Ceram Core™

Product Data

CHEMICAL & INDUSTRIAL

Applications

- Bottom Ash
- Wet Fly Ash
- Vanadium Ore Slurries
- Potash Tailings
- Zinc Tailings
- Taconite Tailings
- Heavy Salt Slurries
- Uranium Ore Slurries
- Dredge Lines
- Smelter Slags
- Wet Process Slurries
- Wood Pulp Slurries
- Copper Tailings
- Iron Ore Tailings
- Diatomaceous Earth
- Concrete Slurries

Materials and Construction

Ceram Core is a fiberglass reinforced epoxy resin pipe with a special abrasion resistant liner composed of small spherical beads of high alumina ceramic, held in an epoxy matrix. Because of its unique combination of ceramic beads and epoxy resin, Ceram Core pipe also exhibits excellent corrosion resistance.

Ceram Core piping is specifically designed for the severe abrasion conditions caused by sharp angular particles in high flow streams. Most noticeable is its successful service in handling bottom ash (see Field Tests). The pipe outlasts and outperforms steel, special alloys, and other lined pipe at competitive costs and is available in 6”-16” diameters in standard 25 foot (7.6 meters lengths ±⅛”), for slurry abrasion service up to 200°F (93°C). The system includes 45° and 90° elbows with a 3-diameter sweep radius. Special angle fittings, including laterals, are available on request.

Fittings

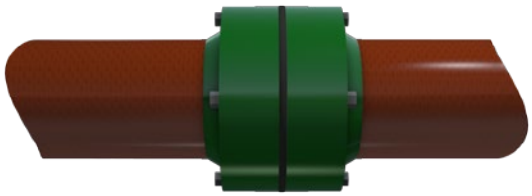
Fittings are manufactured with the same chemical/temperature capabilities as the pipe. Depending on the particular part and size, fittings will be compression molded, contact molded, hand fabricated or filament wound.

Joining System

Flanged

Flanged connections are available for all components and diameters.

View of Joint Illustrations



Flanged

Nominal Dimensional Data

Pipe Size		Outside Diameter		Inside Diameter		Total Wall Thickness		Liner Thickness		Max. Operating Pressure		Max. Operating Temperature* Hydraulic Service		Nominal Weight	
in	mm	in	mm	in	mm	in	mm	in	mm	psig	MPa	°F	°C	lbs/ft	kg/m
6	150	6.70	170.18	6.125	155.58	0.288	7.32	0.13	3.3	225	1.55	200	93	5.6	8.33
8	200	8.71	221.23	8.095	205.61	0.308	7.82	0.13	3.3	225	1.55	200	93	7.8	11.60
10	250	10.78	273.81	10.16	258.06	0.310	7.87	0.13	3.3	225	1.55	200	93	9.8	14.60
12	300	12.98	329.69	12.30	312.42	0.340	8.64	0.13	3.3	225	1.55	200	93	12.8	19.00
14	350	14.75	374.52	14.02	356.11	0.363	9.22	0.13	3.3	100	0.69	200	93	15.4	22.90
16	400	16.80	426.72	16.02	406.91	0.390	9.91	0.13	3.3	100	0.69	200	93	18.8	28.00

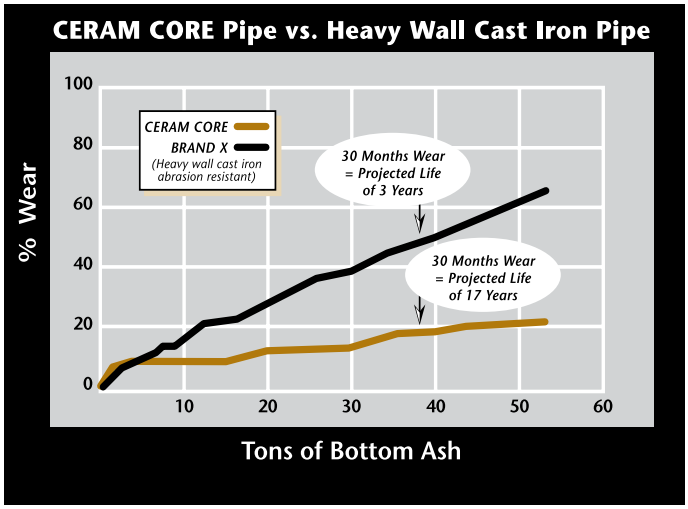
(*) Consult NOV Fiber Glass Systems concerning all pneumatic applications with Ceram Core pipe.

Significant Field Test

An Idaho mine installed a Ceram Core test spool in a zinc slurry to compare it to Schedule 80 steel. Normal life for the steel was one month. After 21 months, the Ceram Core spool was still in service.

A Ceram Core test spool was installed in a Wisconsin taconite operation. Carbon steel in this application lasted from 6 to 12 months without rotation. After 19 months without rotation, the Ceram Core spool showed little wear.

A 10-inch diameter, 18-foot Ceram Core test spool was installed in bottom ash service at a major power station in Georgia. Similar test spools of other types of pipe including heavy wall abrasion resistant cast iron were also installed. After 30 months handling 53,000 tons of ash, the Ceram Core test spool showed a projected continuing wear life of over 17 years versus 3 years for the metallic pipe (see graph). This utility since expanded Ceram Core pipe use, in 8”-12” diameters, to more than 6 miles at five separate plants.



Abrasion Resistant Piping Systems Comparison

Property	Ceram Core Pipe			Basalt Pipe			High Chromium Cast Iron Pipe		
	8”	10”	12”	8”	10”	12”	8”	10”	12”
I.D. Hardness	Brinell - Exceeds 615 MOH - 9 Rockwell - R45N - 79			- MOH - 7.8 -			Brinell - 300-500 - Rockwell - C-34-57		
Flow Factor (Hazen-Williams Coefficient)	130			100			100		
(1) Weight per foot (lbs)	7.2	9.8	12.8	58	70	83	55	60-70	75-93
Standard Length (ft)	25			18			18		
Weight per length of 10” pipe (lbs)	245(1)			1,260			1,170		
Typical fitting weight 90° elbow (lbs)	75	125	190	326	398	462	465	760	1,130

(1) Weight per 25-foot length of Ceram Core pipe includes two flanges.

Labor Estimate Example (Inside Building)

Pipe	Estimated man hours/ft of pipe installed	Estimated man hours to install 6,000 ft of pipe	
10” Ceram Core	0.302	1,814	
10” Cast Iron	0.810	4,860	
10” Basalt	1.140	6,840	
Fittings	**90°**	**45°**	**Laterals**
10” Ceram Core	3.39	3.26	5.89
10” Cast Iron	7.87	7.37	10.80
10” Basalt	10.23	9.58	14.04

Testing

Hydrostatic testing is recommended to evaluate the integrity of all new piping installations. CERAM CORE piping systems may be hydro tested to 1.5 times the maximum operating pressure rating. Note: The lateral fittings pressure ratings are lower than the pipe and standard fittings requiring special consideration. All other fittings match the pipe pressure ratings.

When hydro testing, open high-point vents (if used) to prevent entrapment of air in the lines as the system is slowly filled with water, then close the vents and slowly pressurize to the test pressure. Upon completion of hydro test, relieve the pressure on the system slowly, open vents and any drains to allow for complete drainage of the system.

Water Hammer

Piping systems may be damaged by pressure surges due to water hammer. The use of soft start pumps and slow actuating valves will reduce the magnitude of surge pressures during operation and are highly recommended.

Ceram Core Joining Methods

Proper joining procedures are extremely important to obtain the maximum service life from Ceram Core pipe.

Ceram Core pipe flanges have been designed to align and seal properly when installed as directed. Particular attention must be given to accurately align pipe I.D.’s at all joints. Proper installation prevents undercutting of the lining and protects the piping system from premature wear.

Ceram Core pipe can be installed in a new or existing systems. Since dimensions vary with the application, NOV Fiber Glass Systems will design transition fittings as needed for each installation upon receipt of necessary dimensional information.

More detailed information on proper handling and installation is available in Ceram Core Installation Manual.

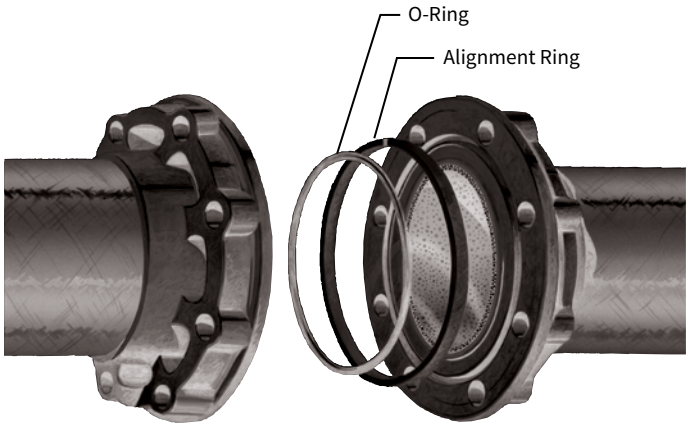
Self-aligning flanges are used on Ceram Core pipe and fittings to assure the inside diameters of the liners are properly aligned.

One filament wound epoxy resin aligning ring and one Buna™ N O-ring, supplied by NOV Fiber Glass Systems, is used on each joint. See Ceram Core pipe installation instructions.

Buna™ is a trademark of DuPont.

Self-Aligning Flanges

Specially designed Ceram Core flanges make it easy to properly align pipe and fittings when installing to new or existing systems.



Maximum Support Spacing for Uninsulated Pipe[1]

Nominal Pipe Size		Continuous Span [2]	
in	**mm**	**ft**	**m**
6	150	22.1	6.75
8	200	24.6	7.50
10	250	26.2	7.99
12	300	28.7	8.75
14	350	30.5	9.30
16	400	32.4	9.88

[1] For Sg=1.0, consult manufacturer for heavier insulated pipe support spans. Span recommendations include no provision for weight of (fittings, valves, etc.) or thrusts at branches and turns. Heavy valves and other appurtenances must be supported separately.

[2] Calculated spans are based on ½” mid-span deflections to ensure good appearance and adequate drainage. Total system stresses should always be taken into account by the system design engineer when determining support spans.

Support Span vs. Specific Gravity

Specific Gravity	1.25	1.5	2.0
Adjustment Factor	0.92	0.85	0.75

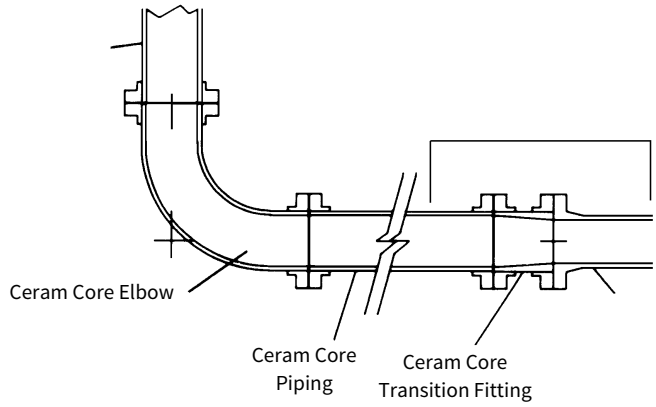
Transition Fittings

Transition fittings are necessary to join Ceram Core pipe to systems with different inside diameters. It is essential that inside diameters of pipe-to-pipe and pipe-to-fittings be exactly matched. Mismatched I.D.'s can cause liners to be undercut and scooped away, causing premature failure.

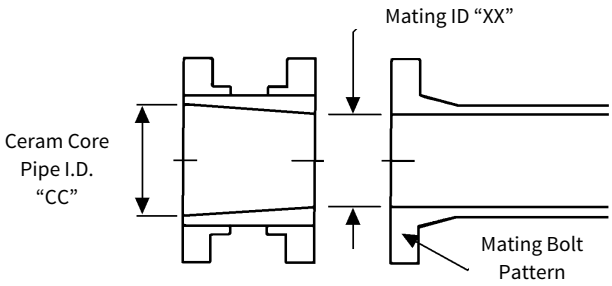
Two flanged transition fittings generally will be required for each application. A typical concentric reducer transition fitting is shown that will join another type of flanged system having an inside diameter "XX" to a Ceram Core system having an inside diameter "CC."

Connection to Other Piping

Ceram Core piping



Other Piping (flanged) - Detail A



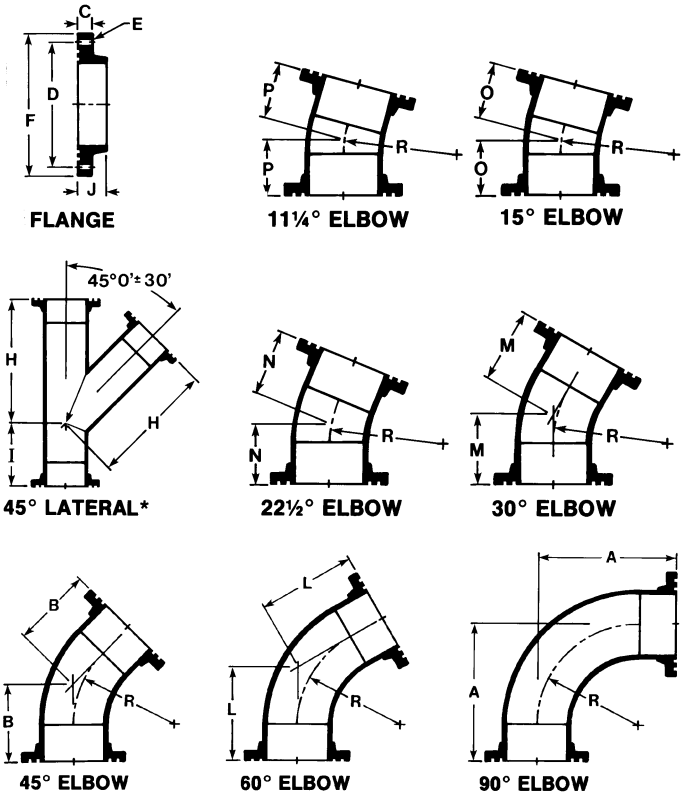
Fittings Information

Ceram Core abrasion resistant fittings 6" through 16" diameters are available in a variety of configurations - 45° elbows and 90° elbows(1), 45° laterals, flanges and 11 ¼°, 15°, 22 ½°, 30°, and 60° elbows, are standard parts. Other odd degree elbows are available on request.

All fittings have liners composed of tiles similar in composition to the alumina ceramic beads used in the liner of Ceram Core pipe. Fittings are designed to resist high turbulence and high impact.

Ceram Core fittings have thermosetting resin and fiberglass reinforcement for physical strength. Self-aligning flanges are utilized on all fittings.(2)

Ceram Core sweep elbows have a center line radius of three times the nominal diameter (see dimension R in table).



(1) 14" and 16" sweep elbows available in 45° or less only

(2) See NOV Fiber Glass Systems **Ceram Core Installation Manual** for bolt torque recommendations.

NOTE: Elbows and flanges pressure ratings match pipe ratings. 6"-12" laterals pressure rating are 100 psig; 14" and 16" are 80 psig. Do not pressurize over 1½ times the maximum operating pressure during hydrotest or due to surge pressure.

General Fittings Dimensions

Pipe Size			A	B	C	D	E	F	H	I	J	L	M	N	O	P	R
6	150	in	23 ½	12 ⅞	1 ½	9 ½	⅞ D-8 Holes	11	18	9	3	15 ⅞	10 ¼	9	7 ⅞	7 ¼	18
		mm	597	329	38	241	22 D - 8 Holes	279	457	229	76	404	262	230	200	184	457
8	200	in	30 ½	16 ⅜	1 ¾	11 ½	⅞ D-8 Holes	13 ½	22	11	4	20 ⅜	12 ⅞	11 ¼	9 ⅝	8 ⅞	24
		mm	775	418	44	298	22 D - 8 Holes	349	559	279	102	517	328	287	246	225	610
10	250	in	37 ¾	20 ⅛	2	14 ¼	1 D - 12 Holes	16	28	14	4 ¾	25	15	13	11 ⅝	10 ⅝	30
		mm	959	513	51	362	25 D - 12 Holes	406	711	356	121	637	402	349	297	271	762
12	300	in	44 ⅝	23 ½	2 ¼	17	1 D - 12 Holes	19	30	16	5	29 ⅜	18 ¼	15	13	12 ⅛	36
		mm	1113	598	57	432	25 D - 12 Holes	483	813	406	127	747	465	402	340	310	914
14	350	in	-	22 ⅞	2½	18 ¾	1 ⅛ D - 12 Holes	20 ¾	36	18	3 ⅛	-	16	13 ⅞	11	9 ⅝	42
		mm	-	581	64	476	29 D - 12 Holes	527	914	457	79	-	425	352	279	244	1067
16	400	in	-	27 ⅛	2 ½	21 ¼	1 ⅛ D - 16 Holes	23 ¼	42	21	3 ⅛	-	20 ⅛	16	13	12	48
		mm	-	689	64	540	29 D - 16 Holes	591	1067	533	79	-	511	427	345	305	1219

NOTE:

Consult NOV Fiber Glass Systems concerning all pneumatic applications with Ceram Core pipe.

Tolerances or maximum/minimum limits can be obtained from NOV Fiber Glass Systems.

For corrosion resistance data in liquid systems, refer to NOV Fiber Glass Systems **Chemical Resistance Guide** and use data for Green Thread™ Product.

Typical Mechanical Properties

Pipe Property	75°F	24°C	200°F	93°C	Method
	psi	MPa	psi	MPa	
Axial Tensile					
Ultimate Stress	9,530	65.7	6,585	45.4	ASTM D2105
Modulus of Elasticity	1.68×10^6	11,583	1.42×10^6	9,791	ASTM D2105
Poisson's Ratio, ν_{ah} (ν_{ha})(1)	0.35 (0.61)				
Axial Compression					
Ultimate Stress	12,510	86.3	8,560	59.0	ASTM D695
Modulus of Elasticity	0.677×10^6	4,668	0.379×10^6	2,620	ASTM D695
Beam Bending					
Ultimate Stress	20,200	139.3	15,400	106.2	ASTM D2925
Modulus of Elasticity (Long Term)	2.60×10^6	17,927	0.72×10^6	4,964	ASTM D2925
Hydrostatic Burst					
Ultimate Hoop Tensile Stress	40,150	276.8	36,480	251.5	ASTM D1599
Hydrostatic Design - Hoop Tensile Stress					
Static 20 Year Life LTHS - 95% LCL	-	-	18,203 - 14,689	125.5 - 101.3	ASTM D2992 - Procedure B
Static 50 Year Life LTHS - 95% LCL	-	-	16,788 - 13,142	115.7 - 90.6	ASTM D2992 - Procedure B
Parallel Plate					
Hoop Modulus of Elasticity	3.02×10^6	20,820	-	-	ASTM D2412
Shear Modulus	1.36×10^6	9,343	1.15×10^6	7,895	-

Typical Physical Properties

Pipe Property	Value	Value	Method
Thermal Conductivity	0.23 BTU/hr•ft•°F	0.4 W/m°C	ASTM D177
Thermal Expansion	8.5×10^{-6} in/in °F	15.3×10^{-6} mm/mm °C	ASTM D696
Absolute Roughness	0.00021 in	0.00053 mm	-
Specific Gravity	1.8		ASTM D792
Hazen-Williams Coefficient	150		-
Manning's Roughness Coefficient	0.009		-

(1) ν_{ah} = The ratio of hoop strain to axial strain resulting from stress in the axial direction.
ν_{ha} = The ratio of axial strain to hoop strain resulting from stress in the hoop direction.

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