MECHANICAL SERVICES MATERIALS AND WORKMANSHIP SPECIFICATION

NG Bailey

CONTENTS

VERSION CONTROL

The tables below provide the current revision approval and revision history for this document.

Approval

	Name	Job Title	Date
Compiled By: (Author)	Will Pitt	Divisional Mechanical Engineering Manager	April 2018
Reviewed By:	Graeme Brady Paul Jaggard Mark Wallace Steve Mancell Andy Bones	Engineering Manager (NG Bailey Offsite) Mechanical QC Manager Project Manager Commissioning Manager Principal Technical Manager	April 2018 – February 2019
Approved By:	Steve Campbell	Technical Director	March 2019

Revision History

Revision	Revision date	Revision description
00	June 2019	Original Issue
01	Oct 2019	Preferred valves and best practice guides added
02	Feb 2020	Section 1.2.7.5 - Pipework expansion image updated
03	June 2020	Various amendments following ARUP review. • 1.2.1.4 – Note added to reference level crown on eccentric reducer. • 1.11 – Push fit pipework removed. • 1.14.23.1 – British Standard reference updated. • Reference to MTHW & HTHW removed (1.14 & 2.2.2) • Rainwater pipework added to exclusions • Insulation - Clause 2.2.12 added. • Best practice pipework details 16-20 updated & detail 25 added
04	May 2021	Section 1.7 Welding standards updated, authorised by W Pitt 5th May 21

INTRODUCTION

The purpose of this specification is to set out the NG Bailey material and workmanship quality standards for building services, mechanical installations.

The specification should be read in conjunction with the following documents:

- NG Bailey 'MySupplychain' catalogue
- NG Bailey 'MyMaterials' catalogue
- NG Bailey internal policies and procedures and best practices guides
- Where reference is made in this standard specification to In-house and industry, design / technical guides. These guides give in-depth information on the technical requirements of particular systems and should be referred to when necessary

Delete this paragraph and the below options as appropriate to suit the purpose of the specification/document at tender/bid submission or prior to entering in to contract, in conjunction with the Bid manager and commercial director.

Option 1: The NG Bailey materials and workmanship specification shall take precedence over the client's specification and / or Employers Requirements.

Option 2: The intent of this specification is to provide a standard workmanship and materials technical specification (to be supplemented by a project specific particular specification).

Option 3: The intent of this specification is to set out the NG Bailey materials and workmanship quality standards for building services, where NG Bailey have provided 'Contractors Proposals', in the absence of, or alternative to a client specification.

Exclusions

The following systems are excluded from this specification:

- Sprinkler systems
- Wet & Dry risers
- Fire hydrants
- Steam and condensate systems
- District heating pipework systems
- Process or medical gases
- Rainwater systems

Offsite Manufacture

Offsite manufacture can offer considerable benefits to both client and project team by allowing savings in time and cost, improvements in quality, productivity and a reduction in risk and in accidents. NG Bailey's offsite manufacturing facility is the largest of its kind in the UK and has the ability to manufacture a broad range of products including:

- Trapeze brackets for MEP services supports
- Pipe spools
- Multi service modules
- Plant skids
- Pre-fabricated risers
- Pre-fabricated plant rooms

It is NG Bailey policy is that offsite manufacturing must be maximized on all projects.

Item	Contact
NG Bailey offsite manufacture	Graeme Brady Graeme.brady@ngbailey.co.uk

Preferred Products

Fixings

Item	Company	Contact
• Fixings to purlins • Fixings to steels • Fixings to decking	Lindapter Ltd	Technical Helpdesk: 01274 521444 Email: support@lindapter.com Website: http://www.lindapter.com/
• Drop-in anchors • Through bolts • Nail in anchors • Frame fixings	Fischer UK Ltd	Technical Helpdesk: 01491 827920 Email: technical@fischer.co.uk Website: www.fischer.co.uk/ Dave Minton (Technical Sales Manager): 07817 076184 Email: dave.minton@fischer.co.uk
• SPIT Concrete screws • SPIT Direct fixing systems Gas & PAT	ITW Construction Products Ltd SPIT	Anthony Coulson (M&E Key Accounts): 07977 121244 Email: NGBaileysupport@itwcp.com Website: www.itwcp.co.uk/
• Bespoke channel and associated componentry	Unistrut Ltd	Richard Good (National Specification Manager): 07805 861042 Email: RGood@atkore.com Website: www.unistrut.co.uk/

Pipework

Item	Company	Contact
Carbon Steel Tube	Tata	Simon Bradford Tel: 01536 404241 Email: simon.bradford@tatasteel.com Technical Contact: Dr Chris Owen Tel: 07770 644364 Email: chris.owen@tatasteel.com
Cast Iron Pipe & Fittings	St Gobain	Matt Lightbody Tel: 07801 316963] Email; Matt.Lightbody@saint-gobain.com
Copper Tube	Lawton	Adam Pugh Tel: 02476 426810 Email: adam@lawtontubes.co.uk Technical Contact: Lee Clayton Tel: 07976 679239 Email: lee@lawtontubes.co.uk

Pipework

Item	Company	Contact
Copper Fittings General	Peglar Yorkshire	Chris Hird Tel: 07966 123892 Email: chris.hird@pegleryorkshire.co.uk
Copper Xpress Press-fit Fittings	Peglar Yorkshire	Technical Contact : Shaun Burrows Tel: 07703 099585 Email: shaun.burrows@pegeryorkshire.co.uk
Stainless Xpress Press-fit Pipefittings		
Plastic Pressure Pipefittings & Valves	GF	Chris Gaunt Tel: 07803 242935 Email: chris.gaunt@georgfischer.com
Plastic Soil Pipe & Fittings above Grnd	Polypipe	Steve Bamforth Tel: 07803234137 Email Steven.bamforth@polypipe.com
Stainless Tube & Fittings (Tru-bore	NG Bailey Offsite / DH Stainless	Chris Turner Tel: 01254 237409 Email: chris.turner@dhstainless.co.uk
Steel Grooved Couplings & Fittings	Victaulic	Alan Mulgrove Tel: 07789640518 Email: alan.mulgrove@victaulic.com

Valves

Item	Company	Contact
Valves	Oventrop	Chris Doherty 07899 793537 Email: chrisdoherty@oventrop.co.uk
	Pegler Yorkshire	Clinton Thacker 07834 257130 Email: Clinton.Thacker@pegleryorkshire.co.uk

Pipe expansion

Item	Company	Contact
Pipe expansion products	DST	David Sallis Tel: 01524 389494 Email: davidsallis@dstgroup.co.uk
Pipe expansion products	Pipe Solutions	Tel: 01423 878828 Email: design@pipesolutions.co.uk

Pipe Protection

Item	Company	Contact
Foil wrapping	Temati	Via Wolesley
Butyl self amalgamating tape – Everbuild	Everbuild	Via Wolesley

Insulation

Item	Company	Contact
Kooltherm Phenolic insulation	Kingspan	Chris Ridge 07860 425523 Email: chris.ridge@kingspan.com
Mineral wool insulation	Rockwool	

Passive Fire stopping of MEP services penetrations

Item	Company	Contact
Approved & tested Passive fire stopping products	Rockwool	Bob Westcombe Tel: 07970 142817 Email: bob.westcombe@rockwool.com
	Hilti	Jon Mashhadi Tel: 07802 205883 Email: jon.mashhadi@hilti.com

Fire & Smoke Control Dampers

Item	Company	Contact
Fire and smoke control dampers	Actionair	Dave Harding Tel: 07710 601523 Email David.Harding@swegonair.co.uk

1.0 PIPEWORK

1.1 General

1.1.1 All pipework and associated pipeline equipment and fittings shall have the appropriate temperature and pressure rating for the system in which it is operating.

1.1.1.1 All fittings and pipeline equipment shall be installed in accordance with the manufacturer's instructions.

1.1.1.2 All materials used in connection with domestic hot and cold water systems shall be listed in the WRAS 'Water Fittings and Materials Directory' or the DWI Regulation 31 list.

1.1.2 Dissimilar metals

1.1.2.1 At junctions between dissimilar metals ensure appropriate galvanic separation is provided to prevent direct contact and consequent galvanic corrosion.

1.1.2.2 Copper tube must be separated from carbon steel pipe by means of a brass or gunmetal fitting.

1.1.2.3 Carbon steel pipework must be separated from stainless steel pipe fittings by means of a brass or gunmetal transition fitting.

1.1.2.4 For flanged pipework, galvanic isolation of dissimilar metals shall be achieved by means of a suitable gasket material.

1.1.3 Pipe Storage

1.1.3.1 Stored pipe shall be supported clear of the ground on stable secure pipe racks. Where pipe cradles are employed, they shall be adequately spaced to prevent pipe bowing.

1.1.3.2 No pipe or other material shall be placed inside another pipe or fitting if any lining or coating has been applied to either.

1.1.3.3 Plastics pipe and components, and rubber or compound gaskets or sleeves shall be stored in a cool area protected from direct sunlight.

1.1.3.4 Pipe racks / storage to be appropriately finished/ protected to ensure no cross contamination occurs (For Stainless Steel)

1.1.3.5 Pipes shall be stored with endcaps and covered when stored externally.

1.1.4 Pipe Cutting & Handling

1.1.4.1 Cuts in pipes shall be made square to the axis of the pipe. All burrs and other irregularities shall be removed. Manufacturer’s instructions must be followed at all times.

1.1.4.2 Ensure that appropriate cutting blades/equipment are only used on one pipe material to ensure there is no cross contamination.

1.1.4.3 Pipes damaged in cutting or handling shall not be used.

1.1.4.4 Devices for aligning or turning pipe shall be used on the barrel of the pipe only.

1.2 Installation

1.2.1 General Requirements

1.2.1.1 Corroded and damaged pipes shall not be used.

1.2.1.2 Pipe bores shall be checked as clear before installation.

1.2.1.3 Bends shall be long radius. Where available in the sectioned pipework system, all tees to be swept pattern unless this prevents natural air venting. Sets, double sets and springs shall be free from buckling and formed from tube using as large a radius as practicable.

1.2.1.4 For general horizontal and vertical pipework distribution, concentric pipe reducers should be used. Eccentric reducers with level crown should be used in areas of cavitation risk including pump suction/inlet connections.

1.2.1.5 Pipes shall be grouped to present a neat appearance, be mutually parallel and parallel or at right angles to building planes. Two or more pipes changing direction together shall remain parallel and co-planar.

1.2.1.6 Clear access to every pipe shall be possible without disturbing other pipes, equipment and ducts.

1.2.1.7 Rising and dropping pipes shall be truly vertical. No joints shall be formed within the thickness of the structure, or in positions inaccessible after completion.

1.2.1.8 Piping to be insulated, or otherwise covered, shall be installed to leave 25mm minimum space between pipes after coverings are applied prior to thermal expansion.

1.2.2 Pipe Sleeves

1.2.2.1 Where pipes pass through floor or roof slabs, walls, or any other form of construction, sleeves shall be accurately fitted into the structure.

1.2.2.2 Sleeves shall provide 15mm minimum clearance around the pipe or the covering surface as applicable and the annular space shall be packed with mineral wool and sealed at both ends with fire-retardant mastic or a proprietary fire-stopping system shall be used. The exception is on gas pipework which should have an open sleeve on one side in accordance with IGEM/UP/2 edition 3.

1.2.2.3 Sleeves in fire compartment walls shall be fire-stopped using a certificated system with provision made for pipe thermal expansion.

1.2.2.4 Plastics pipes greater than DN40 passing through fire compartment construction shall be fitted with intumescent sleeves.

1.2.2.5 Sleeves material should be equal to or softer than the material of the pipe that passes through. Sleeve ends must be deburred.

1.2.3 Water Protecting Pipe Sleeves

1.2.3.1 Water protecting pipe sleeves through floors shall be fitted in all mechanical plantrooms, tankrooms and kitchens and in all floors having a waterproofed finish.

1.2.3.2 Sleeves shall be compatible with pipe material and be lengths of floor thickness plus 50mm, minimum projection, above finished level.

1.2.4 Wall & Floor Plates

1.2.4.1 Chromium plated steel wall plates shall closely fit to the building surface at pipe penetrations except where concealed.

1.2.5 Venting & Draining

1.2.5.1 Piping systems shall be properly arranged for venting and draining. All accessible high points shall have air bottles for the collection of trapped air, with release pipes extended to low level with an accessible lockshield valve, to terminate over an open drain.

1.2.5.2 Automatic air vents (AAV's), with servicing valves, shall be provided at high points on branch pipes with discharge pipes extended to suitable drains. All AAV's shall be fitted with an isolation valve for repair and replacement purposes.

1.2.5.3 The low points at all equipment items shall have hose union drain cocks with caps.

1.2.5.4 Draining taps shall be provided at all other low points.

1.2.5.5 The bottom of all heating, chilled and cooling water risers shall have capped or blank flanged scale and dirt pockets fitted with drain valves with hose union outlets. Riser dirt pockets shall be at least 5 x pipe diameter in length, be of line size and contain a full bore lever ball isolation valve (See NG Bailey best practice pipework details No.4).

1.2.5.6 Flushing drain valves shall be line size up to DN50, installed at major plant items, at ends of headers and any other location to assist flushing in accordance with recommendations from water treatment specialist following review of schematics and layout drawings.

1.2.5.7 System drain valves shall be not less than the sizes indicated in the table below.

Main Pipe Size (DN)	Minimum Drain Valve Size (DN)
25	15
32-100	20
100-300	32
300-600	50

1.2.5.8 Extended drain lines shall be of the same size as the drain valve.

1.2.6 Equipment Connections

1.2.6.1 Connections to plant items shall have flanged or union type connectors on the equipment side of isolating valves to allow for drainage and disconnection. Isolating valves and the requisite flange or union joints shall be positioned in such a way that the equipment can be isolated, disconnected and withdrawn for maintenance or replacement.

1.2.6.2 Union connectors shall be used up to and including DN50 and flanged connectors for DN65 and above.

1.2.7 Thermal Movement and Building Movement Joints

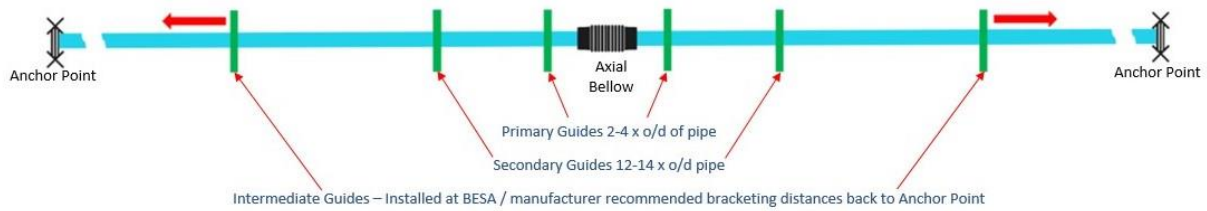
1.2.7.1 An agreed and approved thermal expansion design from the designer or from NG Baileys preferred supply chain manufacturer shall be in place and shown on the installation drawings and signed off by the preferred supply chain manufacturer before the installation commences. The final installation shall be signed off by the preferred supply chain manufacturer before the pipework is commissioned.

1.2.7.2 Wherever possible, thermal expansion or contraction shall be accommodated naturally by use of pipe loops, sets or changes of direction. Any change in direction should be sized correctly to ensure that it is long enough to cater for the movement and reduce stress on the pipe and pipe fittings. This should be checked with the preferred supply chain manufacturer. The preferred supply chain manufacturer shall sign off the final installation drawings and the final installation prior to heat being turned on.

1.2.7.3 Where Natural Flexibility is not practicable because offsets are too short, thermal expansion should be catered for using offset metallic bellows or axial bellows. Offset bellows including angular, fully articulated or gimbal shall be used on changes in direction. Axial bellows shall be used on straight pipework runs only.

1.2.7.4 All expansion devices, guides and anchors shall be installed strictly in accordance with the manufacturer's instructions. Anchor selection should be made based on the anticipated loads expected. The anchor and supporting steelwork / structure should be suitable to take the thrust loads.

1.2.7.5 When using axial bellows, primary and secondary guides shall be installed on both sides of the expansion bellows. Pipe brackets shall be clipped direct to the pipe and mounted on slide guides to aid axial movement. Primary pipe guides shall be located between 2 to 4 pipe diameters from the expansion joint and secondary guides shall be located between 12 to 14 pipe diameters from the expansion joint or as recommended by the manufacturer. Intermediate guides must be fitted to all pipework between anchors. The height of the pipe to the guide should be in line with manufacturer's recommendations.



1.2.7.6 Guiding on bellows other than axial bellow should be advised by the expansion specialist.

1.2.8 Electrical Trace Heating

1.2.8.1 Where pipes are to be electrically trace heated, manufacturer's instructions must be followed in respect of any specific installation, electrical supply or earthing requirements.

1.2.8.2 Pipe support blocks shall be slotted to allow the trace heating to remain in contact with the pipe through the block.

1.3 Supports and Fixings

1.3.1 All pipework supports, hangers and fixings systems shall be from the NG Bailey approved supply chain.

1.3.2 To comply with BS 8539:2012, all fixings into concrete shall be installed in accordance with manufacturer's instructions by trained operatives working under the supervision of Construction Fixing Association (CFA) certified supervisors.

1.3.3 Drop rod sizes are to be calculated using the NG Bailey bracket utility based on the required support distances.

1.3.4 Where suspended pipe services are installed within a designated means of escape or other fire rated space, the drop rod cross sectional area shall be calculated using the maximum allowable tensile stress of steel drop rods in the applicable fire duration (0.5 hr, 1hr or 2hr).

1.3.5 The NG Bailey bracket utility should be used to calculate drop rod diameter for fire rated applications.

1.3.6 Pipe support material used on uninsulated pipework must be compatible with the pipe material to prevent galvanic corrosion.

1.3.7 The maximum spacing for piping supports shall be as indicated in the table below.

Pipe material	Pipe size (DN)	Support spacing	
		Horizontal (m)	Vertical (m)
Mild steel (Tata)	15	1.8	2.4
	20	2.4	3.0
	25	2.4	3.0
	32	2.7	3.0
	40	3.0	3.6
	50	3.0	3.6
	65	3.7	4.6
	80	3.7	4.6
	100	3.7	4.6
	125	3.7	5.4
	150	4.5	5.4

	200	5.0	6.0
	250	5.0	6.0
Copper and stainless steel (Peglar Yorkshire Xpress Pressfit)	15	1.2	1.8
	22-28	1.8	2.4
	35 - 54	2.4	3.0
	67-108	3.0	3.6
Trubore stainless pipe (DH Stainless)	100	5.1	5.3
	125	5.5	5.9
	150	5.8	6.4
	200	6.4	7.1
	250	6.8	7.1
	300	7.2	6.6
	350	8.2	10.5
	400	8.5	10.3
PVCu and other thermoplastics	25 - 40	1.1	1.6
	50 - 80	1.4	2.0
	100	1.7	2.8
Tracpipe	15	2.0	1.5
	22 and above	2.0	2.5

1.3.8 Support systems shall be of correct size and strength, and allow for anchoring of the piping systems.

1.3.9 Vertical drops shall be restrained and supported to prevent offset and sway.

1.3.10 Piping at all equipment and valve positions, and at main junctions, shall be supported to prevent distortion, or transmission of strain to connected equipment or valves.

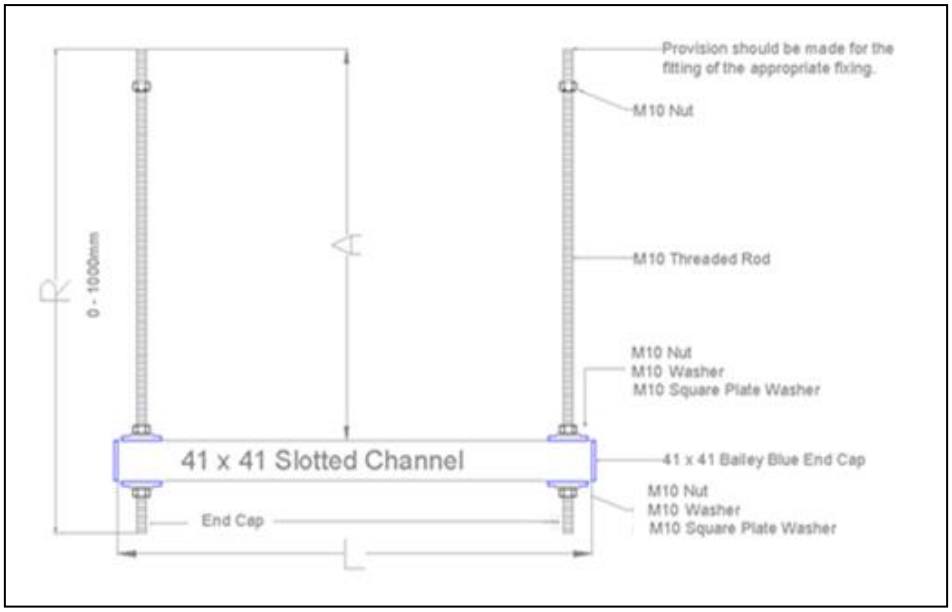
1.3.11 Brackets and supports shall allow sufficient safe access for adjustment, maintenance and removal of any item of equipment with the minimum of dismantling and without need for temporary supports.

1.3.12 Proprietary pipe support systems must be appropriately sized slotted channel galvanized steel as manufactured by and marked as Unistrut. The NG Bailey bracket utility should be used to size the channel.

1.3.13 Steelwork shall be suitable for the environment. Pre dip galvanized for internal use and hot-dip galvanized for external use.

1.3.14 All bespoke pipe support systems must be assessed and approved as suitable for the application by Unistrut or by NG Bailey approved structural engineer.

1.3.15 All trapeze brackets must be installed in accordance with NG Bailey standard bracket arrangement (see detail below).



1.3.16 All Unistrut proprietary pipe support systems must be torqued to the correct manufacturer advised torque settings and marked in accordance with the NG Bailey QC procedure – Management and Inspection of Torque Settings for Supports & Fixings.

1.3.17 Threaded rod in compression supporting pipework shall be no more than 200mm in length.

1.3.18 For general pipework internal and external runs on all piped services (CHW, LTHW, BCWS, MCWS, DHWS) Kingspan insulated pipe support inserts must be used as shown in the preferred option in figure 12 of BS 5970:2012. Wood blocks or rubber lined clips are not permitted.

1.3.19 Either side of expansion bellows on the primary and secondary guides (where pipe supports are normally installed in conjunction with slide guides to aid axial movement) pipe brackets should be clipped direct to the pipe with insulation applied as per the non-preferred option shown in figure 13 of BS 5970:2012. Where pipework is external, the pipe should be supported from below.

1.4 Mild Steel Pipework

1.4.1 Materials

1.4.1.1 Pipe up to DN 150 shall be to Tata Steel INSTALL PLUS 235 Hot-finished, Multi-Certified Tube - High Frequency Welded (HFW) BS EN10255/10217-2 Grade S/P235GH (GH = Get Hot), HVY or MED WEIGHT, CPR-CE Marked CAT 3&4, Made in the UK. Minimum tensile strength of 340N/mm2.

1.4.1.2 Pipe DN200 to DN500 shall be to Tata Steel INLINE 265 Hot-finished, multi-certified tube - High Frequency Welded (HFW) BS EN10217-2/ISO3183/API5LB Grade P265GH (GH = Get Hot) STD WEIGHT. Made in the UK. Minimum tensile strength of 360N/mm2.

1.4.1.3 Pipes over DN500 shall be to BS EN10217-5/ISO3183/API5LB Grade P265, STD WEIGHT. Minimum tensile strength of 360N/mm2.

1.4.1.4 For DN20 and DN40 for screwed joints shall be heavy weight only.

1.4.1.5 For sizes up to DN150 tubes shall be supplied red primer coated.

1.4.1.6 Associated product CE Marking statements / DOP's, PED alignment documentation shall be supplied where applicable.

1.4.1.7 System design, operating and test pressures to be confirmed.

1.4.1.8 System operating temperature range to be confirmed.

1.4.1.9 Service life expectations to be confirmed.

1.4.2 Fittings

1.4.2.1 Screwed fittings shall be to BS EN 10242.

1.4.2.2 Butt welding fittings shall be to BS EN 10253-1.

1.5 Galvanized Mild Steel Pipe

1.5.1 Materials

1.5.1.1 Piping shall be galvanized to BS EN 10255.

1.5.1.2 Pipes shall be galvanized prior to threading. After fixing, exposed threads shall be painted with 'cold galvanizing' solution.

1.5.1.3 Pipes to be fitted with welded-on flanges shall be flanged before galvanizing.

1.5.1.4 Straight lengths of pipes DN 200 and above shall be flanged both ends and galvanized after manufacture.

1.5.2 Fittings

1.5.2.1 Screwed fittings up to DN50 shall be to BS EN 10242 beaded.

1.5.2.2 Flanged fittings DN65 and above shall be to BS EN 10253-1 with flanges of appropriate rating welded on and the fitting hot dipped zinc coated.

1.6 Joints - Steel Pipe

1.6.1 General Requirements

1.6.1.1 Union or flanged joints shall be used to connect adjacent lengths of pipe where it is not possible to rotate either pipe length.

1.6.1.2 Union or flanged joints shall be used at all items of equipment and at intervals in long pipe runs for erection, dismantling and re-fixing.

1.6.1.3 Unions at equipment shall be between the isolating valves and the item of equipment.

1.6.1.4 Jointing material shall be a compound to BS 5292/BS 6956, PTFE tape or Locktite 55 sealing cord. Joint reinforcement material shall be inorganic and WRC approved.

1.6.1.5 Screwed joints to BS 21/BS EN 10226-1 shall be used on sizes up to DN50. Fittings shall be to BS EN 10242. Long- screw connectors shall not be used.

1.6.1.6 Flanged joints shall be used on size DN65 and above.

1.6.2 Mild Steel Piping

1.6.2.1 Welded joints shall be used for DN65 and above.

1.6.2.2 All permanently concealed piping shall be welded.

1.6.2.3 Flanged joints shall be made by screwing or welding drilled flanges onto the pipe ends. Ends of screwed pipes shall be flush with the face of the flange. Flanges forming a joint shall be mutually flush when in position, with all bolt holes in complete alignment.

1.6.2.4 Flanges shall be raised face to BS EN 1092-1 machined over the face, suitable for the system working pressure. Bolts and nuts shall be correctly sized and of correct length all to BS EN 1515. Washers shall be fitted under nuts, and bolt heads..

1.6.3 Galvanized Mild Steel Pipework

1.6.3.1 Fittings shall be beaded type, hot dip zinc coated finish, to BS EN 10242.

1.6.3.2 Joints DN 65 to DN 150 shall be made with hot dip zinc coated, screwed flanges to BS EN 1092-1. Exposed threads shall be painted with 'cold galvanizing' solution.

1.6.3.3 Pipework DN 200 and above shall be of black mild steel with butt welding fittings to BS EN 10253-1, of same outside diameter and pressure rating as the pipe, and flanged. Pipe sections shall be of suitable length for hot dip zinc coating. After fabrication pipe and fittings shall be hot dip zinc coated to BS EN 10255.

1.6.3.4 Flanged joints shall have hot dipped spun galvanized nuts, bolts and washers of correct length to BS EN 1515.

1.6.4 Mechanical Grooved Joints

1.6.4.1 Mechanical grooved couplings may be used on mild steel pipe of suitable wall thickness where the working temperature does not exceed that occurring in low temperature hot water system (90°C maximum) for sizes DN 65 - DN 150. Mechanical grooved couplings may be used on mild steel pipe of suitable wall thickness for sizes DN65 - DN 300 on chilled water and condenser water systems.

1.6.4.2 Mechanical grooved couplings may only be used where direct access is possible.

1.6.4.3 Jointing systems shall comply with a quality system to BS EN 9001 or shall be BBA certificated.

1.6.4.4 Mechanical grooved joints shall only be installed by operatives trained by the manufacturer.

1.6.4.5 The joint shall be self-centering and comprise coupling pieces, sealing gaskets, special nuts and bolts.

1.6.4.6 Gaskets shall be manufactured by the coupling manufacturer.

1.6.4.7 End grooves shall be machine-formed to the manufacturer's instructions and shall be dimensionally compatible with the coupling.

1.6.4.8 All supports shall be provided to the manufacturer's instructions.

1.6.4.9 Where grooved-end valves and strainers are used these shall be installed in rigid jointed grooved-end pipe lengths and be firmly stayed to a local pipe support to prevent fitting rotation on the pipeline axis.

1.6.4.10 Upon completion of a section of pipework all mechanical joint / couplings shall be checked to confirm full metal to metal contact and bolt tightness. Once satisfactory, each bolt is to be marked with a ball point paint marker to denote that it has been quality checked.

1.7 Welding

1.7.1 General Requirements

1.7.1.1 All metal arc-welding operations on pipework and supports shall be carried out in accordance with HSE and BESA (formerly HVCA) recommendations.

1.7.1.2 All welding is required to have a required Weld Procedure Qualification Record (WPQR) to BS EN ISO 15614-1:2017 +A1:2019 – TC.

1.7.1.3 All joint types are required to have a weld procedure specification (WPS) to BS EN ISO 15609: 2019 – TC.

1.7.1.4 Welder Qualification are to be to BS EN ISO 9606-1:2017 – TC.

1.7.1.5 Each weld is required to have a visual inspection to BS EN ISO 17637:2016 TC.

1.7.1.6 The Weld inspector must be qualified in line with BS EN ISO 9712:2012 and hold a CSWIP 3.1 – Weld inspector certificate or equal PCN level.

1.7.1.7 Weld inspectors to hold a current eye test examination.

1.7.2 Classes of operation

1.7.2.1 Classes of operation conditions for welding as defined below shall be employed.

Service	Temperature	Pressure (bar)[1]		
		Up to and including 17	Over 17 up to and including 24	Over 24
	°C			
Gases (including steam)	Below −20	Class II	Class I	Class I
	Over −20 up to and including 220	Class II	Class I	Class I
	Over 220	Class I	Class I	Class I
Liquids	Below −20	Class II	Class I	Class I
	Over −20 up to and including 95	Class II	Class II	Class I
	Over 95 up to and including 200	Class II	Class I	Class I
	Over 200	Class I	Class I	Class I

[1] 1 bar = 10^5 N/m^2 = 100 kPa.

1.7.3 Preparation

1.7.3.1 Preparation and welding techniques for all pipework shall be to BS 2633:1987 Class I or BS 2971:1991 Class II arc-welding of carbon steel pipework for carrying fluids as appropriate.

1.7.3.2 Pipe shall be plain ends for correct end preparation. Each welded joint shall be sufficient to withstand the stresses imposed by system internal pressure, thermal movement, and weight of tube, fittings and other equipment.

1.7.3.3 Fittings shall be to BS EN 10253 with beveled ends and pipe ends shall be site-prepared to match.

1.7.3.4 Manual arc-welding electrodes shall be to BS EN ISO 2560:2020.

1.7.3.5 MIG / MAG filler wire shall be to BS EN ISO 14341:2020.

1.7.3.6 TIG Filler wire shall be to BS EN ISO 636:2017 TC.

1.7.3.7 Oxy-acetylene filler rods shall be as BS EN ISO 20378:2018.

1.7.3.8 Welding filler materials shall be protected from excessive moisture change in storage. Refer to manufacturer's storage instructions for specific details. Material showing sign of deterioration shall not be used.

1.7.3.9 Welded butt joints, including branches ≥50mm diameter, shall be full penetration except at flanges where adequate fillet welds shall be provided at neck and bore of plain or hubbed slip-on flanges. Pipe alignment shall be maintained by mechanical means or by tack welds, which shall either be fused into the final weld or ground out.

1.7.3.10 Butt welds shall be finished with reinforcement of ample dimensions. Welding metal or flux penetration projecting in the form of a root bead into the bore of the pipe shall comply strictly with the limit of the appropriate Standard. The weld shall be of good, clean metal free from slag inclusions and porosity, of even thickness and contour, well fused with the parent metal, (annealed for gas welding), be finished smooth and thoroughly wire-brushed on completion.

1.7.3.11 Branches from mains shall be formed by the use of butt-welding fittings.

1.7.3.12 Set-on branches shall only be used as agreed. Set-in branches without weld preparation are not permitted.

1.7.3.13 Right angle welded set-on branches shall be properly prepared on branches and mains to BS 2633:1987 or BS 2971:1991 as appropriate. Sloping branches and 'easy sweep' branches shall be fitted as shown in BS 2971.

1.7.3.14 Care must be taken in the preparation of welding branches, ensuring that the cut-out in the wall of the main pipe is of the correct size and shape to suit the branch connection. Branch welds shall be prepared by saw cutting or drilling into the main and reaming. Burning-in is not permitted. Each branch weld shall be open to visual inspection of root penetration.

1.7.3.15 For small threaded connections, for 'Binder' type test points, thermostats, drain cocks, etc, best quality mild steel sockets may be welded to mains as set-on branches to saw-cut or drilled openings. These shall be limited to DN10 to DN50 sockets inclusive.

1.7.3.16 Socket weld fittings shall not be used for jointing pipes over DN80.

1.7.3.17 For pipework over DN50 long-radius welding elbows shall be used.
Reducing pieces shall be prefabricated and welded into the pipelines. Eccentric reducers shall be used on horizontal pipes, arranged to avoid air pockets, and concentric reducers on vertical pipes. Springs and sets shall be purpose made at site with obtuse welding elbows.

1.7.3.18 Segmented (or 'cut and shut') welded bends are not permitted.

1.7.3.19 Welded joints in the running length shall not occur within two metres of an anchor point.

1.7.3.20 Operating parts of welded ends valves shall be dismantled during welding within 600mm of the valve.

1.7.3.21 Where welding is carried out in air temperatures lower than 5°C, the parent metal shall be preheated as defined in BS 2971, and include any further necessary preheating or heat treatment.

1.7.3.22 After welding the heated portion and the joint shall cool in draught- free conditions provided by thermal protection with muffs or suitable insulation. Open ends of pipes shall be sealed to prevent cooling by convective air currents.

1.7.3.23 Welded joints shall be completed within the working day and in no case shall a joint be left partly completed overnight.

1.7.3.24 All welds and preparation areas shall be thoroughly cleaned during welding operations and completed welds shall be thoroughly wire brushed.

1.7.3.25 Coatings shall be applied to welded joints after they have been visually inspected.

1.7.3.26 All welding shall be carried out under a 'Hot Works Permit' with an appropriate fire watch period provided at the end of the working session.

1.7.4 Supports

1.7.4.1 Welding of mild steel for supports and brackets for ferrous pipework, plant and equipment shall be to BS EN 1011-1 & -2.

1.7.5 Welder Qualification

1.7.5.1 All welders employed in a fabrication shop preparing work for the site, when welding procedure approval is not required shall be in possession of a currently valid 'Certificate of Competency' in accordance with BS 4872-1:1982 Where approved welding procedures are required all welders shall be qualified in accordance with BS EN 287-1 or BS EN ISO 9606-1 qualification testing of welders..

1.7.5.2 All welders employed on the site or in a fabrication shop preparing work for the site when welding procedure approval is not required shall be qualified by a test in accordance with BS 4872-1:1982. When welding procedure approval is required all welders shall be qualified in accordance with BS EN 287-1 or BS EN ISO 9606-1, in the presence of the Inspector.

1.7.5.3 All welders must be provided with an identity card, with photograph, stating welding process and positions qualified or a valid welder approval test certificate (E4).

1.7.5.4 If non-destructive testing is required, the test welds submitted for welder approval shall be similarly non-destructive tested prior to destructive testing.

1.7.5.5 Destructive testing of prepared sample welds shall be made to qualify welders. Each welder shall be employed only on welding operations for which he has qualified. Destructive testing shall be to BS EN ISO 15614 and BS 4872-1,

1.7.5.6 Each qualifying welder shall have a numbered stamp or tags which shall be used adjacent to the weld made both on or off-site work for identification.

1.7.5.7 When required, A list of welders' names, details of certification, qualification and identifying numbers shall be submitted before welding operations commence.

1.7.5.8 Additional test samples may be required from any welder.

1.7.6 Acceptability of Workmanship

1.7.6.1 All materials used shall be of adequate quality and in full compliance with relevant Specifications.

1.7.6.2 The standards of acceptability applicable to defects located by visual inspection or NDT techniques of the completed weld shall comply with BS 2971 or dependent upon process.

1.7.7 Inspection & Tests

1.7.7.1 Testing requirements will be geared (termed as "incremental") so that a higher failure rate requires a higher rate of retesting as shown in the table below. The percentage of tests includes all welds including any additional welds required as a result of cutting out.

Initial Test Sample	Failure Rate	Retest Sample
10%	20%	20%
20%	10%	50%
30%	5%	100%

1.7.7.2 The level of inspection and testing required as defined in the table below shall be as for "medium" risk, unless otherwise specified.

Application risk level	Maximum system operating pressure (Barg)	Level of inspection and testing required
Low	Below 6	100% visual inspection externally Incremental inspection internally (20% minimum)
Medium	6-12	100% visual inspection externally Incremental inspection internally (50% minimum) Incremental ultrasonic testing of pipes with wall thickness 8mm and above (10% minimum) Incremental radiographic testing (10% minimum) of pipes with wall thickness less than 8mm
High	12 and above	100% visual inspection externally 100% inspection internally
		Incremental radiographic testing (20% minimum)

1.7.7.3 If welds are found to be unsatisfactory, further tests shall be carried out. In the event of persistent failure, the welding personnel concerned shall not be permitted to carry out any further work.

1.7.7.4 100% visual inspection of weld preparation and completed welds shall be to BS EN ISO 17637:2016.

1.7.7.5 Internal inspection shall be carried out using mirrors and torches by a competent inspector. Where inaccessible, a flexible borescope capable of permanently recording images shall be used. Images of all welds inspected shall be retained for examination.

1.7.7.6 Inspection shall be to BS 3923-1 and BS EN ISO 17640 for ultrasonic inspection and to BS EN ISO 17636 for radiographic inspection and be carried out by a member firm of the SAFed. Personnel shall be certificated under the PCN scheme.

1.7.7.7 Internal, ultrasonic and radiographic tests shall be selected at random.

1.7.7.8 Additional welds may be inspected by an independent authority, and any defects found shall be repaired. Any additional testing required as a result shall be carried out without charge. Root penetration shall comply with the requirements of BS 2971.

1.7.7.9 Site radiographic inspections shall be limited by using assemblies fabricated at works wherever possible and making the required inspections at Works. Where site radiographic inspections are necessary, these shall be arranged to be made during "quiet hours".

1.8 Copper Pipework

1.8.1 Materials

1.8.1.1 Copper tube shall be to BS EN 1057 and BS EN 12449. Tube shall be R250 to BS EN 1173 unless stated otherwise. R220 tube shall only be used for instrument and gauge connections, below ground services and where pipes are laid in floor finishes. R290 tube shall not be used.

1.8.1.2 For mild steel systems, copper tube should be used for final CHW and LTHW connections to terminal units downstream of the flushing bypass.

1.8.1.3 All copper tube shall be BS kite-marked.

1.8.1.4 All copper tube shall be certified to be to the requirements of the appropriate Standard.

1.8.1.5 All copper tube shall be supplied by a single manufacturer.

1.8.2 Bends & Fittings

1.8.2.1 Bends, springs and sets in R250 tube up to and including DN42 size may be neatly pulled where standard fittings cannot be used, or where this will give a neater appearance.

1.8.2.2 Fittings shall be to BS EN 1254-1 and BS EN 1245-2 all resistant to dezincification, for sizes DN6 to DN67.

1.8.2.3 For copper on cold water services with insulation containing passivating bore liner, brass threaded or crimped fittings shall be protected by wrapping butyl self-amalgamating tape. Grease should only be used as a means of protection when insulation products not containing passivating bore liners are used.

1.8.3 Jointing

1.8.3.1 Joints up to DN67 size shall be made with capillary fittings and connectors with integral lead-free solder ring, or non-manipulative compression type couplings.

1.8.3.2 Unions, copper to iron adaptors or flanged connections shall be used to connect threaded pipe to copper tubes.

1.8.3.3 Fittings for brazing shall have socket ends for brazing with copper/silver/phosphorous filler rod to BS EN 1044 with pressure rating and service conditions equal to the specified tube.

1.8.3.4 For capillary type joints heat shall be applied uniformly around fittings using two or more heat sources if necessary for larger diameter pipes.

1.8.3.5 Surplus flux and solder shall be cleaned off.

1.8.3.6 Screwed joints shall be made using jointing compounds to BS 5292/BS 6956 or PTFE tape. Joint reinforcement material shall be inorganic.

1.8.3.7 Joints may be made by an approved roll grooving process, which is BS EN 9001 or BBA certificated, carried out fully to the manufacturer's instructions by trained operatives.

1.8.3.8 Press-formed jointing may be used for sizes up to DN 108.

1.8.4 Chromium Plating

1.8.4.1 Chromium plating shall be carried out after all pulled bends and soldered joints are completed.

1.9 Ductile Iron Pipe

1.9.1 Ductile iron pipe, mould-cast fittings, accessories and joints for condenser cooling water shall be to BS EN 545. Jointing shall be by flanges.

1.9.2 The sealing compound for screwed-on flanges shall be entirely suitable for the fluid content.

1.9.3 Gaskets used shall be solely the supply of the pipe manufacturer.

1.10 Stainless Steel Pipework

1.10.1 Stainless steel pipework tube shall be drawn from the XPress Stainless Steel range of SS600 ANSI 316L tube (15 to 54mm), SS620 ANSI 316L tube (76.1mm to 168.3mm).

1.10.2 Fittings shall be drawn from the XPress Stainless Steel range of press-fit fittings and have a body manufactured from ANSI 316L stainless steel with EPDM 'O' rings inserted.

1.10.3 Tru-bore thin wall stainless steel shall be used for large diameter stainless steel pipework (65mm+) including plant room and external distribution or where a welded solution is preferred.

1.10.4 Tru-bore tube shall be plain end longitudinally welded stainless steel tube manufactured to BS EN 10217-7 and BS EN ISO 1127, with outside weld bead ground flush, weld factor equal to 1.0 and pickled descaled finish 500mm<. Pipes 600mm Bore and above are produced in accordance with BS EN 10296-2 with a weld factor of (Z=0.8).

1.10.5 Tru-Bore Fittings shall be stainless steel butt welding fittings, made from BS EN 10217-7 pipe, to BS EN 10253-4, weld factor 1.0, with pickled descaled finish and suitable for the pipeline full service pressure at elevated temperature.

1.10.6 Tru-Bore flange connections shall be pressed collars in combination with PN rated (dependent on pressure) backing flanges. Collars and flanges to BS EN 1092-1. Bore and chamfer backing rings to suit the collars / tafted pipe ends.

1.10.7 All Tru-bore external flanges shall be coated in Akzo Nobel Resicoat R4 Green coated (Skotchcoat).

1.10.8 All stainless-steel pipework shall be foil wrapped with Temati 0.06mm (micron) aluminum pure foil Foil should overlap by 50mm and be orientated to shed any water. Foil wrapping should be installed under phenolic blocks.

1.10.9 For stainless steel on cold water services with insulation containing passivating bore liner, brass threaded or crimped fittings shall be protected by wrapping butyl self-amalgamating tape.

1.10.10 Varying wall thicknesses are available (50mm and above) and the correct wall thickness must be selected and utilized.

1.11 Press-Fit Jointing Systems

1.11.1 Press-fit systems shall be provided as a complete system with all component parts fully compatible and provided by a single manufacturer.

1.11.2 Press-fit systems shall be compatible with the system operating temperatures and pressures including the seal ring material used.

1.11.3 As a minimum, pipework supports shall comply with the manufacturers' requirements.

1.11.4 NG Bailey QC procedure – management and installation of pressfit pipework systems shall be implemented on site to ensure all operatives are correctly trained and certified and that all joints are properly completed marked with the installers ID number and documented before systems are filled and pressure-tested.

1.11.5 Specialist tools shall be regularly cleaned and otherwise maintained to the manufacturers' instructions.

1.11.6 Pipe for press-fit jointing shall be prepared in accordance with the joint and fitting manufacturer's instructions including the neat removal of any plastics coatings to pipes.

1.11.7 All systems shall be leakage tested on completion in accordance with NG Bailey QC Procedure – Pressure testing of pipework systems.

1.11.8 Pipes which have been brazed or welded should not be made into press-fit fittings within the heat effected zone from the braze/weld.

1.11.9 Press-fit pipework systems are not permitted for use on gas.

1.11.10 Press-fit joints may be used with the following types of tube materials:

- Copper
- Stainless steel

1.11.11 Stainless steel shall be to BS EN 1057, BS EN 10312, BS EN ISO 1127, and BS EN 10305.

1.11.12 Tube sizes from 15mm to 108mm may be jointed by this method, sizes 42mm to 108mm joints being accomplished by the additional use of press slings. 18mm tube should not be used.

1.11.13 Tube sizes from 15mm to 108mm may be jointed by this method, sizes 42mm to 108mm joints being accomplished by the additional use of press slings. 18mm tube should not be used.

1.11.14 Purpose-made press-fit jointing fittings shall incorporate factory-fitted seal rings within a circumferential profile.

1.11.15 Pegler Yorkshire preferred XPress branded tooling shall be used for jointing XPress fitting Systems utilising the XPress slings, jaws and tools. Only Pegler Yorkshire Press fit pipework shall be used.

1.11.16 Press-fit jointing fittings shall incorporate a leakage path for unpressed joints to allow them to be identified during pressure testing.

1.11.17 Connections to equipment items shall be made using threaded or flanged press-fit conversion fittings. Threaded fittings shall include a demountable union where the equipment is required to be disconnected.

1.11.18 Press-fit joints shall not be used in locations where the joint does not have direct access or is to be permanently concealed.

1.12 Corrugated Stainless Steel Tube (CSST) Semi-Rigid Pipe

1.12.1 Corrugated stainless steel semi-rigid pipework and components to BS7838 or BS EN15266. Also, BS6891, BS5482 and IGEM/UP/2 Edition 3.

1.12.2 Stainless steel tubing shall be made from 300 series stainless steel strip confirming to BS 7838 or BS EN15266.

1.12.3 Tubing shall not be subjected to heat treating or annealing after the corrugation forming operation.

1.12.4 Tubing shall be suitable for operation with Natural Gas and LPG (Propane and Butane).

1.12.5 CSST jacket to be extruded from fire-retardant polyethylene and shall be resistant to UV light.

1.12.6 All fittings shall be from yellow brass.

1.12.7 All exposed stainless steel must be wrapped with silicone tape following gas tightness test.

1.12.8 Installers must be trained for the use and installation of CSST products.

1.12.9 CSST is not permitted for use as a pipe-in-pipe solution within unventilated voids or risers.

1.13 Thermoplastics, Pipes & Fittings

1.13.1 Materials

1.13.1.1 Pipe and fittings in a system shall be from one manufacturer only.

1.13.1.2 PVC-u pipe and fittings shall be to BS EN 1452. Solvent shall be to BS EN 14814.

1.13.1.3 ABS pipework and fittings shall be acrylonitrile-butadiene-styrene (ABS) pipe to BS 5391 and solvent weld fittings to BS 5392.

1.13.1.4 PB pipe and fittings shall be poly-butylene to BS 7291-1and -2 and copper alloy to BS EN 1254.

1.13.2 Material Identification

1.13.2.1 Pipework and fittings shall be indelibly marked at 3m intervals to show:

- Manufacturer's identification
- Appropriate BS number
- Symbol for the material (e.g. 'PVC-u')
- Nominal size and class.

1.13.2.2 Letters shall be fully legible and not less than 5mm high.

1.13.2.3 Adhesive labels will not be acceptable.

1.13.3 Installation

1.13.3.1 Bends and tees shall be easy sweep. Reduced bore branches shall be made by drilling and solvent welding saddle and spigot branch connections.

1.13.3.2 Connections to pipework of other materials shall be made with correct adaptors.

1.13.3.3 Provide additional supports at all branches and change of direction fittings within 100mm of the fitting.

1.13.3.4 Solvent welding shall not be carried out at ambient temperatures below the minimum temperature stated by the manufacturer.

1.13.4 Joints

1.13.4.1 Flanges shall be stub type to BS EN l452 for PVC-u and BS 5392 for ABS with galvanized steel backing rings. Joints between stub flanges and pipes shall be solvent welded.

1.13.4.2 Joints shall be cleaned of all surplus cement immediately after setting.

1.13.4.3 The threaded ends of PVC-u and ABS fittings shall be jointed using PTFE tape only.

1.13.4.4 PVC-u and ABS socket unions shall incorporate flexible 'O' ring seals.

1.13.5 Fittings

1.13.5.1 Fittings shall be of the same manufacturer as the pipe, fully compatible for jointing, with full bore waterway.

1.13.5.2 Requirements for expanders and reducers shall be as for metal pipe.

1.13.5.3 Correct adaptors shall be used to connect to metallic pipe systems.

1.13.5.4 Bends shall be pre-formed with centreline radius not less than twice nominal pipe size for short radius, and four times nominal size for long radius requirements.

1.13.5.5 Fittings shall generally be solvent weld jointing type with wall thickness of the highest pressure class of pipe.

1.13.5.6 Threaded fittings shall not be used

1.13.6 Expansion Units

1.13.6.1 Expansion units shall be fitted where changes of pipe direction cannot accommodate thermal expansion and be installed in accordance with the manufacturer's instructions.

1.13.7 Thermoplastic Valves

1.13.7.1 Thermoplastic valves only shall be installed in ABS, PVC-u and PB pipework systems.

1.13.7.2 Solvent-weld valves shall be provided for sizes up to DN50. DN63 valves shall be flanged.

1.13.7.3 Pipelines requiring regulation shall have 'B' grade diaphragm valves.

1.13.7.4 Pipelines requiring shut-off provision only shall have ball valves with plain ends for solvent weld jointing in sizes DN15 to DN80 inclusive.

1.13.8 Strainers

1.13.8.1 Strainers shall be installed in PVCu and ABS pipelines in positions specified. Strainer bodies and end plugs shall be ABS, filter screens PVCu with ABS support, and 'O' ring seal 'Dutral'. Connections shall be for solvent welding.

1.13.8.2 Ball type foot valves and strainers shall be PVC for solvent welding.

1.13.9 Solvent Cements

1.13.9.1 Only solvent cements and thinners recommended by pipe and fittings manufacturer shall be used. The label on the container of solvent cement and/or thinners shall bear the name of the manufacturer, recommended procedure for use, and safety procedures necessary.

1.13.9.2 Tests shall be made on jointed solvent-pipe and fittings to establish conformity with standards given.

1.13.10 Testing

1.13.10.1 For sizes up to DN90 one hour (min.) shall elapse for each 4 bar working pressure or proportion thereof, after completion of the last joint before filling the system, and one and a half hours for sizes DN160 and above.

1.13.10.2 Test pressure shall be applied not less than twenty-four hours after completion of jointing.

1.13.10.3 Manufacturer’s instructions for pressure testing shall be followed.

1.13.10.4 Pneumatic testing is not permitted for PVCu pipework.

1.14 Valves

1.14.1 General

1.14.1.1 Valves shall be manufactured to BS EN ISO 9001, or BS EN ISO 9000/1, independently assessed, product-tested to British Standards stated and Kite marked.

1.14.1.2 Valve extension spindles and chain operators shall be provided where necessary.

1.14.1.3 Isolating valves shall be line size unless otherwise indicated.

1.14.1.4 Bonnet bolts shall be re-tightened after two weeks of system operation.

1.14.1.5 Regulating and 'return' valves shall be lockshield type with key operation.

1.14.1.6 Flanges shall be to BS EN 1092 of appropriate pressure rating.

1.14.1.7 Bronze valves with drilled flanges shall be flat-faced for full face gaskets.

1.14.1.8 Flanged copper items shall have suitable gaskets fitted between composite flanges.

1.14.1.9 All valves with the exception of unit valves shall be fitted with valve position indicators clearly marked to show the fully open and fully closed positions. Where valve actuators have opposing 0% to 100% scales on them, the correct scale shall be indicated.

1.14.2 Valve Connections

1.14.2.1 Valves in copper pipework may have compression fitting ends up to 28mm diameter and screwed ends from 35mm to 54mm.

1.14.2.2 Except for parallel slide valves, valves up to and including DN50 shall have screwed ends to BS 21/BS EN 10226-1.

1.14.2.3 Valves DN65 and above, and all parallel slide valves, shall have flanged ends to BS EN 1092.

1.14.2.4 Flanged adaptors to copper with dielectric separation shall be provided where flanged valves are to be installed in copper piping.

1.14.2.5 Flanged adaptors shall be used at valves and strainers in steel pipework having grooved-end jointing systems.

1.14.3 Valve Handwheels & Operators

1.14.3.1 Gate, globe and parallel slide type valves shall have handwheels.

1.14.3.2 Ball, butterfly and plug valves shall have 1/4-turn lever operators.

1.14.3.3 Stop valves and bib taps shall be cross-top head.

1.14.3.4 Handwheels on bronze gate, globe and heating valves shall be of heat resistant malleable iron, finished baked enamel.

1.14.3.5 Cast iron valve handwheels shall be of cast iron and provide easy operation.

1.14.3.6 Handwheels on radiator and convector valves shall be heat resisting composition type, screw fixed.

1.14.4 Markings

1.14.4.1 Check valves, strainers and uni-directional globe valves shall have arrow indication of flow.

1.14.5 Drain Valves

1.14.5.1 Drain valves shall be screwed end, bronze lever-operated gland cocks with slotted head, hose union connector, and iron lever.

1.14.6 Drain Cocks

1.14.6.1 Drain cocks shall be gunmetal or bronze, gland pattern with screwed male inlet, BSP taper thread, hose union outlet and with operating wrench.

1.14.6.2 Hot water and heating system equipment drain-outs shall be gunmetal or bronze draining taps to BS 2879, lockshield pattern.

1.14.7 Parallel Slide Valves

1.14.7.1 Valves up to DN50 shall be of bronze, disc type inside screw to BS 5154.

1.14.7.2 Valves DN65 and above shall be steel to BS EN 1984.

1.14.8 Needle Valves

1.14.8.1 Valve bodies shall be cast bronze to BS 5154/BS EN 12288 ends taper screwed and seat formed as an integral part. The needle shall be integral with the stem. Bonnets shall be screwed and form an asbestos-free re-packable gland. Glands and stem shall be back-seating to allow repacking under pressure on services operating up to 82°C maximum only.

1.14.9 Gauges Cocks

1.14.9.1 Pipeline instruments shall have a gauge cock fitted between the service pipe and the instrument.

1.14.9.2 The bodies shall be bronze construction, polished finish and with parallel threads.

1.14.9.3 Gauge cocks for water above 120°C, shall be straight pattern packed- gland type with screwed bonnet.

1.14.9.4 Gauge cocks for low temperature hot water, chilled water and condenser cooling water shall be straight pattern, ground plug type with lever handle.

1.14.9.5 U syphons shall be used for LTHW systems. For all other pipework systems, U syphons are not required.

1.14.10 Safety Relief Valves

1.14.10.1 Safety relief valves are required for all closed heating, chilled water and condenser water systems.

1.14.10.2 Safety valve set pressures shall be derived from the relevant NG Bailey pressurization unit design & commissioning procedure.

1.14.10.3 The discharge capacity of a safety valve must be equal to or greater than the output of the boiler or system it is protecting.

1.14.10.4 A discharge pipe shall be fitted to the safety valve outlet and taken to low level in full discharge size pipe to terminate in a safe manner.

1.14.10.5 Safety valves shall be located in an accessible position to facilitate service and maintenance checks.

1.14.11 Temperature and pressure relief valve

1.14.11.1 Temperature and pressure relief valves shall be fitted to all unvented domestic hot water storage vessels.

1.14.11.2 Discharge pipes from temperature and pressure relief valves shall terminate in an exhaust stack (tundish) with exhaust head and low level drain. The discharge pipe shall be metal and shall be sized and installed in accordance with Building Regulations Part G3.

1.14.12 Automatic combined air release, anti-vacuum and air release valve

1.14.12.1 Automatic combined air release, anti-vacuum and air release valves shall be installed at the top of all domestic hot and cold water risers in excess of 10 metres head.

1.14.12.2 All automatic combined air release valves shall be provided with a drain connection.

1.14.12.3 Automatic combined air release, anti-vacuum and air release valves shall be the Aquavent type as manufactured by Aquatech Pressmain Ltd.

1.14.13 Three-Way Escape Valves

1.14.13.1 Three-way escape valves sizes DN25 to DN65 inclusive shall be gunmetal, with bronze trim and renewable neoprene seats. Spindle shall be bronze and handwheel cast iron.

1.14.13.2 Closure of one outlet port shall occur when the alternate outlet port is opened. Clockwise handwheel operation shall open the normal vent port.

1.14.13.3 A discharge pipe shall be fitted to the vent port outlet and taken to low level in full discharge size pipe to terminate in a safe manner.

1.14.14 Butterfly Valves

1.14.14.1 Valve stems shall be of stainless steel with either 'O' ring type seals or non-asbestos material packed glands.

1.14.14.2 Valve discs shall be stainless steel or aluminium bronze and give tight shut off against the valve seat. Valves may contain proprietary latex- based materials to ensure that a good seating is obtained. Where used, the materials shall be well-proven in use and fully bonded.

1.14.14.3 Valves shall have graduated indicator plates to show disc position.

1.14.14.4 Valves for regulating purposes shall be gear-operated and lockable in the regulated position.

1.14.14.5 Valves for end-of-line service and equipment isolation shall be fully lugged type.

1.14.14.6 The correct seal material shall be specified for the temperature and media being conveyed. EPDM for water (WRAS approved where applicable) or nitrile butadiene rubber (NBR) for natural gas.

1.14.15 Lubricated Plug Valves

1.14.15.1 Lubricated plug valves shall be used where isolation or manual by- pass only is required.

1.14.15.2 Valves up to and including DN50 shall be either bronze or cast iron. Valves of DN65 and larger shall be cast iron or steel.

1.14.15.3 Multi-port valves shall be cast iron.

1.14.16 Double Check Valves

1.14.16.1 Double-check valves shall be DZR to BS EN 13959, rated at a minimum of 10 bar.

1.14.16.2 Where whole site protection is specified at the mains water incomer the double check valve (or two single check valves) shall be of the verifiable pattern.

1.14.16.3 New or replacement hose union bib taps shall be fitted with double check valve protection to comply with the current Water Regulations for non-domestic.

1.14.17 Ball Valves

1.14.17.1 Ball valves for water up to DN50 shall be to BS EN 12164 and BS EN 12165 with chrome coated ball plug and valve stem, PTFE seat and seals. Valves for gas shall have nitrile seat and seals. They shall be installed with the spindle in the horizontal plane so that the lever swings down to close the valve.

1.14.17.2 Valves shall have a locking plate suitable for gas service.

1.14.17.3 Valves DN65 and above shall be cast iron to BS ISO 7121.

1.14.18 Stop Valves for Water Services

1.14.18.1 Stop valves for water services up to DN50 shall be brass screw-down type, 'easy-clean' pattern to BS 1010-2 with compression ends to BS EN 1254-1 and -2.

1.14.18.2 The operating handle shall be cross-top type.

1.14.19 Foot Valves & Strainers

1.14.19.1 Foot valves with bolted inlet strainer shall be fitted on all pump suction dip pipes.

1.14.19.2 Valves shall have a nitrile rubber flap.

1.14.20 Float Control Valves

1.14.20.1 A stop valve shall be fitted on the inlet to all float valves.

1.14.20.2 Stop valves shall incorporate an in line strainer.

1.14.20.3 Valves DN20 to DN50 shall be to BS 1212-1

1.14.20.4 DN 15 valves shall be to BS 1212-2.

1.14.20.5 Plastic bodied, valves to BS 1212-3 shall only be used for cold water services.

1.14.20.6 Valves DN20 to DN50 shall be gunmetal bodied, double seat equilibrium type.

1.14.20.7 Valves DN65 and over shall be cast iron construction.

1.14.20.8 Delayed action type shall incorporate an equilibrium type ball valve with copper float

1.14.20.9 Delayed action type shall be brass bodied with ceramic disc seating and seal.

1.14.21 Automatic Control Valves

1.14.21.1 Automatic control valves shall be to BS 7350.

1.14.22 Radiator & Convector Valves

1.14.22.1 Valves shall be to BS 2767 with ends to BS 21/BS EN 10226-1, designations R, Rc or Rp, medium weight bronze type, with union connection.

1.14.22.2 Exposed valves shall be 'easyclean' pattern with handwheel on flow and totally-enclosing bonnet on return connection.

1.14.23 Thermostatic Radiator Valves

1.14.23.1 Valves shall be to BS EN 215-1:2004 suitable for 100°C continuous, and 120°C intermittent, maximum water temperatures and achieve tight shut-off in the closed position.

1.14.23.2 Valve bodies shall be of bronze, plain or chromium or nickel plated, with screwed inlet or with compression fittings for copper tube, and outlet with taper threaded radiator union connection.

1.14.23.3 Valves shall be factory tested for 100% seat seal and overall leak tightness.

1.14.23.4 Thermostatic sensing heads shall be wax or liquid filled, detachable from the valve assembly without leakage, and have anti-interference protection.

1.14.23.5 Sensing heads shall be suitable for 50°C maximum air temperature, thermostat range 7-27°C with automatic frost protection and limiting set point. Tight shut-off shall be achieved at set temperature.

1.14.23.6 Sensing heads shall be mounted in the free air-space of the occupied area at no hazard to occupants.

1.14.23.7 Scales shall have numbered heat settings.

1.14.24 Double Regulating Valves

1.14.24.1 Valves shall be oblique-pattern globe valves to BS 7350, with characterized throttle disk, setting device and indicator.

1.14.24.2 Valves up to DN50 shall be to BS 5154/BS EN 12288 of DZR material to BS EN 12164, with slotted disc, pressure test valves, handwheel and PTFE impregnated or non-asbestos packing.

1.14.24.3 Valves DN65 and above shall be to BS EN 13789 rated PN16, outside screw, rising stem, with cast iron body, non-asbestos bonnet gasket and packing.

1.14.24.4 All sizes of valve shall be capable of full isolating action.

1.14.25 Fixed Orifice Double Regulating Valves

1.14.25.1 Valves up to DN50 shall be double regulating valves to BS 7350 directly coupled to a flow measurement device comprising male/female threaded nipple type carrier with integral orifice ring and two double seal pressure test points.

1.14.25.2 Valves DN65 and above shall be cast-iron double regulating valves to BS 7350, flanged PN16.

1.14.25.3 Flow measurement (DN65 and above) shall be by a single piece stainless steel square edged orifice plate and carrier, with two double seal pressure test valves, to fit between the valve outlet flange and mating flange.

1.14.25.4 Low flow rate commissioning sets shall be bronze double regulating globe valves with bronze stem, slotted parabolic disc and screwed ends, close-coupled to bronze carrier with integral fixed orifice and two double seal pressure test points.

1.14.26 Variable Orifice Double Regulating Valves

1.14.26.1 Valves shall have characterized plugs and two double seated pressure test points for flow measurement purposes.

1.14.27 Installation and positioning of regulating, flow measurement and control valves

1.14.27.1 Fixed orifice double regulating valves and variable orifice double regulating valves shall be installed in accordance with manufacturer's recommendations. Upstream and downstream pipe lengths either side of regulating valves should be installed with at least 5 diameter lengths of straight pipe at their inlet and at least 2 diameters length of straight pipe at their outlet (as per CIBSE Commissioning code W:2010).

1.14.27.2 Fixed orifice flow measurement devices such as orifice plates and venturis when installed alone or close coupled to a full bore double regulating valve shall be installed in accordance with the manufacturer's recommendations. In particular, upstream and downstream straight lengths of pipe either side of flow measurement devices should be as

per manufacturer's instructions and should not include any bends, tees, restrictions, enlargements, adapters or flexibles.

1.14.27.3 If not specifically stated on drawings or manufacturers data is unavailable, flow measurement devices should be installed with at least 10 diameter length of straight pipe at their inlet and at least a 5 diameter length of straight pipe at their outlet (as per CIBSE Commissioning code W:2010).

1.14.27.4 Ensure at least 200mm access around flow measurement devices to enable the attachment of pressure tubes and the insertion of temperature probes.

1.14.27.5 Ensure variable volume control valves including pressure independent control valves and differential pressure control valves are installed in accordance with the manufacturer's instructions. If unknown, control valves should be installed with at least 5 diameter length of straight pipe at their inlet and at least 5 diameter length of straight pipe at their outlet.

1.15 Strainers

1.15.1 General Requirements

1.15.1.1 Strainers shall be fitted at inlets to all major heat exchangers and pumps in accordance with NG Bailey best practice pipework details and be of line size or match the connected item.

1.15.1.2 Strainers shall be of 'Y' pattern and be capable of isolation for cleaning. Alternatively, if Flow Trex strainers are acceptable when used in conjunction with an Armstrong pump solution.

1.15.1.3 Baskets/screens shall be suitable for the system contents and be readily accessible for removal.

1.15.1.4 Sizes DN15 to DN300 for use up to 120°C shall have up and downstream self-sealing test points incorporated and two blanked tapped points.

1.15.1.5 Baskets/screens shall be of metallic sheet material and with perforations recommended by the manufacturer for the service application.

1.15.1.6 Strainers upstream of flushing cisterns shall be incorporated within the stop valve.

1.15.1.7 Where large size strainers have the drain plug located off-centre on the flange and the strainer is installed in a vertical pipe, the flange shall be turned so that the plug remains at the bottom.

1.15.1.8 A spare set of gaskets shall be provided for the flushing process.

1.15.2 Materials

1.15.2.1 Strainers for cold service up to 17 bar and sizes DN15 to DN50 shall be gunmetal body, with stainless steel screen, non-ferrous cap and non-asbestos cap gasket.

1.15.2.2 Strainers DN65 to DN300 shall be cast iron body to PN16, with stainless steel strainer screen, cast iron cap, asbestos-free reinforced non-stick cap gasket.

1.15.2.3 Strainers for hot service up to 17 bar and up to DN200 shall be bronze flanged body to PN25 with non-asbestos gasket, metal strainer screen, steel cap bolts studs and nuts, and brass or bronze cap.

1.15.2.4 Strainers above DN300 shall be cast steel flanged pot-type with scantlings as for DN200.

1.15.3 Air and Dirt removal

1.15.3.1 All low temperature hot water systems and chilled water systems over 2500 litres shall be fitted with an X-pot combined dosing pot, side stream filter and deaerator. The x-pot shall be installed in parallel (across the pump) on the primary return between the low loss header and the energy source.

1.15.3.2 Vacuum degassers shall be installed on all chilled water systems and all LTHW systems over 15m static height.

1.15.3.3 For low temperature hot water systems and chilled water systems under 2500 litres a combined air and dirt separator shall be installed.

1.15.3.4 Combined air and dirt separators shall be suitable for a maximum operating pressure of 10 bar g and a maximum operating temperature of 110°C.

1.15.3.5 Combined air and dirt separators DN 50 and above shall be fabricated from carbon steel and shall be fitted with PN16 flanges to BS 4504. Below DN 50 bodies shall be brass and connections screwed.

1.15.3.6 Combined air and dirt separators shall have a large dirt collection chamber and large bore drain connection valve. For line sizes DN 150 and above a flanged demountable dirt chamber shall be provided.

1.15.3.7 Isolating valves shall be fitted either side of all air and dirt removal equipment to permit routine maintenance.

1.16 Flexible Joints

1.16.1 General Requirements

1.16.1.1 All assemblies shall be suitable for the system pressure and operating temperature.

1.16.1.2 All materials shall be resistant to UV light degradation.

1.16.1.3 Electrical continuity shall be maintained across rubber joints.

1.16.1.4 Connections shall be fitted between items of identical diameter. No bushing or other reductions shall be made.

1.16.1.5 Connections shall have an operational life certified by the manufacturer of not less than 10 years when operating in the system.

1.16.2 Flexible Hose

1.16.2.1 Short connections to equipment shall have integral screwed ends at least one of which shall be a union fitting.

1.16.2.2 Connections shall not exceed 600mm in length arranged in long- radius bends.

1.16.2.3 Piping shall be woven mesh reinforced to prevent kinking and restriction of bore at bends.

1.16.2.4 Adequate support shall be provided to suspend lengths without loading to plant items and other services.

1.16.2.5 End threads shall be taper to BS 21/BS EN 10226-1, except that internal parallel threads to BS 21/BS EN 10226-1, designation Rp may be used where allowed specifically in the jointing specification for this service.

1.16.2.6 Union couplings on flexible piping shall be connected to matching fittings supplied, or approved, by the manufacturer. The end threads of the matching fittings shall be taper to BS 21/BS EN 10226-1, except that internal parallel threads to BS 21/BS EN 10226-1, designation Rp may be used in conjunction with a joint incorporating a female parallel thread fitting and flat fibre washer.

1.16.2.7 Plain end and union fittings shall have provisions for spanners and wrenching tools.

1.16.3 Flexible Connectors

1.16.3.1 Flexible connectors shall be soft spherical single convolution EPDM rubber joints of high vibration isolation efficiency, resilience and noise absorbing properties.

1.16.3.2 Reinforcement shall be steel braid for heating water and nylon braid for chilled and cold water applications.

1.16.3.3 Backing flanges shall be mild steel of system pressure rating.

1.17 Pre-commission cleaning of pipework

1.17.1 Heating and chilled water pipework systems must be filled and pre-commission cleaned in accordance with NG Bailey QC Procedure – Pre-commission cleaning of pipework systems.

1.18 Domestic Hot & Cold Water Services

1.18.1 Pipework

1.18.1.1 Chrome plated pipework shall be supported on chromed brass pipe rings and backplates.

1.18.1.2 Exposed pipework in occupied areas shall be supported on brass or mild steel pipe rings to suit material with screw-on backplates.

1.18.2 Chlorination

1.18.2.1 After successful completion and prior to chlorination, systems shall be thoroughly flushed with mains water in accordance with NG Bailey QC Procedure – disinfection and chlorination of pipework.

1.18.2.2 Chlorination procedures shall be to BS8558, BS EN 806 and British Standard document PD 855468.

1.18.2.3 All flow restrictors and filters shall then be removed, cleaned and refitted.

1.18.2.4 On conclusion samples shall be taken from each system as directed for Independent bacteriological analysis by a Public Analyst to confirm water quality.

1.18.2.5 Chlorinating water shall be disposed of to the requirements of the Water Authority.

1.19 Instruments & Gauges

1.19.1 General Requirements

1.19.1.1 Branch extensions shall be provided to all instruments and gauges to carry the item and any isolating device clear of the insulation and covering

1.19.2 Pressure & Altitude Gauges

1.19.2.1 Generally, valved pressure gauges shall be installed at the following locations:

- Each pump discharge and suction, both installed at the same height
- System pressurisation equipment
- Each side of pressure reducing valve sets
- Main pump and boiler headers
- Closed expansion vessels
- Inlet and outlet of evaporators, condensers and cooling towers
- Each boiler installed.
- Cold Inlet to unvented hot water heaters.

1.19.2.2 The pressure gauge range shall be selected so that the indicator will be central at normal operating condition. The gauge shall have an adjustable reference pointer.

1.19.2.3 Gauges shall be 'Bourdon' tube type to BS EN 837-1, 100mm diameter, except those in plantrooms which shall be 150mm diameter. Gauges shall have enamelled mild steel case with chrome bezel, substantial glass face, and phosphor bronze Bourdon tube. Dial face shall be white with black scale graduations and numbering.

1.19.2.4 Gauges shall have overall accuracy of one per cent (1%) of scale range and shall comply with the table below.

Pressure (bar)	Gauge (bar)	Figure intervals (bar)	Intermediate (mbar)
10	0-20	2	500
4.5	0-10	1	100
3.0	0-6	1	100
2.5	0-5	1	100
1.5	0-3	0.5	100

1.19.2.5 Gauge capillary lines shall be neatly run mutually parallel and in horizontal and vertical planes only. Multiple lines shall be neatly clipped to rigidly supported, galvanized tray.

1.19.3 Thermometers

1.19.3.1 Fixed thermometers shall be to BS EN 13190, 150mm diameter dial size in main boiler and plantrooms, and 100mm diameter dial size elsewhere, with black enameled mild steel case with chrome bezel and substantial glass face.

1.19.3.2 Stem immersion length shall be 100mm and shall be bottom or back connection. Thermometers shall match the pressure gauges, align wherever possible, and be complete with stainless steel well with 50mm lagging extension.

1.19.3.3 Thermometers shall be installed vertically in the following locations:

- Chiller evaporator and condenser inlets and outlets
- Cooling tower inlets and outlets
- Boilers and boiler flow and return headers
- Water/water heat exchanger inlets and outlets
- On HWS storage calorifiers
- On common domestic hot water flow and return.

1.19.3.4 Wells for test thermometers shall be installed at water inlet and outlet to each evaporator of the water chilling units and in any other locations specified.

1.19.3.5 Thermometers shall be located to be easily read from the usual walking space at floor level or on platforms.

1.19.4 Self-Sealing Test Points

1.19.4.1 Test points shall be provided at the following locations:

- Inlet and outlet of each heating and cooling coil
- All secondary headers
- All heating and cooling piping main branches
- Each port of each automatic control valve
- Heating and cooling coil connections to air handling units
- Entry to and exit from each plantroom heating and chilled water service

1.19.4.2 Test points shall be dual purpose for pressure gauge and thermometer, be mounted on the sides of pipes, and shall repeatedly reseal.

1.19.4.3 Extended length test points shall be installed to clear the thickness of pipe insulation.

1.20 Pressure Testing

1.20.1 General Requirements

1.20.1.1 All piping systems shall be tested after completion with all branch piping installed, but before being concealed, insulated or equipment fixtures and fittings set and connected.

1.20.1.2 Where previously agreed, piping systems may be tested in sections but a final test shall be made on completion of all work.

1.20.1.3 Test failures shall be rectified and the test repeated until a satisfactory result is achieved.

1.20.2 Test Procedures

1.20.2.1 Test procedures shall be in accordance with NG Bailey QC Procedure – Pressure testing of pipework systems and BESA TR6 – Pressure testing of pipework.

1.20.2.2 Test pressure for closed LTHW and CHW systems shall be not less than 1.5 times maximum working pressure.

1.20.2.3 Test pressure for domestic hot and cold water pipework shall be 1.5 times the closed head pressure of the booster set. Above 10bar closed head pressure, it may be impractical to pressure test pipework to 1.5 x pressure. In this scenario, pipework should be pressure tested to a minimum of 2 bar above the closed head pressure for a period of 2 hours.

1.20.2.4 Plastic pipework systems to be pressure tested in accordance with the manufacturer recommendations.

1.20.3 Gas Pipework

1.20.3.1 Gas pipework shall be isolated from meters and the Utility Supplier service pipe before testing is commenced.

1.20.3.2 The pipework shall be subjected to air test at a pressure of 75mbar or twice maximum working pressure, whichever is greater, maintained for period of 30 minutes without further application of pressure and without drop in indicated pressure after the temperature has stabilized.

1.20.3.3 Pipework joints of the sections undergoing test shall be coated with soap/water solution and visually inspected for indication of leakage.

1.20.3.4 The above tests shall be additional to any requirements of the Utility Supplier.

1.21 Refrigerant Piping

1.21.1 Design, materials and installation of refrigerant piping systems shall be to BS EN 378, and IoR Codes of Practice.

1.21.2 Piping shall be of copper or steel, but copper tube shall not be used with ammonia (R717).

1.21.3 All refrigerant pipework shall be designed for the minimum pressure drop which ensures that oil in the refrigerant leaving the compressor is carried through the system and back to the compressor at the lowest stage of capacity unloading.

1.21.4 Where systems are built-up at site, oil separators, oil reservoir and automatic oil return equipment shall be provided.

1.21.5 The design shall ensure correct refrigerant distribution to evaporators with no liquid refrigerant drainage into the compressor during shutdown, nor liquid entry during operation, and shall avoid lubricant accumulation and slugging in the suction line.

1.21.6 Flexible connections shall be incorporated in both discharge and suction lines at the points of connection to the compressor.

1.21.7 Interconnecting piping between compressor, cooler and condenser shall only be installed by the equipment manufacturer.

1.21.8 Piping shall be thermally insulated. 'Cold bridging' shall be prevented.

1.21.9 Copper tube shall be delivered to site internally degreased and be stored in clean and dry conditions, with ends sealed until required for installation.

1.21.10 Suction, discharge and liquid lines in steel shall be fabricated from seamless pipe to BS EN 10216-2 and BS EN 10217-2, Material Grade 360 minimum quality.

1.21.11 Plastics tube with compression fittings to BS EN 1254-3 may be used for piping to pressure gauges and similar fittings only where these are mounted on instrument or control panels. The grades of tube used shall withstand the test pressure applied and the effects of refrigerant and oil. Plastics pipe shall not be used for any other refrigerant piping.

1.21.12 Joints in copper piping systems may be flared up to 3/4in o/d (DN19) only, flanged or brazed (with or without capillary fittings). Compression fittings shall not be used.

1.21.13 Where joints are brazed, oxidation shall be prevented by a flow of dry nitrogen through the tube.

1.21.14 Non-corrosive flux shall be used for solder joints.

1.21.15 Brazing shall be carried out in accordance with BS EN 14324, BS EN 12797 and BS EN 12799.

1.21.16 Brazing rods shall be cadmium-free and to BS EN 1044.

1.21.17 Joints in steel pipework shall be flanged or welded. Fabricated mitred or segmental bends, unless forming an integral part of equipment design, shall not be used.

1.21.18 Screwed joints may only be used on equipment accessories with either taper form threads using an approved sealing compound, or parallel threads associated with machined joint faces and a suitable joint.

1.21.19 Steel pipe shall be clean and free from all forms of debris including rust, mill scale, flux and welding scale. Pipe shall be stored in clean dry conditions until required for installation. Ingress of dirt and moisture shall be prevented at all times, including during fixing operations, by sealing or use of end caps.

1.21.20 Piping shall be firmly supported, arranged to minimise vibration.

1.21.21 Vibration eliminators shall be fitted to the compressor suction and discharge pipes to minimise transmission of vibration or noise. Where required, a gas pulsation damper shall be fitted in the refrigerant discharge pipe as close as possible to the refrigeration compressor.

1.21.22 Provision shall be made to accommodate thermal expansion and contraction.

1.21.23 Dehydration, pressure and leakage testing and refrigerant charging shall be to CIBSE Commissioning Code R.

1.21.24 Outdoor condensor / heat exchanger to be fitted with F-Gas label detailing refrigerant type and weight of total system charge.

1.22 Pipework Identification

1.22.1 Identification colours and bands shall be to BS 1710:2014.

1.22.2 Pipework identification banding shall be applied after covering and/or protective and decorative painting is complete.

1.22.3 Firefighting system pipework shall be identified by 150mm wide 'Safety Red' bands completely encircling the pipe.

1.22.4 Colour coding shall be provided as follows:

- At 8m intervals on straight runs
- At all changes of direction
- Within 300mm of all valves
- Within 300mm of all equipment items
- At all junction points and branches (unless the end of branch is visible from the junction)
- On all lines passing through walls and floors where lines are accessible and not visible from an identified main.

1.22.5 All piping shall be labelled 'FLOW' and 'RETURN' as applicable with direction of flow clearly indicated.

1.23 Schedule of Pipeline Materials

1.23.1 Chilled Water

Size (DN)	Tube details	Fittings
Up to 22	Copper tube to BS EN 1057- R250 - 15 x 0.7, 22 x 0.9	Non-dezincifiable to BS EN 1254-1 for silver brazing.
Up to 22	Copper tube to BS EN 1057- R250 - 15 x 0.7, 22 x 0.9	Non-dezincifiable to BS EN 1254-1 with integral lead free solder ring.
Up to 50	Black mild steel to BS EN 10255. Medium & heavy weight.	Malleable iron to BS EN 10242.
15 – 108mm	Stainless steel Xpress Pressfit pipework system	XPress Stainless Steel range of press-fit fittings and have a body manufactured from ANSI 316L stainless steel with EPDM 'O' rings inserted
65mm +	Stainless steel - Trubore	Longitudinally welded steel pipe for pressure purposes, usually unanneated with a pickled, descaled finish. Stainless steel pipe to have plain ends. In accordance with EN 10217-7 Tolerances in accordance with ISO 1127.
65-150	Black mild steel to BS EN 10255 medium weight.	Butt welding to BS EN 10253-1. Flanges to BS EN 1092. Gaskets to BS EN 1514-1.
200-400	Carbon steel to BS EN 10216-1 and BS EN 10217-1 and dimensions to BS EN 10220.	Butt welding to BS EN 10253-1. Flanges to BS EN 1092.
Over 400	Carbon steel to BS EN 10216-1 and BS EN 10217-1 and dimensions to BS EN 10220.	Steel butt welding to BS 1640-1. Flanges to BS EN 1092. Gaskets to BS EN 1514-1.
100-200	ABS to BS 5391. Flanged.	ABS to BS 5392. Stub flanged.

1.23.2 Heating Water

Size (DN)	Tube details	Fittings
Up to 22	Copper tube to BS EN 1057- R250 - 15 x 0.7, 22 x 0.9	Non-dezincifiable to BS EN 1254-1 for silver brazing.
Up to 22	Copper tube to BS EN 1057- R250 - 15 x 0.7, 22 x 0.9	Non-dezincifiable to BS EN 1254-1 with integral lead free solder ring.

Up to 50	Black mild steel to BS EN 10255. Medium & heavy weight.	Malleable iron to BS EN 10242.
15 – 108mm	Stainless steel Xpress Pressfit pipework system	XPress Stainless Steel range of press-fit fittings and have a body manufactured from ANSI 316L stainless steel with EPDM 'O' rings inserted
65mm +	Stainless steel - Trubore	Longitudinally welded steel pipe for pressure purposes, usually unanneated with a pickled, descaled finish. Stainless steel pipe to have plain ends. In accordance with EN 10217-7 Tolerances in accordance with ISO 1127.
65-150	Black mild steel to BS EN 10255. Medium weight.	Butt welding to BS EN 10253-1. Flanges to BS EN 1092. Gaskets to BS EN 1514-1.
200-400	Carbon steel to BS EN 10216-1 & BS EN 10217-1. Dimensions to BS EN 10220.	Butt welding fittings to BS EN 10253-1. Flanges to BS EN 1092. Gaskets to BS EN 1514-1.
Over 400	Carbon steel to BS EN 10216-1 & BS EN 10217-1. Dimensions to BS EN 10220.	Butt welding BS 1640-3. Flanges to BS EN 1092. Gaskets to BS EN 1514-1.

1.23.3 Condenser Water

Size (DN)	Tube details	Fittings
Up to 50	Galvanized mild steel to BS EN 10255. Medium & heavy weight.	Malleable iron beaded to BS EN 10242. Hot dip zinc coated.
Up to 50	Black mild steel to BS EN 10255. Medium & heavy weight.	Malleable iron to BS EN 10242 or butt welded to BS EN 10253-1.
65-150	Galvanized mild steel to BS EN 10255. Medium weight.	Butt welding to BS EN 10253-1. Flanges to BS EN 1092-1. Gaskets to BS EN 1514-1.
65-150	Black mild steel to BS EN 10255. Medium weight.	Butt welding to BS EN 10253-1. Flanges to BS EN 1092-1, welded on. Gaskets to BS EN 1514-1.
100-200	ABS to BS 5391. Flanged.	ABS to BS 5392. Flanged.
200 & Over	Carbon steel to BS EN 10216-1 and BS EN 10217-1. Dimensions to BS EN 10220.	Steel butt welding to BS 1640-3. Flanges to BS EN 1092-1. Gaskets to BS EN 1514-1.

1.23.4 Natural Gas

Size (DN)	Tube details	Fittings
20-40	Black mild steel to BS EN 10255. Heavy weight.	Malleable iron to BS EN 10242.
15, 25 & 32	Black mild steel to BS EN 10255. Medium weight.	Malleable iron to BS EN 10242.
15-50	Corrugated Stainless Steel Tube (CSST) to BS7838 or BS EN15266. Also, BS6891, BS5482 and IGEM/UP/2 Edition 3.	
50	Black mild steel to BS EN 10255. Medium weight.	Butt welding to BS EN 10253-1.
65-150	Black mild steel to BS EN 10255. Medium weight.	Butt welding to BS EN 10253-1. Flanges to BS EN 1092-1.
200-400	Carbon steel to BS EN 10216-1 & BS EN 10217-1. Dimensions to BS EN 10220-1.	Butt welding to BS EN 10253-1. Flanges to BS EN 1092-1.
Over 400	Carbon steel to BS EN 10216-1 & BS EN 10217-1. Dimensions to BS EN 10220-1.	Butt welding to BS 1640-3. Flanges to BS EN 1092-1.

1.23.5 Compressed Air

Size (DN)	Tube details	Fittings
Up to 50	Copper to BS EN 12449.	Non-manipulative compression type to BS EN 1254-2.
20 & 40	Galvanized mild steel to BS EN 10255. Heavy weight.	Malleable iron to BS EN 10242 up to DN40.
15, 20, 25, 32, 50, 65, 80, 100 & 150	Galvanized mild steel to BS EN 10255. Medium weight.	Malleable iron to BS EN 10242 up to DN50. Galvanized flanged DN65 and above.
12-110 O.D.	ABS 'Air-line'.	Cold solvent fusion weld type. All items to comply with BCAS Code of Practice.

1.23.6 Condensate Drainage (Terminal Units)

Size (DN)	Tube details	Fittings
Up to 75 O.D.	ABS to BS 5391.	Solvent weld type to BS 5392.
Up to 80	Copper to BS EN 1057.	Non manipulative compressive type to BS EN 1254-2 or capillary type.
Up to 75	PVC u to BS 4514 I BS EN 10242.	Solvent - weld type.

1.23.7 Condensate Drainage from condensing boilers

Size (DN)	Tube details	Fittings
All sizes	ABS to BS 5391.	Solvent weld type to BS 5392.
	PVC u to BS 4514 I BS EN 10242.	Solvent - weld type.

1.23.8 Domestic Hot & Cold Water Services

Size (DN)	Tube details	Fittings
	Ductile iron to BS EN 545. Double flanged.	Double flanged to BS EN 545 with appropriate gaskets
	Ductile iron to BS EN 545. Double flanged. Cement lined at the manufacturers works with PortlandIsulfate resisting cement applied in accordance with BS EN 545.	Double-flanged to BS EN 545 with appropriate gaskets.
15-108	Xpress Copper Pressfit pipework system	Xpress
15-108	Copper tube to BS EN 1057- R250 - 15 x 0.7, 22, 28 x 0.9, 35, 42, 54 x 1.2, 66.7, 76.1, 108, 133 x 1.5, 159 x 2.0	Non-dezincifiable to BS EN 1254-1 for silver brazing.
15-108	Copper tube to BS EN 1057- R250 - 15 x 0.7, 22, 28 x 0.9, 35, 42, 54 x 1.2, 66.7, 76.1, 108, 133 x 1.5, 159 x 2.0	Non-dezincifiable to BS EN 1254-1 with integral lead free solder ring.
15-108	Copper tube to BS EN 1057- R250 - 15 x 0.7, 22, 28 x 0.9, 35, 42, 54 x 1.2, 66.7, x 1.5	Pneumatic compression fitting with "O" ring seals.

15-108	Copper tube to BS EN 1057- R250 - 15 x 0.7, 22, 28 x 0.9	Non-dezincifiable non manipulative type to BS EN 1254-2.
15-108	Copper tube to BS EN 1057- R250 - 15 x 0.7, 22, 28 x 0.9	Non-dezincifiable brass push fit with "O" ring seals and stainless steel grab rings. Fitting to incorporate compression collar for dismantling.
	PB pipe to BS 7291-2.	Fusion weld to BS 7291-2.
	PE-X pipe to BS 7291-3.	Mechanical type to BS 7291-3 as supplied by the pipe manufacturer.
	Stainless steel tube to BS EN 10312.	Non-dezincifiable capillary type to BS EN 1254-1 with integral lead-free solder ring.
	Stainless steel tube to BS EN 10312.	Non-dezincifiable compression type to BS EN 1254-3.
15-108	Stainless steel Xpress Pressfit pipework system	Xpress pressfit
65mm+	Stainless steel – Trubore 316L	Longitudinally welded steel pipe for pressure purposes, usually unanneated with a pickled, descaled finish. Stainless steel pipe to have plain ends. In accordance with EN 10217-7 Tolerances in accordance with ISO 1127.

1.23.9 Overflows & Warning Pipes

Size (DN)	Tube details	Fittings
	Galvanized mild steel to BS EN 10255. Medium weight I heavy weight.	Malleable iron to BS143 &1256, hot dipped galvanized.
	Galvanized mild steel to BS EN 10255. Medium weight I heavy weight.	Galvanized malleable iron grooved end joint system (and couplings).
	Copper tube to BS 1057 -R250 - 15 x 0.7, 22, 28 x 0.9, 35, 42, 54, x 1.2, 66.7, 76.1 x 1.5	Non-dezincifiable to BS EN 1254-1 with integral lead-free solder ring.
	PVC u to BS 5255 I BS EN 1329-1.	PVC u solvent weld.

1.24 Schedule of Valves & Fittings

1.24.1 Chilled Water

Size (DN)	Valve / fitting details	Application	Standard
Up to 50	Bronze gate valve. Non-rising stem; screwed bonnet; one-piece wedge.	Isolating.	BS EN 12288
65-300	Cast iron gate valve. Inside screw; non-rising stem; bronze trim; bolted bonnet.	Isolating.	BS EN 1171
50-900	Cast iron butterfly valve Epoxy resin coated. 50-150mm lever operated, over 150mm handwheel and gear-box operated. Lever valves limited to isolation only. 'U' wafer type through-bolted. Fully lugged, tapped for end-of-line service or equipmentisolation.	Isolating and Coarse balance.	BS EN 593
Up to 50	Bronze globe valve. Renewable disc; union bonnet; rising stem.	Isolating I Throttling.	BS 5154IBS EN 12288
50-150	Cast iron straight pattern globe valve. Bronze trim.	Pump discharge Throttling and Isolating.	BS EN 13789
50-400	Cast steel globe valve. Outside screw and yoke; bolted gland and bonnet.	Isolating I Throttling (High Duty)	BS 1873
Up to 50	Bronze swing check valve. Black nitrile rubber-faced disc; screwed-in cap.	Check I Non- return.	BS 5154 Series B
65-150	Cast iron swing check valve. Bronze seat and trim; nitrile rubber-faced disc.	Check I Non- return.	BS EN 12334
200, 250 & 300	Cast iron swing check. Metal-faced disc; bronze trim.	Check I Non- return.	BS EN 12334
Up to 50	Bronze gland pattern drain cock. Male inletIhose union outlet, wrench operation.	Drain off cock.	
6-50	Malleable iron globe valve. Renewable nickel alloy disc and seat; inside screw.	Air venting.	
Up to 50	Bronze 'Y' type double regulating valve with threaded nipple type orifice ring carrier. Two body bosses fitted sealed test plugs; screwed bonnet; metal plug and seat.	Flow measurement fixed orifice.	BS 7350
65-200	Cast iron 'Y' type double regulating valve with flow measurement plate and carrier. Two body bosses fitted sealed test plugs; outside screw;	Flow measurement fixed orifice.	BS 7350

	ising stem; stainless steel trim; bolted bonnet.		

Size (DN)	Valve / fitting details	Application	Standard
Up to 50	Bronze 'Y' type double regulating valve. Rising stem; screwed bonnet; characterized throttle disc.	Flow regulation.	BS 7350
65-200	Cast iron 'Y' type double regulating valve. Outside screw; rising stem; stainless steel trim; flanged BS EN 1515 and BS EN 1092-1.	Flow regulation.	BS 7350
65-300	Butterfly valve. Cast iron wafer semi-lugged valve, stainless steel stem, aluminium bronze disc, nitrile liner, double regulation function close-coupled to fixed orifice nickel-plated cast iron measuring station, gear-operated with two double seal test points.	Commissioning set.	BS EN 593
15-50	Strainer. Malleable iron 'Y' type; non-ferrous cap; non-asbestos gasket stainless steel screen; ends screwed BS 21/BS EN 10226-1 taper.	Pipeline strainer.	
65-200	Strainer. Cast iron 'Y' type; cast iron cap; non- asbestos gaskets; stainless steel screen; flanged BS EN 1515 and BS EN 1092- 1.	Pipeline strainer.	
250 & over	Strainer. Cast iron or cast steel fabricated pot- type duplex changeover; steel-bolted cap; non-asbestos gaskets; stainless steel screen; flanged BS EN 1515 and BS EN 1092-1.	Duplex strainer.	

1.24.2 Hot & Cold Water Services

Size (DN)	Valve / fitting details	Application	Standard
Up to 50	Bronze gate valve. Non- rising stem; screwed-in bonnet; one-piece wedge.	Isolating.	BS EN 12288
Up to 22	Gunmetal Ball valves with slotted control. Copper ends.	Isolating.	BS 6675
Up to 50	Gunmetal Ball valves with PTFE seatings and metal lever control. Copper ends.	Isolating.	
Up to 50	Gunmetal stop valve. Copper ends.	Isolating. (CWS only)	BS 1010
65-300	Cast iron wedge gate valve. Inside screw; non-rising stem; bronze trim; bolted bonnet.	Isolating.	BS 5163
50-300	Cast iron body butterfly valve. High nitrile rubber liner moulded to form resilient seat and end seals; wafer type between flanges fitting with flange aligning drilled lugs; lever operated	Isolating and coarse balancing. (CWS only)	BS EN 593
Up to 50	Bronze spring loaded axial check valve.	Check I Non- return.	BS 6282
Up to 50	Bronze swing check valve. Renewable nitrile rubber disc; screwed- in cap.	Check I Non- return. (CWS only)	BS 5154IBS EN 12288
65-300	Cast iron swing check valve. Zinc-free bronze trim; bolted cover; resilient seated.	Check I Non- return.	BS EN 12334
Up to 40	Strainer. Malleable iron 'Y' type; brass cap; non-asbestos gasket; stainless screen.	Pipeline strainer.	
50-200	Strainer. Cast iron 'Y' type; cast iron cap; non-asbestos gasket; stainless steel screen.	Pipeline strainer.	
Over 200	Strainer. Cast iron or cast steel fabricated pot- type duplex changeover; steel-bolted cap; non-asbestos gasket; stainless steel screen.	Duplex strainer.	
-	Thermal balancing valves Thermostatic valve with adjustable temperature control range and adjustable residual volume flow for	Balancing	

	ciculation pipes. Automatic thermal disinfection.		
Up to 28	Automatic Combined Air Release, Anti Vacuum & Surge Protection Valve manufactured from Brass and Stainless Steel with VITON and PTFE seals.	Anti-vacuum and surge protection	

1.24.3 Low Temperature Hot Water

Size (DN)	Valve / fitting details	Application	Standard
Up to 50	Bronze gate valve. Solid wedge disc; non-rising stem; screwed-in bonnet.	Isolating.	BS EN 12288
65-300	Cast iron gate valve; bronze trim; wedge disc; non-rising stem; inside screw.	Isolating.	BS EN 1171
50-150	Cast iron straight pattern globe valve bronze trim; non-rising stem; wedge disc.	Isolating.	BS EN 13789
50-300	Cast iron butterfly valve. Replaceable elastomer seat 'U' wafer type through-bolted.	Isolating and Coarse throttling.	BS EN 593
Up to 50	Bronze swing check valve. Bronze disc; screwed-in cap.	Check I Non- return.	BS 5154IBS EN 12288 Series B
Up to 50	Bronze 'Y' type double regulating valve. Threaded nipple type orifice ring carrier; two body bosses fitted sealed test plugs; screwed bonnet; metal plug and seat.	Flow measurement fixed orifice.	BS 7350
65-300	Cast iron swing check valve. Bronze seat and trim.	Check I Non- return.	BS 5154
65-200	Cast iron 'Y' type double regulating valve with flow measurement plate and carrier. Two body bosses fitted sealed test plugs; outside screw; rising stem; stainless steel trim; bolted bonnet.	Flow measurement fixed orifice.	BS 7350
65-300	Butterfly valve as for Chilled water.	Commissioning set.	BS EN 593
Up to 50	Bronze 'Y' type double regulating valve. Rising stem; screwed bonnet; characterized throttle disc.	Flow regulation.	BS 7350
65-200	Cast iron 'Y' type double regulating valve. Outside screw; rising stem; stainless steel trim.	Flow regulation.	BS 7350
Up to 50	Strainer.	Pipeline strainer.	

	Bronze 'Y' type; bronze cap; non-asbestos gasket; monel metal or stainless steel screen.		
65-200	Strainer. Bronze construction 'Y' type; bronze cap; non-asbestos gasket; monel metal or stainless steel screen; steel cap studs and nuts.	Pipeline strainer.	
250 & Over	Strainer. Cast iron or cast steel fabricated pot-type duplex changeover; steel-bolted cap; non-asbestos gasket; stainless steel screen.	Duplex strainer.	

1.24.4 Fuel Oil & Gas

Size (DN)	Valve / fitting details	Application	Standard
15-50	Parallel slide stop valve. Bronze body; renewable nickel alloy discs and seats; inside screw; screwed- in bonnet, union gland nut; cast iron handwheel; flanged BS EN 1092-1 & BS EN 1515.	Isolating.	BS EN 1984
15-80	Bronze globe valve. Screwed-in bonnet; renewable taper metal plug; screwed-in metal seat; pressure-tight back seating; inside screw; flanged BS EN 1092-1 & BS EN 1515.	Isolating 28 bar at 204°C and Controlling.	BS 5154/BS EN 12288
65-100	Parallel slide stop valve. Cast steel body and bolted cover; renewable nickel alloy discs and seats; stainless steel spindle; mild steel pillars and crosshead; bronze gland and bush; cast iron handwheel. Padlock and locking device.	Isolating.	BS EN 1984
65-200	Carbon steel butterfly valve.	Isolating.	BS EN 593
150-600	Parallel slide stop valve. Cast steel body and bolted cover; renewable nickel alloy discs and seats; stainless steel spindle; mild steel pillars and cross head bronze gland and bush; integral by-pass valve; cast iron hand-wheels. Padlock and locking device.	Isolating.	BS EN 1984

Up to 150	Steel globe valve.	Isolating.	BS 1873, BS EN 13709, BS EN ISO 15761
Up to 100	Steel gate valve (flexible wedge).	Isolating.	BS EN ISO 10434
Up to 100	Carbon steel ball valve.	Isolating.	BS ISO 7121
Up to 200	Carbon steel lubricated plug valve.	Isolating.	BS 5158, BS 5353
Up to 50	Gunmetal swing check valve.	Check / Non- return.	BS 5154/BS EN 12288
65-200	Carbon steel 'lift' type check valve.	Check / Non- return.	BS EN 13709 or BS EN ISO 15761
40-500	Cast carbon steel swing check valve. 13% chromium steel trim; bolted cover; flanged BS 1560.	Check / Non- return.	BS 1868
Up to 50	Bronze 'Y' double regulating valve with flow measurement orifice and carrier. Two body bosses fitted with sealed test plugs. Valve flange and mating flange for orifice assembly to BS EN 1515 and BS EN 1092-1.	Flow measurement.	BS 5154/BS EN 12288
65-200	Cast iron 'Y' type double regulating valve with flow measurement plate and carrier. Two body bosses fitted sealed test plugs; outside screw; rising stem.	Flow measurement fixed orifice.	
Up to 50	Bronze 'Y' type pattern double regulating valve. Rising stem; screwed- in bonnet; metal copper alloy plug and seat and regulating disc; double regulating device and indicator.	System regulation.	BS 5154/BS EN 12288
65-200	Cast iron 'Y' type double regulating valve. Outside screw; rising stem; stainless steel trim and regulating disc; double regulating device and indicator.	System regulation.	BS EN 13789
Up to 50	Strainer. Cast-iron body, Y type , flanged with brass screen, brass cap and non-asbestos gasket.	Pipeline strainer.	
65-200	Strainer. Cast-iron body, Y type flanged, with Stainless steel screen, cast-iron cap and Non-asbestos gasket, steel cap studs and nuts.	Pipeline strainer.	

250 & over	Strainer. Cast iron or cast steel fabricated pot-type duplex changeover; steel-bolted cap; non-asbestos gaskets; stainless steel screen.	Pipeline strainer.	

1.24.5 Fuel Oil

Size (DN)	Valve / fitting details	Application	Standard
15-50	Bronze split wedge disc fire gate valve. Screwed-in cap; lever and weight operated together with stainless steel cable, pulleys, fusible link, tensioner and warning labels.	Fire safety cut- off assembly.	

1.24.6 Natural Gas

Size (DN)	Valve / fitting details	Application	Standard
8-50	Brass body ball plug valve. Chrome coated ball plug and valve stem; PTFE seals; top entry type with locking plate; quarter-turn lever operated.	Isolating.	
65-100	Cast iron ball plug valve. Details as for brass body type.	Isolating.	BS ISO 7121
65-300	Cast iron gate valve. Bronze trim; non-rising stem; wedge disc; inside screw.	Isolating.	BS EN 1171
50-300	Cast iron wafer type butterfly valve. Nitrile rubber lined; quarter-turn operation.	Isolating.	BS EN 593
Up to 200mbar	Open bottomed taper plug valves for 1st, 2nd & 3rd family gases.	Isolating.	BS 1552

1.24.7 Vacuum

Size (DN)	Valve / fitting details	Application	Standard
15-50	Bronze globe valve. Rising stem; screwed-in bonnet; rubber disc.	Isolating.	BS 5154/BS EN 12288 Series B
15-100	Bronze globe valve. Rising stem; screwed-in bonnet; rubber disc; flanged BS EN 1515 and BS EN 1092-1.	Isolating.	BS 5154/BS EN 12288 Series B
40-450	Cast iron gate valve. Solid wedge; water seal; inside screw; non-rising stem; bronze trim; flanged BS EN 1515 and BS EN 1092-1.	Isolating.	BS EN 1171

1.24.8 Drain Valves & Cocks

Size (DN)	Valve / fitting details	Application	Standard
15	Bronze screw-down draining tap. Angle type; loose key operated; lockshield pattern; outlet ribbed for hose.	Draining (limit 10 bar 120°C).	BS 2879 Type 2
15-50	Bronze draw-off cock. Straight type; gland pattern; taper plug; inlet threaded male; lose union outlet; lever operated.	Draw-off cock (limit 8.6 bar 200°C).	

1.24.9 Heating Radiators & Convectors

Size (DN)	Valve / fitting details	Application	Standard
15-50	Bronze radiator gate valve. Casting finish; female/male union; composition handwheel.	10 bar, 120°C.	BS 2767
15, 20 & 25	Bronze radiator globe valve. Angle pattern; polished finish; female/male union; composition handwheel.	10 bar, 120°C.	BS 2767

1.24.10 Safety & Pressure Relief Valves

Size (DN)	Valve / fitting details	Application	Standard
15, 22 & 28	Safety valve. Totally enclosed spring loaded with lever.	Unvented Hot water cylinders.	BS EN ISO 4126-1
15, 22 & 28	Combined Temperature and Expansion Relief valve. Totally enclosed spring loaded with lever.	Unvented Hot water cylinders in addition to the safety valve.	BS EN ISO 4126-1
All sizes	Safety valve. Totally enclosed spring loaded with padlock. Relief valves mounted with spindle vertical.	Overpressure protection.	BS EN ISO 4126-1

1.24.11 General

Size (DN)	Valve / fitting details	Application	Standard
All sizes	Lubricated plug valve. Cast iron items with steel accessories and fittings. Cast iron BS 5158, Bronze 6675, Steel (process) BS5353, Gas BS 1552.	Isolation. Manual diversion (three- port)	

2.0 THERMAL INSULATION

2.1 General Requirements

2.1.1 Provide all labour and materials required for thermal insulation and associated finishes for plant, equipment, pipework and ductwork systems. Finally clean off all materials and finishes.

2.1.2 Thermal insulation shall be installed in accordance with this Specification and TIMSA guidance notes and recommendations. The most onerous requirements shall apply.

2.2 Performance and Standards

2.2.1 Requirements for thermal insulation systems (including insulation, sealants, finishes, fixings, etc.) and methods of application used shall be to BS 5422 and BS 5970. The recommendations given in the code of practice shall be applied. Definitions of terms shall be to BS 3533. Calculations shall be to BS EN ISO 12241.

2.2.2 The minimum thickness of insulation for conservation of fuel and power shall be not less than that required to achieve the maximum permissible heat losses given in the TIMSA HVAC Compliance Guide (and BS 5422). Standard temperatures used for compliance calculations shall be described in the TIMSA HVAC Compliance Guide (and BS 5422), summarised below.

Table	Application	Principal Function	Outer Surface Emissivity	Ambient Air Temperature (°C)	Contents Temperature (°C)
2	Hot Water Pipework	Conservation of Fuel and power	0.05	15	60
2	Low Temperature Heating Pipework		0.05	15	75
2	Refrigeration Pipework		0.05	25	0
2	Chilled Water Pipework		0.05	25	5
2	Cold Water Pipework		0.05	25	10
2	Warm Air Ductwork		0.05	15	35
2	Cool Air Ductwork	Fuel and Power	0.05	25	13

2.2.3 The minimum thickness of insulation for control of condensation and frost protection shall be not less than that required by relevant tables in BS 5422 and the TIMSA HVAC Compliance Guide. Standard temperatures described in BS 5422 and the TIMSA HVAC Compliance Guide are summarised below.

Table	Application	Principal Function	Outer Surface Emissivity	Ambient Air Temperature (°C)	Relative Humidity (%)	Contents Temperature (°C)
5	Refrigeration Pipework	Control condensation	0.05	25	80	-40 to 0
8	Chilled Water Pipework	Control condensation	0.05	25	80	5
8	Chilled Water Pipework	Control Condensation	0.05	25	80	10
10	Chilled Air Ductwork	Control condensation	0.05	25	80	10
23	Commercial and Industrial Freezing	Inhibit freezing		-10 (12hrs)		2
24	Domestic Freezing	Inhibit freezing		-6 (8hrs)		2

2.2.4 Where the thickness is not a commercially available size, the nearest larger size shall be selected.

2.2.5 The required minimum thermal conductivity and other performance requirements of insulating materials and systems may also be as specified on the Equipment Data Sheets.

2.2.6 When insulating for more than one purpose the most stringent design parameters apply.

2.2.7 Vapour barriers, finishes and cladding shall not be deemed to contribute to the overall insulating effect or material thickness.

2.2.8 Vapour barriers shall be provided on all services operating below ambient air temperature. Vapour barriers shall be of required permeance for the system operating temperature. The permeance shall not exceed 0.004g/(s.MN) for chilled water and chilled air applications. Vapour barriers shall be sealed and maintained continuous to prevent the passage of water vapour.

2.2.9 Class 0 rating for insulating materials shall be as defined in BS 5422 Annex E. Fire resistance shall be maintained where services pass through fire compartments.

2.2.10 Manufacturer's certified performance data for materials shall be submitted to demonstrate compliance with BS 5422.

2.2.11 Thermal insulation systems shall be applied in accordance with British Standards, manufacturers' recommendations and any particular requirements given in the Specification.

2.2.12 Pipe Insulation to have a BREEAM Green Guide rating of A/A+ in accordance with the 2016 Pipe Insulation Environmental Profile Methodology as shown on the BRE website www.bregroup.com/greenguide.

2.3 Applications

2.3.1 Energy Conservation and Temperature Control.

2.3.2 Thermal insulation shall be applied to limit of heat loss or heat gain, prevent condensation, and ensure fluids are delivered at required conditions at point of use.

2.3.3 Personnel Protection

2.3.3.1 Insulation shall be provided to restrict surface temperatures to the requirements of BS 5970 and the TIMSA HVAC Compliance Guide.

2.3.4 Frost Protection

2.3.4.1 Thermal insulation, in combination with electrical trace heating tape as necessary, shall be applied where freezing is likely to occur.

2.3.5 Condensation Control

2.3.5.1 All services operating below ambient air temperature shall be insulated to prevent surface condensation unless more stringent requirements apply.

2.3.6 General Application Schedule

2.3.6.1 Plant, equipment and services shall be insulated to conserve energy, maintain temperature control, protect personnel, prevent freezing, and control condensation including typical applications and functions given below.

Application	Energy Conservation	Personnel Protection	Frost Protection	Condensation Control
Supply Air Systems	✓			✓
Return Air Systems	✓			
Recirculation Air System	✓			
Air Handling Units	✓			✓
External Louvre Plenums	✓			✓
Air Diffuser Plenum Boxes	✓			✓
Heating Pipework Systems	✓	✓	✓	
Heating Pumps	✓	✓		
Steam and Condensate Pipework Systems	✓	✓		
Refrigerant Evaporators and Pipework Systems	✓	✓		✓
Chilled Water Pipework Systems	✓		✓	✓

Application	Energy Conservation	Personnel Protection	Frost Protection	Condensation Control
Chilled Water Pumps	✓			✓
Condenser Water Pipework Systems			✓	✓
Cold Water Pipework Systems	✓		✓	✓
Cold Water Pumps			✓	✓
Water Heaters and Storage Cylinders	✓	✓		
Hot Water Supply Pipework Systems	✓	✓	✓	
Boilers and Boiler Feed Tanks	✓	✓		
Flue Systems	✓	✓		✓
Heat Exchangers (Hot)	✓	✓		
Heat Exchangers (Cold)	✓	✓		✓
Storage Vessels (Hot)	✓			
Storage Vessels (Cold)	✓			✓
Storage Tanks and Cisterns			✓	✓
Water Treatment Plant	✓			✓
Internal Rainwater Pipework				✓
Notes For the purposes of this table pipework system means pipelines, headers, and all associated equipment and fittings. The requirements apply to internal and external services.				

2.3.6.2 Mineral fibre insulation shall not be used in aseptic areas or kitchen and food preparation areas.

2.4 Materials

2.4.1 General Requirements

2.4.1.1 Insulating materials shall be new and to BS EN 13166, BS 3958 and BS 5422.

2.4.1.2 Insulating materials shall be supplied by a member firm of the Thermal Insulation Manufacturers and Suppliers' Association (TIMSA).

2.4.1.3 Insulating materials shall be applied in accordance with BS 5970, and manufacturer's recommendations.

2.4.1.4 Physical characteristics and fire performance of materials shall be to BS 5422.

2.4.1.5 Insulating system materials shall be suitable for system maximum and minimum temperatures and long term service under normal operating conditions. Insulation system operating temperature limits shall be confirmed by the manufacturer.

2.4.1.6 Insulation materials and finishes shall have a Class 0 spread of flame rating.

2.4.1.7 Insulating materials shall have a zero ozone depletion potential (ODP) rating.

2.4.1.8 Insulating materials with a global warming potential (GWP) of 5 or more, either in manufacture or in composition, shall not be used.

2.4.1.9 Closed cell type insulation shall be used for pipework services, associated vessels and equipment, and low temperature air handling systems operating at or below ambient air temperatures.

2.4.1.10 Direct contact of dissimilar metals shall be avoided. Wire netting reinforcement shall not be used in contact with stainless steel.

2.4.1.11 Products and materials, and work associated with the manufacture, handling, preparation and installation shall comply with guidance provided by the HSE and current regulations.

2.4.2 Man-Made Mineral Fibre Materials

2.4.2.1 Man-made mineral fibrous material (mineral fibre) shall be to BS 3958. Preformed pipe sections shall have a thermal conductivity not exceeding 0.037W/mK at 50°C and slab 0.033W/mk at 10°C. Mineral fibre materials shall be contained or stabilized by bonding or covering to prevent fibre migration from unintentional physical contact or erosion by air-flow.

2.4.3 Phenolic Foam

2.4.3.1 Phenolic foam preformed insulation shall be to BS EN 13166, Type A, free of water-soluble chlorides, with factory-applied bore coating. Phenolic foam shall have an 'aged' thermal conductivity not exceeding 0.021W/mK at 10°C.

2.4.4 Expanded Nitrile Rubber

2.4.4.1 Expanded nitrile rubber shall have an 'aged' thermal conductivity not exceeding 0.037W/mK at 20°C. Water absorption shall be less than 1.5% maximum by volume over 28 days. Resistance to oils and greases shall be 'high' and resistance to ozone (ASTM-D-1171) shall result in 'no cracking'. The material shall incorporate a smooth external impermeable barrier surface.

2.4.5 Cellular Glass

2.4.5.1 Cellular glass preformed insulation shall have a thermal conductivity not exceeding 0.042W/mK at 10°C (and 0.048W/mK at 10°C for load bearing sections). It shall have a density of 120kg/m3 (135kg/m3 for load bearing sections) and be free from water soluble chlorides.

2.4.6 Calcium Silicate

2.4.6.1 Calcium silicate shall comply with the physical requirements of Type 1 material to BS 3958-2. Calcium silicate shall have a thermal conductivity not exceeding 0.061W/mk at 100 °C.

2.4.7 Adhesives and Mastic Sealants

2.4.7.1 Adhesives and mastic sealants used shall be suitable for the operating environment in which they are used.

2.4.7.2 The use of solvent-based adhesives on site shall be restricted as practicable.

2.4.8 Finishes

2.4.8.1 Insulation shall be faced with factory applied reinforced aluminium foil laminate unless otherwise specified.

2.4.8.2 Aluminium-zinc coated steel sheet shall have a minimum coating weight to BS 5970.

2.4.8.3 Stainless steel sheet shall be to:
- AISI Grade 316.
- DIN 17440.
- An agreed equivalent.

2.4.8.4 Poly-isobutylene (PIB) sheet shall not be less than 1.0mm thick.

2.4.8.5 Semi-rigid PVC sheet shall not be less than 0.5mm thick.

2.4.8.6 Expanded nitrile rubber shall be finished to suit the application in accordance with manufacturer's recommendations.

2.4.8.7 Polymeric mastic coatings shall be applied as recommended by the manufacturer for the application in which they are used.

2.5 Installation

2.5.1 General Requirements

2.5.1.1 Insulation systems shall be installed in accordance with BS 5970 and manufacturer's recommendations.

2.5.1.2 Insulation shall be applied to dry, clean surfaces. Where vapour barriers or weatherproof finishes are to be applied, the insulation shall be kept dry until covering is complete.

2.5.1.3 Insulation shall not be applied to pipework, ductwork and associated equipment items until all pressure and leakage tests have been satisfactorily completed and documented, and surfaces cleaned and painted where required.

2.5.1.4 Insulation shall be applied to ensure that full surface contact and constant thickness are maintained. Pre-formed bends shall be used to ensure accurate fit. Where mitred sections have to be used, pieces shall be cut and fitted accurately using the minimum number required. All joints shall be firmly butted together. All individual sections shall be securely fixed.

2.5.1.5 Insulation thickness shall be increased over flanged joints, connections, fasteners, stiffeners and other assembly components to maintain appropriate cover.

2.5.1.6 Where necessary, full insulation thickness shall be achieved by multi- layer application with staggered joints.

2.5.1.7 Insulation in sheet, slab or mattress form shall be fixed with adhesive and suitable mechanical fixings (hangers, aluminium bands, wire mesh, etc.) to ensure that long-term full surface contact is maintained.

2.5.1.8 The outer surface of installed work shall be firm and present a smooth and unbroken appearance. Adjacent services or items of equipment shall be insulated separately and clearances between services maintained.

2.5.1.9 All necessary attachment and support devices shall be provided and fixed. Fixings used shall ensure insulation thickness is maintained and prevent settlement and sagging of insulation material. Fixings shall be corrosion resistant.

2.5.1.10 Insulation at load bearing support inserts shall be of rigid, non- combustible material of same thickness as adjoining insulation. The thermal performance of support inserts shall be at least equivalent to adjoining insulation. Support inserts shall be durable and suitable for longterm service. Support inserts shall be extended by a minimum of 50mm each side of the support to permit sealing the vapour barrier.

2.5.1.11 All metal cladding, exposed reinforcement and other metallic components shall be bonded to a suitable earth connection.

2.5.1.12 Provisions shall be made to accommodate thermal expansion and contraction, including recommendations given by BS 5970.

2.5.1.13 Instruments, gauges and isolating cocks, other fittings and connections shall be clear of the insulation.

2.5.1.14 Where existing cooling plant must remain in operation, surfaces shall be defrosted as necessary with methanol, or equivalent, immediately before application of insulation and a vapour seal applied immediately following. Care shall be taken when handling defrosting agents.

2.5.1.15 Cellular glass sections shall be secured with 12.7mm wide 0.5mm thick BS 304 S16 stainless steel straps at 300mm centres. Wire shall not be used to support or secure cellular glass insulation.

2.5.2 Vapour Barriers

2.5.2.1 Vapour barriers shall be maintained continuous throughout each entire system. Vapour barriers shall be carried across equipment, fittings, and pipe inserts.

2.5.2.2 Vapour barriers shall have an overlap of at least 40mm and shall be sealed by a waterproof adhesive or mastic.

2.5.2.3 Vapour barriers along pipe sections shall be sealed directly to pipework either side of fittings to prevent moisture ingress during maintenance.

2.5.2.4 Cellular glass insulation shall be vapour sealed at all joints and around the bore using a suitable mastic sealant in accordance with manufacturer's recommendations.

2.5.3 Adhesives and Self-Adhesive Tapes

2.5.3.1 Adhesives and self-adhesive tapes shall only be applied to dry, clean surfaces. Adhesives and self-adhesive tapes shall be suitable for the environment in which they are used.

2.5.3.2 Surfaces on which self-adhesive tapes are applied shall be primed with a compatible contact adhesive prior to application of the tape. Self- adhesive 'soft' tapes which do not ensure satisfactory long-term adhesion shall not be used.

2.5.4 Pipework

2.5.4.1 All pipework and fittings shall be insulated and shall be continuous over all fittings and couplings unless otherwise indicated.

2.5.4.2 Pipework shall be insulated with pre-formed pipe sections.

2.5.4.3 Pre-formed mineral fibre and phenolic foam sections shall have a factory applied fully bonded reinforced aluminium foil facing with integral longitudinal self-adhesive lap.

2.5.4.4 Closed cell insulation shall be used for services operating below ambient air temperature.

2.5.4.5 Expanded nitrile rubber tube shall have a Class 0 finish. All joints shall be continuously sealed with adhesive and additionally sealed with self-adhesive tape.

2.5.4.6 Pipe sections shall be secured additionally with 50mm wide self- adhesive aluminium foil tape, or aluminium flat bands, at 300mm centres. Formed bends shall be banded twice on each segment.

2.5.4.7 Insulation at and adjacent to flanges shall use oversize pipe sections and be arranged to allow the removal of fixing bolts and nuts without damage to insulation or finishes.

2.5.4.8 Pumps, pipe fittings and removable assemblies shall be insulated and vapour sealed as adjacent pipework. Vapour barriers shall be maintained continuous.

2.5.4.9 Pipe expansion devices shall operate without interference by insulation which shall be carried over such devices on close-clearance sheet metal sleeves secured at one end only.

2.5.4.10 All stainless steel pipework shall be foil wrapped with 0.06mm aluminum pure foil. Foil wrapping should be installed under phenolic blocks.

2.5.5 Ductwork

2.5.5.1 Rectangular ductwork which is to be exposed or clad shall be insulated with rigid slab material. Slabs on horizontal faces shall overlap those vertical faces to maintain thickness at corners.

2.5.5.2 Circular and flat oval ductwork which is to be exposed or clad shall be insulated with rigid slab and preformed sections or lamella mattress.

2.5.5.3 Rectangular, circular and flat oval ductwork which is 'concealed' shall be insulated with rigid slab or mineral fibre mattress.

2.5.5.4 Mineral fibre mattress shall be secured with 150mm wide bands of suitable adhesive at 300mm centres and wrapped with a full retaining, non-penetrating, wrap of zinc-coated hexagonal steel wire netting with joints laced with 1.6mm bright soft steel wire.

2.5.5.5 All joints shall be securely sealed with 100mm wide soft aluminium tape.

2.5.5.6 Drop rod fixing to bearer supports of suspended ductwork shall leave sufficient clearance for application of insulation, vapour barrier and finish covering to the duct sides.

2.5.5.7 Proprietary or custom-made access doors, covers and panels shall have insulation equivalent to the adjoining ductwork.

2.5.6 Storage Vessels and Heat Exchangers

2.5.6.1 Storage vessels and heat exchangers shall be insulated with preformed insulation.

2.5.6.2 Insulation shall be firmly secured in accordance with manufacturer's recommendations and BS 5970.

2.5.7 Tanks and Cisterns

2.5.7.1 Water storage tanks and cisterns shall be factory insulated.

2.5.8 Hot Water Storage Cylinders

2.5.8.1 Hot water storage cylinders shall be factory insulated.

2.5.9 Removable Covers

2.5.9.1 Removable covers (e.g. access panels, inspection covers, etc.) shall be insulated, vapour sealed and finished to the same standard as the service or equipment in which they are located. Pipe fittings shall be insulated with proprietary, removable, flexible jackets, vapour sealed and finished to the same standard as the service in which they are located.

2.6 Finishes and Cladding

2.6.1 General Requirements

2.6.1.1 Finishes and cladding shall be provided in accordance with the recommendations of BS 5970.

2.6.1.2 All joints shall have 40mm minimum overlaps. All laps shall be securely fixed.

2.6.1.3 Finishes shall be formed to closely fit to the outside dimensions of the insulated work to achieve a neat, lineable appearance. Cladding shall be fitted with longitudinal seams turned away from the major direction of view.

2.6.1.4 All cladding shall be self-supporting and shall not contact metal surfaces or attachments.

2.6.1.5 The vapour barrier shall not be used as the final surface finish if it is likely to be damaged.

2.6.1.6 No cladding fixing or retaining devices shall penetrate vapour barrier material.

2.6.1.7 Methods of fixing used shall accommodate movement due to thermal expansion.

2.6.1.8 Exposed edges and corners of insulation slabs shall be fitted with protective cappings.

2.6.1.9 Test point and fixed instrument penetrations to rigid finishes shall be fitted with purpose-made, close-fitted cover plates or split discs of casing material secured with closed pop-rivets at 75mm centres and/or suitable adhesive.

2.6.1.10 All sheet cladding used for weatherproofing shall have overlaps at joints arranged to shed water. External penetrations shall have covers lapped and sealed to exclude water. Top surfaces of weatherproofed ductwork shall be arranged to fall to shed rain water and prevent ponding.

2.6.2 General Application Schedule

2.6.2.1 Unless otherwise specified on the Equipment Data Sheets, finishes and cladding shall be provided as listed below.

Service Equipment	Location	Finish Cladding
Pipe work and ductwork systems.	Concealed voids (ceiling voids, floor voids, risers, etc.)	Reinforced aluminium foil.
Pipework and ductwork systems.	Exposed to view.	Reinforced aluminium foil and embossed aluminium sheet.
Pipework and ductwork systems greater than 2m above floor or access deck level and where no mechanical damage is likely.	Plantrooms, plant access areas, risers.	Reinforced aluminium foil.
Pipework and ductwork systems less than 2m above floor or access deck level.	Plantrooms, plant access areas, risers.	Reinforced aluminium foil and embossed aluminium or 'Aluzinc" sheet.
Pipework and ductwork systems where mechanical damage is likely.	Plantrooms, plant access areas, risers.	Reinforced aluminium foil and embossed aluminium or 'Aluzinc" sheet.
Pipework and ductwork systems	External routes and plant areas where foot traffic is likely	Reinforced aluminium foil and embossed aluminium or 'Aluzinc" sheet.
Pipework and ductwork systems	External routes and plant areas where no mechanical damage is likely	Polyisobutylene sheet.
Vessels, heat exchangers, calorifiers	Plantrooms	Reinforced aluminium foil and embossed aluminium or 'Aluzinc" sheet.

2.6.3 Reinforced Aluminium Foil

2.6.3.1 Reinforced aluminium foil shall have 40mm overlap at joints fixed down with suitable adhesive.

2.6.4 Sheet Metal Cladding

2.6.4.1 For normal applications the thickness of sheet metal cladding shall not be less than given in BS 5970, Table 9. The thickness shall be increased where the underlying insulation is compressible.

2.6.4.2 Lapped joints shall be secured by pop rivets or self tapping screws fixed at 150mm centres. Where a vapour barrier is required a resilient strip of insulating material of thickness 1.5 x screw depth shall be fitted to absorb the screw penetration. Alternatively the cladding shall be secured by metal straps at 225mm centres. Overlaps shall be a minimum of 100mm for ductwork.

2.6.4.3 Circular bends over 200mm outside diameter may be clad with equal segmental pressed or formed sections.

2.6.4.4 Cut edges on galvanised sheet steel shall be cleaned and painted with zinc-rich paint.

2.6.5 Poly-isobutylene Sheet

2.6.5.1 Poly-isobutylene (PIB) sheet shall be lapped to shed water with 75mm minimum overlaps at all joints, and shall be secured and sealed with adhesive or by solvent welding to provide a weatherproof vapour- resistant finish.

2.6.5.2 Poly-isobutylene sheet shall be retained to prevent sagging.

2.6.6 Polymeric Mastic Coated Mineral Fibre

2.6.6.1 Proprietary mastic coated mineral fibre sheet finish systems shall be applied in accordance with manufacturer's recommendations and shall be secured with one coat of mastic and have 50mm minimum overlaps at all joints. For insulation located internally, a finish coat shall be applied to the entire surface. For external locations, two top coats shall be applied. Each coat shall be of a different colour to indicate correct application. Where insulation is exposed to view a decorative finish shall be provided.

2.6.7 Polymeric Mastic Coated Cellular Glass

2.6.7.1 Proprietary SM polymer coated cellular glass finish systems shall be applied in accordance with manufacturer's recommendations for internal and external locations. Where insulation is exposed to view a decorative finish shall be provided.

2.6.8 Pumps and Pipe Fittings

2.6.8.1 Pump bodies shall be encased in prefabricated, removable, metal casings with quick release clips. All metal edges shall be folded during factory assembly. Casings shall match the pipe cladding.

2.6.8.2 Where adjacent pipework is finished with sheet metal, valves, flanges, strainers, and any other fittings that require routine access, shall be fitted with proprietary removable, formed insulation casings secured with spring release clips. Casings shall match the pipe cladding. Casings shall not impair valve operation. Provision shall be made for removal and refitting securing bolts without damage to insulation or finishes.

2.6.8.3 Fittings, valves and pump bodies casings shall be formed of a minimum number of sections. Components shall be sealed using a non-setting compound.

2.6.9 Storage Vessels and Heat Exchangers

2.6.9.1 Insulated storage vessels and heat exchangers shall be encased in 1.2mm sheet. Joints shall be secured by aluminium pop-rivets or sherardised self-tapping screws at 50mm maximum centres, all finally secured with 25mm wide bright aluminium tensioning bands at 450mm maximum centres.

2.6.9.2 Insulation below 450mm above floor level shall be fitted with 1.6mm thick sheet metal 'kicking strips'.

2.6.10 Removable Covers

2.6.10.1 Custom-made access panels shall have insulation contained within a channel section frame to ISO 6362 with mitred corners. Facing panels shall be formed from sheet metal a minimum of 1.6mm thick and shall be bedded in mastic.

3.0 ABOVE GROUND DRAINAGE

3.1 General Requirements

3.1.1.1 All components associated with rainwater, soil and waste pipework and sanitary appliances shall comply with BS EN 12056.

3.1.1.2 Pipe and fitting types shall be obtained from the same manufacturer.

3.1.1.3 Materials shall be used in accordance with the manufacturer's recommendations.

3.1.1.4 Pipes and fittings shall be examined before fixing. Defective items shall be replaced.

3.1.1.5 Joint ring material shall be to BS EN 681 and BS EN 682 as applicable and shall be stored in bags as-delivered and not exposed to sunlight.

3.1.1.6 Connections between different materials shall be made with purpose- made fittings.

3.1.1.7 Provisions shall be made to accommodate thermal expansion.

3.2 Pipework Installation

3.2.1.1 Pipes shall be cut square, with burrs, cutting swarf or debris removed from pipe.

3.2.1.2 Pipework shall be secure, parallel and plumb with vertical surfaces.

3.2.1.3 Horizontal branch connections shall be swept in direction of flow.

3.2.1.4 Small diameter branches shall be arranged to prevent stress from axial movement.

3.2.1.5 Expansion fittings shall be the same material as the pipe. The female member of the expansion device shall be anchored to allow the male member to take movement.

3.3 Pipe Sleeves

3.3.1.1 Pipes passing through structure shall be fitted with non-combustible sleeves. The sleeve ends shall be flush with the finished wall surfaces.

3.3.1.2 Sleeves shall have clearance around the pipe. The annular space shall be packed with mineral wool.

3.3.1.3 Sleeves in fire compartment walls shall be fire-stopped using a certificated system.

3.3.1.4 External wall and roof sleeves shall be arranged to prevent water penetration.

3.3.1.5 Proprietary pipe sleeve systems incorporating ring seals and cover plates shall be used as a finish to pipework, up to and including DN50 in occupied areas other than plantroom.

3.3.1.6 Water protecting pipe sleeves through floors shall be fitted in mechanical plantrooms, tank rooms, kitchens and all floors with water proof finishes.

3.3.1.7 Water protecting pipe sleeves lengths shall be of floor thickness plus 50mm minimum projection abvove finished level.

3.4 Joints

3.4.1.1 Joints shall not be made within the thickness of the structure.

3.4.1.2 Jointing material shall not project into the bore of the systems.

3.4.1.3 Joints between pipes and WC pan spigots shall be made proprietary flexible connectors.

3.5 Access Points

3.5.1.1 Access points shall be provided at the base of each stack and at junctions to horizontal branches over 40mm diameter.

3.5.1.2 Access points shall be fitted at ends of all horizontal pipework, junctions and changes of direction on branch pipework.

3.6 Terminals

3.6.1.1 Pipes penetrating roofs shall be weathered and waterproof.

3.6.1.2 Stacks shall extend at the full diameter, above roof level and terminate with a suitable grating.

3.6.1.3 Wire terminal balloons shall be used for metal stacks.

3.6.1.4 Balloons for PVC-u stacks shall be of the same material.

3.7 Pipework Materials

3.7.1 Cast Iron Pipework

3.7.1.1 Spigot and socket pipework and fittings shall be jointed with one third caulked un-tarred yarn then two thirds hot run lead.

3.7.1.2 The yarn shall be clean, dry and free from oil. An annular space for lead of the depth specified in the schedule shall be left in the socket. The caulking space shall at no part of the joint be less than 6mm.

3.7.1.3 Lead shall be caulked using the proper tools. Pneumatic, electrical or mechanical tools shall not be used. The joint shall be finished 3mm inside the face of the socket.

3.7.1.4 Joints not completely filled at one running shall be burnt out and remade.

3.7.2 Copper Pipework

3.7.2.1 Pulled bends and sets up to and including DN54 diameter, may be made.

3.7.2.2 Bends or sets which show flattening, rippling or restriction of the bore shall be replaced.

3.7.2.3 Screwed threads to BS 21/BS EN 10226-1 shall be jointed with compounds complying with BS 5292 and BS 6956-5 or PTFE tape.

3.7.2.4 Joints between copper tubes and capillary type fittings shall be made in accordance with the manufacturer's recommendations. Self- cleaning fluxes shall not be used.

3.7.3 Stainless Steel Pipework

3.7.3.1 Stainless steel pipework shall be to BS EN 10312.

3.7.4 PVCu Pipework

3.7.4.1 Pipes shall be jointed with elastomeric ring fittings.

3.7.4.2 Pipes shall be jointed with solvent weld fittings and incorporate elastomeric rings for expansion.

3.7.4.3 A support bracket shall be provided immediately below each pipe connector.

3.7.4.4 Exposed waste pipes shall be white.

3.8 Pipework Supports

3.8.1.1 Pipework supports shall be provided at each side of bends and at intervals shown below.

Pipe Material	Pipe Size (DN)	Support Interval	
		Vertical Pipe (m)	Horizontal Low Gradient Pipes (m)
Cast Iron	All Sizes	3	3
Copper & Stainless Steel	< 32	2.4	1.8
	32 - 40	3.0	2.4
	50	3.0	2.7
	65 - 100	3.7	3.0
PVCu	< 32	0.6	0.5
	32-50	1.2	0.5
	82-110	1.8	0.9

3.8.1.2 Multiple pipe supports systems shall suit the fixing requirements for the smallest pipe.

3.8.1.3 The type of support shall be selected according to the application with allowance for thermal movement.

3.8.1.4 Socketless pipe systems shall be supported adjacent to every joint.

3.8.1.5 Long sections of drain shall be laterally braced to prevent horizontal movement.

3.8.1.6 Angle section mild steel thrust brackets shall be fitted at vertical bends to prevent axial movement of suspended pipes.

3.8.1.7 Steel brackets shall be free of rust and painted one coat of zinc chromate primer paint prior to fixing. After installation brackets shall be painted one further coat of zinc chromate primer.

3.8.1.8 Exposed pipework occupied areas shall be carried on backplate supports.

3.9 Acoustic Insulation

3.9.1.1 Acoustic laminate insulation shall be installed around soil vent pipes where specified.

3.9.1.2 Acoustic laminate insulation shall be a three-part laminate, manufactured from shot free non-combustible glass mineral wool, quilted to eliminate de-lamination and fibre migration. 5-kilo outer mass layer faced with Class O foil.

3.9.1.3 Fire performance to be to Euroclass A1.

3.9.1.4 Thickness and density to be specified by the acoustic consultant.

3.10 Pipework Testing

3.10.1.1 Pipework testing shall be carried out in accordance with NG Bailey QC Procedure – leak testing of soil and vent pipework.

3.10.1.2 All above ground drainage soil and vent pipework shall be tested in accordance with BS EN 12056-2:2000.

3.11 Schedule of Pipe Materials

Service	Pipe	Fittings & Valves
Soil Stacks	Socketless cast iron to BS EN 877	Flexible mechanical joints to BS EN 877
	Socketless cast iron to BS ISO 6594	Flexible mechanical joints as supplied by the pipe manufacturer
	Mild steel tube to BS EN 10255, prefabricated to BS 3868, and galvanized	Galvanized steel socket or 2 piece mechanical joint incorporating a synthetic rubber gasket to BS EN 681-1
	PVCu to BS EN 1329-1	PVCu to BS EN 1329-1
	Socketless HDPE	Spigoted fittings jointed by butt fusion or with Fusion Welded couplings.
	BBA approved Stainless Steel spigot and socket.	Spigot and Socket push fit with EPDM rings
Branch Soil Pipes	Socketless cast iron to BS EN 877	Flexible mechanical joints to BS EN 877
	Socketless cast iron to BS ISO 6594	Flexible mechanical joints as supplied by the pipe manufacturer.
	Mild steel tube to BS EN 10255, prefabricated to BS 3868, and galvanized	Galvanized steel socket or 2 piece mechanical joint incorporating a synthetic rubber gasket to BS EN681-1
	Copper tube to BS EN 1057 - R250 - 108 x 1.5 Prefabricated in accordance with BS 3868	Copper tube to BS EN 1057 - R250 - 108 x 1.5 Prefabricated in accordance with BS 3868
	Socketless HDPE to BS EN 1519-1	Spigoted fittings jointed by butt fusion or with Fusion Welded couplings
	BBA approved Stainless Steel spigot and socket.	Spigot and Socket push fit with EPDM rings
	PVCu to BS EN 1329-1	PVCu to BS EN 1329-1

Service	Pipe	Fittings & Valves
Waste Stacks	Socketless cast iron to BS EN 877	Flexible mechanical joints to BS EN 877
	Socketless cast iron to BS ISO 6594	Flexible mechanical joints as supplied by the pipe manufacturer
	Mild steel tube to BS EN 10255, prefabricated to BS 3868, and galvanized	Galvanized steel socket or 2 piece mechanical joint incorporating a synthetic rubber gasket to BS EN 681-1
	Copper tube to BS EN 1057 - R250 - 54 x 1.2	Copper or copper alloy non-dezincifiable capillary fittings to BS EN 1254-1
	Galvanized mild steel heavy weight to BS EN 10255	Malleable iron to BS EN 10242 hot dipped galvanized
	Socketless HDPE	Spigoted fittings jointed by butt fusion or with Fusion Welded couplings.
	PVCu to BS EN 1329-1	PVCu to BS EN 1329-1
	BBA approved Stainless Steel spigot and socket.	Spigot and Socket push fit with EPDM rings
Branch Waste Pipes	Prefabricated galvanized steel to BS 3868	Galvanized steel socket or 2 piece mechanical joint incorporating a synthetic rubber gasket to BS 7874, BS EN 681-1,-2 and BS EN 682
	ABS to BS EN 1455-1	ABS to BS EN 1455-1
	MPVCu to BS 5255 I BS EN 1329-	MPVCu to BS 5255 I BS EN 1329-
	Copper tube to BS EN 1057 - R250 - 35 x 1.2 42 x 1.2 54 x 1.2	Non-dezincifiable capillary type to BS EN 1254-1
	Socketless HDPE	Spigoted fittings jointed by butt fusion or with Fusion Welded couplings.
	BBA approved Stainless Steel spigot and socket.	Spigot and Socket push fit with EPDM rings

Service	Pipe	Fittings & Valves
Vent Stacks	Socketless cast iron to BS EN 877	Flexible mechanical joints to BS EN 877
	Socketless cast iron to BS ISO 4594	Flexible mechanical joints as supplied by the pipe manufacturer
	BBA approved Stainless Steel spigot and socket.	Spigot and Socket push fit with EPDM rings
	Socketless HDPE	Spigoted fittings jointed by butt fusion or with Fusion Welded couplings.
	Mild steel tube to BS EN 10255, prefabricated to BS 3868, and galvanized	Galvanized steel socket or 2 piece mechanical joint incorporating a synthetic rubber gasket to BS 7874, BS EN 681-1&-2 and BS EN 682
Branch Vent Pipes	Socketless cast iron to BS EN 877	Flexible mechanical joints to BS EN 877
	Socketless cast iron to BS ISO 6594	Flexible mechanical joints as supplied by the pipe manufacturer.
	Socketless HDPE	Spigoted fittings jointed by butt fusion or with fusion welded couplings.
	Mild steel tube to BS EN 10255, prefabricated to BS 3868, and galvanized	Galvanized steel socket or 2 piece mechanical joint incorporating a synthetic rubber gasket to BS 7874, BS EN 681-1, BS EN 681-2 and BS EN 682
	MPVCu to BS 5255 I BS EN 1329-1	MPVCu to BS 5255 I BS EN 1329-1
	BBA approved Stainless Steel spigot and socket.	Spigot and Socket push fit with EPDM rings
	Copper tube to BS EN 1057 - R250 - 35 x 1.2 42 x 1.2 54 x 1.2 66.7 x 1.2 76.1 x 1.5	Capillary type to BS EN 1254-1

Service	Pipe	Fittings & Valves
Suspended Drainage	Cast iron to BS 437	Cast iron to BS 437
	Ductile iron to BS EN 598	Ductile iron to BS EN 598
	Socketless cast iron to BS EN 877	Flexible mechanical joints to BS EN 877
	Socketless cast iron to BS ISO 6594	Flexible mechanical joints as supplied by the pipe manufacturer
	Socketless cast iron conforming to the performance and dimensional requirements of BS 437	Flexible mechanical joints to BS EN 877
	Socketless HDPE	Spigoted fittings jointed by butt fusion or with Fusion Welded couplings.
	BBA approved Stainless Steel spigot and socket.	Spigot and Socket push fit with EPDM rings
Laboratory or chemical waste systems	Borosilicate Glass to BS ISO 3585	Borosilicate Glass to BS ISO 3585
	Socketless HDPE	Spigoted fittings jointed by butt fusion or with Fusion Welded couplings.
	Socketless HDPE	Polypropylene captive nut and compression ring seals.
	Polypropylene to BS EN 1451-1	Pushfit Polypropylene to BS EN 1451-1

4.0 DUCTWORK SYSTEMS

4.1 General Requirements

4.1.1.1 Materials, construction and identification shall be to DW/144 and the requirements of this Specification.

4.1.1.2 High pressure ductwork systems shall be pressure tested in accordance with DW143.

4.1.1.3 If a ductwork system fails to meet the required leakage standard, remedial work shall be carried out as necessary to achieve satisfactory performance in re-tests and further ductwork sections shall be tested as set out in DW/143.

4.1.1.4 Testing of systems shall guarantee operation at a specified leakage rate as required within Appendix A of DW/144 together with DW/143.

4.1.1.5 All necessary ductwork, control, isolating, fire, smoke and balancing dampers, grilles and diffusers to form complete air distribution systems shall be provided.

4.1.1.6 Sheet metal for fabrication shall be new and free from blisters, pits and imperfections in coating. Galvanising shall be to BS EN ISO 1461. Raw edges and areas of metal where galvanizing has been destroyed shall be cleaned, prepared and painted with zinc-rich paint to BS 4652 at works. Transit damage shall be repaired at site prior to erection. All cut edges shall be repaired with zinc-rich paint to BS 4652.

4.1.1.7 Ductwork installations shall be rigid, free from sway, drumming and movement. Ductwork shall be true-to-size and accurately aligned.

4.1.1.8 As far as practicable, longitudinal seams shall be aligned where permanently visible after installation.

4.1.1.9 Duct sizes are clear internal required airway dimensions. Allowance shall be made for any linings and their coverings. There shall be no obstructions or rough surfaces within any ductwork.

4.1.1.10 Cross-breaking and beading shall be permitted on low velocity ductwork only, but not where rigid external insulation is to be applied.

4.1.1.11 Take-offs shall be factory-made conical, bellmouth, or shoe type.

4.1.1.12 Duct size square take-offs from main ducts shall not be used.

4.1.1.13 Holes in main ducts for branches shall not be greater than the branch size.

4.1.1.14 Perforated rivets shall not be used in manufacture or erection of ductwork. The use of self-tapping screws shall be restricted to the completion of site joints in extremely difficult locations only where alternative methods are not possible.

4.1.1.15 Duct branches and equipment items shall be supported locally to prevent distortion.

4.1.1.16 Instrument and controls penetrations and connections shall have adequate local stiffening to provide rigid mountings.

4.1.1.17 Where internal linings are required, fixings shall ensure that the lining is held in continuous contact with duct surfaces under all operating conditions to prevent detachment and fibre migration.

4.1.1.18 Flexible connections shall be made between ductwork and fans and other equipment items.

4.1.1.19 Access shall be maintained to ductwork system components which require inspection, cleaning, or adjustment in accordance with BESA TR19.

4.1.1.20 At every point of duct penetration of the building envelope, a sealed louvre, weather cowl or protective flashing and full closure plate shall be provided to prevent ingress of water.

4.1.1.21 Ductwork immediately behind and connected to an intake or exhaust louvre, shall be painted on internal and external surfaces with epoxy resin or bitumastic paint for a length from the louvre equal to the louvre height, or to the nearest equipment item, whichever is the lesser. The bottom side of the ductwork connection shall slope downwards towards the louvre and shall be drained.

4.1.1.22 Fume or vapour-laden ducts shall be sloped down to a drainage point.

4.1.1.23 Where ducts are metal, there shall be no cross-breaking to the bottom panel.

4.1.1.24 Lubrication points not easily reached shall be extended to an accessible position.

4.1.1.25 All metal fasteners shall be entirely compatible with the materials used.

4.1.1.26 Where site dimensions cannot be obtained in advance of preparation of fabrication drawings, provision shall be made to accommodate any discrepancies between the drawings and site requirements. The fabrication drawings shall show provisions for dismantling by means of bolted, gasketted flanged joints.

4.2 Ductwork Cleanliness

4.2.1.1 Unless specified otherwise, ductwork shall meet TR/19 (2013) intermediate level protection.

4.2.1.2 Provisions made for access for cleaning shall be generally to TR/19 (2013).

4.2.1.3 Ductwork cleaning shall be carried out using methods prescribed within TR19 (2013).

4.2.1.4 Duct outlets and extract fan inlets shall be covered with securely fitted dust collecting bags or material before blowing-out.

4.2.1.5 Soiled bags and material shall be disposed of outside the building.

4.2.1.6 Ductwork shall be cleaned to a higher standard in special areas to house sensitive equipment or furnishings.

4.3 Ductwork Construction

4.3.1.1 All references to tables are those of DW/144.

4.3.1.2 Sheet metal for ductwork, to be galvanized to BS EN ISO 1461 after manufacture, shall be 1.6mm minimum thickness.

4.3.1.3 Rectangular ducts shall be constructed using longitudinal seams with sealant applied internal to the joint seam itself.

4.3.1.4 Circular ducts shall be of spirally wound or straight seam construction. Fittings shall be of spirally wound construction thicknesses.

4.3.1.5 Flat oval ducts shall be of spirally wound construction.

4.3.1.6 Stiffening provisions shall be incorporated.

4.3.1.7 All seams shall incorporate sealant and be tightly formed. Edge sealants shall not be used.

4.3.1.8 Sealant shall be used between sheet and flange section in cross joint assemblies.

4.3.1.9 Flanged joints shall be located at all plant and equipment items, at structural walls and floor slabs and elsewhere where required for disconnection purposes.

4.3.1.10 Joint corners and junction details shall be mutually compatible with longitudinal seam used.

4.3.1.11 Tie rod stiffeners for rectangular and flat oval ducts shall have internal and external nut, metal and compressible washer.

4.3.1.12 All bends shall be 'easy' type.

4.3.1.13 Double skin turning vanes shall be fitted in short radius ('hard') bends over 300mm deep and in all change-direction fittings, except in kitchen exhaust ventilation systems.

4.3.1.14 Change shape tapers shall not exceed a slope of 15 degrees.

4.3.1.15 Segmented bends for circular ducts shall be of five sections.

4.3.1.16 Circular radius pressed bends shall have one diameter throat radius.

4.3.1.17 Change shape tapers for circular ducts shall be 15 degree concentric.

4.3.1.18 Sheet metal casings to air handling equipment components shall be jointed to suit the maximum operating pressure and permitted air leakage.

4.3.1.19 Self-adhesive tapes shall not be used. Glass fibre reinforced tape only shall be used and shall be fixed with spray-applied adhesive at site.

4.3.1.20 Air terminal branch ducts shall terminate clear of final connection flanges.

4.3.1.21 Ductwork connections to building openings, external louvres, grilles etc. shall have compatible flanges for airtight fixing.

4.3.1.22 Kitchen ventilation ductwork shall be to DW/144, DW/172 and:

- No duct shall be less than 0.8mm thickness.
- There shall be no longitudinal seams on the underside.
- Cleaning/access doors shall be set in duct sides 50mm (minimum) from duct underside.
- The pressure and leakage class shall be suitable for the application.

4.4 Supports and Fixings

4.4.1.1 All ductwork supports, hangers and fixings systems shall be from the NG Bailey approved supply chain.

4.4.1.2 To comply with BS 8539:2012, all fixings into concrete shall be installed in accordance with manufacturer's instructions by trained operatives working under the supervision of Construction Fixing Association (CFA) certified supervisors.

4.4.1.3 Where ductwork is installed within a designated means of escape or fire rated space the drop rod cross sectional area shall be calculated using the maximum allowable tensile stress of steel drop rods in the applicable fire duration (0.5hr, 1hr or 2hr).

4.4.1.4 The NG Bailey bracket utility should be used to calculate drop rod diameter for fire rated applications.

4.4.1.5 Supports for internal ductwork shall generally comply with DW 144, except that attachment of horizontal ductwork from duct flanges shall not be permitted.

4.4.1.6 Where ductwork is mounted on an external roof area, the proposed fixing, support and cross bracing solution must be approved by NG Bailey preferred structural engineer based on project wind and snow loadings.

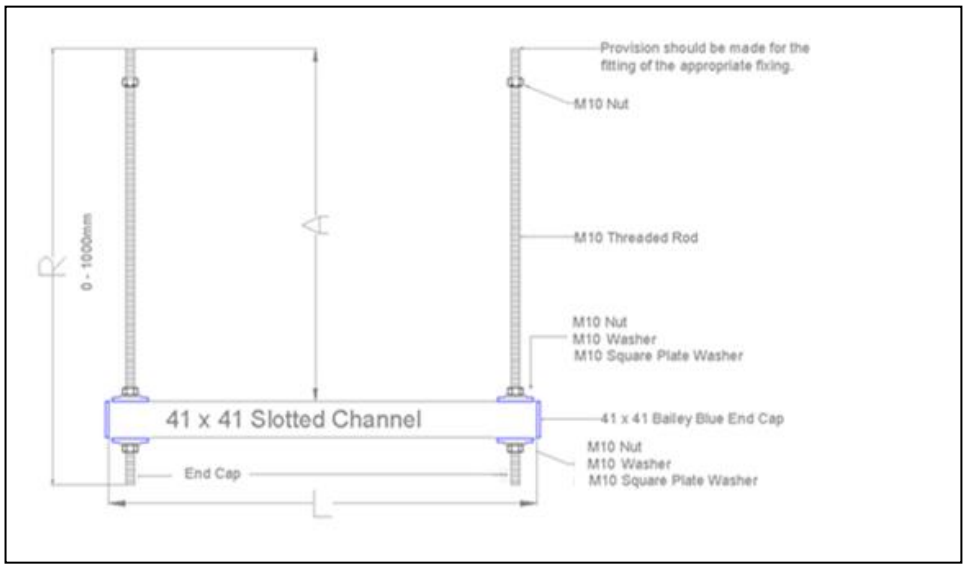
4.4.1.7 Supports shall be external to insulation.

4.4.1.8 Inserts shall be provided between ductwork and supports, of the same thickness and performance as the thermal insulation, and with a compatible vapour barrier finish. The insert and vapour barrier shall not be compressed or damaged by the load imposed. Inserts shall extend an adequate distance each side of the support to allow the insulation to be abutted and the vapour barrier to be sealed to the insert.

4.4.1.9 Proprietary duct support systems must be 41 x 41 slotted channel galvanized steel as manufactured by and marked as Unistrut.

4.4.1.10 Duct hangers, drop rods and lateral supports shall be suitable for the environment i.e. pre galvanized for internal and hot dip galvanized for external.

4.4.1.11 All trapeze brackets must be installed in accordance with NG Bailey standard bracket arrangement (see detail below).



4.4.1.12 All Unistrut proprietary pipe support systems must be torqued to the correct manufacturer advised torque settings and marked in accordance with the NG Bailey QC Procedure – management and inspection of torque settings for supports & fixings.

4.4.1.13 Hangers for ducts to be thermally insulated shall provide clearance for the insulation and any vapour barrier or other covering to be applied and finished. Horizontal bearers shall be lined with low compression insulating material.

4.4.1.14 Where personnel entry into the duct is necessary, floor plates connected to stiffeners shall be provided to accept the loading, with suitable additional local supports.

4.5 Access Openings

4.5.1.1 Access openings shall be located, arranged and sized to permit full access required for maintenance. Inspection covers shall permit associated equipment item to be viewed.

4.5.1.2 Access for inspection shall be to TR/19 (2013) table 3 plus as recommended by the ductwork cleaning specialist.

4.5.1.3 Inspection panels shall also be provided at:

- Other items of equipment (e.g. humidifiers).
- Turning vanes.
- Base of risers.

4.5.1.4 Access panels for dampers shall have a minimum dimension of 400mm.

4.5.1.5 Access openings and inspection covers shall be rigidly framed, with gasketted airtight covers designed for easy removal and accurate relocation and fixing.

4.5.1.6 The minimum number of quick-release fastening devices compatible with the loading shall be used.

4.5.1.7 Self-tapping screws shall not be used.

4.5.1.8 Access to fire and smoke dampers shall permit quick and easy manual resetting of the shutter.

4.5.1.9 Access covers shall have retention devices.

4.5.1.10 Personnel access doors shall be hinged, a minimum of 600mm wide and 1800mm high, or the duct depth whichever is smaller, and fitted with restrainers.

4.5.1.11 Hinged access doors with double-sided operating handles shall be provided as required.

4.5.1.12 Proprietary insulated double-skin hinged access doors shall be fitted in all insulated ducts.

4.5.1.13 In addition to an access opening, a tundish with trapped drain outlet size DN 40 (minimum) shall be provided at the base of kitchen extract ventilation risers.

4.6 Test Holes

4.6.1.1 Test holes shall be provided in all main and branch ducts and adjacent to all duct-mounted temperature and humidity sensors.

4.6.1.2 Test holes shall be 15mm diameter for plain ducts and 25mm diameter for insulated ducts, closed with soft sealing plugs. Test holes shall not impair the rigidity of the ductwork.

4.6.1.3 Locations of all test holes shall be agreed, and subsequently marked and recorded.

4.6.1.4 Test holes shall be accessible for airflow measurement, system balancing, testing and commissioning.

4.7 Control Dampers

4.7.1.1 Dampers shall be constructed to DW/144.

4.7.1.2 Non-return (self-closing) dampers shall be constructed to ensure positive shut-off and quiet closure.

4.7.1.3 Dampers shall be installed in permanently accessible positions.

4.7.1.4 Balancing dampers shall be fitted in each branch from a main or sub- main duct, and elsewhere as required to satisfactorily commission the system. The required distance from the branch-piece shall be maintained.

4.7.1.5 Automatic damper actuators shall have:

- Sufficient torque to open and close against the maximum out-of- balance pressure across the damper.
- Position indicators, unless fitted to terminal units.
- Manual override facility, unless fitted to terminal units.
- A linear stroke/control signal characteristic.

4.8 Fire & Fire Smoke Dampers

4.8.1.1 Fire dampers and fire/smoke dampers shall be provided as described in BS 9999.

4.8.1.2 Fire dampers and fire/smoke dampers shall be classified to BS EN 13501-3 and tested to BS EN 1366-2:2015.

4.8.1.3 Fire dampers shall have an integrity E rating at least equal to the fire resisting wall or floor in which they are installed and not less than 60 minutes (E60).

4.8.1.4 Fire dampers and fire/smoke dampers shall meet the requirements of the Fire Authorities concerned, who shall also approve the method of fixing.

4.8.1.5 Fire dampers of the cased folding-blade spring-loaded type shall have a replaceable and re-settable release mechanism. In the open position the blades shall not restrict the airstream. Dampers for horizontal mounting shall have stainless steel closure springs and positive blade locking devices. Dampers in circular or flat oval ductwork shall have integral spigots to suit the containing ductwork.

4.8.1.6 Plate (single) blade type fire dampers shall be arranged to close against full perimeter stops following blade release by a temperature- sensitive device. The casing shall be of appropriate thickness for the fire rating. Means of blade and release device reset shall be provided.

4.8.1.7 Damper assemblies shall be of corrosion-resistant materials or have protection against corrosion which shall not impair their operation.

4.8.1.8 Purpose-made installation frames with expansion allowance shall be provided and be built into formed openings in fire compartment walls, floors or other openings designated. The joint line shall be masked with firmly fixed metal plating all round to prevent penetration of any gap by flames or gases.

4.8.1.9 Openings sizes shall be restricted to require the minimum of incombustible infill material, to provide a homogeneous construction and maintain the fire resisting integrity of the structure.

4.8.1.10 Fire dampers and frames shall not be supported by adjacent ductwork.

4.8.1.11 Fire dampers and frames shall always be set parallel to the plane of the wall or floor.

4.8.1.12 Where dampers cannot be positioned in the thickness of a fire barrier, ductwork or casing between the barrier and the furthest side of the damper case shall be enclosed with fire resistant material of equal fire rating to that of the fire barrier, adequately supported and fixed to the barrier, in accordance with the manufacturers recommendations to meet recognised and approved fire test methods.

4.8.1.13 Dampers for flexible cavity barriers shall be fixed as the manufacturers' recommendations for the application. Suitable frames and brackets shall ensure compliance with fire test methods.

4.8.1.14 Blade release mechanisms normally retaining fire dampers in the open position shall operate at 72°C ±4°C.

4.8.1.15 Smoke detectors and fire/smoke damper automatic release mechanisms shall be to BS EN 54-7 and BS 5839-3 respectively.

4.8.1.16 Access doors shall be provided adjacent to fire and smoke dampers for inspection and be of sufficient size to permit resetting of release mechanism and blades by one person.

4.8.1.17 Access to fire damper and smoke damper assemblies shall also be provided through building fabric and builders work elements.

4.9 Fire-Resisting Ductwork

General Requirements

4.9.1.1 All fire-resisting ductwork shall be in accordance with Method 3 as described in BS9999 and tested by an accredited laboratory to the applicable standards (detailed below).

4.9.1.2 Fire resisting ducts tested to EN1366-1, EN1366-8 or EN1366-9 shall be subject to Factory Production Control audits and certified by a Notified Body, ducts tested to BS 476-24 shall have third party certification to confirm all performance criteria.

4.9.1.3 The fire resistance of the ductwork shall not be less than the fire resistance of the construction elements through which it passes.

4.9.1.4 Ancillary items used within the ductwork system (i.e. access doors, volume control dampers, sound attenuators etc) shall be third party assessed as a minimum requirement if not tested with the ductwork system.

4.9.1.5 The ductwork shall be supplied and installed to meet the requirements of stability, integrity and insulation as described in the test standards with the support systems designed accordingly.

4.9.1.6 Smoke Control ducts tested to BS476-24 shall retain at least 75% of the cross sectional area under test conditions and ducts tested to EN1366-8 or EN1366-9 shall retain at least 90% of the cross sectional area.

4.9.1.7 All fire resisting ductwork systems are to be provided with a certificate of conformity on completion.

Specific Performance Requirements

4.9.1.8 Fire resisting smoke control ducts up to 1250mm wide x 1000mm high and up to 1000mm diameter shall be tested to EN1366-8 for multi-compartment applications, ducts tested to EN1366-8 and EN1366-9 are acceptable for single compartment applications.

4.9.1.9 Fire resisting ventilation ducts and smoke control ducts outside the above size range shall be tested to BS476-24 or EN1366-1 (ventilation ducts).

4.9.1.10 Stability and Integrity ratings shall be specified by the consultant / fire engineering consultant based on the fire strategy for the building.

4.9.1.11 Insulation rating is subject to a project specific risk assessment.

4.9.1.12 Access panels shall be fire resisting and rate to the same standard as the ductwork system.

4.9.1.13 Access for inspection shall be to TR/19 (2013) table 3 plus as recommended by the ductwork cleaning specialist.

4.10 Flexible Connections

4.10.1.1 Flexible joint connections shall be tightly clamped to prevent air leakage. The material shall remain flexible and without strain or distortion. Material shall be secured to plain circular spigots by use of clipbands with adjustable-screw toggle fitting. Jointing to flanged spigots shall be secured by a drilled backing flat iron flange bolted through properly formed holes in the flexible material to the fixed flange.

4.10.1.2 Flexible joints shall be 50mm minimum and 250mm maximum lengths and shall not intrude into the airway under any condition. Ductwork shall be supported and aligned to prevent undue stress in the flexible joint.

4.10.1.3 Flexible joints shall be fire rated and tested in accordance with BS 476-20.

4.10.1.4 Flexible connections shall be to BS 9999, Section 10.3.

4.11 Bendable & Flexible Ducts

4.11.1.1 Non-rigid ducts shall be of bendable aluminium, flexible metal or flexible fabric construction.

4.11.1.2 The maximum length of each non-rigid section shall be 1000mm or not more than 6 x the diameter of the duct as recommended by DW144 providing allowance is made in the system design for the pressure drop.

4.11.1.3 Changes in direction shall be formed in long radius. Bends where necessary shall be two per length with 90° minimum included angle. Minimum throat radius shall be one diameter.

4.11.1.4 Adequate support shall be provided to prevent sagging. Kinked or flattened non-rigid ductwork will be rejected.

4.11.1.5 Test holes required shall be formed in rigid ductwork adjacent to flexible sections.

4.11.1.6 Ducting shall comply with air-tightness requirements for rigid ducts in the same system.

4.11.1.7 Where required, ducts shall be insulated with soft-formed insulant with external finish.

4.11.1.8 Reinforcement of flexible fabric ducts shall be carried over air terminal and rigid duct branch spigots and secured with worm-drive clips and sealant as recommended by the manufacturer.

4.12 Low Velocity Plastics Ductwork

4.12.1.1 Plastics ductwork and fittings construction and installation shall be to DW/154.

4.12.1.2 Fire dampers, where used, shall be flanged, cased folding-shutter type, entirely constructed of stainless steel of grade 1.4404 to BS EN 10088-1. Access panels shall be provided in the ductwork.

4.13 Sound Absorbent Duct Linings

4.13.1.1 Lining materials shall be fixed to internal surfaces of airways in locations and of thicknesses listed, to leave the indicated clear airway dimensions after application. All joints and cut edges shall be sealed to prevent erosion, and to present a smooth face to the airstream.

4.13.1.2 Adhesives shall be non-combustible after application.

4.13.1.3 Lining materials used shall be incombustible, rot-proof and non- hygroscopic.

4.13.1.4 The complete assembly of materials shall be non-combustible as defined in BS 476-4. If combustible, linings shall have an Index of Performance (I) not exceeding 12, of which not more than 6 shall derive from the initial period (i) of the test to BS 476-6.

4.13.1.5 The lining material shall be faced with a thin, tough and smooth acoustically transparent membrane to face the airstream. The facing shall prevent surface erosion or other material migration at an air passage velocity of 25m/s.

4.13.1.6 Linings shall be retained in position by facing with expanded or perforated metal sheets secured with mechanical fixings. Fixings shall be firmly attached to airway walls. Metal lining sheets shall be 'returned' at the end of each airway section.

4.13.1.7 Damaged factory or site-applied linings will be rejected at any stage of delivery, storage or erection of systems.

4.13.1.8 The installed duct lining shall have the following minimum sound Absorption coefficients when measured in accordance with BS EN ISO 354.

Thickness (mm)	Octave Band Centre Frequency (Hz)					
	125	250	500	1k	2k	4k
15	0.1	0.25	0.45	0.65	0.9	0.85

25	0.1	0.35	0.55	0.85	0.95	0.95
50	0.35	0.5	0.85	0.95	0.95	0.95

4.14 Thermal Insulation

4.14.1.1 Provisions shall be made for the fixing of thermal insulation material.

4.15 Identification of Ductwork

4.15.1.1 Ductwork shall be identified in accordance with the recommendations of DW 144 Appendix B.

4.15.1.2 Explanatory charts and damper schedules shall be provided.

4.15.1.3 Symbols shall be permanently affixed to ducts by use of painted, stencilled letters and figures or self-adhesive plastics applied to a smooth clean surface, or by use of engraved plastic or metal labels riveted to equipment items.

4.15.1.4 Symbols shall be set at 6m intervals on main ducts and within 3m of the main on each branch. Symbols shall be fitted in positions to be easily read from operators' level.

4.15.1.5 Special ductwork shall be identified by particular alphanumeric or colour codes.

4.15.1.6 Fire-resisting ductwork additionally shall have the words "FIRE DUCT" permanently marked in red at 4m intervals with letters 50mm -0/ + 5mm in height.

5.0 PASSIVE FIRE STOPPING OF MEP SERVICES

5.1.1.1 All passive fire stopping of MEP services must be installed in BS EN 1366-3.

5.1.1.2 Where compliance with BS EN 1366-3 is not feasible, an installation in accordance with BS476-20, BRE or other UKAS accredited laboratory may be acceptable subject to approval from the Building Control Body.

5.1.1.3 All passive fire stopping products shall be fully compatible with the tested and certified installation detail from the manufacturer.

5.1.1.4 All products used for passive fire stopping must be from a single supplier. Mixed use of suppliers' materials is forbidden.

5.1.1.5 All passive fire stopping products shall be installed in accordance with manufacturer's instructions.

5.1.1.6 Tested and certified passive fire stopping products shall be compatible with the surrounding fire stop materials.

5.1.1.7 All passive fire stopping products must be from NG Bailey preferred manufacturers (refer to Preferred Products).

APPENDIX 1 – PREFERRED VALVE MANUFACTURER PRODUCT CODES

Oventrop

Valve Type and Application		15mm	20mm	25mm	32mm	40mm	50mm
Ball valves (Heating)	Female ends, standard lever	107 90 04	107 90 06	107 90 08	107 90 10	107 90 12	107 90 16
Ball valves (Chilled water)	Female ends, extended lever	107 91 04	107 91 06	107 91 08	107 91 10	107 91 12	107 91 16
Ball valves (Domestic services)	Compression ends, std lever	107 95 04	107 95 06	107 95 08	107 95 10	107 95 12	107 95 16
Ball valves (Domestic services)	Compression ends, extended lever	107 97 04	107 97 06	107 97 08	107 97 10	107 97 12	107 97 16
Ball valves (Gas)	Female ends, yellow lever	301 64 04	301 64 06	301 64 08	301 64 10	301 64 12	301 64 16
Sanitary ware ball valves	Compression, screwdriver	107 93 04	107 93 06				
Butterfly valves (Heating / Chilled water)	Lugged pattern, lever operated						
	Lugged pattern, gear operated						
Butterfly valves (Potable water)	Lugged pattern, lever operated						
Butterfly valves (Gas / Oil)	Lugged pattern, lever operated						
	Lugged pattern, gear operated						
Check valves	Bronze swing	107 50 04	107 50 06	107 50 08	107 50 10	107 50 12	107 50 16
Check valves	Cast iron swing						
Strainers	Bronze 'Y' type	112 00 04	112 00 06	112 00 08	112 00 10	112 00 12	112 00 16
Strainers	Cast iron 'Y' type						
Double regulating valves	Bronze screwed	106 01 04	106 01 06	106 01 08	106 01 10	106 01 12	106 01 16
Double regulating valves	Cast iron flanged						
Commissioning sets	Bronze screwed	106 04 04	106 04 06	106 04 08	106 04 10	106 04 12	106 04 16
Commissioning sets	Cast iron flanged						
Metering Stations	Bronze screwed	106 06 04	106 06 06	106 06 08	106 06 10	106 06 12	106 06 16
Metering Stations	Cast iron flanged						
Regulating valves (HWS)	Bronze screwed	420 55 04	420 55 06				
Thermostatic radiator valve body	Angle	118 37 04					
	Straight	118 38 64					
Built in sensor		101 85 61					
Built in sensor (Tamperproof head)		101 14 10					
Remote sensor with 2m capillary		101 16 65					
Remote sensor with 5m capillary		101 16 66					
L/S radiator valves	Angle	109 06 62	109 06 63				
	Straight	109 07 62	109 07 63				
W/W radiator valves	Angle	119 15 04	119 15 06				
	Straight	119 16 04	119 16 06				

Valve Type and Application		65mm	80mm	100mm	125mm	150mm	200mm	250mm	300mm
Ball valves (Heating)	Female ends, standard lever								
Ball valves (Chilled water)	Female ends, extended lever								
Ball valves (Domestic services)	Compression ends, std lever								
Ball valves (Domestic services)	Compression ends, extended lever								
Ball valves (Gas)	Female ends, yellow lever								
Sanitary ware ball valves	Compression, screwdriver								
Butterfly valves (Heating / Chilled water)	Lugged pattern, lever operated	104 82 51	104 82 52	104 82 53	Disc	Disc			
	Lugged pattern, gear operated				104 89 54	104 89 55	104 89 56	105 89 56	104 89 58
Butterfly valves (Potable water)	Lugged pattern, lever operated	104 84 51	104 84 52	104 84 53	104 84 54	104 84 55	104 84 56	105 84 56	
Butterfly valves (Gas / Oil)	Lugged pattern, lever operated	104 83 51	104 83 52	104 83 53	104 83 54	104 83 55			
	Lugged pattern, gear operated						104 90 56	105 90 56	104 90 58
Check valves	Bronze swing								
Check valves	Cast iron swing	107 30 51	107 30 52	107 30 53	107 30 54	107 30 55	107 30 56	108 30 56	107 30 58
Strainers	Bronze 'Y' type								
Strainers	Cast iron 'Y' type	112 20 51	112 20 52	112 20 53	112 20 54	112 20 55	112 20 56	113 20 56	112 20 58
Double regulating valves	Bronze screwed								
Double regulating valves	Cast iron flanged	106 26 51	106 26 52	106 26 53	106 26 54	106 26 55	106 26 56	107 26 56	106 26 58
Commissioning sets	Bronze screwed								
Commissioning sets	Cast iron flanged	106 58 51	106 58 52	106 58 53	106 58 54	106 58 55	106 58 56	107 58 56	106 58 58
Metering Stations	Bronze screwed								
Metering Stations	Cast iron flanged	106 07 51	106 07 52	106 07 53	106 07 54	106 07 55	106 07 56	107 07 56	106 07 58
Regulating valves (HWS)	Bronze screwed								
Thermostatic radiator valve body	Angle								
	Straight								
Built in sensor									
Built in sensor (Tamperproof head)									
Remote sensor with 2m capillary									
Remote sensor with 5m capillary									
L/S radiator valves	Angle								
	Straight								
W/W radiator valves	Angle								
	Straight								

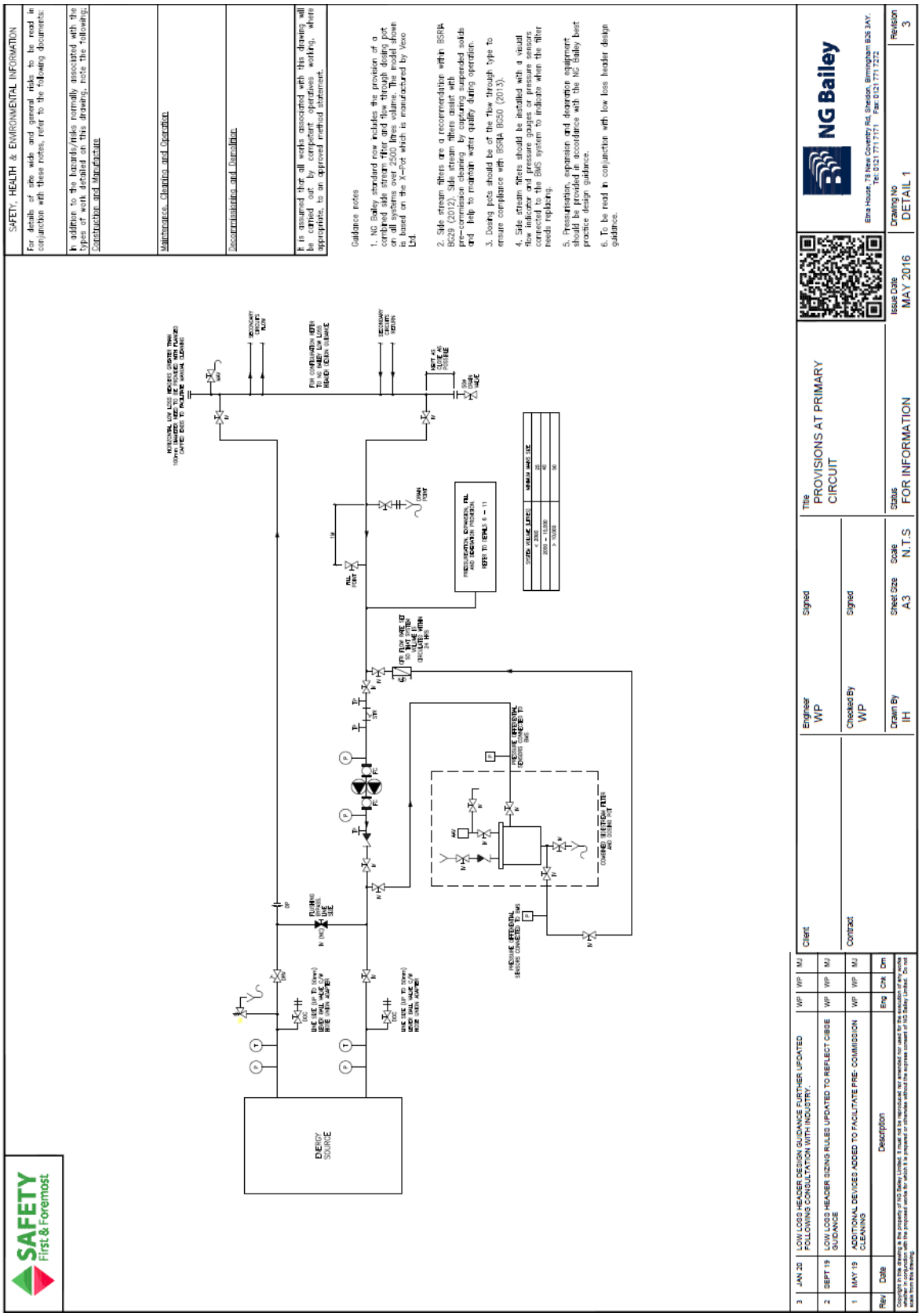
Valve Type and Application		15mm	20mm	25mm	32mm	40mm	50mm
Pressure reducing valves (Domestic)	Compression ends	440 60 04	440 60 06	440 60 08			
Pressure reducing valves (Domestic)	Male BSP ends	440 61 04	440 61 06	440 61 08	440 61 10	440 61 12	440 61 16
Pressure reducing valves (Domestic)	Flanged PN16						
Double check valve	Compression ends	440 00 04	440 00 06	440 00 08			
Double check valve	Male BSP ends	440 01 04	440 01 06	440 01 08	440 01 10	440 01 12	440 01 16
Drain valves (concealed)		168 52 04					
Drain valves (Plantroom)		103 20 04	103 20 06	103 20 08			
Air vents (concealed)		108 83 04					
Air vents (Plantroom)		108 82 03					
Thermostatic mixing valve c/w IV's		130 03 58	130 03 59				
Differential pressure control valves		106 45 04	106 45 06	106 45 08	106 45 10	106 45 12	106 45 16
DP measuring adaptor		168 82 90					
Differential pressure control valves							
DP measuring adaptor		168 82 90					
Pressure independent control valves		114 61 04	114 61 06	114 61 08	114 61 10	114 61 12	114 61 16
Actuator for PICV's		101 27 05					
Pressure independent control valves							
Actuator for PICV's		115 80 30					
FCU assembly (Commissioning set)		445 30 64	445 30 66				
FCU assembly c/w MS (PICV)		445 71 64	445 71 66				
FCU assembly (PICV)		445 51 64	445 51 66				
Actuator for PICV valves		101 27 05					

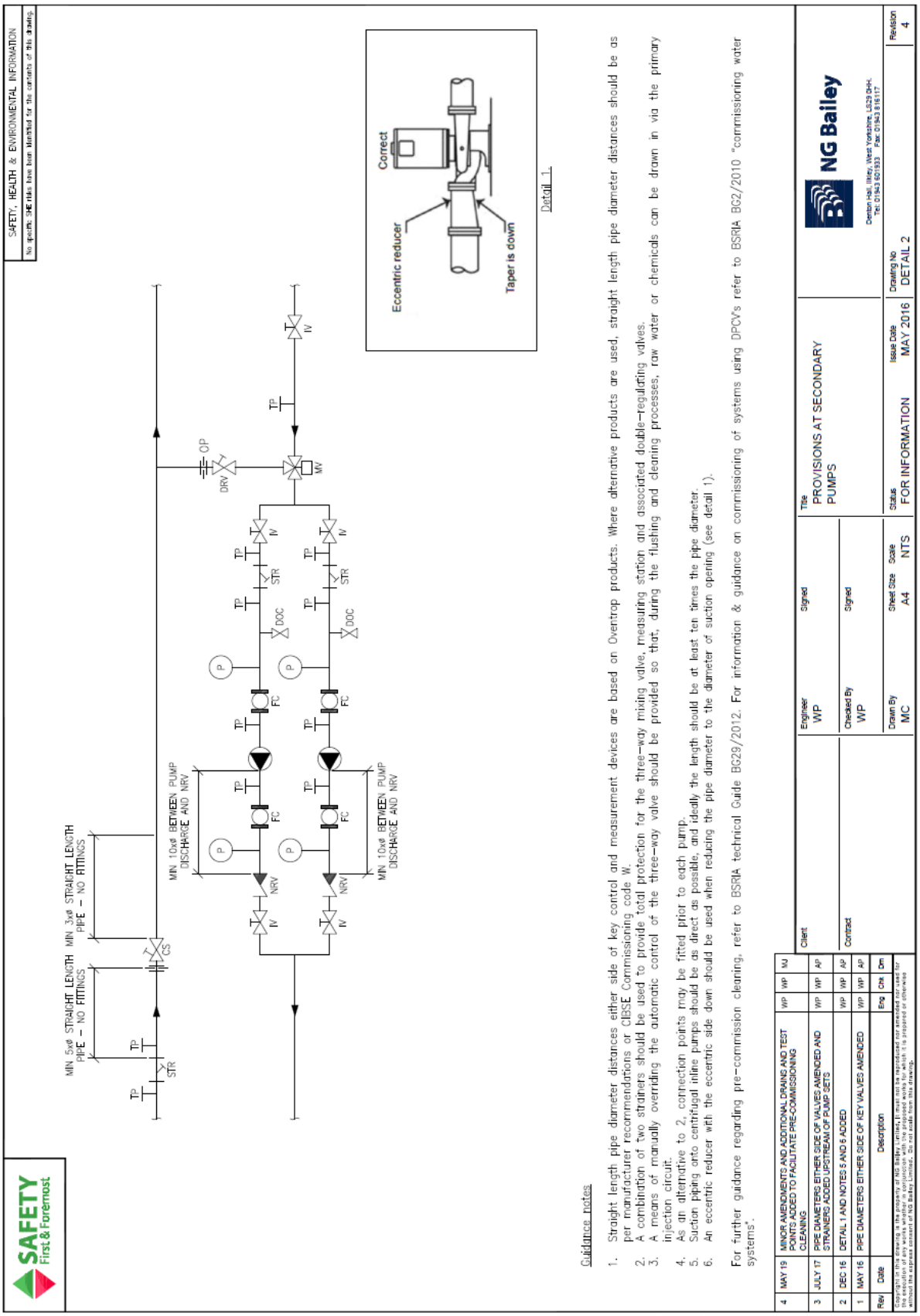
Valve Type and Application		65mm	80mm	100mm	125mm	150mm	200mm	250mm	300mm
Pressure reducing valves (Domestic)	Compression ends								
Pressure reducing valves (Domestic)	Male BSP ends								
Pressure reducing valves (Domestic)	Flanged PN16	440 70 51	440 70 52	440 70 53					
Double check valve	Compression ends								
Double check valve	Male BSP ends								
Drain valves (concealed)									
Drain valves (Plantroom)									
Air vents (concealed)									
Air vents (Plantroom)									
Thermostatic mixing valve c/w IV's									
Differential pressure control valves									
DP measuring adaptor									
Differential pressure control valves		106 46 51	106 46 52	106 46 53	106 46 54	106 46 55	106 47 56		
DP measuring adaptor									
Pressure independent control valves									
Actuator for PICV's									
Pressure independent control valves		114 61.51	114 61.52	114 61.53	114 61.54	114 61.55			
Actuator for PICV's									
FCU assembly (Commissioning set)									
FCU assembly c/w MS (PICV)									
FCU assembly (PICV)									
Actuator for PICV valves									

Valve Type and Application		Pegler Valve Codes		
		TYPE	PS	PSU
Ball valves (Heating)	Female ends, standard lever	PB500	PS500	PSU500
Ball valves (Chilled water)	Female ends, extended lever	PB550EL	PS550EL	PSU550EL
Ball valves (Domestic services)	Compression ends, std lever	PB350		
Ball valves (Domestic services)	Compression ends, extended lever	PB350EL		
Ball valves (Gas)	Female ends, yellow lever	PB500	N/a	N/a
Sanitary ware ball valves	Compression, screwdriver slot	808		
Butterfly valves (Heating / Chilled water)	Lugged pattern, lever operated	V905		
	Lugged pattern, gear operated	V905G		
Butterfly valves (Potable water)	Lugged pattern, lever operated	V905		
Butterfly valves (Gas / Oil)	Lugged pattern, lever operated	V907		
	Lugged pattern, gear operated	V907G		
Check valves	Bronze swing	1060A	PS1060A	PSU1060A
Check valves	Cast iron swing	V914		
Strainers	Bronze 'Y' type	V913	PS913	PSU913
Strainers	Cast iron 'Y' type	V912		
Double regulating valves	DZR screwed	1200SF	PS1200SF	PSU1200
Double regulating valves	Cast iron flanged	V952		
Double regulating valves	Compact Butterfly DRV (DZR)	901S		
Double regulating valves	Venturi Butterfly DRV (Pn16)	901XS		
Commissioning sets	DZR screwed	1260	PS1260	PSU1260
Commissioning sets	Cast iron flanged	V955		
Commissioning sets	Compact Venturi DZR Screwed	900S	PS900S	PSU900S
Commissioning sets	Venturi Butterfly FODRV (Pn16)	900XS		
Metering Stations	Bronze screwed	1250	PS1250	PSU1250
Metering Stations	Cast iron flanged	V953		
Regulating valves (HWS)	Bronze screwed	P605	PS605	PSU605
Radiator valve body, C/w Thermostatic Sensor- Head (Domestic)	Angle	631801		
	Straight	631806		
Thermostatic radiator valve body (Commercial)	Angle	686032		

Valve Type and Application		Pegler Valve Codes		
		TYPE	PS	PSU
	Straight	686034		
Built in sensor (Commercial)		686005		
Built in sensor (Tamperproof Cover)		686121		
Remote sensor with 2m capillary		686011		
Remote sensor with 5m capillary		686012		
Remote sensor with 8m capillary		686013		
L/S radiator valves	Angle	686050		
	Straight	686052		
W/W radiator valves	Angle	686007		
	Straight	681007		
Pressure reducing valves (Domestic)	Tectite Push-Fit ends	5A2050		
Pressure reducing valves (Domestic/Commercial)	Male BSPF ends (Dn15 to Dn100)	PRV4	PS4PRV	PSU4PRV
Pressure reducing valves (Domestic)	Flanged PN16	N/a		
Double check valve	Compression ends	K4424		
Double check valve	Male BSP ends	K4426	PS4426	PSU4426
Drain valves (concealed)		Various		
Drain valves (Plantroom) Gland/Hu		1832		
Drain valves (Plantroom) LBV/Hu		PB60HU		
Air vents (concealed)		P775		
Air vents (Plantroom)		P775		
Thermostatic mixing valve c/w IV's		PEG402UA		
Thermostatic mixing valve (Flow-Through) c/w IV's		PEG402UAX		
Differential Pressure Control Valves	DZR Dn15 to Dn50) (C/w IV & DOC)	DELTA		PSU926
DP measuring adaptor Partner Valve	DZR Dn15 to Dn50)	900PD		PSU900PD
Differential Pressure Control Valves	Cast Pn16	DELTA		
DP measuring adaptor Partner Valve		900XS		
Pressure Independent Control Valves	C/w built-in Venturi MS (Dn15 to Dn50)	Dynamic	PS902	PSU902
Actuator for PICV's		Various		
Pressure independent Control valves	Cast Pn16	902XS		
Actuator for PICV's	240v, 24v & Modulating 0-10v	Included		
FCU assembly (Commissioning set)	FODRV	MVS	All end connections available	
FCU assembly c/w MS (PICV)	PICV C/w MS (Dn15 & Dn20)	MVS	All end connections available	
FCU assembly (PICV)				
Actuator for PICV valves	240v, 24v & Modulating 0-10v	Various		

APPENDIX 2 – NG BAILEY BEST PRACTICE PIPEWORK DETAILS




SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
No specific SHE risks have been identified for the contents of this drawing.
SAFETY First & Foremost
MIN 5xø STRAIGHT LENGTH PIPE – NO FITTINGS
MIN 3xø STRAIGHT LENGTH PIPE – NO FITTINGS
MIN 10xø BETWEEN PUMP DISCHARGE AND NRV
MIN 10xø BETWEEN PUMP DISCHARGE AND NRV
TP
STR
CS
NRV
IV
FC
P
DOC
DRV
OP
MV
Correct
Eccentric reducer
Taper is down
Detail 1.
Guidance notes
1. Straight length pipe diameter distances either side of key control and measurement devices are based on Oventrop products. Where alternative products are used, straight length pipe diameter distances should be as per manufacturer recommendations or CIBSE Commissioning code W.
2. A combination of two strainers should be used to provide total protection for the three-way mixing valve, measuring station and associated double-regulating valves.
3. A means of manually overriding the automatic control of the three-way valve should be provided so that, during the flushing and cleaning processes, raw water or chemicals can be drawn in via the primary injection circuit.
4. As an alternative to 2, connection points may be fitted prior to each pump.
5. Suction piping onto centrifugal inline pumps should be as direct as possible, and ideally the length should be at least ten times the pipe diameter.
6. An eccentric reducer with the eccentric side down should be used when reducing the pipe diameter to the diameter of suction opening (see detail 1).
For further guidance regarding pre-commission cleaning, refer to BSRIA technical Guide BG29/2012. For information & guidance on commissioning of systems using DPCV's refer to BSRIA BG2/2010 "commissioning water systems".
Rev Date Description Eng Chk Dm
4 MAY 19 MINOR AMENDMENTS AND ADDITIONAL DRAINS AND TEST POINTS ADDED TO FACILITATE PRE-COMMISSIONING CLEANING WP WP WJ
3 JULY 17 PIPE DIAMETERS EITHER SIDE OF VALVES AMENDED AND STRAINERS ADDED UPSTREAM OF PUMP SETS WP WP AP
2 DEC 16 DETAIL 1 AND NOTES 5 AND 6 ADDED WP WP AP
1 MAY 16 PIPE DIAMETERS EITHER SIDE OF KEY VALVES AMENDED WP WP AP
Client
Contract
Engineer WP Signed
Checked By WP Signed
Drawn By MC Sheet Size A4 Scale NTS
Title PROVISIONS AT SECONDARY PUMPS
Status FOR INFORMATION Issue Date MAY 2016
Drawing No DETAIL 2
Revision 4
NG Bailey
Denton Hall, Ilkley, West Yorkshire, LS29 8HH. Tel: 01943 851933 Fax: 01943 816117
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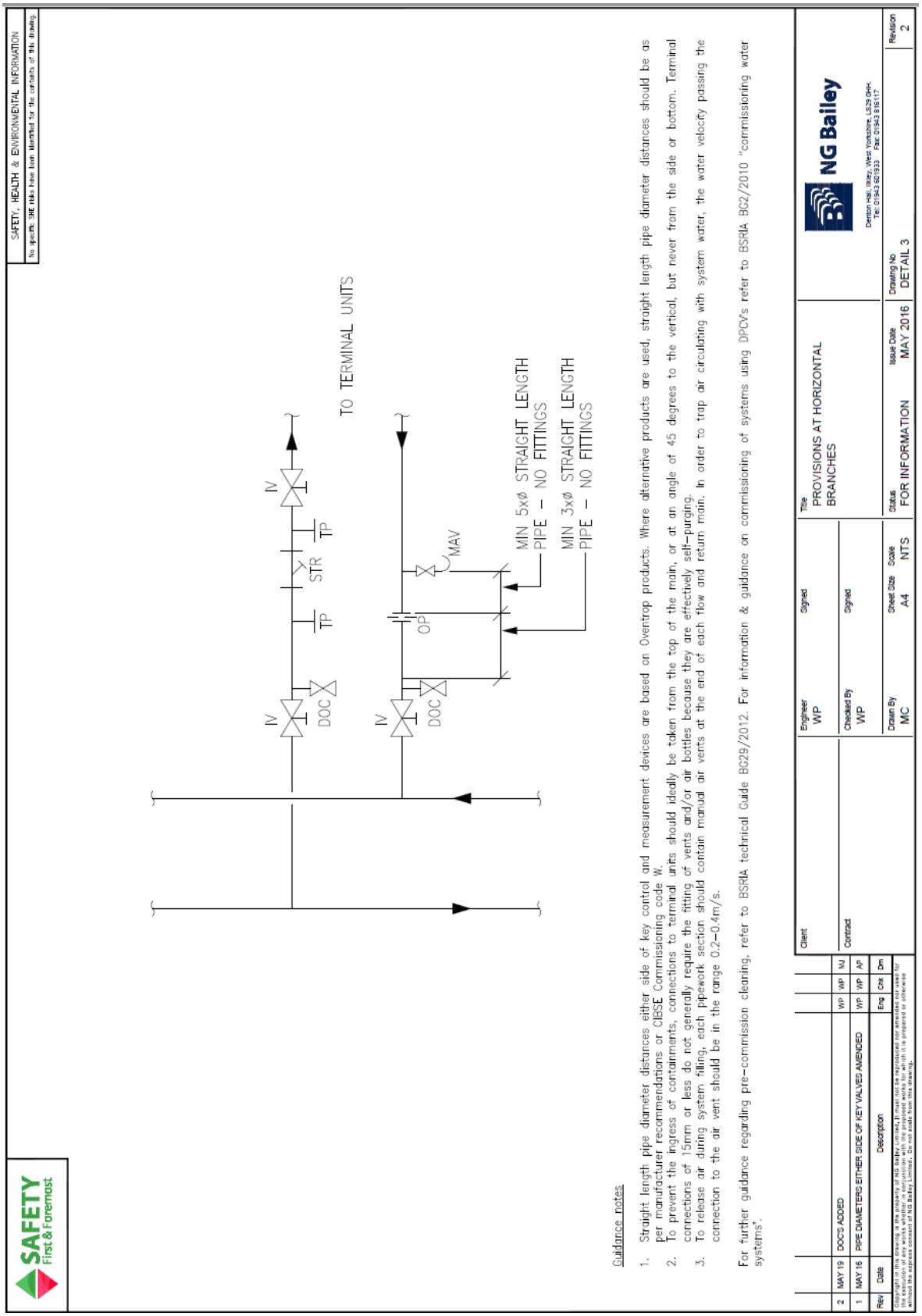
SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
No specific SHE risks have been identified for the contents of this drawing.
SAFETY First & Foremost
IV
DOC
TP
STR
TP
IV
TO TERMINAL UNITS
IV
DOC
OP
MAV
MIN 5xø STRAIGHT LENGTH PIPE – NO FITTINGS
MIN 3xø STRAIGHT LENGTH PIPE – NO FITTINGS
Guidance notes
1. Straight length pipe diameter distances either side of key control and measurement devices are based on Oventrop products. Where alternative products are used, straight length pipe diameter distances should be as per manufacturer recommendations or CIBSE Commissioning code W.
2. To prevent the ingress of containments, connections to terminal units should ideally be taken from the top of the main, or at an angle of 45 degrees to the vertical, but never from the side or bottom. Terminal connections of 15mm or less do not generally require the fitting of vents and/or air bottles because they are effectively self-purging.
3. To release air during system filling, each pipework section should contain manual air vents at the end of each flow and return main. In order to trap air circulating with system water, the water velocity passing the connection to the air vent should be in the range 0.2–0.4m/s.
For further guidance regarding pre-commission cleaning, refer to BSRIA technical Guide BG29/2012. For information & guidance on commissioning of systems using DPCVs refer to BSRIA BG2/2010 "commissioning water systems".
Rev | Date | Description | Eng | Chk | Dm
2 | MAY 19 | DOC'S ADDED | WP | WP | MJ
1 | MAY 16 | PIPE DIAMETERS EITHER SIDE OF KEY VALVES AMENDED | WP | WP | AP
Client
Contract
Engineer WP Signed
Checked By WP Signed
Drawn By MC Sheet Size A4 Scale NTS
Title PROVISIONS AT HORIZONTAL BRANCHES
Status FOR INFORMATION Issue Date MAY 2016
Drawing No DETAIL 3
Revision 2
NG Bailey
Denton Hall, Ilkley, West Yorkshire, LS29 0HH. Tel: 01943 861933 Fax: 01943 816117
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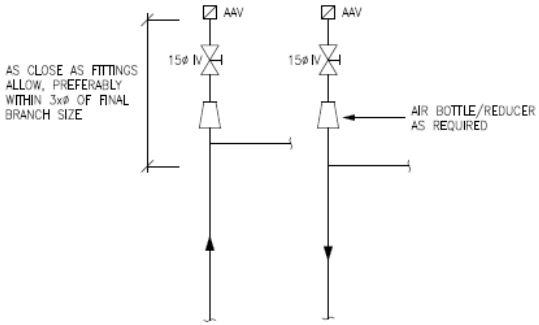
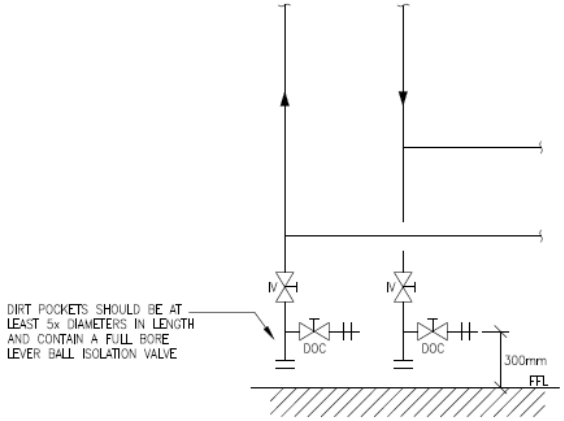
SAFETY First & Foremost

SAFETY, HEALTH & ENVIRONMENTAL INFORMATION

No specific SHE risks have been identified for the contents of this drawing.



TOP OF RISER



BOTTOM OF RISER

Rev	Date	Description	Eng	Chk	Drn
3	MAY 19	TOP OF RISER DETAIL UPDATED TO REMOVE BYPASS	WP	WP	MJ
2	JUL 17	PIPE DIAMETER DIMENSIONS ADDED TO DRV	WP	WP	AP
1	MAY 16	AAV MINIMUM PIPE DIAMETER DIMENSIONS ADDED	WP	WP	AP

Client

Contract

Engineer WP — Signed

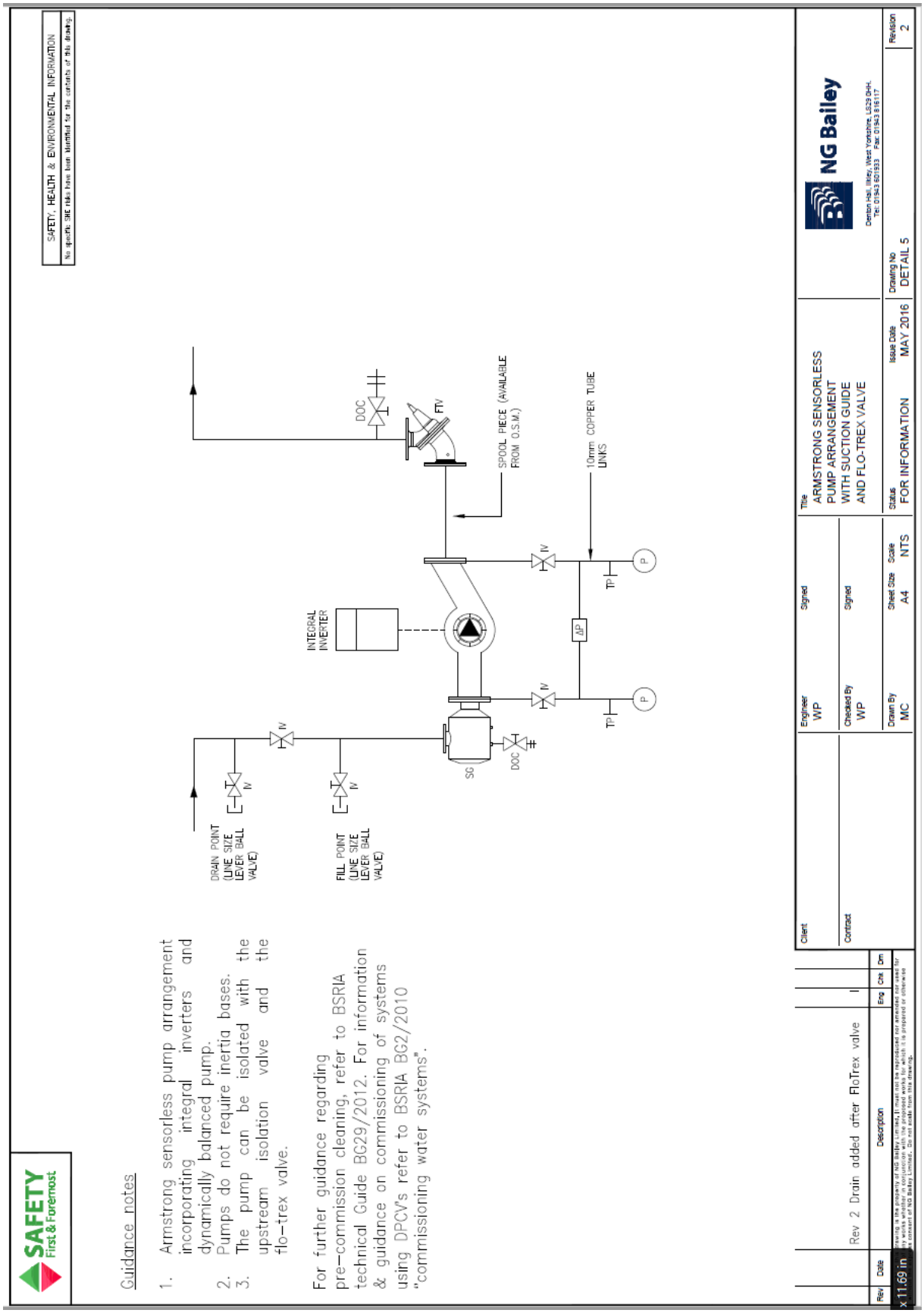
Checked By WP — Signed

Drawn By MC — Sheet Size A4 — Scale NTS

Title: PROVISIONS AT RISERS

NG Bailey
Denton Hall, Ilkley, West Yorkshire, LS29 0HH.
Tel: 01943 601933 Fax: 01943 816117

Status: FOR INFORMATION — Issue Date: MAY 2016 — Drawing No: DETAIL 4 — Revision: 3

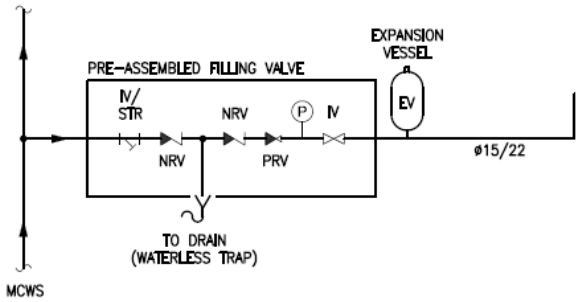

SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
No specific SHE risks have been identified for the contents of this drawing.
SAFETY First & Foremost
Guidance notes
1. Armstrong sensorless pump arrangement incorporating integral inverters and dynamically balanced pump.
2. Pumps do not require inertia bases.
3. The pump can be isolated with the upstream isolation valve and the flo-trex valve.
For further guidance regarding pre-commission cleaning, refer to BSRIA technical Guide BG29/2012. For information & guidance on commissioning of systems using DPCV's refer to BSRIA BG2/2010 "commissioning water systems".
DRAIN POINT (LINE SIZE LEVER BALL VALVE)
FILL POINT (LINE SIZE LEVER BALL VALVE)
IV
INTEGRAL INVERTER
SG
DOC
FTV
SPOOL PIECE (AVAILABLE FROM O.S.M.)
10mm COPPER TUBE LINKS
ΔP
TP
P
Rev 2 Drain added after FloTrex valve
Rev Date Description Eng Chk Dm
Client
Contract
Engineer WP Signed
Checked By WP Signed
Drawn By MC
Sheet Size A4
Scale NTS
Title
ARMSTRONG SENSORLESS PUMP ARRANGEMENT WITH SUCTION GUIDE AND FLO-TREX VALVE
Status FOR INFORMATION
Issue Date MAY 2016
Drawing No DETAIL 5
Revision 2
NG Bailey
Denton Hall, Ilkley, West Yorkshire, LS29 0PH. Tel: 01943 607933 Fax: 01943 816117
x 11.69 in

SAFETY First & Foremost

Guidance Notes:–

1. Backflow prevention & filling device for filling & pressurising sealed domestic heating system or non–house systems with output of less than 45 kW (fluid cat 3).
2. Suitable for system water volumes up to 300 litres.
3. Valve and line size 15 or 22mm

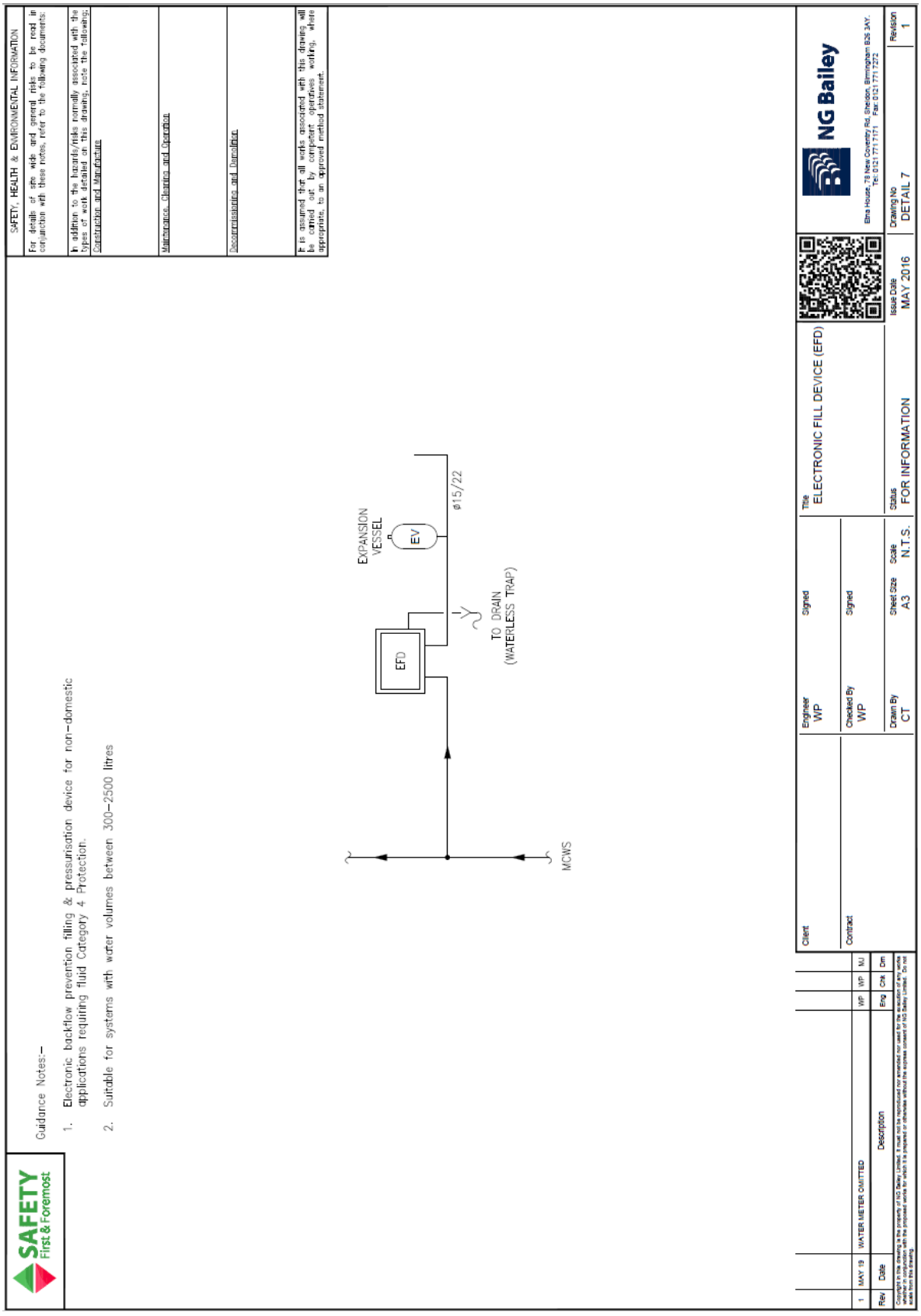
SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
For details of site wide and general risks to be read in conjunction with these notes, refer to the following documents:
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following:
Construction and Manufacture
Maintenance, Clearing and Operation
Decommissioning and Demolition
It is assumed that all works associated with this drawing will be carried out by competent operatives working, where appropriate, to an approved method statement.



Rev	Date	Description	Eng	Chk	Dm
1	MAY 19	WATERLESS TRAP ADDED	WP	WP	MJ

Client	Engineer WP	Signed	Title: DIRECT MAINS CONNECTED FILLING VALVE WITH CA DEVICE
Contract	Checked By WP	Signed	
	Drawn By CT	Sheet Size A3	Scale N.T.S.
	Status FOR INFORMATION	Issue Date MAY 2016	Drawing No DETAIL 6
			Revision 1

NG Bailey
Etna House, 78 New Coventry Rd, Sheldon, Birmingham B26 3AY.
Tel: 0121 771 7171 Fax: 0121 771 7272


SAFETY First & Foremost
Guidance Notes:–
1. Electronic backflow prevention filling & pressurisation device for non–domestic applications requiring fluid Category 4 Protection.
2. Suitable for systems with water volumes between 300–2500 litres
EXPANSION VESSEL
EV
EFD
ø15/22
TO DRAIN (WATERLESS TRAP)
MCWS
SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
For details of site wide and general risks to be read in conjunction with these notes, refer to the following documents:
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following:
Construction and Manufacture
Maintenance, Cleaning and Operation
Decommissioning and Demolition
It is assumed that all works associated with this drawing will be carried out by competent operatives working, where appropriate, to an approved method statement.
Client
Contract
Engineer WP
Checked By WP
Drawn By CT
Signed
Signed
Sheet Size A3
Scale N.T.S.
Title ELECTRONIC FILL DEVICE (EFD)
Status FOR INFORMATION
Issue Date MAY 2016
NG Bailey
Bma House, 78 New Coventry Rd, Sheldon, Birmingham B26 3AY.
Tel: 0121 717 1717 Fax: 0121 777 7222
Drawing No DETAIL 7
Revision 1
Rev Date Description Eng Chk Dm
1 MAY 19 WATER METER OMITTED WP WP NJ
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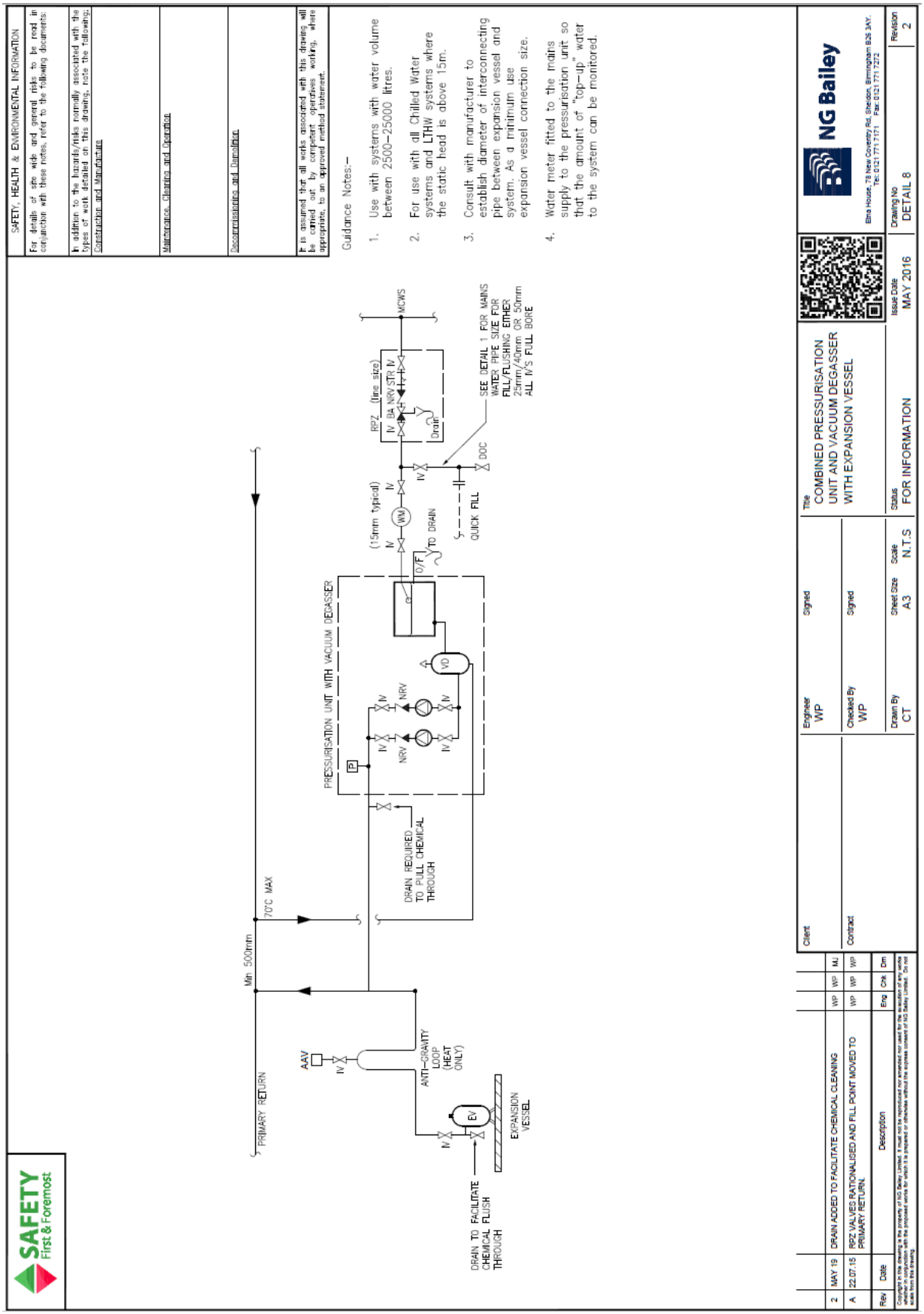
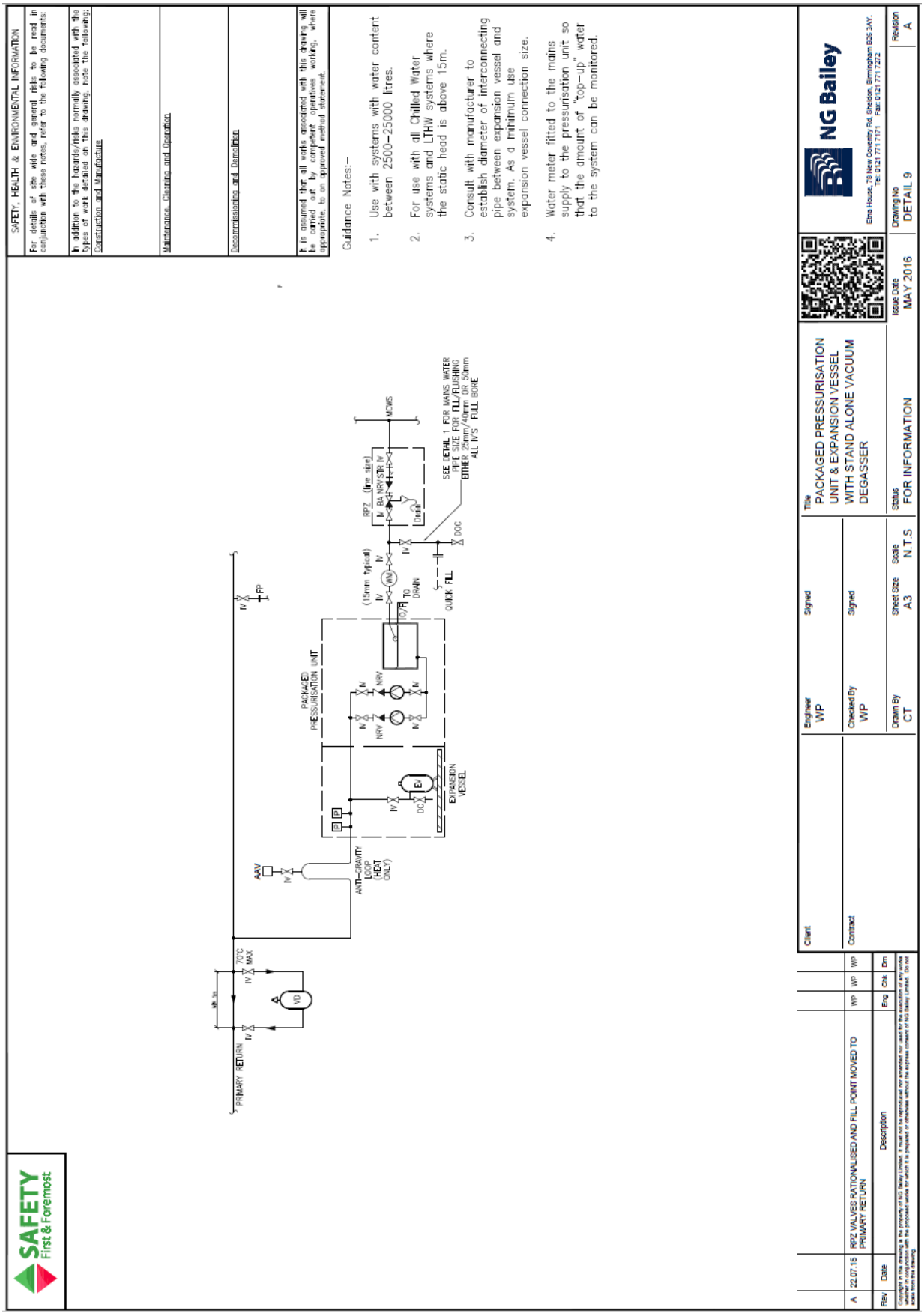
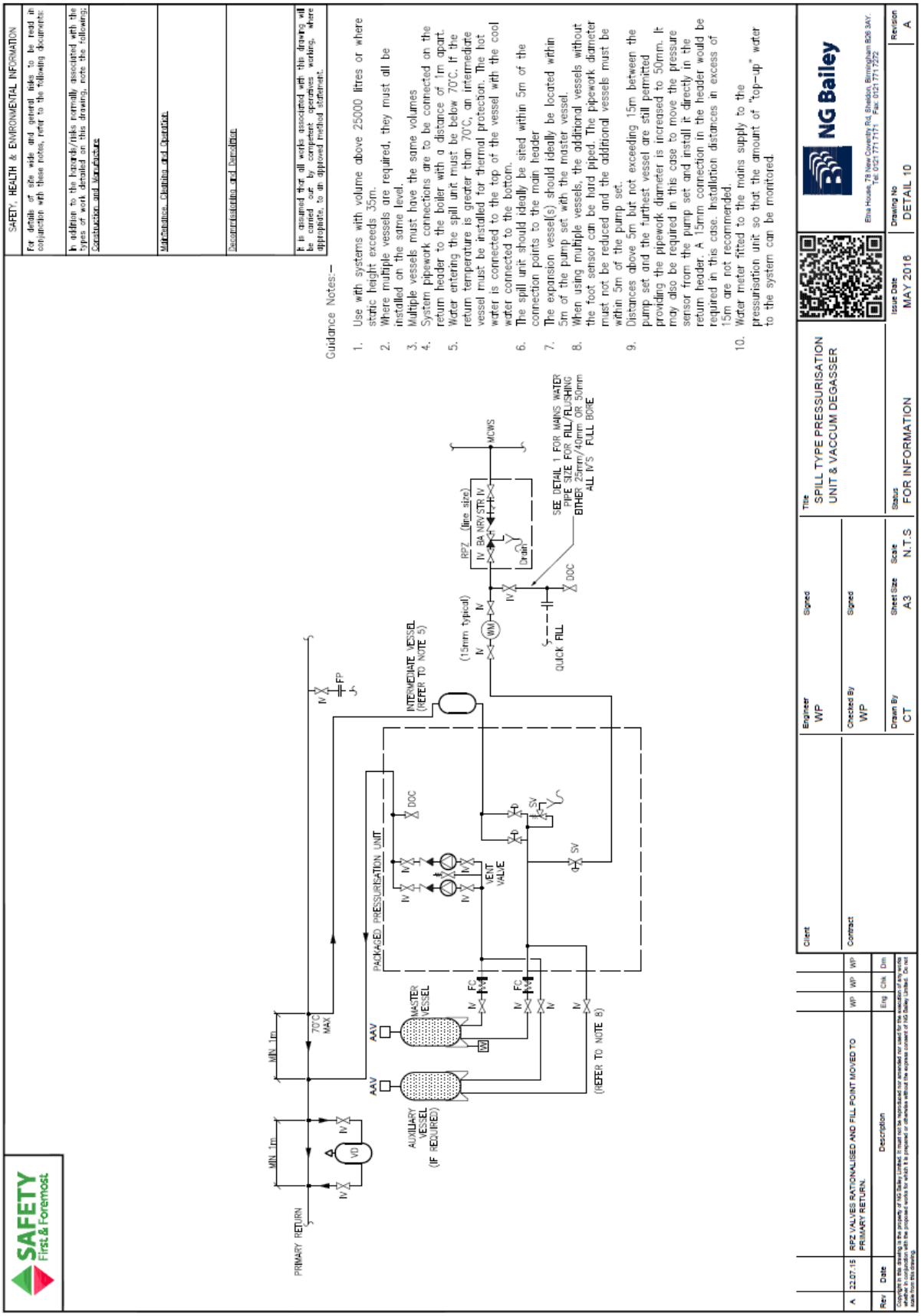

SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
For details of site wide and general risks to be read in conjunction with these notes, refer to the following documents:
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following:
Construction and Manufacture
Maintenance, Cleaning and Operation
Decommissioning and Demolition
It is assumed that all works associated with this drawing will be carried out by competent operatives working, where appropriate, to an approved method statement.
Guidance Notes:-
1. Use with systems with water volume between 2500-25000 litres.
2. For use with all Chilled Water systems and LTHW systems where the static head is above 15m.
3. Consult with manufacturer to establish diameter of interconnecting pipe between expansion vessel and system. As a minimum use expansion vessel connection size.
4. Water meter fitted to the mains supply to the pressurisation unit so that the amount of "top-up" water to the system can be monitored.
PRIMARY RETURN
Min. 500mm
70°C MAX
AAV
ANTI-GRAVITY LOOP (HEAT ONLY)
EV
EXPANSION VESSEL
DRAIN TO FACILITATE CHEMICAL FLUSH THROUGH
PRESSURISATION UNIT WITH VACUUM DEGASSER
DRAIN REQUIRED TO PULL CHEMICAL THROUGH
NRV
VD
O/F
TO DRAIN
(15mm typical)
WM
MCWS
RPZ (line size)
BA NRV STR IV
Drain
QUICK FILL
DOC
SEE DETAIL 1 FOR MAINS WATER PIPE SIZE FOR FILL/FLUSHING EITHER 25mm/40mm OR 50mm ALL IV's FULL BORE
Rev Date Description Eng Chk Dm
2 MAY 19 DRAIN ADDED TO FACILITATE CHEMICAL CLEANING WP WP MJ
A 22.07.15 RPZ VALVES RATIONALISED AND FILL POINT MOVED TO PRIMARY RETURN. WP WP WP
Client
Contract
Engineer WP Signed
Checked By WP Signed
Drawn By CT
Sheet Size A3
Scale N.T.S
Title COMBINED PRESSURISATION UNIT AND VACUUM DEGASSER WITH EXPANSION VESSEL
Status FOR INFORMATION
Issue Date MAY 2016
Drawing No DETAIL 8
Revision 2
NG Bailey
Etna House, 78 New Coventry Rd, Sheldon, Birmingham B26 3AY. Tel: 0121 771 7171 Fax: 0121 771 7272
SAFETY First & Foremost


SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
For details of site wide and general risks to be read in conjunction with these notes, refer to the following documents:
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following:
Construction and Manufacture
Maintenance, Cleaning and Operation
Decommissioning and Demolition
It is assumed that all works associated with this drawing will be carried out by competent operatives working, where appropriate, to an approved method statement.
Guidance Notes:-
1. Use with systems with water content between 2500-25000 litres.
2. For use with all Chilled Water systems and LTHW systems where the static head is above 15m.
3. Consult with manufacturer to establish diameter of interconnecting pipe between expansion vessel and system. As a minimum use expansion vessel connection size.
4. Water meter fitted to the mains supply to the pressurisation unit so that the amount of "top-up" water to the system can be monitored.
PRIMARY RETURN
70°C MAX
VD
AAV
ANTI-GRAVITY LOOP (HEAT ONLY)
PACKAGED PRESSURISATION UNIT
EV
EXPANSION VESSEL
NRV
(15mm Typical)
QUICK FILL
TD DRAIN
RPZ (line size)
MCWS
Drain
SEE DETAIL 1 FOR MAINS WATER PIPE SIZE FOR FILL/FLUSHING EITHER 25mm/40mm OR 50mm ALL IV'S FULL BORE
Client
Contract
Engineer WP
Checked By WP
Drawn By CT
Signed
Sheet Size A3
Scale N.T.S
Title PACKAGED PRESSURISATION UNIT & EXPANSION VESSEL WITH STAND ALONE VACUUM DEGASSER
Status FOR INFORMATION
Issue Date MAY 2016
Drawing No DETAIL 9
Revision A
NG Bailey
Etna House, 78 New Coventry Rd, Sheldon, Birmingham B26 3AY.
Tel: 0121 771 7171 Fax: 0121 771 7272
Rev Date Description Eng Chk Drn
A 22.07.15 RPZ VALVES RATIONALISED AND FILL POINT MOVED TO PRIMARY RETURN WP WP WP
SAFETY First & Foremost


SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
For details of site wide and general risks to be read in conjunction with these notes, refer to the following documents:
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following:
Construction and Workplace
Maintenance, Cleaning and Operation
Decommissioning and Demolition
It is assumed that all works associated with this drawing will be carried out by competent operatives working, where appropriate, to an approved method statement.
Guidance Notes:-
1. Use with systems with volume above 25000 litres or where static height exceeds 35m.
2. Where multiple vessels are required, they must all be installed on the same level.
3. Multiple vessels must have the same volumes
4. System pipework connections are to be connected on the return header to the boiler with a distance of 1m apart.
5. Water entering the spill unit must be below 70°C. If the return temperature is greater than 70°C, an intermediate vessel must be installed for thermal protection. The hot water is connected to the top of the vessel with the cool water connected to the bottom.
6. The spill unit should ideally be sited within 5m of the connection points to the main header
7. The expansion vessel(s) should ideally be located within 5m of the pump set with the master vessel.
8. When using multiple vessels, the additional vessels without the foot sensor can be hard piped. The pipework diameter must not be reduced and the additional vessels must be within 5m of the pump set.
9. Distances above 5m but not exceeding 15m between the pump set and the furthest vessel are still permitted providing the pipework diameter is increased to 50mm. It may also be required in this case to move the pressure sensor from the pump set and install it directly in the return header. A 15mm connection in the header would be required in this case. Installation distances in excess of 15m are not recommended.
10. Water meter fitted to the mains supply to the pressurisation unit so that the amount of "top-up" water to the system can be monitored.
SAFETY First & Foremost
PRIMARY RETURN
MIN 1m
VD
AUXILIARY VESSEL (IF REQUIRED)
AAV
MASTER VESSEL
70°C MAX
PACKAGED PRESSURISATION UNIT
FC
VENT VALVE
SV
DOC
INTERMEDIATE VESSEL (REFER TO NOTE 5)
FP
(15mm typical)
WM
RPZ (line size)
BA NRV STR
Drain
MCWS
QUICK FILL
SEE DETAIL 1 FOR MAINS WATER PIPE SIZE FOR FILL/FLUSHING EITHER 25mm/40mm OR 50mm ALL IV'S FULL BORE
(REFER TO NOTE 8)
Client
Contract
Engineer WP
Signed
Checked By WP
Signed
Drawn By CT
Sheet Size A3
Scale N.T.S
Title
SPILL TYPE PRESSURISATION UNIT & VACCUM DEGASSER
Status FOR INFORMATION
Issue Date MAY 2016
Drawing No DETAIL 10
Revision A
NG Bailey
Etna House, 78 New Coventry Rd, Sheldon, Birmingham B26 3AY.
Tel: 0121 771 7171 Fax: 0121 771 7272
Rev Date Description Eng Chk Dm
A 22.07.15 RPZ VALVES RATIONALISED AND FILL POINT MOVED TO PRIMARY RETURN WP WP WP
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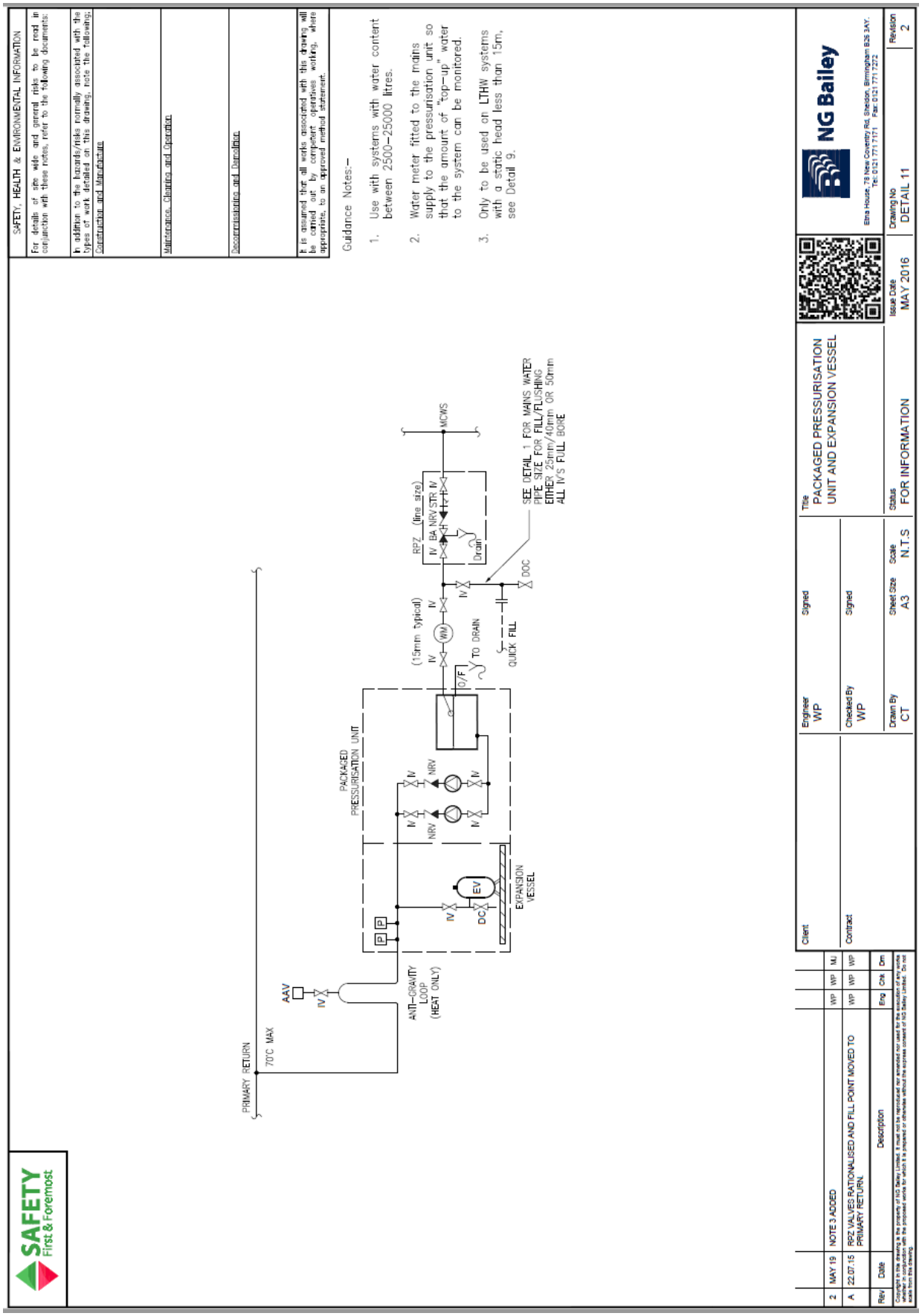
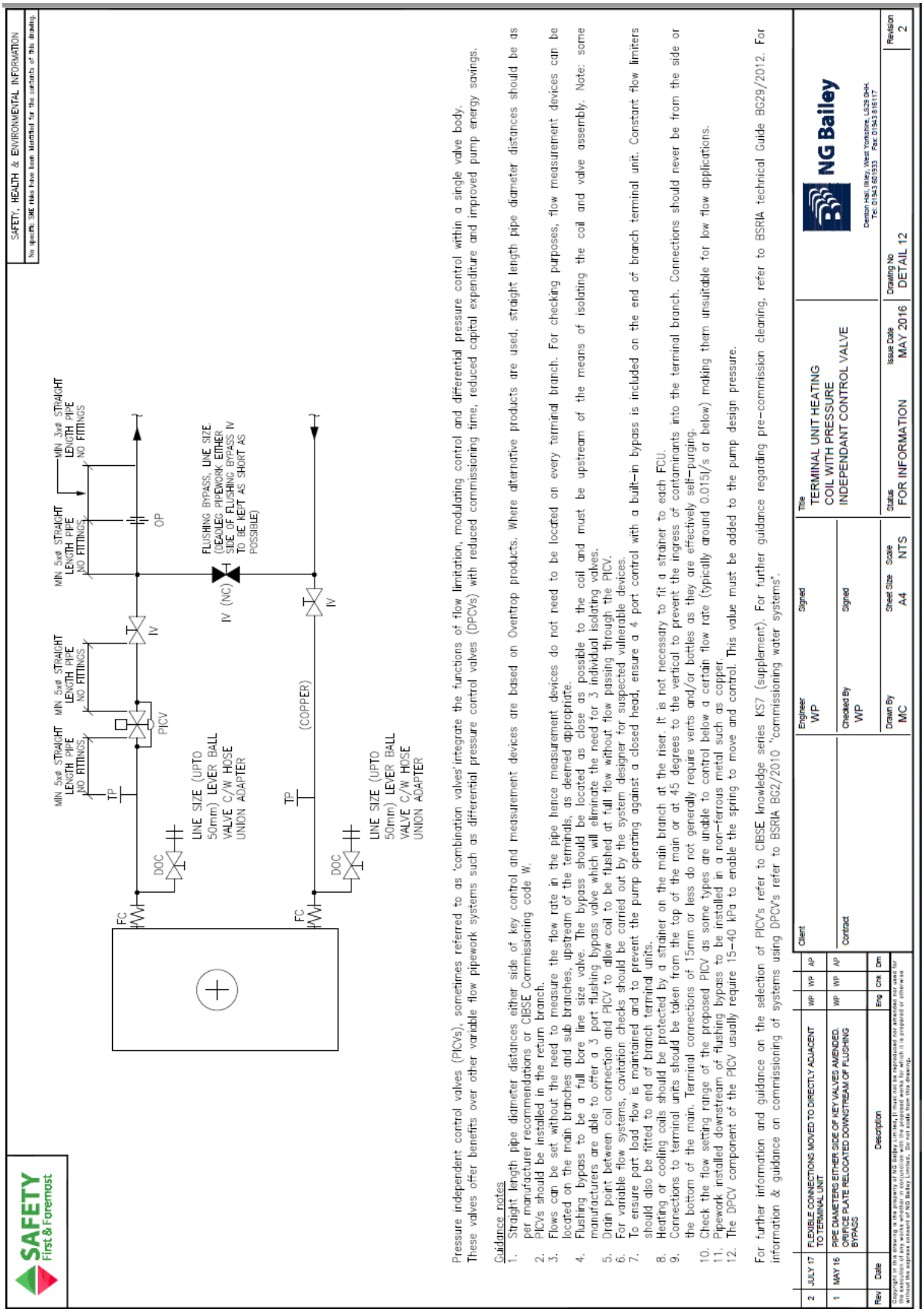

SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
For details of site wide and general risks to be read in conjunction with these notes, refer to the following documents:
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following:
Construction and Manufacture
Maintenance, Clearance and Operation
Decommissioning and Demolition
It is assumed that all works associated with this drawing will be carried out by competent operatives working, where appropriate, to an approved method statement.
Guidance Notes:-
1. Use with systems with water content between 2500-25000 litres.
2. Water meter fitted to the mains supply to the pressurisation unit so that the amount of "top-up" water to the system can be monitored.
3. Only to be used on LTHW systems with a static head less than 15m, see Detail 9.
PRIMARY RETURN
70°C MAX
AAV
ANTI-GRAVITY LOOP (HEAT ONLY)
PACKAGED PRESSURISATION UNIT
EXPANSION VESSEL
EV
DC
NRV
(15mm Typical)
WM
O/F
TO DRAIN
QUICK FILL
RPZ (line size)
BA NRV STR
Drain
MCWS
DOC
SEE DETAIL 1 FOR MAINS WATER PIPE SIZE FOR FILL/FLUSHING
EITHER 25mm/40mm OR 50mm
ALL IV'S FULL BORE
Rev Date Description Drn Chk Dm
2 MAY 19 NOTE 3 ADDED WP WP MJ
A 22.07.15 RPZ VALVES RATIONALISED AND FILL POINT MOVED TO PRIMARY RETURN WP WP WP
Client
Contract
Engineer WP Signed
Checked By WP Signed
Drawn By CT
Sheet Size A3
Scale N.T.S
Title PACKAGED PRESSURISATION UNIT AND EXPANSION VESSEL
Status FOR INFORMATION
Issue Date MAY 2016
NG Bailey
Elms House, 79 New Coventry Rd, Sheldon, Birmingham B26 3AY.
Tel: 0121 771 7171 Fax: 0121 771 7272
Drawing No DETAIL 11
Revision 2
SAFETY First & Foremost



Pressure independent control valves (PICVs), sometimes referred to as 'combination valves' integrate the functions of flow limitation, modulating control and differential pressure control within a single valve body. These valves offer benefits over other variable flow pipework systems such as differential pressure control valves (DPCVs) with reduced commissioning time, reduced capital expenditure and improved pump energy savings.

Guidance notes

1. Straight length pipe diameter distances either side of key control and measurement devices are based on Oventrop products. Where alternative products are used, straight length pipe diameter distances should be as per manufacturer recommendations or CIBSE Commissioning code W.
2. PICVs should be installed in the return branch.
3. Flows can be set without the need to measure the flow rate in the pipe hence measurement devices do not need to be located on every terminal branch. For checking purposes, flow measurement devices can be located on the main branches and sub branches, upstream of the terminals, as deemed appropriate.
4. Flushing bypass to be a full bore line size valve. The bypass should be located as close as possible to the coil and must be upstream of the means of isolating the coil and valve assembly. Note: some manufacturers are able to offer a 3 port flushing bypass valve which will eliminate the need for 3 individual isolating valves.
5. Drain point between coil connection and PICV to allow coil to be flushed at full flow without flow passing through the PICV.
6. For variable flow systems, cavitation checks should be carried out by the system designer for suspected vulnerable devices.
7. To ensure part load flow is maintained and to prevent the pump operating against a closed head, ensure a 4 port control with a built-in bypass is included on the end of branch terminal unit. Constant flow limiters should also be fitted to end of branch terminal units.
8. Heating or cooling coils should be protected by a strainer on the main branch at the riser. It is not necessary to fit a strainer to each FCU.
9. Connections to terminal units should be taken from the top of the main or at 45 degrees to the vertical to prevent the ingress of contaminants into the terminal branch. Connections should never be from the side or the bottom of the main. Terminal connections of 15mm or less do not generally require vents and/or bottles as they are effectively self-purging.
10. Check the flow setting range of the proposed PICV as some types are unable to control below a certain flow rate (typically around 0.015l/s or below) making them unsuitable for low flow applications.
11. Pipework installed downstream of flushing bypass to be installed in a non-ferrous metal such as copper.
12. The DPCV component of the PICV usually require 15-40 kPa to enable the spring to move and control. This value must be added to the pump design pressure.

For further information and guidance on the selection of PICVs refer to CIBSE knowledge series KS7 (supplement). For further guidance regarding pre-commission cleaning, refer to BSRIA technical Guide BG29/2012. For information & guidance on commissioning of systems using DPCVs refer to BSRIA BG2/2010 'commissioning water systems".

Rev	Date	Description	Eng	Chk	Dm
2	JULY 17	FLEXIBLE CONNECTIONS MOVED TO DIRECTLY ADJACENT TO TERMINAL UNIT	WP	WP	AP
1	MAY 16	PIPE DIAMETERS EITHER SIDE OF KEY VALVES AMENDED. ORIFICE PLATE RELOCATED DOWNSTREAM OF FLUSHING BYPASS	WP	AP	

Client

Contract

Engineer WP — Signed

Checked By WP — Signed

Drawn By MC — Sheet Size A4 — Scale NTS

Title: TERMINAL UNIT HEATING COIL WITH PRESSURE INDEPENDANT CONTROL VALVE

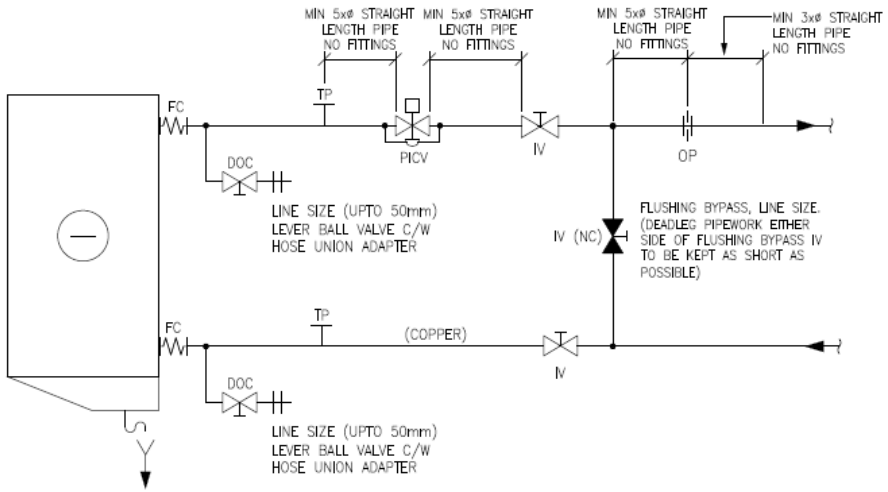
Status: FOR INFORMATION — Issue Date: MAY 2016 — Drawing No: DETAIL 12 — Revision: 2

NG Bailey

Denton Hall, Ilkley, West Yorkshire, LS29 0HH. Tel: 01943 601933 Fax: 01943 816117

SAFETY
First & Foremost

SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
No specific SHE risks have been identified for the contents of this drawing.



Pressure independent control valves (PICVs), sometimes referred to as 'combination valves' integrate the functions of flow limitation, modulating control and differential pressure control within a single valve body. These valves offer benefits over other variable flow pipework systems such as differential pressure control valves (DPCVs) with reduced commissioning time, reduced capital expenditure and improved pump energy savings.

Guidance notes

1. Straight length pipe diameter distances either side of key control and measurement devices are based on Oventrop products. Where alternative products are used, straight length pipe diameter distances should be as per manufacturer recommendations or CIBSE Commissioning code W.
2. PICVs should be installed in the return branch.
3. Flows can be set without the need to measure the flow rate in the pipe hence measurement devices do not need to be located on every terminal branch. For checking purposes, flow measurement devices can be located on the main branches and sub branches, upstream of the terminals, as deemed appropriate.
4. Flushing bypass to be a full bore line size valve. The bypass should be located as close as possible to the coil and must be upstream of the means of isolating the coil and valve assembly. Note: some manufacturers are able to offer a 3 port flushing bypass valve which will eliminate the need for 3 individual isolating valves.
5. Drain point between coil connection and PICV to allow coil to be flushed at full flow without flow passing through the PICV.
6. For variable flow systems, cavitation checks should be carried out by the system designer for suspected vulnerable devices.
7. To ensure part load flow is maintained and to prevent the pump operating against a closed head, ensure a 4 port control with a built-in bypass is included on the end of branch terminal unit. Constant flow limiters should also be fitted to end of branch terminal units.
8. Heating or cooling coils should be protected by a strainer on the main branch at the riser. It is not necessary to fit a strainer to each FCU.
9. Connections to terminal units should be taken from the top of the main or at 45 degrees to the vertical to prevent the ingress of contaminants into the terminal branch. Connections should never be from the side or the bottom of the main. Terminal connections of 15mm or less do not generally require vents and/or bottles as they are effectively self-purging.
10. Check the flow setting range of the proposed PICV as some types are unable to control below a certain flow rate (typically around 0.015l/s or below) making them unsuitable for low flow applications.
11. Pipework installed downstream of flushing bypass to be installed in a non-ferrous metal such as copper.
12. The DPCV component of the PICV usually require 15-40 kPa to enable the spring to move and control. This value must be added to the pump design pressure.

For further information and guidance on the selection of PICV's refer to CIBSE knowledge series KS7 (supplement). For further guidance regarding pre-commission cleaning, refer to BSRIA technical Guide BG29/2012. For information & guidance on commissioning of systems using DPCV's refer to BSRIA BG2/2010 "commissioning water systems".

Rev	Date	Description	Eng	Chk	Drn
2	JULY 17	FLEXIBLE CONNECTIONS MOVED TO DIRECTLY ADJACENT TO TERMINAL UNIT	WP	WP	AP
1	MAY 16	PIPE DIAMETERS EITHER SIDE OF KEY VALVES AMENDED. ORIFICE PLATE RELOCATED DOWNSTREAM OF FLUSHING BYPASS	WP	WP	AP

Client

Contract

Engineer WP Signed

Checked By WP Signed

Drawn By MC Sheet Size A4 Scale NTS

Title: TERMINAL UNIT COOLING COIL WITH PRESSURE INDEPENDENT CONTROL VALVE

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Status FOR INFORMATION Issue Date MAY 2016 Drawing No DETAIL 13 Revision 2

SAFETY
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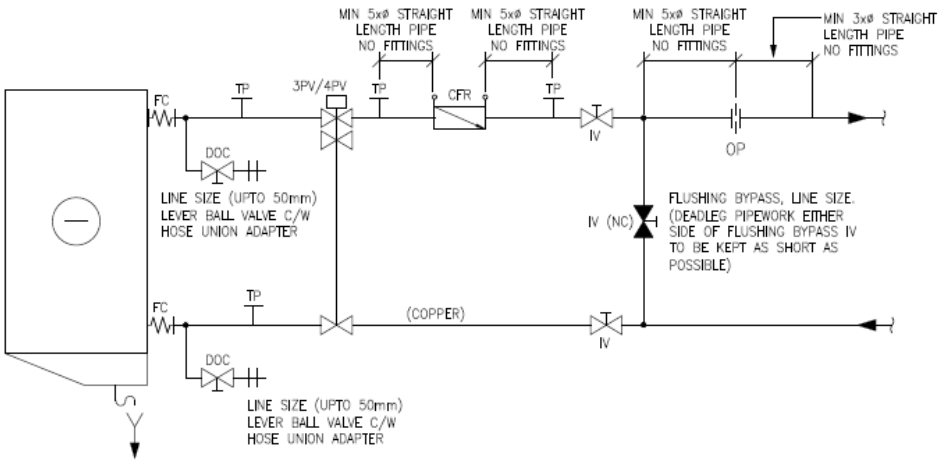
SAFETY, HEALTH & ENVIRONMENTAL INFORMATION

No specific SHE risks have been identified for the contents of this drawing.



Guidance notes

1. Straight length pipe diameter distances either side of key control and measurement devices are based on Oventrop products. Where alternative products are used, straight length pipe diameter distances should be as per manufacturer recommendations or CIBSE Commissioning code W.
2. This configuration is to be used for end of branch terminal units when deployed in a 2 port control valve variable flow system. To ensure part load flow is maintained and to prevent the pump operating against a closed head, ensure 4 port control valve with built-in bypass is included on the end of branch terminal unit.
3. Constant flow limiters should also be fitted to end of branch terminal units.
4. Flushing bypass to be a full bore line size valve. The bypass should be located as close as possible to the coil and must be upstream of the means of isolating the coil and valve assembly.

For further guidance regarding pre-commission cleaning, refer to BSRIA technical Guide BG29/2012. For information & guidance on commissioning of systems using DPCV's refer to BSRIA BG2/2010 "commissioning water systems".

Rev	Date	Description	Eng	Chk	Dm
2	JULY 17	FLEXIBLE CONNECTIONS MOVED TO DIRECTLY ADJACENT TO TERMINAL UNIT	WP	WP	AP
1	MAY 16	PIPE DIAMETERS EITHER SIDE OF KEY VALVES AMENDED. ORIFICE PLATE RELOCATED DOWNSTREAM OF FLUSHING BYPASS	WP	WP	AP

Client

Contract

Engineer: WP — Signed

Checked By: WP — Signed

Drawn By: MC — Sheet Size: A4 — Scale: NTS

Title: END OF RUN TERMINAL UNIT COOLING COIL INCORPORATING 4-PORT CONTROL VALVE (WHEN DEPLOYED IN CONJUNCTION WITH VARIABLE FLOW SYSTEMS).

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Status: FOR INFORMATION — Issue Date: MAY 2016 — Drawing No: DETAIL 14 — Revision: 2

SAFETY
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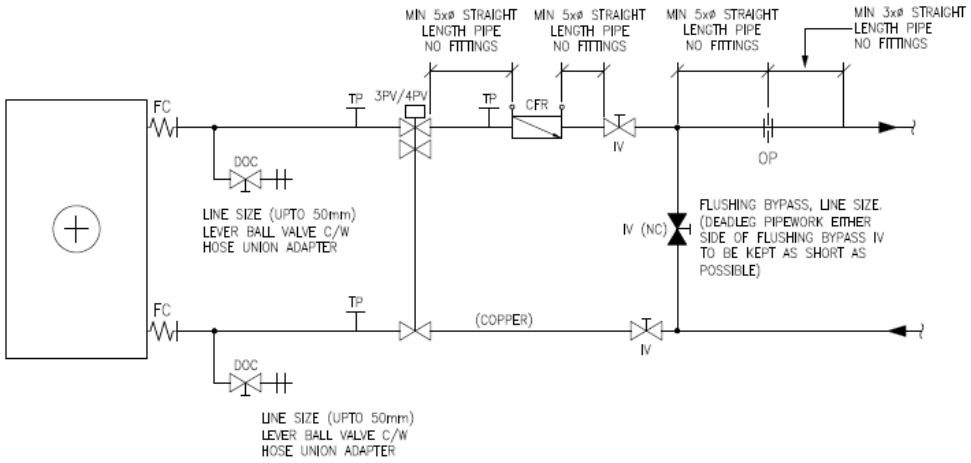
SAFETY, HEALTH & ENVIRONMENTAL INFORMATION

No specific SHE risks have been identified for the contents of this drawing.



Guidance notes

1. Straight length pipe diameter distances either side of key control and measurement devices are based on Oventrop products. Where alternative products are used, straight length pipe diameter distances should be as per manufacturer recommendations or CIBSE Commissioning code W.
2. This configuration is to be used for end of branch terminal units when deployed in a 2 port control valve variable flow system. To ensure part load flow is maintained and to prevent the pump operating against a closed head, ensure 4 port control valve with built-in bypass is included on the end of branch terminal unit.
3. Constant flow limiters should also be fitted to end of branch terminal units.
4. Flushing bypass to be a full bore line size valve. The bypass should be located as close as possible to the coil and must be upstream of the means of isolating the coil and valve assembly.

For further guidance regarding pre-commission cleaning, refer to BSRIA technical Guide BG29/2012. For information & guidance on commissioning of systems using DPCV's refer to BSRIA BG2/2010 "commissioning water systems".

Rev	Date	Description	Eng	Chk	Dm
3	MAY 19	NOTE ADDED TO MINIMISE FLUSHING BYPASS DEADLEG	WP	WP	MJ
2	JULY 17	FLEXIBLE CONNECTIONS MOVED TO DIRECTLY ADJACENT TO TERMINAL UNIT	WP	WP	AP
1	MAY 16	PIPE DIAMETERS EITHER SIDE OF KEY VALVES AMENDED. ORIFICE PLATE RELOCATED DOWNSTREAM OF FLUSHING BYPASS	WP	WP	AP

Client

Contract

Engineer WP Signed

Checked By WP Signed

Drawn By MC Sheet Size A4 Scale NTS

Title: END OF RUN TERMINAL UNIT HEATING COIL INCORPORATING 4-PORT CONTROLVALVE (WHEN DEPLOYED IN CONJUNCTION WITH VARIABLE FLOW SYSTEMS).

Status FOR INFORMATION Issue Date MAY 2016

Drawing No DETAIL 15 Revision 3

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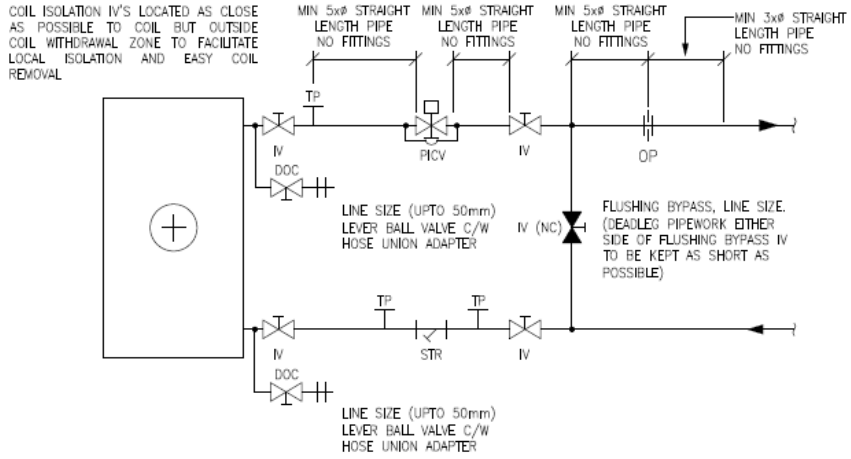
SAFETY, HEALTH & ENVIRONMENTAL INFORMATION

No specific SHE risks have been identified for the contents of this drawing.



Pressure independent control valves (PICVs), sometimes referred to as 'combination valves' integrate the functions of flow limitation, modulating control and differential pressure control within a single valve body. These valves offer benefits over other variable flow pipework systems such as differential pressure control valves (DPCVs) with reduced commissioning time, reduced capital expenditure and improved pump energy savings.

Guidance notes

1. Straight length pipe diameter distances either side of key control and measurement devices are based on Oventrop products. Where alternative products are used, straight length pipe diameter distances should be as per manufacturer recommendations or CIBSE Commissioning code W.
2. PICV's should be installed in the return branch.
3. Major terminal heating/cooling coils or heat exchangers should be protected by local strainers, which provide the additional function of protecting the control valves and measuring station.
4. Flows can be set without the need to measure the flow rate in the pipe hence measurement devices do not need to be located on every terminal branch. For checking purposes, flow measurement devices can be located on the main branches and sub branches, upstream of the terminals, as deemed appropriate.
5. Flushing bypass to be a full bore line size valve. The bypass should be located as close as possible to the coil and must be upstream of the means of isolating the coil and valve assembly.
6. Drain point between coil connection and PICV to allow coil to be flushed at full flow without passing through PICV.
7. The drain valves local to the coil should be as large as possible to enable local back– flushing of the coil to drain. Draining should be carried out using clean, inhibited water, following the chemical cleaning and dosing of the remainder of the system.
8. For variable flow systems, cavitation checks should be carried out by the system designer for suspected vulnerable devices.
9. The DPCV component of the PICV usually requires 15–40kPa to enable the spring to move and control. This value must be added to the pump design pressure.
10. Check maximum pressure differential the DPCV in the PICV can operate against. This is typically in the range of 20–400Kpa.
11. To ensure circulation at all times, provide 3 port valve or bypass with constant flow regulator (CFR) at end of branch terminal unit.
12. The DPCV component of the PICV usually require 15–40 kPa to enable the spring to move and control. This value must be added to the pump design pressure.

For further information and guidance on the selection of PICV's refer to CIBSE knowledge series KS7 (supplement). For further guidance regarding pre–commission cleaning, refer to BSRIA technical Guide BG29/2012. For information & guidance on commissioning of systems using DPCV's refer to BSRIA BG2/2010 "commissioning water systems".

Rev	Date	Description	Eng	Chk	Dm
4	JUNE 20	LOCAL COIL ISOLATION IV'S &. COIL REMOVAL NOTE ADDED	WP	WP	MJ
3	MAY 19	NOTE ADDED TO MINIMISE FLUSHING BYPASS DEADLEG	WP	WP	MJ
2	JULY 17	MINOR AMENDMENTS TO PIPE DIAMETERS EITHER SIDE OF KEY VALVES	WP	WP	AP
1	MAY 16	PIPE DIAMETERS EITHER SIDE OF KEY VALVES AMENDED. ORIFICE PLATE RELOCATED DOWNSTREAM OF FLUSHING BYPASS	WP	WP	AP

Client	Engineer: WP	Signed	Title: AHU HEATING COIL AND PRESSURE INDEPENDENT CONTROL VALVE
Contract	Checked By: WP	Signed	
	Drawn By: MC	Sheet Size: A4	Scale: NTS
	Status: FOR INFORMATION	Issue Date: MAY 2016	Drawing No: DETAIL 16
			Revision: 4

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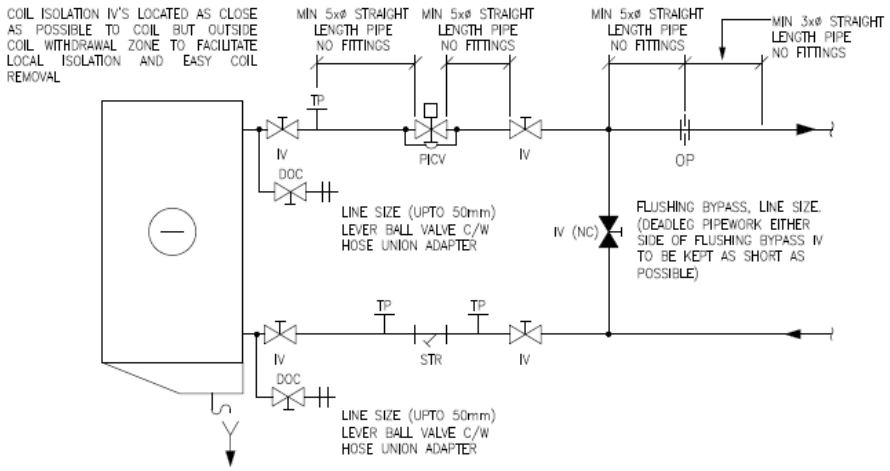
SAFETY, HEALTH & ENVIRONMENTAL INFORMATION

No specific SHE risks have been identified for the contents of this drawing.



Pressure independent control valves (PICV's), sometimes referred to as 'combination valves' integrate the functions of flow limitation, modulating control and differential pressure control within a single valve body. These valves offer benefits over other variable flow pipework systems such as differential pressure control valves (DPCV's) with reduced commissioning time, reduced capital expenditure and improved pump energy savings.

Guidance notes

1. Straight length pipe diameter distances either side of key control and measurement devices are based on Oventrop products. Where alternative products are used, straight length pipe diameter distances should be as per manufacturer recommendations or CIBSE Commissioning code W.
2. PICV's should be installed in the return branch.
3. Major terminal heating/cooling coils or heat exchangers should be protected by local strainers, which provide the additional function of protecting the control valves and measuring station.
4. Flows can be set without the need to measure the flow rate in the pipe hence measurement devices do not need to be located on every terminal branch. For checking purposes, flow measurement devices can be located on the main branches and sub branches, upstream of the terminals, as deemed appropriate.
5. Flushing bypass to be a full bore line size valve. The bypass should be located as close as possible to the coil and must be upstream of the means of isolating the coil and valve assembly.
6. The drain valves local to the coil should be as large as possible to enable local back– flushing of the coil to drain. Draining should be carried out using clean, inhibited water, following the chemical cleaning and dosing of the remainder of the system.
7. For variable flow systems, cavitation checks should be carried out by the system designer for suspected vulnerable devices.
8. The DPCV component of the PICV usually requires 15–40kPa to enable the spring to move and control. This value must be added to the pump design pressure.
9. Check maximum pressure differential the DPCV in the PICV can operate against. This is typically in the range of 20–400Kpa.
10. To ensure minimum pump flow, provide adequate constant flow devices at system extremities.
12. The DPCV component of the PICV usually require 15–40 kPa to enable the spring to move and control. This value must be added to the pump design pressure.

For further information and guidance on the selection of PICV's refer to CIBSE knowledge series KS7 (supplement). For further guidance regarding pre–commission cleaning, refer to BSRIA technical Guide BG29/2012. For information & guidance on commissioning of systems using DPCV's refer to BSRIA BG2/2010 "commissioning water systems".

Rev	Date	Description	Eng	Chk	Dm
4	JUNE 20	LOCAL COIL ISOLATION IV'S & COIL REMOVAL NOTE ADDED	WP	WP	MJ
3	MAY 19	NOTE ADDED TO MINIMISE FLUSHING BYPASS DEADLEG	WP	WP	MJ
2	JULY 17	MINOR AMENDMENTS TO PIPE DIAMETERS EITHER SIDE OF KEY VALVES	WP	WP	AP
1	MAY 16	PIPE DIAMETERS EITHER SIDE OF KEY VALVES AMENDED. ORIFICE PLATE RELOCATED DOWNSTREAM OF FLUSHING BYPASS	WP	WP	AP

Client	Engineer WP	Signed	Title AHU COOLING COIL WITH PRESSURE INDEPENDENT CONTROL VALVE		
Contract	Checked By WP	Signed			
	Drawn By MC	Sheet Size A4	Scale NTS	Status FOR INFORMATION	Issue Date MAY 2016
				Drawing No DETAIL 17	Revision 4

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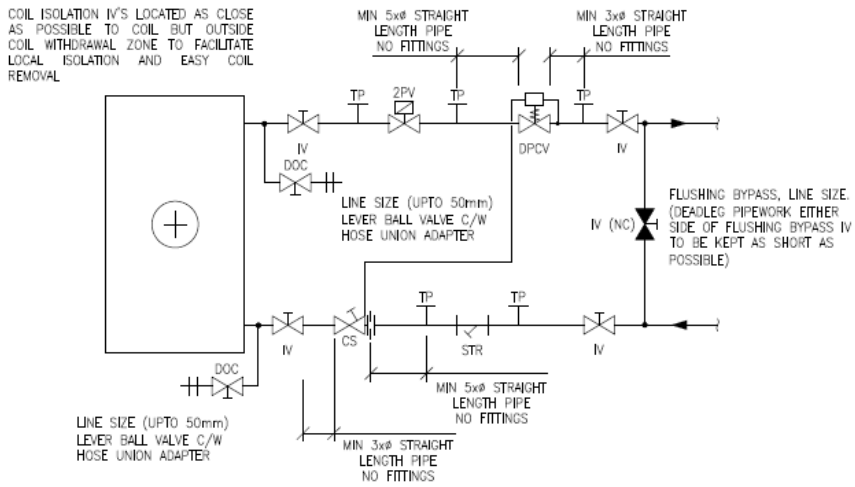
SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
No specific SHE risks have been identified for the contents of this drawing.



Differential pressure control valves (DPCV's) are used to control and limit part load pressure variations at key points in the system. They act to maintain a constant pressure across the branches in which they are connected.

Guidance notes

1. Straight length pipe diameter distances either side of key control and measurement devices are based on Oventrop products. Where alternative products are used, straight length pipe diameter distances should be as per manufacturer recommendations or CIBSE Commissioning code W.
2. The optimum application of DPCV's is locating them as close as possible to the terminal unit. However, this should be balanced against cost as DPCV's are relatively expensive valves even at small sizes. DPCV's are therefore normally installed on individual sub-branches serving a number of terminal units (see figure 5 page 17 of CIBSE KS 7).
3. All terminal units should be fed from standard flow and return pipework circuits.
4. All pipes should be sized within a pressure limit in the region of 250Pa/m.
5. To maximise the number of potential locations for DPCV's the system should be divided into a series of sub-branches each serving as many terminal units as possible but with a limiting criteria (see notes 8 and 9 of CIBSE KS 7 page 18). i.e. the pressure controlled should not exceed1.5 times the design pressure loss across the end terminal branch.
6. DPCV's should be installed in the return pipes from the circuits with a pressure line connecting to the flow side of the controlled pressure.
7. DPCV's require a minimum pressure differential across the valve to operate correctly. This is in the range of 15–30Kpa and must be added to the design pump pressure
8. Flushing bypass to be a full bore line size valve. The bypass should be located as close as possible to the coil and must be upstream of the means of isolating the coil and valve assembly.
9. The drain valves local to the coil should be as large as possible to enable local back- flushing of the coil to drain. Draining should be carried out using clean, inhibited water, following the chemical cleaning and dosing of the remainder of the system.
10. For variable flow systems, cavitation checks should be carried out by the system designer for suspected vulnerable devices.

For further information and guidance on the selection of DPCV's refer to CIBSE knowledge series KS7. For further guidance regarding pre-commission cleaning, refer to BSRIA technical Guide BG29/2012. For information & guidance on commissioning of systems using DPCV's refer to BSRIA BG2/2010 "commissioning water systems".

Rev	Date	Description	Eng	Chk	Dm
3	JUNE 20	LOCAL COIL ISOLATION VALVES AND NOTE REGARDING COIL REMOVAL ADDED. TP ADDED DOWNSTREAM OF DPCV.	WP	WP	AP
2	JULY 17	MINOR AMENDMENTS TO PIPE DIAMETERS EITHER SIDE OF KEY VALVES	WP	WP	AP
1	MAY 16	PIPE DIAMETERS EITHER SIDE OF KEY VALVES AMENDED.	WP	WP	AP

Client	Engineer: WP	Signed	Title: AHU HEATING COIL WITH 2-PORT CONTROL VALVE AND DIFFERENTIAL PRESSURE CONTROL VALVE
Contract	Checked By: WP	Signed	
	Drawn By: MC	Sheet Size: A4	Scale: NTS
	Status: FOR INFORMATION	Issue Date: MAY 2016	Drawing No: DETAIL 18
			Revision: 3

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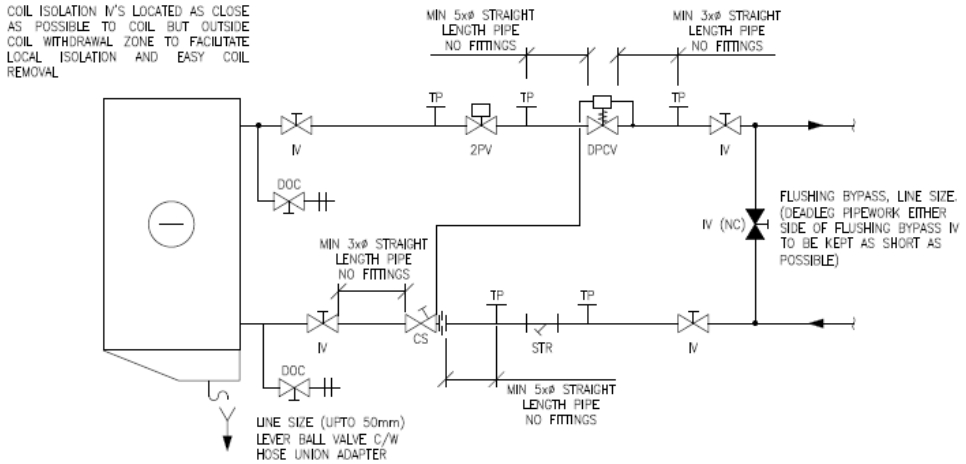
SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
No specific SHE risks have been identified for the contents of this drawing.



Differential pressure control valves (DPCV's) are used to control and limit part load pressure variations at key points in the system. They act to maintain a constant pressure across the branches in which they are connected.

Guidance notes

1. Straight length pipe diameter distances either side of key control and measurement devices are based on Oventrop products. Where alternative products are used, straight length pipe diameter distances should be as per manufacturer recommendations or CIBSE Commissioning code W.
2. The optimum application of DPCV's is locating them as close as possible to the terminal unit. However, this should be balanced against cost as DPCV's are relatively expensive valves even at small sizes. DPCV's are therefore normally installed on individual sub–branches serving a number of terminal units (see figure 5 page 17 of CIBSE KS 7).
3. All terminal units should be fed from standard flow and return pipework circuits.
4. All pipes should be sized within a pressure limit range of 250kPa.
5. To maximise the number of potential locations for DPCV's the system should be divided into a series of sub–branches each serving as many terminal units as possible but with a limiting criteria (see notes 8 and 9 of CIBSE KS 7 page 18). i.e. the pressure controlled should not exceed1.5 times the design pressure loss across the end terminal branch.
6. DPCV's should be installed in the return pipes from the circuits with a pressure line connecting to the flow side of the controlled pressure.
7. DPCV's require a minimum pressure differential across the valve to operate correctly. This is in the range of 15–30Kpa and must be added to the design pump pressure.
8. Flushing bypass to be a full bore line size valve. The bypass should be located as close as possible to the coil and must be upstream of the means of isolating the coil and valve assembly.
9. The drain valves local to the coil should be as large as possible to enable local back– flushing of the coil to drain. Draining should be carried out using clean, inhibited water, following the chemical cleaning and dosing of the remainder of the system.
10. For variable flow systems, cavitation checks should be carried out by the system designer for suspected vulnerable devices.

For further information and guidance on the selection of DPCV's refer to CIBSE knowledge series KS7. For further guidance regarding pre–commission cleaning, refer to BSRIA technical Guide BG29/2012. For information & guidance on commissioning of systems using DPCV's refer to BSRIA BG2/2010 "commissioning water systems".

Rev	Date	Description	Eng	Chk	Drn
3	JUNE 20	LOCAL COIL ISOLATION VALVES AND NOTE REGARDING COIL REMOVAL ADDED. TP ADDED DOWNSTREAM OF DPCV.	WP	WP	AP
2	JULY 17	FLEXIBLE CONNECTIONS MOVED TO DIRECTLY ADJACENT TO TERMINAL UNIT	WP	WP	AP
1	MAY 16	PIPE DIAMETERS EITHER SIDE OF KEY VALVES AMENDED.	WP	WP	AP

Client

Contract

Engineer WP — Signed

Checked By WP — Signed

Drawn By MC — Sheet Size A4 — Scale NTS

Title: AHU COOLING COIL WITH 2-PORT CONTROL VALVE AND DIFFERENTIAL PRESSURE CONTROL VALVE

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Status FOR INFORMATION — Issue Date MAY 2016 — Drawing No DETAIL 19 — Revision 2

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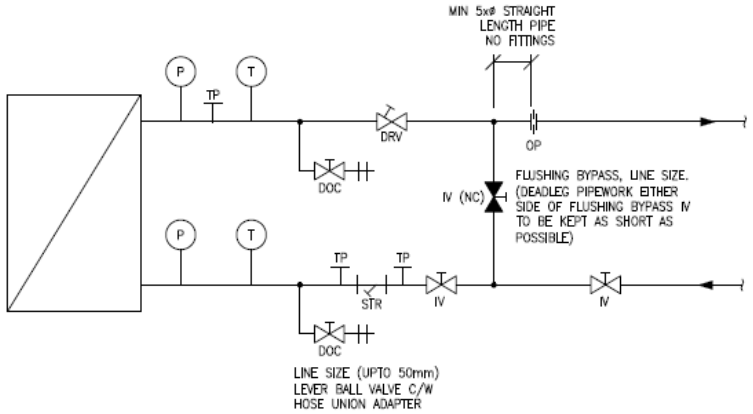
SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
No specific SHE risks have been identified for the contents of this drawing.



Guidance notes

1. Straight length pipe diameter distances either side of key control and measurement devices are based on Oventrop products. Where alternative products are used, straight length pipe diameter distances should be as per manufacturer recommendations or CIBSE Commissioning code W.
2. All primary heat exchangers or generators such as boilers, chillers and major coils should be protected by local strainers fitted as close to possible to the water inlet connection and provided with a means of local isolation.
3. For flushing purposes, the bypass should be line size to minimise pipework resistance at flushing velocities. For multiple chiller installations, the bypass resistance should be balanced with the chiller resistance. This will assist during maintenance operations by allowing individual chillers to be isolated without disrupting the flows to the others. For this function, the isolating valve would be replaced by a regulating valve.
4. Pipework and fittings immediately adjacent to primary heat exchangers should be readily demountable to facilitate visual inspection of the inner surfaces of the heat exchanger.
5. Adequately sized drain connections for flushing and cleaning purposes should be fitted on both sizes of the heat exchanger.

For further guidance regarding pre-commission cleaning, refer to BSRIA technical Guide BG29/2012. For information & guidance on commissioning of systems using DPCV's refer to BSRIA BG2/2012 "commissioning water systems".

Rev	Date	Description	Eng	Chk	Drn
3	MAY 19	ADDITIONAL DEVICES ADDED TO FACILITATE PRE-COMMISSION CLEANING	WP	WP	MJ
2	JULY 17	MINOR AMENDMENTS TO PIPE DIAMETERS EITHER SIDE OF KEY VALVES	WP	WP	AP
1	MAY 16	PIPE DIAMETERS EITHER SIDE OF KEY VALVES AMENDED.	WP	WP	AP

Client

Contract

Engineer: WP — Signed

Checked By: WP — Signed

Drawn By: MC

Sheet Size: A4

Scale: NTS

Title: PROVISIONS AT HEAT EXCHANGERS

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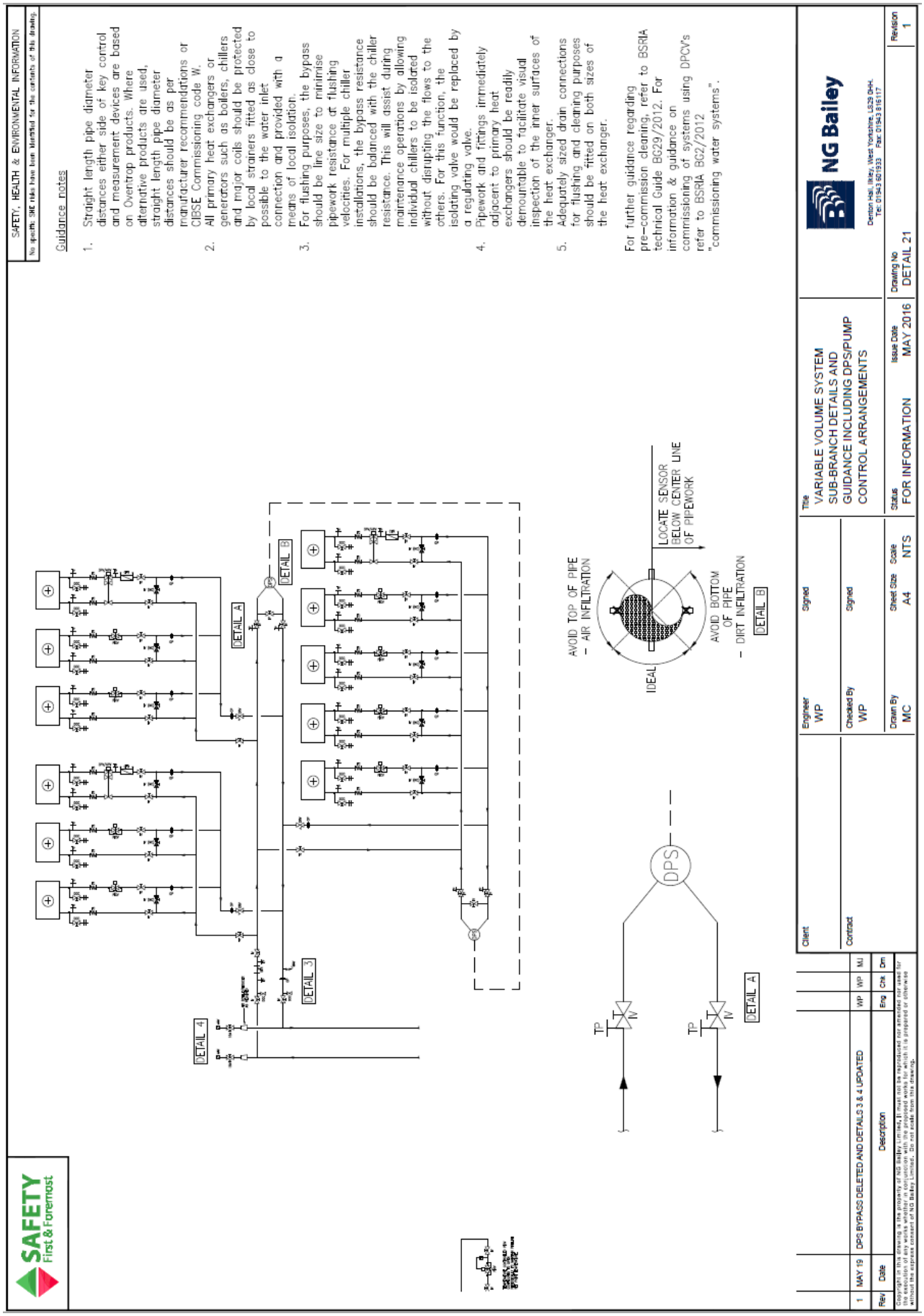
Status: FOR INFORMATION

Issue Date: MAY 2016

Drawing No: DETAIL 20

Revision: 3


SAFETY: HEALTH & ENVIRONMENTAL INFORMATION
No specific SHE risks have been identified for the contents of this drawing.
Guidance notes
1. Straight length pipe diameter distances either side of key control and measurement devices are based on Oventrop products. Where alternative products are used, straight length pipe diameter distances should be as per manufacturer recommendations or CIBSE Commissioning code W.
2. All primary heat exchangers or generators such as boilers, chillers and major coils should be protected by local strainers fitted as close to possible to the water inlet connection and provided with a means of local isolation.
3. For flushing purposes, the bypass should be line size to minimise pipework resistance of flushing velocities. For multiple chiller installations, the bypass resistance should be balanced with the chiller resistance. This will assist during maintenance operations by allowing individual chillers to be isolated without disrupting the flows to the others. For this function, the isolating valve would be replaced by a regulating valve.
4. Pipework and fittings immediately adjacent to primary heat exchangers should be readily demountable to facilitate visual inspection of the inner surfaces of the heat exchanger.
5. Adequately sized drain connections for flushing and cleaning purposes should be fitted on both sizes of the heat exchanger.
For further guidance regarding pre-commission cleaning, refer to BSRIA technical Guide BG29/2012. For information & guidance on commissioning of systems using DPCVs refer to BSRIA BG2/2012 "commissioning water systems".
DETAIL A
DETAIL B
DETAIL 3
DETAIL 4
AVOID TOP OF PIPE – AIR INFILTRATION
LOCATE SENSOR BELOW CENTER LINE OF PIPEWORK
IDEAL
AVOID BOTTOM OF PIPE – DIRT INFILTRATION
DETAIL B
DPS
TP
IV
TP
IV
DETAIL A
Client
Contact
Engineer WP Signed
Checked By WP Signed
Drawn By MC
Sheet Size A4
Scale NTS
Title
VARIABLE VOLUME SYSTEM SUB-BRANCH DETAILS AND GUIDANCE INCLUDING DPS/PUMP CONTROL ARRANGEMENTS
Status FOR INFORMATION
Issue Date MAY 2016
Drawing No DETAIL 21
Revision 1
NG Bailey
Denton Hall, Ilkley, West Yorkshire, LS29 6HH.
Tel: 01943 861933 Fax: 01943 816117
Rev Date Description Eng Chk Dm
1 MAY 19 DPS BYPASS DELETED AND DETAILS 3 & 4 UPDATED WP WP MJ
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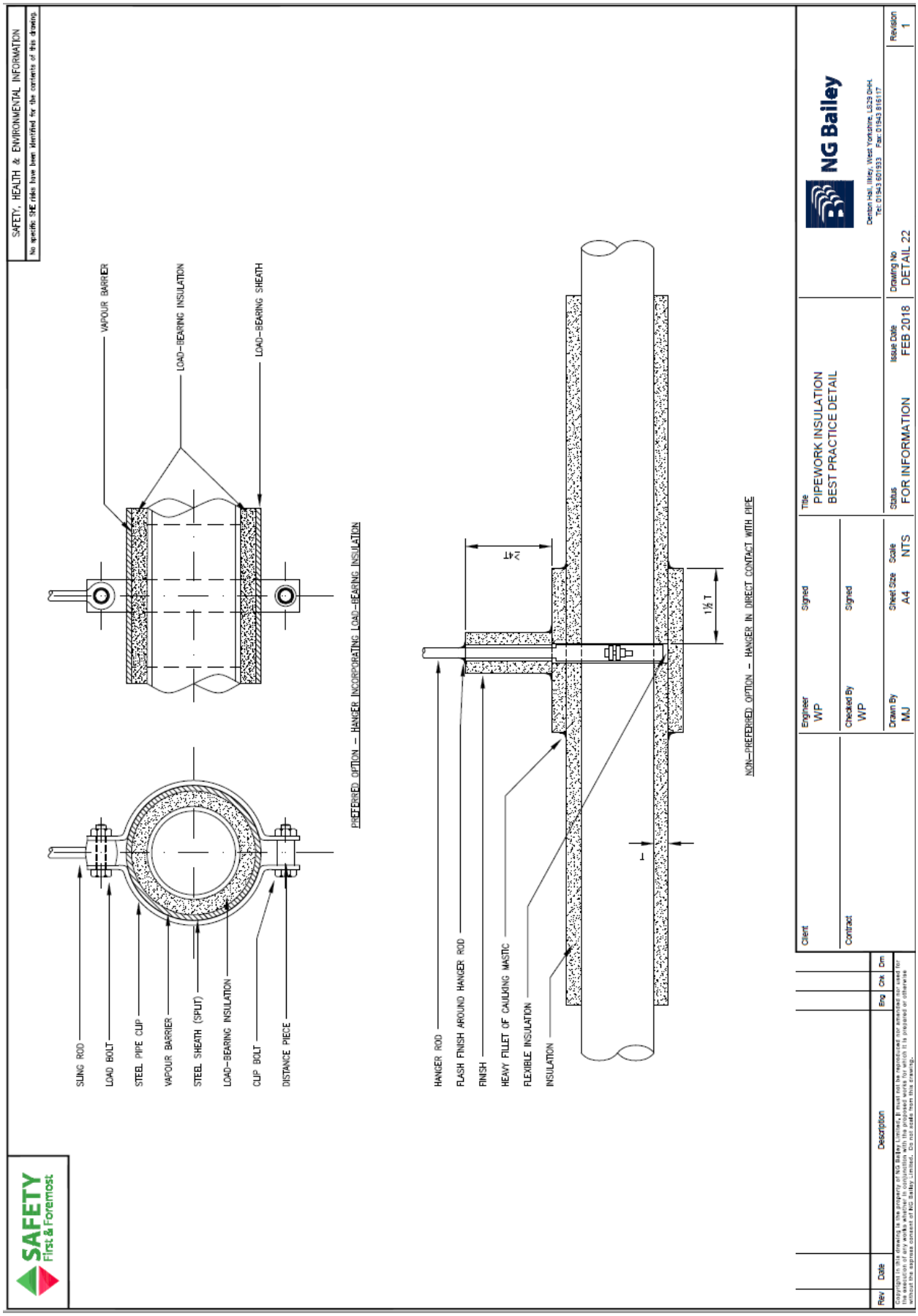
SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
No specific SHE risks have been identified for the contents of this drawing.
VAPOUR BARRIER
LOAD-BEARING INSULATION
LOAD-BEARING SHEATH
SLING ROD
LOAD BOLT
STEEL PIPE CLIP
VAPOUR BARRIER
STEEL SHEATH (SPLIT)
LOAD-BEARING INSULATION
CLIP BOLT
DISTANCE PIECE
PREFERRED OPTION - HANGER INCORPORATING LOAD-BEARING INSULATION
HANGER ROD
FLASH FINISH AROUND HANGER ROD
FINISH
HEAVY FILLET OF CAULKING MASTIC
FLEXIBLE INSULATION
INSULATION
2T
1½ T
T
NON-PREFERRED OPTION - HANGER IN DIRECT CONTACT WITH PIPE
SAFETY First & Foremost
Rev
Date
Description
Eng
Chk
Drn
Client
Contact
Engineer WP
Signed
Checked By WP
Signed
Drawn By MJ
Sheet Size A4
Scale NTS
Title
PIPEWORK INSULATION
BEST PRACTICE DETAIL
Status
FOR INFORMATION
Issue Date
FEB 2018
Drawing No
DETAIL 22
Revision
1
NG Bailey
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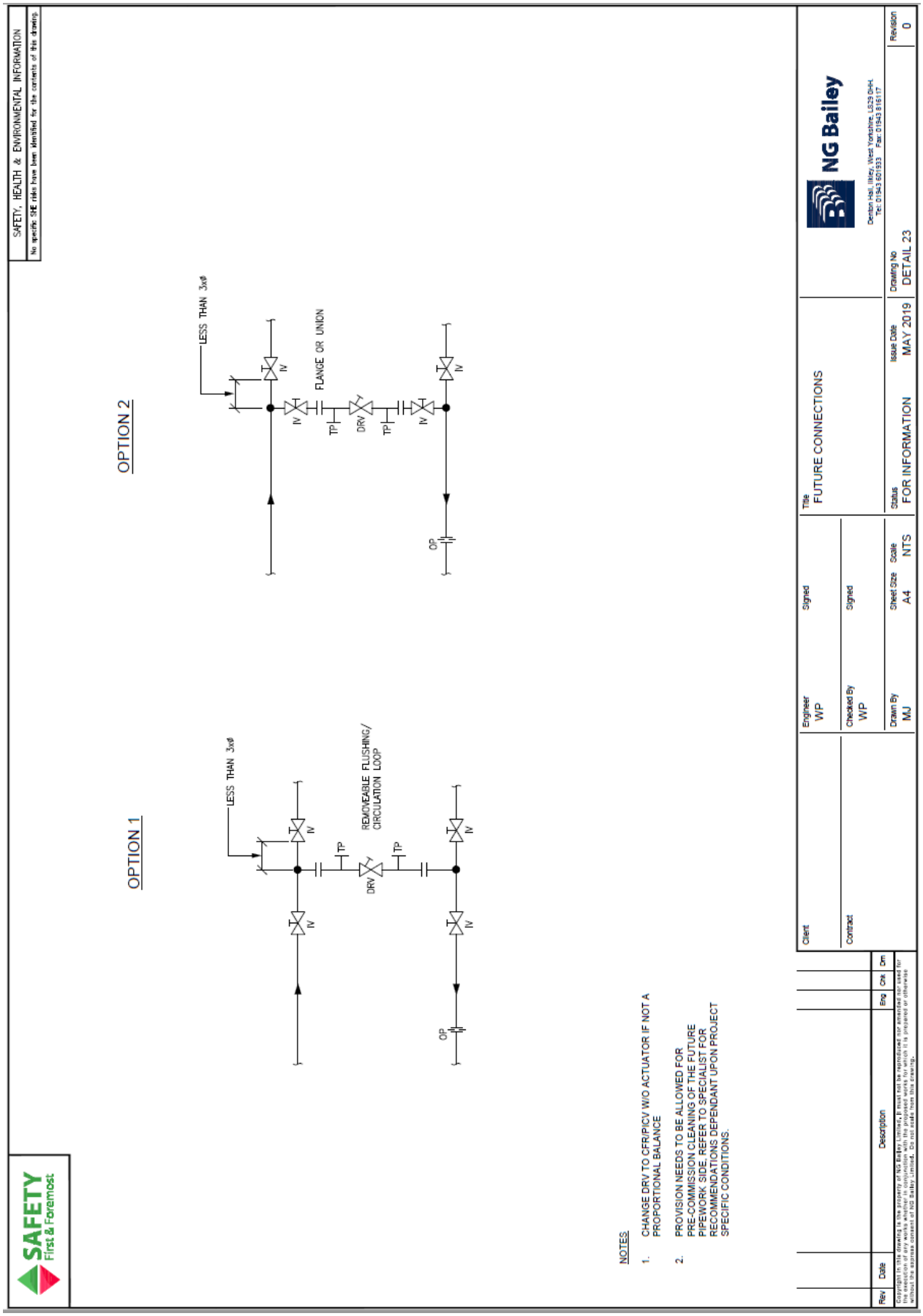
SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
No specific SHE risks have been identified for the contents of this drawing.
OPTION 2
LESS THAN 3xØ
IV
FLANGE OR UNION
TP
DRV
OP
OPTION 1
REMOVEABLE FLUSHING/ CIRCULATION LOOP
NOTES
1. CHANGE DRV TO CFR/PICV W/O ACTUATOR IF NOT A PROPORTIONAL BALANCE
2. PROVISION NEEDS TO BE ALLOWED FOR PRE-COMMISSION CLEANING OF THE FUTURE PIPEWORK SIDE. REFER TO SPECIALIST FOR RECOMMENDATIONS DEPENDANT UPON PROJECT SPECIFIC CONDITIONS.
SAFETY First & Foremost
Rev
Date
Description
Eng
Chk
Dm
Client
Contract
Engineer WP
Signed
Checked By WP
Signed
Drawn By MJ
Sheet Size A4
Scale NTS
Title FUTURE CONNECTIONS
Status FOR INFORMATION
Issue Date MAY 2019
Drawing No DETAIL 23
Revision 0
NG Bailey
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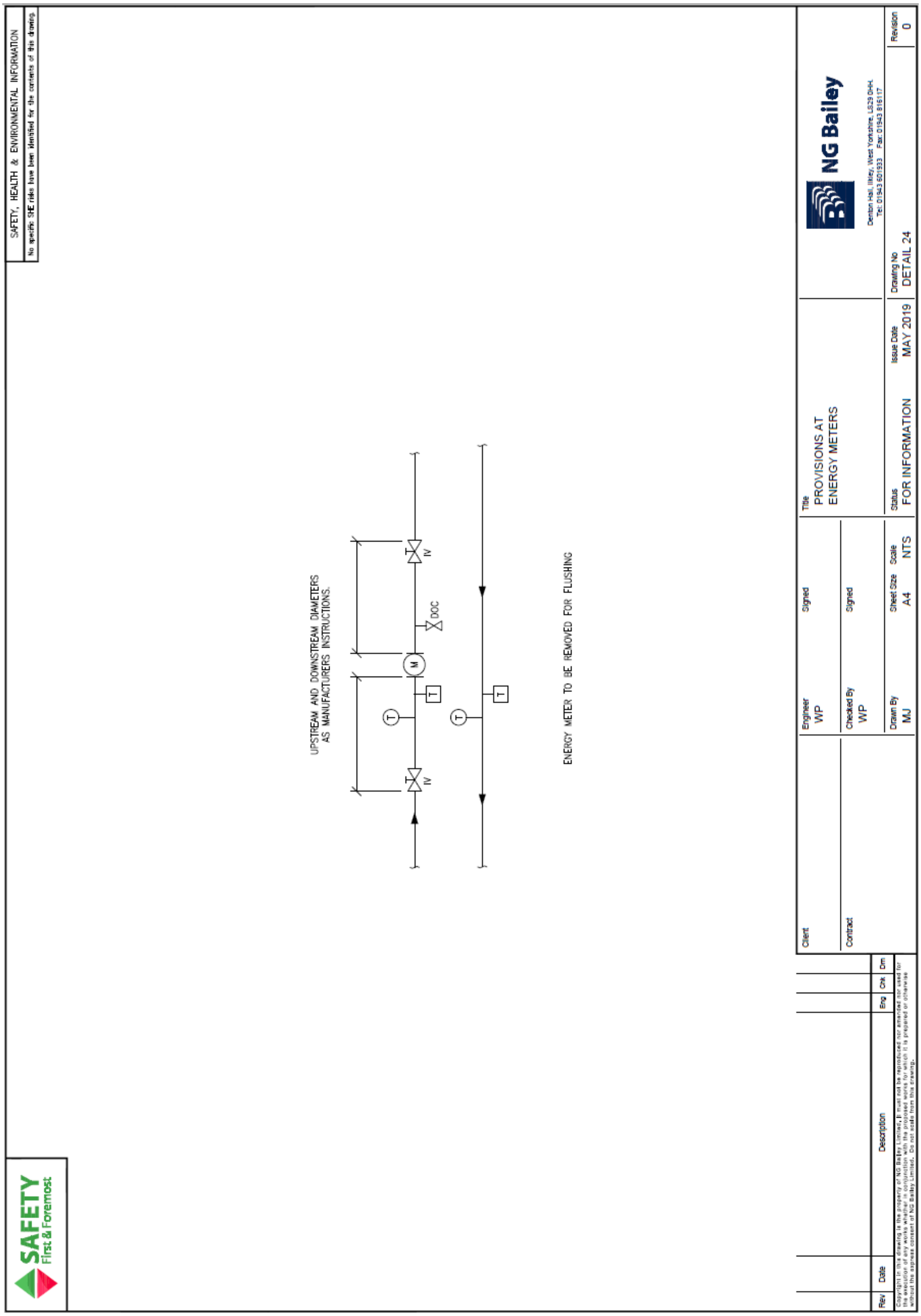
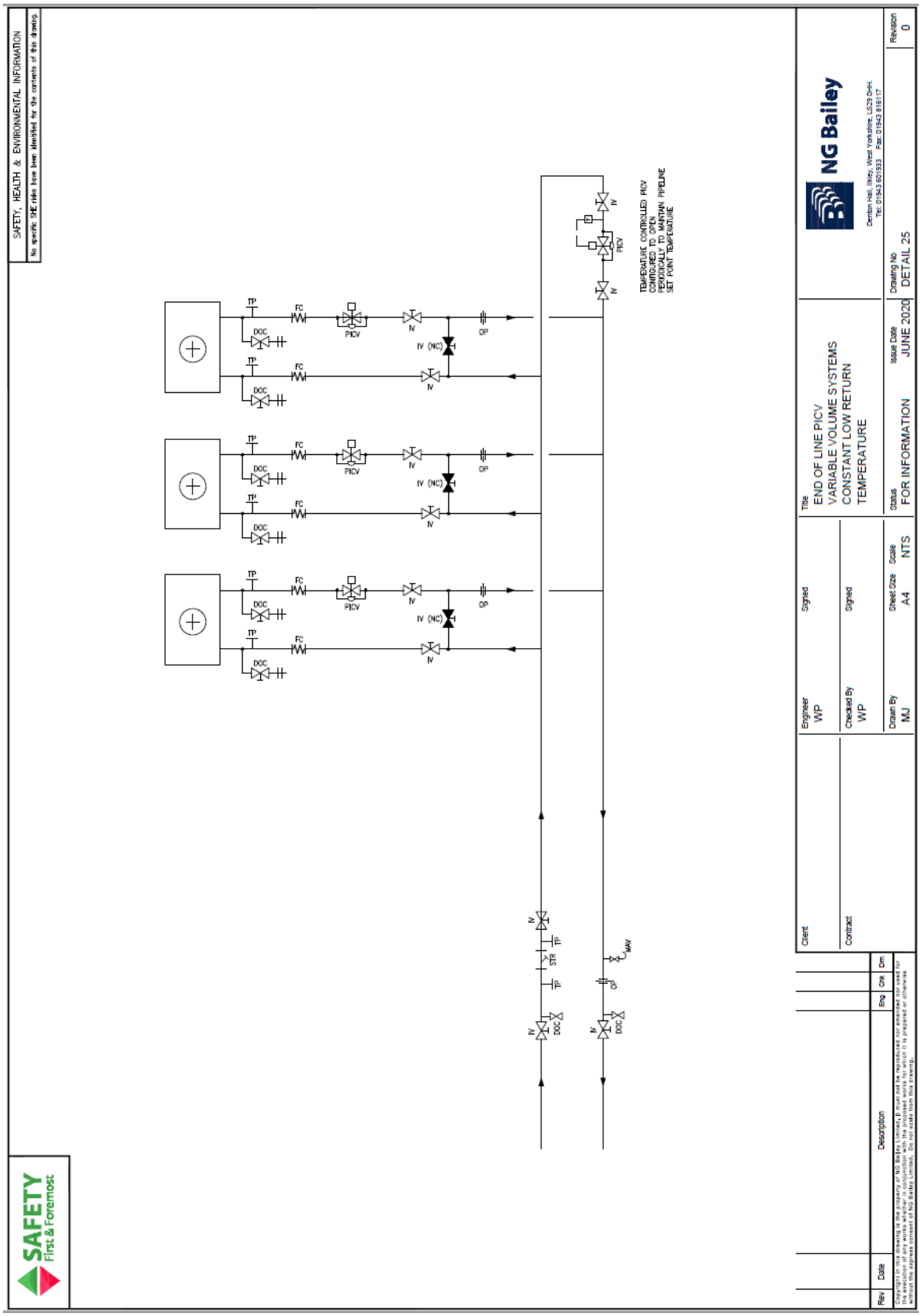

SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
No specific SHE risks have been identified for the contents of this drawing.
UPSTREAM AND DOWNSTREAM DIAMETERS AS MANUFACTURERS INSTRUCTIONS.
IV
DOC
M
T
ENERGY METER TO BE REMOVED FOR FLUSHING
SAFETY First & Foremost
Rev
Date
Description
Eng
Chk
Drn
Client
Contract
Engineer
WP
Checked By
WP
Signed
Signed
Title
PROVISIONS AT ENERGY METERS
NG Bailey
Denton Hall, Ilkley, West Yorkshire, LS29 0HH.
Tel: 01943 601933 Fax: 01943 816117
Drawn By
MJ
Sheet Size
A4
Scale
NTS
Status
FOR INFORMATION
Issue Date
MAY 2019
Drawing No
DETAIL 24
Revision
0


SAFETY, HEALTH & ENVIRONMENTAL INFORMATION
No specific SHE risks have been identified for the contents of this drawing.
TEMPERATURE CONTROLLED PICV CONFIGURED TO OPEN PERIODICALLY TO MAINTAIN PIPELINE SET POINT TEMPERATURE
TP
FC
DOC
PICV
IV
IV (NC)
OP
STR
MAV
NG Bailey
Denton Hall, Illley, West Yorkshire, LS29 0HH.
Tel: 01943 601933 Fax: 01943 816117
Client
Contract
Engineer WP
Checked By WP
Drawn By MJ
Signed
Signed
Sheet Size A4
Scale NTS
Title
END OF LINE PICV
VARIABLE VOLUME SYSTEMS
CONSTANT LOW RETURN
TEMPERATURE
Status FOR INFORMATION
Issue Date JUNE 2020
Drawing No DETAIL 25
Revision 0
Rev
Date
Description
Eng
Chk
Dm
SAFETY First & Foremost