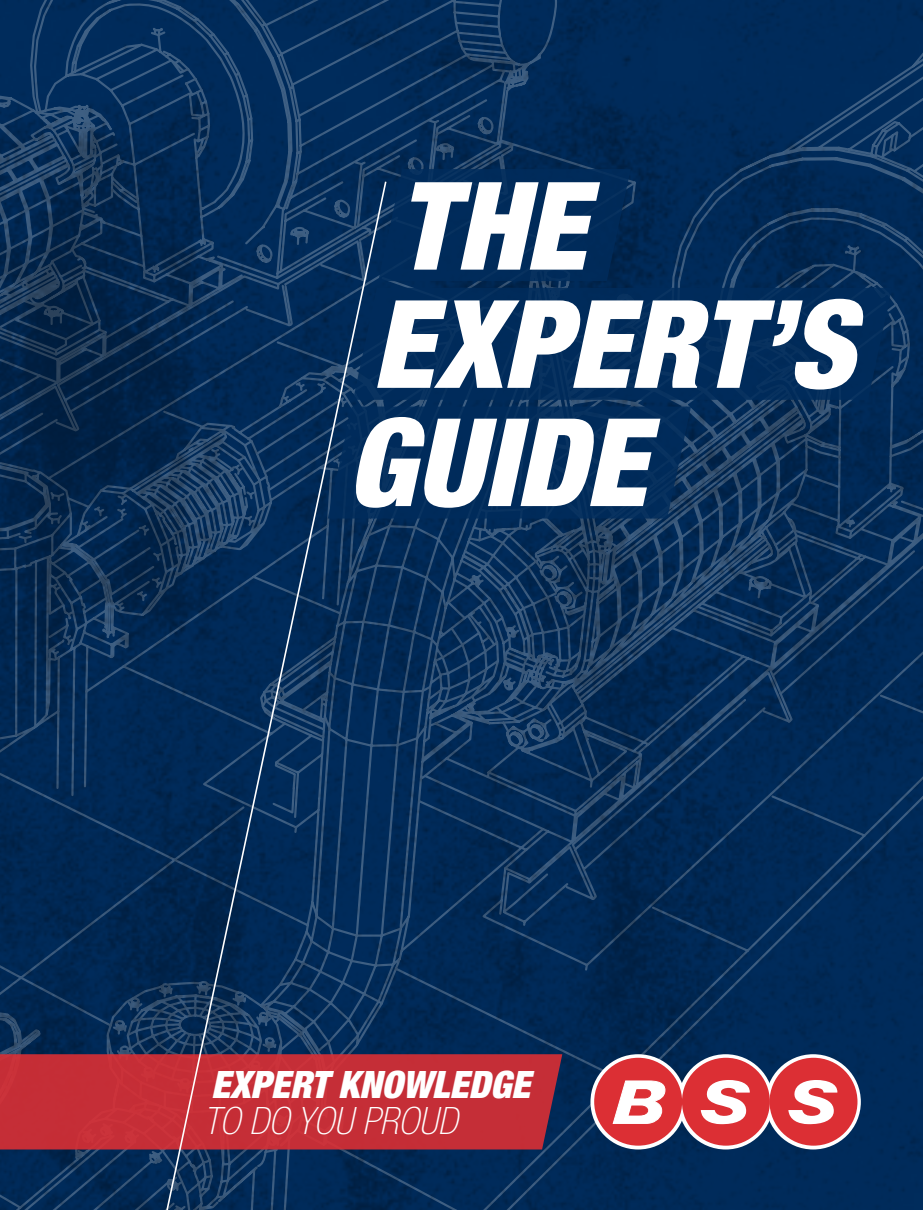


THE EXPERT'S GUIDE

EXPERT KNOWLEDGE
TO DO YOU PROUD

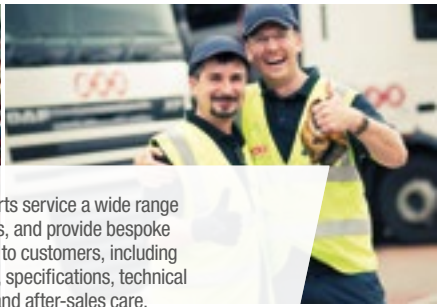
BSS

BY EXPERTS FOR EXPERTS

OVER 1200 EXPERTS *NATIONWIDE*

SERVICE & KNOW-HOW

From tall iconic buildings to local school solutions, our unmatched Service & Know-How will always do you proud.



We are the UK's market-leading distributor of pipeline and heating solutions.

Established over 110 years ago, we have grown into a multi-million-pound, nationwide business, working with the very best brains and brands in the game.

Our experts service a wide range of sectors, and provide bespoke solutions to customers, including products, specifications, technical support and after-sales care.

This technical guide is designed to support your own knowledge while showcasing the range of products available from your BSS.

ALL BRANDS

THE WIDEST PRODUCT RANGE

Our relationships with the best brands mean that our Service & Know-How is supported by market-leading suppliers.

All the best brands stocked in one place. We know your market. No two jobs are the same, so you need a wide selection of products to choose from.

With the widest product line-up in the industry, you can be assured that we will always offer you the best choice possible for the solution you're looking for.

We carefully maintain close relationships with all the leading suppliers to ensure we can offer you the latest innovations as soon as they are launched, so you'll have access to new technology faster.

BAXI
GEBERIT
+GF+
GRUNDFOS
ideal COMMERCIAL
PEGLER PY Valve technology
Polypipe
wilo

THE LEGEND THAT IS BOSS™

Our BOSS™ brand has been around almost as long as the BSS business itself. We launched our first BOSS™ product way back in 1907, and today the range offers the same high quality and outstanding value as those first products over a century ago.

BOSS™

We know our customer relationships are based on trust. That's why we have built a brand you can rely on day in, day out.

BOSS™ delivers products for professionals who demand guaranteed quality and service. We are proud of the history and reputation of our brand and the respect it has in our industry.

Innovation has been the key to our success for over a hundred years and we will continue to develop new and exciting ranges to meet the challenges of the future.

SERVICED, CHECKED AND READY TO GO

CONTACT THE DIRECT HIRE TEAM ON 0344 892 1878

HIRE-IT
TOOL & EQUIPMENT HIRE

Sometimes you don't have the right tools to fit the products you buy from us. Our Hire-It service is available nationwide to ensure you can get hold of the tools you need to finish the job.

Every BSS branch has access to the Hire-It range, so wherever you are buying your tube, you can get your hands on a press gun to fit it. Our range has been put together to complement the products we sell, which means you can buy a product and hire the tools to fit it under one roof.

We can also offer a next-day service on more specialist lines. Our National Distribution Centre will deliver additional items overnight for you to collect first thing the following morning, giving you peace of mind that you will get the tools you need.

If you need to hire something a bit different, we have access to the Travis Perkins Group Tool Hire network. So, if you need a mini digger, a cement mixer or a jackhammer, we can sort that out too.

WE'VE GOT UK & IRELAND COVERED

Our extensive national branch network ensures that wherever your project takes you, we're close to hand.

With over 60 locations across England, Scotland, Wales, Northern Ireland and the Republic of Ireland, we'll always have the stock available no matter where your jobs take you.

Every branch also has its own delivery fleet, so we can get your product to you wherever you need it.

To find your nearest branch, see page 270.

With our National Distribution Centre in the heart of the Midlands, we operate 24 hours a day and deliver to over 60 locations every single weekday using our own primary fleet.

ORDER BY 5PM FOR NEXT DAY DELIVERY

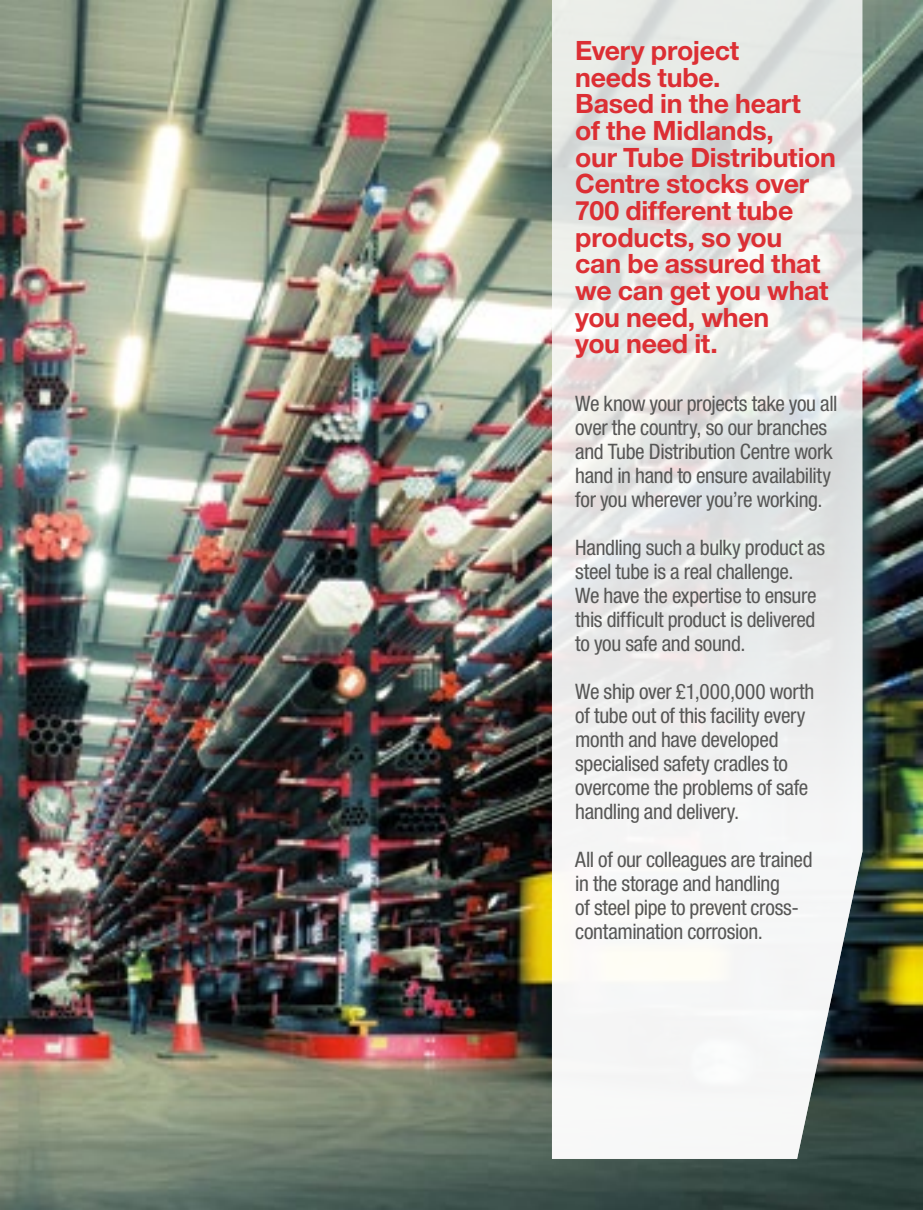
NEXT DAY NATIONWIDE DELIVERY

Any item not in branch can be delivered the next day. This includes tool hire too, as we take care of an extensive range of specialist equipment on-site. As a customer, this means you can order by 5pm and collect your goods first thing the following morning.

We also have a team of highly qualified technical engineers on-hand to assemble, machine and adapt products – such as plate heat exchangers, actuated valve packages, etc. – to your bespoke requirements.

We also offer a site clearance service to help you manage project completion and ensure your costs on the job are minimised where possible.

TUBE DISTRIBUTION CENTRE



Every project needs tube. Based in the heart of the Midlands, our Tube Distribution Centre stocks over 700 different tube products, so you can be assured that we can get you what you need, when you need it.

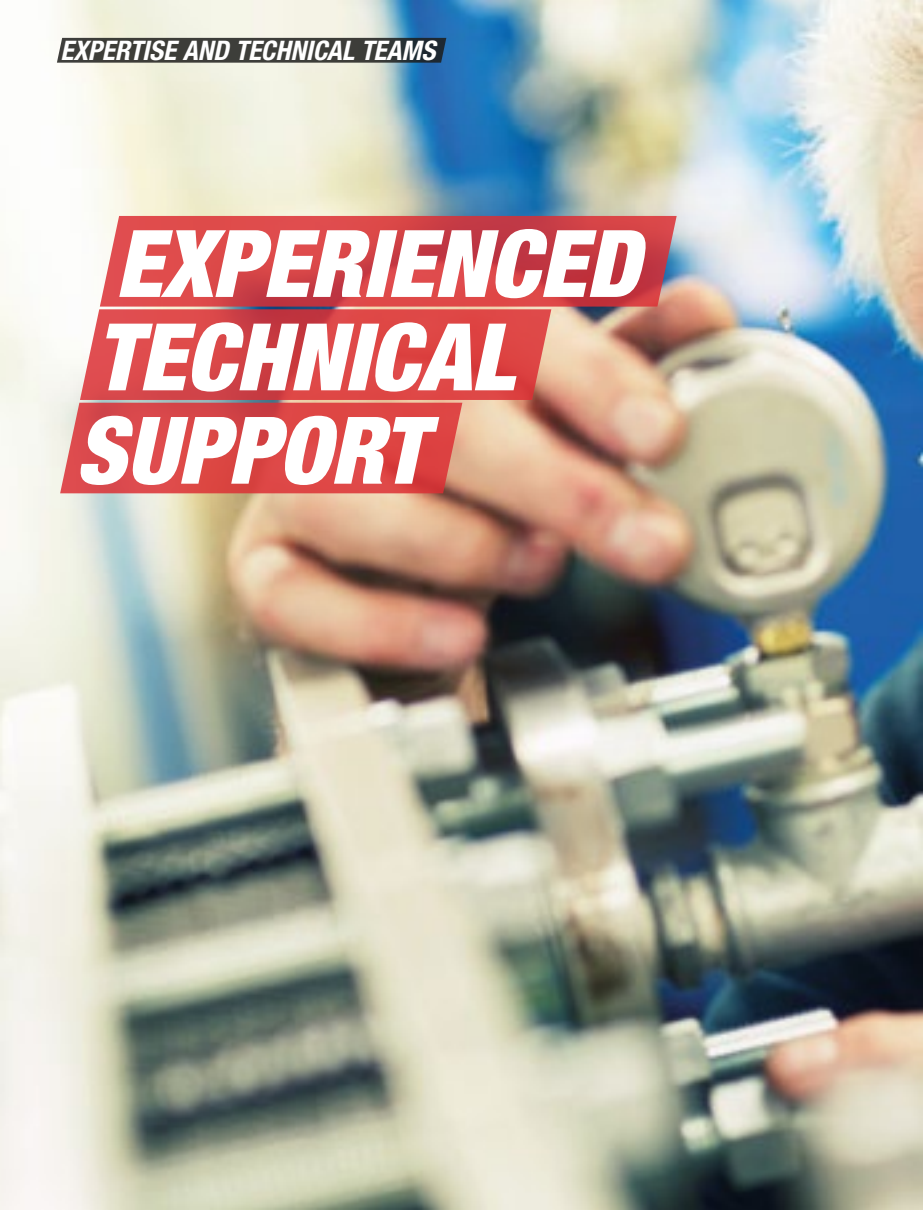
We know your projects take you all over the country, so our branches and Tube Distribution Centre work hand in hand to ensure availability for you wherever you're working.

Handling such a bulky product as steel tube is a real challenge. We have the expertise to ensure this difficult product is delivered to you safe and sound.

We ship over £1,000,000 worth of tube out of this facility every month and have developed specialised safety cradles to overcome the problems of safe handling and delivery.

All of our colleagues are trained in the storage and handling of steel pipe to prevent cross-contamination corrosion.

EXPERIENCED TECHNICAL SUPPORT



Sometimes, the solutions you need are complex, and no two jobs are the same. We have Technical Service teams within our business and experienced staff in every branch to ensure you get the right advice, every time.

We have specialists in heating, valves, plastics, pumps, controls, carbon and stainless steel who are there to ensure you choose the right solution.

These specialists can really speed up the process of selecting the right product. Often, they can offer alternative solutions which can help value engineer your project and deliver cost or energy savings.

We pride ourselves on our experienced branch staff who are there to offer the friendly advice and support you need. Big or small, whatever the challenge, we've got the Know-How to do you proud.

TECHNICAL SERVICES

Technical Services provides colleagues and customers with technical support and advice for products and after-sales service.

BSS CONTROLS

We have technical knowledge and capability and can provide product selection and advice on the following:

- Boiler controls
- AHU controls
- Building automation
- Pressure, time & temperature controls
- Mixing & diverting valves with actuators
- Zone valves
- Fan coil valves & controls
- Gas solenoid safety valves
- Gas solenoid OPSO & UPSO valves
- Gas governors (regulators), filters & pressure proving
- Meters – gas & water
- Solenoid valves
- Thermostatic radiator valves
- Fire-fighting equipment
- Showering
- Damper actuators
- Backflow prevention
- Boiler & burner spares
- Renewables – biomass, heat pumps, buffer tanks & solar panels

Telephone BSS Controls:
0115 973 9560
Email:
controls@bssgroup.com

BSS VALVES

A key specialist team, we have technical knowledge and capability and can provide product selection and sizing for all process valves inc. BOSS™ valves and actuation. Our service to customers is enhanced by our valve & actuation assembly packages and our extensive inspection & test facilities. All built/overseen by our in-house BSS Engineering Dept.

- Industrial actuators, controls & positioners
- Ball valves
- Butterfly valves
- Process control valves
- Diaphragm valves
- Gate, globe & check valves
- Steam control
- Safety / relief valves

Telephone BSS Valves Sales
0115 973 9580
Email:
valves@bssgroup.com

BSS PUMPS

We have technical knowledge and capability and can provide product selection and sizing to meet the demands of:

- Heating and chilled water circulation
- Secondary hot water services
- Pressurised (sealed) systems and expansion vessels
- Pressure-boosting applications and storage tanks
- Drainage and wastewater
- Sewage and treatment
- Chemical process and dosing
- Food process applications
- Fuel oil transfer
- Associated accessories and controls
- Pump spares

Telephone BSS Pumps Sales:
0115 973 9513
Email:
pumps@bssgroup.com

BSS AFTER SALES

A comprehensive range of after-sales services for all applications:

- Repairs on- and off-site
- Commissioning
- Servicing & service contracts
- Energy surveys
- Warranty
- Engineer site visits arranged
- Single point of contact for internal and external customers
- Consistent service levels (customer focus/relationships)

Telephone BSS After Sales:
0115 973 9513
Email:
aftersales@bssgroup.com

BSS CARBON & STAINLESS

Our in-house machine shop allows us to modify flanges, including services such as drilling and tapping, boring, bolt-hole modification and more. We can provide technical support and advice on materials and specifications.

Stainless Steel:

- Welded pipe ASTM A312/A312M - Formerly ASTM A20
- Butt weld fittings ASTM A403/ A403M - Formerly ASTM A276
- Flanges ASTM, BS EN 1092 - Formerly BS 3274 & BS 10
- BSP fittings
- Metric stainless

Carbon Steel:

- Seamless API line pipe
- Welded API line pipe
- Butt weld fittings ASTM A234/ A234M - Formerly ASTM A129
- Flanges ASTM, BS4504 & BS10
- 3000lb fittings in API & SW

BSS Carbon & Stainless:
0115 973 9530
Email:
carbonstainless@bssgroup.com

BSS PLASTICS

Technical knowledge and capability and a product range to service the demands of:

- PVC-U
- PVC-C
- ABS
- Polypropylene
- Polyethylene
- Plastic sheet & hose
- Flow measurement & instrumentation
- HDPE
- Actuation
- Instaflex
- HTA
- PVDF
- Philmac
- PLX
- Guardian
- Dual-containment hose
- Fabrication

Telephone BSS Plastics Sales
0870 242 5586
Email:
plastics@bssgroup.com

We maintain a strong commitment to our Stay Safe culture. We want to ensure that everyone who works for or visits us experiences a safe environment and is protected as much as possible.

SafeContractor APPROVED

CHAS®
Accredited Contractor
CHAS.co.uk

2019
RoSPA
Gold Award

FORS

THE WAY WE WORK HERE

All our branches are regularly audited to ensure they continuously improve their health and safety performance.

Staff are regularly trained to provide everyone with a basic understanding of our Stay Safe policies and culture.

We continually drive innovation in our Stay Safe processes and are always looking for new ways to reduce risk both at our branches and on our vehicles delivering to site.

SAMH

for Scotland's mental health

With mental health problems affecting one in four people every year, hundreds of thousands are struggling to cope.

Both Mind and SAMH provide much-needed support and advice as well as raising awareness of mental health problems and campaigning for better services. We have an ambitious fundraising programme of charity events and activities to support the work of our mental health charities. All that matters is that we make a real difference to the lives of people affected by mental health problems.

PROUDLY SUPPORTING MENTAL HEALTH

OVER 250K RAISED IN 2018

BSS has a long-term commitment to supporting Mind and SAMH (Scottish Association for Mental Health), the leading mental health charities in the UK.

mind
for better mental health

COMMONLY USED SYMBOLS

TYPICAL DRAWING SYMBOLS

	General Valve		Normally Closed Valve
	Isolating Valve Wheelhead		Normally Open Valve
	Isolating Lockshield Valve		2-Port Control Valve
	Non-Return Valve		3-Port Control Valve
	Double Non-Return Valve		4-Port Control Valve
	Pressure-Reducing Valve		Thermostat Mixing Valve
	Double Regulating Valve		Differential Pressure Control Valve
	Commissioning Valve		Balancing Partner Valve
	Metering Station		Plugged Valve: Future Connection
	Auto By-Pass Valve		Drain-Off Cock

	Hose Union Drain Cock
	Flexible Bellow
	Safety Valve
	Float Valve
	Lockshield Radiator Valve
	Thermostatic Radiator Valve
	Gas Cock
	Gas Solenoid Valve
	Three-Way Vent Valve
	Strainer

	Auto Air Vent
	Single Head Pump
	Twin Head Pump
	Sight Glass
	Test Point
	Flanged Connection
	Union
	Capped End
	Reducer
	Pipework

TYPICAL DRAWING SYMBOLS

	Quick Fill		Outside Sensor
	Gas Meter		Air/Dirt Separator
	Water Meter		Expansion Vessel
	Temperature Gauge		Water Conditioner
	Pressure Gauge		Low-Loss Header
	Flow Switch		Dosing Pot
	Panic Button		Side Stream Filtration Unit And Dosing Unit
	Pressure Switch		Actuator
	Thermostat		Filter
	Temperature Sensor		Gauge

	PHE
	Pump
	Strainer
	Valve
	Duct
	Return Duct
	Return Duct 2
	Supply Duct
	Supply Duct 2
	2-Fan Sections

	3-Fan Sections
	4-Fan Sections
	Side-To-Side Pipe
	Top-To-Bottom Pipe
	Side-To-Bottom Pipe
	Pipe Flow Arrow
	VAV Box
	DD VAV Box
	Fan Coil Housing
	Unit Heater

TYPICAL DRAWING SYMBOLS

	Centrifugal Fan		Gate Valve
	Propeller Fan		Water Flow Meter
	Vane Axial Fan		Chiller
	Damper		Cooling Tower
	Filter		Boiler
	Airflow Station		Equipment
	Humidifier		VSD
	Heating/Cooling Coil		Start
	Pump		
	Valve		

IMPERIAL TO METRIC

LENGTH
ft x 0.305 = m
in x 25.4 = mm

VOLUME
ft^3 x 0.028 = m^3
UK Gal x 4.546 = Litres

WEIGHT
lb x 0.45 = kg

PRESSURE
psi x 0.069 = barg
psi x 6.89 = kPa (kN/m^2)
barg x 100 = kPa (kN/m^2)
ft.hd. x 2.98 = kPa (kN/m^2)
in.w.g. x 0.249 = kPa (kN/m^2)

HEAT AND ENERGY
BTU/hr x 0.00029 = kW
BTU/hr x 0.252 = kcal/hr
BTU/hr/ft^2 °F x 5.68 = w/m^2 °C
hp x 746 = W
BTU/lb x 2.326 = kJ/kg

TEMPERATURE
(°F - 32) x 0.555 = °C

VELOCITY/FLOW RATE
gpm x 0.076 = l/s
lbs/hr x 0.000126 = kg/s
ft^3/min x 0.000472 = m^3/s
ft^2/min x 1.7 = m^3/hr
ft/min x 0.0051 = m/s
ft/s x 0.305 = m/s

METRIC TO IMPERIAL

LENGTH
m x 3.28 = ft
mm x 0.039 = in

VOLUME
m^3 x 35.31 = ft^3
Litres x 0.22 = UK Gal

WEIGHT
kg x 2.2 = lb

PRESSURE
barg x 14.5 = psi
kPa (kN/m^2) x 0.145 = psi
kPa (kN/m^2) x 0.01 = barg
kPa (kN/m^2) x 0.33 = ft.hd.
kPa (kN/m^2) x 4 = in.w.g.

HEAT AND ENERGY
kW x 3412 = BTU/hr
kcal/hr x 3.97 = BTU/hr
w/m^2 °C x 0.176 = BTU/hr/ft^2 °F
W x 0.0013 = hp
kJ/kg x 0.43 = BTU/lb

TEMPERATURE
(°C x 1.8) + 32 = °F

VELOCITY/FLOW RATE
l/s x 13.2 = gpm
kg/s x 7937 = lbs/hr
m^3/s x 2119 = ft^3/min
m^3/hr x 0.588 = ft^3/min
m/s x 197 = ft/min
m/s x 3.28 = ft/s

DECIMAL MULTIPLES AND SUBMULTIPLES

Although the SI units are preferred, it is not practical for everyday use to limit usage to only use SI units and therefore their decimal multiples and submultiples will also be used. These are formed by using the following prefixes:

FACTOR BY WHICH THE UNIT IS MULTIPLIED	PREFIX	SYMBOL
10^{12}	ter	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10	deca	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

EQUIVALENT NOMINAL SIZES

DIN RATING	ANSI CLASS
PN 10	
	125 lb
PN 16	
	150 lb
PN 25	
PN 40	
	300 lb
PN 63	
PN 100	600 lb
	900 lb
PN 160	
PN 250	1500 lb
PN 320	
PN 400	
	2500 lb
PN 630	

DN	
METRIC	IMPERIAL
8mm	¼"
10mm	⅜"
15mm	½"
20mm	¾"
25mm	1"
32mm	1¼"
40mm	1½"
50mm	2"
65mm	2½"
80mm	3"
100mm	4"
125mm	5"
150mm	6"
200mm	8"
300mm	12"
350mm	14"
400mm	16"
450mm	18"
500mm	20"
600mm	24"
700mm	28"
750mm	30"
800mm	32"
900mm	36"
1000mm	40"
1050mm	42"
1200mm	48"

SATURATED STEAM TABLES

Gauge Pressure bar	Absolute Pressure bar	Temperature °C
0.0	1.013	100
0.1	1.113	102.66
0.2	1.213	105.10
0.3	1.313	107.39
0.4	1.413	109.55
0.5	1.513	111.61
0.6	1.613	113.56
0.7	1.713	115.40
0.8	1.813	117.14
0.9	1.913	118.80
1.0	2.013	120.42
1.1	2.113	121.96
1.2	2.213	123.46
1.3	2.313	124.90
1.4	2.413	126.28
1.5	2.513	127.62
1.6	2.613	128.89
1.7	2.713	130.13
1.8	2.813	131.37
1.9	2.913	132.54
2.0	3.013	133.69
2.1	3.113	134.82
2.2	3.213	135.88
2.3	3.313	136.98
2.4	3.413	138.01
2.5	3.513	139.02
2.6	3.613	140.00
2.7	3.713	140.96
2.8	3.813	141.92
2.9	3.913	142.86
3.0	4.013	143.75
3.1	4.113	144.67

Gauge Pressure bar	Absolute Pressure bar	Temperature °C
3.2	4.213	145.46
3.3	4.313	146.36
3.4	4.413	147.20
3.5	4.513	148.02
3.6	4.613	148.84
3.7	4.713	149.64
3.8	4.813	150.44
3.9	4.913	151.23
4.0	5.013	151.96
4.1	5.113	152.68
4.2	5.213	153.40
4.3	5.313	154.12
4.4	5.413	154.84
4.5	5.513	155.55
4.6	5.613	156.24
4.7	5.713	156.94
4.8	5.813	157.62
4.9	5.913	158.28
5.0	6.013	158.92
5.2	6.213	160.20
5.4	6.413	161.45
5.6	6.613	162.68
5.8	6.813	163.86
6.0	7.013	165.04
6.2	7.213	166.16
6.4	7.413	167.29
6.6	7.613	168.38
6.8	7.813	169.43
7.0	8.013	170.50
7.2	8.213	171.53
7.4	8.413	172.53
7.6	8.613	173.50

SATURATED STEAM TABLES

Gauge Pressure bar	Absolute Pressure bar	Temperature °C
7.8	8.813	174.46
8.0	9.013	175.43
8.2	9.213	176.37
8.4	9.413	177.27
8.6	9.613	178.20
8.8	9.813	179.08
9.0	10.013	179.97
9.2	10.213	180.83
9.4	10.413	181.68
9.6	10.613	182.51
9.8	10.813	183.31
10.0	11.013	184.13
10.2	11.213	184.92
10.4	11.413	185.68
10.6	11.613	186.49
10.8	11.813	187.25
11.0	12.013	188.02
11.2	12.213	188.78
11.4	12.413	189.52
11.6	12.613	190.24
11.8	12.813	190.97
12.0	13.013	191.68
12.2	13.213	192.38
12.4	13.413	193.08
12.6	13.613	193.77
12.8	13.813	194.43
13.0	14.013	195.10
13.2	14.213	195.77
13.4	14.413	196.43
13.6	14.613	197.08
13.8	14.813	197.72

Gauge Pressure bar	Absolute Pressure bar	Temperature °C
14.0	15.013	198.35
14.2	15.213	198.98
14.4	15.413	199.61
14.6	15.613	200.23
14.8	15.813	200.84
15.0	16.013	201.45
15.2	16.213	202.04
15.4	16.413	202.62
15.6	16.613	203.21
15.8	16.813	203.79
16.0	17.013	204.38
16.2	17.213	204.94
16.4	17.413	205.49
16.6	17.613	206.05
16.8	17.813	206.61
17.0	18.013	207.17
17.2	18.213	207.75
17.4	18.413	208.30
17.6	18.613	208.84
17.8	18.813	209.37
18.0	19.013	209.90
18.2	19.213	210.43
18.4	19.413	210.96
18.6	19.613	211.47
18.8	19.813	211.98
19.0	20.013	212.47
19.2	20.213	212.98
19.4	20.413	213.49
19.6	20.613	213.99
19.8	20.813	214.48
20.0	21.013	214.96

A WORLD OF PUMP INFORMATION ON THE GO.

Wilo-Assistant Smartphone app.

Our handy smartphone app places a world of pump information in the palm of your hand. From Pump sizing tools, replacement guides, fault code listings and operating manuals. It's a must have when dealing with pumps for the HVAC, Building Services and Water Management industries.

Download it today either by scanning the QR code with your phone's camera, or search "Wilo Assistant" in the app stores.

Google play

Available on the App Store

CONVERSION TO SI UNITS

PRESSURE AND LIQUID HEAD

	Kilogram force per square centimetre	Pound force per square inch		Foot of water	
1	2	3	4	5	
barg	kgf/cm^2	lbf/in^2	atm	ft H_2O	
1	1.0197	14.5038	0.9869	33.4553	
0.9807	1	14.2233	0.9878	32.8084	
0.0689	0.0703	1	0.0609	2.3067	
1.0133	1.0332	14.6959	1	33.889	
0.0299	0.0305	0.4335	0.0295	1	
0.0025	0.0025	0.0361	0.0025	0.0833	
0.0981	0.1	1.422	0.0968	3.2808	
0.0133	0.0136	0.1934	0.0132	0.4461	
0.0339	0.0345	0.4911	0.0334	1.133	
0.0013	0.0014	0.0193	0.0013	0.446	

1 1 barg = $105 N/m^2$

2 Technical (metric) atmosphere (atm)

3 Often denoted non-technically as psi

STANDARD GAS CONDITIONS AND MODULAR VOLUMES

Normal (e.g. nft^3) - European and scientific work	= 0°C and 1.0133 barg
Standard (e.g. std ft^3) - British Gas Industry	= 15.55°C and 1.016 barg
Standard (scf) - USA	= 15.55°C and 1.0133 barg

PRESSURE STANDARDS

International standard atmosphere	(1 atm)	= 1.0133 barg = 1.0332 kgf/cm^2 = 14.6959 lbf/in^2
Metric atmosphere	(1 atm) ata atu	= 0.9807 barg = absolute w = 14.2233 lbf/in^2 = at absolute w = at gauge
Standard conditions – s.t.p. or NTP		= 1.0133 barg 0°C = 14.6959 lbf/in^2 at 0°C

Inch of water	Metre of water	Centimetre of mercury	Inch of mercury	Millimetre of mercury
in H_2O	m H_2O	cm Hg	in Hg	[6] mm Hg
401.463	10.1972	75.0062	29.530	750.062
393.701	10	73.556	28.959	735.559
27.68	0.7031	5.1715	2.036	51.715
406.782	10.3323	76.0	29.9213	760
12	0.3048	2.242	0.8827	22.4198
1	0.0254	0.1868	0.0734	1.8683
39.3701	1	7.3556	2.896	73.356
5.3524	0.136	1	0.3937	10
13.5951	0.3453	2.54	1	25.4
0.5352	0.0136	0.1	0.0394	1

[4] International standard atmosphere

[5] At density 1g/cm^3

[6] Also known as torr

DENSITY			
Gram per millilitre g/ml	Kilogram per cubic metre kg/m^3	Pound per cubic foot lb/ft^3	Pound per cubic inch lb/in^3
1	1000	62.428	0.0361
0.001	1	0.0624	0.000036
0.016	16.02	1	0.00058
27.6807	27679.9	1728	1

CONVERSION TO SI UNITS

HEAT FLOW RATE

Watts W	Calorie per second cal/s	Kilocalorie per hour kcal/h	British Thermal unit per hour BTU/h
1	0.2388	0.8598	3.4121
4.1868	1	3.6	14.286
1.163	0.2778	1	3.9683
0.231	0.07	0.252	1

FORCE

Kilonewton kN	Kilogram force kgf	Pound force lbf	Poundal pdl
1	101.972	224.809	7233.01
0.00981	1	2.2046	70.9316
0.0044	0.4536	1	32.174
0.000138	0.0141	0.0311	1

POWER

Watt W	Kilogram force metre per second kgf m/s	Metric horse power	Foot pound force per second ft lbf/s	Horse power hp
1	0.102	0.00136	0.7376	0.00134
9.8067	1	0.01333	7.233	0.01315
735.499	75	1	542.476	0.98632
1.3558	0.1383	0.00184	1	0.00182
745.70	76.0402	0.0139	550.0	1

MASS/VOLUMETRIC RATE OF FLOW FORMULAE

Gases

$ft^3/h\ (std) = \frac{lb/h \times 379}{M}$	$m^3/h\ (norm) = \frac{kg/h \times 22.40}{M}$
$ft^3/h\ (std) = \frac{lb/h}{p1}$	$m^3/h\ (norm) = \frac{kg/h}{p2}$
$ft^3/h\ (std) = \frac{lb/h \times 13.1}{G1}$	$m^3/h\ (norm) = \frac{kg/h \times 0.82}{G2}$

TORQUE

Newton metre Nm	Kilogram force metre kgf m	Pound force feet lbf ft	Pound force inch lbf in
1	0.102	0.7376	8.8508
9.8067	1	7.233	86.7962
1.3558	0.1383	1	12
0.113	0.0115	0.0833	1

LIQUIDS

$US\ gal/min = \frac{lb/h}{50 \times SG}$	$m^3/h\ (norm) = \frac{0.001\ kg/h}{SG2}$

Where:
(std) is at 14.7 lbf/in^2 (abs) and 60°F
(norm) is at 760 mm Hg and 0°C
SG1 Water = 1 at 60°F
SG2 Water = 1 at 4°C
M = Molecular Weight
p1 = Density lb/ft^3 (std)
p2 = Density kg/cm^3 (norm)
G1 = sp.gr. Air = 1 (std)
G2 = sp.gr. Air = 1 (norm)

CONVERSION TO SI UNITS

CONVERSION TABLE FOR SPECIFIC ENTHALPY

	kJ/kg = J/g	kJ/kg = cal/g	BTU/lb
1 kJ/kg	*1	0.238846	0.429923
1 kcal/kg	*4.186 8	*1	*1.8
1 BTU/lb	*2.326	0.555556	*1
1 kgf m/kg	*9.806 65 x 10^{-3}	2.342 28 x 10^{-3}	4.216 10 x 10^{-3}
1 ft lbf/lb	2.989 07 x 10^{-3}	7.139 26 x 10^{-4}	1.285 07 x 10^{-3}
1 kWh/kg	*3600	859.845	1547.72

SPECIFIC GRAVITY AND MOLECULAR WEIGHT OF GASES

Gas	Symbol	Specific Gravity	Molecular Weights
Air		1.000	28.97
Ammonia	NH_3	0.5963	17.03
Carbon Dioxide	CO_2	1.529	44.00
Carbon Monoxide	CO	0.967	28.00
Chlorine	Cl_2	2.486	70.91
Ethylene	C_2H_4	0.9749	28.03
Helium	He	0.138	4.00
Hydrogen	H_2	0.0695	2.016
Hydrogen Sulphide	H_2S	1.19	34.08
Methane	CH_4	0.5544	16.03
Methyl Chloride	CH_3Cl	1.7848	50.48
Nitrogen	N_2	0.9672	28.02
Nitrous Oxide	N_2O	1.530	44.02
Oxygen	O_2	1.105	32.00
Sulphur Dioxide	SO_2	2.264	64.06
Natural Gas (typical)		0.60	

	kgf m/kg	ft lbf/lb	kWh/kg = Wh/g
	101.972	334.553	$2.777\ 78 \times 10^{-4}$
	426.935	1400.70	$*1.163 \times 10^{-3}$
	237.186	778.169	$6.461\ 11 \times 10^{-4}$
	*1	3.28084	$2.724\ 07 \times 10^{-6}$
	*0.304 8	*1	$0.830\ 296 \times 10^{-6}$
	3.670 98 x 105	1.204 39 x 106	*1

SPECIFIC GRAVITY OF LIQUIDS

Water	1.0
Sea Water	1.025
Kerosene	0.80
Sulphuric Acid 100%	1.83
Hydrochloric Acid 45%	1.48
Sodium Hydroxide 25%	1.27
Carbon Tetrachloride	1.60
Petrol (Gasoline)	0.65-0.80
Benzene	0.88
Turpentine	1.1-1.2

COMBINED IMPERIAL AND SI STEAM TABLES

GAUGE PRESSURE		ABSOLUTE PRESSURE		SATURATION TEMPERATURE TS		
barg	lbf/in²g	bar a	lb/in²a	°C	°F	
-0.96	28.4	0.05	0.725	32.9	91	
-0.91	27.0	0.1	1.45	45.8	114	
-0.86	25.5	0.15	2.18	54.0	129	
-0.81	24.0	0.2	2.90	60.1	140	
-0.76	22.5	0.25	3.63	65.0	149	
-0.71	21.1	0.3	4.35	69.1	156	
-0.66	19.6	0.35	5.08	72.7	163	
-0.61	18.1	0.4	5.80	75.9	169	
-0.56	16.6	0.45	6.53	78.7	174	
-0.51	15.1	0.5	7.25	81.3	178	
-0.46	13.7	0.55	7.98	83.7	183	
-0.41	12.2	0.6	8.70	85.9	187	
-0.36	10.7	0.65	9.43	88.0	190	
-0.31	9.24	0.7	10.2	90.0	194	
-0.26	7.77	0.75	10.9	91.8	197	
-0.21	6.29	0.8	11.6	93.5	200	
-0.16	4.81	0.85	12.3	95.1	203	
-0.11	3.34	0.9	13.1	96.7	206	
-0.06	1.86	0.95	13.8	98.2	209	
-0.01	0.38	1.0	14.5	99.6	211	
0	0	1.013	14.696	100	212	
0.1	1.45	1.11	16.1	103	217	
0.2	2.90	1.21	17.5	105	221	
0.3	4.35	1.31	19.0	107	225	
0.4	5.80	1.41	20.5	110	230	
0.5	7.25	1.51	21.9	112	234	
0.6	8.70	1.61	23.4	114	237	
0.7	10.2	1.71	24.8	115	239	
0.8	11.6	1.81	26.3	117	243	
0.9	13.1	1.91	27.7	119	246	
1.0	14.5	2.01	29.2	120	248	
1.1	16.0	2.11	30.6	122	252	
1.2	17.4	2.21	32.1	123	253	
1.3	18.9	2.31	33.5	125	257	
1.4	20.3	2.41	35.0	126	259	
1.5	21.8	2.51	36.4	128	262	
1.6	23.2	2.61	37.9	129	264	
1.7	24.7	2.71	39.3	130	266	

These figures are in inches of Mercury

VACUUM

VACUUM

	SPECIFIC ENTHALPY				SPECIFIC VOLUME STEAM VG	
	Water Sensible Heat (hf) kJ/kg	Evaporation Latent Heat (hf_g) kJ/kg	Water Sensible Heat (hf) BTU/lb	Evaporation Latent Heat (hf_g) BTU/lb	m^3/kg	ft^3/lb
	138	2423	59	1042	28.2	452
	192	2392	82	1029	14.7	236
	226	2373	97	1020	10.0	160
	251	2358	108	1014	7.65	123
	272	2346	117	1009	6.20	99.3
	289	2336	124	1004	5.23	83.8
	304	2327	131	1000	4.53	72.6
	318	2319	137	997	3.99	63.9
	330	2312	142	994	3.58	57.3
	341	2305	147	991	3.24	51.9
	351	2299	151	988	2.96	47.4
	360	2294	155	986	2.73	43.7
	369	2288	159	984	2.54	40.7
	377	2283	162	982	2.37	38.0
	384	2279	165	980	2.22	35.6
	392	2274	169	978	2.09	33.5
	399	2270	172	976	1.97	31.6
	405	2266	174	974	1.87	30.1
	411	2262	177	972	1.78	28.5
	418	2258	179	971	1.69	27.1
	419	2257	180	970	1.67	26.8
	430	2250	185	967	1.53	24.5
	441	2243	190	964	1.41	22.6
	450	2237	194	962	1.31	21.0
	460	2231	198	959	1.23	19.7
	468	2226	201	957	1.15	18.4
	476	2220	205	954	1.08	17.3
	484	2215	208	952	1.02	16.3
	492	2211	212	951	0.971	15.6
	499	2206	215	948	0.923	14.8
	506	2201	218	946	0.881	14.1
	512	2197	220	945	0.841	13.5
	519	2193	223	943	0.806	12.9
	525	2189	226	941	0.773	12.4
	531	2185	228	939	0.743	11.9
	536	2181	230	938	0.714	11.4
	542	2177	233	936	0.689	11.0
	547	2174	235	935	0.665	10.7

COMBINED IMPERIAL AND SI STEAM TABLES

GAUGE PRESSURE		ABSOLUTE PRESSURE		SATURATION TEMPERATURE TS		
barg	lbf/in²g	bar a	lb/in²a	°C	°F	
1.8	26.1	2.81	40.8	131	268	
1.9	27.6	2.91	42.2	133	271	
2.0	29.0	3.01	43.7	134	273	
2.2	31.9	3.21	46.6	136	277	
2.4	34.8	3.41	49.5	138	280	
2.6	37.7	3.61	52.4	140	284	
2.8	40.6	3.81	55.3	142	288	
3.0	43.5	4.01	58.2	144	289	
3.2	46.4	4.21	61.1	146	293	
3.4	49.3	4.41	64.0	147	297	
3.6	52.2	4.61	66.9	149	298	
3.8	55.1	4.81	69.8	150	302	
4.0	58.0	5.01	72.7	152	304	
4.2	60.9	5.21	75.6	153	307	
4.4	63.8	5.41	78.5	155	309	
4.6	66.7	5.61	81.4	156	313	
4.8	69.6	5.81	84.3	158	315	
5.0	72.5	6.01	87.2	159	316	
5.5	79.8	6.51	94.4	162	324	
6.0	87.0	7.01	102	165	329	
6.5	94.3	7.51	109	168	333	
7.0	102	8.01	116	171	338	
7.5	109	8.51	123	173	343	
8.0	116	9.01	131	175	347	
8.5	123	9.51	138	178	351	
9.0	131	10.0	145	180	354	
9.5	138	10.5	152	182	360	
10.0	145	11.0	160	184	363	
10.5	152	11.5	167	186	367	
11.0	160	12.0	174	188	370	
11.5	167	12.5	181	190	374	
12.0	174	13.0	189	192	376	
12.5	181	13.5	196	193	379	
13.0	189	14.0	203	195	383	
13.5	196	14.5	210	197	385	
14.0	203	15.0	218	198	388	
14.5	210	15.5	225	200	392	
15.0	218	16.0	232	202	394	

	SPECIFIC ENTHALPY				SPECIFIC VOLUME STEAM VG	
	Water Sensible Heat (hf) kJ/kg	Evaporation Latent Heat (hf_g) kJ/kg	Water Sensible Heat (hf) BTU/lb	Evaporation Latent Heat (hf_g) BTU/lb	m^3/kg	ft^3/lb
	552	2170	237	933	0.643	10.3
	557	2167	240	932	0.622	9.96
	562	2163	242	930	0.603	9.66
	572	2157	246	927	0.568	9.10
	581	2151	250	925	0.536	8.59
	589	2145	253	922	0.509	8.15
	597	2139	257	920	0.483	7.74
	605	2133	260	917	0.461	7.38
	613	2128	264	915	0.440	7.05
	620	2123	267	913	0.422	6.76
	627	2118	270	911	0.405	6.49
	634	2113	273	908	0.389	6.23
	641	2108	276	906	0.374	5.99
	647	2104	278	905	0.361	5.78
	653	2099	281	902	0.348	5.57
	659	2095	283	901	0.336	5.38
	665	2090	286	899	0.325	5.21
	671	2086	289	897	0.315	5.01
	685	2076	295	893	0.292	4.68
	698	2066	300	888	0.272	4.36
	710	2057	305	884	0.255	4.09
	721	2048	310	880	0.240	3.84
	733	2039	315	877	0.227	3.64
	743	2031	319	873	0.215	3.44
	753	2023	324	870	0.204	3.27
	763	2015	328	866	0.194	3.11
	773	2008	332	863	0.185	2.96
	782	2000	336	860	0.177	2.84
	790	1993	340	857	0.171	2.74
	798	1986	344	854	0.163	2.61
	807	1979	347	851	0.157	2.51
	815	1973	350	848	0.151	2.42
	823	1966	354	845	0.146	2.34
	830	1960	357	843	0.141	2.26
	838	1953	360	840	0.136	2.18
	845	1947	363	837	0.132	2.11
	852	1941	366	834	0.128	2.05
	859	1935	369	832	0.124	1.99

STANDARD TUBE WEIGHTS AND PRESSURES

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METRIC AND ISO STANDARD PIPE – KEY FEATURES

- ID-based system (Metric)
- Compatible with 'nominal bore' systems (ISO Standard)
- Lightweight
- System flexibility
- Faster welding times
- Fewer consumables used
- Demountable and reusable
- Recyclable
- High residual value
- Attractive appearance
- Clean, hygienic 'high-tech' image
- Low environmental impact
- Good wear and fatigue resistance
- Low maintenance and long service life
- Simple fabrication and erection
- Fast and easy commissioning procedures
- Good mechanical properties
- Good ductility and weldability
- High material utilisation factor
- Lower footprint, reduced handling weights and transport costs
- Fit-up flexibility with adoption of spinning backing flanges
- Ease of alteration
- High corrosion resistance
- Consistent operation
- No reinvestment required
- Wide product range and availability
- No corrosion or leachant products, no organoleptic or turbidity problems
- No coatings or linings (under normal conditions)
- Smooth surface

METRIC ENQUIRY CHECKLIST	
Grades:	30.4L (1.4307) 31.6L (1.4432 or 1.4404)
PRODUCT	
Tube:	What specification? Any special testing/requirements?
Elbows:	Rad 1.5D/D+100/3D
Tees:	Pressed or Pulled
Con and Ecc Rads:	Note: Len = 3x(D-d)
Pressed Collars	Non-Pressure Rated or Pressure Rated (NPR or PR)
Angle Collars:	Large Dias 30x30 / 40x40 / 50x50 / 60x60 / 70x70
Flanges:	Full Thickness or Reduced Drilling - PN10 or PN16 Coating - Finish Zinc / Coated Flanges / Scotchkote / Stainless
Pressure Rating Data:	Max Working Pressure in bar Max Test Pressure in bar Max Working Temp in ˚C Max Test Temp in ˚C

TYPES OF STAINLESS STEEL – INTRODUCTION

Stainless steel is the name given to a group of corrosion-resistant steels containing a minimum of 11% chromium together with varying additions of nickel, molybdenum, titanium, niobium and other elements. There are four main types of stainless steel used in the production of tubular products, namely Austenitic, Ferritic, Duplex and Martensitic.

Austenitic Stainless Steels: This is the most common and extensive class of stainless steels, sometimes referred to as 18-8 i.e. 18% chromium and 8% nickel.

- **Corrosion resistance –** Austenitics are among the most highly corrosion-resistant materials available. They can, however, be susceptible to stress corrosion cracking.
- **Ductility –** Austenitics are ductile and can be formed easily. This applies at both high and low temperatures.
- **Tensile strength –** Austenitics have high tensile and yield strengths. Susceptibility to stress corrosion cracking means that high tensile stresses in service should be minimised.
- **Hardness –** Austenitics cannot be hardened by heat treatment but they do strain harden rapidly when cold worked. Heat treatment is used to provide stress relief after cold working.
- **Weldability –** Good, assuming manufacturer's recommendations are followed. Austenitics are less problematic than ferritic and martensitic stainless steels in this respect.
- **Magnetism –** Austenitics are non-magnetic. Cold working may increase magnetic permeability.
- **Thermal expansion –** Austenitics have a thermal expansion approximately 50% higher than that of carbon steel.

STEEL EXAMPLES	
Conventional austenitic grades	(eg. AISI/SAE 301, 302, 303, 304, 305, 308, 310, 316, 317)
Low-carbon austenitic grades	(eg. AISI/SAE 304L, 316L, 317L)
Duplex Stainless Steel	Duplex stainless steels have a mixed microstructure of austenite and ferrite, and hence combine the optimum properties of austenitic and ferritic steels.
Ferritic Stainless Steel	Ferritic stainless steels contain chromium in the range 11-18%.
Martensitic Stainless Steel	Martensitic stainless steels combine high strength with corrosion resistance. They have a chromium content of 11-14% and have a higher carbon content than other stainless steels.
Corrosion resistance	Martensitics have good corrosion resistance.
Ductility	Martensitics are less ductile than the other stainless steels.
Tensile strength	Martensitics have high tensile and yield strengths. Maximum strength depends upon carbon content and the heat treatment applied.

DIMENSIONS AND WEIGHTS PER METRE – STAINLESS STEEL PIPE

	OD		Schedule 5S*		
Nominal Pipe Size	in	mm	in	mm	kg/m
⅛	0.405	10.3	-	-	-
¼	0.54	13.7	-	-	-
⅜	0.675	17.1	-	-	-
½	0.84	21.3	0.065	1.65	0.8
¾	1.05	26.7	0.065	1.65	1.03
1	1.315	33.4	0.065	1.65	1.3
1¼	1.66	42.2	0.065	1.65	1.65
1½	1.9	48.3	0.065	1.65	1.91
2	2.375	60.3	0.065	1.65	2.4
2½	2.875	73	0.083	2.11	3.69
3	3.5	88.9	0.083	2.11	4.51
3½	4	101.6	0.083	2.11	5.18
4	4.5	114.3	0.083	2.11	5.84
5	5.563	141.3	0.109	2.77	9.47
6	6.625	168.3	0.109	2.77	11.32
8	8.625	219.1	0.109	2.77	14.79
10	10.75	273.1	0.134	3.4	22.63
12	12.75	323.9	0.156	3.96	31.25
14	14	355.6	0.156	3.96	34.36
16	16	406.4	0.165	4.19	41.56
18	18	457	0.165	4.19	46.81
20	20	508	0.188	4.78	59.25
22	22	559	0.188	4.78	65.24
24	24	610	0.218	5.54	82.47
30	30	762	0.25	6.35	118.31

Notes

*Schedules 5S and 10S wall thicknesses do not permit threading in accordance with ANSI/ASME B1.20.1.

**These dimensions and weights do not conform to ANSI/ASME B36.10M.

The suffix 'S' after the schedule number indicates that the pipe dimensions and weight are in compliance with this stainless steel pipe specification, ANSI/ASME B36.19M, and not the more general ANSI/ASME B36.10M specification.

Although this specification is applicable to stainless steel, quoted weights are for carbon steel pipe and should be multiplied by 1.014 for austenitic and duplex steels, or by 0.985 for ferritic and martensitic steels.

DIMENSIONS AND WEIGHTS PER METRE – STAINLESS STEEL PIPE

Schedule 10S*			Schedule 40S*			Schedule 80S*		
in	mm	kg/m	in	mm	kg/m	in	mm	kg/m
0.049	1.24	0.28	0.068	1.73	0.37	0.095	2.41	0.47
0.065	1.65	0.49	0.088	2.24	0.63	0.119	3.02	0.8
0.065	1.65	0.63	0.091	2.31	0.84	0.126	3.2	1.1
0.083	2.11	1	0.109	2.77	1.27	0.147	3.73	1.62
0.083	2.11	1.28	0.113	2.87	1.69	0.154	3.91	2.2
0.109	2.77	2.09	0.133	3.38	2.5	0.179	4.55	3.24
0.109	2.77	2.7	0.104	3.56	3.39	0.191	4.85	4.47
0.109	2.77	3.11	0.145	3.68	4.05	0.2	5.08	5.41
0.109	2.77	3.93	0.154	3.91	5.44	0.218	5.54	7.48
0.12	3.05	5.26	0.203	5.16	8.63	0.276	7.01	11.41
0.12	3.05	6.45	0.216	5.49	11.29	0.3	7.62	15.27
0.12	3.05	7.4	0.226	5.74	13.57	0.318	8.08	18.63
0.12	3.05	8.36	0.237	6.02	16.07	0.337	8.56	22.32
0.134	3.4	11.57	0.258	6.55	21.77	0.375	9.53	30.97
0.134	3.4	13.84	0.28	7.11	28.26	0.432	10.97	42.56
0.148	3.76	19.96	0.322	8.18	42.55	0.5	12.7	64.64
0.165	4.19	27.78	0.365	9.27	60.31	0.500**	12.70**	96.01**
0.18	4.57	36	0.375**	9.53**	73.88**	0.500**	12.70**	132.08**
0.188**	4.78**	41.30**	-	-	-	-	-	-
0.188**	4.78**	47.29**	-	-	-	-	-	-
0.188**	4.78**	53.26**	-	-	-	-	-	-
0.218**	5.54**	68.61**	-	-	-	-	-	-
0.218**	5.54**	75.53**	-	-	-	-	-	-
0.25	6.35	94.45	-	-	-	-	-	-
0.312	7.92	147.36	-	-	-	-	-	-

ANSI/ASME B36.10M

DIMENSIONS AND WEIGHTS PER METRE – STEEL PIPE						
	OD		Schedule 10			
Nominal Pipe Size	in	mm	in	mm	kg/m	
⅛	0.405	10.3	-	-	-	
¼	0.54	13.7	-	-	-	
⅜	0.675	17.1	-	-	-	
½	0.84	21.3	-	-	-	
¾	1.05	26.7	-	-	-	
1	1.315	33.4	-	-	-	
1¼	1.66	42.2	-	-	-	
1½	1.9	48.3	-	-	-	
2	2.375	60.3	-	-	-	
2½	2.875	73	-	-	-	
3	3.5	88.9	-	-	-	
3½	4	101.6	-	-	-	
4	4.5	114.3	-	-	-	
5	5.563	141.3	-	-	-	
6	6.625	168.3	-	-	-	
8	8.625	219.1	-	-	-	
10	10.75	273.1	-	-	-	
12	12.75	323.8	-	-	-	
14	14	355.6	0.25	6.35	54.69	
16	16	406.4	0.25	6.35	62.64	
18	18	457	0.25	6.35	70.57	
20	20	508	0.25	6.35	78.55	
22	22	559	0.25	6.35	86.54	
24	24	610	0.25	6.35	94.53	
26	26	660	0.312	7.92	127.36	
28	28	711	0.312	7.92	137.32	
30	30	762	0.312	7.92	147.28	
32	32	813	0.312	7.92	157.24	
34	34	864	0.312	7.92	167.2	
36	36	914	0.312	7.92	176.96	
38	38	965	-	-	-	
40	40	1016	-	-	-	
42	42	1067	-	-	-	
44	44	1118	-	-	-	
46	46	1168	-	-	-	
48	48	1219	-	-	-	

This specification is applicable to all steel pipe including stainless steel. Quoted weights are for carbon steel pipe and should be multiplied by 1.014 for austentic and duplex steels, or by 0.985 for ferritic and martensitic steels.

DIMENSIONS AND WEIGHTS PER METRE – STEEL PIPE

Schedule 20			Schedule 30			Schedule 40		
in	mm	kg/m	in	mm	kg/m	in	mm	kg/m
-	-	-	0.057	1.45	0.32	0.068	1.73	0.37
-	-	-	0.073	1.85	0.54	0.088	2.24	0.63
-	-	-	0.073	1.85	0.7	0.091	2.31	0.84
-	-	-	0.095	2.41	1.12	0.109	2.77	1.27
-	-	-	0.095	2.41	1.44	0.113	2.87	1.69
-	-	-	0.114	2.9	2.18	0.133	3.38	2.5
-	-	-	0.117	2.97	2.87	0.14	3.56	3.39
-	-	-	0.125	3.18	3.53	0.145	3.68	4.05
-	-	-	0.125	3.18	4.48	0.154	3.91	5.44
-	-	-	0.188	4.78	8.04	0.203	5.16	8.63
-	-	-	0.188	4.78	9.92	0.216	5.49	11.29
-	-	-	0.188	4.78	11.41	0.226	5.74	13.57
-	-	-	0.188	4.78	12.91	0.237	6.02	16.07
-	-	-	-	-	-	0.258	6.55	21.77
-	-	-	-	-	-	0.28	7.11	28.26
0.25	6.35	33.31	0.277	7.04	36.81	0.322	8.18	42.55
0.25	6.35	41.77	0.307	7.8	51.03	0.365	9.27	60.31
0.25	6.35	49.73	0.33	8.38	65.2	0.406	10.31	79.73
0.312	7.92	67.9	0.375	9.53	81.33	0.438	11.13	94.55
0.312	7.92	77.83	0.375	9.53	93.27	0.5	12.7	123.3
0.312	7.92	87.71	0.438	11.13	122.38	0.562	14.27	155.8
0.375	9.53	117.15	0.5	12.7	155.12	0.594	15.09	183.42
0.375	9.53	129.13	0.5	12.7	171.19	-	-	-
0.375	9.53	141.12	0.562	14.27	209.64	0.688	17.48	255.41
0.5	12.7	202.72	-	-	-	-	-	-
0.5	12.7	218.69	0.625	15.88	271.21	-	-	-
0.5	12.7	234.67	0.625	15.88	292.18	-	-	-
0.5	12.7	250.64	0.625	15.88	312.15	0.688	17.48	342.91
0.5	12.7	266.611	0.625	15.88	332.12	0.688	17.48	364.9
0.5	12.7	282.27	0.625	15.88	351.7	0.75	19.05	420.42
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

ANSI/ASME B36.10M

DIMENSIONS AND WEIGHTS PER METRE – STEEL PIPE						
	OD		Standard (STD)			
Nominal Pipe Size	in	mm	in	mm	kg/m	
⅛	0.405	10.3	10.3	0.068	1.73	
¼	0.54	13.7	13.7	0.088	2.24	
⅜	0.675	17.1	17.1	0.091	2.31	
½	0.84	21.3	21.3	0.109	2.77	
¾	1.05	26.7	26.7	0.113	2.87	
1	1.315	33.4	33.4	0.133	3.38	
1¼	1.66	42.2	42.2	0.14	3.56	
1½	1.9	48.3	48.3	0.145	3.68	
2	2.375	60.3	60.3	0.154	3.91	
2½	2.875	73	73	0.203	5.16	
3	3.5	88.9	88.9	0.216	5.49	
3½	4	101.6	101.6	0.226	5.74	
4	4.5	114.3	114.3	0.237	6.02	
5	5.563	141.3	141.3	0.258	6.55	
6	6.625	168.3	168.3	0.258	7.11	
8	8.625	219.1	219.1	0.322	8.18	
10	10.75	273.1	273	0.365	9.27	
12	12.75	323.8	323.8	0.375	9.53	
14	14	355.6	355.6	0.375	9.53	
16	16	406.4	406.4	0.375	9.53	
18	18	457	457	0.375	9.53	
20	20	508	508	0.375	9.53	
22	22	559	559	0.375	9.53	
24	24	610	610	0.375	9.53	
26	26	660	660	0.375	9.53	
28	28	711	711	0.375	9.53	
30	30	762	762	0.375	9.53	
32	32	813	813	0.375	9.53	
34	34	864	864	0.375	9.53	
36	36	914	914	0.375	9.53	
38	38	965	965	0.375	9.53	
40	40	1016	1016	0.375	9.53	
42	42	1067	1067	0.375	9.53	
44	44	1118	1118	0.375	9.53	
46	46	1168	1168	0.375	9.53	
48	48	1219	1219	0.375	9.53	

This specification is applicable to all steel pipe including stainless steel. Quoted weights are for carbon steel pipe and should be multiplied by 1.014 for austentic and duplex steels, or by 0.985 for ferritic and martensitic steels.

DIMENSIONS AND WEIGHTS PER METRE – STEEL PIPE

Schedule 60			Extra Strong (XS)			Schedule 80		
in	mm	kg/m	in	mm	kg/m	in	mm	kg/m
0.37	-	-	-	0.095	2.41	0.47	0.095	2.41
0.63	-	-	-	0.119	3.02	0.8	0.119	3.02
0.84	-	-	-	0.126	3.2	1.1	0.126	3.2
1.27	-	-	-	0.147	3.73	1.62	0.147	3.73
1.69	-	-	-	0.154	3.91	2.2	0.154	3.91
2.5	-	-	-	0.179	4.55	3.24	0.179	4.55
3.39	-	-	-	0.191	4.85	4.47	0.191	4.85
4.05	-	-	-	0.2	5.08	5.41	0.2	5.08
5.44	-	-	-	0.218	5.54	7.48	0.218	5.54
8.63	-	-	-	0.276	7.01	11.41	0.276	7.01
11.29	-	-	-	0.3	7.62	15.27	0.3	7.62
13.57	-	-	-	0.318	8.08	18.63	0.318	8.08
16.07	-	-	-	0.337	8.56	22.32	0.337	8.56
21.77	-	-	-	0.375	9.53	30.97	0.375	9.53
28.26	-	-	-	0.432	10.97	42.56	0.432	10.97
42.55	0.406	10.31	53.08	0.5	12.7	64.64	0.5	12.7
60.31	0.5	12.7	81.55	0.5	12.7	81.55	0.594	15.09
73.88	0.562	14.27	108.96	0.5	12.7	97.46	0.688	17.48
81.33	0.594	15.09	126.71	0.5	12.7	107.39	0.75	19.05
93.27	0.656	16.66	160.12	0.5	12.7	123.3	0.844	21.44
105.16	0.75	19.05	205.74	0.5	12.7	139.15	0.938	23.83
117.15	0.812	20.62	247.83	0.5	12.7	155.12	1.031	26.19
129.13	0.875	22.23	294.25	0.5	12.7	171.09	0.125	28.58
141.12	0.969	24.61	355.26	0.5	12.7	187.06	1.219	30.96
152.87	-	-	-	0.5	12.7	202.72	-	-
164.85	-	-	-	0.5	12.7	218.69	-	-
176.84	-	-	-	0.5	12.7	234.67	-	-
188.82	-	-	-	0.5	12.7	250.64	-	-
200.31	-	-	-	0.5	12.7	266.61	-	-
212.56	-	-	-	0.5	12.7	282.27	-	-
224.54	-	-	-	0.5	12.7	298.24	-	-
236.53	-	-	-	0.5	12.7	314.22	-	-
248.52	-	-	-	0.5	12.7	330.19	-	-
260.52	-	-	-	0.5	12.7	346.16	-	-
272.25	-	-	-	0.5	12.7	351.82	-	-
284.24	-	-	-	0.5	12.7	377.79	-	-

STAINLESS STEEL WORKING PRESSURES

OD (mm)	Wall Thickness (mm)	Grade	Weight / Mtr (kg)	
54	2	EN 1.4307 (304L)	2.6	
70	2	EN 1.4307 (304L)	3.38	
84	2	EN 1.4307 (304L)	4.11	
104	2	EN 1.4307 (304L)	5.11	
129	2	EN 1.4307 (304L)	6.36	
154	2	EN 1.4307 (304L)	7.61	
204	2	EN 1.4307 (304L)	10.12	
254	2	EN 1.4307 (304L)	12.62	
304	2	EN 1.4307 (304L)	15.12	
54	2	EN 1.4404 (316L)	2.6	
70	2	EN 1.4404 (316L)	3.38	
84	2	EN 1.4404 (316L)	4.11	
104	2	EN 1.4404 (316L)	5.11	
129	2	EN 1.4404 (316L)	6.36	
154	2	EN 1.4404 (316L)	7.61	
204	2	EN 1.4404 (316L)	10.12	
254	2	EN 1.4404 (316L)	12.62	
304	2	EN 1.4404 (316L)	15.12	
53	1.5	EN 1.4307 (304L)	1.93	
83	1.5	EN 1.4307 (304L)	3.06	
103	1.5	EN 1.4307 (304L)	3.81	
153	1.5	EN 1.4307 (304L)	5.69	
53	1.5	EN 1.4404 (316L)	1.93	
83	1.5	EN 1.4404 (316L)	3.06	
103	1.5	EN 1.4404 (316L)	3.81	
153	1.5	EN 1.4404 (316L)	5.69	

MAXIMUM ALLOWABLE PRESSURE IN BAR							
20°C	100°C	150°C	200°C	250°C	300°C	350°C	400°C
95	80	74	67	62	59	56	53
74	62	56	51	48	45	43	41
61	51	47	42	39	37	35	34
50	42	38	34	32	30	29	27
40	33	30	27	25	24	23	22
33	28	25	23	21	20	19	18
25	21	19	17	16	15	14	14
20	17	15	14	13	12	12	11
17	14	13	12	11	10	10	9
100	88	83	76	71	67	64	61
78	68	63	58	55	51	49	48
64	56	53	48	45	42	40	39
53	46	43	39	37	34	33	31
42	36	34	31	29	27	26	26
35	31	28	26	24	23	22	21
26	23	21	19	18	17	16	16
21	19	17	16	15	14	14	13
18	15	15	14	13	11	12	10
73	61	56	51	47	44	42	40
47	39	35	32	30	28	27	25
37	31	28	26	24	23	22	20
25	21	19	17	16	15	14	14
77	67	63	58	54	50	48	46
49	43	39	36	35	32	31	29
39	34	31	30	28	26	25	23
26	23	21	19	18	17	16	16

STAINLESS STEEL WORKING TEMPERATURES

SIZES ACC TO ASME B36.10M					
Size NPS	OD mm	Wall Thickness mm	Weight kg/m	Schedule No.	
⅛	10.3	1.24	0.28	10s	
		1.73	0.37	40s	
¼	13.7	1.65	0.49	10s	
		2.24	0.63	40s	
⅜	17.1	1.65	0.63	10s	
		2.31	0.84	40s	
½	21.3	2.11	1.00	10s	
		2.77	1.27	40s	
¾	26.7	2.11	1.28	10s	
		2.87	1.69	40s	
1	33.4	2.77	2.09	10s	
		3.38	2.50	40s	
1¼	42.2	2.77	2.70	10s	
		3.56	3.39	40s	
1½	48.3	2.77	3.11	10s	
		3.68	4.05	40s	
2	60.3	2.77	3.93	10s	
		3.91	5.44	40s	
2½	73	3.05	5.26	10s	
		5.16	8.63	40s	

	TEMPERATURE							
°F	-20 to 100	200	300	400	500	600	700	800
°C	-28.9 to 37.8	93	149	204	260	316	371	427
	bar	bar	bar	bar	bar	bar	bar	bar
	180	155	138	126	118	113	108	104
	260	222	199	182	170	162	156	150
	179	154	138	125	117	112	108	104
	251	215	192	176	164	157	151	145
	141	121	108	98	92	88	85	82
	203	174	156	142	133	127	122	118
	145	124	111	101	95	90	87	84
	195	167	149	136	114	122	117	113
	114	98	88	80	75	71	67	66
	159	136	122	111	104	99	96	92
	120	103	92	84	79	75	72	70
	148	127	114	104	97	93	89	86
	94	80	72	66	61	59	56	54
	122	105	94	86	80	76	74	71
	82	70	63	57	53	51	49	47
	110	94	84	77	72	69	66	64
	65	55	50	45	42	40	39	37
	93	79	71	65	61	58	56	54
	59	50	45	41	38	37	35	34
	101	87	78	71	66	63	61	59

STAINLESS STEEL WORKING TEMPERATURES

SIZES ACC TO ASME B36.10M					
Size NPS	OD mm	Wall Thickness mm	Weight kg/m	Schedule No.	
3	88.9	3.05	6.45	10s	
		5.49	11.29	40s	
3½	101.6	3.05	7.40	10s	
		5.74	13.57	40s	
4	114.3	3.05	8.36	10s	
		6.02	16.07	40s	
5	141.3	3.40	11.57	10s	
		6.55	21.77	40s	
6	168.3	3.40	13.84	10s	
		7.11	28.26	40s	
8	219.1	3.76	19.96	10s	
		8.18	42.55	40s	
10	273.1	4.19	27.78	10s	
12	323.9	4.57	36.00	10s	

	TEMPERATURE							
°F	-20 to 100	200	300	400	500	600	700	800
°C	-28.9 to 37.8	93	149	204	260	316	371	427
	bar	bar	bar	bar	bar	bar	bar	bar
	48	41	37	34	31	30	29	28
	88	75	68	62	58	55	53	51
	42	36	32	29	27	26	25	24
	80	69	62	56	52	50	48	46
	37	32	28	26	24	23	22	21
	75	64	57	52	49	47	45	43
	33	29	26	23	22	21	20	19
	65	56	50	46	43	41	39	38
	28	24	21	20	18	17	17	16
	59	51	46	42	39	37	36	34
	24	20	18	17	16	15	14	14
	40	35	31	28	26	25	24	23
	21	18	16	15	14	13	13	12
	19	17	15	14	13	12	12	11

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STEEL TUBE EN 10255

OD	Nominal Bore NB		Outside Diameter OD		
OD	mm	inch	Max (mm)	Min (mm)	
21.3	15	½	21.8	21	
26.9	20	¾	27.3	26.5	
33.7	25	1	34.2	33.3	
42.4	32	1¼	42.9	42	
48.3	40	1½	48.8	47.9	
60.3	50	2	60.8	59.7	
76.1	65	2½	76.6	75.3	
88.9	80	3	89.5	88	
114.3	100	4	115	113.1	
139.7	125	5	140.8	138.5	
165.1	150	6	166.5	163.9	

	Wall Thickness T	HEAVY WEIGHT Weight per meter		Wall Thickness T	MEDIUM WEIGHT	
		Plain end/ grooved tube	Screwed and socketed		Plain end/ grooved tube	Screwed and socketed
	mm	kg/m	kg/m	mm	kg/m	kg/m
	3.2	1.44	1.45	2.6	1.21	1.22
	3.2	1.87	1.88	2.6	1.56	1.57
	4	2.93	2.95	3.2	2.41	2.43
	4	3.79	3.82	3.2	3.1	3.13
	4	4.37	4.41	3.2	3.56	3.6
	4.5	6.19	6.26	3.6	5.03	5.1
	4.5	7.93	8.15	3.6	6.42	6.54
	5	10.3	10.5	4	8.36	8.53
	5.4	14.5	14.8	4.5	12.2	12.5
	5.4	17.9	18.4	5	16.6	17.1
	5.4	21.3	21.9	5	19.8	20.4

CARBON STEEL WORKING PRESSURES - WELDED

		THICKNESS	
NPS(“)	OD(mm)	(mm)	
2	60.3	3.91	
		5.45	
3	88.9	5.49	
		7.62	
4	114.3	6.02	
		8.56	
6	168.3	7.11	
		10.97	
8	219.1	6.35	
		7.04	
		8.18	
		10.31	
		12.7	
		15.1	
10	273.1	6.35	
		7.8	
		9.27	
		12.7	
		15.09	
12	323.9	6.35	
		8.38	
		9.53	
		10.31	
		12.7	
		14.27	

	DESIGNATION		MASS	RECOMMENDED MAXIMUM OPERATING PRESSURE (BAR) BASED ON 245 MPA MIN YIELD	
	STD/XS	Schedule	(kg/m)	Ambient Temperature	Elevated Temperature ≤ 300°C
	STD	40	5.42	148	114
	XS	80	7.43	209	161
	STD	40	11.31	142	110
	XS	80	15.24	197	152
	STD	40	16.02	121	94
	XS	80	22.42	174	134
	STD	40	28.22	97	75
	XS	80	42.67	151	117
	-	20	33.57	65	52
	-	30	36.61	73	64
	STD	40	42.65	85	67
	-	60	53.03	107	84
	XS	80	64.64	133	104
	-	100	75.96	160	124
	-	20	42.09	52	42
	-	30	51.03	64	57
	STD	40	60.5	77	61
	XS	60	81.55	106	83
	-	80	96.07	127	99
	-	20	50.11	44	35
	-	30	65.35	58	47
	STD	-	73.65	66	53
	-	40	79.65	72	57
	XS	-	97.46	89	70
	-	60	109.18	100	79

CARBON STEEL WORKING PRESSURES - WELDED

		THICKNESS	
NPS(“)	OD(mm)	(mm)	
14	355.6	6.35	
		7.92	
		9.53	
		11.13	
		12.7	
		15.09	
16	406.4	6.35	
		7.92	
		9.53	
		12.7	
18	457	6.35	
		7.92	
		9.53	
		11.13	
		12.7	
		14.27	
20	508	6.35	
		9.53	
		12.7	
		15.09	

	DESIGNATION		MASS	RECOMMENDED MAXIMUM OPERATING PRESSURE (BAR) BASED ON 245 MPA MIN YIELD	
	STD/XS	Schedule	(kg/m)	Ambient Temperature	Elevated Temperature ≤ 300°C
	-	10	55.11	40	32
	-	20	67.74	50	40
	STD	30	81.08	60	48
	-	40	94.3	71	56
	XS	-	107.39	81	64
	-	60	126.79	97	76
	-	10	63.13	35	28
	-	20	77.63	44	35
	STD	30	92.96	53	42
	XS	40	123.3	71	56
	-	10	71.12	31	25
	-	20	87.49	39	31
	STD	-	104.84	47	37
	-	30	122.05	55	44
	XS	-	139.15	63	50
	-	40	156.11	70	56
	-	10	79.16	28	23
	STD	20	116.78	42	34
	XS	30	155.12	56	45
	-	40	183.54	67	53

CARBON STEEL WORKING PRESSURES - SEAMLESS

SIZES ACC TO ASME B36.10M						
Size	OD	Wall Thickness	Weight	Weight	Schedule No.	
NPS	mm	mm	kg/m	category		
½	21.3	2.77	1.27	STD	40	
		3.73	1.62	XS	80	
¾	26.7	2.87	1.69	STD	40	
		3.91	2.2	XS	80	
1	33.4	3.38	2.5	STD	40	
		4.55	3.24	XS	80	
1¼	42.2	3.56	3.39	STD	40	
		4.85	4.47	XS	80	
1½	48.3	3.68	4.05	STD	40	
		5.08	5.41	XS	80	
2	60.3	3.91	5.44	STD	40	
		5.54	7.48	XS	80	
		8.74	11.11	-	160	

F0 = 0.72 acc to EN 1594 para 7.2.

The pressure rating information above is calculated based on a combination of EN 1594 and European guidelines (ISO 3183) for straight pipes, and is provided for information only. Pipework systems should be designed in accordance with appropriate established standards or codes and due consideration must be taken of additional factors, such as any allowance required for corrosion and bending, fittings etc. It is the responsibility of the user to ensure that the tube is suitable for the intended application, that they are operating fully in accordance with all relevant statutory and legislative requirements and that all standards and engineering documents referenced are correctly applied.

	MAXIMUM WORKING PRESSURE CALCULATION [BAR] ACC TO EN 1594, FOR YIELD STRENGTH				
	WT min	YS = min 245 MPa	YS = min 290 MPa	YS = min 360 MPa	YS = min 415 MPa
	mm	[bar]	[bar]	[bar]	[bar]
	2.27	376	376	376	376
	3.23	535	535	535	535
	2.37	313	313	313	313
	3.41	451	451	451	451
	2.88	304	304	304	304
	3.99	421	421	421	421
	3.06	256	256	256	256
	4.25	355	355	355	355
	3.18	232	232	232	232
	4.45	325	325	325	325
	3.41	200	200	200	200
	4.85	284	284	284	284
	7.65	448	448	448	448
		B-API 5L, B-ASTM A106/ A106M - Formerly ANSI B36.10M	B/X42-API 5L, B-ASTM A106/ A106M - Formerly ANSI B36.10M	X52-API 5L	X60-API 5L

CARBON STEEL WORKING PRESSURES - SEAMLESS

SIZES ACC TO ASME B36.10M						
Size	OD	Wall Thickness	Weight	Weight	Schedule No.	
NPS	mm	mm	kg/m	category		
2½	73	5.16	8.63	STD	40	
		7.01	11.41	XS	80	
		9.53	14.92	-	160	
3	88.9	3.18	6.72	-	-	
		3.96	8.29	-	-	
		4.78	9.92	-	-	
		5.49	11.29	STD	40	
		6.35	12.93	-	-	
		7.14	14.4	-	-	
		7.62	15.27	XS	80	
		11.13	21.35	-	160	
3½	101.6	3.96	9.53	-	-	
		4.78	11.41	-	-	
		5.74	13.57	STD	40	
		6.35	14.92	-	-	
		7.14	16.63	-	-	
		8.08	18.63	XS	80	

F0 = 0.72 acc to EN 1594 para 7.2.

The pressure rating information above is calculated based on a combination of EN 1594 and European guidelines (ISO 3183) for straight pipes, and is provided for information only. Pipework systems should be designed in accordance with appropriate established standards or codes and due consideration must be taken of additional factors, such as any allowance required for corrosion and bending, fittings etc. It is the responsbility of the user to ensure that the tube is suitable for the intended application, that they are operating fully in accordance with all relevant statutory and legislative requirements and that all standards and engineering documents referenced are correctly applied.

	MAXIMUM WORKING PRESSURE CALCULATION [BAR] ACC TO EN 1594, FOR YIELD STRENGTH				
	WT min	YS = min 245 MPa	YS = min 290 MPa	YS = min 360 MPa	YS = min 415 MPa
	mm	[bar]	[bar]	[bar]	[bar]
	4.52	218	218	218	218
	6.14	297	297	297	297
	8.34	403	403	403	403
	2.68	106	106	106	106
	3.46	137	137	137	137
	4.19	166	166	166	166
	4.81	191	191	191	191
	5.56	221	221	221	221
	6.25	248	248	248	248
	6.67	265	265	265	265
	9.74	387	387	387	387
	3.46	120	120	120	120
	4.19	145	145	145	145
	5.03	175	175	175	175
	5.56	193	193	193	193
	6.25	217	217	217	217
	7.07	246	246	246	246
		B-API 5L, B-ASTM A106/ A106M - Formerly ANSI B36.10M	B/X42-API 5L, B-ASTM A106/ A106M - Formerly ANSI B36.10M	X52-API 5L	X60-API 5L

CARBON STEEL WORKING PRESSURES - SEAMLESS

SIZES ACC TO ASME B36.10M						
Size	OD	Wall Thickness	Weight	Weight	Schedule No.	
NPS	mm	mm	kg/m	category		
4	114.3	3.96	10.78	-	-	
		4.78	12.91	-	-	
		5.56	14.91	-	-	
		6.02	16.07	STD	40	
		6.35	16.9	-	-	
		7.14	18.87	-	-	
		7.92	20.78	-	-	
		8.56	22.32	XS	80	
		11.13	28.32	-	120	
		13.49	33.54	-	160	
5	141.3	3.96	13.41	-	-	
		4.78	16.09	-	-	
		5.56	18.61	-	-	
		6.55	21.77	STD	40	
		7.14	23.62	-	-	
		7.92	26.05	-	-	
		8.74	28.57	-	-	
		9.53	30.94	XS	80	
		12.7	40.28	-	120	

F0 = 0.72 acc to EN 1594 para 7.2.

The pressure rating information above is calculated based on a combination of EN 1594 and European guidelines (ISO 3183) for straight pipes, and is provided for information only. Pipework systems should be designed in accordance with appropriate established standards or codes and due consideration must be taken of additional factors, such as any allowance required for corrosion and bending, fittings etc. It is the responsbility of the user to ensure that the tube is suitable for the intended application, that they are operating fully in accordance with all relevant statutory and legislative requirements and that all standards and engineering documents referenced are correctly applied.

	MAXIMUM WORKING PRESSURE CALCULATION [BAR] ACC TO EN 1594, FOR YIELD STRENGTH				
	WT min	YS = min 245 MPa	YS = min 290 MPa	YS = min 360 MPa	YS = min 415 MPa
	mm	[bar]	[bar]	[bar]	[bar]
	3.46	107	107	107	107
	4.19	129	129	129	129
	4.87	150	150	150	150
	5.27	163	163	163	163
	5.56	172	172	172	172
	6.25	193	193	193	193
	6.93	214	214	214	214
	7.49	231	231	231	231
	9.74	301	301	301	301
	11.81	365	365	365	365
	3.46	86	86	86	86
	4.19	105	105	105	105
	4.87	122	122	122	122
	5.74	143	143	143	143
	6.25	156	156	156	156
	6.93	173	173	173	173
	7.65	191	191	191	191
	8.34	208	208	208	208
	11.12	278	278	278	278
		B-API 5L, B-ASTM A106/ A106M - Formerly ANSI B36.10M	B/X42-API 5L, B-ASTM A106/ A106M - Formerly ANSI B36.10M	X52-API 5L	X60-API 5L

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CARBON STEEL WORKING PRESSURES - SEAMLESS

SIZES ACC TO ASME B36.10M						
Size	OD	Wall Thickness	Weight	Weight	Schedule No.	
NPS	mm	mm	kg/m	category		
6	168.3	4.781	19.27	-	-	
		5.561	22.31	-	-	
		6.35	25.36	-	-	
		7.11	28.26	STD	40	
		7.92	31.32	-	-	
		8.74	34.39	-	-	
		9.52	37.28	-	-	
		10.97	42.56	XS	80	
		12.7	48.73	-	-	
		14.27	54.2	-	120	
		15.88	59.69	-	-	
		18.26	67.56	-	160	

F0 = 0.72 acc to EN 1594 para 7.2.

The pressure rating information above is calculated based on a combination of EN 1594 and European guidelines (ISO 3183) for straight pipes, and is provided for information only. Pipework systems should be designed in accordance with appropriate established standards or codes and due consideration must be taken of additional factors, such as any allowance required for corrosion and bending, fittings etc. It is the responsbility of the user to ensure that the tube is suitable for the intended application, that they are operating fully in accordance with all relevant statutory and legislative requirements and that all standards and engineering documents referenced are correctly applied.

	MAXIMUM WORKING PRESSURE CALCULATION [BAR] ACC TO EN 1594, FOR YIELD STRENGTH				
	WT min	YS = min 245 MPa	YS = min 290 MPa	YS = min 360 MPa	YS = min 415 MPa
	mm	[bar]	[bar]	[bar]	[bar]
	4.19	88	88	88	88
	4.87	102	102	102	102
	5.56	117	117	117	117
	6.23	131	131	131	131
	6.93	145	145	145	145
	7.65	160	160	160	160
	8.33	175	175	175	175
	9.6	201	201	201	201
	11.12	233	233	233	233
	12.49	262	262	262	262
	13.9	291	291	291	291
	15.98	335	335	335	335
		B-API 5L, B-ASTM A106/ A106M - Formerly ANSI B36.10M	B/X42-API 5L, B-ASTM A106/ A106M - Formerly ANSI B36.10M	X52-API 5L	X60-API 5L

CARBON STEEL WORKING PRESSURES - SEAMLESS

SIZES ACC TO ASME B36.10M						
Size	OD	Wall Thickness	Weight	Weight	Schedule No.	
NPS	mm	mm	kg/m	category		
8	219.1	6.35	33.31	-	20	
		7.04	36.81	-	30	
		7.92	41.24	-	-	
		8.18	42.55	STD	40	
		8.74	45.34	-	-	
		9.52	49.2	-	-	
		10.31	53.08	-	60	
		11.13	57.08	-	-	
		12.7	64.64	XS	80	
		14.27	72.08	-	-	
		15.09	75.92	-	100	
		15.88	79.59	-	-	
		18.26	90.44		120	

F0 = 0.72 acc to EN 1594 para 7.2.

The pressure rating information above is calculated based on a combination of EN 1594 and European guidelines (ISO 3183) for straight pipes, and is provided for information only. Pipework systems should be designed in accordance with appropriate established standards or codes and due consideration must be taken of additional factors, such as any allowance required for corrosion and bending, fittings etc. It is the responsbility of the user to ensure that the tube is suitable for the intended application, that they are operating fully in accordance with all relevant statutory and legislative requirements and that all standards and engineering documents referenced are correctly applied.

	MAXIMUM WORKING PRESSURE CALCULATION [BAR] ACC TO EN 1594, FOR YIELD STRENGTH				
	WT min	YS = min 245 MPa	YS = min 290 MPa	YS = min 360 MPa	YS = min 415 MPa
	mm	[bar]	[bar]	[bar]	[bar]
	5.56	90	90	90	90
	6.16	99	99	99	99
	6.93	112	112	112	112
	7.16	115	115	115	115
	7.65	123	123	123	123
	8.33	134	134	134	134
	9.03	145	145	145	145
	9.74	157	157	157	157
	11.12	179	179	179	179
	12.49	201	201	201	201
	13.21	213	213	213	213
	13.9	224	224	224	224
	15.98	257	257	257	257
		B-API 5L, B-ASTM A106/ A106M - Formerly ANSI B36.10M	B/X42-API 5L, B-ASTM A106/ A106M - Formerly ANSI B36.10M	X52-API 5L	X60-API 5L

CARBON STEEL WORKING PRESSURES - SEAMLESS

SIZES ACC TO ASME B36.10M						
Size	OD	Wall Thickness	Weight	Weight	Schedule No.	
NPS	mm	mm	kg/m	category		
10	273	6.35	41.75	…	20	
		7.09	46.49			
		7.8	51.01		30	
		8.74	56.96			
		9.27	60.29	STD	40	
		11.13	71.87			
		12.7	81.52	XS	60	
		15.09	95.97		80	
		15.88	100.69	…	…	
		18.261	114.7		100	

F0 = 0.72 acc to EN 1594 para 7.2.
The pressure rating information above is calculated based on a combination of EN 1594 and European guidelines (ISO 3183) for straight pipes, and is provided for information only. Pipework systems should be designed in accordance with appropriate established standards or codes and due consideration must be taken of additional factors, such as any allowance required for corrosion and bending, fittings etc. It is the responsbility of the user to ensure that the tube is suitable for the intended application, that they are operating fully in accordance with all relevant statutory and legislative requirements and that all standards and engineering documents referenced are correctly applied.

	MAXIMUM WORKING PRESSURE CALCULATION [BAR] ACC TO EN 1594, FOR YIELD STRENGTH				
	WT min	YS = min 245 MPa	YS = min 290 MPa	YS = min 360 MPa	YS = min 415 MPa
	mm	[bar]	[bar]	[bar]	[bar]
	5.56	72	72	72	72
	6.21	80	80	80	80
	6.83	88	88	88	88
	7.65	99	99	99	99
	8.12	105	105	105	105
	9.74	126	126	126	126
	11.12	144	144	144	144
	13.21	171	171	171	171
	13.9	180	180	180	180
	15.98	207	207	207	207
		B-API 5L, B-ASTM A106/ A106M - Formerly ANSI B36.10M	B/X42-API 5L, B-ASTM A106/ A106M - Formerly ANSI B36.10M	X52-API 5L	X60-API 5L

AMERICAN STANDARDS

DIMENSIONAL FITTINGS SPECIFICATIONS

ANSI B 16.9 steel butt-welding fittings. Covers dimensions and tolerances of welding fittings ½" to 24" with the exception of short-radius elbows & returns.

ANSI B 16.11 steel socket welding fittings.

ANSI B 16.25 butt-welding ends. Covers the preparation and design details of butt-welding ends for all components of butt-welded pipe systems.

MSS SP-43 wrought stainless steel butt-welding fittings.

Covers dimensions and tolerances of elbows and returns. Schedule 5S and 10S only in sizes ¾" – 24".

ASME B16.9 - Formerly BS 6759 Parts 1-3 steel butt-welding fittings (26" and larger) covers dimensions and tolerances of long-radius elbows, tees and reducers in sizes 26" to 36".

ASME B16.9 - Formerly BS 806 steel butt-welding short-radius elbows and returns. Covers dimensions and tolerances of short-radius elbows and returns only in sizes 1" to 24".

DIMENSIONAL PIPE SPECIFICATIONS

ANSI B 36.10 wrought steel and wrought iron pipe. Covers diameters and wall thicknesses of pipe ½" to 36" with the exception of schedules 5S and 10S.

ANSI B 36.19 stainless steel pipe. Covers diameters and wall thickness of stainless steel pipe in schedules 5S, 10S, 40S and 80S in sizes ⅛" to 30".

MATERIAL SPECIFICATIONS FOR FITTINGS

ASTM A234/A234M - Formerly ASTM A129 factory-made wrought carbon steel and ferritic-alloy steel welded fittings. Covers materials and physical properties of carbon, carbon-molybdenum and chromium-molybdenum fittings.

ASTM A403/A403M - Formerly ASTM A276 factory-made wrought austenitic steel welded fittings.

ASTM A420/A420M - Formerly ASTM A333 factory-made wrought carbon steel and alloy.

ASTM A333 - Steel welded fittings of seamless or welded construction for low-temperature service.

ASTM B361 factory-made wrought aluminium and aluminium-alloy welding fittings.

MSS SP-63 high-strength wrought welding fittings. Covers materials for the manufacture of welding fittings for high-pressure transmission service piping.

MATERIAL SPECIFICATIONS FOR PIPES AND TUBES

ASTM A53/A53M - Formerly ASTM A352 welded and seamless steel pipe.

ASTM A106 seamless carbon steel pipe for high-temperature service.

ASTM A671/A671M - Formerly API STD 5A electric-fusion-welded steel pipe for high-temperature service.

ASTM A179/A179M - Formerly API STD 5LX seamless cold-drawn low carbon steel.

HEAT EXCHANGER AND CONDENSER TUBES

ASTM A269/A269M - Formerly ASTM A167 seamless and welded austenitic stainless steel tubing of general service.

ASTM A312/A312M - Formerly ASTM A20 seamless and welded austenitic stainless steel pipe.

ASTM A333/A333M - Formerly ASTM A201 seamless and welded steel pipe for low-temperature service.

ASTM A335/A335M - Formerly ASTM A203 seamless ferritic-alloy steel pipe specially heat-treated for high-temperature service.

ASTM A376/A376M - Formerly ASTM A240 seamless austenitic steel pipe for high-temperature central-station services.

ASTM A405 seamless ferritic-alloy steel pipe specially heat-treated for high-temperature service.

ASTM A409/A409M - Formerly ASTM A312 welded large-diameter austenitic steel pipe for corrosive or high-temperature service (for eletric-fusion-welded, light-wall, austenitic chromium-nickel-alloy steel pipe)

TEMPERATURE SERVICE

ASTM B210/B210M - Formerly ASTM A357 aluminium-alloy tubes.

ASTM B221 - Formerly ASTM A376 aluminium-alloy extruded tubes.

AMERICAN STANDARDS

MATERIAL SPECIFICATIONS FOR PLATES

ASTM A20/A20M - Formerly ASME B36.10M general requirements for delivery of rolled steel plates of flange and firebox qualities.

ASTM A129 open-hearth iron plates of flange quality.

ASTM A167 specification for corrosion-resisting chromium-nickel steel plate, sheet or strip.

ASTM A515/A515M - Formerly ASME B36.19M carbon-silicon steel plates of intermediate tensile ranges for fusion-welded boilers and other pressure vessels.

ASTM A203/A203M - Formerly ASTM A105 nickel-steel plates for boilers and other pressure vessels.

ASTM A204/A204M - Formerly ASTM A106 molybdenum-alloy steel plates for boilers and other pressure vessels.

ASTM A515/A515M - Formerly ASTM A107 high tensile strength carbon-silicon steel plates for boilers and other pressure vessels.

ASTM A240/A240M - Formerly ASTM A155 corrosion-resisting chromium and chromium-nickel steel plate, sheet and strip for pressure vessels and other applications.

ASTM A285/A285M - Formerly ASTM A181 low and intermediate tensile strength plates of flange and firebox qualities.

ASTM A300 steel plates for pressure vessels for service at low temperatures.

ASTM A387/A387M - Formerly ASTM A234 5% chromium, 0.5% molybdenum steel plates for boilers and other pressure vessels.

ASTM A387/A387M - Formerly ASTM A269 chromium-molybdenum steel plates for boilers and other pressure vessels.

ASTM A515/A515M - Formerly ASTM A350 carbon steel plates of intermediate tensile strength for intermediate- and higher-temperature service.

MATERIAL SPECIFICATIONS FOR BARS

ASTM A575 - Formerly ANSI B36.19M hot-rolled carbon steel bars.

ASTM A182/A182M - Formerly ASME B1.20.1 forged or rolled alloy steel pipe flanges.

ASTM A989 Forged fittings and valves and parts for high-temperature service.

ASTM A276/A276M - Formerly ASTM A179 hot-rolled and cold-finished corrosion-resisting steel bars.

SPECIFICATIONS FOR FLANGES

ANSI B16.5 steel pipe flanges and flanged fittings (150-2500 lbs).

ASTM A105/A105M - Formerly ANSI B31.8 forged or rolled steel pipe flanges, forged fittings and valves and parts for high-temperature service.

ASTM A181/A181M - forged or rolled steel pipe flanges, forged fittings and valves and parts for general service.

ASTM A182/A182M - Formerly ASME B1.20.1 forged or rolled alloy steel pipe flanges, forged fittings and valves and parts for high temperature service.

ASTM A350/A350M - Formerly ASTM A204 forged or rolled carbon and alloy steel pipe flanges, forged fittings, valves and parts for low-temperature service.

ASTM A404 forged or rolled alloy steel pipe flanges, forged fittings and valves and parts specially heat-treated for high temperature service.

ASTM A465 leaded carbon steel forged pipe flanges and parts for pressure and general service.

MISCELLANEOUS AMERICAN SPECIFICATIONS

ANSI B31.1 code for pressure piping.

ANSI B31.3 code for pressure piping: petroleum refinery piping.

ANSI B31.8 gas transmission and distribution piping systems.

ASTM B210/B210M - Formerly ASTM A357 aluminium-alloy drawn seamless tubes.

API SPEC 5DP - Formerly ANSI B16.11 API specification for casing, tubing and drill pipe.

API SPEC 5L - Formerly ANSI B16.25 API specification for line pipe.

API STD 5LX API specification for high-test line pipe.

ASME boiler and pressure vessel code specifications

BRITISH STANDARDS

SPECIFICATIONS FOR STEEL PIPE, FITTINGS AND FLANGES

BS 1560 steel pipe flanges and flanged fittings (½" to 24") for the petroleum industry.

BS EN 10253-3 - Formerly BS 1400 steel butt-welding pipe fittings for the petroleum industry.
Part 1: wrought carbon and ferritic-alloy steel fittings.
Part 2: wrought and cast austenitic chromium-nickel steel fittings.

BS EN 10253-2 - Formerly BS 1500 butt-welding pipe fittings for pressure purposes.
Part 1: carbon steel.
Part 2: austenitic stainless steel.

BS 3293 carbon steel pipe flanges over 24" for the petroleum industry.

BS 3799 forged steel pipe fittings, screwed and socket-welding for the petroleum industry.

SPECIFICATIONS FOR STEEL PIPE, FITTINGS & FLANGES

BS EN 10213 - Formerly ASTM A465 steels for use in the chemical, petroleum and allied industries.

BS EN 10269 - Formerly ASTM B210 low temperature supplementary requirements to BS 1501-1506.

SPECIFICATIONS FOR PIPES AND TUBES

BS 1600 dimensions of wrought steel pipe for the petroleum industry.

BS EN 10216-1 - Formerly BS 1640 Part 1 steel pipes and tubes for pressure purposes: carbon steel ordinary duties.

BS EN 10216-2 - Formerly BS 1640 Part 2 steel pipes and tubes for pressure purposes: carbon steel high-temperature duties.

BS EN 10216-4 - Formerly BS 1965 steel pipes and tubes for pressure purposes: carbon steel low-temperature duties.

BS EN 10216-2 - Formerly BS 1965 Part 1 steel pipes and tubes for pressure purposes: low- and medium-alloy steel.

BS EN 10216-5 - Formerly BS 1965 Part 2 steel pipes and tubes for pressure purposes: austenitic stainless steel.

BS 3351 piping systems for the petroleum industry.

BS EN 10312 - Formerly BS 2041 light gauge stainless steel tube, also known as permatube.

BRITISH STANDARDS

MISCELLANEOUS BRITISH SPECIFICATIONS

BS EN 13480-1 - Formerly BS 3602 ferrous pipes and piping installations for and in connection with lead boilers.
BS PD 5500 - Formerly ASTM A420 fusion-welded pressure vessels for use in the chemical, petroleum and allied industries.
BS 2041 tubular heat exchangers for use in the petroleum industry.
BS EN ISO 17636-1 - Formerly BS 1510 general recommendations for the radiographic examination of fusion-welded circumferential butt-joints.
BS 3274 tubular heat exchangers for general purposes.
BS EN 10204 fully traceable test certificates with chemical analysis.

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MATERIALS SELECTION CHARTS

Section	Material	Typical Applications	Size Range	
Industrial	PVC-U	Acids and Alkalis; Effluents; Potable Water; Chemical Processing	12mm to 315mm (Metric) ⅜" to 12" (Imperial)	
	ABS	Chilled Water; Air Conditioning; Boosted Cold Water; Vacuum Systems; Waste Water; De-Mineralised Water	16mm to 315mm (Metric) ⅜" to 12" (Imperial)	
	PVC-C	Acids and Alkalis; Demineralised Water; Industrial Waste Treatments; Chemical Processing; Soaps; Paper & Pulps; Effluents	16mm to 160mm (Metric) ⅜" to 6" (Imperial)	
	Polypropylene	Acids and Alkalis; Chemical Processing; Industrial Waste Treatments; Pharmaceuticals; Effluents	20mm to 100mm (Metric) ½" to 4" (Imperial)	
	PVDF	Pharmaceutical Grade Purified Water (PW) and DI Water; Using Hot Water; Steam Chemical or Ozone Sanitisation. Chemical Process Industry; Microelectronics; Life Sciences	16mm to 315mm (Metric) ⅜" to 12" (Imperial)	

For chemical resistance data please speak to the BSS Plastics team on:
T: 0870 242 5586 E: plastics@bssgroup.com

	Pressure Rating	Temperature Rating	Jointing Technique	Key Product Features
	METRIC: PN16 20 to 63mm pipe; PN16 12 to 160mm; PN10 20 to 315mm; **IMPERIAL:** ½" to 6" pipe Class E; ⅜" to 12" fittings Class E	5ºC to 60ºC	Solvent weld	Lightweight; Easy to install; Corrosion resistant
	METRIC: PN10 16 to 250mm; PN8 315mm **IMPERIAL:** Up to 4" Class E; Up to 8" Class C; 10" and 12" Class B	-40ºC to 70ºC	Two-step solvent weld	Lightweight; Easy to install; Wide temperature range; Tough and durable; Corrosion resistant
	PN16 16mm to 110mm PN10 160mm	5ºC to 95ºC	Solvent weld	Excellent chemical resistance; Lightweight; Wide temperature range; Easy to install; High-temperature acids and alkalis
	METRIC: PN10; **IMPERIAL:** ⅜" to ¾" Class E; 1" to 2" Class D; 3" to 4" Class C	0ºC to 100ºC	Fusion welded using socket butt	Lightweight; Excellent chemical resistance; Multiple jointing options
	16mm to 225mm PN16. 90mm to 315mm PN10	-20ºC to +140ºC	Fusion welded using socket &/or butt	Outstanding mechanical properties; even at high temperatures Long service life; even under intensely corrosive conditions; Very pure material. Secure jointing; Smooth inner surface

MATERIALS SELECTION CHARTS

Section	Material	Typical Applications	Size Range	
Building Services	BOSS™ PVC-C	Domestic Hot & Cold Water	16mm to 225mm	
	Aquasystem	Hot and Cold Water Supply; Heating Systems; Chilled; Compressed Air Lines	20mm to 125mm	
	Friatherm®	Hospitals; Schools; Commercial Buildings; Hotels; Sports Stadiums; Residential Buildings	16mm to 160mm	
	Geberit Mepla	Hot and Cold Water Supply (Mains And Risers); Industrial Applications; Fire Sprinkler Systems; Air Supply	16mm to 63mm	
	Polypress	Potable Water; Hot and Cold Plumbing And Heating Systems	16mm to 63mm	
	John Guest	Potable Water; Hot and Cold Plumbing and Heating Systems	10mm to 28mm	

For chemical resistance data please speak to the BSS Plastics team on:
T: 0870 242 5586 E: plastics@bssgroup.com

	Pressure Rating	Temperature Rating	Jointing Technique	Key Product Features
	PN10 75mm to 225mm; PN16 16mm to 160mm	0ºC to 80ºC	Solvent Weld	Excellent chemical resistance; Lightweight; Wide temperature range; Easy to install; High-temperature acids and alkalis
	-	0ºC to 80ºC	Electrofusion, socket fusion	Lightweight; Limescale and corrosion free; Fully WRAS approved
	PN25 Up to 63mm; PN16 75mm and 160mm	0ºC to 95ºC	One-step solvent weld	Lightweight; Limescale and corrosion free; Minimum 50 years service life; No power or hot works required; Fully WRAS approved
	10 bar operating pressure. 16 Bar test pressure	0ºC to 95ºC	Crimp compression	Lightweight; High stability; High temperature resistance; Expansion resistance; Hygienic; Corrosion resistant
	10 bar	0ºC to 95ºC	Crimp compression	Lightweight; Optimum Flow charictistics; High temperature resistance; Expansion resistance; Corrosion resistant
	12 bar	0ºC to 105ºC	Twist & lock fittings, Pushfit connection	Demountable; lightweight; flexible; corrosion free

MATERIALS SELECTION CHARTS

Section	Material	Typical Applications	
Drainage	Soil & Waste	Above and Below Ground: Residential (Apartments), Industrial, Commercial Drainage	
	HDPE - Geberit	Above and Below Ground: Residential (Apartments), Industrial, Commercial Drainage	
	HDPE - Terrain	Above and Below Ground: Residential (Apartments), Industrial, Commercial Drainage	
	Acoustic Drainage - Geberit db20	Acoustic Drainage Requirements for Multiple Dwellings; Libraries; Public Buildings; Restaurants; Cinemas; Hospitals; Hotels And Offices	
	Acoustic Drainage - Terrain db12	Acoustic Drainage Requirements for Multiple Dwellings; Libraries; Public Buildings; Restaurants; Cinemas; Hospitals; Hotels And Offices	
	Acoustic Drainage - Friaphon®	Acoustic Drainage Requirements for Multiple Dwellings; Libraries; Public Buildings; Restaurants; Cinemas; Hospitals; Hotels and Offices	
	Vulcathene	Laboratories in: Schools; Universities and Colleges; Hospitals and Clinics; Pharmaceutical Companies; Research Organisations	

Section	Material	Typical Applications	Size Range	
Utilities	Polyethylene	Gas and water utilities; industrial water applications; cooling; irrigation; industrial effulents	20mm to 1000mm	

When considering applications, pressure and temperature, please refer to the manufacturer's data for precise information regarding operating details and product suitability as manufacturers' material blends will differ and may affect the suitability.

	Size Range	Temperature Rating	Jointing Technique	Key Product Features
	32mm to 160mm	N/A	Solvent weld range and ring seal push fit	Integrated soil; waste and trap system.
	32mm to 315mm	N/A	Butt weld or electroweld fittings	Lightweight; chemical; abrasion and impact resistant.
	40mm to 315mm	N/A	Electrofusion, mechanical coupling and butt welding	Lightweight; chemical; abrasion and impact resistant.
	56mm to 160mm	N/A	Butt weld or electroweld fittings	Acoustic drainage
	40mm to 160mm	N/A	Push fit	Acoustic drainage
	110mm to 160mm	N/A	Push fit	Superb Sound Insulation; Lower Cost Alternative to Cast Iron; No Lagging Required; Lower Cost Alternative to Lagged Plastic; Push-fit Assembly; High-Impact and Temperature Resistant
	38mm to 152mm	-20ºC to 100ºC (only intermittent at100ºC)	Mechanical compression & end-fusion techniques	Purpose designed for chemical drainage; Two easy jointing methods; Fully BBA approved

	Pressure Rating	Temperature Rating	Jointing Technique	Key Product Features
	20mm to 63mm; 12.5bar 90mm to 710mm; 16bar 90mm to 1000mm; 10bar	0ºC to 60ºC	Butt fusion and electrofusion fittings	Lightweight; Chemical; Abrasion and Impact Resistant.

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PIPE DIMENSION COMPARISONS

Plastic pipelines need to be supported at certain intervals depending on several factors: the material, the average pipe wall temperature, the density of the medium transported and the size and wall thickness of the pipe.

The determination of the spacing between pipe brackets has been based on the permissible deflection of the pipe between consecutive brackets. The values given in the tables apply only to pipelines which are freely movable in the axial direction. These are only a guideline, please refer to the manufacturer's data.

ABS

Pipe Bracket Spacing for ABS for liquids with a density of 1g/cm³ ABS

d	DN	Pipe bracket intervals L for SDR 21 / S10 / PN10 pipes in mm at pipe wall temperature				
mm	inch	<20°C	30°C	40°C	50°C	60°C
16	⅜	700	650	600	550	450
20	½	800	700	650	600	500
25	¾	850	800	750	650	600
32	1	1000	900	850	750	650
40	1¼	1100	1000	950	850	750
50	1½	1150	1100	1000	900	800
63	2	1300	1200	1100	1000	850
75	2½	1500	1350	1200	1100	950
90	3	1600	1450	1350	1200	1050
110	4	1800	1650	1550	1350	1200
140	5	2050	1800	1700	1400	1250
160	6	2200	1850	1750	1450	1300
200	7	2300	2050	1850	1550	1350
225	8	2400	2200	1900	1600	1450
250	9	2500	2300	2000	1650	1500
280	10	2650	2400	2100	1700	1600
315	12	2800	2500	2200	1800	1650

For other classes, multiply the values given in the table with the following factor:
> Class 0.90B > Class 1.05D > Class 1.09E

The pipe bracket spacing given in the table may be increased by 30% in the case of vertical pipe runs.

Pipe bracket spacing for ABS for fluids of a density other than 1g/cm³

If the liquid to be transported has a density not equal to 1g/cm³, then the bracket spacing in the table above should be multiplied by the factor of the following table.

Density of the fluid in g/cm³	Factor for the pipe bracket spacing
1.25	0.96
1.5	0.92

PVC-U Pipe Bracket Spacing for PVC-U for liquids with a density of 1g/cm³ PVC-U						
d	DN	Pipe bracket intervals L for SDR 21 / S10 / PN10 pipes in mm at pipe wall temperature				
mm	inch	<20°C	30°C	40°C	50°C	60°C
16	⅜	950	900	850	750	600
20	½	1100	1050	1000	900	700
25	¾	1200	1150	1050	950	750
32	1	1350	1300	1250	1100	900
40	1¼	1450	1400	1350	1250	1000
50	1½	1600	1550	1500	1400	1150
63	2	1800	1750	1700	1550	1300
75	2½	2000	1900	1850	1700	1450
90	3	2200	2100	2000	1850	1550
110	4	2400	2300	2250	2050	1750
125	-	2550	2450	2400	2200	1850
140	5	2700	2600	2500	2300	1950
160	6	2900	2800	2700	2500	2100
180	-	3100	2950	2850	2650	2200
200	-	3250	3150	3000	2800	2350
225	8	3450	3300	3200	2950	2500
250	-	3650	3500	3350	3100	2600
280	10	3750	3700	3550	3300	2750
315	12	4100	3900	3750	3500	2950
355	14	4300	4200	4000	3700	3100
400	16	4600	4450	4250	3950	3300

For other SDR, multiply the values given in the table with the following factor:

> SDR 13.6 / S 6.3 / PN16 with 1.08
> SDR 11 / S 5 / PN20 with 1.15

The pipe bracket spacing given in the table may be increased by 30% in the case of vertical pipe runs.

Pipe bracket spacing for PVC-U for fluids of a density other than 1g/cm³

If the liquid to be transported has a density not equal to 1g/cm³, then the bracket spacing in the table above should be multiplied by the factor of the following table.

Density of the fluid in g/cm³	Factor for the pipe bracket spacing
1.25	0.96
1.5	0.92
<0.01 (Gas)	1.42 for SDR21 / S8 / PN10
	1.30 for SDR13.6 / S6.3 / PN16
	1.20 for SDR11 / S5 / PN20

PVC-C Pipe Bracket Spacing for PVC-C for liquids with a density of 1g/cm³ PVC-C							
d	Pipe bracket intervals L for SDR 21 / S10 / PN10 pipes in mm at pipe wall temperature						
mm	<20°C	30°C	40°C	50°C	60°C	70°C	80°C
16	1000	950	900	850	750	675	600
20	1150	1100	1025	950	875	775	700
25	1200	1150	1100	1000	900	800	700
32	1350	1250	1200	1100	1000	900	800
40	1500	1400	1300	1250	1150	1050	900
50	1650	1600	1500	1400	1300	1200	1100
63	1850	1750	1650	1600	1500	1350	1250
75	2050	1950	1850	1750	1650	1500	1350
90	2250	2100	2000	1900	1800	1650	1500
110	2500	2350	2200	2100	1950	1800	1650
125	2650	2500	2350	2250	2100	1950	1750
140	2800	2650	2500	2350	2200	2050	1850
160	3000	2850	2700	2550	2400	2200	2000
180	3150	3000	2850	2700	2500	2300	2100
200	3350	3150	3000	2850	2650	2450	2200
225	3550	3350	3200	3000	2800	2600	2350
250	3750	3550	3350	3150	3000	2750	2500
280	3950	3750	3550	3350	3150	2900	2650
315	4200	4000	3750	3550	3350	3050	2800
350	4450	4250	4000	3800	3550	3250	2950
400	4750	4500	4250	4000	3750	3450	3150

For other SDR multiply the values given in the table with the following factor:

> SDR13.6 / S6.3 / PN16 with 1.08
> SDR11 / S5 / PN20 with 1.12

The pipe bracket spacing given in the table may be increased by 30% in the case of vertical pipe runs.

Pipe bracket spacing for PVC-U for fluids of a density other than 1g/cm³

If the liquid to be transported has a density not equal to 1g/cm³, then the bracket spacing in the table above should be multiplied by the factor of the following table.

Density of the fluid in g/cm³	Factor for the pipe bracket spacing
1.25	0.96
1.5	0.92
<0.01 (Gas)	1.40 for SDR21 / S10 / PN10
	1.27 for SDR13.6 / S6.3 / PN16
	1.23 for SDR11 / S5 / PN20

PVDF

Pipe Bracket Spacing for PVDF for liquids with a density of 1g/cm³ PVDF

d	Pipe bracket spacing L for SDR33 / S16 / PN10 and SDR21 / S10 / PN16 in mm at pipe wall temperature									
mm	<20°C	30°C	40°C	50°C	60°C	70°C	80°C	100°C	120°C	140°C
16	725	700	650	600	575	550	500	450	400	300
20	850	800	750	750	700	650	600	500	450	400
25	950	900	850	800	750	700	675	600	500	450
32	1100	1050	1000	950	900	850	800	700	600	500
40	1200	1150	1100	1050	1000	900	900	750	650	550
50	1400	1350	1300	1200	1150	1000	1000	900	750	600

d	Pipe bracket spacing L for SDR21 / S10 / PN16 in mm at pipe wall temperature:									
mm	<20°C	30°C	40°C	50°C	60°C	70°C	80°C	100°C	120°C	140°C
63	1400	1350	1300	1250	1200	1150	1100	950	800	650
75	1500	1450	1400	1350	1300	1250	1200	1050	850	700
90	1600	1550	1500	1450	1400	1350	1300	1100	950	850
110	1800	1750	1700	1650	1550	1500	1450	1250	1100	950
125	1900	1850	1800	1700	1650	1600	1500	1350	1200	1000
140	2000	1950	1900	1800	1750	1700	1600	1450	1250	1050
160	2150	2100	2050	1950	1850	1800	1700	1550	1350	1150
180	2300	2200	2150	2050	1950	1900	1800	1600	1400	1200
200	2400	2350	2250	2150	2100	2000	1900	1700	1500	1300
225	2550	2500	2400	2300	2200	2100	2000	1800	1600	1400
250	2650	2600	2500	2400	2300	2200	2100	1900	1700	1500
280	2850	2750	2650	2550	2450	2350	2250	2000	1800	1600
315	3000	2950	2850	2750	2600	2500	2400	2150	1900	1650
355	3200	3100	3000	2850	2750	2650	2500	2250	2000	1750
400	3400	3300	3200	3050	2950	2800	2650	2400	2100	1800

For other SDR the values should be multiplied by the following factors:

- SDR21 / S10 / PN16 in the dimensional range d63 to d400 with 1.08
- SDR17 / S8 / PN20 in the entire dimensional range with 1.12

The pipe bracket spacing given in the table may be increased by 30% in the case of vertical pipe runs.

Pipe bracket spacing for PVDF for fluids of a density other than 1g/cm³

If the liquid to be transported has a density not equal to 1g/cm³, then the bracket spacing in the table above should be multiplied by the factor of the following table.

Density of the fluid in g/cm³	Factor for the pipe bracket spacing
1.25	0.96
1.5	0.92
<0.01 (Gas)	1.48 for SDR33 / S16 / PN10
	1.36 for SDR21 / S16 / PN16
	1.31 for SDR17 / S8 / PN20

PIPE DIMENSION COMPARISONS

PE Pipe Bracket Spacing for PE for liquids with a density of 1g/cm³ PE					
d	Pipe bracket intervals L for pipes SDR17 / S8 or Class C in mm at pipe wall temperature				
mm	<20°C	30°C	40°C	50°C	60°C
16	500	450	450	400	350
20	575	550	500	450	400
25	650	600	550	550	500
32	750	750	650	650	550
40	900	850	750	750	650
50	1050	1000	900	850	750
63	1200	1150	1050	1000	900
75	1350	1300	1200	1100	1000
90	1500	1450	1350	1250	1150
110	1650	1600	1500	1450	1300
125	1750	1700	1600	1550	1400
140	1900	1850	1750	1650	1500
160	2050	1950	1850	1750	1600
180	2150	2050	1950	1850	1750
200	2300	2200	2100	2000	1900
225	2450	350	2250	2150	2050
250	2600	2500	2400	2300	2100
280	2750	2650	2550	2400	2200
315	2900	2800	2700	2550	2350
355	3100	3000	2900	2750	2550
400	3300	3150	3050	2900	2700

For other SDR multiply the values given in the table with the following factor:

- SDR17 and SDR17.6 with 0.91
- SDR7.4 with 1.07

The pipe bracket spacing given in the table may be increased by 30% in the case of vertical pipe runs.

Pipe bracket spacing for PE for fluids of a density other than 1g/cm³

If the liquid to be transported has a density not equal to 1g/cm³, then the bracket spacing in the table above should be multiplied by the factor of the following table.

Density of the fluid in g/cm³	Factor for the pipe bracket spacing
1.25	0.96
1.5	0.92
<0.01 (Gas)	1.30 for SDR11
	1.21 for SDR7.4

PP-H Pipe Bracket Spacing for PP-H for liquids with a density of 1g/cm³ PP-H						
d	Pipe bracket intervals L for SDR21 / S10 / PN10 pipes in mm at pipe wall temperature					
mm	<20°C	30°C	40°C	50°C	60°C	80°C
16	650	625	600	575	550	500
20	700	675	650	625	600	550
25	800	775	750	725	700	650
32	950	925	900	875	850	750
40	1100	1075	1050	1000	950	875
50	1250	1225	1200	1150	1100	1000
63	1450	1425	1400	1350	1300	1200
75	1550	1500	1450	1400	1350	1250
90	1650	1600	1550	1500	1450	1350
110	1850	1800	1750	1700	1600	1400
125	2000	1950	1900	1800	1700	1500
140	2100	2050	2000	1900	1800	1600
160	2250	2200	2100	2000	1900	1700
180	2350	2300	2200	2100	2000	1800
200	2500	2400	2300	2200	2100	1900
225	2650	2550	2450	2350	2250	2000
250	2800	2700	2600	2500	2400	2150
315	3150	3050	2950	2850	2700	2450

For other SDR multiply the values given in the table with the following factor:

> SDR17 and SDR17.6 with 0.91

The pipe bracket spacing given in the table may be increased by 30% in the case of vertical pipe runs.

Pipe bracket spacing for PE for fluids of a density other than 1g/cm³

If the liquid to be transported has a density not equal to 1g/cm³, then the bracket spacing in the table above should be multiplied by the factor of the following table.

Density of the fluid in g/cm³	Factor for the pipe bracket spacing
1.25	0.96
1.5	0.92
<0.01 (Gas)	1.30 for SDR 11
	1.47 for SDR 17.6 and SDR 17

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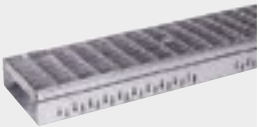

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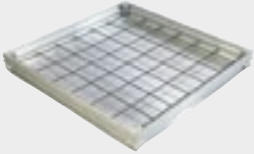

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FLANGE DIMENSION CHARTS

BS EN 1092 - FORMERLY BS 3274 TABLE 6 (DIMENSIONS IN MM)

Nominal bore	Flange diameter	Thickness	Length and diameter of bolts	Number of holes	PCD
15	80	12	M10 x 40	4	55
20	90	14	M10 x 45	4	65
25	100	14	M10 x 45	4	75
32	120	14	M12 x 50	4	90
40	130	14	M12 x 50	4	100
50	140	14	M12 x 50	4	110
65	160	14	M12 x 50	4	130
80	190	16	M16 x 60	4	150
100	210	16	M16 x 60	4	170
125	240	18	M16 x 60	8	200
150	265	18	M16 x 60	8	225
200	320	20	M16 x 65	8	280
250	375	22	M16 x 70	12	335
300	440	22	M20 x 70	12	395

BS EN 1092 - FORMERLY BS 3274 TABLE 10 (DIMENSIONS IN MM)

Nominal bore	Flange diameter	Thickness	Length and diameter of bolts	Number of holes	PCD
15	95	14	M12 x 45	4	65
20	105	16	M12 x 50	4	75
25	115	16	M12 x 50	4	85
32	140	16	M16 x 60	4	100
40	150	16	M16 x 60	4	110
50	165	18	M16 x 60	4	125
65	185	18	M16 x 60	4	145
80	200	20	M16 x 65	8	160
100	220	20	M16 x 70	8	180
125	250	22	M16 x 70	8	210
150	285	22	M20 x 70	8	240
200	340	24	M20 x 80	8	295
250	395	26	M20 x 80	12	350
300	445	26	M20 x 80	12	400

BS 10-1962 TABLE D (DIMENSIONS IN INCHES)

Nominal bore	Flange diameter	Thickness	Length and diameter of bolts	Number of holes	PCD
½	3¾	3/16	1 x ½	4	2⅝
¾	4	3/16	1 x ½	4	2⅝
1	4½	3/16	1 x ½	4	3¼
1¼	4¾	¼	1¼ x ½	4	3 7/16
1½	5¼	¼	1¼ x ½	4	3⅞
2	6	5/16	1½ x ⅝	4	4½
2½	6½	5/16	1½ x ⅝	4	5
3	7¼	⅜	1¾ x ⅝	4	5¾
4	8½	⅜	1¾ x ⅝	4	7
5	10	½	2 x ⅝	8	8¼
6	11	½	2 x ⅝	8	9¼
8	13¼	½	2 x ⅝	8	11½
10	16	⅝	2¼ x ¾	8	14
12	18	¾	2½ x ¾	12	16

BS EN 1092 - FORMERLY BS 3274 TABLE 16 (DIMENSIONS IN MM)

Nominal bore	Flange diameter	Thickness	Length and diameter of bolts	Number of holes	PCD
15	95	14	M12 x 45	4	65
20	105	16	M12 x 50	4	75
25	115	16	M12 x 50	4	85
32	140	16	M16 x 60	4	100
40	150	16	M16 x 60	4	110
50	165	18	M16 x 60	4	125
65	185	18	M16 x 60	4	145
80	200	20	M16 x 65	8	160
100	220	20	M16 x 70	8	180
125	250	22	M16 x 70	8	210
150	285	22	M20 x 70	8	240
200	340	24	M20 x 90	12	295
250	405	26	M24 x 90	12	355
300	460	28	M24 x 90	12	410

FLANGE DIMENSION CHARTS

BS 1560 ASA150

Nominal bore	Flange diameter	Thickness	Length and diameter of bolts	Number of holes	PCD
½	3½	7/16	1¾ x ½	4	2⅜
¾	3⅛	½	2 x ½	4	2¾
1	4¼	9/16	2 x ½	4	3⅛
1¼	4⅝	⅝	2¼ x ½	4	3½
1½	5	11/16	2¼ x ½	4	3⅞
2	6	¾	2¾ x ⅝	4	4¾
2½	7	⅞	3 x ⅝	4	5½
3	7½	15/16	3 x ⅝	4	6
4	9	15/16	3 x ⅝	8	7½
5	10	15/16	3¼ x ¾	8	8½
6	11	1	3¼ x ¾	8	9½
8	13½	1⅛	3½ x ¾	8	11¾
10	16	1 3/16	3¾ x ⅞	12	14¼
12	19	1¼	4 x ⅞	12	17

BS 10-1962 TABLE E

Nominal bore	Flange diameter	Thickness	Length and diameter of bolts	Number of holes	PCD
½	3¾	¼	1¼ x ½	4	2⅝
¾	4	¼	1¼ x ½	4	2⅝
1	4½	9/32	1¼ x ½	4	3¼
1¼	4¾	5/16	1½ x ½	4	3 7/16
1½	5¼	11/32	1½ x ½	4	3⅞
2	6	⅜	1¾ x ⅝	4	4½
2½	6½	13/32	1¾ x ⅝	4	5
3	7¼	7/16	1¾ x ⅝	4	5¾
4	8½	½	2 x ⅝	8	7
5	10	9/16	2 x ⅝	8	8¼
6	11	11/16	2½ x ¾	8	9¼
8	13¼	¾	2½ x ¾	8	11½
10	16	⅞	2¾ x ¾	12	14
12	18	1	3¼ x ¾	12	16

PRESSURE & TEMPERATURE GUIDE

PRESSURE RATING					
The pressure rating of a system is the continuous pressure at which the pipework can operate throughout its design life. It is NOT the burst pressure.					
Class	**B**	**C**	**D**	**E**	**T or 7***
Ft.Head Water	200	300	400	500	400
lbf/in^2	87	130	173	217	173
bar	6	9	12	15	12

Class	PN6	PN10	PN16
bar	6	10	16
lbf/in^2	87	130	173
bar	6	9	12

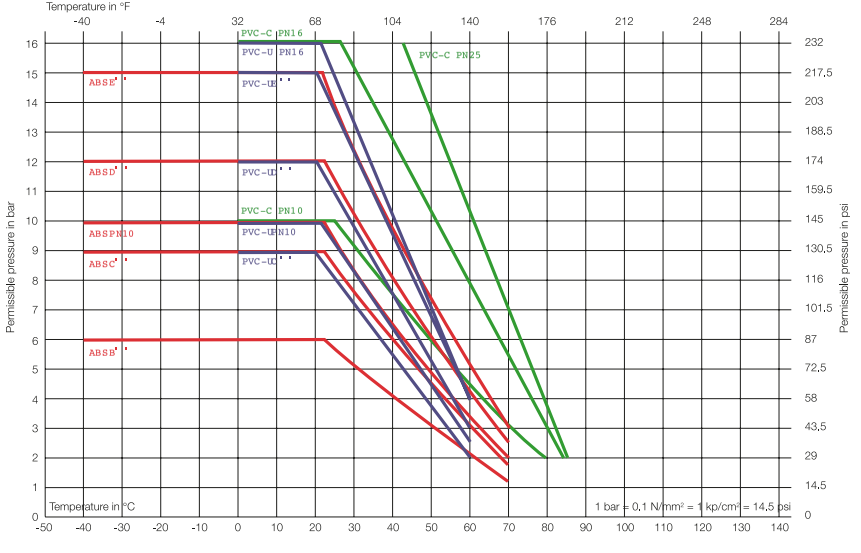
*Thicker wall tube for threading. All pressure ratings are calculated at 20ºC.

COPPER TO PLASTICS CONVERSIONS

SIZE CONVERSION CHART FROM TRADITIONAL MATERIALS TO THEIR PLASTIC EQUIVALENT					
BS EN 10255 - Formerly ASTM A404 Steel	**Copper**	**Metric Plastic**	**BS 1387 Steel**	**Copper**	**Metric Plastic**
⅜" - 10mm	10mm	16mm	3" - 80mm	76mm	90mm
½" - 15mm	15mm	20mm	4" - 100mm	108mm	110mm
¾" - 20mm	22mm	25mm	x	x	125mm
1" - 25mm	28mm	32mm	5" - 125mm	133mm	140mm
1¼" - 32mm	35mm	40mm	6" - 150mm	159mm	160mm
1½" - 40mm	42mm	50mm	x	x	225mm
x	x	56mm	x	x	250mm
2" - 50mm	54mm	63mm	x	x	315mm
2½" - 65mm	67mm	75mm	-	-	-

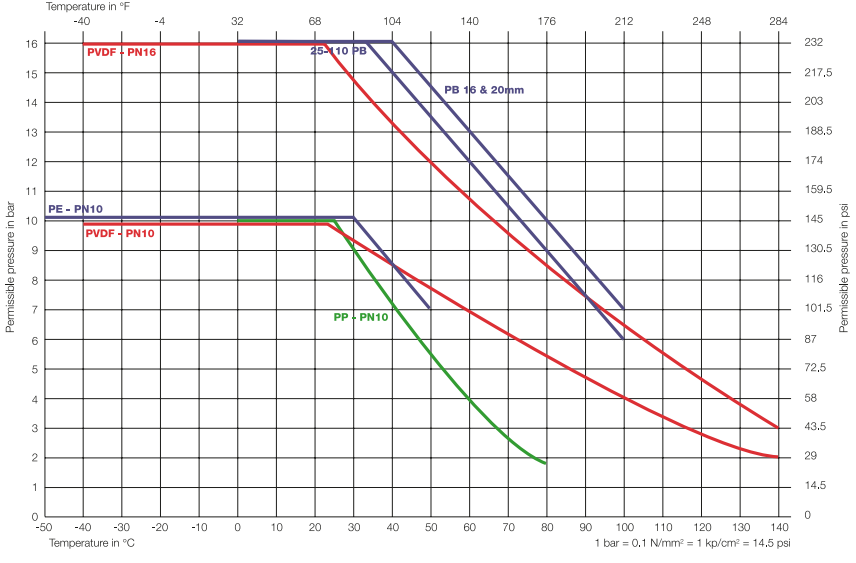
SOLVENT-WELDED SYSTEMS

APPLICATION LIMITS OF PIPES AND FITTINGS MADE OF THERMOPLASTIC MATERIALS (25 years operation with safety factor incorporated)



FUSION-WELDED SYSTEMS

APPLICATION LIMITS OF PIPES AND FITTINGS MADE OF THERMOPLASTIC MATERIALS (25 years operation with safety factor incorporated)



FLANGES

FLANGE OVERVIEW

General Information

A flange is a method of connecting pipes, valves, pumps and other equipment to form a pipework system. It also provides easy access for cleaning, inspection or modification. Flanges are usually welded or screwed into such systems and then joined with bolts.

What type of flange is required?

Weld Neck

Used in critical applications, this is circumferentially welded into the system at its neck which means that the integrity of the butt-welded area can be easily examined by x-ray radiography. The bores of both pipe and flange match, thus reducing turbulence and erosion.

Slip-On

This is slipped over the pipe and then fillet welded. Easy to use in fabricated applications.

Blind

Sometimes called a blanking flange, this is used for blanking off pipelines, valves and pumps and as an inspection cover.

Socket Weld

This is counter-bored to accept the pipe, which is then fillet welded. The bore of both the pipe and the flange are the same to ensure good flows.

Screwed/Threaded

This requires no welding and is used to connect other threaded components in low-pressure, non-critical applications.

Lap Joint

These are always used with either a stub end or a taft which is butt-welded to the pipe with the flange loose behind it. Thus, the stub end or the taft always provides the sealing face. Easily assembled and aligned, it is favoured in low-pressure applications. To reduce cost, these backing flanges can be supplied without a hub and/or made from coated carbon steel.

Ring-Type Joint

This can be employed on weld neck, slip-on or blind flanges for a leak-proof connection at high pressures. The seal is made by a metal ring being compressed into a hexagonal groove on the flange face.

What size is the flange?

This will be the same size as the pipe's nominal bore or nominal pipe size, and for weld-neck flanges the schedule wall thickness.

What grade of stainless steel is required?

This will normally be the same as the pipe with the most readily available grades from stock being 304L and 316L.

What sort of face should it have?

Of the four choices available, the most common configurations are:

- For ANSI and BS EN 1092 - Formerly BS 3274 – Raised Face (to facilitate welding)
- BS 10 – Flat Face
- Ring-Type Joint and Tongue and Groove are also available

What is the required pressure rating?

The pressure rating will also determine the dimensions of the flange:

What markings will be on the flange?

All flanges should be permanently marked on the external diameter of the base with:

- Pipe size (NPS/NB)
- Pipe wall thickness (schedule) if appropriate
- Specification
- Grade
- Heat number
- Manufacturer's name or symbol

FLANGE TYPE	ANSI B16.5 LBS	ANSI B16.47 SERIES A MSS SP-44 LBS*	ANSI/ASME B16.47 SERIES B - FORMERLY ANSI B1.20.1	BS 4504 BAR
Weld Neck	150-2500	150-900	150-300	2.5-40
Weld Neck Ring-Type Joint	300-2500	300-900	150-300	-
Slip-On	150-1500	-	-	2.5-40
Slip-On Ring-Type Joint	300-1500	-	-	-
Threaded	150-2500	-	-	6-40
Lap Joint	150-2500	-	-	6-40
Blind	150-2500	-	-	2.5-40
Socket Weld	150-1500	-	-	-

* Flange sizes 26" and above.

TYPES OF FLANGES

TYPES OF STEEL FLANGES AND ANCILLARY COMPONENTS	
Type No.	**Description**
01	Plate flange for welding
02	Loose plate flange with weld-on plate collar or for lapped pipe end
04	Loose plate flange with weld-neck collar
05	Blank flange
11	Weld-neck flange
12	Hubbed slip-on flange for welding
13	Hubbed threaded flange
21[a]	Integral flange
32[b]	Weld-on plate collar
33[b]	Lapped pipe end
34[b]	Weld-neck collar

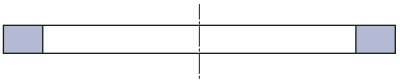
a Flange type 21 is an integral part of some other equipment or component.

b Ancillary components type numbers 32 and 33 are for use with type 02 flanges and type number 34 is for use with type 04 flanges.

NOTE - Type numbers have been made non-consecutive to permit possible future additions.

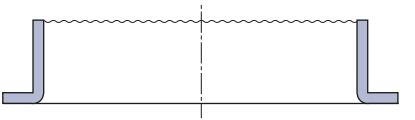
Type 32

Weld-on collar plate



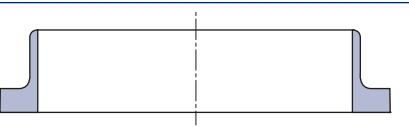
Type 33

Lapped pipe end



Type 34

Weld-neck collar



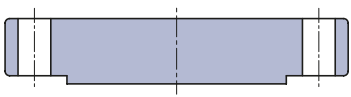
BS 10 / BS EN 1092 - Formerly BS 3274 Flanges

101 / 3

(i.e. 16/101 or 16/3)
BS 4504: Slip-on plate flange
BS 10: Plate flange

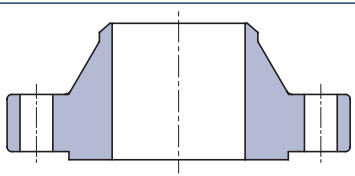
105 / 8

(i.e. 16/105 or 16/8)
BS 4504: Blank flange
BS 10: Blind flange



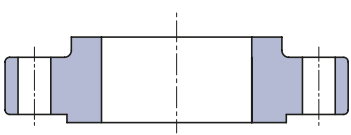
111 / 2

(i.e. 16/111 or 16/2)
BS 4504: Weld-neck flange
BS 10: N/A



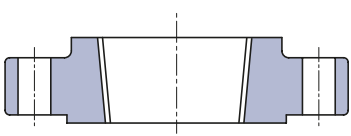
112 / 5

(i.e. 16/112 or 16/5)
BS 4504: Bossed slip-on flange
BS 10: Slip-on flange



113 / 4

(i.e. 16/113 or 16/4)
BS 4504: Threaded flange
BS 10: Screwed flange

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BOSS™ FLANGE BOLTING KIT SELECTOR

All BZP-finish Bolts and Nuts to BS 4190 Gr 46 and Form 'A' Washers

FLANGE TABLES / KIT NUMBER						
Size	**D**	**E**	**F**	**H**	**PN6**	**PN10/16**
15mm - ½"	-	-	-	1	-	-
20mm - ¾"	-	-	-	1	-	-
25mm - 1"	-	-	1	1	-	-
32mm - 1¼"	-	-	1	2	-	2
40mm - 1½"	-	-	1	2	-	2
50mm - 2"	1	1	1	2	-	2
65mm - 2½"	1	1	3	3	-	2
80mm - 3"	1	1	3	3	2	3
100mm - 4"	2	3	3	-	2	3
125mm - 5"	3	3	5	6	3	-
150mm - 6"	3	5	-	-	3	5
200mm - 8"	3	5	-	-	3	5
250mm - 10"	5	-	-	-	-	-

FLANGE BOLTING KITS BZP (INC NUTS, BOLTS & WASHERS)		
	Description	**Code**
1	Flange Bolting Kit 4-ZP M16x50	84088703
2	Flange Bolting Kit 4-ZP M16x65	84088714
3	Flange Bolting Kit 8-ZP M16x65 80mm	84088725
4	Flange Bolting Kit 8-ZP M16x65 100mm	84088736
5	Flange Bolting Kit 8-ZP M20x80	84088747
6	Flange Bolting Kit 8-ZP M20x90	84088758

NOMINAL SIZE 15MM (½")

		Diameter of Flange	Hole Diameter	
BS EN 1092 - Formerly BS 3274	PN6	80	11	
	PN10	95	14	
	PN16	95	14	
	PN25	95	14	
	PN40	95	14	

		Diameter of Flange	Diameter of Raised Face	
ANSI	Class 125/150	3½ (89)	1⅜ (35)	
	Class 300	3¾ (95)	1⅜ (35)	
	Class 600	3¾ (95)	1⅜ (35)	
	Class 900	4¾ (121)	1⅜ (35)	
	Class 1500	4¾ (121)	1⅜ (35)	
BS 10	Table D	3¾ (95)	-	
	Table E	3¾ (95)	-	
	Table F	3¾ (95)	-	
	Table H	4½ (114)	2¼ (57)	
	Table J	4½ (114)	2¼ (57)	
	Table K	4½ (114)	2½ (64)	
	Table R	4½ (114)	2½ (64)	
	Table S	5 (127)	2½ (64)	
	Table T	5½ (140)	2½ (64)	

* Flange code 104 not available in pressure rating PN16

** Flange code 113 not available in pressure ratings PN10 and PN25

\+ Bolt lengths shown are for joining loose forged-steel flanges and include an allowance for gaskets etc. When mating loose flanges to integral flanges, check the length of bolt required

x Ensure the bolt specification is suitable for the duty. Studs may be required in lieu of bolts for the higher pressure/temperature applications

	Flange Thickness Code			Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	Code 01, 02, 04*	Code 11, 12, 13, 21**	Code 05				
	12	12	12	55	4	M10	40
	14	14	14	65	4	M12	45
	14	14	14	65	4	M12	45
	14	16	16	65	4	M12	50
	14	16	16	65	4	M12	50

	Height of Raised Face	Thickness of Flange	Hole Diameter	Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	1/16 (2)	7/16 (11)	5/8 (16)	2 3/8 (60)	4	M12	50
	1/16 (2)	9/16 (14)	5/8 (16)	2 5/8 (67)	4	M12	55
	1/4 (6)	9/16 (14)	5/8 (16)	2 5/8 (67)	4	M12	75x
	1/4 (6)	7/8 (22)	7/8 (22)	3 1/4 (83)	4	M20	110x
	1/4 (6)	7/8 (22)	7/8 (22)	3 1/4 (83)	4	M20	110x
	-	3/8 (10)	9/16 (14)	2 5/8 (67)	4	M12	40
	-	3/8 (10)	9/16 (14)	2 5/8 (67)	4	M12	40
	-	3/8 (10)	9/16 (14)	2 5/8 (67)	4	M12	40
	1/16 (2)	1/2 (13)	11/16 (17)	3 1/4 (83)	4	M16	50
	1/16 (2)	5/8 (16)	11/16 (17)	3 1/4 (83)	4	M16	55
	1/16 (2)	3/4 (19)	11/16 (17)	3 1/4 (83)	4	M16	65
	1/16 (2)	3/4 (19)	11/16 (17)	3 1/4 (83)	4	M16	65
	1/16 (2)	7/8 (22)	7/8 (22)	3 1/2 (89)	4	M20	70
	1/16 (2)	1 (25)	7/8 (22)	4 (102)	4	M20	75

NOMINAL SIZE 20MM (¾")

		Diameter of Flange	Hole Diameter	
BS EN 1092 - Formerly BS 3274	PN6	90	11	
	PN10	105	14	
	PN16	105	14	
	PN25	105	14	
	PN40	105	14	

		Diameter of Flange	Diameter of Raised Face	
ANSI	Class 125/150	3⅞ (98)	1 11⁄16 (43)	
	Class 300	4⅝ (117)	1 11⁄16 (43)	
	Class 600	4⅝ (117)	1 11⁄16 (43)	
	Class 900	5½ (130)	1 11⁄16 (43)	
	Class 1500	5½ (130)	1 11⁄16 (43)	
BS 10	Table D	4 (102)	-	
	Table E	4 (102)	-	
	Table F	4 (102)	-	
	Table H	4½ (114)	2¼ (57)	
	Table J	4½ (114)	2¼ (57)	
	Table K	4½ (114)	2½ (64)	
	Table R	4½ (114)	2½ (64)	
	Table S	5 (127)	2½ (64)	
	Table T	5½ (140)	2½ (64)	

* Flange code 104 not available in pressure rating PN16

** Flange code 113 not available in pressure ratings PN10 and PN25

\+ Bolt lengths shown are for joining loose forged-steel flanges and include an allowance for gaskets etc. When mating loose flanges to integral flanges, check the length of bolt required

x Ensure the bolt specification is suitable for the duty. Studs may be required in lieu of bolts for the higher pressure/temperature applications

	Flange Thickness Code			Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	Code 01, 02, 04*	Code 11, 12, 13, 21**	Code 05				
	14	14	14	65	4	M10	45
	16	16	16	75	4	M12	50
	16	16	16	75	4	M12	50
	18	18	18	75	4	M12	55
	18	18	18	75	4	M12	55

	Height of Raised Face	Thickness of Flange	Hole Diameter	Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	1/16 (2)	1/2 (14)	5/8 (16)	2 3/4 (70)	4	M12	55
	1/16 (2)	5/8 (16)	3/4 (19)	3 1/4 (83)	4	M16	65
	1/4 (4)	5/8 (16)	3/4 (19)	3 1/4 (83)	4	M16	90x
	1/4 (4)	1 (25)	7/8 (22)	3 1/2 (89)	4	M20	110x
	1/4 (4)	1 (25)	7/8 (22)	3 1/2 (89)	4	M20	110x
	-	3/8 (10)	9/16 (14)	2 5/8 (67)	4	M12	40
	-	3/8 (10)	9/16 (14)	2 5/8 (67)	4	M12	40
	-	3/8 (10)	9/16 (14)	2 5/8 (67)	4	M12	40
	1/16 (2)	1/2 (13)	11/16 (17)	3 1/4 (83)	4	M16	50
	1/16 (2)	5/8 (16)	11/16 (17)	3 1/4 (83)	4	M16	55
	1/16 (2)	3/4 (19)	11/16 (17)	3 1/4 (83)	4	M16	65
	1/16 (2)	3/4 (19)	11/16 (17)	3 1/4 (83)	4	M16	65
	1/16 (2)	7/8 (22)	7/8 (22)	3 1/2 (89)	4	M20	70
	1/16 (2)	1 (25)	7/8 (22)	4 (102)	4	M20	75

NOMINAL SIZE 25MM (1”)

		Diameter of Flange	Hole Diameter	
BS EN 1092 - Formerly BS 3274	PN6	100	11	
	PN10	115	14	
	PN16	115	14	
	PN25	115	14	
	PN40	115	14	

		Diameter of Flange	Diameter of Raised Face	
ANSI	Class 125/150	4¼ (114)	2 (51)	
	Class 300	4⅞ (124)	2 (51)	
	Class 600	4⅞ (124)	2 (51)	
	Class 900	5⅞ (149)	2 (51)	
	Class 1500	5⅞ (149)	2 (51)	
BS 10	Table D	4½ (114)	-	
	Table E	4½ (114)	-	
	Table F	4¾ (121)	-	
	Table H	4¾ (121)	2½ (64)	
	Table J	4¾ (121)	2½ (64)	
	Table K	5 (127)	3 (76)	
	Table R	5 (127)	3 (76)	
	Table S	5½ (140)	3 (76)	
	Table T	5¾ (146)	3 (76)	

* Flange code 104 not available in pressure rating PN16

** Flange code 113 not available in pressure ratings PN10 and PN25

\+ Bolt lengths shown are for joining loose forged-steel flanges and include an allowance for gaskets etc. When mating loose flanges to integral flanges, check the length of bolt required

x Ensure the bolt specification is suitable for the duty. Studs may be required in lieu of bolts for the higher pressure/temperature applications

	Flange Thickness Code			Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	Code 01, 02, 04*	Code 11, 12, 13, 21**	Code 05				
	14	14	14	75	4	M10	45
	16	16	16	85	4	M12	50
	16	16	16	85	4	M12	50
	16	18	18	85	4	M12	55
	16	18	18	85	4	M12	55

	Height of Raised Face	Thickness of Flange	Hole Diameter	Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	1/16 (2)	9/16 (14)	5/8 (16)	3 1/8 (79)	4	M12	55
	1/16 (2)	11/16 (17)	3/4 (19)	3 1/2 (89)	4	M16	65
	1/4 (6)	11/16 (17)	3/4 (19)	3 1/2 (89)	4	M16	90x
	1/4 (6)	1 1/8 (29)	1 (25)	4 (102)	4	M20	125x
	1/4 (6)	1 1/8 (29)	1 (25)	4 (102)	4	M20	125x
	-	3/8 (10)	9/16 (14)	3 1/4 (83)	4	M12	40
	-	3/8 (10)	9/16 (14)	3 1/4 (83)	4	M12	40
	-	3/8 (10)	11/16 (17)	3 7/16 (87)	4	M16	45
	1/16 (2)	9/16 (14)	11/16 (17)	3 7/16 (87)	4	M16	50
	1/16 (2)	3/4 (19)	11/16 (17)	3 7/16 (87)	4	M16	65
	1/16 (2)	7/8 (22)	11/16 (17)	3 3/4 (95)	4	M16	70
	1/16 (2)	7/8 (22)	11/16 (17)	3 3/4 (95)	4	M16	70
	1/16 (2)	1 (25)	7/8 (22)	4 (102)	4	M20	75
	1/16 (2)	1 1/8 (29)	7/8 (22)	4 1/4 (108)	4	M20	90

NOMINAL SIZE 32MM (1¼")

		Diameter of Flange	Hole Diameter	
BS EN 1092 - Formerly BS 3274	PN6	120	14	
	PN10	140	18	
	PN16	140	18	
	PN25	140	18	
	PN40	140	18	

		Diameter of Flange	Diameter of Raised Face	
ANSI	Class 125/150	4⅝ (117)	2½ (64)	
	Class 300	5¼ (133)	2½ (64)	
	Class 600	5¼ (133)	2½ (64)	
	Class 900	6¼ (159)	2½ (64)	
	Class 1500	6¼ (159)	2½ (64)	
BS 10	Table D	4¾ (121)	-	
	Table E	4¾ (121)	-	
	Table F	5¼ (133)	-	
	Table H	5¼ (133)	3 (76)	
	Table J	5¼ (133)	3 (76)	
	Table K	5¼ (133)	3 (76)	
	Table R	5¼ (133)	3 (76)	
	Table S	5¾ (146)	3¼ (83)	
	Table T	6¼ (159)	3¼ (83)	

* Flange code 104 not available in pressure rating PN16

** Flange code 113 not available in pressure ratings PN10 and PN25

\+ Bolt lengths shown are for joining loose forged-steel flanges and include an allowance for gaskets etc. When mating loose flanges to integral flanges, check the length of bolt required

x Ensure the bolt specification is suitable for the duty. Studs may be required in lieu of bolts for the higher pressure/temperature applications

	Flange Thickness Code			Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	Code 01, 02, 04*	Code 11, 12, 13, 21**	Code 05				
	16	14	14	90	4	M12	45
	18	14	14	100	4	M16	55
	18	16	16	100	4	M16	55
	18	18	18	100	4	M16	60
	18	18	18	100	4	M16	60

	Height of Raised Face	Thickness of Flange	Hole Diameter	Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	1/16 (2)	3/8 (16)	5/8 (16)	3 1/2 (89)	4	M12	55
	1/16 (2)	3/4 (19)	3/4 (19)	3 7/8 (98)	4	M16	70
	1/4 (6)	13/16 (21)	3/4 (19)	3 7/8 (98)	4	M16	100x
	1/4 (6)	1 1/8 (29)	1 (25)	4 3/8 (111)	4	M20	125x
	1/4 (6)	1 1/8 (29)	1 (25)	4 3/8 (111)	4	M20	125x
	-	1/2 (13)	9/16 (14)	3 7/16 (87)	4	M12	40
	-	1/2 (13)	9/16 (14)	3 7/16 (87)	4	M12	40
	-	1/2 (13)	11/16 (17)	3 7/8 (98)	4	M16	50
	1/16 (2)	11/16 (17)	11/16 (17)	3 7/8 (98)	4	M16	55
	1/16 (2)	3/4 (19)	11/16 (17)	3 7/8 (98)	4	M16	65
	1/16 (2)	7/8 (22)	11/16 (17)	3 7/8 (98)	4	M16	70
	1/16 (2)	7/8 (22)	11/16 (17)	3 7/8 (98)	4	M16	70
	1/16 (2)	1 1/8 (29)	7/8 (22)	4 1/4 (108)	4	M20	90
	1/16 (2)	1 1/4 (32)	1 (25)	4 3/4 (121)	4	M20	100

NOMINAL SIZE 40MM (1½")

		Diameter of Flange	Hole Diameter	
BS EN 1092 - Formerly BS 3274	PN6	130	14	
	PN10	150	18	
	PN16	150	18	
	PN25	150	18	
	PN40	150	18	

		Diameter of Flange	Diameter of Raised Face	
ANSI	Class 125/150	5 (127)	2⅞ (73)	
	Class 300	6⅛ (156)	2⅞ (73)	
	Class 600	6⅛ (156)	2⅞ (73)	
	Class 900	7 (178)	2⅞ (73)	
	Class 1500	7 (178)	2⅞ (73)	
BS 10	Table D	5¼ (133)	-	
	Table E	5¼ (133)	-	
	Table F	5¼ (133)	-	
	Table H	5½ (140)	3¼ (83)	
	Table J	5½ (140)	3¼ (83)	
	Table K	6 (152)	3½ (89)	
	Table R	6 (152)	3½ (89)	
	Table S	6¼ (159)	3½ (89)	
	Table T	6¾ (171)	3½ (89)	

* Flange code 104 not available in pressure rating PN16

** Flange code 113 not available in pressure ratings PN10 and PN25

\+ Bolt lengths shown are for joining loose forged-steel flanges and include an allowance for gaskets etc. When mating loose flanges to integral flanges, check the length of bolt required

x Ensure the bolt specification is suitable for the duty. Studs may be required in lieu of bolts for the higher pressure/temperature applications

	Flange Thickness Code			Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	Code 01, 02, 04*	Code 11, 12, 13, 21**	Code 05				
	16	14	14	100	4	M12	45
	18	16	16	110	4	M16	55
	18	16	16	110	4	M16	55
	18	18	18	110	4	M16	60
	18	18	18	110	4	M16	60

	Height of Raised Face	Thickness of Flange	Hole Diameter	Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	1/16 (2)	9/16 (14)	5/8 (16)	3 7/8 (98)	4	M12	65
	1/16 (2)	13/16 (121)	7/8 (22)	4 1/2 (114)	4	M20	75
	1/4 (6)	7/8 (22)	7/8 (22)	4 1/2 (114)	4	M20	100x
	1/4 (6)	1 1/4 (32)	1 1/8 (29)	4 7/8 (124)	4	M24	140x
	1/4 (6)	1 1/4 (32)	1 1/8 (29)	4 7/8 (124)	4	M24	140x
	-	1/2 (13)	9/16 (14)	3 7/8 (98)	4	M12	40
	-	1/2 (13)	9/16 (14)	3 7/8 (98)	4	M12	40
	-	1/2 (13)	11/16 (17)	4 1/8 (105)	4	M16	50
	1/16 (2)	11/16 (17)	11/16 (17)	4 1/8 (105)	4	M16	55
	1/16 (2)	7/8 (22)	11/16 (17)	4 1/8 (105)	4	M16	70
	1/16 (2)	1 (25)	7/8 (22)	4 1/2 (114)	4	M20	75
	1/16 (2)	1 (25)	7/8 (22)	4 1/2 (114)	4	M20	75
	1/16 (2)	1 1/8 (29)	7/8 (22)	4 3/4 (121)	4	M20	90
	1/16 (2)	1 3/8 (35)	7/8 (22)	5 1/4 (133)	4	M20	100

NOMINAL SIZE 50MM (2”)

		Diameter of Flange	Hole Diameter	
BS EN 1092 - Formerly BS 3274	PN6	140	14	
	PN10	165	18	
	PN16	165	18	
	PN25	165	18	
	PN40	165	18	

		Diameter of Flange	Diameter of Raised Face	
ANSI	Class 125/150	6 (152)	3⅝ (92)	
	Class 300	6½ (165)	3⅝ (92)	
	Class 600	6½ (165)	3⅝ (92)	
	Class 900	8½ (216)	3⅝ (92)	
	Class 1500	8½ (216)	3⅝ (92)	
BS 10	Table D	6 (152)	-	
	Table E	6 (152)	-	
	Table F	6½ (165)	-	
	Table H	6½ (165)	4 (102)	
	Table J	6½ (165)	4 (102)	
	Table K	6½ (165)	4 (102)	
	Table R	6½ (165)	4 (102)	
	Table S	6¾ (171)	3½ (189)	
	Table T	7¼ (184)	4 (102)	

* Flange code 104 not available in pressure rating PN16

** Flange code 113 not available in pressure ratings PN10 and PN25

\+ Bolt lengths shown are for joining loose forged-steel flanges and include an allowance for gaskets etc. When mating loose flanges to integral flanges, check the length of bolt required

x Ensure the bolt specification is suitable for the duty. Studs may be required in lieu of bolts for the higher pressure/temperature applications

	Flange Thickness Code			Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	Code 01, 02, 04*	Code 11, 12, 13, 21**	Code 05				
	16	14	14	110	4	M12	45
	20	18	18	125	4	M16	60
	20	18	18	125	4	M16	60
	20	20	20	125	4	M16	65
	20	20	20	125	4	M16	65

	Height of Raised Face	Thickness of Flange	Hole Diameter	Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	1/16 (2)	3/4 (19)	3/4 (19)	4 3/4 (121)	4	M16	70
	1/16 (2)	7/8 (22)	3/4 (19)	5 (127)	4	M16	75
	1/4 (6)	1 (25)	3/4 (19)	5 (127)	4	M16	110x
	1/4 (6)	1 1/2 (38)	1 (25)	6 1/2 (165)	4	M20	150x
	1/4 (6)	1 1/2 (38)	1 (25)	6 1/2 (165)	4	M20	150x
	-	9/16 (14)	11/16 (17)	4 1/2 (114)	4	M16	50
	-	9/16 (14)	11/16 (17)	4 1/2 (114)	4	M16	50
	-	5/8 (16)	11/16 (17)	5 (127)	4	M16	55
	1/16 (2)	3/4 (19)	11/16 (17)	5 (127)	4	M16	65
	1/16 (2)	1 (25)	7/8 (22)	5 (127)	4	M20	75
	1/16 (2)	1 (25)	11/16 (17)	5 (127)	8	M16	75
	1/16 (2)	1 (25)	11/16 (17)	5 (127)	8	M16	75
	1/16 (2)	1 1/4 (32)	7/8 (22)	5 1/4 (133)	8	M20	90
	1/16 (2)	1 3/8 (35)	7/8 (22)	5 3/4 (146)	8	M20	90

NOMINAL SIZE 65MM (2½")

		Diameter of Flange	Hole Diameter	
BS EN 1092 - Formerly BS 3274	PN6	160	14	
	PN10	185	18	
	PN16	185	18	
	PN25	185	18	
	PN40	185	18	

		Diameter of Flange	Diameter of Raised Face	
ANSI	Class 125/150	7 (178)	4⅛ (105)	
	Class 300	7½ (191)	4⅛ (105)	
	Class 600	7½ (191)	4⅛ (105)	
	Class 900	9⅝ (244)	4⅛ (105)	
	Class 1500	9⅝ (244)	4⅛ (105)	
BS 10	Table D	6½ (165)	-	
	Table E	6½ (165)	-	
	Table F	7¼ (184)	-	
	Table H	7¼ (184)	4½ (144)	
	Table J	7¼ (184)	4½ (144)	
	Table K	7¼ (184)	4½ (144)	
	Table R	7¼ (184)	4½ (144)	
	Table S	7¼ (184)	4 (102)	
	Table T	8 (203)	4½ (144)	

* Flange code 104 not available in pressure rating PN16

** Flange code 113 not available in pressure ratings PN10 and PN25

\+ Bolt lengths shown are for joining loose forged-steel flanges and include an allowance for gaskets etc. When mating loose flanges to integral flanges, check the length of bolt required

x Ensure the bolt specification is suitable for the duty. Studs may be required in lieu of bolts for the higher pressure/temperature applications

	Flange Thickness Code			Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	Code 01, 02, 04*	Code 11, 12, 13, 21**	Code 05				
	16	14	14	130	4	M12	45
	20	18	18	145	4	M16	60
	20	18	18	145	4	M16	60
	22	22	22	145	8	M16	70
	22	22	22	145	8	M16	70

	Height of Raised Face	Thickness of Flange	Hole Diameter	Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	1/16 (2)	7/8 (22)	3/4 (19)	5 1/2 (140)	4	M16	75
	1/16 (2)	1 (25)	7/8 (22)	5 7/8 (149)	8	M20	90
	1/4 (6)	1 1/8 (29)	7/8 (22)	5 7/8 (149)	8	M20	120x
	1/4 (6)	1 5/8 (41)	1 1/8 (29)	7 1/2 (191)	8	M24	165x
	1/4 (6)	1 5/8 (41)	1 1/8 (29)	7 1/2 (191)	8	M24	165x
	-	9/16 (14)	11/16 (17)	5 (127)	4	M16	50
	-	9/16 (14)	11/16 (17)	5 (127)	4	M16	50
	-	5/8 (16)	11/16 (17)	5 3/4 (146)	8	M16	55
	1/16 (2)	3/4 (19)	11/16 (17)	5 3/4 (146)	8	M16	65
	1/16 (2)	1 (25)	7/8 (22)	5 3/4 (146)	8	M20	75
	1/16 (2)	1 1/8 (29)	7/8 (22)	5 3/4 (146)	8	M20	90
	1/16 (2)	1 1/8 (29)	7/8 (22)	5 3/4 (146)	8	M20	90
	1/16 (2)	1 1/4 (32)	7/8 (22)	5 3/4 (146)	8	M20	100
	1/16 (2)	1 5/8 (41)	1 (25)	6 1/2 (165)	8	M20	110

NOMINAL SIZE 80MM (3”)

		Diameter of Flange	Hole Diameter	
BS EN 1092 - Formerly BS 3274	PN6	190	18	
	PN10	200	18	
	PN16	200	18	
	PN25	200	18	
	PN40	200	18	

		Diameter of Flange	Diameter of Raised Face	
ANSI	Class 125/150	7½ (191)	5 (127)	
	Class 300	8¼ (210)	5 (127)	
	Class 600	8¼ (210)	5 (127)	
	Class 900	9½ (241)	5 (127)	
	Class 1500	10½ (267)	5 (127)	
BS 10	Table D	7½ (184)	-	
	Table E	7½ (184)	-	
	Table F	8 (203)	-	
	Table H	8 (203)	5 (127)	
	Table J	8 (203)	5 (127)	
	Table K	8 (203)	5 (127)	
	Table R	8 (203)	5 (127)	
	Table S	8 (203)	4½ (114)	
	Table T	9¼ (235)	5 (127)	

* Flange code 104 not available in pressure rating PN16

** Flange code 113 not available in pressure ratings PN10 and PN25

\+ Bolt lengths shown are for joining loose forged-steel flanges and include an allowance for gaskets etc. When mating loose flanges to integral flanges, check the length of bolt required

x Ensure the bolt specification is suitable for the duty. Studs may be required in lieu of bolts for the higher pressure/temperature applications

	Flange Thickness Code			Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	Code 01, 02, 04*	Code 11, 12, 13, 21**	Code 05				
	18	16	16	150	4	M16	55
	20	20	20	160	8	M16	560
	20	20	20	160	8	M16	60
	24	24	24	160	8	M16	70
	24	24	24	160	8	M16	70

	Height of Raised Face	Thickness of Flange	Hole Diameter	Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	1/16 (2)	15/16 (24)	3/4 (19)	6 (152)	4	M16	75
	1/16 (2)	1 1/8 (29)	7/8 (22)	6 5/8 (168)	8	M20	90
	1/4 (6)	1 1/4 (32)	7/8 (22)	6 5/8 (168)	8	M20	125x
	1/4 (6)	1 1/2 (38)	1 (25)	7 1/2 (192)	8	M20	150x
	1/4 (6)	1 7/8 (48)	1 1/4 (32)	8 (203)	8	M20	180x
	-	9/16 (14)	5 3/4 (146)	11/16 (17)	4	M16	50
	-	9/16 (14)	5 3/4 (146)	11/16 (17)	4	M16	50
	-	5/8 (16)	6 1/2 (165)	11/16 (17)	8	M16	55
	1/16 (2)	7/8 (22)	6 1/2 (165)	11/16 (17)	8	M16	65
	1/16 (2)	1 1/4 (32)	6 1/2 (165)	7/8 (22)	8	M20	75
	1/16 (2)	1 1/4 (32)	6 1/2 (165)	7/8 (22)	8	M20	90
	1/16 (2)	1 1/4 (32)	6 1/2 (165)	7/8 (22)	8	M20	90
	1/16 (2)	1 3/8 (35)	6 1/2 (165)	1 (25)	8	M20	100
	1/16 (2)	1 7/8 (48)	7 1/2 (191)	1 1/8 (29)	8	M20	110

NOMINAL SIZE 100MM (4”)

		Diameter of Flange	Hole Diameter	
BS EN 1092 - Formerly BS 3274	PN6	210	18	
	PN10	220	18	
	PN16	220	18	
	PN25	235	22	
	PN40	235	22	

		Diameter of Flange	Diameter of Raised Face	
ANSI	Class 125/150	9 (229)	6 3/16 (157)	
	Class 300	20 (254)	6 3/16 (157)	
	Class 600	10 3/4 (273)	6 3/16 (157)	
	Class 900	11 1/2 (292)	6 3/16 (157)	
	Class 1500	12 1/4 (311)	6 3/16 (157)	
BS 10	Table D	8 1/2 (216)	-	
	Table E	8 1/2 (216)	-	
	Table F	9 (229)	-	
	Table H	9 (229)	6 (152)	
	Table J	9 (229)	6 (152)	
	Table K	9 1/2 (241)	6 (152)	
	Table R	9 1/2 (241)	6 (152)	
	Table S	9 3/4 (248)	6 1/4 (159)	
	Table T	11 1/2 (286)	6 1/4 (159)	

* Flange code 104 not available in pressure rating PN16

** Flange code 113 not available in pressure ratings PN10 and PN25

\+ Bolt lengths shown are for joining loose forged-steel flanges and include an allowance for gaskets etc. When mating loose flanges to integral flanges, check the length of bolt required

x Ensure the bolt specification is suitable for the duty. Studs may be required in lieu of bolts for the higher pressure/temperature applications

	Flange Thickness Code			Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	Code 01, 02, 04*	Code 11, 12, 13, 21**	Code 05				
	18	16	16	170	4	M16	55
	20	20	20	180	8	M16	65
	22	20	20	180	8	M16	65
	26	24	24	190	8	M20	75
	26	24	24	190	8	M20	80

	Height of Raised Face	Thickness of Flange	Hole Diameter	Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	1/16 (2)	15/16 (24)	3/4 (19)	7 1/2 (192)	8	M16	75
	1/16 (2)	1 1/4 (32)	7/8 (22)	7 7/8 (200)	8	M20	100
	1/4 (6)	1 1/2 (38)	1 (25)	8 1/2 (216)	8	M20	150x
	1/4 (6)	1 3/4 (44)	1 1/4 (32)	9 1/4 (235)	8	M24	175x
	1/4 (6)	2 1/8 (54)	1 3/8 (35)	9 1/2 (241)	8	M24	200x
	-	11/16 (17)	11/16 (17)	7 (178)	4	M16	55
	-	11/16 (17)	11/16 (17)	7 (178)	8	M16	55
	-	3/4 (19)	11/16 (17)	7 1/2 (191)	8	M16	65
	1/16 (2)	1 (25)	11/16 (17)	7 1/2 (191)	8	M16	75
	1/16 (2)	1 3/8 (35)	7/8 (22)	7 1/2 (191)	8	M20	100
	1/16 (2)	1 3/8 (35)	1 (25)	7 3/4 (197)	8	M20	100
	1/16 (2)	1 3/8 (35)	1 (25)	7 3/4 (197)	8	M20	100
	1/16 (2)	1 5/8 (41)	1 1/8 (29)	8 (203)	8	M24	110
	1/16 (2)	2 1/4 (57)	1 1/4 (32)	9 1/4 (235)	8	M30	175

NOMINAL SIZE 125MM (5”)

		Diameter of Flange	Hole Diameter	
BS EN 1092 - Formerly BS 3274	PN6	1450	18	
	PN10	150	18	
	PN16	150	18	
	PN25	170	26	
	PN40	170	26	

		Diameter of Flange	Diameter of Raised Face	
ANSI	Class 125/150	10 (254)	7⅝ (186)	
	Class 300	11 (279)	7⅝ (186)	
	Class 600	13 (330)	7⅝ (186)	
	Class 900	13¾ (349)	7⅝ (186)	
	Class 1500	14¾	7⅝ (186)	
BS 10	Table D	10 (254)	-	
	Table E	10 (254)	-	
	Table F	11 (279)	-	
	Table H	11 (279)	7 (178)	
	Table J	11 (279)	7 (178)	
	Table K	11 (279)	7 (178)	
	Table R	11 (279)	7 (178)	
	Table S	11¼ (286)	7½ (191)	
	Table T	12¾ (324)	8¼ (210)	

* Flange code 104 not available in pressure rating PN16

** Flange code 113 not available in pressure ratings PN10 and PN25

\+ Bolt lengths shown are for joining loose forged-steel flanges and include an allowance for gaskets etc. When mating loose flanges to integral flanges, check the length of bolt required

x Ensure the bolt specification is suitable for the duty. Studs may be required in lieu of bolts for the higher pressure/temperature applications

	Flange Thickness Code			Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	Code 01, 02, 04*	Code 11, 12, 13, 21**	Code 05				
	20	18	18	200	8	M16	60
	22	22	22	210	8	M16	70
	22	22	22	210	8	M16	70
	28	26	26	220	8	M24	80
	28	26	26	220	8	M24	80

	Height of Raised Face	Thickness of Flange	Hole Diameter	Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	1/16 (2)	15/16 (24)	7/8 (22)	8 1/2 (216)	8	M20	90
	1/16 (2)	1 3/8 (35)	7/8 (22)	9 1/4 (235)	8	M20	110
	1/4 (6)	1 3/4 (44)	1 1/8 (29)	10 1/2 (267)	8	M24	165x
	1/4 (6)	2 (51)	1 3/8 (35)	11 (279)	8	M30	200x
	1/4 (6)	2 7/8 (73)	1 5/8 (41)	11 1/2 (292)	8	M36	250x
	-	11/16 (17)	11/16 (17)	8 1/4 (210)	8	M16	55
	-	11/16 (17)	11/16 (17)	8 1/4 (210)	8	M16	55
	-	7/8 (22)	7/8 (22)	9 1/4 (235)	8	M20	75
	1/16 (2)	1 1/8 (29)	7/8 (22)	9 1/4 (235)	8	M20	90
	1/16 (2)	1 1/2 (38)	1 (25)	9 1/4 (235)	8	M20	110
	1/16 (2)	1 5/8 (41)	1 (25)	9 1/4 (235)	12	M20	110
	1/16 (2)	1 5/8 (41)	1 (25)	9 1/4 (235)	12	M20	110
	1/16 (2)	1 3/4 (44)	1 (25)	9 1/4 (235)	12	M20	125
	1/16 (2)	2 5/8 (67)	1 1/4 (32)	10 3/4 (273)	12	M30	180

NOMINAL SIZE 150MM (6”)

		Diameter of Flange	Hole Diameter	
BS EN 1092 - Formerly BS 3274	PN6	265	18	
	PN10	285	22	
	PN16	285	22	
	PN25	300	26	
	PN40	300	26	

		Diameter of Flange	Diameter of Raised Face	
ANSI	Class 125/150	11 (279)	8½ (216)	
	Class 300	12½ (318)	8½ (216)	
	Class 600	14 (356)	8½ (216)	
	Class 900	15 (381)	8½ (216)	
	Class 1500	15½ (394)	8½ (216)	
BS 10	Table D	11 (279)	-	
	Table E	11 (279)	-	
	Table F	12 (305)	-	
	Table H	12 (305)	8¼ (210)	
	Table J	12 (305)	8¼ (210)	
	Table K	12 (305)	8¼ (210)	
	Table R	12 (305)	8¼ (210)	
	Table S	12¾ (324)	8¼ (210)	
	Table T	14¾ (375)	9 (229)	

* Flange code 104 not available in pressure rating PN16

** Flange code 113 not available in pressure ratings PN10 and PN25

\+ Bolt lengths shown are for joining loose forged-steel flanges and include an allowance for gaskets etc. When mating loose flanges to integral flanges, check the length of bolt required

x Ensure the bolt specification is suitable for the duty. Studs may be required in lieu of bolts for the higher pressure/temperature applications

	Flange Thickness Code			Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	Code 01, 02, 04*	Code 11, 12, 13, 21**	Code 05				
	20	18	18	225	8	M16	60
	24	22	22	240	8	M20	70
	24	22	22	240	8	M20	70
	30	28	28	250	8	M24	90
	30	28	28	250	8	M24	90

	Height of Raised Face	Thickness of Flange	Hole Diameter	Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	1/16 (2)	1 (25)	7/8 (22)	9 1/2 (241)	8	M20	90
	1/16 (2)	1 7/16 (37)	7/8 (22)	10 5/8 (270)	12	M20	110
	1/4 (6)	1 7/8 (48)	1 1/8 (29)	11 1/2 (292)	12	M24	165x
	1/4 (6)	2 3/16 (56)	1 1/4 (32)	12 1/2 (318)	12	M30	180x
	1/4 (6)	3 1/4 (83)	1 1/2 (38)	12 1/2 (318)	12	M36	250x
	-	11/16 (17)	11/16 (17)	9 1/4 (235)	8	M16	50
	-	11/16 (17)	7/8 (22)	9 1/4 (235)	8	M20	65
	-	7/8 (22)	7/8 (22)	10 1/4 (360)	12	M20	75
	1/16 (2)	1 1/8 (29)	7/8 (22)	10 1/4 (360)	12	M20	90
	1/16 (2)	1 1/2 (38)	1 (25)	10 1/4 (360)	12	M20	110
	1/16 (2)	1 5/8 (41)	1 (25)	10 1/4 (360)	12	M20	110
	1/16 (2)	1 3/4 (44)	1 (25)	10 1/4 (360)	12	M20	125
	1/16 (2)	2 (51)	1 1/8 (29)	10 3/4 (273)	12	M24	140
	1/16 (2)	2 7/8 (73)	1 3/8 (35)	12 1/2 (318)	12	M30	180

NOMINAL SIZE 200MM (8”)

		Diameter of Flange	Hole Diameter	
BS EN 1092 - Formerly BS 3274	PN6	320	18	
	PN10	340	22	
	PN16	340	22	
	PN25	360	26	
	PN40	375	30	

		Diameter of Flange	Diameter of Raised Face	
ANSI	Class 125/150	13½ (343)	10⅝ (270)	
	Class 300	15 (381)	10⅝ (270)	
	Class 600	16½ (419)	10⅝ (270)	
	Class 900	18½ (470)	10⅝ (270)	
	Class 1500	19 (483)	10⅝ (270)	
BS 10	Table D	13¼ (337)	-	
	Table E	13¼ (337)	-	
	Table F	14½ (368)	-	
	Table H	14½ (368)	10¼ (260)	
	Table J	14½ (368)	10¼ (260)	
	Table K	14½ (368)	10¼ (260)	
	Table R	14½ (368)	10¼ (260)	
	Table S	16¼ (413)	10¼ (260)	
	Table T	18¾ (476)	10¼ (260)	

* Flange code 104 not available in pressure rating PN16

** Flange code 113 not available in pressure ratings PN10 and PN25

\+ Bolt lengths shown are for joining loose forged-steel flanges and include an allowance for gaskets etc. When mating loose flanges to integral flanges, check the length of bolt required

x Ensure the bolt specification is suitable for the duty. Studs may be required in lieu of bolts for the higher pressure/temperature applications

	Flange Thickness Code			Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	Code 01, 02, 04*	Code 11, 12, 13, 21**	Code 05				
	22	20	20	280	8	M16	60
	25	24	24	295	8	M20	75
	26	24	24	295	12	M20	75
	30	30	30	310	12	M24	90
	36	34	34	320	12	M24	100

	Height of Raised Face	Thickness of Flange	Hole Diameter	Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	1/16 (2)	1 1/8 (29)	7/8 (22)	11 3/4 (298)	8	M20	90
	1/16 (2)	1 5/8 (41)	1 (25)	13 (330)	12	M20	120
	1/4 (6)	2 3/16 (56)	1 1/4 (32)	13 3/4 (349)	12	M30	180x
	1/4 (6)	2 1/2 (64)	1 1/2 (38)	15 1/2 (394)	12	M36	225x
	1/4 (6)	3 5/8 (92)	1 3/4 (44)	15 1/2 (394)	12	M42	275x
	-	3/4 (19)	11/16 (17)	11 1/2 (292)	8	M16	55
	-	3/4 (19)	7/8 (22)	11 1/2 (292)	8	M20	65
	-	1 (25)	7/8 (22)	12 3/4 (324)	12	M20	90
	1/16 (2)	1 1/4 (32)	7/8 (22)	12 3/4 (324)	12	M20	90
	1/16 (2)	1 5/8 (41)	1 (25)	12 3/4 (324)	12	M20	110
	1/16 (2)	1 7/8 (48)	1 1/8 (29)	12 1/2 (318)	12	M24	125
	1/16 (2)	2 (51)	1 1/8 (29)	12 3/4 (324)	12	M24	150
	1/16 (2)	2 1/2 (64)	1 3/8 (35)	14 (356)	12	M30	180
	1/16 (2)	3 1/2 (89)	1 5/8 (41)	16 (406)	12	M36	225

NOMINAL SIZE 250MM (10”)

		Diameter of Flange	Hole Diameter	
BS EN 1092 - Formerly BS 3274	PN6	375	18	
	PN10	395	22	
	PN16	405	26	
	PN25	425	30	
	PN40	450	33	

		Diameter of Flange	Diameter of Raised Face	
ANSI	Class 125/150	16 (406)	12¾ (324)	
	Class 300	17½ (445)	12¾ (324)	
	Class 600	20 (508)	12¾ (324)	
	Class 900	21½ (546)	12¾ (324)	
	Class 1500	23 (584)	12¾ (324)	
BS 10	Table D	16 (406)	-	
	Table E	16 (406)	-	
	Table F	17 (432)	-	
	Table H	17 (432)	12¼ (311)	
	Table J	17 (432)	12¼ (311)	
	Table K	17 (432)	12¼ (311)	
	Table R	17 (432)	12¼ (311)	
	Table S	19 (483)	13 (330)	
	Table T	22 (559)	14 (356)	

* Flange code 104 not available in pressure rating PN16

** Flange code 113 not available in pressure ratings PN10 and PN25

\+ Bolt lengths shown are for joining loose forged-steel flanges and include an allowance for gaskets etc. When mating loose flanges to integral flanges, check the length of bolt required

x Ensure the bolt specification is suitable for the duty. Studs may be required in lieu of bolts for the higher pressure/temperature applications

	Flange Thickness Code			Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	Code 01, 02, 04*	Code 11, 12, 13, 21**	Code 05				
	24	22	22	335	12	M16	65
	26	26	26	350	12	M20	75
	29	26	26	355	12	M24	90
	35	32	32	370	12	M27	100
	42	38	38	385	12	M30	110

	Height of Raised Face	Thickness of Flange	Hole Diameter	Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	1/16 (2)	1 3/16 (30)	1 (25)	14 1/4 (362)	12	M20	100
	1/16 (2)	1 7/8 (48)	1 1/8 (29)	15 1/4 (387)	16	M24	150
	1/4 (6)	2 1/2 (64)	1 3/8 (35)	17 (432)	16	M30	215x
	1/4 (6)	2 3/4 (70)	1 1/2 (38)	18 1/2 (470)	16	M36	250x
	1/4 (6)	4 1/4 (108)	2 (51)	19 (483)	12	M48	325x
	-	3/4 (19)	7/8 (22)	14 (356)	8	M20	60
	-	7/8 (22)	7/8 (22)	14 (356)	12	M20	75
	-	1 1/8 (29)	1 (25)	15 (381)	12	M20	90
	1/16 (2)	1 3/8 (35)	1 (25)	15 (381)	12	M20	100
	1/16 (2)	1 7/8 (48)	1 1/8 (29)	15 (381)	12	M24	125
	1/16 (2)	2 (51)	1 1/8 (29)	15 (381)	16	M24	150
	1/16 (2)	2 3/8 (60)	1 1/8 (29)	15 1/4 (387)	16	M24	180
	1/16 (2)	3 1/8 (79)	1 3/8 (35)	16 3/4 (425)	16	M30	200
	1/16 (2)	4 1/4 (108)	1 5/8 (41)	19 1/4 (489)	16	M36	300

NOMINAL SIZE 300MM (12”)

		Diameter of Flange	Hole Diameter	
BS EN 1092 - Formerly BS 3274	PN6	440	22	
	PN10	445	22	
	PN16	460	26	
	PN25	485	30	
	PN40	515	33	

		Diameter of Flange	Diameter of Raised Face	
ANSI	Class 125/150	19 (483)	15 (381)	
	Class 300	20½ (521)	15 (381)	
	Class 600	22 (559)	15 (381)	
	Class 900	24 (610)	15 (381)	
	Class 1500	26½ (673)	15 (381)	
BS 10	Table D	18 (457)	-	
	Table E	18 (457)	-	
	Table F	19¼ (489)	-	
	Table H	19¼ (489)	14¼ (362)	
	Table J	19¼ (489)	14¼ (362)	
	Table K	19¼ (489)	14¼ (362)	
	Table R	20 (508)	14¼ (362)	
	Table S	22¾ (578)	15 (381)	
	Table T	22¾ (654)	16¼ (413)	

* Flange code 104 not available in pressure rating PN16

** Flange code 113 not available in pressure ratings PN10 and PN25

\+ Bolt lengths shown are for joining loose forged-steel flanges and include an allowance for gaskets etc. When mating loose flanges to integral flanges, check the length of bolt required

x Ensure the bolt specification is suitable for the duty. Studs may be required in lieu of bolts for the higher pressure/temperature applications

	Flange Thickness Code			Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	Code 01, 02, 04*	Code 11, 12, 13, 21**	Code 05				
	24	22	22	395	12	M20	70
	26	26	26	400	12	M30	75
	32	28	28	410	12	M30	90
	38	34	34	430	16	M36	110
	48	42	42	450	16	M48	120

	Height of Raised Face	Thickness of Flange	Hole Diameter	Bolt Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Length+
	1/16 (2)	1 1/4 (32)	1 (25)	17 (432)	12	M20	100
	1/16 (2)	2 (51)	1 1/4 (32)	17 3/4 (451)	16	M30	150
	1/4 (6)	2 5/8 (67)	1 3/8 (35)	19 1/4 (489)	20	M30	225x
	1/4 (6)	3 1/8 (79)	1 1/2 (38)	21 (533)	20	M36	250x
	1/4 (6)	4 7/8 (124)	2 1/8 (54)	22 1/2 (571)	16	M48	375x
	-	7/8 (22)	7/8 (22)	16 (406)	12	M20	60
	-	1 (25)	1 (25)	16 (406)	12	M20	90
	-	1 1/4 (32)	1 (25)	17 1/4 (438)	16	M20	90
	1/16 (2)	1 5/8 (41)	1 (25)	17 1/4 (438)	16	M20	125
	1/16 (2)	2 (51)	1 1/8 (29)	17 1/4 (438)	16	M24	150
	1/16 (2)	2 1/4 (57)	1 1/4 (32)	17 (432)	16	M30	150
	1/16 (2)	2 3/4 (70)	1 1/4 (32)	18 (457)	16	M30	165
	1/16 (2)	3 5/8 (92)	1 5/8 (41)	20 (508)	16	M36	215
	1/16 (2)	4 3/4 (121)	1 7/8 (48)	22 1/2 (572)	16	M42	300

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NOMINAL SIZE 400MM (16”)

BS EN 1092	Diameter of Flange	Bolt Circle Diameter	No of Bolts	Diameter of Bolts	Diameter of Holes Iron	Diameter of Holes Steel	
PN6	540	495	16	M20	23	22	
PN10	565	515	16	M24	28	26	
PN16	580	525	16	M27	31	30	
PN25	620	550	16	M33	37	36	
PN40	660	585	16	M36	41	39	
PN64	670	585	16	M39	-	42	
PN100	715	620	16	M45	-	48	
ANSI							
Class 125/150	23½ (597)	21¼ (540)	16	1 (25)	1⅛ (29)	1⅛ (29)	
Class 300	25½ (648)	22½ (571)	20	1¼ (32)	-	1⅜ (35)	
Class 600	27 (686)	23¾ (603)	20	1½ (38)	-	1⅝ (41)	
Class 900	27¾ (705)	24¼ (616)	20	1⅝ (41)	-	1¾ (44)	
Class 1500	32½ (826)	27¾ (705)	16	2½ (64)	-	2⅝ (67)	
BS 10							
Table A	22¾ (578)	20½ (521)	12	⅞ (22)	1 (25)	1 (25)	
Table D	22¾ (578)	20½ (521)	12	⅞ (22)	1 (25)	1 (25)	
Table E	22¾ (578)	20½ (521)	12	⅞ (22)	1 (25)	1 (25)	
Table F	24 (610)	21¾ (552)	20	1 (25)	1⅛ (29)	1⅛ (29)	
Table H	24 (610)	21¾ (552)	20	1 (25)	1⅛ (29)	1⅛ (29)	

1. These flange thicknesses are also valid for ductile iron flanges type 21-2
2. For ductile iron pipes and fittings, the outside diameters shall be: for PN10, D = 455mm, for PN16, D = 455mm
3. Copper-alloy flanges are always flat-faced

	Diameter of Raised Face(3) Iron	Diameter of Raised Face(3) Steel	Height of Raised Face(3) Iron	Height of Raised Face(3) Steel	Thickness Of Flange			
					Grey Cast Iron	Copper Alloy	Cast & Forged Steel	Ductile Cast Iron
	463	465	4	2	28 (1)	-	22	-
	480	482	4	2	32 (1)	-	26	24.5
	480	490	4	2	38 (1)	-	32	28
	503	505	4	2	48 (1)	-	40	32
	535	535	4	2	-	-	50	48
	-	535	-	2	-	-	60	-
	-	535	-	2	-	-	78	-
	-	18½ (470)	-	1/16 (2)	1 7/16 (37)	-	1 7/16 (37)	-
	-	18½ (470)	-	1/16 (2)	-	-	2¼(57)	-
	-	18½ (470)	-	¼ (6)	-	-	3 (76)	-
	-	18½ (470)	-	¼ (6)	-	-	3½ (89)	-
	-	18½ (470)	-	¼ (6)	-	-	5¾ (146)	-
	-	-	-	-	1 1/16 (27)	1 (25)	-	-
	-	-	-	-	1⅛ (29)	1 (25)	1 (25)	-
	-	-	-	-	1¼ (32)	1 (25)	1 (25)	-
	-	-	-	-	1⅜ (35)	1¼ (32)	1¼ (32)	-
	-	19 (483)	-	1/16 (2)	2 (51)	1¾ (44)	1¾ (44)	-

NOMINAL SIZE 450MM (18”)

BS EN 1092	Diameter of Flange	Bolt Circle Diameter	No of Bolts	Diameter of Bolts	Diameter of Holes Iron	Diameter of Holes Steel	
PN6	595	550	16	M20	23	22	
PN10	615	565	20	M24	28	26	
PN16	640	585	20	M27	31	30	
PN25	670	600	20	M33	37	36	
PN40	685	610	20	M36	41	39	
PN64	-	-	-	-	-	-	
PN100	-	-	-	-	-	-	
ANSI							
Class 125/150	25 (635)	22¾ (578)	16	1⅛ (29)	1¼ (32)	1¼ (32)	
Class 300	28 (711)	24¾ (629)	24	1¼ (32)	-	1⅜ (35)	
Class 600	29¼ (743)	25¾ (654)	20	1⅝ (41)	-	1¾ (44)	
Class 900	31 (787)	27 (686)	20	1⅞ (48)	-	2 (51)	
Class 1500	36 (914)	30½ (775)	16	2¾ (70)	-	2⅞ (73)	
BS 10							
Table A	25¼ (641)	23 (584)	12	⅞ (22)	-	1 (25)	
Table D	25¼ (641)	23 (584)	12	⅞ (22)	-	1 (25)	
Table E	25¼ (641)	23 (584)	16	⅞ (22)	-	1 (25)	
Table F	26½ (673)	24 (610)	20	1⅛ (29)	-	1¼ (32)	
Table H	26½ (673)	24 (610)	20	1⅛ (29)	-	1¼ (32)	

1. These flange thicknesses are also valid for ductile iron flanges type 21-2
2. Flange thicknesses for copper alloy are from BS EN 1092 - Formerly BS 3274
3. Copper-alloy flanges are always flat-faced

	Diameter of Raised Face(3) Iron	Diameter of Raised Face(3) Steel	Height of Raised Face(3) Iron	Height of Raised Face(3) Steel	Thickness Of Flange			
					Grey Cast Iron	Copper Alloy	Cast & Forged Steel	Ductile Cast Iron
	518	520	4	2	28 (1)	-	22	-
	530	532	4	2	32 (1)	-	28	25.5
	548	550	4	2	40 (1)	-	40	30
	548	555	4	2	50 (1)	-	46	34.5
	560	560	4	2	-	-	57	49
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	21 (533)	-	1/16 (2)	1 9/16 (40)	-	1 9/16 (40)	-
	-	21 (533)	-	1/16 (2)	-	-	2 3/8 (60)	-
	-	21 (533)	-	1/4 (6)	-	-	3 1/4 (83)	-
	-	21 (533)	-	1/4 (6)	-	-	4 (102)	-
	-	21 (533)	-	1/4 (6)	-	-	6 3/8 (162)	-
	-	-	-	-	1 1/16 (27)	1/16 (27)	-	-
	-	-	-	-	1 1/4 (32)	1 1/8 (29)	1 1/8 (29)	-
	-	-	-	-	1 3/8 (35)	1 1/8 (29)	1 1/8 (29)	-
	-	-	-	-	1 1/2 (38)	1 3/8 (35)	1 3/8 (35)	-
	-	21 (533)	-	1/16 (2)	2 1/8 (54)	1 7/8 (48)	1 7/8 (48)	-

NOMINAL SIZE 500MM (20”)

BS EN 1092	Diameter of Flange	Bolt Circle Diameter	No of Bolts	Diameter of Bolts	Diameter of Holes Iron	Diameter of Holes Steel	
PN6	645	600	20	M20	23	22	
PN10	670	620	20	M24	28	26	
PN16	715	650	20	M30	34	33	
PN25	730	660	20	M33	37	36	
PN40	755	670	20	M39	44	42	
PN64	800	705	20	M45	-	48	
PN100	870	760	20	M52	-	56	
ANSI							
Class 125/150	27½ (699)	25 (635)	20	1⅛ (29)	1¼ (32)	1¼ (32)	
Class 300	30½ (775)	27 (686)	24	1¼ (32)	-	1⅜ (35)	
Class 600	32 (813)	28½ (724)	24	1⅝ (41)	-	1¾ (44)	
Class 900	33¾ (857)	29½ (749)	20	2 (51)	-	2⅛ (54)	
Class 1500	38¾ (984)	32¾ (832)	16	3 (76)	-	3⅛ (79)	
BS 10							
Table A	27¾ (705)	25¼ (641)	12	⅞ (22)	1 (25)	1 (25)	
Table D	27¾ (705)	25¼ (641)	16	⅞ (22)	1 (25)	1 (25)	
Table E	27¾ (705)	25¼ (641)	16	⅞ (22)	1 (25)	1 (25)	
Table F	29 (737)	26½ (673)	24	1⅛ (29)	1¼ (32)	1¼ (32)	
Table H	29 (737)	26½ (673)	24	1⅛ (29)	1¼ (32)	1¼ (32)	

1. These flange thicknesses are also valid for ductile iron flanges type 21-2
2. These flange thicknesses are changed substantially as a result of the flange calculation method used in BS EN 1092-1
3. Copper-alloy flanges are always flat-faced

	Diameter of Raised Face(3) Iron	Diameter of Raised Face(3) Steel	Height of Raised Face(3) Iron	Height of Raised Face(3) Steel	Thickness Of Flange			
					Grey Cast Iron	Copper Alloy	Cast & Forged Steel	Ductile Cast Iron
	568	570	4	2	30 (1)	-	24 (2)	-
	582	585	4	2	34 (1)	-	28 (2)	26.5
	609	610	4	2	42 (1)	-	44 (2)	31.5
	609	615	4	2	52 (1)	-	48 (2)	36.5
	615	615	4	2	-	-	57 (2)	52
	-	615	-	2	-	-	68 (2)	-
	-	615	-	2	-	-	94 (2)	-
	-	23 (584)	-	1/16 (2)	1 1/16 (43)	-	1 1/16 (43)	-
	-	23 (584)	-	1/16 (2)	-	-	2½ (64)	-
	-	23 (584)	-	¼ (6)	-	-	3½ (89)	-
	-	23 (584)	-	¼ (6)	-	-	4¼ (108)	-
	-	23 (584)	-	¼ (6)	-	-	7 (178)	-
	-	-	-	-	1⅛ (29)	1⅛ (29)	-	-
	-	-	-	-	1¼ (32)	1¼ (32)	-	-
	-	-	-	-	1½ (38)	1¼ (32)	1¼ (32)	-
	-	-	-	-	1⅝ (41)	1½ (38)	1½ (38)	-
	-	23½ (597)	-	1/16 (2)	2¼(57)	2 (51)	2 (51)	-

NOMINAL SIZE 600MM (24”)

BS EN 1092	Diameter of Flange	Bolt Circle Diameter	No of Bolts	Diameter of Bolts	Diameter of Holes Iron	Diameter of Holes Steel	
PN6	755	705	20	M24	28	26	
PN10	780	725	20	M27	31	30	
PN16	840	770	20	M33	37	36	
PN25	845	770	20	M36	41	39	
PN40	890	795	20	M45	50	48	
PN64	930	820	20	M52	-	56	
ANSI							
Class 125/150	32 (813)	29½ (749)	20	1¼ (32)	1⅜ (35)	1⅜ (35)	
Class 300	36 (914)	32 (813)	24	1½ (38)	-	1⅝ (41)	
Class 600	37 (940)	33 (838)	24	1⅞ (48)	-	2 (51)	
Class 900	41 (1041)	35½ (902)	20	2½ (64)	-	2⅝ (67)	
Class 1500	46 (1168)	39 (991)	16	3½ (89)	-	3⅝ (92)	
BS 10							
Table A	32½ (826)	29¾ (756)	12	1 (25)	1⅛ (29)	1⅛ (29)	
Table D	32½ (826)	29¾ (756)	16	1 (25)	1⅛ (29)	1 ⅛ (29)	
Table E	32½ (826)	29¾ (756)	16	1⅛ (29)	1¼ (32)	1¼ (32)	
Table F	33½ (851)	30¾ (781)	24	1¼ (32)	1¼ (32)	1⅜ (35)	
Table H	33½ (851)	30¾ (781)	24	1¼ (32)	1⅜ (35)	1⅜ (35)	

1. These flange thicknesses are also valid for ductile iron flanges type 21-2
2. These flange thicknesses are changed substantially as a result of the flange calculation method used in BS EN 1092-1
3. Copper-alloy flanges are always flat-faced

	Diameter of Raised Face(3) Iron	Diameter of Raised Face(3) Steel	Height of Raised Face(3) Iron	Height of Raised Face(3) Steel	Thickness Of Flange			
					Grey Cast Iron	Copper Alloy	Cast & Forged Steel	Ductile Cast Iron
	667	670	5	2	30 (1)	-	30	-
	682	685	5	2	36 (1)	-	34	30
	720	720	5	2	48 (1)	-	54	36
	720	725	5	2	-	-	58	42
	735	735	5	2	-	-	72	58
	-	735	-	2	-	-	76	-
	-	27¼ (692)	-	1/16 (2)	1⅞ (48)	-	1⅞ (48)	-
	-	27¼ (692)	-	1/16 (2)	-	-	2¾ (70)	-
	-	27¼ (692)	-	¼ (6)	-	-	4 (102)	-
	-	27¼ (692)	-	¼ (6)	-	-	5½ (140)	-
	-	27¼ (692)	-	¼ (6)	-	-	8 (203)	-
	-	-	-	-	1 3/16 (30)	1 3/16 (30)	-	-
	-	-	-	-	1⅜ (35)	1⅜ (35)	1⅜ (35)	-
	-	-	-	-	1⅝ (41)	1½ (38)	1½ (38)	-
	-	-	-	-	1¾ (44)	1⅝ (41)	1⅝ (41)	-
	-	27½ (699)	-	1/16 (2)	2½ (64)	2¼(57)	2¼(57)	-

NOMINAL SIZE 700MM (28”)

FLANGE TYPE		FLANGE DIMENSIONS			
Standard	Class Rating Table	Outside Diameter	Raised Face Diameter	Thickness	
				Iron	
DIN 2501-Part 1 (PN6-100) BS ISO 7005-1:2011 - Formerly BS 4504 (PN6-40) BS EN 1092 - Formerly BS 3274-Section 3.2:1989 (PN6-40)	PN6	860	775	32	
	PN10	895	800	40	
	PN16	910	795	54	
	PN25	960	820	-	
	PN40	995	840	-	
	PN64	1045	840	-	
	PN100	1145	840	-	

NOMINAL SIZE 800MM (32”)

FLANGE TYPE		FLANGE DIMENSIONS			
Standard	Class Rating Table	Outside Diameter	Raised Face Diameter	Thickness	
				Iron	
DIN 2501-Part 1 (PN6-100) BS ISO 7005-1:2011 - Formerly BS 4504 (PN6-40) BS EN 1092 - Formerly BS 3274-Section 3.2:1989 (PN6-40)	PN6	975	880	34	
	PN10	1015	905	44	
	PN16	1025	900	58	
	PN25	1085	930	-	
	PN40	1140	960	-	
	PN64	1165	960	-	
	PN100	-	-	-	

		BOLT DATA				
	Thickness	Bolt Circle Diameter	No. of Bolts	Bolt Size		Hole Size
	Steel			Metric	Inch	
	34	810	24	M24	-	26
	46	840	24	M27	-	30
	58	840	24	M33	-	36
	-	875	24	M39	-	42
	-	900	24	M45	-	48
	-	935	24	M52	-	56
	-	1020	24	M64	-	70

		BOLT DATA				
	Thickness	Bolt Circle Diameter	No. of Bolts	Bolt Size		Hole Size
	Steel			Metric	Inch	
	38	920	24	M27	-	29.5
	52	950	24	M30	-	33
	64	950	24	M36	-	39
	-	990	24	M45	-	48
	-	1030	24	M52	-	56
	-	1050	24	M56	-	62
	-	-	-	-	-	-

NOMINAL SIZE 900MM (36”)

FLANGE TYPE		FLANGE DIMENSIONS			
Standard	Class Rating Table	Outside Diameter	Raised Face Diameter	Thickness	
				Iron	
DIN 2501-Part 1 (PN6-100) BS ISO 7005-1:2011 - Formerly BS 4504 (PN6-40) BS EN 1092 - Formerly BS 3274-Section 3.2:1989 (PN6-40)	PN6	1075	980	36	
	PN10	1115	1005	46	
	PN16	1125	1000	62	
	PN25	1185	1030	55.5	
	PN40	1285	1070	-	
	PN64	1285	1070	-	
	PN100	-	-	-	

NOMINAL SIZE 1000MM (40”)

FLANGE TYPE		FLANGE DIMENSIONS			
Standard	Class Rating Table	Outside Diameter	Raised Face Diameter	Thickness	
				Iron	
DIN 2501-Part 1 (PN6-100) BS ISO 7005-1:2011 - Formerly BS 4504 (PN6-40) BS EN 1092 - Formerly BS 3274-Section 3.2:1989 (PN6-40)	PN6	1175	1080	36	
	PN10	1230	1110	50	
	PN16	1255	1115	66	
	PN25	1320	1140	60	
	PN40	1360	1180	-	
	PN64	1415	1180	-	
	PN100	-	-	-	

		BOLT DATA				
	Thickness	Bolt Circle Diameter	No. of Bolts	Bolt Size		Hole Size
	Steel			Metric	Inch	
	42	1020	24	M27	-	30
	56	1050	28	M30	-	33
	72	1050	28	M36	-	39
	58	1090	28	M45	-	48
	-	1170	28	M52	-	56
	-	1170	28	M56	-	62
	-	-	-	-	-	-

		BOLT DATA				
	Thickness	Bolt Circle Diameter	No. of Bolts	Bolt Size		Hole Size
	Steel			Metric	Inch	
	46	1120	28	M27	-	30
	62	1160	28	M33	-	36
	78	1170	28	M39	-	42
	-	1210	28	M52	-	56
	-	1250	28	M52	-	56
	-	1290	28	M64	-	70
	-	-	-	-	-	-

NOMINAL SIZE 1200MM (48")

FLANGE TYPE		FLANGE DIMENSIONS			
Standard	Class Rating Table	Outside Diameter	Raised Face Diameter	Thickness	
				Iron	
DIN 2501-Part 1 (PN6-100) ISO 7005-1:1992 (PN6-40) BS EN 1092 - Formerly BS 3274-Section 3.2:1989 (PN6-40)	PN6	1405	1295	40	
	PN10	1455	1330	56	
	PN16	1485	1330	-	
	PN25	1530	1350	-	
	PN40	1575	1380	-	
	PN64	1665	1380	-	
	PN100	-	-	-	

NOMINAL SIZE 1400MM (56")

FLANGE TYPE		FLANGE DIMENSIONS			
Standard	Class Rating Table	Outside Diameter	Raised Face Diameter	Thickness	
				Iron	
DIN 2501-Part 1 (PN6-100) ISO 7005-1:1992 (PN6-40) BS EN 1092 - Formerly BS 3274-Section 3.2:1989 (PN6-40)	PN6	1630	1510	-	
	PN10	1675	1535	-	
	PN16	1685	1530	-	
	PN25	1755	1560	-	
	PN40	1795	1600	-	
	PN64	-	-	-	
	PN100	-	-	-	

		BOLT DATA				
	Thickness	Bolt Circle Diameter	No. of Bolts	Bolt Size		Hole Size
	Steel			Metric	Inch	
	56	1340	32	M30	-	33
	74	1380	32	M36	-	39
	94	1390	32	M45	-	48
	-	1420	32	M52	-	56
	-	1460	32	M56	-	62
	-	1530	32	M72	-	78
	-	-	-	-	-	-

		BOLT DATA				
	Thickness	Bolt Circle Diameter	No. of Bolts	Bolt Size		Hole Size
	Steel			Metric	Inch	
	-	1560	36	M33	-	36
	-	1590	36	M39	-	42
	-	1590	36	M45	-	48
	-	1640	36	M56	-	60
	-	1680	36	M56	-	62
	-	-	-	-	-	-
	-	-	-	-	-	-

NOMINAL SIZE 1600MM (64”)

FLANGE TYPE		FLANGE DIMENSIONS			
Standard	Class Rating Table	Outside Diameter	Raised Face Diameter	Thickness	
				Iron	
DIN 2501-Part 1 (PN6-100) ISO 7005-1:1992 (PN6-40) BS EN 1092 - Formerly BS 3274-Section 3.2:1989 (PN6-40)	PN6	1830	1710	-	
	PN10	1915	1760	-	
	PN16	1930	1750	-	
	PN25	1975	1780	-	
	PN40	2025	1815	-	
	PN64	-	-	-	
	PN100	-	-	-	

NOMINAL SIZE 1800MM (72”)

FLANGE TYPE		FLANGE DIMENSIONS			
Standard	Class Rating Table	Outside Diameter	Raised Face Diameter	Thickness	
				Iron	
DIN 2501-Part 1 (PN6-100) ISO 7005-1:1992 (PN6-40) BS EN 1092 - Formerly BS 3274-Section 3.2:1989 (PN6-40)	PN6	2045	1920	-	
	PN10	2115	1960	-	
	PN16	2130	1950	-	
	PN25	2195	1985	-	
	PN40	-	-	-	
	PN64	-	-	-	
	PN100	-	-	-	

		BOLT DATA				
	Thickness	Bolt Circle Diameter	No. of Bolts	Bolt Size		Hole Size
	Steel			Metric	Inch	
	-	1760	40	M33	-	36
	-	1820	40	M45	-	48
	-	1820	40	M52	-	56
	-	1860	40	M56	-	60
	-	1900	40	M64	-	70
	-	-	-	-	-	-
	-	-	-	-	-	-

		BOLT DATA				
	Thickness	Bolt Circle Diameter	No. of Bolts	Bolt Size		Hole Size
	Steel			Metric	Inch	
	-	1970	44	M36	-	39
	-	2020	44	M45	-	48
	-	2020	44	M52	-	56
	-	-	-	-	-	-
	-	2070	44	M64	-	69
	-	-	-	-	-	-
	-	-	-	-	-	-

GREY CAST IRON AND COPPER ALLOY

TYPICAL MATERIALS FOR[1]						
Nominal Pressure (bar gauge)	Flanges		-200 to -101	-100 to -51	-50 to -31	
	Cast Iron	Copper Alloy				
2.5	BS EN 1561 - Formerly ASTM A409 Grade 10					
	BS EN 1561 - Formerly ASTM A409 Grade 12					
6	BS EN 1561 - Formerly ASTM A409 Grade 10					
	BS EN 1561 - Formerly ASTM A409 Grade 12					
10	BS EN 1561 - Formerly ASTM A409 Grade 10					
	BS EN 1561 - Formerly ASTM A409 Grade 12					
16	BS EN 1561 - Formerly ASTM A409 Grade 12	BS EN 1982 - Formerly ASTM A405 LG 2 C	16	16	16	
25	BS EN 1561 - Formerly ASTM A409 Grade 14	BS EN 1982 - Formerly ASTM A405 LG 2 C	25	25	25	
40		BS EN 1982 - Formerly ASTM A405 LG 2C	40	40	40	

[1] See relevant British Standards for materials referred to in this table.

[2] Intermediate values can be obtained by linear interpolation.

[3] Application of these ratings is dependent upon bolting materials and other factors. Refer to BS EN 1092 - Formerly BS 3274 Table A2

DESIGN PRESSURE (BAR GAUGE) AT TEMPERATURE °C [2, 3]									
	-3 to -11	-10 to 120	150	180	200	220	250	260	300
		2.5							
		2.5	2.3	2	2	2	1.8	1.7	1.5
		6							
		6	5.6	5.2	5	5	4.5	4.3	3.6
		10							
		10	9.2	8.5	8	8	7	6.8	6
		16	14.8	13.9	13	13	11	10.8	10
	16	16	16	16	13.5	11.3	8	7	
	25	25	23	21.2	20	19	18	17.5	16
		25	25	25	21.2	17.5	12.2	10.5	
	40	40	38.5	34	30	25.5	19.5	17.5	

TYPICAL MATERIALS FOR[1]			
Nominal Pressure (bar gauge)	Flanges		
	Steel Forgings	Copper Alloy	
2.5	BS EN 10213 - Formerly ASTM A515-503 LT100	BS EN 10213 - Formerly ASTM A53-503[3]	
	BS EN 10213 - Formerly ASTM A515-224-28A LT 50	BS EN 10213 - Formerly ASTM A53-161 A[3]	
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A	BS EN 10213 - Formerly ASTM A53-161A	
	070 M20		
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A	BS EN 10213 - Formerly ASTM A53-161A	
6	BS EN 10213 - Formerly ASTM A515-503 LT 100	BS EN 10213 - Formerly ASTM A53-503[3]	
	BS EN 10213 - Formerly ASTM A515-224-28ALT50	BS EN 10213 - Formerly ASTM A53-161 A[3]	
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A	BS EN 10213 - Formerly ASTM A53-161 A	
	070 M20		
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A	BS EN 10213 - Formerly ASTM A53-161 A	
10	BS EN 10213 - Formerly ASTM A515-503 LT 100	BS EN 10213 - Formerly ASTM A53-503[3]	
	BS EN 10213 - Formerly ASTM A515-224-28A LT 50	BS EN 10213 - Formerly ASTM A53-161 A*	
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A	BS EN 10213 - Formerly ASTM A53-161A	
	070 M20		
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A	BS EN 10213 - Formerly ASTM A53-161A	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
16	BS EN 10213 - Formerly ASTM A515-503 LT 100	BS EN 10213 - Formerly ASTM A53-503[3]	
	BS EN 10213 - Formerly ASTM A515-224-28ALT50	BS EN 10213 - Formerly ASTM A53-161 A[3]	
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A		
	070 M20	BS EN 10213 - Formerly ASTM A53-161A	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	

[1] See relevant British Standards for materials referred to in this table.

[2] Application of these ratings is dependent upon bolting materials and other factors. Refer to BS 4504 Table A1.

[3] These tables do not include changes contained in amendment AMD 861 published 1 5.2.72 Refer to BS 4504 Table A2

	DESIGN PRESSURE (BAR GAUGE) AT TEMPERATURE °C [2]								
	-100 to -51	-50 to -31	-30 to -11	-10 to 120	200	250	300	350	400
	2.5	2.5	2.5	2.5					
		2.5	2.5	2.5					
			2.5	2.5					
				2.5	2	1.8	1.5		
	6	6	6	6					
		6	6	6					
			6	6					
				6	5	4.5			
				6	5	5.5	5		
	10	10	10	10					
		10	10	10					
			10	10					
				10	8	7			
				10	10	9	8		
				10	10	9	8	7	6
	16	16	16	16					
		16	16	16					
			16	16					
				16	14	13			
				16	16	15	13	11	9

* Specification for castings subject to impact tests are not yet available. In the meantime, the impact testing of castings shall be the subject of special agreement between the purchaser and the manufacturer.

TYPICAL MATERIALS FOR[1]			
Nominal Pressure (bar gauge)	Flanges		
	Steel Forgings	Copper Alloy	
25	BS EN 10213 - Formerly ASTM A515-503 LT100	BS EN 10213 - Formerly ASTM A53-503*	
	BS EN 10213 - Formerly ASTM A515-224-28A LT 50	BS EN 10213 - Formerly ASTM A53-161 A[3]	
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A	BS EN 10213 - Formerly ASTM A53-161A	
	070 M20		
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	
40	BS EN 10213 - Formerly ASTM A515-503 LT 100	BS EN 10213 - Formerly ASTM A53-503[3]	
	BS EN 10213 - Formerly ASTM A515-224-28A LT 50	BS EN 10213 - Formerly ASTM A53[3]	
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A	BS EN 10213 - Formerly ASTM A53-161A	
	070 M20		
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	

[1] See relevant British Standards for materials referred to in this table.

[2] Application of these ratings is dependent upon bolting materials and other factors.

[3] These tables do not include changes contained in amendment AMD 861 published 1 5.2.72
Refer to BS 4504 Table A2

	DESIGN PRESSURE (BAR GAUGE) AT TEMPERATURE °C [2]															
	-100 to -51	-50 to -31	-30 to -11	-10 to 120	200	250	300	350	400	425	450	475	500	510	520	530
	25	25	25	25												
		25	25	25												
			25	25												
				25	20	18										
				25	25	24	21	17	14							
					25	24	21	17	14	12	9	6				
						25	22	20	19	18	17	14				
						25	22	20	19	18	17	14	10	9		
							25	24	23	22	21	20	18	15		
							26	24	23	22	21	20	18	15	12	9
	40	40	40	40												
		40	40	40												
			40	40												
				40	32	28										
				40	40	38	33	28	23							
					40	38	33	28	23	20	15	10				
						40	35	31	30	29	28	22				
						40	35	31	30	29	28	22	17	15		
							40	38	36	35	34	33	29	24		
							40	38	36	35	34	33	29	24	19	15

* Specification for castings subject to impact tests are not yet available. In the meantime, the impact testing of castings shall be the subject of special agreement between the purchaser and the manufacturer.

TYPICAL MATERIALS FOR[1]			
Nominal Pressure (bar gauge)	Flanges		
	Steel Forgings	Copper Alloy	
64	BS EN 10213 - Formerly ASTM A515-503 LT 100	BS EN 10213 - Formerly ASTM A53-503[3]	
	BS EN 10213 - Formerly ASTM A515-224-28ALT50	BS EN 10213 - Formerly ASTM A53[3]	
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A	BS EN 10213 - Formerly ASTM A53-161A	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	
100	BS EN 10213 - Formerly ASTM A515-503 LT 100	BS EN 10213 - Formerly ASTM A53-503[3]	
	BS EN 10213 - Formerly ASTM A515-224-28A LT50	BS EN 10213 - Formerly ASTM A53-161A[3]	
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A	BS EN 10213 - Formerly ASTM A53-161A	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	

[1] See relevant British Standards for materials referred to in this table.

[2] Application of these ratings is dependent upon bolting materials and other factors.

[3] These tables do not include changes contained in amendment AMD 861 published 1 5.2.72
Refer to BS 4504 Table A2

	DESIGN PRESSURE (BAR GAUGE) AT TEMPERATURE °C [2]															
	-100 to -51	-50 to -31	-30 to -11	-10 to 120	200	250	300	350	400	425	450	475	500	510	520	530
	64	64	64	64												
		64	64	64												
			64	64												
				64	64	61	53	44	36							
					64	61	53	44	36	32	24	16				
						64	56	50	47	46	45	36				
						64	56	50	47	46	45	36	27	24		
							64	61	58	57	56	53	47	40		
							64	61	58	57	56	53	47	40	32	25
	100	100	100	100												
		100	100	100												
			100	100												
				100	100	95	82	70	57							
				100	100	95	82	70	57	50	37	25				
						100	87	78	74	72	70	57				
						100	87	78	74	72	70	57	42	36		
							100	95	91	89	87	82	74	62		
							100	95	91	89	97	82	74	62	49	38

* Specification for castings subject to impact tests are not yet available. In the meantime, the impact testing of castings shall be the subject of special agreement between the purchaser and the manufacturer.

TYPICAL MATERIALS FOR[1]			
Nominal Pressure (bar gauge)	Flanges		
	Steel Forgings	Copper Alloy	
160	BS EN 10213 - Formerly ASTM A515-503 LT 100	BS EN 10213 - Formerly ASTM A53-503[3]	
	BS EN 10213 - Formerly ASTM A515-224-28ALT50	BS EN 10213 - Formerly ASTM A53[3]	
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A	BS EN 10213 - Formerly ASTM A53-161A	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	
	BS EN 10213 - Formerly ASTM A515-622	BS EN 10213 - Formerly ASTM A53-622	
250	BS EN 10213 - Formerly ASTM A515-503 LT 100	BS EN 10213 - Formerly ASTM A53-503[3]	
	BS EN 10213 - Formerly ASTM A515-224-28A LT50	BS EN 10213 - Formerly ASTM A53-161A[3]	
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A	BS EN 10213 - Formerly ASTM A53-161A	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	
	BS EN 10213 - Formerly ASTM A515-622	BS EN 10213 - Formerly ASTM A53-622	

[1] See relevant British Standards for materials referred to in this table.

[2] Application of these ratings is dependent upon bolting materials and other factors.

[3] These tables do not include changes contained in amendment AMD 861 published 1 5.2.72
Refer to BS 4504 Table A2

	DESIGN PRESSURE (BAR GAUGE) AT TEMPERATURE °C [2]																	
	-100 to -51	-50 to -31	-30 to -11	-10 to 120	200	250	300	350	400	425	450	475	500	510	520	530	540	550
	160	160	160	160														
		160	160	160														
			160	160														
				160	160	152	132	112	92									
				160	160	152	132	112	92	80	60	40						
						160	139	125	118	115	112	90						
						160	139	125	118	115	112	90	68	60				
							160	153	146	142	139	132	118	100				
							160	153	146	142	139	132	118	100	79	62	46	35
							160	153	146	142	139	132	118	100	79	70	61	52
	250	250	250	250														
		250	250	250														
			250	250														
				250	250	238	206	174	142									
				250	250	238	206	174	142	125	95	64						
						250	217	195	185	179	174	139						
						250	217	195	185	179	174	139	104	90				
							250	238	227	223	217	206	184	154				
							250	238	227	223	217	206	184	154	124	97	73	54
							250	238	227	223	217	206	184	154	124	108	95	81

* Specification for castings subject to impact tests are not yet available. In the meantime, the impact testing of castings shall be the subject of special agreement between the purchaser and the manufacturer.

TYPICAL MATERIALS FOR[1]			
Nominal Pressure (bar gauge)	Flanges		
	Steel Forgings	Copper Alloy	
320	BS EN 10213 - Formerly ASTM A515-503 LT 100	BS EN 10213 - Formerly ASTM A53-503[3]	
	BS EN 10213 - Formerly ASTM A515-224-28ALT50	BS EN 10213 - Formerly ASTM A53[3]	
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A	BS EN 10213 - Formerly ASTM A53-161A	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	
	BS EN 10213 - Formerly ASTM A515-622	BS EN 10213 - Formerly ASTM A53-622	
400	BS EN 10213 - Formerly ASTM A515-503 LT 100	BS EN 10213 - Formerly ASTM A53-503[3]	
	BS EN 10213 - Formerly ASTM A515-224-28A LT50	BS EN 10213 - Formerly ASTM A53-161 A*	
	BS EN 10213 - Formerly ASTM A515-161 Grade 26A	BS EN 10213 - Formerly ASTM A53-161A	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-161 Grade 28A	BS EN 10213 - Formerly ASTM A53-161B	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-271A	BS EN 10213 - Formerly ASTM A53-240	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	
	BS EN 10213 - Formerly ASTM A515-621	BS EN 10213 - Formerly ASTM A53-621	
	BS EN 10213 - Formerly ASTM A515-622	BS EN 10213 - Formerly ASTM A53-622	

[1] See relevant British Standards for materials referred to in this table.

[2] Application of these ratings is dependent upon bolting materials and other factors.

[3] These tables do not include changes contained in amendment AMD 861 published 1 5.2.72
Refer to BS 4504 Table A2

	DESIGN PRESSURE (BAR GAUGE) AT TEMPERATURE °C [2]																	
	-100 to -51	-50 to -31	-30 to -11	-10 to 120	200	250	300	350	400	425	450	475	500	510	520	530	540	550
	320	320	320	320														
		320	520	320														
			320	320														
				320	320	305	264	222	180									
					320	305	264	222	180	160	120	80						
						320	278	250	236	230	222	176						
						320	278	250	236	230	222	176	131	113				
							320	304	292	285	278	264	237	200				
							320	304	292	285	278	264	237	200	158	124	93	69
							320	304	292	285	278	264	237	200	158	139	121	104
	400	400	400	400														
		400	400	400														
			400	400														
				400	400	382	330	278	226									
						382	330	278	226	200	150	100						
						400	348	312	296	286	278	222						
						400	348	312	296	286	278	222	166	143				
							400	380	364	356	348	330	295	250				
							400	380	364	356	348	330	295	250	198	155	116	87
							400	380	364	356	348	330	295	250	198	174	151	130

* Specification for castings subject to impact tests are not yet available. In the meantime, the impact testing of castings shall be the subject of special agreement between the purchaser and the manufacturer.

GREY CAST IRON

TEMPERATURE							
Table	°F	0 to 250	0 to 300	0 to 350	0 to 375	0 to 430	Maximum Hydraulic Test Pressure (lbf/in²)
	°C	-17.8 to 121.1	-17.8 to 148.9	-17.8 to 176.7	-17.8 to 190.6	-17.8 to 221	

PRESSURE (LBF/IN²)							
	Boiler Feed Pipe Installations, etc. Steam						
A*	50 ‡§ǁ				25†		100
D	100 ‡§	75			50		200
E	200 ‡§		150		100		400
F	300 §			200	190**		600
H	500 §	(BS EN 13480-1 - Formerly BS 3602¶ limits the use of CI feed pipes to 200 lbf/in²)			190††		1000

* In sizes 27" to 48" inclusive, it is recommended that for cast iron valves, Table D flanges be specified instead of Table A.

† This rating does not apply to flange sizes above 36".

‡ Flanges of material as defined in Clause 4 of BS EN 545 - Formerly BS 1503, 'Cast iron flanged pipes and flanged fittings' shall be used for these ratings only.

§ These ratings do not apply to boiler feed pipe installations or other water pipes, valves and fittings subject to shock.

ǁ It is customary in the gas industry to limit the use of Table A flanges to working gas pressures not exceeding 30lbf/in². It is recommended that this limitation be also applied to compressed air.

¶ BS EN 13480-1 - Formerly BS 3602, 'Ferrous pipes and piping installations for and in connection with land boilers'.

** This rating applies only up to and including the 12" flange size. Above this size the pressure rating shall be reduced to 150lbf/in².

†† This is the maximum pressure allowable for cast iron at 221°C.

COPPER ALLOY ½IN TO 3IN (INCLUSIVE)

Table	°F to 250	300	350	400	450	500	Maximum Hydraulic Test Pressure (lbf/in²)
	°C -17.8 to 121.1	148.9	176.7	204.4	232.2	260.0	

PRESSURE (LBF/IN²)

A	50‡				25†		75
D	100	95	95	80	65	50	150
E	200	200	200	165	130	100	300
F	300	200	300	345	195	150	450
H	500	500	500	410	330	250	750
J	550	525	525	440	390	350	825
K	700	670	670	555	500	450	1050

PRESSURE (LBF/IN²) APPLYING TO THE SIZE RANGE

Over 3in to 24in		Over 3in to 8in						
A	50‡		-	-	-	25†	-	75
D	100		95	90	80	65	50	150
E	175		165	155	135	120	100	265
F	250		240	220	195	175	150	375
H	400		380	350	320	285	250	600
J		550	525	485	440	390	350	825
K		700	670	615	555	500	450	1050

Intermediate values may be obtained by linear interpolation, except for Table A.

‡ It is customary in the gas industry to limit the use of Table A flanges to working gas pressures not exceeding 30 lbf/in². It is recommended that this limitation be also applied to compressed air.

† This rating applies to temperatures above 121.1°C up to and including 232.2°C.

CARBON STEEL

TEMPERATURE								
Table	°F	0 to 250	0 to 450	500	550	600	650	
	°C	-17.8 to 121.1	-17.8 to 232.2	260.0	287.8	315.6	343.3	

PRESSURE (LBF/IN²)								
A		50†	25*					
D			100	95	85	80	70	
E			200	185	170	155	140	
F			300	280	255	235	215	
H			500	465	430	395	355	
J			700	650	600	550	500	
K			900	835	770	705	645	
R			1200	1115	1030	945	855	
S			1800	1670	1545	1415	1285	
T			2800	2600	2400	2200	2000	

Intermediate values above 232.2°C may be obtained by linear interpolation.

* This rating applies to temperatures above 121.1°C up to and including 232.2°C and does not apply to flange sizes above 36in.

† It is customary in the gas industry to limit the use of Table A flanges to working gas pressures not exceeding 30 lbf/in². It is recommended that this limitation be also applied to compressed air.

	TEMPERATURE							
	700	750	800	825	850	875	900	Maximum Hydraulic Test Pressure (lbf/in^2)
	371.1	399	427	441	454	468	482	

	PRESSURE (LBF/IN^2)							
								75
	65	55	50					150
	130	115	100					300
	195	170	150					450
	320	285	250	215	180	150	115	750
	450	400	350	300	255	210	160	1050
	580	515	450	390	325	265	205	1350
	770	685	600	520	435	355	275	1800
	1155	1030	900	780	655	535	415	2700
	1800	1600	1400	1210	1025	835	645	4200

ALLOY STEELS

TEMPERATURE								
Table	°F	0 to 450	500	550	600	650	700	750
	°C	-17.8 to 232.2	260.0	287.8	315.6	343.3	371.1	399

PRESSURE (LBF/IN^2)								
H		500	470	445	415	390	360	335
J		700	660	620	585	545	505	465
K		900	850	800	750	700	650	600
R		1200	1135	1065	1000	935	865	800
S		1800	1700	1600	1500	1400	1300	1200
T		2800	2645	2490	2335	2180	2020	1865

	TEMPERATURE								
	800	825	850	875	900	925	950	975	Maximum Hydraulic Test Pressure (lbf/in^2)
	427	441	454	468	482	496	510	524	

	PRESSURE (LBF/IN^2)								
	305	290	280	265	250	195	140	80	750
	430	410	390	370	350	270	190	110	1050
	550	525	500	475	450	350	245	145	1350
	735	700	665	635	600	465	330	195	1800
	1100	1050	1000	950	900	700	495	295	2700
	1710	1635	1555	1480	1400	1085	770	455	4200

STEEL 150LB

[1] Code Limitations. A product used under the jurisdiction of the ASME Boiler and Vessel Code of the ANSI Code for Pressure Piping is subject to any limitation of that code. This includes any maximum temperature limitation for a material, or a code rule governing the use of a material at a low temperature.

[2] Low Temperature Ratings. For a material shown in this and the following tables, the pressure rating for service at any temperature below -20°F shall be the same as the rating shown in the table for -20°F. For the 'low temperature' materials (ASTM A350/A350M - Formerly ASTM A204 or ASTM A352/A352M - Formerly ASTM A212), the pressure rating for below -20°F shall be the same as shown for carbon steel (at -20°F to 100°F).

Service Temp Deg F	MATERIAL								
	Carbon Steel	Carbon Molyb	Cr-Mo ½-½	Cr-Mo 1-½	Cr-Mo 1¼-½	Cr-Mo 2-½	Cr-Mo 2¼-1	Cr-Mo 3-1	
-20°F to100[2]								275	
150								255	
200								240	
250								225	
300								210	
350								195	
400								180	
450								165	
500								150	
550								140	
600								130	
650								120	
700								110	
750								100	
800								92	
850	82[1]							82	
875	75[1]	75[1]						75	
900	70[1]	70[1]						70	
925	60[1]	60[1]						60	
950	55[1]	55[1]						55	
975	50[1]	50[1]						50	
1000	40[1]	40[1]						40	
Hydrostatic Shell Test Pressure								425	

Some of the materials listed in the rating tables undergo a decrease in impact resistance at temperatures lower than -20°F to 100°F[2] to such an extent as to be unable to safely resist shock loadings, sudden changes of stress or high stress concentrations.

										Service Temp Deg F
	Cr-Mo 5-½	Cr-Mo 5-½-Si	Cr-Mo 9-1	Types						
				304	347 & 321	316	310	304L	316L	
	275									-20°F to100[2]
	255									150
	240									200
	225									250
	210									300
	195									350
	180									400
	165									450
	150									500
	140									550
	130									600
	120									650
	110									700
	100									750
	92									800
	82							-	82	850
	75							-	-	875
	70							-	-	900
	60							-	-	925
	55							-	-	950
	50							-	-	975
	40							-	-	1000
	425									

STEEL 300LB

Service Temp Deg F	MATERIAL								
	Carbon Steel	Carbon Molyb	Cr-Mo ½-½	Cr-Mo 1-½	Cr-Mo 1¼-½	Cr-Mo 2-½	Cr-Mo 2¼-1	Cr-Mo 3-1	
-20°F to100[2]						720			
150						710			
200						700			
250						690			
300						680			
350						675			
400						665			
450						650			
500						625			
550						590			
600						555			
650						515			
700	470	480	480	485	485	480	485	480	
750	425	445	445	450	450	445	450	445	
800	365	410	410	415	415	410	415	410	
850	3001	370	370	385	385	370	385	370	
875	2601	3551	355	365	365	355	365	355	
900	2251	3351	335	350	350	335	350’	335	
925	1901	3201	320	335	335	320	335	320	
950	1551	3001	300	315	315	300	315	300	
975	1201	2801	280	300	300	280	300	275	
1000	851	2151	215	255	265	215	265	240	
1025				215	2301	180	235	215	
1050				170	1901	145	200	190	
1075				135	1651	120	1701	165	
1100				95	1351	95	1451	135	
1125				751	1101	75	1251	115	
1150				551	851	60	1051	95	
1175				451	651	50	851	70	
1200				351	401	40	701	50	
1225									

Cr-Mo 5-½	Cr-Mo 5-½-Si	Cr-Mo 9-1	Types						Service Temp Deg F
			304	347 & 321	316	310	304L	316L	
			615		720		515	515	-20°F to100[2]
			585		710		510	515	150
			550		700		505	515	200
			520		690		465	495	250
			495		680		430	475	300
			470		675		395	435	350
			450		665		360	395	400
			430		650		340	380	450
			410		625		320	360	500
			395		590		310	350	550
			380		555		300	335	600
			370		515		290	325	650
485	480	485	355	495		490	280	310	700
450	445	450	340	470		465	275	300	750
415	410	415	330	450		440	265	290	800
385	370	385	320	425		415		280	850
365	355	365	315	415		400			875
350	335	350	310	400		390			900
335	320	335	305	390		375			925
315	300	315	305	380		365			950
300	250	300	300	370		350			975
250	190	290	300	355		340			1000
215	155	240	295	345		325			1025
180	120	190	290	335		315			1050
145	105	150	275	325		300			1075
115	85	115	255	310		290			1100
95	75	95	225	300		270			1125
75	60	75	195	260	290	250			1150
65	50	65	175	215	260	225			1175
50	40	50	155	170	235	205			1200
			135	140	205	185			1225

STEEL 300LB

Service Temp Deg F	MATERIAL								
	Carbon Steel	Carbon Molyb	Cr-Mo ½-½	Cr-Mo 1-½	Cr-Mo 1¼-½	Cr-Mo 2-½	Cr-Mo 2¼-1	Cr-Mo 3-1	
1250									
1275									
1300									
1325									
1350									
1375			For Notes 1 and 2 see 150lb table						
1400									
1425									
1450									
1475									
1500									
Hydrostatic Shell Test Pressure			1100						

											Service Temp Deg F
	Cr-Mo 5-½	Cr-Mo 5-½-Si	Cr-Mo 9-1	Types							
				304	347 & 321	316	310	304L	316L		
				110	115	180	165				1250
				100	95	160	140				1275
				85	75	135	120				1300
				75	65	115	100				1325
				60	50	95	80				1350
				55	45	80	70				1375
				50	40	70	55				1400
				40	35	60	45				1425
				35	30	50	40				1450
				30	30	45	30				1475
				25	25	35	25				1500
				925	1100			775			

STEEL 400LB

Service Temp Deg F	MATERIAL								
	Carbon Steel	Carbon Molyb	Cr-Mo ½-½	Cr-Mo 1-½	Cr-Mo 1¼-½	Cr-Mo 2-½	Cr-Mo 2¼-1	Cr-Mo 3-1	
-20 to 100[2]						960			
150						945			
200						930			
250						920			
300						910			
350						900			
400						890			
450						870			
500						835			
550						790			
600						740			
650						690			
700	635	640	640	645	645	640	645	640	
750	575	590	590	600	600	590	600	590	
800	490	545	545	555	555	545	555	545	
850	4001	495	495	510	510	495	510	495	
875	3501	4701	470	490	490	470	490	470	
900	2951	4501	450	465	465	450	465	450	
925	2501	4251	425	445	445	425	445	425	
950	2051	4001	400	420	420	400	420	400	
975	1601	3701	370	400	400	370	400	365	
1000	1151	2851	285	345	355	285	355	320	
1025				285	3051	240	310	285	
1050				230	2501	190	265	250	
1075				180	2151	160	2301	215	
1100				130	1851	125	1901	185	
1125				1001	1501	105	1651	155	
1150				701	1151	80	1351	125	
1175				601	851	65	1151	95	
1200				451	551	55	901	70	
1225									

Cr-Mo 5-½	Cr-Mo 5-½-Si	Cr-Mo 9-1	Types 304	347 & 321	316	310	304L	316L	Service Temp Deg F
			825		960		685	685	-20 to 100[2]
			775		945		680	685	150
			730		930		670	685	200
			695		920		625	660	250
			660		910		575	635	300
			630		900		530	580	350
			600		890		485	525	400
			575		870		455	505	450
			550		835		425	485	500
			530		790		410	465	550
			510		740		400	445	600
			490		690		385	430	650
645	640	645	475	660		655	375	415	700
600	590	600	455	625		620	365	400	750
555	545	555	440	595		585	355	385	800
510	495	510	425	565		550		375	850
490	470	490	420	550		535			875
465	450	465	415	535		520			900
445	425	445	410	520		500			925
420	400	420	405	505		485			950
400	330	400	405	490		470			975
335	250	390	400	475		450			1000
285	205	320	395	460		435			1025
240	160	250	390	445		415			1050
195	135	200	365	430		400			1075
150	115	150	345	415		390			1100
125	100	125	305	400		360			1125
100	80	100	265	345	390	330			1150
85	70	85	235	290	350	305			1175
70	55	70	205	230	310	275			1200
			175	190	275	245			1225

STEEL 400LB

Service Temp Deg F	MATERIAL								
	Carbon Steel	Carbon Molyb	Cr-Mo ½-½	Cr-Mo 1-½	Cr-Mo 1¼-½	Cr-Mo 2-½	Cr-Mo 2¼-1	Cr-Mo 3-1	
1250									
1275									
1300									
1325									
1350									
1375			For Notes 1 and 2 see 150lb table						
1400									
1425									
1450									
1475									
1500									
Hydrostatic Shell Test Pressure			1450						

	Cr-Mo 5-½	Cr-Mo 5-½-Si	Cr-Mo 9-1	Types						Service Temp Deg F
				304	347 & 321	316	310	304L	316L	
				150	150	240	215			1250
				130	125	215	190			1275
				110	100	185	160			1300
				95	85	155	135			1325
				80	70	125	105			1350
				75	60	105	90			1375
				65	55	90	75			1400
				55	50	80	60			1425
				45	40	70	50			1450
				40	40	55	40			1475
				35	35	45	35			1500
				1250	1450			1025		

STEEL 600LB

Service Temp Deg F	MATERIAL								
	Carbon Steel	Carbon Molyb	Cr-Mo ½-½	Cr-Mo 1-½	Cr-Mo 1¼-½	Cr-Mo 2-½	Cr-Mo 2¼-1	Cr-Mo 3-1	
-20 to 100[2]						1440			
150						1420			
200						1400			
250						1380			
300						1365			
350						1350			
400						1330			
450						1305			
500						1250			
550						1180			
600						1110			
650						1030			
700	940	960	960	965	965	960	965	960	
750	850	890	890	900	900	890	900	890	
800	730	815	815	835	835	815	835	815	
850	6001	745	745	765	765	745	765	745	
875	5251	7101	710	735	735	710	735	710	
900	4451	6701	670	700	700	670	700	670	
925	3751	6351	635	665	665	635	665	635	
950	3101	6001	600	635	635	600	635	600	
975	2401	5551	555	600	600	555	600	550	
1000	1701	4301	430	515	535	425	535	480	
1025				430	4551	355	465	430	
1050				345	3751	290	400	375	
1075				265	3251	240	3451	325	
1100				190	2751	190	2901	275	
1125				1501	2251	155	2451	230	
1150				1051	1701	120	2051	185	
1175				851	1251	100	1701	145	
1200				701	801	80	1351	105	
1225									

											Service Temp Deg F
	Cr-Mo 5-½	Cr-Mo 5-½-Si	Cr-Mo 9-1	Types							
				304	347 & 321	316	310	304L	316L		
				1235		1440		1030	1030		-20 to 100[2]
				1165		1420		1020	1030		150
				1095		1400		1005	1030		200
				1040		1380		935	990		250
				985		1365		860	955		300
				945		1350		795	870		350
				900		1330		725	790		400
				860		1305		680	755		450
				825		1250		640	725		500
				795		1180		615	695		550
				765		1110		600	670		600
				735		1030		575	645		650
	965	960	965	710		985		980	560	620	700
	900	890	900	685		940		930	545	600	750
	835	815	835	660		895		880	535	580	800
	765	745	765	640		850		830		560	850
	735	710	735	630		825		805			875
	700	670	700	620		805		780			900
	665	635	665	615		780		755			925
	635	600	635	610		760		725			950
	600	495	600	605		735		700			975
	500	375	585	600		715		675			1000
	430	310	480	595		690		650			1025
	355	240	375	585		670		625			1050
	290	205	300	550		645		600			1075
	225	170	225	515		625		585			1100
	190	145	190	455		600		540			1125
	150	125	150	395	520	585		495			1150
	125	105	125	350	430	525		455			1175
	105	80	105	310	345	465		410			1200
				265	285	415		370			1225

STEEL 600LB

Service Temp Deg F	MATERIAL								
	Carbon Steel	Carbon Molyb	Cr-Mo ½-½	Cr-Mo 1-½	Cr-Mo 1¼-½	Cr-Mo 2-½	Cr-Mo 2¼-1	Cr-Mo 3-1	
1250									
1275									
1300									
1325									
1350									
1375			For Notes 1 and 2 see 150lb table						
1400									
1425									
1450									
1475									
1500									
Hydrostatic Shell Test Pressure			2175						

	Cr-Mo 5-½	Cr-Mo 5-½-Si	Cr-Mo 9-1	Types						Service Temp Deg F
				304	347 & 321	316	310	304L	316L	
				225	225	365	325			1250
				195	190	320	285			1275
				170	150	275	240			1300
				145	125	230	200			1325
				125	105	185	160			1350
				110	95	160	135			1375
				95	80	135	110			1400
				80	70	120	95			1425
				70	60	105	75			1450
				60	55	85	65			1475
				50	50	70	50			1500
				1875	2175			1550		

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BOSS™ VALVE APPLICATION CHARTS

APPLICATION SUMMARY

Valve Type		Size Range mm	LTHW <90°C	MTHW 90-120°C	HTHW 120-180°C	Chilled Water	
Isolation	Gate	15-50	R55	-	-	-	
		15-80	25SM	25SM	25SM*	25SM	
		50-200	7XS/SE	7XS/SE	-	7XS/SE	
	Ball	15-50	965S	965S	-	965S	
		15-50	965NREXT	965NREXT	-	965NREXT	
		15-50/54	966S/LS/ EXT/968/LS	966S/ LS/968/LS	-		
		15-32	966T	-	-	-	
		15-25/28	Miniball	-	-	-	
		15-50/54	-	-	-	-	
		15-32	-	-	-	-	
		15-50	985DZR	985DZR	-	-	
		15-54	986PR/BL Pressfit	986PR/BL Pressfit	-	-	
		15-50	LN190	LN190	-	-	
		15-50	LN240	LN240	-	-	
		65-100	967S	967S	-	-	
	Globe	15-50	62S	62S	-	-	
		50-200	9XS	9XS	-	-	
	Butterfly	50-300	16LSE/SSE	-	-	16LSE/SSE	

* 9barg 180ºC
** Inert Gases
^ Tank Cold Water
† Mains Cold Water
‡ 70ºC Maximum
± 100ºC Maximum
§ 10bar Maximum
· 10bar Maximum at 150ºC
° 15.9bar Maximum
≥ 14bar Maximum

	Domestic Hot Water	MCW† Potable Water	TCW‾	Steam to 10bar	Air	Gas	Oil
	R55	R55	R55	-	R55	-	-
	-	-	-	-	25SM	-	25SM
	-	-	-	-	7XS/SE	-	7XS/SE
	-	-	-	-	965S	-	965S
	-	-	-	-	-	-	-
	966S/ LS/968/LS	966S/ LS/968/LS	966S/ LS/968/LS	-	966S/ LS/968/LS	-	966S/ LS/968/LS
	966T	966T	966T	-	-	-	-
	Miniball	Miniball	Miniball	-	-	-	-
	-	-	-	-	-	966SYL/968SYL	-
	-	-	-	-	-	966SYT	-
	985DZR	985DZR	985DZR	-	985DZR	-	985DZR
	986PR/BL	986PR/BL	986PR/BL	-	-	-	-
	-	-	-	-	LN190	-	LN190
	-	-	-	-	LN240	-	LN240
	967S	967S	967S	-	967S	-	967S
	-	-	-	62S	-	-	62S
	-	-	-	9XS	-	-	9XS
	16LSE/SSE	16LSE/SSE	16LSE/SSE	-	16LNB/LSB	16LNBY/LSB	16LNB/LSB

APPLICATION SUMMARY

Valve Type		Size Range mm	LTHW <90°C	MTHW 90-120°C	HTHW 120-180°C	Chilled Water	
Non-Return/ Check	Swing	15-80	113S	113S	113S	113S	
		65-300	8XS	8XS	8XS	8XS	
	Dual Plate Wafer NRV	50-300	10XS	-	-	10XS	
	Horizontal Lift	15-80	96S	96S	-	96S	
		15-50	99S	99S		99S	
	Vertical Lift (Spring Assisted)	15-50	103S	103S	103S	103S	
	Single Check NRV	15-50/15-28	101S/SC	-	-	-	
	Double Check NRV	15-50/15-28	102S/SC	-	-	-	
	Single and Double NRV	50-250	11XS	-	-	-	
Venturi Double Regulating	Venturi DRV	15-50	901S/SC	901S/SC	-	901S	
		65-300	901XS	-	-	901XS	
Fixed Orifice Double Regulating	DRV	15-50	9510	9510	-	9510	
		65-200	9510X	9510X	-	9510X	

* 9barg 180ºC
** Inert Gases
^ Tank Cold Water
† Mains Cold Water
‡ 70ºC Maximum
± 100ºC Maximum
§ 10bar Maximum
· 10bar Maximum at 150ºC
° 15.9bar Maximum
≥ 14bar Maximum

For more information on any of our BOSS™ products, contact the BOSS™ technical team. Email: technicalteam@bssgroup.com

	Domestic Hot Water	MCW† Potable Water	TCW‾	Steam to 10bar	Air	Gas	Oil
	-	-	-	-	-	-	113S
	-	-	-	-	-	-	8XS
	10XS	10XS	10XS	-	-	-	-
	-	-	-	-	-	-	96S
	-	-	-	-	-	-	99S
	-	-	-	-	-	-	103S
	101S/SC	101S/SC	101S/SC	-	-	-	-
	102S/SC	102S/SC	102S/SC	-	-	-	-
	11XS	11XS	11XS	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-

APPLICATION SUMMARY

Valve Type		Size Range mm	LTHW <90°C	MTHW 90-120°C	HTHW 120-180°C	Chilled Water	
Commissioning Sets	Venturi FODRV	15-50	900S/SC	900S	-	900S	
	Venturi FODRV	65-300	900XSS	-	-	900XSS	
	FODRV with Drain	15-50	903S	903S	-	903S	
	FODRV	15-50	9515	9515	-	9515	
	Metering Station	15-50	9400	9400	-	9400	
	Metering Station	65-200	9400X	9400X	-	9400X	
Pressure Independent Control Valve	PICV	15-50	902	902	-	902	
Differential Pressure Control Valve	DPCV	15-50	904	904	-	904	
DPCV Partner Valve	DPCV Partner Valve	15-50	903S	903S	-	903S	
Strainers		15-50	47N	47N	-	47N	
		15-100	47XN	47XN	-	47XN	
		15-28	46CW	-	-	-	
		15-50	46W	-	-	-	
		50-300	52XN	52XN	-	52XN	
		65-200	52W	-	-	52W	
		15-50	51SS	51SS	-	51SS	

* 9barg 180ºC
** Inert Gases
^ Tank Cold Water
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‡ 70ºC Maximum
± 100ºC Maximum
§ 10bar Maximum
· 10bar Maximum at 150ºC
° 15.9bar Maximum
≥ 14bar Maximum

	Domestic Hot Water	MCW† Potable Water	TCW‾	Steam to 10bar	Air	Gas	Oil
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	47N	-	-	47N
	-	-	-	47XN	-	-	47XN
	46CW	46CW	46CW	-	-	-	-
	46W	46W	46W	-	-	-	-
	-	-	-	-	52XN	-	-
	52W	52W	52W	-		-	-
	-	-	-	-	-	-	-

APPLICATION SUMMARY

Valve Type		Size Range mm	LTHW <90°C	MTHW 90-120°C	HTHW 120-180°C	Chilled Water	
Drain Cocks		15-25	81HU	81HU	-	81HU	
		15-25	370	-	-	370	
		15-25	371LS	-	-	371LS	
		15	372/CP	-	-	-	
		15	22S	-	-	-	
Thermostatic Mixing	BOSSMIX	15-22	-	-	-	-	
Radiator Valves	BOSSTRV	15	BOSSTRV	-	-	-	
Thermal Balancing	TBV 205	15-22	-	-	-	-	
Safety/Relief	707 EPDM	15-50	707 EPDM	707 EPDM	-	707 EPDM	
	707 AFLAS	15-50	707 AFLAS	707 AFLAS	707 AFLAS	707 AFLAS	
	959 Hi-Lift	15-50	959	959	959	959	
Pressure Reducing Valve	PRV - 216	15-28	-	-	-	-	
		15-50	-	-	-	-	
Reduced Backflow Preventer	RPZ - 574/575	15-100	-	-	-	-	
Flow Regulators	Calfow 282CF	15	-	-	-	-	

* 9barg 180ºC
** Inert Gases
^ Tank Cold Water
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‡ 70ºC Maximum
± 100ºC Maximum
§ 10bar Maximum
· 10bar Maximum at 150ºC
° 15.9bar Maximum
≥ 14bar Maximum

	Domestic Hot Water	MCW† Potable Water	TCW‾	Steam to 10bar	Air	Gas	Oil
	-	-	-	-	-	-	-
	370	370	370	-	-	-	-
	-	-	-	-	-	-	-
	372/CP	372/CP	372/CP	-	-	-	-
	-	-	-	-	-	-	-
	BOSSMIX	BOSSMIX	BOSSMIX	-	-	-	-
	-	-	-	-	-	-	-
	205	-	-	-	-	-	-
	707 EPDM	707 EPDM	707 EPDM	-	707 EPDM	-	-
	-	-	-	707 AFLAS°	707 AFLAS	-	-
	959	959	959	959≥	959	-	-
	216	216	216	-	216	216**	-
	216	216	216	-	216	216**	-
	-	574/575	574/575	-	-	-	
	282CF	282CF	282CF	-	-	-	-

BOSS™ 707 RELIEF VALVES

AIR CAPACITY CHART

(l/s) @ 0.3barg or 10% overpressure* and 15°C
BS EN ISO 4126 Pt 1 (BS EN ISO 4126 - Formerly BS 3601)

Set Pressure (barg)	DN15	DN20	DN25	DN32	DN40	DN50
0.35	3.93	11.4	15.0	24.7	38.7	60.6
1.0	8.28	23.9	31.6	52.0	81.5	128
2.0	13.6	39.1	51.7	85.0	133	209
3.0	18.3	52.8	69.8	115	180	282
4.0	22.9	66.3	87.6	144	226	354
5.0	27.6	79.7	105	173	272	426
6.0	32.3	93.2	123	203	317	497
7.0	36.9	107	141	232	363	569
8.0	41.6	120	159	261	409	641
9.0	46.2	134	177	290	455	713
10.0	50.9	147	194	320	501	785
12.0	60.2		230	378	593	929
12.5	66.6		239	393	616	965
14.0	69.5					
16.0	78.9					

* Minimum overpressure = 0.07barg at set pressure less than 1.0barg.

Other Gases

If you wish to use the valve on other compatible gases, the sizing details above can be used. The valve capacity will, however, change depending on the specific gravity of the flowing gas. Multiply the valve air capacity by 1/ √SG to give the gas capacity.

SG = specific gravity (relative to air = 1).

SATURATED STEAM CAPACITY CHART

kg/h

BS EN ISO 4126 Pt 1 (BS EN ISO 4126 - Formerly BS 3601 @ 10% overpressure*)

Set Pressure (barg)	DN15	DN20	DN25	DN32	DN40	DN50
0.35	9.68	28.0	37.0	60.8	95.3	149
1.0	22.6	65.2	86.2	142	222	348
2.0	35.9	104	137	225	353	553
3.0	47.8	138	182	300	470	737
4.0	59.3	171	226	372	583	914
5.0	76.6	221	292	481	753	1181
6.0	89.0	257	340	559	876	1372
7.0	99.9	289	381	627	983	1540
8.0	112	324	428	705	1104	1731
9.0	123	355	469	771	1208	1893
10.0	135	390	515	848	1329	2082
12.0	157		600	987	1548	2425
12.5	167		637	1048	1642	2573
14.0	182					
16.0	201					

* Minimum overpressure = 0.07barg at set pressure less than 0.7barg.

BOSS™ 707 RELIEF VALVES

WATER CAPACITY CHART l/min @ 10% overpressure* @ 20°C BS EN ISO 4126 - Formerly BS 3601						
Set Pressure (barg)	**DN15**	**DN20**	**DN25**	**DN32**	**DN40**	**DN50**
0.35	10.3	29.8	39.4	64.8	102	159
1.0	16.7	48.3	63.8	105	164	258
2.0	23.6	68.3	90.2	148	233	364
3.0	28.9	83.6	110	182	285	446
4.0	33.4	96.5	128	210	329	515
5.0	37.4	108	143	235	368	576
6.0	40.9	118	156	257	403	631
7.0	44.2	128	169	278	435	682
8.0	47.3	137	180	297	465	729
9.0	50.1	145	191	315	493	773
10.0	52.8	153	202	332	520	815
12.0	57.9		221	363	570	893
12.5	59.1		226	371	581	911
14.0	62.5					
16.0	66.8					

* Minimum overpressure = 0.07barg at set pressure less than 0.7barg.

Other Liquids

If you wish to use the valve on other compatible liquids, the sizing details above can be used. The valve capacity will, however, change depending on the specific gravity of the flowing liquid. Multiply the valve water capacity by $1/\sqrt{}$ SG to give the liquid capacity.

SG = specific gravity (relative to water = 1).

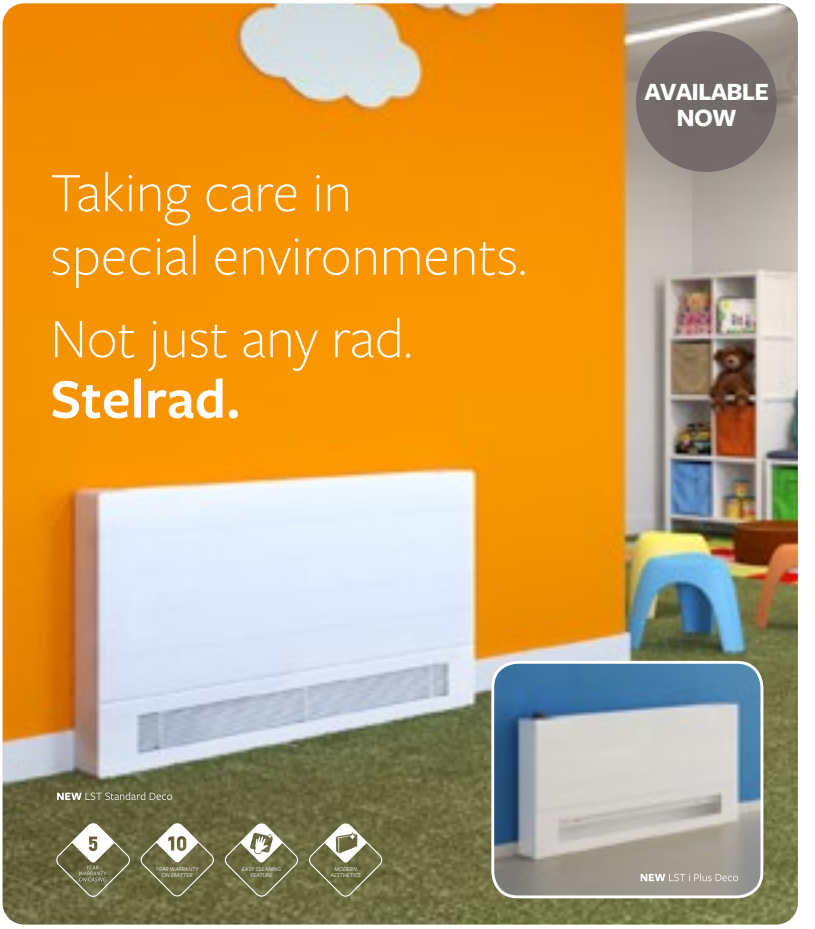
HOT WATER CAPACITY CHART (kW) For a pressurised (unvented) system BS EN ISO 4126 - Formerly BS 3601 @ 10% overpressure*						
Set Pressure (barg)	**DN15**	**DN20**	**DN25**	**DN32**	**DN40**	**DN50**
0.35	6.88	19.9	26.3	43.2	67.7	106
1.0	14.0	40.5	53.5	88.0	138	216
2.0	22.9	66.3	87.5	144	226	354
3.0	30.9	89.4	118	194	304	477
4.0	38.8	112	148	244	382	599
5.0	46.7	135	178	293	460	720
6.0	54.6	158	208	343	537	842
7.0	62.5	181	239	392	615	964
8.0	70.4	203	269	442	693	1085
9.0	78.3	226	299	491	770	1207
10.0	86.2	249	329	541	848	1329
12.0	102		389	640	1003	1572
12.5	106		404	665	1042	1633
14.0	118					
16.0	133					

* Minimum overpressure = 0.07barg at set pressure less than 0.7barg.

Note

Pressurised (unvented) hot water systems have the entire discharge capacity handled solely by the valve.

Open vented systems take into account the discharge capacities of the vent. Hence the equivalent discharge of the valve/system is considered to be double the above chart capacities.



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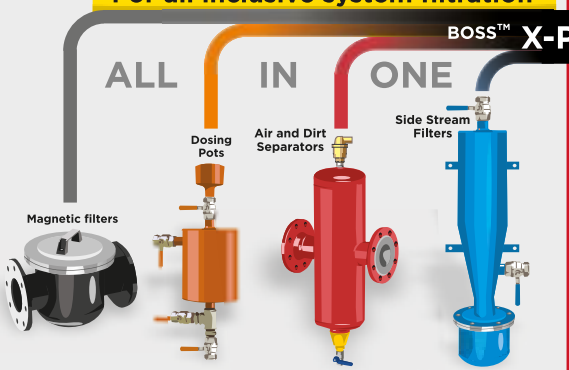

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SIEVE MICRON SIZE COMPARISON TABLE		
Microns	mm	Mesh No. UK
8000	8	n/a
6700	6.7	1
5600	5.6	3
4750	4.75	3.5
4000	4	4
3350	3.35	5
2800	2.8	6
2360	2.36	7
2000	2	8
1700	1.7	10
1400	1.4	12
1180	1.18	14
1000	1	16
850	0.85	18
710	0.71	22
600	0.6	25
500	0.5	30
425	0.425	36

SIEVE MICRON SIZE COMPARISON TABLE		
Microns	mm	Mesh No. UK
355	0.355	44
300	0.3	52
250	0.25	60
212	0.212	72
180	0.18	85
150	0.15	100
125	0.125	120
106	0.106	150
90	0.09	170
75	0.075	200
63	0.063	240
53	0.053	300
45	0.045	350
38	0.038	400
32	0.032	440
25	0.025	n/a
20	0.02	n/a

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FLOW OF WATER AT 75°C IN COPPER PIPES

ΔPI	V	12mm		15mm		22mm		
		M	l_e	M	l_e	M	l_e	
80.0		0.020	0.3	0.038	0.4	0.110	0.8	
82.5		0.020	0.3	0.038	0.4	0.112	0.8	
85.0		0.021	0.3	0.039	0.4	0.114	0.8	
87.5		0.021	0.3	0.040	0.4	0.116	0.8	
90.0		0.021	0.3	0.040	0.4	0.118	0.8	
92.5		0.022	0.3	0.041	0.4	0.120	0.8	
95.0		0.022	0.3	0.042	0.4	0.122	0.8	
97.5		0.022	0.3	0.042	0.4	0.124	0.8	
100.0		0.023	0.3	0.043	0.4	0.125	0.8	
120.0	0.3	0.025	0.3	0.047	0.5	0.139	0.8	
140.0		0.028	0.3	0.052	0.5	0.152	0.8	
160.0		0.030	0.3	0.056	0.5	0.164	0.8	
180.0		0.032	0.3	0.060	0.5	0.175	0.8	
200.0		0.034	0.4	0.064	0.5	0.186	0.9	
220.0		0.036	0.4	0.067	0.5	0.196	0.9	
240.0		0.038	0.4	0.071	0.5	0.206	0.9	
260.0		0.039	0.4	0.074	0.5	0.215	0.9	
280.0		0.041	0.4	0.077	0.5	0.224	0.9	
		0.043	0.4	0.080	0.5	0.233	0.9	
320.0	0.5	0.044	0.4	0.083	0.5	0.242	0.9	
340.0		0.046	0.4	0.086	0.5	0.250	0.9	
360.0		0.048	0.4	0.089	0.5	0.258	0.9	
380.0		0.049	0.4	0.092	0.5	0.266	0.9	
400.0		0.050	0.4	0.094	0.5	0.274	0.9	
420.0		0.052	0.4	0.097	0.5	0.282	0.9	
440.0		0.053	0.4	0.099	0.5	0.289	0.9	
460.0		0.055	0.4	0.102	0.5	0.297	1.0	
480.0		0.056	0.4	0.104	0.6	0.304	1.0	
500.0		0.057	0.4	0.107	0.6	0.311	1.0	
520.0		0.059	0.4	0.109	0.6	0.318	1.0	
540.0		0.060	0.4	0.112	0.6	0.324	1.0	
560.0		0.061	0.4	0.114	0.6	0.331	1.0	

M = Mass Flow Rate (kg/s) l_e = Equivalent Length of Pipe (m)
ΔPI = Pressure Loss per Unit Length (Pa/m) V = Velocity (m/s)

28mm		35mm		42mm		V	ΔPl
M	I_e	M	I_e	M	I_e		
0.223	1.1	0.403	1.5	0.679	1.9		80.0
0.227	1.1	0.410	1.5	0.691	2.0		82.5
0.231	1.1	0.417	1.5	0.703	2.0		85.0
0.235	1.1	0.424	1.5	0.714	2.0		87.5
0.239	1.1	0.430	1.5	0.725	2.0		90.0
0.242	1.1	0.437	1.5	0.737	2.0		92.5
0.246	1.1	0.444	1.5	0.748	2.0		95.0
0.250	1.1	0.450	1.5	0.759	2.0		97.5
0.253	1.1	0.457	1.5	0.769	2.0		100.0
0.281	1.2	0.506	1.6	0.852	2.0		120.0
0.306	1.2	0.551	1.6	0.928	2.1		140.0
0.330	1.2	0.594	1.6	1.000	2.1		160.0
0.352	1.2	0.635	1.6	1.070	2.1		180.0
0.374	1.2	0.673	1.7	1.130	2.2		200.0
0.394	1.2	0.710	1.7	1.190	2.2	1.0	220.0
0.414	1.3	0.745	1.7	1.250	2.2		240.0
0.433	1.3	0.779	1.7	1.310	2.2		260.0
0.451	1.3	0.812	1.7	1.370	2.2		280.0
0.469	1.3	0.844	1.7	1.420	2.3		300.0
0.486	1.3	0.874	1.8	1.470	2.3		320.0
0.503	1.3	0.904	1.8	1.520	2.3		340.0
0.519	1.3	0.934	1.8	1.570	2.3		360.0
0.535	1.3	0.962	1.8	1.620	2.3		380.0
0.551	1.3	0.990	1.8	1.660	2.3		400.0
0.566	1.3	1.020	1.8	1.710	2.3		420.0
0.581	1.4	1.040	1.8	1.750	2.4		440.0
0.595	1.4	1.070	1.8	1.800	2.4	1.5	460.0
0.610	1.4	1.100	1.8	1.840	2.4		480.0
0.624	1.4	1.120	1.8	1.880	2.4		500.0
0.637	1.4	1.150	1.8	1.920	2.4		520.0
0.651	1.4	1.170	1.9	1.960	2.4		540.0
0.664	1.4	1.190	1.9	2.000	2.4		560.0

FLOW OF WATER AT 75°C IN COPPER PIPES

ΔPI	V	12mm		15mm		22mm		
		M	l_e	M	l_e	M	l_e	
580.0		0.062	0.4	0.116	0.6	0.338	1.0	
600.0		0.064	0.4	0.119	0.6	0.344	1.0	
620.0		0.065	0.4	0.121	0.6	0.350	1.0	
640.0		0.066	0.4	0.123	0.6	0.357	1.0	
660.0		0.067	0.4	0.125	0.6	0.363	1.0	
680.0		0.068	0.4	0.127	0.6	0.369	1.0	
700.0		0.069	0.4	0.129	0.6	0.375	1.0	
720.0		0.070	0.4	0.131	0.6	0.381	1.0	
740.0		0.072	0.4	0.133	0.6	0.387	1.0	
760.0		0.073	0.4	0.135	0.6	0.392	1.0	
780.0		0.074	0.4	0.137	0.6	0.398	1.0	
800.0		0.075	0.4	0.139	0.6	0.404	1.0	
820.0		0.076	0.4	0.141	0.6	0.409	1.0	
840.0		0.077	0.4	0.143	0.6	0.415	1.0	
860.0		0.078	0.4	0.145	0.6	0.420	1.0	
880.0		0.079	0.4	0.147	0.6	0.426	1.0	
900.0		0.080	0.4	0.149	0.6	0.431	1.0	
920.0		0.081	0.4	0.151	0.6	0.437	1.0	
940.0		0.082	0.4	0.153	0.6	0.442	1.0	
960.0		0.083	0.4	0.154	0.6	0.447	1.0	
980.0		0.084	0.4	0.156	0.6	0.452	1.0	
1000.0	1.0	0.085	0.4	0.158	0.6	0.457	1.0	
1100.0		0.090	0.4	0.167	0.6	0.482	1.1	
1200.0		0.094	0.5	0.175	0.6	0.506	1.1	
1300.0		0.098	0.5	0.183	0.6	0.529	1.1	
1400.0		0.103	0.5	0.191	0.6	0.551	1.1	
1500.0		0.107	0.5	0.198	0.6	0.573	1.1	
1600.0		0.111	0.5	0.205	0.6	0.593	1.1	
1700.0		0.114	0.5	0.213	0.6	0.614	1.1	
1800.0		0.118	0.5	0.219	0.6	0.633	1.1	
1900.0		0.122	0.5	0.226	0.7	0.653	1.1	
2000.0		0.125	0.5	0.233	0.7	0.671	1.1	

M = Mass Flow Rate (kg/s) l_e = Equivalent Length of Pipe (m)
ΔPI = Pressure Loss per Unit Length (Pa/m) V = Velocity (m/s)

28mm		35mm		42mm		V	ΔPl
M	I_e	M	I_e	M	I_e		
0.677	1.4	1.220	1.9	2.040	2.4		580.0
0.690	1.4	1.240	1.9	2.080	2.4		600.0
0.703	1.4	1.260	1.9	2.120	2.4		620.0
0.715	1.4	1.280	1.9	2.160	2.4		640.0
0.728	1.4	1.310	1.9	2.190	2.5		660.0
0.740	1.4	1.330	1.9	2.230	2.5		680.0
0.752	1.4	1.350	1.9	2.260	2.5		700.0
0.764	1.4	1.370	1.9	2.300	2.5		720.0
0.775	1.4	1.390	1.9	2.330	2.5		740.0
0.787	1.4	1.410	1.9	2.370	2.5		760.0
0.798	1.4	1.430	1.9	2.400	2.5	2.0	780.0
0.810	1.4	1.450	1.9	2.440	2.5		800.0
0.821	1.4	1.470	1.9	2.480	2.5		820.0
0.832	1.5	1.490	1.9	2.500	2.5		840.0
0.843	1.5	1.510	1.9	2.540	2.5		860.0
0.853	1.5	1.530	2.0	2.570	2.5		880.0
0.864	1.5	1.550	2.0	2.600	2.5		900.0
0.875	1.5	1.570	2.0	2.630	2.5		920.0
0.885	1.5	1.590	2.0	2.660	2.5		940.0
0.896	1.5	1.610	2.0	2.690	2.5		960.0
0.906	1.5	1.620	2.0	2.720	2.6		980.0
0.916	1.5	1.640	2.0	2.750	2.6		1000.0
0.965	1.5	1.730	2.0	2.900	2.6		1100.0
1.010	1.5	1.820	2.0	3.040	2.6		1200.0
1.060	1.5	1.900	2.0	3.180	2.6		1300.0
1.100	1.5	1.980	2.0	3.310	2.6		1400.0
1.150	1.5	2.050	2.1	3.440	2.7		1500.0
1.190	1.6	2.130	2.1	3.560	2.7	3.0	1600.0
1.230	1.6	2.200	2.1	3.680	2.7		1700.0
1.270	1.6	2.270	2.1	3.800	2.7		1800.0
1.310	1.6	2.340	2.1	3.910	2.7		1900.0
1.340	1.6	2.400	2.1	4.020	2.7		2000.0

FLOW OF WATER AT 75°C IN COPPER PIPES

ΔPI	V	54mm		67mm		76mm	
		M	l_e	M	l_e	M	l_e
80.0		1.38	2.8	2.48	3.7	3.51	4.4
82.5		1.40	2.8	2.52	3.7	3.57	4.5
85.0		1.43	2.8	2.56	3.8	3.63	4.5
87.5		1.45	2.8	2.60	3.8	3.69	4.5
90.0		1.48	2.8	2.64	3.8	3.74	4.5
92.5		1.50	2.8	2.68	3.8	3.80	4.5
95.0		1.52	2.8	2.72	3.8	3.86	4.5
97.5		1.54	2.8	2.76	3.8	3.91	4.5
100.0		1.56	2.9	2.80	3.8	3.97	4.6
120.0		1.73	2.9	3.10	3.9	4.39	4.6
140.0		1.88	3.0	3.38	4.0	4.78	4.7
160.0	1.0	2.03	3.0	3.63	4.0	5.14	4.8
180.0		2.16	3.0	3.88	4.1	5.49	4.8
200.0		2.29	3.1	4.11	4.1	5.81	4.9
220.0		2.42	3.1	4.33	4.2	6.12	4.9
240.0		2.54	3.1	4.54	4.2	6.42	5.0
260.0		2.65	3.2	4.75	4.2	6.72	5.0
280.0		2.76	3.2	4.95	4.3	6.99	5.0
300.0		2.87	3.2	5.14	4.3	7.26	5.1
320.0		2.97	3.2	5.32	4.3	7.52	5.1
340.0		3.08	3.3	5.50	4.3	7.78	5.1
360.0		3.17	3.3	5.68	4.4	8.02	5.2
380.0		3.27	3.3	5.85	4.4	8.26	5.2
400.0		3.36	3.3	6.02	4.4	8.50	5.2
420.0		3.45	3.3	6.18	4.4	8.73	5.2
440.0		3.54	3.3	6.34	4.4	8.95	5.3
460.0		3.63	3.4	6.49	4.5	9.17	5.3
480.0		3.72	3.4	6.65	4.5	9.39	5.3
500.0		3.80	3.4	6.80	4.5	9.60	5.3
520.0		3.88	3.4	6.94	4.5	9.81	5.3
540.0		3.97	3.4	7.09	4.5	10.0	5.4
560.0	2.0	4.05	3.4	7.23	4.5	10.2	5.4

M = Mass Flow Rate (kg/s) l_e = Equivalent Length of Pipe (m)
ΔPI = Pressure Loss per Unit Length (Pa/m) V = Velocity (m/s)

108mm		133mm		159mm		V	ΔPI
M	I_e	M	I_e	M	I_e		
9.18	7.2	16.2	9.5	25.8	11.9		80.0
9.33	7.2	16.5	9.5	26.3	11.9		82.5
9.49	7.2	16.8	9.5	26.7	12.0		85.0
9.64	7.2	17.1	9.6	27.1	12.0		87.5
9.79	7.2	17.3	9.6	27.6	12.0		90.0
9.94	7.3	17.6	9.6	27.9	12.1		92.5
10.1	7.3	17.8	9.6	28.4	12.1		95.0
10.2	7.3	18.1	9.7	28.8	12.1		97.5
10.4	7.3	18.4	9.7	29.2	12.2		100.0
11.5	7.5	20.3	9.9	32.2	12.4		120.0
12.5	7.6	22.1	10.0	35.1	12.5	2.0	140.0
13.4	7.7	23.7	10.1	37.7	12.7		160.0
14.3	7.7	25.3	10.2	40.2	12.8		180.0
15.2	7.8	26.8	10.3	42.6	12.9		200.0
16.0	7.9	28.2	10.4	44.8	13.0		220.0
16.7	8.0	29.6	10.5	47.0	13.1		240.0
17.5	8.0	30.9	10.6	49.1	13.2		260.0
18.2	8.1	32.2	10.6	51.1	13.3		280.0
18.9	8.1	33.4	10.7	53.0	13.4		300.0
19.6	8.2	34.6	10.8	55.0	13.5	3.0	320.0
20.2	8.2	35.7	10.8	56.8	13.5		340.0
20.9	8.3	36.9	10.9	58.5	13.6		360.0
21.5	8.3	38.0	10.9	60.3	13.6		380.0
22.1	8.3	39.0	11.0	62.0	13.7		400.0
22.7	8.4	40.1	11.0	63.6	13.8		420.0
23.3	8.4	41.1	11.1	65.2	13.8		440.0
23.9	8.4	42.1	11.1	66.8	13.9		460.0
24.4	8.5	43.1	11.1	68.4	13.9		480.0
25.0	8.5	44.1	11.2	69.9	13.9		500.0
25.5	8.5	45.0	11.2	71.4	14.0		520.0
26.0	8.5	46.0	11.2	72.9	14.0	4.0	540.0
26.6	8.6	46.8	11.3	74.3	14.1		560.0

FLOW OF WATER AT 75°C IN COPPER PIPES

ΔPI	V	54mm		67mm		76mm	
		M	l_e	M	l_e	M	l_e
580.0		4.12	3.4	7.37	4.6	10.4	5.4
600.0		4.20	3.4	7.51	4.6	10.6	5.4
620.0		4.28	3.5	7.64	4.6	10.8	5.4
640.0		4.35	3.5	7.78	4.6	11.0	5.5
660.0		4.43	3.5	7.91	4.6	11.2	5.5
680.0		4.50	3.5	8.04	4.6	11.4	5.5
700.0		4.57	3.5	8.17	4.6	11.6	5.5
720.0		4.64	3.5	8.29	4.7	11.7	5.5
740.0		4.71	3.5	8.42	4.7	11.9	5.5
760.0		4.78	3.5	8.54	4.7	12.1	5.5
780.0		4.85	3.5	8.66	4.7	12.2	5.5
800.0		4.92	3.5	8.78	4.7	12.4	5.6
820.0		4.98	3.5	8.90	4.7	12.6	5.6
840.0		5.05	3.6	9.02	4.7	12.7	5.6
860.0		5.12	3.6	9.14	4.7	12.9	5.6
880.0		5.18	3.6	9.25	4.7	13.1	5.6
900.0		5.24	3.6	9.37	4.7	13.2	5.6
920.0		5.31	3.6	9.48	4.8	13.4	5.6
940.0		5.37	3.6	9.59	4.8	13.5	5.6
960.0		5.43	3.6	9.70	4.8	13.7	5.6
980.0		5.49	3.6	9.81	4.8	13.8	5.7
1000.0		5.56	3.6	9.92	4.8	14.0	5.7
1100.0	3.0	5.85	3.6	10.4	4.8	14.7	5.7
1200.0		6.14	3.7	11.0	4.9	15.5	5.8
1300.0		6.41	3.7	11.4	4.9	16.1	5.8
1400.0		6.67	3.7	11.9	4.9	16.8	5.8
1500.0		6.93	3.7	12.4	5.0	17.4	5.9
1600.0		7.18	3.8	12.8	5.0	18.1	5.9
1700.0		7.42	3.8	13.2	5.0	18.7	5.9
1800.0		7.65	3.8	13.6	5.0	19.2	5.9
1900.0		7.88	3.8	14.0	5.1	19.8	6.0
2000.0		8.10	3.8	14.4	5.1	20.4	6.0

M = Mass Flow Rate (kg/s) l_e = Equivalent Length of Pipe (m)
ΔPI = Pressure Loss per Unit Length (Pa/m) V = Velocity (m/s)

108mm		133mm		159mm		V	ΔPI
M	I_e	M	I_e	M	I_e		
27.1	8.6	47.7	11.3	75.7	14.1		580.0
27.6	8.6	48.6	11.3	77.1	14.1		600.0
28.1	8.6	49.5	11.4	78.5	14.2		620.0
28.5	8.7	50.3	11.4	79.8	14.2		640.0
29.0	8.7	51.2	11.4	81.2	14.2		660.0
29.5	8.7	52.0	11.4	82.5	14.3		680.0
30.0	8.7	52.8	11.5	83.8	14.3		700.0
30.4	8.8	53.6	11.5	85.1	14.3		720.0
30.9	8.8	54.4	11.5	86.3	14.4		740.0
31.3	8.8	55.2	11.5	87.6	14.4		760.0
31.8	8.8	55.9	11.6	88.8	14.4		780.0
32.2	8.8	56.8	11.6	90.0	14.5		800.0
32.6	8.8	57.5	11.6	91.2	14.5		820.0
33.1	8.9	58.3	11.6	92.4	14.5	5.0	840.0
33.5	8.9	59.0	11.7	93.9	14.5		860.0
33.9	8.9	59.7	11.7	94.8	14.6		880.0
34.3	8.9	60.5	11.7	95.9	14.6		900.0
34.7	8.9	61.2	11.7	97.0	14.6		920.0
35.1	8.9	61.9	11.7	98.2	14.6		940.0
35.5	9.0	62.6	11.8	99.3	14.6		960.0
35.9	9.0	63.3	11.8	100.0	14.7		980.0
36.3	9.0	64.0	11.8	102.0	14.7		1000.0
38.2	9.1	67.4	11.8	107.0	14.8	6.0	1100.0
40.1	9.1	70.6	12.0				1200.0
41.8	9.2	73.7	12.0				1300.0
43.6	9.2	76.7	12.1				1400.0
45.2	9.3	79.6	12.1				1500.0
46.8	9.3						1600.0
48.3	9.4						1700.0
49.8	9.4						1800.0
							1900.0
							2000.0

FLOW OF WATER AT 75°C IN STEEL PIPES

ΔPI	V	10mm		15mm		20mm		25mm	
		M	l_e	M	l_e	M	l_e	M	l_e
80.0		0.021	0.3	0.045	0.4	0.105	0.7	0.194	0.9
82.5		0.021	0.3	0.046	0.4	0.107	0.7	0.197	0.9
85.0		0.022	0.3	0.046	0.4	0.108	0.7	0.201	0.9
87.5		0.022	0.3	0.047	0.4	0.110	0.7	0.204	0.9
90.0		0.023	0.3	0.048	0.4	0.112	0.7	0.207	0.9
92.5		0.023	0.3	0.049	0.4	0.113	0.7	0.210	0.9
95.0		0.023	0.3	0.049	0.4	0.115	0.7	0.213	0.9
97.5		0.024	0.3	0.050	0.4	0.117	0.7	0.216	0.9
100.0		0.024	0.3	0.051	0.4	0.118	0.7	0.219	0.9
120.0		0.026	0.3	0.056	0.4	0.131	0.7	0.242	0.9
140.0	0.3	0.029	0.3	0.061	0.5	0.142	0.7	0.262	0.9
160.0		0.031	0.3	0.065	0.5	0.152	0.7	0.282	1.0
180.0		0.033	0.3	0.070	0.5	0.162	0.7	0.300	1.0
200.0		0.035	0.3	0.074	0.5	0.172	0.7	0.317	1.0
220.0		0.037	0.3	0.078	0.5	0.181	0.7	0.334	1.0
240.0		0.039	0.3	0.081	0.5	0.189	0.7	0.349	1.0
260.0		0.040	0.3	0.085	0.5	0.198	0.7	0.364	1.0
280.0		0.042	0.3	0.088	0.5	0.206	0.7	0.379	1.0
300.0		0.044	0.3	0.092	0.5	0.213	0.7	0.393	1.0
320.0		0.045	0.3	0.095	0.5	0.221	0.7	0.407	1.0
340.0		0.047	0.3	0.098	0.5	0.228	0.7	0.420	1.0
360.0		0.048	0.3	0.101	0.5	0.235	0.7	0.433	1.0
380.0	0.5	0.049	0.3	0.104	0.5	0.242	0.7	0.445	1.0
400.0		0.051	0.3	0.107	0.5	0.248	0.7	0.457	1.0
420.0		0.052	0.3	0.110	0.5	0.255	0.7	0.469	1.0
440.0		0.054	0.3	0.113	0.5	0.261	0.7	0.481	1.0
460.0		0.055	0.3	0.115	0.5	0.267	0.7	0.492	1.0
480.0		0.056	0.3	0.118	0.5	0.273	0.8	0.503	1.0
500.0		0.057	0.3	0.120	0.5	0.279	0.8	0.514	1.0
520.0		0.059	0.3	0.123	0.5	0.285	0.8	0.524	1.0
540.0		0.060	0.3	0.125	0.5	0.291	0.8	0.535	1.0
560.0		0.061	0.3	0.128	0.5	0.296	0.8	0.545	1.0

M = Mass Flow Rate (kg/s) l_e = Equivalent Length of Pipe (m)
ΔPI = Pressure Loss per Unit Length (Pa/m) V = Velocity (m/s)

	32mm		40mm		40mm		V	ΔPI
	M	I_e	M	I_e	M	I_e		
	0.425	1.4	0.649	1.7	1.24	2.3		80.0
	0.432	1.4	0.659	1.7	1.26	2.3		82.5
	0.439	1.4	0.670	1.7	1.28	2.3		85.0
	0.446	1.4	0.680	1.7	1.30	2.3		87.5
	0.452	1.4	0.691	1.7	1.31	2.3		90.0
	0.459	1.4	0.701	1.7	1.33	2.3		92.5
	0.466	1.4	0.711	1.7	1.35	2.3		95.0
	0.472	1.4	0.721	1.7	1.37	2.3		97.5
	0.479	1.4	0.731	1.7	1.39	2.3		100.0
	0.527	1.4	0.805	1.7	1.53	2.4		120.0
	0.572	1.4	0.873	1.7	1.66	2.4		140.0
	0.614	1.4	0.937	1.7	1.78	2.4		160.0
	0.654	1.4	0.997	1.8	1.89	2.4		180.0
	0.691	1.4	1.05	1.8	2.00	2.4	1.0	200.0
	0.727	1.4	1.11	1.8	2.10	2.4		220.0
	0.761	1.4	1.16	1.8	2.20	2.4		240.0
	0.793	1.5	1.21	1.8	2.29	2.4		260.0
	0.825	1.5	1.26	1.8	2.38	2.4		280.0
	0.855	1.5	1.30	1.8	2.47	2.5		300.0
	0.884	1.5	1.35	1.8	2.55	2.5		320.0
	0.913	1.5	1.39	1.8	2.64	2.5		340.0
	0.941	1.5	1.43	1.8	2.71	2.5		360.0
	0.970	1.5	1.47	1.8	2.79	2.5		380.0
	0.994	1.5	1.51	1.8	2.87	2.5		400.0
	1.02	1.5	1.55	1.8	2.94	2.5		420.0
	1.04	1.5	1.59	1.8	3.01	2.5	1.5	440.0
	1.07	1.5	1.63	1.8	3.08	2.5		460.0
	1.09	1.5	1.66	1.8	3.15	2.5		480.0
	1.12	1.5	1.69	1.8	3.22	2.5		500.0
	1.14	1.5	1.73	1.8	3.28	2.5		520.0
	1.16	1.5	1.77	1.8	3.35	2.5		540.0
	1.17	1.5	1.80	1.8	3.41	2.5		560.0

FLOW OF WATER AT 75°C IN STEEL PIPES

ΔPI	V	10mm		15mm		20mm		25mm	
		M	l_e	M	l_e	M	l_e	M	l_e
580.0		0.062	0.3	0.130	0.5	0.302	0.8	0.555	1.0
600.0		0.063	0.3	0.133	0.5	0.307	0.8	0.565	1.0
620.0		0.064	0.3	0.135	0.5	0.312	0.8	0.575	1.0
640.0		0.065	0.3	0.137	0.5	0.318	0.8	0.584	1.0
660.0		0.066	0.3	0.139	0.5	0.323	0.8	0.594	1.0
680.0		0.067	0.3	0.142	0.5	0.328	0.8	0.603	1.0
700.0		0.069	0.3	0.144	0.5	0.333	0.8	0.612	1.0
720.0		0.070	0.3	0.146	0.5	0.338	0.8	0.621	1.0
740.0		0.071	0.3	0.148	0.5	0.343	0.8	0.630	1.0
760.0		0.072	0.3	0.150	0.5	0.347	0.8	0.639	1.0
780.0		0.073	0.3	0.152	0.5	0.352	0.8	0.648	1.0
800.0		0.074	0.3	0.154	0.5	0.357	0.8	0.656	1.0
820.0		0.075	0.4	0.156	0.5	0.362	0.8	0.665	1.0
840.0		0.075	0.4	0.158	0.5	0.366	0.8	0.673	1.0
860.0		0.076	0.4	0.160	0.5	0.371	0.8	0.681	1.0
880.0		0.077	0.4	0.162	0.5	0.375	0.8	0.689	1.0
900.0		0.078	0.4	0.164	0.5	0.379	0.8	0.698	1.0
920.0		0.079	0.4	0.166	0.5	0.384	0.8	0.706	1.0
940.0		0.080	0.4	0.168	0.5	0.388	0.8	0.713	1.0
960.0		0.081	0.4	0.170	0.5	0.392	0.8	0.721	1.0
980.0		0.082	0.4	0.172	0.5	0.397	0.8	0.729	1.0
1000.0		0.083	0.4	0.173	0.5	0.401	0.8	0.737	1.0
1100.0		0.087	0.4	0.182	0.5	0.421	0.8	0.774	1.1
1200.0		0.091	0.4	0.191	0.5	0.441	0.8	0.809	1.1
1300.0	1.0	0.095	0.4	0.199	0.5	0.459	0.8	0.844	1.1
1400.0		0.099	0.4	0.207	0.5	0.477	0.8	0.876	1.1
1500.0		0.102	0.4	0.214	0.5	0.495	0.8	0.908	1.1
1600.0		0.106	0.4	0.222	0.5	0.511	0.8	0.939	1.1
1700.0		0 109	0.4	0.229	0.5	0.528	0.8	0.968	1.1
1800.0		0.113	0.4	0.236	0.5	0.543	0.8	0.997	1.1
1900.0		0.116	0.4	0.242	0.5	0.559	0.8	1.03	1.1
2000.0		0.119	0.4	0.249	0.5	0.574	0.8	1.05	1.1

M = Mass Flow Rate (kg/s) l_e = Equivalent Length of Pipe (m)
ΔPI = Pressure Loss per Unit Length (Pa/m) V = Velocity (m/s)

32mm		40mm		40mm		V	ΔPI
M	I_e	M	I_e	M	I_e		
1.21	1.5	1.83	1.8	3.47	2.5		580.0
1.23	1.5	1.87	1.8	3.53	2.5		600.0
1.25	1.5	1.90	1.8	3.59	2.5		620.0
1.27	1.5	1.93	1.8	3.65	2.5		640.0
1.29	1.5	1.96	1.8	3.71	2.5		660.0
1.31	1.5	1.99	1.9	3.77	2.5		680.0
1.33	1.5	2.02	1.9	3.83	2.5		700.0
1.35	1.5	2.05	1.9	3.88	2.5		720.0
1.37	1.5	2.08	1.9	3.94	2.5		740.0
1.39	1.5	2.10	1.9	3.99	2.5	2.0	760.0
1.41	1.5	2.14	1.9	4.04	2.5		780.0
1.42	1.5	2.17	1.9	4.10	2.5		800.0
1.44	1.5	2.19	1.9	4.15	2.5		820.0
1.46	1.5	2.22	1.9	4.20	2.5		840.0
1.48	1.5	2.25	1.9	4.25	2.5		860.0
1.50	1.5	2.27	1.9	4.30	2.5		880.0
1.51	1.5	2.30	1.9	4.35	2.5		900.0
1.53	1.5	2.33	1.9	4.40	2.5		920.0
1.55	1.5	2.35	1.9	4.45	2.5		940.0
1.56	1.5	2.38	1.9	4.50	2.5		960.0
1.58	1.5	2.40	1.9	4.55	2.5		980.0
1.60	1.5	2.43	1.9	4.59	2.5		1000.0
1.68	1.5	2.55	1.9	4.82	2.6		1100.0
1.75	1.5	2.67	1.9	5.04	2.6		1200.0
1.83	1.5	2.78	1.9	5.25	2.6		1300.0
1.90	1.5	2.89	1.9	5.46	2.6		1400.0
1.98	1.5	2.99	1.9	5.65	2.6		1500.0
2.03	1.5	3.09	1.9	5.84	2.6		1600.0
2.10	1.5	3.19	1.9	6.02	2.6	3.0	1700.0
2.16	1.6	3.28	1.9				1800.0
2.22	1.6	3.37	1.9				1900.0
2.28	1.6	3.46	1.9				2000.0

FLOW OF WATER AT 75°C IN STEEL PIPES

ΔPI	V	65mm		80mm		90mm		
		M	l_e	M	l_e	M	l_e	
80.0		2.51	3.3	3.90	4.0	5.75	4.9	
82.5		2.55	3.3	3.96	4.1	5.84	4.9	
85.0		2.59	3.3	4.02	4.1	5.93	4.9	
87.5		2.63	3.3	4.09	4.1	6.02	4.9	
90.0		2.67	3.3	4.15	4.1	6.11	4.9	
92.5		2.71	3.3	4.21	4.1	6.20	4.9	
95.0		2.75	3.3	4.27	4.1	6.29	4.9	
97.5		2.79	3.3	4.32	4.1	6.37	4.9	
100.0		2.82	3.3	4.38	4.1	6.46	4.9	
120.0		3.11	3.3	4.82	4.1	7.10	5.0	
140.0	1.0	3.37	3.4	5.22	4.2	7.69	5.0	
160.0		3.61	3.4	5.60	4.2	8.25	5.0	
180.0		3.84	3.4	5.95	4.2	8.76	5.0	
200.0		4.05	3.4	6.29	4.2	9.25	5.0	
220.0		4.26	3.4	6.60	4.2	9.72	5.1	
240.0		4.46	3.4	6.91	4.2	10.2	5.1	
260.0		4.65	3.4	7.20	4.2	10.6	5.1	
280.0		4.83	3.4	7.48	4.3	11.0	5.1	
300.0	1.5	5.00	3.5	7.75	4.3	11.4	5.1	
320.0		5.17	3.5	8.01	4.3	11.8	5.1	
340.0		5.34	3.5	8.27	4.3	12.2	5.2	
360.0		5.50	3.5	8.51	4.3	12.5	5.2	
380.0		5.65	3.5	8.75	4.3	12.8	5.2	
400.0		5.80	3.5	8.99	4.3	13.2	5.2	
420.0		5.95	3.5	9.22	4.3	13.6	5.2	
440.0		6.09	3.5	9.44	4.3	13.9	5.2	
460.0		6.24	3.5	9.66	4.3	14.2	5.2	
480.0		6.37	3.5	9.87	4.3	14.5	5.2	
500.0		6.51	3.5	10.1	4.3	14.8	5.2	
520.0		6.64	3.5	10.3	4.3	15.1	5.2	
540.0	2.0	6.77	3.5	10.5	4.3	15.4	5.2	
560.0		6.90	3.5	10.7	4.3	15.7	5.2	

M = Mass Flow Rate (kg/s) l_e = Equivalent Length of Pipe (m)
ΔPI = Pressure Loss per Unit Length (Pa/m) V = Velocity (m/s)

100mm		125mm		150mm		V	ΔPI
M	I_e	M	I_e	M	I_e		
7.90	5.7	14.2	7.6	22.8	9.5		80.0
8.02	5.7	14.4	7.6	23.2	9.5		82.5
8.15	5.7	14.6	7.6	23.5	9.5		85.0
8.27	5.7	14.8	7.6	23.9	9.5		87.5
8.40	5.7	15.0	7.6	24.2	9.5		90.0
8.52	5.7	15.3	7.6	24.6	9.5		92.5
8.64	5.7	15.5	7.6	24.9	9.6		95.0
8.75	5.8	15.7	7.6	25.2	9.6		97.5
8.87	5.8	15.9	7.6	25.6	9.6	1.5	100.0
9.75	5.8	17.5	7.7	28.1	9.6		120.0
10.6	5.8	18.9	7.7	30.4	9.7		140.0
11.3	5.9	20.3	7.7	32.6	9.7		160.0
12.0	5.9	21.6	7.8	34.6	9.7	2.0	180.0
12.7	5.9	22.7	7.8	36.5	9.8		200.0
13.3	5.9	23.9	7.8	38.4	9.8		220.0
14.0	5.9	25.0	7.8	40.1	9.8		240.0
14.5	6.0	26.0	7.9	41.8	9.8		260.0
15.1	6.0	27.0	7.9	43.4	9.9		280.0
15.6	6.0	28.0	7.9	45.0	9.9		300.0
16.2	6.0	29.0	7.9	46.5	9.9		320.0
16.7	6.0	29.8	7.9	47.9	9.9		340.0
17.2	6.0	30.7	7.9	49.4	9.9		360.0
17.7	6.0	31.6	7.9	50.7	9.9		380.0
18.1	6.0	32.4	7.9	52.1	9.9		400.0
18.6	6.0	33.2	7.9	53.4	9.9		420.0
19.0	6.0	34.0	7.9	54.7	9.9	3.0	440.0
19.5	6.0	34.8	8.0	55.9	9.9		460.0
19.9	6.0	35.6	8.0	57.2	10		480.0
20.3	6.0	36.3	8.0	58.4	10		500.0
20.7	6.1	37.1	8.0	59.5	10		520.0
21.1	6.1	37.8	8.0	60.7	10		540.0
21.5	6.1	38.5	8.0	61.8	10		560.0

FLOW OF WATER AT 75°C IN STEEL PIPES

ΔPI	V	65mm		80mm		90mm		
		M	l_e	M	l_e	M	l_e	
580.0		7.02	3.5	10.9	4.3	16.0	5.2	
600.0		7.15	3.5	11.1	4.3	16.3	5.2	
620.0		7.27	3.5	11.3	4.4	16.6	5.2	
640.0		7.39	3.5	11.4	4.4	16.8	5.2	
660.0		7.50	3.5	11.6	4.4	17.1	5.2	
680.0		7.62	3.5	11.8	4.4	17.3	5.2	
700.0		7.73	3.5	12.0	4.4	17.6	5.2	
720.0		7.85	3.5	12.2	4.4	17.8	5.2	
740.0		7.96	3.5	12.3	4.4	18.1	5.2	
760.0		8.07	3.5	12.4	4.4	18.4	5.3	
780.0		8.17	3.5	12.6	4.4	18.6	5.3	
800.0		8.28	3.6	12.8	4.4	18.8	5.3	
820.0		8.39	3.6	12.9	4.4	19.1	5.3	
840.0		8.49	3.6	13.1	4.4	19.3	5.3	
860.0		8.59	3.6	13.3	4.4	19.6	5.3	
880.0		8.69	3.6	13.5	4.4	19.8	5.3	
900.0		8.80	3.6	13.6	4.4	20.0	5.3	
920.0		8.89	3.6	13.8	4.4	20.2	5.3	
940.0		8.99	3.6	13.9	4.4	20.5	5.3	
960.0		9.09	3.6	14.1	4.4	20.7	5.3	
980.0		9.19	3.6	14.2	4.4	20.9	5.3	
1000.0		9.28	3.6	14.4	4.4	21.1	5.3	
1100.0		9.74	3.6	15.1	4.4	22.2	5.3	
1200.0	3.0	10.2	3.6	15.8	4.4	23.2	5.3	
1300.0		10.6	3.6	16.4	4.4	24.1	5.3	
1400.0		11.0	3.6	17.0	4.4	25.0	5.3	
1500.0		11.4	3.6	17.6	4.4			
1600.0		11.8	3.6	18.2	4.4			
1700.0		12.2	3.6	18.8	4.4			
1800.0		12.5	3.6					
1900.0		12.9	3.6					
2000.0		13.2	3.6					

M = Mass Flow Rate (kg/s) l_e = Equivalent Length of Pipe (m)
ΔPI = Pressure Loss per Unit Length (Pa/m) V = Velocity (m/s)

100mm		125mm		150mm		V	ΔPI
M	I_e	M	I_e	M	I_e		
21.9	6.1	39.2	8.0	62.9	10		580.0
22.3	6.1	39.9	8.0	64.0	10		600.0
22.7	6.1	40.5	8.0	65.1	10		620.0
23.1	6.1	41.2	8.0	66.2	10		640.0
23.4	6.1	41.9	8.0	67.2	10		660.0
23.8	6.1	42.5	8.0	68.2	10		680.0
24.1	6.1	43.1	8.0	69.2	10		700.0
24.5	6.1	43.7	8.0	70.2	10		720.0
24.8	6.1	44.4	8.0	71.2	10		740.0
25.1	6.1	45.0	8.0	72.2	10	4.0	760.0
25.5	6.1	45.6	8.0				780.0
25.8	6.1	46.2	8.0				800.0
26.2	6.1	46.7	8.0				820.0
26.5	6.1	47.3	8.0				840.0
26.8	6.1	47.9	8.0				860.0
27.1	6.1	48.4	8.0				880.0
27.4	6.1	49.0	8.0				900.0
27.7	6.1	49.6	8.1				920.0
28.0	6.1	50.1	8.1				940.0
28.3	6.1	50.6	8.1				960.0
28.6	6.1						980.0
28.9	6.1						1000.0
30.4	6.1						1100.0
31.7	6.1						1200.0
							1300.0
							1400.0
							1500.0
							1600.0
							1700.0
							1800.0
							1900.0
							2000.0

FLOW OF NATURAL GAS IN MEDIUM-GRADE STEEL PIPES

ΔPI	c	10mm		15mm		
		q_v	l_e	q_v	l_e	
0.5		0.000028	0.1	0.000078	0.1	
0.6		0.000033	0.1	0.000093	0.2	
0.7		0.000038	0.1	0.000108	0.2	
0.8		0.000044	0.1	0.000124	0.2	
0.9		0.000049	0.1	0.000139	0.2	
1.0	0.5	0.000055	0.1	0.000155	0.2	
1.5		0.000082	0.2	0.000232	0.3	
2.0		0.000109	0.2	0.000309	0.4	
2.5		0.000136	0.2	0.000386*	0.5	
3.0		0.000163	0.3	0.000413	0.5	
3.5	1.5	0.000190	0.3	0.000430	0.5	
4.0		0.000217	0.3	0.000447	0.5	
4.5		0.000245	0.4	0.000465	0.4	
5.0		0.000272	0.4	0.000482	0.4	
5.5		0.000299	0.4	0.000499	0.4	
6.0		0.000311*	0.4	0.000516	0.4	
6.5		0.000317	0.4	0.000534	0.4	
7.0		0.000323	0.4	0.000551	0.4	
7.5		0.000329	0.4	0.000568	0.4	
8.0		0.000335	0.4	0.000585	0.4	
8.5		0.000341	0.4	0.000603†	0.4	
9.0		0.000347	0.4	0.000624	0.4	
9.5		0.000353	0.4	0.000643	0.4	
10.0	3.0	0.000359	0.3	0.000663	0.4	
12.5		0.000388	0.3	0.000753	0.4	
15.0		0.000418	0.3	0.000836	0.4	
17.5		0.000448†	0.3	0.000912	0.4	
20.0		0.000480	0.3	0.000984	0.4	
22.5		0.000514	0.3	0.00105	0.5	
25.0		0.000545	0.3	0.00112	0.5	

q_v = volume flow rate — m^3/s
c = velocity — m/s
ΔPI = pressure drop per unit length — Pa/m
l_e = equivalent length of a component for $\zeta = 1$ — m
* (Re) = 2000 for q = 0.68 kg/m^3
† (Re) = 3000

	20mm		25mm		c	ΔPI
	q_v	l_e	q_v	l_e		
	0.000250	0.4	0.000638	0.9		0.5
	0.000300	0.4	0.000696*	0.9		0.6
	0.000350	0.5	0.000725	0.9		0.7
	0.000400	0.6	0.000755	0.9		0.8
	0.000450	0.6	0.000784	0.9		0.9
	0.000500*	0.7	0.000814	0.9		1.0
	0.000583	0.6	0.000961	1.0	1.5	1.5
	0.000640	0.6	0.00112	1.0		2.0
	0.000697	0.5	0.00128	1.1		2.5
	0.000754	0.5	0.00142	1.1		3.0
	0.000813†	0.5	0.00155	1.1		3.5
	0.000878	0.5	0.00167	1.1		4.0
	0.000940	0.5	0.00179	1.1	3.0	4.5
	0.000999	0.6	0.00190	1.1		5.0
	0.00106	0.6	0.00201	1.1		5.5
	0.00111	0.6	0.00211	1.2		6.0
	0.00116	0.6	0.00221	1.2		6.5
	0.00121	0.6	0.00230	1.2		7.0
	0.00126	0.6	0.00239	1.2		7.5
	0.00131	0.6	0.00248	1.2		8.0
	0.00135	0.6	0.00257	1.2		8.5
	0.00140	0.6	0.00265	1.2		9.0
	0.00144	0.6	0.00274	1.2		9.5
	0.00149	0.6	0.00282	1.2		10.0
	0.00169	0.6	0.00319	1.2		12.5
	0.00187	0.6	0.00354	1.3		15.0
	0.00204	0.7	0.00385	1.3		17.5
	0.00220	0.7	0.00415	1.3		20.0
	0.00235	0.7	0.00443	1.3		22.5
	0.00249	0.7	0.00470	1.3		25.0

FLOW OF NATURAL GAS IN MEDIUM-GRADE STEEL PIPES

ΔPI	c	32mm		40mm		
		q_v	l_e	q_v	l_e	
0.5		0.00113	0.9	0.00164	1.0	
0.6		0.00122	0.9	0.00182	1.0	
0.7		0.00131†	0.9	0.00199	1.1	
0.8		0.00141	0.9	0.00215	1.1	
0.9	1.5	0.00151	0.9	0.00230	1.1	
1.0		0.00161	0.9	0.00245	1.1	
1.5		0.00204	1.0	0.00309	1.2	
2.0		0.00240	1.0	0.00364	1.2	
2.5		0.00273	1.0	0.00413	1.3	
3.0	3.0	0.00303	1.1	0.00458	1.3	
3.5		0.00331	1.1	0.00500	1.3	
4.0		0.00357	1.1	0.00539	1.4	
4.5		0.00381	1.1	0.00576	1.4	
5.0		0.00405	1.1	0.00612	1.4	
5.5		0.00427	1.1	0.00645	1.4	
6.0		0.00449	1.2	0.00677	1.4	
6.5		0.00469	1.2	0.00708	1.4	
7.0		0.00489	1.2	0.00738	1.4	
7.5	5.0	0.00508	1.2	0.00767	1.5	
8.0		0.00527	1.2	0.00795	1.5	
8.5		0.00545	1.2	0.00823	1.5	
9.0		0.00563	1.2	0.00849	1.5	
9.5		0.00580	1.2	0.00875	1.5	
10.0		0.00597	1.2	0.00900	1.5	
12.5		0.00676	1.2	0.0102	1.5	
15.0		0.00748	1.3	0.0113	1.6	
17.5		0.00814	1.3	0.0123	1.6	
20.0		0.00877	1.3	0.0132	1.6	
22.5		0.00935	1.3	0.0141	1.6	
25.0		0.00991	1.3	0.0149	1.6	

q_v = volume flow rate m³/s
c = velocity m/s
ΔPI = pressure drop per unit length Pa/m
l_e = equivalent length of a component for $\zeta = 1$ m
* (Re) = 2000 for q = 0.68 kg/m³
† (Re) = 3000

	50mm		65mm		c	ΔPI
	q_v	l_e	q_v	l_e		
	0.00313	1.4	0.00637	2.1		0.5
	0.00347	1.5	0.00707	2.1		0.6
	0.00380	1.5	0.00772	2.2		0.7
	0.00410	1.5	0.00833	2.2		0.8
	0.00439	1.5	0.00890	2.2		0.9
	0.00466	1.6	0.00945	2.3		1.0
	0.00587	1.7	0.0119	2.4	3.0	1.5
	0.00691	1.7	0.0140	2.5		2.0
	0.00784	1.8	0.0158	2.5		2.5
	0.00869	1.8	0.0175	2.6		3.0
	0.00947	1.8	0.0191	2.6	5.0	3.5
	0.0102	1.9	0.0206	2.7		4.0
	0.0109	1.9	0.0220	2.7		4.5
	0.0116	1.9	0.0233	2.7		5.0
	0.0122	1.9	0.0245	2.8		5.5
	0.0128	2.0	0.0257	2.8		6.0
	0.0134	2.0	0.0269	2.8		6.5
	0.0139	2.0	0.0280	2.8		7.0
	0.0145	2.0	0.0291	2.8		7.5
	0.0150	2.0	0.0301	2.9		8.0
	0.0155	2.0	0.0312	2.9		8.5
	0.0160	2.1	0.0322	2.9		9.0
	0.0165	2.1	0.0331	2.9		9.5
	0.0170	2.1	0.0341	2.9		10.0
	0.0192	2.1	0.0385	3.0	10.0	12.5
	0.0212	2.1	0.0425	3.0		15.0
	0.0231	2.2	0.0462	3.1		17.5
	0.0248	2.2	0.0496	3.1		20.0
	0.0264	2.2	0.0529	3.1		22.5
	0.0280	2.2	0.0560	3.2		25.0

FLOW OF NATURAL GAS IN MEDIUM-GRADE STEEL PIPES

ΔPl	c	80mm		90mm		100mm		
		q_v	l_e	q_v	l_e	q_v	l_e	
0.5		0.00988	2.6	0.0146	3.2	0.0203	3.8	
0.6		0.0110	2.7	0.0162	3.2	0.0224	3.8	
0.7		0.0120	2.7	0.0177	3.3	0.0245	3.9	
0.8		0.0129	2.8	0.0190	3.4	0.0264	4.0	
0.9		0.0138	2.8	0.0203	3.4	0.0282	4.0	
1.0	3.0	0.0146	2.8	0.0216	3.5	0.0299	4.1	
1.5		0.0184	3.0	0.0271	3.6	0.0375	4.3	
2.0		0.0216	3.1	0.0318	3.7	0.0440	4.4	
2.5	5.0	0.0245	3.2	0.0360	3.8	0.0498	4.5	
3.0		0.0271	3.2	0.0398	3.9	0.0550	4.6	
3.5		0.0295	3.3	0.0433	4.0	0.0599	4.7	
4.0		0.0317	3.3	0.0466	4.0	0.0645	4.7	
4.5		0.0339	3.4	0.0498	4.1	0.0688	4.8	
5.0		0.0359	3.4	0.0572	4.1	0.0728	4.8	
5.5		0.0378	3.4	0.0555	4.2	0.0767	4.9	
6.0		0.0397	3.5	0.0583	4.2	0.0804	4.9	
6.5		0.0414	3.5	0.0609	4.2	0.0840	5.0	
7.0		0.0432	3.5	0.0634	4.2	0.0875	5.0	
7.5		0.0448	3.5	0.0658	4.3	0.0908	5.0	
8.0		0.0464	3.6	0.0681	4.3	0.0941	5.0	
8.5		0.0480	3.6	0.0704	4.3	0.0972	5.1	
9.0		0.0495	3.6	0.0726	4.3	0.100	5.1	
9.5	10.0	0.0510	3.6	0.0748	4.4	0.103	5.1	
10.0		0.0524	3.6	0.0769	4.4	0.106	5.1	
12.5		0.0592	3.7	0.0868	4.5	0.120	5.2	
15.0		0.0653	3.7	0.0957	4.5	0.132	5.3	
17.5	15.0	0.0710	3.8	0.104	4.6	0.143	5.4	
20.0		0.0763	3.8	0.112	4.6	0.154	5.4	
22.5		0.0812	3.9	0.119	4.7	0.164	5.4	
25.0		0.0860	3.9	0.126	4.7	0.173	5.5	

q_v = volume flow rate m³/s
c = velocity m/s
ΔPl = pressure drop per unit length Pa/m
l_e = equivalent length of a component for $\zeta = 1$ m
* (Re) = 2000 for q = 0.68 kg/m³
† (Re) = 3000

	125mm		150mm		c	ΔPl
	q_v	l_e	q_v	l_e		
	0.0360	5.1	0.0583	6.5	3.0	0.5
	0.0400	5.2	0.0645	6.6		0.6
	0.0434	5.3	0.0703	6.7		0.7
	0.0468	5.3	0.0757	6.8		0.8
	0.0500	5.4	0.0808	6.9		0.9
	0.0530	5.5	0.0857	7.0		1.0
	0.0663	5.7	0.107	7.3	5.0	1.5
	0.0778	5.9	0.126	7.5		2.0
	0.0879	6.0	0.142	7.7		2.5
	0.0972	6.1	0.157	7.8		3.0
	0.106	6.2	0.170	7.9		3.5
	0.114	6.3	0.183	8.0	10.0	4.0
	0.121	6.4	0.195	8.1		4.5
	0.128	6.4	0.207	8.1		5.0
	0.135	6.5	0.218	8.2		5.5
	0.142	6.5	0.228	8.2		6.0
	0.148	6.6	0.238	8.3		6.5
	0.154	6.6	0.248	8.3		7.0
	0.160	6.6	0.257	8.4		7.5
	0.166	6.7	0.266	8.4		8.0
	0.171	6.7	0.275	8.5		8.5
	0.176	6.7	0.284	8.5	15.0	9.0
	0.182	6.8	0.292	8.5		9.5
	0.187	6.8	0.300	8.6		10.0
	0.210	6.9	0.338	8.7		12.5
	0.232	7.0	0.373	8.8		15.0
	0.252	7.1	0.404	8.9		17.5
	0.270	7.1	0.434	9.0		20.0
	0.288	7.2	0.462	9.0		22.5
	0.304	7.2	0.488	9.2		25.0

FLOW OF NATURAL GAS IN COPPER PIPES

ΔPl	c	6mm		8mm		10mm		
		q_v	l_e	q_v	l_e	q_v	l_e	
0.5		0.000001	0.0	0.000003	0.0	0.000007	0.0	
0.6		0.000001	0.0	0.000003	0.0	0.000009	0.0	
0.7		0.000001	0.0	0.000004	0.0	0.000010	0.0	
0.8		0.000001	0.0	0.000004	0.0	0.000012	0.0	
0.9		0.000002	0.0	0.000005	0.0	0.000013	0.0	
1.0	0.1	0.000002	0.0	0.000005	0.0	0.000014	0.0	
1.5		0.000002	0.0	0.000008	0.0	0.000021	0.0	
2.0	0.15	0.000003	0.0	0.000010	0.0	0.000028	0.0	
2.5		0.000004	0.0	0.000013	0.0	0.000035	0.0	
3.0		0.000004	0.0	0.000015	0.0	0.000042	0.1	
3.5		0.000005	0.0	0.000018	0.0	0.000049	0.1	
4.0	0.3	0.000005	0.0	0.000020	0.0	0.000056	0.1	
4.5		0.000006	0.0	0.000023	0.0	0.000062	0.1	
5.0		0.000007	0.0	0.000025	0.0	0.000069	0.1	
5.5		0.000007	0.0	0.000027	0.0	0.000076	0.1	
6.0		0.000008	0.0	0.000030	0.0	0.000083	0.2	
6.5		0.000008	0.0	0.000032	0.0	0.000090	0.2	
7.0		0.000009	0.0	0.000035	0.0	0.000097	0.2	
7.5		0.000010	0.0	0.000037	0.1	0.000104	0.2	
8.0		0.000010	0.0	0.000040	0.1	0.000111	0.2	
8.5		0.000011	0.0	0.000042	0.1	0.000117	0.2	
9.0		0.000011	0.0	0.000045	0.1	0.000124	0.2	
9.5		0.000012	0.0	0.000047	0.1	0.000131	0.2	
10.0		0.000013	0.0	0.000050	0.1	0.000138	0.2	
12.5		0.000016	0.0	0.000062	0.1	0.000172	0.3	
15.0	1.0	0.000019	0.0	0.000074	0.1	0.000207*	0.3	
17.5		0.000022	0.0	0.000086	0.1	0.000224	0.3	
20.0		0.000025	0.0	0.000099	0.1	0.000232	0.3	
22.5		0.000028	0.0	0.000111	0.2	0.000240	0.3	

q_v = volume flow rate m³/s
c = velocity m/s
ΔPl = pressure drop per unit length Pa/m
l_e = equivalent length of a component for $\zeta = 1$ m
* (Re) = 2000 for q = 0.68 kg/m³
† (Re) = 3000

	12mm		15mm		c	ΔPl
	q_v	l_e	q_v	l_e		
	0.000016	0.0	0.000040	0.1	0.3	0.5
	0.000019	0.0	0.000048	0.1		0.6
	0.000022	0.0	0.000055	0.1		0.7
	0.000025	0.0	0.000063	0.1		0.8
	0.000029	0.0	0.000071	0.1		0.9
	0.000032	0.0	0.000079	0.2		1.0
	0.000047	0.1	0.000118	0.2		1.5
	0.000063	0.1	0.000157	0.2	1.0	2.0
	0.000079	0.1	0.000197	0.3		2.5
	0.000094	0.1	0.000236	0.3		3.0
	0.000110	0.1	0.000275	0.4		3.5
	0.000125	0.2	0.000314	0.4		4.0
	0.000141	0.2	0.000341*	0.5		4.5
	0.000157	0.2	0.000350	0.4		5.0
	0.000172	0.2	0.000360	0.4		5.5
	0.000188	0.2	0.000369	0.4		6.0
	0.000203	0.3	0.000379	0.4		6.5
	0.000219	0.3	0.000388	0.4		7.0
	0.000235	0.3	0.000398	0.4		7.5
	0.000250	0.4	0.000407	0.4		8.0
	0.000266*	0.4	0.000417	0.4		8.5
	0.000271	0.3	0.000426	0.4		9.0
	0.000275	0.3	0.000436	0.4	3.0	9.5
	0.000278	0.3	0.000445	0.4		10.0
	0.000297	0.3	0.000493†	0.4		12.5
	0.000316	0.3	0.000546	0.4		15.0
	0.000335	0.3	0.000597	0.4		17.5
	0.000354	0.3	0.000646	0.4		20.0
	0.000373	0.3	0.000692	0.4		22.5

FLOW OF NATURAL GAS IN COPPER PIPES

ΔPl	c	22mm		28mm		35mm		
		q_v	l_e	q_v	l_e	q_v	l_e	
0.5		0.000192	0.3	0.000543	0.7	0.000927	0.8	
0.6		0.000231	0.3	0.000649*	0.9	0.000990	0.8	
0.7	1.0	0.000269	0.4	0.000675	0.8	0.00105	0.8	
0.8		0.000307	0.4	0.000702	0.8	0.00112	0.8	
0.9		0.000346	0.5	0.000728	0.7	0.00118	0.8	
1.0		0.000384	0.5	0.000754	0.7	0.00125	0.8	
1.5		0.000519*	0.6	0.000886	0.7	0.00158	0.9	
2.0		0.000565	0.5	0.00102†	0.7	0.00187	0.9	
2.5		0.000611	0.5	0.00117	0.7	0.00213	0.9	
3.0		0.000658	0.5	0.00130	0.7	0.00237	1.0	
3.5		0.000704	0.5	0.00142	0.7	0.00260	1.0	
4.0		0.000751†	0.5	0.00154	0.7	0.00281	1.0	
4.5		0.000805	0.5	0.00165	0.8	0.00300	1.0	
5.0		0.000856	0.5	0.00175	0.8	0.00319	1.0	
5.5		0.000906	0.5	0.00185	0.8	0.00337	1.1	
6.0	3.0	0.000953	0.5	0.00195	0.8	0.00355	1.1	
6.5		0.000999	0.6	0.00204	0.8	0.00371	1.1	
7.0		0.00104	0.6	0.00213	0.8	0.00388	1.1	
7.5		0.00109	0.6	0.00222	0.8	0.00403	1.1	
8.0		0.00113	0.6	0.00230	0.8	0.00419	1.1	
8.5		0.00117	0.6	0.00239	0.8	0.00433	1.1	
9.0		0.00121	0.6	0.00247	0.8	0.00448	1.1	
9.5		0.00125	0.6	0.00254	0.8	0.00462	1.1	
10.0		0.00129	0.6	0.00262	0.9	0.00476	1.2	
12.5		0.00146	0.6	0.00298	0.9	0.00541	1.2	
15.0	5.0	0.00163	0.6	0.00331	0.9	0.00600	1.2	
17.5		0.00178	0.6	0.00361	0.9	0.00656	1.2	
20.0		0.00192	0.7	0.00390	0.9	0.00707	1.3	
22.5		0.00206	0.7	0.00418	1.0	0.00756	1.3	
25.0		0.00219	0.7	0.00444	1.0	0.00803	1.3	

q_v = volume flow rate m³/s
c = velocity m/s
ΔPl = pressure drop per unit length Pa/m
l_e = equivalent length of a component for $\zeta = 1$ m
* (Re) = 2000 for q = 0.68 kg/m³
† (Re) = 3000

	42mm		54mm		c	ΔPl
	q_v	l_e	q_v	l_e		
	0.00143	1.0	0.00295	1.4		0.5
	0.00158	1.0	0.00328	1.4		0.6
	0.00173	1.0	0.00359	1.5		0.7
	0.00187	1.0	0.00388	1.5		0.8
	0.00201	1.0	0.00415	1.5		0.9
	0.00213	1.1	0.00442	1.6		1.0
	0.00270	1.1	0.00558	1.7		1.5
	0.00320	1.2	0.00659	1.7	3.0	2.0
	0.00364	1.2	0.00749	1.8		2.5
	0.00404	1.3	0.00832	1.8		3.0
	0.00442	1.3	0.00909	1.9		3.5
	0.00477	1.3	0.00981	1.9		4.0
	0.00510	1.3	0.0105	1.9	5.0	4.5
	0.00543	1.4	0.0111	2.0		5.0
	0.00573	1.4	0.0118	2.0		5.5
	0.00603	1.4	0.0124	2.0		6.0
	0.00631	1.4	0.0129	2.0		6.5
	0.00658	1.4	0.0135	2.1		7.0
	0.00685	1.4	0.0140	2.1		7.5
	0.00710	1.5	0.0146	2.1		8.0
	0.00736	1.5	0.0151	2.1		8.5
	0.00760	1.5	0.0156	2.1		9.0
	0.00784	1.5	0.0160	2.2		9.5
	0.00807	1.5	0.0165	2.2		10.0
	0.00917	1.6	0.0187	2.2		12.5
	0.0102	1.6	0.0208	2.3	10.0	15.0
	0.0111	1.6	0.0227	2.3		17.5
	0.0120	1.7	0.0244	2.4		20.0
	0.0128	1.7	0.0261	2.4		22.5
	0.0136	1.7	0.0277	2.4		25.0

AIR FLOW RATES

EQUATION:

Pressure Drop $\Delta Pl = 1.6 \times 10^8 \times \frac{V^{1.85} \times L}{d^5 \times P}$

Wher Δe P = Pressure Drop in bar

V = Free Air Flow m^3/sec = L/sec x 10^{-3}

L = Pipe Length in Metres

d = Inside Pipe Diameter in Millimetres

P = Initial Pressure in bar (gauge)

NOMOGRAM

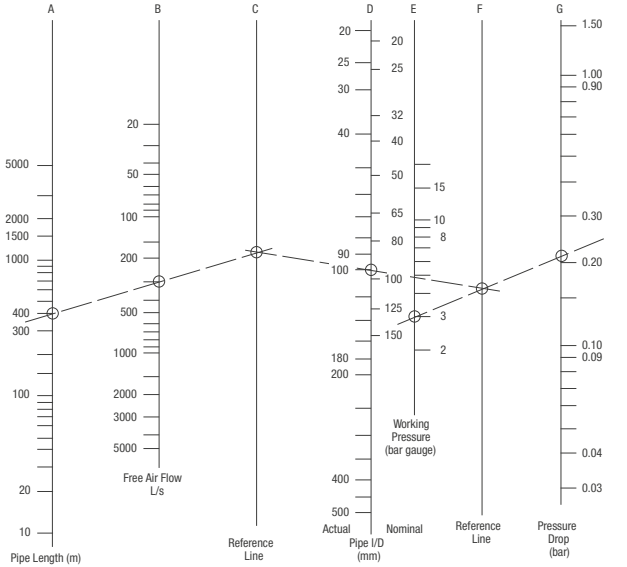
The nomogram solves the pressure drop equation.

To complete the nomogram, follow the example shown where:

The Pipe Length (A) is connected to the Free Air Flow Line (B) and then extended to Reference Line (C).

The intersection on Reference Line (C) is then connected to Pipe I/D Line (D) and extended to the Reference Line (F).

Using the intersection on Reference Line (F) as a pivot, connect the actual Working Pressure (E) through the pivot point to Pressure Drop Line (G) and read off the pressure drop.



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IP RATINGS

Protection of persons and protection of equipment indicated by the IP code.

Protection provided by enclosures for electrical equipment is indicated by the IP code's two:
CHARACTERISTIC NUMERALS

The first numeral indicates protection of persons against access to hazardous parts, and protection of equipment against ingress of solid foreign objects. (see AS 1939, Clause 5).

The second numeral indicates protection of equipment against harmful ingress of water (see AS 1939, Clause 6).

X
Protection unspecified (untested).

0
Non-protected.

The 'Flash' symbol indicates hazardous parts (live or moving)

1

Protection of the back of the hand against accidental access to hazardous parts, and protection of equipment against objects larger than 50mm.

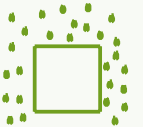
2

Protection of fingers against access to hazardous parts, and protection of equipment against objects larger than 12.5mm.

X
Protection unspecified (untested).

0
Non-protected.

1



Protection against drops of water falling vertically.

2

Protection against drops of water falling vertically when the object is tilted up to 15° from its normal position (in any direction).

3

Protection of persons holding tools or wires (larger than 2.5mm diameter), and protection of equipment against objects larger than 2.5mm (e.g. ball bearings).

4

Protection of persons holding small tools or wires (larger than 1mm diameter), and protection of equipment against objects larger than 1mm (e.g. ball bearings).

5

Protection against entry of dust in sufficient quantity to interfere with satisfactory operation of equipment.

6

Complete protection against entry of dust.

3

Protection against spraying water at up to 60fl from the vertical.

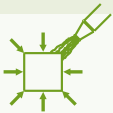
4

Protection against splashing and spraying water from all practicable directions.

5

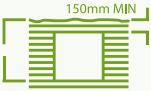
Protection against low-pressure jets of water from all practicable directions.

6



Protection against heavy seas or a strong jet of water from all practicable directions.

7



Protection against temporary immersion.

8

Protection against continuous submersion (tests subject to agreement, but no less severe).

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STRESS CORROSION CRACKING

WHAT IS STRESS CORROSION CRACKING (SCC)?

When subjected to the combined effects of stress and corrosion, many alloys can develop cracks over a period of time. Specifically, copper-zinc alloys such as brass can be sensitive to stress corrosion attack, particularly in the presence of moisture through condensation.

However, SCC occurs only in the presence of sufficiently high tensile stress and a specific corrosive environment. For brasses, the environment involved is usually one containing ammonia or closely related substances such as amines. The presence of ammonia or related substances could typically arise from the insulation material or from various sources of chemicals used on an installation, and may even be airborne.

Since all brasses are susceptible to stress corrosion cracking, it is important to avoid the combination of high stress and an unfavourable environment that may cause stress corrosion.

Stress corrosion cracking of joints can occur with quite low concentrations of ammonia and may be accompanied by black staining of the surrounding surface. SCC is usually localised, with the cracks running roughly perpendicular to the direction of the tensile stress.

CONDENSATION AND INSULATION

Condensation of water vapour will occur on a surface that is at a temperature below the atmospheric dew point temperature. This is due to the water vapour being drawn towards the cold surface as a result of a difference in partial vapour pressure between the air at ambient temperature and that at the temperature of the cold surface. Without adequate vapour sealing, moisture can be deposited through condensation within the insulating material and on the insulated metal surface.

Precautions must be taken to exclude moisture (condensation) from the system. Therefore, an effective vapour barrier is required. The purpose of the vapour barrier is to reduce and – if possible – prevent the ingress of water vapour into the insulating material, and it must be applied before the water in the pipe is cooled. Any joints in the insulating material must be fully sealed to ensure vapour permeance is maintained continuously. Particular care must be taken at termination points to ensure that the integrity of the insulation and vapour barrier is maintained.

Only dry insulation material should be used, and it should be kept dry until after the vapour barrier has been applied. Unsealed joints, badly fitting insulation and inadequate vapour sealing of termination points such as valve headworks, stems and test points can provide an easy passage for water vapour and subsequent condensation. Pipe supports should not be attached directly to the pipe because it is difficult to seal the insulation surface where the support projects through. Therefore, the pipe support brackets should be clamped over the exterior of the insulation where possible.


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SYSTEMS

Copper alloy valves and fittings are widely used throughout HVAC systems on hot water heating, chilled water and domestic hot and cold water. It is reasonable to assume that fitting practices are the same throughout all the systems, but failure due to stress corrosion cracking (SCC) is almost invariably encountered with brass products in chilled water systems. Nickel plating of products does not provide protection against SCC.

Products manufactured in bronze are not susceptible to SCC and DZR brass products are also less susceptible.

INSTALLATION

Joints must be made in accordance with our installation instructions. Correctly fitting tools, such as spanners, must be used to avoid causing damage and localised stress to the component. 'Stilson' type wrenches must not be used. Excessive use of jointing material combined with high tightening forces can generate high hoop stresses in female threaded components.

Where failure does occur as a result of SCC, the stresses involved will almost always have been generated during installation.

REDUCE THE RISK OF SCC

- Preferably install products manufactured in bronze or DZR brass material. If DZR brass is installed, the use of compression-ended components is not recommended.
- Ensure that ball valves are supplied with extensions.
- All insulation and vapour barriers must comply with BS 5970:2012 - Formerly BS 3351 and BS 5422:2009.

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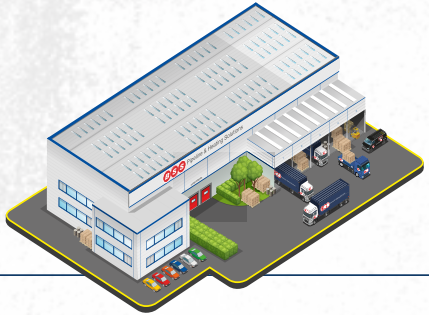

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