

PRODUCT AND MATERIAL SPECIFICATIONS

DATE OF PRINT
SEPT. 30 1994
OF 4

NON METALLIC RESOURCES, INC.

PAGE NO.
1

PVC AND CPVC SEAMLESS PVC/AR AND CPVC/AR DUAL LAMINATE PIPE AND FITTINGS

1. SCOPE

- 1.1 This specification provides design information applicable to patented NMR PVC/AR and CPVC/AR (seamless dual laminate) piping products. These products include pipe spools, fittings and fabrications.
- 1.2 This specification covers products with 150# flange drilling per ANSI 16.5 which are suitable for 150 PSI continuous service.
- 1.3 Flanged fittings are to ANSI 16.1 dimension.
- 1.4 Products covered by this specification are suitable for continuous service temperatures to +170°F. (77°C.) for PVC/AR and 190°F. (88°C.) for CPVC/AR, unless otherwise specified.
- 1.5 Because of seamless, bonded liner construction these products can be designed for full vacuum service.

2. MATERIALS

- 2.1 Liner: PVC (CPVC) liners are **SEAMLESS**. Only virgin PVC (CPVC) is used in the extrusion of liners. This resin meets the requirements of ASTM D-1784 and may include less than 1% inorganic pigment for identification. A partial list of physical properties follows:

PROPERTY	PVC VALUE	CPVC VALUE	TEST
Specific Gravity	2.13 – 2.15	1.52	ASTM D-792
Tensile Strength (PSI)	3800 – 4100 PSI	8,200	ASTM D-638

- 2.2 Bonding Layer: The bonding of the PVC (CPVC) liner is accomplished through a proprietary process resulting in a chemical linking of casing to liner.

A. Laminar Shear per ASTM D-2733-70 Method B Mod. PVC (CPVC) material surface yields before bond between liner and casing reaches failure (1500 PSI minimum).

- 2.3 Outer Casing: The PVC (CPVC) bonding layer composite is reinforced by hand lay-up or filament wound fiberglass vinyl ester construction yielding a totally bonded laminate. This specification indicates filament wound thicknesses. Hand lay-up construction when performed is per Product Standard PS-15-69. A premium grade vinyl ester resin is used with glass reinforcement and UV stabilized exterior gel coat.

3. DESIGN AND FABRICATION DETAILS

- 3.1 Dimensional drawings included in paragraph 8 of this section pertain to products listed in paragraph 1.
- 3.2 Flanges for pipe spools and fittings shall have bolt circle diameters, hole diameter and number of bolt holes in accordance with ANSI 16.5, unless otherwise specified.
- 3.3 Fittings shall have standard face to centerline dimensions for 150# ANSI 16.1, unless otherwise specified.
- 3.4 Pipe and fittings fabrication tolerances are as follows:

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



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4. APPLICATION AND OPERATIONAL PARAMETERS

- 4.1 Temperature Range: PVC/AR (CPVC/AR) is suitable for continuous operation to +170°F (CPVC 190°F), unless otherwise specified.
- 4.2 Pressure Range: PVC/AR (CPVC/AR) is suitable for continuous operation from full vacuum to 150 PSI.
- 4.3 Thermal expansion and contraction of the PVC/AR (CPVC/AR) system is 1.7×10^{-5} in/in/°F
- 4.4 Chemical Resistance (liner): PVC/AR (CPVC/AR) liner is chemically inert to the following broad general commercial chemicals:

- Mineral acids
- Alkalies
- Salt solutions
- Alcohols

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

- 4.5 Chemical Resistance (outside casing): The inherent resistance of the vinyl ester casing to chemical plant corrosive atmospheres normally requires no additional protection. This casing also allows burial without additional protection. For specific environments, consult factory. Casing does contain UV stabilizer and fire retardant protection is available.
- 4.6 Permeation: The gas permeation if present through PVC (CPVC) occurs faster through the vinyl ester casing eliminating the condensation between liner and casing which occurs in lined steel pipe. Since these gases are not trapped by the PVC/AR (CPVC/AR)'s vinyl ester casing material, no weep holes are required.
- 4.7 Heat Tracing: Heat tracing can be provided between structural casing and an exterior FRP casing taking advantage of the vinyl ester fiberglass casing's inherent insulating properties. See NMR's pre-insulated piping specification for details.
- 4.8 Insulation Qualities of casing materials: Fiberglass construction yields a heat conduction factor (k) of 1.5 Btu/FT²/hr/°F/in. Check dimensional data for casing thickness.

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 in the fittings which is cause for rejection. This test is to be performed by factory only with properly controlled voltage and procedures.

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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-200 and STD-205.
- 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.



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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 PVC (CPVC) 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:

PVC/AR AS PROVIDED BY NON METALLIC RESOURCES INC
DUAL LAMINATE, SEAMLESS PVC LINER WITH
BONDED FIBERGLASS REINFORCED VINYL ESTER CASING.

SIZE/RATING:

1 1/2" - 12" FULL VACUUM - 150psi 32-170°F.
14" - 24" FULL VACUUM - 150psi 32-170°F.

PIPE:

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

WELDING: (SEE NOTE 1 & 3)

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

BRANCH CONNECTIONS: (SEE NOTE 3)

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
PVC LINER BONDED TO FACE.

ATTACHMENTS:

STD-101C FLANGE DIMENSIONS 1' - 12"
STD-200 PIPE DIMENSIONS 14' - 24"
STD-205 PIPE DIMENSIONS 1 1/2' - 24"
STD-201 FITTING DIMENSIONS

SPACERS:

SOLID PVC OR FRP SPOOL WITH PVC LINER FLARED
OVER EACH END.

GASKETS:

ELASTOMERIC MATERIAL OF 50-70 DUROMETER SUITABLE
FOR INTENDED CHEMICAL SERVICE. 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"Ø
HEAVY HEX NUTS 8" thru 24"Ø.

WELDING:

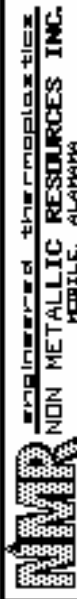
ONLY AS PROVIDED BY MANUFACTURER.

VALVES:

AS SPECIFIED BY USER.

N O T E S

1. FITTINGS ARE MOLDED OR 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).



DRAWN: JES	PIPING SPECIFICATION		
DATE: 4-92			
CHK'D:			PVC/AR
DATE:	SEAMLESS PVC/FRP	DUAL LAMINATE	
SCALE	JOB NO.	P.O. NO.	SPEC. NO. REV.
NONE			200 1

NO.	DATE	BY	DESCRIPTION	REVISIONS
1	11-3-88	BLS	GENERAL UPDATE	

SERVICE:

AS SPECIFIED BY USER OR ENGINEERING

MATERIAL:

CPVC/AR AS PROVIDED BY NON METALLIC RESOURCES Inc.
DUAL LAMINATE, SEAMLESS CPVC LINER THROUGH 12",
WELDED FLAT SHEET 14" THROUGH 24",
BONDED FIBERGLASS REINFORCED VINYL ESTER CASING.

SIZE/RATING:

1 1/2" - 12" FULL VACUUM - 150 PSI 22-190°F,
14" - 24" FULL VACUUM - 100 PSI 32-190°F.

PIPE:

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

FITTINGS: (SEE NOTE 1 & 3)

FLANGED, 150 # RATING,
FLANGE DRILLING PER ANSI 16.5.

BRANCH CONNECTIONS: (SEE NOTE 3)

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 1/8" MIN. THICKNESS
CPVC LINER BONDED TO FACE.

ATTACHMENTS:

- STD-101C FLANGE DIMENSIONS 1' - 12"
- STD-200 PIPE DIMENSIONS 14' - 24"
- STD-205 PIPE DIMENSIONS 1 1/2" - 24"
- STD-201 FITTING DIMENSIONS

1	11-2-98	BLS	GENERAL UPDATE
			DESCRIPTION
			REVISIONS

SPACERS:

SOLID CPVC OR FRP SPOOL WITH CPVC LINER FLARED
OVER EACH END.

GASKETS:

ELASTOMERIC MATERIAL OF 55-70 DUROMETER SUITABLE
FOR INTENDED CHEMICAL SERVICE. 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"Ø
HEAVY HEX NUTS 8" thru 24"Ø IF PREFERRED.

WELDING:

ONLY AS PROVIDED BY MANUFACTURER.


VALVES:

AS SPECIFIED BY USER.

N O T E S

1. FITTINGS ARE MOLDED OR 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).

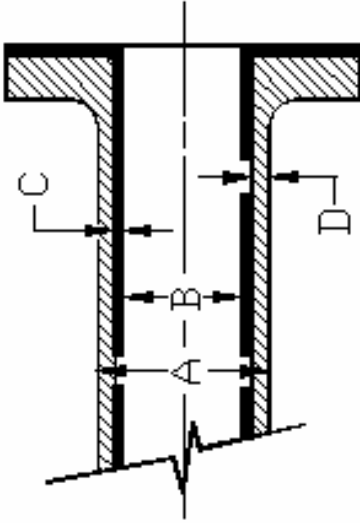
spec-201.dwg

 <small>engineered thermoplastics</small> NON METALLIC RESOURCES INC. <small>MOBILE, ALABAMA</small>		DRAWN: JES	
		DATE: 4-92	
CHK'D:		DATE:	
SCALE: NONE		JOB NO.:	
NONE		P.O. NO.:	
		SPEC. NO.:	
		REV.:	
		201	
		1	

PIPING SPECIFICATION

CPVC/AR

SEAMLESS CPVC/AR DUAL LAMINATE



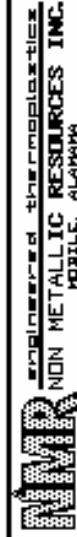
NOMINAL DIAMETER	A	B	C	D
1	1.52	1.05	.13	.10
1 1/2	2.27	1.61	.15	.17
2	2.75	2.07	.15	.17
3	3.84	3.07	.22	.19
4	4.84	4.03	.23	.19
6	7.05	6.07	.24	.21
8	9.13	7.98	.28	.25
10	11.42	10.02	.32	.34
12	13.51	11.94	.37	.38

APPROXIMATE WEIGHT OF PIPE AND FITTINGS

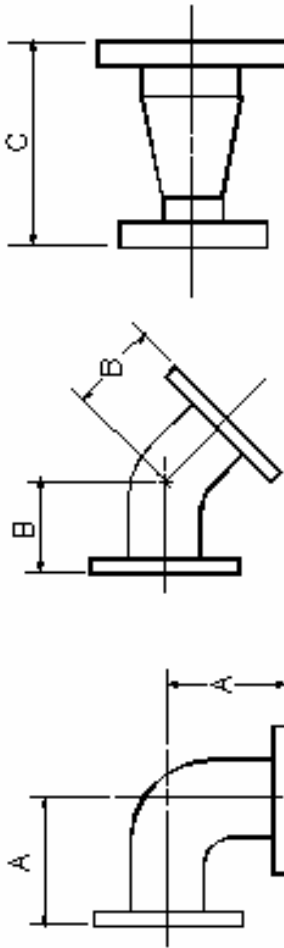
NOMINAL DIAMETER	PIPE PER FOOT	FLANGE	10' SPOOL	20' SPOOL	FLANGED 90° ELL	FLANGED 45° ELL	FLANGED TEE	FLANGED CROSS	FLANGED LATERAL
1	.7	1.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1 1/2	1.5	1.3	18	33	4	3.5	5.5	7.5	7
2	1.9	2.0	23	42	5.5	5	8	11	10
3	3.0	4.0	38	68	11	11	17	22	20
4	4.0	4.5	49	89	14	13	21	29	25
6	7.3	7.0	87	160	26	25	39	52	46
8	11.1	11.5	134	245	48	45	72	95	81
10	17.3	15.0	203	376	73	65	110	146	129
12	23.0	24.0	278	509	117	94	175	233	194

N O T E S

1. SEE STD-201 FOR FITTING DIMENSIONS
2. SEE STD-101C FOR FLANGE DIMENSIONS.



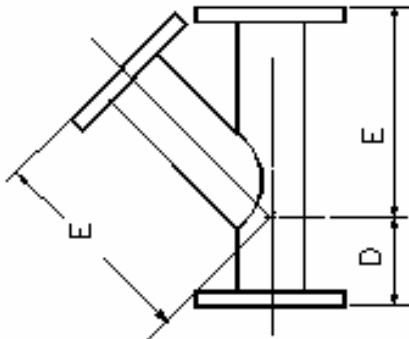
DRAWN: JES	S T A N D A R D		
DATE: 4-90	PVC/AR & CPVC/AR PIPE AND FITTINGS		
CHK'D:	JOB NO.	FIG. NO.	REV.
DATE:	NONE	STANDARD	STD-200
SCALE:			0



90° ELBOW

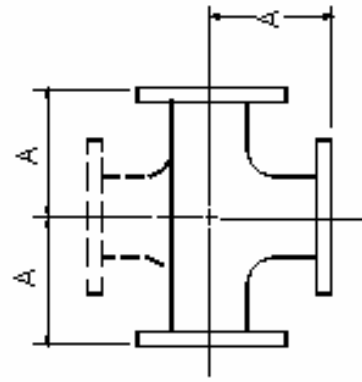
45° ELBOW

REDUCERS
(CONC & ECC)



45° LATERAL;

SEE NOTE 3



TEES & CROSSES

SEE NOTE 3

SIZE	DIMENSIONS (INCHES)				
	A	B	C	D	E
1 1/2	4 1/2	3 1/2	5	6	10
2	4 1/2	4	5	6	10
3	6	5	6	6	12
4	7 1/2	6	7	6	14
6	10	9	9	9	16
8	13 1/2	12	11	10	20
10	15	12	12	10	24
12	18	12	14	12	26
14	21	14	16	12	30
16	24	14	16	14	32
18	27	16	20	14	36
20	30	18	22	16	38
24	36	18	24	18	42

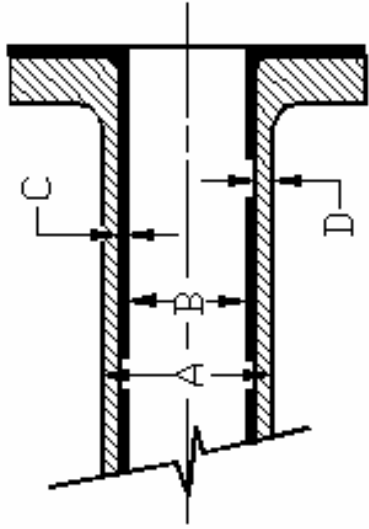
N O T E S

1. SEE STD-101C FFR FLANGE DIMENSIONS
2. SEE STD-200 FOR THICKNESSES
3. TEES, CROSSES AND LATERALS ARE AVAILABLE WITH REDUCING BRANCHES.
4. DIMENSIONS ARE SAME AS FULL SIZE. FITTINGS AVAILABLE WITH NON STANDARD DIMENSIONS. CONTACT FACTORY FOR DETAILS.

DRAWN: JES
 DATE: 4-90
 CHK'D:
 DATE:
 SCALE: NONE
 JOB NO. STANDARD
 P.D. NO.
 DWG. NO. STD-201
 REV. 1

S T A N D A R D
PVC/CPVC FITTINGS

NO.	DATE	BY	GENERAL REVISION	JH
1	5-92	JS		
NO.	DATE	BY	DESCRIPTION	CKD
REVISIONS				



NOMINAL DIAMETER	A	B	C	D
14	14.67	13.12	.44 *	.34
16	16.76	15.00	.50 *	.38
18	18.84	16.88	.56 *	.42
20	20.92	18.81	.59 *	.46
24	25.00	22.62	.69 *	.50

* LINER THK. SHOWN IS SCH 40 AND MAY VARY. CONSULT FACTORY FOR SPECIFICS.

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	25	27	304	554	147	112	240	317	250
16	32	35	390	710	201	148	323	430	335
18	38	37	454	834	240	176	101	534	420
20	48	49	578	1058	320	224	532	708	540
24	64	65	770	1410	460	322	775	1030	750

N O T E S

1. SEE STD-201 FOR FITTING DIMENSIONS
2. SEE STD-101C FOR FLANGE DIMENSIONS

NMR engineered thermoplastics
NON METALLIC RESOURCES INC.
 MOBILE, ALABAMA

DRAWN: JES
 DATE: 5-92
 CHK'D:
 DATE:
 SCALE: NONE
 JOB NO.: STANDARD
 DWG NO.: STD-205
 REV: 0

S T A N D A R D

PVC/AR & CPVC/AR
 PIPE AND FITTINGS

