



Exploration & Production

GENERAL SPECIFICATION

CIVIL WORKS

GS EP CIV 405

Plumbing and sanitary for onshore and offshore installations

03	10/07	Update and Addition of References
02	10/05	Addition of "EP" root to GS identification
01	09/03	Change of Group name and logo
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1. Scope

This specification covers studies relative to plumbing and sanitary, and is more specially meant for use by Engineering CONTRACTORS.

General Specifications define what the COMPANY considers as an acceptable minimum. Nonetheless, certain works may present particular problems. In such a case, the COMPANY reserves the right to modify General Specifications or supplement them with special specifications.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

When local national standards, regulations and codes exist, all design, engineering, materials and construction shall conform to their latest requirements, which complete or modify the present specifications.

In case of lack of obligatory local national standards, international norms and standards will be applied.

In case of lack of international norms and standards, national norms and standards listed hereafter will be applied.

In all cases the system adopted shall be consistent, i.e. the various texts shall present no incompatibility. Any dispute shall be resolved by basing works on the most stringent text for the CONTRACTOR and at his expense.

The list of specifications and norms quoted is not exhaustive: the CONTRACTOR shall respect the secondary standards and regulations, which cover the works described in the present specification.

Certain specifications and norms may be indicated with an issue date. This is for information only and on the understanding that the most recent issue shall be used.

Standards

International standards and codes

Reference	Title
ISO 161-1 - 1996	Thermoplastics pipes for the conveyance of fluids. Nominal Pressures – Part 1: Metric Series
ISO 162-2 - 1996	Thermoplastics Pipes for the Conveyance of fluids – Nominal Outside Diameters and Nominal Pressures – Part 2: Inch-Based Series
ISO 264 - 1976 Add1 - 1982	Unplasticized polyvinyl chloride (PVC) fittings with plain sockets for pipes under pressure - Laying lengths - Metric series
ISO 727-1 - 2002	Fittings Made From Unplasticized Poly(Vinyl Chloride) (PVC-U), Chlorinated Poly(Vinyl Chloride) (PVC-C) or Acrylonitrile/Butadiene/Styrene (ABS) With Plain Sockets for Pipes Under Pressure - Part 1: Metric Series

Reference	Title
ISO 727-2 - 2005	Fittings made from unplasticized poly(vinyl chloride) (PVC-U), chlorinated poly(vinyl chloride) (PVC-C) or acrylonitrile/butadiene/styrene (ABS) with plain sockets for pipes under pressure Part 2: Inch-based series
ISO 2045 - 1988	Single sockets for unplasticized polyvinyl chloride (PVC-U) and chlorinated polyvinyl chloride (PVC-C) pressure pipes with elastic sealing ring type joint - Minimum depths of engagement
ISO 2048 - 1990	Double-socket fittings for unplasticized polyvinyl chloride (PVC-U) pressure pipes with elastic sealing ring type joints - Minimum depths of engagement
ISO 3822-1 - 1999	Acoustics. Laboratory tests on noise emission from appliances and equipment used in water supply installations. Part 1 : method of measurements
ISO 3822-2 - 1995	Acoustics. Laboratory tests on noise emission from appliances and equipment used in water supply installations. Part 2 : mounting and operating conditions for draw-off taps and mixing valves
ISO 3822-3 - 1997	Acoustics. Laboratory tests on noise emission from appliances and equipment used in water supply installations. Part 3 : mounting and operating conditions for in-line valves and appliances
ISO 3822-4 - 1997	Acoustics. Laboratory tests on noise emission from appliances and equipment used in water supply installations. Part 4 : mounting and operating conditions for special appliances
ISO 6259-1 - 2002	Thermoplastics pipes Determination of tensile properties Part 1: General test method

European standards and codes

Reference	Title
EN 26 - 2006	Gas-fired instantaneous water heaters for the production of domestic hot water, fitted with atmospheric burners
EN 31 - 1999	Pedestal wash basins - Connecting dimensions
EN 32 - 1999	Wall-hung wash basins - Connecting dimensions
EN 33 - 2004	Pedestal WC pans with close-coupled flushing cistern - Connecting dimensions
EN 34 - 1992	Wall hung WC pan - Wall hung WC pan with close coupled cistern - Connecting dimensions
EN 35 - 2001	Pedestal bidets with over-rim supply - Connecting dimensions
EN 36 - 1999	Wall-hung bidets with over-rim supply - Connecting dimensions

Reference	Title
EN 37 - 1999	Pedestal WC pans with independent water supply - Connecting dimensions
EN 38 - 1992	Wall hung WC pan - Wall hung WC pan with independent water supply - Connecting dimensions
EN 161 - 2007	Automatics shut-off valves for gas burners and gas appliances
EN 200 - 2005	Sanitary tapware - Single taps and combination taps (PN 10) - General technical specification
EN 232 - 2003	Bath - Connecting dimensions
EN 251 - 2003	Shower trays - Connecting dimensions
EN 274-1 - 2002	Waste fittings for sanitary appliances - Part 1 : requirements
EN 274-2 - 2002	Waste fittings for sanitary appliances - Part 2 : test methods
EN 274-3 - 2002	Waste fittings for sanitary appliances - Part 3 : quality control
EN 295-1 - 1999	Vitrified clay pipes and fittings and pipe joints for drains and sewers
EN 295-2 - 1999	Vitrified clay pipes and fittings and pipe joints for drains and sewers. Part 2 : quality control and sampling
EN 295-3 - 1999	Vitrified clay pipes and fittings and pipe joints for drains and sewers. Part 3 : test methods
EN 294-4 - 1995	Vitrified clay pipes and fittings and pipe joints for drains and sewers. Part 4 : requirements for special fittings, adaptors and compatible accessories
EN 295-5 - 1999	Vitrified clay pipes and fittings and pipe joints for drains and sewers - Part 5: Requirements for perforated vitrified clay pipes and fittings
EN 295-6 - 1996	Vitrified clay pipes and fittings and pipe joints for drains and sewers. Part 6 : requirements for vitrified clay manholes
EN 295-7 - 1996	Vitrified clays pipes and fittings and pipe joints for drains and sewers. Part 7 : requirements for vitrified clay pipes and joints for pipe jacking
EN 295-10 - 1996	Vitrified clays pipes and fittings and pipe joints for drains and sewers. Part 7 : requirements for vitrified clay pipes and joints for pipe jacking
EN 411 - 1995	Sanitary tapware - Waste fittings for sinks - General technical specifications
EN 695 - 1997	Kitchen sinks - Connecting dimensions
EN 727 - 1995	Plastics piping and ducting systems - Thermoplastics pipes and fittings - Determination of Vicat softening temperature (VST)

Reference	Title
EN 877 - 2006	Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings - Requirements, test methods and quality assurance
EN 921 - 1995	Plastics piping systems - Thermoplastics pipes - Determination of resistance to internal pressure at constant temperature
EN 997 - 2007	WC pans and WC suites with integral trap
EN 1057 - 2006	Copper and copper alloys - Seamless, round copper tubes for water and gas in sanitary and heating applications
EN 1092-2 - 1997	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Part 2 : cast iron flanges
EN 1111 - 1999	Sanitary tapware - Thermostatic mixing valves (PN 10) - General technical specifications
EN 1112 - 1997	Shower outlets for (PN 10) sanitary tapware
EN 1286 - 1999	Sanitary tapware - Low pressure mechanical mixing valves - General technical specification
EN 1287 - 1999	Sanitary tapware - Low pressure thermostatic mixing valves - General technical specifications
EN 1401-1 - 1998	Plastics piping systems for non-pressure underground drainage and sewerage - Unplasticized poly vinylchloride (PVC-U) - Specifications for pipes, fittings and the system
EN 1452-1 - 2000	Plastics piping systems for water supply – Unplasticized Polyvinyl Chloride (PVC-U) – Part 1: General
EN 1452-2 - 2000	Plastics Piping Systems for Water Supply - Unplasticized Poly (Vinyl Chloride) (PVC-U) - Part 2: Pipes
EN 1452-3 - 2000	Plastics Piping Systems for Water Supply - Unplasticized Poly (Vinyl Chloride) (PVC-U) - Part 3: Fittings
EN 1452-4 - 2000	Plastics Piping Systems for Water Supply - Unplasticized Poly (Vinyl Chloride) (PVC-U) - Part 4: Valves and Ancillary Equipment
EN 1452-5 - 2000	Plastics Piping Systems for Water Supply - Unplasticized Poly (Vinyl Chloride) (PVC-U) - Part 5: Fitness for Purpose of the System
EN 1561 - 1997	Founding - Grey cast irons
EN 10233 - 1994	Metallic materials - Tube - Flattening test
EN 10242 - 2004	Threaded pipe fittings in malleable cast iron

French standards and codes

Reference	Title
NF A 48-830 - 1983	Foundry products. Spheroidal graphite cast iron fittings for PVC drinking water pipes under pressure
NF A 48-851 - 1985	<i>Tuyaux en fonte à graphite sphéroïdal pour canalisations avec pression - Revêtement extérieur polyuréthane</i> Spheroidal graphite cast iron pipes under pressure with external polyurethane coating
NF A 48-860 - 1981	<i>Éléments de canalisations en fonte ductile pour conduite avec pression - Série à emboîtement - Joint express GS - Dimensions d'assemblage et</i> Spheroidal cast iron pipes for pressurised line - jointing line - express GS connection - dimensions
NF A 48-870 - 1981	<i>Éléments de canalisations en fonte ductile pour conduite avec pression - Série à emboîtement - Joint standard GS - Dimensions d'assemblage et accessoires de joint</i> Spheroidal graphite cast iron pipes for pressurised line – jointing line – standard GS connection - dimensions
NF A 48-902 - 1985	Foundry products. Ductile iron pipes for pressure pipelines. Centrifugal cement mortar internal lining. Composition controls of freshly applied mortar
NF A 49-147 - 1980	<i>Tubes en acier - Tubes soudés longitudinalement à extrémités lisses pour canalisations et usages généraux - Aciers inoxydables austénitiques (dimensions - Conditions techniques de livraison)</i> Steel tubes - Plain-end longitudinally welded tubes for pipelines and general uses - Austenitic stainless steels - (Dimensions - Technical delivery conditions)
NF A 49-148 - 1980	<i>Tubes en acier - Tubes soudés longitudinalement à extrémités lisses pour canalisations et usages généraux - Aciers inoxydables ferritiques (dimensions - Conditions techniques de livraison)</i> Steel tubes - Plain end longitudinally welded tubes for pipe lines and general uses - Ferritic stainless steels - (Dimensions - Technical delivery conditions)
NF A 03-263 - 1983	<i>Cuivre - Essai de cintrage des tubes ronds à braser par capillarité</i> Copper – Bend test on round tubes for capillary brazing
NF C 73-221 - 1989	<i>Appareils électrodomestiques et analogues - Aptitude à la fonction des chauffe-eau non instantanés</i> Non-instantaneous water heaters - functional tests

Reference	Title
NF C 73-222 - 1987	<i>Chauffe-eau muraux verticaux fixes non instantanés - Cotes de fixation et de raccordement aux installations d'eau</i> Non-instantaneous water heaters - Dimensions for fixation and connection to water equipment
NF D 11-101 - 1987	<i>Lavabos en céramique sanitaire</i> Ceramic wash basins
NF D 11-107 - 1987	<i>Bidets en céramique sanitaire</i> Ceramic bidets
NF D 11-112 - 1987	<i>Baignoires en matériaux émaillés</i> Glazed bathes
NF D 11-114 - 1979	<i>Urinoirs muraux sans siphon incorporé - Cotes de Raccordement</i> Wall hung urinals - Connecting dimensions
NF D 11-115 - 1979	<i>Urinoirs muraux - Cotes d'encombrement</i> Urinals - Clearance dimensions
NF D 11-124 - 1988	<i>Appareils sanitaires - Receveurs de douche en matériaux émaillés</i> Sanitary equipment - Glazed shower basins
NF D 12-101 - 1987	<i>Cuvette de W.C. En céramique sanitaire</i> Ceramic W.C. pan
NF D 13-101 - 2006	Sanitary appliances – Vitreous enamelled sinks
NF D 14-501 to NF D 14-510 - 1987	<i>Appareils sanitaires - Contrôles dimensionnels - Essais.</i> Sanitary equipment - Size controls - Tests
NF D 18-001 - 1965	<i>Robinetterie sanitaire - Robinet simple d'appareil sanitaire –</i> Sanitary taps - Single taps
NF D 18-202 - 1984	<i>Robinetterie sanitaire - Mitigeurs mécaniques - Spécifications techniques générales</i> Sanitary taps - Mechanical mixer taps - General technical specification
NF D 18-205 - 1989	<i>Robinetterie sanitaire - Accessoires de douche - Spécifications techniques générales.</i> Sanitary taps - Showers accessories - General technical specification
NF E 03-004 - 1981	<i>Filetages pour tuyauterie (dits "gaz") avec étanchéité dans le filet - Filetages extérieur conique et intérieur cylindrique.</i> Threading for pipes with tightness in thread – External conical and internal cylindrical threading

Reference	Title
NF E 29-002 - 1982	<i>Tuyauteries - Pressions et températures – Définitions</i> Pipes – Pressures and temperatures - definitions
NF E 29-010 - 1975	<i>Tuyauteries industrielles - Guide méthodologique pour la conception d'une tuyauterie</i> Industrial pipes - Handbook for piping conceptual design
NF P 43-001 - 1985	<i>Robinetterie de bâtiment - Robinets d'arrêt à soupape - Spécifications techniques générales</i> Valves and taps for building services - Stop valves – General technical specification
NF P 43-003 - 1983	<i>Robinetterie de bâtiment - Robinet pour réservoir de chasse - Spécifications techniques générales</i> Valves and taps for building services - Stop valves for cistern – General technical specification
NF P 43-015 - 1985	<i>Robinetterie de bâtiment - Robinets de puisage à soupape - Spécifications techniques générales.</i> Valves and taps for building services - Draw off taps - General technical specification
NF E 29-539 - 1981	<i>Tuyauterie - Éléments de raccords à visser à jonction sphéro-conique pour installation de chauffage - PN 16.</i> Pipes- screwed fittings with sphericonic connection for heating installation - NP16
NF P 16-352 - 1987	<i>Canalisations, assainissement, égouts - Éléments de canalisations en polychlorure de vinyle non plastifié pour l'assainissement</i> Unplasticized PVC pipes for sewage systems requirements
NF P 41-102 - 1942	<i>Terminologie - Évacuation des eaux usées,</i> Definitions – Water drainage system
NF Q 34-001 - 1984	<i>Articles pour usages sanitaires et domestiques - Papiers hygiéniques - Caractéristiques</i> Sanitary and domestic items - Toilet papers - Characteristics
NF T 54-002 - 1981	<i>Plastiques - Éléments de canalisations en matières thermoplastiques - Définitions - Dimensions</i> Plastics - Thermoplastic piping components - Definitions - Dimensions
NF T 54-003 - 1984	<i>Plastiques - Tubes en polychlorure de vinyle non plastifié - Spécifications générales</i> Plastics - Unplasticized PVC pipes - General Specification

Reference	Title
NF T 54-017 - 1981	<i>Plastiques - Tubes et raccords en polychlorure de vinyle non plastifié pour installation d'évacuation sans pression des eaux domestiques - Spécifications</i> Plastics - Unplasticized PVC pipes for underground drainage systems requirements - pipes, connections - specification
NF T 54-022 - 1980	<i>Tubes et raccords en matières thermoplastiques - Détermination de la masse volumique</i> Plastics - Thermoplastic pipes - Density test
NF T 54-028 - 1984	<i>Plastiques - Éléments de canalisations en polychlorure de vinyle non plastifié - Assemblage par collage - Caractéristiques dimensionnelles.</i> Plastics – Unplasticized PVC pipes and components – Adhered joints – Dimensional characteristic
NF T 54-029 - 1981	<i>Plastiques - Raccords moulés en polychlorure de vinyle non plastifié - Série pression - Spécifications</i> Plastics - Unplasticized PVC connections - Pressure line - specification
NF T 54-031 - 1981	<i>Plastiques - Éléments de canalisation en polychlorure de vinyle non plastifié - Assemblages fixes à bagues d'étanchéité pour installation d'évacuation sans pression des eaux domestiques - Caractéristiques dimensionnelles</i>
NF T 54-032 - 1981	<i>Plastiques - Éléments de canalisation en polychlorure de vinyle non plastifié - Assemblages coulissants à bagues d'étanchéité pour installation d'évacuation sans pression des eaux domestiques - Caractéristiques dimensionnelles</i>
NF T 54-037 - 1981	<i>Plastiques - Éléments de canalisation en polychlorure de vinyle non plastifié - Assemblages à bagues d'étanchéité pour installation d'évacuation sans pression des eaux domestiques - Aptitude à l'emploi - Spécifications</i>
NF T 54-038 - 1981	<i>Plastiques - Assemblages fixes à bagues d'étanchéité pour tubes en polychlorure de vinyle non plastifié avec pression - Caractéristiques dimensionnelles</i> Plastics - Unplasticized PVC piping components - Fixed joints with ring seals for pressurised system - Dimensional characteristics.

American standards and codes

Reference	Title
ASME A112.1.2 - 2004	Air gaps in plumbing systems (For Plumbing Fixtures and water-connected receptors)
ASME A112.18.1M - 2005	Plumbing fixture fittings

Reference	Title
ASME A112.18.3M - 2002	Performance Requirements for Backflow Protection Devices and Systems in Plumbing Fixture Fittings
ASME A112.19.1M – 1994 (R 2004)	Enamelled cast iron plumbing fixtures
ASME A112.19.2M - 2003	Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
ASME A112.19.3M - 2000 (R2004)	Stainless Steel Plumbing Fixtures (Designed for Residential Use)-
ASME A112.19.4M – 1994 (R 2004)	Porcelain enamelled formed steel plumbing fixtures
ASME A112.19.5 - 2005	Trim for water-closet bowls, tanks and urinals
ASME A112.19.6 - 1995	Hydraulic Performance Requirements for Water Closets and Urinals
ASME A112.19.9M - 1991 (R2000)	Non-vitreous ceramic plumbing fixtures
ASME A112.6.1M – 1997 (R 2002)	Supports for off-the-floor plumbing fixtures for public use
ASME Y32.4 - 1977 (R2004)	Graphic symbols for plumbing fixtures for diagrams used in architecture and building construction
ASSE 1037 - 1990	Pressurised flushing devices (flushometers) for plumbing fixtures
ASSE 1050 - 2002	Performance Requirements for Stack Air Admittance Valves for Sanitary Drainage Systems
ASSE 1051 - 2002	Performance Requirements for Individual and Branch Type Air Admittance Valves for Sanitary Drainage Systems
ASSE 1056 - 2001	Performance Requirements for Spill Resistant Vacuum Breakers
ASTM B42 – 02 (R2003)	Standard specification for seamless copper pipe, standard sizes
ASTM B43 – 98 (E 2003)	Standard specification for seamless red brass pipe, standard sizes
ASTM B687 – 99 (R,E 2005)	Standard specification for brass, copper, and chromium-plated pipe nipples
ASTM B698 - 02	Standard classification for seamless copper and copper alloy plumbing pipe and tube
ASTM B828 - 02	Standard practice for making capillary joints by soldering of copper and copper alloy tube and fittings
ASTM C1440 - 03	Standard specification for thermoplastic elastomeric (TPE) gasket materials for drain, waste, and vent (DWV), sewer, sanitary and storm plumbing systems

Reference	Title
ASTM D5926 - 04	Standard specification for polyvinyl chloride (PVC) gaskets for drain, waste, and vent (DWV), sewer, sanitary and storm plumbing systems
UPC - 2003	2003 Uniform Plumbing Code

Professional Documents

Reference	Title
NF P 40-201 - 2000	DTU 60.1 - Travaux de bâtiment - Plomberie sanitaire pour bâtiments à usage d'habitation - Cahier des charges - DTU 60.2 - Canalisations en fonte, évacuation d'eaux usées, d'eaux pluviales et d'eaux vannes - Cahier des clauses techniques Building works - Sanitary plumbing in residential buildings - Technical specifications - Cast iron pipes for soil water, rainwater and wastewater drainage - Technical specifications
DTU 60.11 - 1988	Règles de calcul des installations de plomberie sanitaire et des installations d'évacuation des eaux pluviales Dimensioning rules for sanitary plumbing and drainage system
DTU 60.31	Travaux de bâtiment - Canalisations en chlorure de polyvinyle non plastifié - Eau froide avec pression - Cahier des charges. Building works - Unplasticized polyvinyl chloride piping installations: cold water under pressure - Technical specifications. General criteria for selection materials
NF P 41-212 - 2000	DTU 60.32 - Travaux de bâtiment - Canalisations en polychlorure de vinyle non plastifié - Évacuation des eaux pluviales - Cahier des charges Building works - Unplasticized polyvinyl chloride piping installations – Rainwater downpipes - Technical specifications
NF P 41-213 - 2000	DTU 60.33 - Travaux de bâtiment - Travaux de canalisations en polychlorure de vinyle non plastifié - Évacuation d'eaux usées et d'eaux vannes - Cahier des charges Building works - Unplasticized polyvinyl chloride piping installations: waste water drainage - Technical specifications
NF P 41-221 - 2000	DTU 60.5 - Travaux de bâtiment - Canalisations en cuivre - Distribution d'eau froide et chaude sanitaire, évacuation d'eaux usées, d'eaux pluviales, installations de génie climatique - Cahier des clauses techniques Building works - Copper pipes - Cold and hot water supply, waste and rainwater drainage, climatic engineering equipment - Technical specifications

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS EP CIV 202	Drainage and underground networks
GS EP SAF 322	Fixed fire water systems

3. General

3.1 Application

This specification deals with new sanitary plumbing for onshore buildings and offshore living quarters that are to be used for habitation, offices and/or industrial purposes.

The installations concern the supply of water, at an adequate flow and at the desired temperature in all points, the quick and healthy evacuation of rainwater, waste and foul water, along with correct ventilation of the evacuation network.

The general distribution of water to buildings and the sewage network for buildings as a whole are not dealt with in this specification. The specification **GS EP CIV 202** deals with these aspects.

The fire network (within buildings, either by empty or full pipes) is not dealt with in this specification. Reference should be made to **GS EP SAF 322** and in general to "Safety" specifications.

3.2 Technical file

The Engineering CONTRACTOR shall supply calculation notes, characteristics of equipment which are described neither in this specification nor in Particular Specifications, associated with drawings and diagrams required for the performance of the works. In particular, duct layout drawings (plan and elevation) for each level, with flow indicators, shut-off valves, non-return valves, safety valves and surge tanks shall be provided.

These documents shall be submitted to the COMPANY for approval.

4. Water properties

4.1 Water analysis bulletin

For all plumbing installations, the COMPANY shall provide a water analysis bulletin to the Engineering CONTRACTOR.

This document shall be used by the Construction CONTRACTOR to propose supplementary water treatment.

This treatment should result in obtaining water that is in compliance with drinking water standards.

If the distributed water is obtained by mixing, all components of the mix shall be treated.

4.2 Corrosion by cold water

Cold water distribution installations shall be protected from corrosion if the transported water shows one or more of the following characteristics, at temperature $t = 20^{\circ}\text{C}$:

Table 1

Resistivity	less than $1500 \Omega \times \text{cm}$
Resistivity	more than $4500 \Omega \times \text{cm}$
T.A.C. or T.A.C. methyloange	less than 1.6 mg/l
Dissolved oxygen	less than 4 mg/l
Free CO_2	more than 30 mg/l
Acid CO_2	more than 5 mg/l
Ca^{++} calcium	less than 32 mg/l
SO_4^- sulphates	more than 150 mg/l
Cl^- chlorides	more than 100 mg/l

4.3 Corrosion by hot water

Hot water distribution installations shall be protected from corrosion if the transported water shows one or more of the following characteristics, at temperature $t = 20^{\circ}\text{C}$:

Table 2

Resistivity	less than $2200 \Omega \times \text{cm}$
Resistivity	more than $4500 \Omega \times \text{cm}$
T.A.C. or T.A.C. methylorange	less than 1.6 mg/l
Free CO_2	more than 15 mg/l
Ca^{++} calcium	less than 32 mg/l
SO_4^- sulphates	more than 96 mg/l
Cl^- chlorides	more than 71 mg/l
Sulphates and chlorides	more than 3 meq/l

5. Basic flows - Simultaneity - Pipe and siphon diameters

5.1 Basic supply flow for sanitary equipment

For calculations, the following basic flows shall be considered:

Type of equipment	Minimum basic flow in lines per tap	
	Cold water (l/s)	Hot water (l/s)
Sink - simple tap	0.20	0.20
Washbasin	0.20	0.20
Collective washbasin (per jet)	0.05	0.05
Bidet	0.20	0.20
Bath	0.33	0.33
Shower	0.20	0.20
Water tap ½"	0.33	
Water tap ¾"	0.42	
WC with cistern flush	0.12	
WC with tap flush	1.50	
Urinal with individual tap	0.15	
Urinal with siphon	0.50	
Washing machine	0.20	
Dishwasher	0.10	
Outdoor tap or hose connection (20 mm diameter)	ASTM 1440-03	ASTM 1440-03

5.2 Simultaneous flow theory for pipe design calculations (in the same building)

- a) Except otherwise stated within the Particular Specifications, the following simultaneous flow theory shall be used for sanitary equipment duct calculations. This is not applicable for tap flush equipment.

The total flow necessary for sanitary equipment shall be multiplied by a coefficient given by the following formula:

$$Y = \frac{0.8}{\sqrt{X-1}} \text{ for } X > 5$$

Where:

Y = Probability of simultaneous flow coefficient

X = Number of pieces of equipment

However, it shall be necessary to distinguish the type of building or plant, to forecast the internal use of equipment at certain times of the day and to check that the installation which

has been calculated from this general theory is adequate (living quarters for single people and families, offices, workshops, cloakrooms, etc.).

The simultaneous flow theory shall take into consideration the fact that, on offshore platforms, continuous shift work is carried out, and washbasins, showers and WC operate constantly, and at the same time during shift changes.

b) As far as tap flush equipment is concerned the following theories shall be used:

- In case tap flush is supplied by the same network as other equipment its input shall not be taken into account in the pipe diameter calculations.
- In case tap flush is supplied by an independent network, the following simultaneous flow theory shall be used:

No. of pieces of equipment installed	No. of pieces of equipment operating at the same time
3	1
4 to 12	2
13 to 24	3
25 to 49	4
More than 50	5

The remark made in a) above for the actual use of equipment is also applicable for tap flush equipment.

5.3 Diameters for pipes and siphons

5.3.1 Down pipe and secondary ventilation pipe

The following table indicates the internal diameters (in mm) for down pipes and secondary ventilation columns according to the actual amount of equipment in use.

According to the equipment used, the diameter equal to, or immediately larger, than that shown in the table shall be used.

Type of equipment	Downpipe		Secondary ventilation column
	W.O. secondary ventilation	W. secondary ventilation	
WC with direct flush			
1 or more	90	90	40
Baths, showers, washbasins, bidets, sinks or simple taps			
Up to 3	50	50	30
From 4 to 10	65	65	30
More than 11	90	90	40
Common downpipe where all equipment other than WC have secondary ventilation (1)		90	

(1) Connection of WC to downpipe should be separate from collector used for other equipment.

5.3.2 Siphons

The table below indicates in mm the minimum internal diameters for siphons or output for sanitary equipment with associated flowrates, which should be taken as a basis for calculation:

Type of equipment	Min. internal diameter	Basic flow in litres	
		Per minute	Per second
Bath	33 (38 if longer than 1.00 m)	72	1.20
Shower	33	30	0.50
Wash basin	30	45	0.75
Bidet	30	30	0.50
Sink	33	45	0,75
Laundry sink	33	45	0.75
Urinary	33	30	0.50
Urinal with siphon	33	60	1.00
WC with direct flush	80	90	1.50
WC with siphon	60 (77 if longer than 1.00 m)	90	1.50
Washing machine	33	40	0.65
Dishwasher	33	25	0.40

5.4 Diameters for foul water drains

The flow of foul water shall be computed by adding up individual flow from each piece of equipment and applying a simultaneous flow coefficient (refer to § 5.2) in case some pieces of equipment are not used simultaneously.

Diameters shall be established according to the Bazin formula for the water flow, taking a friction coefficient equal to 0.16 and a duct filling coefficient p equal to 0.50 (ratio between height of water and internal diameter of the pipe).

The flow speed at maximum flow rate shall be between 0.60 m/s and 3 m/s.

The optimum speed is around 1.5 m/s.

The minimum slope for these ducts inside inhabited buildings shall be 0.01 m per m.

5.5 Diameters for rain water down pipes

As a minimum requirement, they shall be calculated by taking into account a flow equal to 3 l/min/m² over the horizontal area of the roof.

If, however, the ten-year rainfall over a 30 minute-period has an intensity greater than 180 mm/h, the actual intensity shall be considered.

In case of a flow of 3 l/min/m², the down pipe diameter shall be determined as follows:

- Pipe connected to eaves or gutters by a cylindrical section: 1 cm² of down pipe drains 1 m² of roof area
- Pipe connected by large cone or trough: 0.70 cm² of down pipe drains 1 m² of roof area.

5.6 Diameters for rainwater pipes

The flow shall be calculated as indicated in section 5.5.

Calculations shall be performed according to the Bazin formula.

Filling coefficient shall be $p = \frac{h}{d} = 0.7$.

Minimum slope shall be 2%.

Pipes shall be separate from those used for foul and wastewater.

6. Supply and distribution of hot and cold water

6.1 General

Only drinking water shall be distributed inside buildings.

The plumbing shall be designed in accordance with expected needs. It shall be permanently adequate, safe and involve low-cost maintenance.

Cold and hot water shall be distributed at appropriate temperatures (as far as possible +15°C for cold water, +60/65°C for hot water) and at as a constant pressure as possible.

Should the pressure be difficult to maintain, elevated tanks, or preferably pressurized tanks with a capacity of $\frac{1}{4}$ to $\frac{3}{4}$ of daily consumption shall be installed.

If, on the contrary, the pressure is too high (more than 3.5-4 bars) pressure regulators shall be installed at inlets into the buildings.

6.2 Hot water production

6.2.1 General

Hot water production may be individual or collective.

It shall be produced by either:

- Storage water heater system
- Instantaneous water heater system operating on gas or electricity.

If the water contains significant dissolved lime, a water softener shall be installed (hydrometric degree after softening shall be more than 13).

6.2.2 Hot water requirements (+60/65°C)

	Individual production	Collective production
Bath	85/180 l	70 l
Washbasin	7/10 l	4 to 7 l
Bidet	5 l	5 l
Shower	20 l	20 l
Sink and simple tap	35 l	25 l
Washing up	65 l	50 l

6.2.3 Storage system production

In case of use of this system a capacity of the tank equal to 50% to 100% of the daily consumption of the overall equipment shall be provided.

The Particular Specifications shall indicate the heating delay.

The "indirect" process (primary circuit between boiler and tank, and secondary circuit supplying the equipment) shall be the only system used.

6.3 Flow pipes

The supply piping for each building shall, as a general rule, have an initial pressure of 1 to 1.5 bar more than the highest tap pressure. In this way the Engineering CONTRACTOR will ensure a margin for head losses and will maintain a residual pressure of 0.2 or 0.5 bar over that of the tap, depending on whether it is an ordinary tap or a flush.

In all cases, the initial pressure shall not be more than 3.5 or 4 bars.

Diameters for supply piping shall be calculated depending on the flow requirements, section lengths, distribution height and initial pressure.

Section lengths shall be increased by 15% to account for accessories.

The calculations may be based on the Flamant formula or Daires table. Justified calculations shall be required from the Engineering CONTRACTOR, no matter which formula is employed.

Piping diameters shall be such that there shall be no interference between the different rooms and storeys.

(In small installations, the network may not be looped; in other cases, looping or gridding shall be mandatory depending on the size of the installation).

Theoretical speed for water shall not be more than (particularly for steel piping):

- Basement or foundation area piping: 2.00 m/s
- Rising mains: 1.50 m/s
- Floor and equipment connections: 1.00 m/s

In horizontal hot water return piping, the theoretical speed, without tapping, should be at least 0.20 m/s.

The main piping should avoid crossing "aesthetic" and/or living areas.

In case this is not achievable:

- Hidden pipes must be accessible for inspection (wooden removable casing, etc.)
- Precaution must be taken to avoid transmission of noise from the installation:
 - Heavy piping (lead, etc.)
 - Low speed
 - Insulation between pipes and fixing device
 - Installation of surge tanks at column heads for hot and cold water as well as at extremities of long horizontal piping.

They shall be suited to the likely amount of overpressure and the type of air or inert gas.

They shall also be of robust construction.

Their type shall be submitted to COMPANY for approval.

Cold water pipes shall be thermal insulated when certain conditions are met (condensation risk, etc.). Details shall be given in the Particular Specifications.

Pipes exposed to frost:

- Shall be thermal insulated
- Have a minimum slope of 0.2% towards low points equipped with purge.

In sunny regions pipes should never be exposed to the sun. Any tank on rooftop should be placed in the shade of light and ventilated shelters.

6.4 Sections, draining, connections

The main distribution network for each building should be equipped with a general shut-off valve and with a tap enabling fast draining of the installation.

The valve should be placed near an external wall, either indoors in an area with easy access, or outdoor near a meter if there is one. Valve and meter shall be protected against frost.

In case of a loop distribution, shut-off and drain valves shall enable isolation by sections.

This shall allow repairs or transformations without too much interference to the installation. They shall be of direct passage type.

The shut-off valves may be grouped together in the same area by using pigs with marks clearly indicating what each valve operates.

High points shall be equipped with vents and shall include 20 mm plugs so as to facilitate hydrostatic test at 7-bar pressure.

It shall be mandatory that all flush, water heater, immersion heater, meter or special apparatus shall be equipped with individual shut-off valves.

In addition, collective sanitary equipment shall be isolated as a whole or by groups with shut-off valves.

All valves shall be in compliance with standards in force. They shall be of the same diameter as the piping to which they are connected and shall be easily dismantled.

6.5 Hot water network

Hot water network shall be of looped type. For small installation, gravity method shall be used and for large installations, pumps shall enable circulation (this latter system shall include parallel running pumps i.e. one spare with shut-off and non-return valves). Particular Specifications shall define this arrangement.

Hot water shall be distributed at a temperature not more than 65°C.

In case of hot water distribution by galvanized steel pipe, this temperature limit shall be lowered to 60°C. Should the water be produced at a higher temperature, a temperature-lowering device shall be provided.

The supply piping for hot water produced by immersion tank apparatus under direct pressure shall be equipped with non-return valve and the apparatus itself shall have a safety valve connected to the drainage network.

The piping shall be free to expand and therefore shall be provided:

- Pipe sleeves when running through brickwork and collars that do not clamp.
- Thermal insulation.

In addition, pipes shall be set at least 4 cm from the walls.

6.6 Equipment

Sanitary equipment, valves, cocks and fittings shall be in compliance with standards in force.

Joints between equipment and walls shall be caulked with putty.

Pedestal baths shall be installed at such a height that their siphons remain over the floor. Their side panel shall be such that they may be totally dismantled and provide easy access to supply and drainage system.

English <or Western ? > type WC (seated) shall be equipped with silent flush tanks.

Eastern type WC ("hole in the ground") shall be equipped with direct flush taps if the water pressure is at least 0.5 bar, if not, with 10 litre-tank (per piece of equipment). The tank shall be placed at a minimum height of 3 m above the equipment if the pressure available is less than 0.5 bar.

Minimum internal diameters for pipes are as follows:

- 33 mm for a pressure less than, or equal to, 4 bar
- 27 mm for a pressure between 4 and 10 bar
- 21 mm for a pressure of more than 10 bar.

6.6.1 Collective washbasins

The spray bars shall be feed via the middle and not the extremities. Drains shall be made of rigid materials (40 to 50 mm or 60 mm diameter for more than 6 sprays).

Ventilation shall be provided.

6.6.2 Collective showers

No. of showers supplied	Diameter in mm
1	12
2	15
3 or 4	20
5	25
6 or 7	27
10	30
15	40
30	50
50	60

Where water is supplied by a tank situated at least 5 m high, the diameter of the main pipe shall be increased within the range: 20 mm for one shower, 100 mm for 50 showers. Hot and cold water shall be at the same pressure. If not, two tanks on the same horizontal level shall be installed, the cold water one being supplied by float gauge. The distribution shall be made in loop form circuit, spreading the tapings evenly over the circuit. If necessary, a pump shall be installed.

Water temperature shall be regulated by thermostats placed at heating tank outlets or at the beginning of the distribution circuit. The mixed water should not be over 40°C. Pressure stabilizing (hot water/cold water) should be carried out at each mixer inlet.

Mixers shall be of the thermostatic type in the following cases:

- Collective distribution of hot water for showers at a temperature suitable for use and where hot water cannot be stored at a sufficiently constant temperature

In this case, a collective thermostatic mixer shall be used.

- Regulation of the temperature of water supplied to different showers, where there is a risk of sudden changes in the pressure of hot and cold water

In this case, individual thermostatic mixers shall be used.

In case of use of a collective thermostatic mixer, the following precautions shall be taken:

- If a system with no storage of hot water is used (water-heater, immersion tank), the hot water shall not be distributed to a large amount of equipment or to equipment which is widely dispersed
- The mixer shall be feed with cold water with a connection onto the same pipe as that used for the hot water generator supply

- Connections for distant or important cold water taps shall be made upstream
- If pressure regulation devices are used, these shall operate over the whole installation and not only over the hot water generator system.

7. Water evacuation

7.1 Rain water

Rainwater drainage network shall have separate downpipes from those used for foul and wastewater.

External rainwater down pipes may be simply made up of interlocked elements as long as they are equipped with siphon.

However, internal downpipes, as for all other evacuation pipes, shall be permanently and solidly water and airtight.

Bends and direction changes shall be sufficiently wide so as not to slow down evacuation. Connections shall be made with an angle of at least 75°.

7.2 Foul water - Primary and secondary ventilation

Collectors for canteen and kitchen water shall include starch and grease separators. For laundry, foul water decanting basins shall be provided. They shall be set in a well-ventilated area, with access for vehicles and as close as possible to the equipment which they drain.

A minimum temperature of 10°C shall be maintained in the degreaser by electrical flame-proof heating elements.

Foul and wastewater down pipes shall be led away from the roofs by ventilation ducts of the same diameter.

The Particular Specifications shall define the equipment whose siphons shall be connected to the secondary ventilation network.

This arrangement is mandatory for all equipment other than WC, which are connected to a single downpipe and in case of an installation where several pieces of equipment are connected to the same flow circuit. Diameters for drain connections shall be at least equal to that of the siphons. Diameters for household water down pipes, single down pipes and secondary ventilation columns shall be selected in compliance with standards. Their diameters shall be constant over the whole height of the columns.

Secondary ventilation columns shall be lengthened as for primary ventilation or connected to the latter, at least one metre above the highest equipment.

They shall be made of a rustproof material. They shall present no reverse gradient and shall be connected at the foot of the downpipe for the evacuation of condensation waters.

7.3 Openings for cleaning

These openings, also known as “clean-out plugs” or “airtight plugs” shall have a diameter equal to that of the piping to which they are connected. They shall be set at the foot of each downpipe for household and rainwater, on any branch connection as well as on any horizontal section of more than one meter.

7.4 Siphons

The water seal to be maintained in all siphons shall be at least 5 cm high.

Each piece of sanitary equipment shall include a siphon of suitable diameter placed immediately at the outlet.

Minimum dimensions for siphons and outlets for sanitary equipment, as well as their flow, and diameters for relative secondary ventilation are defined in accordance with section 5.3.2.

Under no circumstance shall the outlet from a sanitary piece of equipment be connected to a W.C siphon or branch connection.

Siphons which cannot be taken apart shall have an adequate clean-out plug. If they are underground, access shall be provided.

Water from floors (yards, workshops, warehouses, cloakrooms) shall be gathered via large siphons with removable baskets and grids for cleaning.

In hot countries, bell gullies shall be prohibited.

8. Pipes: Type - Installation - Testing

8.1 Type of pipes

Unless otherwise stated within the Particular Specifications the following materials shall be used.

8.1.1 For water supply equipment

- Malleable cast iron
- Hot galvanized steel

Galvanized steel piping shall be constantly under pressure to avoid deposit of rust. They shall be assembled by galvanized joints or by welding/brazing

The Engineering CONTRACTOR shall ensure that no copper or copper-type metal may cause any electrolytic reactions

- Internally protected carbon steel pipes. Assembly by joints or endogen welding
- Copper, deoxidised, UGC or UGD quality
- Polyvinyl chloride (P.V.C)
- High density polyethylene (PEhd)
- GRP

8.1.2 For foul water evacuation

8.1.2.1 Down pipes

- Malleable cast iron
- Lead
- Copper
- P.V.C.

8.1.2.2 Horizontal collectors

- Lead
- Varnished stoneware
- Concrete
- P.V.C.

8.1.3 Rain water downpipes

8.1.3.1 Outside

- Zinc
- Cast iron
- Steel (anti-corrosion protection)
- P.V.C.

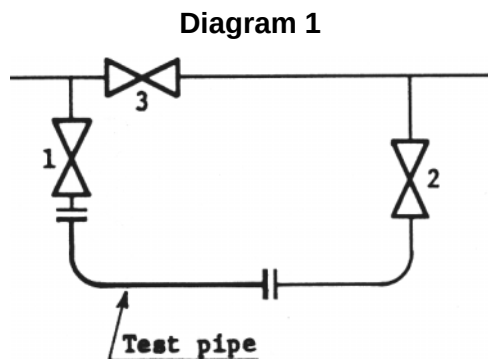
8.1.3.2 Inside

- Cast iron
- Steel (anti-corrosion protection)
- P.V.C.

8.1.4 Test pipes

In an installation made up of steel piping, test pipes for corrosion shall be assembled in the following manner (these pipes enable internal inspection of piping):

- If water treatment is carried out inside the building, a test pipe shall be installed downstream from the treatment equipment and as close as possible to the said equipment
- If no water treatment is carried out, the test pipe shall be placed close to and downstream from the meter
- For a looped circuit for hot water, the test pipe shall be placed on the return section, at the loop extremity and upstream from non-return valve.



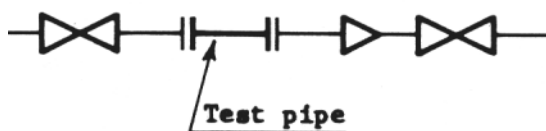
On a cold water circuit, the test pipe shall be bent at 90° lengthened by a straight section 0.50 m long minimum.

The straight part shall be horizontal, whichever the direction of the circuit is.

In normal operation condition, valves 1 and 2 are open, valve 3 is closed.

When test pipe is to be dismantled, the opposite applies

Diagram 2



For hot water return piping, by-pass is not required.

Test pipe, 0.50 m long minimum, is set horizontally, as shown on diagram.

In this case, it is necessary to stop water circulation in order to dismount the pipe.

8.1.5 Choice of ducts

Unless stated otherwise within Particular Specifications, the Engineering CONTRACTOR shall submit his choice of ducts to the COMPANY for approval.

8.2 General rules - Support spacing

All pipes shall be fixed by supports that enable dismounting.

Spacing shall be as follows:

Type of piping	Max. spacing	Observations
Lead		
Horizontal piping	0.40 m	A binding piece should be fixed every meter
Vertical piping	0.50 m	
Copper		
Internal diameter less than or equal to 20 mm	1.25 m	
Internal diameter of 21 to 40 mm inclusive	1.80 m	
Internal diameter more than or equal to 41 mm	2.50 m	
Steel		
Internal diameter less than or equal to 20 mm	1.50 m	
Internal diameter of 21 to 40 mm inclusive	2.25 m	
Internal diameter more than or equal to 41 mm	3.00 m	
Cast iron		One support per element 1 m or more
Drawn zinc		One support per element 1 m or more
Rolled zinc		One support per 2 m with protection
PVC-PEHD-GRP		According to MANUFACTURER's instructions

Equipment shall be design to allow for easy dismounting by means of joints and/or flanges located in accessible areas.

However, only equipment that has to be assembled for the installation shall be made of parts that may be disassembled.

Juxtaposition of two metals that may create electrical current shall be prohibited.

Sections of piping that may be exposed to impact shall be protected by (or made with) resistant materials. Piping through walls or flooring shall be sheathed.

8.3 Type of assembly for evacuation piping - Walls and floors crossing

8.3.1 Types of assembly

Evacuation piping shall be assembled in the way that the MANUFACTURER considers best to avoid leaks.

Before beginning assembly, the piping shall be cleared of any foreign matter: masonry sandstone, waste cuttings. Section ends shall be bored to diameter.

8.3.2 Crossing through walls and floors

Apart from connection pipe joints for WC and floor siphons, no assembly by filled interlocking joints shall be made through floors. Other types of assembly (bell and spigot joints, preformed or compressed joints, brazed or welded/brazed joints, or adhesive joints) are acceptable within limits defined in the Particular Specifications. This applies to the different materials that are used for piping through floors and walls.

Materials placed in direct contact with piping to form a coating, to act as back filling or caulking shall have no chemical action on the piping and shall protect the piping from moisture.

In case of expected expansion of the pipe a sheath shall be provided to isolate piping from the building.

If the piping is made of metal it shall be isolated from other metal piping or concrete reinforcement. The material used to separate the different elements from one another shall be electrically insulated.

8.3.3 Pipe marking

Marks shall be painted according to standard colours.

8.4 Checking and testing of installations

8.4.1 Water-tightness tests

8.4.1.1 Water distribution

The water network shall be completely cleaned, either by compressed air or drinking water before tests start.

It shall be disinfected in compliance with:

- The administrative memorandum dated March 15th 1962 (*Journal Officiel*) dated March 27th and April 13th 1962) of the French Ministry of Health and Population
- The test pressure shall be higher than 10 bars or 1.5 times the operating pressure, without exceeding at any point the test pressure of each piece of equipment
- The pressure shall be maintained during the necessary time for inspecting and not less than 30 minutes with all taps and drains closed and shut-off valves open. No leak shall appear. The same procedure shall be adopted for hot water storage tanks.

8.4.1.2 Foul water evacuation

Test shall be carried out with water.

For horizontal draining pipe which diameter is over 110 mm, the test shall be carried out under 0.1 bar water pressure.

8.4.2 Operational test

These tests shall be carried out at the operational pressure.

They shall consist, on the one hand, of testing separately valves, cocks and fittings from sanitary equipment (taps, drains, flushes), and on the other hand, of testing the whole installation according to the simultaneous flow theory which was used as the design basis, thus:

- Checking of filling-up and drainage durations of equipment
- Checking that there is no vibration noise under test pressure
- Checking the correct performance of primary and secondary ventilation.

Siphons shall be tested for auto-siphoning effects, and the water seal after testing shall be at least 50 mm.

All of these tests shall be performed before painting or casing of piping.

8.4.3 Materials and equipment control check

This control checking shall enable the detection of defects. It shall consist of inspection, simple site tests, tests during works, analysis of start-up reports, plus factory and laboratory acceptance tests.

Particular Specifications shall define procedures to be used.