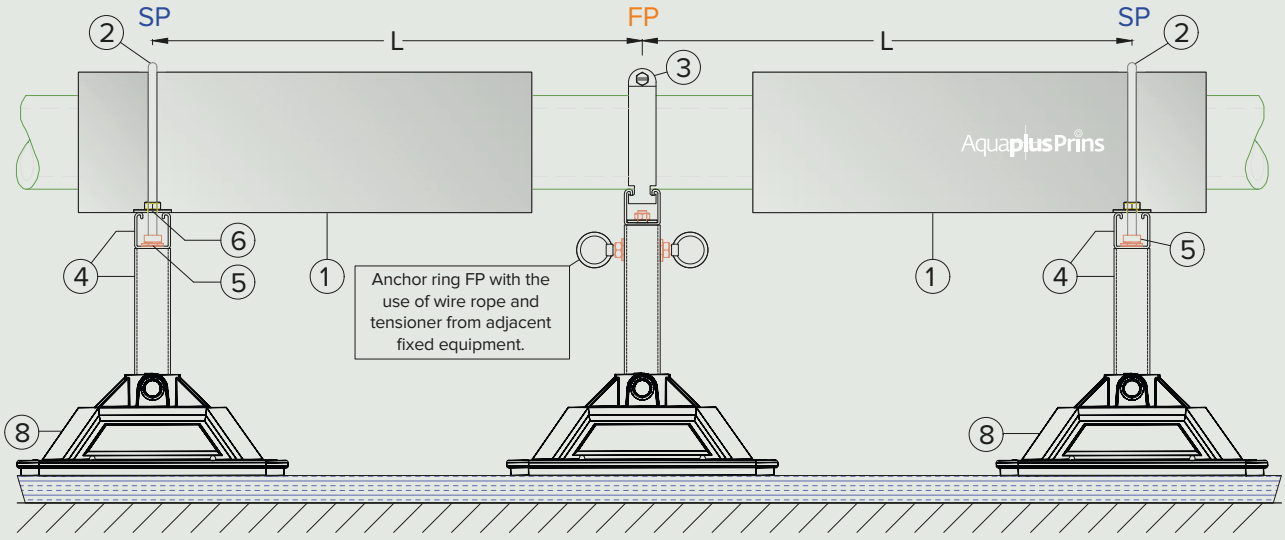
1. PRE-INSULATED PP-R/PUR/M-PVC PIPE Aqua-Plus Prins
2. DUAL-USE BILATERAL RAIL 41 SUPPORT
   (FIX & SLIDER POINT)
3. MOUNTING COMPONENT FOR RAIL 41 M10, M12
4. RAIL 41x41x2.0/2,5mm
5. MOUNTING BASES FOR RAIL 41, SF-L, SF-S
6. RAIL 41 MOUNTING ANGLE 90°
7. SPACER FOR BILATERAL SUPPORT
   ONLY FOR SLIDER POINT

- FP. FIX POINT - FIXED SUPPORT
- SP. SLIDER POINT / SLIDING SUPPORT

L. DISTANCE OF SUPPORTS
CONSULT THE RELATED TABLE

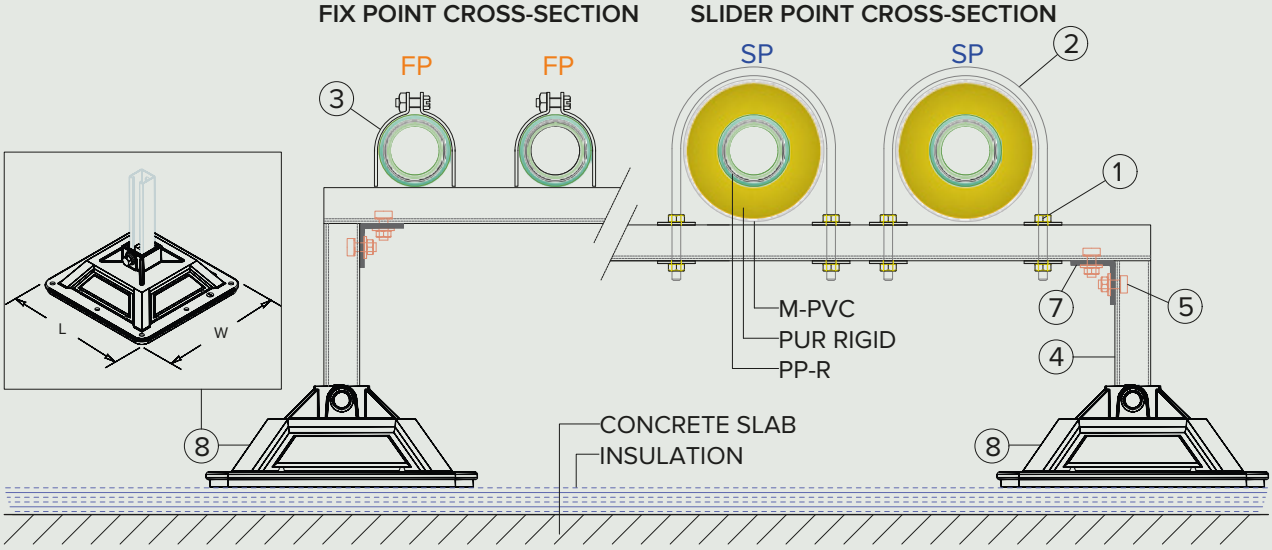
NOTE:
The type of support used to create a fixed or slippery point is the same. At the fixed point (FP), the support anchors the PP transport tube. At the slip point (SP), the support surrounds the outer wall of the M-PVC and the slip gap is maintained with the addition of a spacer.

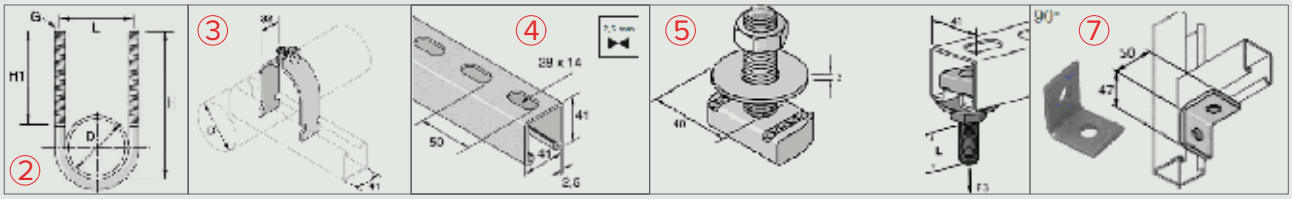
HORIZONTAL INSTALLATION WITH SLIDING GUIDE: SIDE VIEW



FIX POINT CROSS-SECTION

SLIDER POINT CROSS-SECTION





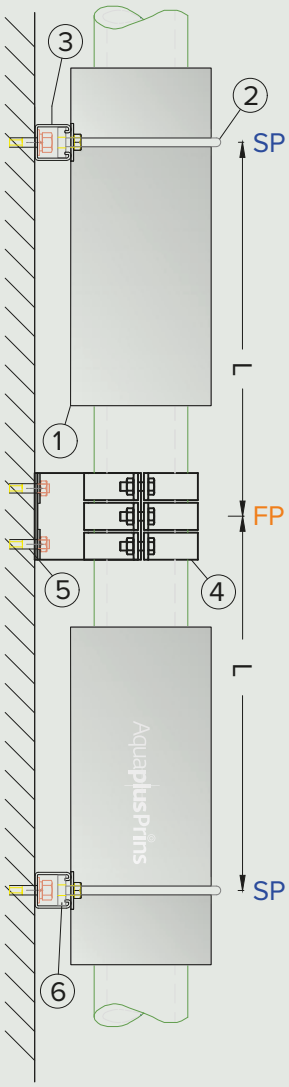
1 PRE-INSULATED PP-R/PUR/M-PVC PIPE Aqua-Plus Prins
2 U-BOLT M10-M16
3 DUAL-USE BILATERAL RAIL 41 SUPPORT (FIX POINT)
4 RAIL 41x41x2.0/2,5mm
5 MOUNTING COMPONENT FOR RAIL 41 M1, M12
6 MOUNTING COMPONENT U-BOLT M10-M16
7 MOUNTING BASES FOR RAIL 41, SF-L, SF-S
8 RAIL 41 MOUNTING ANGLE 90°
9 POLYAMIDE SLIDING GUIDE WITH RAIL 41 SUPPORT BASE

- FP. FIX POINT - FIXED SUPPORT
- SP. SLIDER POINT / SLIDING SUPPORT

L. DISTANCE OF SUPPORTS
CONSULT THE RELATED TABLE

NOTE:
Fixed base (FP) sliding guide shoes should be immobilized. They can be immobilized by using a wire rope and a tensioner from adjacent fixed points on the roof.

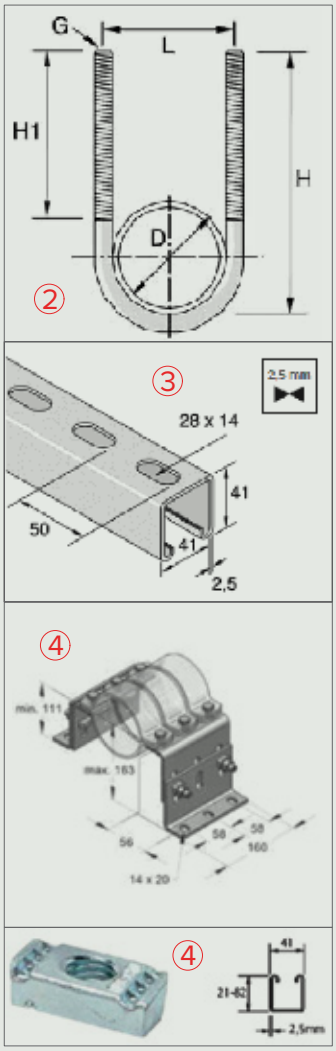
VERTICAL INSTALLATION: SIDE VIEW



1 PRE-INSULATED PP-R/PUR/M-PVC PIPE Aqua-Plus Prins
2 U-BOLT M10-M16 - SLIDER POINT
3 RAIL 41x41x2.0/2,5mm
4 FIX POINT OF VARIABLE HEIGHT 20-30 kN
5 MOUNTING COMPONENT FOR RAIL 41 M1, M12
6 UPRIGHT NUT FOR RAIL 41 M10-M16
● FP. FIX POINT - FIXED SUPPORT
● SP. SLIDER POINT / SLIDING SUPPORT
L. DISTANCE OF SUPPORTS
CONSULT THE RELATED TABLE

NOTE:
In the case of a vertical wall support, the use of a different type of fixed support (FP) is recommended. In the vertical sections there are, in addition to the expansion stresses, large weight loads that create requirements for the distribution of stresses on the surface of the pipe as well as for high tensile strength.

IMPORTANT NOTE:
Support details are standard. The sizes of the proposed mounting components are indicative and are subject to change.
The final choice for the suitable type of rail, plugs, connectors, etc., should occur after consultation with the support supplier, knowing the weight load and the number of pipes per array.
For any extra information regarding the network support not covered in this manual, please contact Interplast Technical Support.



TABLES OF DISTANCES BETWEEN SUPPORTS FOR HORIZONAL INSTALLATION OF AQUA-PLUS PRINS PP-R or PP-RCT

SDR 7,4													
	External Diameter D (mm)												
ΔT (°C)	20	25	32	40	50	63	75	90	110	125	160	200	250
	Support Distance (cm)												
0	170	195	225	250	285	320	345	365	405	450	490	530	575
20	125	145	170	190	215	245	260	275	300	335	380	415	435
30	125	145	170	190	215	245	260	275	295	315	345	370	390
40	120	135	155	175	205	230	245	260	280	300	330	350	370
50	120	135	155	175	195	230	245	260	265	275	285	300	355
60	110	125	145	170	190	215	230	245	250	260	275	285	300
70	100	110	135	155	180	205	230	230	240	245	260	275	285

SDR 9													
	External Diameter D (mm)												
ΔT (°C)	32	40	50	63	75	90	110	125	160	200	250	315	355
	Support Distance (cm)												
0	215	245	280	315	335	355	400	420	435	440	455	475	475
20	160	180	210	240	250	265	295	315	315	335	345	355	355
30	160	180	210	240	250	265	280	295	300	315	320	345	345
40	145	170	195	225	240	250	265	280	285	300	315	320	320
50	145	170	195	225	240	250	250	260	275	285	300	310	310
60	140	160	180	210	225	240	240	245	260	275	280	295	295
70	125	145	175	195	215	215	225	230	245	260	265	285	285

SDR 11															
	External Diameter D (mm)														
ΔT (°C)	32	40	50	63	75	90	110	125	160	200	250	315	355	400	450
	Support Distance (cm)														
0	210	240	275	310	330	350	385	390	400	405	420	435	440	455	455
20	155	175	205	230	245	260	280	285	295	310	315	320	330	350	370
30	155	175	205	230	245	260	265	275	280	295	300	310	315	335	355
40	140	160	190	215	230	245	250	260	265	280	295	295	300	320	345
50	140	160	190	215	225	240	240	245	250	265	285	285	285	310	330
60	135	155	175	205	210	225	225	230	240	250	265	265	275	285	310
70	120	155	170	190	195	205	210	215	225	240	260	260	265	275	295

SDR 17								
	External Diameter D (mm)							
ΔT (°C)	125	160	200	250	315	355	400	450
	Support Distance (cm)							
0	365	370	380	390	400	405	435	435
20	265	275	285	295	300	310	330	345
30	250	260	275	280	285	295	315	330
40	245	250	260	275	275	280	300	320
50	230	240	250	260	265	275	285	310
60	215	225	240	245	250	260	265	285
70	205	210	225	230	245	250	260	275

The distances between the supports for a vertical installation can be increased by 20% of the table's values.

CALCULATIONS OF LINEAR EXPANSION

Outdoor networks
In visible heating & air conditioning networks, the visual aesthetics, the stability of the form of the networks, and the absence of stresses play a significant role in the construction.

Maintaining the correct support distances, as well as the construction of expansion joints prevent the creation of mechanical stresses in the networks, ensuring at the same time a longer lifespan and an excellent aesthetic result.

The construction of expansion joints in the Aqua-Plus Prins insulated system applies in straight lines longer than 80m or when the calculated linear expansion ΔL is greater than 50mm.

The linear expansion is calculated according to the following equation:

ΔL= a x L x ΔT

Where:
ΔL: Length of linear expansion [mm]
α: Linear expansion coefficient [mm/m·°C]
L: Pipe length [m]
ΔT: Temperature difference between the fluid and the environment [°C]

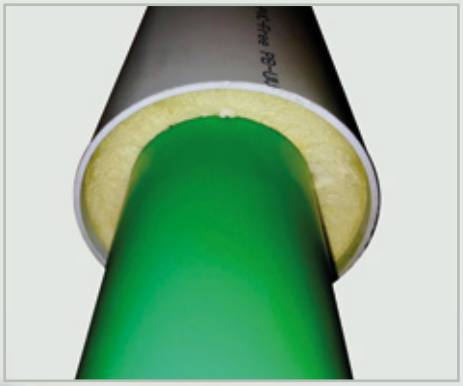
Table of linear expansion ΔL in [mm]: Aqua-Plus Prins | a=0,016 mm/m·°C

Pipe length	$\Delta T = T_{\text{fluid temperature}} - T\alpha_{\text{ambient temperature}}$							
	10°C	20°C	30°C	40°C	50°C	60°C	70°C	80°C
	Linear expansion ΔL (mm)							
10m	2	4	5	7	8	10	12	13
20m	4	7	10	13	16	20	23	26
30m	5	10	15	20	24	29	34	39
40m	7	13	20	26	32	39	45	52
50m	8	16	24	32	40	48	56	64
60m	10	20	29	39	48	58	68	77
70m	12	23	34	45	56	68	79	90
80m	13	26	39	52	64	77	90	103
90m	15	29	44	58	72	87	101	116
100m	16	32	48	64	80	96	112	128

POLYURETHANE AND HYDRAULIC TEST CHARACTERISTICS AT -10°C

TECHNICAL DATA	STABLE POLYURETHANE FOAM
Density	> 60 Kgr/m^3
Percentage of closed cells	> 94%
Water permeability	< 10% (Vol)
Compressive strength at 10% compression	> 0,3 N/mm^2
Shear resistance	> 0,12 N/mm^2
Tangential shear resistance	> 0,20 N/mm^2
Thermal conductivity coefficient	0,021 W/mK

To meet specialized industrial applications, Interplast offers a certified measurement for systems operating with propylene glycol at -10°C and a nominal pressure of 26.5 bar. That makes the Aqua-Plus Prins system suitable for complicated applications in the refrigeration industry, covering all aspects of the food industry.



OXYGEN BARRIER AND AQUA-PLUS PRINS

According to the revised stricter limits of the European standard EN ISO 21003-2 and EN ISO 17455, the daily intake of oxygen in closed heating systems should not exceed the value Fox, day ≤ 3.6mg O_2/m^2·day, with water at 80°C. Globally, this is the strictest current oxygen uptake limit.

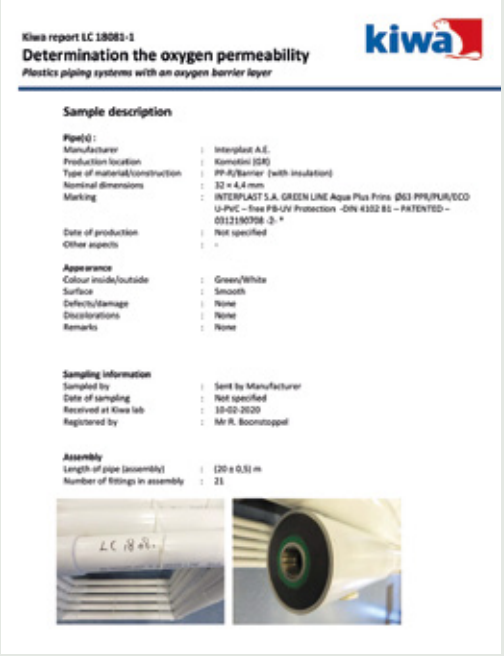
The Aqua-Plus Prins system, after a measurement of oxygen permeability, conducted by the Dutch institute KIWA, was measured to have Fox, day ≤ 1.34mg O_2/m^2·day, at 80°C.

That means that it exceeds the requirement limit by 62,78%.

In the Aqua-Plus Prins system, the specialized M-PVC mantle ensures the oxygen barrier. Therefore, the insulation and the transport pipe are both protected without the need for scraping the last one, as is the case of PP-R pipes coated with EVOH film.

In conclusion, it is the only plastic system in the world in which pipes and fittings contribute to the requirements of the standards.

On the pipe, among others, the description "Oxygen Tight" is also included, which identifies its technical characteristics. All measurements were taken by the Dutch institute KIWA.



Kiwa report LC 18081-1

Determination the oxygen permeability

Plastics piping systems with an oxygen barrier layer

kiwa

Sample description

Pipe(s) :

Manufacturer	:	Interplast A.E.
Production location	:	Komotini (GR)
Type of material/construction	:	PP-R/Barrier (with insulation)
Nominal dimensions	:	32 x 4,4 mm
Marking	:	INTERPLAST S.A. GREEN LINE Aqua Plus Prins Ø63 PPR/PLR/ECO U-PVC – free PB-UV Protection -DIN 4102 B1 – PATENTED – 0312190708 -3- *
Date of production	:	Not specified
Other aspects	:	-

Appearance

Colour inside/outside	:	Green/White
Surface	:	Smooth
Defects/damage	:	None
Discolorations	:	None
Remarks	:	None

Sampling information

Sampled by	:	Sent by Manufacturer
Date of sampling	:	Not specified
Received at Kiwa lab	:	10-02-2020
Registered by	:	Mr R. Boomstoppel

Assembly

Length of pipe (assembly)	:	(20 ± 0,5) m
Number of fittings in assembly	:	21

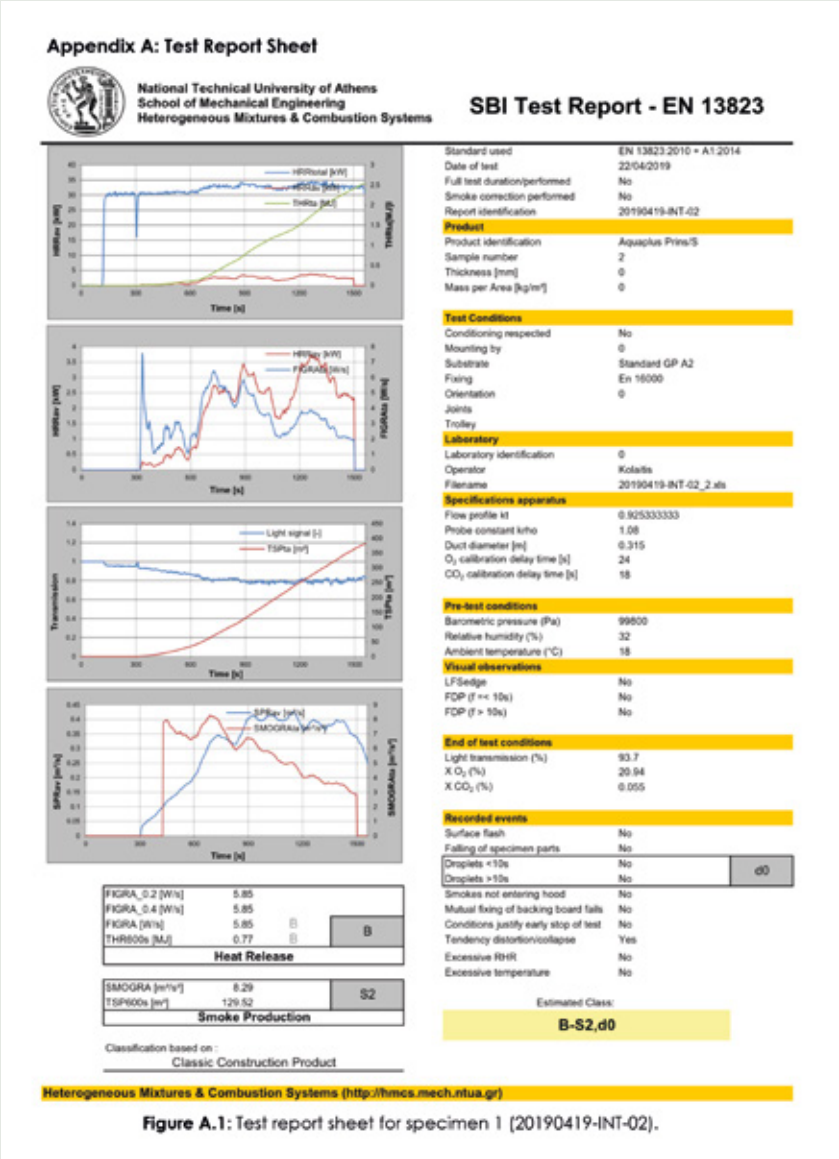
WATERPROOF CERTIFICATIONS OF CONNECTIONS

The waterproofing of the connections in the underground as well as in external networks requires extra care to avoid the absorption of moisture by Polyurethane.

Interplast holds a certified measurement of the waterproofing of fittings and piping according to EN 489.

ΕΚΘΕΣΗ ΕΡΓΑΣΤΗΡΙΑΚΩΝ ΔΟΚΙΜΩΝ

CLASSIFICATION B-S2, D0 FOR AQUA-PLUS PRINS



Appendix A: Test Report Sheet

National Technical University of Athens
School of Mechanical Engineering
Heterogeneous Mixtures & Combustion Systems

SBI Test Report - EN 13823

Standard used	EN 13823:2010 + A1:2014
Date of test	22/04/2019
Full test duration/performed	No
Smoke correction performed	No
Report identification	20190419-INT-02
Product	
Product identification	Aquaplus Prins/S
Sample number	2
Thickness [mm]	0
Mass per Area [kg/m²]	0
Test Conditions	
Conditioning respected	No
Mounting by	0
Substrate	Standard GP A2
Fixing	En 16000
Orientation	0
Joints	
Trolley	
Laboratory	
Laboratory identification	0
Operator	Kolaitis
Filename	20190419-INT-02_2.xls
Specifications apparatus	
Flow profile kt	0.925333333
Probe constant kotho	1.08
Duct diameter [m]	0.315
O_2 calibration delay time [s]	24
CO_2 calibration delay time [s]	18
Pre-test conditions	
Barometric pressure (Pa)	99600
Relative humidity (%)	32
Ambient temperature (°C)	18
Visual observations	
LFSedge	No
FDP (t =< 10s)	No
FDP (t > 10s)	No
End of test conditions	
Light transmission (%)	93.7
X O_2 (%)	20.94
X CO_2 (%)	0.055
Recorded events	
Surface flash	No
Falling of specimen parts	No
Droplets <10s	No
Droplets >10s	No
Smokes not entering hood	No
Mutual fixing of backing board fails	No
Conditions justify early stop of test	No
Tendency distortion/collapse	Yes
Excessive RHR	No
Excessive temperature	No

d0

FIGRA_0.2 [W/s]	5.85	
FIGRA_0.4 [W/s]	5.85	
FIGRA [W/s]	5.85	B
THR600s [MJ]	0.77	B
Heat Release		B

SMOGRA [m²/s²]	8.29	
TSP600s [m²]	129.52	
Smoke Production		S2

Classification based on :
Classic Construction Product

Estimated Class:
B-S2,d0

Heterogeneous Mixtures & Combustion Systems (http://hmcs.mech.ntua.gr)

Figure A.1: Test report sheet for specimen 1 (20190419-INT-02).

Interplast, following the global fire standards, is constantly evolving its systems towards this direction. In recent years, it has developed a high knowledge of special fire-resistant additives in the production process.

Thus, after years of research and testing, the Aqua-Plus Prins system achieved B-s2, d0 categorization.

Aqua-Plus Prins is following the Passive Fire Protection Regulation of Buildings, as described in the P.D. 41/2018. Furthermore, it also holds B-s2, d0 categorization, which means that the final product achieves a very high standard for a polymer.

PRE-INSULATED SYSTEM FITTINGS FOR AQUA-PLUS PRINS

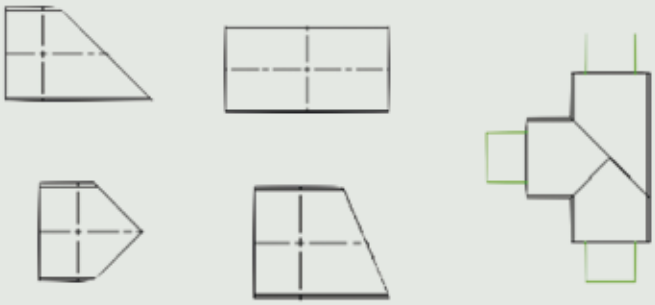
OPTION No 1 for fittings
The first option is to use only the special pieces and to inject the Polyurethane by the installer (corners and tees). M-PVC fittings are shipped ready-made for ease of installation and are 0.5mm larger than the shell of the pre-insulated pipe. The special M-PVC pieces (elbow, half-elbow, socket) have a 20mm hole for the filling of the insulator.
The welding of the M-PVC components is achieved by using special glue and spray for the complete sealing of the system. Also, the components get filled with a special polyurethane gun after mixing isocyanates and polyols with a static mixer (for more information, refer to the installation details of the pre-insulated system).

—With the mantle, we can join two pipes or one pipe and a ready-made pre-insulated fitting.

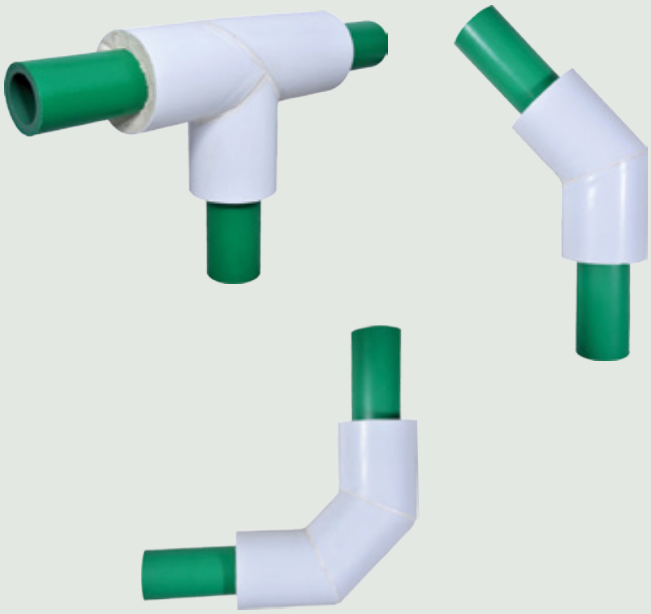
—By using two special 45° pieces, a 90° angle is created.

—By using two special 22,5° pieces, a 45° angle is created.

—By using two special pieces for tees and one special 45° piece, a tee is created.



OPTION No 2 for fittings
Use of ready-made pre-insulated factory fittings. In this case, we use only the mantle for the welding between pipes or between a pipe and a fitting.



Fast and easy pre-insulation of the supply saddle

INSTRUCTIONS FOR THE INSTALLATION OF THE PRE-INSULATED SYSTEM AQUA-PLUS PRINS

Casing pipe and polyurethane removal procedure

Using a measuring tape and an indelible marker, mark the cutting point of the part of the housing to be removed and of the polyurethane from the front of the edges.

In a pre-insulated piece with inner tube up to **Ø63/100**, we remove **150mm**, while in a pre-insulated **Ø75/125** piece and above, we remove **225mm** from the front of the edges. The insulated pieces are factory-produced in straight lengths of 4m-5.8m and maintain the same standard of the insulator and housing removal from the fronts of the edges according to the above lengths.

On the mark, cut the PVC housing transversely and around the perimeter using a pipe cutter. Next, using a knife cut the insulator in-depth, until the main PP-R pipe.

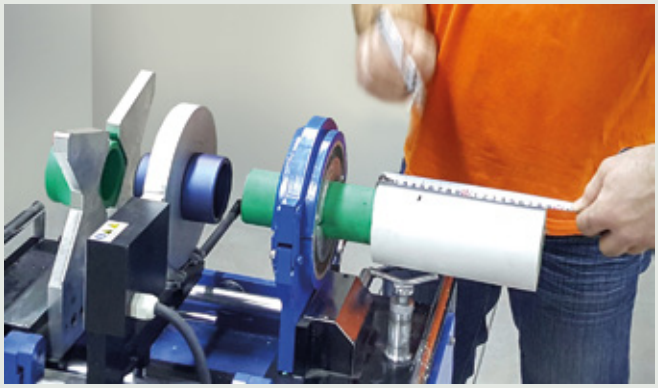
The housing is also cut along the longitudinal axis, perpendicular to the transverse perimeter cut, with a simple hand saw, separating it from the polyurethane.

WARNING!
Throughout this process, we must be extra careful not to damage the PP-R inner pipe.

Remove the insulator. Any polyurethane residues should be removed using fine sandpaper with rotating and reciprocating motions until they are eliminated.

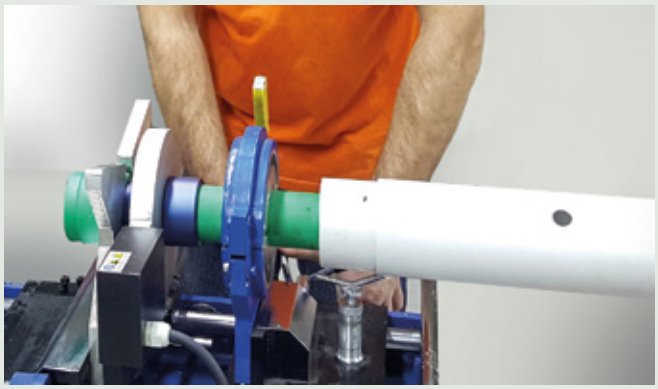
Clean the PP-R tube and the outer housing with a suitable 99% ethyl alcohol chemical solvent ($C_2 H_5 OH$) and a cloth.

Application of a PP-R socket & PVC mantle in linear connections

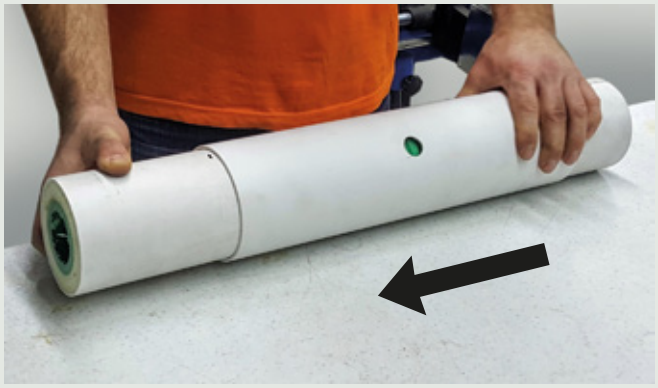


Inspect the ends that you will weld. Remove impurities from any foreign bodies or cutting residues (grease) at the ends of the PP-R pipes and the PVC case pipe with a suitable chemical alcohol solvent and a cloth.

Place the PVC mantle in one of the two pre-insulated pieces, whichever works best. The PVC mantle always has a larger diameter than the PVC housing, so it can easily touch and slide onto it.



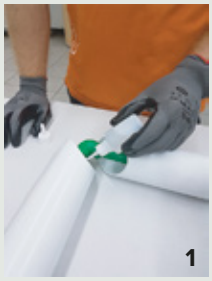
Mark both ends of the PP-R pipe for the corresponding inlet length of the fitting (PP-R socket). Weld the two ends of the PP-R pipe and the PP-R socket in a straight line with a suitable heat welding machine at 260°C using the matrices that correspond in size.



Slide the mantle along with the connection until it meets one of the two points marked on the housing. In the case of underground networks, place additional PVC tape in the union points of the mantle with the housing. Optionally, we can use PVC glue on the union points between the mantle and the housing. The mantle has a Ø20mm hole for the filling of the insulator. Ensure easy access to the polyurethane injection hole. In any case, the mantle must evenly cover the M-PVC housing.

For connecting elbows, contractions, supplies and tees, there are special pieces of M-PVC mantles.

NOTE:
All M-PVC mantles are delivered ready for installation by the factory.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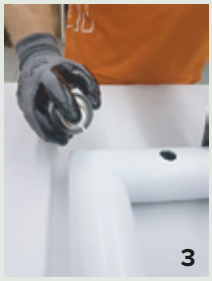
2

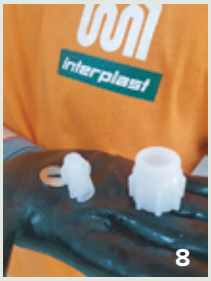

3

Before the injection, seal the mantles with the special two-component glue provided by our company, so that there are no leaks of polyurethane during the injection (fig. 1, 2, 3).
First, place the special glue (fig. 1) on the whole side of the mantle's cross-section and join with the other side, holding the piece steady for 5'' (fig. 2).
Then spray with the special spray (fig. 3) around the adhesive surface.


4


5
6
7

With a calibrated cartridge (fig. 4), take equal parts by volume (in ml) of polyol and polyisocyanate, according to the suggested quantities (attached company table, p. 68), which may vary depending on the size and the type of the connection.
For larger cross-sections, we recommend as the most suitable solution the electric pistol with has a total injection capacity of 1.5lt (fig. 5).



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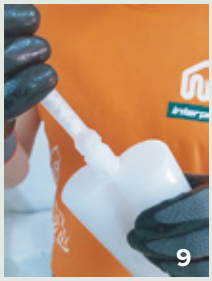
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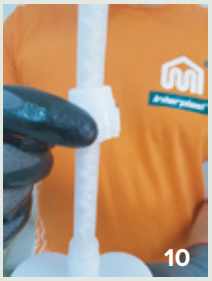

10

Before the injection, remove the cartridge cap (fig. 8) by unscrewing the cap, without removing the metal fuse. Then, place the static mixer (fig. 7 & 9) and, finally, fix it with the help of the cap nut (fig. 10).


11


12

Then empty the liquid content into the hole of the mantle (fig. 11). Measure the quantity according to the calibrated scale of the package, using the table of polyurethane injection quantities.

WARNING:
The ml measurement will start as soon as the polyurethane is on the edge of the static mixer.
Place the special cap in the hole of the mantle.
After the reaction is completed, the polyurethane will expand, and air will be expelled from the cap hole (fig. 12).
After 10 minutes and when the polyurethane has solidified, remove the gel and the cap.
For underground and outdoor networks, seal the hole with a special sealant that ensures the waterproofing of the system (MS 45). After that use the adhesive material (MS 45) surrounding on the edge of jackets. Depending the case of installation use a tape to the above points.

TIP:
While waiting, to save time, you can repeat the same process in the following compounds.

NOTE:
The same procedure is followed for all fittings, such as 90° corners, 45° corners, tees accompanied by their corresponding PVC mantles.

Especially in underground networks, a waterproofing test between the mantle and the PVC shell is required, following the requirements of EN 13941 regarding EN 489. Leakage control can be carried out with air pressure or other suitable gases.
The test requires a pressure of 0.2bar for 2min duration at a maximum outer temperature of 40°C.
We also test the hydraulic system for its strength and permeability, according to Interplast's pressure test protocol.

SOCKET

DIMENSION	POLYOL (mL)	ISOCYANATE (mL)	TOTAL (mL)
20/63	28	28	56
25/63	26	26	52
32/63	23	23	46
40/75	31	31	62
50/90	44	44	88
63/100	45	45	90
75/125	117	117	234
90/140	134	134	268
110/160	159	159	318
125/200	300	300	600
160/225	302	302	604
200/250	377	377	754
250/315	471	471	942
315/400	589	589	1178

ELBOW 90°

DIMENSION	POLYOL (mL)	ISOCYANATE (mL)	TOTAL (mL)
20/63	34	34	68
25/63	32	32	64
32/63	28	28	56
40/75	38	38	76
50/90	54	54	108
63/100	55	55	110
75/125	143	143	286
90/140	163	163	326
110/160	194	194	388
125/200	366	366	732
160/225	368	368	736
200/250	420	420	840
250/315	622	622	1244
315/400	808	808	1616

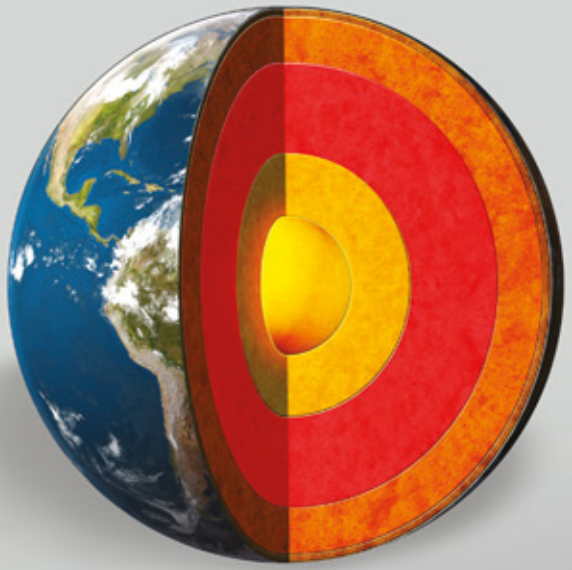
ELBOW 45°

DIMENSION	POLYOL (mL)	ISOCYANATE (mL)	TOTAL (mL)
20/63	31	31	62
25/63	29	29	58
32/63	26	26	52
40/75	35	35	70
50/90	49	49	98
63/100	50	50	100
75/125	131	131	262
90/140	150	150	300
110/160	178	178	356
125/200	336	336	672
160/225	338	338	676
200/250	439	439	878
250/315	571	571	1142
315/400	742	742	1484

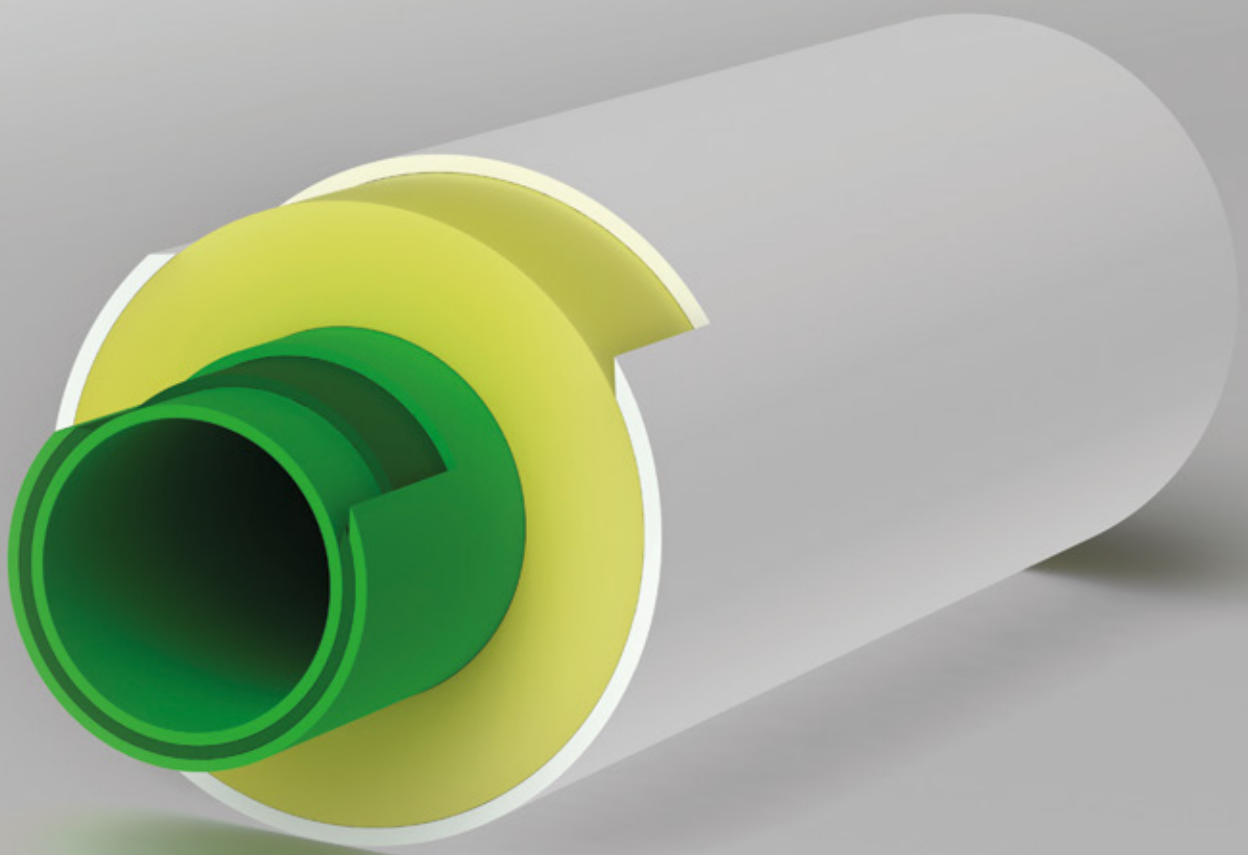
TEE

DIMENSION	POLYOL (mL)	ISOCYANATE (mL)	TOTAL (mL)
20/63	51	51	102
25/63	48	48	96
32/63	42	42	84
40/75	57	57	114
50/90	81	81	162
63/100	82	82	164
75/125	214	214	428
90/140	245	245	490
110/160	291	291	582
125/200	549	549	1098
160/225	553	553	1106
200/250	791	791	1582
250/315	949	949	1898
315/400	1139	1139	2278

Nature cares for some things
to be completely insulated...



So do we.



Aquaplus Prins

06

FITTINGS

AQUA-PLUS PN 30 FULL FLOW FITTINGS MADE OF PP-R 125

Interplast changes the rules of PP-R fittings once again upgrading them to PN 30 instrad of PN 25, using raw material made of PP-R 125. This strategic choice strengthens the overall polypropylene networks, increasing the resistance of high-stress points (fittings) of each installation.

"The new fittings are certified according to the European standard EN 15874-3"

ADVANTAGES

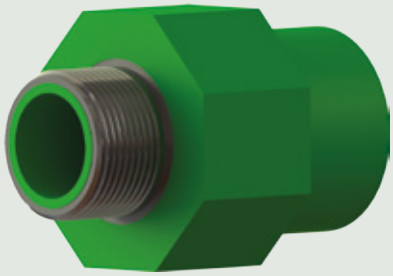
—**Use of full flow raw material,** same as the one used for the pipes, so that the mechanical strengths of the pipe do not differ from those of the fittings
Guaranteed network flows
—PP-R 125 covers their inner male brass inserts
—Perimetric channels for retaining the fitting
—Cross-shaped channels
—Enhanced pressure controls of over 100 bar instead of 64 bar in the PN20 series.
—Brass parts are reinforced, of heavy-duty and low hardness (105 Brinell)
—Metal deactivators
—UV stabilizers
—**Special additive that increases the adhesion between plastic and metal**

IMPORTANT NOTE:
In the production of fittings up to Ø125mm, the nominal pressure is PN 30, while for prefabricated fittings (over 160mm) their strength depends on the wall thickness of the pipe.

GUARANTEED NETWORK FLOWS BY INTERPLAST'S SYSTEM

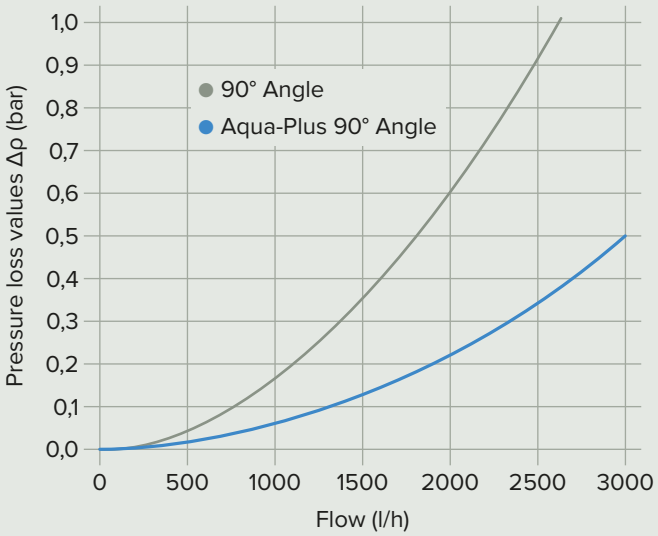
Our company designs, manufactures and offers to the technical sector a complete certified network flow system. Due to the geometry of the components, the local resistance coefficient is significantly reduced compared to a smaller wall and PN fittings.

Polypropylene, which covers the inner surface of the brass fittings, works decisively in the balance of the network and the correct calculation of the flows.

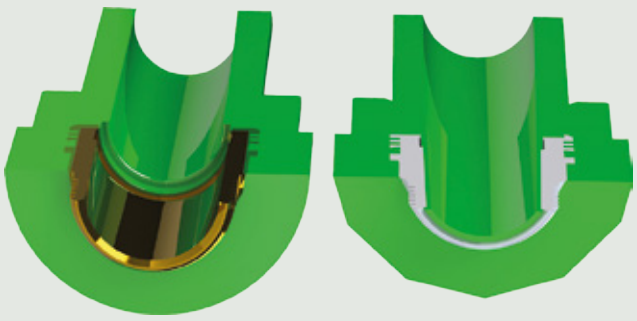


ADVANTAGES
—Larger wall thickness
—Better internal geometry
—Reduction of hydraulic losses
—Improved network flows

EXAMPLE
The local resistance coefficient (ζ) of the 90° elbow for the common PN 20 fittings is 1,2, while for the PN 30 fittings, the (ζ) is 0,9, i.e. reduced by at least 25%.

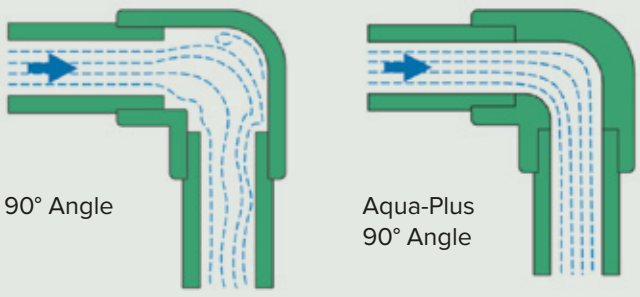


In the following 3D design, you will notice what happens after the thermal welding of a pipe with a male coupling made of PP-R. In one case (left), you see the welding of a simple fitting without polypropylene on the inside, while in the other (right), the Aqua-Plus system.



CONCLUSION:
After the thermal welding of the common component, the cross section of the pipe is smaller than the fitting, resulting in a significant alteration of the system's balance.

In the following designs, you will notice that high wall thickness allows us to design components with better geometry to reduce the value of hydraulic losses, resulting in a significant improvement in the overall flow of the system.

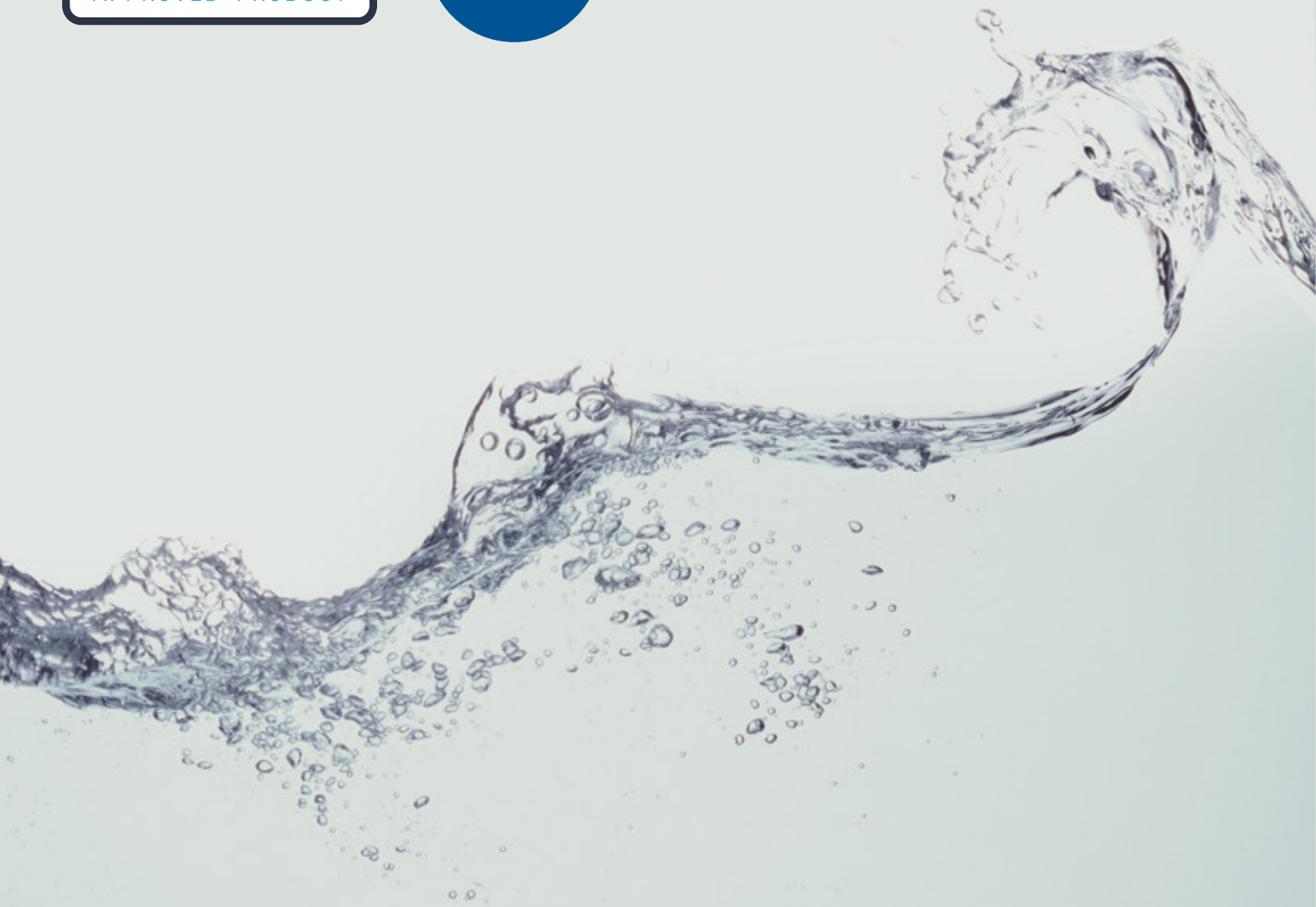


CERTIFIED FITTINGS FOR DRINKING WATER WITH NO CONTACT WITH METAL PARTS

Aqua-Plus fittings are among the few in the world that are certified for their mechanical strength and their contact with drinking water from WRAS (EU) and NSF (USA).
Furthermore, polypropylene covers the male inserts inside them, so as a result, water does not come into contact with metal parts.

ADVANTAGES

—Metal does not interfere anywhere in the installation
—Avoidance of the deposition of solid residues that would result in reduced flow
—Reduced risk of electrochemical corrosion of the metal parts of the installation



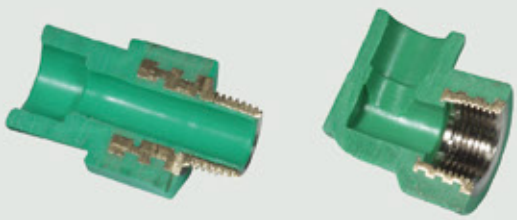
ELVIOM BRASS FITTINGS

PRODUCTION OF BRASS FITTINGS

Interplast is one of the few companies worldwide that produces all parts of the polypropylene system. Our subsidiary, ELVIOM S.A. produces the brass inserts of the mixed polypropylene fittings.

Perimetric channels for holding the fitting
One side of the channel has a negative slope from outside to inside to hold the PP-R material and prevent the metal part from being pulled out of the plastic in tensile forces.

The two photographs show the differences between Interplast's fittings and a common component, both in the wall thickness of the metal part and in the observance of the negative slopes.



Cross-shaped channels
They are processed in cross-shaped channels, at the base of the brass insert to exclude the torsion and, consequently, the detachment of the metal from the plastic part.

Heavy-duty brass fittings
The brass parts are reinforced, of heavy-duty and low hardness (105 Brinell), following the specifications and requirements of the international standards.

Procedure for stress relieving

1) Order of the raw material made of brass with specific standards, reduced hardness (Low Brinell) and suitable for drinking water applications

2) Production of brass bars by the supplier.

3) Heat treatment (annealing) on the specific brass bars by the supplier.

4) Raw material pick up by ELVIOM.

5) Processing of raw material in suitable machinery and production of fittings by ELVIOM.

6) After ELVIOM completes the fittings production, all fittings produced get in a special oven of high temperatures, where they remain for a specific time at a specific temperature (annealing).
The second heat treatment carried out on the brass fittings (final product), creates ductile fittings (softer), completely eliminates the possibility of developing internal stresses and increases their resistance to corrosion (stress corrosion cracking). This procedure eliminates the cases in which cracks occur, particularly observed in female threaded fittings.

7) Delivery of fittings with very low hardness 105 Brinell (Low Hardness fittings).

MANIFOLDS AND SPECIAL FITTINGS

PREFABRICATED AQUA-PLUS MANIFOLDS AND FITTINGS

Interplast manufactures fittings (PFF) of large diameters and central distribution manifolds. This specific department is housed inside our factory in Komotini and consists of certified welders who follow all international welding rules in each special manufacture. In addition, the tools used meet all specifications and hold individual certifications.

> ***"All prefabricated manifolds and fittings are subject to quality control checks after their manufacture and are covered by a 10-year warranty"***

MANUFACTURING PROCEDURE OF MAINFOLDS OR SPECIAL FITTINGS

1. DEMAND - OFFER

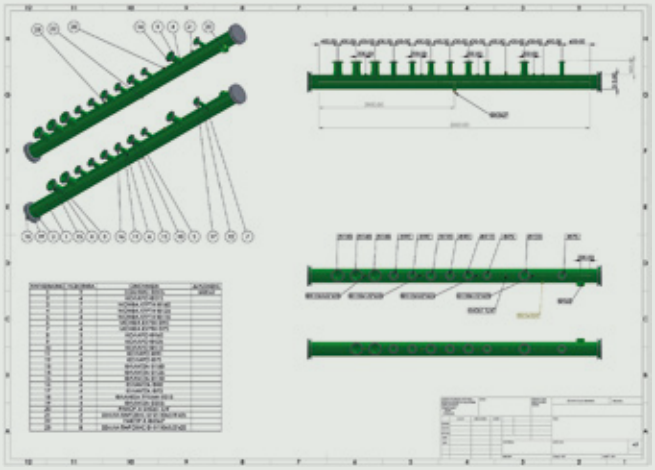
First of all, we receive the design of the special manifolds. The design should be in electronic form for better communication and error avoidance.

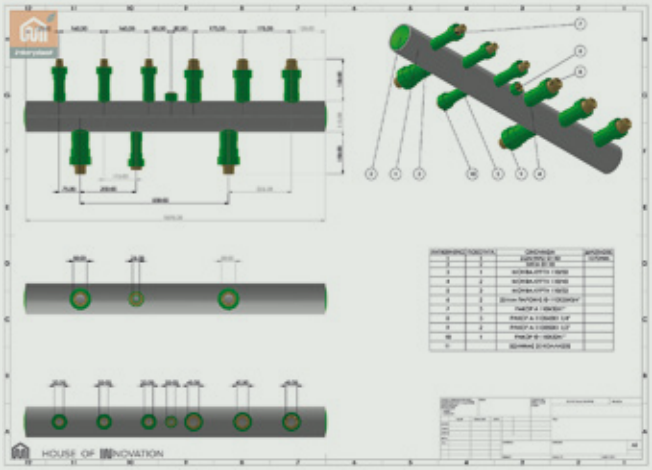
In cases where there is no possibility of receiving an electronic-type design, Interplast provides the following form to fill in the details of each manufacture. Afterwards, the Interplast manifolds department contacts the customer for any technical clarifications.

For the perfect handling of the manufacture, it is important to get from the customer as much information as possible. Afterwards, the customer receives the financial offer.

2. DESIGN AND ORDER CONFIRMATION

Interplast, at its organized 3D design department, designs manifolds or fittings after the order confirmation. That results in the correct display of the original design and the avoidance of errors.





3. MANUFACTURE

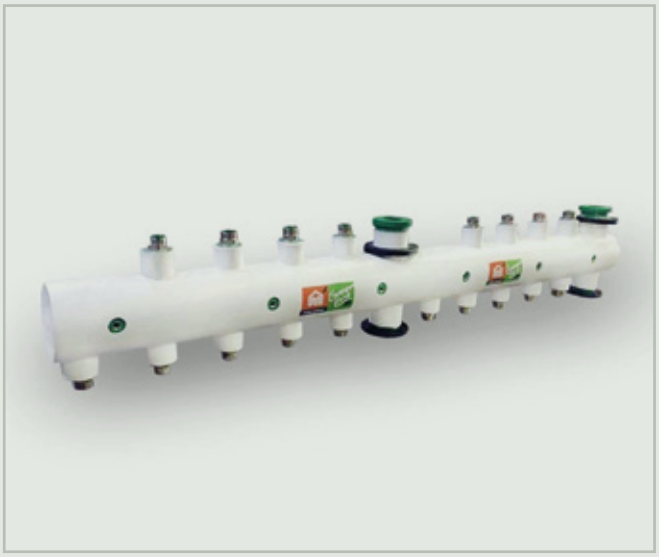
Before manufacture, we perform a quality control check on all products that will form the final image of the system (fitting or manifold) based on the confirmed 3D design. After manufacture, we perform an extra quality control check regarding leaks and the general operation.

PREINSULATED MANIFOLDS MADE OF PP-R OR PP-RCT

Preinsulated manifolds are the ideal solution for indoor and outdoor installations, as they provide a solution to the chronic problem of maintenance and contribute decisively to energy savings. Filling all surfaces with solid polyurethane results in the elimination of liquefaction and the dramatic reduction of losses.
The outer housing made of special PVC composition offers mechanical protection and a perfect aesthetic result.
High durability over time allows the final consumer to save money, as frequent maintenance is avoided, especially in air conditioning networks.

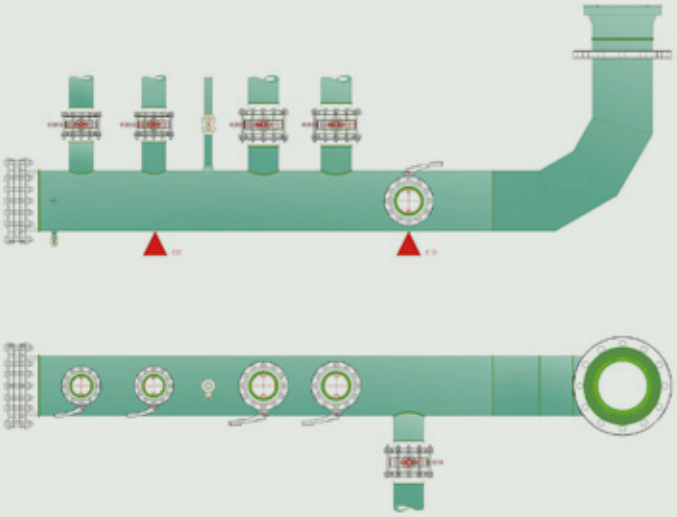
ADVANTAGES

—Zero maintenance
—Elimination of condensations
—Insulation performance for over 30 years
—Reduction of energy losses by 70%
—Quick investment payback
—Resistance to extreme weather conditions
—Resistance to external temperatures ranging from -40°C / +80°C
—High resistance to external strains
—UV Protection
—Fire resistance category B-s2, d0 (EN 13501)
—Linear expansions same as those of metal manifolds
—Offers oxygen barrier
—Certified tools
—Certified welding department



MAIN MANIFOLDS MADE OF PP-R OR PP-RCT

Central manifolds are intricate and complex manufacture in the heating-water supply and air-conditioning installations. External conditions, specific material-technical structures, and lack of special equipment make their manufacture difficult, time-consuming, and expensive.
Interplast understands the needs of the technical industry and manufactures complete manifolds and special pieces up to 630 mm made-to-order.

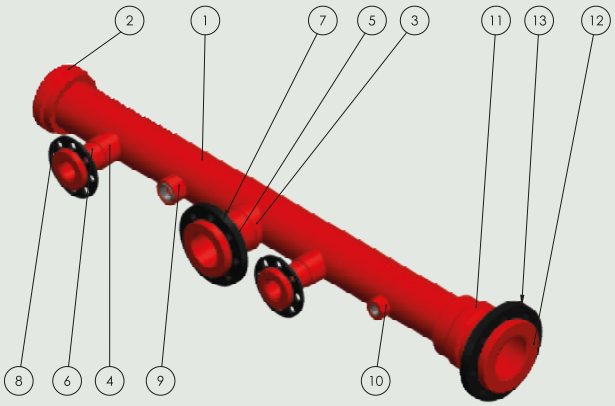


ADVANTAGES

—Industrial manufacture
—Special industrial equipment
—Possibility of complex manufactures
—Welding and strength tests controls
—Assurance of high-quality and manufacture
—Certified tools
—Certified welding department

MAIN FIREFIGHTING MANIFOLDS MADE OF PP-R 125

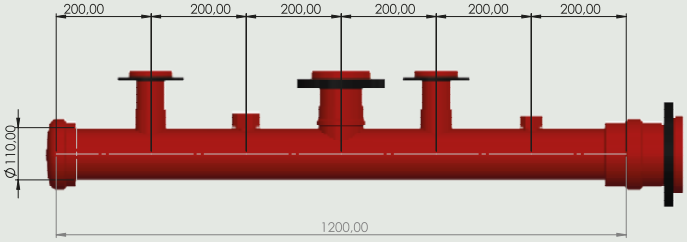
Interplast manufactures central manifolds for firefighting networks.
Thanks to our excellent special constructions department and the innovative nature of FireFighter Plus system made of polypropylene, we can offer the technical world a unique solution for main firefighting networks.

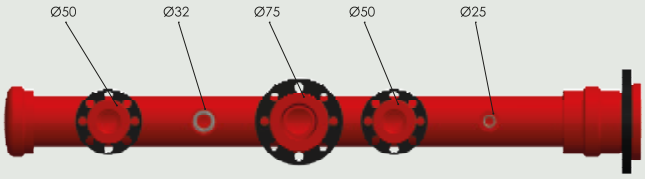


OBJECT	QUANTITY	NAME
1	1	FIREFIGHTER Ø110
2	1	CAP Ø110
3	1	SADDLE SOCKET Ø110/75
4	2	SADDLE SOCKET Ø110/50
5	1	PP-R NECK Ø75
6	2	PP-R NECK Ø50
7	1	FLANGE Ø75
8	2	FLANGE Ø50
9	1	SUPPLY SADDLE Θ Ø110x1"x32
10	1	SUPPLY SADDLE Θ Ø110x2"x25
11	1	SOCKET Ø110
12	1	PP-R NECK Ø110
13	1	FLANGE Ø110

ADVANTAGES

—Certified system by AENOR with C-s1, d0 according to EN 13501
—No corrosion phenomena
—Fast and easy installation
—Low weight compared to metal manifolds
—Easy transport
—Painting of the pipes is not required, as in the respective metal ones
—Pipes and fittings are connected in the same way as in the corresponding PP-R. The welding equipment remains the same.
—Certified welders
—Testing and control prior to the delivery of the manifolds

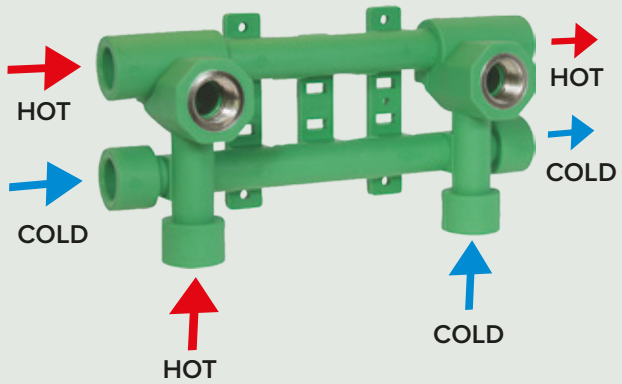


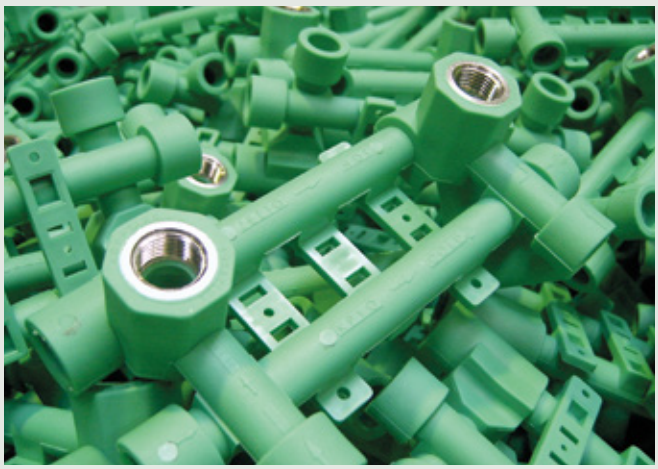


WATER SUPPLY ELBOW

This is a water supply with predetermined connection distances of the bathroom faucet which allows the cold or hot water pipes to be connected, either from the floor or from the wall. The innovation lies in the fact that we have the possibility of many options concerning the connections of hot-cold water pipes, as well as the fact that the water supply allows us to continue the hot or cold water line directly, without the interference of other components. Available with four male thermal self-welding plugs.

CHARACTERISTICS
—Predetermined supply distances for bathroom faucet (153mm)
—Simplified support structure that leaves water supplies aligned
—Possibility of connecting the hot-cold water lines from the floor or the wall
—Possibility of multiple connections (eg. Boiler, Solar Water Heater) directly to the supply, without the use of additional fittings
—Possibility to continue the hot-cold lines from the floor (vertically) to the wall (parallel)
—Possibility to connect a recirculation device without the use of additional fittings
—Extremely easy wall support





HYDRAULIC CIRCUIT SEPARATOR
(No Patented: 20120100649)

The hydraulic separation concept
The concept and purpose of hydraulic separation is the creation of hydraulic balancing and maintenance of supplies of different sources and branches.

Operating principle
The hydraulic separation manifold resembles a hydraulic container of infinite mass and thermal capacity, which is not hydraulically and thermally affected by outgoing or incoming currents and fluid masses.

Benefits – advantages
The hydraulic separation manifold achieves considerable savings and right use of thermal and electric energy. It also achieves optimal operation without a high acquisition cost.

Fields of application
—Heating, cooling, air conditioning systems.
—Autonomous water supply branches.
—Parallelism of more than one energy source (boiler - heat pump) etc.
—Significant reduction of operating and equipment consumption costs.

Operation – analysis
As the flows in consumption and energy source change according to demand, the following three possible conditions prevail within the hydraulic manifold:

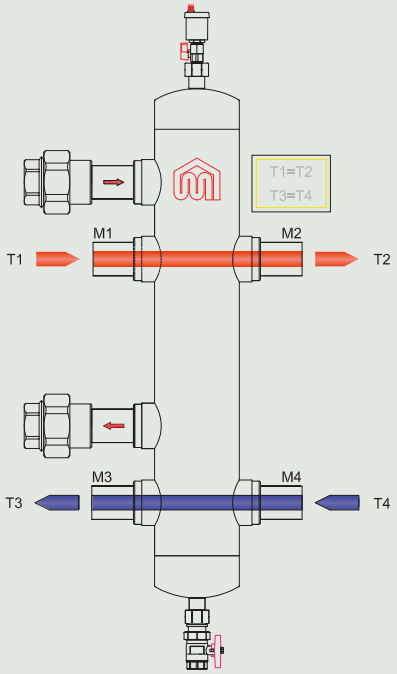
The energy supply (primary) is equal to the supply to the consumption (secondary).

The energy supply (primary) is greater than the supply to the consumption (secondary).

The energy supply (primary) is less than the supply to the consumption (secondary).

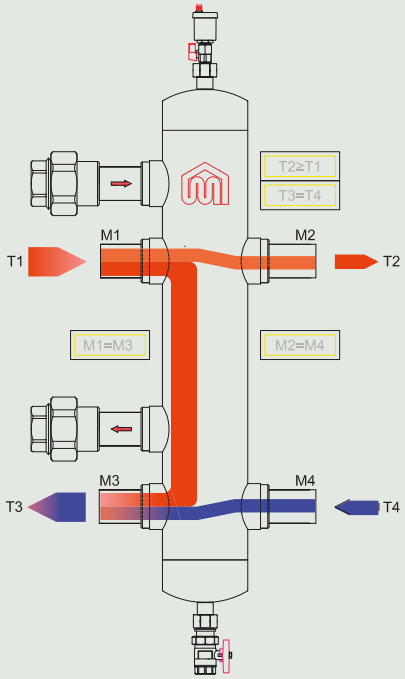
Each condition is governed by the basic rules of thermo-dynamics.

Condition I:
The water supplies of the source of energy– installation are equal MI=M2 &M4=M3.



Inside the hydraulic separator, negligible temperature mixing takes place due to the hydraulic balance of the supplies.

Condition 2:
The water supply of the installation is less than the supply of the source of energy MI-M3>M2-M4.
While the supply in the primary network is greater, the temperature in the secondary network after mixing is equal and higher according to the condition T2≥TI.

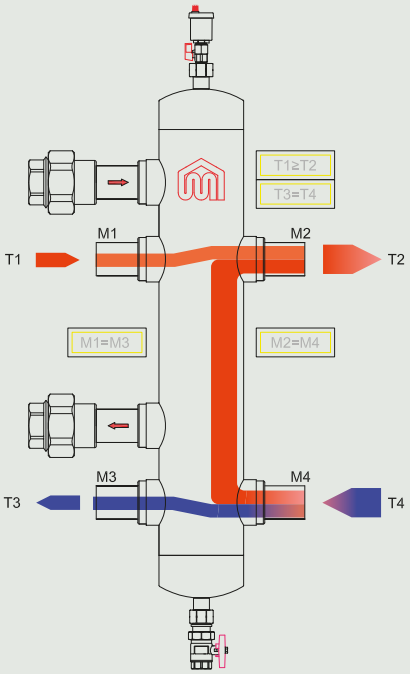


The mixing temperature in position (T2), outgoing to the installation network, can be calculated by the following equation:

$$T2 = \left[\frac{(M4-M1)T4+(M1)T1}{M4} \right]$$

Where:
M4 = Return supply water from the installation in m^3/h
MI = Outgoing supply water from the source of energy in m^3/h
T4 = Temperature of return water from the installation in °C
TI = Temperature of outgoing water from the source of energy in °C
Water is mixed inside the separator.

Condition 3:
The water supply of the installation is greater than the supply of the source of energy MI-M3<M2-M4.



The mixing temperature in positions (T2) & (T3) can be calculated by the following equations:

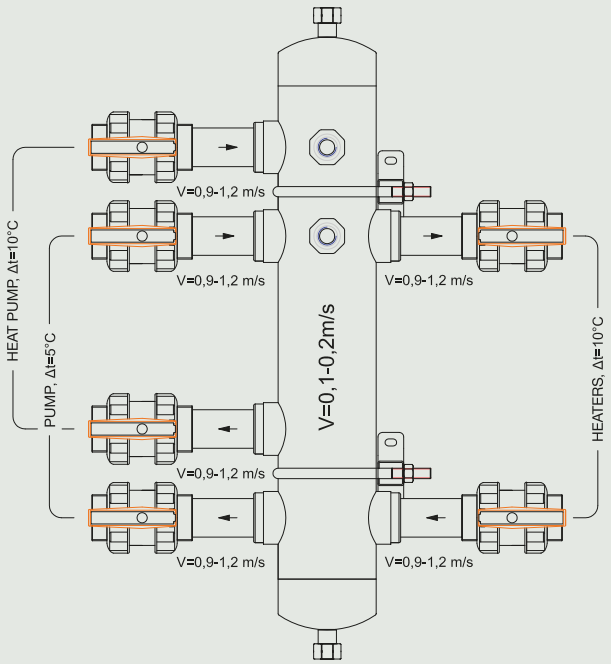
$$T2 = \left[\frac{(M4-M1)T4+(M1)T1}{M4} \right]$$

$$T3 = \left[\frac{(M1-M2)T1+(M4)T4}{M1} \right]$$

Where:
M4 = Return supply water from the installation in m^3/h
M2 = Outgoing supply water to the installation in m^3/h
MI = Outgoing supply water from the source of energy in m^3/h
T4 = Temperature of return water from the installation in °C
TI = Temperature of outgoing water from the source of energy in °C
Water is mixed inside the separator.

Sizing – Selection

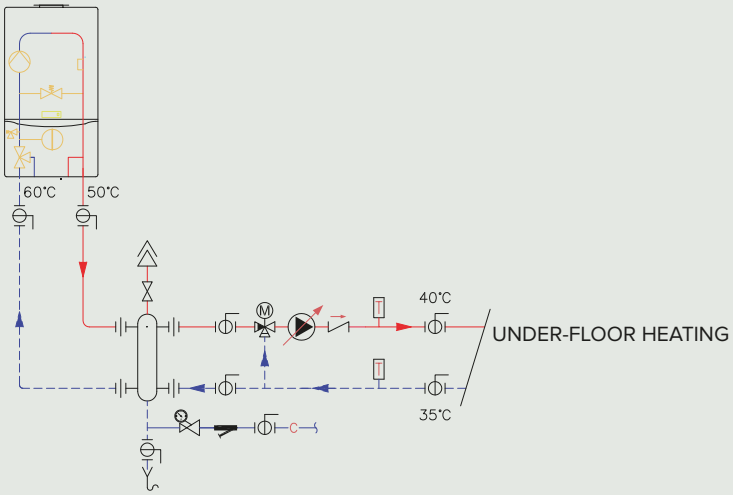
The suitable dimension of the sizes of the main pipe, as well as of the smaller intake pipes, must satisfy a specific condition of velocity - fluid supply. The separator can act both as a gasifier and a particle retaining filter at its bottom. Excessive velocities, above the limits, in conditions of maximum load, cancel its additional functions. The maximum allowed velocity limits of the water are for central pipe (max 0.2m/s) and fields (max 1.2 m/s).

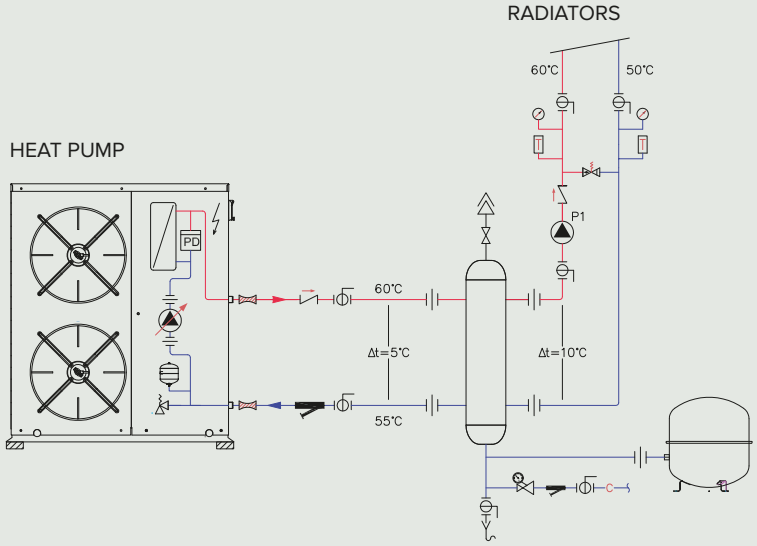


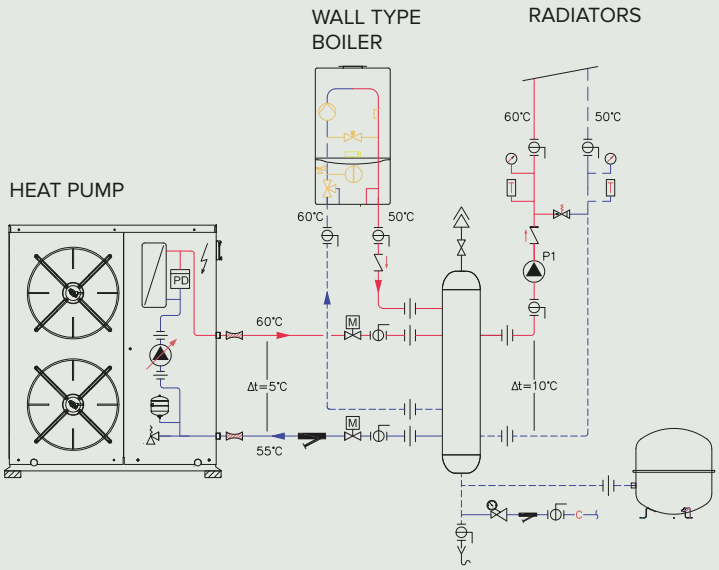
TYPE OF HYDRAULIC SPLITTER	1 (4/2) - 2 (2/2-1) - 3 (2/2-2)			
	160/75	125/50	110/40	90/32
DIMENSION OF MAIN DUCT	Ø160	Ø125	Ø110	Ø90
DIMENSION OF COLLECTION BRANCH	Ø75	Ø50	Ø40	Ø32
SUPPLY m^3/h Δt10°C	3.44	2.58	1.72	0.86
SUPPLY m^3/h Δt5°C	6.88	5.16	3.44	1.72
POWER [KW] για Δt10°C	80 KW	40 KW	30 KW	20 KW
POWER [KW] για Δt5°C	40 KW	30 KW	20 KW	10 KW
CAPACITY PER LITRE (Lt) FOR FIBERGLASS PIPES SDR 7.4	12.93lt	6.47lt	4.04lt	2.20lt

Examples of Applications with Hydraulic Separators

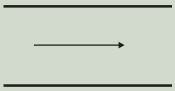
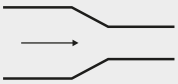
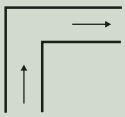
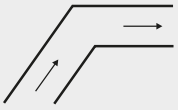
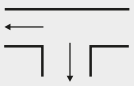
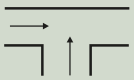
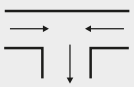
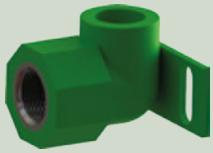
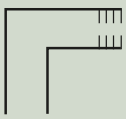
WALL TYPE BOILER

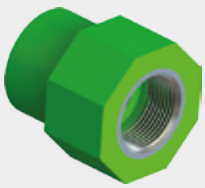
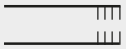
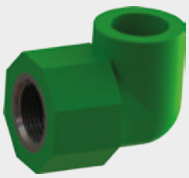
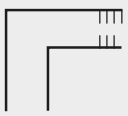
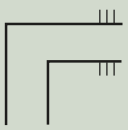
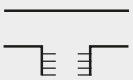
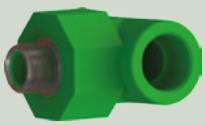
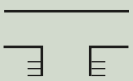
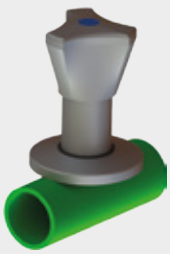
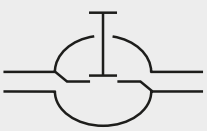






COEFFICIENT OF SPOT RESISTANCE ζ FOR AQUA-PLUS SYSTEM FITTINGS

	Type	Symbol	Remarks	ζ
	Socket		All diameters	0,25
	Reducing bush		Reduction by 1 size Reduction by 2 sizes Reduction by 3 sizes	0,3 0,5 0,55
	Elbow 90°		All diameters	0,9
	Elbow 45°		All diameters	0,4
	Tees (all diameters)		Straight flow	0,5
			Bifurcation	1,2
			Side inflow	0,8
			Convergent stream	3,0
			Divergent stream	1,8
	Contraction tee		from the sum of ζs, and the contraction	
	Female angle with support		All diameters	1,4

	Type	Symbol	Remarks	ζ
	Coupling female		20 mm ∏ 25 mm	0,4
			32 mm ∏ 75 mm	0,4
	Coupling male		20 mm ∏ 25 mm	0,5
			32 mm ∏ 75 mm	0,5
	Female elbow		All diameters	1,4
	Male elbow		All diameters	1,6
	Tee female threaded		All diameters	1,5
	Tee male threaded		All diameters	1,8
	Stop valve		20 25 32	13 11 10

VALVES

BALL VALVES 20-63 made of POLYPROPYLENE UNION BLOCKED - SUPER QUALITY

Interplast, within the integrated Aqua-Plus system, provides high quality ball valves with connection nuts, with operating pressure 10 bar at 20°C.

ADVANTAGES

—Easy and fast installation
—Special fitting (union block) that secures the two nuts
—Network made of 100% polypropylene
—No contact with metal elements
—Avoidance of corrosion phenomena
—Possibility of installing and uninstalling the valve thanks to the two nuts

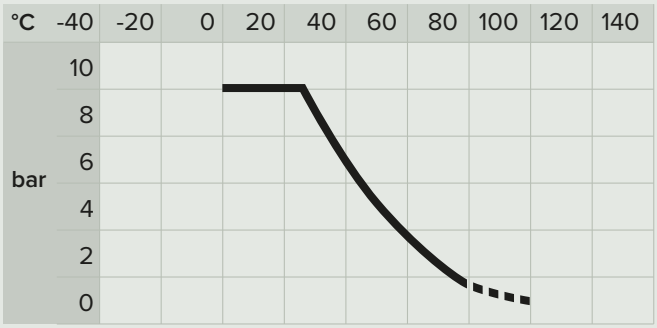
TRANSPORTATION AND STORAGE

The valves must not be subject to shocks and falls that could affect the structural strength of the fittings under pressure. The valves should be stored in rooms with temperatures ranging from -10°C to 50°C and should not be exposed to UV radiation.

WARNING:

It is important to avoid rapid closing of the valves to eliminate the possibility of damage to the pipeline (hydraulic shock).

Nominal pressure/temperature



Operating temperature

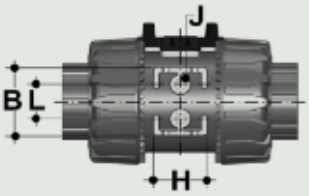
Flow coefficient Kv100

Kv100 is the volume of water measured in liters at a temperature of 20°C that passes per minute through a valve with pressure drop Dp = 1 bar.
The Kv100 values shown in the table are measured with the valve fully open.

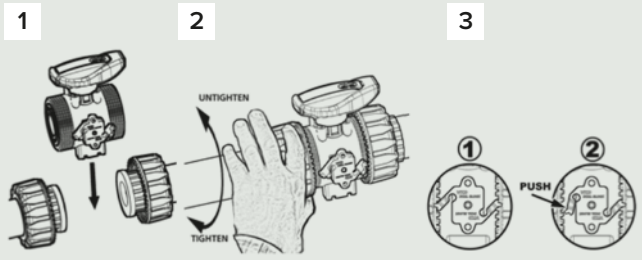
size (mm)	20	25	32	40	50	63
l/min	200	385	770	1100	1750	3400

SUPPORTS AND VALVE FIXING

The supports should withstand the weight of the valve and the stresses transmitted through the valve body during its operation.
Therefore, all valves are provided with built-in support on the valve body for easy and rapid anchoring.
One should be careful when using these support systems, as the ball valve acts as the anchor of the pipe, so all end thermal loads developed by adjacent pipes could damage the valve components, in the case of extended operating temperature fluctuations.
The systems' design should take into consideration the expansion and contraction of the pipes that may occur.

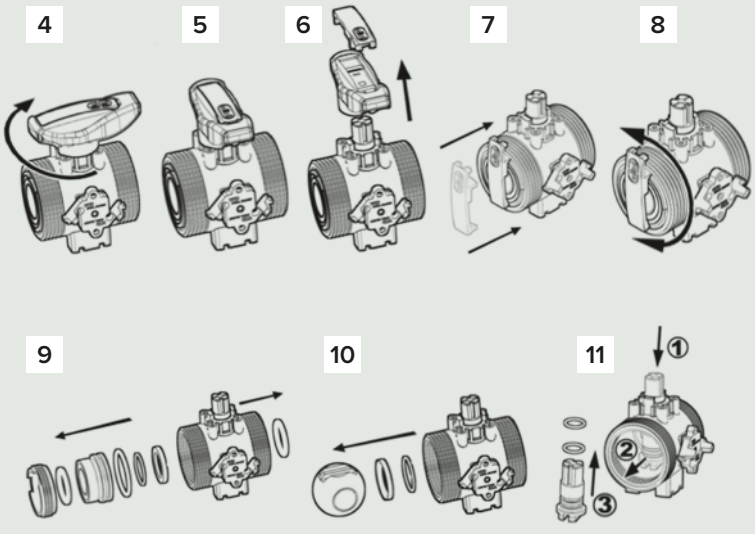


d	B	H	L	J
20	32	27	20	M4x6
25	40	30	20	M4x6
32	40	30	20	M4x6
40	50	35	30	M6x10
50	50	35	30	M6x10
63	60	40	30	M6x10



Assembling:
1-3
Check that the pipes connected to the valve are aligned axially to avoid mechanical stress on the threaded connections.

Disassembling:
3-1
Disconnect the valve from the line (relieve pressure and empty the piping).



ASSEMBLING

Disassembling: 4-11

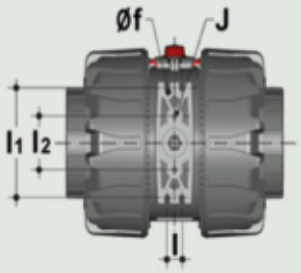
Assembling: 11-4

When assembling the valve components,
we recommend you lubricate the O-ring seals.

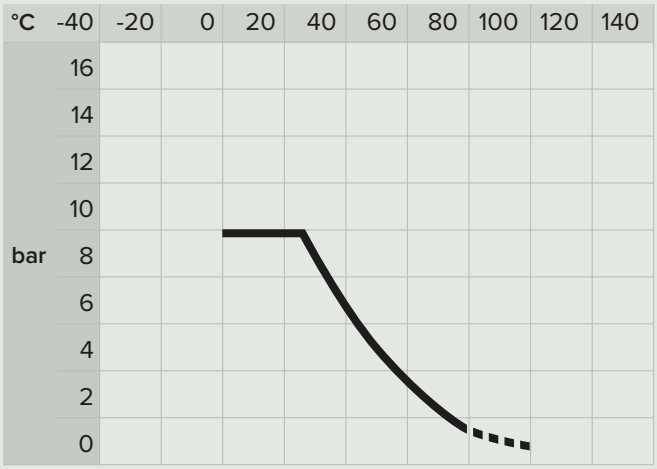
Do not use mineral oils as they affect
the EPDM rubber.

BALL VALVES 75-110 made of POLYPROPYLENE
UNION BLOCKED - SUPER QUALITY

d	J	f	l	l1	l2
75	M6	6,3	17,4	90	51,8
90	M6	8,4	21,2	112,6	63
110	M8	8,4	21,2	137	67



Nominal pressure/temperature



Operating temperature

	T min. (°C)	T max. (°C)
PP	0	100

Flow coefficient Kv100

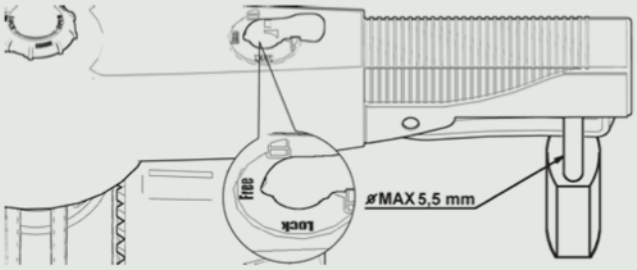
size (mm)	d75	d90	d110
l/min	5250	7100	9500

SUPPORTS AND VALVE FIXING

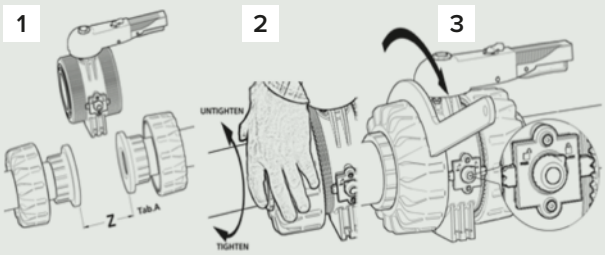
The supports should withstand the weight of the valve and the stresses transmitted through the valve body during its operation.
Therefore, all valves are provided with built-in support on the valve body for easy and rapid anchoring.
One should be careful when using these support systems, as the ball valve acts as the anchor of the pipe, so all end thermal loads developed by adjacent pipes could damage the valve components, in the case of extended operating temperature fluctuations.
The systems' design should take into consideration the expansion and contraction of the pipes that may occur.

Free Lock
The ratchet plate includes 12 stops for mounting the ball valve, which provide fast operation shutdown in the 1/4 turn position and high-precision flow choking.

One can lock the valve lever in any of the 12 positions using the elevated sliding button "Free Lock" on the lever. It is possible to install a padlock on the lever handle in applications that require safe valve storage.

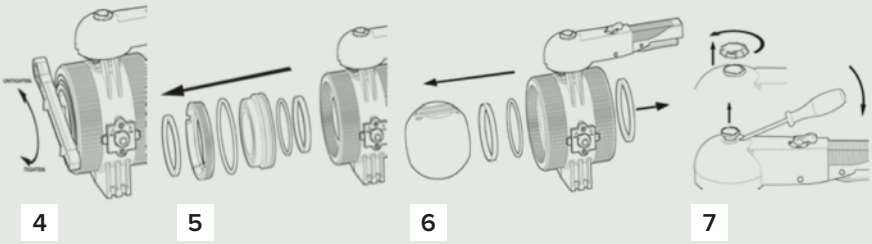


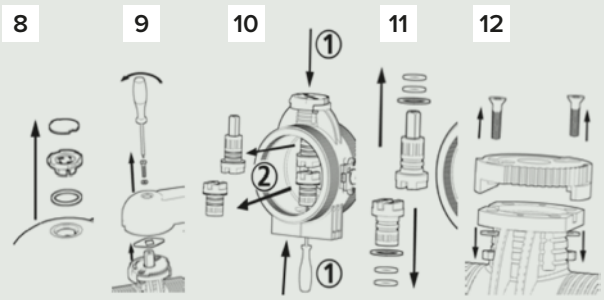
NOTE
The valve can be equipped with actuators upon request. It is possible to use a basic type pneumatic or electric actuator or gear reducer, using a small GR-PP flange with perforation, according to the ISO 5211 standard.



Assembling:
1-3
Check that the pipes connected to the valve are aligned axially to avoid mechanical stress on the threaded connections.

Disassembling:
3-1
Disconnect the valve from the line (relieve pressure and empty the piping).





ASSEMBLING

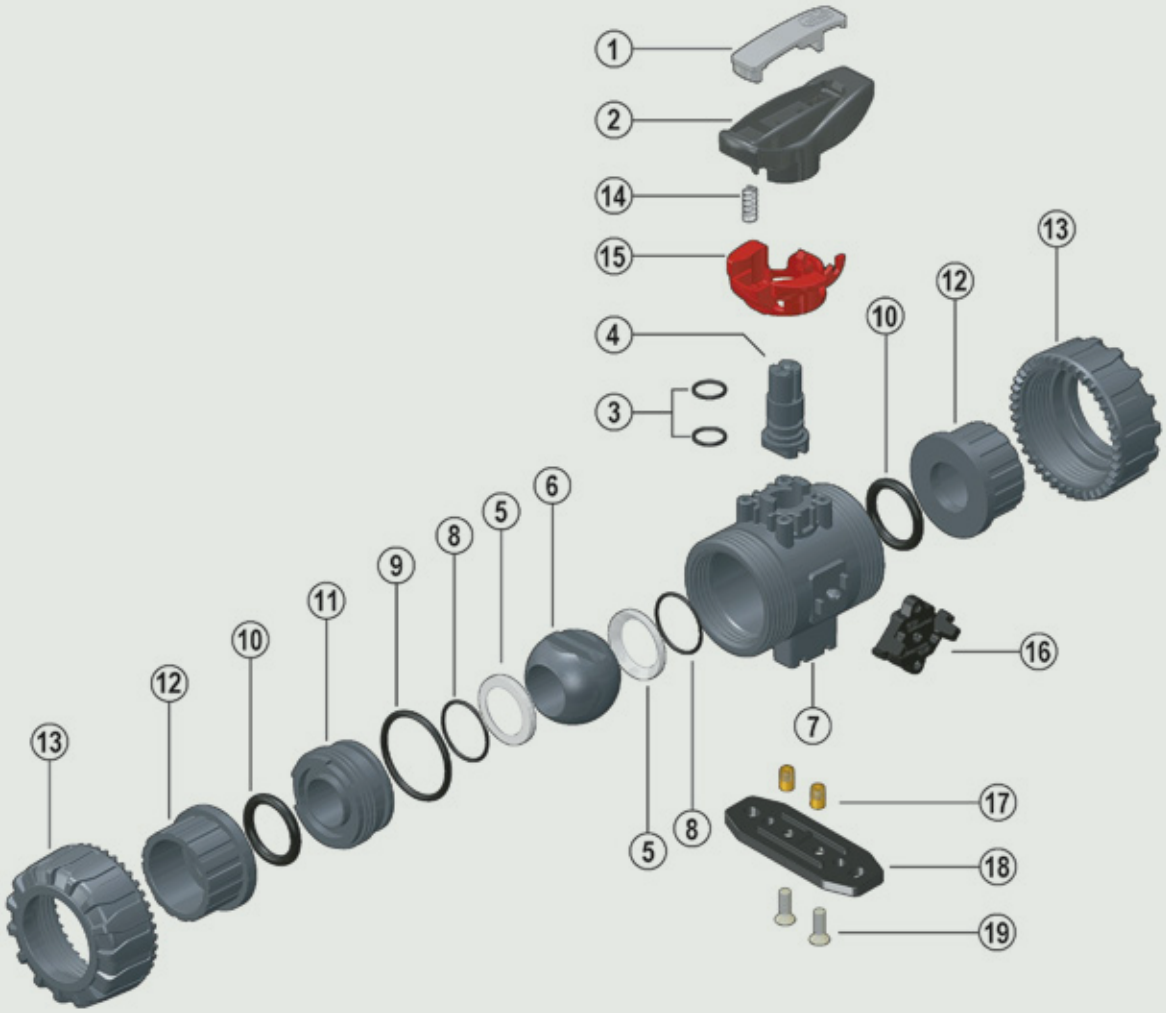
Disassembling: 4-12

Assembling: 12-4

When assembling the valve components, we recommend you lubricate the O-ring seals.

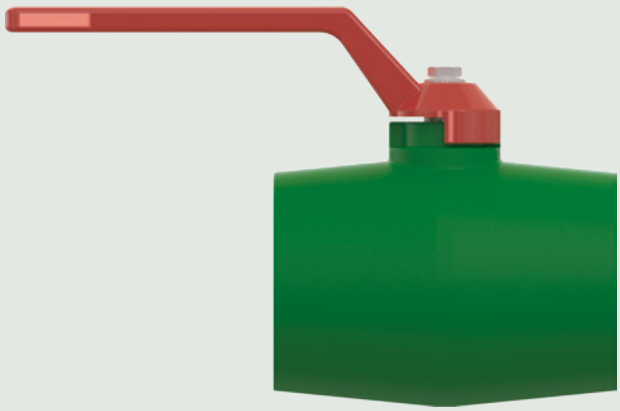
Do not use mineral oils as they affect the EPDM rubber.

BALL VALVE COMPONENTS



1	Gasket	PVC
2	Handle	HIPvC
3	O-ring stem	EPDM-FPM
4	Stem	PP-R
5	Ball seat (ball valve)	PTFE
6	Ball	PP-R
7	Body	PP-R
8	O-ring for ball base support	EPDM-FPM
9	O-ring	EPDM-FPM
10	O-ring	EPDM-FPM
11	Ball base support	PP-R
12	End clip	PP-R
13	Connection nut	PP-R
14	Spring	Stainless steel
15	Handle lock	PP-GR
16	UNION BLOCK	POM
17	Support ring	Stainless steel or brass
18	Support / distance plate	PP-GR
19	Screw	Stainless steel

PP-R BALL VALVE FOR HIGH PRESSURES and TEMPERATURES



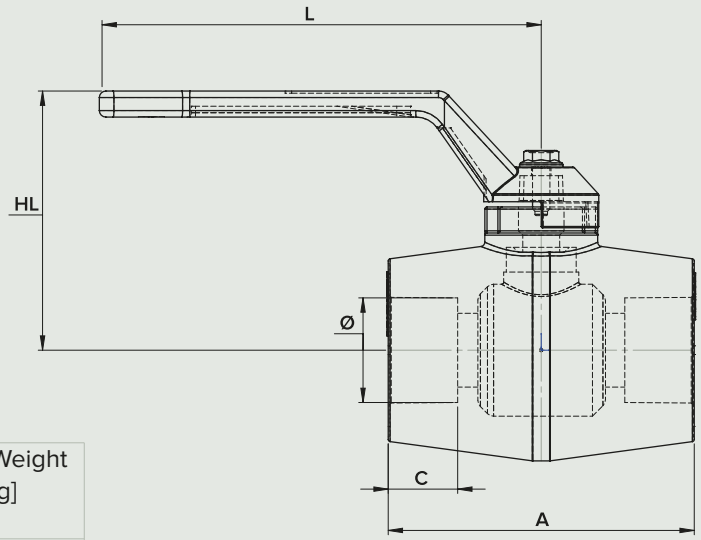
CHARACTERISTICS

—Resists pressures exceeding 20 bar at high temperatures
—Thermal welded ends according to DIN 16962
—With no connections or couplings at the ends
—Removable and fully sealed shaft
—Red handle made of reinforced polyamide
—In accordance with the technical regulations TR CU 010
—Free from CE marking requirements (According to Art. 4.3 Dir. 2014/68/EU)

VALVE OPERATING CONDITIONS

—Suitable for: water with temperatures ranging from 0°C to +75°C
—Unsuitable for: group 1 & 2 gases and group 1 liquids (Dir. 2014/68/EU)

Part description	Material	EN Standard
Sealing base	PTFE	-
Ball	Chrome plated brass	EN12164 CW617N [1]
Body	PP-R	-
Shaft	Chrome plated brass	EN12164 CW617N
O-ring	NBR	-
Handle screw	Metallized steel	EN12164 CW617N
Handle	PA6 Polyamide[2]	-



Ø [mm]	A [mm]	C [mm]	HL [mm]	L [mm]	K_v [m^3/h]	Weight [g]
20	67,5	14,5	60	102	9,5	116
25	70,5	16,0	60	102	19	135
32	79,5	18,1	64	102	38,5	189
40	94,0	20,5	78	120	19	347
50	109,0	23,5	83	120	38,5	517
63	130,0	27,4	103	146	19	935
75	151,0	31,0	110	146	38,5	1200
90	173	35,5	65	133		2280

BUTTERFLY VALVE PP

Wafer type butterfly valve, with spindle, with PP-H interchangeable disc and body made of PP-GF polypropylene homopolymer according to ASTM D-4101, designed for operating temperatures ranging from 0° C to 90°C.
PP valve is unaffected by alkalis, salts, organic solvents, and most acids, especially hydrochloric and phosphoric acid. It is unsuitable for strong acids, chlorinated hydrocarbons, aromatic compounds, and high concentrations of free chlorine.
PP is a multi-inert material and, therefore, it is popular for high purity applications, such as deionized water, etc.
The raw material contains a pigment that provides resistance to ultraviolet sunlight. The use of PP valves composes a complete solution in polypropylene networks by replacing the metal valves.

APPLICATIONS
—Drinking water – water supply
—Air conditioning of home facilities
—Air conditioning – Cooling of industrial facilities
—Compressed air

ADVANTAGES
—Sizes: DN 50-300, Ø 63-315mm (ISO 5752)
—Large flow with low pressure drop. The geometry of the spherical disk offers a smooth flow without cavitation.
—Complete sealing. With single cast elastomer base and "O-ring" shaft – disc made of EPDM.
—Protection against excessive tightening. The body's design prevents the transmission of compressive strains to the disc shaft, even with excessive tightening of the flanges.
—Easy installation. No additional sealing materials are needed.
—The same properties as with PP-R apply concerning allowed chemicals and concentrations.
—Suitability for drinking water. PP, PTFE, EPDM, SS components do not affect the human body.
—Possibility of installation of reducer & electric motor.
—0-90° calibration with 10° increase and safety handle. Full 90° motion open-closed.
—Possibility of using plastic & metal flanges. Plastic flanges DIN 8063, metal flanges DIN 2501.

DISPLAY OF INTERNAL COMPONENTS: BUTTERFLY VALVE Ø 63-200MM

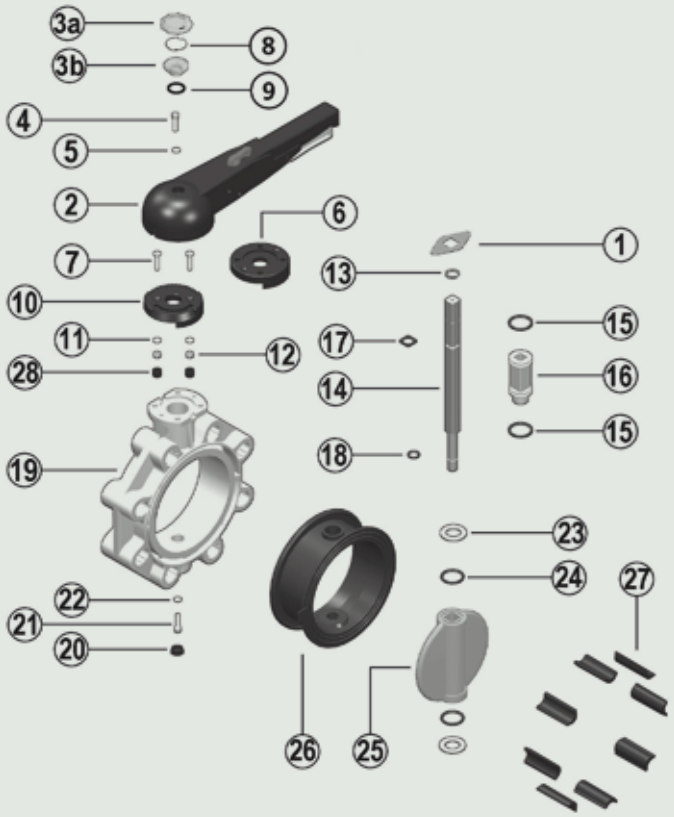


Table 1. Analysis of internal components

1	Position indicator	(PA – 1 pc)
2	Handle	(HIPVC – 1 pc)
3	Transparent protection plug	(PVC – 1 pc)
4	Fastening screw	(Stainless steel – 1 pc)
5	Washer	(Stainless steel – 1 pc)
6	Flange	(PP-GR – 1 pc)
7	Screw	(Stainless steel – 2 pcs)
8	Tag holder	(PVC – 1 pc)
9	O-ring	(NBR – 1 pc)
10	Plate	(PA – 1 pc)
11	Washer	(Stainless steel – 2 pcs)
12	Nut	(Stainless steel – 2 pcs)
13	Seeger ring	(Stainless steel – 1 pc)
14	Stem	(Stainless steel – 1 pc)
15	Bush O-ring	(EPDM – 2 pcs)
16	Bush	(NAYLON – 1 pc)
17	Stem O-Ring	(EPDM – 1 pc)
18	Stem O-Ring	(EPDM – 1 pc)
19	Body	(PP-GR – 1 pc)
20	Protection plug	(PE – 1 pc)
21	Screw	(Stainless steel – 1 pc)
22	Washer	(Stainless steel – 1 pc)
23	Anti-friction ring	(PTFE – 2 pcs)
24	Disk O-ring	(EPDM – 2 pcs)
25	Disk	(PP-H – 1 pc)
26	Liner	(EPDM – 1 pc)
27	Inserts	(ABS – 4-8 pcs)
28	Plug	(PE – 2 pcs)

BRIEF TECHNICAL DATA

Construction	Bi Directional centric butterfly valve, Wafer type
Size range	Ø 63-315mm
Nominal pressure	**Wafer edition** Ø 63-250mm: PN 10 with water at 20°C Ø 315mm: PN 8 with water at 20°C
Temperature range	0°C – 100°C
Standards	Construction: EN ISO 16136, EN ISO 15494 Test methods & requirements: ISO 9393 Flanging system: EN ISO 15494, DIN 2501, ISO 7005-1, EN 1092-1, ANSI B16.5, CL 150, JIS B 2220 Actuator couplings: ISO 5211
Valve material	Body: PP-GR Disk: PP-H Stem: AISI steel 316
Seal material	Liner: EPDM

DISPLAY OF INTERNAL COMPONENTS: BUTTERFLY VALVE Ø 250-315mm

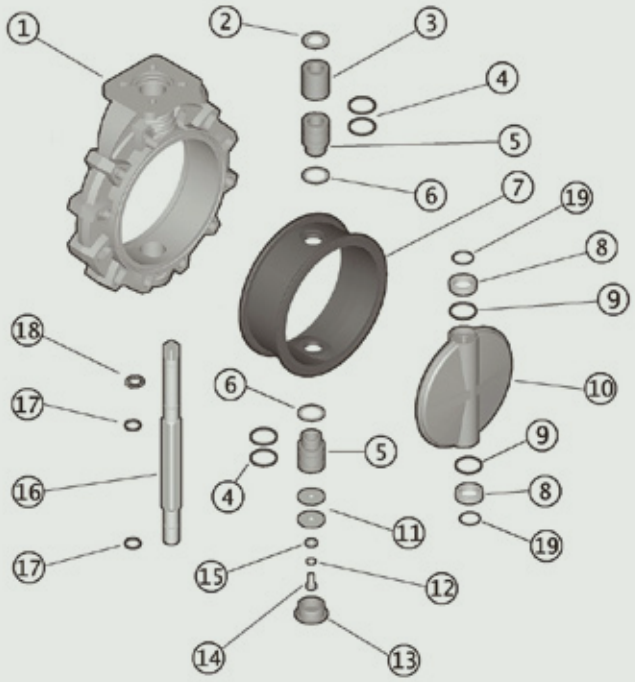


Table 2. Analysis of internal components

1	Body	(PP-GR – 1 τεμ.)
2	Washer	(Stainless steel – 1 pc)
3	Bush	(PP – 1 pc)
4	Bush O-Ring	(EPDM – 4 pcs)
5	Bush	(PP – 2 pcs)
6	Washer	(PTFE – 2 pcs)
7	Liner	(EPDM – 1 pc)
8	Anti-friction ring	(PTFE – 2 pcs)
9	Disk O-Ring	(EPDM – 1 pc)
10	Disk	(PP–H – 1 pc)
11	Washer	(Stainless steel – 2 pcs)
12	Washer	(Stainless steel – 1 pc)
13	Protection plug	(PE – 1 pc)
14	Screw	(Stainless steel – 1 pc)
15	Washer	(Stainless steel – 1 pc)
16	Stem	(Stainless steel 316 – 1 τρc)
17	Stem O-Ring	(EPDM – 2 pcs)
18	Seeger ring	(Stainless steel – 1 pc)
19	O-ring	(EPDM – 2 pcs)

BRIEF TECHNICAL DATA

Construction	Bi Directional centric butterfly valve, Wafer type
Size range	Ø 63-315mm
Nominal pressure	**Wafer edition** Ø 63-250mm: PN 10 with water at 20°C
Temperature range	0°C – 100°C
Standards	Construction: EN ISO 16136, EN ISO 15494 Test methods & requirements: ISO 9393 Flanging system: EN ISO 15494, DIN 2501, ISO 7005-1, EN 1092-1, ANSI B16.5, CL 150, JIS B 2220 Actuator couplings: ISO 5211
Valve material	Body: PP-GR Disk: PP-H Stem: AISI steel 316
Seal material	Liner: EPDM

Design -Dimensions

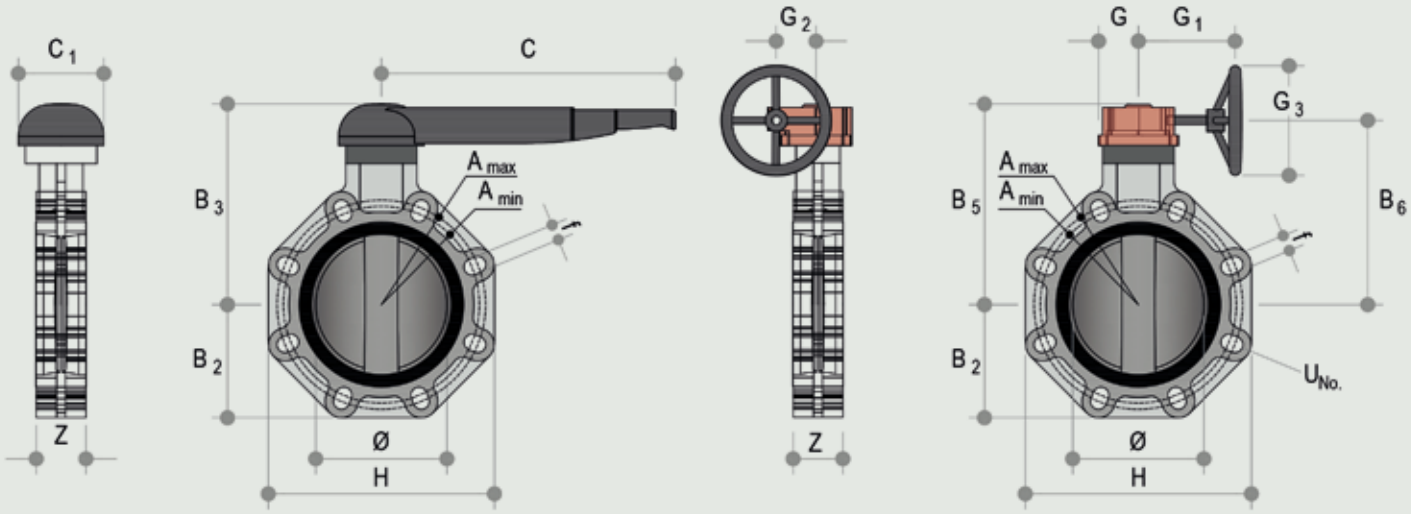


Table 3. Dimensions of 63-200mm valves with handle

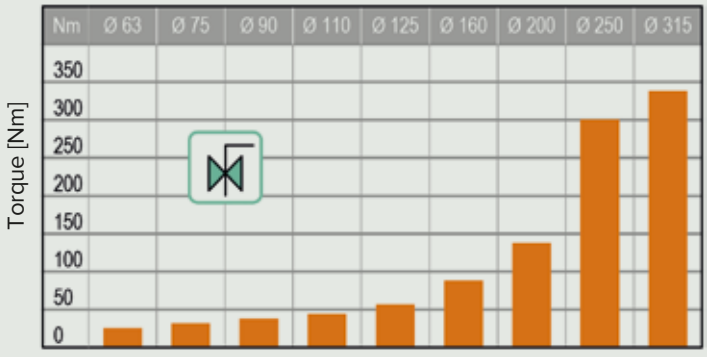
Ø [mm]	PN [Bar]	A_{min} [mm]	A_{max} [mm]	B_2 [mm]	B_3 [mm]	C [mm]
63	10	115	125,5	70	143	175
75	10	128	144	80	164	175
90	10	145	160	93	178	175
110	10	165	190	107	192	272
125	10	204	215	120	212	330
160	10	230	242	134	225	330
200	10	280	298	161	272	420

Table 4. Dimensions of 250-315mm valves with reducer

Ø [mm]	PN [Bar]	A_{min} [mm]	A_{max} [mm]	ØA [mm]	B_2 [mm]	B_5 [mm]	B_6 [mm]
250	10	-	-	350	210	317	281
315	8	-	-	350	245	317	281

Graph 1. Torque

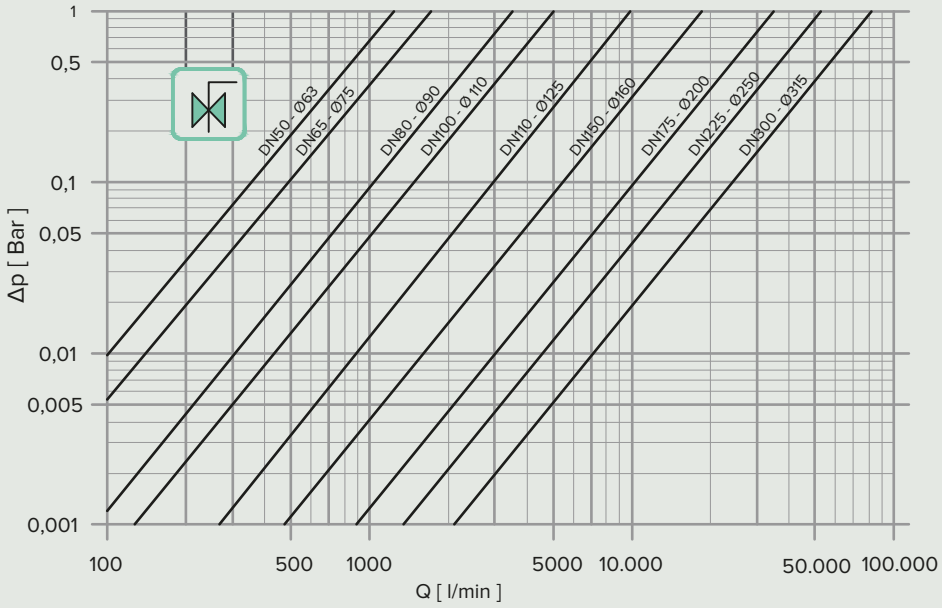
Required disk torque at maximum operating pressure



Graph 2. Pressure drop [a]

Graph for finding the pressure drop as a function of the volumetric flow flowing through the valve.
The graph shows pressure drop for water with temperatures ranging from 5°C to 30°C.

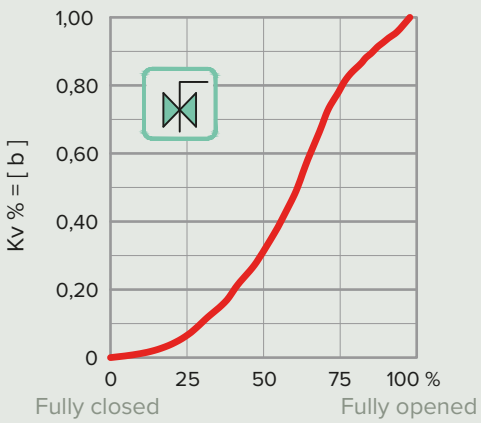
Q: Volumetric flow in l/min
Δp: Pressure drop in Bar



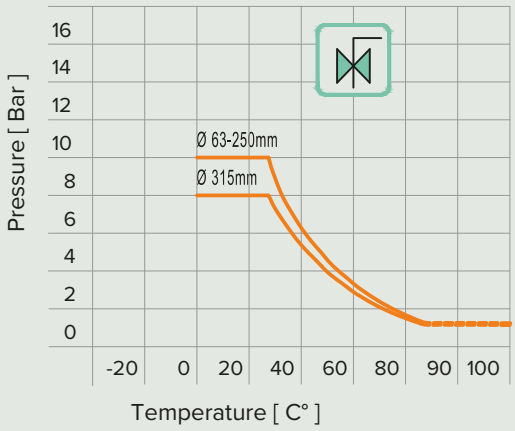
Flow coefficient K_v 100
The volumetric water supply Qinl/min at 20°C is what causes a pressure drop Δp = 1 bar at the ends of the valves. The value of K_v100 was calculated with the valve in fully open position.

Ø mm	63	75	90	110	125	160	200	250	315
BPS inch	2"	2 ½"	3"	4"	4 ½"	6"	7"	9"	12"
DN	50	65	80	100	110	150	200	250	300
K_v 100 l/min	1285	1700	3550	5000	9850	18700	30500	53200	81600

Graph 3: Coefficient K_v 0-100%



Graph 4: Pressure & temperature limits

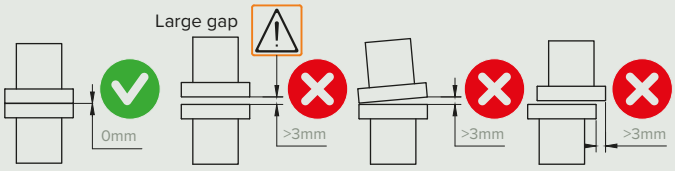


Calculation of flow in intermediate positions:
Calculate the coefficient K_v%=[b] according to the position of the disk from graph 3. Use graph 2 to calculate the flow [a] as a function of the pressure drop at the valve ends. The volumetric flow rate at 20° is axb in lt/min.

The pressure-temperature graph is based on a 25-year operating period with water of average hardness 7-14 d° and pH in the range 5-8.

BRIEF INSTRUCTIONS OF SAFE INSTALLATION

General principles:
Before connecting the valves with the flanges, make sure that:
—The collars of the connections are aligned, while the sealing surfaces remain parallel to each other.
—Check the gap between the collars by using a dummy or the valve itself. The allowable gap should not exceed 3mm.
—A subsequent correction after the collars' welding will bring additional stress to the flanges and should be avoided.
—It is important to ensure that the sealing surfaces are clean and intact.



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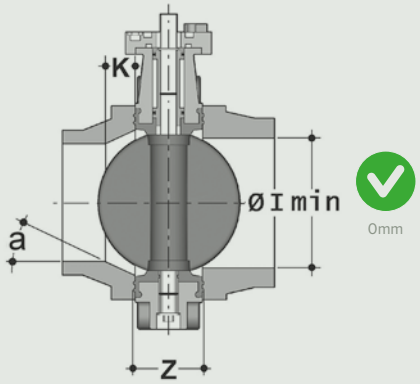
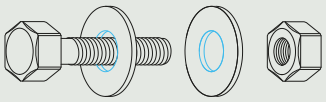


Connections
Choosing the right screw and nut material is critical. For this reason, one should use materials with low abrasion resistance. These materials allow the torque's smooth and gradual distribution, ensuring that the flange is not subject to sudden stress that may lead to its breaking.

Acceptable set of materials (screw, nut, washer):
—Galvanized set with or without lubrication
—Stainless steel set with or without lubrication

Use the set (screw-nut) combined with washers. Their purpose is to distribute the force over a wider area by reducing the compression tension on the screw and bolt head. If you do not use washers, the hardware warranty is void.



Always use new connections. Corroded materials always have a high abrasion resistance, so the torque exerted by the tool will not be the actual one.
The length of the screw should be selected so that there are at least two whole spirals left over from the end of the nut (bolt), when tightened by hand. This ensures a permanent connection.

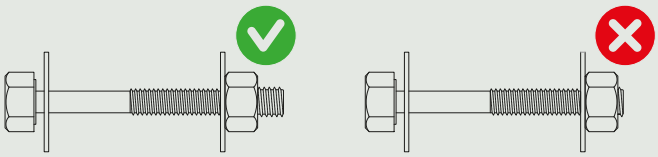
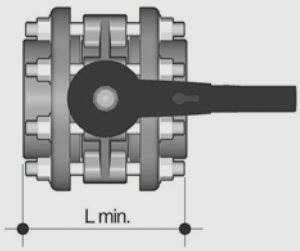


Table 3.1 & 4.1 Required connection parts

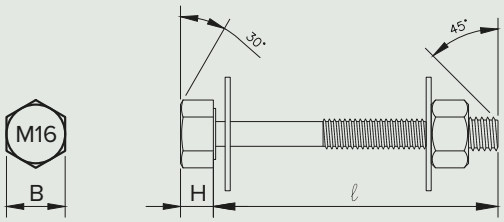
Ø [mm]	Torque	U No.	M x L_{min} [mm]
63	13	4	M16x150
75	15	4	M16x170
90	18	12	M16x180
110	20	8	M16x180
125	35	8	M16x210
160	40	8	M20x240
200	55	8	M20x260
250	80	12	M20x310
315	90	12	M20x340

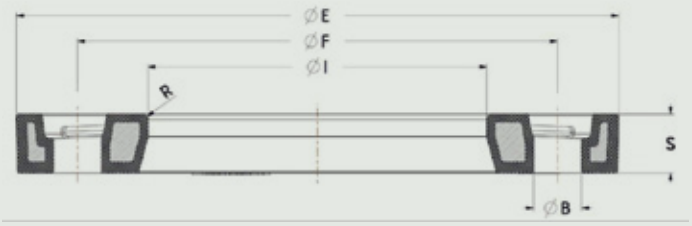


*torque wrench adjustment

The use of butterfly valves in oil and organic oil networks is not allowed. For use with respective fluids, the EPDM "O-rings" must be replaced by a different type of sealing.

Standardization of connections according to ISO





Nomimal Diameter	M6	M8	M10	M12	M14	M16	M20
B x H	10x4	13x5.5	17x7	19x8	22x9	24x10	30x13
Pitch	10x4	13x5.5	1.5	1.75	2.0	2.0	2.5
Threaded Posistion	25~30	22~30	26~30	30	35	40	50

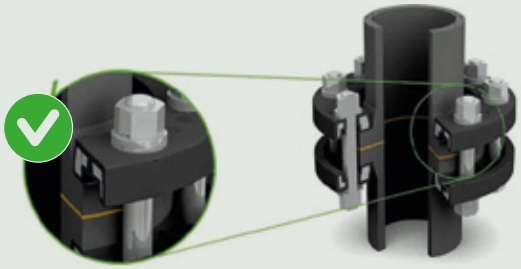
Flanges

Interplast suggests the use of flanges made of spherical cast iron GJS-500-7, with an outer polypropylene PP-GF30 coating, according to the standards EN ISO 15494, EN 1092-1 and ISO 7005.

Ø mm	DN mm	PN mm	Ø E mm	Ø F mm	Ø I mm	Ø B mm	Ø S mm	N Bolts	bolts	R mm	Preload min mm	Preload max mm	Weight Kg
63	50	16	170	125	78	18	20	4	M16	1	30	40	0,9
75	65	16	191	145	92	18	21	4	M16	1	40	50	1,25
90	80	16	206	160	108	18	21	8	M16	1	40	50	1,3
110	100	16	226	180	127	18	22	8	M16	2	40	60	1,55
125	100	16	256	110	158	18	25	8	M16	1	50	70	1,70
160	150	16	291	240	178	22	28	8	M20	1	60	80	2,5
200	200	10	346	295	238	22	29	8	M20	1	80	90	3,5
250	250	10	404	350	288	22	31	12	M20	1	80	100	4,35
315	300	10	456	400	337	22	40	12	M20	2	90	120	7,5
200	200	16	346	295	238	22	29	12	M20	1	80	100	3,4
250	250	16	412	355	288	26	34	12	M24	1	90	120	5,15
315	300	16	468	410	337	26	42	12	M24	2	100	150	8,7

BASIC CHARACTERISTICS

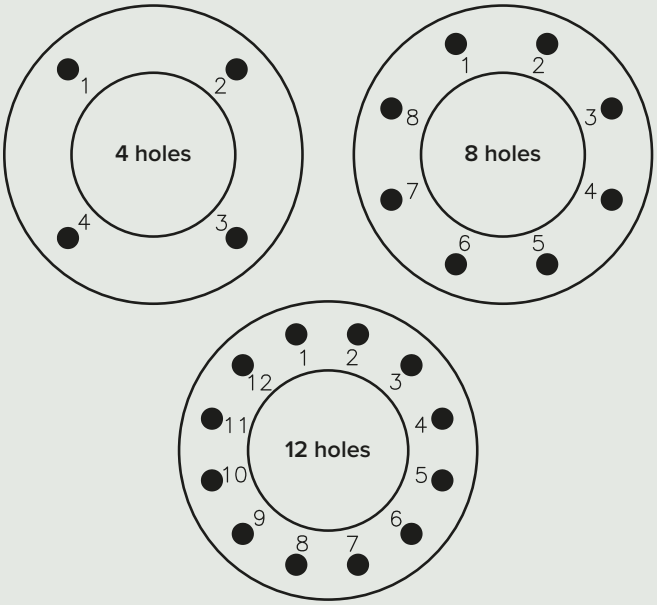
—Designed for loads up to 4 times larger than those required
—Single load distribution in the sealing neck profile
—GJS-500-7 cast iron offers elastic deformation during loading and reset to its original shape during discharge
—Reduced weight by 70% compared to conventional metal flanges
—High corrosion resistance thanks to the PP-GF30 coating (min 3mm)
—Sizes according to the standard EN ISO 15494-4



Tightening of connections
For a uniform force distribution (surface pressure), to achieve optimal sealing, observe the following:
—The tightening of the connections must be performed diagonally and evenly, observing the sequence indicated in Table 6
—Apply the recommended torques as per Table 4

Table 6. Flange tightening sequence

Number of holes	Cross-tightening sequence model
4	1–3–2–4
8	1–5–3–7–2–6–4–8
12	1–7–4–10–2–8–5–11–3–9–6–12



Tightening one screw to the maximum recommended torque while the others are tightened by hand, or tightening in the wrong sequence, produces non-uniform stresses that may lead to a faulty sealing.

Tighten all nuts by hand. As you tighten the nuts, the nuts on the opposite side will slightly loosen.

Repeat the tightening until all the nuts are fixed. Next, apply the recommended torques shown in Tables 3.1 and 4.1, following the sequence given in Table 6, for the corresponding number of holes.
The following torque values of the Table resulted from laboratory measurements aim at the optimal sealing, applying the lowest possible mechanical stress for each type of flange material.

Dimension			Number of holes	Torque Nm				
								GJS 500-7
Ø mm	DN	Inch		A	B	C	D	E
63	50	2”	4	12	20	34	35	13
75	65	2 ½”	4	15	25	34	40	15
90	80	3”	4	18	15	34	40	18
110	100	4”	8	20	20	34	50	20
125	110	4 ½”	8	23	25	41	50	35
160	150	6”	8	40	35	54	60	40
200	200	7”	8	55	45	54	75	66
250	250	9”	12	70	35	87	95	80
315	300	12”	12	70	50	87	100	90

A	Sealer with EPDM profile. Butterfly valve PP-H & plastic flange.
B	EPDM flat sealer for plastic flange.
C	Permanite flat sealer for plastic flange.
D	Sealer with EPDM profile. Recommended torques for metal flange.
E	Sealer with EPDM profile. Recommended torques for metal flange GJS-500-7.

Suitable equipment

The application of the recommended torque value is a "critical" parameter, which determines the degree of tightness and the integrity of both the plastic and the metal flange.

The use of a properly calibrated torque wrench with an accuracy of ± 1 Nm is imperative.

Experienced installers may be tempted to forget to use a torque wrench, relying instead on their "feeling". Interplast does not endorse this practice.

Studies have shown that experienced installers are slightly better than new learners at estimating the required torque on a sensory basis. The torque wrench is always a necessary tool.

Torque units conversions

Table 7. Coefficients for the conversion of torque units

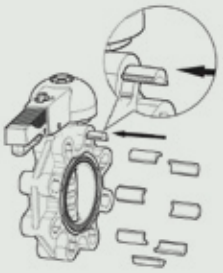
Units	S.I.	Imperlal			Metric
	N m	ozf in	lbf in	lbf ft	kgf m
1 N m =	1	141,6	8,851	0,738	0,102
1 ozf in =	0,007	1	0,0625	0,005	0,0007
1 lbf in =	0,113	16	1	0,083	0,0115
1 lbf ft =	1,356	192	12	1	0,138
1 kgf m =	9,807	1389	86,8	7,233	1

CAUTION

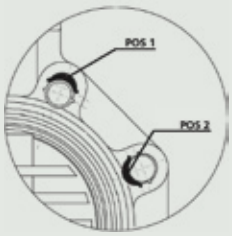
Do not use impact tools
to tighten the nuts on the flanges.

Connection to network
Follow the numbered installation steps below to connect and disconnect the network.

1



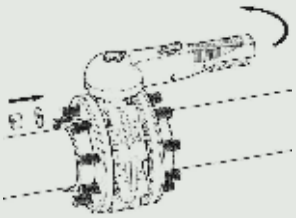
1.1



2

3

4



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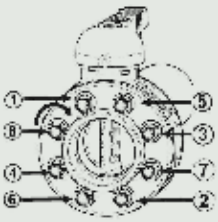
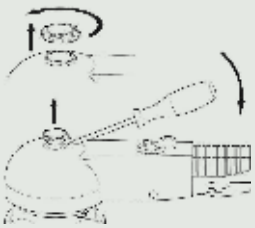


6

Assembly – disassembly
In case of repairing or cleaning the valves, follow the numbered steps below for disassembling and assembling the components.

7

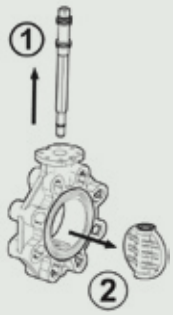


8

9

10

11



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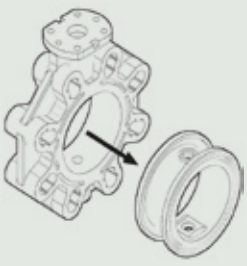
13

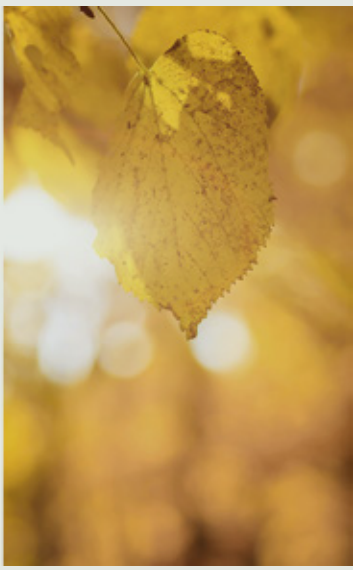
14



07

LIFESPAN



All over the world, the polypropylene water distribution system has been considered safe and reliable for the last 40 years. It is designed to last over 50 years, for temperatures up to 95°C and operating pressures from 6 to 26 bar. Temperature peaks of 110°C at an operating pressure of 4 bar do not affect the Aqua-Plus system.

The Aqua-Plus system shows extreme resistance to age hardening in conditions with high temperatures and pressures. The lifespan diagram confirms its excellent behavior when used according to the manufacturer's specifications and instructions.

In general, the Aqua-Plus system is durable and reliable in water supply and heating systems.

The lifespan of the pipe depends on factors such as pressure, temperature and external stress.

The formula that relates to the above parameters is:

$$p = \frac{2 \cdot S\,min \cdot \sigma}{d\text{-}S\,min}$$

Where:
p: maximum internal pressure
d: outer dimension
S min: wall thickness (minimum)
σ: peripheral stress in N/mm^2

As we can see in the following table, in the case of water supply systems it is possible to achieve at least 50 years within a wide range of temperatures, when a similar result is achieved in heating systems, at very high temperatures and operating pressures.

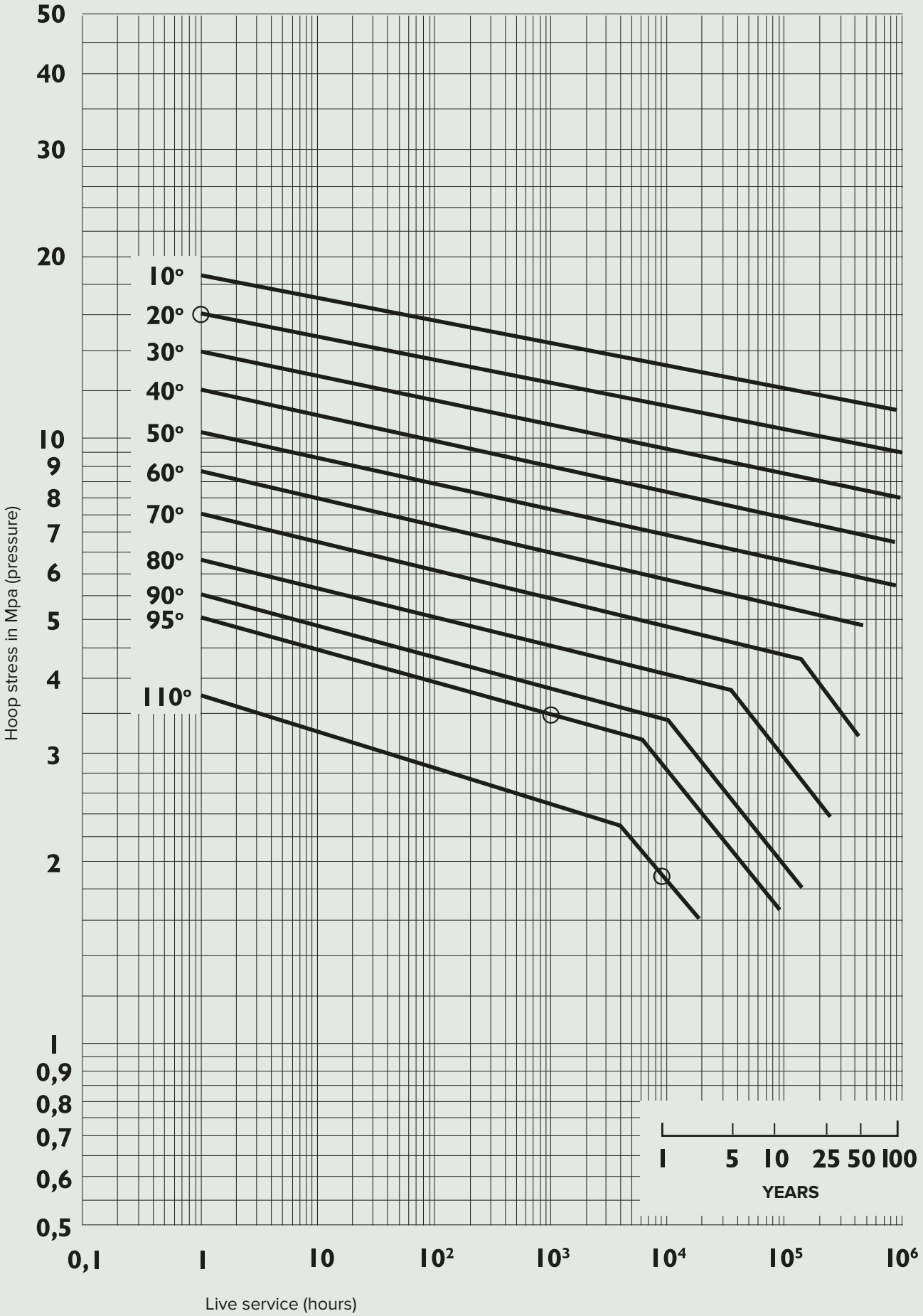
EN, ASTM and DIN standards are exceeded thanks to the quality of the raw material and the high-quality characteristics of the additions.

The company's high-level factory equipment makes it possible to control the strength of the raw material and display the relevant hydraulic strength diagram that determines the pipes' strength concerning temperature and lifespan.

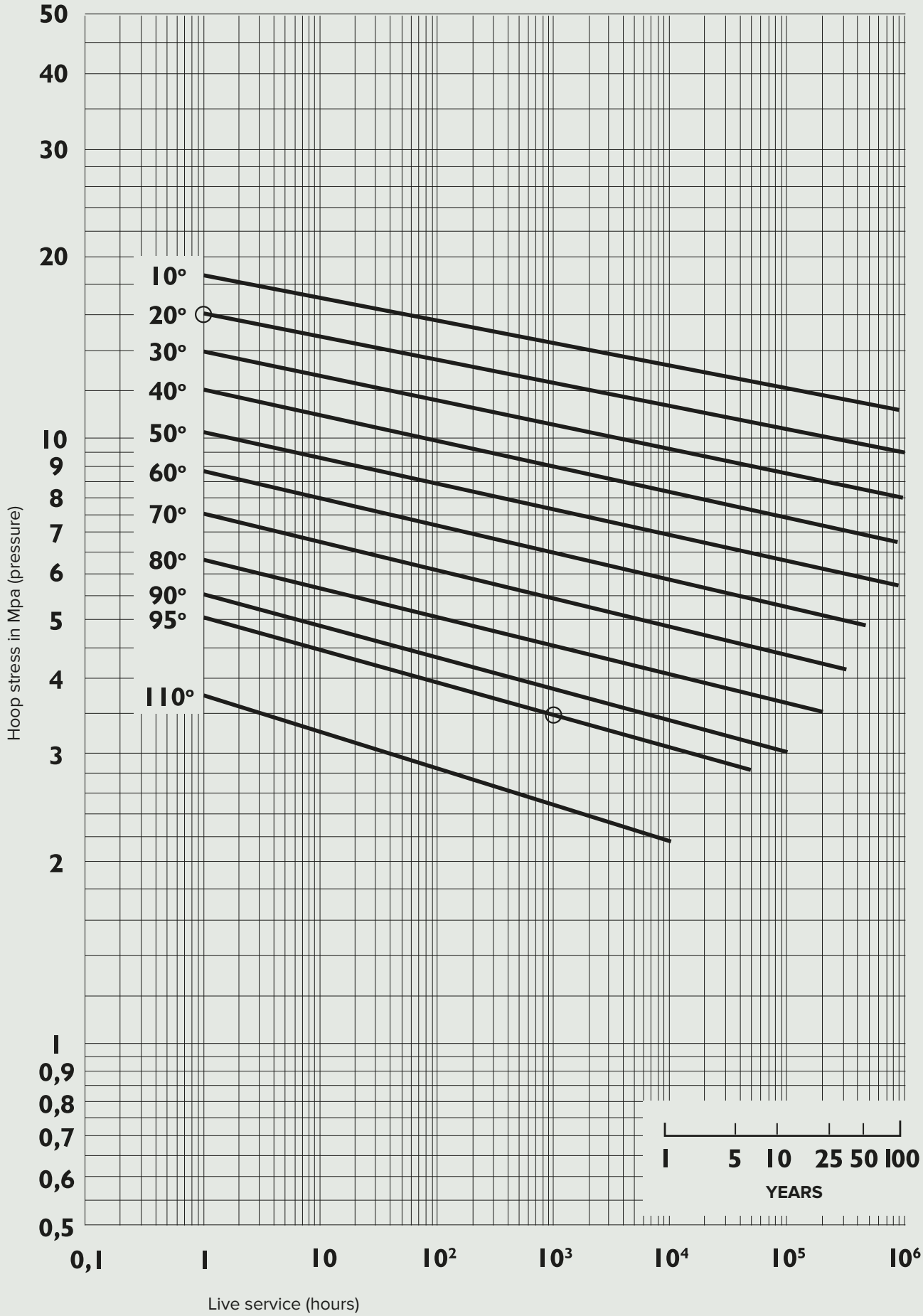
LIFESPAN TABLE

Temperature (°C)	Lifespan (years)	Operating pressure PP-R 80 SDR 6 (bar)	Operating pressure PP-R 125 SDR 7,4 (bar)	Operating pressure PP-RCT SDR 9 (bar)	Operating pressure PP-R 125 SDR 11 (bar)	Operating pressure PP-RCT SDR 17 (bar)
10	1	35,2	36,2	35,6	27,8	17,8
	5	33,1	35,1	34,5	26,2	17,3
	10	32,3	34,7	34,1	25,6	17,0
	25	31,2	34,1	33,5	24,7	16.6
	50	30,4	33,6	33	24,1	16,5
	100	29,6	33,2	32,6	23,5	16,2
20	1	29,9	31,5	31,3	23,8	15,7
	5	28,3	30,5	30,3	22,3	15,2
	10	27,5	30,1	29,9	21,7	15,1
	25	26,7	29,6	29,4	21,0	14,7
	50	25,9	29,2	29	20,4	14,6
	100	25,1	28,8	28,6	19,9	14,4
30	1	25,6	27,3	27,3	20,2	13,6
	5	24,0	26,4	26,4	18,9	13,2
	10	23,2	26,0	26,0	18,4	13,0
	25	22,4	25,5	25,5	17,8	12,7
	50	21,9	25,1	25,1	17,3	12,3
40	1	21,6	23,5	23,6	17,1	11,7
	5	20,3	22,6	22,7	16,0	11,3
	10	19,7	22,3	22,4	15,6	11,1
	25	18,9	21,8	21,9	15,0	11,0
	50	18,4	21,5	21,6	14,6	10,7
50	1	18,3	20,1	20,5	14,5	10,4
	5	17,1	19,3	19,7	13,5	10,2
	10	16,5	19,0	19,4	13,1	10,0
	25	16,0	18,6	19,0	12,6	9,9
	50	15,5	18,3	18,7	12,2	9,7
60	1	15,5	17,0	17,7	12,2	8,4
	5	14,4	16,3	17,0	11,4	8,2
	10	13,9	16,0	16,7	11,0	8,1
	25	13,3	15,7	16,4	10,6	7,9
	50	12,9	15,4	16,1	10,3	7,8
70	1	13,1	14,3	15,4	10,3	6,27
	5	12,0	13,7	14,8	9,6	5,93
	10	11,6	13,5	14,6	9,2	5,82
	25	9,9	13,1	14,2	8,0	5,71
	50	8,5	12,9	14,0	6,8	5,63
80	1	10,9	11,9	13,4	8,6	
	5	9,6	11,4	12,9	7,7	
	10	8,0	11,2	12,7	6,5	
	25	6,4	10,9	12,4	5,2	
90	1	-	8,8	9,2	7,2	
	5	-	6,1	7,8	5,1	
	10	-	5,2	7,5	4,3	

PP-R / EN 15874


50
40
30
20
10
9
8
7
6
5
4
3
2
1
0,9
0,8
0,7
0,6
0,5
10°
20°
30°
40°
50°
60°
70°
80°
90°
95°
110°
Hoop stress in Mpa (pressure)
0,1
1
10
10²
10³
10⁴
10⁵
10⁶
Live service (hours)
1
5
10
25
50
100
YEARS

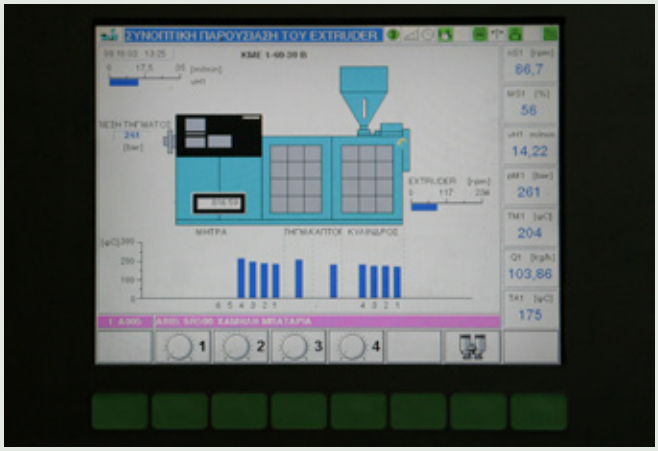
PP-RCT / EN 15874



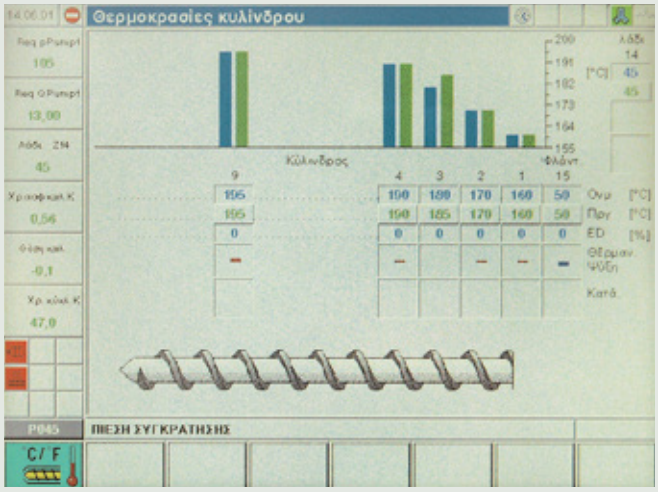
08

QUALITY ASSURANCE DURING PRODUCTION

Our first concern and primary commitment are to ensure outstanding quality. Much of our efforts focus on this area. The mechanical equipment used in Aqua-Plus pipes and fittings production reassures the system's quality to an absolute degree. In addition to the commonly used mechanical equipment required for the production of pipes, Interplast production lines are equipped with the following equipment that assures the consumer of having at his disposal excellent high-quality products.



Automatic correction of screw RPM
In this way, we achieve stability in the produced pipe, which also means stable dimensions. It is the first part of the pipe's dimensional safety.



Raw material dehumidifier
In this way, we achieve stabilization of the Extruder data for raw materials that absorb moisture. Thus, we avoid dimensional changes phenomena observed in several pipes.

Automatic correction of the wall thickness of the pipe
A system in which we set the desired limits of the wall thickness, which are automatically adjusted via the haul off of the production line. It is the second part of the pipe's dimensional safety.

Control of the outer dimension with LASER
It is the third and last part of the electronic controls. The absolute values of the LASER SCANNER ensure the correct application of the pipe to the fitting during the heat welding.

Pipe and fitting assembly check by using the device for thermal self-welding.

Dimensional inspection of the pipes by the line operator. The outer dimension is checked with a circumference tape, while the wall thickness and the oval shape of the pipe are checked with an electronic caliper. The measured specimens are stored for final inspection by the production manager and the technical director, who give the disposal order after the conclusion of the laboratory tests. All measurement data get registered in the ISO, which is updated daily.

09

LABORATORY CONTROLS

The strict specifications followed by Interplast in the production of pipes and fittings are certified in its ultra modern, privately owned laboratories, with tests defined by the European norms EN ISO 15874-1/2/3 and the German DIN 8077, 8078 and 16962. The factory supplies pipes and fittings tested for quality by the following procedures:

Control of the flow index of raw materials and finished products.
That is a standard control check, carried out every time we receive raw materials and produce new products. The flow index of the raw materials is significant to the definition of the temperature profile of the EXTRUDER and, consequently, to the homogenization of the material, so its short deviation from the flow index of the corresponding product proves the correct processing of the material.

Visual inspection of the surface of the pipes, measuring the external diameter and measuring the wall thickness with calibrated instruments.
These are tests that certify the continuous measurements made during the production phase.

Control of durability and reliability over time of pipes and fittings with thermal cycle test.
The products are tested as a system in extreme operating conditions for 5,000 hours. The water temperature changes every 15 minutes between 20°C and 95°C (consecutive thermal shocks), while the hydraulic pressure is constantly at 6 bar, according to the standards ISO 19893 and EN 12295.

Control of the % heat reversion of the pipes.
Production samples are kept in a laboratory oven at 135°C for 2 hours. The resulted measurements should not exceed 2%, according to the specifications of DIN and EN ISO. Aqua-Plus pipes show values of 0.4%, while Aqua-Plus-Aluminum and Aqua-Plus-Fiberglass pipes show values of 0.2%. That translates into particularly small coefficients of thermal linear expansion during their operation in heating installations.

Microscopic control of homogenization of the material.
This is one of the most important control tests, as it proves the correct processing of the raw material. All pipes and fittings present the best possible homogenization, resulting in their very long lifespan.

Control of the mechanical strength of pipes and fittings to internal hydrostatic pressure, at a test time of 1 hour at 20°C and 95°C, 22, 165 & 1,000 hours at 95°C and 8,760 hours at 110°C, as specified by European norms and by German and Spanish standards.
The 1-hour tests are performed per batch of the final product, while the 22 and 165 hours tests once a year per section and type of pipe.

Impact test according to the requirements of DIN 8078, DIN 53453, EN ISO 15874-2 and ISO 9854-1/2, which describe the test method.
PP-R pipes must be able to withstand breakage at 0°C and 15J energy shocks. The high quality of Aqua-Plus pipes allows them to endure breakage at temperatures of -5°C and 25J energy shocks, which exceeds the standard requirement by 66%.

10

STANDARDS AND REGULATIONS

EN ISO 15874-1
Plastic PP piping systems for hot and cold water installations.

EN ISO 15874-2
Plastic PP piping systems for hot and cold water installations. Pipes.

EN ISO 15874-3
Plastic PP piping systems for hot and cold water installations. Fittings.

EN ISO 21003-2:2008 + A1:2001
Multi-layer piping systems for hot and cold water installations.

EBETAM – MIRTEC, SKZ H.R. 3.28
Certification regulations and testing for multi-layered PP-R pipes with glass fibers.

DIN 8077
Polypropylene pipes, dimensions.

DIN 8078
Polypropylene pipes, general quality requirements-testing.

DIN 8076
Metal parts of fittings, testing methods.

ISO 17455:2005
Plastic piping systems – Multi-layered pipes. Determination of oxygen permeability.

ASTM F2389
Standard specification for PP piping systems.

BS 6920-A
Suitability for use in contact with drinking water.

DIN 2999
Polypropylene fittings with inner metal part.

DIN 16962
Polypropylene pipes and fittings.
Sheet 5: General quality requirements, testing.
Sheet 6: Elbows for welding with connections, dimensions.
Sheet 7: Tees for welding with connections, dimensions.
Sheet 8: Caps and studs for welding with connections, dimensions.
Sheet 9: Construction studs for welding with connections, dimensions.
Sheet 10: Collars, flanges and valves for welding with connections, dimensions.

DIN 2000
Guidelines for the requirements for drinking water. Design, development and operation of facilities.

DIN 1988
Drinking water pipes. Part I. Technical specifications for drinking water installations.

EN 12845
Fixed firefighting systems – automatic sprinkler systems.

EN 13823
Reaction to fire tests for building products – SBI Test.

EN 13501
Fire classification of construction products according to reaction to fire tests.

DIN 4109, Sheet 5
Sound insulation in water pipes.

DIN 4109
Noise reduction in buildings (internal networks).

DIN 16774
Thermoplastic mass: Polypropylene (PP).

DIN 53735
Testing of plastic materials: Determination of the melt flow index of thermoplastics.

DIN 16960
Welding of thermoplastic materials, principles.

DVS 2203
Testing of thermoplastic fittings for welding.

DVS 2207, part II
Welding of thermoplastic materials, polypropylene, pipes and fittings.

DVS 2208, part I
Machinery and equipment for welding of thermoplastics.

11

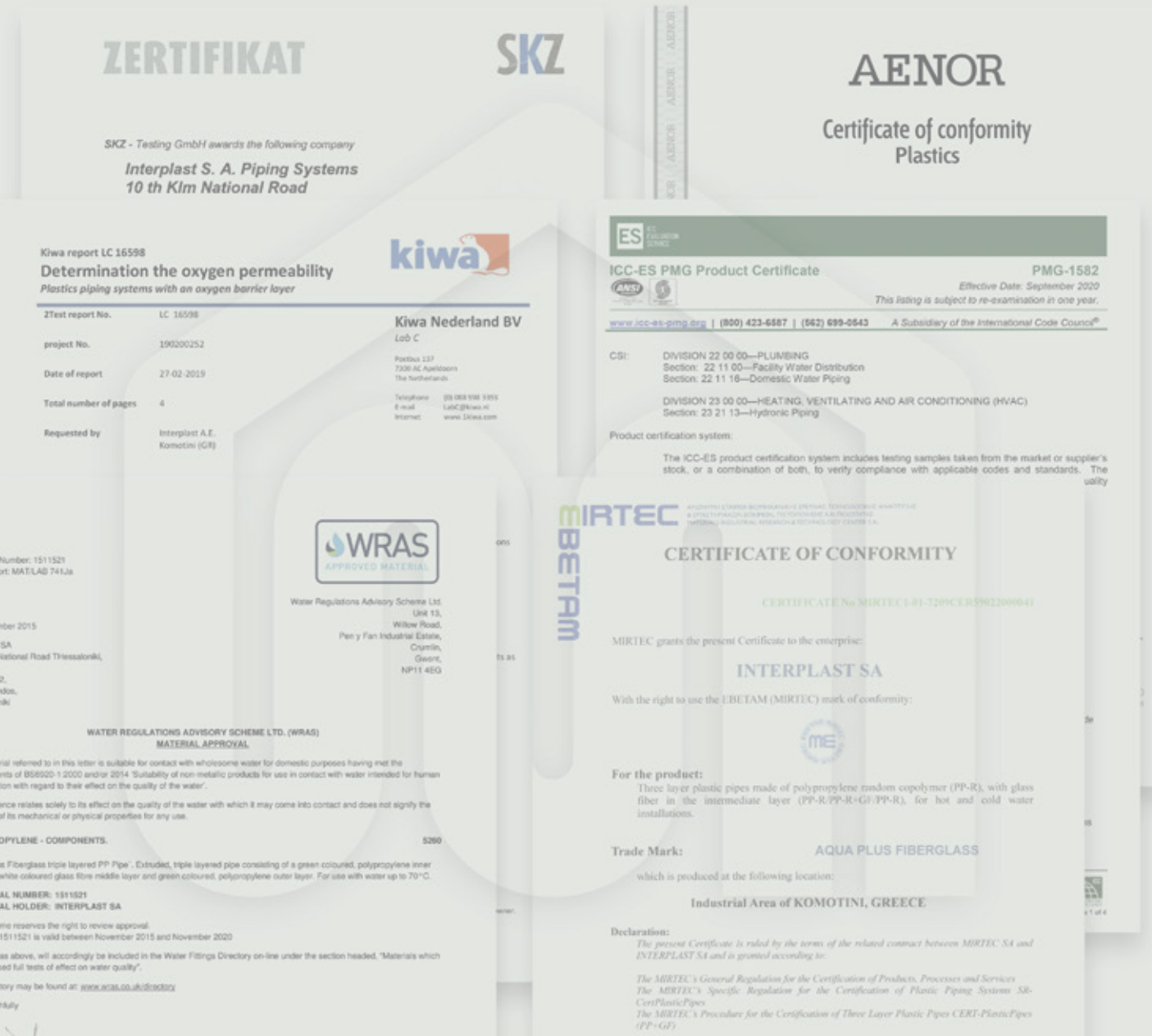
CERTIFICATIONS

Interplast pipes and fittings exceed the requirements set by **European Standards EN, international ISO standards**, German standards, Spanish UNE, British BS and **American ASTM - NSF standards**.

As a result, the Aqua-Plus pipes and fittings do not show any failing in the regular semi-annual inspections carried out by official institutes concerning random samples from production and storage.

The crown of the above is the fact that Aqua-Plus pipes and fittings are certified as a final product by many accredited organizations, collecting over 50 corporate certifications.

TUV–EN ISO 9001:2015	AENOR (Spain)
ISO 14001:2015	KIWA (Netherlands)
ISO 50001:2015	EMI (Hungary)
EPD (Sweden)	NNK (Hungary)
MIRTEC (Greece)	OKF (Hungary)
WRAS / NSF (England)	SII (Israel)
ICC / ASTM (USA)	ZIK (Croatia)
ICC / NSF (USA)	GOST (Russia)
SKZ (Germany)	General Chemistry State
FFI (Germany)	Laboratory (Greece)



Green line

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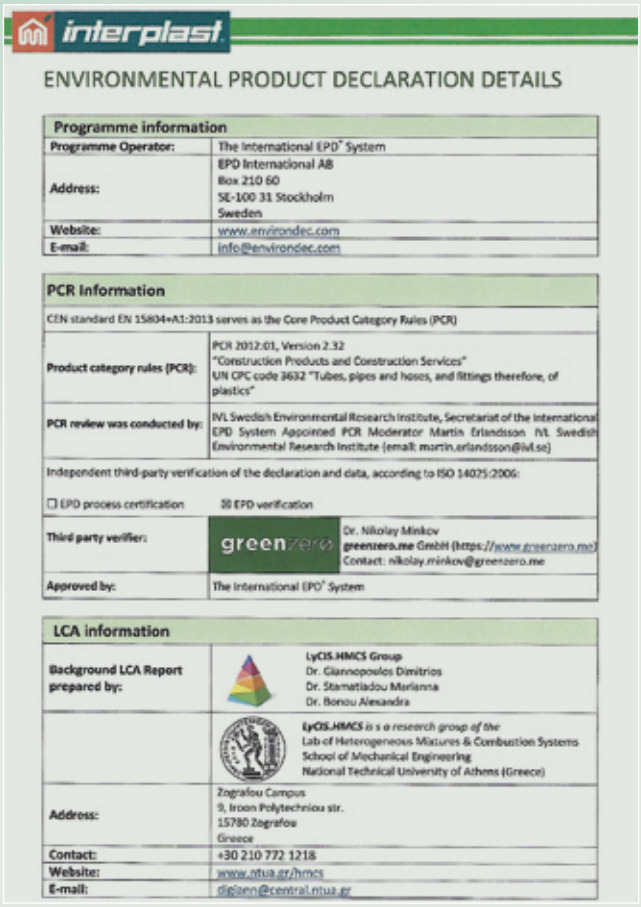
AQUA-PLUS TOWARDS ENVIRONMENT

ECOLOGICAL SYSTEM, ENVIRONMENTALLY AND HUMAN FRIENDLY

—Polypropylene meets Leed requirements
—Nontoxic material without dioxins
—Recyclable in pipes and fittings
—Long lifespan that contributes to its non-replacement for many years
—Product free of heavy metals
—Chemically inert
—Installation without emissions of pollutants and harmful gases for the environment

In the last century, the earth is facing an unprecedented increase in population, estimated to reach 11.2 billion by 2100. Overpopulation causes the depletion of the natural resources of our planet.
The solution to this environmental crisis is to shift from a linear to a circular economy, where products live longer and are recycled at the end of their lifespan.

Considering the above facts, Interplast decided and implemented a **triple certification**, focused exclusively on the protection of the environment:
1) Completed the certification process by elaborating an integrated Environmental Management system following **ELOT EN ISO 14001:2015**.
2) Completed the certification process by installing all the provided energy-saving "tools" according to **ELOT EN ISO 50001:2018**.
3) Completed the elaboration of the necessary **LCA** that leads to the mandatory **EPD (Environmental Product Declaration)**, which was registered on its electronic platform with code **SP-02120**, as provided by **ISO 14025** and **EN 15804**. The EPD or Environmental Product Declaration is an eco-labeling system, which in international markets and especially in Europe and the United States, is used as the "**International gold standard**" to display and communicate products' environmental performance during their life cycle.



interplast

ENVIRONMENTAL PRODUCT DECLARATION DETAILS

Programme information	
Programme Operator:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com
E-mail:	info@environdec.com

PCR Information	
CEN standard EN 15804+A1:2013 serves as the Core Product Category Rules (PCR)	
Product category rules (PCR):	PCR 2012:01, Version 2.32 "Construction Products and Construction Services" UN CPC code 3632 "Tubes, pipes and hoses, and fittings therefore, of plastics"
PCR review was conducted by:	IVL Swedish Environmental Research Institute, Secretariat of the International EPD System Appointed PCR Moderator Martin Erlandsson IVL Swedish Environmental Research Institute (email: martin.erlandsson@ivl.se)
Independent third-party verification of the declaration and data, according to ISO 14025:2006:	
☐ EPD process certification	☒ EPD verification
Third party verifier:	greenzero Dr. Nikolay Minkov greenzero.me GmbH (https://www.greenzero.me) Contact: nikolay.minkov@greenzero.me
Approved by:	The International EPD® System

LCA information	
Background LCA Report prepared by:	LyCIS.HMCS Group Dr. Giannopoulos Dimitrios Dr. Stamatiadou Marianna Dr. Bonou Alexandra
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IQNet

THE INTERNATIONAL CERTIFICATION NETWORK

CERTIFICATE

MIRTEC S.A. has issued an IQNet recognized certificate that the organization:

INTERPLAST S.A.

INDUSTRIAL AREA OF KOMOTINI, GR-691 00 KOMOTINI

has implemented and maintains a
Energy Management System

for the following scope(s):

- ✓ MANUFACTURE OF PLASTIC PIPES & FITTINGS FOR WATER SUPPLY, HEATING, AIR CONDITIONING & DRAINAGE
- ✓ PRODUCTION OF PRE-INSULATED PIPES

which fulfils the requirements of the following standard

ELOT EN ISO 50001:2018

Issued on : 2020-07-15
First issued on : 2020-07-15
Expires on : 2023-07-15

This attestation is directly linked to the IQNet Partner's original certificate and shall not be used as a stand-alone document

Registration Number : MIRTEC1-01-7209CER11.6072000475

Alex Stoichitoiu
President of IQNet

Ioannis Dimitriadis
General Director of Inspection & Certification of MIRTEC S.A.

IQNet Partners*:
AENOR Spain AFNOR Certification France APCER Portugal CCC Cyprus CISQ Italy CQC China CQM China CQS Czech Republic Cro Cert Croatia DQS Holding GmbH Germany EAGLE Certification Group USA FCAV Brazil FONDONORMA Venezuela ICONTEC Colombia Inspecta Sertifiointi Oy Finland INTECO Costa Rica IRAM Argentina JQA Japan KFQ Korea MIRTEC Greece MSZT Hungary Nemko AS Norway NSAI Ireland PCBC Poland SIQ Slovenia SIRIM QAS International Malaysia SQS Switzerland SRAC Romania TEST St Petersburg Russia TSE Turkey YUQS Serbia

* The list of IQNet partners is valid at the time of issue of this certificate. Updated information is available under www.iqnet-certification.com

All the above demonstrate in the most emphatic way the commitment and vision of Interplast to become a model production company with environmental awareness, with products that are an ideal choice for **buildings with bioclimatic design**. That helps designers, constructors - buyers, and users of buildings to evaluate and, if they wish, to classify their buildings as "green buildings" of low or zero emissions, according to the **LEED V4, BREEAM, DGNB** protocols, which work as an evaluation basis for the requirements of **EN 15978 - Sustainability of Construction works**.

Polypropylene can be recycled and reused in hotels, homes, hospitals as well as in other applications. In addition, polypropylene products (PP-R or PP-RCT) are designed to last for over 70 years, resulting in zero maintenance or replacement costs.

Finally, the innovative Aqua-Plus Prins pre-insulated system offers an extended lifespan regarding also insulation ability. Therefore, it is one of the few integrated certified system products (pipes, fittings, and insulation) worldwide with zero maintenance and long service life.

IQNet

THE INTERNATIONAL CERTIFICATION NETWORK

CERTIFICATE

MIRTEC S.A. as an IQNet Partner hereby states that the organization:

INTERPLAST S.A.

INDUSTRIAL AREA OF KOMOTINI, GR-691 00 KOMOTINI, GREECE

has implemented and maintains a
Quality Management System

for the following scope:

- ✓ MANUFACTURE OF PLASTIC PIPES & FITTINGS FOR WATER SUPPLY, HEATING, AIR CONDITIONING & DRAINAGE
- ✓ PRODUCTION OF PRE-INSULATED PIPES

ELOT EN ISO 14001:2015

Issued on : 2020-02-26
First issued on : 2020-02-26
Expires on : 2023-02-26

for the validity date, please refer to the original certificate* issued by ERETAM-MIRTEC S.A

Registration Number :
GR-MIRTEC1-01-7209CER11.2022000400

Alex Stoichitoiu
President of IQNet

Athanasios Stamou
Certification Manager
MIRTEC S.A.

IQNet Partners**:
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IQNet is represented in the USA by: AFNOR Certification, CISQ, DQS Holding GmbH and NSAI Inc.

* This attestation is directly linked to the IQNet Partner's original certificate and shall not be used as a stand-alone document
** The list of IQNet partners is valid at the time of issue of this certificate. Updated information is available under www.iqnet-certification.com

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APPLICATIONS

The PP-R or PP-RCT water distribution system has been used safely and reliably for the last 40 years, at temperatures up to 95°C and operating pressures ranging from 6 to 26 bar. Temperature peaks of 110°C at an operating pressure of 4 bar do not affect the Aqua-Plus system.

The material's properties combined with its purity and non-toxicity, excellent corrosion resistance, and low friction coefficient have made the PP-R or PP-PCT system one of the primary choices of the technical world for plumbing and heating installations.

WATER SUPPLY INSTALLATIONS

For the water supply systems, the following installation designs exist:

T arrangement, where different outflow points can be supplied with water from the same piping branch. The advantage of this installation method, which has the same philosophy as the traditional way of installing metal pipes, is the smaller number of pipes in the building.

Combination of polypropylene with crosslinked polyethylene. Polypropylene is used as the main supply up to the manifold. The water is then distributed separately to different outlets with cross-linked polyethylene pipes. The great advantage of this installation method is the isolation of the circuits in case of battery failure.

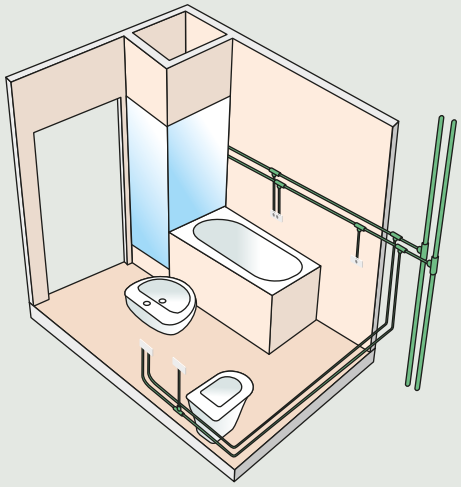
The Aqua-Plus system can be used in combination with the supply saddles produced by Interplast in the water-meter arrangements.

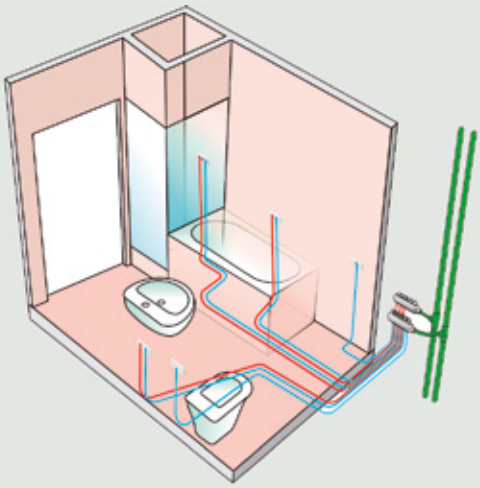
HEATING AND UNDERFLOOR HEATING INSTALLATIONS

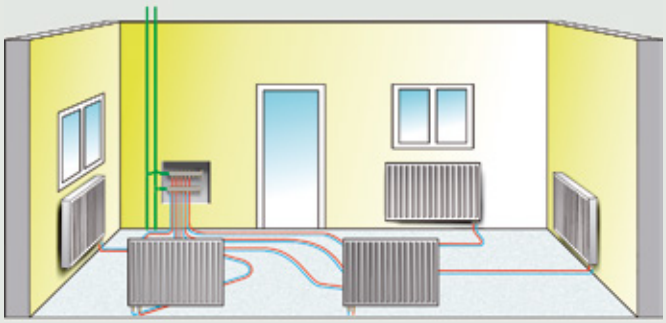
It is used as a main supply from the boiler or heat pump to the manifold in installations with radiators and underfloor heating installations. The low linear expansion of the Aqua-Plus system guarantees a fearless use of polypropylene pipes and fittings as a central supply line (risers) in heating installations.

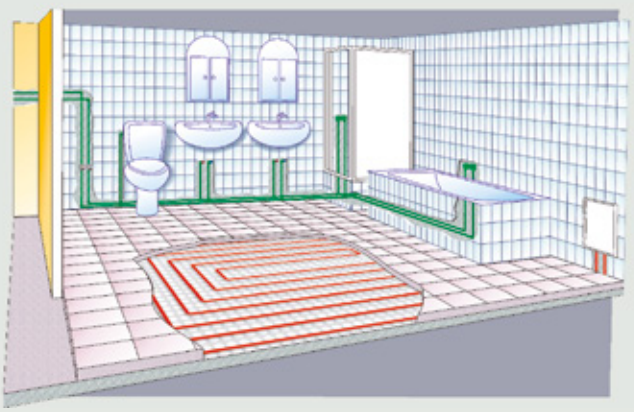
SPECIAL APPLICATIONS

The Aqua-Plus system applies in compressed air and cooling installations in industry and networks for various aggressive liquids. It also applies in swimming pools and heat pump connections.









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STORAGE — TRANSPORTATION

1_The ends of the pipe require special attention.
In case of damaged parts, you should remove them before installation.

2_Dents and scratches deeper than 5% of the wall thickness are considered as damage.

3_When storing the pipe on storage tacks, always have at least three supports less than 4 meters long and four supports less than 5.8 meters long.

4_Pipes should be stored only on a flat and clean surface.

5_**Do not remove the pipes from their packaging**, especially for outdoor storage. The packaging protects from scratches, dust, sunlight and weather conditions.

6_Warranty does not cover pipes stored uncovered in outdoor places for a period longer than 3 months. For pipes with UV protection (outdoor installations), contact the Technical Support Department of the company.

7_When covering the pipe with a protective paint, always use a light shade, e.g. white color. Do not use black paint, as it may cause thermal damage to the pipe.

8_When transporting the pipe, always place it on a flat and clean surface or with equable support.

9_**Fittings should be placed in cardboard boxes** for as long as needed.

10_**For pipes with large cross-section it is forbidden to transport them with the forks of forklift trucks.**
If you cannot use a crane, place pads around the forks of the forklift truck.

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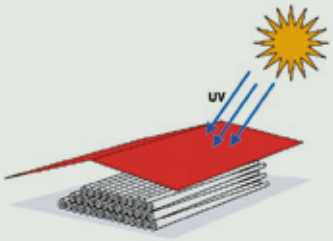
USE INSTRUCTIONS

Ultraviolet radiation is harmful to polypropylene. Thus, long-term exposure to sunlight can degrade the functional properties of the system. This is especially true when the items are stored outdoors, in courtyards or installed without protection on external wall surfaces. In both cases, the pipes and fittings must be transported in closed storage areas or covered with a suitable insulating material. However, in pipes installed next to balcony doors, windows or skylights, the effect of UV radiation on the lifespan of the Aqua-Plus system can be negligible.



Aqua-Plus pipes and fittings should not be left exposed to sunlight for long. In outdoor installations, insulation or two-layer coating with black emulsion paint should be applied, which should be re-applied at least every 5 years. For pipes with UV protection, contact the Technical Support Department.

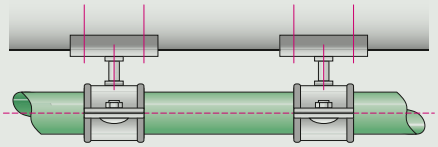
For cutting, we use the special cutting tools for plastic pipes (shears), so that the section is perpendicular to the longitudinal axis of the pipes. Cutting with a knife, a bevel or a hacksaw is prohibited. When you use multi-layered pipes with aluminum (Aqua-Plus-Aluminum), you should clean the ends of the pipes with the scrapers very carefully so that no pieces of aluminum remain on the outer surface of the pipes.

Plastic pipes should not be heated by a flame. When local heating of the pipe is required, it should be performed with hot air at a temperature of 130°C, while the pipe should return to ambient temperature by itself.

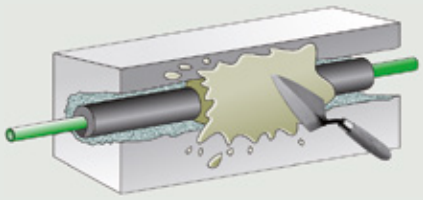
You should avoid the use of an excessive amount of thread sealing cord, as well as the excessive tightening of the screw connections of plastic-brass and brass fittings. The threads are made with high precision, in order to ensure tightness with a simple tightening.

When connecting a metal pipe with an Aqua-Plus pipe it is recommended to use a socket (F/F) and connect the Aqua-Plus fittings with a male thread on this socket.

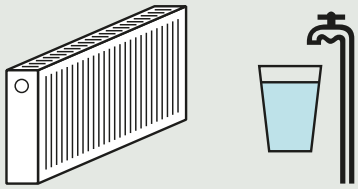
In the event of frost and for installations that remain out of operation for long during winter (high altitude holiday homes), even though the Aqua-Plus system has excellent elasticity, it is recommended to discharge the network.



You must follow the correct supports distances according to the instructions in this technical manual.



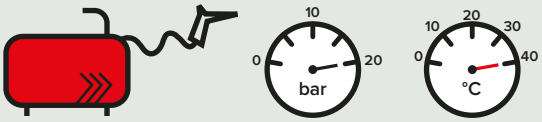
In embedded installations in the floor or wall, the coating of the pipes with plaster or cement must have a thickness of at least three centimeters.
That avoids any thermal elongation of the piping.



Interplast polypropylene pipes and fittings with the brand name "Aqua-Plus System" are suitable for drinking water supply systems and heating systems in buildings.

Their lifespan exceeds 50 years and their specifications for continuous operation are 20°C temperature with a pressure of 20 bar and 70°C temperature with a pressure of 10 bar. The categorization of the pipes recommended for these uses is PN 20 and, for fittings, PN 30.

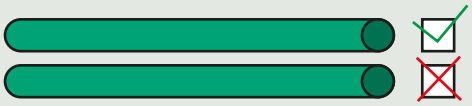
The system's behavior against flame is categorized as class B2 (normal ignition) according to the German standard DIN 4102-I, while during the combustion of the pipes no toxic products are released.



The Aqua-Plus system applies in compressed air applications. The pressure should not exceed 20 bar and the temperature 40°C.

In air conditioning applications, the system shows good chemical resistance to aqueous glycol solutions or pure glycol (ethylene glycol or propylene glycol) and the operating pressure should not exceed 5 bar, as long as the temperature of the antifreeze agent is between -15°C and +5°C.

Pipes are covered by a 10-year warranty provided by the insurance company Generali. The guarantee is valid, when pipes and fittings are parts of the Aqua-Plus system for reasons related to the homogeneity of the heat-welded materials, the system pressure test is completed, and the installation procedures follow the Aqua-Plus technical manual.



The Aqua-Plus system can be used in oil transfer applications, with the use of suitable earthing in the system, to avoid static electricity phenomena, as well as for the transportation of ethyl alcohol (alcohol). The transportation of the above liquids should be performed at room temperature.
The system should not be used to transport gasoline, benzol, chlorine and xylene, as well as other highly aggressive liquids.

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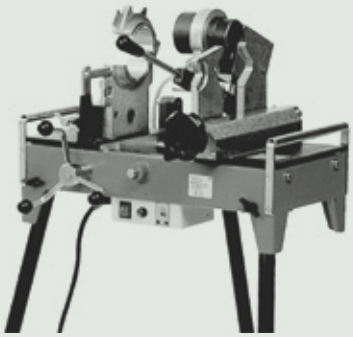
THERMAL FUSION WELDING

16.1 WELDING MACHINES



Bench-type socket welding machine 25mm-125mm

Socket welding machine (SET) 20mm-40mm

Compact welding machine SPIDER
for difficult access points up to 125mm

Digital socket welding machine (SET) 20mm-63mm

Butt welding machine
160mm-315mm | 315mm-450mm | 355mm-630mm

Socket welding machine (Racket) 63mm-110mm

Internal debeader machine for butt welding

Socket welding machine RITMO 20mm-63mm

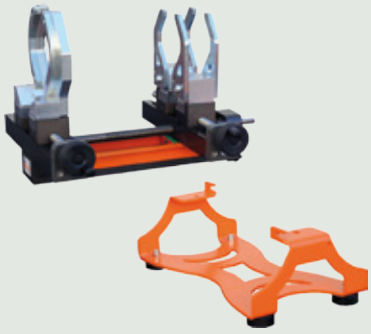
Butt welding machine RITMO 160mm–315mm

Socket welding machine RITMO (Racquet) 63mm-125mm

Butt welding machine RITMO 200mm-500mm

Socket Bench-type welding machine RITMO 25mm-125mm

Butt welding machine RITMO 315mm-630mm



Compact welding machine PRISMA JIG - RITMO 20mm-125mm

Arc welding machine RITMO 20mm-160mm
*available also in 20mm-315mm and 20mm-500mm

16.2 TOOLS

The pipes and fittings of the Aqua-Plus system connect using fusion welding. This process involves mixing the molten material of the outer surface of the pipe and the inner surface of the fitting after heated to 260-280°C. Connections welded properly do not show gaps between the two elements along the entire length of the connection when cut perpendicular to the longitudinal axis of the pipe.

For the welding of the pipes and the fittings, we use the following tools:

—Pipe cutting tools, which are available in two types.
1. Cutting tools, used for pipes with an outer dimension between 20 to 40mm
2. Cutting tools, used for pipes with an outer dimension between 50 to 63mm

—Pipes with dimensions between of 75 to 125mm are cut with:
1. Rotary pipe cutting tools
2. Mechanical circular saws

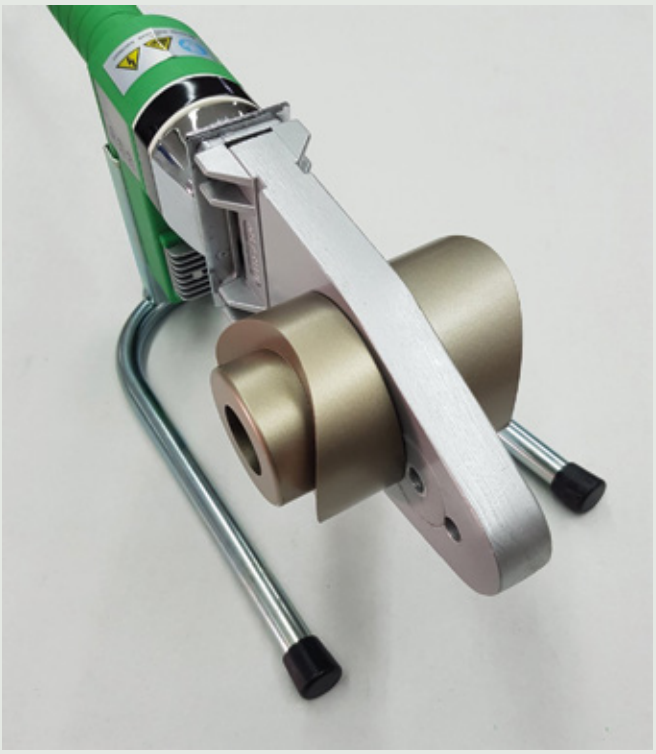
After cutting with a circular saw, you should remove the protrusions from the inner end of the cut pipe.
-Cross-sections from 106 to 450mm get cut using a band or sword saw.

IMPORTANT NOTES
—Any cutting residues (metal scraps) should be removed from the end of the pipe.
—In sections from 75 to 125mm, a bench-type welding machine should be used for thermal welding rather than a racket.

16.3 ASSEMBLY GUIDELINES

Before starting the welding machine, we place the dies corresponding to the diameter of the elements we want to weld to the heating plate, using the tool set that comes along with the welding machine.

Make sure the dies are in perfect contact with the heating surface.



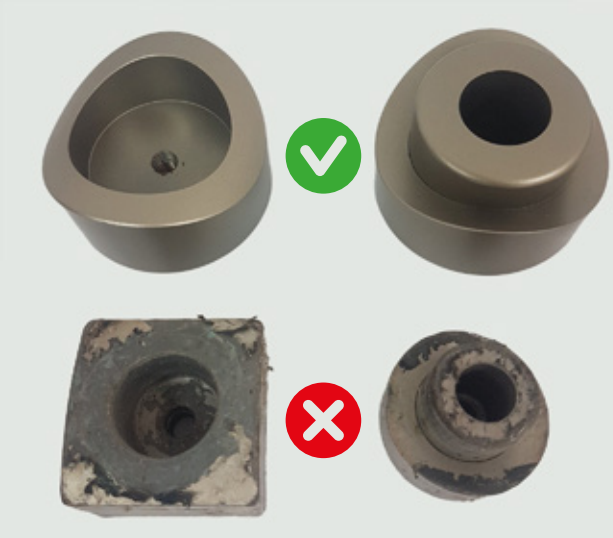
TIP: It is recommended to use welding machines, dies, and tools of the same manufacturer.

The dies are heated by the heating plate. Therefore, it is important to tighten them firmly on the plate to ensure contact of the entire surface between the plate and the die.

The thermal fusion welding machine must be in an excellent working condition and should maintain a constant temperature of at least 260°C. Otherwise, welding failure (cold welding) will occur.

The dies are made of aluminum coated with Teflon. Therefore, they should be wiped periodically with a soft cloth (polishes are not allowed) and cleaned with mild ethyl alcohol.
Never use pliers or other unsuitable tools that could damage the plating of the welding tools.

The welding dies should be in excellent condition, without the slightest scratch or bump. The Teflon layer on their surface ensures proper welding, as there are no remains of molten plastic inside and outside the dies after welding. The opposite would result in a decrease in the surface temperature of the dies and the formation of a gasket in the next welding, which would make the welding (cold welding) particularly difficult.



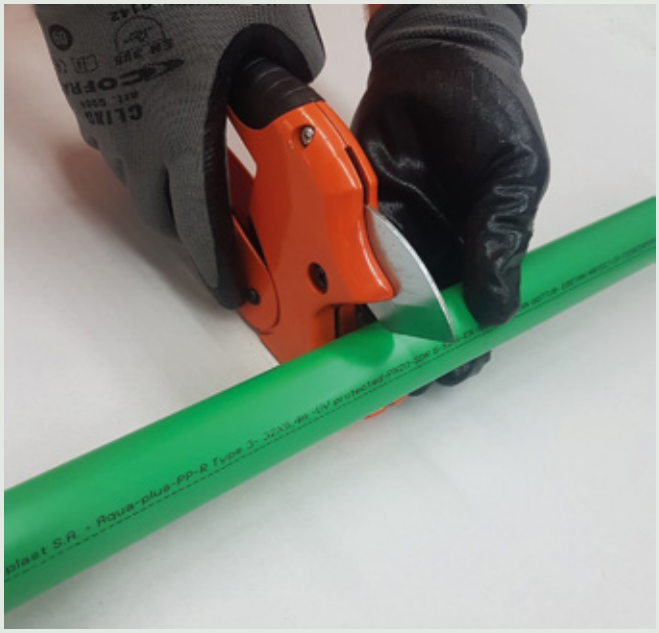
Two pairs of dies can be placed on the heating plate, the simultaneous welding of two different dimensions.
Dies with dimensions larger than 40mm must always be fitted to the rear hole of the heating plate.

After starting the machine, the first welding can occur 2-3 minutes after it has reached the appropriate temperature.

SOS
After use, unplug the welding machine and allow it to cool down. Do not use water to cool the welding machine, as it may damage the heating resistances.
For perfect welding, you will need to replace damaged or dirty welding dies in order to obtain a flawless result.

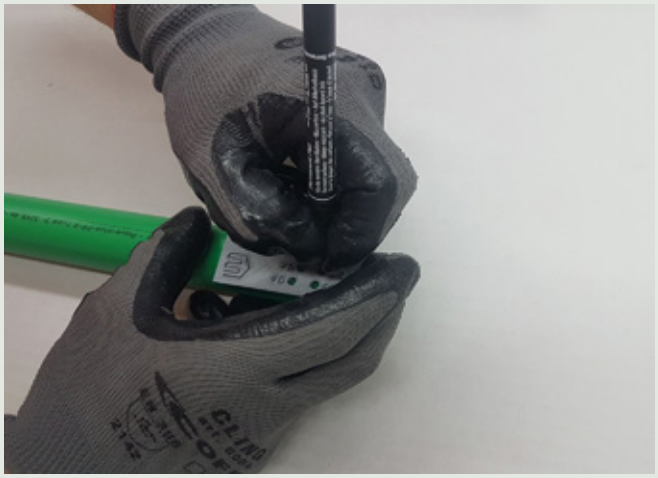
16.4 WELDING

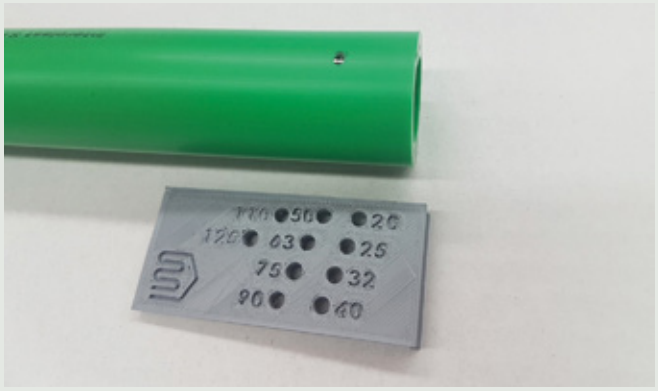
A) Pipe cutting
The pipes must be cut to the appropriate length, perpendicular to their axis. Make sure there are no chips inside.



B) Cleaning
Before welding, clean the interior of the fittings and the exterior of the pipe. The presence of dust or any other material can cause improper welding.

C) Pipe marking
Mark the pipe as far as regards the penetration depth into the die. The marking must remain visible until the pipe is heated and connected to the fitting.





The depth depends on the outer dimension of the pipe and the correct value is selected from the table below.

Pipe Dimension	Penetration depth
(mm)	(mm)
20	14
25	16
32	18
40	20
50	23
63	26
75	28
90	31
110	33
125	40

D) Heating
Heat the tube and the fitting by pressing simultaneously into the welding die.

The heating time starts when the pipe and fitting are placed in the welding die. Once they are warmed up for the right amount of time, slowly remove the components in a horizontal position from the appliance.
At ambient temperatures below 5°C (should be avoided), the heating time is extended by 50%.

Welding at ambient temperatures below 0°C is not allowed.

Pipes and fittings must be heated simultaneously and only once. Second heating is not allowed. The heating and welding process must not be interrupted.

The required times are listed in the table below.

Pipe Dimension	Heating Time
(mm)	(sec)
20	5
25	7
32	8
40	12
50	18
63	24
75	30
90	40
110	50
125	60

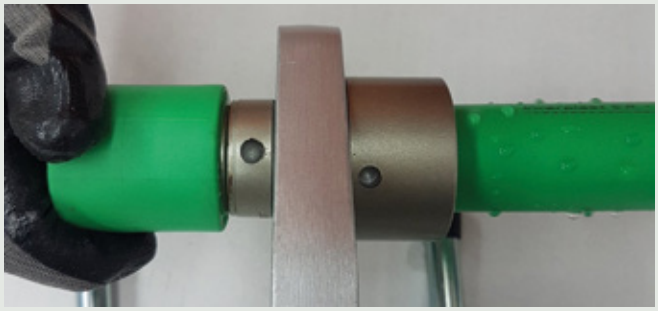
IMPORTANT NOTE
If the pipe or fitting remain for less time inside the die, this will result in cold welding and a higher risk of detachment. More time will result in excessive melting of the material which can lead to a reduction in its cross-section.

E) Welding
Join the pipe and fitting by checking the marking. The elements can be aligned with the embossed line on the fitting and the dashed line on the tube.

IMPORTANT NOTE
During welding, the rotation of the welded elements around their axis is not allowed. It is allowed to adjust the axes of the elements up to +/-3°.

During the welding check, the outer seam around the pipe must not be interrupted. In the case of double seam, the two seams must be tangential.

IMPORTANT NOTES
—The welding must not come into contact with water or other liquid elements.



—The pipe must not come into contact frontally, at any point, with the fitting.

—The welding should be replaced, if it shows as follows.

The required time for welding is listed in the table below.

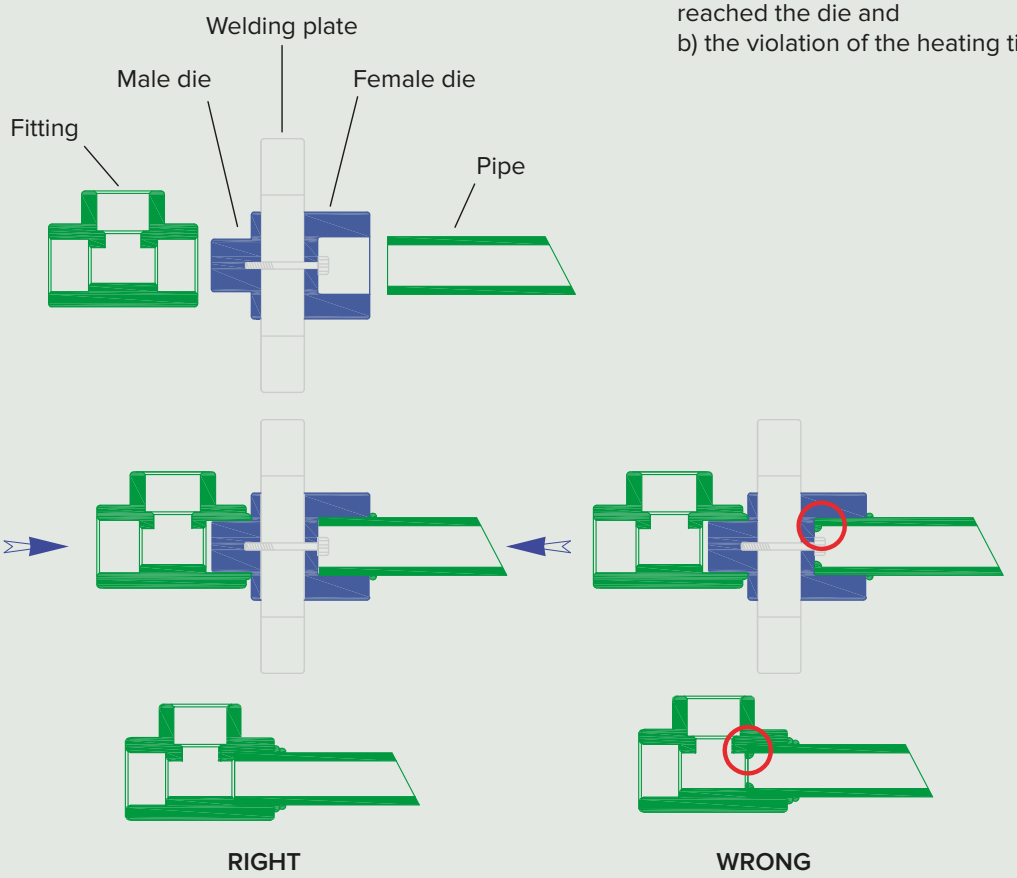
Pipe Dimension	Welding Time
(mm)	(sec)
20	4
25	4
32	6
40	6
50	6
63	8
75	10
90	10
110	10
125	15

F) Cooling
The welded elements must remain stationary until they cool down, at a time specified in the table below.

Pipe Dimension	Cooling Time
(mm)	(min)
20	2
25	2
32	4
40	4
50	4
63	6
75	8
90	8
110	8
125	10

PP-R Welding

Inside the pipe, a peripheral narrowing occurs due to:
a) the constant pressure on the pipe when its end has reached the die and
b) the violation of the heating time limits.



16.5 INSTRUCTIONS OF INSTALLATION OF BUTT WELDING MACHINE FOR PP-R OR PP-RCT

General
Butt welding is a process that uses heat and pressure to join two sides (profiles) of pipes without the need to use fittings, while maintaining the mechanical strength of the connections.

Assemblage of welding tools
In this manual, Interplast describes the butt welding technique according to DVS 2207 part II.

WARNING
Use only welding equipment and tools approved by Interplast.

Welding machine for pipes with dimensions 160-315mm

1. Device for unit control and oil compression
2. Pipe clamps
3. Hydraulic pressure pipes
4. Hydraulic cylinder with base
5. Sharpening device
6. Heating device

Explanation of Butt welding
The basic steps for a successful welding.

Alignment: the pipes should be aligned and fastened through the clamping elements. Gap width up to 315mm, outer dimension = 0,5mm (image 1).
The maximum alignment deviation should not exceed 10% of the wall thickness or 2mm (image 2).

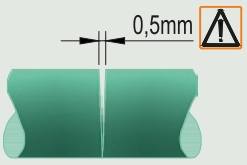


image 1

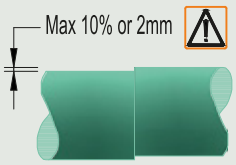
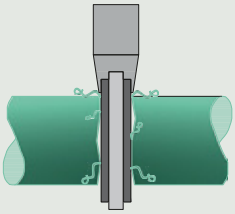
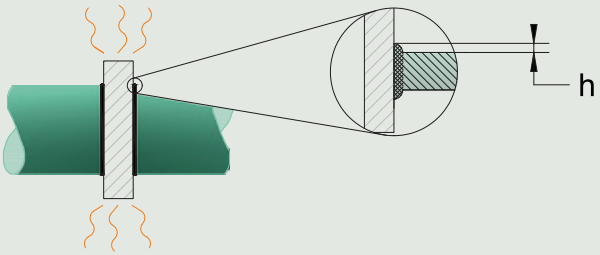


image 2

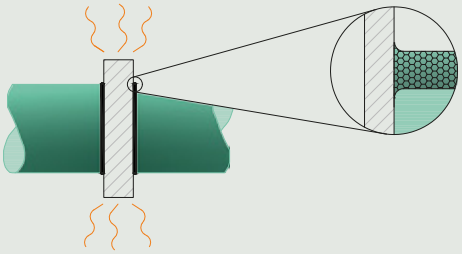
Surface parallelism (Frontal placement):
The pipes should be placed in a way to ensure sufficient parallelism of the two surfaces and to remove any traces or oxides.



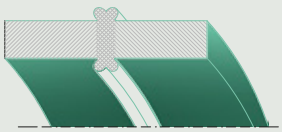
Adjustment:
Create the correct fusion ring.



Heating:
As the pipe heats up, the PP-R molecular chains are activated for fusion.



Fusion:
By exerting the aforementioned pressure on the surfaces of the two pipelines, we create a permissible connection. The applied pressure causes the chains to fill any gaps, minimizing the possibility of leakage.



Butt welding pressures
Each stage of frontal welding requires a certain pressure. The four pressures you will need to know are the Drag Pressure [Pd], the Interfacial Pressure [P1], the Preheating Pressure [P2] and the Welding Pressure [P3]. Calculate the reported pressures before starting the welding procedure.

Drag pressure [Pd]:
It is the minimum hydraulic pressure required to move the pipes in the hydraulic clamps. Determine the drag pressure by slowly increasing the pressure control until the pipe starts to move. The drag pressure varies depending on the design of the machine, the orientation of the machine and the size of the pipe.

Interfacial pressure [P1]:
It is the force required at the fusion point for welding. Apply this pressure until the appropriate fusion ring is formed. The pressure value (P1) can be found in table 1, on the next page. The interfacial pressure is calculated from the pressure gauge of the machine.

Preheating pressure [P2]:
It is the force required by the machine in order to achieve the proper pressure between the two surfaces. The pressure value varies depending on the size of the machine cylinder as well as the dimension of the pipe. Welding pressures are provided by the manufacturer and are included in the manual. The preheating pressure is calculated from the pressure gauge of the machine.

Welding pressure [P3]:
Drag pressure [Pd] and Interfacial pressure [P1] are added to generate the welding pressure, which will be used twice during the welding process, once during welding and once during cooling. The welding pressure should be adjusted on the machine after adjusting the drag pressure and the interfacial pressure.

WARNING
The pressures, once adjusted, should remain constant throughout the welding procedure. They should be changed only if the length and dimension of the pipe are changed.

Steps for butt welding
Each phase of the butt welding process consists of the basic steps of surface parallelism, adjustment, heating and fusion, applying the aforementioned pressures to perform a complete welding. Each phase has a required time or a visual indication in order to inform you that the specific step has been completed.

Surface parallelism phase:
The pressure for surface parallelism varies depending on the size of the pipes and the starting conditions at the drag pressure, gradually increasing the pressure between the pipe and the machine until two continuous 360° washers are removed on both sides of the pipe.

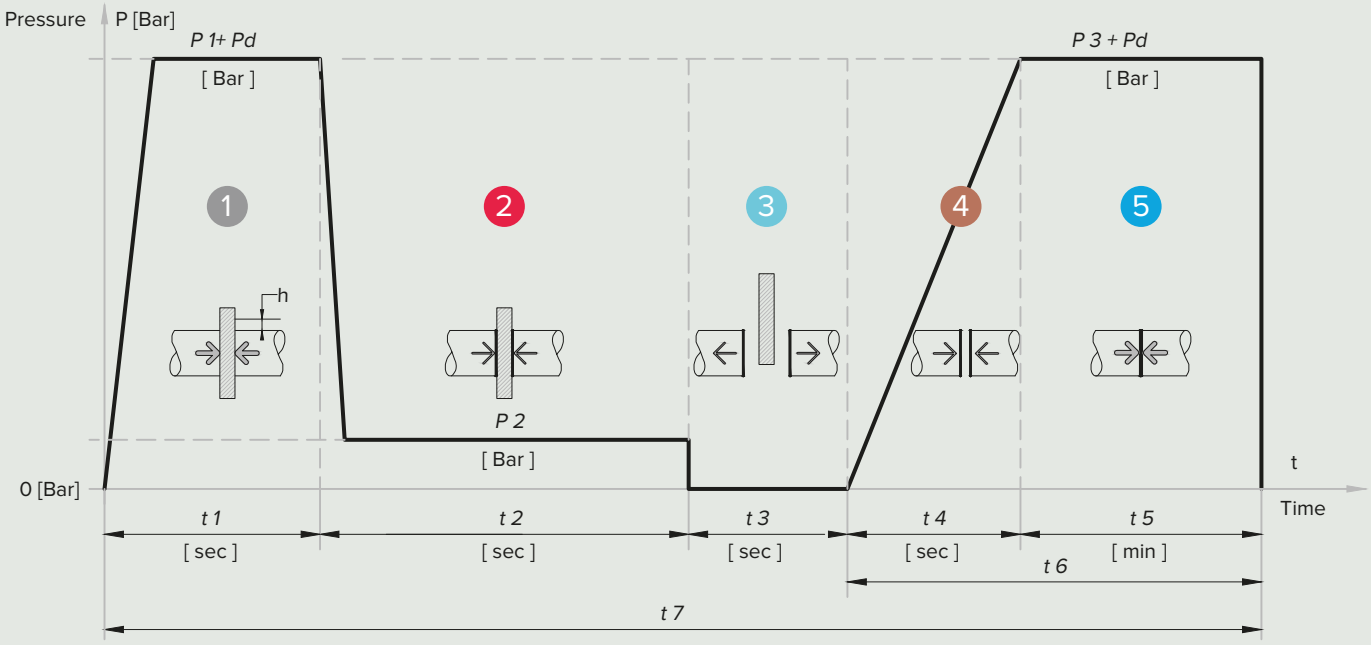
Adjustment phase:
This phase pushes the exposed surface away from the connection by pressing the pipe profile away from the heated surface at full pressure.
This specific phase is completed when the displaced material displays a visible ring.

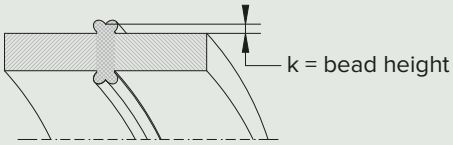
Heating phase:
During heating, the pipe remains in contact with the heated surface under low pressure. That allows heat to penetrate into the pipe molecules without displacing the PP-R material. Heating hours (and any other reported time) are listed in the table below.

Welding phase:
After removing the heated iron, the two heated pipes are joined under maximum pressure. The pipes must be joined within the transition time and subjected to the maximum pressure (Pd + P3) within the welding time.

Cooling phase:
As the fusion takes place, keep the connection under full pressure (Pd + P3) for at least half the cooling time. The joined tubes can then be removed from the jaws, but must remain supported for the remaining cooling time. A pipe that cannot be supported must remain under full pressure throughout the cooling time.

PP-R Butt welding Design and Table





NOTE:
Welding parameters are based on room temperature of 20°C and 0,0 bar Pd (drag pressure).

SDR	D/s, Standard Dimensional Ratio
D	Outer pipe dimension
s	Pipe wall thickness
T	Temperature of welding plate
P1	Interfacial pressure
P2	Preheating pressure
P3	Welding and cooling pressure
Pd	Drag pressure
1-5	Welding phases
t1...t5	Welding times (sec/min)

					1			2			3	4	5	
					Adjusting			Heating			Change	Conn-ection	Welding & Cooling	
					Pressure		Bead height	Pressure		Time	Time	Time	Pressure	Time
	SDR	D	s	T	P1		k	P2		t2	t3	t4	P3	t5
	D/s	mm	mm	C°	MPa	Bar	mm	MPa	Bar	sec	sec	sec	Bar	min
RITMO BASIC 315 (V0,V1)	7,4	160	21,9	200-220		14,0	1,5		1,0	233	10	19	14,0	21
		200	27,4			22,0	2,0		2,0	283	11	23	22,0	25
	9,0	160	17,9			12,0	1,0		1,0	194	9	16	12,0	17
		200	22,4			19,0	1,5		2,0	236	10	19	19,0	21
	11,0	160	14,6			10,0	1,0		1,0	161	8	13	10,0	14
		200	18,2			16,0	1,0		2,0	198	9	16	16,0	17
		250	22,7			24,0	1,5		2,0	240	10	20	24,0	21
		315	28,6			39,0	2,0		4,0	239	12	24	39,0	26
	17	160	9,5			7,0	1,0		1,0	108	6	9	7,0	9
		200	11,9			11,0	1,0		1,0	134	7	11	11,0	12
		250	14,8			16,0	1,0		2,0	163	8	13	16,0	14
		315	18,7			26,0	1,0		3,0	203	9	17	26,0	18

RITMO BASIC 315 (V0,V1) | Piston area = 6.680cm² | Standard: DVS 2207/11 (02/17) | Pi=0.1Mpa

Abbreviations:

1—5
Welding phases (steps)

k
Melting ring height (phase 1) figure 2.
Measured in mm, with a suitable tool.

t1
Time required for the creation of the melt ring of height [k].

t2
Preheating time. Follow the values of the table regardless of the welding angles.

t3
Maximum time for the removal of the hot plate from the welding machine.

t4
Time of gradual increase of pressure from 0 [MPa/Bar] to the final welding pressure P3 [MPa/Bar].

t5
Required welding and cooling time under pressure.
This time must be reduced by up to 50%, if:
—The connections are manufactured in laboratory conditions
—The welded parts have a lower weight load
—The pipes have a wall thickness ≥ of 15mm

t6
Total connection time.

t7
Total welding process time.

To find the Pd, you need to place the pipes or fittings to be welded into the machine.
The hydraulic clamps must be at the end of the path (clamp deviation). Next, turn on the hydraulic pump with the lever in the clamping position, holding it steady. At the same time, turn the pressure valve clockwise gradually until the moving parts of the clamps start moving slowly. Record the Pd pressure displayed on the pressure gauge. Add Pd to the corresponding values P1 & P3.

Standards and equipment

Welding standards PP
PP-R, PP-H butt welding according to DVS 2207 – part 11 (August 2008).

Standard requirements
—Pi interfacial ring presure [0,10N/mm^2]
—Ph interfacial preheating pressure [0,01N/mm^2]
—Welding plate temperature 210±°C, ambient temperature 20°C

Note: 1 N/mm^2 = 10 Bar

Table of Standard DVS part 11

Wall thickness	Adjustment Bead Height	Preheating Preheating time	Change	Welding	
				Gradual increase pressure	Cooling
mm	mm	sec	sec	sec	min
4,5-7	0,5	135-175	5-6	6-7	6-12
7-12	1,0	175-245	6-7	7-11	12-20
12-19	1,0	245-330	7-9	11-17	20-30
19-26	1,5	330-400	9-11	17-22	30-40
26-37	2,0	400-485	11-14	22-32	40-50

Welding machine
Model: CH DHJ-315 Ø 160-315mm
Total Effective Piston Area T.E.P.A. [452 x 2 = 904 mm^2]

Calculation – equations

$$A = (D-s) \times s \times T \quad crE\ [mm^2]$$

$$P1 = \frac{A \times Pi}{T.E.P.A.} + Pd\ crE\ [MPa]$$

$$P1 = \frac{A \times Ph}{T.E.P.A.}\ crE\ [MPa]$$

Pipe dimensions for butt welding 160-450mm
Available Interplast pipe series:
Aqua-Plus in SDR 7,4 – 9 – 11 – 17.

—Intreplast supports butt weldings for dimensions of 160mm and larger, in all SDR.
—Before welding the Aqua-Plus Oxygen Tight (OT) pipes, you must remove the blocking film from the welding area.

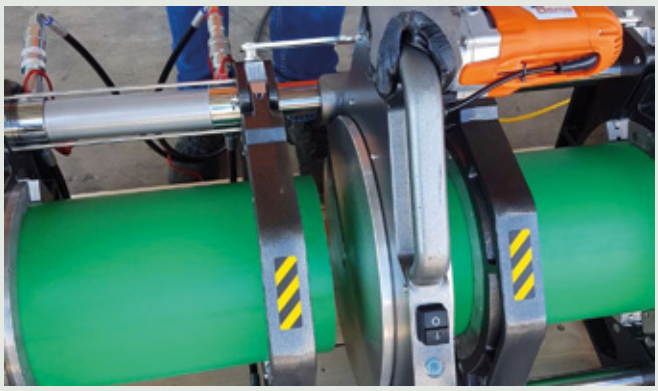
Butt welding instructions:
Protect your workplace from the weather conditions (rain-wind, etc.). Before starting any work, you should follow the instructions below for welding and proper use of the equipment.

Step 1. Cutting

Before welding, you must cut the pipes to the required length with the appropriate tools. Do not use tools or methods that damage the pipes.

Step 2. Adjustment

Adjust and test the machine. Follow all manufacturer's instructions. Perform any maintenance if necessary.

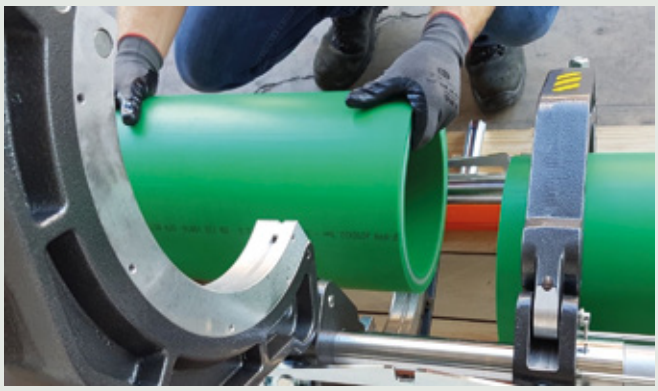


Check and tighten the machine's hydraulics seals. Release any air bubbles by bringing the machine to full pressure.

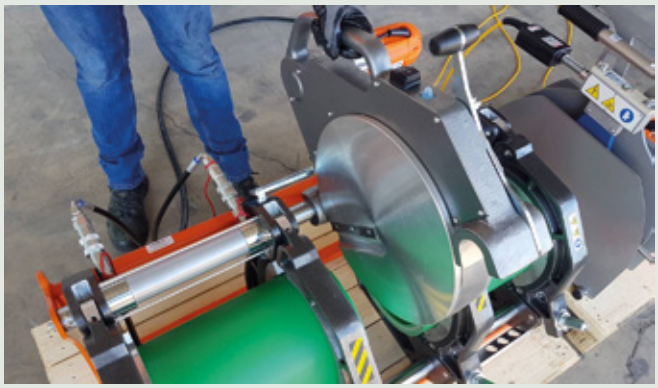
Inspect the welding plate and turn it on. Make sure it is clean and set at a temperature of 210°C ± 10°C.

Step 3. Alignment

Select the appropriate size for the pipe clamp and install it.



Cut the pipe at least 25mm longer than the final length.



Tighten the pipe supporting clamps. Check the alignment of the pipes by running your finger on the ends of the pipes along the gap between them.

Step 4. Pipe profile preparation
Open the carrier and secure the plane tools. Turn it on and allow it to reach full speed.

The correct surface (profile) occurs when 360° strips are produced for each pipe.

Remove material residues and clean pipe profiles with acetone or alcohol.

Step 5. Welding
5.1 Find the drag pressure. Adjust the welding pressure (P1 + P drag).
Do not change this pressure during adjustment.

5.2 Set the preheating temperature (t2) on timer A. Set the welding temperature on temperature controller B.

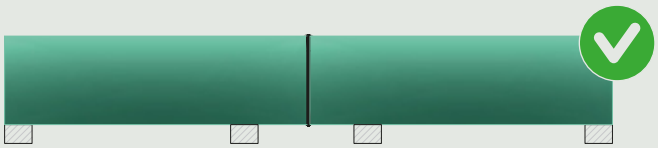
5.3 Open the stretcher and place there the heating plate. Make sure the temperature is correct, at 210°C. In the first use, check the temperature with an external instrument.
5.4 Close the stretcher so that the pipes are touching the heating plate at full pressure.
5.5 Create the appropriate ring and do not exceed the recommended sizes.

5.6 After creating the ring, return the system to drag pressure. If necessary, add up to 10% of the welding pressure.
5.7 Supervise the whole process (using a clock). Less time will cause non-acceptable welding. Do not exceed the heating time.
5.8 Open the stretcher and remove the heating plate. Make sure there is a safe spot and place it there.
5.9 Bring the pipes into contact within the limit, within the transition time, and ensure that the machine is at full pressure throughout the welding time.

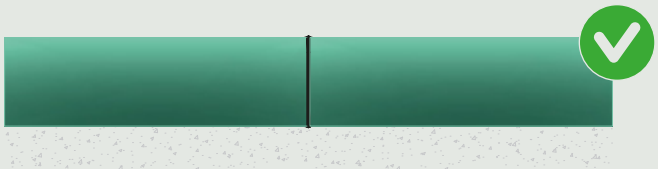
Step 6. Cooling
6.1 Follow the full cooling time. Do not try to reduce the time by using water at the welding point.
6.2 Release the pressure from the stretcher. Do not loosen the clamps until the pressure is fully released.
6.3 Remove the connection (pipes) from the machine.

The cooling time can vary depending on the size and the support of the pipes to be welded (long parts). Small parts, as they are properly supported, can have a reduced cooling time, but larger ones require full cooling time.

Pipe support during cooling time:
Pipe connections should not be exposed to any stressful conditions during cooling.
The following images show the desired and the unwanted pipe supports.

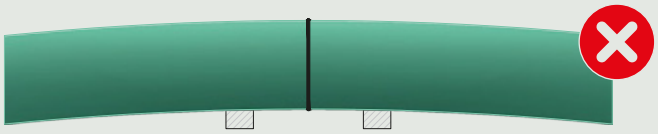


Proper horizontal support on chocks

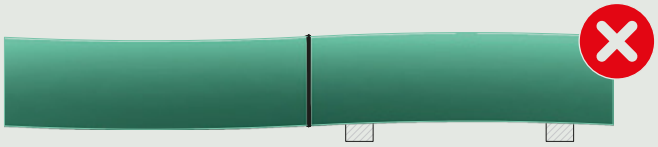


Proper horizontal support on levelling sand or soil

Wrong support with chocks only at the edges

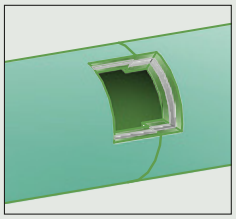


Wrong support with chocks only near the welding point



Wrong support (unfinished)

Welding of dissimilar SDR
In case you want to weld pipes of different SDRs, you will need to perform the following steps:



1. Use the heating time of the pipe with the lower SDR (higher wall thickness).
2. Use the pressure of the highest SDR (thin tube).
3. Follow the average of the two SDRs for the ring height.
The outer ring should be visible. The inner ring will appear on one side of the connection and this won't be a problem. The system will have the lowest operating pressure.

GENERAL RULE
Avoid the welding between different SDRs. Do not butt weld pipes with different diameters.

Pressures P1 & P2 of the table apply only to this welding machine. In case of a different type of machine, you should consult the Technical Support Department of our company. Please contact your nearest Interplast sales office for more detailed advice.

Safety measures
Before any procedure, you must follow the instructions below regarding personnel safety, proper installation of products, and proper use of Interplast equipment:


Follow the instructions herein, as well as the references in the machine user manual


Take all necessary precautions regarding the operating location of the machine and your safety


Always wear a protective helmet of your size


Always wear safety goggles


Wear suitable, comfortable clothing of your size


Wear heat-resistant gloves when using the welding machine


Wear suitable work shoes, with metal protection inside and non-slip sole


Take proper precautions around electrical appliances and follow the instructions for use


Pay special attention to the hot surfaces of the welding machines


Caution! Keep your fingers, hands, feet and head away from the moving parts of the hydraulic clamps


Do not weld in front of air currents and when ambient temperature is less than +5°C


Caution! Heavy object

Pictograms


Important information


Danger for safety

Standards, regulations, technical instructions

Calculations – Equations
A = Welding surface area [mm^2]
D = Outer dimension of pipe [mm]
s = Pipe wall thickness [mm]
π = Constant (3,14)
P1 = Interfacial pressure [MPa]
P2 = Preheating pressure [MPa]
Pi = Interfacial ring pressure [N/mm^2]
Ph = Interfacial preheating pressure [N/mm^2]
Pg = Drag (moving) pressure [MPa]
T.E.P.A. = Active piston surface [mm^2]

Machine technical data

RITMO
Materials: HDPE, PP, PP-R, PVDF
Power supply: 110V Single Phase 50/60Hz 230V Single Phase 50/60Hz
Total absorbed power: 3900 W (110V) 4500W (230V)
Working temperature: 180° ÷ 280°C (356° ÷ 536°F)
Outside temperature range: -10° ÷ 40°C (14° ÷ 104°F)
Time to reach welding temperature: < 20’
Dimensions machine body (WxDxH): 981x586x520mm (37”x23”x20.5”)
Weight machine body: 86Kg (190lb)
Weight standard composition: 166Kg (366lb)

16.6 ELECTROFUSION

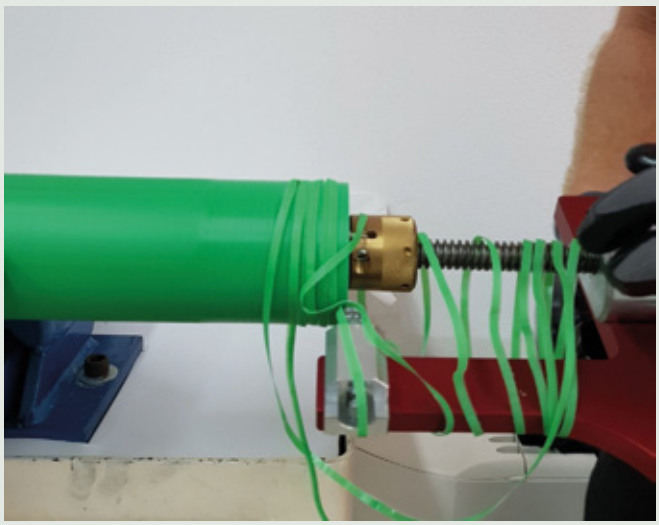
The welding with the pipe can occur with electric couplings, with the help of an electrofusion machine. This connection method is useful in repairing cases, where it is difficult to use the welding machine, due to little space available.

IMPORTANT NOTE

All parts of the connection must have the same temperature according to DVS 2207. Also, the connection must be avoided during bad weather conditions (rain, wind, high humidity, etc.) and the welding must be carried out at outdoor temperatures of +5°C up to +40°C.

During the welding process, **follow the instructions below:**

1. Scrape the surface of the pipe or fitting with the appropriate scraper for electric welding of the electric coupling



2. Before welding, remove any greasy substances from the surface of the pipe with a solvent and a clean cotton cloth. Wait until all surfaces are dry.

3. Measure the inner length of the part.

4. Mark on the pipe the connection's length, which must be the same as the inside of the fitting.

5. Insert the ends of the tubes into the sockets of the electric coupling until they reach the inner end. Make sure the two ends of the pipe are aligned.

IMPORTANT NOTICE
The mechanical pressures during the process of electrofusion and the cooling time must be avoided.

6. Secure the electrofusion machine cables to prevent them from coming into contact with the clamps. Connect the clamps to the resistor terminals on the component and make sure the connections are correct.

7. Start the welding process by scanning the barcode.

8. The electrofusion machine, using barcode data, regulates proportionally and automatically the connection process. If the barcode is not used, the connection adjustments will be done manually.

9. Never reduce cooling time with water or cold air. After welding, follow the minimum cooling time below.

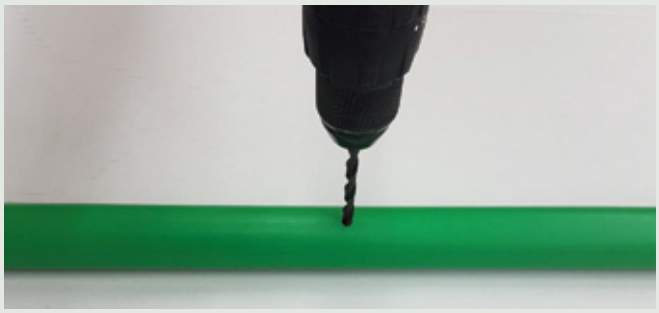
∅	20	25	32	40	50	63	75	90	110	125	160
min	10	10	10	15	15	20	25	30	32	33	34

10. About 2 hours are needed for hardening, from the time the component cools, before any pressure tests are performed.

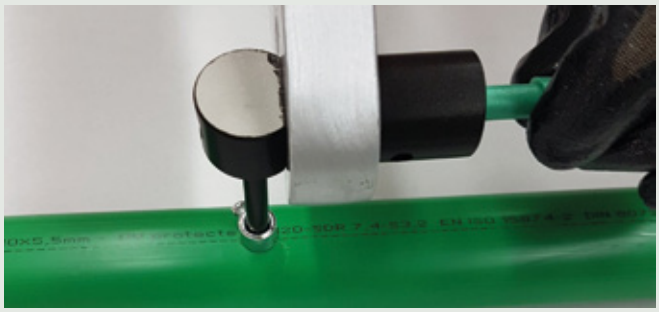
16.7 REPAIR

Pipe damage can be repaired by welding and arc welding, as mentioned in the relevant chapter. Additionally, in case of accidental drilling, it is possible to repair the hole as described below.

—Inspect the size of the hole. 7 and 11mm repair sticks are available for 6 and 10 mm hole repair respectively.
Adjust the hole to these dimensions.



—Proceed with the welding, heating the two parts for 5 seconds.

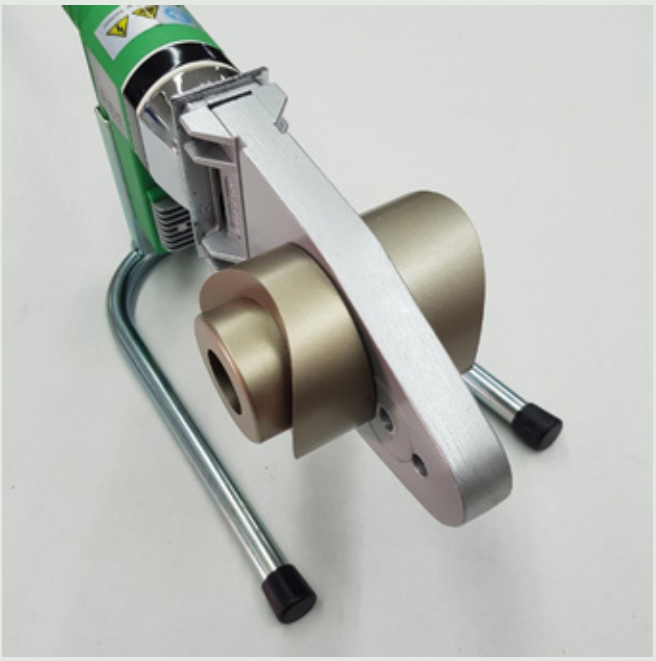


—Join the two parts and hold the repair unit, until it cools down.

—Wait after the cooling time, before cutting the excess.

16.8 SUPPLY SADDLES

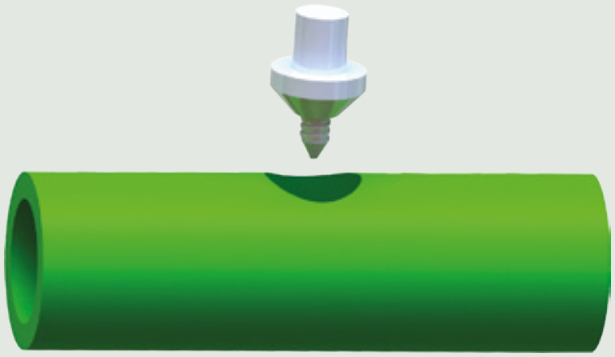
Supply saddles are available for pipes with external dimensions from 40 to 450mm, with outlets ranging from 20 to 315mm, as well as with 1/2”, 3/4” and 1” outlets with male or female threads. To weld the saddle to the pipe, follow the steps below:



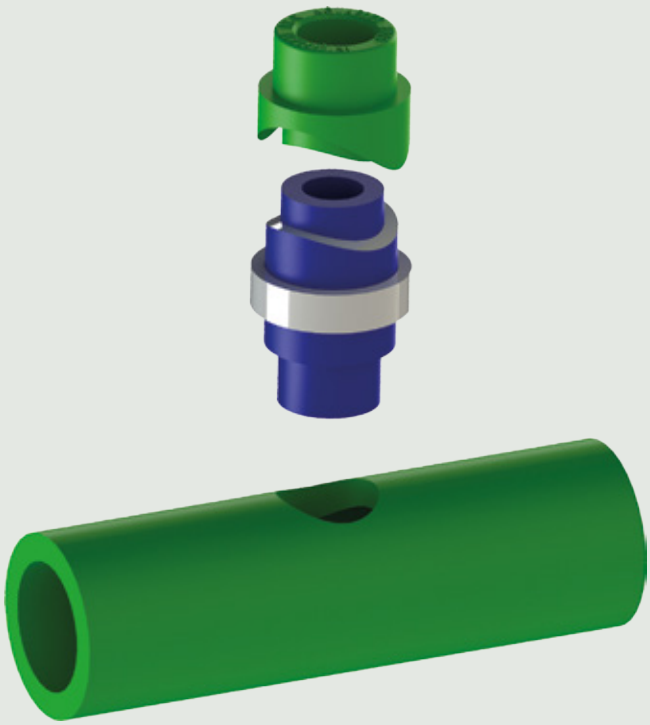
—Assemble the special curved dies in the welding machine. Check the welding machine temperature to be between 260°C and 280°C.

—Check the surface to be welded, which should be clean and dry. Next, mark the point where the hole will be made.

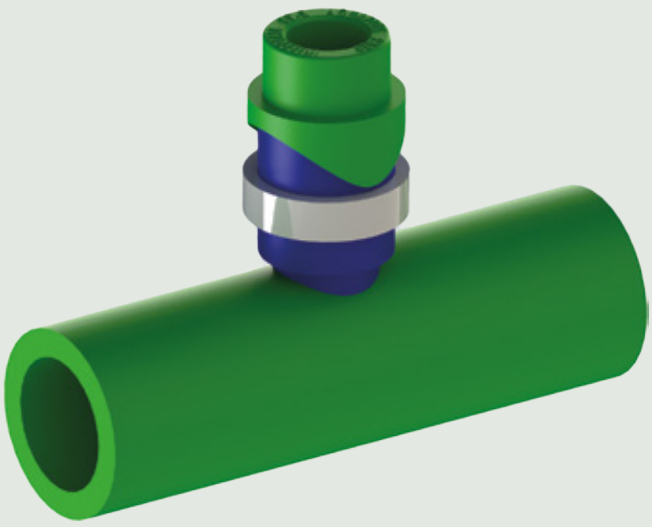
—Drill the pipe wall at the exit point using the special drill. **Do not forget to clean the drilled part of the pipe.**



—Insert the attachment on the curved side of the die. Insert the hollow side into the pipe until it is in full contact with the outer wall of the pipe. The heating time of the parts is 30 seconds.



—After the heating phase is complete, remove the welding unit and place the supply saddle on the pipe. Secure it with light pressure, avoiding rotation for another 20 seconds.



—The system can be operated after 20 minutes from the latest welding.

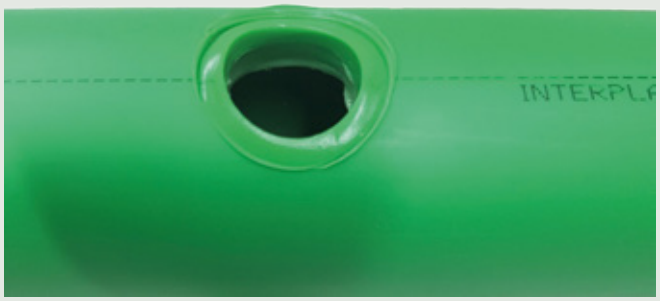
IMPORTANT NOTES

—The supply saddle should not press hard the welding tool for saddle, as it will cause a problem in the internal cross section. Also, the rim that will be created in the curved coupling must be visible at all points.

—The force exerted when connecting the curved coupling to the pipe should not be excessive.

TIP:

An on-site pipe heating quality control check can occur, which should have the following image. In any other case, the pipe must be replaced.



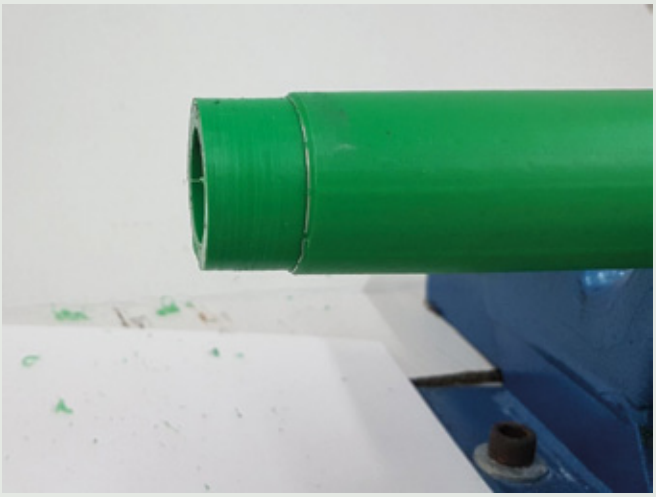
16.9 PIPE WELDING WITH ALUMINIUM PROCEDURE

ROTARY TOOL SCRAPER (DRILL)
The rotary tool scraper has:
• 1 or more adjustable cutting blades, depending on the size of the tool.
• Connection shaft suitable for application on chock/SDS rotary tool.
—Insert the scraper of the appropriate size (proportional to the dimension of the pipe) to the rotary tool, e.g. Drill.
—Apply the scraper to the front of the pipe and align it with the pipe.
Start with a clockwise rotation and a slight push. Throughout the process, constantly check the concentric alignment between the pipe and the scraper.

The process is completed by ending the scraper on the front of the pipe. Scraping depth and thickness are factory pre-set.

Inspect the depth and circumference of the scraping. If there is any material left, you can carefully repeat the scraping of the spot.

More scraping applications will reduce the required dimension for welding. The required dimension is defined as the nominal diameter of the pipe plus one to two-tenths of a millimeter, e.g. Ø40.2mm.



HAND SCRAPER

The hand scraper has:

• 1 or more adjustable cutting blades, depending on the size of the tool.

• 2 screw handles.

Insert the scraper of the appropriate size (proportional to the dimension of the pipe) to the rotary tool, e.g. Drill.

Apply the scraper to the front of the pipe and align it with the pipe.

Start with a clockwise rotation and a slight push. Throughout the process, constantly check the concentric alignment between the pipe and the scraper.

The process is completed by ending the scraper on the front of the pipe. Scraping depth and thickness are factory pre-set.

Inspect the depth and circumference of the scraping. If there is any material left, you can carefully repeat the scraping of the spot. More scraping applications will reduce the required dimension for welding. The required dimension is defined as the nominal diameter of the pipe plus one to two-tenths of a millimeter, e.g. Ø40.2mm.

16.10 PIPE WELDING WITH OXYGEN BARRIER PROCEDURE

Oxygen barrier layer cleaning system in 20 to 75 mm PP-R pipe.

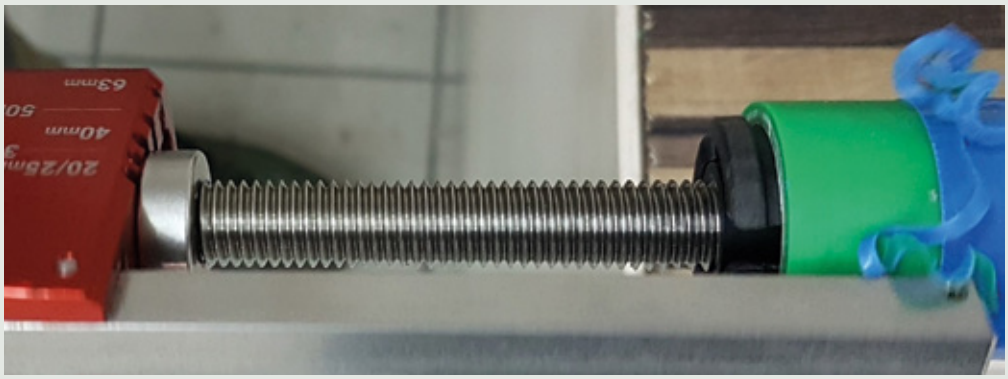
PIPE PREPARATION
—Pipe cleaning
Use a clean cloth to remove dust, dirt and grease from the surface of the pipe.
—Determination of oxygen block cleaning surface
Mark the cleaning depth depending on the type of welding, with the help of a marker.

Select the appropriate dimension at the base of the scraper.
To select the position, use the hand tool.

Install the shaft that fits the dimension of the pipe.
Screw the shaft to the rim so that it reaches the same level as the cutter.

Insert the cutter shaft into the tube with the oxygen barrier.
Place the electric drill on the hexagonal edge of the cutter.

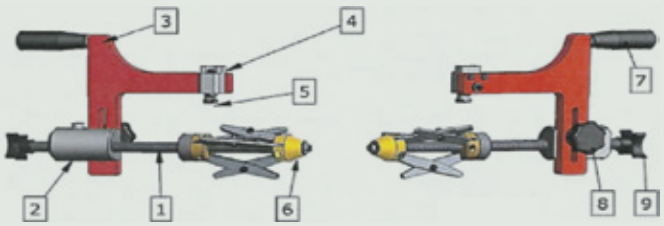
After marking the length needed for peeling the pipe,
start rotating the cutter up to the desired point.
Lastly, remove the cutting machine, clean the cutting
residues and you are are ready to proceed with the welding.



WARNING
Any barrier residues are cleaned with the hand scraper.

You should never use the scraper for a second time in the same end of the pipe.

Oxygen barrier layer cleaning system in 63 to 200mm PP-R pipe

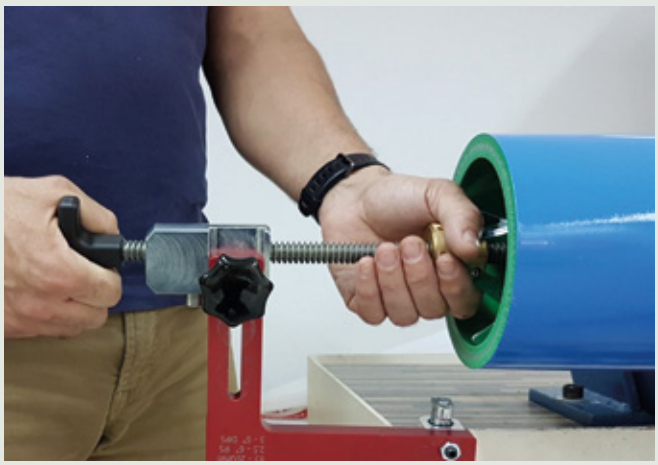


1 Worm screw with plastic handle
2 Worm base for dimension 63-200mm
3 Swivel arm with cylindrical handle
4 Knife base with knife
5 Scraper knife
6 Head for device centering
7 Cylindrical handle
8 Adjustment handle
9 Plastic handle for head tightening

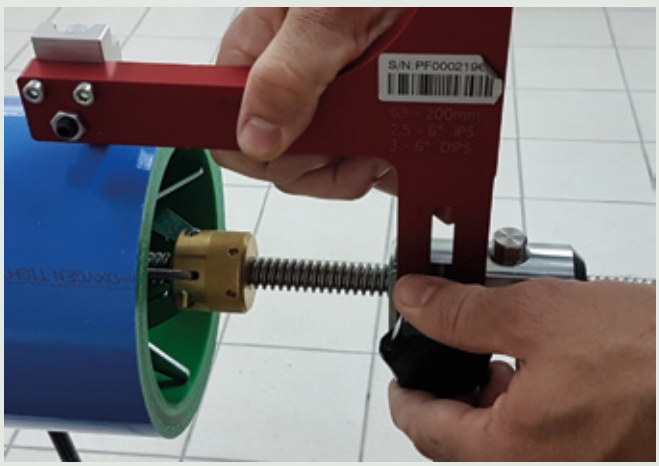
PIPE PREPARATION
—PIPE CLEANING
Use a clean cloth to remove dust, dirt and grease from the surface of the pipe.
—Determination of oxygen barrier cleaning surface
Mark the cleaning depth depending on the type of welding, with the help of a marker.

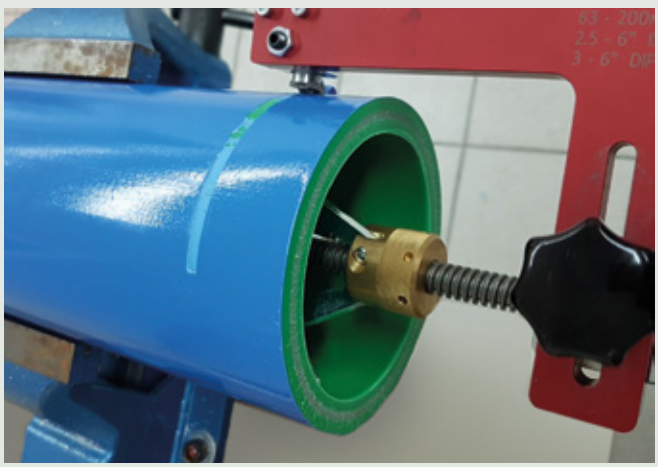
Scraper preparation:
—To prepare the scraper, unscrew the adjustment handle No 8.
—Close the centering head. Turn the plastic tightening handle clockwise.
—Press the release button at the end of the worm.

Position the centering head (6) and turn the tightening handle anticlockwise to center the head (9). Press the release button of the worm base (2) and advance the knife base (4) up to the point where you want to reach the cleaning of the barrier.

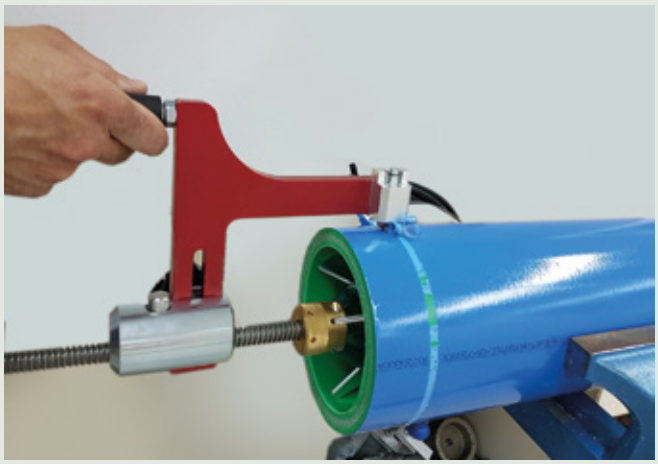


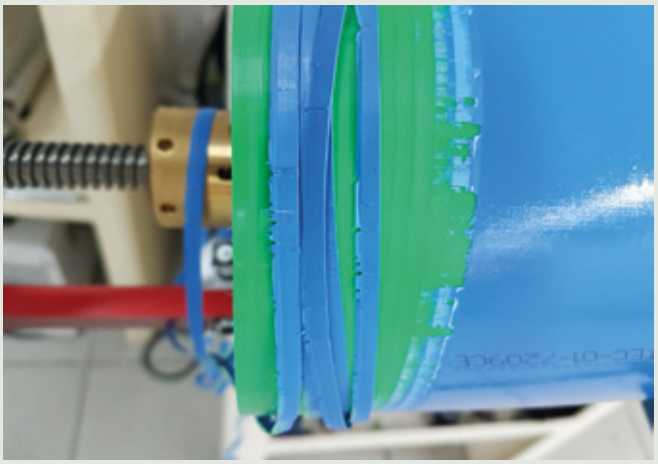
Press the swivel arm on the pipe to create pre-tension on the cutting head (4).
Screw the tightening handle of the arm.



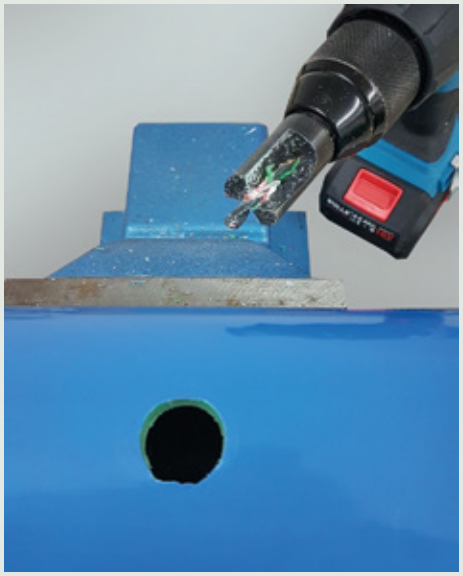


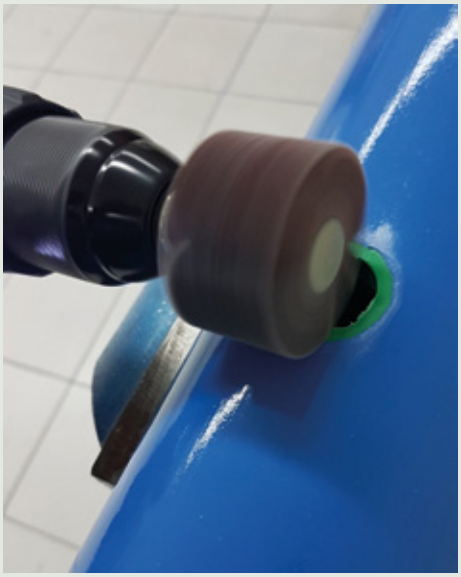
Rotate the arm clockwise until it reaches the end of the pipe.
Lastly, remove the cutting machine, clean the cutting residues and you are ready for the welding process.



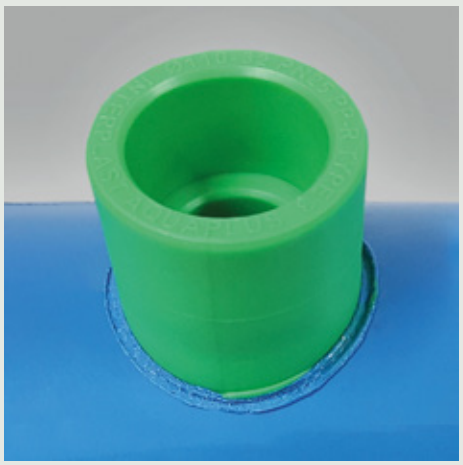


Cleaning for welding curved coupling or supply saddle
Open the hole in the pipe where you will stick the curved coupling or the supply saddle.
Clean the barrier with a flap wheel for drill.





Proceed to welding, using the appropriate curved welding die.



IMPORTANT NOTE
You must be sure that the oxygen barrier (blue color) has been completely peeled off in order for the thermal welding to take place properly.

17

PRESSURE TESTING PIPEWORK

Principles of pressure test

Successful conduct and documentation of the pressure test is a requirement for any claims under the Interplast warranty. For safety reasons, it is recommended to perform the network pressure test with water. Tests with compressed air are associated with a significant risk of failure due to the large volume of the pipe.

According to DIN EN 806-4 and DIN 1988, the pressure test should be performed on complete pipe parts, not covered in the connection points.

Statements related to the waterproofing of the system are based on the overpressure test protocol, which requires:

—A preliminary, main, and final testing of the system.

—The waterproofing of the system can only be checked by visually inspection of the uncovered connection points.

—Small leaks can only be detected by visual inspection (release of high pressure water).

Dividing the entire network into smaller test segments increases the accuracy of the results.

Leakage test with water

Preparation of pressure tests with water

1. Make sure that the connection points between the pipe and the fittings are accessible during the tests.
2. Remove the pressure locks of the network or even the equipment that does not meet the test pressure limits (sensitive counters, switches, etc.) where required, and replace with pipe dummies or caps until the end of the testing.
3. Gradually fill the network from the deepest point, avoiding any air entrapment with filtered drinking water. The water temperature should not be much different from the ambient temperature (D ≤ 10 K).
4. Release the remaining air so that only water comes out from the venting points.
5. For the hydraulic pressure test, use a pressure gauge with a measurement accuracy of 100 hPa (0.1 bar).
6. Connect the hydraulic compression & control device to the deepest point of the network.
7. Carefully close all network discharge points.
8. Make sure the temperature remains as constant as possible during the tests.
9. Prepare the log sheet and note the system data and the measured quantities.

The test pressure can be significantly affected by temperature changes in the piping network, e.g. a 10K temperature change can cause a change in the pressure gauge from 0.5 to 1.0 bar. During the testing, pressure fluctuations may occur due to the viscoelastic properties of the material (e.g. elongation of the pipe with increasing pressure).

During the pressure test, it is not safe to conclude the impermeability of the system from the manometric pressure alone. Therefore, the whole installation, as provided by the standards, should be checked for its impermeability also by visual inspection.

Initiation of testing procedure

Preliminary test

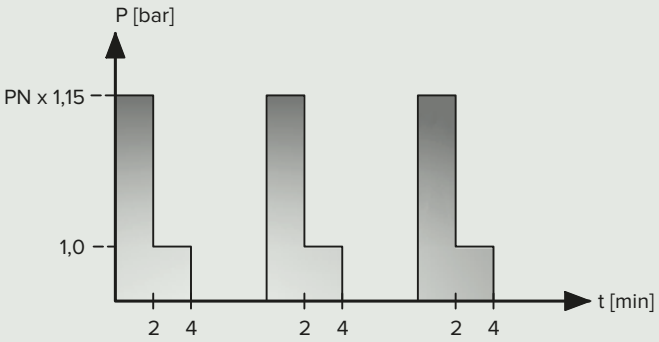
In the preliminary test, a pressure 1.15 times higher than the nominal operating pressure of the pipe (PN - Pressure Nominal) is applied (= 1.15 x maximum nominal pressure).

The test pressure (PN x 1.15) & 1 bar are considered necessary to be applied alternately every 2 minutes in 3 repetitions.

WARNING

Between repetitions, the network should be completely decompressed and the fluid temperature should not exceed 20°C. The above procedure is performed to expand – normalize the network.

Calculation example: 1.15 x 10 bar (at 20°C) = 11.5 bar



If the network under testing consists of pipes with different PN or SDR, then the maximum design pressure will be based on the smaller PN or the larger SDR (thinner walls).

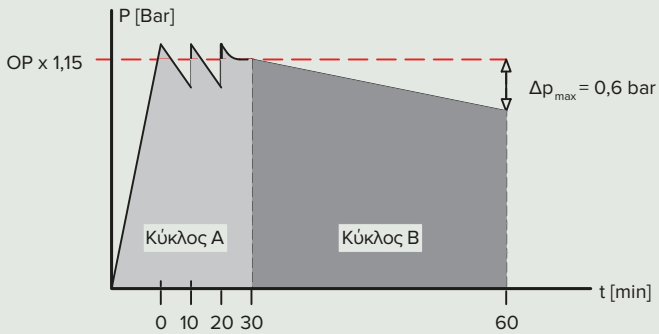
Principal test

In the main test, a pressure 1.15 times greater than the operating pressure is applied (= 1.15 x operating pressure).

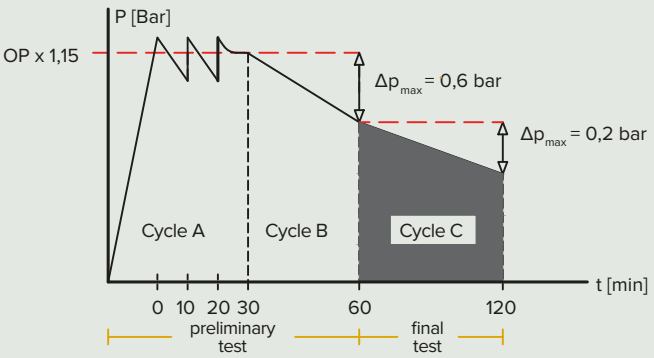
Calculation example: 1.15 x 6 bar (at 20°C) = 6,9 bar.

Maintain the testing pressure for 30 minutes. Re-apply the testing pressure at intervals of 10 minutes (2 times) to expand - normalize the network (Cycle A).

Then, after the pressure has stabilized, note the pressure value on the record sheet after 60 minutes. The acceptable pressure drop after 60 minutes (Cycle B) should not exceed 0.6 bar (0.1bar/5 minutes).



Final test
Note the testing pressure on the record sheet after 2 hours. The acceptable pressure drop after 120 minutes (Cycle C) should not exceed 0.2 bar.



Completion of testing
Confirm the impermeability of the entire system, partially at the connections, by visual inspection.
In the event of a decrease of the testing pressure:
—Perform another thorough visual inspection of the pipes, the ventilation and the connection points.
—After repairing the cause of the pressure drop, repeat the pressure check in the system.
If no leaks are detected during the visual inspection and the impermeability test is complete throughout the network, then:
1. Empty the network and remove the pressure test device.
2. Replace the safety and measuring equipment.
3. Connect the network segments that were checked individually.
4. Gradually fill the network until the design pressure is reached, excluding possible air entrapment, with filtered drinking water.

WARNING
The network should remain under pressure throughout all the procedures until the completion of the project.

Completing a test report
The company that performed the network test, as well as the customer, must document the test results by completing the impermeability control sheet. The record sheet should be signed by the supervising representative and the contractor.
-Submit the impermeability control sheet to Interplast within 30 days of completing the tests.
-If you checked the network partially, save all the measurement sheets and submit them collectively.
-Submit the registration number of the certified welders who carried out the installation - connection of the networks.

Network washing
After the installation is complete, the closed air-conditioning - heating circuits, but much more the drinking water networks, will have to be cleaned of fine-grained materials and dirt. Before the installation starts operating, it is necessary to do the following according to DIN 1988, part 2:
—Ensure the quality of drinking water
—Avoid corrosion
—Avoid damaging the components & the equipment
—Clean the inner surface of the network
Regardless of the piping material, all the networks that carry drinking water must be cleaned before they can be put into operation.

Suitable washing procedures:
—Cleaning with water
—Cleaning with a mixture of air and water
The first procedure, in cleaning with water, requires repeated charges - discharges until complete clarity of the outflowing water is achieved.
In cases where pipes and fittings of the Aqua-Plus system are used, rinsing only with drinking water is enough to clean the networks.
However, the appropriate rinsing process should be selected according to the manufacturer's experience, the customer requirements, and the factory instructions. Special requirements for sterilization of networks using chemical disinfectants will be strictly followed, with the consent of Interplast company.

Standards – Regulations
Follow all applicable national and international safety and accident prevention regulations when installing Aqua-Plus systems, as well as the instructions in this technical data sheet. Also, comply with applicable laws, standards, guidelines and regulations (e.g. DIN, EN ISO, DVS, MIRTEC, WRAS) and product civil liability insurance regulations.
Areas of application that are not included in this technical sheet (custom applications) require consultation with our technical applications department.
Please contact your nearest Interplast sales office for more detailed advice.

Regulations regarding the execution of tests
DIN 1988
Technical rules for drinking water installation.

DIN EN 806
Specifications for installations inside buildings: transportation of water for human consumption.

VDI 4708
Pressure control and maintenance, ventilation, venting.

BSRIA BG 50/2013
Water treatment for closed heating and cooling systems.

Fulfillment of test report

INSTALLATION DETAILS

Project:.....

Location:.....

Owner / supervisor:

.....

Contractor / construction manager:

.....

Network Usage / Operation:

.....

TYPE OF NETWORK CHECKED (check with ☑)

- ☐ Aqua plus SDR 6 SL
- ☐ Aqua plus SDR 7.4 SL
- ☐ Aqua plus SDR 9 SL
- ☐ Aqua plus SDR 11 SL
- ☐ Aqua plus SDR 17 SL
- ☐ Aqua plus SDR 7.4 GF
- ☐ Aqua plus SDR 9 GF
- ☐ Aqua plus SDR 11 GF
- ☐ Aqua plus SDR 17 GF
- ☐ Aqua plus PRINS SDR 11
- ☐ Aqua plus PRINS SDR 7.4 GF
- ☐ Aqua plus PRINS SDR 11 GF
- ☐ Aqua plus aluminum SDR 7.4

LENGTHS OF NETWORKS INSTALLED [m]

- Ø 20mm
- Ø 25mm
- Ø 32mm
- Ø 40mm
- Ø 50mm
- Ø 63mm
- Ø 75mm
- Ø 90mm
- Ø 110mm
- Ø 125mm
- Ø 160mm
- Ø 200mm
- Ø 250mm
- Ø 315mm
- Ø 355mm
- Ø 400mm
- Ø 450mm

TESTING PREPARATION

The filling water is filtered and the pipe network is completely vented.

Water temperature ϑ_W= .....°C

Ambient temperature ϑ_a= .....°C

Temp. difference $\Delta\vartheta = \vartheta_a - \vartheta_w$, $\Delta\vartheta$= .....K

Location / date of test:.....

Test start time: ..... Test end time: .....

Client / supervisor

Stamp / signature

Please send the control sheet via e-mail: info@interplast.gr or via fax: +30 25310 38813

PRELIMINARY TEST

Preliminary test pressure:.....Bar

Pressure drop after 30 minutes*:.....Bar

Test result: ☐ Successful ☐ Failed

**Δp max = 0.6 Bar*

PRINCIPAL TEST

Main test pressure:.....Bar

Pressure drop after 120 minutes*:.....Bar

Test result: ☐ Successful ☐ Failed

**Δp max = 0.2 Bar*

FINAL TEST

Final test pressure:.....Bar

Completion of the first cycle: ☐

Completion of the second cycle: ☐

Completion of the third cycle: ☐

Between cycles, the network should be fully decompressed and the fluid temperature should not exceed 20°C.

INSPECTORS AND INSTALLERS

Head of testing:

.....

Number of license of inspector – welder:

.....

COMMENTS

.....

.....

.....

.....

.....

.....

Contractor / manufacturer

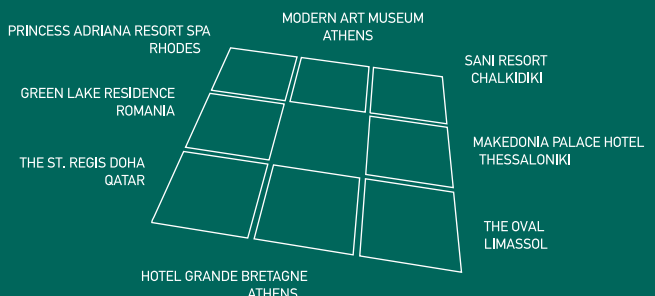
Stamp / signature

Large scale and modern projects trusted Interplast's products for their facilities in plumbing, heating, cooling and sewage systems.

The steady growth of Interplast both in Greece and abroad, is a result of multiannual human experience that combines technology, high quality and innovation, managed to set Interplast among the largest European plastic pipe manufacturing companies. They trusted the market leader in Greece of plastic pipes for building premises.

MAJOR PROJECTS TRUST

interplast



interplast.gr/en

HOUSE OF INNOVATION

CHEMICAL AND THERMAL DISINFECTION

Polyolefins, where thermoplastic polymers, such as polypropylene (PP) belong, show presumably good behavior in an oxidizing environment. However, in the long run, they are affected by oxidizing agents, such as chlorine. Their chemical resistance to highly concentrated chlorine, such as sodium hypochlorite or chlorine dioxide, is unsatisfactory, so make sure you pay attention to the amounts used. Nonetheless, these chlorine substances are dosed in aqueous solutions with low concentrations and a temperature of 20°C. That reduces the impact of oxidative degradation on polypropylene.
A lighter oxidative effect is observed in b-nucleation PP-RCT (Beta PP-RCT). This type exhibits higher resistance to aqueous chlorine solutions thanks to its modified crystalline structure (addition of type β nucleating agents) combined with special phenol stabilizers.
PP-RCT shows much better behavior and is four times more durable than PP-R, in networks using chlorinated water.
The effect of β nucleation on PP-RCT improves aging behavior, resistance to crack growth, and resistance to chlorinated water. When comparing the two types of PP-R, alpha-nucleated PP-R shows significantly higher brittleness due to exposure to hot chlorinated water in tensile tests of small samples. In FCG (aging-fatigue) experiments with cracked round rod samples, beta-nucleated PP-RCT also exceeds the alpha-nucleated type in both chlorinated and non-chlorinated water.

Protection
For consumers protection against microbial and viral infections, most European countries have clear guidelines and recommendations for piping systems in healthcare facilities.
Among many crucial points, they clearly state the points below:
—Chlorine content in sanitary water from 0.3 to 5 ppm
—Recommended disinfectants:
NaOCl, Cl_2, ClO_2, $CaCO_2$, H_2O_2
—Continuous disinfection / Discontinuous disinfection (Shock)
—Thermal disinfection without chemicals

Continuous disinfection
The continuous disinfection application is a routine technique widely used in hospitals, hotels (ZNX recirculation) to prevent the growth of microorganisms in drinking water. By definition, this technique leads to long-term contact between the disinfectant and the system materials. As a result, due to the high oxidation potential, all the materials of the installation, i.e., metals, rubbers and plastics, are affected.
In continuous disinfection, the maximum chlorine content should be up to 0.3ppm (mg/l).
The maximum temperature should not exceed 70°C.

Discontinuous disinfection (Shock)
This application (shock) is a discontinuous measure, which should be applied only in cases of proven infection. That is, if the critical pathogen exceeds the maximum concentrations set by the health authorities.
The maximum chlorine content in the case of continuous disinfection should not exceed 5ppm (mg/l).
Furthermore, discontinuous disinfection (shock) can be applied for a limited number of times (depending on the type) over the lifespan of a network.

Thermal Disinfection for legionella without chemicals
Thermal disinfection for protection against the legionella bacterium is carried out for at least 3 minutes at 70°C, periodically, depending on the category of the facility, such as: hospitals, hotels, home applications, etc.
For proper prevention, we must be sure that the disinfection will occur throughout the whole network at the same temperature, time and pressure.

Design and prevention measures

—The application of continuous chemical disinfection should not be performed in conjunction with thermal disinfection.

—In all parts of the network, the temperature, the concentration of the aqueous solution and the duration should not exceed the recommended values of the World Health Organization.

—The combination of high chlorine content, max 5ppm with pH ≤ 6,5-8 or high ORP at 70°C will affect the properties of the material (PP) in the long term.

—Maintain a maximum temperature limit of 70°C.

—Disinfection must be performed by specialized personnel.

—Treatment conditions, i.e., disinfectant, concentration, duration, temperature, pressure, etc., should be properly recorded in the maintenance book to provide maintenance personnel with proper traceability.

—Lower flow speeds and increased cross-sections in recirculation networks are recommended.

—**It is recommended to use high-efficiency PP-RCT (β-nucleation)** pipes for pressurized hot water circulation systems in domestic and industrial applications, when high impact resistance, excellent chemical resistance, excellent crack resistance and long service life are required, instead of of PP-R or classic PP-RCT (a-nucleation).

—**Choose class PN 30 components and PP-RCT material**, specially designed to ensure uniform geometry inside, preventing local speed increase (gradation).

—In hot water & recirculation networks under pressure, when combined with continuous disinfection, we recommend the application of a pre-insulated Aqua-Plus Prins system. The product ensures a uniform temperature between the source and the outlets, thus increasing the disinfectant action, even at a lower temperature. The powerful PUR insulation offers higher scale economy compared to conventional solutions.

PP-R installation combined with an already existing copper network

In cases where polypropylene is installed in an already existing copper network, special attention should be paid to the velocity of the water and the overall structure of the system.

For the safety of the system, all parts of the installation should be examined, such as valves, circulators, pumps, etc.

It is also recommended to check the level of copper present in the water and to observe its content levels according to the guidelines of the World Health Organization. Constant high levels of copper in ZNX networks can damage the polypropylene system.

Instructions to avoid problems after Polypropylene installation in an already existing copper network

—The maximum operating temperature of the system must not exceed 60°C, except in certain cases, for a specific time, where is necessary for hygiene issues.

—The water temperature and the network pressures cannot exceed the lifespan tables of the Aqua-Plus system.

—The network velocity should not exceed 0.5 - 0.7 m/s at any point of the installation with a maximum of 1m/s in specific cases.

—Small quantities of copper pipes or other parts of the copper installation can not affect the polypropylene system.

—The copper content in the network should not exceed 0.1ppm (mg/l). In this case, it would mean that copper has a high corrosion level that can damage the plastic.

—Safety valves and network flow control components should be used.

—Contact Interplast's technical department, if chlorine needs to be used in a polypropylene installation, in an already existing copper network.

IMPORTANT NOTE

If the above instructions are not followed and quality problems arise in the polypropylene network, the Aqua-Plus system warranty is not valid.

18

PIPES SELECTION

18.1 WATER SUPPLY

Calculation of Water Supply networks
For the calculation of drinking water and water supply networks, you can follow the following steps:
—Divide the network into sections.
—Calculate the supply (qn) for each section in order to get the total requisites of the building (Σqn).
—Calculate the required flow of the building (q) taking into account the simultaneous operation of the outlets.
—Choose a pipe of suitable dimension for each section.
—Calculate the linear pressure drop of the network.
—Calculate the local pressure drop at the fittings.

Calculation of supply
The calculation of the supply for each of the sections into which we have divided the network is determined by the number of its outlets.
For each outlet, the required supply (qn) is specified and given in Table 18.1.
After adding the required supplies (Σqn), we can calculate the flow (q) based on the equations in Table 18.2. For speed reasons, we can calculate the network supply based on the table "Pipe friction grading and flow speed", which, taking into account the simultaneous operation of the outlets, indicates in detail the network supply for different types of buildings.

18.1 | TABLE FOR CHOOSING PIPE DIAMETERS AND WATER FLOW

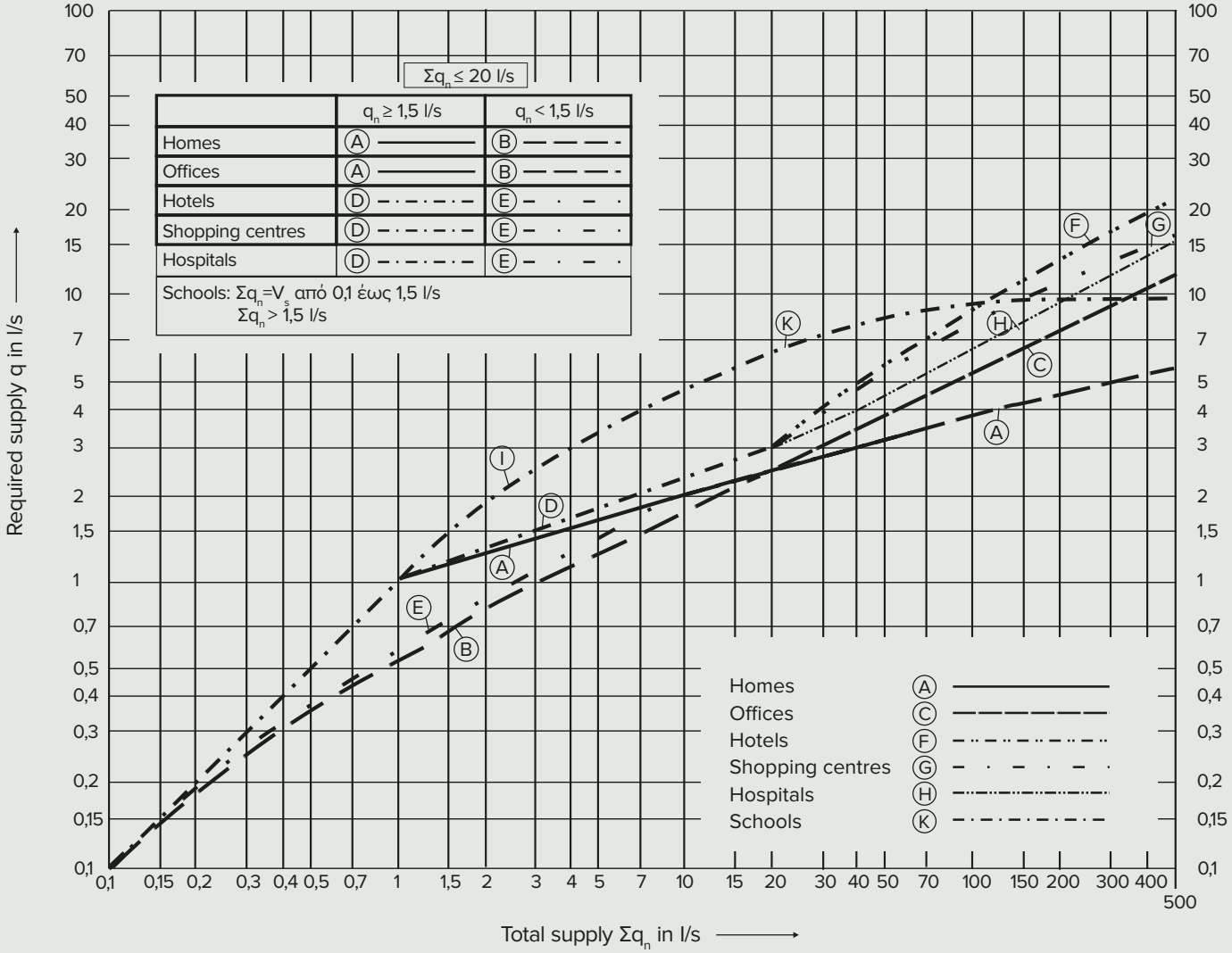
Water Connection Point	Flow (l/sec)	Pressure (bar)	Pipe Diameter (mm)
Wash - Basin			
Tap DN 15	0,07	0,50	20
Mixer Tap DN 15	0,07	1,00	20
Bidet			
Tap DN 15	0,07	0,50	20
Mixer Tap DN 15	0,07	1,00	20
Bath tub			
Mixer tap			
DN 15	0,15	1,00	20
DN 20	0,40	1,00	25
DN 25	1,00	1,00	32
Shower			
Spinkler DN 15	0,15	1,00	20
Small side Spinkler DN 15	0,06	1,00	20
Spinkler DN 20	0,18	1,00	20
Spinkler DN 25	0,31	1,00	20
Flush and flusing tank			
Flush DN 20	1,00	1,20	32
Flush tank DN 15	0,13	0,50	20
Electric and gas Boilers			
6kW	0,07	1,00	20
12kW	0,10	1,00	20
18kW	0,15	1,00	20
21kW	0,17	1,00	20
24kW	0,20	1,00	20
33kW	0,30	1,00	20
Sinks			
Mixer			
DN 15	0,07	1,00	20
DN 20	0,02	1,00	20
Dishwashers	**0,15**	**1,00**	**20**
Washing machines	**0,25**	**1,00**	**20**
Urinals			
Flush DN 15	0,30	1,20	20
Flusing Tank DN 15	0,13	0,50	20

18.2 | TABLE OF FORMULA FOR DETERMINATION OF REQUIRED SUPPLY IN CENTRAL WATER DISTRIBUTION NETWORKS

Type of building	Formula	Remarks
Residential buildings	$q = 0,682\ (\Sigma q_n)^{0,45} - 0,14$	for $0,07 \leq \Sigma q_n \leq 20$ l/s and for fittings with $q_n < 0,5$ l/s
	$q = 1,7\ (\Sigma q_n)^{0,21} - 0,7$	for $\Sigma q_n > 20$ l/s and for fittings with $q_n \geq 0,5$ l/s
Office and administration buildings	$q = 0,682\ (\Sigma q_n)^{0,45} - 0,14$	for $\Sigma q_n \leq 20$ l/s
	$q = 0,4\ (\Sigma q_n)^{0,54} + 0,48$	for $\Sigma q_n > 20$ l/s
Hotels and department stores	$q = 0,4\ (\Sigma q_n)^{0,366}$	for draw-off points with $q_n > 0,5$ l/s within the range $1 < \Sigma q_n \leq 20$ l/s
	$q = 0,698\ (\Sigma q_n)^{0,5} - 0,12$	for draw-off points with $q_n < 0,5$ l/s και within the range of $0,1 < \Sigma q_n \leq 20$ l/s
	$q = 1,08\ (\Sigma q_n)^{0,5} - 1,82$	for $\Sigma q_n > 20$ l/s (for hotels)
	$q = 0,698\ (\Sigma q_n)^{0,5} - 0,12$	for $\Sigma q_n > 20$ l/s (for department stores)
Hospitals	$q = 0,698\ (\Sigma q_n)^{0,5} - 0,12$	for $\Sigma q_n \leq 20$ l/s
	$q = 0,25\ (\Sigma q_n)^{0,65} + 1,25$	for $\Sigma q_n > 20$ l/s
Schools	$q = 4,4\ (\Sigma q_n)^{0,27} - 3,41$	for $1,5 < \Sigma q_n \leq 20$ l/s for $\Sigma q_n \leq 1,5$ l/s $q = Ó q_n$
	$q = -22,5\ (\Sigma q_n)^{-0,5} + 11,5$	for $\Sigma q_n > 20$ l/s

q_n = outlets supply, l/sec
Σq_n = sum of all outlets supplies, l/sec
q = required supply, l/sec

* For main networks of different buildings than those mentioned above,
the type for calculating the required supply must be selected based on the use of the specific network.



Flow velocity

In a piping network operating under pressure, the following are usually taken as maximum flow velocities, depending on the use of the network:

WATER SUPPLY NETWORK

—At the connection points from the vertical column to the outlets .....2,0 m/sec
—At the vertical columns .....2,0 m/sec
—At the distribution pipes .....1,5 m/sec
—At the water connection points 1,5m/sec

Piping calculation

Based on the supply we have already calculated, but also taking into account the maximum flow velocities, we refer to table 5 in the appendix, which can be found at the end of the technical manual, and we select the dimension of the pipes that we will use in each network section, while observing the pressure drop per each meter of pipe.

Linear pressure drop

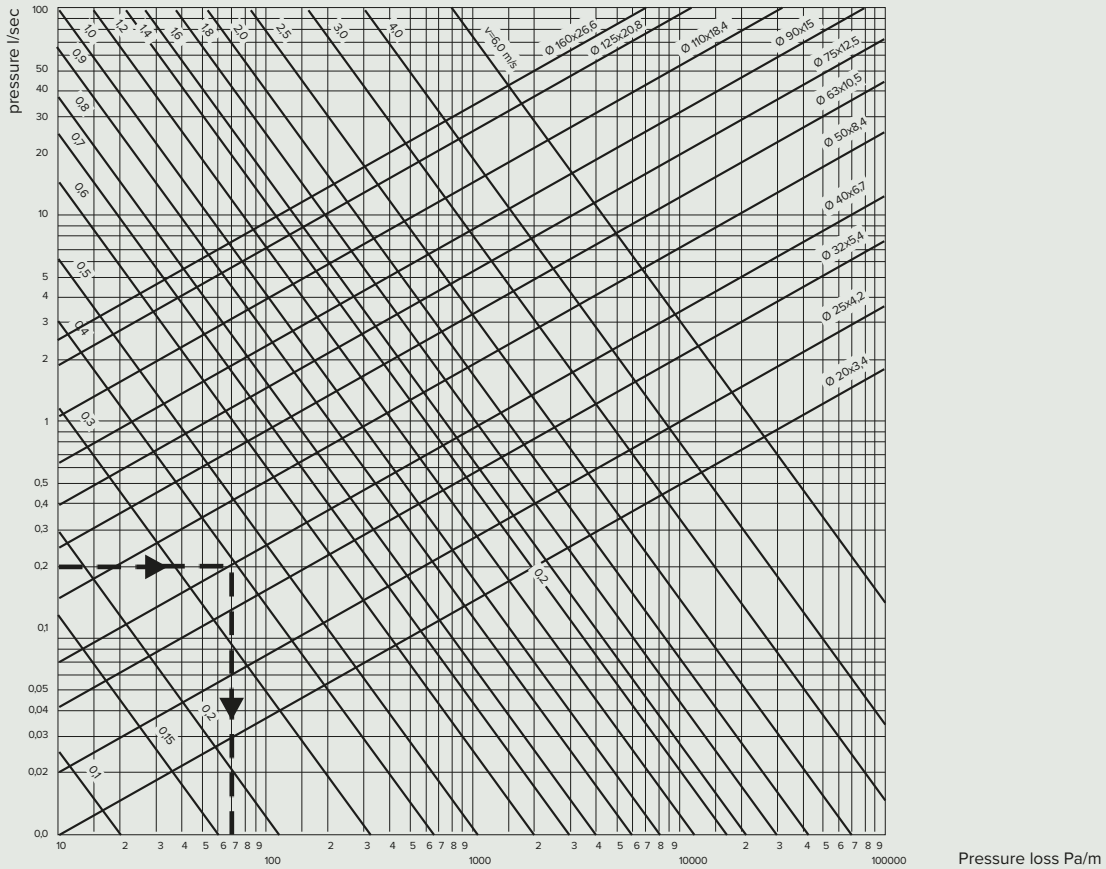
The linear pressure loss for each section of the network is calculated by the Darcy–Weisbach equation:

$$\Delta h_l = R \cdot L = \lambda \cdot L / D_w v^2 / 2g$$

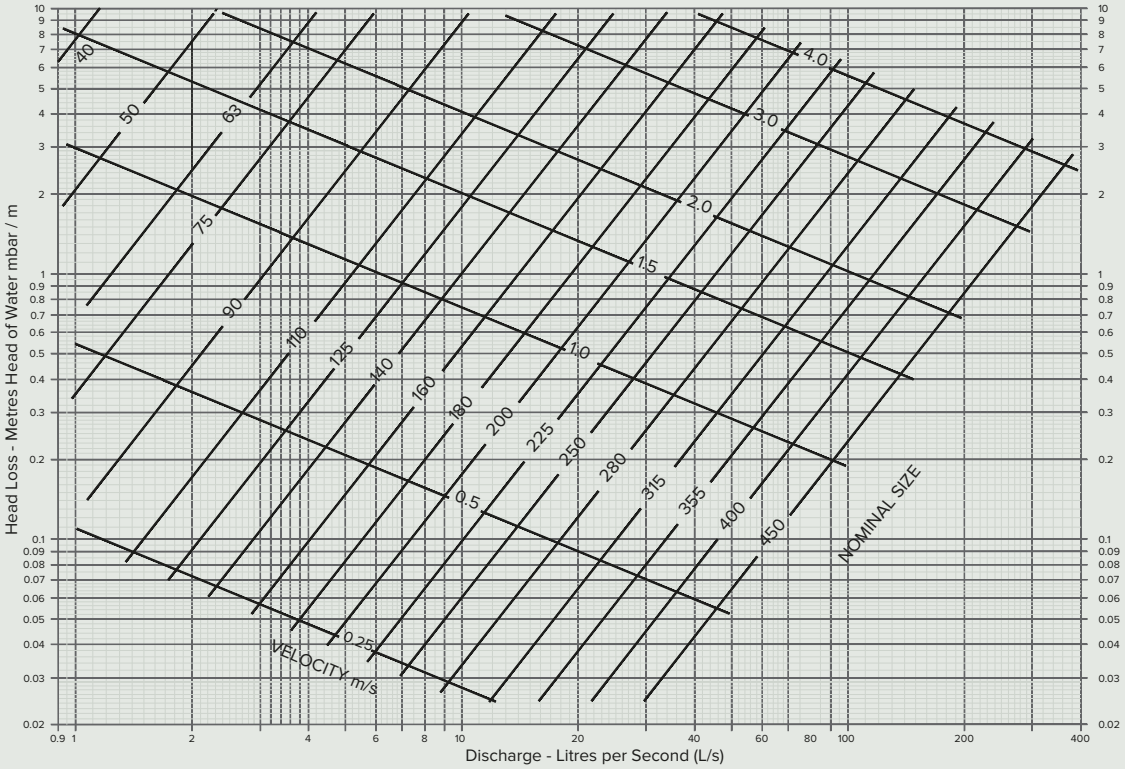
Where:
Δh_l= linear pressure drop (mH_2O)
R = unit pressure drop (hPa/m)
L = length of network section (m)
λ = linear resistance coefficient
D_w= inner pipe dimension (m)
v = mean internal flow in the network section (m/sec)
g = gravitational accelleration (m/sec^2)

The value of the coefficient **λ** is calculated by the Colebrook White equation, considering that the velocity coefficient **k** of the PP-R pipes is equal to 0.007mm. In order to facilitate the process of calculating the linear pressure drop, the diagrams show the values of the pressure drop R for different flow values for pipe dimensions and the standard temperatures.

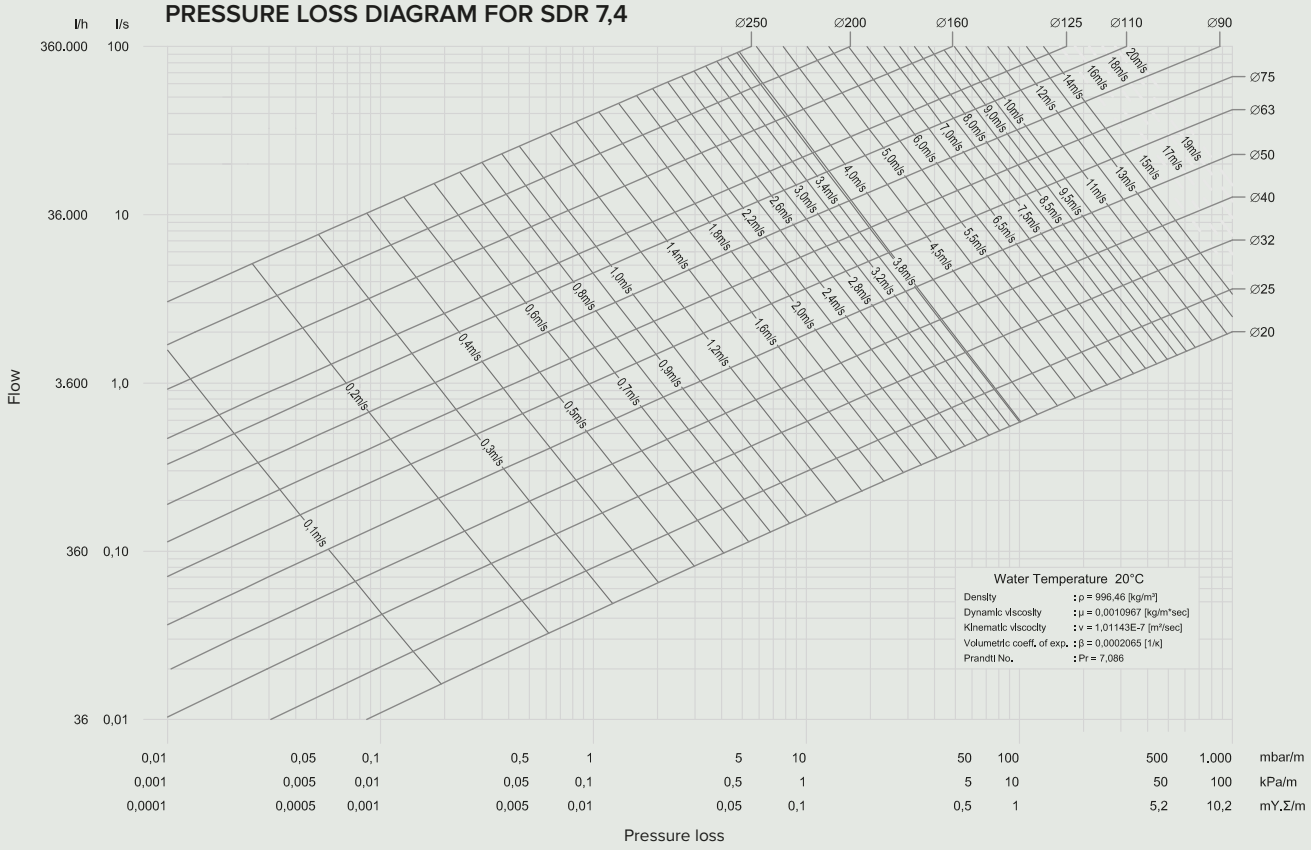
PRESSURE LOSS DIAGRAM FOR SDR 6



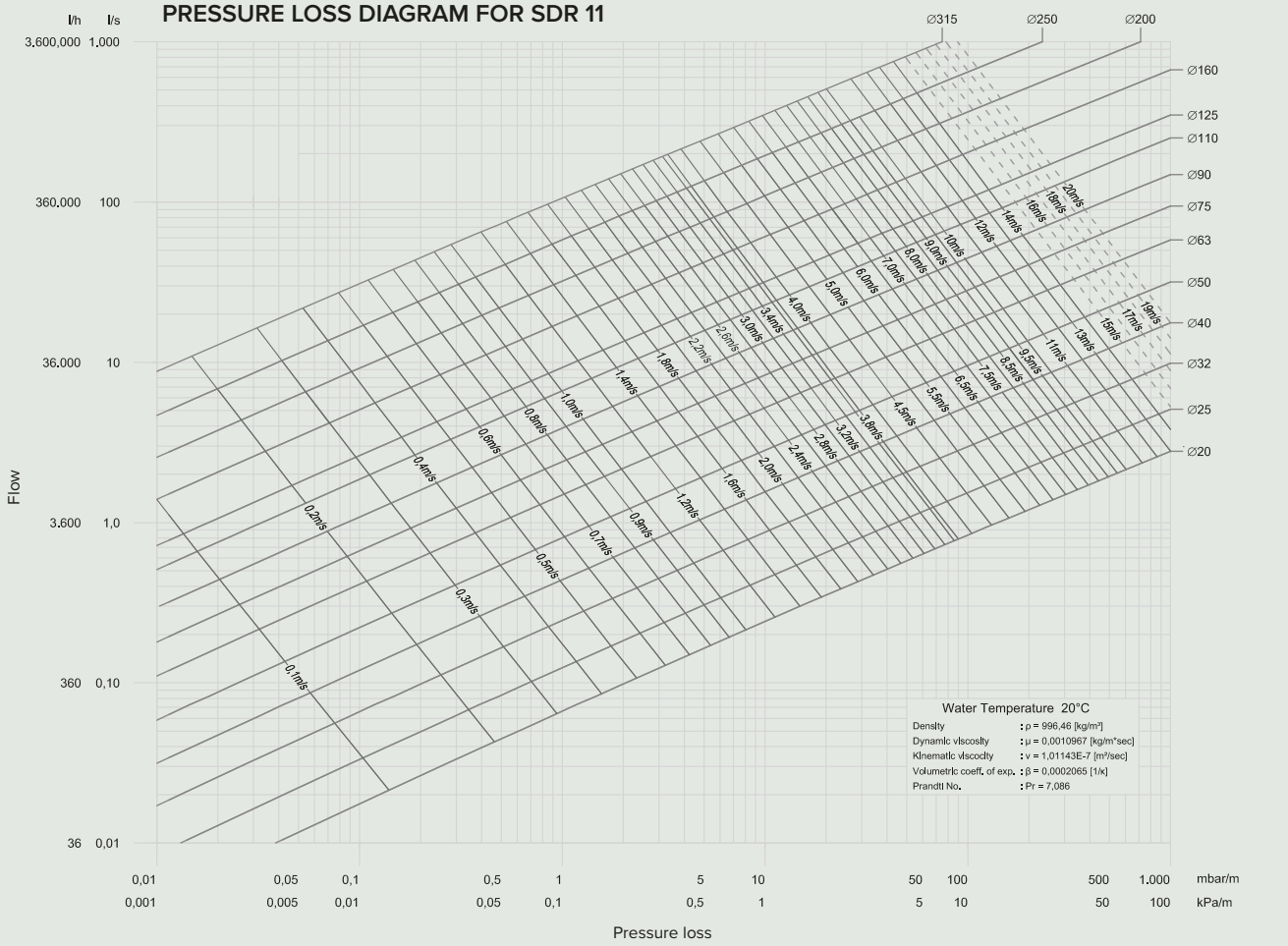
PRESSURE LOSS DIAGRAM FOR SDR 9



PRESSURE LOSS DIAGRAM FOR SDR 7,4



PRESSURE LOSS DIAGRAM FOR SDR 11



Local pressure drop at fittings
The local pressure drop due to network fittings is calculated according to the Weisbach equation:

$$\Delta h_m = \zeta \cdot v^2/2 \cdot g \ (2)$$

Where:
Δh_m = local pressure drop (m H_2O)
ζ = local resistance coefficient
v = mean flow velocity in the network section (m/sec)
g = gravitational acceleration (m/sec^2)

Total pressure losses
The sum of the local pressure drops in the network and the linear pressure drop will give us the total pressure drop of the network.

$$\Delta h = \Delta h_l + \Sigma \Delta h_m$$

EXAMPLE OF NETWORK CALCULATION
Suppose you want to calculate a network of cold water supply for a two-storey residence.
Divide the network into 2 sections (per level) and calculate, using the table, the flow for each section according to its outlets, i.e.:

GROUND FLOOR	Sink	q_n = 0,07 l/sec
	Dishwasher	q_n = 0,15 l/sec
	WC Wash basin	q_n = 0,07 l/sec
	WC Cistern	q_n = 0,13 l/sec
UPPER LEVEL	Bathroom wash basin	q_n = 0,07 l/sec
	Washing machine	q_n = 0,25 l/sec
	Bathtub	q_n = 0,15 l/sec
	Bathroom cistern	q_n = 0,13 l/sec

The total arising needs of the residence, by adding the above, will be:

$$\Sigma q_n = 1{,}02 \text{ l/sec}$$

Taking into account the simultaneous operation of the above devices, it results, with the help of table 4 of our annexes, that the total network requirement is equal to

$$q = 0{,}55 \text{ l/sec}$$

To meet these needs (in the main columns) and according to table 5 of the annex, for cold water supply (20°C) it results that 0.6 l/sec can be provided by the PP-R pipe Φ25 × 4.2 with speed v = 2.8 m/sec and R = 0.525 mH_2O. Alternatively, the PP-R Φ32 × 5.4 pipe with velocity v = 1.7 m/sec and R = 0.16m H_2O could be used.
Next, we calculate the linear pressure drop which, according to equation (I), will be:

$$\Delta hl = R \cdot L = 4 \cdot 0{,}525 = 2{,}1 \text{ m } H_2O$$

To calculate the local pressure at each outlet, we use the following equation with the help of the table on pages 82 and 83, which gives us the values of the local resistance coefficient ζ for the network fittings:

$$\Delta hm = \zeta \cdot v^2/2 \cdot g = 1{,}2 \cdot (2{,}8^2/2 \cdot 9{,}81) = 0{,}479 \text{ m } H_2O$$

The above local pressure, multiplied by the number of outlets, gives us the total local pressure drop.
Lastly, we calculate the total pressure drop of the network by summing the linear and the total of the local pressure drops:

$$\Delta h = \Delta h_l + \Sigma \Delta h_m = 2{,}1 + 8 \cdot 0{,}479 = 5{,}932 \text{ m } H_2O = 0{,}58 \text{ bar}$$

18.2 HEATING

Calculation for Main Heating networks
After calculating the calories required by each area and determining the temperature of the supply and return water, we refer to the table "Pressure losses and calculation of pipe dimension" to select a pipe of suitable diameter for each section.
When designing the installation, we must take into account that, due to the flow resistance, the speeds in the main heating networks range between 0.2 and 1.0 m/sec.
In specific cases, higher speed values are accepted, provided the network is protected against possible noise or vibration.

PRESSURE UNITS CONVERSION TABLE					
bar	mH_2O	at	daPa	hPa	Mpa
1	10	1	10000	1000	0,1
2	20	2	20000	2000	0,2
3	30	3	30000	3000	0,3
4	40	4	40000	4000	0,4
5	50	5	50000	5000	0,5
6	60	6	60000	6000	0,6
7	70	7	70000	7000	0,7
8	80	8	80000	8000	0,8
9	90	9	90000	9000	0,9
10	100	10	100000	10000	1,0

FLOW UNITS CONVERSION TABLE		
dm^3/s	dm^3/min	M^3/h
2	120	7,2
4	240	14,4
6	360	21,6
8	480	28,8
10	600	36
12	720	43,2
14	840	50,4
16	960	57,6
18	1080	64,8
20	1200	72

CALCULATION OF REQUIRED NETWORK SUPPLY ON THE BASIS OF TOTAL SUPPLY OF DISCHARGE POINTS

Σq_n		q	Σq_n	q	Σq_n	q
<0,5 l/s	≥0,5 l/s	l/s	l/s	l/s	l/s	l/s
0,06		0,05	21,89	2,55	331	5,05
0,10		0,10	23,54	2,60	345	5,10
0,15		0,15	25,28	2,65	360	5,15
0,21		0,20	27,13	2,70	374	5,20
0,29		0,25	29,08	2,75	390	5,25
0,38		0,30	31,15	2,80	406	5,30
0,48		0,35	33,32	2,85	422	5,35
0,60		0,40	35,62	2,90	439	5,40
0,72		0,45	38,04	2,95	456	5,45
0,87	0,50	0,50	40,58	3,00	474	5,50
1,03	0,55	0,55	43,26	3,05	493	5,55
1,20	0,60	0,60	46,08	3,10	512	5,60
1,39	0,65	0,65	49,04	3,15		
1,59	0,70	0,70	52,15	3,20		
1,81	0,75	0,75	55,41	3,25		
2,04	0,80	0,80	58,83	3,30		
2,29	0,85	0,85	62,41	3,35		
2,55	0,90	0,90	66,17	3,40		
2,83	0,95	0,95	70,10	3,45		
3,13	1,00	1,00	74,21	3,50		
3,45	1,15	1,05	78,51	3,55		
3,78	1,31	1,10	83,01	3,60		
4,12	1,50	1,15	87,84	3,65		
4,49	1,70	1,20	92,62	3,70		
4,87	1,92	1,25	97,74	3,75		
5,26	2,17	1,30	103,08	3,80		
5,68	2,44	1,35	108,65	3,85		
6,11	2,74	1,40	114,45	3,90		
6,56	3,06	1,45	120,50	3,95		
7,03	3,41	1,50	126,79	4,00		
7,51	3,80	1,55	133	4,05		
8,02	4,22	1,60	140	4,10		
8,54	4,67	1,65	147	4,15		
9,08	5,17	1,70	155	4,20		
9,63	5,70	1,75	162	4,25		
10,21	6,27	1,80	170	4,30		
10,80	6,89	1,85	178	4,35		
11,41	7,56	1,90	187	4,40		
12,04	8,28	1,95	196	4,45		
12,69	9,05	2,00	205	4,50		
13,36	9,88	2,05	215	4,55		
14,05	10,76	2,10	225	4,60		
14,76	11,84	2,15	235	4,65		
15,48	12,72	2,20	246	4,70		
16,23	13,80	2,25	257	4,75		
16,99	14,95	2,30	268	4,80		
17,78	16,17	2,35	280	4,85		
18,58	17,48	2,40	292	4,90		
19,40	18,86	2,45	305	4,95		
20,24	20,33	2,50	318	5,00		

CALCULATION OF REQUIRED SUPPLY FOR HOMES

Σq_n in l/s for discharge points with		q	Σq_n	q	Σq_n	q
<0,5 l/s	≥0,5 l/s	in l/s	in l/s	in l/s	in l/s	in l/s
0,06		0,05	21,89	2,55	331	5,05
0,10		0,10	23,54	2,60	345	5,10
0,15		0,15	25,28	2,65	360	5,15
0,21		0,20	27,13	2,70	374	5,20
0,29		0,25	29,08	2,75	390	5,25
0,38		0,30	31,15	2,80	406	5,30
0,48		0,35	33,32	2,85	422	5,35
0,60		0,40	35,62	2,90	439	5,40
0,72		0,45	38,04	2,95	456	5,45
0,87	0,50	0,50	40,58	3,00	474	5,50
1,03	0,55	0,55	43,26	3,05	493	5,55
1,20	0,60	0,60	46,08	3,10	512	5,60
1,39	0,65	0,65	49,04	3,15		
1,59	0,70	0,70	52,15	3,20		
1,81	0,75	0,75	55,41	3,25		
2,04	0,80	0,80	58,83	3,30		
2,29	0,85	0,85	62,41	3,35		
2,55	0,90	0,90	66,17	3,40		
2,83	0,95	0,95	70,10	3,45		
3,13	1,00	1,00	74,21	3,50		
3,45	1,15	1,05	78,51	3,55		
3,78	1,31	1,11	83,01	3,60		
4,12	1,50	1,15	87,71	3,65		
4,49	1,70	1,20	92,62	3,70		
4,87	1,92	1,25	97,74	3,75		
5,26	2,17	1,30	103,08	3,80		
5,68	2,44	1,35	108,65	3,85		
6,11	2,74	1,40	114,45	3,90		
6,56	3,06	1,45	120,50	3,95		
7,03	3,41	1,50	126,79	4,00		
7,51	3,80	1,55	133	4,05		
8,02	4,22	1,60	140	4,10		
8,54	4,67	1,65	147	4,15		
9,08	5,17	1,70	155	4,20		
9,63	5,70	1,75	162	4,25		
10,21	6,27	1,80	170	4,30		
10,80	6,89	1,85	178	4,35		
11,41	7,56	1,90	187	4,40		
12,04	8,28	1,95	196	4,45		
12,69	9,05	2,00	205	4,50		
13,36	9,88	2,05	215	4,55		
14,05	10,76	2,10	225	4,60		
14,76	11,71	2,15	235	4,65		
15,48	12,72	2,20	246	4,70		
16,23	13,80	2,25	257	4,75		
16,99	14,95	2,30	268	4,80		
17,78	16,17	2,35	280	4,85		
18,58	17,48	2,40	292	4,90		
19,40	18,86	2,45	305	4,95		
20,24	20,33	2,50	318	5,00		

CALCULATION OF REQUIRED SUPPLY FOR OFFICES

Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s
for Σq_n less than 20 l/s please refer to the previous table					
20,00	2,50				
20,93	2,55	90,58	5,05	293,0	9,1
21,87	2,60	92,42	5,10	299,3	9,2
22,84	2,65	94,28	5,15	305,7	9,3
23,82	2,70	96,16	5,20	312,2	9,4
24,82	2,75	98,05	5,25	318,7	9,5
25,84	2,80	99,96	5,30	325,2	9,6
26,88	2,85	101,89	5,35	331,8	9,7
27,94	2,90	103,83	5,40	338,5	9,8
29,02	2,95	105,79	5,45	345,3	9,9
30,11	3,00	107,77	5,50	352,1	10,0
31,23	3,05	109,76	5,55	359,0	10,1
32,36	3,10	111,77	5,60	365,9	10,2
33,51	3,15	113,80	5,65	372,9	10,3
34,68	3,20	115,85	5,70	380,0	10,4
35,87	3,25	117,91	5,75	387,1	10,5
37,08	3,30	119,98	5,80	394,3	10,6
38,31	3,35	122,08	5,85	401,5	10,7
39,55	3,40	124,19	5,90	408,8	10,8
40,81	3,45	126,32	5,95	416,1	10,9
42,09	3,50	128,46	6,00	423,6	11,0
43,39	3,55	132,8	6,1	431,0	11,1
44,71	3,60	137,2	6,2	438,6	11,2
46,04	3,65	141,7	6,3	446,2	11,3
47,39	3,70	146,2	6,4	453,8	11,4
48,76	3,75	150,8	6,5	461,6	11,5
50,15	3,80	155,5	6,6	469,3	11,6
51,56	3,85	160,2	6,7	477,2	11,7
52,98	3,90	165,0	6,8	485,1	11,8
54,43	3,95	169,0	6,9	493,0	11,9
55,88	4,00	174,8	7,0	501,0	12,0
57,36	4,05	179,8	7,1		
58,86	4,10	184,9	7,2		
60,37	4,15	190,0	7,3		
61,90	4,20	195,2	7,4		
63,45	4,25	200,4	7,5		
65,01	4,30	205,7	7,6		
66,60	4,35	211,1	7,7		
68,20	4,40	216,5	7,8		
69,82	4,45	222,0	7,9		
71,45	4,50	227,6	8,0		
73,10	4,55	233,2	8,1		
74,77	4,60	238,9	8,2		
76,46	4,65	244,7	8,3		
78,17	4,70	250,5	8,4		
79,89	4,75	256,4	8,5		
81,63	4,80	262,3	8,6		
83,38	4,85	268,4	8,7		
85,16	4,90	274,4	8,8		
86,95	4,95	280,6	8,9		
88,76	5,00	286,7	9,0		

CALCULATION OF REQUIRED SUPPLY FOR HOTELS

Σq_n for discharge points with <0,5 l/s	Σq_n for discharge points with ≥0,5 l/s	q in l/s	Σq_n for discharge points with <0,5 l/s	Σq_n for discharge points with ≥0,5 l/s	q in l/s	Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s
0,10		0,10	14,63	12,85	2,55	41,2	5,1	122,2	10,1	248,6	15,2
0,15		0,15	15,19	13,54	2,60	42,4	5,2	1245,1	10,2	254,5	15,4
0,21		0,20	15,75	14,27	2,65	43,6	5,3	126,1	10,3	260,5	15,6
0,28		0,25	16,32	15,01	2,70	44,8	5,4	128,2	10,4	266,5	15,8
0,36		0,30	16,91	15,78	2,75	46,1	5,5	130,3	10,5	272,6	16,0
0,45		0,35	17,50	16,58	2,80	47,3	5,6	132,5	10,6	278,7	16,2
0,56		0,40	18,11	17,40	2,85	48,6	5,7	134,6	10,7	284,9	16,4
0,67		0,45	18,72	18,24	2,90	49,9	5,8	136,8	10,8	291,2	16,6
0,79	0,50	0,50	19,34	19,11	2,95	51,2	5,9	138,9	10,9	297,6	16,8
			19,98	20,01	3,00	52,6	6,0	141,1	11,0	304,0	17,0
0,92	0,55	0,55									
1,06	0,60	0,60	20,42		3,05	53,9	6,1	143,3	11,1	310,5	17,2
1,22	0,65	0,65	20,84		3,10	55,3	6,2	145,6	11,2	317,0	17,4
1,38	0,70	0,70	21,26		3,15	56,7	6,3	147,8	11,3	323,7	17,6
1,55	0,75	0,75	21,69		3,20	58,1	6,4	150,1	11,4	330,4	17,8
1,74	0,80	0,80	22,12		3,25	59,5	6,5	152,3	11,5	337,1	18,0
1,93	0,85	0,85	22,56		3,30	60,3	6,6	154,6	11,6	344,0	18,2
2,14	0,90	0,90	23,00		3,35	62,4	6,7	156,9	11,7	350,9	18,4
2,35	0,95	0,95	23,45		3,40	63,9	6,8	159,3	11,8	357,8	18,6
2,57	1,00	1,00	23,90		3,45	65,3	6,9	161,6	11,9	364,9	18,8
			24,36		3,50	66,8	7,0	164,0	12,0	372,0	19,0
2,81	1,14	1,05									
3,05	1,30	1,10	24,82		3,55	68,4	7,1	166,4	12,1	379,2	19,2
3,31	1,46	1,15	25,28		3,60	69,9	7,2	168,8	12,2	386,4	19,4
3,58	1,64	1,20	25,75		3,65	71,5	7,3	171,2	12,3	393,7	19,6
3,85	1,84	1,25	26,22		3,70	73,0	7,4	173,6	12,4	401,1	19,8
4,14	2,05	1,30	26,69		3,75	74,6	7,5	176,1	12,5	408,6	20,0
4,44	2,27	1,35	27,17		3,80	76,2	7,6	178,5	12,6	416,1	20,2
4,74	2,50	1,40	27,66		3,85	77,9	7,7	181,0	12,7	423,7	20,4
5,06	2,75	1,45	28,15		3,90	79,5	7,8	183,5	12,8	431,3	20,6
5,39	3,02	1,50	28,64		3,95	81,2	7,9	186,0	12,9	439,1	20,8
			29,14		4,00	82,8	8,0	188,6	13,0	446,9	21,0
5,72	3,30	1,55									
6,07	3,60	1,60	29,64		4,05	84,5	8,1	191,1	13,1	454,7	21,2
6,43	3,92	1,65	30,15		4,10	86,2	8,2	193,7	13,2	462,6	21,4
6,80	4,25	1,70	30,66		4,15	88,0	8,3	196,3	13,3	470,6	21,6
7,18	4,60	1,75	31,17		4,20	89,7	8,4	198,9	13,4	478,7	21,8
7,57	4,97	1,80	31,69		4,25	91,5	8,5	201,5	13,5	486,9	22,0
7,97	5,35	1,85	32,22		4,30	93,3	8,6	204,1	13,6	495,1	22,2
8,38	5,76	1,90	32,74		4,35	95,1	8,7	206,8	13,7	50,3	22,4
8,79	6,18	1,95	33,28		4,40	96,9	8,8	209,4	13,8		
9,22	6,62	2,00	33,81		4,45	98,7	8,9	212,1	13,9		
			34,35		4,50	100,6	9,0	214,8	14,0		
9,67	7,08	2,05									
10,12	7,56	2,10	34,90		4,55	102,4	9,1	217,6	14,1		
10,58	8,07	2,15	35,45		4,60	104,3	9,2	220,3	14,2		
11,05	8,59	2,20	36,00		4,65	106,2	9,3	222,1	14,3		
11,53	9,13	2,25	36,56		4,70	108,1	9,4	225,8	14,4		
12,02	9,69	2,30	27,12		4,75	110,1	9,5	228,6	14,5		
12,52	10,28	2,35	37,69		4,80	112,0	9,6	231,4	14,6		
13,03	10,89	2,40	38,26		4,85	114,0	9,7	234,3	14,7		
13,56	11,52	2,45	38,83		4,90	116,0	9,8	237,1	14,8		
14,09	12,17	2,50	39,41		4,95	118,0	9,9	240,0	14,9		
			39,99		5,00	120,0	10,0	242,8	15,0		

CALCULATION OF REQUIRED SUPPLY FOR SHOPPING CENTRES

Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s
for Σq_n less than 20 l/s please refer to the previous table					
20,00	3,00				
20,39	3,05	47,70	5,55	154,4	10,1
20,78	3,10	48,43	5,60	157,9	10,2
21,18	3,15	49,16	5,65	161,4	10,3
21,58	3,20	49,91	5,70	164,9	10,4
21,99	3,25	50,66	5,75	168,5	10,5
22,41	3,30	51,42	5,80	172,2	10,6
22,83	3,35	52,19	5,85	175,9	10,7
23,25	3,40	52,97	5,90	179,7	10,8
23,68	3,45	53,76	5,95	183,6	10,9
24,12	3,50	54,55	6,00	187,5	11,0
24,56	3,55	56,2	6,1	191,4	11,1
25,01	3,60	57,8	6,2	195,5	11,2
25,47	3,65	59,5	6,3	199,5	11,3
25,93	3,70	61,2	6,4	203,7	11,4
26,40	3,75	63,0	6,5	207,9	11,5
26,87	3,80	64,8	6,6	212,2	11,6
27,35	3,85	66,6	6,7	216,5	11,7
27,84	3,90	68,5	6,8	220,9	11,8
28,33	3,95	70,4	6,9	225,4	11,9
28,83	4,00	72,3	7,0	229,9	12,0
29,33	4,05	74,3	7,1	234,5	12,1
29,34	4,10	76,3	7,2	239,2	12,2
30,36	4,15	78,4	7,3	243,9	12,3
30,88	4,20	80,5	7,4	248,8	12,4
31,42	4,25	82,6	7,5	253,6	12,5
31,95	4,30	84,8	7,6	258,6	12,6
32,50	4,35	87,0	7,7	263,6	12,7
33,05	4,40	89,3	7,8	268,7	12,8
33,61	4,45	91,6	7,9	273,8	12,9
34,17	4,50	94,0	8,0	279,1	13,0
34,74	4,55	96,4	8,1	284,3	13,1
35,32	4,60	98,8	8,2	289,7	13,2
35,90	4,65	101,3	8,3	295,2	13,3
36,50	4,70	103,9	8,4	300,7	13,4
37,10	4,75	106,4	8,5	306,3	13,5
37,70	4,80	109,1	8,6	312,0	13,6
38,32	4,85	111,7	8,7	317,7	13,7
38,94	4,90	114,5	8,8	323,5	13,8
39,57	4,95	117,2	8,9	329,4	13,9
40,20	5,00	120,0	9,0	335,4	14,0
40,84	5,05	122,9	9,1	348	14,2
41,50	5,10	125,8	9,2	360	14,4
42,15	5,15	128,8	9,3	373	14,6
42,82	5,20	131,8	9,4	386	14,8
43,49	5,25	134,9	9,5	400	15,0
44,17	5,30	138,0	9,6	414	15,2
44,86	5,35	141,2	9,7	428	15,4
45,56	5,40	144,4	9,8	442	15,6
46,26	5,45	147,7	9,9	457	15,8
46,98	5,50	151,0	10,0	472	16,0
				488	16,2
				504	16,4

CALCULATION OF REQUIRED SUPPLY FOR HOSPITALS

		Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s
for Σq_n less than 20 l/s please refer to the p159 table					
20,00	3,00				
20,88	3,05	79,80	5,55	242,4	10,1
21,78	3,10	81,23	5,60	246,6	10,2
22,70	3,15	82,67	5,65	250,9	10,3
23,62	3,20	84,12	5,70	255,2	10,4
24,56	3,25	85,58	5,75	259,5	10,5
25,51	3,30	87,05	5,80	263,8	10,6
26,48	3,35	88,53	5,85	268,2	10,7
27,45	3,40	90,01	5,90	272,5	10,8
28,44	3,45	91,51	5,95	277,0	10,9
29,44	3,50	93,01	6,00	281,4	11,0
30,46	3,55	96,0	6,1	285,8	11,1
31,48	3,60	99,1	6,2	290,3	11,2
32,52	3,65	102,2	6,3	294,8	11,3
33,57	3,70	105,3	6,4	299,3	11,4
34,63	3,75	108,5	6,5	303,9	11,5
35,70	3,80	111,7	6,6	308,5	11,6
36,78	3,85	114,9	6,7	313,1	11,7
37,88	3,90	118,2	6,8	317,7	11,8
38,98	3,95	121,5	6,9	322,3	11,9
40,10	4,00	124,8	7,0	327,0	12,0
41,23	4,05	128,2	7,1	331,7	12,1
42,37	4,10	131,6	7,2	336,4	12,2
43,51	4,15	135,0	7,3	341,2	12,3
44,68	4,20	138,4	7,4	345,9	12,4
45,85	4,25	141,9	7,5	350,7	12,5
47,03	4,30	145,4	7,6	355,5	12,6
48,22	4,35	149,0	7,7	360,4	12,7
49,42	4,40	152,5	7,8	365,2	12,8
50,63	4,45	156,1	7,9	370,1	12,9
51,86	4,50	159,8	8,0	375,0	13,0
53,09	4,55	163,4	8,1	379,9	13,1
54,33	4,60	167,1	8,2	384,9	13,2
55,59	4,65	170,8	8,3	389,8	13,3
56,85	4,70	174,6	8,4	394,8	13,4
58,12	4,75	178,3	8,5	399,9	13,5
59,41	4,80	182,1	8,6	404,9	13,6
60,70	4,85	186,0	8,7	409,9	13,7
62,00	4,90	189,8	8,8	415,0	13,8
63,32	4,95	193,7	8,9	420,1	13,9
64,64	5,00	197,6	9,0	425,3	14,0
65,97	5,05	201,6	9,1	436	14,2
67,31	5,10	205,5	9,2	446	14,4
68,66	5,15	209,5	9,3	456	14,6
70,02	5,20	213,5	9,4	467	14,8
71,39	5,25	217,6	9,5	478	15,0
72,77	5,30	221,7	9,6	488	15,2
74,16	5,35	225,8	9,7	499	15,4
75,55	5,40	229,9	9,8	510	15,6
76,96	5,45	234,0	9,9		
78,37	5,50	238,2	10,0		

CALCULATION OF REQUIRED SUPPLY FOR SCHOOLS

Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s
0,05		2,22	2,05	7,07	4,05	26,15	7,10
0,10		2,30	2,10	7,24	4,10	27,38	7,20
0,15		2,38	2,15	7,42	4,15	28,70	7,30
0,20		2,46	2,20	7,61	4,20	30,12	7,40
0,25		2,54	2,25	7,79	4,25	31,64	7,50
0,30		2,63	2,30	7,98	4,30	33,28	7,60
0,35		2,71	2,35	8,18	4,35	35,06	7,70
0,40		2,80	2,40	8,37	4,40	36,98	7,80
0,45		2,89	2,45	8,57	4,45	39,06	7,90
0,50		2,98	2,50	8,78	4,50	41,33	8,00
0,55		3,08	2,55	8,99	4,55	43,79	8,10
0,60		3,17	2,60	9,20	4,60	46,49	8,20
0,65		3,27	2,65	9,41	4,65	49,44	8,30
0,70		3,37	2,70	9,63	4,70	52,68	8,40
0,75		3,48	2,75	9,85	4,75	56,25	8,50
0,80		3,58	2,80	10,08	4,80	60,20	8,60
0,85		3,69	2,85	10,31	4,85	64,57	8,70
0,90		3,80	2,90	10,54	4,90	69,44	8,80
0,95		3,91	2,95	10,78	4,95	74,89	8,90
1,00		4,03	3,00	11,02	5,00	81,00	9,00
1,05		4,15	3,05	11,51	5,10	87,89	9,10
1,10		4,27	3,10	12,02	5,20	95,70	9,20
1,15		4,39	3,15	12,54	5,30	104,60	9,30
1,20		4,51	3,20	13,08	5,40	114,80	9,40
1,25		4,64	3,25	13,64	5,50	126,56	9,50
1,30		4,77	3,30	14,22	5,60	140,24	9,60
1,35		4,91	3,35	14,81	5,70	156,25	9,70
1,40		5,04	3,40	15,42	5,80	175,17	9,80
1,45		5,18	3,45	16,05	5,90	197,75	9,90
1,50		5,32	3,50	16,70	6,00	225,00	10,00
1,56	1,55	5,47	3,55	17,37	6,10	258,29	10,10
1,62	1,60	5,61	3,60	18,05	6,20	299,56	10,20
1,68	1,65	5,76	3,65	18,76	6,30	351,56	10,30
1,74	1,70	5,91	3,70	19,48	6,40	418,39	10,40
1,80	1,75	6,07	3,75	20,25	6,50	506,25	10,50
1,87	1,80	6,23	3,80	21,08	6,60		
1,94	1,85	6,39	3,85	21,97	6,70		
2,01	1,90	6,55	3,90	22,92	6,80		
2,08	1,95	6,72	3,95	23,92	6,90		
2,15	2,00	6,89	4,00	25,00	7,00		

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 6

HYDRAULIC AND PIPE PROPERTIES

V = flow rate [l/s]
R = friction [mbar/m]
v = velocity [m/s]
d = pipe outside diameter [mm]
S = pipe wall thickness [mm]
di = pipe inner diameter [mm]

WATER PROPERTIES

Density: ρ = 998,2 [Kg/m^3]
Viscosity: v = 1,004x10^{-6} [m^2/s]
Temperature: t = 20°C

SDR 6
20°C

q (supply) (l/s)	R (m/s) (friction) v (m/s) (velocity)	PN 20								
		20	25	32	40	50	63	75	90	110
0,01	R	0.13	0.04	0.01						
	v	0.07	0.05	0.03						
0,02	R	0.41	0.14	0.04						
	v	0.15	0.09	0.06						
0,03	R	0.81	0.28	0.09						
	v	0.22	0.14	0.08						
0,04	R	1.32	0.45	0.14	0.05					
	v	0.29	0.18	0.11	0.07					
0,05	R	1.94	0.66	0.21	0.07					
	v	0.37	0.23	0.14	0.09					
0,06	R	2.66	0.90	0.28	0.01					
	v	0.44	0.28	0.17	0.11					
0,07	R	3.47	1.17	0.37	0.13	0.04				
	v	0.51	0.32	0.20	0.13	0.08				
0,08	R	4.38	1.47	0.46	0.16	0.05				
	v	0.58	0.37	0.23	0.14	0.09				
0,09	R	5.37	1.81	0.57	0.19	0.07				
	v	0.66	0.42	0.25	0.16	0.10				
0,10	R	6.46	2.17	0.68	0.23	0.08				
	v	0.73	0.46	0.28	0.18	0.11				
0,12	R	8.90	2.98	0.93	0.32	0.11	0.04			
	v	0.88	0.55	0.34	0.22	0.14	0.09			
0,16	R	14.79	4.93	1.54	0.52	0.18	0.06			
	v	1.17	0.74	0.45	0.29	0.18	0.12			
0,18	R	18.24	6.07	1.89	0.64	0.22	0.07			
	v	1.32	0.83	0.51	0.32	0.21	0.13			
0,20	R	22.00	7.31	2.27	0.77	0.26	0.09	0.04		
	v	1.46	0.92	0.57	0.36	0.23	0.14	0.10		
0,30	R	45.52	15.02	4.63	1.57	0.53	0.18	0.08	0.03	
	v	2.19	1.39	0.85	0.54	0.34	0.22	0.15	0.11	
0,40	R	76.63	25.16	7.73	2.60	0.88	0.29	0.13	0.05	
	v	2.92	1.85	1.13	0.72	0.46	0.29	0.20	0.14	
0,50	R	115.12	37.63	11.51	3.86	1.30	0.43	0.19	0.08	
	v	3.65	2.31	1.42	0.90	0.57	0.36	0.25	0.18	
0,60	R	160.87	52.38	15.97	5.34	1.79	0.60	0.26	0.11	
	v	4.38	2.77	1.70	1.08	0.68	0.43	0.31	0.21	
0,70	R	213.78	69.37	21.09	7.04	2.35	0.79	0.34	0.14	0.05
	v	5.12	3.23	1.98	1.26	0.80	0.51	0.36	0.25	0.17
0,80	R		88.57	26.85	8.94	2.99	1.00	0.43	0.18	0.07
	v		3.70	2.27	1.44	0.91	0.58	0.41	0.28	0.19
0,90			109.97	33.25	11.05	3.69	1.23	0.53	0.22	0.09
			4.16	2.55	1.62	1.03	0.65	0.46	0.32	0.21

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 6

HYDRAULIC AND PIPE PROPERTIES
V = flow rate [l/s]
R = friction [mbar/m]
v = velocity [m/s]
d = pipe outside diameter [mm]
S = pipe wall thickness [mm]
di = pipe inner diameter [mm]

WATER PROPERTIES
Density: ρ = 998,2 [Kg/m^3]
Viscosity: v = 1,004x10^{-6} [m^2/s]
Temperature: t = 20°C

SDR 6
20°C

q (supply) (l/s)	R (m/s) (friction) v (m/s) (velocity)	PN 20								
		20	25	32	40	50	63	75	90	110
1,00	R		133.53	40.28	13.37	4.45	1.48	0.64	0.27	0.10
	v		4.62	2.83	1.80	1.14	0.72	0.51	0.35	0.24
1,20	R		187.12	56.21	18.60	6.17	2.05	0.89	0.37	0.14
	v		5.54	3.40	2.16	1.37	0.87	0.61	0.42	0.28
1,40	R			74.61	24.61	8.15	2.70	1.17	0.49	0.19
	v			3.97	2.52	1.60	1.01	0.71	0.50	0.33
1,60	R			95.44	31.40	10.38	3.43	1.48	0.62	0.24
	v			4.53	2.88	1.83	1.15	0.81	0.57	0.38
1,80	R			118.68	38.95	12.85	4.24	1.83	0.76	0.29
	v			5.01	3.24	2.05	1.30	0.92	0.64	0.43
2,00	R				47.26	15.56	5.12	2.21	0.92	0.35
	v				3.60	2.28	1.44	1.02	0.71	0.47
2,20	R				56.32	18.51	6.09	2.62	1.09	0.41
	v				3.96	2.51	1.59	1.12	0.78	0.52
2,40	R				66.13	21.70	7.12	3.07	1.27	0.48
	v				4.32	2.74	1.73	1.22	0.85	0.57
2,60	R				76.68	25.12	8.24	3.54	1.47	0.56
	v				4.68	2.97	1.88	1.32	0.92	0.61
2,80	R				87.97	28.78	9.42	4.05	1.68	0.64
	v				5.04	3.20	2.02	1.43	0.99	0.66
3,00	R					32.66	10.68	4.59	1.90	0.72
	v					3.42	2.17	1.53	1.06	0.71
3,20	R					36.78	12.02	5.15	2.13	0.81
	v					3.65	2.31	1.63	1.13	0.76
3,40	R					41.13	13.42	5.75	2.38	0.90
	v					3.88	2.45	1.73	1.20	0.80
3,60	R					45.71	14.90	6.38	2.64	1.00
	v					4.11	2.60	1.83	1.27	0.85
3,80	R					50.51	16.45	7.04	2.91	1.10
	v					4.34	2.74	1.94	1.34	0.90
4,00	R					55.54	18.07	7.73	3.19	1.21
	v					4.57	2.89	2.04	1.41	0.95
4,20	R					60.80	19.77	8.45	3.49	1.32
	v					4.79	3.03	2.14	1.49	0.99
4,40	R					66.28	21.53	9.20	3.80	1.43
	v					5.02	3.18	2.24	1.56	1.04
4,60	R						23.36	9.98	4.12	1.55
	v						3.32	2.34	1.63	1.09
4,80	R						25.27	10.78	4.45	1.68
	v						3.46	2.44	1.70	1.13
5,00							27.24	11.62	4.79	1.81
							3.61	2.55	1.77	1.18

q (supply) (l/s)	R (m/s) (friction) v (m/s) (velocity)	PN 20								
		20	25	32	40	50	63	75	90	110
5.20	R						29.28	12.49	5.14	1.94
	v						3.75	2.65	1.84	1.23
5.40	R						31.40	13.38	5.51	2.07
	v						3.90	2.75	1.91	1.28
5.60	R						33.58	14.30	5.89	2.22
	v						4.04	2.85	1.98	1.32
5.80	R						35.83	15.25	6.28	2.36
	v						4.19	2.95	2.05	1.37
6.00	R						38.15	16.23	6.68	2.51
	v						4.33	3.06	2.12	1.42
6.20	R						40.54	17.24	7.09	2.66
	v						4.48	3.16	2.19	1.47
6.40	R						43.00	18.28	7.51	2.82
	v						4.62	3.26	2.26	1.51
6.60	R						45.53	19.35	7.95	2.99
	v						4.76	3.36	2.33	1.56
6.80	R						48.12	20.44	8.39	3.15
	v						4.91	3.46	2.41	1.61
7.00	R						50.79	21.56	8.85	3.32
	v						5.05	3.57	2.48	1.65
7.50	R							24.49	10.04	3.77
	v							3.82	2.65	1.77
8.00	R							27.60	11.31	4.24
	v							4.07	2.83	1.89
9.00	R							34.33	14.04	5.25
	v							4.58	3.18	2.13
10.0	R							41.76	17.05	6.37
	v							5.09	3.54	2.36
12.0	R								23.89	8.90
	v								4.24	2.84
14.0	R									11.83
	v									3.31

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 7,4

HYDRAULIC AND PIPE PROPERTIES

V = flow rate [l/s]
R = friction [mbar/m]
v = velocity [m/s]
d = pipe outside diameter [mm]
S = pipe wall thickness [mm]
di = pipe inner diameter [mm]

WATER PROPERTIES

Density: ρ = 998,2 [Kg/m^3]
Viscosity: v = 1,004x10^{-6} [m^2/s]
Temperature: t = 20°C

SDR 7,4
20°C

Flow	d	20mm	25mm	32mm	40mm	50mm	63mm	75mm	90mm	110mm	125mm	160mm	200mm	250mm
rate	S	2,8mm	7,0mm	4,4mm	5,5mm	6,9mm	8,6mm	10,3mm	12,3mm	15,1mm	17,1mm	21,9mm	27,4mm	34,2mm
V	di	14,4mm	18,0mm	23,2mm	29,0mm	36,2mm	45,8mm	54,4mm	65,4mm	79,8mm	90,8mm	116,2mm	145,2mm	181,6mm
0,02l/s	R	0,3												
	v	0,1m/s												
0,03l/s	R	0,5	0,2											
	v	0,2m/s	0,1m/s											
0,04l/s	R	0,9	0,3											
	v	0,2m/s	0,2m/s											
0,05l/s	R	1,3	0,4	0,1										
	v	0,3m/s	0,2m/s	0,1m/s										
0,06l/s	R	1,7	0,6	0,2										
	v	0,4m/s	0,2m/s	0,1m/s										
0,07l/s	R	2,3	0,8	0,2	0,1									
	v	0,4m/s	0,3m/s	0,2m/s	0,1m/s									
0,08l/s	R	2,9	1	0,3	0,1									
	v	0,5m/s	0,3m/s	0,2m/s	0,1m/s									
0,09l/s	R	3,5	1,2	0,4	0,1									
	v	0,6m/s	0,4m/s	0,2m/s	0,1m/s									
0,10l/s	R	4,2	1,5	0,4	0,2									
	v	0,6m/s	0,4m/s	0,2m/s	0,2m/s									
0,12l/s	R	5,8	2	0,6	0,2	0,1								
	v	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s								
0,16l/s	R	9,7	3,3	1	0,3	0,1								
	v	1,0m/s	0,6m/s	0,4m/s	0,2m/s	0,2m/s								
0,18l/s	R	11,9	4,1	1,2	0,4	0,1	0							
	v	1,1m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s							
0,20l/s	R	14,4	4,9	1,5	0,5	0,2	0,1							
	v	1,2m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s							
0,30l/s	R	29,8	10,1	3	1	0,4	0,1	0,1						
	v	1,8m/s	1,2m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s						
0,40l/s	R	50,1	17	5	1,7	0,6	0,2	0,1	0					
	v	2,5m/s	1,6m/s	0,9m/s	0,6m/s	0,4m/s	0,2m/s	0,2m/s	0,1m/s					
0,50l/s	R	75,1	25,3	7,4	2,5	0,9	0,3	0,1	0,1					
	v	3,1m/s	2,0m/s	1,2m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s					
0,60l/s	R	104,8	35,3	10,3	3,5	1,2	0,4	0,2	0,1	0				
	v	3,7m/s	2,4m/s	1,4m/s	0,9m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s				
0,70l/s	R	139,2	46,7	13,6	4,6	1,6	0,5	0,2	0,1	0	0			
	v	4,3m/s	2,8m/s	1,7m/s	1,1m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	0,1m/s			
0,80l/s	R	178,1	59,5	17,3	5,9	2	0,7	0,3	0,1	0	0			
	v	4,9m/s	3,1m/s	1,9m/s	1,2m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,2m/s	0,1m/s			
0,90l/s	R	221,5	73,9	21,4	7,3	2,5	0,8	0,4	0,1	0,1	0			
	v	5,5m/s	3,5m/s	2,1m/s	1,4m/s	0,9m/s	0,5m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s			
1,00l/s	R	269,4	89,7	25,9	8,8	3	1	0,4	0,2	0,1	0			
	v	6,1m/s	3,9m/s	2,4m/s	1,5m/s	1,0m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,2m/s			
1,20l/s	R	378,6	125,5	36,2	12,2	4,2	1,3	0,6	0,2	0,1	0	0		
	v	7,4m/s	4,7m/s	2,8m/s	1,8m/s	1,2m/s	0,7m/s	0,5m/s	0,4m/s	0,2m/s	0,2m/s	0,1m/s		
1,40l/s	R	505,5	167	48	16,2	5,5	1,8	0,8	0,3	0,1	0,1	0		
	v	8,6m/s	5,5m/s	3,3m/s	2,1m/s	1,4m/s	0,8m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s		

SDR 7,4
20°C

Flow	d	20mm	25mm	32mm	40mm	50mm	63mm	75mm	90mm	110mm	125mm	160mm	200mm	250mm
rate	S	2,8mm	7,0mm	4,4mm	5,5mm	6,9mm	8,6mm	10,3mm	12,3mm	15,1mm	17,1mm	21,9mm	27,4mm	34,2mm
V	di	14,4mm	18,0mm	23,2mm	29,0mm	36,2mm	45,8mm	54,4mm	65,4mm	79,8mm	90,8mm	116,2mm	145,2mm	181,6mm
1,60l/s	R	650,1	214,1	61,3	20,6	7	2,3	1	0,4	0,2	0,1	0		
	v	9,8m/s	6,3m/s	3,8m/s	2,4m/s	1,6m/s	1,0m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,2m/s		
1,80l/s	R	812,2	266,7	76,2	25,5	8,7	2,8	1,2	0,5	0,2	0,1	0	0	
	v	11,1m/s	7,1m/s	4,3m/s	2,7m/s	1,7m/s	1,1m/s	0,8m/s	0,5m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	
2,00l/s	R	991,9	325	92,5	31	10,5	3,4	1,5	0,6	0,2	0,1	0	0	
	v	12,3m/s	7,9m/s	4,7m/s	3,0m/s	1,9m/s	1,2m/s	0,9m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	
2,20l/s	R	1189,1	388,7	110,4	36,9	12,5	4	1,7	0,7	0,3	0,1	0	0	
	v	13,5m/s	8,6m/s	5,2m/s	3,3m/s	2,1m/s	1,3m/s	0,9m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	
2,40l/s	R	1403,8	457,9	129,8	43,3	14,7	4,7	2	0,8	0,3	0,2	0,1	0	
	v	14,7m/s	9,4m/s	5,7m/s	3,6m/s	2,3m/s	1,5m/s	1,0m/s	0,7m/s	0,5m/s	0,4m/s	0,2m/s	0,1m/s	
2,60l/s	R	1635,9	532,6	150,7	50,2	17	5,4	2,4	1	0,4	0,2	0,1	0	0
	v	16,0m/s	10,2m/s	6,2m/s	3,9m/s	2,5m/s	1,6m/s	1,1m/s	0,8m/s	0,5m/s	0,4m/s	0,2m/s	0,2m/s	0,1m/s
2,80l/s	R	1885,4	612,8	173	57,5	19,4	6,2	2,7	1,1	0,4	0,2	0,1	0	0
	v	17,2m/s	11,0m/s	6,6m/s	4,2m/s	2,7m/s	1,7m/s	1,2m/s	0,8m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s
3,00l/s	R	2152,4	698,5	196,9	65,4	22	7	3,1	1,3	0,5	0,3	0,1	0	0
	v	18,4m/s	11,8m/s	7,1m/s	4,5m/s	2,9m/s	1,8m/s	1,3m/s	0,9m/s	0,6m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s
3,20l/s	R	2436,8	789,7	222,2	73,7	24,8	7,9	3,4	1,4	0,5	0,3	0,1	0	0
	v	19,6m/s	12,6m/s	7,6m/s	4,8m/s	3,1m/s	1,9m/s	1,4m/s	1,0m/s	0,6m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s
3,40l/s	R	2738,5	886,3	249	82,4	27,7	8,8	3,8	1,6	0,6	0,3	0,1	0	0
	v	20,9m/s	13,4m/s	8,0m/s	5,1m/s	3,3m/s	2,1m/s	1,5m/s	1,0m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s
3,60l/s	R	3057,7	988,3	277,2	91,7	30,8	9,8	4,2	1,7	0,7	0,4	0,1	0	0
	v	22,1m/s	14,1m/s	8,5m/s	5,5m/s	3,5m/s	2,2m/s	1,5m/s	1,1m/s	0,7m/s	0,6m/s	0,3m/s	0,2m/s	0,1m/s
3,80l/s	R	3394,3	1095,8	306,9	101,4	34	10,8	4,7	1,9	0,7	0,4	0,1	0	0
	v	23,3m/s	14,9m/s	9,0m/s	5,8m/s	3,7m/s	2,3m/s	1,6m/s	1,1m/s	0,8m/s	0,6m/s	0,4m/s	0,2m/s	0,1m/s
4,00l/s	R	3748,2	1208,8	338,1	111,6	37,4	11,9	5,1	2,1	0,8	0,4	0,1	0	0
	v	24,6m/s	15,7m/s	9,5m/s	6,1m/s	3,9m/s	2,4m/s	1,7m/s	1,2m/s	0,8m/s	0,6m/s	0,4m/s	0,2m/s	0,2m/s
4,20l/s	R		1327,1	370,8	122,2	41	13	5,6	2,3	0,9	0,5	0,1	0	0
	v		16,5m/s	9,9m/s	6,4m/s	4,1m/s	2,5m/s	1,8m/s	1,3m/s	0,8m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s
4,40l/s	R		1451	404,9	133,3	44,6	14,1	6,1	2,5	1	0,5	0,2	0,1	0
	v		17,3m/s	10,4m/s	6,7m/s	4,3m/s	2,7m/s	1,9m/s	1,3m/s	0,9m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s
4,60l/s	R		1580,2	440,4	144,9	48,5	15,3	6,6	2,7	1	0,6	0,2	0,1	0
	v		18,1m/s	10,9m/s	7,0m/s	4,5m/s	2,8m/s	2,0m/s	1,4m/s	0,9m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s
4,80l/s	R		1714,9	477,4	156,9	52,4	16,6	7,2	2,9	1,1	0,6	0,2	0,1	0
	v		18,9m/s	11,4m/s	7,3m/s	4,7m/s	2,9m/s	2,1m/s	1,4m/s	1,0m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s
5,00l/s	R		1855	515,9	169,4	56,6	17,8	7,7	3,2	1,2	0,6	0,2	0,1	0
	v		19,6m/s	11,8m/s	7,6m/s	4,9m/s	3,0m/s	2,2m/s	1,5m/s	1,0m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s
5,20l/s	R		2000,5	555,9	182,3	60,8	19,2	8,3	3,4	1,3	0,7	0,2	0,1	0
	v		20,4m/s	12,3m/s	7,9m/s	5,1m/s	3,2m/s	2,2m/s	1,5m/s	1,0m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s
5,40l/s	R		2151,5	597,2	195,8	65,3	20,6	8,9	3,6	1,4	0,7	0,2	0,1	0
	v		21,2m/s	12,8m/s	8,2m/s	5,2m/s	3,3m/s	2,3m/s	1,6m/s	1,1m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s
5,60l/s	R		2307,9	640,1	209,6	69,8	22,0	9,5	3,9	1,5	0,8	0,2	0,1	0
	v		22,0m/s	13,2m/s	8,5m/s	5,4m/s	3,4m/s	2,4m/s	1,7m/s	1,1m/s	0,9m/s	0,5m/s	0,3m/s	0,2m/s
5,80l/s	R		2469,7	684,4	224,0	74,6	23,5	10,1	4,1	1,6	0,8	0,3	0,1	0
	v		22,8m/s	13,7m/s	8,8m/s	5,6m/s	3,5m/s	2,5m/s	1,7m/s	1,2m/s	0,9m/s	0,5m/s	0,4m/s	0,2m/s
6,00l/s	R		2636,9	730,1	238,7	79,4	25,0	10,8	4,4	1,7	0,9	0,3	0,1	0
	v		23,6m/s	14,2m/s	9,1m/s	5,8m/s	3,6m/s	2,6m/s	1,8m/s	1,2m/s	0,9m/s	0,6m/s	0,4m/s	0,2m/s

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 7,4

HYDRAULIC AND PIPE PROPERTIES

V = flow rate [l/s]
R = friction [mbar/m]
v = velocity [m/s]
d = pipe outside diameter [mm]
S = pipe wall thickness [mm]
di = pipe inner diameter [mm]

WATER PROPERTIES

Density: ρ = 998,2 [Kg/m^3]
Viscosity: v = 1,004x10^{-6} [m^2/s]
Temperature: t = 20°C

SDR 7,4
20°C

Flow	d	32mm	40mm	50mm	63mm	75mm	90mm	110mm	125mm	160mm	200mm	250mm
rate	S	4,4mm	5,5mm	6,9mm	8,6mm	10,3mm	12,3mm	15,1mm	17,1mm	21,9mm	27,4mm	34,2mm
V	di	23,2mm	29,0mm	36,2mm	45,8mm	54,4mm	65,4mm	79,8mm	90,8mm	116,2mm	145,2mm	181,6mm
6,20l/s	R	777,3	254,0	84,4	26,5	11,4	4,7	1,8	1	0,3	0,1	0
	v	14,7m/s	9,4m/s	6,0m/s	3,8m/s	2,7m/s	1,8m/s	1,2m/s	1,0m/s	0,6m/s	0,4m/s	0,2m/s
6,40l/s	R	825,9	269,7	89,6	28,1	12,1	4,9	1,9	1	0,3	0,1	0
	v	15,1m/s	9,7m/s	6,2m/s	3,9m/s	2,8m/s	1,9m/s	1,3m/s	1,0m/s	0,6m/s	0,4m/s	0,2m/s
6,60l/s	R	876	285,9	94,9	29,8	12,8	5,2	2	1,1	0,3	0,1	0
	v	15,6m/s	10,0m/s	6,4m/s	4,0m/s	2,8m/s	2,0m/s	1,3m/s	1,0m/s	0,6m/s	0,4m/s	0,3m/s
6,80l/s	R	927,6	302,5	100,4	31,5	13,5	5,5	2,1	1,1	0,3	0,1	0,0
	v	16,1m/s	10,3m/s	6,6m/s	4,1m/s	2,9m/s	2,0m/s	1,4m/s	1,1m/s	0,6m/s	0,4m/s	0,3m/s
7,00l/s	R	980,6	319,5	106,0	33,2	14,3	5,8	2,2	1,2	0,4	0,1	0,0
	v	16,6m/s	10,6m/s	6,8m/s	4,2m/s	3,0m/s	2,1m/s	1,4m/s	1,1m/s	0,7m/s	0,4m/s	0,3m/s
7,50l/s	R	1119,4	364,2	120,6	37,7	16,2	6,6	2,5	1,3	0,4	0,1	0,0
	v	17,7m/s	11,4m/s	7,3m/s	4,6m/s	3,2m/s	2,2m/s	1,5m/s	1,2m/s	0,7m/s	0,5m/s	0,3m/s
8,00l/s	R	1267,2	411,7	136,1	42,5	18,3	7,4	2,8	1,5	0,5	0,2	0,1
	v	18,9m/s	12,1m/s	7,8m/s	4,9m/s	3,4m/s	2,4m/s	1,6m/s	1,2m/s	0,8m/s	0,5m/s	0,3m/s
9,00l/s	R	1589,9	515,3	169,9	53,0	22,7	9,2	3,5	1,9	0,6	0,2	0,1
	v	21,3m/s	13,6m/s	8,7m/s	5,5m/s	3,9m/s	2,7m/s	1,8m/s	1,4m/s	0,8m/s	0,5m/s	0,3m/s
10,0l/s	R	1948,8	630,2	207,3	64,5	27,6	11,2	4,2	2,3	0,7	0,2	0,1
	v	23,7m/s	15,1m/s	9,7m/s	6,1m/s	4,3m/s	3,0m/s	2,0m/s	1,5m/s	0,9m/s	0,6m/s	0,4m/s
12,0l/s	R		894,0	293,0	90,7	38,7	15,7	5,9	3,2	1,0	0,3	0,1
	v		18,2m/s	11,7m/s	7,3m/s	5,2m/s	3,6m/s	2,4m/s	1,9m/s	1,1m/s	0,7m/s	0,5m/s
14,0l/s	R		1203,0	393,0	121,3	51,7	20,9	7,9	4,2	1,3	0,4	0,1
	v		21,2m/s	13,6m/s	8,5m/s	6,0m/s	4,2m/s	2,8m/s	2,2m/s	1,3m/s	0,8m/s	0,5m/s
16,0l/s	R		1557,2	507,2	156,1	66,4	26,7	10,1	5,4	1,6	0,5	0,2
	v		24,2m/s	15,5m/s	9,7m/s	6,9m/s	4,8m/s	3,2m/s	2,5m/s	1,5m/s	1,0m/s	0,6m/s
18,0l/s	R			635,8	195,1	82,8	33,3	12,5	6,7	2,0	0,7	0,2
	v			17,5m/s	10,9m/s	7,7m/s	5,4m/s	3,6m/s	2,8m/s	1,7m/s	1,1m/s	0,7m/s
20,0l/s	R			778,7	238,4	101,0	40,5	15,2	8,1	2,4	0,8	0,3
	v			19,4m/s	12,1m/s	8,6m/s	6,0m/s	4,0m/s	3,1m/s	1,9m/s	1,2m/s	0,8m/s
22,0l/s	R			935,8	285,9	120,9	48,5	18,2	9,6	2,9	1,0	0,3
	v			21,4m/s	13,4m/s	9,5m/s	6,5m/s	4,4m/s	3,4m/s	2,1m/s	1,3m/s	0,8m/s
24,0l/s	R			1107,1	337,6	142,6	57,1	21,4	11,3	3,4	1,1	0,4
	v			23,3m/s	14,6m/s	10,3m/s	7,1m/s	4,8m/s	3,7m/s	2,3m/s	1,4m/s	0,9m/s
26,0l/s	R				393,5	166,0	66,3	24,8	13,1	3,9	1,3	0,5
	v				15,8m/s	11,2m/s	7,7m/s	5,2m/s	4,0m/s	2,5m/s	1,6m/s	1,0m/s
28,0l/s	R				453,6	191,1	76,3	28,5	15,1	4,5	1,5	0,5
	v				17,0m/s	12,0m/s	8,3m/s	5,6m/s	4,3m/s	2,6m/s	1,7m/s	
30,0l/s	R				517,9	217,9	86,9	32,4	17,1	5,1	1,7	
	v				18,2m/s	12,9m/s	8,9m/s	6,0m/s	4,6m/s	2,8m/s	1,8m/s	
32,0l/s	R				586,4	246,5	98,2	36,6	19,3	5,8	1,9	
	v				19,4m/s	13,8m/s	9,5m/s	6,4m/s	4,9m/s	3,0m/s	1,9m/s	
34,0l/s	R				659,1	276,8	110,1	41,0	21,6	6,4	2,2	
	v				20,6m/s	14,6m/s	10,1m/s	6,8m/s	5,3m/s	3,2m/s	2,1m/s	
36,0l/s	R				736,0	308,8	122,7	45,6	24,1	7,2	2,4	
	v				21,9m/s	15,5m/s	10,7m/s	7,2m/s	5,6m/s	3,4m/s	2,2m/s	
38,0l/s	R				817,1	342,6	136,0	50,5	26,7	7,9	2,7	
	v				23,1m/s	16,3m/s	11,3m/s	7,6m/s	5,9m/s	3,6m/s	2,3m/s	

SDR 7,4
20°C

Flow	d	32mm	40mm	50mm	63mm	75mm	90mm	110mm	125mm	160mm	200mm	250mm
rate	S	4,4mm	5,5mm	6,9mm	8,6mm	10,3mm	12,3mm	15,1mm	17,1mm	21,9mm	27,4mm	34,2mm
V	di	23,2mm	29,0mm	36,2mm	45,8mm	54,4mm	65,4mm	79,8mm	90,8mm	116,2mm	145,2mm	181,6mm
40,0l/s	R				902,3	378,0	150,0	55,6	29,3	8,7	2,9	1,0
	v				24,3m/s	17,2m/s	11,9m/s	8,0m/s	6,2m/s	3,8m/s	2,4m/s	1,5m/s
42,0l/s	R					415,2	164,6	61,0	32,2	9,5	3,2	1,1
	v					18,1m/s	12,5m/s	8,4m/s	6,5m/s	4,0m/s	2,5m/s	1,6m/s
44,0l/s	R					454,1	179,8	66,6	35,1	10,4	3,5	1,2
	v					18,9m/s	13,1m/s	8,8m/s	6,8m/s	4,1m/s	2,7m/s	1,7m/s
46,0l/s	R					494,7	195,8	72,4	38,1	11,3	3,8	1,3
	v					19,8m/s	13,7m/s	9,2m/s	7,1m/s	4,3m/s	2,8m/s	1,8m/s
48,0l/s	R					537,0	212,4	78,5	41,3	12,2	4,1	1,4
	v					20,7m/s	14,3m/s	9,6m/s	7,4m/s	4,5m/s	2,9m/s	1,9m/s
50,0l/s	R					581,1	229,6	84,8	44,6	13,2	4,4	1,5
	v					21,5m/s	14,9m/s	10,0m/s	7,7m/s	4,7m/s	3,0m/s	1,9m/s
52,0l/s	R					626,8	247,5	91,4	48,1	14,2	4,8	1,6
	v					22,4m/s	15,5m/s	10,4m/s	8,0m/s	4,9m/s	3,1m/s	2,0m/s
54,0l/s	R					674,3	266,1	98,2	51,6	15,2	5,1	1,7
	v					23,2m/s	16,1m/s	10,8m/s	8,3m/s	5,1m/s	3,3m/s	2,1m/s
56,0l/s	R					723,4	285,4	105,2	55,3	16,3	5,5	1,8
	v					24,1m/s	16,7m/s	11,2m/s	8,6m/s	5,3m/s	3,4m/s	2,2m/s
58,0l/s	R					774,3	305,3	112,5	59,1	17,4	5,8	2,0
	v					25,0m/s	17,3m/s	11,6m/s	9,0m/s	5,5m/s	3,5m/s	2,2m/s
60,0l/s	R						325,8	120,0	63,0	18,6	6,2	2,1
	v						17,9m/s	12,0m/s	9,3m/s	5,7m/s	3,6m/s	2,3m/s
62,0l/s	R						347,1	127,7	67,0	19,7	6,6	2,2
	v						18,5m/s	12,4m/s	9,6m/s	5,8m/s	3,7m/s	2,4m/s
64,0l/s	R						368,9	135,7	71,2	20,9	7,0	2,3
	v						19,1m/s	12,8m/s	9,9m/s	6,0m/s	3,9m/s	2,5m/s
66,0l/s	R						391,5	143,9	75,5	22,2	7,4	2,5
	v						19,6m/s	13,2m/s	10,2m/s	6,2m/s	4,0m/s	2,5m/s
68,0l/s	R						414,7	152,3	79,9	23,5	7,8	2,6
	v						20,2m/s	13,6m/s	10,5m/s	6,4m/s	4,1m/s	2,6m/s
70,0l/s	R						438,5	161,0	84,4	24,8	8,3	2,8
	v						20,8m/s	14,0m/s	10,8m/s	6,6m/s	4,2m/s	2,7m/s
72,0l/s	R						463,0	169,9	89,0	26,1	8,7	2,9
	v						21,4m/s	14,4m/s	11,1m/s	6,8m/s	4,3m/s	2,8m/s
74,0l/s	R						488,2	179,1	93,8	27,5	9,2	3,1
	v						22,0m/s	14,8m/s	11,4m/s	7,0m/s	4,5m/s	2,9m/s
76,0l/s	R						514,0	188,5	98,7	28,9	9,6	3,2
	v						22,6m/s	15,2m/s	11,7m/s	7,2m/s	4,6m/s	2,9m/s
78,0l/s	R						540,5	198,1	103,7	30,4	10,1	3,4
	v						23,2m/s	15,6m/s	12,0m/s	7,4m/s	4,7m/s	3,0m/s
80,0l/s	R						567,7	208,0	108,8	31,9	10,6	3,5
	v						23,8m/s	16,0m/s	12,4m/s	7,5m/s	4,8m/s	3,1m/s
85,0l/s	R							233,6	122,2	35,7	11,9	4,0
	v							17,0m/s	13,1m/s	8,0m/s	5,1m/s	3,3m/s
90,0l/s	R							260,8	136,3	39,8	13,2	4,4
	v							18,0m/s	13,9m/s	8,5m/s	5,4m/s	3,5m/s

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 7,4

HYDRAULIC AND PIPE PROPERTIES

V = flow rate [l/s]
R = friction [mbar/m]
v = velocity [m/s]
d = pipe outside diameter [mm]
S = pipe wall thickness [mm]
di = pipe inner diameter [mm]

WATER PROPERTIES

Density: ρ = 998,2 [Kg/m^3]
Viscosity: v = 1,004x10^{-6} [m^2/s]
Temperature: t = 20°C

SDR 7,4
20°C

Flow rate V	d S di	110mm 15,1mm 79,8mm	125mm 17,1mm 90,8mm	160mm 21,9mm 116,2mm	200mm 27,4mm 145,2mm	250mm 34,2mm 181,6mm
95,0l/s	R	289,4	151,1	44,1	14,6	4,9
	v	19,0m/s	14,7m/s	9,0m/s	5,7m/s	3,7m/s
100,0l/s	R	319,5	166,7	48,6	16,1	5,4
	v	20,0m/s	15,4m/s	9,4m/s	6,0m/s	3,9m/s
110,0l/s	R	384,0	200,2	58,2	19,3	6,4
	v	22,0m/s	17,0m/s	10,4m/s	6,6m/s	4,2m/s
120,0l/s	R	454,4	236,7	68,7	22,7	7,5
	v	24,0m/s	18,5m/s	11,3m/s	7,2m/s	4,6m/s
130,0l/s	R		276,2	80,0	26,4	8,7
	v		20,1m/s	12,3m/s	7,9m/s	5,0m/s
140,0l/s	R		318,7	92,2	30,4	`
	v		21,6m/s	13,2m/s	8,5m/s	5,4m/s
150,0l/s	R		364,2	105,2	34,6	11,4
	v		23,2m/s	14,1m/s	9,1m/s	5,8m/s
160,0l/s	R		412,7	119,0	39,1	12,9
	v		24,7m/s	15,1m/s	9,7m/s	6,2m/s
170,0l/s	R			133,7	43,9	14,5
	v			16,0m/s	10,3m/s	6,6m/s
180,0l/s	R			149,2	48,9	16,1
	v			17,0m/s	10,9m/s	6,9m/s
190,0l/s	R			165,6	54,2	17,8
	v			17,9m/s	11,5m/s	7,3m/s
200,0l/s	R			182,8	59,8	19,6
	v			18,9m/s	12,1m/s	7,7m/s
210,0l/s	R			200,8	65,6	21,5
	v			19,8m/s	12,7m/s	8,1m/s
220,0l/s	R			219,7	71,7	23,5
	v			20,7m/s	13,3m/s	8,5m/s
230,0l/s	R			239,4	78,1	25,6
	v			21,7m/s	13,9m/s	8,9m/s
240,0l/s	R			259,9	84,7	27,7
	v			22,6m/s	14,5m/s	9,3m/s
250,0l/s	R			281,3	91,6	30,0
	v			23,6m/s	15,1m/s	9,7m/s
260,0l/s	R			303,5	98,8	32,3
	v			24,5m/s	15,7m/s	10,0m/s
270,0l/s	R				106,2	34,7
	v				16,3m/s	10,4m/s
280,0l/s	R				113,9	37,2
	v				16,9m/s	10,8m/s
290,0l/s	R				121,8	39,7
	v				17,5m/s	11,2m/s
300,0l/s	R				130,0	42,4
	v				18,1m/s	11,6m/s
310,0l/s	R				138,5	45,1
	v				18,7m/s	12,0m/s

Flow rate V	d S di	200mm 27,4mm 145,2mm	250mm 34,2mm 181,6mm
320,0l/s	R	147,3	47,9
	v	19,3m/s	12,4m/s
330,0l/s	R	156,3	50,8
	v	19,9m/s	12,7m/s
340,0l/s	R	165,5	53,8
	v	20,5m/s	13,1m/s
350,0l/s	R	175,1	56,9
	v	21,1m/s	13,5m/s
360,0l/s	R	184,9	60,1
	v	21,7m/s	13,9m/s
370,0l/s	R	194,9	63,3
	v	22,3m/s	14,3m/s
380,0l/s	R	205,3	66,6
	v	22,9m/s	14,7m/s
390,0l/s	R	215,9	70,0
	v	23,6m/s	15,1m/s
400,0l/s	R	226,7	73,5
	v	24,2m/s	15,4m/s
410,0l/s	R	237,8	77,1
	v	24,8m/s	15,8m/s
420,0l/s	R		80,7
	v		16,2m/s
430,0l/s	R		84,5
	v		16,6m/s
440,0l/s	R		88,3
	v		17,0m/s
450,0l/s	R		92,2
	v		17,4m/s
460,0l/s	R		96,2
	v		17,8m/s
470,0l/s	R		100,2
	v		18,1m/s
480,0l/s	R		104,4
	v		18,5m/s
490,0l/s	R		108,6
	v		18,9m/s
500,0l/s	R		112,9
	v		19,3m/s
510,0l/s	R		117,3
	v		19,7m/s
520,0l/s	R		121,8
	v		20,1m/s
530,0l/s	R		126,4
	v		20,5m/s
540,0l/s	R		131,0
	v		20,8m/s

Flow rate V	d S di	250mm 34,2mm 181,6mm
550,0l/s	R	135,7
	v	21,2m/s
560,0l/s	R	140,6
	v	21,6m/s
570,0l/s	R	145,4
	v	22,0m/s
580,0l/s	R	150,4
	v	22,4m/s
590,0l/s	R	155,5
	v	22,8m/s
600,0l/s	R	160,6
	v	23,2m/s
610,0l/s	R	165,9
	v	23,6m/s
620,0l/s	R	171,2
	v	23,9m/s
630,0l/s	R	176,6
	v	24,3m/s
640,0l/s	R	182,0
	v	24,7m/s

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 9

HYDRAULIC AND PIPE PROPERTIES
V = flow rate [l/s]
R = friction [mbar/m]
v = velocity [m/s]

WATER PROPERTIES
Density: ρ = 998,2 [Kg/m^3]
Viscosity: v = 1,004x10^{-6} [m^2/s]
Temperature: t = 20°C

SDR 9
20°C

Flow	d	32mm	40mm	50mm	63mm	75mm	90mm	110mm	125mm	160mm
rate	S	2,8mm	4,5mm	5,6mm	7,1mm	8,4mm	10,1mm	12,3mm	14,0mm	17,9mm
V	di	24,8mm	31,0mm	38,8mm	48,8mm	58,2mm	69,8mm	85,4mm	97,0mm	124,2mm
0,06l/s	R	0,1								
	v	0,1m/s								
0,07l/s	R	0,2								
	v	0,1m/s								
0,08l/s	R	0,2	0,1							
	v	0,2m/s	0,1m/s							
0,09l/s	R	0,3	0,1							
	v	0,2m/s	0,1m/s							
0,10l/s	R	0,3	0,1							
	v	0,2m/s	0,1m/s							
0,12l/s	R	0,4	0,2	0,1						
	v	0,2m/s	0,2m/s	0,1m/s						
0,16l/s	R	0,7	0,2	0,1						
	v	0,3m/s	0,2m/s	0,1m/s						
0,18l/s	R	0,9	0,3	0,1						
	v	0,4m/s	0,2m/s	0,2m/s						
0,20l/s	R	1,1	0,4	0,1	0,0					
	v	0,4m/s	0,3m/s	0,2m/s	0,1m/s					
0,30l/s	R	2,2	0,7	0,3	0,1	0,0				
	v	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s				
0,40l/s	R	3,6	1,2	0,4	0,1	0,1	0,0			
	v	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,2m/s	0,1m/s			
0,50l/s	R	5,4	1,8	0,6	0,2	0,1	0,0			
	v	1,0m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s			
0,60l/s	R	7,5	2,6	0,9	0,3	0,1	0,1	0,0		
	v	1,2m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,2m/s	0,1m/s		
0,70l/s	R	9,9	3,4	1,1	0,4	0,2	0,1	0,0		
	v	1,4m/s	0,9m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s		
0,80l/s	R	12,5	4,3	1,5	0,5	0,2	0,1	0,0	0,0	
	v	1,7m/s	1,1m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	0,1m/s	
0,90l/s	R	15,5	5,3	1,8	0,6	0,3	0,1	0,0	0,0	
	v	1,9m/s	1,2m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,2m/s	0,1m/s	
1,00l/s	R	18,8	6,4	2,2	0,7	0,3	0,1	0,0	0,0	
	v	2,1m/s	1,3m/s	0,8m/s	0,5m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	
1,20l/s	R	26,1	8,8	3,0	1,0	0,4	0,2	0,1	0,0	
	v	2,5m/s	1,6m/s	1,0m/s	0,6m/s	0,5m/s	0,3m/s	0,2m/s	0,2m/s	
1,40l/s	R	34,6	11,7	3,9	1,3	0,6	0,2	0,1	0,0	0,0
	v	2,9m/s	1,9m/s	1,2m/s	0,7m/s	0,5m/s	0,4m/s	0,2m/s	0,2m/s	0,1m/s
1,60l/s	R	44,2	14,9	5,0	1,7	0,7	0,3	0,1	0,1	0,0
	v	3,3m/s	2,1m/s	1,4m/s	0,9m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 9

HYDRAULIC AND PIPE PROPERTIES
V = flow rate [l/s]
R = friction [mbar/m]
v = velocity [m/s]

WATER PROPERTIES
Density: ρ = 998,2 [Kg/m^3]
Viscosity: v = 1,004x10^{-6} [m^2/s]
Temperature: t = 20°C

SDR 9
20°C

Flow	d	32mm	40mm	50mm	63mm	75mm	90mm	110mm	125mm	160mm	200mm	250mm	315mm	355mm
rate	S	3,6mm	4,5mm	5,6mm	7,1mm	8,4mm	10,1mm	12,3mm	14,0mm	17,9mm	22,4mm	27,9mm	35,2mm	39,7mm
V	di	24,8mm	31,0mm	38,8mm	48,8mm	58,2mm	69,8mm	85,4mm	97,0mm	124,2mm	155,2mm	194,2mm	244,6mm	275,6mm
1,80l/s	R	54,9	18,5	6,2	2,1	0,9	0,4	0,1	0,1	0,0				
	v	3,7m/s	2,4m/s	1,5m/s	1,0m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s				
2,00l/s	R	66,7	22,4	7,5	2,5	1,1	0,4	0,2	0,1	0,0	0,0			
	v	4,1m/s	2,6m/s	1,7m/s	1,1m/s	0,8m/s	0,5m/s	0,3m/s	0,3m/s	0,2m/s	0,1m/s			
2,20l/s	R	79,5	26,6	8,9	2,9	1,3	0,5	0,2	0,1	0,0	0,0			
	v	4,6m/s	2,9m/s	1,9m/s	1,2m/s	0,8m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s			
2,40l/s	R	93,4	31,2	10,5	3,4	1,5	0,6	0,2	0,1	0,0	0,0			
	v	5,0m/s	3,2m/s	2,0m/s	1,3m/s	0,9m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s			
2,60l/s	R	108,4	36,2	12,1	4,0	1,7	0,7	0,3	0,1	0,0	0,0			
	v	5,4m/s	3,4m/s	2,2m/s	1,4m/s	1,0m/s	0,7m/s	0,5m/s	0,4m/s	0,2m/s	0,1m/s			
2,80l/s	R	124,4	41,5	13,9	4,6	1,9	0,8	0,3	0,2	0,1	0,0			
	v	5,8m/s	3,7m/s	2,4m/s	1,5m/s	1,1m/s	0,7m/s	0,5m/s	0,4m/s	0,2m/s	0,1m/s			
3,00l/s	R	141,4	47,1	15,7	5,2	2,2	0,9	0,3	0,2	0,1	0,0	0,0		
	v	6,2m/s	4,0m/s	2,5m/s	1,6m/s	1,1m/s	0,8m/s	0,5m/s	0,4m/s	0,2m/s	0,2m/s	0,1m/s		
3,20l/s	R	159,6	53,1	17,7	5,8	2,5	1,0	0,4	0,2	0,1	0,0	0,0		
	v	6,6m/s	4,2m/s	2,7m/s	1,7m/s	1,2m/s	0,8m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s		
3,40l/s	R	178,7	59,4	19,8	6,5	2,8	1,1	0,4	0,2	0,1	0,0	0,0		
	v	7,0m/s	4,5m/s	2,9m/s	1,8m/s	1,3m/s	0,9m/s	0,6m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s		
3,60l/s	R	198,9	66,0	22,0	7,2	3,1	1,3	0,5	0,3	0,1	0,0	0,0		
	v	7,5m/s	4,8m/s	3,0m/s	1,9m/s	1,4m/s	0,9m/s	0,6m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s		
3,80l/s	R	220,2	73,0	24,2	7,9	3,4	1,4	0,5	0,3	0,1	0,0	0,0		
	v	7,9m/s	5,0m/s	3,2m/s	2,0m/s	1,4m/s	1,0m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s		
4,00l/s	R	242,5	80,3	26,6	8,7	3,7	1,5	0,6	0,3	0,1	0,0	0,0		
	v	8,3m/s	5,3m/s	3,4m/s	2,1m/s	1,5m/s	1,0m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s		
4,20l/s	R	265,8	87,9	29,1	9,5	4,0	1,7	0,6	0,3	0,1	0,0	0,0		
	v	8,7m/s	5,6m/s	3,6m/s	2,2m/s	1,6m/s	1,1m/s	0,7m/s	0,6m/s	0,3m/s	0,2m/s	0,1m/s		
4,40l/s	R	290,2	95,8	31,8	10,4	4,4	1,8	0,7	0,4	0,1	0,0	0,0		
	v	9,1m/s	5,8m/s	3,7m/s	2,4m/s	1,7m/s	1,1m/s	0,8m/s	0,6m/s	0,4m/s	0,2m/s	0,1m/s		
4,60l/s	R	315,6	104,1	34,5	11,2	4,8	2,0	0,7	0,4	0,1	0,0	0,0		
	v	9,5m/s	6,1m/s	3,9m/s	2,5m/s	1,7m/s	1,2m/s	0,8m/s	0,6m/s	0,4m/s	0,2m/s	0,2m/s		
4,80l/s	R	342,0	112,7	37,3	12,1	5,2	2,1	0,8	0,4	0,1	0,0	0,0	0,0	
	v	9,9m/s	6,4m/s	4,1m/s	2,6m/s	1,8m/s	1,3m/s	0,8m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	
5,00l/s	R	369,4	121,7	40,2	13,1	5,6	2,3	0,9	0,5	0,1	0,0	0,0	0,0	
	v	10,4m/s	6,6m/s	4,2m/s	2,7m/s	1,9m/s	1,3m/s	0,9m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	
5,20l/s	R	397,9	131,0	43,2	14,1	6,0	2,5	0,9	0,5	0,2	0,1	0,0	0,0	
	v	10,8m/s	6,9m/s	4,4m/s	2,8m/s	2,0m/s	1,4m/s	0,9m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	
5,40l/s	R	427,4	140,5	46,4	15,1	6,4	2,6	1,0	0,5	0,2	0,1	0,0	0,0	
	v	11,2m/s	7,2m/s	4,6m/s	2,9m/s	2,0m/s	1,4m/s	0,9m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	
5,60l/s	R	458,0	150,5	49,6	16,1	6,8	2,8	1,1	0,6	0,2	0,1	0,0	0,0	
	v	11,6m/s	7,4m/s	4,7m/s	3,0m/s	2,1m/s	1,5m/s	1,0m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s	
5,80l/s	R	489,6	160,7	53,0	17,2	7,3	3,0	1,1	0,6	0,2	0,1	0,0	0,0	
	v	12,0m/s	7,7m/s	4,9m/s	3,1m/s	2,2m/s	1,5m/s	1,0m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s	
6,00l/s	R	522,2	171,3	56,4	18,3	7,7	3,2	1,2	0,7	0,2	0,1	0,0	0,0	0,0
	v	12,4m/s	7,9m/s	5,1m/s	3,2m/s	2,3m/s	1,6m/s	1,0m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s	0,1m/s
6,20l/s	R	555,8	182,2	60,0	19,4	8,2	3,4	1,3	0,7	0,2	0,1	0,0	0,0	0,0
	v	12,8m/s	8,2m/s	5,2m/s	3,3m/s	2,3m/s	1,6m/s	1,1m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s	0,1m/s
6,40l/s	R	590,5	193,4	63,6	20,6	8,7	3,6	1,4	0,7	0,2	0,1	0,0	0,0	0,0
	v	13,2m/s	8,5m/s	5,4m/s	3,4m/s	2,4m/s	1,7m/s	1,1m/s	0,9m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s	0,1m/s
6,60l/s	R	626,1	205,0	67,4	21,8	9,2	3,8	1,4	0,8	0,2	0,1	0,0	0,0	0,0
	v	13,7m/s	8,7m/s	5,6m/s	3,5m/s	2,5m/s	1,7m/s	1,2m/s	0,9m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s	0,1m/s

Flow	d	32mm	40mm	50mm	63mm	75mm	90mm	110mm	125mm	160mm	200mm	250mm	315mm	355mm
rate	S	2,8mm	4,5mm	5,6mm	7,1mm	8,4mm	10,1mm	12,3mm	14,0mm	17,9mm	22,4mm	27,9mm	35,2mm	39,7mm
V	di	24,8mm	31,0mm	38,8mm	48,8mm	58,2mm	69,8mm	85,4mm	97,0mm	124,2mm	155,2mm	194,2mm	244,6mm	275,6mm
6,80l/s	R	662,8	216,8	71,2	23,1	9,7	4,0	1,5	0,8	0,2	0,1	0,0	0,0	0,0
	v	14,1m/s	9,0m/s	5,8m/s	3,6m/s	2,6m/s	1,8m/s	1,2m/s	0,9m/s	0,6m/s	0,4m/s	0,2m/s	0,1m/s	0,1m/s
7,00l/s	R	700,6	229,0	75,2	24,3	10,3	4,2	1,6	0,9	0,3	0,1	0,0	0,0	0,0
	v	14,5m/s	9,3m/s	5,9m/s	3,7m/s	2,6m/s	1,8m/s	1,2m/s	0,9m/s	0,6m/s	0,4m/s	0,2m/s	0,1m/s	0,1m/s
7,50l/s	R	799,4	260,9	85,5	27,6	11,7	4,8	1,8	1,0	0,3	0,1	0,0	0,0	0,0
	v	15,5m/s	9,9m/s	6,3m/s	4,0m/s	2,8m/s	2,0m/s	1,3m/s	1,0m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s
8,00l/s	R	904,6	294,8	96,5	31,1	13,1	5,4	2,0	1,1	0,3	0,1	0,0	0,0	0,0
	v	16,6m/s	10,6m/s	6,8m/s	4,3m/s	3,0m/s	2,1m/s	1,4m/s	1,1m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s
9,00l/s	R	1134,1	368,7	120,4	38,7	16,3	6,7	2,5	1,4	0,4	0,1	0,0	0,0	0,0
	v	18,6m/s	11,9m/s	7,6m/s	4,8m/s	3,4m/s	2,4m/s	1,6m/s	1,2m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,2m/s
10,0l/s	R	1389,2	450,6	146,8	47,1	19,8	8,2	3,1	1,6	0,5	0,2	0,1	0,0	0,0
	v	20,7m/s	13,2m/s	8,5m/s	5,3m/s	3,8m/s	2,6m/s	1,7m/s	1,4m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,2m/s
12,0l/s	R	1975,9	638,5	207,1	66,3	27,8	11,4	4,3	2,3	0,7	0,2	0,1	0,0	0,0
	v	24,8m/s	15,9m/s	10,1m/s	6,4m/s	4,5m/s	3,1m/s	2,1m/s	1,6m/s	1,0m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s
14,0l/s	R		858,4	277,5	88,5	37,0	15,2	5,7	3,0	0,9	0,3	0,1	0,0	0,0
	v		18,5m/s	11,8m/s	7,5m/s	5,3m/s	3,7m/s	2,4m/s	1,9m/s	1,2m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s
16,0l/s	R		1110,2	357,9	113,8	47,5	19,4	7,2	3,9	1,2	0,4	0,1	0,0	0,0
	v		21,2m/s	13,5m/s	8,6m/s	6,0m/s	4,2m/s	2,8m/s	2,2m/s	1,3m/s	0,8m/s	0,5m/s	0,3m/s	0,3m/s
18,0l/s	R		1393,9	448,3	142,1	59,2	24,2	9,0	4,8	1,5	0,5	0,2	0,1	0,0
	v		23,8m/s	15,2m/s	9,6m/s	6,8m/s	4,7m/s	3,1m/s	2,4m/s	1,5m/s	1,0m/s	0,6m/s	0,4m/s	0,3m/s
20,0l/s	R			548,6	173,5	72,2	29,4	10,9	5,9	1,8	0,6	0,2	0,1	0,0
	v			16,9m/s	10,7m/s	7,5m/s	5,2m/s	3,5m/s	2,7m/s	1,7m/s	1,1m/s	0,7m/s	0,4m/s	0,3m/s
22,0l/s	R			658,9	208,0	86,4	35,1	13,0	7,0	2,1	0,7	0,2	0,1	0,0
	v			18,6m/s	11,8m/s	8,3m/s	5,7m/s	3,8m/s	3,0m/s	1,8m/s	1,2m/s	0,7m/s	0,5m/s	0,4m/s
24,0l/s	R			779,1	245,5	101,8	41,3	15,3	8,2	2,5	0,8	0,3	0,1	0,1
	v			20,3m/s	12,8m/s	9,0m/s	6,3m/s	4,2m/s	3,2m/s	2,0m/s	1,3m/s	0,8m/s	0,5m/s	0,4m/s
26,0l/s	R			909,2	286,0	118,5	48,0	17,8	9,5	2,8	1,0	0,3	0,1	0,1
	v			22,0m/s	13,9m/s	9,8m/s	6,8m/s	4,5m/s	3,5m/s	2,1m/s	1,4m/s	0,9m/s	0,6m/s	0,4m/s
28,0l/s	R			1049,3	329,6	136,3	55,2	20,4	10,9	3,3	1,1	0,4	0,1	0,1
	v			23,7m/s	15,0m/s	10,5m/s	7,3m/s	4,9m/s	3,8m/s	2,3m/s	1,5m/s	0,9m/s	0,6m/s	0,5m/s
30,0l/s	R				376,1	155,4	62,9	23,2	12,4	3,7	1,3	0,4	0,1	0,1
	v				16,0m/s	11,3m/s	7,8m/s	5,2m/s	4,1m/s	2,5m/s	1,6m/s	1,0m/s	0,6m/s	0,5m/s
32,0l/s	R				425,7	175,7	71,0	26,2	14,0	4,2	1,4	0,5	0,2	0,1
	v				17,1m/s	12,0m/s	8,4m/s	5,6m/s	4,3m/s	2,6m/s	1,7m/s	1,1m/s	0,7m/s	0,5m/s
34,0l/s	R				478,4	197,3	79,6	29,3	15,6	4,7	1,6	0,5	0,2	0,1
	v				18,2m/s	12,8m/s	8,9m/s	5,9m/s	4,6m/s	2,8m/s	1,8m/s	1,1m/s	0,7m/s	0,6m/s
36,0l/s	R				534,0	220,0	88,7	32,6	17,4	5,2	1,7	0,6	0,2	0,1
	v				19,2m/s	13,5m/s	9,4m/s	6,3m/s	4,9m/s	3,0m/s	1,9m/s	1,2m/s	0,8m/s	0,6m/s
38,0l/s	R				592,6	244,0	98,3	36,1	19,2	5,7	1,9	0,6	0,2	0,1
	v				20,3m/s	14,3m/s	9,9m/s	6,6m/s	5,1m/s	3,1m/s	2,0m/s	1,3m/s	0,8m/s	0,6m/s
40,0l/s	R				654,3	269,1	108,3	39,7	21,2	6,3	2,1	0,7	0,2	0,1
	v				21,4m/s	15,0m/s	10,5m/s	7,0m/s	5,4m/s	3,3m/s	2,1m/s	1,4m/s	0,9m/s	0,7m/s
42,0l/s	R				719,0	295,5	118,8	43,6	23,2	6,9	2,3	0,8	0,3	0,1
	v				22,5m/s	15,8m/s	11,0m/s	7,3m/s	5,7m/s	3,5m/s	2,2m/s	1,4m/s	0,9m/s	0,7m/s
44,0l/s	R				786,7	323,1	129,8	47,5	25,3	7,5	2,5	0,8	0,3	0,2
	v				23,5m/s	16,5m/s	11,5m/s	7,7m/s	6,0m/s	3,6m/s	2,3m/s	1,5m/s	0,9m/s	0,7m/s
46,0l/s	R				857,4	351,9	141,3	51,7	27,5	8,2	2,7	0,9	0,3	0,2
	v				24,6m/s	17,3m/s	12,0m/s	8,0m/s	6,2m/s	3,8m/s	2,4m/s	1,6m/s	1,0m/s	0,8m/s
48,0l/s	R					381,9	153,2	56,0	29,8	8,8	3,0	1,0	0,3	0,2
	v					18,0m/s	12,5m/s	8,4m/s	6,5m/s	4,0m/s	2,5m/s	1,6m/s	1,0m/s	0,8m/s
50,0l/s	R					413,1	165,6	60,5	32,2	9,5	3,2	1,1	0,4	0,2
	v					18,8m/s	13,1m/s	8,7m/s	6,8m/s	4,1m/s	2,6m/s	1,7m/s	1,1m/s	0,8m/s
52,0l/s	R					445,5	178,5	65,2	34,6	10,2	3,4	1,2	0,4	0,2
	v					19,5m/s	13,6m/s	9,1m/s	7,0m/s	4,3m/s	2,7m/s	1,8m/s	1,1m/s	0,9m/s

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 9

HYDRAULIC AND PIPE PROPERTIES
V = flow rate [l/s]
R = friction [mbar/m]
v = velocity [m/s]

WATER PROPERTIES
Density: ρ = 998,2 [Kg/m^3]
Viscosity: v = 1,004x10^{-6} [m^2/s]
Temperature: t = 20°C

SDR 9
20°C

Flow	d	75mm	90mm	110mm	125mm	160mm	200mm	250mm	315mm	355mm
rate	S	8,4mm	10,1mm	12,3mm	14,0mm	17,9mm	22,4mm	27,9mm	35,2mm	39,7mm
V	di	58,2mm	69,8mm	85,4mm	97,0mm	124,2mm	155,2mm	194,2mm	244,6mm	275,6mm
54,0l/s	R	479,2	191,9	70,0	37,2	11,0	3,7	1,2	0,4	0,2
	v	20,3m/s	14,1m/s	9,4m/s	7,3m/s	4,5m/s	2,9m/s	1,8m/s	1,1m/s	0,9m/s
56,0l/s	R	514,0	205,7	75,0	39,8	11,8	3,9	1,3	0,4	0,2
	v	21,1m/s	14,6m/s	9,8m/s	7,6m/s	4,6m/s	3,0m/s	1,9m/s	1,2m/s	0,9m/s
58,0l/s	R	550,0	220,0	80,2	42,5	12,5	4,2	1,4	0,5	0,3
	v	21,8m/s	15,2m/s	10,1m/s	7,8m/s	4,8m/s	3,1m/s	2,0m/s	1,2m/s	1,0m/s
60,0l/s	R	587,3	234,8	85,5	45,4	13,4	4,5	1,5	0,5	0,3
	v	22,6m/s	15,7m/s	10,5m/s	8,1m/s	5,0m/s	3,2m/s	2,0m/s	1,3m/s	1,0m/s
62,0l/s	R	625,7	250,0	91,0	48,3	14,2	4,8	1,6	0,5	0,3
	v	23,3m/s	16,2m/s	10,8m/s	8,4m/s	5,1m/s	3,3m/s	2,1m/s	1,3m/s	1,0m/s
64,0l/s	R	665,4	265,7	96,7	51,2	15,1	5,0	1,7	0,6	0,3
	v	24,1m/s	16,7m/s	11,2m/s	8,7m/s	5,3m/s	3,4m/s	2,2m/s	1,4m/s	1,1m/s
66,0l/s	R	706,3	281,9	102,5	54,3	16,0	5,3	1,8	0,6	0,3
	v	24,8m/s	17,2m/s	11,5m/s	8,9m/s	5,4m/s	3,5m/s	2,2m/s	1,4m/s	1,1m/s
68,0l/s	R		298,6	108,5	57,5	16,9	5,6	1,9	0,6	0,3
	v		17,8m/s	11,9m/s	9,2m/s	5,6m/s	3,6m/s	2,3m/s	1,4m/s	1,1m/s
70,0l/s	R		315,7	114,6	60,7	17,8	6,0	2,0	0,6	0,4
	v		18,3m/s	12,2m/s	9,5m/s	5,8m/s	3,7m/s	2,4m/s	1,5m/s	1,2m/s
72,0l/s	R		333,3	121,0	64,0	18,8	6,3	2,1	0,7	0,4
	v		18,8m/s	12,6m/s	9,7m/s	5,9m/s	3,8m/s	2,4m/s	1,5m/s	1,2m/s
74,0l/s	R		351,4	127,5	67,5	19,8	6,6	2,2	0,7	0,4
	v		19,3m/s	12,9m/s	10,0m/s	6,1m/s	3,9m/s	2,5m/s	1,6m/s	1,2m/s
76,0l/s	R		369,9	134,1	71,0	20,8	6,9	2,3	0,8	0,4
	v		19,9m/s	13,3m/s	10,3m/s	6,3m/s	4,0m/s	2,6m/s	1,6m/s	1,3m/s
78,0l/s	R		388,9	140,9	74,6	21,8	7,3	2,4	0,8	0,4
	v		20,4m/s	13,6m/s	10,6m/s	6,4m/s	4,1m/s	2,6m/s	1,7m/s	1,3m/s
80,0l/s	R		408,4	147,9	78,2	22,9	7,6	2,5	0,8	0,5
	v		20,9m/s	14,0m/s	10,8m/s	6,6m/s	4,2m/s	2,7m/s	1,7m/s	1,3m/s
85,0l/s	R		459,1	166,1	87,8	25,7	8,6	2,9	0,9	0,5
	v		22,2m/s	14,8m/s	11,5m/s	7,0m/s	4,5m/s	2,9m/s	1,8m/s	1,4m/s
90,0l/s	R		512,8	185,4	97,9	28,6	9,5	3,2	1,0	0,6
	v		23,5m/s	15,7m/s	12,2m/s	7,4m/s	4,8m/s	3,0m/s	1,9m/s	1,5m/s
95,0l/s	R		569,4	205,7	108,5	31,7	10,5	3,5	1,1	0,6
	v		24,8m/s	16,6m/s	12,9m/s	7,8m/s	5,0m/s	3,2m/s	2,0m/s	1,6m/s
100,0l/s	R			227,0	119,7	34,9	11,6	3,9	1,2	0,7
	v			17,5m/s	13,5m/s	8,3m/s	5,3m/s	3,4m/s	2,1m/s	1,7m/s
110,0l/s	R			272,7	143,7	41,8	13,9	4,6	1,5	0,8
	v			19,2m/s	14,9m/s	9,1m/s	5,8m/s	3,7m/s	2,3m/s	1,8m/s
120,0l/s	R			322,5	169,8	49,3	16,3	5,4	1,7	1,0
	v			20,9m/s	16,2m/s	9,9m/s	6,3m/s	4,1m/s	2,6m/s	2,0m/s
130,0l/s	R			376,5	198,0	57,4	19,0	6,3	2,0	1,1
	v			22,7m/s	17,6m/s	10,7m/s	6,9m/s	4,4m/s	2,8m/s	2,2m/s
140,0l/s	R			434,6	228,4	66,1	21,8	7,2	2,3	1,3
	v			24,4m/s	18,9m/s	11,6m/s	7,4m/s	4,7m/s	3,0m/s	2,3m/s
150,0l/s	R				260,9	75,4	24,8	8,2	2,6	1,5
	v				20,3m/s	12,4m/s	7,9m/s	5,1m/s	3,2m/s	2,5m/s
160,0l/s	R				295,5	85,3	28,1	9,3	3,0	1,7
	v				21,7m/s	13,2m/s	8,5m/s	5,4m/s	3,4m/s	2,7m/s
170,0l/s	R				332,3	95,7	31,5	10,4	3,3	1,9
	v				23,0m/s	14,0m/s	9,0m/s	5,7m/s	3,6m/s	2,8m/s
180,0l/s	R				371,1	106,8	35,1	11,6	3,7	2,1
	v				24,4m/s	14,9m/s	9,5m/s	6,1m/s	3,8m/s	3,0m/s

SDR 9
20°C

Flow	d	160mm	200mm	250mm	315mm	355mm
rate	S	17,9mm	22,4mm	27,9mm	35,2mm	39,7mm
V	di	124,2mm	155,2mm	194,2mm	244,6mm	275,6mm
190,0l/s	R	118,5	38,9	12,8	4,1	2,3
	v	15,7m/s	10,0m/s	6,4m/s	4,0m/s	3,2m/s
200,0l/s	R	130,8	42,9	14,1	4,5	2,5
	v	16,5m/s	10,6m/s	6,8m/s	4,3m/s	3,4m/s
210,0l/s	R	143,6	47,0	15,4	4,9	2,8
	v	17,3m/s	11,1m/s	7,1m/s	4,5m/s	3,5m/s
220,0l/s	R	157,1	51,4	16,9	5,4	3,0
	v	18,2m/s	11,6m/s	7,4m/s	4,7m/s	3,7m/s
230,0l/s	R	171,1	55,9	18,3	5,9	3,3
	v	19,0m/s	12,2m/s	7,8m/s	4,9m/s	3,9m/s
240,0l/s	R	185,7	60,7	19,9	6,4	3,5
	v	19,8m/s	12,7m/s	8,1m/s	5,1m/s	4,0m/s
250,0l/s	R	201,0	65,6	21,5	6,9	3,8
	v	20,6m/s	13,2m/s	8,4m/s	5,3m/s	4,2m/s
260,0l/s	R	216,8	70,7	23,1	7,4	4,1
	v	21,5m/s	13,7m/s	8,8m/s	5,5m/s	4,4m/s
270,0l/s	R	233,2	76,0	24,8	7,9	4,4
	v	22,3m/s	14,3m/s	9,1m/s	5,7m/s	4,5m/s
280,0l/s	R	250,2	81,5	26,6	8,5	4,7
	v	23,1m/s	14,8m/s	9,5m/s	6,0m/s	4,7m/s
290,0l/s	R	267,8	87,2	28,4	9,1	5,0
	v	23,9m/s	15,3m/s	9,8m/s	6,2m/s	4,9m/s
300,0l/s	R	286,0	93,0	30,3	9,7	5,4
	v	24,8m/s	15,9m/s	10,1m/s	6,4m/s	5,0m/s
310,0l/s	R		99,1	32,3	10,3	5,7
	v		16,4m/s	10,5m/s	6,6m/s	5,2m/s
320,0l/s	R		105,3	34,3	10,9	6,1
	v		16,9m/s	10,8m/s	6,8m/s	5,4m/s
330,0l/s	R		111,8	36,4	11,6	6,4
	v		17,4m/s	11,1m/s	7,0m/s	5,5m/s
340,0l/s	R		118,4	38,5	12,2	6,8
	v		18,0m/s	11,5m/s	7,2m/s	5,7m/s
350,0l/s	R		125,2	40,7	12,9	7,2
	v		18,5m/s	11,8m/s	7,4m/s	5,9m/s
360,0l/s	R		132,2	42,9	13,6	7,6
	v		19,0m/s	12,2m/s	7,7m/s	6,0m/s
370,0l/s	R		139,3	45,2	14,4	8,0
	v		19,6m/s	12,5m/s	7,9m/s	6,2m/s
380,0l/s	R		146,7	47,6	15,1	8,4
	v		20,1m/s	12,8m/s	8,1m/s	6,4m/s
390,0l/s	R		154,2	50,0	15,9	8,8
	v		20,6m/s	13,2m/s	8,3m/s	6,5m/s
400,0l/s	R		162,0	52,5	16,6	9,2
	v		21,1m/s	13,5m/s	8,5m/s	6,7m/s
410,0l/s	R		169,9	55,1	17,4	9,6
	v		21,7m/s	13,8m/s	8,7m/s	6,9m/s
420,0l/s	R		178,0	57,7	18,2	10,1
	v		22,2m/s	14,2m/s	8,9m/s	7,0m/s
430,0l/s	R		186,3	60,3	19,1	10,6
	v		22,7m/s	14,5m/s	9,2m/s	7,2m/s
440,0l/s	R		194,8	63,0	19,9	11,0
	v		23,3m/s	14,9m/s	9,4m/s	7,4m/s

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 9

HYDRAULIC AND PIPE PROPERTIES
V = flow rate [l/s]
R = friction [mbar/m]
v = velocity [m/s]

WATER PROPERTIES
Density: ρ = 998,2 [Kg/m^3]
Viscosity: v = 1,004x10^{-6} [m^2/s]
Temperature: t = 20°C

SDR 9
20°C

Flow	d	200mm	250mm	315mm	355mm
rate	S	22,4mm	27,9mm	35,2mm	39,7mm
V	di	155,2mm	194,2mm	244,6mm	275,6mm
450,0l/s	R	203,4	65,8	20,8	11,5
	v	23,8m/s	15,2m/s	9,6m/s	7,5m/s
460,0l/s	R	212,3	68,7	21,7	12,0
	v	24,3m/s	15,5m/s	9,8m/s	7,7m/s
470,0l/s	R	221,3	71,6	22,6	12,5
	v	24,8m/s	15,9m/s	10,0m/s	7,9m/s
480,0l/s	R		74,5	23,5	13,0
	v		16,2m/s	10,2m/s	8,0m/s
490,0l/s	R		77,5	24,5	13,5
	v		16,5m/s	10,4m/s	8,2m/s
500,0l/s	R		80,6	25,4	14,0
	v		16,9m/s	10,6m/s	8,4m/s
510,0l/s	R		83,7	26,4	14,6
	v		17,2m/s	10,9m/s	8,5m/s
520,0l/s	R		86,9	27,4	15,1
	v		17,6m/s	11,1m/s	8,7m/s
530,0l/s	R		90,2	28,4	15,7
	v		17,9m/s	11,3m/s	8,9m/s
540,0l/s	R		93,5	29,4	16,2
	v		18,2m/s	11,5m/s	9,1m/s
550,0l/s	R		96,8	30,5	16,8
	v		18,6m/s	11,7m/s	9,2m/s
560,0l/s	R		100,2	31,5	17,4
	v		18,9m/s	11,9m/s	9,4m/s
570,0l/s	R		103,7	32,6	18,0
	v		19,2m/s	12,1m/s	9,6m/s
580,0l/s	R		107,3	33,7	18,6
	v		19,6m/s	12,3m/s	9,7m/s
590,0l/s	R		110,9	34,8	19,2
	v		19,9m/s	12,6m/s	9,9m/s
600,0l/s	R		114,5	36,0	19,8
	v		20,3m/s	12,8m/s	10,1m/s
610,0l/s	R		118,2	37,1	20,5
	v		20,6m/s	13,0m/s	10,2m/s
620,0l/s	R		122,0	38,3	21,1
	v		20,9m/s	13,2m/s	10,4m/s
630,0l/s	R		125,8	39,5	21,8
	v		21,3m/s	13,4m/s	10,6m/s
640,0l/s	R		129,7	40,7	22,4
	v		21,6m/s	13,6m/s	10,7m/s
650,0l/s	R		133,7	41,9	23,1
	v		21,9m/s	13,8m/s	10,9m/s
660,0l/s	R		137,7	43,2	23,8
	v		22,3m/s	14,0m/s	11,1m/s
670,0l/s	R		141,8	44,5	24,5
	v		22,6m/s	14,3m/s	11,2m/s
680,0l/s	R		145,9	45,7	25,2
	v		23,0m/s	14,5m/s	11,4m/s
690,0l/s	R		150,1	47,0	25,9
	v		23,3m/s	14,7m/s	11,6m/s
700,0l/s	R		154,3	48,3	26,6
	v		23,6m/s	14,9m/s	11,7m/s

Flow	d	250mm	315mm	355mm
rate	S	27,9mm	35,2mm	39,7mm
V	di	194,2mm	244,6mm	275,6mm
710,0l/s	R	158,6	49,7	27,4
	v	24,0m/s	15,1m/s	11,9m/s
720,0l/s	R	163,0	51,0	28,1
	v	24,3m/s	15,3m/s	12,1m/s
730,0l/s	R	167,4	52,4	28,8
	v	24,6m/s	15,5m/s	12,2m/s
740,0l/s	R	171,9	53,8	29,6
	v	25,0m/s	15,7m/s	12,4m/s
750,0l/s	R		55,2	30,4
	v		16,0m/s	12,6m/s
760,0l/s	R		56,6	31,2
	v		16,2m/s	12,7m/s
770,0l/s	R		58,1	31,9
	v		16,4m/s	12,9m/s
780,0l/s	R		59,5	32,7
	v		16,6m/s	13,1m/s
790,0l/s	R		61,0	33,6
	v		16,8m/s	13,2m/s
800,0l/s	R		62,5	34,4
	v		17,0m/s	13,4m/s
810,0l/s	R		64,0	35,2
	v		17,2m/s	13,6m/s
820,0l/s	R		65,5	36,0
	v		17,5m/s	13,7m/s

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 11

HYDRAULIC AND PIPE PROPERTIES

V = flow rate [l/s]
R = friction [mbar/m]
v = velocity [m/s]
d = pipe outside diameter [mm]
S = pipe wall thickness [mm]
di = pipe inner diameter [mm]

WATER PROPERTIES

Density: ρ = 998,2 [Kg/m^3]
Viscosity: v = 1,004x10^{-6} [m^2/s]
Temperature: t = 20°C

SDR 11
20°C

Flow	d	32mm	40mm	50mm	63mm	75mm	90mm	110mm	125mm	160mm	200mm	250mm	315mm	355mm
rate	S	2,9mm	3,7mm	4,6mm	5,8mm	6,8mm	8,2mm	10,0mm	11,4mm	14,6mm	18,2mm	22,7mm	28,6mm	32,2mm
V	di	26,2mm	32,6mm	40,8mm	51,4mm	61,4mm	73,6mm	90,0mm	102,2mm	130,8mm	136,6mm	204,6mm	257,8mm	290,6mm
0,03l/s	R													
	v													
0,04l/s	R													
	v													
0,05l/s	R													
	v													
0,06l/s	R	0,1												
	v	0,1m/s												
0,07l/s	R	0,1												
	v	0,1m/s												
0,08l/s	R	0,2												
	v	0,1m/s												
0,09l/s	R	0,2	0,1											
	v	0,2m/s	0,1m/s											
0,10l/s	R	0,2	0,1											
	v	0,2m/s	0,1m/s											
0,12l/s	R	0,3	0,1											
	v	0,2m/s	0,1m/s											
0,16l/s	R	0,6	0,2	0,1										
	v	0,3m/s	0,2m/s	0,1m/s										
0,18l/s	R	0,7	0,2	0,1										
	v	0,3m/s	0,2m/s	0,1m/s										
0,20l/s	R	0,8	0,3	0,1										
	v	0,4m/s	0,2m/s	0,2m/s										
0,30l/s	R	1,7	0,6	0,2	0,1	0,0								
	v	0,6m/s	0,4m/s	0,2m/s	0,1m/s	0,1m/s								
0,40l/s	R	2,8	1,0	0,3	0,1	0,0								
	v	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s								
0,50l/s	R	4,1	1,4	0,5	0,2	0,1	0,0							
	v	0,9m/s	0,6m/s	0,4m/s	0,2m/s	0,2m/s	0,1m/s							
0,60l/s	R	5,7	2,0	0,7	0,2	0,1	0,0							
	v	1,1m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s							
0,70l/s	R	7,6	2,6	0,9	0,3	0,1	0,1	0,0						
	v	1,3m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,2m/s	0,1m/s						
0,80l/s	R	9,6	3,3	1,1	0,4	0,2	0,1	0,0						
	v	1,5m/s	1,0m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s						
0,90l/s	R	11,9	4,1	1,4	0,5	0,2	0,1	0,0	0,0					
	v	1,7m/s	1,1m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	0,1m/s					
1,00l/s	R	14,4	5,0	1,7	0,6	0,2	0,1	0,0	0,0					
	v	1,9m/s	1,2m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,2m/s	0,1m/s					
1,20l/s	R	20,0	6,9	2,3	0,8	0,3	0,1	0,1	0,0					
	v	2,2m/s	1,4m/s	0,9m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s					
1,40l/s	R	26,5	9,2	3,1	1,0	0,4	0,2	0,1	0,0	0,0				
	v	2,6m/s	1,7m/s	1,1m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,2m/s	0,1m/s				
1,60l/s	R	33,8	11,7	3,9	1,3	0,6	0,2	0,1	0,0	0,0				
	v	3,0m/s	1,9m/s	1,2m/s	0,8m/s	0,5m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s				

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 11

HYDRAULIC AND PIPE PROPERTIES

V = flow rate [l/s]
R = friction [mbar/m]
v = velocity [m/s]
d = pipe outside diameter [mm]
S = pipe wall thickness [mm]
di = pipe inner diameter [mm]

WATER PROPERTIES

Density: ρ = 998,2 [Kg/m^3]
Viscosity: v = 1,004x10^{-6} [m^2/s]
Temperature: t = 20°C

SDR 11
20°C

Flow	d	32mm	40mm	50mm	63mm	75mm	90mm	110mm	125mm	160mm	200mm	250mm	315mm	355mm
rate	S	2,9mm	3,7mm	4,6mm	5,8mm	6,8mm	8,2mm	10,0mm	11,4mm	14,6mm	18,2mm	22,7mm	28,6mm	32,2mm
V	di	26,2mm	32,6mm	40,8mm	51,4mm	61,4mm	73,6mm	90,0mm	102,2mm	130,8mm	136,6mm	204,6mm	257,8mm	290,6mm
1,80l/s	R	42,0	14,5	4,9	1,6	0,7	0,3	0,1	0,1	0,0				
	v	3,3m/s	2,2m/s	1,4m/s	0,9m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s				
2,00l/s	R	50,9	17,5	5,9	1,9	0,8	0,3	0,1	0,1	0,0				
	v	3,7m/s	2,4m/s	1,5m/s	1,0m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s				
2,20l/s	R	60,7	20,8	7,0	2,3	1,0	0,4	0,2	0,1	0,0	0,0			
	v	4,1m/s	2,6m/s	1,7m/s	1,1m/s	0,7m/s	0,5m/s	0,3m/s	0,3m/s	0,2m/s	0,1m/s			
2,40l/s	R	71,3	24,4	8,2	2,7	1,1	0,5	0,2	0,1	0,0	0,0			
	v	4,5m/s	2,9m/s	1,8m/s	1,2m/s	0,8m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s			
2,60l/s	R	82,7	28,3	9,5	3,1	1,3	0,5	0,2	0,1	0,0	0,0			
	v	4,8m/s	3,1m/s	2,0m/s	1,3m/s	0,9m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s			
2,80l/s	R	94,8	32,4	10,9	3,5	1,5	0,6	0,2	0,1	0,0	0,0			
	v	5,2m/s	3,4m/s	2,1m/s	1,3m/s	0,9m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s			
3,00l/s	R	107,8	36,8	12,3	4,0	1,7	0,7	0,3	0,1	0,0	0,0			
	v	5,6m/s	3,6m/s	2,3m/s	1,4m/s	1,0m/s	0,7m/s	0,5m/s	0,4m/s	0,2m/s	0,1m/s			
3,20l/s	R	121,6	41,4	13,8	4,5	1,9	0,8	0,3	0,2	0,1	0,0			
	v	5,9m/s	3,8m/s	2,4m/s	1,5m/s	1,1m/s	0,8m/s	0,5m/s	0,4m/s	0,2m/s	0,2m/s			
3,40l/s	R	136,1	46,4	15,5	5,0	2,1	0,9	0,3	0,2	0,1	0,0	0,0		
	v	6,3m/s	4,1m/s	2,6m/s	1,6m/s	1,1m/s	0,8m/s	0,5m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s		
3,60l/s	R	151,5	51,5	17,2	5,6	2,4	1,0	0,4	0,2	0,1	0,0	0,0		
	v	6,7m/s	4,3m/s	2,8m/s	1,7m/s	1,2m/s	0,8m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s		
3,80l/s	R	167,6	56,9	19,0	6,2	2,6	1,1	0,4	0,2	0,1	0,0	0,0		
	v	7,0m/s	4,6m/s	2,9m/s	1,8m/s	1,3m/s	0,9m/s	0,6m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s		
4,00l/s	R	184,5	62,6	20,8	6,8	2,9	1,2	0,5	0,2	0,1	0,0	0,0		
	v	7,4m/s	4,8m/s	3,1m/s	1,9m/s	1,4m/s	0,9m/s	0,6m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s		
4,20l/s	R	202,2	68,6	22,8	7,4	3,1	1,3	0,5	0,3	0,1	0,0	0,0		
	v	7,8m/s	5,0m/s	3,2m/s	2,0m/s	1,4m/s	1,0m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s		
4,40l/s	R	220,7	74,8	24,8	8,0	3,4	1,4	0,5	0,3	0,1	0,0	0,0		
	v	8,2m/s	5,3m/s	3,4m/s	2,1m/s	1,5m/s	1,0m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s		
4,60l/s	R	240,0	81,2	26,9	8,7	3,7	1,5	0,6	0,3	0,1	0,0	0,0		
	v	8,5m/s	5,5m/s	3,5m/s	2,2m/s	1,6m/s	1,1m/s	0,7m/s	0,6m/s	0,3m/s	0,2m/s	0,1m/s		
4,80l/s	R	260,0	87,9	29,1	9,4	4,0	1,7	0,6	0,3	0,1	0,0	0,0		
	v	8,9m/s	5,8m/s	3,7m/s	2,3m/s	1,6m/s	1,1m/s	0,8m/s	0,6m/s	0,4m/s	0,2m/s	0,1m/s		
5,00l/s	R	280,8	94,9	31,4	10,2	4,3	1,8	0,7	0,4	0,1	0,0	0,0		
	v	9,3m/s	6,0m/s	3,8m/s	2,4m/s	1,7m/s	1,2m/s	0,8m/s	0,6m/s	0,4m/s	0,2m/s	0,2m/s		
5,20l/s	R	302,4	102,1	33,8	10,9	4,6	1,9	0,7	0,4	0,1	0,0	0,0		
	v	9,6m/s	6,2m/s	4,0m/s	2,5m/s	1,8m/s	1,2m/s	0,8m/s	0,6m/s	0,4m/s	0,2m/s	0,2m/s		
5,40l/s	R	324,8	109,5	36,2	11,7	4,9	2,0	0,8	0,4	0,1	0,0	0,0	0,0	
	v	10,0m/s	6,5m/s	4,1m/s	2,6m/s	1,8m/s	1,3m/s	0,8m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	
5,60l/s	R	347,9	117,2	38,8	12,5	5,3	2,2	0,8	0,4	0,1	0,0	0,0	0,0	
	v	10,4m/s	6,7m/s	4,3m/s	2,7m/s	1,9m/s	1,3m/s	0,9m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	
5,80l/s	R	371,8	125,2	41,4	13,3	5,6	2,3	0,9	0,5	0,1	0,0	0,0	0,0	
	v	10,8m/s	6,9m/s	4,4m/s	2,8m/s	2,0m/s	1,4m/s	0,9m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	
6,00l/s	R	396,5	133,4	44,0	14,2	6,0	2,5	0,9	0,5	0,2	0,1	0,0	0,0	
	v	11,1m/s	7,2m/s	4,6m/s	2,9m/s	2,0m/s	1,4m/s	0,9m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	
6,20l/s	R	422,0	141,9	46,8	15,1	6,3	2,6	1,0	0,5	0,2	0,1	0,0	0,0	
	v	11,5m/s	7,4m/s	4,7m/s	3,0m/s	2,1m/s	1,5m/s	1,0m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s	

Flow	d	32mm	40mm	50mm	63mm	75mm	90mm	110mm	125mm	160mm	200mm	250mm	315mm	355mm
rate	S	2,9mm	3,7mm	4,6mm	5,8mm	6,8mm	8,2mm	10,0mm	11,4mm	14,6mm	18,2mm	22,7mm	28,6mm	32,2mm
V	di	26,2mm	32,6mm	40,8mm	51,4mm	61,4mm	73,6mm	90,0mm	102,2mm	130,8mm	136,6mm	204,6mm	257,8mm	290,6mm
6,40l/s	R	448,2	150,6	49,6	16,0	6,7	2,8	1,1	0,6	0,2	0,1	0,0	0,0	
	v	11,9m/s	7,7m/s	4,9m/s	3,1m/s	2,2m/s	1,5m/s	1,0m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s	
6,60l/s	R	475,2	159,6	52,6	16,9	7,1	2,9	1,1	0,6	0,2	0,1	0,0	0,0	
	v	12,2m/s	7,9m/s	5,0m/s	3,2m/s	2,2m/s	1,6m/s	1,0m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s	
6,80l/s	R	503,0	168,8	55,6	17,9	7,5	3,1	1,2	0,6	0,2	0,1	0,0	0,0	0,0
	v	12,6m/s	8,1m/s	5,2m/s	3,3m/s	2,3m/s	1,6m/s	1,1m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s	0,1m/s
7,00l/s	R	531,5	178,2	58,7	18,9	7,9	3,3	1,2	0,7	0,2	0,1	0,0	0,0	0,0
	v	13,0m/s	8,4m/s	5,4m/s	3,4m/s	2,4m/s	1,6m/s	1,1m/s	0,9m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s	0,1m/s
7,50l/s	R	606,3	203,0	66,7	21,4	9,0	3,7	1,4	0,8	0,2	0,1	0,0	0,0	0,0
	v	13,9m/s	9,0m/s	5,7m/s	3,6m/s	2,5m/s	1,8m/s	1,2m/s	0,9m/s	0,6m/s	0,4m/s	0,2m/s	0,1m/s	0,1m/s
8,00l/s	R	685,8	229,3	75,2	24,1	10,1	4,2	1,6	0,9	0,3	0,1	0,0	0,0	0,0
	v	14,8m/s	9,6m/s	6,1m/s	3,9m/s	2,7m/s	1,9m/s	1,3m/s	1,0m/s	0,6m/s	0,4m/s	0,2m/s	0,2m/s	0,1m/s
9,00l/s	R	859,3	286,6	93,8	30,0	12,6	5,2	2,0	1,1	0,3	0,1	0,0	0,0	0,0
	v	16,7m/s	10,8m/s	6,9m/s	4,3m/s	3,0m/s	2,1m/s	1,4m/s	1,1m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s
10,0l/s	R	1052,0	350,1	114,3	36,5	15,3	6,3	2,4	1,3	0,4	0,1	0,0	0,0	0,0
	v	18,5m/s	12,0m/s	7,6m/s	4,8m/s	3,4m/s	2,4m/s	1,6m/s	1,2m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,2m/s
12,0l/s	R	1495,0	495,6	161,2	51,3	21,4	8,8	3,3	1,8	0,5	0,2	0,1	0,0	0,0
	v	22,3m/s	14,4m/s	9,2m/s	5,8m/s	4,1m/s	2,8m/s	1,9m/s	1,5m/s	0,9m/s	0,6m/s	0,4m/s	0,2m/s	0,2m/s
14,0l/s	R		665,8	215,8	68,4	28,4	11,7	4,4	2,4	0,7	0,2	0,1	0,0	0,0
	v		16,8m/s	10,7m/s	6,7m/s	4,7m/s	3,3m/s	2,2m/s	1,7m/s	1,0m/s	0,7m/s	0,4m/s	0,3m/s	0,2m/s
16,0l/s	R		860,5	278,1	87,9	36,5	15,0	5,6	3,0	0,9	0,3	0,1	0,0	0,0
	v		19,2m/s	12,2m/s	7,7m/s	5,4m/s	3,8m/s	2,5m/s	2,0m/s	1,2m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s
18,0l/s	R		1079,9	348,2	109,8	45,5	18,6	7,0	3,7	1,1	0,4	0,1	0,0	0,0
	v		21,6m/s	13,8m/s	8,7m/s	6,1m/s	4,2m/s	2,8m/s	2,2m/s	1,3m/s	0,9m/s	0,5m/s	0,3m/s	0,3m/s
20,0l/s	R		1323,8	425,9	133,9	55,4	22,6	8,4	4,5	1,4	0,5	0,2	0,1	0,0
	v		24,0m/s	15,3m/s	9,6m/s	6,8m/s	4,7m/s	3,1m/s	2,4m/s	1,5m/s	1,0m/s	0,6m/s	0,4m/s	0,3m/s
22,0l/s	R			511,3	160,5	66,2	27,0	10,1	5,4	1,6	0,6	0,2	0,1	0,0
	v			16,8m/s	10,6m/s	7,4m/s	5,2m/s	3,5m/s	2,7m/s	1,6m/s	1,0m/s	0,7m/s	0,4m/s	0,3m/s
24,0l/s	R			604,3	189,3	78,0	31,8	11,8	6,3	1,9	0,6	0,2	0,1	0,0
	v			18,4m/s	11,6m/s	8,1m/s	5,6m/s	3,8m/s	2,9m/s	1,8m/s	1,1m/s	0,7m/s	0,5m/s	0,4m/s
26,0l/s	R			705,0	220,5	90,8	37,0	13,7	7,4	2,2	0,7	0,3	0,1	0,0
	v			19,9m/s	12,5m/s	8,8m/s	6,1m/s	4,1m/s	3,2m/s	1,9m/s	1,2m/s	0,8m/s	0,5m/s	0,4m/s
28,0l/s	R			813,3	253,9	104,4	42,5	15,7	8,4	2,5	0,9	0,3	0,1	0,1
	v			21,4m/s	13,5m/s	9,5m/s	6,6m/s	4,4m/s	3,4m/s	2,1m/s	1,3m/s	0,9m/s	0,5m/s	0,4m/s
30,0l/s	R			929,3	289,7	119,0	48,3	17,9	9,6	2,9	1,0	0,3	0,1	0,1
	v			22,9m/s	14,5m/s	10,1m/s	7,1m/s	4,7m/s	3,7m/s	2,2m/s	1,4m/s	0,9m/s	0,6m/s	0,5m/s
32,0l/s	R			1052,9	327,8	134,5	54,6	20,2	10,8	3,2	1,1	0,4	0,1	0,1
	v			24,5m/s	15,4m/s	10,8m/s	7,5m/s	5,0m/s	3,9m/s	2,4m/s	1,5m/s	1,0m/s	0,6m/s	0,5m/s
34,0l/s	R				368,2	150,9	61,2	22,6	12,1	3,6	1,2	0,4	0,1	0,1
	v				16,4m/s	11,5m/s	8,0m/s	5,3m/s	4,1m/s	2,5m/s	1,6m/s	1,0m/s	0,7m/s	0,5m/s
36,0l/s	R				410,9	168,3	68,1	25,2	13,5	4,0	1,4	0,5	0,1	0,1
	v				17,3m/s	12,2m/s	8,5m/s	5,7m/s	4,4m/s	2,7m/s	1,7m/s	1,1m/s	0,7m/s	0,5m/s
38,0l/s	R				456,0	186,5	75,5	27,8	14,9	4,4	1,5	0,5	0,2	0,1
	v				18,3m/s	12,8m/s	8,9m/s	6,0m/s	4,6m/s	2,8m/s	1,8m/s	1,2m/s	0,7m/s	0,6m/s
40,0l/s	R				503,3	205,7	83,2	30,7	16,4	4,9	1,6	0,6	0,2	0,1
	v				19,3m/s	13,5m/s	9,4m/s	6,3m/s	4,9m/s	3,0m/s	1,9m/s	1,2m/s	0,8m/s	0,6m/s

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 11

HYDRAULIC AND PIPE PROPERTIES

V = flow rate [l/s]
R = friction [mbar/m]
v = velocity [m/s]
d = pipe outside diameter [mm]
S = pipe wall thickness [mm]
di = pipe inner diameter [mm]

WATER PROPERTIES

Density: ρ = 998,2 [Kg/m^3]
Viscosity: v = 1,004x10^{-6} [m^2/s]
Temperature: t = 20°C

SDR 11
20°C

Flow	d	63mm	75mm	90mm	110mm	125mm	160mm	200mm	250mm	315mm	355mm	400mm	450mm
rate	S	5,8mm	6,8mm	8,2mm	10,0mm	11,4mm	14,6mm	18,2mm	22,7mm	28,6mm	32,2mm	36,3mm	40,9mm
V	di	51,4mm	61,4mm	73,6mm	90,0mm	102,2mm	130,8mm	136,6mm	204,6mm	257,8mm	290,6mm	327,6mm	368,2mm
42,0l/s	R	552,9	225,8	91,2	33,6	17,9	5,3	1,8	0,6	0,2	0,1	0,1	0,0
	v	20,2m/s	14,2m/s	9,9m/s	6,6m/s	5,1m/s	3,1m/s	2,0m/s	1,3m/s	0,8m/s	0,6m/s	0,5m/s	0,4m/s
44,0l/s	R	604,8	246,8	99,6	36,7	19,6	5,8	2,0	0,7	0,2	0,1	0,1	0,0
	v	21,2m/s	14,9m/s	10,3m/s	6,9m/s	5,4m/s	3,3m/s	2,1m/s	1,3m/s	0,8m/s	0,7m/s	0,5m/s	0,4m/s
46,0l/s	R	659,1	268,8	108,4	39,9	21,3	6,3	2,1	0,7	0,2	0,1	0,1	0,0
	v	22,2m/s	15,5m/s	10,8m/s	7,2m/s	5,6m/s	3,4m/s	2,2m/s	1,4m/s	0,9m/s	0,7m/s	0,5m/s	0,4m/s
48,0l/s	R	715,6	291,6	117,5	43,2	23,0	6,8	2,3	0,8	0,3	0,1	0,1	0,0
	v	23,1m/s	16,2m/s	11,3m/s	7,5m/s	5,9m/s	3,6m/s	2,3m/s	1,5m/s	0,9m/s	0,7m/s	0,6m/s	0,5m/s
50,0l/s	R	774,4	315,4	127,0	46,6	24,9	7,4	2,5	0,8	0,3	0,2	0,1	0,0
	v	24,1m/s	16,9m/s	11,8m/s	7,9m/s	6,1m/s	3,7m/s	2,4m/s	1,5m/s	1,0m/s	0,8m/s	0,6m/s	0,5m/s
52,0l/s	R		340,1	136,9	50,2	26,8	7,9	2,7	0,9	0,3	0,2	0,1	0,1
	v		17,6m/s	12,2m/s	8,2m/s	6,3m/s	3,9m/s	2,5m/s	1,6m/s	1,0m/s	0,8m/s	0,6m/s	0,5m/s
54,0l/s	R		365,7	147,1	53,9	28,7	8,5	2,8	1,0	0,3	0,2	0,1	0,1
	v		18,2m/s	12,7m/s	8,5m/s	6,6m/s	4,0m/s	2,6m/s	1,6m/s	1,0m/s	0,8m/s	0,6m/s	0,5m/s
56,0l/s	R		392,2	157,7	57,8	30,7	9,1	3,0	1,0	0,3	0,2	0,1	0,1
	v		18,9m/s	13,2m/s	8,8m/s	6,8m/s	4,2m/s	2,7m/s	1,7m/s	1,1m/s	0,8m/s	0,7m/s	0,5m/s
58,0l/s	R		419,7	168,6	61,7	32,8	9,7	3,3	1,1	0,4	0,2	0,1	0,1
	v		19,6m/s	13,6m/s	9,1m/s	7,1m/s	4,3m/s	2,8m/s	1,8m/s	1,1m/s	0,9m/s	0,7m/s	0,5m/s
60,0l/s	R		448,0	179,9	65,8	35,0	10,4	3,5	1,2	0,4	0,2	0,1	0,1
	v		20,3m/s	14,1m/s	9,4m/s	7,3m/s	4,5m/s	2,9m/s	1,8m/s	1,1m/s	0,9m/s	0,7m/s	0,6m/s
62,0l/s	R		477,3	191,5	70,0	37,2	11,0	3,7	1,2	0,4	0,2	0,1	0,1
	v		20,9m/s	14,6m/s	9,7m/s	7,6m/s	4,6m/s	2,9m/s	1,9m/s	1,2m/s	0,9m/s	0,7m/s	0,6m/s
64,0l/s	R		507,5	203,6	74,4	39,5	11,7	3,9	1,3	0,4	0,2	0,1	0,1
	v		21,6m/s	15,0m/s	10,1m/s	7,8m/s	4,8m/s	3,0m/s	1,9m/s	1,2m/s	1,0m/s	0,8m/s	0,6m/s
66,0l/s	R		538,6	215,9	78,9	41,9	12,4	4,1	1,4	0,5	0,3	0,1	0,1
	v		22,3m/s	15,5m/s	10,4m/s	8,0m/s	4,9m/s	3,1m/s	2,0m/s	1,3m/s	1,0m/s	0,8m/s	0,6m/s
68,0l/s	R		570,6	228,6	83,5	44,3	13,1	4,4	1,5	0,5	0,3	0,1	0,1
	v		23,0m/s	16,0m/s	10,7m/s	8,3m/s	5,1m/s	3,2m/s	2,1m/s	1,3m/s	1,0m/s	0,8m/s	0,6m/s
70,0l/s	R		603,5	241,7	88,2	46,8	13,8	4,6	1,5	0,5	0,3	0,2	0,1
	v		23,6m/s	16,5m/s	11,0m/s	8,5m/s	5,2m/s	3,3m/s	2,1m/s	1,3m/s	1,1m/s	0,8m/s	0,7m/s
72,0l/s	R		637,3	255,2	93,1	49,4	14,6	4,9	1,6	0,5	0,3	0,2	0,1
	v		24,3m/s	16,9m/s	11,3m/s	8,8m/s	5,4m/s	3,4m/s	2,2m/s	1,4m/s	1,1m/s	0,9m/s	0,7m/s
74,0l/s	R		672,1	269,0	98,0	52,0	15,3	5,1	1,7	0,6	0,3	0,2	0,1
	v		25,0m/s	17,4m/s	11,6m/s	9,0m/s	5,5m/s	3,5m/s	2,3m/s	1,4m/s	1,1m/s	0,9m/s	0,7m/s
76,0l/s	R			283,1	103,1	54,7	16,1	5,4	1,8	0,6	0,3	0,2	0,1
	v			17,9m/s	11,9m/s	9,3m/s	5,7m/s	3,6m/s	2,3m/s	1,5m/s	1,1m/s	0,9m/s	0,7m/s
78,0l/s	R			297,6	108,4	57,5	16,9	5,6	1,9	0,6	0,3	0,2	0,1
	v			18,3m/s	12,3m/s	9,5m/s	5,8m/s	3,7m/s	2,4m/s	1,5m/s	1,2m/s	0,9m/s	0,7m/s
80,0l/s	R			312,5	113,7	60,3	17,7	5,9	2,0	0,6	0,4	0,2	0,1
	v			18,8m/s	12,6m/s	9,8m/s	6,0m/s	3,8m/s	2,4m/s	1,5m/s	1,2m/s	0,9m/s	0,8m/s
85,0l/s	R			351,2	127,7	67,7	19,9	6,6	2,2	0,7	0,4	0,2	0,1
	v			20,0m/s	13,4m/s	10,4m/s	6,3m/s	4,0m/s	2,6m/s	1,6m/s	1,3m/s	1,0m/s	0,8m/s
90,0l/s	R			392,2	142,5	75,4	22,1	7,3	2,5	0,8	0,4	0,2	0,1
	v			21,2m/s	14,1m/s	11,0m/s	6,7m/s	4,3m/s	2,7m/s	1,7m/s	1,4m/s	1,1m/s	0,8m/s
95,0l/s	R			435,4	158,0	83,6	24,5	8,1	2,7	0,9	0,5	0,3	0,2
	v			22,3m/s	14,9m/s	11,6m/s	7,1m/s	4,5m/s	2,9m/s	1,8m/s	1,4m/s	1,1m/s	0,9m/s

Flow	d	90mm	110mm	125mm	160mm	200mm	250mm	315mm	355mm	400mm	450mm
rate	S	8,2mm	10,0mm	11,4mm	14,6mm	18,2mm	22,7mm	28,6mm	32,2mm	36,3mm	40,9mm
V	di	73,6mm	90,0mm	102,2mm	130,8mm	136,6mm	204,6mm	257,8mm	290,6mm	327,6mm	368,2mm
100,0l/s	R	480,8	174,3	92,2	27,0	8,9	3,0	1,0	0,5	0,3	0,2
	v	23,5m/s	15,7m/s	12,2m/s	7,4m/s	4,8m/s	3,0m/s	1,9m/s	1,5m/s	1,2m/s	0,9m/s
110,0l/s	R		209,3	110,6	32,3	10,7	3,6	1,2	0,6	0,4	0,2
	v		17,3m/s	13,4m/s	8,2m/s	5,2m/s	3,3m/s	2,1m/s	1,7m/s	1,3m/s	1,0m/s
120,0l/s	R		247,5	130,6	38,1	12,6	4,2	1,4	0,8	0,4	0,2
	v		18,9m/s	14,6m/s	8,9m/s	5,7m/s	3,6m/s	2,3m/s	1,8m/s	1,4m/s	1,1m/s
130,0l/s	R		288,8	152,3	44,3	14,6	4,9	1,6	0,9	0,5	0,3
	v		20,4m/s	15,8m/s	9,7m/s	6,2m/s	4,0m/s	2,5m/s	2,0m/s	1,5m/s	1,2m/s
140,0l/s	R		333,3	175,6	51,0	16,8	5,6	1,8	1,0	0,6	0,3
	v		22,0m/s	17,1m/s	10,4m/s	6,7m/s	4,3m/s	2,7m/s	2,1m/s	1,7m/s	1,3m/s
150,0l/s	R		380,9	200,5	58,2	19,1	6,3	2,0	1,1	0,6	0,4
	v		23,6m/s	18,3m/s	11,2m/s	7,1m/s	4,6m/s	2,9m/s	2,3m/s	1,8m/s	1,4m/s
160,0l/s	R			227,0	65,8	21,6	7,2	2,3	1,3	0,7	0,4
	v			19,5m/s	11,9m/s	7,6m/s	4,9m/s	3,1m/s	2,4m/s	1,9m/s	1,5m/s
170,0l/s	R			255,2	73,9	24,2	8,0	2,6	1,4	0,8	0,5
	v			20,7m/s	12,7m/s	8,1m/s	5,2m/s	3,3m/s	2,6m/s	2,0m/s	1,6m/s
180,0l/s	R			285,0	82,4	27,0	8,9	2,9	1,6	0,9	0,5
	v			21,9m/s	13,4m/s	8,6m/s	5,5m/s	3,4m/s	2,7m/s	2,1m/s	1,7m/s
190,0l/s	R			316,4	91,4	29,9	9,9	3,2	1,8	1,0	0,6
	v			23,2m/s	14,1m/s	9,0m/s	5,8m/s	3,6m/s	2,9m/s	2,3m/s	1,8m/s
200,0l/s	R			349,5	100,8	33,0	10,9	3,5	1,9	1,1	0,6
	v			24,4m/s	14,9m/s	9,5m/s	6,1m/s	3,8m/s	3,0m/s	2,4m/s	1,9m/s
210,0l/s	R				110,7	36,2	11,9	3,8	2,1	1,2	0,7
	v				15,6m/s	10,0m/s	6,4m/s	4,0m/s	3,2m/s	2,5m/s	2,0m/s
220,0l/s	R				121,1	39,5	13,0	4,2	2,3	1,3	0,7
	v				16,4m/s	10,5m/s	6,7m/s	4,2m/s	3,3m/s	2,6m/s	2,1m/s
230,0l/s	R				131,9	43,0	14,2	4,5	2,5	1,4	0,8
	v				17,1m/s	10,9m/s	7,0m/s	4,4m/s	3,5m/s	2,7m/s	2,2m/s
240,0l/s	R				143,1	46,6	15,3	4,9	2,7	1,5	0,9
	v				17,9m/s	11,4m/s	7,3m/s	4,6m/s	3,6m/s	2,8m/s	2,3m/s
250,0l/s	R				154,8	50,4	16,6	5,3	2,9	1,6	0,9
	v				18,6m/s	11,9m/s	7,6m/s	4,8m/s	3,8m/s	3,0m/s	2,3m/s
260,0l/s	R				167,0	54,3	17,8	5,7	3,2	1,8	1,0
	v				19,3m/s	12,4m/s	7,9m/s	5,0m/s	3,9m/s	3,1m/s	2,4m/s
270,0l/s	R				179,6	58,4	19,2	6,1	3,4	1,9	1,1
	v				20,1m/s	12,8m/s	8,2m/s	5,2m/s	4,1m/s	3,2m/s	2,5m/s
280,0l/s	R				192,7	62,6	20,5	6,5	3,6	2,0	1,1
	v				20,8m/s	13,3m/s	8,5m/s	5,4m/s	4,2m/s	3,3m/s	2,6m/s
290,0l/s	R				206,2	66,9	21,9	7,0	3,9	2,2	1,2
	v				21,6m/s	13,8m/s	8,8m/s	5,6m/s	4,4m/s	3,4m/s	2,7m/s
300,0l/s	R				220,1	71,4	23,4	7,5	4,1	2,3	1,3
	v				22,3m/s	14,3m/s	9,1m/s	5,7m/s	4,5m/s	3,6m/s	2,8m/s
310,0l/s	R				234,6	76,1	24,9	7,9	4,4	2,4	1,4
	v				23,1m/s	14,7m/s	9,4m/s	5,9m/s	4,7m/s	3,7m/s	2,9m/s
320,0l/s	R				249,4	80,8	26,5	8,4	4,7	2,6	1,5
	v				23,8m/s	15,2m/s	9,7m/s	6,1m/s	4,8m/s	3,8m/s	3,0m/s

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 11

HYDRAULIC AND PIPE PROPERTIES

V = flow rate [l/s]
R = friction [mbar/m]
v = velocity [m/s]
d = pipe outside diameter [mm]
S = pipe wall thickness [mm]
di = pipe inner diameter [mm]

WATER PROPERTIES

Density: ρ = 998,2 [Kg/m^3]
Viscosity: v = 1,004x10^{-6} [m^2/s]
Temperature: t = 20°C

SDR 11
20°C

Flow rate	d	160mm	200mm	250mm	315mm	355mm	400mm	450mm
	S	14,6mm	18,2mm	22,7mm	28,6mm	32,2mm	36,3mm	40,9mm
V	di	130,8mm	136,6mm	204,6mm	257,8mm	290,6mm	327,6mm	368,2mm
330,0l/s	R	264,8	85,8	28,0	8,9	4,9	2,7	1,5
	v	24,6m/s	15,7m/s	10,0m/s	6,3m/s	5,0m/s	3,9m/s	3,1m/s
340,0l/s	R		90,8	29,7	9,4	5,2	2,9	1,6
	v		16,2m/s	10,3m/s	6,5m/s	5,1m/s	4,0m/s	3,2m/s
350,0l/s	R		96,0	31,4	10,0	5,5	3,1	1,7
	v		16,6m/s	10,6m/s	6,7m/s	5,3m/s	4,2m/s	3,3m/s
360,0l/s	R		101,4	33,1	10,5	5,8	3,2	1,8
	v		17,1m/s	10,9m/s	6,9m/s	5,4m/s	4,3m/s	3,4m/s
370,0l/s	R		106,9	34,9	11,1	6,1	3,4	1,9
	v		17,6m/s	11,3m/s	7,1m/s	5,6m/s	4,4m/s	3,5m/s
380,0l/s	R		112,5	36,7	11,6	6,4	3,6	2,0
	v		18,1m/s	11,6m/s	7,3m/s	5,7m/s	4,5m/s	3,6m/s
390,0l/s	R		118,3	38,6	12,2	6,8	3,7	2,1
	v		18,6m/s	11,9m/s	7,5m/s	5,9m/s	4,6m/s	3,7m/s
400,0l/s	R		124,2	40,5	12,8	7,1	3,9	2,2
	v		19,0m/s	12,2m/s	7,7m/s	6,0m/s	4,7m/s	3,8m/s
410,0l/s	R		130,2	42,4	13,4	7,4	4,1	2,3
	v		19,5m/s	12,5m/s	7,9m/s	6,2m/s	4,9m/s	3,9m/s
420,0l/s	R		136,4	44,4	14,1	7,8	4,3	2,4
	v		20,0m/s	12,8m/s	8,0m/s	6,3m/s	5,0m/s	3,9m/s
430,0l/s	R		142,8	46,5	14,7	8,1	4,5	2,5
	v		20,5m/s	13,1m/s	8,2m/s	6,5m/s	5,1m/s	4,0m/s
440,0l/s	R		149,3	48,5	15,3	8,5	4,7	2,6
	v		20,9m/s	13,4m/s	8,4m/s	6,6m/s	5,2m/s	4,1m/s
450,0l/s	R		155,9	50,7	16,0	8,8	4,9	2,8
	v		21,4m/s	13,7m/s	8,6m/s	6,8m/s	5,3m/s	4,2m/s
460,0l/s	R		162,7	52,9	16,7	9,2	5,1	2,9
	v		21,9m/s	14,0m/s	8,8m/s	6,9m/s	5,5m/s	4,3m/s
470,0l/s	R		169,6	55,1	17,4	9,6	5,3	3,0
	v		22,4m/s	14,3m/s	9,0m/s	7,1m/s	5,6m/s	4,4m/s
480,0l/s	R		176,6	57,4	18,1	10,0	5,5	3,1
	v		22,8m/s	14,6m/s	9,2m/s	7,2m/s	5,7m/s	4,5m/s
490,0l/s	R		183,8	59,7	18,8	10,4	5,7	3,2
	v		23,3m/s	14,9m/s	9,4m/s	7,4m/s	5,8m/s	4,6m/s
500,0l/s	R		191,2	62,0	19,6	10,8	6,0	3,4
	v		23,8m/s	15,2m/s	9,6m/s	7,5m/s	5,9m/s	4,7m/s
510,0l/s	R		198,6	64,4	20,3	11,2	6,2	3,5
	v		24,3m/s	15,5m/s	9,8m/s	7,7m/s	6,1m/s	4,8m/s
520,0l/s	R		206,3	66,9	21,1	11,6	6,4	3,6
	v		24,7m/s	15,8m/s	10,0m/s	7,8m/s	6,2m/s	4,9m/s
530,0l/s	R			69,4	21,9	12,1	6,7	3,7
	v			16,1m/s	10,2m/s	8,0m/s	6,3m/s	5,0m/s
540,0l/s	R			71,9	22,6	12,5	6,9	3,9
	v			16,4m/s	10,3m/s	8,1m/s	6,4m/s	5,1m/s
550,0l/s	R			74,5	23,4	12,9	7,1	4,0
	v			16,7m/s	10,5m/s	8,3m/s	6,5m/s	5,2m/s

Flow rate	d	250mm	315mm	355mm	400mm	450mm
	S	22,7mm	28,6mm	32,2mm	36,3mm	40,9mm
V	di	204,6mm	257,8mm	290,6mm	327,6mm	368,2mm
560,0l/s	R	77,1	24,3	13,4	7,4	4,2
	v	17,0m/s	10,7m/s	8,4m/s	6,6m/s	5,3m/s
570,0l/s	R	79,8	25,1	13,8	7,6	4,3
	v	17,3m/s	10,9m/s	8,6m/s	6,8m/s	5,4m/s
580,0l/s	R	82,5	25,9	14,3	7,9	4,4
	v	17,6m/s	11,1m/s	8,7m/s	6,9m/s	5,4m/s
590,0l/s	R	85,3	26,8	14,8	8,2	4,6
	v	17,9m/s	11,3m/s	8,9m/s	7,0m/s	5,5m/s
600,0l/s	R	88,1	27,7	15,2	8,4	4,7
	v	18,2m/s	11,5m/s	9,0m/s	7,1m/s	5,6m/s
610,0l/s	R	90,9	28,6	15,7	8,7	4,9
	v	18,6m/s	11,7m/s	9,2m/s	7,2m/s	5,7m/s
620,0l/s	R	93,8	29,5	16,2	9,0	5,0
	v	18,9m/s	11,9m/s	9,3m/s	7,4m/s	5,8m/s
630,0l/s	R	96,8	30,4	16,7	9,2	5,2
	v	19,2m/s	12,1m/s	9,5m/s	7,5m/s	5,9m/s
640,0l/s	R	99,8	31,3	17,2	9,5	5,3
	v	19,5m/s	12,3m/s	9,6m/s	7,6m/s	6,0m/s
650,0l/s	R	102,8	32,3	17,8	9,8	5,5
	v	19,8m/s	12,5m/s	9,8m/s	7,7m/s	6,1m/s
660,0l/s	R	105,9	33,2	18,3	10,1	5,7
	v	20,1m/s	12,6m/s	10,0m/s	7,8m/s	6,2m/s
670,0l/s	R	109,0	34,2	18,8	10,4	5,8
	v	20,4m/s	12,8m/s	10,1m/s	7,9m/s	6,3m/s
680,0l/s	R	112,1	35,2	19,3	10,7	6,0
	v	20,7m/s	13,0m/s	10,3m/s	8,1m/s	6,4m/s
690,0l/s	R	115,4	36,2	19,9	11,0	6,1
	v	21,0m/s	13,2m/s	10,4m/s	8,2m/s	6,5m/s
700,0l/s	R	118,6	37,2	20,4	11,3	6,3
	v	21,3m/s	13,4m/s	10,6m/s	8,3m/s	6,6m/s
710,0l/s	R	121,9	38,2	21,0	11,6	6,5
	v	21,6m/s	13,6m/s	10,7m/s	8,4m/s	6,7m/s
720,0l/s	R	125,2	39,2	21,6	11,9	6,7
	v	21,9m/s	13,8m/s	10,9m/s	8,5m/s	6,8m/s
730,0l/s	R	128,6	40,3	22,1	12,2	6,8
	v	22,2m/s	14,0m/s	11,0m/s	8,7m/s	6,9m/s
740,0l/s	R	132,1	41,3	22,7	12,5	7,0
	v	22,5m/s	14,2m/s	11,2m/s	8,8m/s	6,9m/s
750,0l/s	R	135,5	42,4	23,3	12,8	7,2
	v	22,8m/s	14,4m/s	11,3m/s	8,9m/s	7,0m/s
760,0l/s	R	139,1	43,5	23,9	13,2	7,4
	v	23,1m/s	14,6m/s	11,5m/s	9,0m/s	7,1m/s
770,0l/s	R	142,6	44,6	24,5	13,5	7,6
	v	23,4m/s	14,8m/s	11,6m/s	9,1m/s	7,2m/s
780,0l/s	R	146,2	45,7	25,1	13,8	7,8
	v	23,7m/s	14,9m/s	11,8m/s	9,3m/s	7,3m/s

Flow rate	d	250mm	315mm	355mm	400mm	450mm
	S	22,7mm	28,6mm	32,2mm	36,3mm	40,9mm
V	di	204,6mm	257,8mm	290,6mm	327,6mm	368,2mm
790,0l/s	R	149,9	46,9	25,7	14,2	7,9
	v	24,0m/s	15,1m/s	11,9m/s	9,4m/s	7,4m/s
800,0l/s	R	153,6	48,0	26,4	14,5	8,1
	v	24,3m/s	15,3m/s	12,1m/s	9,5m/s	7,5m/s
810,0l/s	R	157,3	49,2	27,0	14,9	8,3
	v	24,6m/s	15,5m/s	12,2m/s	9,6m/s	7,6m/s
820,0l/s	R	161,1	50,3	27,6	15,2	8,5
	v	24,9m/s	15,7m/s	12,4m/s	9,7m/s	7,7m/s
830,0l/s	R		51,9	28,1	15,5	8,6
	v		15,9m/s	12,5m/s	9,8m/s	7,8m/s
840,0l/s	R		52,5	28,7	15,8	8,8
	v		16,1m/s	12,7m/s	10,0m/s	7,9m/s
850,0l/s	R		53,6	29,4	16,2	9,0
	v		16,3m/s	12,8m/s	10,0m/s	8,0m/s
860,0l/s	R		54,9	30,1	16,6	9,2
	v		16,5m/s	13,0m/s	10,2m/s	8,0m/s
870,0l/s	R		56,1	33,4	16,9	9,4
	v		16,7m/s	13,1m/s	10,3m/s	8,2m/s
880,0l/s	R		53,4	31,5	17,3	9,7
	v		16,9m/s	13,3m/s	10,4m/s	8,3m/s
890,0l/s	R		58,6	32,2	17,7	9,9
	v		17,1m/s	13,4m/s	10,6m/s	8,4m/s
900,0l/s	R		59,9	32,9	18,0	10,1
	v		17,2m/s	13,6m/s	10,7m/s	8,4m/s
910,0l/s	R		61,2	33,5	10,4	10,3
	v		17,4m/s	13,7m/s	10,8m/s	8,5m/s
920,0l/s	R		62,5	34,2	18,8	10,5
	v		17,6m/s	13,9m.s	10,9m/s	8,6m/s
930,0l/s	R		63,8	35,0	19,2	10,7
	v		17,8m/s	14,0m/s	11,0m/s	8,7m/s
940,0l/s	R		65,2	35,7	19,6	11,0
	v		18,0m/s	14,2m/s	11,2m/s	8,8m/s
950,0l/s	R		66,5	34,5	20,0	11,2
	v		18,2m/s	14,3m/s	11,3m/s	8,9m/s
960,0l/s	R		67,9	37,2	20,4	11,4
	v		18,4m/s	14,5m/s	11,4m/s	9,0m/s
970,0l/s	R		69,2	38,0	20,8	11,7
	v		18,6m/s	14,6m/s	11,5m/s	9,1m/s
980,0l/s	R		70,6	38,7	21,3	12,0
	v		18,8m/s	14,8m/s	11,6m/s	9,2m/s
990,0l/s	R		72,1	39,4	21,7	12,1
	v		19,0m/s	14,9m/s	11,7m/s	9,3m/s
1000,l/s	R		73,4	40,2	22,1	12,4
	v		19,2m/s	15,1m/s	11,9m/s	9,4m/s
	R					
	v					

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 17

HYDRAULIC AND PIPE PROPERTIES

V = flow rate [l/s] — d = pipe outside diameter [mm]
R = friction [mbar/m] — S = pipe wall thickness [mm]
v = velocity [m/s] — di = pipe inner diameter [mm]

WATER PROPERTIES

Density: ρ = 1000 [Kg/m^3]
Viscosity: v = 1,307x10^{-6} [m^2/s]
Temperature: t = 10°C

SDR 17
20°C

Flow rate	d	125mm	160mm	200mm	250mm	315mm	355mm	400mm	450mm
	S	7,4mm	9,5mm	11,9mm	14,8mm	18,7mm	21,1mm	23,7mm	26,7mm
V	di	110,2mm	141,0mm	176,2mm	220,4mm	277,6mm	312,8mm	352,6mm	399,6mm
1,00l/s	R	0,0							0,0
	v	0,1m/s							0,0
1,20l/s	R	0,0							
	v	0,1m/s							
1,40l/s	R	0,0							
	v	0,1m/s							
1,60l/s	R	0,0	0,0						
	v	0,2m/s	0,1m/s						
1,80l/s	R	0,0	0,0						
	v	0,2m/s	0,1m/s						
2,00l/s	R	0,1	0,0						
	v	0,2m/s	0,1m/s						
2,20l/s	R	0,1	0,0						
	v	0,2m/s	0,1m/s						
2,40l/s	R	0,1	0,0	0,0					
	v	0,3m/s	0,2m/s	0,1					
2,60l/s	R	0,1	0,0	0,0					
	v	0,3m/s	0,2m/s	0,1m/s					
2,80l/s	R	0,1	0,0	0,0					
	v	0,3m/s	0,2m/s	0,1m/s					
3,00l/s	R	0,1	0,0	0,0					
	v	0,3m/s	0,2m/s	0,1m/s					
3,20l/s	R	0,1	0,0	0,0					
	v	0,3m/s	0,2m/s	0,1m/s					
3,40l/s	R	0,1	0,0	0,0					
	v	0,4m/s	0,2m/s	0,1m/s					
3,60l/s	R	0,2	0,0	0,0					
	v	0,4m/s	0,2m/s	0,1m/s					
3,80l/s	R	0,2	0,1	0,0					
	v	0,4m/s	0,2m/s	0,2m/s					
4,00l/s	R	0,2	0,1	0,0	0,0				
	v	0,4m/s	0,3m/s	0,2m/s	0,1m/s				
4,20l/s	R	0,2	0,1	0,0	0,0				
	v	0,4m/s	0,3m/s	0,2m/s	0,1m/s				
4,40l/s	R	0,2	0,1	0,0	0,0				
	v	0,5m/s	0,3m/s	0,2m/s	0,1m/s				
4,60l/s	R	0,2	0,1	0,0	0,0				
	v	0,5m/s	0,3m/s	0,2m/s	0,1m/s				
4,80l/s	R	0,2	0,1	0,0	0,0				
	v	0,5m/s	0,3m/s	0,2m/s	0,1m/s				
5,00l/s	R	0,3	0,1	0,0	0,0				
	v	0,5m/s	0,3m/s	0,2m/s	0,1m/s				
5,20l/s	R	0,3	0,1	0,0	0,0				
	v	0,5m/s	0,3m/s	0,2m/s	0,1m/s				
5,40l/s	R	0,3	0,1	0,0	0,0				
	v	0,6m/s	0,3m/s	0,2m/s	0,1m/s				

Flow rate	d	125mm	160mm	200mm	250mm	315mm	355mm	400mm	450mm
	S	7,4mm	9,5mm	11,9mm	14,8mm	18,7mm	21,1mm	23,7mm	26,7mm
V	di	110,2mm	141,0mm	176,2mm	220,4mm	277,6mm	312,8mm	352,6mm	399,6mm
5,60l/s	R	0,3	0,1	0,0	0,0				
	v	0,6m/s	0,4m/s	0,2m/s	0,1m/s				
5,80l/s	R	0,3	0,1	0,0	0,0				
	v	0,6m/s	0,4m/s	0,2m/s	0,2m/s				
6,00l/s	R	0,4	0,1	0,0	0,0				
	v	0,6m/s	0,4m/s	0,2m/s	0,2m/s				
6,20l/s	R	0,4	0,1	0,0	0,0	0,0			
	v	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s			
6,40l/s	R	0,4	0,1	0,0	0,0	0,0			
	v	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s			
6,60l/s	R	0,4	0,1	0,0	0,0	0,0			
	v	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s			
6,80l/s	R	0,5	0,1	0,0	0,0	0,0			
	v	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s			
7,00l/s	R	0,5	0,1	0,1	0,0	0,0			
	v	0,7m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s			
8,00l/s	R	0,6	0,2	0,1	0,0	0,0	0,0		
	v	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,1m/s	0,1m/s		
9,00l/s	R	0,8	0,2	0,1	0,0	0,0	0,0		
	v	0,9m/s	0,6m/s	0,4m/s	0,2m/s	0,1m/s	0,1m/s		
10,0l/s	R	0,9	0,3	0,1	0,0	0,0	0,0	0,0	
	v	1,0m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,1m/s	0,1m/s	
12,0l/s	R	1,3	0,4	0,1	0,0	0,0	0,0	0,0	
	v	1,2m/s	0,8m/s	0,5m/s	0,3m/s	0,2m/s	0,2m/s	0,1m/s	
14,0l/s	R	1,7	0,5	0,2	0,1	0,0	0,0	0,0	0,0
	v	1,5m/s	0,9m/s	0,6m/s	0,4m/s	0,2m/s	0,2m/s	0,1m/s	0,1m/s
16,0l/s	R	2,1	0,6	0,2	0,1	0,0	0,0	0,0	0,0
	v	1,7m/s	1,0m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,2m/s	0,1m/s
18,0l/s	R	2,6	0,8	0,3	0,1	0,0	0,0	0,0	0,0
	v	1,9m/s	1,1m/s	0,7m/s	0,5m/s	0,3m/s	0,2m/s	0,2m/s	0,1m/s
20,0l/s	R	3,2	1,0	0,3	0,1	0,0	0,0	0,0	0,0
	v	2,1m/s	1,3m/s	0,8m/s	0,5m/s	0,3m/s	0,3m/s	0,2m/s	0,2m/s
22,0l/s	R	3,8	1,2	0,4	0,1	0,0	0,0	0,0	0,0
	v	2,3m/s	1,4m/s	0,9m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,2m/s
24,0l/s	R	4,5	1,4	0,5	0,2	0,1	0,0	0,0	0,0
	v	2,5m/s	1,5m/s	1,0m/s	0,6m/s	0,4m/s	0,3m/s	0,2m/s	0,2m/s
26,0l/s	R	5,2	1,6	0,5	0,2	0,1	0,0	0,0	0,0
	v	2,7m/s	1,6m/s	1,1m/s	0,7m/s	0,4m/s	0,3m/s	0,3m/s	0,2m/s
28,0l/s	R	5,9	1,8	0,6	0,2	0,1	0,0	0,0	0,0
	v	2,9m/s	1,8m/s	1,1m/s	0,7m/s	0,5m/s	0,4m/s	0,3m/s	0,2m/s
30,0l/s	R	6,7	2,0	0,7	0,2	0,1	0,0	0,0	0,0
	v	3,1m/s	1,9m/s	1,2m/s	0,8m/s	0,5m/s	0,4m/s	0,3m/s	0,2m/s
32,0l/s	R	7,6	2,3	0,8	0,3	0,1	0,0	0,0	0,0
	v	3,3m/s	2,0m/s	1,3m/s	0,8m/s	0,5m/s	0,4m/s	0,3m/s	0,3m/s
34,0l/s	R	8,5	2,6	0,9	0,3	0,1	0,1	0,0	0,0
	v	3,5m/s	2,2m/s	1,4m/s	0,9m/s	0,6m/s	0,4m/s	0,3m/s	0,3m/s

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 17

HYDRAULIC AND PIPE PROPERTIES

V = flow rate [l/s] — d = pipe outside diameter [mm]
R = friction [mbar/m] — S = pipe wall thickness [mm]
v = velocity [m/s] — di = pipe inner diameter [mm]

WATER PROPERTIES

Density: ρ = 1000 [Kg/m^3]
Viscosity: v = 1,307x10^{-6} [m^2/s]
Temperature: t = 10°C

SDR 17
20°C

Flow rate	d	125mm	160mm	200mm	250mm	315mm	355mm	400mm	450mm
	S	7,4mm	9,5mm	11,9mm	14,8mm	18,7mm	21,1mm	23,7mm	26,7mm
V	di	110,2mm	141,0mm	176,2mm	220,4mm	277,6mm	312,8mm	352,6mm	399,6mm
36,0l/s	R	9,4	2,8	1,0	0,3	0,1	0,1	0,0	0,0
	v	3,7m/s	2,3m/s	1,5m/s	0,9m/s	0,6m/s	0,5m/s	0,4m/s	0,3m/s
38,0l/s	R	10,4	3,1	1,1	0,4	0,1	0,1	0,0	0,0
	v	3,9m/s	2,4m/s	1,5m/s	1,0m/s	0,6m/s	0,5m/s	0,4m/s	0,3m/s
40,0l/s	R	11,4	3,4	1,2	0,4	0,1	0,1	0,0	0,0
	v	4,1m/s	2,5m/s	1,6m/s	1,0m/s	0,7m/s	0,5m/s	0,4m/s	0,3m/s
42,0l/s	R	12,5	3,8	1,3	0,4	0,1	0,1	0,0	0,0
	v	4,4m/s	2,7m/s	1,7m/s	1,1m/s	0,7m/s	0,5m/s	0,4m/s	0,3m/s
44,0l/s	R	13,7	4,1	1,4	0,5	0,2	0,1	0,0	0,0
	v	4,6m/s	2,8m/s	1,8m/s	1,1m/s	0,7m/s	0,6m/s	0,4m/s	0,4m/s
46,0l/s	R	14,8	4,4	1,5	0,5	0,2	0,1	0,1	0,0
	v	4,8m/s	2,9m/s	1,9m/s	1,2m/s	0,8m/s	0,6m/s	0,5m/s	0,4m/s
48,0l/s	R	16,0	4,8	1,6	0,6	0,2	0,1	0,1	0,0
	v	5,0m/s	3,0m/s	1,9m/s	1,2m/s	0,8m/s	0,6m/s	0,5m/s	0,4m/s
50,0l/s	R	17,3	5,2	1,8	0,6	0,2	0,1	0,1	0,0
	v	5,2m/s	3,2m/s	2,0m/s	1,3m/s	0,8m/s	0,6m/s	0,5m/s	0,4m/s
52,0l/s	R	18,6	5,6	1,9	0,6	0,2	0,1	0,1	0,0
	v	5,4m/s	3,3m/s	2,1m/s	1,3m/s	0,8m/s	0,7m/s	0,5m/s	0,4m/s
54,0l/s	R	20,0	6,0	2,0	0,7	0,2	0,1	0,1	0,0
	v	5,6m/s	3,4m/s	2,2m/s	1,4m/s	0,9m/s	0,7m/s	0,5m/s	0,4m/s
56,0l/s	R	21,4	6,4	2,2	0,7	0,2	0,1	0,1	0,0
	v	5,8m/s	3,5m/s	2,3m/s	1,5m/s	0,9m/s	0,7m/s	0,6m/s	0,4m/s
58,0l/s	R	22,8	6,8	2,3	0,8	0,3	0,1	0,1	0,0
	v	6,0m/s	3,7m/s	2,4m/s	1,5m/s	0,9m/s	0,7m/s	0,6m/s	0,5m/s
60,0l/s	R	24,3	7,2	2,4	0,8	0,3	0,2	0,1	0,0
	v	6,2m/s	3,8m/s	2,4m/s	1,6m/s	1,0m/s	0,8m/s	0,6m/s	0,5m/s
62,0l/s	R	25,8	7,7	2,6	0,9	0,3	0,2	0,1	0,1
	v	6,4m/s	3,9m/s	2,5m/s	1,6m/s	1,0m/s	0,8m/s	0,6m/s	0,5m/s
64,0l/s	R	27,4	8,2	2,8	0,9	0,3	0,2	0,1	0,1
	v	6,6m/s	4,1m/s	2,6m/s	1,7m/s	1,0m/s	0,8m/s	0,6m/s	0,5m/s
66,0l/s	R	29,0	8,6	2,9	1,0	0,3	0,2	0,1	0,1
	v	6,8m/s	4,2m/s	2,7m/s	1,7m/s	1,1m/s	0,8m/s	0,7m/s	0,5m/s
68,0l/s	R	30,7	9,1	3,1	1,0	0,3	0,2	0,1	0,1
	v	7,1m/s	4,3m/s	2,8m/s	1,8m/s	1,1m/s	0,9m/s	0,7m/s	0,5m/s
70,0l/s	R	32,4	9,6	3,2	1,1	0,4	0,2	0,1	0,1
	v	7,3m/s	4,4m/s	2,8m/s	1,8m/s	1,1m/s	0,9m/s	0,7m/s	0,6m/s
72,0l/s	R	34,2	10,2	3,4	1,2	0,4	0,2	0,1	0,1
	v	7,5m/s	4,6m/s	2,9m/s	1,9m/s	1,2m/s	0,9m/s	0,7m/s	0,6m/s
74,0l/s	R	36,0	10,7	3,6	1,2	0,4	0,2	0,1	0,1
	v	7,7m/s	4,7m/s	3,0m/s	1,9m/s	1,2m/s	1,0m/s	0,7m/s	0,6m/s
76,0l/s	R	37,8	11,2	3,8	1,3	0,4	0,2	0,1	0,1
	v	7,9m/s	4,8m/s	3,1m/s	2,0m/s	1,2m/s	1,0m/s	0,8m/s	0,6m/s
78,0l/s	R	39,7	11,8	4,0	1,3	0,4	0,2	0,1	0,1
	v	8,1m/s	4,9m/s	3,2m/s	2,0m/s	1,3m/s	1,0m/s	0,8m/s	0,6m/s
80,0l/s	R	41,6	12,4	4,2	1,4	0,5	0,3	0,1	0,1
	v	8,3m/s	5,1m/s	3,2m/s	2,1m/s	1,3m/s	1,0m/s	0,8m/s	0,6m/s

Flow rate	d	125mm	160mm	200mm	250mm	315mm	355mm	400mm	450mm
	S	7,4mm	9,5mm	11,9mm	14,8mm	18,7mm	21,1mm	23,7mm	26,7mm
V	di	110,2mm	141,0mm	176,2mm	220,4mm	277,6mm	312,8mm	352,6mm	399,6mm
85,0l/s	R	46,6	13,8	4,6	1,6	0,5	0,3	0,2	0,1
	v	8,8m/s	5,4m/s	3,4m/s	2,2m/s	1,4m/s	1,1m/s	0,9m/s	0,7m/s
90,0l/s	R	51,9	15,4	5,2	1,7	0,6	0,3	0,2	0,1
	v	9,3m/s	5,7m/s	3,6m/s	2,3m/s	1,5m/s	1,2m/s	0,9m/s	0,7m/s
95,0l/s	R	57,5	17,0	5,7	1,9	0,6	0,3	0,2	0,1
	v	9,9m/s	6,0m/s	3,9m/s	2,5m/s	1,6m/s	1,2m/s	1,0m/s	0,8m/s
100,0l/s	R	63,4	18,7	6,3	2,1	0,7	0,4	0,2	0,1
	v	10,4m/s	6,3m/s	4,1m/s	2,6m/s	1,6m/s	1,3m/s	1,0m/s	0,8m/s
110,0l/s	R	75,9	22,4	7,5	2,5	0,8	0,5	0,3	0,1
	v	11,4m/s	7,0m/s	4,5m/s	2,9m/s	1,8m/s	1,4m/s	1,1m/s	0,9m/s
120,0l/s	R	89,5	26,3	8,8	2,9	1,0	0,5	0,3	0,2
	v	12,4m/s	7,6m/s	4,9m/s	3,1m/s	2,0m/s	1,5m/s	1,2m/s	1,0m/s
130,0l/s	R	104,1	30,6	10,2	3,4	1,1	0,6	0,3	0,2
	v	13,5m/s	8,2m/s	5,3m/s	3,4m/s	2,1m/s	1,7m/s	1,3m/s	1,0m/s
140,0l/s	R	119,9	35,2	11,7	3,9	1,3	0,7	0,4	0,2
	v	14,5m/s	8,9m/s	5,7m/s	3,6m/s	2,3m/s	1,8m/s	1,4m/s	1,1m/s
150,0l/s	R	136,8	40,1	13,3	4,5	1,4	0,8	0,5	0,3
	v	15,6m/s	9,5m/s	6,1m/s	3,9m/s	2,5m/s	1,9m/s	1,5m/s	1,2m/s
160,0l/s	R	154,7	45,3	15,3	5,0	1,6	0,9	0,5	0,3
	v	16,6m/s	10,1m/s	6,5m/s	4,1m/s	2,6m/s	2,1m/s	1,6m/s	1,3m/s
170,0l/s	R	173,7	50,8	17,0	5,6	1,8	1,0	0,6	0,3
	v	17,6m/s	10,8m/s	7,0m/s	4,4m/s	2,8m/s	2,2m/s	1,7m/s	1,4m/s
180,0l/s	R	193,8	56,6	18,8	6,3	2,0	1,1	0,6	0,4
	v	18,7m/s	11,4m/s	7,3m/s	4,7m/s	2,9m/s	2,3m/s	1,8m/s	1,4m/s
190,0l/s	R	214,9	62,7	20,8	6,9	2,2	1,2	0,7	0,4
	v	19,7m/s	12,0m/s	7,7m/s	4,9m/s	3,1m/s	2,4m/s	1,9m/s	1,5m/s
200,0l/s	R	237,1	69,1	22,9	7,6	2,5	1,4	0,8	0,4
	v	20,7m/s	12,7m/s	8,1m/s	5,2m/s	3,3m/s	2,6m/s	2,0m/s	1,6m/s
210,0l/s	R	260,4	75,8	25,1	8,3	2,7	1,5	0,8	0,5
	v	21,8m/s	13,3m/s	8,5m/s	5,4m/s	3,4m/s	2,7m/s	2,1m/s	1,7m/s
220,0l/s	R	284,8	82,8	27,4	9,1	2,9	1,6	0,9	0,5
	v	22,8m/s	13,9m/s	8,9m/s	5,7m/s	3,6m/s	2,8m/s	2,2m/s	1,8m/s
230,0l/s	R	310,3	90,1	29,8	9,9	3,2	1,8	1,0	0,6
	v	23,9m/s	14,6m/s	9,3m/s	6,0m/s	3,8m/s	3,0m/s	2,3m/s	1,8m/s
240,0l/s	R	336,8	97,7	32,2	10,7	3,4	1,9	1,1	0,6
	v	24,9m/s	15,2m/s	9,7m/s	6,2m/s	3,9m/s	3,1m/s	2,4m/s	1,9m/s
250,0l/s	R		105,6	34,8	11,5	3,7	2,1	1,2	0,7
	v		15,8m/s	10,1m/s	6,5m/s	4,1m/s	3,2m/s	2,5m/s	2,0m/s
260,0l/s	R		113,8	37,5	12,4	4,0	2,2	1,2	0,7
	v		16,5m/s	10,5m/s	6,7m/s	4,2m/s	3,3m/s	2,6m/s	2,1m/s
270,0l/s	R		122,3	40,3	13,3	4,3	2,4	1,3	0,8
	v		17,1m/s	10,9m/s	7,0m/s	4,4m/s	3,5m/s	2,7m/s	2,2m/s
280,0l/s	R		131,1	43,1	14,3	4,6	2,5	1,4	0,8
	v		17,7m/s	11,4m/s	7,3m/s	4,6m/s	3,6m/s	2,8m/s	2,2m/s
290,0l/s	R		140,2	46,1	15,2	4,9	2,7	1,5	0,9
	v		18,4m/s	11,8m/s	7,5m/s	4,7m/s	3,7m/s	2,9m/s	2,3m/s

TABLE OF PRESSURE LOSSES / VELOCITY FOR PIPES SDR 17

HYDRAULIC AND PIPE PROPERTIES

V = flow rate [l/s] — d = pipe outside diameter [mm]
R = friction [mbar/m] — S = pipe wall thickness [mm]
v = velocity [m/s] — di = pipe inner diameter [mm]

WATER PROPERTIES

Density: ρ = 1000 [Kg/m^3]
Viscosity: v = 1,307x10^{-6} [m^2/s]
Temperature: t = 10°C

SDR 17
20°C

Flow rate	d	160mm	200mm	250mm	315mm	355mm	400mm	450mm
	S	9,5mm	11,9mm	14,8mm	18,7mm	21,1mm	23,7mm	26,7mm
V	di	141,0mm	176,2mm	220,4mm	277,6mm	312,8mm	352,6mm	399,6mm
300,0l/s	R	149,7	49,2	16,2	5,2	2,9	1,6	0,9
	v	19,0m/s	12,2m/s	7,8m/s	4,9m/s	3,9m/s	3,0m/s	2,4m/s
310,0l/s	R	159,4	52,3	17,3	5,5	3,1	1,7	1,0
	v	19,6m/s	12,6m/s	8,0m/s	5,1m/s	4,0m/s	3,1m/s	2,5m/s
320,0l/s	R	169,4	55,6	18,3	5,9	3,3	1,8	1,0
	v	20,3m/s	13,0m/s	8,3m/s	5,2m/s	4,1m/s	3,2m/s	2,6m/s
330,0l/s	R	179,7	58,9	19,4	6,2	3,5	1,9	1,1
	v	20,9m/s	13,4m/s	8,6m/s	5,4m/s	4,2m/s	3,3m/s	2,6m/s
340,0l/s	R	190,3	62,4	20,6	6,6	3,7	2,0	1,1
	v	21,5m/s	13,8m/s	8,8m/s	5,6m/s	4,4m/s	3,4m/s	2,7m/s
350,0l/s	R	201,2	65,9	21,7	6,9	3,9	2,2	1,2
	v	22,2m/s	14,2m/s	9,1m/s	5,7m/s	4,5m/s	3,5m/s	2,8m/s
360,0l/s	R	212,4	69,6	22,9	7,3	4,1	2,3	1,3
	v	22,8m/s	14,6m/s	9,3m/s	5,9m/s	4,6m/s	3,6m/s	2,9m/s
370,0l/s	R	223,9	73,3	24,1	7,7	4,3	2,4	1,3
	v	23,4m/s	15,0m/s	9,6m/s	6,0m/s	4,8m/s	3,7m/s	3,0m/s
380,0l/s	R	235,7	77,1	25,4	8,1	4,5	2,5	1,4
	v	24,1m/s	15,4m/s	9,9m/s	6,2m/s	4,9m/s	3,8m/s	3,0m/s
390,0l/s	R	247,8	81,0	26,6	8,5	4,7	2,6	1,5
	v	24,7m/s	15,8m/s	10,1m/s	6,4m/s	5,0m/s	3,9m/s	3,1m/s
400,0l/s	R		85,0	27,9	8,9	4,9	2,8	1,6
	v		16,2m/s	10,4m/s	6,5m/s	5,1m/s	4,1m/s	3,2m/s
410,0l/s	R		89,2	29,3	9,3	5,2	2,9	1,6
	v		16,6m/s	10,6m/s	6,7m/s	5,3m/s	4,2m/s	3,3m/s
420,0l/s	R		93,4	30,6	9,8	5,4	3,0	1,7
	v		17,0m/s	10,9m/s	6,9m/s	5,4m/s	4,3m/s	3,4m/s
430,0l/s	R		97,7	32,0	10,2	5,7	3,2	1,8
	v		17,4m/s	11,1m/s	7,0m/s	5,5m/s	4,4m/s	3,4m/s
440,0l/s	R		102,1	33,5	10,7	5,9	3,3	1,9
	v		17,8m/s	11,4m/s	7,2m/s	5,7m/s	4,5m/s	3,5m/s
450,0l/s	R		106,5	34,9	11,1	6,2	3,4	1,9
	v		18,2m/s	11,7m/s	7,4m/s	5,8m/s	4,6m/s	3,6m/s
460,0l/s	R		111,1	36,4	11,6	6,4	3,6	2,0
	v		18,7m/s	11,9m/s	7,5m/s	5,9m/s	4,7m/s	3,7m/s
470,0l/s	R		115,8	37,9	12,1	6,7	3,7	2,1
	v		19,1m/s	12,2m/s	7,7m/s	6,0m/s	4,8m/s	3,8m/s
480,0l/s	R		120,6	39,5	12,6	7,0	3,9	2,2
	v		19,5m/s	12,4m/s	7,8m/s	6,2m/s	4,9m/s	3,8m/s
490,0l/s	R		125,4	41,1	13,1	7,2	4,0	2,3
	v		19,9m/s	12,7m/s	8,0m/s	6,3m/s	5,0m/s	3,9m/s
500,0l/s	R		130,4	42,7	13,6	7,5	4,2	2,3
	v		20,3m/s	13,0m/s	8,2m/s	6,4m/s	5,1m/s	4,0m/s
510,0l/s	R		135,5	44,3	14,1	7,8	4,3	2,4
	v		20,7m/s	13,2m/s	8,3m/s	6,6m/s	5,2m/s	4,1m/s
520,0l/s	R		140,6	46,0	14,6	8,1	4,5	2,5
	v		21,1m/s	13,5m/s	8,5m/s	6,7m/s	5,3m/s	4,2m/s

Flow rate V	d S di	200mm 11,9mm 176,2mm	250mm 14,8mm 220,4mm	315mm 18,7mm 277,6mm	355mm 21,1mm 312,8mm	400mm 23,7mm 352,6mm	450mm 26,7mm 399,6mm
530,0l/s	R	145,8	47,7	15,1	8,4	4,7	2,6
	v	21,5m/s	13,7m/s	8,7m/s	6,8m/s	5,4m/s	4,2m/s
540,0l/s	R	151,2	49,4	15,7	8,7	4,8	2,7
	v	21,9m/s	14,0m/s	8,8m/s	6,9m/s	5,5m/s	4,3m/s
550,0l/s	R	156,6	51,1	16,2	9,0	5,0	2,8
	v	22,3m/s	14,3m/s	9,0m/s	7,1m/s	5,6m/s	4,4m/s
560,0l/s	R	162,1	52,9	16,8	9,3	5,2	2,9
	v	22,7m/s	14,5m/s	9,1m/s	7,2m/s	5,7m/s	4,5m/s
570,0l/s	R	167,8	54,7	17,4	9,6	5,3	3,0
	v	23,1m/s	14,8m/s	9,3m/s	7,3m/s	5,8m/s	4,6m/s
580,0l/s	R	173,5	56,6	17,9	9,9	5,5	3,1
	v	23,5m/s	15,0m/s	9,5m/s	7,5m/s	5,9m/s	4,6m/s
590,0l/s	R	179,3	58,5	18,5	10,2	5,7	3,2
	v	23,9m/s	15,3m/s	9,6m/s	7,6m/s	6,0m/s	4,7m/s
600,0l/s	R	185,2	60,4	19,1	10,6	5,9	3,3
	v	24,3m/s	15,6m/s	9,8m/s	7,7m/s	6,1m/s	4,8m/s
610,0l/s	R	191,2	62,3	19,7	10,9	6,1	3,4
	v	24,7m/s	15,8m/s	10,0m/s	7,8m/s	6,2m/s	4,9m/s
620,0l/s	R		64,3	20,4	11,2	6,3	3,5
	v		16,1m/s	10,1m/s	8,0m/s	6,3m/s	5,0m/s
630,0l/s	R		66,3	21,0	11,6	6,4	3,6
	v		16,3m/s	10,3m/s	8,1m/s	6,4m/s	5,0m/s
640,0l/s	R		68,3	21,6	11,9	6,6	3,7
	v		16,6m/s	10,5m/s	8,2m/s	6,5m/s	5,1m/s
650,0l/s	R		70,4	22,3	12,3	6,8	3,8
	v		16,9m/s	10,6m/s	8,4m/s	6,6m/s	5,2m/s
660,0l/s	R		72,4	22,9	12,7	7,0	3,9
	v		17,1m/s	10,8m/s	8,5m/s	6,7m/s	5,3m/s
670,0l/s	R		74,6	23,6	13,0	7,2	4,0
	v		17,4m/s	10,9m/s	8,6m/s	6,8m/s	5,4m/s
680,0l/s	R		76,7	24,3	13,4	7,4	4,2
	v		17,6m/s	11,1m/s	8,7m/s	6,9m/s	5,4m/s
690,0l/s	R		78,9	24,9	13,8	7,6	4,3
	v		17,9m/s	11,3m/s	8,9m/s	7,0m/s	5,5m/s
700,0l/s	R		81,1	25,6	14,1	7,9	4,4
	v		18,1m/s	11,4m/s	9,0m/s	7,1m/s	5,6m/s
710,0l/s	R		83,3	26,3	14,5	8,1	4,5
	v		18,4m/s	11,6m/s	9,1m/s	7,2m/s	5,7m/s
720,0l/s	R		85,6	27,0	14,9	8,3	4,6
	v		18,7m/s	11,8m/s	9,3m/s	7,3m/s	5,8m/s
730,0l/s	R		87,9	27,7	15,3	8,5	4,8
	v		18,9m/s	11,9m/s	9,4m/s	7,4m/s	5,8m/s
740,0l/s	R		90,2	28,5	15,7	8,7	4,9
	v		19,2m/s	12,1m/s	9,5m/s	7,5m/s	5,9m/s
750,0l/s	R		92,6	29,2	16,1	8,9	5,0
	v		19,4m/s	12,3m/s	9,6m/s	7,6m/s	6,0m/s

Flow rate V	d S di	250mm 14,8mm 220,4mm	315mm 18,7mm 277,6mm	355mm 21,1mm 312,8mm	400mm 23,7mm 352,6mm	450mm 26,7mm 399,6mm
760,0l/s	R	94,9	30,0	16,5	9,2	5,1
	v	19,7m/s	12,4m/s	9,8m/s	7,7m/s	6,1m/s
770,0l/s	R	97,3	30,7	16,9	9,4	5,3
	v	20,0m/s	12,6m/s	9,9m/s	7,8m/s	6,2m/s
780,0l/s	R	99,8	31,5	17,3	9,6	5,4
	v	20,2m/s	12,7m/s	10,0m/s	7,9m/s	6,2m/s
790,0l/s	R	102,3	32,2	17,8	9,9	5,5
	v	20,5m/s	12,9m/s	10,2m/s	8,0m/s	6,3m/s
800,0l/s	R	104,8	33,0	18,2	10,1	5,6
	v	20,7m/s	13,1m/s	10,3m/s	8,1m/s	6,4m/s
810,0l/s	R	107,3	33,8	18,6	10,3	5,8
	v	21,0m/s	13,2m/s	10,4m/s	8,2m/s	6,5m/s
820,0l/s	R	109,9	34,6	19,1	10,6	5,9
	v	21,3m/s	13,4m/s	10,5m/s	8,3m/s	6,6m/s

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THERMAL EXPANSION - CONTRACTION

General principles
According to the laws of physics, all piping materials expand when heated and contract when cooled. This phenomenon, which occurs independently of the piping material, must be taken into account when installing the Aqua-Plus polypropylene system.
The thermal change in the longitudinal axis (linear expansion/contraction) occurs mainly due to the temperature difference between the operating temperature of the fluid (water) and the ambient temperature where the pipe is located. A change in length can also be caused by internal pressure in a small percentage.

Length change due to heat
The change in length due to heat (linear expansion/contraction) is calculated by the equation:

$$\Delta L = a \cdot L \cdot \Delta T$$

ΔL = Length variation due to heat (mm)
a = Linear expansion coefficient of the pipe materials (mm/m · K)
L = Calculated pipe length (m)
T_w = Operating temperature of the fluid inside the pipe (K)
T_a = Ambient temperature at the exterior of the pipe (K)
ΔT = Temperature difference [$\Delta T = T_W - T_a$] (K)

*1 The linear expansion coefficient (a) is different for each pipe type and structure.

Length change due to internal pressure
The change in length due to internal hydraulic pressure is calculated by the equation:

$$\Delta L_p = \frac{0.1 \cdot P_i}{E_{CR}} - \frac{(1-2\cdot\mu)}{\left(\frac{d_e}{d_i}\right)-1} \cdot L_{PIPE}$$

ΔL_p = Length variation due to internal pressure (mm)
P_i = Internal pressure (Bar)
E_{CR} = Material creep coefficient (N/mm²)
d_e = Outer diameter (mm)
d_i = Inner diameter (mm)
L_{PIPE} = Pipe length (mm)
μ = Poisson ratio $\mu = - \varepsilon_t - \varepsilon_l$ (-). Usually 0,38 for PP
ε_t = Transverse strain (m/m)
ε_l = Longitudinal or axial strain (m/m)

Structure of Aqua-Plus pipe	Linear expansion	(a) mm/m·K
Single layer pipe **(SL)**		0,07
Multilayer pipe with fiberglass **(GF)**		0,030
Multilayer pipe with aluminium **(AL)**		0,025

The coefficient of linear change (a) for the pipe type (OT) with oxygen barrier and the type (UV) with protection against solar radiation derives from the main structure of the pipe they serve.

Tables for quick calculation of the length variation ΔL

Single layer pipe (SL) PP-R, PP-RCT a=0,07mm/m·k

Length [m]	$\Delta T=T_{water}-T_{ambient}$							
	10	20	30	40	50	60	70	80
	Linear expansion ΔL [mm]							
5	4	7	11	14	18	21	25	28
10	7	14	21	28	35	42	49	56
15	11	21	32	42	53	63	74	84
20	14	28	42	56	70	84	98	112
25	18	35	53	70	88	105	123	140
30	21	42	63	84	105	126	147	168
35	25	49	74	98	123	147	172	196
40	28	56	84	112	140	168	196	224
45	32	63	95	126	158	189	221	252
50	35	70	105	140	175	210	245	280

Multi-layer pipe with fiberglass (GF) PP-R, PP-RCT/GF/PP-R / a=0,030mm/m·k

Length [m]	$\Delta T=T_{water}-T_{ambient}$							
	10	20	30	40	50	60	70	80
	Linear expansion ΔL [mm]							
5	2	3	5	6	8	9	11	12
10	3	6	9	12	15	18	21	24
15	5	9	14	18	23	27	32	36
20	6	12	18	24	30	36	42	48
25	8	15	23	30	38	45	53	60
30	9	18	27	36	45	54	63	72
35	11	21	32	42	53	63	74	84
40	12	24	36	48	60	72	84	96
45	14	27	41	54	68	81	95	108
50	15	30	45	60	75	90	105	120
60	18	36	54	72	90	108	126	144
70	21	42	63	84	105	126	147	168
80	24	48	72	96	120	144	168	192
90	27	54	81	108	135	162	189	216
100	30	60	90	120	150	180	210	240

Multi-layer pipe with aluminium (AL) PP-R/AL/PP-R a=0,025mm/m·k

Length [m]	$\Delta T=T_{water}-T_{ambient}$							
	10	20	30	40	50	60	70	80
	Linear expansion ΔL [mm]							
5	1	3	4	5	6	8	9	10
10	3	5	8	10	13	15	18	20
15	4	8	11	15	19	23	26	30
20	5	10	15	20	25	30	35	40
25	6	13	19	25	31	38	44	50
30	8	15	23	30	38	45	53	60
35	9	18	26	35	44	53	61	70
40	10	20	30	40	50	60	70	80
45	11	23	34	45	56	68	79	90
50	13	25	38	50	63	75	88	100
60	15	30	45	60	75	90	105	120
70	18	35	53	70	88	105	123	140
80	20	40	60	80	100	120	140	160
90	23	45	68	90	113	135	158	180
100	25	50	75	100	125	150	175	200

Categorization of installations
Due to the heat-dependent material expansion, we suggest some solutions to counterbalance the effects of linear expansion according to the different types of installation, distinguishing them into:
—Embedded installation in floor or wall
—External visible installation, vertical or horizontal

Embedding in floor or wall

Pipe with insulation
An insulation of sufficient thickness is capable of absorbing the expansion of the pipe. If the expansion is larger than the moving space in the insulation, the material completely absorbs any remaining expansion resulting from the inherent elasticity of the pipe itself.

Pipe without insulation
The same applies to pipes that do not need to be insulated according to current thermal insulation regulations. Temperature-induced linear expansion is prevented by enclosing in the floor, in concrete or plaster.
The compression and tensile stresses resulting from this are not critical, as they are absorbed by the material itself.
The "absorption" mechanism is based on the already small but variable modulus of elasticity of the material (which decreases with increasing temperature-time), as well as the application of a single evenly distributed anchorage of its walls.
When external stresses (concrete, coating, sand, etc.) are larger than the expansion tendencies of the pipe (surfacial, cubic, radial, axial), the polymer molecules oscillate in relation to the inside of the pipe, without affecting its structure.

External installation
In cases where the pipes are installed externally, e.g., mechanical wells (vertical) or in roofs (horizontal) and are subject to a change in their length, it is important to take compensatory measures with provisions that will allow or prevent movement for each case accordingly. Proper installation should ensure stability and excellent visual characteristics.
For best control, the length of the linear expansion/contraction should not exceed the limit of ΔL> 50mm between two fixed points (FP).

In long straight lines, it is recommended to apply expansion arrangements per:

—10m for single layer pipe (SL)

—40m for glass fiber pipe (GF)

—50m for aluminum pipe (AL)

—80-100m for pre-insulated pipe

As compensation arrangements are characterized:
The position of the anchor points, which can be a fixed point (FP) or a slippery point (SP), the flexible arm, the omega loop.
As a rule, the compensating arrangements (except the support) are made of components of the piping material. Otherwise, ready-made commercial components may be used.

Fixing collars (bilateral supports) should be of galvanized metal, with specific dimensions, suitable for plastic pipes. Inside they need to have EPDM/SBR rubber with or without felt and distance adjustment rings.
Fixing collars that allow (SP) or prevent (FP) the axial movements of the pipe must not mechanically injure its outer surface.

Compensation arrangement with fixed anchor points (FP)

The use of these fixed anchor points (FP) serves:
1. The division of a network's expansion into individual units (expansion direction, expansion size division) (Figures: 1a, 1b).
2. The protection of inelastic connections (Figure: 2).
3. The holding of weight loads (vertical column).

Always attempt to anchor non-flexible connectors, measuring devices or instruments that must not be subjected to forces due to linear expansion/contraction.

Figure: 1a

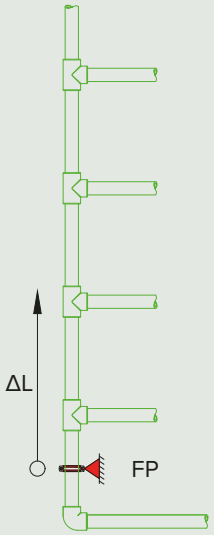


Figure: 1b

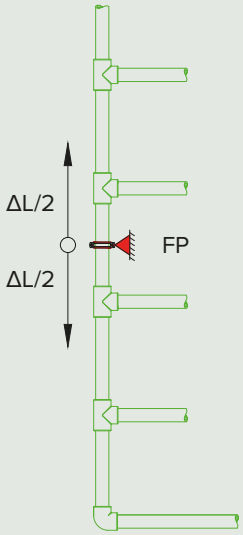
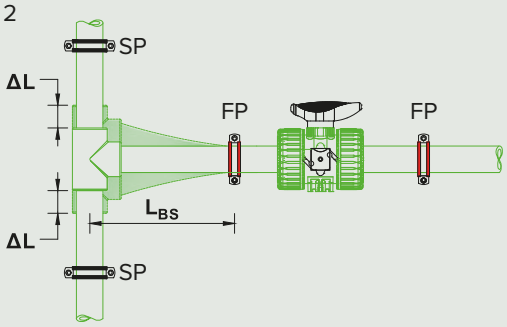


Figure: 2

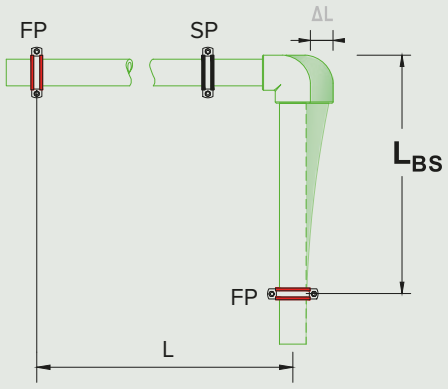


Flexible arm arrangement
In most cases, changes in the direction of the network are used as absorbing arrangemetns for the thermal elongation of straight sections.
The Length of the Flexible Arm (LBS) is taken from calculation tables on the following pages.
The Length of the Flexible Arm (LBS), apart from the tables, is calculated by the equation:

$L_{BS}=c\sqrt{(de\cdot\Delta L)}$

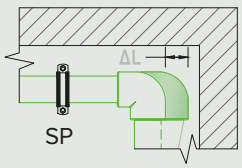
Where:
LBS = Required length of flexible arm (mm)
C = Interplast polypropylene material constant (15,0)
de = Outer pipe dimension (mm)
ΔL = Length variation due to heat (mm)
FP = Fixed anchor point
SP = Slippery fixing point
L = Length of straight section extending between the (FP) and the change of direction

Figure: 3



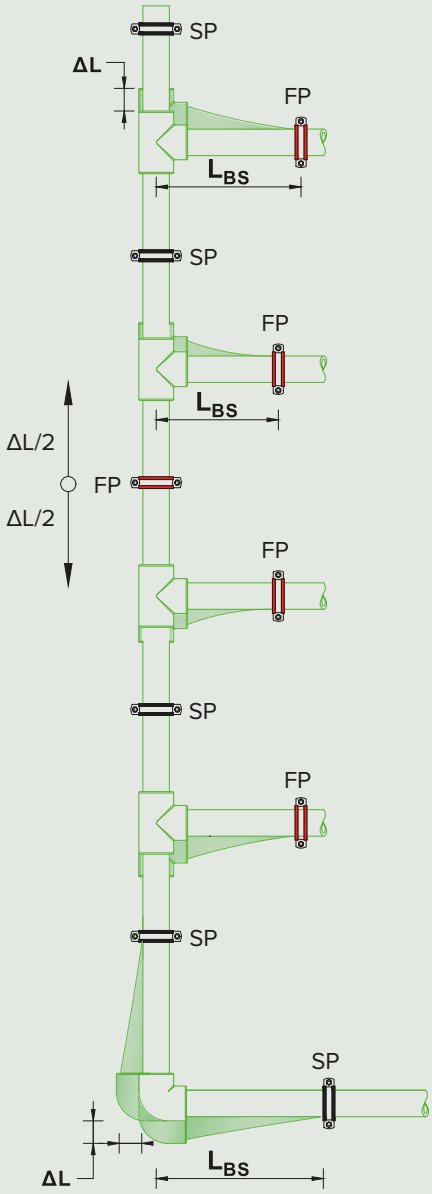
Ensure that there is sufficient space between obstacles for the expansion.

Figure: 4



Flexible arm arrangement in vertical column
As you can see, the LBS distance of the horizontal sections increases as we move away from the main fixed support (FP) of the vertical section. That happens because the expansion at the ends of the pipe is larger, while close to the main (FP) is smaller. Keep the longest LBS distance typically in all horizontal branches.

Figure: 5



Omega loop expansion

If the linear expansion cannot be compensated by the changes in direction, it is necessary to install an omega loop, using straight pipe sections and four 90° elbows. In this arrangement, the required length of the flexible arm 1B should be calculated, as well as the minimum bending width (A).

The minimum bending width (A) is calculated by the equation:

$$A_{min} = 2 \cdot \Delta L + SG$$

Where:

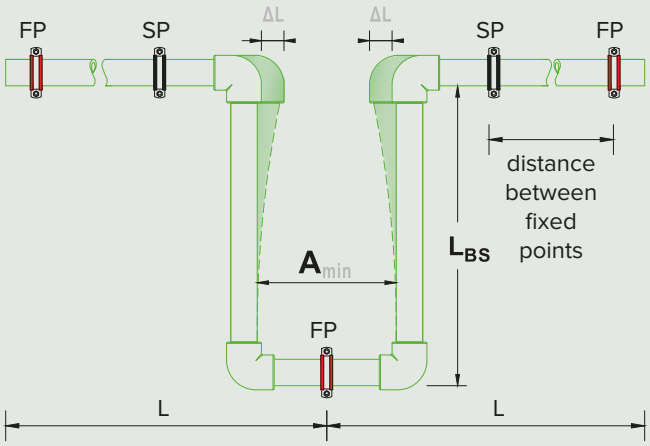
A_{min} = Minimum bending width of omega loop (mm)

ΔL = Length variation due to heat

SG = Safety distance 150 (mm)

L = Length of straight section extending between two fixed points (FP)

Figure: 6



Prestressing omega loop

When space is limited, it is possible to reduce the minimum bending width (Amin), as well as the length of the flexible arm (L/BS), with prestressing.

The use of a prestressing omega loop requires careful application and is recommended only in cases where it is required.

The length of the prestressed omega arm is calculated by the equation:

$$L_{PS} = c \cdot \sqrt{d_e \cdot \frac{\Delta L}{2}}$$

Where:

L_{PS} = Length of prestressed flexible arm (mm)

c = Interplast polypropylene material constant (15,0)

d_e = Outer pipe diameter (mm)

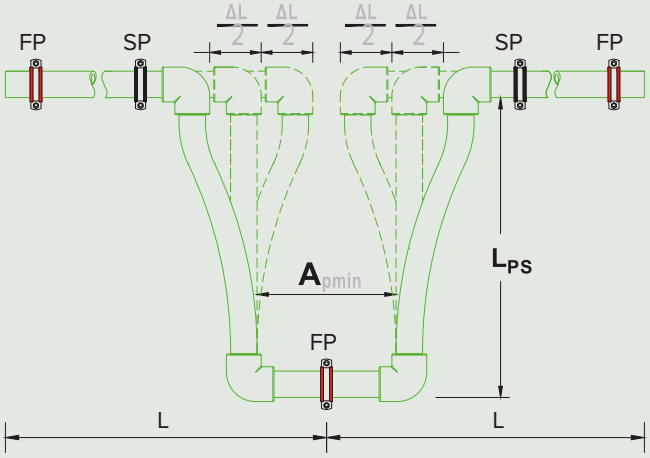
ΔL = Length variation due to heat

FP = Fixed anchor point

SP = Slippery fixing point

L = Length of straight section extending between two fixed points (FP)

Figure: 7



The above expansion arrangements only apply to polypropylene.

Wavy expansion arrangements, designed for metal networks, are unsuitable for the Aqua-Plus system.

Length of flexible arm L_{BS}

The flexible arm length L_{BS} is obtained from the following table for each pipe dimension and predetermined linear expansion value.

Pipe dimension	Linear Expansion ΔL [mm]											
	10	20	30	40	50	60	70	80	90	100	110	120
	Bending side length L_{BS}											
20	212	300	367	424	474	520	561	600	636	671	704	735
25	237	335	411	474	530	581	627	671	712	750	787	822
32	268	379	465	537	600	657	710	759	805	849	890	930
40	300	424	520	600	671	735	794	849	900	949	995	1039
50	335	474	581	671	750	822	887	949	1006	1061	1112	1162
63	376	532	652	753	842	922	996	1065	1129	1191	1249	1304
75	411	581	712	822	919	1006	1087	1162	1232	1299	1362	1423
90	450	636	779	900	1006	1102	1191	1273	1350	1423	1492	1559
110	497	704	862	995	1112	1219	1316	1407	1492	1573	1650	1723
125	530	750	919	1061	1186	1299	1403	1500	1591	1677	1759	1837
160	600	849	1039	1200	1342	1470	1587	1697	1800	1897	1990	2078
200	671	949	1162	1342	1500	1643	1775	1897	2012	2121	2225	2324
250	750	1061	1299	1500	1677	1837	1984	2121	2250	2372	2487	2598
315	842	1191	1458	1684	1882	2062	2227	2381	2526	2662	2792	2916
355	894	1264	1548	1787	1998	2189	2365	2528	2681	2826	2964	3096
400	949	1342	1643	1897	2121	2324	2510	2683	2846	3000	3146	3286
450	1006	1423	1743	2012	2250	2465	2662	2846	3019	3182	3337	3486

Length of flexible arm L_{PS}

The flexible prestressed arm length L_{PS} is obtained from the following table for each pipe dimension and predetermined linear expansion value.

Pipe dimension	Linear Expansion ΔL [mm]											
	10	20	30	40	50	60	70	80	90	100	110	120
	Bending side length L_{PS}											
20	150	212	260	300	335	367	397	424	450	474	497	520
25	168	237	290	335	375	411	444	474	503	530	556	581
32	190	268	329	379	424	465	502	537	569	600	629	657
40	212	300	367	424	474	520	561	600	636	671	704	735
50	237	335	411	474	530	581	627	671	712	750	787	822
63	266	376	461	532	595	652	704	753	799	842	883	922
75	290	411	503	581	650	712	769	822	871	919	963	1006
90	318	450	551	636	712	779	842	900	955	1006	1055	1102
110	352	497	609	704	787	862	931	995	1055	1112	1167	1219
125	375	530	650	750	839	919	992	1061	1125	1186	1244	1299
160	424	600	735	849	949	1039	1122	1200	1273	1342	1407	1470
200	474	671	822	949	1061	1162	1255	1342	1423	1500	1573	1643
250	530	750	919	1061	1186	1299	1403	1500	1591	1677	1759	1837
315	595	842	1031	1191	1331	1458	1575	1684	1786	1882	1974	2062
355	632	894	1095	1264	1413	1548	1672	1787	1896	1998	2096	2189
400	671	949	1162	1342	1500	1643	1775	1897	2012	2121	2225	2324
450	712	1006	1232	1423	1591	1743	1882	2012	2135	2250	2360	2465

Expansion arrangements on the market
Suitable expansion joints that could work harmoniously with the polypropylene system are those that have high elasticity, low pre-load tension, pressure-temperature resistance and chemical resistance analogous to PP material.

Acceptable types:
—Expansion joints of axial motion
—Expansion joints made of composite materials with metal neck and elastic with metal protection mesh (Figures: 8 & 9)

In any case, before choosing, consult Interplast's technical department, as well as the instructions of the manufacturers.

Figure: 8

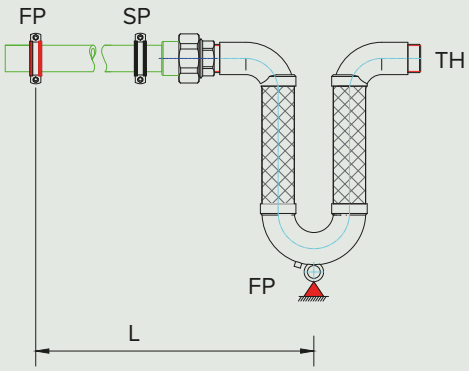
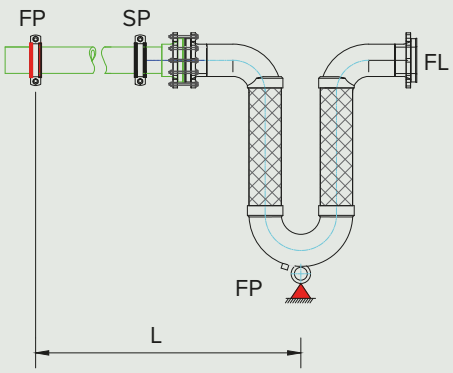


Figure: 9



Anchoring load
A fixed anchor point (FP) should prevent a pipe system from moving or slipping in any direction.

Its dimensioning is done taking into account all the possible forces that can be exerted, which are:
—Forces resulting from linear expansion
—Weight of vertical piping system
—Weight of water-mixture
—Network operating pressure
—Slip resistances of the supports (SP)
—Hydraulic arrangement resistances (U, Z, L)

It is important to know that the expansion forces are independent of the length of the network. The strain generated by the linear expansion in a 1m pipe is equal to the strain in a 100m pipe, under the same operating conditions.

The strain resulting from the expansion of the pipe is calculated by the equation:

$$\mathbf{F_{FP} = A_R E_C \cdot \Delta L}$$

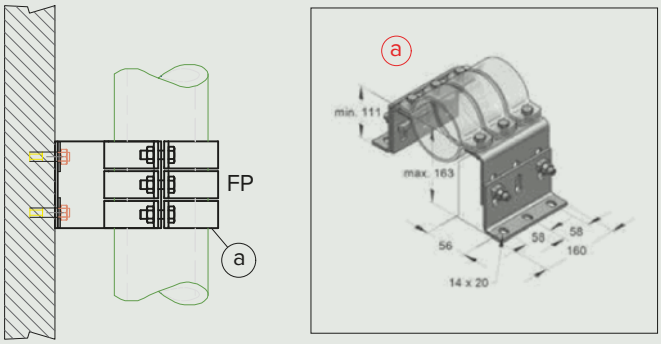
Where:
F_{FP} = Expansion load on the anchor (N)
A_R = Pipe ring area (mm^2)
E_C = Elasticity module for 100 min (N/mm^2)
ΔL = Resulting linear elongation (mm)

$$\mathbf{A_R = (d_e^2 - d_i^2)\frac{\pi}{4}}$$

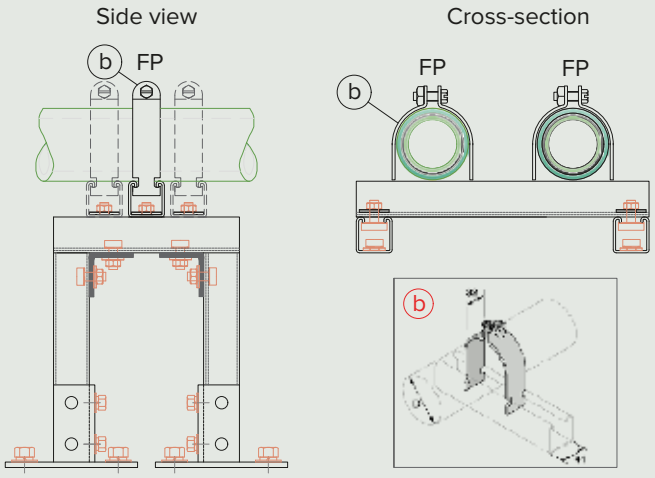
Where:
d_e = Outer dimension (mm)
d_i = Inner dimension (mm)

Indicative support types (FP) + (SP) for PP pipes

1. Ultra heavy type, for vertical installation

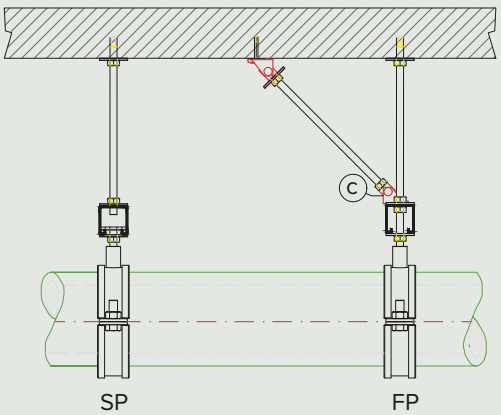


2. (FP) Heavy type, horizontally, on a concrete slab



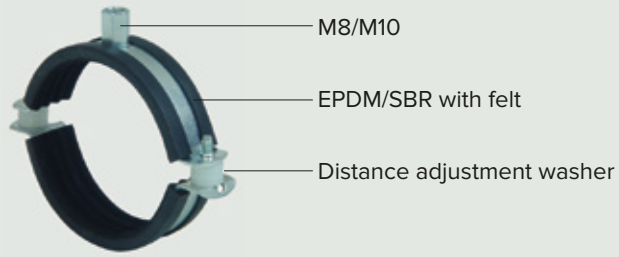
3. (FP) Horizontal suspension from a high ceiling

Struts joints mounting for stabilizing the rail and the (FP).

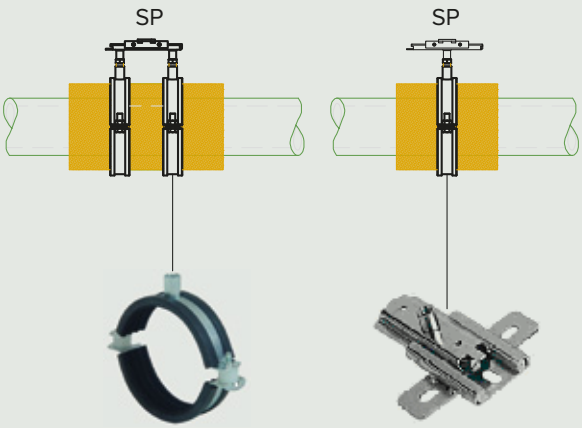


4. (FP) + (SP) STANDARD P

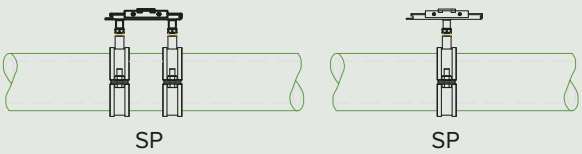
Divided, dual-use support M8/M10 with rubber and felt, suitable for plastic pipes
Standards: EN 10327, EN 1011, EN 12329



5. (SP) Heavy type double/single with a polyurethane shell



6. (SP) Heavy type double/single



Support types and mounting practices vary from case to case and are indicative. For the calculation, the sizing, and the selection of suitable support materials, contact the manufacturer or supplier of the equipment.

TABLES OF DISTANCES BETWEEN SUPPORTS FOR HORIZONTAL INSTALLATION

Aqua-Plus PP-R or PP-RCT SL, SDR 6 / 7,4 / 9 / 11									
	External Diameter D (mm)								
ΔT (°C)	20	25	32	40	50	63	75	90	110
	Support Distance (cm)								
0	85	105	125	140	165	190	205	220	250
20	70	85	100	110	130	150	160	170	190
30	70	85	100	110	130	150	160	170	190
40	70	80	90	100	120	140	150	160	180
50	70	80	90	100	120	140	150	160	180
60	65	75	85	95	110	125	135	150	170
70	60	70	85	90	105	115	125	135	150

Aqua-Plus PP-R or PP-RCT AL (aluminium) SDR 7,4									
	External Diameter D (mm)								
ΔT (°C)	20	25	32	40	50	63	75	90	110
	Support Distance (cm)								
0	120	150	170	190	215	240	255	270	300
20	120	130	150	170	190	210	220	230	250
30	120	130	150	170	190	210	220	230	250
40	110	120	140	160	180	200	210	220	230
50	110	120	140	160	180	200	210	220	230
60	100	110	130	150	170	190	200	210	220
70	90	100	120	140	160	180	190	200	210

Aqua-Plus PP-R or PP-RCT GF (fiberglass) SDR 7,4													
	External Diameter D (mm)												
ΔT (°C)	20	25	32	40	50	63	75	90	110	125	160	200	250
	Support Distance (cm)												
0	120	140	160	180	205	230	245	260	290	320	350	380	410
20	90	105	120	135	155	175	185	195	215	240	270	295	310
30	90	105	120	135	155	175	185	195	210	225	245	265	280
40	85	95	110	125	145	165	175	185	200	215	235	250	265
50	85	95	110	125	140	165	175	185	190	195	205	215	225
60	80	90	105	120	135	155	165	175	180	185	195	205	215
70	70	80	95	110	130	145	165	165	170	175	185	195	205

Aqua-Plus PP-R or PP-RCT GF (fiberglass) SDR 9													
	External Diameter D (mm)												
ΔT (°C)	32	40	50	63	75	90	110	125	160	200	250	315	355
	Support Distance (cm)												
0	155	175	200	225	240	255	285	300	310	315	325	335	340
20	115	130	150	170	180	190	210	225	225	240	245	250	255
30	115	130	150	170	180	190	200	210	215	225	230	240	245
40	105	120	140	160	170	180	190	200	205	215	225	225	230
50	105	120	140	160	170	180	180	185	195	205	215	220	220
60	100	115	130	150	160	170	170	175	185	195	200	205	210
70	90	105	125	140	155	155	160	165	175	185	190	200	205

Aqua Plus PP-R or PP-RCT GF (fiberglass) SDR 11															
	External Diameter D (mm)														
ΔT (°C)	32	40	50	63	75	90	110	125	160	200	250	315	355	400	450
	Support Distance (cm)														
0	150	170	195	220	235	250	275	280	285	290	300	310	315	325	325
20	110	125	145	165	175	185	200	205	210	220	225	230	235	250	265
30	110	125	145	165	175	185	190	195	200	210	215	220	225	240	255
40	100	115	135	155	165	175	180	185	190	200	210	210	215	230	245
50	100	115	135	155	160	170	170	175	180	190	205	205	205	220	235
60	95	110	125	145	150	160	160	165	170	180	190	190	195	205	220
70	85	110	120	135	140	145	150	155	160	170	185	185	190	195	210

Aqua-Plus PP-R & PP-RCT GF (fiberglass) SDR 17								
	External Diameter D (mm)							
ΔT (°C)	125	160	200	250	315	355	400	450
	Support Distance (cm)							
0	260	265	270	280	285	290	310	310
20	190	195	205	210	215	220	235	245
30	180	185	195	200	205	210	225	235
40	175	180	185	195	195	200	215	230
50	165	170	180	185	190	195	205	220
60	155	160	170	175	180	185	190	205
70	145	150	160	165	175	180	185	195

The distances between the supports for vertical installation can be increased by 20% of the values of the tables.

PIPINGS SUPPORT

Divided supports with rubber M8/M10 for plastic pipes Standard type

The support is used for inner installations, is made with special tightening materials and has spacers that do not allow the support to press the pipe. At the same time, the special rubber of the support with felt lining allows the pipe to slide without sticking. That ensures the necessary movement of the pipes and the transfer of contractions - expansions to the calculated points, without deforming the network.
The rubber also offers protection against sound transmission and vibration.
It can work with M8 and M10 cables.
The allowed load values for the supports range from 0,6 Kn to 1,9 Kn, depending on their dimensions.

TECHNICAL CHARACTERISTICS
Support: Steel DX5ID – EN 10327 (< 40mm) + DDII–ENI0III
Rubber: EPDM/SBR with felt, SHREA–45°± 5°
Temperature endurance: -40°C to +100°C
Average value of sound dampening: 17 dB(A)
Surface support protection: Electro galvanized – EN ISO 12329 (>50mm)

Divided supports with rubber M8/M10 Perfect type

The support is intended for inner installations, at supporting points. It can work with M8 and M10 cables. The special design of the side screws allows the quick assemblage and disassembly of the support. The rubber that is integrated on the support offers protection against sound transmission and vibration.
The permitted load values for the supports range from 0,8 Kn to 1,9 Kn, depending on their dimensions.

TECHNICAL CHARACTERISTICS
Support: Steel DDII – ENI0III
Rubber: EPDM/SBR black, SHROA = 45 ° ± 5°
Temperature endurance: -40°C to +100°C
Average value of sound dampening: 17 dB(A)
Surface support protection: Electro galvanized – EN ISO 12329

Divided supports without rubber M8/M10 Perfect type

The support is intended for outdoor installations exposed to sunlight. Depending on the degree of tightness of the pipe support, it can be used in points where stable or sliding support is required. It can work with M8 and M10 cables. The special design of the side screws allows the quick assemblage and disassembly of the support. The permitted load values of the supports range from 0,8 Kn to 1,9 Kn, depending on their dimensions.

TECHNICAL CHARACTERISTICS
Support: Steel DDII–ENI0III
Surface support protection: Electro galvanized –
EN ISO 12329

Divided polyurethane shells with supports without rubber M8/M10

The polyurethane shell is intended for the support points of insulated pipes in indoor and outdoor installations. Due to its hardness, the shell offers excellent mechanical properties in the support of the pipe, while it offers excellent thermal insulation due to the polyurethane material (W = 0.030 W/Mk). In this way, the thermal bridges with the external environment and the damages of the pipe insulation are avoided at the support points. The shell has a length of 10cm and a thickness of 15mm (for dimension <= 63mm) or 20mm (for dimension> 63mm). Externally, it has a protective cover of black aluminum, which protects the polyurethane from water vapor diffusion. The support that fits on the shell can work with M8 and MI0 cables.

Polyurethane density: 50 kg/m^3 upo to 90mm dimension, 80 kg/m^3 above that.
Temperature endurance: -50°C to +105°C

PP-R PIPE RESISTANCE TO EXTERNAL PRESSURE
Determination of the mechanical strength of a PP-R pipe under the influence of external compressive stress, according to the measure of elasticity module and the Poisson ratio of the specific material, as determined by the manufacturers of the raw material (E=8.508 kgf/cm^2 & v=0,45), results from the following equation:

$P = 2E / (I\text{-}v^2) \times (s/D)^2$

Where:
P = outer pressure in kgf/cm^2
E = modulus of elasticity in kg/cm^2
D = nominal diameter in cm
S = wall thickness in cm
V = Poisson ratio

Example: pipe Ø20X3, 4mm

D=2cm, s=0,34cm

P= $[(2x8.508)/(1\text{-}0,45^2)] \times (0,34/2)^3$=(17.0I6/0,7975) × 0,0049I3 = 104,72 kgf/cm^2

Regarding this value, it must be corrected according to the corresponding coefficient that results from the respective deformation of the pipe and depends on the ratio of the outer dimension to the wall thickness (SDR or PP-R pipes series).

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PIPES THERMAL INSULATION

Compared to traditional materials (steel, stainless steel, copper), polypropylene offers excellent thermal insulation. The thermal conductivity of PP-R type or PP-RCT is equal to 0.17 W/(m.K).
Due to the lower thermal conductivity value of the material, compared to metal piping systems, the required thermal insulation thickness may be reduced compared to the required thicknesses for metal pipes, determined by National, European and International Regulations.
Although polypropylene has a high thermal resistance, polypropylene systems must be provided with thermal insulation for the following reasons:
—Condensation of water vapor (creation of moisture drops) and increase of the temperature of the transported water (cold water systems).
—Temperature reduction of the transported water (hot water and heating systems).
—Cold drinking water installations must be protected from heat and condensation.
The values for the thickness of the insulation according to the standard ASHRAE 90.1-2010 & 2012 IECC, in combination with the λ of the insulator are indicated in the following table.

Thermal conductivity (λ)	0,021 (W/mk)		0,040 (W/mk)	
Water temperature	41-60°C	4-16°C	41-60°C	4-16°C
Pipe dimension PP-R or PP-RCT	Insulation wall thickness (mm)			
20mm	9,3	6,4	25,0	15,0
25mm	9,8	6,6	25,0	15,0
32mm	10,2	6,8	25,0	15,0
40mm	15,6	11,0	40,0	25,0
50mm	16,3	11,3	40,0	25,0
63mm	16,9	11,6	40,0	25,0
75mm	17,4	11,9	40,0	25,0
90mm	17,8	12,1	40,0	25,0
110mm	18,3	12,3	40,0	25,0
125mm	18,5	12,4	40,0	25,0
160mm	19,0	12,6	40,0	25,0
200mm	19,3	12,8	40,0	25,0
250mm	19,6	12,9	40,0	25,0
315mm	19,9	13,0	40,0	25,0
355mm	20,0	13,1	40,0	25,0
400mm	20,1	13,1	40,0	25,0
450mm	20,2	13,1	40,0	25,0

21 FAQ

QUESTIONS AND ANSWERS

Is Aqua-Plus suitable for drinking water?

The pipes and fittings of the Aqua-Plus system are non-toxic and completely safe for contact with drinking water and food.
After all, most food packaging is made from PP-R, the same material used in the Aqua-Plus system.
Aqua-Plus pipes and fittings are officially certified for their suitability for hot and cold drinking water by the British WRAS Institute (a member of the International NSF Organization) and the American ICC Institute, according to the NSF of the United States.

Can the Aqua-Plus pipe be used in heating installations?

According to the tests of the Aqua-Plus pipe, the relevant lifespan diagrams in combination with pressure and increased temperature, as well as the properties of the material, make the Aqua-Plus system suitable for heating installations.
A good combination of materials in the heating system is to use the Aqua-Plus system for the main supply and return columns, providing hot water to the main heating distribution manifolds and the Como-Pex cross-linked polyethylene pipe from the manifolds to the radiators.

Is the Aqua-Plus pipe resistant to frost?

Like all materials, the Aqua-Plus pipe also requires great care during its installation when ambient temperatures are close to 0°C.
However, once installed and after the beginning of its operation, due to the elasticity of the material combined with the relatively large wall thickness, the Aqua-Plus pipe behaves better than any other classic material (e.g., metal) in frozen water, thus reducing the maintenance costs of the installation.

Can we heat the Aqua-Plus pipe to make bends?

Although a full range of elbows (45° and 90° fittings), as well as vertical pipe “V” diversions are available, in cases where it is considered necessary, the pipe can be heated by a special hot air blowing device regulated at 135°C.

Is the pipe resistant to sunlight radiation?

In general, plastic pipes should not be exposed to sunlight for a long time. In cases where an outdoor installation is required, the pipes should be protected with external insulation or painted with plastic paint. In indoor installations (e.g., basements) pipes do not need to be coated. For pipes bearing the UV mark, please contact the Technical Support Department of our company.

How much do Aqua-Plus pipes expand and contract?

In general, plastic pipes are subject to a greater thermal expansion and contraction compared with metal ones.

For this reason, in long straight lengths of piping provisions must be made for thermal expansion and contraction through the use of expansion fittings, supports and connections (e.g., flexible arm).
However, when we use Aqua-Plus aluminum pipes or pipes with Fiber Glass, the expansions of the pipes are significantly reduced.
When the pipe is embedded in concrete, it follows the general rule for plastic pipes, which do not expand longitudinally but inwards.
That is why it is recommended, even in cases where in-wall installation of the piping occurs, the thickness of the plaster to be 3cm.

FAQ

How are Aqua-Plus pipes and fittings tested?

Interplast is certified with ISO 9001, 14001 & 50001 and complies with all the procedures of the Quality Assurance System. The inspections to which our products are subject start from the acceptance tests of raw materials, various materials and packaging materials.
Then, the testing of the final products occurs, which includes dimensional and visual tests, pressure and temperature tests, reversion tests after heating, impact tests, tests during the packaging phase and sampling tests during the storage phase.
At the same time, the international certification bodies SKZ, AENOR, WRAS check the quality of our pipes at regular intervals (every 6 months) by conducting random sampling checks from warehouses and production lines.

What is the service life of the Aqua-Plus pipes and fittings?

The Aqua-Plus system has been designed for a service life of at least 50 years for continuous use (24 hours, 365 days) at high temperature and pressure conditions.

If the Aqua-Plus pipe is punctured or breaks, what can we do?

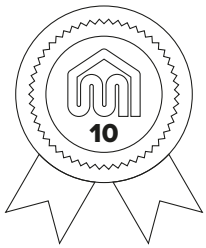
Provision has been made in the Aqua-Plus pipes and fittings systems for cases of an accidental puncture.
By using a special item (restore tack 7/11mm) we can repair the damage with negligible cost.
If it is necessary to repair a pipe which at some point along its length shows a crack or a burst, we can use a nelectric coupling or a brass mechanical clamping device (connection) for cold water installation cases.

In Aqua-Plus pipes does the inner dimension tend to clog up after some years as in metal ones?

A great advantage of the Aqua-Plus system is that the smooth inner surface, in conjunction with the properties of the material, is not susceptible to electro chemical corrosion or scaling (as in the case of metal pipes). As a result, the pipes remain unaltered through time, making the operation of the installation more economical, without being subject to changes and problems.

Do the Aqua-Plus pipes offer a guarantee?

The Aqua-Plus pipes & fittings system is covered by a 10-year guarantee, provided by the Generali insurance company, against damages that occur from proven failure of the material, to a sum of €500.000 per incident and up to a maximum of €3.000.000 within a one-year period.



HOUSE OF INNOVATION

WARRANTY STATEMENT

Statement No. .....

Customer (Beneficiary) .....

Person in charge of installation .....

Installation date .....

Sales outlet .....

Date of purchase .....

Pipe manufacturing Lot no .....

This warranty covers the Aqua-Plus pipes and fittings described in the Polypropylene Random handbook for 10 years.
In the case of defect, Interplast S.A. will undertake to disassemble and reassemble the articles in question and repair consequential damages arising from its products, under its own supervision or at its own expense, subject to prior inspection and approval by Interplast of its estimated responsibility.
In addition, Interplast will award compensation for damages arising out of product liability and for any manufacturing defect of the products mentioned above.
We guarantee these products for the aforementioned time of 10 years from the date of purchase to a sum of €500.000 per incident and up to a maximum of €3.000.00 in a one-year period, through the cover of Generali insurance company.

To be eligible for the above compensations, you should meet these conditions:
a. You should report the damage within a maximum of 14 days.
b. You should ensure that you have accurately followed the guidelines (see handbook) regarding the installation method and the operation of Interplast's pipes and fittings
c. You must submit the declaration herein signed within a maximum of 15 days from the beginning of the operation.

For Interplast S.A.

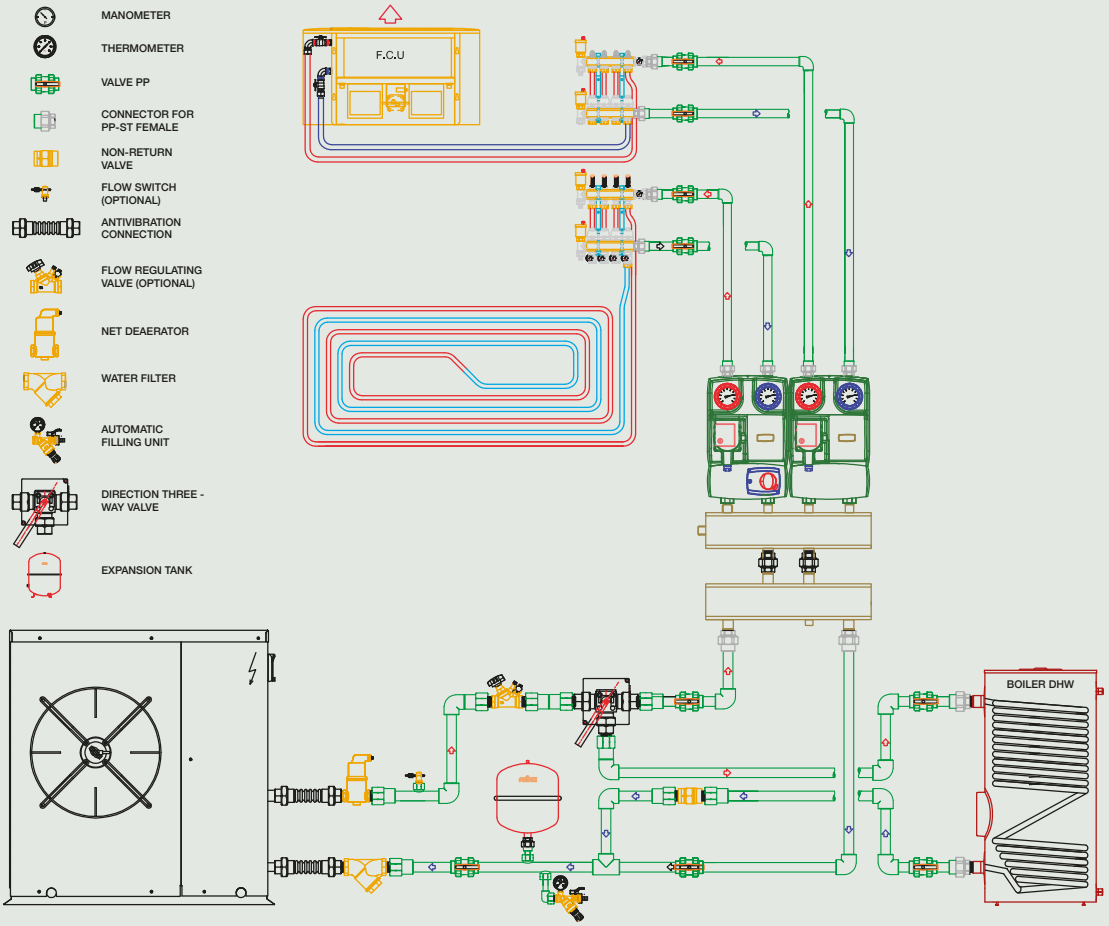
.....

We certify that in the works we carried out, we installed Interplast S.A. pipes and fittings according to the guidelines in the handbook.

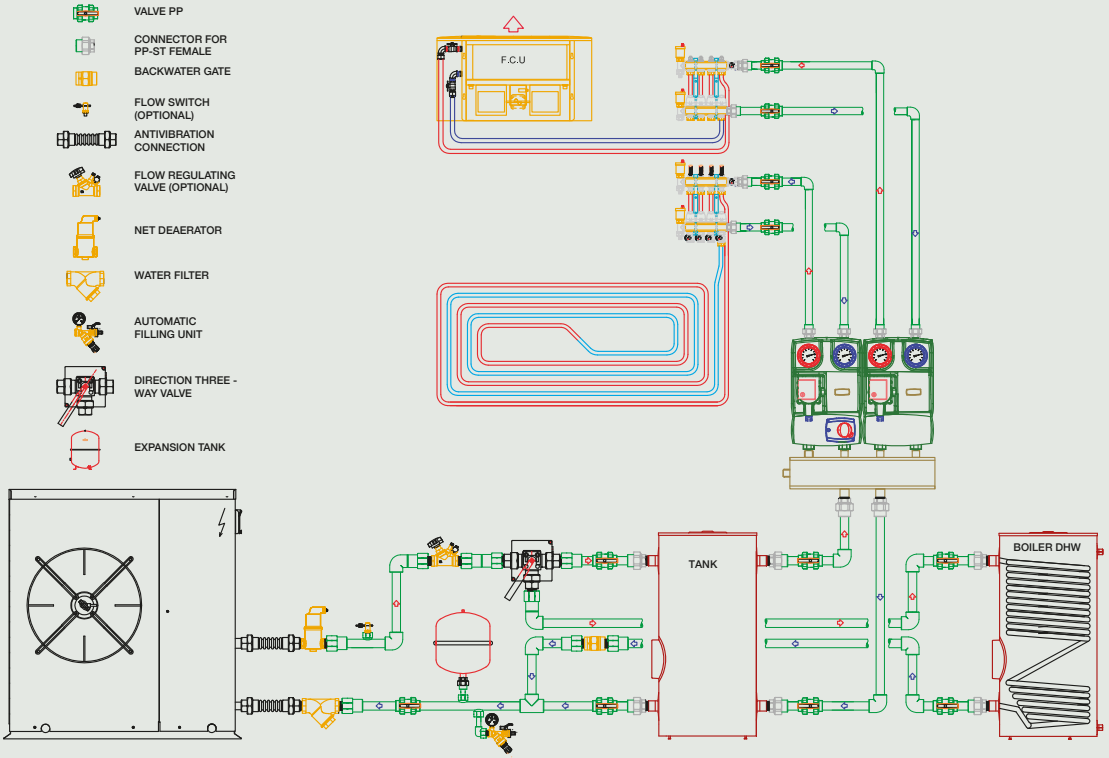
.....	.....	.....
Place	*Date*	*Plumbing Technician (Stamp-Signature)*

22 DESIGNS

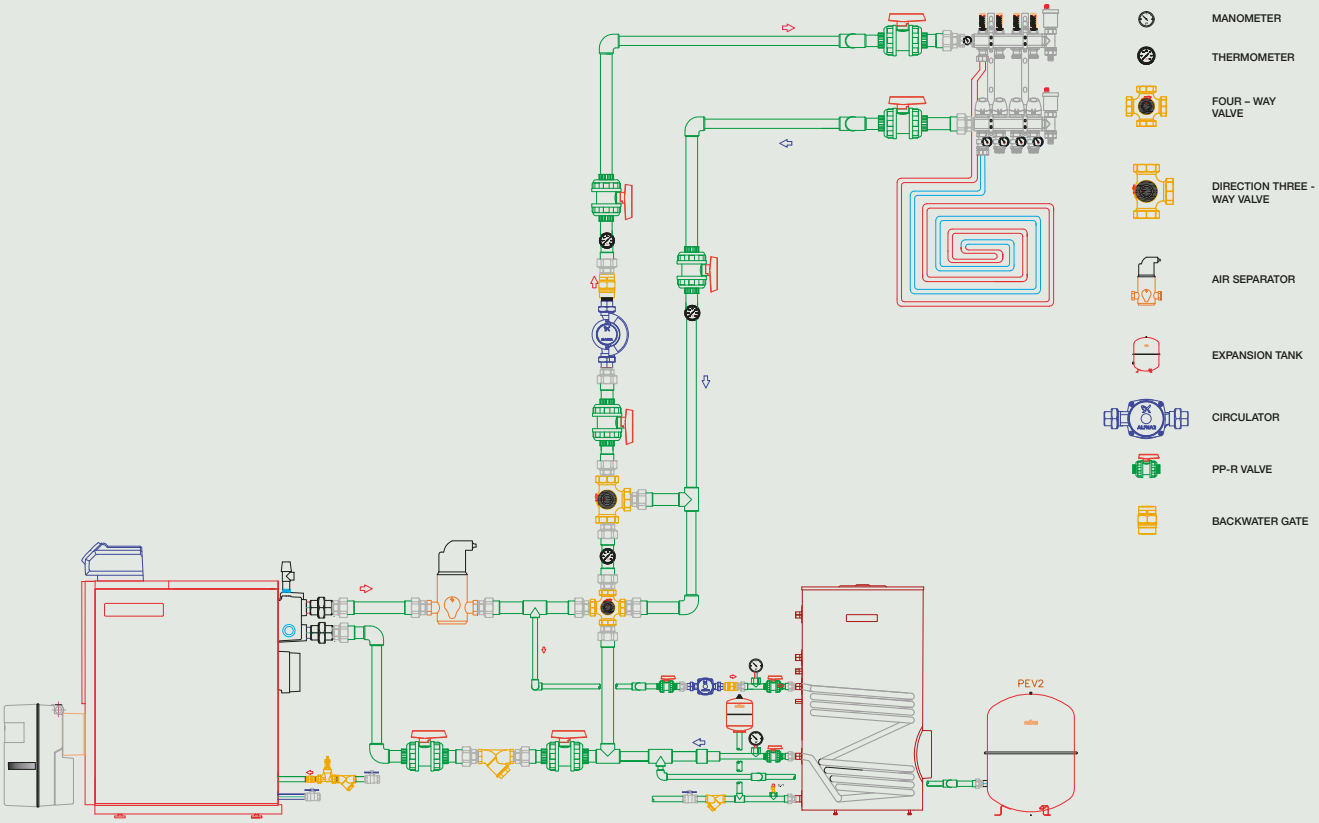
1. Mechanical drawing of the pumped storage room with heat-pump Inverter, working with underfloor heating, FCU and DHW.



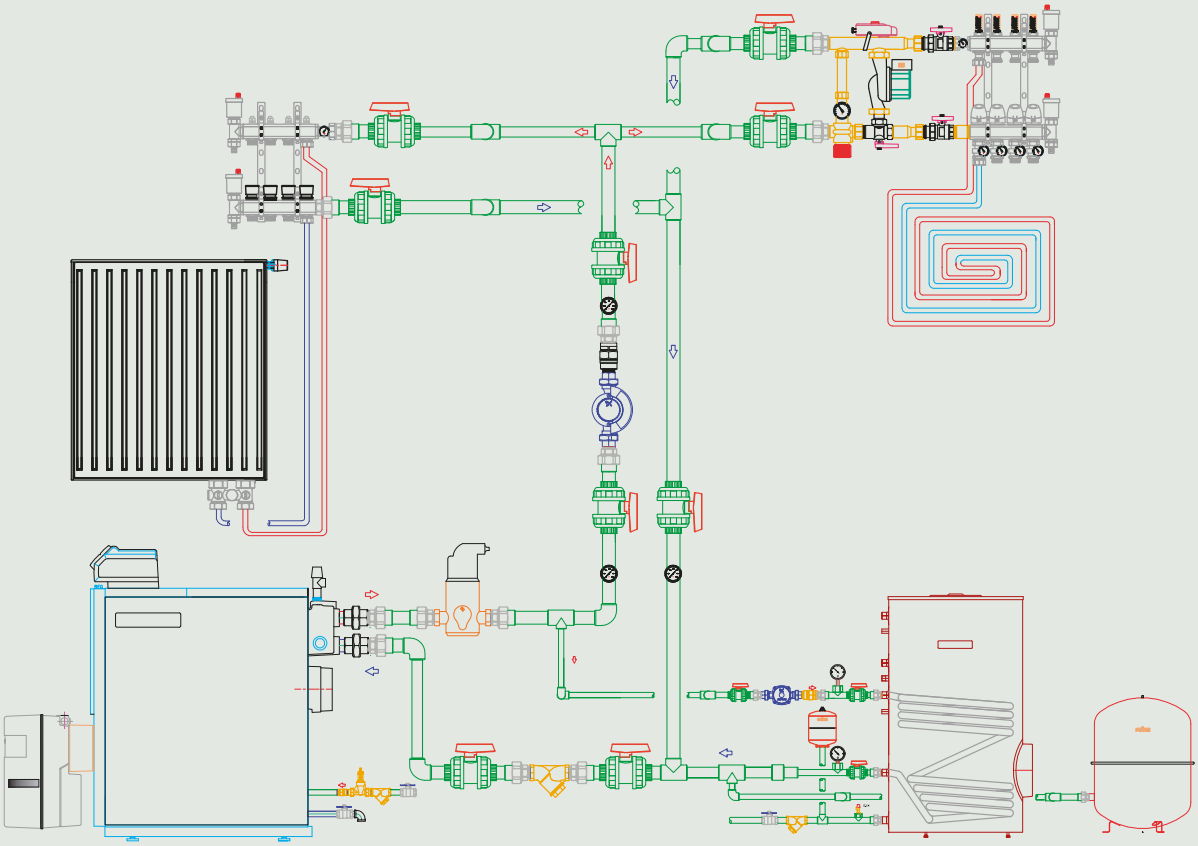
2. Mechanical drawing of the pumped storage room with fixed power heat-pump, working with underfloor heating, FCU and DHW.



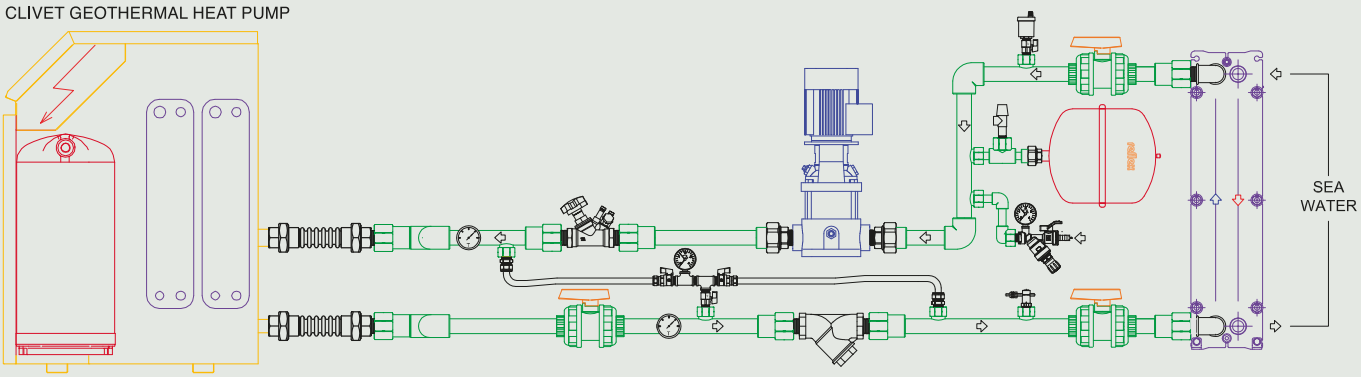
3. Mechanical drawing of the pumped storage room for underfloor heating and DHW.



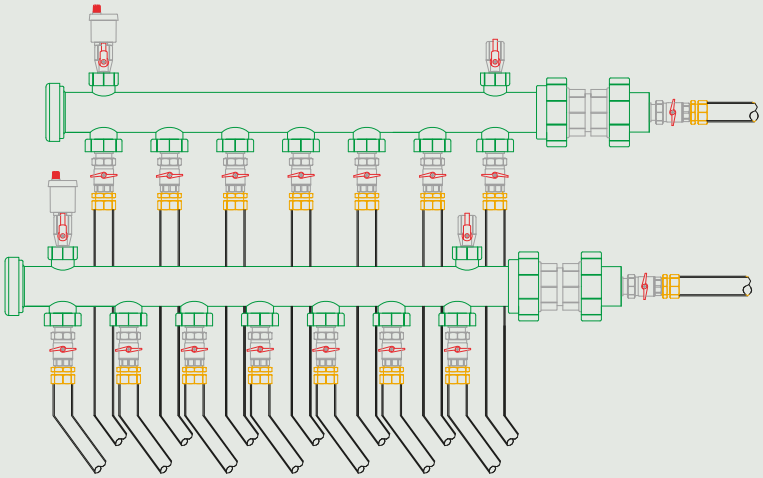
4. Mechanical drawing of the pumped storage room with two central risers for supply of Conventional and underfloor heating system.



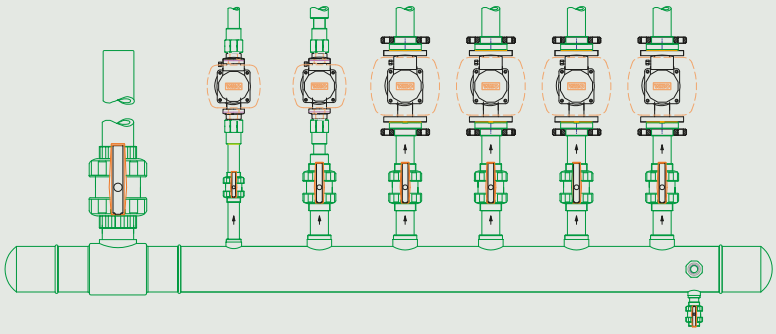
5. Mechanical drawing of Geothermal pump in combination with exchanger for exploitation of sea water.



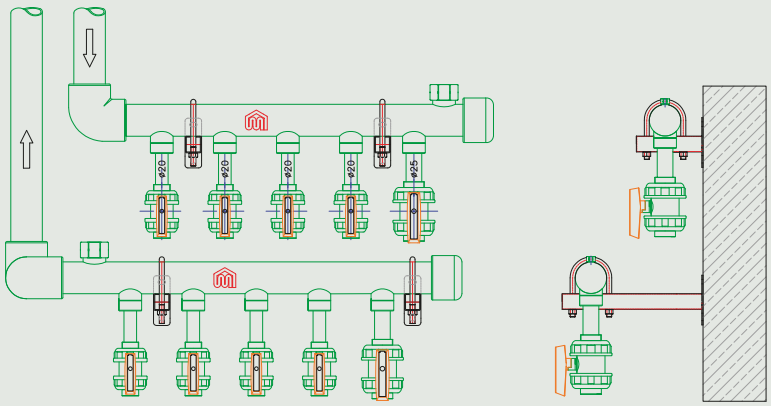
6. Geothermal PP manifold.



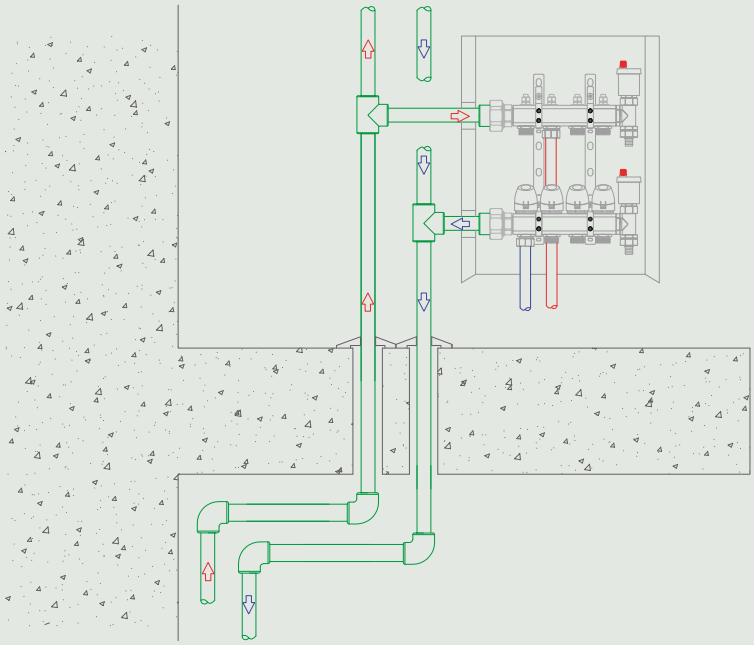
7. PP manifold for central networks.



8. Support of the Manifold in central networks made of PP.



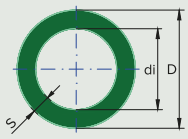
9. PP Central risers and connection of group manifolds for underfloor heating.



23

AQUA-PLUS SYSTEM TABLES

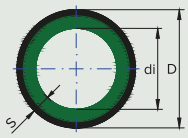
23.1 AQUA-PLUS PIPES TABLES



Aqua-Plus (SL) PP-R 100 - PN 20 - SDR 6

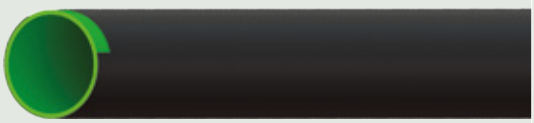
Structure of pipe: Single Layer (SL)
Type of pipe: SDR 6 / S 2.5
Material: PP-R 100
Standards: DIN 8077/78 - EN ISO 15874
Color: Green
Length: Ø20 - Ø110 straight lengths 4 m

External Diameter D (mm)	Wall Thickness S (mm)	Internal Diameter Di (mm)	Water Capacity (l/m)	Pipe Weight (kgr/m)	Package (m)
SOCKET WELDING					
20	3,4	13,2	0,137	0,172	100
25	4,2	16,6	0,216	0,267	80
32	5,4	21,2	0,353	0,435	60
40	6,7	26,6	0,556	0,671	40
50	8,4	33,2	0,866	1,050	16
63	10,5	42,0	1,385	1,650	12
75	12,5	50,0	1,963	2,340	8
90	15,0	60,0	2,827	3,400	4
110	18,4	73,2	4,208	5,040	4

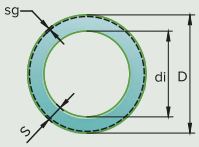


Aqua-Plus (SL) UV PP-R 125 - PN 20 - SDR 7,4

Structure of pipe: Single Layer (SL) - Full UV Protected
Type of pipe: SDR 7,4 / S 3.2
Material: PP-R 125
Standards: DIN 8077/78 - EN ISO 15874
Color: Black
Length: Ø20 - Ø110 straight lengths 4 m



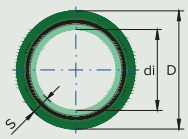
External Diameter D (mm)	Wall Thickness S (mm)	Internal Diameter Di (mm)	Water Capacity (l/m)	Pipe Weight (kgr/m)	Package (m)
SOCKET WELDING					
20	2,8	14,4	0,163	0,19	100
25	3,5	18,0	0,254	0,29	80
32	4,4	23,2	0,423	0,47	60
40	5,5	29,0	0,660	0,72	40
50	6,9	36,2	1,029	1,10	16
63	8,6	45,8	1,647	1,73	12
75	10,3	54,4	2,323	2,45	8
90	12,3	65,4	3,358	3,37	4
110	15,1	79,8	4,999	5,10	4



Aqua Plus AL PP-R 125 - PN 20 - SDR 7,4

Structure of pipe: Multi-layer, with aluminium (AL)
Type of pipe: SDR 7,4 / S 3.2
Material: PP-R 125
Standards: DIN 8077/78 - EN ISO 15874
Color: Green
Length: Ø20 - Ø110 straight lengths 4 m

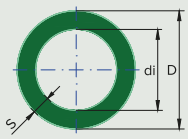
External Diameter D (mm)	Wall Thickness S (mm)	Internal Diameter Di (mm)	Water Capacity (l/m)	Pipe Weight (kgr/m)	Package (m)
SOCKET WELDING					
20	2,8	14,4	0,163	0,178	100
25	3,5	18,0	0,254	0,263	80
32	4,4	23,2	0,423	0,42	60
40	5,5	29,0	0,660	0,63	40
50	6,9	36,2	1,029	0,96	16
63	8,6	45,8	1,647	1,48	12
75	10,3	54,4	2,323	2,08	8
90	12,3	65,4	3,358	2,96	4
110	15,1	79,8	4,999	4,40	4



Aqua Plus (GF) PP-R 125 - PN 20 - SDR 7,4

Structure of pipe: Multi-layer, reinforced with glass fiber (GF)
Type of pipe: SDR 7,4 / S 3.2
Material: PP-R 125 or PP-RCT (PN 25)
Standards: DIN 8077/78 - EN ISO 15874 -
EN ISO 21003 - CSA 137.11 - ASTM F 2389
Color: Green
Length: Ø20 - Ø125 straight lengths 4 m
Ø160 - Ø250 straight lengths 5,8 m
Upon request, straight lengths 11,6 m

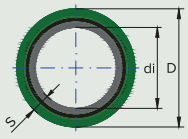
External Diameter D (mm)	Wall Thickness S (mm)	Internal Diameter Di (mm)	Water Capacity (l/m)	Pipe Weight (kgr/m)	Package (m)
SOCKET WELDING					
20	2,8	14,4	0,163	0,158	100
25	3,5	18,0	0,254	0,246	80
32	4,4	23,2	0,423	0,394	60
40	5,5	29,0	0,660	0,613	40
50	6,9	36,2	1,029	0,955	16
63	8,6	45,8	1,647	1,500	12
75	10,3	54,4	2,323	2,135	8
90	12,3	65,4	3,358	3,058	4
110	15,1	79,8	4,999	4,576	4
125	17,1	90,8	6,472	5,891	4
BUTT WELDING					
160	21,9	116,2	10,599	9,538	5,8
200	27,4	145,2	16,550	14,944	5,8
250	34,2	181,6	25,901	23,312	5,8



Aqua Plus (SL) PP-R 125 - PN 20 - SDR 7,4

Structure of pipe: Single Layer (SL)
Type of pipe: SDR 7,4 / S 3.2
Material: PP-R 125 or PP-RCT (PN 25)
Standards: DIN 8077/78 - EN ISO 15874 - EN ISO 21003 - CSA 137.11 - ASTM F 2389
Color: Green
Length: Ø20 - Ø125 straight lengths 4 m
Ø160 - Ø250 straight lengths 5,8 m
Upon request, straight lengths 11,6 m

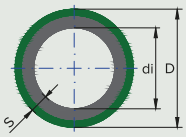
External Diameter D (mm)	Wall Thickness S (mm)	Internal Diameter Di (mm)	Water Capacity (l/m)	Pipe Weight (kgr/m)	Package (m)
SOCKET WELDING					
20	2,8	14,4	0,163	0,15	100
25	3,5	18,0	0,254	0,23	80
32	4,4	23,2	0,423	0,37	60
40	5,5	29,0	0,660	0,57	40
50	6,9	36,2	1,029	0,88	16
63	8,6	45,8	1,647	1,38	12
75	10,3	54,4	2,323	1,96	8
90	12,3	65,4	3,358	2,81	4
110	15,1	79,8	4,999	4,23	4
125	17,1	90,8	6,472	5,41	4
BUTT WELDING					
160	21,9	116,2	10,599	8,79	5,8
200	27,4	145,2	16,550	13,70	5,8
250	34,2	181,6	25,901	21,22	5,8



Aqua-Plus (GF) PP-RCT - PN 20 - SDR 9

Structure of pipe: Multi-layer, reinforced with glass fiber (GF)
Type of pipe: SDR 9 / S 4
Material: PP-RCT
Standards: DIN 8077/78 - EN ISO 15874 - EN ISO 21003 - CSA 137.11 - ASTM F 2389
Color: Green
Length: Ø20 - Ø125 straight lengths 4 m
Ø160 - Ø355 straight lengths 5,8 m
Upon request, straight lengths 11,6 m

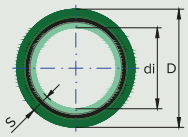
External Diameter D (mm)	Wall Thickness S (mm)	Internal Diameter Di (mm)	Water Capacity (l/m)	Pipe Weight (kgr/m)	Package (m)
SOCKET WELDING					
20 (sdr 7,4)	2,8	14,4	0,163	0,158	100
25 (sdr 7,4)	3,5	18,0	0,254	0,246	80
32	3,6	24,8	0,483	0,32	60
40	4,5	31,0	0,754	0,51	40
50	5,6	38,8	1,182	0,791	16
63	7,1	48,8	1,869	1,26	12
75	8,4	58,2	2,659	1,77	8
90	10,1	69,8	3,83	2,55	4
110	12,3	85,4	5,72	3,78	4
125	14,0	97,0	7,386	4,88	4
BUTT WELDING					
160	17,9	124,2	12,110	7,98	5,80
200	22,4	155,2	18,91	12,48	5,80
250	27,9	194,20	29,61	19,42	5,80
315	35,2	244,6	46,97	30,87	5,80
355	39,7	275,6	59,63	39,2	5,80



Aqua-Plus (SL) PP-RCT - PN 20 - SDR 9

Structure of pipe: Single Layer (SL)
Type of pipe: SDR 9 / S 4
Material: PP-RCT
Standards: DIN 8077/78 - EN ISO 15874 - EN ISO 21003 - CSA 137.11 - ASTM F 2389
Color: Green
Length: Ø20 - Ø125 straight lengths 4 m
Ø160 - Ø355 straight lengths 5,8 m
Upon request, straight lengths 11,6 m

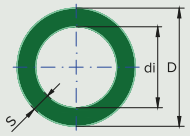
External Diameter D (mm)	Wall Thickness S (mm)	Internal Diameter Di (mm)	Water Capacity (l/m)	Pipe Weight (kgr/m)	Package (m)
SOCKET WELDING					
20 (sdr 7,4)	2,8	14,4	0,163	0,15	100
25 (sdr 7,4)	3,5	18,0	0,254	0,23	80
32	3,6	24,8	0,483	0,31	60
40	4,5	31,0	0,754	0,49	40
50	5,6	38,8	1,182	0,755	16
63	7,1	48,8	1,869	1,200	12
75	8,4	58,2	2,659	1,690	8
90	10,1	69,8	3,83	2,440	4
110	12,3	85,4	5,72	3,620	4
125	14,0	97,0	7,386	4,63	4
BUTT WELDING					
160	17,9	124,2	12,110	7,54	5,8
200	22,4	155,2	18,91	11,70	5,8
250	27,9	194,20	29,61	18,16	5,8
315	35,2	244,6	46,97	28,68	5,8
355	39,7	275,6	59,63	35,35	5,8



Aqua-Plus (GF) PP-R 125 - PN 16 - SDR 11

Structure of pipe: Multi-layer, reinforced with glass fiber (GF)
Type of pipe: SDR 11 / S 5
Material: PP-R 125 or PP-RCT
Standards: DIN 8077/78 - EN ISO 15874 - EN ISO 21003 - CSA 137.11 - ASTM F 2389
Color: Green
Length: Ø20 - Ø125 straight lengths 4 m
Ø160 - Ø450 straight lengths 5,8 m
Upon request, straight lengths 11,6 m

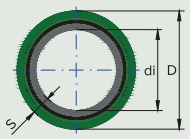
External Diameter D (mm)	Wall Thickness S (mm)	Internal Diameter Di (mm)	Water Capacity (l/m)	Pipe Weight (kgr/m)	Package (m)
SOCKET WELDING					
32	2,9	26,2	0,539	0,275	60
40	3,7	32,6	0,834	0,435	40
50	4,6	40,8	1,307	0,674	16
63	5,8	51,4	2,074	1,065	12
75	6,8	61,4	2,959	1,48	8
90	8,2	73,6	4,252	2,15	4
110	10,0	90,0	6,359	3,18	4
125	11,4	102,2	8,199	4,13	4
BUTT WELDING					
160	14,6	130,8	13,430	6,75	5,8
200	18,2	163,6	21,010	10,51	5,8
250	22,7	204,6	32,861	16,36	5,8
315	28,6	257,8	52,172	25,96	5,8
355	32,2	290,60	66,29	32,94	5,8
400	36,3	327,6	84,29	41,82	5,8
450	40,9	368,2	106,48	52,93	5,8



Aqua-Plus (SL) PP-R 125 - PN 16 - SDR 11

Structure of pipe: Single Layer (SL)
Type of pipe: SDR 11 / S 5
Material: PP-R 125 or PP-RCT
Standards: DIN 8077/78 - EN ISO 15874 - EN ISO 21003 - CSA 137.11 - ASTM F 2389
Color: Green
Length: Ø20 - Ø125 straight lengths 4 m
Ø160 - Ø450 straight lengths 5,8 m
Upon request, straight lengths 11,6 m

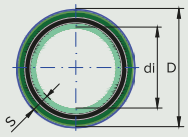
External Diameter D (mm)	Wall Thickness S (mm)	Internal Diameter Di (mm)	Water Capacity (l/m)	Pipe Weight (kgr/m)	Package (m)
SOCKET WELDING					
32	2,9	26,2	0,539	0,26	60
40	3,7	32,6	0,834	0,40	40
50	4,6	40,8	1,307	0,63	16
63	5,8	51,4	2,074	0,99	12
75	6,8	61,4	2,959	1,37	8
90	8,2	73,6	4,252	1,99	4
110	10,0	90,0	6,359	2,96	4
125	11,4	102,2	8,199	3,84	4
BUTT WELDING					
160	14,6	130,8	13,430	6,22	5,8
200	18,2	163,6	21,010	9,76	5,8
250	22,7	204,6	32,861	15,00	5,8
315	28,6	257,8	52,172	23,70	5,8
355	32,20	290,60	66,29	30,00	5,8
400	36,30	327,40	84,29	38,00	5,8
450	40,90	368,2	106,48	48,00	5,8



Aqua-Plus (GF) PP-RCT - PN 10 - SDR 17

Structure of pipe: Multi-layer, reinforced with glass fiber (GF)
Type of pipe: SDR 17 / S 8
Material: PP-RCT
Standards: DIN 8077/78 - EN ISO 15874 - EN ISO 21003 - CSA 137.11 - ASTM F 2389
Color: Green
Length: Ø125 straight lengths 4 m
Ø160 - Ø450 straight lengths 5,8 m
Upon request, straight lengths 11,6 m

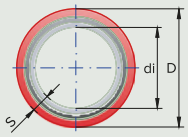
External Diameter D (mm)	Wall Thickness S (mm)	Internal Diameter Di (mm)	Water Capacity (l/m)	Pipe Weight (kgr/m)	Package (m)
SOCKET WELDING					
125	7,4	110,2	9,54	2,65	4
BUTT WELDING					
160	9,5	141,0	15,61	4,47	5,8
200	11,9	176,2	24,37	7,12	5,8
250	14,8	220,4	38,13	11,02	5,8
315	18,7	277,6	60,49	17,45	5,8
355	21,1	312,80	76,81	22,09	5,8
400	23,7	352,60	97,60	27,94	5,8
450	26,7	396,60	123,64	34,16	5,8



Aqua-Plus (GF) OT 5 layer PP-R 125 - PN 20/16 - SDR 7,4 / 11

Structure of pipe: Five layer, reinforced with glass fiber (GF) and oxygen barrier (OT)
Type of pipe: SDR 7,4 / S 3.2 - SDR 11 / S 5
Material: PP-R 125 or PP -RCT (SDR 7,4 - PN 25)
Standards: DIN 8077/78 - EN ISO 15874 - EN ISO 21003 - CSA 137.11 - ASTM F 2389
Color: Blue
Length: Ø20 - Ø125 straight lengths 4 m
Ø160 straight lengths 5,8 m

External Diameter D (mm)	Wall Thickness S (mm)	Internal Diameter Di (mm)	Water Capacity (l/m)	Pipe Weight (kgr/m)	Package (m)
SOCKET WELDING					
20 (sdr 7,4)	2,8	14,4	0,163	0,20	100
25 (sdr 7,4)	3,5	18,0	0,254	0,31	80
32	2,9	26,2	0,539	0,35	60
40	3,7	32,6	0,834	0,55	40
50	4,6	40,8	1,307	0,83	16
63	5,8	51,4	2,074	1,27	12
75	6,8	61,4	2,959	1,73	8
90	8,2	73,6	4,252	2,50	4
110	10,0	90,0	6,359	3,74	4
125	11,4	102,2	8,199	4,80	4
BUTT WELDING					
160	14,6	130,8	13,430	6,80	5,8



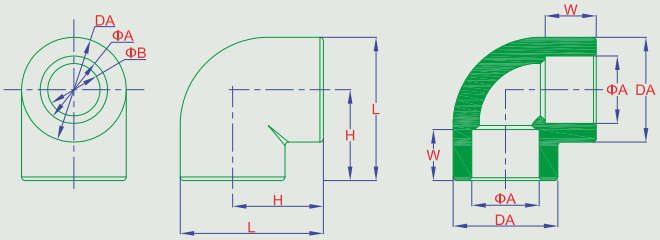
Aqua Plus (GF) PP-R 125 - SDR 7,4

Structure of pipe: Multi-layer, reinforced with glass fiber (GF), fire resistance
Type of pipe: SDR 7,4 / S 3.2
Material: PP-R 125
Standards: DIN 8077/78 - EN ISO 15874 - EN ISO 21003 - EN 13501
Color: Red
Length: Ø20 - Ø125 straight lengths 4 m

External Diameter D (mm)	Wall Thickness S (mm)	Internal Diameter Di (mm)	Water Capacity (l/m)	Pipe Weight (kgr/m)	Package (m)
SOCKET WELDING					
20	2,8	14,4	0,163	0,173	100
25	3,5	18,0	0,254	0,27	80
32	4,4	23,2	0,423	0,433	60
40	5,5	29,0	0,660	0,674	40
50	6,9	36,2	1,029	1,050	16
63	8,6	45,8	1,647	1,650	12
75	10,3	54,4	2,323	2,348	8
90	12,3	65,4	3,358	3,363	4
110	15,1	79,8	4,999	5,023	4
125	17,1	90,8	6,472	6,479	4

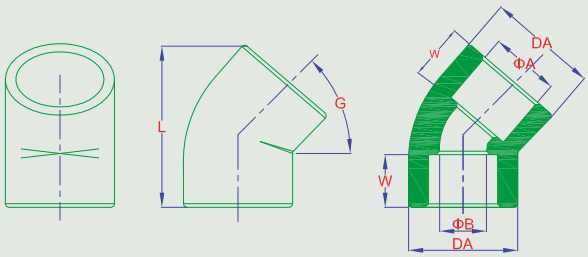
23.2 AQUA-PLUS FITTINGS TABLES

Elbow 90° - PN 30

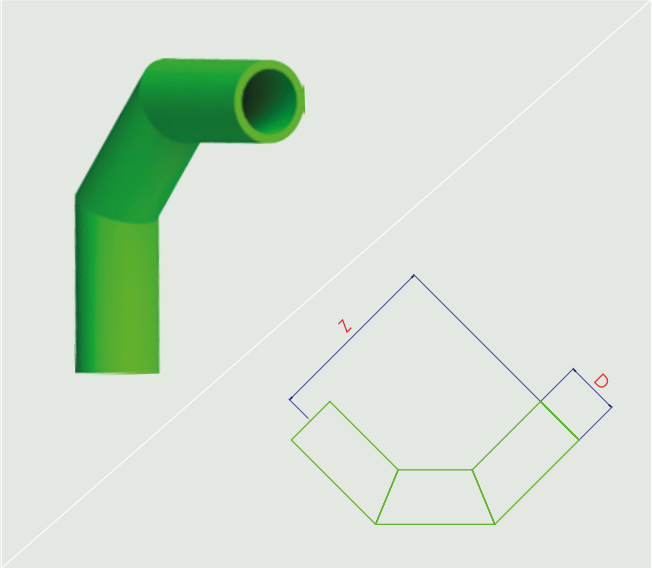


CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	ΦB	H	W	L
SOCKET WELDING										
790030020	20	140	20	0,019	30	19	13,5	26	14,5	41
790030025	25	80	10	0,03	36	24	17	30	16	48
790030032	32	50	10	0,05	44	31	21	34	19	57
790030040	40	50	10	0,11	57	39	30	43	22,5	71
790030050	50	30	10	0,17	66,5	49	41	53	25	86
790030063	63	15	5	0,315	84	62	52	64	29	106
790030075	75	10	2	0,524	98	74	62	73	33,5	44
790030090	90	5	1	0,892	118	89	74	89	38	148
790030110	110	2	1	1,452	140	108,5	91	100	43	170
790030125	125	2	1	1,596	166	124	116	110	43,5	195

Elbow 45° - PN 30

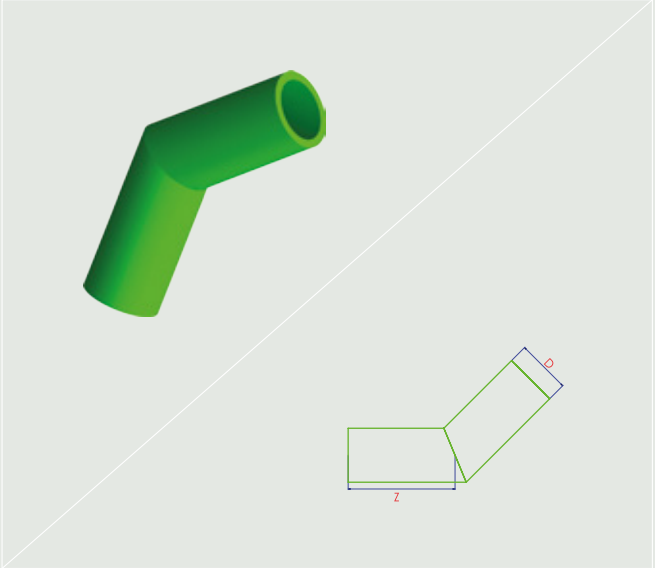


CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	ΦB	H	W	L
SOCKET WELDING										
790040020	20	140	20	0,016	30	19	13,5	14,5	45	44,5
790040025	25	80	10	0,025	36	24	17	16	45	53
790040032	32	50	10	0,036	44	31	21	18,5	45	63
790040040	40	50	10	0,078	56,5	39	30	21,5	45	78
790040050	50	30	10	0,14	66	49	41	25	45	95
790040063	63	15	5	0,26	83	61,7	52	29	45	123
790040075	75	10	2	0,426	98	73,5	62	33	45	143
790040090	90	6	1	0,758	116,5	88,5	74	38	45	170
790040110	110	4	1	1,187	137	108,5	91	43	45	205
790040125	125	2	1	1,603	165	123,5	116	44	45	220



Elbow 90° - Segmented fitting (PFF)

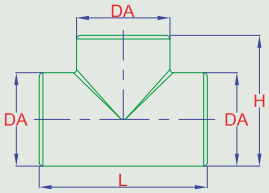
CODES	SDR	DIMENSIONS	D	Z
BUTT WELDING				
790030160-74	7,4	160	160	392
790030200-74	7,4	200	200	450
790030250-74	7,4	250	250	625
790030160-09	9	160	160	392
790030200-09	9	200	200	450
790030250-09	9	250	250	625
790030315-09	9	315	315	773
790030355-09	9	355	355	833
790030160-11	11	160	160	392
790030200-11	11	200	200	450
790030250-11	11	250	250	625
790030315-11	11	315	315	773
790030355-11	11	355	355	833
790030400-11	11	400	400	900
790030450-11	11	450	450	975

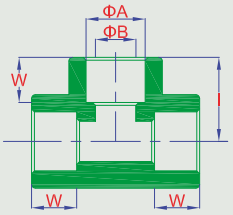


Elbow 45° - Segmented fitting (PFF)

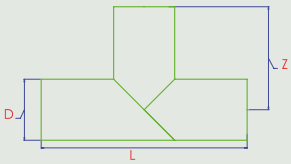
CODES	SDR	DIMENSIONS	D	Z
BUTT WELDING				
790040160-74	7,4	160	160	250
790040200-74	7,4	200	200	275
790040250-74	7,4	250	250	405
790040160-09	9	160	160	250
790040200-09	9	200	200	275
790040250-09	9	250	250	405
790040315-09	9	315	315	495
790040350-09	9	355	355	520
790040160-11	11	160	160	250
790040200-11	11	200	200	275
790040250-11	11	250	250	405
790040315-11	11	315	315	495
790040355-11	11	355	355	520
790040400-11	11	400	400	550
790040450-11	11	450	450	580

Tee – PN 30



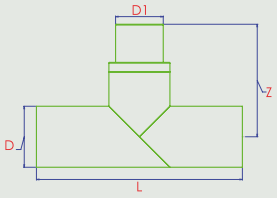


CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	ΦB	H	W	L	I
SOCKET WELDING											
790070020	20-20-20	100	10	0,027	30	19	13	42	14,5	54	27
790070025	25-25-25	60	10	0,042	36	24	17	49	16	62	31
790070032	32-32-32	30	6	0,07	44	31	21	60	20	75	38
790070040	40-40-40	40	10	0,124	57	39	30	71	21	85	42,5
790070050	50-50-50	24	8	0,21	66	49	41	87	25	106	54
790070063	63-63-63	12	4	0,404	83	62	52	108	29	130	66
790070075	75-75-75	9	3	0,672	98	74	62	129	33	153	80
790070090	90-90-90	2	1	1,118	116	89	74	151	37,5	180	93
790070110	110-110-110	2	1	2,072	137	108,5	91	180	43,5	210	111
790070125	125-125-125	1	1	2,5	165	124	115	200	44	242	117



Tee - Segmented fitting (PFF)

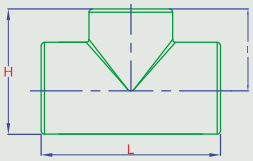
CODES	SDR	DIMENSIONS	DA	C	Z
BUTT WELDING					
790070160-74	7,4	160-160-160	160	470	235
790070200-74	7,4	200-200-200	200	510	255
790070250-74	7,4	250-250-250	250	760	380
790070160-09	9	160-160-160	160	470	235
790070200-09	9	200-200-200	200	510	255
790070250-09	9	250-250-250	250	760	380
790070315-09	9	315-315-315	315	930	465
790070355-09	9	355-355-355	355	970	485
790070160-11	11	160-160-160	160	470	235
790070200-11	11	200-200-200	200	510	255
790070250-11	11	250-250-250	250	760	380
790070315-11	11	315-315-315	315	930	465
790070355-11	11	355-355-355	355	970	485
790070400-11	11	400-400-400	400	1010	505
790070450-11	11	450-450-450	450	1060	530

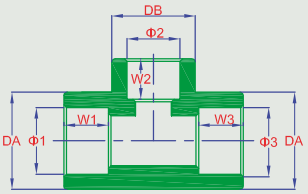


Tee - Segmented fitting (PFF) with reducing bush

SDR	D (m)	D1	L
BUTT WELDING			
7,4	200	160	510
7,4	250	200	760
9	200	160	510
9	250	200	760
9	315	250	930
9	355	315	970
11/17	200	160	510
11/17	250	200	930
11/17	315	250	1010
11/17	355	315	970
11/17	450	400	1060

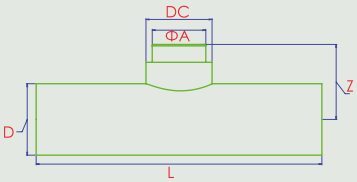
Reducing Tee - PN 30





CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	DB	Φ1	Φ2	Φ3	W1	W2	W3	L	H	I
SOCKET WELDING															
790060001	25x20x25	60	10	0,039	36	30	24	19	24	16	14,5	16	62	48	30
790060017	25x20x20	50	10	0,048	36	36	24	13	19	16	14,5	14,5	62	49	31
790060018	25x25x20	50	10	0,044	36	36	24	24	19	16	16	14,5	62	49	31
790060002	32X20X32	30	6	0,062	44	30	31	19	31	20	14,5	20	76	55	33
790060003	32x25x32	30	6	0,063	44	36	31	24	31	20	16	20	75	55	33
790060024	32x32x20	30	6	0,07	44	30	31	19	31	20	14,5	20	76	55	33
790060019	32x25x25	30	6	0,066	44	36	31	24	24	20	16	16	76	56	35
790060025	32x20x20	30	6	0,066	44	30	31	19	19	20	14,5	14,5	76	55	35
790060022	32x25x20	30	6	0,066	44	36	31	24	19	20	16	14,5	76	56	35
790060023	32x20x25	30	6	0,066	44	30	31	19	24	20	14,5	16	76	55	35
790060021	32x32x25	30	6	0,072	44	44	31	31	24	20	20	16	76	60	38
790060042	40x20x40	20	6	0,125	57	42	39	19,2	39	21	15	21	85	66	37
790060016	40x25x40	20	6	0,114	57	36	39	24	39	21	16	21	85	66	37
790060004	40x32x40	20	4	0,116	57	44	39	31	39	21	18	21	85	68	40
790060043	50x20x50	10	2	0,2	66	53	49	19	49	25,7	15,1	25,7	106	88	53
790060044	50x25x50	10	2	0,21	66	53	49	24	49	25,7	16	25,7	106	88	53
790060007	50x32x50	10	4	0,214	66	53	49	31	49	25	20	25	106	88	53
790060005	50x40x50	14	2	0,204	66	54	49	39	49	25	19	25	106	88	54
790060010	63x25x63	14	2	0,4	84	67	62	24	62	29	16	29	130	109	65
790060015	63x32x63	14	2	0,412	84	67	62	31	62	29	19	29	130	109	65
790060020	63x40x63	14	2	0,406	84	67	62	39	62	29	21	29	130	109	65
790060006	63x50x63	14	2	0,386	84	67	62	49	62	29	25	29	130	109	65
790060045	75x20x75	10	1	0,681	98	85	73	18,8	73	33	14,6	33	153	128	76
790060051	75x25x75	10	1	0,685	98	84	73	24,4	73	33	17	33	153	128	76
790060046	75x32x75	10	1	0,686	98	82	73	30,5	73	33	17	33	153	128	76
790060047	75x40x75	10	1	0,687	98	84	73	39,3	73	33	20,8	33	153	128	76
790060011	75x50x75	10	1	0,682	98	83	74	49	74	33	25	33	153	128	76
790060012	75x63x75	10	1	0,662	98	84	74	62	74	33	22	33	153	128	76
790060048	90x40x90	6	1	1,165	117	118	89	39	89	38	21	38	180	151	90
790060049	90x50x90	6	1	1,167	117	118	89	49	89	38	25,5	38	180	151	90
790060028	90x63x90	6	1	1,13	117	120	89	62	89	38	29	38	180	151	90
790060008	90x75x90	6	1	1,154	117	116	89	74	89	38	32	38	180	151	90
790060050	110x50x110	3	1	1,8	137	137	108	49,2	108	44	24,9	44	215	180	107
790060013	110x63x110	3	1	1,801	137	137	108	62	109	43	28	43	215	180	107
790060027	110x75x110	3	1	1,827	144	141	109	74	109	44	33	44	213	180	107
790060026	110x90x110	3	1	1,985	144	120	109	89	109	45	39	45	213	180	107
790060030	125x75x125	2	1	2,77	164	164	124	74	124	44	33	44	240	205	107
790060031	125x90x125	2	1	2,77	164	164	124	89	124	44	38	44	240	205	128
790060032	125x110x125	2	1	2,82	164	166	124	109	124	44	44	44	245	205	123

Reducing Tee - Segmented fitting (PFF) with saddle socket

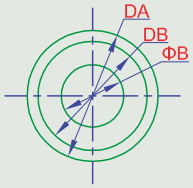


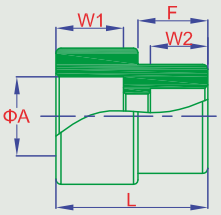
CODES	SDR	DIMENSIONS	DA	DC	ΦA	L	Z
BUTT - SOCKET WELDING							
790060053-74	7,4	160X63X160	160	63	61,2	470	98
790060055-74	7,4	160X75X160	160	75	73,8	470	110
790060040-74	7,4	160x90x160	160	90	89,5	470	115
790060041-74	7,4	160x110x160	160	110	108,5	470	127
790060070-74	7,4	160x125x160	160	125	124,4	470	140
790060125-74	7,4	200x63x200	200	63	61,2	510	118
790060056-74	7,4	200x75x200	200	75	73,8	510	130
790060057-74	7,4	200x90x200	200	90	89,5	510	135
790060058-74	7,4	200x110x200	200	110	108,5	510	150
790060059-74	7,4	200x125x200	200	125	124,4	510	137
790060060-74	7,4	250x75x250	250	75	74,15	760	155
790060061-74	7,4	250x90x250	250	90	89,4	760	160
790060062-74	7,4	250x110x250	250	110	108	760	165
790060063-74	7,4	250x125x250	250	125	123	760	172
790060064-74	7,4	250x160x250	250	160	119	760	176
790060053-09	9	160X63X160	160	63	61,2	470	98
790060055-09	9	160X75X160	160	75	73,8	470	110
790060040-09	9	160x90x160	160	90	89,5	470	115
790060041-09	9	160x110x160	160	110	108,5	470	127
790060052-09	9	160x125x160	160	125	124,4	470	140
790060125-09	9	200x63x200	200	63	61,2	510	118
790060056-09	9	200x75x200	200	75	73,8	510	130
790060057-09	9	200x90x200	200	90	89,5	510	135
790060058-09	9	200x110x200	200	110	108,5	510	150
790060059-09	9	200x125x200	200	125	124,4	510	137
790060060-09	9	250x75x250	250	75	74,15	760	155
790060061-09	9	250x90x250	250	90	89,4	760	160
790060062-09	9	250x110x250	250	110	108	760	165
790060063-09	9	250x125x250	250	125	123	760	172
790060064-09	9	250x160x250	250	160	119	760	176
790060065-09	9	315x75x315	315	75	74,15	930	187,5
790060066-09	9	315x90x315	315	90	89,4	930	192,5
790060067-09	9	315x110x315	315	110	108	930	207,5
790060068-09	9	315x125x315	315	125	123	930	204,5
790060069-09	9	315x160x315	315	160	119	930	208
790060126-09	9	355x110x355	315	110	108	970	225,5
790060127-09	9	355x125x355	315	125	123	970	227,5
790060128-09	9	355x160x355	315	160	119	970	229,5

Reducing Tee - Segmented fitting (PFF) with saddle socket

CODES	SDR	DIMENSIONS	DA	DC	ΦA	L	Z
BUTT - SOCKET WELDING							
Upon Request	9	355x200x355					
Upon Request	9	355x250x355					
790060053-11	11	160X63X160	160	63	61,2	470	98
790060055-11	11	160X75X160	160	75	73,8	470	110
790060040-11	11	160x90x160	160	90	89,5	470	115
790060041-11	11	160x110x160	160	110	108,5	470	127
790060052-11	11	160x125x160	160	125	124,4	470	140
790060125-11	11	200x63x200	200	63	61,2	510	118
790060056-11	11	200x75x200	200	75	73,8	510	130
790060057-11	11	200x90x200	200	90	89,5	510	135
790060058-11	11	200x110x200	200	110	108,5	510	150
790060059-11	11	200x125x200	200	125	124,4	510	137
790060060-11	11	250x75x250	250	75	74,15	760	155
790060061-11	11	250x90x250	250	90	89,4	760	160
790060062-11	11	250x110x250	250	110	108	760	165
790060063-11	11	250x125x250	250	125	123	760	172
790060064-11	11	250x160x250	250	160	119	760	176
BUTT WELDING							
790060065-11	11	315x75x315	315	75	74,15	930	187,5
790060066-11	11	315x90x315	315	90	89,4	930	192,5
790060067-11	11	315x110x315	315	110	108	930	207,5
790060068-11	11	315x125x315	315	125	123	930	204,5
790060069-11	11	315x160x315	315	160	119	930	208
790060126-11	11	355x110x355	315	110	108	970	225,5
790060127-11	11	355x125x355	315	125	123	970	227,5
790060128-11	11	355x160x355	315	160	119	970	229,5
Upon Request	11/17	355x200x355					
Upon Request	11/17	355x250x355					
Upon Request	11/17	400x160x400					
Upon Request	11/17	400x200x400					
Upon Request	11/17	400x250x400					
Upon Request	11/17	450x160x450					
Upon Request	11/17	450x200x450					
Upon Request	11/17	450x250x450					

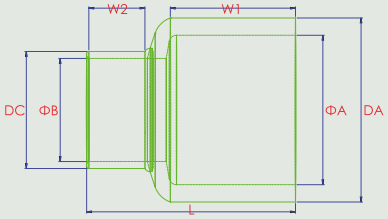
Reducing bush - PN 30





CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	DB	ΦA	ΦB	F	W1	W2	L
SOCKET WELDING												
790082520	25X20	200	20	0,012	36	25	19	13,5	16	14,5	13,5	35
790013220	32X20	160	20	0,022	44	32	19	13,5	20	14,5	13,5	40
790013225	32X25	90	10	0,024	44	32	24	21	20	16	14,5	40
790084020	40X20	80	10	0,027	57	40	19	19	18	16	13,5	45
790084025	40X25	80	10	0,028	57	40	24	20	23	17	14,5	45
790084032	40X32	80	10	0,030	57	40	31	27	22	17	16	45
790085020	50X20	40	8	0,054	66	50	19	19	20	20	13,5	61
790085025	50X25	40	8	0,052	66	50	24	24	24	20	14,5	62
790085032	50X32	40	8	0,060	66	50	31	23	31	20	16	60
790085040	50X40	40	8	0,113	66	50	39	36	23	20	17	61
790086320	63X20	20	5	0,104	83	63	19	19	39	21	14,5	70
790086325	63X25	20	5	0,106	83	63	24	16	40	21	16	70
790086332	63X32	20	5	0,106	83	63	31	23	40	19	16	70
790086340	63X40	20	5	0,106	83	63	39	36	40	22	16	70
790086350	63X50	20	5	0,106	83	63	49	45	35	21	20	71
790087525	75x25	16	2	0,141	89	75	49,4	24	35	24	16	70
790087532	75x32	16	4	0,143	89	75	49	30	35	25	20	70
790087540	75x40	16	2	0,146	89	75	49	39	35	25	21	70
790087550	75X50	16	2	0,164	89	75	49	41	50	25	20	85
790087563	75X63	12	2	0,188	89	75	62	52	44	25	21	84
790089050	90x50	12	2	0,220	116	90	62	50	34	28	24	80
790089063	90X63	12	2	0,282	116	90	62	53	46	29	21	100
790089075	90X75	6	2	0,322	116	90	74	64	47	29	25	100
790081163	110x63	5	1	0,380	137	110	74	62	49	31	28	100
790081075	110X75	5	1	0,500	137	110	74	62	60	33	25	120
790081090	110X90	5	1	0,552	137	110	89	77	60	37	29	119
790081275	125-160/75	4	1	0,480	165	125	88	74	50	38	32	100
790081290	125-160/90	6	1	0,592	165	125	125	89	79	30	29	100
790081211	125-160/110	4	1	0,913	165	125	125	108	80	50	33	123
790020125	160x125	1	1		171	125	125	114	89	112	98	220
BUTT WELDING												
790082016-01	200x160	1	1									
790082521-01	250x200	1	1									
790083125-01	315x250	1	1									
Upon Request	355x315	1	1									
Upon Request	400x355	1	1									
Upon Request	450x400	1	1									

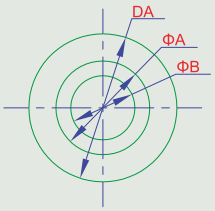
Special Reducing bush

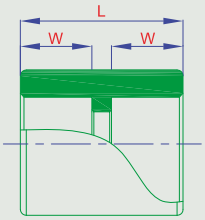


CODES	DIMENSIONS	PACKAGE	Kgm/ITEM	DA	ΦA	DC	ΦA	ΦB	W2	W1	L
SOCKET - BUTT WELDING											
791081620	160X20	1	1,286	161	114	31	19,1	19,4	5,5	97	168,0
791081625	160X25	1	1,296	161	114	35,7	19,3	19,1	9,6	97	174,0
791081632	160X32	1	1,306	161	114	42,7	31,4	31,8	-	97	182,2
791081640	160X40	1	1,326	161	114	56,9	39,4	39,3	-	97	180,2
791081650	160X50	1	1,346	161	114	65,9	47,5	47,9	12	97	207,2
791081663	160X63	1	1,426	161	114	81,8	61,2	61,2	15,2	97	215,4
791081675	160X75	1	1,466	161	114	94,3	73,8	73	28,2	97	206,0
791081690	160X90	1	1,666	161	114	116	89,5	89,3	30,2	97	221,3
791081611	160X110	1	1,72	161	114	116	89,5	109	41,4	170	280,0
791082020	200X20	1	1,98	200	161	31	19,1	19,4	5,5	170	205,0
791082025	200X25	1	1,99	200	161	35,7	19,3	19,1	9,6	170	211,0
791082032	200X32	1	2	200	161	42,7	31,4	31,8	-	170	219,2
791082040	200X40	1	2,02	200	161	56,9	39,4	39,3	-	170	217,2
791082050	200X50	1	2,04	200	161	65,9	47,5	47,9	12	170	244,2
791082063	200X63	1	2,12	200	161	81,8	61,2	61,2	15,2	170	252,4
791082075	200X75	1	2,16	200	161	94,3	73,8	73	28,2	170	243,0
791082090	200X90	1	2,36	200	161	116	89,5	89,3	30,2	170	258,3
791082011	200X110	1	2,52	200	161	139,1	108,5	109	41,4	170	277,0
791082012	200X125	1	2,74	200	161	164,9	124,4	124,8	-	170	285,0
791082563	250X63	1	3,26	250	203	81,8	62,2	62,2	14,4	195	250,3
791082575	250X75	1	3,3	250	203	93,6	74,15	72,9	28,3	195	258,6
791082590	250X90	1	3,48	250	203	116,8	89,4	89,2	30	195	272,0
791082511	250X110	1	3,66	250	203	138	108	109	40	195	283,4
791082512	250X125	1	3,85	250	203	165	123	125,5	-	195	285,0
791082516	250X160	1	4,74	250	203	160	119	120	10,8	195	365,0
791083163	315X63	1	6,06	315	253	81,8	62,2	62,2	14,4	215	270,3
791083175	315X75	1	6,1	315	253	93,6	74,15	72,9	28,3	215	278,6
791083190	315X90	1	6,28	315	253	116,8	89,4	89,2	30	215	292,0
791083111	315X110	1	6,46	315	253	138	108	109	40	215	303,4
791083112	315X125	1	6,65	315	253	165	123	125,5	-	215	305,0
791083116	315X160	1	7,54	315	253	160	119	120	10,8	215	385,0

Upon Request: 355x160, 355x200, 355x250, 400x160, 400x200, 400x250, 450x160, 450x200, 450x250

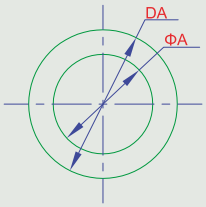
Socket - PN 30

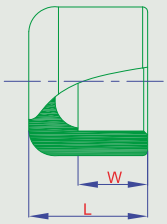




CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	ΦB	W	L
SOCKET WELDING									
790020020	20	180	20	0,0130	30	19	13	15	33
790020025	25	130	10	0,0200	36	24	17	16	36
790020032	32	70	10	0,0400	45	31	20	20	44
790020040	40	40	10	0,0580	57	39	30	22	50
790020050	50	25	5	0,0940	66	49	41	25	56
790020063	63	20	2	0,1740	82	62	52	29	69
790020075	75	20	2	0,2600	97	74	53	34	83
790020090	90	12	2	0,4800	124	89	75	39	100
790020110	110	6	1	0,7580	138	109	91	44	122
790020125	125	6	1	0,7840	166	124	116	38	90

Cap - PN 30

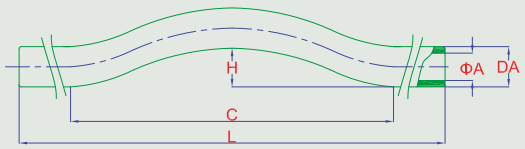




CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	W	L
SOCKET WELDING								
790090020	20	200	20	0,01	30	19	16	24
790090025	25	200	20	0,014	36	24	17	26
790090032	32	100	10	0,02	44	31	19	28
790090040	40	50	8	0,056	57	39	23	41
790090050	50	40	10	0,068	66	49	24	44
790090063	63	40	5	0,148	83	62	29	50
790090075	75	11	1	0,247	94	74	29	56
790090090	90	12	3	0,4	117	89	38	60
790090110	110	10	2	0,714	138	108,5	43	66
790090125	125	10	1	0,739	166	124	41	78
BUTT WELDING								
790090160	160	1	1	1,266	161	114	97	143
700090200	200	1	1	1,96	200	161	170	180
700090250	250	1	1	3,1	250	203	195	200
700090315	315	1	1	5,9	315	253	215	220

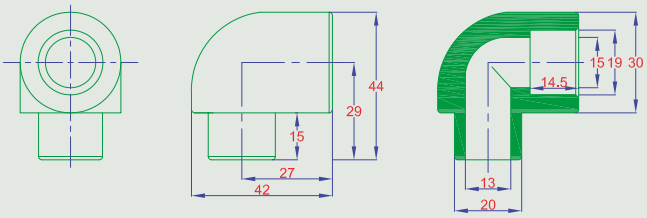
Upon Request: 355, 400, 450

V



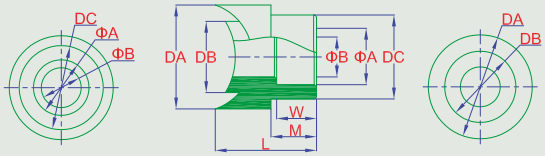
CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	C	H	L
SOCKET WELDING									
790050020	20	80	20	0,069	20	13	16	22	40
790050025	25	60	10	0,097	25	16	18	26	40
790050032	32	32	8	0,157	32	22	25	20	40

ELBOW M/F 90° - PN30



CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM
SOCKET WELDING				
790170020	20	140	20	0,022

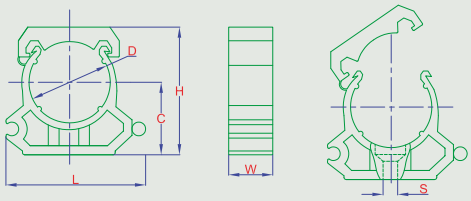
Saddle socket - PN 30



CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	DB	DC	ΦA	ΦB	W	M	L
SOCKET - BUTT WELDING												
790404020	40-20	100	10	0,015	37	20	30	19	13,5	14,5	15,5	35
790404025	40-25	100	10	0,0155	36	25	36	24	17	16	-	35
790405020	50-20	100	10	0,0152	37	20	30	19	13,5	14,5	15	34
790405025	50-25	100	10	0,0156	35	25	36	24	17	16	-	35
790406320	63-20	100	10	0,0157	37	20	30	19	13,5	14,5	15,5	36
790406325	63-25	100	10	0,0162	36	25	36	24	17	16	-	37
790406332	63-32	100	10	0,0257	42	32	42	31	21	20	-	44
790407520	75-20	100	10	0,0162	37	20	30	19	13,5	14,5	15,5	37
790407525	75-25	100	10	0,0163	35,5	25	35,5	24	17	16	-	39
790407532	75-32	50	10	0,0272	43	32	43	31	21	20	-	46
790407540	75-40	40	10	0,06	57	40	57,1	39	38,8	22,1	-	44
790409020	90-20	100	10	0,016	37	20	30	19	13,5	14,5	15,5	36
790409025	90-25	100	10	0,016	36	25	36	24	17	16	-	37
790409032	90-32	50	10	0,0285	43	32	43	31	21	20	-	48
790409040	90-40	40	10	0,049	57	40	57	39	30	21	-	50
790401120	110-20	100	10	0,016	37	20	30	19	13,5	14,5	15,5	36
790401125	110-25	100	10	0,016	35,5	25	35,5	24	17	16	-	37
790401132	110-32	50	10	0,0306	43	32	43	31	21	20	-	52
790401140	110-40	40	10	0,0514	57	40	57	39	30	21	-	54
790401150	110-50	25	5	0,08	69	50	66	49,2	48,9	25	15,1	48
790401220	125-20	140	20	0,0101	29,5	20	30	19	13,5	15		36
790401225	125-25	100	10	0,0158	35,5	25	35,5	24	17	16		38
790401232	125-32	100	10	0,0234	59	32	43	31	20	20		
790401240	125-40	50	5	0,0442	57	40	57	39	30	21		46
790401250	125-50	25	5	0,08	69	50	66	49	37	13	14	46
790401263	125-63	12	4	0,140	85	63	82	61	47	15	17	67
790401620	160-200/20	10	5	0,020	32	20	31	19,1	19,4	5,5	-	25
790401625	160-200/25	10	5	0,030	35,7	25	35,7	19,3	19,1	9,6	10	31
790401632	160-200/32	1	1	0,040	42,7	32	42,7	31,4	31,8	-	-	39,2
790401640	160-200/40	1	1	0,060	56,6	40	56,9	39,4	39,3	-	-	37,2
790401650	160-200/50	1	1	0,080	65,5	50	65,9	47,5	47,9	12	15,8	64,2
790401663	160-200/63	1	1	0,160	81,5	63	81,8	61,2	61,2	15,2	17,7	72,4
790401675	160-200/75	1	1	0,200	93,5	75	94,3	73,8	73	28,2	35,5	63
790401690	160-200/90	1	1	0,4	115	90	116	89,5	89,3	30,2	34,8	78,3
790402011	160-200/110	1	1	0,56	139	110	139,1	108,5	109	41,4	47	97
790402012	160-200/125	1	1	0,78	164,4	125	164,9	124,4	124,8	-	-	105
790402563	250-315/63	1	1	0,16	82	62,6	81,8	62,2	62,2	14,4	17	50,3
790402573	250-315/75	1	1	0,2	93	75	93,6	74,15	72,9	28,3	31,3	58,6
790402590	250-315/90	1	1	0,38	116	90	116,8	89,4	89,2	30	34	72
790402511	250-315/110	1	1	0,56	138	111	138	108	109	40	46	83,4
790402512	250-315/125	1	1	0,75	164	125	165	123	125,5	-	-	85
790402516	250-315/160	1	1	1,64	198	160	160	119	120	10,8	11	165

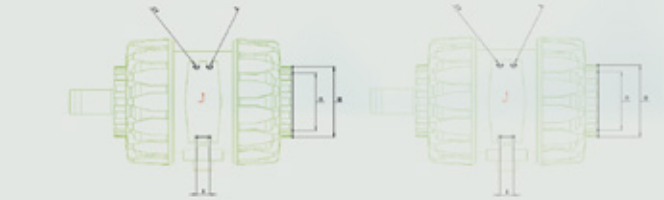
Upon Request: 355-400x160, 355-400x200, 355-400x250, 450x160, 450x200, 450x250

Support

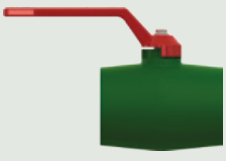


CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	D	H	C	W	S	L
790200020	20	100	30	0,008	20	36	21	15	5	40
790200025	25	100	30	0,009	25	42	23	15	5	45
790200032	32	50	20	0,01	32	49	26,5	15	5	52
790200040	40	50	10	0,026	40	57	32,5	15	5	64
700200050	50	50	10	0,032	50	75	46,5	25	6,5	69
700200063	63	50	10	0,048	63	92	56,5	25	8,5	83
700200075	75	80	1	0,024	75	97	-	19	6,4	75
700200090	90	40	1	0,036	90	113	-	20	6,4	90
700200110	110	30	1	0,059	110	134	-	23	6,4	125
700200125	125	20	1	0,07	125	151	-	25	6,4	140
700200160	160	10	1	0,24	160	190	-	30	6,4	180

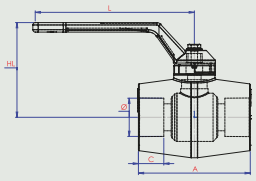
Ball valve Union Blocked (super quality)



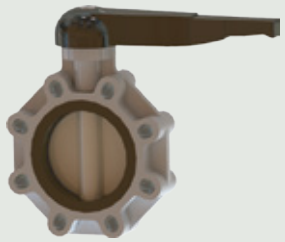
CODES	D (mm)	B	H	L	J	F	I	I1	I2
SOCKET WELDING									
700380020	20	32	27	20	M4x6	-	-	-	-
700380025	25	40	30	20	M4x6	-	-	-	-
700380032	32	40	30	20	M4x6	-	-	-	-
700380040	40	50	35	30	M6x10	-	-	-	-
700380050	50	50	35	30	M6x10	-	-	-	-
700380063	63	60	40	30	M6x10	-	-	-	-
700380075	75	-	-	-	M6	6,3	17,4	90	51,8
700380090	90	-	-	-	M6	8,4	21,2	112,6	63
700380110	110	-	-	-	M6	8,4	21,2	137	67



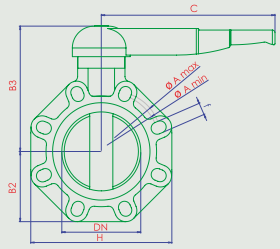
Ball valve High pressure and temperature



CODES	D (mm)	A (mm)	C (mm)	P (mm)	HL (mm)	L (mm)	HF (mm)	F (mm)	Kv (m³/h)	Weight (g)
SOCKET WELDING										
700370020	20	67,5	14,5	15	60	102	55	65	9,5	116/113
700370025	25	70,5	16	15	60	102	55	65	19	135/132
700370032	32	79,5	18,1	20	64	102	59	65	38,5	189/186
700370040	40	94	20,5	25	78	120	75	82	19	347/363
700370050	50	109	23,5	32	83	120	80	82	38,5	517/536
700370063	63	130	27,4	40	103	146	-	-	19	935
700370075	75	151	31	50	110	146	-	-	38,5	1200

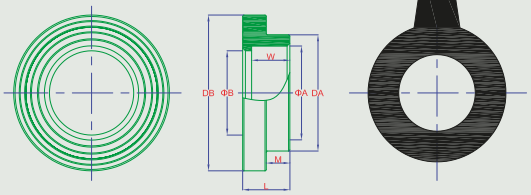


Butterfly valve



CODES	DIMENSIONS	A min	A max	B2	B3	C	C1	H	U	Z	g
700390063-20	63	115	125,5	70	143	175	100	147	4	43	980
700390075-20	75	128	144	80	164	175	110	165	4	46	1370
700390090-20	90	145	160	93	178	175	100	185	12	49	1770
7003900110-20	110	165	190	107	192	272	110	211	8	56	2120
7003900125-20	125	204	215	120	212	330	110	240	8	64	3000
7003900160-20	160	230	242	134	225	330	110	268	8	70	3750
7003900200-20	200	280	298	161	272	420	122	323	8	71	6650
7003900250-20	250	-	-	210	317	-	-	405	12	114	18400
7003900315-20	315	-	-	245	317	-	-	405	12	114	25450

Flange neck female



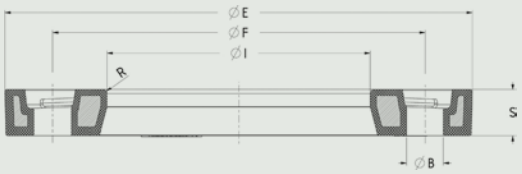
CODES	DIMENSIONS	PACKAGE ITEM/BAG	Kgm/ITEM	DA	DB	ΦA	ΦB	W	M	L
SOCKET WELDING										
790350050	50	12	0,120	60	90	48,9	55,6	25	16,8	32
790350063	63	12	0,160	75,5	105,1	61,7	42,1	29	19	36
790350075	75	10	0,210	91	121	74	66	30	20	38
790350090	90	8	0,294	110	136	89	71	31	21	42
790350110	110	12	0,369	130	158	109	91	36	26	47
790350125	125	10	0,532	148	180	124	95	40	25	50
BUTT WELDING										
790350160	160	2	2,261	160	213	115	115	165	168	191
790350200	200	1	2,440	200	271	164	169	170	164	195
790350250	250	1	3,580	250	320	207	212	174	165	200
790350315	315	1	5,600	315	375	260	264	194	185	220

Upon Request: 355, 400, 450

Flange neck male

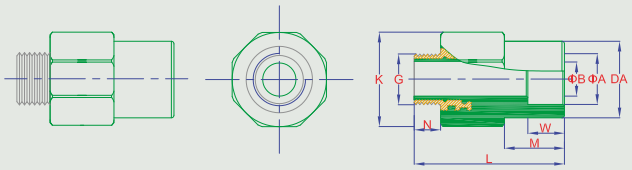
CODES	DIMENSIONS	PACKAGE	Kgm/ITEM	DA	DB	ΦA	M	N	L
SOCKET WELDING									
700210075	Ø 75	1	2,716	75	113	50	60	10,5	76
700210090	Ø 90	1	3,552	90	128	60	72	12,5	91
700210110	Ø 110	1	4,198	110	148	73	87	14	110

Metal profiled (plastic) flange with fiberglass

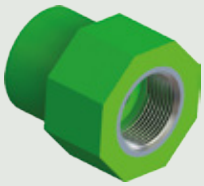


CODES	D (mm)	ΦE	ΦF	ΦI	ΦB	S (mm)	N (bolts)	Bolts	R (mm)	Preload min (Nm)	Preload max (Nm)	Weight (kg)
790360050	50	155	110	67	18	19	4	M16	2	20	30	0,7
790360063	63	170	125	78	18	20	4	M16	1	30	40	0,9
790360075	75	191	145	92	18	21	4	M16	1	40	50	1,25
790360090	90	206	160	108	18	21	8	M16	1	40	50	1,3
790360110	110	226	180	127	18	22	8	M16	2	40	60	1,55
790360125	125	256	110	158	18	25	8	M16	1	50	70	1,70
790360160	160	291	240	178	22	28	8	M20	1	60	80	2,5
790360200	200	346	295	238	22	29	8	M20	1	80	90	3,5
790360250	250	412	355	288	26	34	12	M24	1	90	120	5,15
790360315	315	468	410	337	26	42	12	M24	2	100	150	8,7

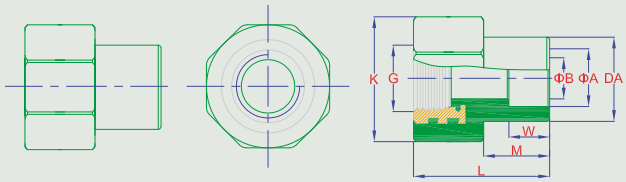
Coupling male – PN 30



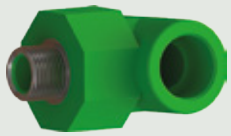
CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	ΦB	K	G	W	M	N	L
SOCKET WELDING													
790112012	20x1/2"	90	10	0,087	30	19	12,5	37	1/2"	14,5	23	15	63
790112034	20x3/4"	60	10	0,141	36	19	16,5	45	3/4"	14,5	23	16	64
790112512	25x1/2"	60	10	0,1	36	24	13	44	1/2"	15,5	23	15	64
790112534	25x3/4"	60	10	0,139	36	24	16,5	44	3/4"	15	23	16	64
790113234	32x3/4"	30	6	0,161	44	31	16,5	56	3/4"	21	19	16	62
790113201	32x1"	30	6	0,316	44	31	22,3	56,5	1"	21	20	17	74
790114001	40x1"	16	4	0,368	54	39	20,5	68	1"	21	21	17	82
790114014	40x11/4"	16	4	0,488	54	39	27,5	68	11/4"	21	21	21	90
790115014	50x11/4"	12	2	0,545	70	49	28	79	11/4"	25	24	21	93
790115012	50x11/2"	12	2	0,641	70	49	34,5	79	11/2"	25	24	18	89
790116312	63x11/2"	10	2	0,685	83	62	35	88	11/2"	28	30	20	93
790116302	63x2"	10	2	0,893	83	62	45	88	2"	28	30	24	104
790117502	75x2"	2	1	1,0283	98	74	45,5	111	2"	34	30	24	113
790117502	75x21/2"	2	1	1,699	98	74	61	112	21/2"	34	30	26	117
790119003	90x3"	2	1	1,6	117	89	70	138	3"	39	42	30	129
790111104	110x4"	1	1	0,78	137	109	86	163	4"	45	49	39	152



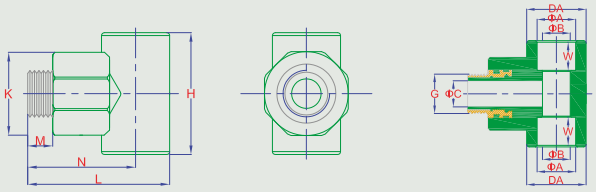
Coupling female – PN 30



CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	ΦB	K	G	W	M	L
SOCKET WELDING												
790122012	20x1/2"	100	10	0,075	30	19	12,5	37	1/2"	14,5	23	48
790122034	20x3/4"	70	10	0,116	36	19	16,5	44	3/4"	14,5	23	48
790122512	25x1/2"	70	10	0,089	36	24	13	44	1/2"	15,5	23	48
790122534	25x3/4"	70	10	0,095	36	24	16,5	44	3/4"	15	23	48
790123234	32x3/4"	30	6	0,117	44	31	16,5	56	3/4"	21	20	47
790123201	32x1"	30	6	0,23	44	31	22,3	56,5	1"	21	20	57
790124001	40x1"	16	4	0,273	54	39	20,5	68	1"	21	22	63
790124014	40x11/4"	16	4	0,376	54	39	27,5	68	11/4"	21	21	68
790125014	50x11/4"	12	2	0,428	70	49	28	79	11/4"	25	24	71
790125012	50x11/2"	12	2	0,556	70	49	34,5	79	11/2"	25	24	71
790126312	63x11/2"	10	2	0,607	83	62	35	88	11/2"	28	30	75
790126302	63x2"	2	1	0,69	83	62	45	88	2"	28	30	80
790127502	75x2"	2	1	0,8431	98	74	45,5	111	2"	34	30	88
790127512	75x21/2"	4	1	1,2353	98	74	61	112	21/2"	34	30	88
790129003	90x3"	2	1	1,469	117	89	70	138	3"	39	42	99
790121104	110x4"	1	1	3,071	137	109	86	163	4"	45	49	117

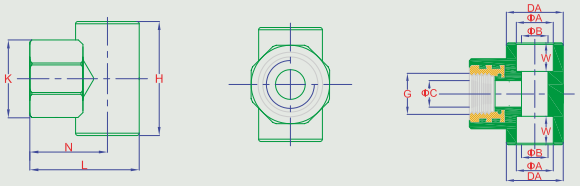


Male tee – PN 30



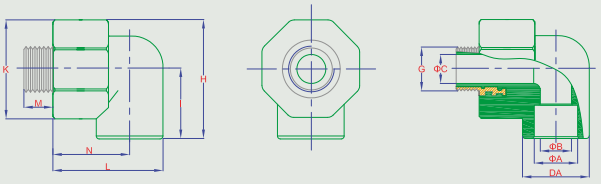
CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	ΦB	ΦC	K	G	W	M	N	H	L
SOCKET WELDING															
790152012	20x1/2"x20	60	10	0,1	30	19	13	13	37	1/2"	15	15	50	54	65
700152512	25x1/2"x25	36	6	0,123	36	24	13	13	44	1/2"	16	16	55	62	73
790152534	25x3/4"x25	36	6	0,159	36	24	16,5	16,5	44	3/4"	16	16	55	62	73
790153201	32x1"x32	20	4	0,356	45	31	24	21,5	57	1"	21	53	69	76	92

Female tee – PN 30

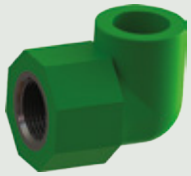


CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	ΦB	ΦC	K	G	W	M	N	H	L
SOCKET WELDING															
790162012	20x1/2"x20	70	10	0,085	30	19	13	13	37	1/2"	15	15	34	54	49
790162512	25x1/2"x25	40	6	0,112	36	24	13	13	44	1/2"	16	15	42	62	60
790162534	25x3/4"x25	40	6	0,116	36	24	16,5	16,5	44	3/4"	16	16	42	62	60
790163201	32x1"x32	18	4	0,267	45	31	24	21,5	39	1"	20	53	52,5	76	75

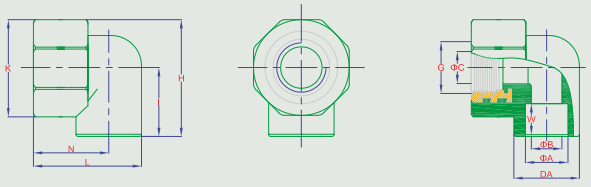
Male elbow – PN 30



CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	ΦB	ΦC	K	G	W	M	N	H	I	L
SOCKET WELDING																
790132012	20x1/2"	70	10	0,093	30	19	13	13	37	1/2"	14,5	15	50	45	26,5	65
700132512	25x1/2"	40	8	0,117	36	24	13	13	44	1/2"	16	15	56	53	31	74
790132534	25x3/4"	40	8	0,151	36	24	16,5	16,5	44	3/4"	16	16	57	53	31	75
790133201	32x1"	24	4	0,346	45	31	24	21,5	39	1"	20	17	68,5	66	38	91

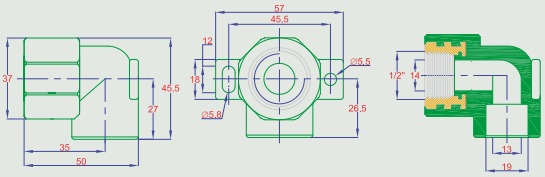


Female elbow – PN 30



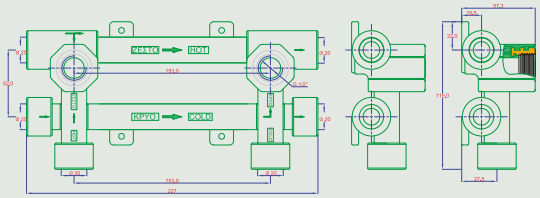
CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	ΦB	ΦC	K	G	W	N	H	I	L
SOCKET WELDING															
790142012	20x1/2"	80	10	0,08	30	19	13	13	37	1/2"	14,5	34	45	26,5	49
790142512	25x1/2"	40	8	0,104	36	24	13	13	44	1/2"	16	41	53	31	59
790142534	25x3/4"	40	8	0,109	36	24	16,5	16,5	44	3/4"	16	41	53	31	59
790143201	32x1"	24	4	0,253	45	31	24	21,5	39	1"	20	51,5	66	38	74

Wall plate elbow 90° - PN 30

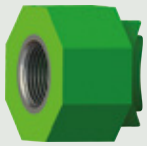


CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM
SOCKET WELDING				
790172012	20X1/2	70	10	0,085
790172512	25X3/4	40	8	0,105
790172534	25X1/2	40	8	0,102

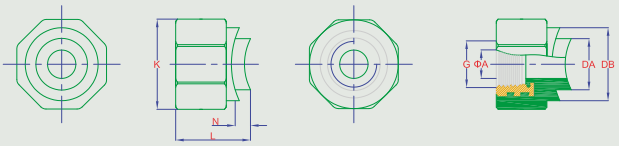
Aligning water intake template PN 30



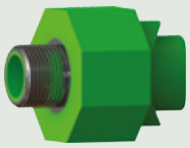
CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM
SOCKET WELDING				
790210000	20X1/2	16	1	0,336



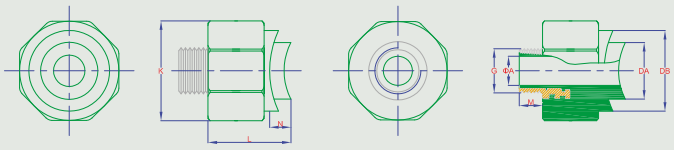
Supply saddle female – PN 30



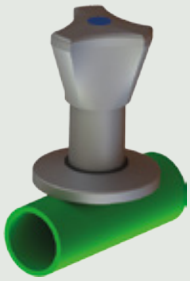
CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	DB	ΦA	K	G	N	L
SOCKET WELDING											
790224012	40x1/2"x25	100	10	0,083	25	36	14,5	44	1/2"	7	42
790224034	40x3/4"x25	80	10	0,089	25	36	16,5	44	3/4"	7	38
790224011	40x1"x25	30	6	0,23	25	37	16,5	57	1"	6,5	55,5
790225012	50x1/2"x25	100	10	0,083	25	36	14,5	44	1/2"	8,5	39
790225034	50x3/4"x25	80	10	0,084	25	36	16,5	44	3/4"	8,5	39
790225011	50x1"x32	30	6	0,23	32	43	16,5	57	1"	8,5	55
790226312	63x1/2"x25	100	10	0,072	25	36,5	15	38	1/2"	8,5	40,5
790226334	63x3/4"x25	90	10	0,089	25	36,5	16,5	44	3/4"	8,5	40,5
790226301	63x1"x32	30	6	0,231	32	43	22	57	1"	10,5	61
790226314	63x11/4"x40	16	4	0,384	40	57	32	74	11/4"	10,5	71
790227512	75x1/2"x25	100	10	0,072	25	36	14	38	1/2"	9,5	41
790227534	75x3/4"x25	90	10	0,089	25	43	16,5	44	3/4"	10	41
790227501	75x1"x32	30	6	0,227	32	43	22,5	57	1"	12,5	61,5
790227514	75x11/4"x40	16	4	0,362	40	57	32	74	11/4"	12,5	70
790229012	90x1/2"x25	100	10	0,08	25	36	13,5	44	1/2"	?	37
790229034	90x3/4"x25	80	10	0,087	25	36	16,5	44	3/4"	13	43
790229001	90x1"x32	30	6	0,23	32	42	21	57	1"	13	61
790221112	110x1/2"x25	100	10	0,081	25	36	14	44	1/2"	12,5	42
790221134	110x3/4"x25	80	80	0,086	25	36	16,5	44	3/4"	12,5	42
790221101	110X1"x32	30	6	0,0228	32	43	21	57	1"	12,5	60



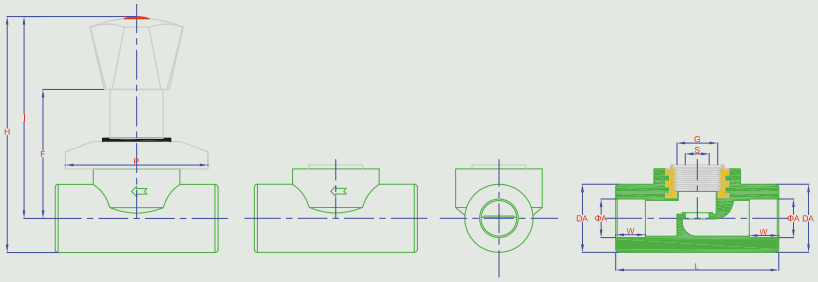
Supply saddle male – PN 30



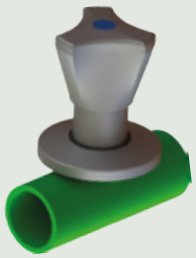
CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	DB	ΦA	K	G	M	N	L
SOCKET WELDING												
790394012	40x1/2"x25	80	10	0,093	25	36	13	44	1/2"	15	8,5	57
790394034	40x3/4"x25	80	10	0,132	25	36	16,5	44	3/4"	16	7	54
790394011	40x1"x25	30	6	0,322	25	37	21,5	57	1"	17	6,5	73
790395012	50x1/2"x25	80	10	0,093	25	36	14,5	44	1/2"	15	8,5	54
790395034	50x3/4"x25	80	10	0,132	25	36	16,5	44	3/4"	16	8,5	55
790395011	50x1"x25	30	6	0,319	25	43	21,5	57	1"	17	8,5	72
790399011	90x1/2"x25	80	10	0,091	25	36	13	44	1/2"	15	6	53
790399034	90x3/4"x25	80	10	0,132	25	36	16,5	44	3/4"	16	13	58
790399001	90x1"x32	30	6	0,327	32	42	21,5	57	1"	17	13	78
790391112	110x1/2"x25	80	10	0,094	25	36	13	44	1/2"	15	12,5	57
790391134	110x3/4"x25	80	10	0,131	25	36	16,5	44	3/4"	16	12,5	58
790391101	110X1"x32	30	6	0,325	32	43	21,5	57	1"	17	12,5	77



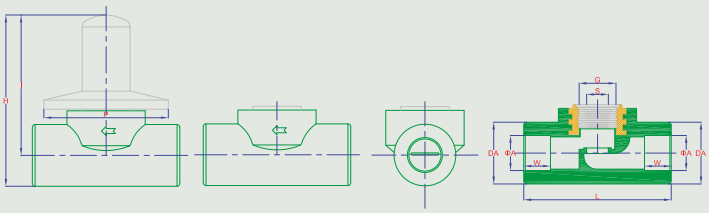
Stop valve (Luxury type)



CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	G	S	H	I	F	W	P	L
SOCKET WELDING														
790100020	20x1/2	16	1	0,361	34	19	1/2	10	112	95	60	14,5	70	80
790100220	20x3/4	16	1	0,364	34	19	3/4	11	111	94	60	15	71	81
790100025	25x1/2	16	1	0,367	36	24	1/2	10	124	106	42	16	68	85
790100225	25x3/4	16	1	0,38	34	24,2	3/4	15	114	93	60	16	69	84
790100032	32x1	12	1	0,516	44	24,2	1	19	140	118	45	20	69	90

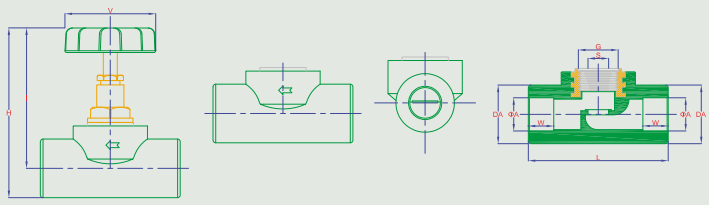


Stop valve with short neck (Luxury type)

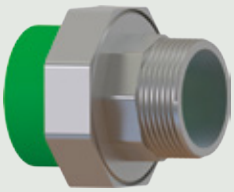


CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	G	S	H	I	W	P	L
SOCKET WELDING													
790300020	Φ 20	16	1	0,254	34	19	1/2"	10	86	69	14,5	70	80
790300025	Φ25	16	1	0,265	36	24	1/2"	10	87	69	16	70	85
790300032	Φ32	16	1	0,455	43,5	31	1"	19	90	69	20	70	90

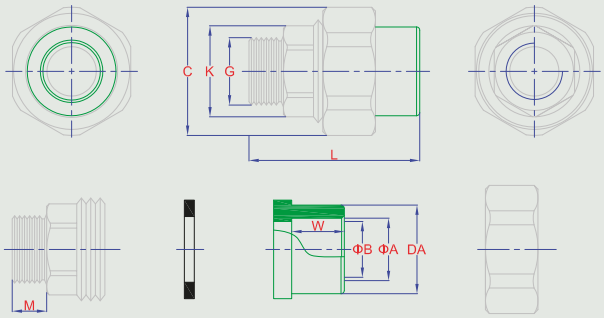
Rotative valve



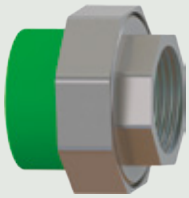
CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	G	S	H	I	W	V	L
SOCKET WELDING													
790100120	Φ 20	16	1	0,18	34	19	1/2"	10	102	87	14,5	52	80
790100125	Φ25X1/2"	16	1	0,186	36	24	1/2"	10	105	87	16	52	86
790100132	Φ32	16	1	0,346	43,5	31	1"	19	118	97	20	58	90



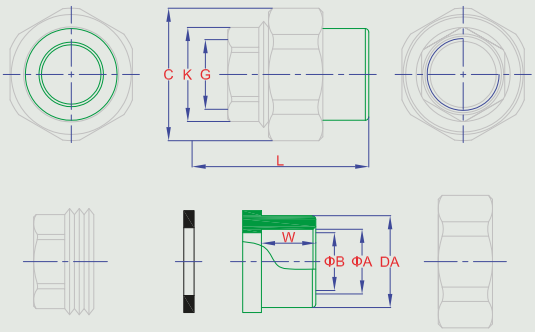
Brass union male / PP-R socket



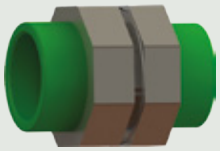
CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	ΦB	C	K	G	W	L
SOCKET WELDING												
700422012	20X1/2	80	10	0,106	27	19	17	36	27	1/2"	16	55
700422534	25X3/4	50	10	0,150	35	24	21	46	32	3/4"	17	55
700423201	32X1	30	6	0,231	40	31	29	52	37	1"	19	63
700424014	40X 1 1/4	16	4	0,428	51	39	37	65	46	1 1/4"	21	66
700425012	50X 1 1/2	12	2	0,460	63	49	49	80	50	1 1/2"	21,5	67
700426302	63X2	10	1	0,600	81,1	61,1	62	98	61,5	2"	27	76,7



Brass union female / PP-R socket



CODES	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM	DA	ΦA	ΦB	C	K	G	W	L
SOCKET WELDING												
700412012	20X1/2	80	10	0,085	27	19	17	36	27	1/2"	16	41
700412534	25X3/4	60	10	0,152	35	24	21	45	32	3/4"	17	45
700413201	32X1	30	6	0,180	40	31	29	52	37	1"	19	48
700414014	40X 1 1/4	16	4	0,328	51	39	37	65	46	1 1/4"	21	53
700415012	50X 1 1/2	12	2	0,380	63	48,5	49,2	79,7	53,2		21,4	52,1
700416302	63X2	10	1	0,540	80,7	61,5	61,6	98	65	2"	27	58,1

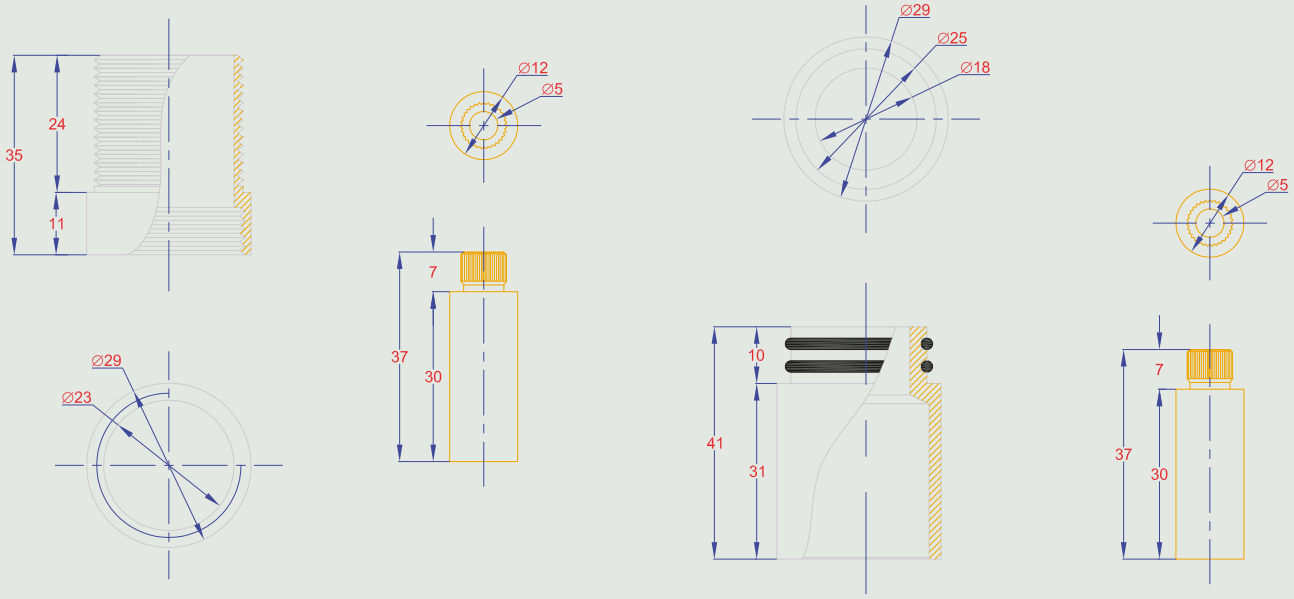


Brass union with PP-R socket

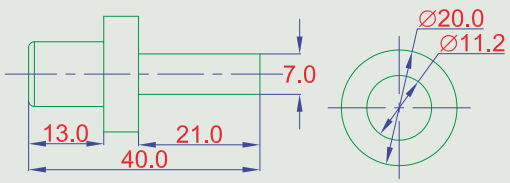
CODES	D (mm)	Kgm/ITEM	DA	DB	DΓ	L1	L2	L3	L4	L5	L6	L7	ΦA	ΦB	ΦΓ	ΦΔ
SOCKET WELDING																
700432020	20	0,1	27	36	40	16	8	9,5	9,5	12	7	1	36	30,5	35	34,5
700432525	25	0,16	35	45	49	19	8	9	10	9	12	2	48,75	44,6	40	43,5
700433232	32	0,16	40,5	47,5	55	18	7,5	7	12,5	10	2,5	9	45,3	52	49,7	59
700434040	40	0,3	51,5	60	69	20	10	17	15	19,5	8	10	57,5	63	63	51,5
700435050	50	0,58	64	76	90	23	12	13	18	15	5	3	81	71,5	82,47	79,51
700436363	63	1,34	83	105	115	30	14,5	16	20	16	6	4	90,8	104,79	101,83	110

Extensions for stop valve

CODE	PACKAGE	Kgm/ITEM
542240000002	10	0,074



Hole repairing plug



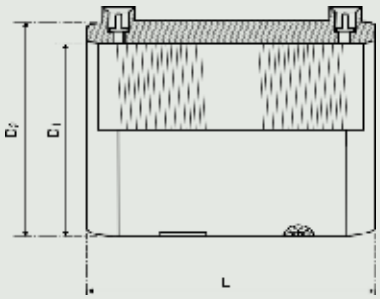
CODE	DIMENSIONS	PACKAGE	ITEM/BAG	Kgm/ITEM
790510711	7*11	500	100	0,0045

Nut-Washer screws for butterfly valves

700390063	63 (16x140)
700390075	75 (16x150)
700390090	90 (16x160)
700390110	110 (16x180)
700390125	125 (16x190)
700390160	160 (20x210)
700390200	200 (20x240)
700390250	250 (20x280)
700390315	315 (20x300)

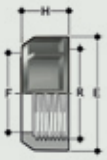
D		D2	D3	D4	T	F	n	Package
MM	INC							
20	1/2"	28	65	95	12	14	4	85
25	3/4"	34	75	105	12	14	4	68
32	1"	42	85	115	16	14	4	52
40	1 1/4"	51	100	140	16	18	4	20
50	1 1/2"	62	110	150	18	18	4	15
63	2"	78	125	165	18	18	4	15
75	2 1/2"	92	145	188	18	18	4	15
90	3"	108	160	204	20	18	8	10
110	4"	128	180	224	20	18	8	10
125	4 1/2"	135	210	224	20	18	8	10
140	5"	158	240	252	24	18	8	6
160	6"	187	295	285	24	22	8	6
200	7"	188	295	340	24	22	8	4
225	8"	235	295	340	27	22	8	4
250	9"	238	350	395	27	22	12	4
280	10"	288	350	395	30	22	12	2
315	12"	294	400	445	30	22	12	2

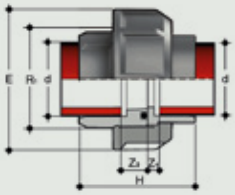
Electrosockets



CODES	D1	SDR	D2	L	Weight (gr/pc)
700230020	20	9	32	72	43
		11			
700230025	25	9	38	73	55
		11			
700230032	32	9	45	77	70
		11			
700230040	40	9	53	90	93
		11			
700230050	50	9	66	101	152
		11			
	63	6	86	192	530
700230063		11	79	114	200
	75	9	98	121	375
700230075		11			
	90	9	118	130	550
70023090		11	114	124	405
	110	9	142	141	780
700230110		11	137	138	554
	125	9	160	154	1175
700230125		11	152	153	750
	160	11	191	170	1360
700230160	200	9	197	171	1800
		9	249	196	2970
700230200		11	239		2680
		17	230	195	1715
	250	9	308	218	5100
700230250		11			
		17	288	212	2950
	315	9	396	280	11350
700230315		11	375	260	7200
700230355	355	13,6	410	225	6300
700230400	400	13,6	462	240	7000

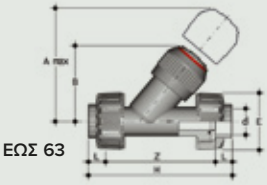
Union PP

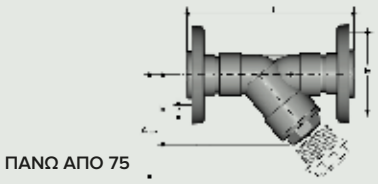




CODES	DIMENSIONS	PN	E	H	Z1	Z2	g
700450020	20	10	47	45,5	12	5,5	34
700450025	25	10	58	49,5	12	5,5	59
700450032	32	10	65	53,5	12	5,5	73
700450040	40	10	78	59,5	14	5,5	115
700450050	50	10	85	67,5	16	5,5	146
700450063	63	10	103	79,5	20	5,5	249

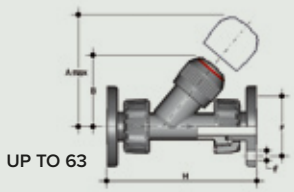
Sediment strainer PP

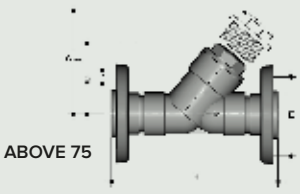




CODES	DIMENSIONS	PN	Amax	B	E	H	Z	g
700550020	20	10	125	71	55	138	109	165
700550025	25	10	145	83	66	157	125	227
700550032	32	10	165	94	74	179	143	380
700550040	40	10	190	109	86	205	164	645
700550050	50	10	210	119	99	244	197	915
700550063	63	10	240	143	120	294	239	1555
700550075	75	6	300	176	145	18	356	5120
700550090	90	4	325	192	160	18	404	6020
700550110	110	4	385	231	180	18	475	7965

Check valve PP





CODES	DIMENSIONS	PN	Amax	B	F	f	H	g
700570020	20	10	125	72	65	14	163	265
700570025	25	10	145	84	75	14	193	327
700570032	32	10	165	95	85	14	211	480
700570040	40	10	190	111	100	18	244	795
700570050	50	10	210	120	110	18	277	1065
700570063	63	10	240	139	125	18	331	1705
700570075	75	6	300	179	145	18	356	5990
700570090	90	4	325	192	160	18	404	7230

TABLE OF PP-R MATERIAL CHEMICAL RESISTANCE

		TEMPERATURE		
Compounds or elements	**Concentration**	**20°C**	**60°C**	**100°C**
A				
acetic anhydride	above 96%	S	L	NS
acetic acid (concentr.)	up to 40%	S	S	-
acetic acid	50%	S	S	L
acetic acid	100%	S	S	-
acetone	100%	S	L	-
acetophenone	100%	S	-	-
acrylonitrile	-	S	S	S
air	-	NS	NS	NS
aliphatic hydrocarbons	sol	S	-	-
alum	100%	L	-	-
amyl acetate	100%	S	S	S
amyl alcohol	100%	S	-	-
ammonia (gas)	100%	S	-	-
ammonia (saturated)	up to 30%	S	-	-
ammonia liquor	sat. sol.	S	S	-
ammonium acetate	sat. sol.	S	S	-
ammonium bicarbonate	sat. sol.	S	-	-
ammonium chloride	sol.	S	S	-
ammonium fluoride	sol.	S	-	-
ammonium hydroxide	sat. sol.	S	S	S
ammonium metaphosphate	sat. sol.	S	S	S
ammonium nitrate	sat. sol.	S	-	-
ammonium phosphate	sat. sol.	S	S	S
ammonium sulphate	100%	S	S	-
aniline	100%	L	-	-
anisole	-	S	-	-
apple juice				
aqua regia	-	NS	NS	NS
B				
barium carbonate	sat. sol.	S	S	S
barium chloride	sat. sol.	S	S	S
barium hydroxide	sat. sol.	S	S	S
barium sulphate	sat. sol.	S	S	S
benzene	100%	L	NS	NS
benzoic acid	sat. sol.	S	-	-
benzoic chloride	100%	L	-	-
benzoyl alcohol	100%	S	L	-
borax	sol.	S	S	-
boric acid	sat. sol.	S	-	-
bromine (dry vapour)	-	S	NS	NS
bromine (liquid)	100%	NS	NS	NS
bromine water	sol.	NS	NS	NS
butane	100%	S	-	-
butyl acetate	100%	L	NS	NS
butanol	100%	S	L	L
butylglycol	100%	S	-	-

		TEMPERATURE		
Compounds or elements	**Concentration**	**20°C**	**60°C**	**100°C**
butylphenol	cold st. sol.	S	-	-
butyl phtalate	100%	S	L	L
C				
calcium carbonate	sat. sol.	S	S	S
calcium chloride	sat. sol.	S	S	S
calcium hydroxide	sat. sol.	S	S	-
calcium hypochlorite	sol.	S	-	-
calcium nitrate	sat. sol.	S	S	-
carbon dioxide, gaseous, dry	100%	S	S	-
carbon dioxide, gaseous, wet	-	S	S	-
carbon disulphide	100%	S	NS	NS
carbon tetrachloride	100%	NS	NS	NS
chlorine (gaseous, dry)	100%	NS	NS	NS
chlorine (liquid)	100%	NS	NS	NS
chloroacetic water	sat. sol.	S	L	-
chloroacetic acid	sol.	S	-	-
chloroethanol	100%	S	-	-
chloroform	100%	L	NS	NS
chlorosulphonic acid	100%	NS	NS	NS
chrome alum	sol.	S	S	-
chromic acid	up to 40%	S	L	NS
citric acid	10%	S	S	S
copper (cu") nitrate	sat. sol.	S	S	-
cresol	above 90%	S	-	-
cupric (cu") nitrate	30%	S	S	S
cupric (cu") sulphate	sat. sol.	S	S	-
cyclohexane	100%	S	-	-
cyclohexanol	100%	S	L	-
cyclohexanone	100%	S	L	-
D				
dekalin (dekalydronaphtalene)	100%	NS	NS	NS
dextrin	sol.	S	S	-
dextrose	sol.	S	S	-
dibutyl phtalate	100%	S	L	NS
dichloroacetic acid	100%	L	-	-
dichloroethylene	100%	L	-	-
diethanolamine	100%	S	-	-
diethylene glycol	100%	S	S	-
diethyl ether	100%	S	L	-
diglycolic acid	sat. sol.	S	-	-
diisoctyl phtalate	100%	S	L	-
dimethylamine	100%	S	-	-
dimethylformamide	100%	S	S	-
dioctyl phtalate	100%	L	L	-
dioxan	100%	L	L	-

		TEMPERATURE		
Compounds or elements	**Concentration**	**20°C**	**60°C**	**100°C**
E				
ethanolamine	100%	S	-	-
ethyl acetate	100%	L	NS	NS
ethylalcohol	up to 95%	S	S	S
ethyl chloride	100%	NS	NS	NS
ethylene chloride	100%	L	L	-
ethylene glycol	100%	S	S	S
F				
formaldehyde	40%	S	-	-
formic acid	10%	S	S	L
formic acid	85%	S	NS	NS
formic acid	100%	S	L	L
fructose	sol.	S	S	S
fruit juice	-	S	S	S
G				
gelatin	-	S	S	-
glucose	20%	S	S	S
glycerine	100%	S	S	S
glycolic acid	30%	S	-	-
H				
heptane	100%	L	NS	NS
hexane	100%	S	L	-
hydrobromic acid	up to 48%	S	L	NS
hydrobromic acid	2-7%	S	S	S
hydrobromic acid	10-20%	S	S	-
hydrobromic acid	30%	S	L	L
hydrobromic acid	35-36%	S	-	-
hydrobromic acid	100%	S	S	-
hydrofluoric acid	dil. sol.	S	-	-
hydrofluoric acid	40%	S	-	-
hydrogen	100%	S	-	-
hydrogen peroxide	up to 10%	S	-	-
hydrogen peroxide	up to 30%	S	-	-
hydrogen sulphide, gaseous, dry	100%	S	-	-
I				
iodine (alcoholic solution)	-	S	-	-
isoctane	100%	L	NS	NS
isopropylalcohol	100%	S	S	S
isopropylether	100%	L	-	-
L				
lactic acid	up to 90%	S	S	-
lanoline	-	S	L	-

		TEMPERATURE		
Compounds or elements	**Concentration**	**20°C**	**60°C**	**100°C**
M				
magnesium carbonate	sat. sol.	S	S	S
magnesium cloride	sat. sol.	S	S	-
magnesium sulphate	sat. sol.	S	S	-
malic acid	sol.	S	S	-
mercuric cyanide	sat. sol.	S	S	-
mercuric chloride	sat. sol.	S	S	-
mercurous nitrate	sol.	S	S	-
mercury	100%	S	S	-
methyl acetate	100%	S	S	-
methyl alcohol	5%	S	L	L
methylamine	up to 32%	S	-	-
methyl bromide	100%	NS	NS	NS
methylene chloride	100%	L	NS	NS
methyl ketone	100%	S	-	-
milk	-	S	S	S
monochloroacetic acid	-	S	S	-
N				
naphta	-	S	NS	NS
nickel chloride	sat. sol.	S	S	-
nickel nitrate	sat. sol.	S	S	-
nickel sulphate	sat. sol.	S	S	-
nitric acid	10%	S	NS	NS
nitric acid	30%	S	-	-
nitric acid	40-50%	L	NS	NS
nitric acid, fuming (with nitric oxide)	-	NS	NS	NS
nitrobenzene	100%	S	-	-
O				
oil	-	S	-	-
almond	-	NS	NS	NS
camphor	-	S	S	-
castor	100%	S	-	-
coconut	-	S	L	-
corn	-	S	S	-
cotton	-	S	S	S
linseed	-	S	S	L
olive	-	S	L	NS
paraffin (FL 65)	-	S	S	-
peanut	-	S	-	-
peppermint	-	S	S	S
silicone	-	S	L	-
soyábean	-	S	-	-
oleic acid	100%	S	L	-
oleum (sulphuric acid contain 60% So_3)	-	NS	NS	NS
oxalic acid	sat. sol.	S	L	NS
oxygen	100%	S	-	-

		TEMPERATURE		
Compounds or elements	**Concentration**	**20°C**	**60°C**	**100°C**
P				
perchloric acid	2N	S	-	-
petroleum ether (ligroin)	-	L	L	-
phenol	5%	S	S	-
phenol	90%	S	-	-
phosphoric acid	25%	S	S	S
phosphoric acid	25-85%	S	S	S
phosphorus oxychloride	100%	L	-	-
picric acid	sat. sol.	S	-	-
potassium	sat. sol.	S	S	-
potassium borate	sat. sol.	S	S	-
potassium bromate	up to 10%	S	S	-
potassium bromide	sat. sol.	S	S	-
potassium carbonate	sat. sol.	S	-	-
potassium chlorate	sat. sol.	S	S	-
potassium chloride	sat. sol.	S	-	-
potassium chromate	sat. sol.	S	S	-
potassium cyanide	sol.	S	-	-
potassium fluoride	sat. sol.	S	S	-
potassium hydroxide	up to 50%	S	S	S
potassium iodide	sat. sol.	S	-	-
potassium nitrate	sat. sol.	S	S	-
potassium perchlorate	10%	S	S	-
potassium permanganate	2N	S	-	-
potassium persulphate	sat. sol.	S	-	-
potassium sulphate	sat. sol.	S	-	-
propane	100%	S	-	-
propionic acid	above 50%	S	-	-
pyridine	100%	L	-	-
S				
silver nitrate	sat. sol.	S	S	L
sodium acetate	sat. sol.	S	S	S
sodium benzoete	35%	S	-	-
sodium bicarbonate	sat. sol.	S	S	S
sodium bisulfite	sol.	S	-	-
sodium bisulphate	sat. sol.	S	S	-
sodium carbonate	up to 50%	S	S	L
sodium chlorate	sat. sol.	S	-	-
sodium chloride	10%	S	S	S
sodium chlorite	2%	S	L	NS
sodium chlorite	20%	S	L	NS
sodium dichromate	sat. sol.	S	S	S
sodium hydroxide	up to 60%	S	S	S
sodium hypochlorite	5%	S	S	-
sodium hypochlorite	10%	S	-	-
sodium hypochlorite	20%	S	L	-

		TEMPERATURE		
Compounds or elements	**Concentration**	**20°C**	**60°C**	**100°C**
sodium metaphosphate	sol.	S	-	-
sodium nitrate	sat. sol.	S	S	-
sodium orthophosphate	sat. sol.	S	S	S
sodium perborate	sol.	S	S	-
sodium silicate	sat. sol.	S	-	-
sodium sulfide	40%	S	S	S
sodium sulphate	sat. sol.	S	-	-
sodium thiosulphate (hypo)	sat. sol.	S	S	-
stannic chloride	sat. sol.	S	S	-
stannous chloride	sat. sol.	S	S	-
succinic acid	100%	S	-	-
sulphuric acid	up to 10%	S	S	S
sulphuric acid	10 to 30%	S	S	S
sulphuric acid	50%	S	S	-
sulphuric acid	96%	S	L	NS
sulphuric acid	98%	L	NS	NS
sulphurous acid	sol.	S	-	-
T				
tertatic acid	10%		S	
tetrahydrofuran	100%	S	NS	-
tetrahydronaphtalene	100%	L	NS	NS
thiophene	100%	NS	L	NS
toluene	100%	S	NS	-
trichloroacetic acid	up to 50%	L	S	NS
trichlotoethylene	100%	S	NS	-
triethanolamine	sol.	NS	-	NS
turpentine	-	S	NS	-
U				
urea	sat. sol.	NS	-	NS
W				
water, brackish		S	S	S
mineral-drinkable	-	S	S	S
water, distilled	100%	S	S	S
water (sea water)	-	S	S	S

Compounds or elements (The following solutions must be avoided)	Concentration
aliphatic hydrocarbons	100%
aqua regia	HCl/HNO_3=3/1
benzol	100%
bromine water	sol.
bromine (dry vapour)	dil.
bromine (liquid)	100%
butyl acetate	100%
camphor oil	-
chlorine, gaseous, dry	100%
chlorine (liquid)	100%
chloroform	100%
chlorosulfonic acid	100%
cyclohexanone	100%
dekalin	100%
ethylacetate	100%
ethylchloride	100%
heptane	100%
issoctane	100%
nitric acid	above 40%
methyl bromide	100%
methylene chloride	100%
oleic acid	100%
oleum (suphuric acid with 60% SO_3)	-
paraffin oil	-
sulfuric acid	98%
tetrahydrofuran	100%
tetrahydronaphtalene	100%
toluene	100%
trichloroethylene	100%
turpentine	-
xilene	100%

REMARKS
Concentrations are reported by volume.
Aqueous solutions of dilute chemical solutions are considered saturated to calculate their effect on polypropylene.
The table above lists the chemical names with their usual reference.

S	Satisfactorily
L	Limited
NS	Not satisfactorily
Sat. Sol.	Saturated solutions, ready at 20°C
Sol.	Solutions with a concentration above 10%, not saturated
Dil. Sol.	Diluted solution with 10% maximum concentration

NOTES

NOTES

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