

VOLUME I: DRAINAGE SYSTEMS FOR NONCOMBUSTIBLE CONSTRUCTION

MECHANICAL
TECHNICAL MANUAL SERIES



DWV SYSTEMS

System 15® Pipe & Fittings

System XFR® Pipe & Fittings

Drain-Guard™ Double Containment

MJ Grey™ Mechanical Couplings

Compatible product lines designed for use in Drain, Waste and Vent (DWV) applications for buildings designated as noncombustible construction.

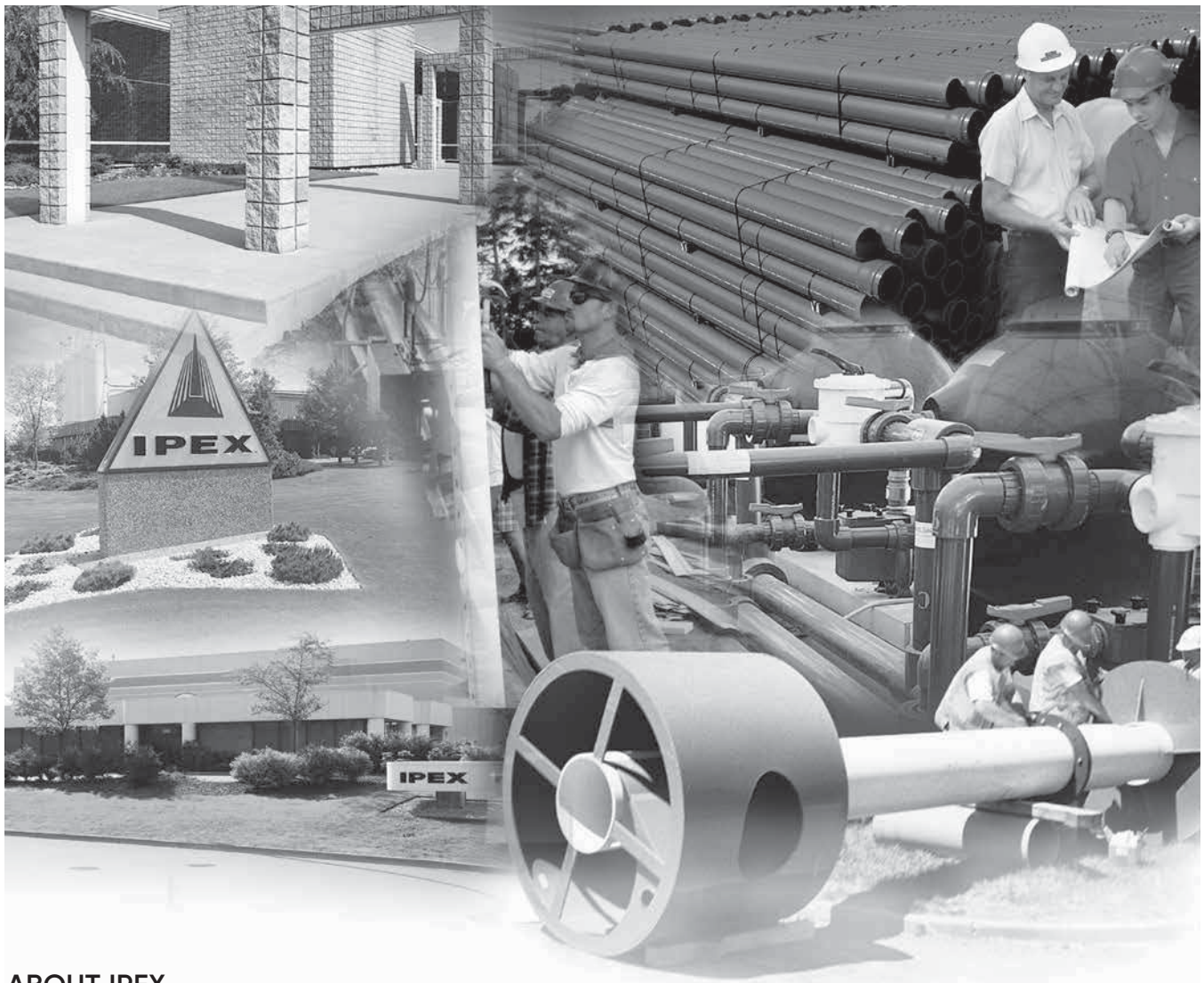
We build tough products for tough environments®

Drainage Systems for Noncombustible Construction

Mechanical Technical Manual Series, Vol. I

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ABOUT IPEX

At IPEX, we have been manufacturing non-metallic pipe and fittings since 1951. We formulate our own compounds and maintain strict quality control during production. Our products are made available for customers thanks to a network of regional stocking locations throughout North America. We offer a wide variety of systems including complete lines of piping, fittings, valves and custom-fabricated items.

More importantly, we are committed to meeting our customers' needs. As a leader in the plastic piping industry, IPEX continually develops new products, modernizes manufacturing facilities and acquires innovative process technology. In addition, our staff take pride in their work, making available to customers their extensive thermoplastic knowledge and field experience. IPEX personnel are committed to improving the safety, reliability and performance of thermoplastic materials. We are involved in several standards committees and are members of and/or comply with the organizations listed on this page.

For specific details about any IPEX product, contact our customer service department.

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SECTION ONE: GENERAL INFORMATION

OVERVIEW

System 15®, System XFR® and Drain-Guard™ by IPEX are compatible product lines designed for use in Drain, Waste and Vent (DWV) applications for buildings designated as noncombustible construction.

While our thermoplastic systems meet the demanding Flame Spread Rating requirements for noncombustible construction,

System XFR also meets the Smoke Developed Classification requirements for installation in high buildings and air plenum spaces.

This manual describes design and usage of these DWV systems. Information presented here is intended to supplement basic knowledge of DWV systems. Should designers or contractors require additional information or clarification, please contact IPEX.

IPEX DWV SYSTEMS

Complete Product Lines

System 15, System XFR and Drain-Guard are complete PVC drainage packages designed to maximize system integrity. Each system includes compatible pipe, fittings and cements as well as a listed line of firestop systems. These complete product lines ensure practical matters of specifying, ordering and installing piping systems are all rendered trouble-free.

Lower Installation Costs

In addition to lower material costs, both System 15 and System XFR can significantly reduce labour and transportation costs on a typical installation. How? Thermoplastic piping products are easily handled, stored, cut, and joined. These PVC systems eliminate the cumbersome tools and torches required to install conventional piping systems.

Improved Flow

IPEX DWV pipe and fittings exhibit a substantially lower roughness factor compared to metal and other piping materials; and since thermoplastics do not rust, pit, scale or corrode, their interior walls remain smooth in virtually any service condition. In addition, the larger inside diameters, longer lengths and fewer joints that are inherent to System 15 and System XFR make designs with flatter grades and smaller pipe diameters possible.

High Impact Strength

System 15, System XFR and Drain-Guard withstand demanding cold weather conditions. Their high impact strengths at cold temperatures save material costs by reducing damage and breakage at the jobsite. Both of these drainage systems are impact tested at 0°C and 23°C, and certified under CSA B181.2.

Lower Thermal Conductivity

With a dramatically lower rate of thermal conductivity compared to metal products, thermoplastic piping systems can reduce and even eliminate the need for insulation. Since thermoplastic piping is, by nature, very insulating, it resists condensation droplets from forming on its surface.

Fire-resistant Performance

Three features combine to make System 15, System XFR and Drain-Guard three of the most fire-resistant piping products available today:

- PVC is resistant to ignition. The ignition point of System 15 and System XFR is several hundred degrees higher than many construction products.
- The inherent self-extinguishing feature of these systems ensures that, in the absence of flame, neither product can cause a fire to spread.
- With their electrically non-conductive characteristics, neither system will cause fire when in contact with an electrical short.

System 15

DWV is certified to CSA B181.2, made to Schedule 40 thickness and exhibits a Flame Spread Rating of not greater than 25 as per ULC S102.2 test methods. With some restrictions, System 15 is permitted for use in many commercial DWV applications.

System XFR

System XFR DWV is also certified to CSA B181.2 and made to Schedule 40 thickness. System XFR is listed to ULC S102.2 to exhibit a Flame Spread Rating of not greater than 25 as well as a Smoke Developed Classification of not greater than 50. Having this makes System XFR permissible for use in High Buildings (as defined in NBC section 3.2.6) and Air Plenums (section 3.6.4.3).

Drain-Guard Double Containment

Depending on your application, Drain-Guard is a double containment piping system using System 15 and or System XFR as its primary components. The many performance benefits of System 15 and System XFR are enhanced by this dual pipe concept, including excellent thermal properties, improved flow, longevity and durability, and the security of meeting all code requirements for noncombustible buildings.

Drain-Guard piping systems provide safe transport of sanitary or storm drainage in critical areas. Should a leak occur, people, equipment and valuable property will be protected from possible harm.

Drain-Guard provides the secure environment necessary for piping in vital areas of a wide variety of buildings, including hospitals, museums, historical sites, libraries, art galleries, theatres, data centres, restaurants, and arenas.

Contact IPEX to discuss how Drain-Guard can enhance the protection of critical areas on your project.

Visual ID

From a distance, there are some differences in appearance between System 15 and System XFR to help with their identification.

Description	System 15	System XFR
Colour	Light grey	Dark grey
Pipe Print Line	Black	Green
Fitting Labels	White	Green

MJ Grey couplings can be easily differentiated from standard cast iron couplings by noting that the rubber interior sleeve is grey in colour (versus the traditional black colour) and exterior identification labels showing the System XFR trade name and the Flame and Smoke values as per ULC S102.2.

MJ Grey Couplings

MJ Grey Couplings are a mechanical joint assembly suitable only for use on IPEX System 15 or System XFR DWV piping sizes 1-1/2" through 18", are certified to CSA B602 and are listed to ULC S102.2 to exhibit a Flame/Smoke rating of 25/50.

DWV Fittings

All System 15 and System XFR fittings are manufactured and tested according to the requirements of CSA B181.2. IPEX's comprehensive line of DWV fittings complements pipe sizes from 1-1/2" to 24" diameter.

Various fittings are available including innovative 'apartment fittings', used to connect drainage outlets to the main drain of a multi-storey residential building. These one-piece fittings are compact enough to be installed between floors.

Firestop Systems

Firestopping systems for System 15 and System XFR shall be listed to CAN4-S115 and tested with a pressure differential of 50 Pa. Listed firestopping systems are required whenever the piping penetrates a fire-rated vertical or horizontal separation.

Design and Installation

The design and installation of PVC systems shall be performed in accordance with the recommendations detailed in the Handling and Installation section of this Submittal Data Sheet, local and national regulations where applicable.

The photo below shows the position of one of two labels on System XFR fittings and a close-up of information printed on the label.

Please note that the Flame and Smoke listing for System XFR fittings is issued based on tests performed on these fittings assembled with System XFR pipe and System 15/XFR solvent cement only.



SECTION TWO: PHYSICAL PROPERTIES

MATERIAL DESCRIPTION

PVC is the most frequently specified of all thermoplastic piping materials. It has been used successfully for over 60 years. PVC is characterized by distinctive physical properties, and is resistant to corrosion and chemical attack by acids, alkalis, salt solutions and many other chemicals.

Pipe Dimensions

The physical dimensions and tolerances of System 15 and System XFR pipe and fittings meet the requirements of CSA B181.2.

System 15 and System XFR Pipe Dimensions=

Diameter (in.)	Avg. Outside Diameter (in.)	Avg. Inside Diameter (in.)
1-1/2	1.90	1.56
2	2.38	2.01
3	3.50	3.01
4	4.50	3.95
6	6.63	5.97
8	8.62	7.82
10	10.75	9.81
12	12.75	11.70
14	14.00	12.86
16	16.00	14.69
18	18.00	16.54
20	20.00	18.45
24	24.00	22.19

NOTES:

- System XFR is now available up to 18" diameter and is made in 12 foot lengths for all sizes
- System 15 pipe lengths of 12 foot are plain end while 20 foot lengths of pipe are bell ended
- 24" System 15 is not ULC Listed for a Flame Spread Rating not greater than 25.

Drain-Guard Double Containment

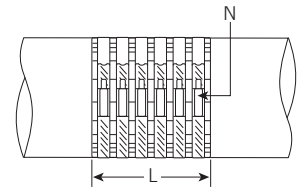
Product Availability (inches)
Carrier: 1-1/2" – 8"
Containment: 4" – 12"
(Larger sizes available upon request)

MJ Grey Dimensions

Coupling Size (inches)	Length (L) (inches)	(N) Number of Clamps
1-1/2	4.0	4
2	4.0	4
3	4.0	4
4	4.0	4
6	6.0	6
8	6.0	6
10	6.0	6
12	6.0	6
14	8.0	8
16	8.0	8
18	8.0	8

Pipe Weight

Weight differences between piping materials can influence a project significantly. During handling and installation, heavier piping products may incur additional costs for the extra manpower and equipment. Other effects of heavier systems may include reduced daily production levels, hanger requirements and impact on worker safety and fatigue.



The table below compares the weights of System 15 and System XFR versus cast iron.

Weight Comparison

Size (in.)	System 15 and System XFR		Cast Iron	
	(lb/ft)	(kg/m)	(lb/ft)	(kg/m)
1-1/2	0.5	0.8	2.7	4.0
2	0.7	1.0	3.7	5.5
3	1.4	2.1	5.0	7.5
4	2.1	3.1	7.0	10.4
6	3.6	5.4	11.5	17.1
8	5.4	8.1	16.0	23.8
10	7.7	11.5	25.5	38.0
12	10.2	15.2	30.0	44.7
14	12.1	18.0	–	–
15	–	–	52.5	78.2
16	15.8	23.5	–	–
18	19.9	29.7	–	–
20	23.3	34.7	–	–
24	32.2	47.9	–	–

Sound Levels

In 2019, IPEX consulted with HGC Engineering, one of Canada's largest engineering consulting firms specializing exclusively in noise, vibration, and acoustics. This 3rd party firm independently conducted in-situ measurements of toilet flushes in several multi-family mid and high-rise residential concrete buildings ranging between 8 to 45 storeys prior to occupancy. The primary purpose of the measurements was to compare the noise levels generated from toilets flushing into different drain pipe materials against the plumbing noise level criteria published in ASHRAE Chapter 48: Noise and Vibration Control, Table 5, where the published criteria for plumbing noise levels in residential bathrooms is 45 dBA. No attempt was made to control real-world variables such as construction deficiencies, differing plumbing layouts, etc., and the measurements taken thus represented authentic scenarios found in-suite.

Where PVC was used, the in-situ stack sound level measurements showed compliance with the ASHRAE Chapter 48 criteria (see Figure 1). The results confirmed that PVC drain piping such as System XFR is very suitable for use in high-rise condos. Further, the observed difference between in-situ measurements of PVC and traditional cast iron drain pipes was found to be audibly indistinguishable.

In-Situ Test Results for PVC Stacks vs. ASHRAE Chapter 48 (Table 5)

Material	Average Measured Sound Level (A-Weighted, dBA)	ASHRAE Criteria for Residential Bathrooms (dBA)
PVC	37 ✓	45

The report also discusses recent condo surveys of Canadian condo occupants in 2019 (pre-pandemic) and 2021 (working from home during the pandemic) that were published in the Canadian Acoustical Association journal. These surveys were performed to determine the levels of annoyance resulting from various condo noise sources. It was found that in both the 2019 and 2021 surveys that noise originating from "water sources" (i.e. drainage or supply) was reported to be among the least of all indoor annoyances. The surveys concluded that for indoor noise, noise from neighbors (airborne) and noise from heating and cooling systems (HVAC) were identified as more annoying than other sources.

Some best practices to minimize the transmission of sound from any DWV piping system would be the following:

1. Provide insulation inside the wall/ceiling cavity where the piping system is located.
2. Use high efficiency fixtures to minimize the flow rates within the piping.
3. Be selective when laying out plumbing stacks and branches to avoid critical areas such as sleeping or living areas.
4. Support pipe properly ensuring it is not in contact with the wall/ceiling material and allow adequate clearances between piping and holes cut in framing members.

For a copy of the HGC report and a technical training on the facts about acoustics of DWV piping in high-rise condos, contact IPEX.

Impact Strength

The impact strength of a material is a measure of its ability to absorb impact energy without failure. Pipe that is resistant to impact is not easily damaged or broken, trimming material costs at the jobsite. In addition, impact resistance for certain applications, such as school gymnasiums, can be an important design consideration.

Test methods developed by CSA and ASTM for PVC DWV pipe involve dropping known weight onto a pipe from a specified height at a given temperature.

Impact energy is defined as: $E_i = wh$,

where: w = weight, lbs

h = height, ft

(70ft-lb impact energy is similar to striking a pipe with a 14 lb. hammer from a distance of 5 feet.)

Impact resistance for some piping materials is either not specified or not a requirement of the test standards. For instance, cast iron, by nature brittle, withstands only 20ft-lbs of impact in some sizes before cracking or breaking, when tested in drop impact tests.

The CSA B181.2 standard requires System 15 and System XFR pipe withstand the following minimum impacts:

- 96ft-lb through to 229ft-lb at 73°F (23°C), depending on the pipe diameter.
- 52ft-lb through to 220ft-lb at 32°F (0°C), depending on pipe diameter.

Testing conducted by CSA on the System 15 and System XFR confirms that both systems meet and exceed these required standards. System 15 and System XFR exhibit the highest impact resistance of any commercial DWV piping products available in Canada today.

Temperature Considerations

For continuous flow non-pressure applications, System 15 and System XFR can be safely used up to 140°F (60°C). Designers and installers should always consider the effects of thermal expansion and contraction when designing or installing a DWV system.

In addition, both products may be used up to 180°F (82°C) for intermittent gravity flow.

Thermal Conductivity

Compared to traditional metal materials, the thermal conductivity of thermoplastics is low. This characteristic gives thermoplastics its insulating properties. As an insulator, thermoplastics such as PVC can reduce or even prevent condensation from forming on a piping system. Conversely, most metal piping products require insulation to limit condensation.

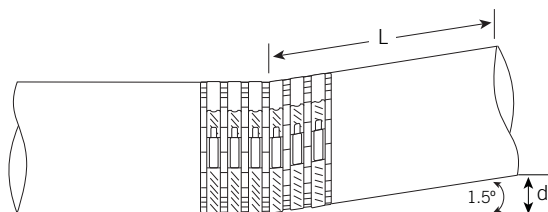
Coefficients of Thermal Conductivity

Material	Coefficient of Thermal Conductivity BTU.in./ft ² .hr.°F
System 15®	1.2
System XFR®	1.2
Carbon Steel	360.0
Wrought Iron	436.0
Pure Iron	498.0
Copper	2700.0

MJ Grey Joint Deflection

The MJ Grey coupling may be used to accommodate small changes in alignment up to 1.5° in any direction.

Below are the offset distances resulting from a deflection limit of 1.5 degrees:



Pipe Length (L) (feet)	Offset (d) (mm)	Offset (d) (in)
3	23	0.9
5	41	1.5
10	79	3.1
12	97	3.8

Resistance to Corrosion

PVC is well known for resistance to internal and external corrosion. In many cases, replacing metal products with PVC piping may solve corrosion problems since aggressive chemical waste does not generally plague PVC systems. For example, parking garage structures.

System 15 and System XFR piping systems are nonconductive and therefore immune to galvanic and electrolytic erosion. In addition, the non-corroding properties of these systems ensure there is no deterioration in flow characteristics over the life of the installation, which cuts maintenance costs and lengthens performance life.

In comparison, the life cycle of metal piping products in applications such as certain washroom fixtures or systems that handle chemical waste streams may be limited. Cast iron DWV systems, for instance, are not recommended for waste streams from concentrated or undiluted carbonated soft drinks sources, specific types of cleaning chemicals or waste with a pH level of 4.3 or less.

(Note: When handling chemical waste, refer to IPEX's Chemical Resistance Guide to ensure compatibility.)

Expansion and Contraction

All piping products expand and contract with changes in temperature. the degree of thermal expansion or contraction depends on four things:

- duration of temperature change,
- coefficient of thermal expansion,
- system temperature differential, and
- length of pipe run between changes in direction.

Because System 15 and System XFR have very low rates of thermal conductivity, it takes a long time for the PVC pipe wall to absorb or lose heat and thus expand or contract. Therefore, a temporary flow of hot water through a PVC stack may not have a measurable effect with respect to expansion and or contraction.

The amount of thermal expansion that might occur in a System 15 and System XFR pipeline can be calculated using the formula below:

$$\Delta L = Y \frac{(T_{\max} - T_{\min})}{10} \times \frac{L}{100}$$

where: ΔL = linear distance of expansion or contraction, inches

Y = rate of expansion/contraction. For System 15 and System XFR material
 $y = 0.36''/10^{\circ}\text{F}/100'$

T = temperature, $^{\circ}\text{F}$ (note $T_{\max} - T_{\min}$ may also be expressed as ΔT)

L = length of pipe run, feet

Example

Assume a slab-on-grade four-storey apartment building in which System 15 or System XFR pipe system is installed with a developed plumbing stack length of 50 feet. The installation temperature is 30°F . When the indoor air temperature stabilizes at 70°F , what is the potential overall expansion of this stack?

$$\Delta L = Y \frac{(T_{\max} - T_{\min})}{10} \times \frac{L}{100}$$

$$\Delta L = 0.36 \times 4 \times 0.50 = 0.72''$$

The table below summarizes values for ΔL for various ΔT and Length of Run values.

Typically System 15 and System XFR systems will include many laterals that restrict movement and frequent changes in direction that limit the distance of pipe runs. Thus, the need for expansion compensating devices may be low. However, should the need arise, IPEX suggests expansion or contraction be accommodated using one of these 3 methods:

- CSA certified Mechanical Joint Couplings installed every second floor for vertical stacks;
 - CSA certified expansion joints** where available installed every second floor for vertical stacks;
- or
- Directional offsets to limit the run lengths of piping.

**** Note – Expansion joints certified for use on System 15 and System XFR are not certified for cast iron vertical stacks and thus may not be used on cast iron.**

Thermal Expansion (ΔL) of System 15 and System XFR (inches)

Temp. Change $\Delta T^{\circ}\text{F}$	Length of Run in Feet									
	10	20	30	40	50	60	70	80	90	100
20	0.07	0.14	0.22	0.29	0.36	0.43	0.50	0.58	0.65	0.72
30	0.11	0.22	0.32	0.43	0.54	0.65	0.76	0.86	0.97	1.08
40	0.14	0.29	0.43	0.58	0.72	0.86	1.01	1.15	1.30	1.44
50	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.40	1.62	1.80
60	0.22	0.43	0.65	0.86	1.08	1.30	1.51	1.73	1.94	2.16
70	0.25	0.50	0.76	1.01	1.26	1.51	1.76	2.02	2.27	2.52
80	0.29	0.58	0.86	1.15	1.44	1.73	2.02	2.30	2.59	2.88
90	0.32	0.65	0.97	1.30	1.62	1.94	2.27	2.59	2.92	3.24
100	0.36	0.72	1.03	1.44	1.80	2.16	2.52	2.88	3.24	3.60

Support Spacing

Every piping system needs adequate support. In DWV systems, support spacing is a function of pipe size, operating temperature and fluid characteristics. To ensure satisfactory operation of a thermoplastic piping system, carefully consider the location and type of hanger used.

Support of pipe and placement of hangers must adhere to the requirements of the National Plumbing Code of Canada or the local plumbing Authority Having Jurisdiction. Specifically, the Code calls for a minimum support spacing of 1.2m (4ft) for horizontal pipe runs of all sizes. However, local authorities may be receptive to increased spacing of hangers if supported by engineering analysis.

Consider the following guidelines when designing a DWV system:

1. Allow the pipe to move freely within the hangers. Do not tighten the hangers so that the pipe is compressed, distorted or bent. Since thermoplastic pipe expands and contracts approximately three times that of steel, hangers should not be of the type that will restrict this movement.
2. Use strap-type metal hangers or equivalent that are free of rough edges and burrs, and have a broad support base. Hangers should provide as much bearing surface as possible. Sharp supports or sharp edges on supports should not be used with these materials since they will cause mechanical damage if the pipe moves.
3. Avoid placing System 15 and System XFR lines alongside steam or other high temperature pipelines.
4. Refer to the support spacing chart and fluid correction factors for recommended support locations.

Correction Factors for Support Spacing

Specific Gravity	Correction Factor
1.0	1.00
1.1	0.98
1.2	0.96
1.4	0.93
1.6	0.90
2.0	0.85
2.5	0.80

The chart below gives recommended support spacing for PVC pipe at various temperatures. This data is based on fluids with a specific gravity of 1.0. For heavier fluids, multiply the support spacing from the chart by the correction factors shown above.

Recommended Maximum Support Spacing (feet)*

Nominal Pipe Size (in.)	Temperature 73°F / 23°C	Temperature 140°F / 60°C
1-1/2	4.6	4.1
2	5.2	4.6
3	6.6	5.9
4	7.5	6.7
6	9.2	8.2
8	10.6	9.4
10	12.0	10.6
12	13.2	11.7
14	13.9	12.4
16	15.2	13.5
18	16.5	14.6
20	17.4	15.5
24	19.5	17.3

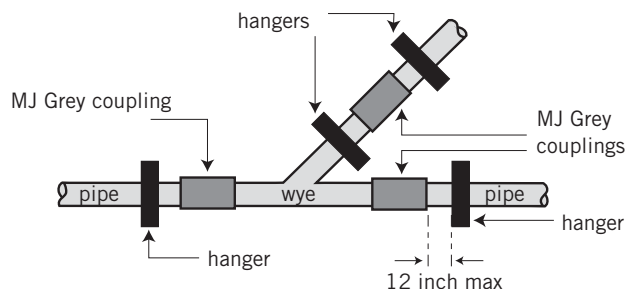
* based on an engineering analysis with centre span sag limited to 0.2% of span length

MJ Grey Support Spacing

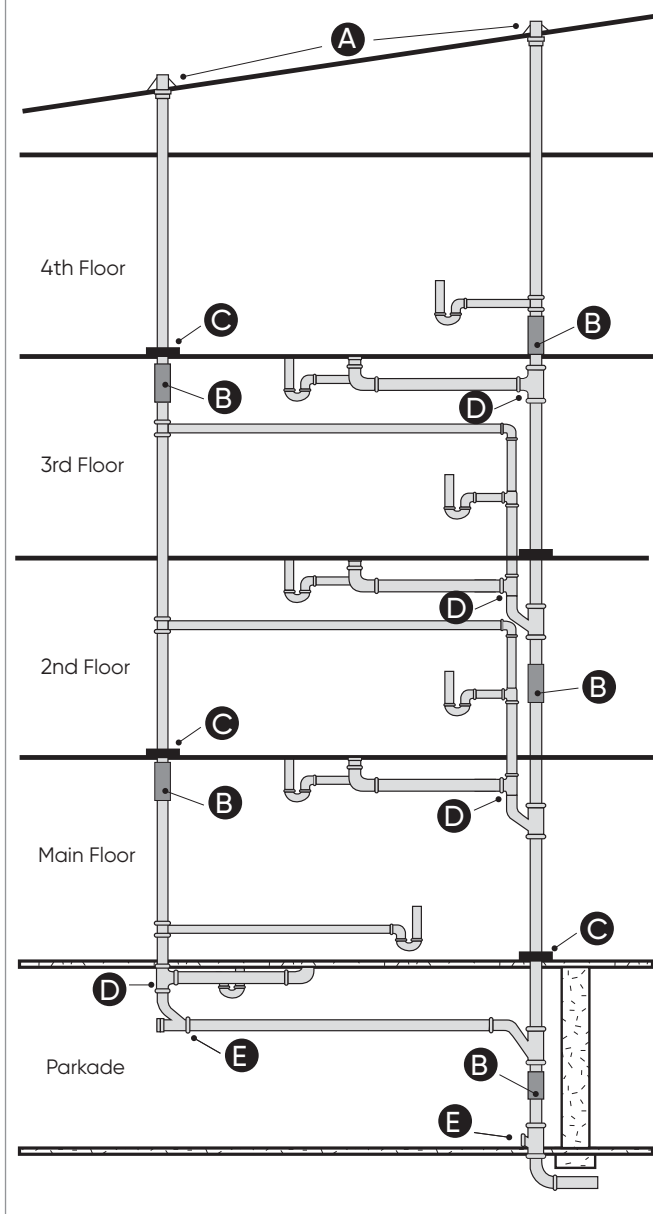
Horizontal: All MJ Grey coupling installations should be supported on each side (both the pipe and fitting side) to a maximum distance of 12" (300mm) away from the coupling, and in accordance local building codes. (see figure below)

Vertical: Regular vertical support methods for solvent weld System 15 or System XFR may be employed.

Restraints: Fully restraining fittings that will be exposed to high thrust forces may be required. Consult the project engineer.



Addressing Movement in a DWV Stack



A Neoprene flashing may be considered to be an expansion compensator

B Expansion fitting

C Riser Clamps

D Side inlet, TY

E Pipe anchor and/or support at the base of all stacks

Note: This is an example only and may not be appropriate for all installations.

Addressing Movement in a Wood Framed Building

In the case of wood-framed construction, building settlement and shrinkage can be more significant than thermal expansion or contraction. Wood shrinkage can be as high as 3/4" (20mm) per floor depending on moisture content and height of the wood framing. Building shrinkage is not considered significant for piping design in noncombustible (i.e. steel/concrete) structures.

The following installation recommendations for this example are based on years of experience and have proven successful in most installations:

- Install a rubber coupling, MJ Grey or CSA-certified expansion joint at every second floor of the building.
- Rigidly support the stack pipe on alternating floors to direct any movement into the appropriate expansion compensator.

Installation will segment the pipeline and thus limit its overall movement.

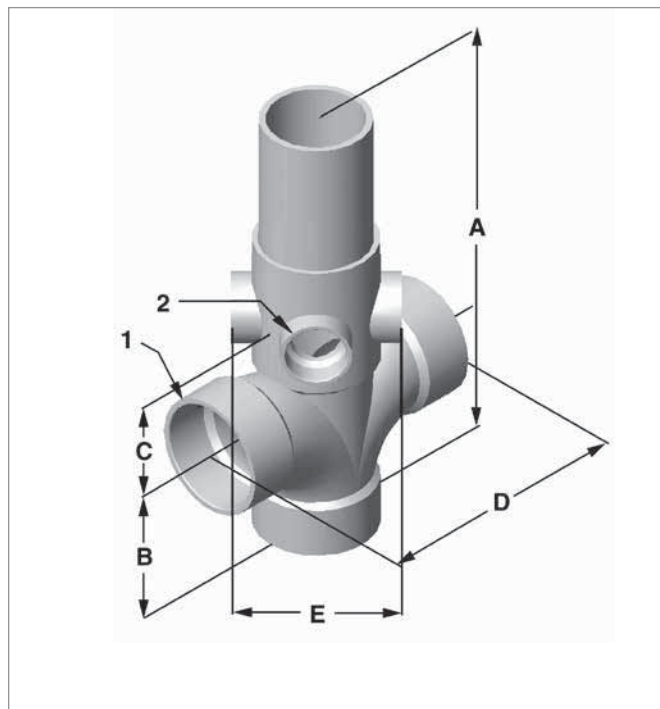
The illustration, 'Addressing Movement in a DWV Stack' indicates the proper location for the devices to be installed.

Using this method of installation will limit movement between any two floors of the building. If you require additional information, please contact IPEX.

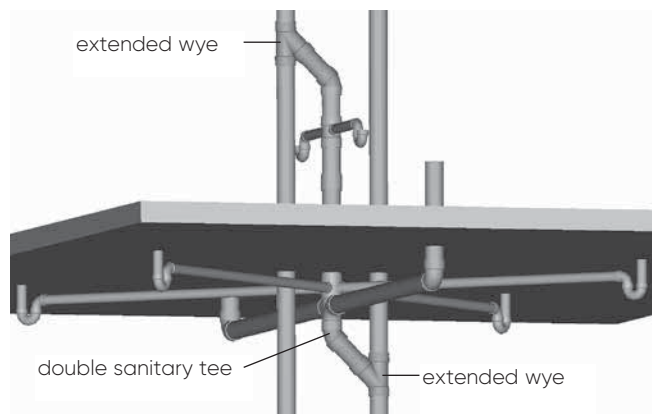
Follow IPEX installation instructions for proper installation of expansion joints in either the horizontal or vertical position. Always check with the local authority having jurisdiction for approval prior to installation of the DWV system.

Apartment Fittings

IPEX Apartment Fittings for connecting drainage outlets to the main drain in tight ceiling assemblies are ideal for multiple-story apartment buildings. IPEX Apartment Fittings are easy to install and, unlike metallic fittings, are corrosion-free, ensuring a long service life.



Double Sanitary Tee



Extended Wye

Apartment Fittings Dimensions

Symbol	Double Sanitary Tee Product Code 026008		Single Sanitary Tee Product Code 026007		Extended Wye Product Code 026006	
	in	mm	in	mm	in	mm
1	3 - Hub	75 - Hub	3 - Hub	75 - Hub	n/a	n/a
2	1-1/2 - 45° Hub	40 - 45° Hub	1-1/2 - 45° Hub	40 - 45° Hub	n/a	n/a
A	27-1/4	693	27-1/4	693	13-1/2	343
B	4-9/16	116	4-9/16	116	8-1/16	205
C	3-5/16	84	3-5/16	84	9	229
D	9-1/16	231	4-9/16	116	n/a	n/a
E	5-1/8	180	n/a	n/a	n/a	n/a

Flow Characteristics

PVC systems offer a low roughness coefficient. This combined with the larger inside diameters inherent to System 15 and System XFR enhances the flow characteristics of these systems.

The high carrying capacity of PVC piping often results in the use of flatter grades or smaller diameter pipe. In addition, excellent corrosion resistance of System 15 and System XFR means that this low friction loss characteristic remains unchanged over time.

Manning's Roughness Factor

In 1890, Manning derived a formula to compute flow of liquids in a steady flow at constant depth:

$$V = \left(\frac{1.486}{N} \right) R^{2/3} S^{1/2}$$

where: V = average velocity at a cross section, fps

R = hydraulic radius, ft

S = slope, ft/ft

N = coefficient of roughness

The Manning's coefficient of a pipe is related to a pipe material's surface roughness. Pipe with a lower coefficient has a smoother wall, which contributes significantly to greater flow capacity and higher flow rate.

Values of the coefficient, N, determined by tests on actual pipes are listed in the following table.

Inside Diameter

Pipe designed with a larger inside diameter provides

Values of Manning's Roughness Coefficient, N

Material	Manning's N
System 15 and System XFR	.009
Copper	.011
Concrete	.013
Cast Iron (new)	.012
Cast Iron (used)	.015
Corrugated metal	.022

a greater cross-sectional area for flow, raising both carrying capacity and flow rates. The table below compares inside diameters of different DWV piping materials.

A comparison of discharge capacity rates between cast-iron and System 15 / System XFR are be found in the tables below.

Cast Iron

Discharge Rates and Velocities in Sloping Drains (Full Flow - Cast-Iron, n = 0.013)

Nominal Diameter of Pipe (inches)	1/16 in/ft Slope		1/8 in/ft Slope		1/4 in/ft Slope	
	Discharge (gpm)	Velocity (fps)	Discharge (gpm)	Velocity (fps)	Discharge (gpm)	Velocity (fps)
1-1/2	4	0.78	5	1.10	7	1.56
2	8	0.95	12	1.35	17	1.90
3	26	1.26	36	1.79	51	2.53
4	57	1.54	80	2.18	114	3.09
5	103	1.79	145	2.53	205	3.58
6	168	2.02	238	2.86	336	4.04
8	360	2.45	510	3.46	721	4.89
10	652	2.84	922	4.01	1303	5.68
12	1077	3.22	1523	4.55	2154	6.44
15	1935	3.73	2737	5.27	3870	7.45

System 15 and System XFR

Discharge Rates and Velocities in Sloping Drains (Full Flow - PVC, n = 0.009)

Nominal Diameter of Pipe (inches)	1/16 in/ft Slope		1/8 in/ft Slope		1/4 in/ft Slope	
	Discharge (gpm)	Velocity (fps)	Discharge (gpm)	Velocity (fps)	Discharge (gpm)	Velocity (fps)
1-1/2	7	1.21	10	1.71	14	2.42
2	14	1.44	20	2.03	29	2.88
3	42	1.88	59	2.66	84	3.76
4	86	2.26	122	3.19	173	4.51
6	259	2.97	366	4.20	517	5.94
8	532	3.55	752	5.03	1064	7.11
10	974	4.13	1378	5.85	1949	8.27
12	1557	4.65	2202	6.57	3114	9.30
14	2006	4.95	2837	7.00	4012	9.91
16	2860	5.41	4045	7.65	5720	10.82
18	3924	5.86	5549	8.28	7847	11.71
20	5248	6.30	7421	8.91	10496	12.60
24	8587	7.12	12144	10.08	17174	14.25

Notes:

1. A flow velocity of 2 fps will prevent the solids within a pipe from settling out and forming a system stoppage.
2. For PVC, n=0.009; For Cast-Iron, n=0.013.
3. For ID dimensions, refer to CSA B70 for cast iron and CSA B181.2 for PVC.
4. For Half Flow, divide Discharge Rates by 2.

Pipe Condensation

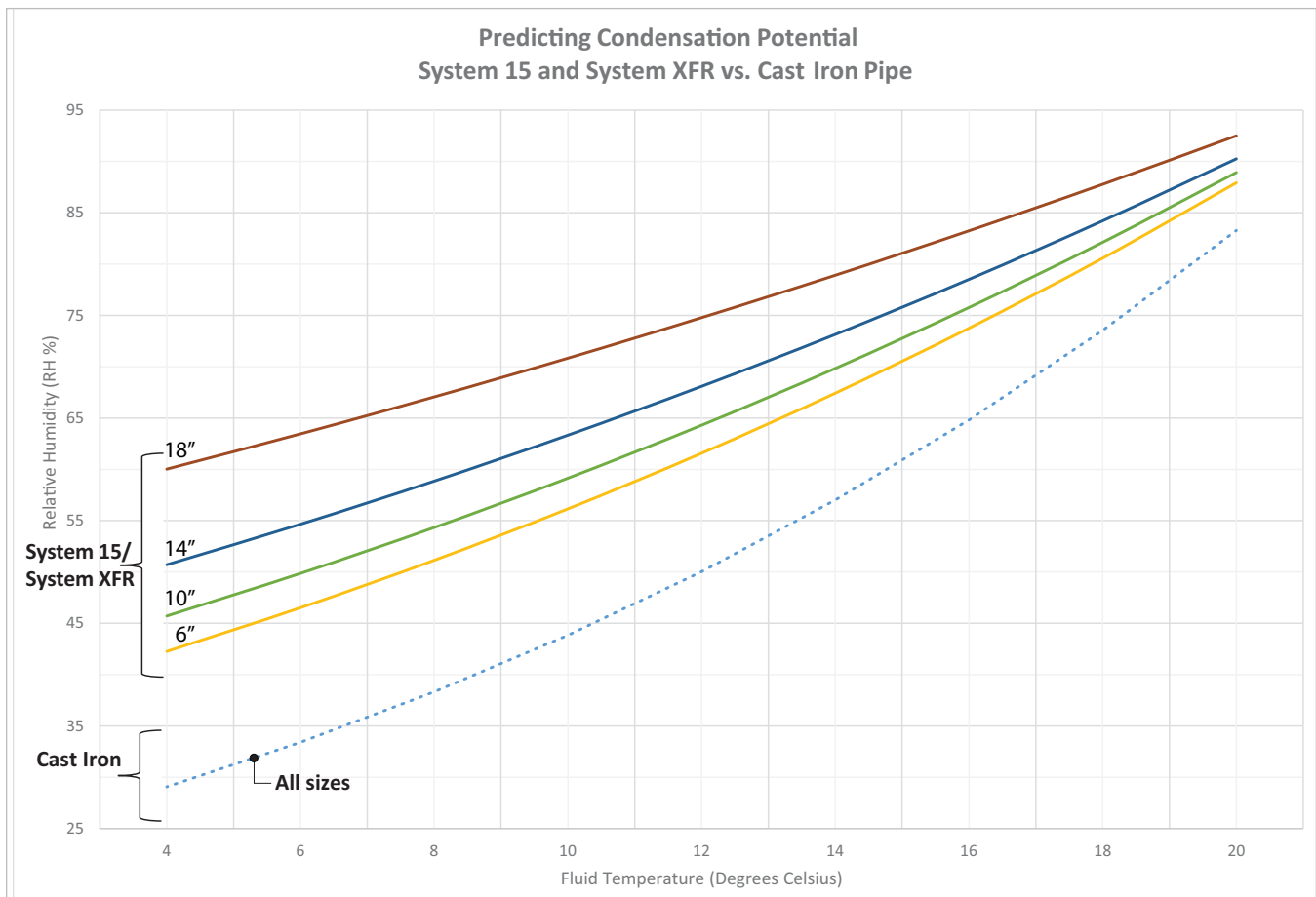
PVC pipe sweats less than metal pipe because of its excellent insulating properties. However, should a number of conditions occur simultaneously, condensation will form on PVC pipe as well.

For a given pipe material, pipe size, relative humidity and fluid temperature, condensation potential can be predicted by using the graphs below. A comparison of condensation potential between traditional materials (asbestos cement pipe & cast-iron) and System 15 or System XFR are found in the charts below.

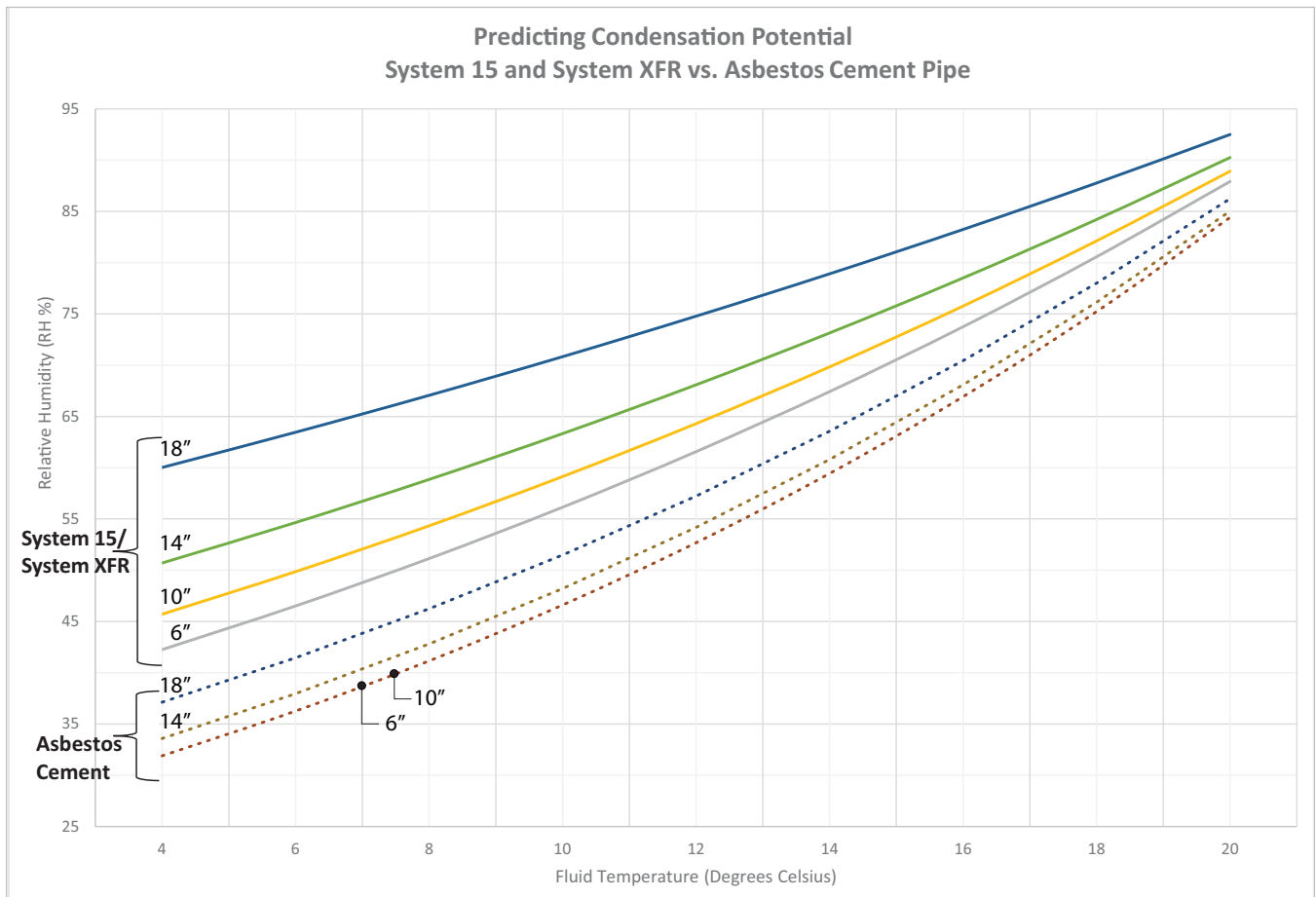
Example:

Given a relative humidity of 45% and fluid temperature of 6 C (43 F), will condensation form on a 6" pipe? Assume an ambient air temperature of 23 C (73 F).

1. For System 15 or System XFR: No, condensation will not occur. The given data point falls to the right/below of the corresponding line.
2. For cast iron: Yes, condensation may occur. The given data point falls to the left/above the corresponding line.
3. For asbestos cement: Yes, condensation may occur. The given data point falls to the left/above the corresponding line.



1. Condensation may occur if conditions exist above the curve for each diameter.
2. Assumed ambient air temperature is 23°C
3. Conservatively assumed a full pipe with sufficient time for fluid to transfer heat to the pipe wall exterior.
4. Coefficient of Thermal Conductivity: System 15 and System XFR = 0.17 W/mK, Cast Iron = 55 W/mK



1. Condensation may occur if conditions exist above the curve for each diameter.
2. Assumed ambient air temperature is 23°C
3. Conservatively assumed a full pipe with sufficient time for fluid to transfer heat to the pipe wall exterior.
4. Coefficient of Thermal Conductivity: System 15 and System XFR = 0.17 W/mK, Asbestos Cement = 2.07 W/mK

Heat Tracing

Heat tracing may be necessary to prevent freezing in unconditioned spaces. Heat tracing can be applied directly on the pipe within the insulation in a configuration intended to evenly distribute the heat along the pipe (for example, a spiral), and must not exceed the operating temperature limit of the pipe. In some cases, it may be necessary to install two or more cables with reduced output to ensure a more even heat distribution and penetration without exceeding the maximum operating temperature of the pipe. Refer to the heat tracing manufacturer's installation instructions.

Combustible DWV Pipe in Vertical Service Spaces

When using System 15 or System XFR, contractors and designers must be aware that National and Provincial Building Codes restrict the use of the combustible piping in vertical service spaces.

A vertical service space is an open area that is intended to accommodate a number of building services such as mechanical, electrical and communication systems. A vertical service space generally runs from the basement of a building through to the top of the building, much like an elevator shaft or garbage chute. As an area that is completely open from the bottom to the top of the building, it offers no opportunity to properly firestop the combustible piping system at each floor as required by Code.

Distinct from a vertical service space, a 'chase' is a designated area that also runs vertically through the building from bottom to top. This designated area may be a vertical wall assembly or other area designated to accommodate building services.

In a 'chase', specific holes are drilled through the horizontal fire separations to accommodate each individual service, allowing proper fire stopping materials to be used as the service penetrates each separation. By firestopping at each level through the building, the integrity of the fire separations are maintained and the building remains compartmentalized.

If the only option to accommodate a stack is to use a vertical shaft, then the following recommendations may be helpful:

1. At the horizontal fire separation where System 15 or System XFR would penetrate up through to the floor above, install a ceiling/floor that meets the fire resistance rating as prescribed by code.
2. Then, install a listed firestop system that satisfies the required fire resistance rating.

By following these steps, the floor/ceiling system is properly firestopped, and the shaft restriction has been removed. Before proceeding with this type of assembly, be sure to contact your local authority to gain approval.

Handling and Storage

Pipe

System 15 and System XFR are strong, lightweight piping materials and, as such, are easily handled. However, because of their light weight there is a tendency for this product to be mishandled on the jobsite.



CAUTION

Use a forklift to unload System 15 and System XFR crates directly from the delivery vehicle. Avoid using wire ropes, chains or slings. Failure to properly handle crates may cause injury.

As is common for most rigid piping materials, impact strength for System 15 and System XFR is reduced in colder weather. Thus, when unloading these components in cold weather, take extra care to minimize impact damage. Since the soundness of any joint depends on the condition of the pipe end, exercise care during storage and handling to avoid damaging these ends.

While in transit, make sure pipe and fittings are well-secured, so there is no potential for a load to shift.

When storing System 15 and System XFR pipe, bear the following points in mind:

- Treat these products as you would other DWV piping products: take care during handling and storage to prevent damaging the pipe.
- Store System 15 and System XFR pipe on a level surface. If placed on the ground, make sure the pipe is supported by timbers spaced no more than 3 feet apart.
- When storing pipe on a flat smooth surface place smaller diameter pipe on top of larger pipe.
- Make sure the pipe is not stored close to sources of heat such as boilers, steam lines, engine exhaust outlets, etc.

Prolonged outdoor storage and protection

Prolonged exposure of System 15 and System XFR pipe to direct rays of the sun will not damage the pipe. However, some mild discoloration may take place in the form of a milky film on exposed surfaces. This change in colour indicates a harmless chemical transformation at the surface of the pipe. A slight reduction in impact strength may occur at the discolored surfaces, but is not enough to cause problems in field installation or operation.

Discoloration of the pipe can be avoided by shading it from the direct rays of the sun. This can be accomplished by covering the stockpile or the crated pipe with an opaque material such as canvas. If the pipe is covered, always allow for circulation of air through the pipe to avoid heat buildup in hot summer weather. (Refer to the section entitled 'Painting' for more information.)

Painting

System 15 and System XFR pipe and fittings can be easily protected from ultraviolet oxidation by painting with a heavily pigmented, exterior water-based latex paint. White or a similar light colour is preferred to minimize heat absorption on the pipe surface. Apply latex paint thickly as an opaque coating on well cleaned and lightly sanded pipe and fittings.

Solvent Cement

Store in the shade between 4°C (40°F) and 43°C (110°F) or as specified on label. Keep away from heat, spark, open flame and other sources of ignition. Keep container closed when not in use. If the unopened container is subjected to freezing, it may become extremely thick or gelled. This cement can be placed in a warm area, where after a period of time, it will return to its original, usable condition. But such is not the case when gelatin has taken place because of actual solvent loss — for example, when the container was left open too long during use or not properly sealed after use. Cement in this condition should not be used and should be properly discarded.

IPEX solvent cements are formulated to be used "as received" in original containers. Adding thinners or primers to change viscosity is not permitted. If the cement is found to be jelly-like and not free flowing, it should not be used.

WARNING

PVC Primer and cement must be used within 3 years of the date of manufacture shown on the bottom of the can.

DO NOT USE primer or cement which is greater than 3 years old.

Only high quality IPEX System 15 and System XFR cements and primers are recommended for use with System 15 or System XFR DWV piping.

This product offering includes One-Step (i.e. no primer required) in both Medium Bodied and Heavy Bodied, as well as Two-Step formulations, all of which are grey in color. Our System 15 and System XFR cement products are CSA certified.

Specific cement recommendations are shown below for proper selection of System 15 and System XFR cement products.

Pipe Diameter (in.)	IPEX System 15 System XFR
1-1/2 to 6	One-Step with or without Primer
8 to 12	Two-Step Cement with Primer
14 and larger	Xirtec 19 PVC cement with primer

Proper Cement Applicators

Pipe Diameter (in.)	Applicator
1-1/2 to 3	1" Round Dauber
3 to 6	3" Roller
8 and larger	7" Roller or 6" Swab



Cement Selection

Pipe Diameters 1-1/2" to 6"

Installers have two options for these sized pipes: either One- or Two-Step cement. IPEX System 15 and System XFR one-step cement eliminates primer from the solvent welding process, thus saving time and material costs.

Because, System 15 and System XFR One-Step cement does not require the use of a primer, there is a minimum temperature recommended when using this product. Contact IPEX for guidelines.

Although a number of One-Step cements are available, not all of them are equal. Various levels of solvent and PVC resin in each formulation may alter results of the installation:

- A product with too little solvent may not sufficiently soften the surfaces prior to inserting the pipe into the fitting.
- A product with too little PVC resin may not be heavy enough to sufficiently fill the area between pipe and fitting at the socket end of the joint.

IPEX System15 and XFR One-Step Cement has been tested with System 15 and System XFR piping and is strongly recommended to be used for best results.

Pipe Diameters 8" and above

IPEX does not recommend One-Step cement be used for DWV applications with this size pipe diameter. For specific installation recommendations using large diameter pipe, consult IPEX's Solvent Cementing Guide. When requested, IPEX representatives will also visit a jobsite to provide an onsite demonstration of recommended solvent cementing procedures.

For larger pipe diameters, select System 15 and System XFR Two-Step cement along with System 15 and System XFR primer. This Two-Step cement is a heavy-bodied, medium-setting cement that provides the good gap filling capabilities required for pipe sizes through to 12".

IPEX recommends Xirtec® 19 PVC cement for System 15 in sizes larger than 12".

More care should be used when using solvent cement in below freezing temperatures. Solvent cement products should be stored in a warm environment prior to use in colder weather to avoid the possibility of freezing. Consideration may also be given to the use of MJ Grey Couplings in available sizes as an alternate to solvent welding in colder conditions.

Testing Drainage Systems

After a system is installed and all solvent weld joints cured, a hydrostatic pressure test should be performed prior to the piping system being commissioned. Testing of drainage and venting systems shall be conducted in accordance to the requirements of local plumbing codes.

When pressure testing, the system should be slowly filled with water and all air bled from the highest and farthest points in the installation. Once the system has reached the desired test pressure, it should remain at this pressure for one hour.

During this time the assembled sections should be visually inspected for joint leaks that may have occurred in the system. If a leak is discovered at a solvent weld joint, the joint must be removed and replaced or alternatively may be back-welded in place by a worker certified or experienced in thermoplastic welding. It is not necessary to fully drain the system if the affected fitting can be isolated for the required work.

Solvent weld systems may be pressure-tested with water at levels higher than code requirements if desired by the project design engineer. Contact IPEX for details.

Normal testing procedures for System 15 or System XFR may be employed if using MJ Grey couplings. Maximum water pressure shall be 10 feet of head for all sizes. Proper safety precautions and protective equipment should be employed during all testing procedures.

CODE COMPATIBILITY

System 15 and System XFR pipe and fittings satisfies the requirements of the National and Provincial Building Codes.

- To use thermoplastic piping in a building classified as noncombustible, the material must meet a Flame Spread Rating of 25 or less.
- Products for use within air plenums must meet a flame spread of 25 or less and a Smoke Developed Classification of 50 or less. (Building Code article 3.6.4.3. (1).)
- Products to be used within a building deemed to be high must also meet a maximum Flame Spread Rating of 25 and maximum Smoke Developed Classification of 50.
- The above Flame and Smoke values are confirmed through listings to ULC S102.2, latest edition.

System 15® Pipe & Fittings

System 15 meets the requirements of noncombustible construction.

In noncombustible buildings, System 15 may be used throughout the building, except for the limitations noted on the following page in the Specifications section. When the piping system enters an air plenum, the transition to System XFR must be made before entering into the plenum space.

System XFR® Pipe & Fittings

System XFR meets the requirements for noncombustible buildings, and the further restrictions of smoke development for air plenums and high buildings.

In high buildings, System XFR must be used throughout the building including parking garages in order to meet the Smoke Developed limit of 50.

Note: Combustible DWV piping products are not allowed in a vertical service space.

Drain-Guard™ Double Containment

Depending on your application, Drain-Guard is a double containment piping system using System 15 and or System XFR as its primary components. The many performance benefits of System 15 and System XFR are enhanced by this dual pipe concept.

MECHANICAL EASY SPEC

USE OF PIPING AS PER 2010 NATIONAL PLUMBING CODE

PRODUCT	SIZE RANGE	STANDARDS	APPLICATIONS	INSIDE BUILDING		
				ABOVE GROUND	UNDER GROUND	BUILDING SEWER
DWV SYSTEMS						
ABS DWV (Solid Wall)	1-1/4" - 6" (30mm - 150mm)	CSA B181.1	Drain, waste & vent lines, Storm & rain water lines	P	P	P
ABS DWV (Cell Core)	1-1/2" - 4" (40mm - 100mm)	ASTM F628	Drain, waste & vent lines, Storm & rain water lines	P	P	P
PVC Building Sewer & Drain Pipe	3" - 6" (75mm - 150mm)	CSA B182.1	Building sewer pipe, Septic fields, Perimeter drainage, Landscape drainage	N	P	P
System 15 DWV Pipe	1-1/2" - 24" (40mm - 600mm)	CSA B181.2	Drain, waste & vent lines, Storm & rain water lines	P	P	P
System XFR DWV Pipe	1-1/2" - 12" (40mm - 300mm)	CSA B181.2	Drain, waste & vent lines, Storm & rain water lines	P	P	P
Drain-Guard Double Containment	Depending on your application, Drain-Guard is a double containment piping system using System 15 and or System XFR as its primary components.					

FOOTNOTES:

P = Permitted, N = Not Permitted

APPLICATIONS AS PER 2010 NBC SUITABILITY FOR USE

PRODUCT	NONCOMBUSTIBLE BUILDING				
	General Usage	Air Plenum	Vertical Service Spaces	High-Rise Building	Under-ground
System 15 DWV	P=	N	N	N	P
System XFR DWV	P	P	N	P	P
Drain-Guard Double Containment	Depending on your application, Drain-Guard is a double containment piping system using System 15 and or System XFR as its primary components.				
MJ Grey Coupling	P	P	N	P	P*

= 24" is not permitted

* Permitted by Code but not recommended by IPEX

CERTIFICATIONS AND LISTINGS

IPEX System 15® and System XFR® pipe and fittings have been tested and certified by CSA to the CSA B181.2 standard. System XFR pipe and fittings are listed with ITS (Warnock Hersey) to exhibit Flame and Smoke values as per CAN/ULC S102.2.

Please note that the Flame and Smoke listing for System XFR fittings is issued based on tests performed on these fittings assembled with System XFR pipe and System 15/XFR solvent cement only.

Test Results

ITS (Warnock Hersey) conducted the testing in accordance with CAN/ULC S102.2 test standard. The following table summarizes the results of these tests.

Component	Flame-Spread Rating	Smoke Developed Classification
System 15®		
Pipe	10	> 50
Fittings	15	> 50
System XFR®		
Pipe	≤ 25	≤ 50
Fittings	≤ 25	≤ 50
Drain-Guard™ Double Containment		
Depending on your application, Drain-Guard is a double containment piping system using System 15 and or System XFR as its primary components. The many performance benefits of System 15 and System XFR are enhanced by this dual pipe concept.		
MJ Grey™		
Couplings	≤ 25	≤ 50

System 15® DWV Pipe and Fittings

IPEX System 15 Drain, Waste and Vent pipe and fittings shall be certified to CSA B181.2. When combustible pipe and fittings are used in buildings required to be of noncombustible construction, they shall be listed in accordance with ULC S102.2 and clearly marked with the certification logo of the testing agency indicating a Flame Spread Rating not greater than 25.

System XFR® DWV Pipe and Fittings

IPEX System XFR Drain, Waste and Vent pipe and fittings shall be certified to CSA B181.2 and when used in noncombustible construction, high buildings and air plenums, they shall be tested and listed in accordance with CAN/ULC S102.2 and clearly marked with the certification logo indicating a Flame Spread Rating not more than 25 and a Smoke Developed Classification not exceeding 50.

Please note that the Flame and Smoke listing for System XFR fittings is issued based on tests performed on these fittings assembled with System XFR pipe and System 15/XFR solvent cement only.

Drain-Guard™ Double Containment

Drain-Guard double containment piping systems provide safe transport of sanitary or storm drainage in critical areas. Should a leak occur, people, equipment and valuable property will be protected from possible harm.

Depending on your application, Drain-Guard is a double containment piping system using System 15 and or System XFR as its primary components. The many performance benefits of System 15 and System XFR are enhanced by this dual pipe concept, including excellent thermal properties, improved flow, longevity and durability, and the security of meeting all code requirements for noncombustible buildings.

MJ Grey™ Couplings

MJ Grey Couplings are a mechanical joint assembly suitable only for use on IPEX System 15 or System XFR pipe and fittings. These couplings come in sizes 1-1/2" – 18", are certified to CSA B602 and are listed to ULC S102.2 exhibiting Flame/Smoke ratings of 25/50.

Firestopping Devices

Firestopping systems for System 15 and System XFR shall be listed to CAN4-S115 and tested with a pressure differential of 50 Pa. Listed firestopping systems are required whenever the piping penetrates a fire-rated vertical or horizontal separation.

Solvent Cements

System 15 and System XFR cements shall be CSA certified and meet the requirements of ASTM D2564. System 15 and System XFR One-Step Cement may be used for sizes 1-1/2" to 6" only. For sizes 8" to 12", System 15 and System XFR Two-Step cement must be used in conjunction with System 15 and System XFR primer. For sizes larger than 12", IPEX recommends the use of Xirtec® 19 PVC Cement. Proper solvent cementing procedures must be followed at all times.

Frequently Asked Questions – System 15 and System XFR DWV

1. What's the difference between System 15 and System XFR?

System 15 is a thermoplastic piping system for DWV applications (sizes 1-1/2" – 24") which carries a Flame Spread Rating of not greater than 25 in accordance with CAN/ULC S102.2. System XFR is a thermoplastic piping system for DWV applications (sizes 1-1/2" – 18") which carries a Flame Spread Rating not greater than 25 and a Smoke Developed Classification of not greater than 50 in accordance with CAN/ULC S102.2. Both piping systems are 3rd party certified to CSA B181.2 and CAN/ULC S102.2.

System XFR is required only in buildings that are classified as High Buildings (per OBC 3.2.6/NBC 3.2.6) and in Plenum spaces (per OBC 3.6.4.3(1a)/NBC 3.6.4.3(1a)). System 15 is used in all other building types and is also often used for below ground applications.

2. Can System 15 or System XFR be used in a non-combustible building?

Yes. Per OBC 3.1.5.16/NBC 3.1.5.19, combustible piping materials are permitted to be used in a building required to be of non-combustible construction, provided they exhibit a Flame Spread Rating of not more than 25 and, if used in a High Building or Plenum space, exhibit a Smoke Developed Classification of not more than 50.

3. Is System XFR better than System 15 or vice versa? Which should I choose?

Although System XFR carries an additional Smoke Developed Classification of not greater than 50, both piping systems are 3rd party certified to the same CSA B181.2 standard while each provides the same level of performance as a plumbing system. System XFR is the only thermoplastic option for use in High Buildings (per OBC 3.2.6/NBC 3.2.6) and in Plenum spaces (per OBC 3.6.4.3(1a)/NBC 3.6.4.3(1a)) where the Smoke Developed Classification limit is mandatory by Code. For all other DWV applications, System 15 would be well suited and the more economical option.

4. Are System 15 and System XFR considered "non-combustible piping systems"?

No. Both System 15 and System XFR are combustible piping systems.

5. How do I know if the building is classified as a High Building?

High Buildings are described in OBC 3.2.6/NBC 3.2.6. To summarize, a High Building depends on the height of the building and occupancy type. Some examples are:

- A residential building would be considered a High Building if the floor level of the highest storey is more than 18 m above grade.
- A commercial or industrial building would be considered a High Building if the building is more than 36 m between grade and the floor level of the top storey. Also, where the total occupant load on or above any storey above grade, other than the first storey, divided by 1.8 times the width in metres of all exit stairs at that storey, exceeds 300, the height limit would be 18 m between grade and the floor level of the top storey.
- A hospital, care-facility or penitentiary building would be considered a High Building if the building is more than 3 storeys.

Refer to the Building Code Matrix in the Architectural Drawings to confirm whether the building is a High Building or not.

6. What DWV piping system would be code-compliant for use in a High Building (per OBC 3.2.6 / NBC 3.2.6)?

System XFR, per OBC 3.1.5.16 (1b) / NBC 3.1.5.19 (1b).

7. What DWV piping system would be code-compliant for use in a Plenum space?

System XFR, per OBC 3.6.4.3(1a) / NBC 3.6.4.3(1a).

8. Can I penetrate a fire separation required to have a fire resistance rating with System 15 or System XFR?

Yes. Combustible piping penetrations are discussed in OBC 3.1.9.4/NBC 3.1.9.5. All penetrations of a fire separation required to have a fire resistance rating must be firestopped regardless of the piping material. Contact IPEX for the most appropriate firestop solution for your application.

9. Are firestop devices such as collars or "donuts" the only method to firestop System XFR?

No. Firestopping has come a long way with solutions including intumescent caulking, wrap strips, collars and devices from multiple firestop manufacturers. Depending on the diameter of the pipe and assembly construction, inexpensive firestop solutions such as caulking-only listings exist today. Contact IPEX for the most appropriate firestop solution for your application.

10. Are Fire Stops required to be tested in accordance with the requirements of CAN/ULC S102.2 to achieve Flame Spread Ratings and Smoke Developed Classifications?

No, fire stops are listed as Minor Combustible Components per OBC 3.1.5.2(c)/NBC 3.1.5.2(c).

11. Does thermal expansion and contraction need to be accommodated for System 15 or System XFR?

Typically, System 15 and System XFR systems will include many laterals that restrict movement and frequent changes in direction that limit the distance of pipe runs. Thus, the need for expansion compensating devices may be low. However, should the need arise, IPEX suggests using one of these three methods:

- CSA certified Mechanical Joint Couplings installed every second floor for vertical stacks;
- CSA certified expansion joints installed every second floor for vertical stacks;
- Directional offsets to limit the run lengths of piping.

12. Can System 15 or System XFR be used for light pressure applications such as storm water pumping?

For occasional light duty pressure applications such as storm water pumping, System XFR and System 15 (both made to Schedule 40 thickness) have capacity to withstand internal pressure. For pressures exceeding that of 14.5 psi (approx. 33.5 ft of Head of water), contact IPEX for further information prior to the installation of the piping system.

Designers should also consider structural support and lateral restraint to accommodate for any surge within the piping system should they desire to apply pressure to a System XFR or System 15 DWV line to levels higher than the Code minimum test pressure. The use of System XFR or System 15 outside the scope of its certification would be subject to the approval of the Engineer of Record and/or the Authority Having Jurisdiction.

13. Can System 15 or System XFR be heat-traced?

Yes. Heat tracing may be necessary to prevent freezing in unconditioned spaces. Heat tracing can be applied directly on the pipe within the insulation in a configuration intended to evenly distribute the heat along the pipe (for example, a spiral), and must not exceed the operating temperature limit of the pipe. In some cases, it may be necessary to install two or more cables with reduced output to ensure a more even heat distribution and penetration without

exceeding the maximum operating temperature of the pipe. Refer to the heat tracing manufacturer's installation instructions.

14. Are System 15 or System XFR suitable for exposed cold weather applications like parking garages and stadiums?

Yes. System 15 and System XFR are commonly used for parking garage applications because of their superior corrosion resistance against substances such as common de-icing salt runoff. It is also common to run this piping in exposed conditions (i.e. an open above ground parking garage).

Some additional points to consider PVC for exposed applications are listed below:

- IPEX plants conduct regular testing on our products to all tests prescribed in the relevant industry standards whether they be CSA, ASTM, NSF or UL.
 - a. CSA B181.2 requires that impact testing be done on samples that have been conditioned to be 0°C to better represent maintaining good impact strength in colder climate conditions. Pipe standards for other pipe materials or from other countries either do not mandate any impact testing to be done or the testing is conducted in less rigorous conditions of 23°C.
 - b. The wall thickness of System 15 and System XFR represents an excellent balance of both stiffness and flexibility for exposed applications. For example, System 15 and System XFR will actually have about 50% better impact strength than Sch 80 pressure pipe even though Sch 80 has a heavier wall by approx. 20-25%.
- IPEX has supplied System 15 pipe for exposed applications in various high profile projects such as the Investor's Group Field in Winnipeg, MB, Riders Stadium in Regina, SK, and BMO Field in Toronto, ON.
- IPEX regularly stores many of our PVC pipe products outdoors year round in such cold climate areas as Winnipeg, Calgary, Edmonton, Montreal, Saint John, and Toronto. No harm is imposed to the pipe from this outdoor, year-round storage.

15. Is System 15 or System XFR louder than traditional DWV piping materials behind drywall?

No, it is not. In 2019, IPEX consulted with one of Canada's largest engineering consulting firms specializing exclusively in noise, vibration, and acoustics. This 3rd party firm independently conducted in-situ measurements of toilet flushes

in several multi-family mid and high-rise residential concrete buildings prior to occupancy. The study concluded that the observed difference between in-situ measurements of PVC and traditional cast iron drain pipes was found to be audibly indistinguishable. In addition to that, the study concluded that PVC showed compliance with the ASHRAE Chapter 48 criteria for plumbing noise levels in residential bathrooms. The 3rd party engineering acoustic study is available upon request.

16. What are some design considerations to minimize the transmission of sound from either PVC or cast-iron DWV piping systems?

Some best practices to minimize the transmission of sound from any DWV piping system would be the following:

1. Provide insulation inside the wall/ceiling cavity where the piping system is located.
2. Use high efficiency fixtures to minimize the flow rates within the piping.
3. Be selective when laying out plumbing stacks and branches to avoid critical areas such as sleeping or living areas.
4. Support pipe properly ensuring it is not in contact with the wall/ceiling material and allow adequate clearances between piping and holes cut in framing members.

17. Are System 15 and System XFR "Fire-Rated"?

The term "Fire-Rated" is a slang term used when describing the fire-resistance rating of individual products or assemblies. The fire-resistance rating applies to an assembly consisting of various building materials that can resist the exposure of a standardized fire exposure test for a specific duration (e.g. 2 hr). Therefore, System 15 and System XFR do not carry individual fire-resistance ratings, however, both System 15 and System XFR may be used as components of an assembly consisting of various building materials to achieve a fire-resistance rating when tested in accordance with CAN/ULC S115.

It should be noted that both System 15 and System XFR carry Flame Spread Ratings of not greater than 25, and in the case of System XFR, a Smoke Developed Classification of not greater than 50 in accordance with CAN/ULC S102.2.

18. Does System 15 and System XFR require insulation to prevent the formation of condensation on the pipe exterior?

Not likely, but it depends. Compared with traditional pipe materials, the thermal conductivity of PVC is low and it essentially acts as an insulator. This insulating property provides System 15 and System XFR a distinct advantage over traditional materials to prevent "sweating" or formation of condensation on the pipe wall. The need for insulation may, in certain instances, be completely eliminated by using System 15 or System XFR for DWV systems.

For more information, refer to the IPEX DWV Technical Manual to help determine whether condensation will form based on parameters such as relative humidity, fluid temperature and pipe wall thickness.

19. What are the advantages of using System 15 or System XFR over traditional materials such as cast iron or copper?

Some of the key advantages of using System 15 or System XFR over traditional materials are summarized below:

- Lower installation costs
 - o Thermoplastic piping products are easily handled, stored, cut, and joined. These PVC systems eliminate the cumbersome tools and torches required to install conventional piping systems.
- Improved flow
 - o IPEX DWV pipe and fittings exhibit a substantially lower roughness factor compared to metal and other piping materials; and since thermoplastics do not scale or corrode, their interior walls remain smooth in virtually any service condition.
- High Impact Strength
 - o System 15 and System XFR withstand demanding cold weather conditions. Their high impact strengths at cold temperatures save material costs by reducing damage and breakage at the jobsite. Both of these drainage systems are impact tested at 0°C and certified under CSA B181.2.
- Lower Thermal Conductivity
 - o With a dramatically lower rate of thermal conductivity compared to metal products, thermoplastic piping systems can reduce and even eliminate the need for insulation. Since thermoplastic piping is, by nature, very insulating, it resists condensation droplets from forming on its surface.
- Solvent Welded Joints

- o Solvent welded joints allow multiple storeys to be hydrostatically tested at once (14.5 psi or 33 ft of head) compared to mechanical joints which limit to testing one storey at a time (4.5 psi or 10 ft of head).

20. Can ABS be used in all types of combustible buildings?

No. While ABS is typically used in combustible buildings, the Building Code requires combustible piping for mid-storey wood frame construction to meet a Flame Spread Rating of 25 or less.

For residential buildings per OBC 3.2.2.43A (Group C, up to 6 Storeys, Sprinklered, Combustible Construction) and for business and personal services occupancy buildings per OBC 3.2.2.50A (Group D, up to 6 Storeys, Sprinklered, Combustible Construction), combustible piping must have a Flame Spread Rating of not more than 25 (per OBC 3.1.4.9). Therefore, System 15 as a minimum would be required for these building occupancies.

Please refer to the local building code having jurisdiction.

21. What is the best way to specify thermoplastic DWV systems to avoid confusion?

IPEX recommends using application-specific language for specifications such as low buildings, high buildings, plenum spaces and double containment applications. An example would be the following:

- .1 For below-ground applications:
 - .1 IPEX System 15 DWV certified to CAN/CSA B181.2.
 - .2 IPEX BDS (Building Drain, Sewer, and Storm) certified to CAN/CSA B182.1.
- .2 For above-ground DWV applications:
 - .1 IPEX System 15 DWV certified to CAN/CSA B181.2 and having a Flame Spread Rating not more than 25.
- .3 For above-ground DWV applications within air plenums (including entry and exit from plenum):
 - .1 IPEX System XFR DWV certified to CAN/CSA B181.2 and having a Flame Spread Rating not more than 25 and Smoke Developed Classification not more than 50.
- .4 For above-ground DWV applications in High Buildings:
 - .1 IPEX System XFR DWV certified to CAN/CSA B181.2 and having a Flame Spread Rating not more than 25 and Smoke Developed Classification not more than 50.
- .5 For double-containment applications:
 - .1 IPEX DRAIN-GUARD DWV certified to CAN/CSA B181.2 and having a Flame Spread Rating not more than 25 and/or Smoke Developed Classification not more than 50.

Contact IPEX for a full 3-part specification for DWV applications.

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NOTES

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About the IPEX Group of Companies

As leading suppliers of thermoplastic piping systems, the IPEX Group of Companies provides our customers with some of the largest and most comprehensive product lines. All IPEX products are backed by more than 50 years of experience. With state-of-the-art manufacturing facilities and distribution centres across North America, we have earned our reputation for product innovation, quality, end-user focus and performance.

Markets served by the IPEX Group of Companies include:

- Electrical systems
- Telecommunications and utility piping systems
- Industrial process piping systems
- Municipal pressure and gravity piping systems
- Plumbing and mechanical piping systems
- Electrofusion systems for gas and water
- Industrial, plumbing and electrical cements
- Irrigation systems
- PVC, CPVC, PP, PVDF, PE, ABS, and PEX pipe and fittings

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