Series Specifications 20JF16.E3 (Series 20JF16, 20JF16-C)
Rev B - Feb-19-2009

Table 20JF16.E3.1A
(Series 20JF16, 20JF16-C)
Mechanical Specifications

Series	20JF16, 20JF16-C

Temp (F)	Pipe Strengths (psi)					Pipe Moduli (psi)				
	Axial Tensile	Hoop Tensile	Axial Flex.	Hoop Flex.	Axial Comp.	Axial Tensile	Hoop Tensile	Axial Flex.	Hoop Flex.	Axial Comp.
Ambient	8,400	26,400	16,800	N/A	18,000	1,400,000	2,200,000	1,400,000	2,200,000	1,500,000
150	8,400	26,400	16,800	N/A	18,000	1,400,000	2,200,000	1,400,000	2,200,000	1,500,000
175	7,980	25,080	15,540	N/A	17,100	1,330,000	2,090,000	1,295,000	2,035,000	1,425,000
200	7,560	23,760	14,280	N/A	16,200	1,260,000	1,980,000	1,190,000	1,870,000	1,350,000
225										
250										

ASTM D4024 / D5421 Flange Codes

2" - 6" Flanges, 232psi	RTR-111D-445; CM-B4I
8" Flanges, 232psi	RTR-111D-446; CM-B4I
10" - 12" Flanges, 232psi	RTR-111D-447; CM-B4I

All materials are contact molded (closest definition to filament wound in D4024), epoxy vinyl ester resin, integrally molded flange.
The grade epoxy is interpreted to include epoxy vinyl esters.
ASTM D5421 does not have ratings above 150psi.

ASTM D2310 / D2996 Pipe Codes

2" - 3" Pipe	RTRP-11FT1-1112
4" Pipe	RTRP-11FT1-1113
6" Pipe	RTRP-11FT1-1114
8" and larger Pipe	RTRP-11FT1-1116

All materials are filament wound, epoxy vinyl ester resin, reinforced liner, HDB of > 5,000psi for joints, > 10,000psi for pipe (axial loads included).
Short term hoop strength > 10,000psi; long. tensile strength > 8,000psi;
Long. tensile modulus > 1,000,000psi; stiffness factor varies with pipe size.
The grade epoxy is interpreted to include epoxy vinyl esters.
Replace 'T' with 'Q' for the HDB rating of joints.

ASTM F1173 / ISO15840 Codes

Type I, Resin 2, Class B, Rating Method 1 and 4
Fire Endurance: Fluid S, Fire Type IF, Integrity B, Duration 30

ASTM F1173 / ISO15840 Codes (continued)

Fire Endurance: Fluid EF, Fire Type JF, Integrity C, Duration 25
Fire Endurance: Fluid EF, Fire Type IF, Integrity B, Duration 30

Other Properties

Density (lb/cu in.)	0.06
Shear Modulus (psi)	1,400,000
Thermal Expansion Coefficient (in./in./F)	0.00001
Thermal Conductivity (BTU-in./ft^2-hr-F)	1.3
Minor Poisson's Ratio, υmin = υha	0.55
Major Poisson's Ratio, Ea/Eh*υha = υah	0.35
Hazen Williams Coefficient	150
Specific Roughness (in.)	0.0002

ASTM D5685 Fittings Codes

2" - 24" Fittings, 232psi RTRF 52E4E
Contact molded fittings, epoxy vinyl ester resin, reinforced liner, butt & strap joint, 200psig rating (closest to 232psi)

Notes:
1. Axial flexural is also termed bending; hoop flexural is also termed circumferential.
2. Blank areas are Not Recommended.

Series Specifications 20JF16.E3 (Series 20JF16, 20JF16-C)
Rev B - Feb-19-2009

Table 20JF16.E3M.1A (Metric)
(Series 20JF16, 20JF16-C)
Mechanical Specifications

Series	20JF16, 20JF16-C

Temp (C)	Pipe Strengths (MPa)					Pipe Moduli (GPa)				
	Axial Tensile	Hoop Tensile	Axial Flex.	Hoop Flex.	Axial Comp.	Axial Tensile	Hoop Tensile	Axial Flex.	Hoop Flex.	Axial Comp.
Ambient	57.9	182.0	115.8	N/A	124.1	9.7	15.2	9.7	15.2	10.3
65.6	57.9	182.0	115.8	N/A	124.1	9.7	15.2	9.7	15.2	10.3
79.4	55.0	172.9	107.1	N/A	117.9	9.2	14.4	8.9	14.0	9.8
93.3	52.1	163.8	98.5	N/A	111.7	8.7	13.7	8.2	12.9	9.3
107.2										
121.1										

ASTM D4024 / D5421 Flange Codes

2" - 6" Flanges, 232psi	RTR-111D-445; CM-B4I
8" Flanges, 232psi	RTR-111D-446; CM-B4I
10" - 12" Flanges, 232psi	RTR-111D-447; CM-B4I

All materials are contact molded (closest definition to filament wound in D4024), epoxy vinyl ester resin, integrally molded flange.
The grade epoxy is interpreted to include epoxy vinyl esters.
ASTM D5421 does not have ratings above 150psi.

ASTM D2310 / D2996 Pipe Codes

2" - 3" Pipe	RTRP-11FT1-1112
4" Pipe	RTRP-11FT1-1113
6" Pipe	RTRP-11FT1-1114
8" and larger Pipe	RTRP-11FT1-1116

All materials are filament wound, epoxy vinyl ester resin, reinforced liner, HDB of > 5,000psi for joints, > 10,000psi for pipe (axial loads included).
Short term hoop strength > 10,000psi; long. tensile strength > 8,000psi;
Long. tensile modulus > 1,000,000psi; stiffness factor varies with pipe size.
The grade epoxy is interpreted to include epoxy vinyl esters.
Replace 'T' with 'Q' for the HDB rating of joints.

ASTM F1173 / ISO15840 Codes

Type I, Resin 2, Class B, Rating Method 1 and 4
Fire Endurance: Fluid S, Fire Type IF, Integrity B, Duration 30

ASTM F1173 / ISO15840 Codes (continued)

Fire Endurance: Fluid EF, Fire Type JF, Integrity C, Duration 25
Fire Endurance: Fluid EF, Fire Type IF, Integrity B, Duration 30

Other Properties

Density (g/cu cm)	1.7
Shear Modulus (GPa)	9.7
Thermal Expansion Coefficient (mm/mm/C)	0.000018
Thermal Conductivity (W-cm/cm^2-C)	0.0019
Minor Poisson's Ratio, υmin = υha	0.55
Major Poisson's Ratio, Ea/Eh*υha = υah	0.35
Hazen Williams Coefficient	150
Specific Roughness (cm)	0.0005

ASTM D5685 Fittings Codes

2" - 24" Fittings, 232psi RTRF 52E4E
Contact molded fittings, epoxy vinyl ester resin, reinforced liner, butt & strap joint, 200psig rating (closest to 232psi)

Notes:
1. Axial flexural is also termed bending; hoop flexural is also termed circumferential.
2. Blank areas are Not Recommended.

Rev B - Sep-23-2010

Table 20JF16.E3.5A
(Series 20JF16, 20JF16-C)
Stress Analysis Data

Material Properties

C_t	0.000010	in./in./F	0.000018	mm/mm/C
$E_a = E_x$	1,400,000	psi	9.7	GPa
$\upsilon_{min} = \upsilon_{ha}$	0.55		0.55	
E_h	2,200,000	psi	15.2	GPa
rho	0.060	lb/in.^{3}	1.7	g/cm^3
$E_a/E_h * \nu_{ha} = \upsilon_{ah}$	0.35		0.35	

UKOOA Data

SH, f_1*LTHS	10,000 psi	69.0 MPa
R, Sa(0:1) / Sa(2:1)	0.64	0.64
f_2 - sustained	0.67	0.67
f_2 - thermal	0.83	0.83
f_2 - occasional	0.89	0.89
K	Mean temperature change multiplier, 0.85 for liquids, 0.8 for gases, 1.0 for amb. temp changes.	

BS7159 Data

SH, ε_d*E_a	2,520 psi	17.4 MPa
	(based on 0.0018 design strain)	
E_h/E_a	1.57	1.57
K	Mean temperature change multiplier, 0.85 for liquids, 0.8 for gases, 1.0 for amb. temp changes.	
Kn	Fatigue factor, 1.0 for static applications	

ISO14692 Data

al(0:1)	2,722 psi	18.8 MPa
al(2:1)	4,278 psi	29.5 MPa
hl(2:1)	8,556 psi	59.0 MPa
Qs-bends	4,850 psi	33.4 MPa
r-bends	1.9	1.9
Eh/Ea-bends	1.0	1.0
Qs-joints	4,104 psi	28.3 MPa
r-joints	2.0	2.0
A1	1.0 up to 150F	1.0 up to 65c
System design factor	0.67-sustained, 0.83-thermal, 0.89-occasional	
Thermal factor, k	Same as UKOOA	

Caution should be used when selecting ISO14692 as a design code in some software. The inability to adjust the biaxial stress ratio for tees and the inability to select Type 2 laminate construction for elbows may have an effect on the results. UKOOA as a design code may be a better selection even though this code does not offer the ability to adjust f_2 for the various loading cases.

D	tr,min
1	0.60"
1.5	0.60"
2	0.60"
3	0.60"
4	0.60"
6	0.60"
8	0.60"
10	0.60"
12	0.60"
14	0.64"
16	0.71"
18	0.78"
20	0.85"
24	0.99"

D	tr,min
25	15.2mm
40	15.2mm
50	15.2mm
80	15.2mm
100	15.2mm
150	15.2mm
200	15.2mm
250	15.2mm
300	15.2mm
350	16.2mm
400	18.1mm
450	19.8mm
500	21.5mm
600	25.1mm

Stress Intensification Factors (Series 20JF, 20JF-C)
Rev A - Oct-27-2008

Table 20JF16.E3.4A
(20JF16, 20JF16-C)
ISO 14692 Part 3 - Annex D Calculations

Stress Intensification Factors (SIFs), Flexibility Factors (Kappa), Pressure Stress Multipliers (PSMs)
(BS7159, Type 2 Laminate, 0.0012 design strain)

Size	Series 20JF, 20JF-C						
	Elbows					Tees	
	Flexibility	Axial bending SIF		Hoop bending SIF			
(in.)	Factor	In-plane	Out-of-plane	In-plane	Out-of-plane	SIF	PSM
2	1.3	1.1	1.2	1.9	1.7	1.1	1.0
3	1.9	1.5	1.6	2.5	2.2	1.3	1.0
4	2.5	1.7	1.8	2.5	2.5	1.5	1.0
6	2.9	1.9	2.1	2.5	2.5	1.7	1.0
8	2.8	1.9	2.0	2.5	2.5	1.7	1.0
10	3.0	2.0	2.1	2.5	2.5	1.8	1.0
12	2.9	1.9	2.1	2.5	2.5	1.7	1.0
14	3.0	2.2	2.4	2.5	2.5	2.0	1.0
16	3.0	2.1	2.3	2.5	2.5	1.9	1.0
18	3.0	2.3	2.4	2.5	2.5	2.0	1.0
20	3.0	2.3	2.4	2.5	2.5	2.1	1.0
24	3.0	2.3	2.5	2.5	2.5	2.1	1.0
30	3.0	2.5	2.5	2.5	2.5	2.3	1.0
36	3.0	2.5	2.5	2.5	2.5	2.3	1.0
42	3.0	2.5	2.5	2.5	2.5	2.3	1.0
48	3.0	2.5	2.5	2.5	2.5	2.3	1.0

Note: Tees that are qualified according to ISO14692 have a PSM of 1.0. Tees that are not qualified will typically have PSMs ranging from 1.8 to 3.0. Reducing tees will have slightly different SIFs than tees; however, it is acceptable to use the same values as the same-size tees. e.g., a 6"x2" reducing tee or olet would have the same SIF as a 6" tee.