

Du  Safe

Double Containment

pipng systems
design and installation guide



Engineered protection for the environment

ips

Double containment systems protect against leaks of hazardous or corrosive fluids from primary piping systems. They provide a cost-effective and reliable solution for workplace safety and to prevent environmental damage - helping companies to meet their statutory and moral obligations.

The IPS range of double containment piping includes DuoSafe systems in PVC-U and PVC-C in addition to DuoSafe FLEX for small diameter chemical dosing applications. Poly-Flo and AgruSafe are rigid double containment systems manufactured from Polypropylene, Polyethylene, PVDF and ECTFE. Please enquire for details on our complete range.

Quality and reliability assured

DuoSafe rigid pipe systems have been engineered from an original design developed by Spears® Manufacturing Co. With in excess of 35 years experience in the production in PVC-U and PVC-C, Spears are one of the world's largest manufacturers of industrial plastic piping products.

Engineered for simple, low cost installation

DuoSafe is a complete system including double contained pipes, fittings and valves. The components are assembled using standard solvent welding techniques, and are designed for ease of installation so that systems may be fitted at lower costs when compared to similar products.

Systems for a wide range of applications

DuoSafe Systems are manufactured from PVC-U and PVC-C piping products that meet international standards. These materials are safe to handle many aggressive fluids at temperatures up to 60°C (PVC-U) and 100°C (PVC-C).

System overview

Double contained systems use twin-wall pipes and fittings so that if there is a leak or failure in the primary, fluid handling pipe, any discharge is safely contained within the void between the two pipes. In double contained piping, the primary, fluid handling system is referred to as the **carrier pipe**, and the outer pipe is known as the **containment pipe**.

Different combinations of materials and pressure ratings are possible with DuoSafe systems. Carrier pipes are manufactured from PVC-U or PVC-C. Containment pipes are available in clear or grey PVC-U, PVC-C, ABS or Polyethylene (PE). Systems are produced using inch or metric sized pipes, except for ABS and PE - which are metric sizes only. For simplicity, this guide does not include systems that incorporate ABS or PE containment.

DuoSafe pipes are pre-assembled prior to arrival at site. The carrier pipe is fitted within the containment pipe using snap-on centralisers at predetermined distances to ensure the correct alignment and adequate support. The carrier pipe is free to move within the containment pipe. This makes installation easier and makes provision for possible thermal expansion or contraction without causing stresses in the system.

To simplify installation, DuoSafe fittings are supplied unassembled. The carrier (internal) fitting has extended legs with pre-fitted sockets ready to connect to the pipe. This has two benefits - firstly, the joint area becomes readily accessible and therefore solvent weld jointing is more reliable, and secondly the extended leg is a controlled dimension so that the calculation of pipe cut lengths is made straightforward.

There are no centralisers in the fittings - the system uses a "floating carrier design." Jointing is easier because of this, but the primary benefit is that the unrestrained carrier fittings can better accommodate thermal expansion and contraction within the carrier piping.



In-line ball valves are pre-assembled into fully pressure rated tee pieces with end connections configured to provide direct fixing to the carrier and containment pipes. The valve stem is extended and fitted with double 'O'-ring seals as it passes through a bolted containment flange on the branch of the tee. The location of the handle outside of the containment allows safe, easily accessible operation of the valves. Electric or pneumatic actuators can be fitted if required.

DuoSafe systems can accommodate conventional leak detection methods. Most commonly, the system is zoned and "low points" are created so that leaking fluids will drain to a point that has a visible chamber or leak detection sensor. Simple leak detection may also be provided by the installation of clear (transparent) PVC-U piping directly as part of the containment system.

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Planning the system

Planning fundamentals for double containment piping systems are broadly the same as those for single pipe systems. Factors that must be given consideration include:

- Materials of construction
- System sizing

Other factors that are specific to the project will include pipework routing. Below ground piping needs special consideration with regard to ground conditions and to the methods used for leak detection. Above ground, factors such as UV exposure, weatherability and the availability of suitable support will each require attention.

Materials of construction

The selection of a suitable material will require consideration of the following variables:

- What chemical(s) will be in contact with the system?
- What pressure will the system operate at?
- What is the concentration of the chemical(s)?
- What is the operating and ambient temperature?

Reference should be made to the chemical resistance tables in the IPS Handbook to ascertain the chemical resistance of the material. Specific questions about aggressive chemicals or chemical mixtures should be addressed to the IPS technical support team. All components of the piping system should be checked - including valves, gaskets and valve seats and seals.

The maximum working pressure available for each type of pipe is quoted for handling water at 20°C. Particular care should be taken to design out hydraulic shock caused by high velocity of flow, changes of direction, fast closing valves or trapped air. These factors can cause short bursts of pressure considerably in excess of safe maximum levels. The maximum system operating pressures (Bar) are as follows:

Inch Systems						Metric Systems					
Pipe Size	DuoSafe PVC-U			DuoSafe PVC-C			Pipe Size	DuoSafe PVC-U			
	Class C	Class D	Class E	Sch. 40	Sch. 80	Sch. 40		Sch. 80	PN6	PN10	PN16
1/2"	-	-	15	15	15	15	15	20mm	6	10	16
3/4"	-	-	15	15	15	15	15	25mm	6	10	16
1"	-	-	15	15	15	15	15	32mm	6	10	16
1 1/2"	-	12	15	15	15	15	15	50mm	6	10	16
2"	9	12	15	12	15	12	15	63mm	6	10	16
3"	9	12	15	12	15	12	15	90mm	6	10	16
4"	9	12	15	10	15	10	15	110mm	6	10	16
6"	9	12	15	10	15	10	15	160mm	6	10	16
8"	9	12	15	9	15	9	15	200mm	6	10	16

DuoSafe PVC-U piping may be operated at temperatures up to 60°C. DuoSafe PVC-C piping may be operated at temperatures up to 100°C. However it is important to understand that the system pressure rating reduces as the operating temperature increases. The following table indicates the approximate de-rating factors to apply to the maximum working pressure according to the temperature:

Working Temperature	DuoSafe PVC-U	DuoSafe PVC-C
	Pressure De-Rating Factor	Pressure De-Rating Factor
20°C	1.00	1.00
30°C	0.80	0.92
40°C	0.58	0.81
50°C	0.39	0.65
60°C	0.22	0.50
70°C	-	0.40
80°C	-	0.26
90°C	-	0.21
100°C	-	Non-Pressure Only

If there are changes in the system operating temperature (such as those that may occur in systems that occasionally discharge hot fluids), it may be necessary to make provision for thermal expansion and contraction. Expansion joints for the carrier and containment pipes should be incorporated where necessary. For guidance on the calculation of thermal movement, contact our technical department.

The installed environment should also be considered in respect of the containment piping material. Factors such as UV exposure, risk from freezing and/or impact damage may determine the selection of material. Equally, when a system is buried, the containment pipe bears the static ground load and possibly dynamic loading from traffic, etc. Irregular and/or unstable ground must also be considered when determining materials for the containment pipe.

System Sizing

The size of the carrier pipe is determined by the outcome from a number of factors: pipe diameter, flow rate, flow velocity and pressure drop due to frictional losses. It is important to remember that the maximum recommended velocity for plastic piping systems is 1.5m/sec. Guidance on pipe sizing for a specific application is available on request.

The designer will also need to take into account the size of the containment pipe when planning the system. There may be physical space constraints in trenches or in above ground pipe racks. Support centres must be at distances recommended for the containment pipe size.

The combination of carrier and containment sizes that are available is as follows:

Duosafe Inch Systems					Duosafe Metric Systems					Support Centres	
Containment	PVC-U	PVC-C	PVC-U	Carrier	Containment	PVC-U	ABS	PE	20°C	40°C	
Carrier	PVC-U	PVC-C	PVC-C		Carrier	PVC-U	PVC-U	PVC-U			
2"	1/2"	•	•	•	50mm	20mm	•	•	1.2m	1.1m	
3"	3/4"	•	•	•	63mm	25mm	•	•	1.5m	1.4m	
3"	1"	•	•	•	75mm	32mm	•	•	1.5m	1.4m	
4"	1 1/2"	•	•	•	110mm	50mm	•	•	1.7m	1.5m	
4"	2"	•	•	•	125mm	63mm	•	•	1.7m	1.5m	
6"	3"	on request	on request	on request	160mm	90mm	on request	on request	2.1m	1.9m	
8"	4"	on request	on request	on request	200mm	110mm	on request	on request	2.5m	2.3m	

Installation guidelines

System installation begins with the consecutive assembly of pipes and fittings usually beginning with a connection to a single pipe system. In this case, the easiest way to start installing a DuoSafe system is with a termination fitting. This fitting terminates the containment and provides a transition to a single pipe system. The termination fitting connects to the double containment piping using solvent weld connections. The (terminated) connection to the single pipe can either be a solvent weld socket or a flange.

Cutting pipes to length

A key benefit to the DuoSafe system is the ease by which pipe lengths between fittings can be calculated. With the termination fitting installed, and the position of the next fitting known, this is the method used to calculate the cutting length of the carrier and containment pipes:

Carrier (Inner) Pipe Cut Length

Measure the distance between the containment socket end face of the first fitting and the socket end face of the second containment fitting. Cut the carrier pipe to this length. Alternatively, if working to system centrelines, the following formula can be used:

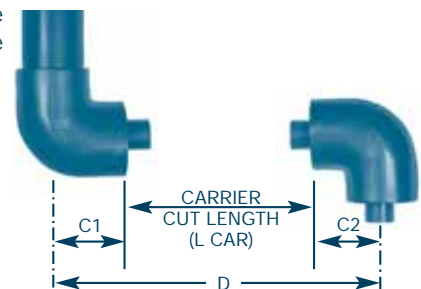
$$\text{Carrier pipe cut length (Lcar)} = D - (C1 + C2)$$

Where: Lcar - carrier pipe cut length

D = centreline to centreline distance between containment fittings

C1 = centreline to socket end of first containment fitting

C2 = centreline to socket end of second containment fitting



Containment (Outer) Pipe Cut Length

Measure the socket depth of the first and second containment fittings, and add this value to the carrier pipe cut length. Cut the containment pipe to this length.

This can be expressed as a formula as follows:

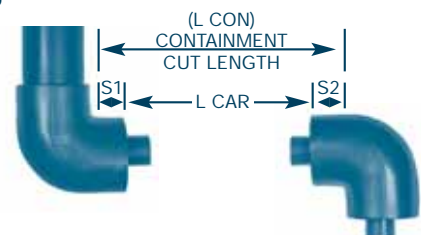
$$\text{Containment pipe cut length (Lcon)} = \text{Lcar} + S1 + S2$$

Where: Lcon = containment pipe cut length

Lcar = carrier pipe cut length

S1 = Socket depth of first containment fitting

S2 = Socket depth of second containment fitting



Note: When pipes are cut to length, re-position the centralisers in accordance with the support centres shown in the above table for the carrier pipe size.

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Assembly procedure

To guarantee sound joints in the system, care must be taken to ensure that all pipes are cut square, de-burred and are correctly chamfered. A rotary pipe cutter is recommended as it enables accurate cutting to length and provides a square cut. Power tools may be used provided they have suitable blades for use with plastic pipe. If a hand saw is used it is recommended to use a mitre box. Once cut and the length checked, the pipe should be de-burred and a 10° to 15° chamfer applied to the outside of the pipe, preferably using a proprietary plastic pipe chamfering tool.

The solvent cement, primer and cleaner that is used for jointing is hazardous and therefore the health and safety instructions must be followed at all times. Good ventilation in the work area is essential. Solvent cements, primers and cleaners are highly flammable and therefore naked flames or sparks should be avoided. Smoking is not permitted. All waste materials containing traces of the jointing materials should be disposed of carefully.

The DuoSafe system has been developed and tested with Weld-On 724 solvent cement, together with Weld-On P70 primer and C65 cleaner. Joints made using Weld-On 724 solvent cement have superior chemical resistance, especially for applications involving high concentrations of sulphuric, hydrochloric, nitric or hydrofluoric acids. The use of any other jointing materials is not recommended and the system warranty becomes invalid if such products are used.



Assembly instructions

- 1 When the pipe lengths have been cut and the pipes prepared for jointing, position the double containment piping then pull out the carrier pipe far enough to allow make up of the joint.
- 2 Prior to making the carrier and containment pipe joints, inspect the pipe end and the socket of the fitting to ensure that the proper preparation has been carried out and that the area to be jointed is clean and dry. If required, clean with Weld-On C65 cleaner applied using a clean, lint-free cloth or paper towel.
- 3 Make the joint on the carrier pipe first. Using a correctly sized applicator or natural bristle brush, apply Weld-On P70 primer to the outside of the pipe and to the inside of the socket of the fitting. "Work" the primer into the material to ensure penetration. Avoid "puddling" excessive primer in the socket of the fitting.
- 4 Immediately apply the Weld-On 724 solvent cement while the primer is still wet. Using a correctly sized applicator or natural bristle brush, apply a generous coat to the pipe then to the socket of the fitting. Quickly apply a second coat to the pipe.
- 5 Working quickly, assemble the joint until the pipe bottoms fully in the socket. Hold together for 10 to 20 seconds to avoid pushout. Any excess cement can be removed using a clean, dry cloth.
Note: bad joints are frequently the result of poor preparation (for example pipes not cut square or not chamfered) but most commonly they occur because insufficient cement has been applied. The application must be generous (without being excessive) so that the surfaces are fully and uniformly coated, and the joint must be brought together while the solvent cement is still wet.
- 6 Next, make the joint on the containment pipe using steps 3 to 5 above. Use a larger applicator or brushes if necessary.
- 7 At the next jointing position, continue to assemble joint in the same way: carrier pipe first then containment pipe. Continue to repeat this procedure to the end of the system - usually with a termination fitting. Occasionally the system design may necessitate simultaneous jointing of the carrier and containment pipes. In such cases, slide the containment fitting back as much as possible and follow the correct procedure to apply primer then cement to all jointing surfaces. It is important to work quickly, and to ensure an adequate coating of cement on all surfaces. Immediately assemble the joints ensuring that the components are correctly aligned.



Double containment tees

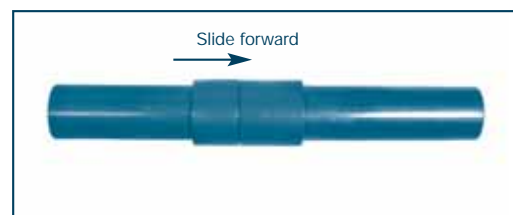
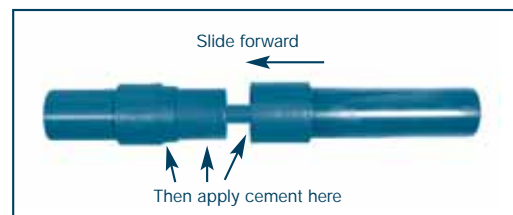
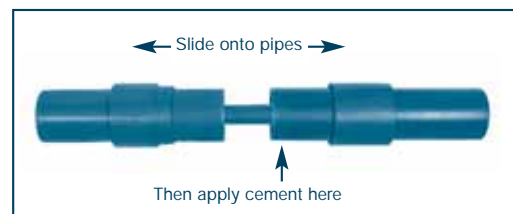
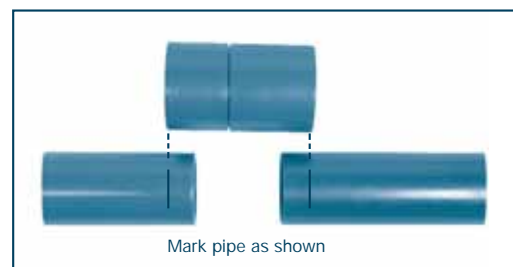
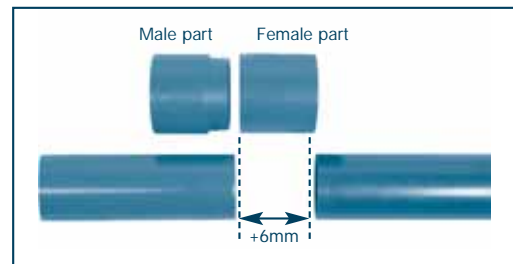
Some of the double containment tees are manufactured with the carrier tee branch socket extension separated from the carrier tee to allow easy movement of the carrier fitting during assembly, when this is the case, the carrier tee branch must be solvent welded into place after the first connections of the run carrier and containment tees have been made.

Closure fittings

Closure fittings are a special split coupling for jointing meeting runs of containment piping. The fitting is in two parts, with a male and female joint connection. An internal O-ring on each component ensures that the solvent cement is held in the correct joint area.

Assembly instructions

- 1 Following the guidelines for cutting on page 4, cut the containment pipes to length, leaving a space equal to the length of one part of the closure fitting plus approximately 6mm.
- 2 Dry fit together the male and female component parts of the closure fitting. Centralise next to the space in the containment fitting and mark both ends for reference.
- 3 Separate the closure fitting. One by one, place each part of the fitting on the containment pipe and slide back.
- 4 Assemble the carrier pipe using the solvent welding technique described earlier.
- 5 To assemble the closure fitting, first apply Weld-On P70 primer then immediately apply a generous coat of Weld-On 724 to the pipe end with the female closure component part. The primer and cement should be applied well past the mark on the pipe (the O-ring will wipe off any excess). Without delay, slide the closure fitting forward to the mark on the pipe (step 2). Let the cement cure for at least 5 minutes before proceeding further.
- 6 Apply primer and cement to the pipe end with the male closure component part, at the same time applying primer and cement to the male part of the closure fitting and to the socket of the female part of the closure fitting. Immediately slide the male fitting into the female fitting until it reaches the bottom. Hold for at least 10 to 20 seconds to prevent push-out.



Control fittings

Most double containment systems will incorporate a means to provide leak detection. Most commonly this will involve designing a number of low points in a system so that leaks will collect at a point where a sensor can trigger an alarm, or where a short clear tube can give a visible indication that a leak has occurred. Systems designed to provide controls of this type may be zoned so that leaks may be accurately located and more effectively controlled. The DuoSafe system includes a number of fittings to facilitate this, including Zoning Fittings, Leak Detection Tees and Leak Detection Saddles.

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Pressure testing

Pressure testing of the system can only occur once all of the solvent welded joints have been cured. The time taken for this to happen can depend upon a number of factors, including the tightness of fit as well as the ambient temperature and humidity. In general terms, a solvent welded joint will cure faster in warmer, drier conditions and when assemblies have a tighter fit. It is generally recommended that, wherever possible, joints be left for 24 hours to cure before pressure is applied. Prior to pressure testing, all joints, including flanges and threaded connections, should be inspected for tightness.

There are several important guidelines that must be adhered to when pressure testing the system:

- The carrier pipe system must be tested with liquid (normally water).
The use of gas or compressed air is not permitted as a test medium
- The system needs to be fully vented during filling so that no air pockets remain.

Test method - carrier pipe

Prior to testing, the system should be divided into sections (if appropriate). Fill with cold water, taking care to vent all trapped air. During filling and prior to applying any pressure, check the system for any obvious leaks. When the system is full, raise the test pressure in the first instance to 3 bar (50 psi) and hold at this level for at least 10 minutes. If the pressure gauge shows any fall, make further inspections to identify the problem. If the pressure remains constant, slowly raise the test pressure until a level of 1.5 x the maximum working pressure is reached. The pressure gauge should not show any fall during the minimum specified period (usually 1 hour).

If leaks are found at any stage, the system must be de-pressurised and drained. It is not possible to make a repair to a leaking pipe or fitting, therefore such components must be cut out and replaced. All new joints must be fully cured before re-testing.

Test method - containment pipe

After all joints have been fully cured, the containment piping may be low-pressure air tested at between 0.3 to 0.5 bar regulated pressure. The system must not be connected directly to an air-line, nitrogen bottle or to any unregulated pressure device. The test apparatus must be equipped with both a pressure limiting device set to 0.5 bar at the source, and an air relief device at the end of the system set to 0.5 bar. **Failure to follow this procedure can result in serious or fatal injury.**

Use a spray bottle containing a soap and water solution to check for leaks in the containment piping. If leaks are found, the system must be de-pressurised before components are cut out and replaced.

Installation Training

IPS provide free of charge training on installation methods to contractors, either at our in-house training facility or on site. Details of this service are available from our technical support team.

Sample Engineering Specification

- 1.0 System Design and Manufacturer
 - 1.1 The thermoplastic double contained piping system shall be a floating carrier design.
 - 1.2 Standard configurations (tees, elbows, etc.) of carrier fitting shall incorporate extender couplings for ease of installation.
 - 1.3 The system shall be "DuoSafe" as supplied by International Plastic Systems Ltd.
- 2.0 Size and Materials
 - 2.1 The double containment system shall be (specify: size, material and pressure rating) carrier pipe and fittings, and (specify: size, material and pressure rating) containment pipe and fittings.
- 3.0 Installation
 - 3.1 The system shall be installed in accordance with the DuoSafe Design and Installation Guide.
 - 3.2 Only persons trained in the installation of DuoSafe systems shall carry out the installation.
 - 3.3 Solvent welding shall be carried out only using Weld-On 724 solvent cement, in conjunction with P-70 primer and C-65 cleaner.

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