

CONFIDENTIAL REPORT

Corrugated Fiberglass Well Casing And Cap Tests

for

GP Fiberglass Ltd. Melfort Saskatchewan

by

Product Design & Development

Small Industry Services

SRC Publication No. 10177-1C00

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1 Introduction

GP Fiberglass Ltd, located near Melfort, Saskatchewan, manufacture 30-inch diameter corrugated well casing in 25 foot lengths and also fiberglass caps which fit over the end of the well casing. Each length of casing is provided with a serial number and associated with each serial number is production data including manufacturing times for each phase, amount and type of resin, amount and type of glass and catalyst used to manufacture the pipe.

The fiberglass well casing had been successfully manufactured and used. However, some clients have requested physical property data for the fiberglass components.

Mr. Gregg Phillips, President of GP Fiberglass Ltd., obtained the required test equipment and requested that all the tests be witnessed by engineering personnel from the Product Design and Development Group of the Saskatchewan Research Council. This report outlines the tests that were conducted and the data that was obtained on June 12, 2000 by Tony Kaminski, P. Eng, PhD, a principal engineer at the Saskatchewan Research Council in Saskatoon.

2 Objective

The objective of the tests was to obtain the following:

- (1) load and stress data when the well casing is positioned vertically and loaded to failure
- (2) load data when the well casing is positioned horizontally and loaded to failure
- (3) load data when the cap is positioned on a vertical casing and loaded to failure

3 Test Procedure

Tests were conducted using both 1-ft and 3-ft lengths of well casing cut from pipes made on different days. The following data was obtained for both the well casing and well caps.

- (1) component weight using a Toledo platform scale
- (2) surface hardness using a Rex Model 1600 Type D gauge
- (3) wall thickness using a Mitutoyo 8-inch digital micrometer
- (4) product temperature using a infrared thermometer
- (5) test time using a digital stop watch
- (6) product length or diameter using a tape measure
- (7) vertical test force using a CDK RL9000 100,000 lb capacity load cell with a Rice Lake Weighing System Model IQ + 355-2A indicator supplied by Norac Systems in Saskatoon

Each component was loaded using a 100-ton hydraulic press manufactured by Fasoli Industries Ltd., a Model 36-60-100 having a 36" x 60" bed. The vertical well casings were tested as shown in Figure 1.

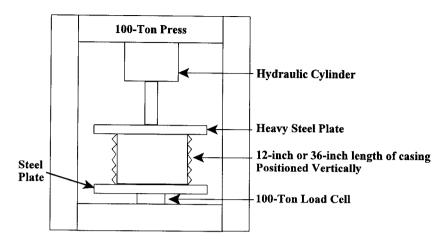


Figure 1: Vertical Loading of 30" Corrugated Well Casing

The well casing was also positioned horizontally as shown in Figure 2.

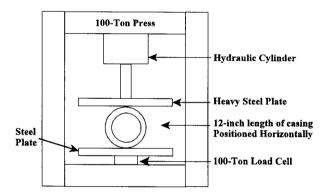


Figure 2: Horizontal Loading of 30" Corrugated Well Casing

The well casing caps were tested as shown in Figure 3.

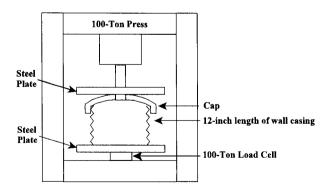


Figure 3: Vertical Loading of Well Casing Cap

The general test procedure consisted of the following:

- (1) record serial number, weights, dimensions, temperature and hardness. The hardness was taken at the top of the corrugation
- (2) mount the casing or cap in the press
- (3) start stop watch, apply initial load and for casing tests measure distance between steel plates. For cap tests measure the distance from bottom of rim to upper steel plate. The sawed casing ends were somewhat irregular so the well casings were not uniformly loaded around the circumference
- (4) increase load in varying increments and take length or diameter data between each load change
- (5) record the maximum observed load prior to failure
- (6) read time on stop watch
- (7) perform calculations such as average wall thickness, average diameter and, in some cases, average wall stress

The well casing wall thickness varied considerably so four readings were taken of the minimum thickness found at the bottom of the corrugation when viewed from the outside of the casing. Four thickness readings were also taken at the top of the corrugation having the maximum wall thickness. The cap thickness varied also with four measurements made at the top around the 6 5/8 inch diameter hole where the wall thickness was about twice the thickness of the rim around the outside. Data sheets for all the tests are included in the Appendices.

4 Tests with Vertical Loading of 30-Inch Diameter Corrugated Well Casing

All these tests were conducted with the well casing positioned vertically in the hydraulic press as shown in Figure 1. The data sheets are contained in Appendix A. Summarized in Table 1 are the results of the eight tests that were conducted.

Casing Pipe Serial Date of Average Wall Fracture Average Bending Length Number Manufacture **Thickness** Load Stress in Wall 12" 199910203 October/99 .235" 35,000 lb 1,646 lb/in² 199910203 October/99 .226" 36,000 lb 1,767 lb/in² 199910203 October/99 .227" 38,000 lb 1.851 lb/in² 20000671 June 2000 .222" 34,800 lb 1,691 lb/in² 20000681 June 2000 .232" 33,000 lb 1,571 lb/in² 20000681 June 2000 .232" 38,000 lb 1,809 lb/in² 36" 20000671 June 2000 .221" 33,500 lb 1,675 lb/in² 20000681 June 2000 .222" 33,200 lb 1,652 lb/in² .227" Average Values 35,188 lb 1,708 lb/in²

Table 1. Test Data with Vertical Loading of 30" Well Casing

The eight tests with vertical loading of 30" diameter corrugated well casing showed the following:

- (1) the casing samples had similar weight and wall thickness
- (2) the maximum vertical fracture loads varied from 33,200 lb to 38,000 lb with an average value of 35,188 lb
- (3) the casings typically fractured at the bottom of the corrugations having the lower wall thickness
- (4) the average bending stress in the casing wall at failure varied from 1,571 lb/in² to 1,851 lb/in² with an average value of 1,708 lb/in²
- (5) the load data obtained with 12-inch lengths was similar to the load data obtained with 36-inch lengths
- (6) the 12-inch casing length decreased about 5/16" in length prior to failure whereas the 36-inch casings decreased almost 3/4" in length prior to failure which represented about 2 to 2 1/2% of the casing length
- (7) the surface hardness on top of the corrugations was typically 80 to 85 D for all the fiberglass components
- (8) the test times varied from 2.5 to 10 minutes with an average time of 5.14 minutes

5 Tests with Horizontal Loading of 30-inch Diameter Corrugated Well Casing

All these tests were conducted with the well casing positioned horizontally in the hydraulic press as shown in Figure 2. The data sheets for these tests are provided in Appendix B. Summarized in Table 2 are the results obtained in the four tests that were conducted with 12-inch lengths of well casing.

Table 2. Test Data with Horizontal Loading of 12-inch Lengths of 30-inch Diameter Well Casing

Casing Length	Pipe Serial Number	Date of Manufacture	Average Wall Thickness	Fracture Load	Loading Per Inch of Length
12"	20000671	June 2000	.229"	840 lb	70 lb/in
	20000681	June 2000	.229"	850 lb	70.8 lb/in
i .	199910203	October/99	.228"	925 lb	77.1 lb/in
	199910203	October/99	.228"	1,045 lb	87.1 lb/in
Average V	alues		.229"	915 lb	76.3 lb/in

The 4 tests with horizontal loading of 12-inch lengths of 30-inch diameter well casing showed the following:

- (1) the fracture loads varied from 840 to 1045 lbs with an average of 915 lbs which represented an average uniform loading of 76.3 lb/in of pipe length
- (2) the casings had similar weights and wall thicknesses
- the fiberglass well casing, when subjected to horizontal loading, deforms at least 10 inches or over 30% of its diameter prior to fracturing along the severely bent sides
- (4) the well casing deforms into an irregular shape due to side loading
- (5) the average time for the casing tests was 4.72 minutes
- (6) the surface hardness on the top of the corrugations typically varied from 80 to 90 D and were similar for all casing samples

6 Tests with Vertical Loading of Well Casing Caps

The casing caps were positioned on top of a 12-inch length of 30-inch diameter well casing and tested as shown in Figure 3. The following types of fiberglass caps were tested:

- (1) molded fiberglass caps without a hole in the center
- (2) molded fiberglass caps with a 6 5/8" diameter hole in the center
- (3) prototype hand sprayed cap without a center hole
- (4) prototype hand sprayed cap with a 6 5/8" diameter center hole

The data sheets for the 10 well cap tests are in Appendix C. The molded caps had a curved top with the dome height at the center being about 1 1/2 inches higher than the height around the outside rim. This non-uniform cap height made it impossible to use a flat steel plate to produce a uniform loading over the entire cap area which would more closely represent soil loading in a typical application. Ideally a special molded interface section is required between the flat steel plate and the dome surface of the cap.

Application of a vertical load on a cap using a flat steel plate resulted in vertical force being applied to only the center portion of the cap. If the top of the cap was relatively thin then the cap would flatten out and permit the load to be applied to the outside of the cap which is supported by the relatively strong well casing. If the top of the cap was relatively thick and stiff then application of a load only at the center of the cap would result in a high bending moment which could cause the bottom lip of the cap to crack due to excessive tensile stresses.

In order to attempt to distribute the downward force of the hydraulic press over a larger area of the cap, some tests were conducted using the following modifications:

- (1) a 17" diameter truck wheel having a 19 1/2" O.D. tire rim complete with an old tire positioned on top the cap
- (2) adding two spacer rings each made by cutting up the tops of the well caps as shown in Figure 4

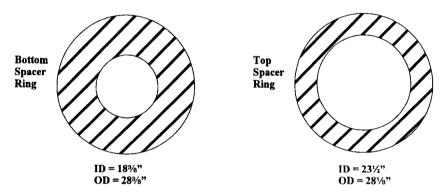


Figure 4: Two Fiberglass Spacer Rings Having Similar O.D.

(3) adding two fiberglass spacers with the bottom ring having a larger outside diameter as shown in Figure 5

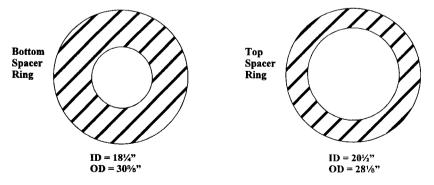


Figure 5: Two Fiberglass Spacer Ring With Larger Diameter Rings Positioned At Bottom

The fiberglass spacer rings were used to distribute the force on the well cap as shown in Figure 6.

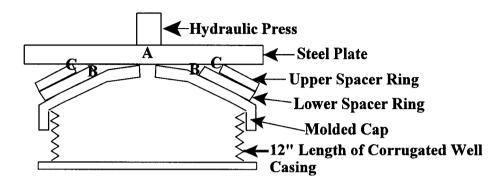


Figure 6: Distribution of Cap Loads Using Spacer Rings

With the spacer rings mounted as shown in Figure 6 the force of the hydraulic press was applied at points B and C in addition to A.

The results of the well cap tests are summarized in Table 3.

Table 3. Test Data with Vertical Loading of 30 5/8" OD Well Cap

Cap Identification	Cap Type		rage kness	Loading Configuration	Deflection Prior to	Fracture Load
		Тор	Rim		Failure	
Heavy Prototype made 10/99	Hand sprayed No hole	.376"	.334"	Center only	1.44"	27,000 lb (flattened, no fracture)
Heavy Prototype made 10/99	Hand sprayed 6 5/8" hole	.376"	.334"	Center only	1.31"	23,600 lb (cracked across center)
Light Prototype made 10/98	Hand sprayed 6 5/8" hole	.407"	.180"	Center only	1.88"	25,300 lb (flat at 5,000 lb)
Light Prototype made 12/98	Hand sprayed No hole			19 1/4" OD tire rim	1.94"	7,640 lb (cracked around top of cap rim)

2000060718 made 6/00	Molded 6 5/8" hole	.441"	.174"	Center only	.59"	3,100 lb - (rim cracked)
2000060719 made 6/00	Molded 6 5/8" hole	.466"	.183"	19 1/4" OD tire rim	2.69"	5,300 lb - (cap rim cracked)
20000607 made 6/00	Molded No hole			Center only	.75"	3,030 lb - (cap rim cracked)
2000060814 made 6/00	Molded 6 5/8" hole	.456"	.184"	Two fiberglass rings shown in Figure 4	.38"	14,600 lb - rim and top cracked
2000060807 made 6/00	Molded 6 5/8" hole	.408"	.179"	Two fiberglass rings shown in Figure 4	.38"	Started cracking between 12,500 lb and 27,400 lb
2000060723 made 6/00	Molded 6 5/8" hole	.472"	.185"	Two fiberglass rings shown in Figure 5	.19"	Initial failure at about 20,000 lb 22,900 max load applied

The results of the 10 well cap tests indicated the following:

- (1) The hand sprayed caps had thicker rims and thinner tops so they would flatten out without the rim cracking and enabled the well casing to support loads of 23,600 to 27,000 pounds when loaded with a flat steel plate. The actual behavior under soil loading is unknown but the deflection data indicated that when the loads exceeded about 8,000 lbs there was generally no further deflection of the cap indicating that the load was being transferred to the casing.
- (2) The molded caps had relatively thick domes and thinner rims which would crack when loads exceeding about 3,000 lbs were applied only at the center of the cap.
- (3) Placing a 19 1/4" OD truck rim on the molded cap increased the load carrying capacity of the cap to about 5,300 lb before the cap rim cracked.
- (4) Placing two fiberglass spacer rings to distribute the loading on the top of the cap enabled the cap to carry loads up to about 20,000 lbs before failure.
- (5) There was considerable variation on the amount of cap deflection prior to failure. Deflection varied from about 1/4" for the molded caps with two support rings to almost 2" for the lighter hand sprayed caps.
- (6) The presence of a 6 5/8" diameter hole at the center of the cap did not appear to significantly affect the support capability of the cap when loaded using a steel plate.
- (7) Normally the failure of the molded caps resulted from rim failure which then propagated up along the top.

- (8) Increasing the thickness of the rim increases the load carrying capacity of the cap considerably. Perhaps it would be advantageous to use a uniform thickness for the top and rim of the cap.
- (9) The loading configuration on the cap plays a very important role in determining the maximum load that the cap can support. Laboratory tests should be conducted simulating loading similar to what would be expected in the field.

7 Summary and Conclusions

A total of 22 laboratory tests were conducted on sections of 30-inch diameter corrugated fiberglass casings and fiberglass well caps using an instrumented hydraulic press. The components were well molded and there was generally good repetition of the test data. The results of these tests showed the following:

- (1) well casings positioned vertically can support maximum vertical loads of 33,200 to 38,000 lbs which represented average bending stress in the casing wall of 1,571 lb/in² to 1,851 lb/in at the time of failure
- (2) well casings positioned horizontally can support maximum concentrated vertical loads of 70.0 to 87.1 lb/inch of pipe length at failure
- (3) the maximum vertical load a fiberglass well cap can support varied greatly with the loading configuration and varied from about 3,100 to 20,000 pounds. Well cap strength can be increased by increasing the thickness of the rim

APPENDIX A

Data Sheets for 8 Tests with Vertical Loading of 30-inch Diameter Well Casing

	# 1999 10203 Pipe Serie			Number #1. F12		Date of Manufacture		1999
		Date of Te	est June 12/ 2000		Temperatu		70° F	
		Weight of Resin	329	_LB.	Weight of	Glass	72.5 LB.	
		Pipe Length	25 A	<u>r-</u> 4"				
		Pipe Diameter	Outsid	e <u>29</u> 5/8	•	Inside	28"	
	Con	rugation Pattern	Depth 181	Spacing	298"			
		W	all Thickness -	Bottom of Cor	rugation (M	linimum)	(Meximum)	
		1196"	2.203 3.19	13 4 .189		Average	.1951)	
		V	Vall Thickness -	Top of Corru	ıgation (Mi	nimum) (Maximum)	(235)
		1_,273	2,276 3,2	75 4 .278		Average	,275"	
			Te	est Sample				
	Length	15"		Weigth	146-	7/202		
	Sample Or	ientation	Vertica	al <u>×</u>	OR	Horizontal		
		LOAD	ENGTH DIAMET	TER DEFLE	CTION]	Collected Data	a
	1	275	12/8					- "
	2	1347	12/32			Average D	Diameter	28,81"
	3	30 <i>82</i>	1131/32					
	4	<u> </u>	11/5/16					
	5		112/32			1		2122 2
41.40	6		11 7/32			1	Cross Section	<u>21,01</u> m
Spice	7	100//00	1124/32			1	Area	
No Air Spice inited con	8	52000	11 25/32		.	}		
initics cre	10	29,400	11 24/32 Major freedire			Mavimum	Compression	
	11	35,000	Mayor freezente			Stress	Complession	1646 lb/2
	12					0.1033		10/19
	13					1		
	14					1		
	15							
	16					1		
	17					1		
	18]		
	19]		
		Start test	12:07 pm		12:17 pm	Total Time	e 10 minr	ls,
		Hardness on top	corrigation 80 - 8	<u>دې</u> ۵				

		Pipe Serial Number #2	•		arranta. c	/	•)
	Date of T	est June 12/ 2000		Temperatu	ıre	78°F	
	Weight of Resir	1 32 <u>9 🐯 </u> LВ.	002	Weight of	Glass	72、J LB.	
	Pipe Length	25-44					
	i ipe Length		20V			28	
	Pipe Diameter	Outside _	29/2		Inside		
С	Corrugation Pattern	Depth	Spacing	298			
	١٨	/all Thickness - Bott	om of Cor	rugation (N	/linimum)	(Movies)	
		yan mokness Bok		, uguno, ,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	(11122	
	1 .186	2.185 3.193	4 . 189		Average	188	
		100					
	,	Wall Thickness - To	p of Corru	ugation (M	nimum) (Maximum)	
	1 .262	2.257 3.286	. 276]	A.,	,263	
	1_,662	2,60/ 3,06	4 , 0125	j	Average	, , , ,	(,22)
		Test Sa	ımple				(,7
Length	12"	,	Meiath	14 13	り子		
Lengin	<u></u>	·	vveigin	<u>., , , , , , , , , , , , , , , , , , , </u>			
Sample	Orientation	Vertical _	X	OR	Horizonta	ł	
	LOAD	LENGTH / DIAMETER	DEFLE	CTION	7	Collected Data	a
	1 340	12/16					
	1 010						26 26
	2 2125	12			Average I		28.75
		113/32			Average I		28.75
	2 2125 3 4760 4 8100	12 113/32 113/32			Average I		2 <u>8.75</u>
	2 2125 3 4760 4 8100 5 11,375	113/32				Diameter	
3100	2 2125 3 4760 4 8100	113/32				Diameter Cross Section	
	2 2125 3 4760 4 8100 5 11,375 6 15,500 7 18,400	113/32				Diameter	
	2 2125 3 4760 4 8 00 5 11,375 6 15,500 7 18,400 8 20,600	12 11 ³ / ₃₂ 11 ³ / ₃₂ 11 ² / ₃₂				Diameter Cross Section	
N Str	2 2125 3 4760 4 8 50 5 11,375 6 15 500 7 18,400 8 20,600 9 23,425	12 11 ³ / ₃₂ 11 ³ / ₃₂ 11 ² / ₃₂			Average	Diameter Cross Section Area	
N 844	2 2125 3 4760 4 8100 5 11,375 6 15,500 7 18,400 8 20,600 9 23,425 10 27,200	12 11 ³ / ₃₂ 11 ³ / ₃₂ 11 ² / ₃₂			Average Maximum	Diameter Cross Section	20.37 m
N Str	2 2125 3 4760 4 8/00 5 11,375 6 15,500 7 18,400 8 20,600 9 23,425 10 27,200 11 31,000	12 11 ³ / ₃₂ 11 ³ / ₃₂ 11 ² / ₃₂			Average	Diameter Cross Section Area	20.37 m
N Shr	2 2125 3 4760 4 8/00 5 11,375 6 15,500 7 18,400 8 20,600 9 23,425 10 27,200 11 31,000 12 34,000	12 11 ³ / ₃₂ 11 ³ / ₃₂ 11 ² / ₃₂			Average Maximum	Diameter Cross Section Area	20.37 m
N De	2 2125 3 4760 4 8/00 5 11/375 6 15 500 7 18 400 8 20,600 9 23 425 10 27,200 11 3 (000) 12 34,000	12 11 ³ / ₃₂ 11 ³ / ₃₂ 11 ² / ₃₂			Average Maximum	Diameter Cross Section Area	20.37 m
N Spir	2 2125 3 4760 4 8 00 5 11,375 6 15 500 7 18,400 8 20,600 9 23,425 10 27,200 11 31,000 12 34,000 13	12 11 ³ / ₃₂ 11 ³ / ₃₂ 11 ² / ₃₂			Average Maximum	Diameter Cross Section Area	20.37 m
	2 2125 3 4760 4 8100 5 11,375 6 15,500 7 18 400 8 20,600 9 23,425 10 27,200 11 31,000 12 34,000 13 14	12 11 ³ / ₃₂ 11 ³ / ₃₂ 11 ² / ₃₂			Average Maximum	Diameter Cross Section Area	20.37 m
N SPLA	2 2125 3 4760 4 8100 5 11,375 6 15,500 7 18 400 8 20,600 9 23,425 10 27,200 11 31,000 12 34,000 13 14	12 11 ³ / ₃₂ 11 ³ / ₃₂ 11 ² / ₃₂			Average Maximum	Diameter Cross Section Area	20.37 m
N SPLA	2 2125 3 4760 4 8 00 5 11,375 6 15,500 7 18,400 8 20,600 9 23,425 10 27,200 11 31,000 12 31,000 13 14 15 16	12 11 ³ / ₃₂ 11 ³ / ₃₂ 11 ² / ₃₂			Average Maximum	Diameter Cross Section Area	20.37 m
N 3844	2 2 2 3 5 3 4760 4 8 50 5 11,375 6 15 500 7 18 400 8 20,600 9 23 425 10 27,200 11 3 600 12 31,000 13 14 15 16 17 18	12 11 ³ / ₃₂ 11 ³ / ₃₂ 11 ² / ₃₂			Average Maximum	Diameter Cross Section Area	20.37 m
N 844	2 2125 3 4760 4 8 00 5 11,375 6 15,500 7 18,400 8 20,600 9 23,425 10 27,200 11 31,000 12 31,000 13 14 15 16	12 11 ³ / ₃₂ 11 ³ / ₃₂ 11 ² / ₃₂			Average Maximum	Diameter Cross Section Area	
N 3844	2 2 2 3 5 3 4760 4 8 50 5 11,375 6 15 500 7 18 400 8 20,600 9 23 425 10 27,200 11 3 600 12 31,000 13 14 15 16 17 18	12 11 ³ / ₃ 2 11 ² / ₃ 2 11		1.72	Average Maximum Stress	Diameter Cross Section Area	20.37 in

# 199910203	Pipe Serial Numb	per Na 3 of 12	Date of Ma	anufacture	Det 20/	1999
Date of T	est June 12/ 2000	1	Temperati	ure	750	
Weight of Resir	1 <u>32</u>	<u>9</u> LB.	Weight of	Glass	72.5 LB.	
Pipe Length	<u>251.</u>	_4"				
Pipe Diameter	Outs	side <u>29/1</u> 2	<i>1</i> **1	Inside	28	
Corrugation Pattern	Depth -83	Spacing	238			
W	/all Thickness -	Bottom of Co	rrugation (N	Minimum)	(Maximum)	
1182	2.173 3.	183 4 · 185		Average	.181	
Y	Wall Thickness -	- Top of Corr	ugation () (M aximum)	,227
125%	2 ,284 3 ,2	259 4.291		Average	.273	,,,,
		Test Sample	_			
Length <u>12"</u>		Weigth	1416-	402		
Sample Orientation	Vert	ical <u>×</u>	OR	Horizontal		
LOAD	LENGTH / DIAM	DEFLI	ECTION]	Collected Data	a
1 285	12/32			 Average D)iameter	28,78
3 6755	1) 39/32			Triverage B	nameter	20710
4 9965	12/32]		
5 13500	1128/32			┧.		on 53
6 18,310 7 22,250	112/32			Average	Cross Section	<u> 207</u>
8 27,100	1125/32			-{	Area	
9 30,500	11-7/32			1		
10 34,00/	12/22				Compression	1
11 38000	Farline			Stress		1851 /b/ -
12	<u> </u>		·	4		/ //
13 14				-		
15				-		
16				1		
17				1		
18]		
19						
Start test		Finshed		Total Time	4 mm -	1280
Hardness on to	corrigation	7 D_D				

<u>∞∞∞5</u> #	67/19	Pipe Serial	Number		Date of Ma	anufacture	June 7/2	2000
	Date of Te	st June 12/	2000		Temperatu	ıre	73°F	
W	Veight of Resin		332_LB.		Weight of	Glass	73 LB.	
Р	ipe Length	;	251-411					
Р	ipe Diameter		Outside	29/16	5/8	Inside	28	
Corru	gation Pattern [Depth		Spacing	25/8			
	Wa	II Thickness	s - Bo	ttom of Cor	rugation (N	/linimum)	(Maximent)	
1	19 1	2 .177	3,182	4 ,172		Average	,181	
<u> </u>			ss - T		•			(127)
Г			Τ	· 	1	, ,	,	
1_	,26S	2,25 <u>3</u>	3.272	4.258]	Average	162	
	1.1		Test S	•		_		
Length	120			Weigth	1416-	502		
Sample Orie	ntation		Vertical	X	OR	Horizontal		
	OAD		DIAMETER	DEFLE	CTION]	Collected Data	a
2	30U 32 36	12/3				_ Average	Diameter	28.80
3	6550	12						
5	9700	$\frac{1131}{3}$	2			4		
6	13,230 16,665	11273	<u>) </u>			Average	Cross Section	20,58
7	19.76.5	1128/	74]	Area	
8	23,910	1128/	シン			4		
9	27.100	26/2	37			Mavimum	Compression	
11	35,100 34.800	11 -10	/32			Stress	Compression	1691 /6/17
12	37,000	13V LaC			·····			///
13						_		
14				-		-		
16	1.4.40				<u></u>	-		
17				1		1		
18								
19						ا		
S	tart test	1:41 pr	<u>-</u>	Finshed	<u> </u>	Total Time	= 5mm/	
H	lardness on top	corrigation	86-85	D				

# S000C	6 81	Pipe Serial	Number		Date of Ma	anufacture	JONE 87	200
	Date of Te	est June 12/	2000		Temperatu		75°F	
We	eight of Resin	•	<u>333</u> lв		Weight of	Glass	<u>73</u> LB.	
Pip	e Length		25-41					
Pip	oe Diameter		Outside	293/40	192	Inside	28	
Corruga	ation Pattern I	Depth	<u>.79</u>	29 3/4-2 Spacing	25/8			
	Wa						(Meximum)	
	105	· · · ·		19/			.70	
<u> 1</u>	.185	2.176	3.192	4_1186]	Average	.105	(204)
	W	/all Thicknes	ss - T	op of Corru	ugation (🌬	oiaman) (l	Maximum)	
1_	.264	2,284	3.290	4,28)		Average	.280	
			Test S	Sample				
Length 1	2"			Weigth	146-4	102		
Sample Orient	tation		Vertical	×	OR	Horizontal		
ILO	AD (16)	LENGTH / [DIAMETER	DEFLE	CTION		Collected Data	a
1 4	485	1248	•					
	000	12/14	•			Average D	iameter	28,81
	5150	12		<u> </u>]		
	10,350	113/3						
	15,190	11 32	32					210 2
	19,900	112/	32			1	Cross Section	4,017
	2,600		/32				Area	
	26500	1) 2/	32	 		4		
10	33,000		/32-	-		Maximum	Compression	
11						Stress	Compression	1571 16/2
12						Siless		1571 16/19
13								ί''
								
14			· · · · · · · · · · · · · · · · · · ·	ļ	· · · · · · · · · · · · · · · · · · ·			
15								
16				-		4		
17						1		
18 19								
[[8]				<u> </u>		j		
Sta	art test	1.55	-	Finshed	***************************************	Total Time	2min-3	DSec
Ha	rdness on top	corrigatio	-80	D				

# 50000 68	Pipe Seria	l Number		Date of M	anufacture	JUNE 8/	200
D	ate of Test June 12	2/ 2000		Temperat	ure	77°F	
Weight	of Resin	333 LB.		Weight of	Glass	<u>73</u> LB.	
Pipe Le	ngth	25/4/					
Pipe Dia	ameter	Outside	295/8		Inside	28	
Corrugation	Pattern Depth	181"	Spacing	25/8			
	Wall Thicknes	ss - Bo	ttom of Cor	rugation (f	Minimum) ((Meximum)	
	100]		181 H	
116	7 2 180	3 186	4 190]	Average	.186"	
	Wall Thickn	ess - T	op of Corru	ugation (M	inimum) (I	Maximum)	(,232)
1_,26	9 2,285	3 .279	4.282		Average	.279	
1		Test S	ample	_			
Length 12 ^{il}			•	1416-	602		
Sample Orientation		Vertical	×	OR	Horizontal		
LOAD		DIMETER	DEFLE	CTION		Collected Data	1
1 431			DEILL	2011014	1	Collected Date	
2 3513					Average D	iameter	28,8/
3 661		<u>. </u>			1		
4 752		S	<u> </u>				
5 15,32		37			1		~
6 180	3/2 1130	5/32			Average	Cross Section	21,00 /n
7 21,5	11 50	/32			_	Area	
8 25 2	DO 11 29	/32			1		
9 298		/32.					
10 388		re		.,	Maximum	Compression	12.041
11					Stress	•	1809 /5/12
12					7		
13					1		•
14			 		1		
15					1		
16					7		
17					7		
18					7		
19					7		
Start tes	st		Finshed		Total Time	4 mine	ζ,
Hardnes	ss on top corrigatior	80-85	D				

<u>~ 200</u>	00 6711	Pipe Serial	Number		Date of Ma	anufacture	JONE 7	/2000
	Date of T	est June 12	2000		Temperati	ıre	74°F	
	Weight of Resin	ı	3 <u>32,</u> LB		Weight of	Glass	<u>73</u> LB.	
	Pipe Length		25/-4	()				
	Pipe Diameter		Outside	29%		Inside	28	
Cor	rugation Pattern	Depth	18	Spacing	288			
	w	all Thicknes	s - Bo	ttom of Cor	rugation (N	minimur Minimuri)	(Meuimum)	
	1 . 85	2,154					17911	
	\	Vall Thickne	ss - T	op of Corru	- ugation(M	Maganu	4	(221)
	1_,262_	2,267	3268	4.258		Average	.264	4% 9
			Test S	Sample				
Length	36"			Weigth	43 13			W.
Sample Or	ientation		Vertical	_×_	OR	Horizontal		- 1
	LOAD	LENGTH /	Diameter	DEFLE	CTION]	Collected Data	1
1	450	36/1	5	1		Average	liamotor	28.81
3	3050	36	/.,	<u> </u>		Average D	лаптетет	<u> </u>
4	6500	357	1/2-			4		
5	9240	35.00	/32		AUI.	-		
6	13.030	35 7	132			Average	Cross Section	20,00
7	16,700 20,885	35 18	732 76	 	·	1	Area	
8	25.000	35%	4			1		
9	29.400	259/4	4					
10	33,500	Forder				→	Compression	1675/16/12
11		<u> </u>				Stress		16/3/0/2
12		.				1		//~
13		ļ				_		
14		<u> </u>				-		
15						-		
16 17				 		4		
17						1		
19						1		
	Start test	2:/2 pm	~	Finshed		Total Time	3min 3	782
	Hardness on top	corrigation	80-85	D				

(, kis)

# 20000681	Pipe Serial Number		Date of M	lanufacture	JUNE &	/2000
Date of Te	st June 12/ 2000		Temperat	ure	75°F	
Weight of Resin	333_LE	3.	Weight of	Glass	<u>73</u> LB.	
Pipe Length	25-41	<i>I</i>				
Pipe Diameter	Outside	295/8		Inside	28	
Corrugation Pattern D	Depth 181	Spacing	2/8	_		
Wa	II Thickness - Bo	ottom of Cor	rugation (Minimum)	(Maximum)	
1_188	2,159 3.174	4184		Average	.176	_
w	/all Thickness -	Top of Corru	ugation (N	liniaa (Maximum)	,222
1 .264	2,265 3,274	4.269		Average	1268	
	Test	Sample				
Length <u>36"</u>		Weigth	43/	2		c h
Sample Orientation	Vertical	<u> </u>	OR	Horizonta	<u> </u>	53
LOAD	LENGTH / DIAME	DEFLE	ECTION		Collected Data	a
1 660 2 3646	36716 36716			Average [Diameter	58.81
3 6920 4 10,030	35 15/16			-		
5 13.745	35 14/6					
6 17,890	35 YH			Average	Cross Section	20,07
7 21,035	35 7/16			_	Area	
8 25,00	35 7/32			-		
10 33.20	Farence			Maximum	Compression	
11	· ·			Stress		1652 16/12
12						/ i M
13				_		
14		1		-		
15 16				-		
17				-		
18						
19						
Start test	2:23	Finshed		Total Tim	e 4 min -	30 Bc

Hardness on top corrigation 80-85 D

APPENDIX B

Data Sheets for 4 Tests with Horizontal Loading of 30-inch Diameter Corrugated Well Casing

Seam top and bottom

<u> 2005</u>	06-71-4	Pipe Serial	Number		Date of Ma	anufacture	Jone 7/	2000
	Date of Te	est June 12/	2000		Temperati	ıre	Jone 7/	
	Weight of Resin		332_LB	-	Weight of	Glass	<u>73</u> _LB.	
	Pipe Length		251-411					
	Pipe Diameter		Outside	29/8		Inside	28"	
Col	rrugation Pattern I	Denth		Spacing			· · · · · · · · · · · · · · · · · · ·	
001	J	·					/ N.	
	Wa	all Thickness	s - Bo	ttom of Col	rugation (N _	/linimum)	(Moximum)	
	1179	2,189	3.185	4185		Average	.185	
	V	Vall Thicknes	ss - T	op of Corr	ugation (M	inimum) (Maximum)	(229
	1_,273	2.276	3,270	4.271]	Average	.273	
			Test S	Sample				
Length	12"			-	1416	502		
Sample O	rientation		Vertical		OR	Horizontal		
	LOAD	LENGTH/		DEFLE	ECTION		Collected Data	a
1	1-10	299		<u> </u>		↓		28,81"
2		28 1/2	<u>ي</u>	<u> </u>		Average D	plameter	20,01
3		2/1/7	<i>)</i>	<u>.</u>		4		
4		261/4	<i>/</i>	 		-{		
5	 	25 %	4	ļ		┨.		
6		25/2	<u> </u>	ļ		-1	Cross Section	
7		24/4	<u>f</u>				Area	
8		23/8	<u> </u>			<u> </u>		
9		55/2	P			1		
10		215/8	•	<u> </u>		-1	Compression	
11		20				Stress		
12	840 G	celade				_		
13	,							
14		·						
15								
16					***************************************	1		
17						1		
18						1		
19			* * * * * * * * * * * * * * * * * * * 			1		
	Start test	4:28	2 -10.		4.32	Total Time	4 mm	D
	Hardness on top	corrigation	(CEE)	_D				

# <u>Z001</u>	00681	Pipe Serial I	Number		Date of Ma	anufacture	JONE 8/2000
	Date of Te	st June 12/	2000		Temperatu		78°F
	Weight of Resin		<u>333</u> lb.		Weight of	Glass	<u>73</u> _LB.
	Pipe Length						
			Outside	2954		Inside	28
	Pipe Diameter			2178		IIISIUE	
Con	rugation Pattern [Depth	181	Spacing	2/8		
	Wa	all Thickness	- Bot	tom of Cor	rugation (N	/linimum)	(M adina))
Į	1_183	2 ,183	3,192	4 <u>193</u>		Average	<u>1188''</u>
	W	/all Thicknes	s - To	op of Corru	igation (M i	nimum) (Maximum)
,		· · · · · · · · · · · · · · · · · · ·	T	•	1	, `	, , J
	1,262	2 <u>.283</u>	3 . 265	4.270		Average	1270"
			Test S	amnle			
	1211		1631 0		21	_	
Length	12			Weigth	1415	702	
Sample Or	ientation		Vertical		OR	Horizonta	<u> </u>
	LOAD	L 5NOTH /[DIAMETER	DEFLE	CTION]	Collected Data
1	16	29/4	b			Average [Diamotor
2	510 110	2878				TAVELAGE L	Jianielei
4	310	26/2	,			1	
5	365	254/	16]	
6	450	241/	6			-	Cross Section
7	530	23/2				1	Area
8	605	22/2	<u>, </u>			4	
9	685	21//	<u>/</u>			Maximum	Compression
10 11	730	21/4				Stress	Compression
12	785 850	Crack				10000	
13	<u> </u>	UTIOS	<u> </u>		· M .	1	
14						1	
15]	
16]	
17							
18						1	
19		<u> </u>				J	
							e 5 min 55 sec

Hardness on top corrigation 85-90 D

Seam top and bottom

# 199910200	Pipe Serial Nu	ımber 5	12	Date of Ma	ınufacture	16 °F	1999
Date of	Test June 12/ 20	000		Temperatu	ire	76°F	
Weight of Res	sin 🚡	3 <u>29</u> LB.		Weight of	Glass	7 <u>2,5</u> LB.	
Pipe Length	-	25-4M					
Pipe Diameter	· C	outside _	29/8		Inside	28"	
Corrugation Patter	n Depth _	181	Spacing	25/8/1			
V	Wall Thickness				linimum)	(M asimum)	
1187	2.189: 3	.195	1.188		Average	190	
	Wall Thickness	- To	p of Corru	igation(Mi	niman)(Maximum)	(.228
1_,263	2,265 3	.272	.267		Average	,267	
		Test Sa	mple				
Length		١	Veigth	14/6			
Sample Orientation	V	ertical _		OR	Horizontal		
LOAD	LEMEN / DI/	AMETER	DEFLE	CTION		Collected Data	
2 130%	28 1/4				Average [Diameter	
3 230	2717/16	>					
5 39.5	26/8						
6 485	1 4770						
	251				Average	Cross Section	
<u> </u>	257				_	Cross Section Area	and the second s
7 575 8 630	25"				_	Cross Section Area	
7 575 8 630 9 715	25' 24" 23'4" 22'/8"				_		
7 575 8 630 9 715 10 925	25 ' 24 " 23 44" 22 48" Cracked	in half			Maximum		
7 575 8 630 9 715 10 925	25 1 24 " 23 44" 22 48" Crailed	u hall				Area	
7 575 8 630 9 715 10 725 11	25" 24" 23'4" 22'/8" Crail-L	in hall			Maximum	Area	
7 575 8 630 9 715 10 925 11 12	25 1 24 " 23 14" 22 1/8" Cracked	in boally			Maximum	Area	
7 575 8 630 9 715 10 925 11 12 13	25 1 24 " 23 44" 22 48" Crailed	in half			Maximum	Area	
7 575 8 630 9 715 10 725 11 12 13 14	25 ' 24 " 23 44" 22 48" Cracked	in half			Maximum	Area	
7 575 8 630 9 715 10 925 11 12 13	25 1 24 " 23 44" 22 18" Cracked	in half			Maximum	Area	
7 575 8 630 9 715 10 925 11 12 13 14 15	25 1 24 " 23 44" 22 48" Crawled	in half			Maximum	Area	
7 575 8 630 9 715 10 925 11 12 13 14 15 16	25 1 24 " 23 44" 22 18" Cracked	in half			Maximum	Area	
7 575 8 630 9 715 10 925 11 12 13 14 15 16 17	25 1 24 " 23 44" 22 1/8" Crailed 5:02 pm		inshed		Maximum Stress	Area	~!

Jeans or 5/des

Hardness on top corrigation **85-9D** D

	110203	Pipe Serial N	Number &	pair	Date of Ma	anufacture	Oct 20	1999
	Date of To	est June 12/	2000		Temperati	ure	78	
	Weight of Resin	ı	329 LB	l.	Weight of	Glass	<u>ን </u>	
	Pipe Length		251-4	Ú				
	Pipe Diameter		Outside	295/8		Inside	28"	
Con	rugation Pattern	Depth		Spacing	2			
	w	all Thickness	- Bo	ottom of Cor	rugation (N	Minimum)	(Maximum)	
	1_181	2.187	3 <u>,183</u>	4,19)		Average	,186	
	V	Vall Thicknes	s - T	op of Corru	ugation (M i) (Maximum)	,228
	1268	2,260	3.278	4,277		Average	,271	
·				Sample	•			
Length	124			Weigth	1416	402		
Sample Or	ientation		Vertical		OR	Horizonta	<u> </u>	
	LOAD	LENGTH / D	NAMETER	DEFLE	OTION	7		
1	10	003/4			CHON	j	Collected Data	1
2		29/16	·		ECTION			1
	130	281/4	/		CHON	Average [·
3	245	-7/	/		ECTION	Average [<u> </u>
4	245 340	281/4	/		ECTION	Average [
4 5	245 340 420	287/H 219/4 263/4 26	,		CHON		Diameter	
4 5 6	245 340 420 505	287/4 219/4 267/4 26 253/4	<u>.</u>		CHON	Average	Diameter Cross Section	
4 5 6 7	245 340 420 505 595	287/H 219/4 263/4 26	<u>.</u>		CHON	Average	Diameter	
4 5 6	245 340 420 505 595 685	287/14 21 8/4 26/4 25/4 25/4 24/5	6		CHON	Average	Diameter Cross Section	
4 5 6 7 8	245 340 420 505 595 685 750	287/14 21 1/4 26 1/4 26 25 1/4 24 1/5 23/4 22 1/2	6 6	atar	CHON	Average	Diameter Cross Section	
4 5 6 7 8 9	245 340 420 505 595 685	287/14 21 8/4 26/4 25/4 25/4 24/5	6 6	star	CHON	Average	Diameter Cross Section Area	
4 5 6 7 8 9 10 11	245 340 420 505 595 685 750	287/14 21 1/4 26 1/4 26 25 1/4 24 1/5 23/4 22 1/2	6 6	attar	CHON	Average Maximum	Diameter Cross Section Area	
4 5 6 7 8 9 10 11 12 13	245 340 420 505 595 685 750	287/14 21 1/4 26 1/4 26 25 1/4 24 1/5 23/4 22 1/2	6 6	estar	CHON	Average Maximum	Diameter Cross Section Area	
4 5 6 7 8 9 10 11 12 13	245 340 420 505 595 685 750	287/14 21 1/4 26 1/4 26 25 1/4 24 1/5 23/4 22 1/2	6 6	attar	CHON	Average Maximum	Diameter Cross Section Area	
4 5 6 7 8 9 10 11 12 13 14	245 340 420 505 595 685 750	287/14 21 1/4 26 1/4 26 25 1/4 24 1/5 23/4 22 1/2	6 6	attar	CHON	Average Maximum	Diameter Cross Section Area	
4 5 6 7 8 9 10 11 12 13 14 15	245 340 420 505 595 685 750	287/14 21 1/4 26 1/4 26 25 1/4 24 1/5 23/4 22 1/2	6 6	otar	CHON	Average Maximum	Diameter Cross Section Area	
4 5 6 7 8 9 10 11 12 13 14 15 16	245 340 420 505 595 685 750	287/14 21 1/4 26 1/4 26 25 1/4 24 1/5 23/4 22 1/2	6 6	a Jan	CHON	Average Maximum	Diameter Cross Section Area	
4 5 6 7 8 9 10 11 12 13 14 15 16 17	245 340 420 505 595 685 750	287/14 21 1/4 26 1/4 26 25 1/4 24 1/5 23/4 22 1/2	6 6	attar	CHON	Average Maximum	Diameter Cross Section Area	
4 5 6 7 8 9 10 11 12 13 14 15 16	245 340 420 505 595 685 750	287/14 21 1/4 26 1/4 26 25 1/4 24 1/5 23/4 22 1/2	6 6	s.ter	CHON	Average Maximum	Diameter Cross Section Area	

APPENDIX C

Data Sheets for 10 Tests with Vertical Loading on Well Caps Positioned on Well Casing

God Howy Cap-sprayed by hand -12 hole in contar

WELL CAP TEST DATA

# <u>Proto</u>	Serial Numl	ber			Date of Ma	nufacture	00,1499
	Date of Te	st June 12/	2000		Temperatu	ıre	83°F
	Weight of Resin		LB.		Weight of	Glass	LB.
	Pipe Length						
	Pipe Diameter		Outside	303/4	il	Inside	
				Corrug	ation Patter	n Depth	
	.4375	Wall Thic	kness っつい	Top of C	ap) Minimu	ım-) (M ax	imum)
	1_7/16	2 3/16	3 7/16	4 .442		Average	<u>i376</u>
		Wall Thic	ckness -	Lip of C	ap Minimo	mr) (M axi	imum-)
	1_1249	2 <u>-378</u>	3_393	4 :3/7		Average	.334
			Test S	Sample			
Length				Weigth	2516		
Sample O	rientation		Vertical		OR	Horizontal	
	LOAD	LENGTH /		DEFLE	CTION]	Collected Data
1		41/2				Ave	erage Diameter
3		315/1					
		23/4	6]	
7		3/2	,	ļ		Average	Cross Section
		35/11		<u> </u>		†	
ç	24630	3/4]	
10 11		3/4					n Compression Stress
12			·			† `	
13]	
1 <u>1</u> 5						-	
16						1	
17	7					1	
18						_	
19	"			I		_	

4:07 pm

3 mm 8 sec

Heavy hand sprayed well cap with 6% dim contar hole

WELL CAP TEST DATA

# Protot	Fipe Serial Num	ber			Date of Ma	anufacture	00 1999
	Date of Te	est June 12/	2000		Temperatu	ıre	78
	Weight of Resin		LB	•	Weight of	Glass	LB.
	Pipe Length						
	Pipe Diameter		Outside	3034		Inside	
				Corrug	ation Patter	n Depth	
		Wall Thic	kness -	Top of C	ap Minim	lm) (Max	illum-)
	1	2	3	4		Average	.376
		Wall Thic	ckness -	Lip of C	ap Minimu		
	1	2	3	4		Average	1 <u>334</u>
			Test S	Sample			ŕ
Length				Weigth	24/21	6,	
Sample Or	ientation		Vertical		OR	Horizontal	
	LOAD	LENGTH /	DIAMETER	DEFLE	ECTION]	Collected Data
1	265 10.	49/1	21/2				
2	1935	47/	6			Ave	erage Diameter
3		4-3/16	•				
4		4/8					
5		3 13/11	, >			1	
6	777	3/8				Average	Cross Section
7	70-0	35/8					
8		3/2		_			
9		37/6	· · · · · · · · · · · · · · · · · · ·			.	
10		33/8		.			n Compression
11	18,800	3/4		ļ			Stress
12	23,680	3/4	л	_			
13		Cracked	across	contan			
14							
15						1	
16							
17]	
18							
19				Ī		l .	

Hard sprayed, lighter - thinner well cap

WELL CAP TEST DATA

	# Prototy	≇r pe Serial Num	ber			Date of Ma	nufacture	Dec 1998
		Date of Te	est June 12/	2000		Temperatu	ire	7608
		Weight of Resin		LB.		Weight of	Glass	LB.
		Pipe Length			.			
		Pipe Diameter		Outside	303/8	,	Inside	
					Corrug	ation Patter	n Depth	
			Wall Thic	kness -	1 -	ap) Minimu	ım) (Max	imum)
		1 100	2 302	3 -440	4 19		Average	.407
			Wall Thic	ckness -	(Lip of C	ap Minimo	ı m) (M axi	/////////////////////////////////////
		1_186	2 1/81	3.165	4 1/86		Average	,180
				Test S	ample			
	Length	Name of the Control o			Weigth	202	B	
	Sample Or	ientation		Vertical		OR	Horizontal	
		LOAD	LENGTH /	DIAMETER	DEFLE	ECTION]	Collected Data
	1	30D	53/16	7				
	2	1015	5/8				l Ave	rage Diameter
	3	2195	4/8				1	
	5	3320	4.40	<u> </u>			-	
	6	3915	4/1	5			Avorago	Cross Section
	7	4300 4180	4/8				i Avelage	Closs Section
Fie	8	4200	37/1	, to			1	
	9	4900	37/6				1	
	10	8020	37/6	>			Maximun	n Compression
	11	16.170	35/16] 8	Stress
	12	25,300	35/16]	
	13	7]	
	14						1	
	15						1	
	16							
	17						1	
	18 19						1	
- 1	19				L		j	

Light had sprayed cap without hole and 1914'OD tric rim

WELL CAP TEST DATA

#P	Pipe Serial Num	ber			Date of Ma	nufacture	De, 1998	
	Date of Te	st June 12/	2000		Temperatu	re	78°	
	Weight of Resin		LB.		Weight of	Glass	LB.	
	Pipe Length							
	Pipe Diameter		Outside			Inside		
				Corruga	ation Patter	n Depth		
		Wall Thic	kness -	Top of C	ap (Minimu	ım) (Max	imum)	
	1	2	3	4		Average		
		Wall Thic			ı ap (Minimu	_	mum)	
		Tan IIIo	1	[) 	iii) (itiaxi		
	1	2	3	4		Average	-	
			Test S	ample				
Length				Weigth				
Sample O	rientation		Vertical		OR	Horizontal		
1	LOAD	LENGTH /	DIAMETER 7	DEFLE	CTION	:	Collected Data	
2	2360	93/1	6.4			Ave	rage Diameter	
4 5	6625	93/16	,					
6 7			Circumson	entrally		Average	Cross Section	
8		owouns	e rep	1/10	Z			
10			. 7-77				n Compression Stress	
12 13								
14 15								
16 17								
18								

4:35 pm.

~	2000 6071	x		WELL	CAP TEST			
#	Pipe Serial Num				Date of Ma	anufacture	JUNE 1/2	200
	Date of Te	est June 12/ 200	00	Tempera		ıre	JUNE 7/2000 75 638" HO	
	Weight of Resin		16 LB.		Weight of Glass		_ <u>3_</u> LB.	6/8 "
	Pipe Length							
	Pipe Diameter	Oı	utside	30/8"		Inside		Tastad 6. I to langth of pape
				Corrug	ation Patter	n Depth		1 to larget
		Wall Thickne	ess -	Top of C	ap) Minim	um) (Ma x	timum)	of pipe
	1436	2.437 3	.445	4.446]	Average	,441 ¹¹	
		Wall Thickne	ess -	Lip of C	ap) Minimu	ım)(Max	imum)	
	1_,177	2 174 3	172	4173		Average	.174	
			Test S	Sample				
Length				Weigth	2111-	1/202		
Sample O	Prientation	Ve	ertical		OR	Horizonta	l	
-	LOAD	LENGTH / DIA	METER	DEFLE	CTION]	Collected Data	
	1 21b	417/32						
2		45/16				Ave	erage Diameter	
4	1630	16/22				-		
	2390	4/32		 		†		. 7-
6		33932	·			Average	Cross Section	702 m
7	3/00	Failure]		_
	3 l	,		1		I		

1	216 1630	417/32	
2	1066	45/16	
3	1630	4-1/4	
4	1975	46/32	
5	1975 237b 2955 3100	4 1/32	
6	2955	3 3932 Failure	
7	3100	Failure	
8		,	
9			
10	11,540 -	-	
11			
12			
13			
14			
15			
16			
17			
18			
19			

Done Heylt = 12" | Hardness 86-85 DV

2:56 pm

4/2 minutes

Tested with 192' 00 The Rim Sitting on Usel Cap (17" Thickfin) with del the

_	–	10		WELL	CAP TEST		
###	DOOD 6 07 Pipe Serial Num	ber			Date of Ma	nufacture	JUNE 7/2000
	Date of Te	est June 12/	2000		Temperatu	re	TEPF
	Weight of Resin		<u>16</u> LB.		Weight of C	Glass	<u>3</u> _LB.
	Pipe Length			44			
	Pipe Diameter		Outside	3044		Inside	
				Corrug	ation Patterr	n Depth	
		Wall Thick	kness -	Top of C	ap) Minimu	m) (Ma x	imum)
	1467	2 .474	3.459	4 1464		Average	1466
		Wall Thic	kness -	Lip of C	ap) Minimu	m)(Maxi	imum)
	1 ,172	2,196	3.174	4 .19/		Average	183
	-		Test S		•	-	
Length				-	22/6-	4/2 az	5
	Prientation		Vertical		OR	Horizontal	
	LOAD	LENGTH / I	DIEMETER	DEFLE	ECTION	1	Collected Data
	1 185	117/6	Ч				
	2 1076	115/16				Ave	erage Diameter
	3 2985	113/16					
	4 4 2000	03/1					
	6 5300	974	eked at	VILE.		Average	e Cross Section
	7			1111]	
	8						
	9						Camanaanian
1						-1	n Compression Stress
1						· '	Oli 633
	3	 					
	4					1	
	5					1	
	6						
1	7						
	8					1	
1	9					J	

3:49 pm

Hadres 80-85 D

Well Cap Wo Hole in Conta

WELL CAP TEST DATA 26000607 Pipe Serial Number Date of Manufacture 87°F Date of Test June 12/ 2000 Temperature Weight of Resin ____LB. Weight of Glass LB. Pipe Length Pipe Diameter Outside Inside Corrugation Pattern Depth Wall Thickness Top of Cap (Minimum) (Maximum) Average Wall Thickness -Lip of Cap (Minimum) (Maximum) Average _____ Test Sample Length Weigth Sample Orientation Vertical OR Horizontal _____ LOAD LENGTH / DIAMETER DEFLECTION **Collected Data** 100 1400 Average Diameter _____ 2140 3030 Average Cross Section 7 8 9 10 Maximum Compression 11 Stress 12 13 14 15

3:20 pm

16 17 18 Molded cap will 6 % have and two spacer virgo on top to made more uniform loading at the top

WELL	CAP 1	EST	DATA

_	1 67	B = 11/		**	07.11 1.20 1	D/ 11/1		
# <u> </u>	066658 Pipe Serial Numl	ber 14			Date of Ma	anufacture	JONE 8/0	كحصك
	Date of Test June 12/ 2000				Temperature 73		73°F	003/1
	Weight of Resin		16 LB.		Weight of Glass		_3_LB.	< 28%
	Pipe Length	_						m1838-3
	Pipe Diameter	C	Dutside	30%		Inside	{	
				Corruga	ation Patter	n Depth	/	Bottom Ring
		Wall Thickr	ness -	Top of C	ap Minim	um)(Max	imum)	
					•			-11 h
	1	2-400	.467	4.456		Average	456"	288
		Wall Thick	ness -	Lip of Ca	ap (Minimu	ım)(Max i	i mu m)	
					1	7	. 11	11 - 2 1
	1 .182	2,179	191	4.183		Average	184"	Top Rong
			Test S	ample				
				•	1))		
Length				Weigth	225/B)		=234=
Sample Or	rientation	`	√ertical		OR	Horizontal		
	LOAD	LENGTH / D	AMETER	DEFLE	CTION]	Collected Data	
1	65 lb	43/4"						1
2	340	45/2"				. Ave	erage Diameter	·
3		450"		<u> </u>				
4		43/4"				1		
5		421				╣,	0	
6	- 7.72	4716				Average	Cross Section	
7		478				4		
8	7	473		,		4		
9		cracked		Man 10	XLAND	.	•	
10		in lig	راست ۲	hop			n Compression	
11						- `	Stress	
12						1		
13 14						-		
15			u, u			1		
15						1		
16						-		
						-		
18 19						1		
19	<u></u>			L		_		
				T(0 -	77		. ^	10

Hardner = 85-900

Time: 2 minutes

Mothed cap with 6%" hole and two speed plate - 28% x 18% plus
23/2 x 28/8)

		0 -		WELL	CAP TEST	DATA		
	060800				Data of 14	£	TUERAN	N)
#	Pipe Serial Numl	per			Date of Ma	anutacture	ONE G/ GEO	
	Date of Te	Date of Manufacture Temperature		80°F				
	Weight of Resin	<u>/6,5</u> lb.		Weight of Glass		<u>3</u> LB.		
	Pipe Length							
	Pipe Diameter		Outside	30/8"		Inside	de constante de la constante d	
				Corrug	ation Patter	n Depth		
		Wall Thick	kness -	Top of C	ap)(Minim		,	
	421 1	415	317	- 397 4 , 1999		Average	<u>.408</u> 1	
		Wall Thic	kness -	Lip of C	ap (Minimum.) - (Maximum.)			
	1.190	2,174	3,176	4 1174		Average	1179	
			Test S	ample				
Length				Weigth	20 B			
Sample Or	ientation		Vertical		OR	Horizontal		
	LOAD	LENGTH / [DIAMETER	DEFLE	CTION]	Collected Data	
1	234	49/16	•]		
2	730	4/16] Ave	erage Diameter _	
3	1015	4416						
4	205	478						
5	4430	45/16]		
6	7000	45/16				Average	Cross Section _	
7	9100	4/4						
8	10,300	414]		
9	12,500	03/H						
10	stant	d cracke	~ g] Maximun	n Compression	
11	271400		J]	Stress	
12]		
13]		
14						}		
15								
16								
17]		
18						1		

Hadron = 85D

MoHad cap with 6%" have with two specar plates 184x30% (Botton)

2000	06076	3	WELL CAP TES	T DATA
#	Pipe Serial Num	ber	Date of M	anufacture June 7/2000
	Date of Te	est June 12/ 2000	Temperat	ure <u>75°</u> F
	Weight of Resin	LB.	Weight of	Glass <u>3</u> LB.
	Pipe Length			
	Pipe Diameter	Outside	303/400	Inside
			Corrugation Patte	rn Depth
		Wall Thickness -	Top of Cap Minim	um)(Maximum)
	1 H69	2,465 3,480	4.474	Average .472
		Wall Thickness -	Lip of Cap Minim	um)(Maximum)
	1 .174	2,193 3,173	4.198	Average ,185
		Test Sa	ample	
Length			Weigth 23 15	
Sample O	rientation	Vertical	OR	Horizontal
	LOAD	LENGTH / DIAMETER	DEFLECTION	Collected Data
1		45/7	021 220 11011	
2		4 19/32		Average Diameter
3		4.9/16		1
- 4		47/32		7
		417/32		
6		413/12		Average Cross Section
7		41/2		
8	11/300	47/6		
9		4716		
10	22,900	Freetrie		Maximum Compression
11	about	20,000 intel fra	ture	Stress
12	<u> </u>	, , , ,		_
13				_
14				
15				_
16				_
17				
18				_
19)			

Hardness = 85D