

PRODUCT AND MATERIAL SPECIFICATIONS

DATE OF PRINT

JANUARY 1, 2000

NON METALLIC RESOURCES, INC.

PAGE NO.

1 OF 4

MAXAR®

SEAMLESS FEP/FRP DUAL LAMINATE PIPE AND FITTINGS

1. SCOPE

This specification provides design information applicable to NMR's patented MAXAR® piping products (seamless FEP/FRP dual laminate). Standard manufacturing specifications and dimensions are provided, however, custom specifications and designs can be tailored for unique requirements. Consult manufacturer for more information.

2. MATERIALS

2.1 Liner: MAXAR® liners are **SEAMLESS** Fluorinated Ethylene Propylene (FEP) Teflon®. This resin meets the requirements of ASTM D2116 Type III and may include less than 1% inorganic pigment for identification. A partial list of physical properties follows:

PROPERTY	VALUE	TEST
Specific Gravity	2.13 – 2.15	ASTM D-792
Tensile Strength	3800 – 4100 PSI	ASTM D-638
Elongation	280 – 330%	ASTM D-638

2.2 Bonding Layer: Using a patented process, a seamless knit fiberglass sock is melt-bonded and partially embedded into the O.D. surface of the FEP liner. Bond strength between the FEP liner and reinforced vinyl ester casing as measured by ASTM D1781 – Climbing Drum Peel Test for Adhesives, is a minimum of 35 PLI.

2.3 Outer Casing: The bonded FEP liner is reinforced by filament wound (standard) or hand lay-up vinyl ester fiberglass construction yielding a totally bonded dual laminate. This specification indicates filament wound thicknesses per drawings STD-300 and STD-304. Hand lay-up construction when performed is per ASTM C582 Type II, Class V. Only premium grade vinyl ester resins are used with glass reinforcement and UV stabilized exterior gel coat.

3. DESIGN AND FABRICATION DETAILS

3.1 All dimensional drawings included in this paragraph are suitable for use in the design of pipe systems. Tolerances in subparagraph 3.4 should be considered in design.

3.2 Flanges for pipe spools and fittings shall have bolt circle, hole diameter and number of boltholes in accordance with ANSI 16.5 (150#), unless otherwise specified.

3.3 Fittings shall have standard face to centerline dimensions in accordance with ANSI 16.1 (150#), unless otherwise specified.

3.4 Pipe and fitting fabrication tolerances are as follows:

ITEM	DIMENSION	TOLERANCES
Pipe Spools	Length	±1/8"
	Bolt hole alignment	±1/16"
	Flange alignment	±1/32" (1" thru 4")
	(with theoretic pipe centerline)	±3/64" (6">)
Flanges	All dimensions except Thickness	ANSI 16.5
Fittings	Face to centerline	±1/8"
	Flange alignment	±1/32" (1" thru 4")
	(with theoretic pipe centerline)	±3/64" (6">)
ID/OD Radius		±1/16" (1" thru 6")
		±1/8" (8" thru 14")
		±1/4" (16" thru 24")



PRODUCT AND MATERIAL SPECIFICATIONS

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NON METALLIC RESOURCES, INC.

PAGE NO.
2 OF 4

MAXAR®

SEAMLESS FEP/FRP DUAL LAMINATE PIPE AND FITTINGS

- 3.5 Dimensional drawings of standard MAXAR® FEP products:
- SPEC-300 Piping Specification
 - STD-101 Flange Dimensions
 - STD-300 Pipe Dimensions, Pipe and Fitting Weights (1 ½"φ thru 12"φ)
 - STD-304 Pipe Dimensions, Pipe and Fitting Weights (14"φ thru 24"φ)
 - STD-301 Fitting Dimensions (1 ½"φ thru 4"φ)
 - STD-305 Fitting Dimensions (6"φ thru 24"φ)

NOTE: Non-Standard items will require customer-approved prints prior to fabrication.

4. APPLICATION AND OPERATIONAL PARAMETERS

- 4.1 Temperature Range: MAXAR® is suitable for continuous operation from <32°F (0°C) to 300°F (149°C), unless otherwise specified.
- 4.2 Pressure Range: MAXAR® is suitable for continuous operation from full vacuum to 150 PSI for 1 ½" diameter through 12" diameter and full vacuum to 100 PSI for 14" diameter through 24" diameter when operating within the temperature range specified in subsection 4.1.
- 4.3 Thermal Expansion: MAXAR® will expand (and contract) 1.7×10^{-5} in/in/°F when operating within the temperature range specified in subsection 4.1.
- 4.4 Chemical Resistance (liner): MAXAR's FEP-Teflon® liner is chemically inert to a broad range of commercial chemicals including the following:

- All acids including hydrofluoric, hydrochloric, sulfuric, and aqua regia
- All chlorides – organic and inorganic
- All sulfates – organic and inorganic
- All bleach solutions
- All solvents, all caustics, all phenols, all peroxides

*For specific corrosion resistance data, consult corrosion chart or manufacturer.

- 4.5 Chemical Resistance (structural casing): MAXAR's vinyl ester casing is inherently corrosion resistant. This typically allows open air or direct burial installation in harsh chemical environments with no additional protection. Gel coat exterior contains UV stabilizer. Fire retardant protection is available. For specific environments, consult manufacturer.
- 4.6 Gas Permeation: MAXAR's patented bonding technology eliminates air gaps between the FEP liner and vinyl ester casing. If a gas permeates the FEP liner, it is conducted directly to the vinyl-ester casing, which permeates at a higher rate than the FEP liner. This eliminates condensation between the liner and casing which is a common problem in lined steel pipe. Since these gases are not trapped between MAXAR's FEP liner and vinyl ester casing, no weep holes are required and internal corrosion of the structure is eliminated.
- 4.7 Insulation Qualities: MAXAR's vinyl ester casing yields a heat conduction factor (k) of 1.5 Btu*in/FT²/hr/°F. Check dimensional data for casing thickness. If additional thermal protection is necessary, more information is available under the PRE-INSULATED and DUAL CONTAINMENT tabs of this manual or contact the manufacturer for details on Heat Traceable, Pre-insulated and/or Dual Contained MAXAR® Systems.
- 4.8 Heat Tracing: MAXAR's vinyl ester casing is capable of handling dry heat trace applications up to 180°F. On pre-insulated MAXAR systems, channels can be provided for heat trace wire. More information is available under the PRE-INSULATED tab of this manual or contact the manufacturer.

5. INSPECTION

- 5.1 All extruded liners are inspected prior to fabrication for pinholes, cracks, gouges, nicks, or inclusion of foreign particles.
- 5.2 Completed fittings shall be subjected to a 10,000-volt, non-destructive, electrostatic test to detect pinholes. This test is to be performed by manufacturer only with properly controlled voltage and procedures.

PRODUCT AND MATERIAL SPECIFICATIONS

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JANUARY 1, 2000

NON METALLIC RESOURCES, INC.

PAGE NO.

3 OF 4

MAXAR®

SEAMLESS FEP/FRP DUAL LAMINATE PIPE AND FITTINGS

6. HANDLING AND SHIPPING

- 6.1 The gasket face of each spool or fitting shall be protected by end plates or other suitable protective means.
- 6.2 All spools and fittings shall be suitably packed to provide necessary protection during handling, shipping, and storage.

7. INSTALLATION AND ASSEMBLY DATA

- 7.1 Supports: Hangers and supports may be ordered from NMR or supplied by customer. Supports should have a 1/8" thick rubber liner. Verify actual pipe outside diameter before ordering supports. See attached drawings STD-300 and STD-304.
- 7.2 Support spacing: Support spacing can vary depending on actual service conditions and piping configuration. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending and shear stresses in the piping with special consideration given where components such as flanges and valves impose concentrated loads. Where calculations are not made, suggested maximum spacing of supports are given in the table below. Vertical supports shall be spaced to prevent the pipe from being over stressed from the combination of all loading effects (ANSI B31.1). In addition, Appendix III, Non-Mandatory Rules for Nonmetallic Piping of ANSI B31.1 should be taken into consideration. The values listed in the table are based on maximum operating conditions but do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc.

Maximum Pipe Support Spacing (ft) At Pressure Rating (psi) and Pipe Size (in)

PIPE SIZE	25	50	75	100	125	150
1 1/2"	6.0	6.0	6.0	6.0	6.0	6.0
2"	6.0	6.0	6.0	6.0	6.0	6.0
3"	6.5	6.5	6.5	6.5	8.0	8.0
4"	7.0	7.0	7.0	8.5	8.5	8.5
6"	8.0	8.0	9.0	9.0	10.0	10.5
8"	8.5	10.0	10.0	10.5	11.0	11.5
10"	9.5	10.5	11.5	12.0	12.5	13.0
12"	10.0	11.5	12.5	13.0	13.5	14.0
14"	10.5	12.0	13.0	14.0		
16"	11.0	12.5	13.5	15.0		
18"	12.0	13.5	14.5	17.0		
20"	12.5	14.0	16.0	19.0		
24"	15.0	17.5	19.0	22.0		

- 7.3 Gaskets: **GASKETS MUST BE USED IN MAXAR PIPING SYSTEMS.** Recommended gaskets are Garlock's Envelon™ Style 3565.
- 7.4 Bolts: Size and grade per ANSI specification. SAE washers shall be used on all flanged fittings. Standard hex nuts shall be used on fittings 1 1/2" diameter through 6" diameter. Fittings 8" and up can accommodate heavy hex nuts if preferred.
- 7.5 Torquing Procedure: The following procedure will insure that the necessary forces are applied to seat Envelon™ Style 3565 gaskets using the torque values of subsection 7.6. When other gasket materials are used, they should not exceed 70 durometer to assure proper seating.
 - A. Grease all bolts and nuts with a suitable grease, finger tighten all nuts.
 - B. With torque wrench, using a criss-cross method, tighten each bolt in increments as outlined below until appropriate torque values are met as specified in the Maximum Bolt Torque table under subsection 7.6.
 - C. After 24-30 hours, a temperature cycle, or a pressure cycle, torque for each bolt shall be checked. Those below the minimum are to be re-torqued to the values listed in subsection 7.6.



PRODUCT AND MATERIAL SPECIFICATIONS

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NON METALLIC RESOURCES, INC.

PAGE NO.

4 OF 4

MAXAR®

SEAMLESS FEP/FRP DUAL LAMINATE PIPE AND FITTINGS

7.6 Bolt Torque: Clamping forces between flanges can vary greatly depending on whether or not lubricated bolts are used when torquing bolts. The values listed in the table below assume that bolts are lubricated.

Maximum Bolt Torque (ft) At Pressure Rating (psi) and Pipe Size (in)

PIPE SIZE	25	50	75	100	125	150
1 1/2"	15	15	15	15	15	15
2"	25	25	25	25	25	25
3"	25	25	25	25	25	25
4"	25	25	25	25	25	25
6"	25	25	25	25	25	40
8"	25	25	30	40	50	60
10"	25	25	30	40	50	70
12"	25	25	35	45	60	80
14"	35	45	60	80		
16"	40	50	70	90		
18"	50	60	80	90		
20"	60	70	80	100		
24"	60	70	90	100		

*Indicated bolt torque is required to seat gaskets of 70 durometer on full-face flanges.

8. WARRANTY

All standard MAXAR® products are warranted for one (1) year from start-up or 18 months from delivery. Consult manufacturer for warranty information concerning customized parts or systems.

9. WAIVER

- 9.1 Every effort has been made to insure that the information provided in this specification is accurate. Changes or updates may occur without notice.
- 9.2 This specification does not purport to address any personnel safety issues associated with handling, installing, and operating pressure or vacuum pipe systems. For specific information regarding these issues, refer to applicable ASME/ANSI Codes and Standards, ASTM Standards, OSHA Regulations and qualified piping and safety engineers.



SERVICE:

AS SPECIFIED BY USER OR ENGINEERING

MATERIAL:

MAXAR AS PROVIDED BY NON METALLIC RESOURCES INC.
DUAL LAMINATE, SEAMLESS FEP TEFLON LINER WITH
BONDED FIBERGLASS REINFORCED VINYL ESTER CASING.

SIZE/RATING:

1 1/2" - 12" FULL VACUUM - 150psi 0-300°F.
14" - 24" FULL VACUUM - 100psi 0-300°F.

PIPE:

150 # FLANGED SPOOLS. 20'-0" MAXIMUM LENGTH

FITTINGS: (SEE NOTE 1 & 3)

FLANGED, 150 # RATING TO ANSI 16.1 DIMENSIONS.
FLANGE DRILLING PER ANSI 16.5.

BRANCH CONNECTIONS: (SEE NOTE 1)

USE FULL SIZE OR REDUCING TEES.

INSTRUMENT CONNECTIONS: (SEE NOTE 2)

USE TEE

FLANGES: (SEE NOTE 3)

ALL FLANGES 150# RATING PER ANSI 16.5 DIMENSIONS
(EXCEPT THICKNESS)

FIXED: FULL FACE FLANGES TO BE FABRICATED ON PIPE
SPOOLS BY PIPE MANUFACTURER. PIPE LINER TO BE
FLARED OVER FACE OF FLANGE TO INSIDE OF BOLT HOLES.

LAP JOINT: STUB END WITH LOOSE RING FABRICATED
ON PIPE BY PIPE MANUFACTURER. PIPE LINER TO BE
FLARED OVER STUB FACE TO OUTSIDE DIAMETER OF STUB.

BLINDS: FLAT FACED FRP WITH 90 MIL MIN. THICKNESS
FEP TEFLON LINER BONDED TO FACE.

ATTACHMENTS:

STD-101	FLANGE DIMENSIONS	1" - 12"
STD-300	PIPE DIMENSIONS	14" - 24"
STD-304	PIPE DIMENSIONS	1 1/2" - 4"
STD-301	FITTING DIMENSIONS	6" - 24"
STD-305	FITTING DIMENSIONS	

SPACERS:

SOLID TEFLON OR FRP WITH FEP FLARED FACE SPACERS
MAY BE USED FOR MAKEUP.

GASKETS:

GASKET MATERIAL SUITABLE FOR INTENDED SERVICE
CONDITIONS. CONSULT GASKET MANUFACTURER FOR
RECOMMENDATION. GARLOCK™, ENVELO™ 3565 GASKET
MATERIAL IS COMPARABLE TO MAXAR™ LINER MATERIAL.
RING TYPE OR FULL FACE. 1/16" MIN-1/8" MAX. THICK.

BOLTING:

ALLOY STEEL MACHINE BOLTS OR STUDS WITH (2) SAE
WASHERS AND STANDARD NUTS 1 1/2" thru 6"φ
HEAVY HEX NUTS 8" thru 24"φ IF PREFERRED.

WELDING:

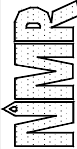
ONLY AS PROVIDED BY MANUFACTURER.

VALVES:

AS SPECIFIED BY USER.

N O T E S

1. FULL SIZE FITTINGS THRU 4" DIAMETER ARE MOLDED.
6" DIAMETER AND LARGER ARE FABRICATED.
2. INSTRUMENT CONNECTIONS (INCLUDING VENTS AND DRAINS)
MAY BE FABRICATED DIRECTLY INTO PIPE SPOOLS.
MINIMUM SIZE IS 1" DIAMETER.
3. PIPING MAY BE SHOP FABRICATED OR FIELD WELDED
BY MANUFACTURER.
4. ONE INCH (1") PIPING IS AVAILABLE IN SHORT SPOOLS
ONLY (24" OR LESS).

		engineered thermoplastics	
NON METALLIC RESOURCES INC.		MOBILE, ALABAMA	
DRAWN: JES	PIPING SPECIFICATION		
DATE: 4-92	M A X A R		
CHK'D:	SEAMLESS FEP/FRP DUAL LAMINATE		
DATE:	JOB NO.	P.O. NO.	SPEC. NO.
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REV.			1

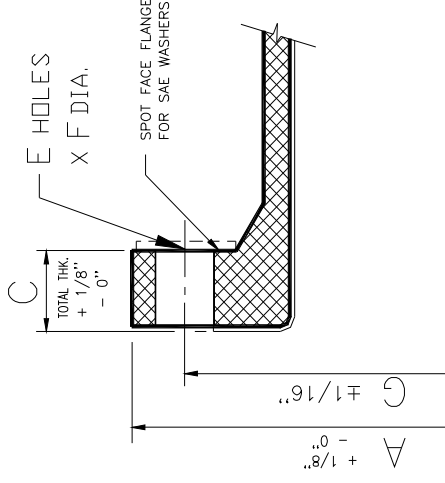
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1	11-30-98	BLS	REVISIONS

NOM. SIZE	A O.D. FLANGE	B O.D. STUB END	C FLG/STUB THK.	D LAP JT. THK.	E NO. HOLES	F HOLE SIZE	G BOLT CIRCLE	BOLT SIZE SEE NOTE 3
1	4 1/4	2 1/2	1	1	4	5/8	3 1/8	1/2 X 3
1 1/2	5	3 1/4	1	1	4	5/8	3 7/8	1/2 X 3
2	6	4	1 1/8	1 1/4	4	3/4	4 3/4	5/8 X 3 1/2
3	7 1/2	5 1/4	1 1/8	1 1/4	4	3/4	6	5/8 X 3 1/2
4	9	6 3/4	1 1/4	1 3/8	8	3/4	7 1/2	5/8 X 3 3/4
6	11	8 5/8	1 1/2	1 3/4	8	7/8	9 1/2	3/4 X 4 1/4
8	13 1/2	10 7/8	1 3/4	2	8	7/8	11 3/4	3/4 X 4 3/4
10	16	13 1/4	1 3/4	2	12	1	14 1/4	7/8 X 5
12	19	16	2	2 1/4	12	1	17	7/8 X 5 1/2
14	21	17 5/8	2	2 1/4	12	1 1/8	18 3/4	1 X 5 1/2
16	23 1/2	20 1/8	2 1/8	2 3/8	16	1 1/8	21 1/4	1 X 5 3/4
18	25	21 1/2	2 1/4	2 1/2	16	1 1/4	22 3/4	1 1/8 X 6 1/4
20	27 1/2	23 3/4	2 1/2	2 3/4	20	1 1/4	25	1 1/8 X 6 3/4
24	32	28 1/8	2 5/8	2 7/8	20	1 3/8	29 1/2	1 1/4 X 7

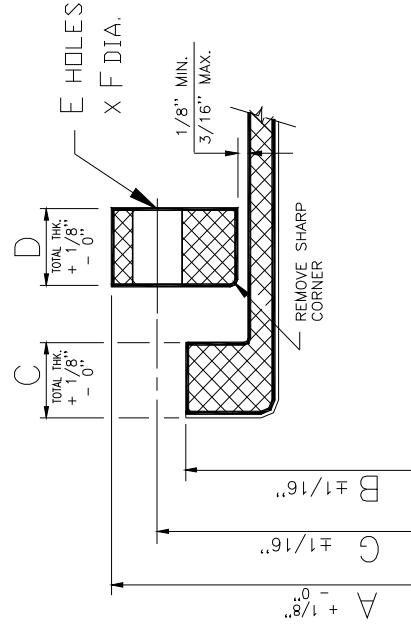
** FLANGE PRESSURE RATING: 150 PSI THRU 12"
100 PSI 14"-24"

NOTES

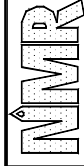
- DIMENSIONS SHOWN ARE FOR ALL FLANGES AND INCLUDES THERMOPLASTIC FLANGE FACE WHERE APPLICABLE.
- FOR BOLT LENGTHS WHEN USING LAP JOINT FLANGES, ADD LAP JOINT FLANGE THICKNESS TO LENGTH SHOWN.



FIXED FLANGE



LAP JOINT FLANGE



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MOBILE, ALABAMA

DRAWN: JES
DATE: 4-90

S T A N D A R D

CHK'D:
DATE:

FLANGE DIMENSIONS

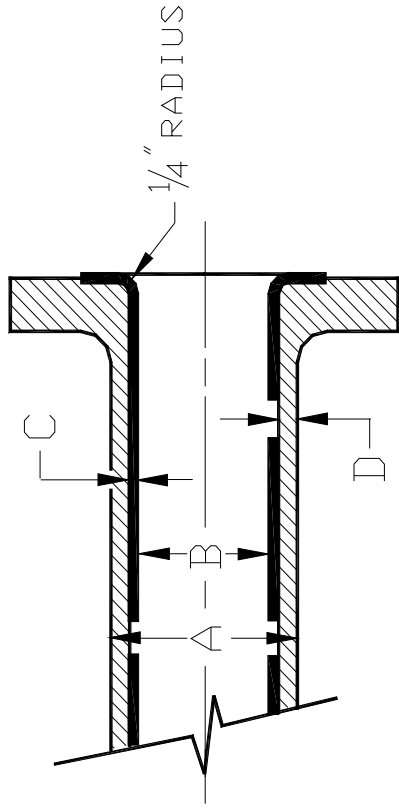
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JOB NO.
STANDARD

1	11-30-98	JBL	GENERAL	UPDATE
NO	DATE	BY	DESCRIPTION	CKD
REVISIONS				

DWG. NO. STD-101
REV. 1

NOMINAL DIAMETER	A	B	C	D
1	1.32	1.00	.08	.10
1 1/2	2.09	1.55	.08	.17
2	2.58	2.05	.08	.17
3	3.69	3.18	.09	.19
4	4.68	4.14	.10	.19
6	6.65	6.03	.10	.21
8	8.83	8.13	.10	.25
10	11.01	10.14	.10	.34
12	12.90	11.95	.10	.38



APPROXIMATE WEIGHT OF PIPE AND FITTINGS (lbs.)

NOMINAL DIAMETER	PIPE PER FOOT	FLANGE	10' SPOOL	20' SPOOL	FLANGED 90° ELL	FLANGED 45° ELL	FLANGED TEE	FLANGED CROSS	FLANGED LATERAL
1	.6	1.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1 1/2	1.4	1.3	17	31	3.5	3	5.5	7	5.5
2	1.7	2.0	21	38	5.5	5	8	11	8.5
3	2.5	4.0	33	59	11	10	16	21	17
4	3.4	1.5	43	77	13	11	19	25	21
6	5.6	7.0	70	126	22	19	32	43	36
8	8.3	11.5	106	189	35	31	51	68	62
10	12.8	15.0	158	286	54	44	80	107	94
12	16.6	24.0	214	380	81	69	121	162	147

N O T E S

- SEE STD-301 FOR FITTING DIMENSIONS
- SEE STD-101 FOR FLANGE DIMENSIONS.

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MOBILE, ALABAMA

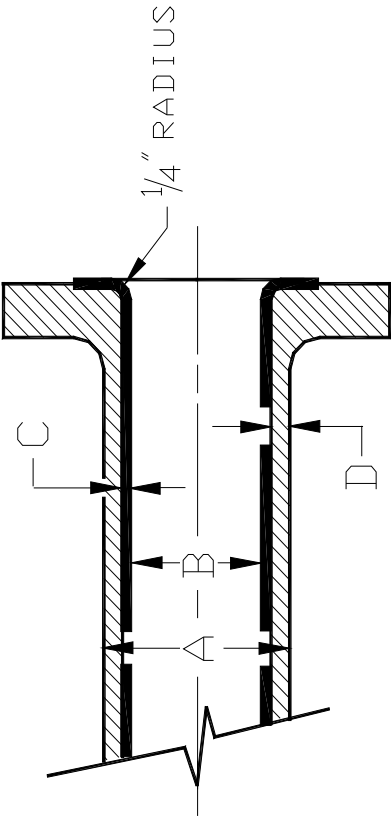
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CHK'D:
DATE:

SCALE: NONE
JOB NO.: STANDARD
P.I. NO.:
DWC. NO.:
REV.:

S T A N D A R D
M A X A R
P I P E A N D F I T T I N G S

STD-300 1

NO	DATE	BY	DESCRIPTION	CKD
1	11-30-98	BLS	GENERAL UPDATE	
REVISIONS				



NOMINAL DIAMETER	A	B	C	D
14	14.54	13.67	.10	.34
16	16.87	15.92	.10	.38
18	19.43	18.39	.10	.42
20	21.40	20.28	.10	.46
24	25.24	24.04	.10	.50

APPROXIMATE WEIGHT OF PIPE AND FITTINGS

NOMINAL DIAMETER	PIPE PER FOOT	FLANGE	10' SPOOL	20' SPOOL	FLANGED 90° ELL	FLANGED 45° ELL	FLANGED TEE	FLANGED CROSS	FLANGED LATERAL
14	17	27	224	394	105	80	172	227	183
16	21	35	280	490	144	106	231	308	242
18	26	37	334	594	172	126	287	382	300
20	31	49	408	718	230	160	380	506	386
24	40	65	530	980	330	230	555	740	535

N O T E S

1. SEE STD-305 FOR FITTING DIMENSIONS
2. SEE STD-101 FOR FLANGE DIMENSIONS

NMR engineered thermoplastics
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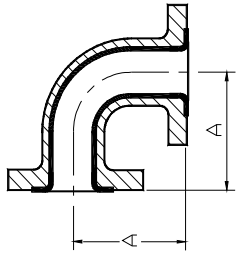
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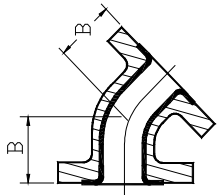
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 M A X A R P I P E

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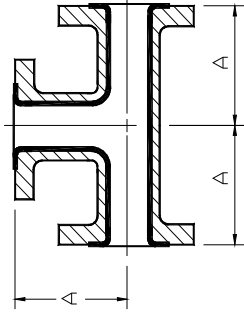
90° ELBOW

SEE NOTE 1 & 3



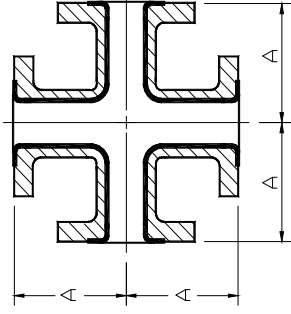
45° ELBOW

SEE NOTE 1 & 3



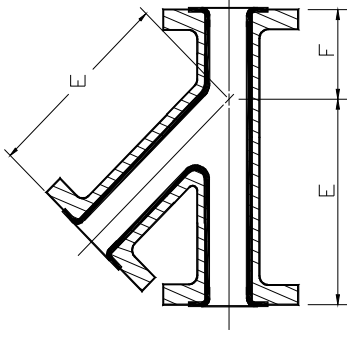
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SEE NOTE 1 & 3



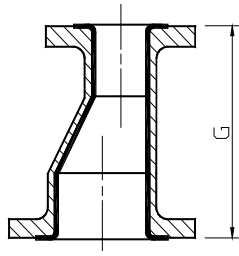
CROSS

SEE NOTE 3

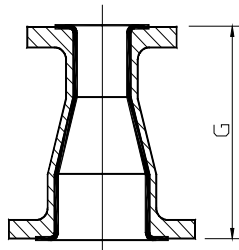


LATERAL

SEE NOTE 3



ECCENTRIC
REDUCER



CONCENTRIC
REDUCER

NOMINAL DIAMETER	A	B	E	F	G
1 1/2	4	2 1/4	7	2	5
2	4 1/2	2 1/2	8	2 1/2	5
3	5 1/2	3	10	3	6
4	6 1/2	4	12	3	7

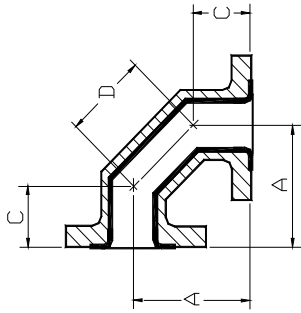
N O T E S

- 45° ELBOW, 90° ELBOW AND TEE ARE SEAMLESS, MOLDED FITTINGS, SMOOTH RADIUS. (1" thru 4")
- SEE STD-101 FOR FLANGE DIMENSIONS
- SEE STD-300 FOR WALL AND LINER THICKNESSES
- TEES, CROSSES AND LATERALS ARE ALSO AVAILABLE WITH REDUCING BRANCH CONNECTIONS. DIMENSIONS ARE SAME AS FULL SIZE.
- FITTINGS ARE ALSO AVAILABLE WITH NON STANDARD DIMENSIONS. CONTACT FACTORY FOR DETAILS.

DRAWN: JES	S T A N D A R D
DATE: 4-90	MAXAR FITTINGS
CHK'D:	JOB NO.
DATE:	SCALE
	NONE
	STD-301
	REV. 1

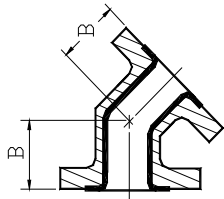
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1	11-30-98	BLS	GENERAL UPDATE

REVISIONS



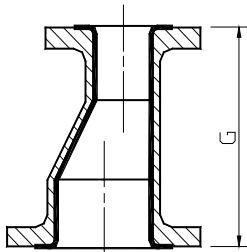
90° ELBOW

SEE NOTE 1 & 3

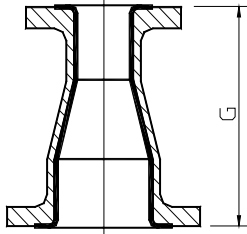


45° ELBOW

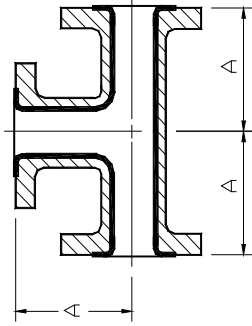
SEE NOTE 1 & 3



ECCENTRIC REDUCER

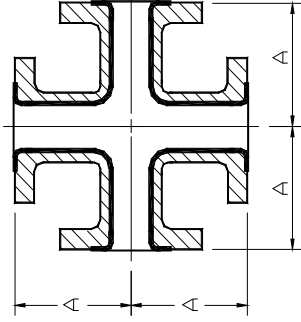


CONCENTRIC REDUCER



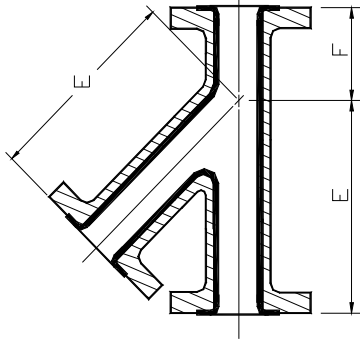
TEE

SEE NOTE 1 & 3



CROSS

SEE NOTE 3




LATERAL

SEE NOTE 3

NOMINAL DIAMETER	A	B	C	D	E	F	G
6	8	5	4 1/2	4 15/16	14 1/2	3 1/2	9
8	9	5 1/2	5	5 5/8	17 1/2	4 1/2	11
10	11	6 1/2	6 1/4	6 11/16	20 1/2	5	12
12	12	7 1/2	7	7 1/16	24 1/2	5 1/2	14
14	21	8 3/4	8 3/4	17 1/4	30	12	12
16	24	10	10	19 3/4	32	14	12
18	27	11 1/4	11 1/4	22 1/4	36	14	12
20	30	12 1/2	12 1/2	24 3/4	38	16	12
24	36	15	15	29 3/4	42	18	15

N O T E S

1. SEE STD-101 FOR FLANGE DIMENSIONS
2. SEE STD-304 FOR THICKNESSES
3. TEES, CROSSES AND LATERALS ARE ALSO AVAILABLE WITH REDUCING BRANCH CONNECTIONS. DIMENSIONS ARE SAME AS FULL SIZE.
4. FITTINGS ARE ALSO AVAILABLE WITH NON STANDARD DIMENSIONS. CONTACT FACTORY FOR DETAILS.

		NON METALLIC RESOURCES INC. MOBILE, ALABAMA	
DRAWN: JES DATE: 1-92 CHK'D: DATE:	S T A N D A R D		
SCALE NONE		MAXAR FITTINGS	
JOB NO. STANDARD	P.O. NO.	DWG. NO. STD-305	REV. 0