cpi marine

Ride the Wave of the Future

CPI Marine Collar Systems

Air Collar with Removable Bladders

Air-Backed Foam Collar

Construction
- 40 oz/sq yd urethane-coated polyester fabric
- Seams are heat welded with color-matching seam tape applied
- Heavy grade extruded PVC rub strake 8 or 16 inch
- Outfitted with stainless steel D-Rings
- Standard boat rope strips for attaching the collar to the boat
- Custom attachments can be substituted

Removable Air Bladders
- Each chamber has it's own removable, repairable and replaceable air bladder with an air valve assembly containing fill valve and PRV
- Bladders are constructed of urethane film and can be replaced in minutes thereby reducing down time
- All collars are supplied with a repair kit
- Two spare bladders are supplied with each tube. One bladder is for the bow of the boat and the other is interchangeable with either the port or starboard sides of the boat
- Repair kit contains all tools needed to remove, repair and replace bladders
- All seams on the bladders are heat welded

Removable Air Bladder
Patent No. US 7,275,494 B2

Outer Fabric
- 40 oz/sq yd urethane-coated polyester fabric
- Heat welded and double taped seams
- 1/2 inch diameter solid-braid rope strips (attachment flaps) standard
- Attachment flaps with various rope diameters or without rope are available
- Standard colors are gray, orange and black
- Custom colors available

Foam
- 2.2 lbs/cu ft closed-cell polyethylene (PE) foam
- Natural color (Off White)
- Water absorption less than 0.3 lbs/sq ft exposed/Less than 3% by volume
- Buoyancy: 58 lbs/cu ft
- Completed foam sections heat-welded and hot-wired shaped to finished profile

Air Bladder
- Sets in behind the polyethylene foam enabling the collar to give when used primarily as a bumper
- Heavy duty and wear resistant urethane film construction
- Heat-welded seams
- Usually one or two bladders are used per side of the boat
- Remote toping valve accessible from outside of the collar
- Other valve arrangements or configurations available

GSA Contract Holder
Contract GS-07F-5886R

CPI Marine manufactures air & air-backed foam collars for leading RIB (rigid inflatable boat) builders.

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USA

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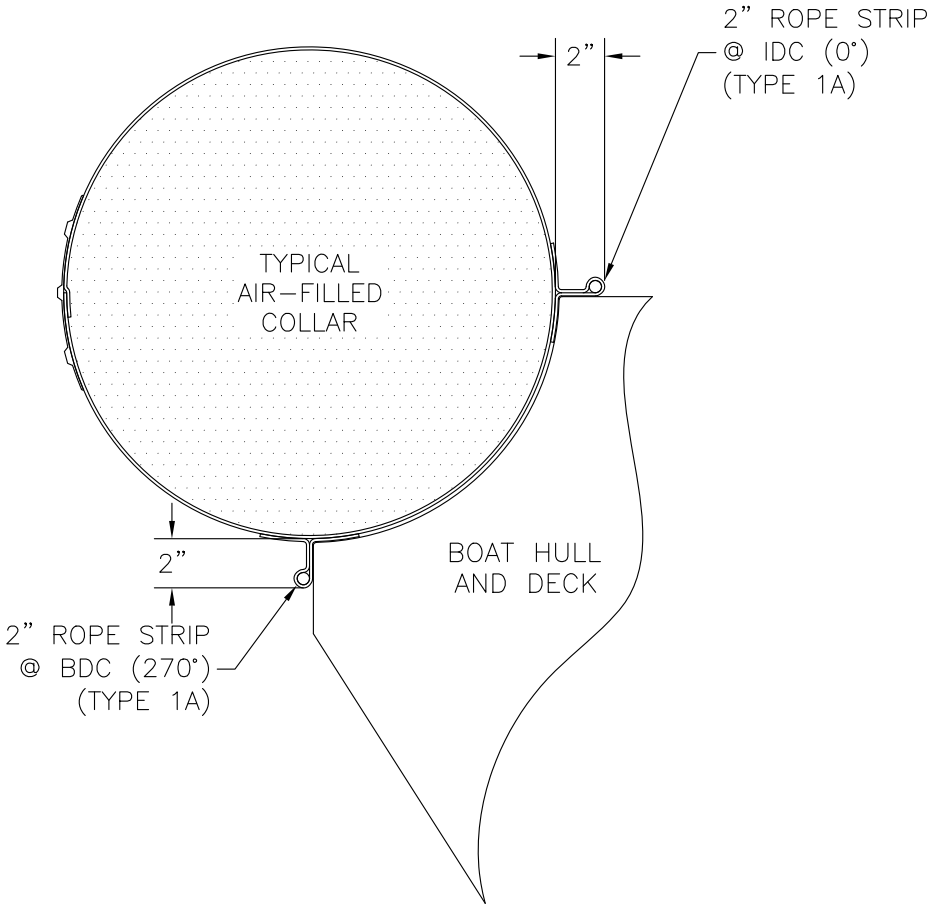
www.cpitx.com

Safe, Reliable, Durable
American-Made Products



AIR–FILLED COLLAR

STANDARD ATTACHMENT
SECTIONAL DETAIL

GENERAL NOTES

1. RIB COLLARS MAY BE ATTACHED USING THE FOLLOWING METHODS:
   A. BOLT–ON THROUGH A ROPE STRIP (STD FOR AIR–FILLED COLLAR);
   B. BOLT–ON THROUGH A STRIP WITHOUT A ROPE;
   C. SLIDE–ON THROUGH A ROPE CHANNEL (STD FOR HYBRID COLLAR);
   D. TIE DOWN FROM D–RINGS OR GROMMETS TO LUGS, D–RINGS OR GROMMETS IN BOAT;
   E. LASHING STRIPS THAT ENCIRCLE THE COLLAR AND ATTACH TO THE BOAT; OR
   F. ANY COMBINATION OF THE ABOVE.

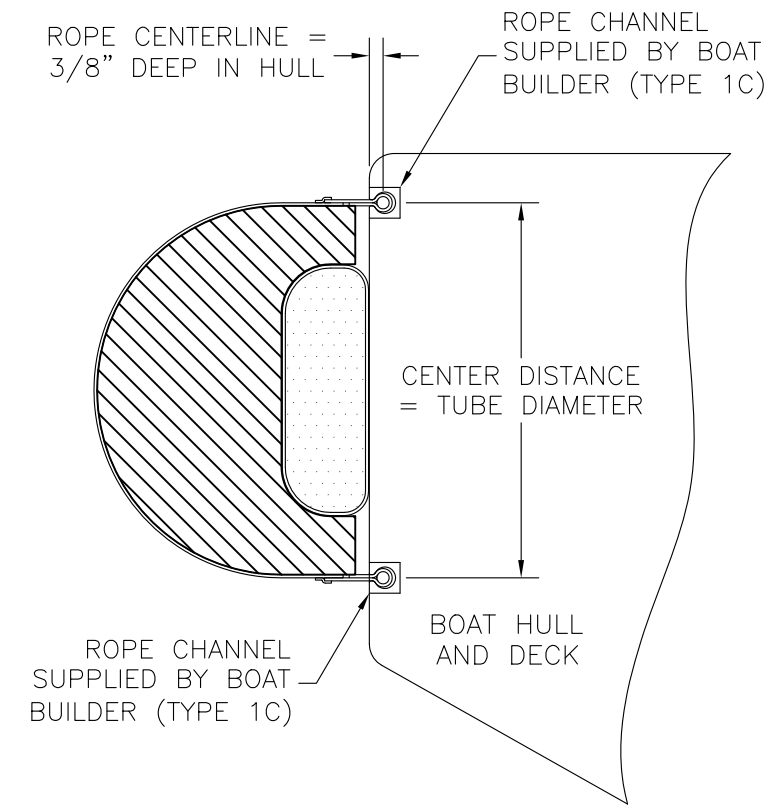
   ATTACHMENT TYPES 1A AND 1C (OR A COMBINATION OF THE TWO) ARE PREFERRED FOR HEAVY–DUTY, MILITARY AND INDUSTRIAL USE.

2. COLLARS CAN BE INSTALLED BY DRILLING THROUGH ATTACHMENT STRIPS WITH SELF–TAPPING SCREWS, PROVIDED THAT THEY ARE SPACED CORRECTLY TO PROVIDE ADEQUATE HOLDING STRENGTH AND THERE IS ENOUGH MATERIAL IN THE HULL/DECK TO HOLD THE SCREW THREADS. OTHERWISE, GLUE–IN OR EXPANDING THREADED INSERTS AND THREADED BOLTS ARE RECOMMENDED (ESPECIALLY WHEN SEALING OF HOLES IS AN ISSUE). A BACKING BAR OR LARGE "FENDER" WASHERS ARE REQUIRED TO SPREAD LOAD ON THE FABRIC WHEN BOLTING OR SCREWING DOWN AN ATTACHMENT STRIP.

3. 316 OR 316L STAINLESS STEEL FASTENERS ARE RECOMMENDED FOR MARINE USE. ROPE CHANNELS ARE TYPICALLY OF EXTRUDED ALUMINUM OR POLYMER CONSTRUCTION. ALUMINIUM THREADED INSERTS MAY BE USED IF PROPERLY SPACED AND NOT OVERLOADED. ALL FASTENERS ARE SUPPLIED BY BOAT MANUFACTURER UNLESS SPECIFICALLY REQUESTED.

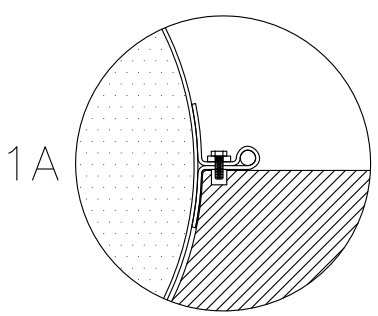
4. TRANSOM ATTACHMENT: TRANSOM ATTACMENTS ARE SOMETIMES REQUIRED TO MAINTAIN A POSITIVE SEAL AGAINST THE BACK TRANSOM, OR TO POSITIVELY LOCK THE COLLAR TO THE BOAT IF DUAL SLIDE–ON ROPE STRIPS ARE USED. USUALLY ARE FIELD INSTALLED TO ENSURE PROPER LOCATION. THEY CONSIST OF THE FOLLOWING:
   A. GLUE–ON STRAP THAT IS BOLTED TO THE TOP OF THE TRANSOM;
   B. GLUE–ON D–RING TIED TO A LUG ON THE TOP OF THE TRANSOM;
   C. A FLAP IS FASTENED TO THE TRANSOM TO CLOSE THE END OF THE COLLAR (USUALLY FOR HYBRID COLLARS ONLY).

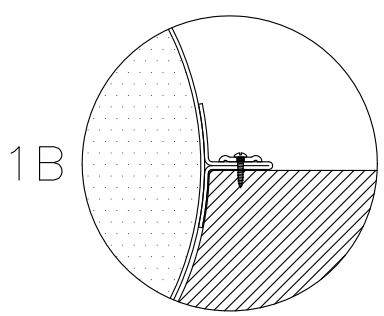
5. FOR OTHER ATTACHMENT METHODS OR FOR DESIGN ASSISTANCE, CONTACT CPI MARINE.

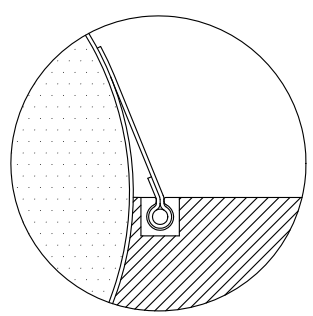


HYBRID COLLAR

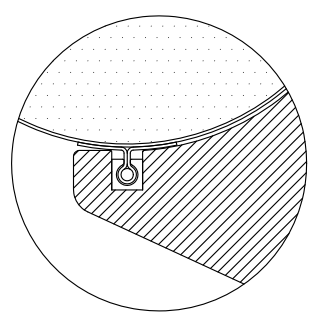
(A.K.A. AIR–BACKED FOAM)
STANDARD ATTACHMENT
SECTIONAL DETAIL



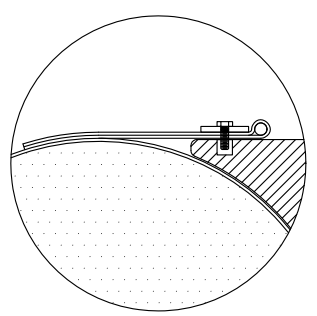


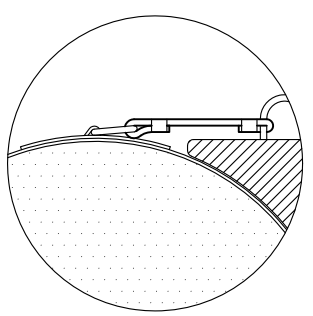


AIR COLLAR/DECK
ATTACHMENT



AIR COLLAR/HULL
ATTACHMENT





STANDARD TOLERANCES (U.N.O)		UNITS: INCHES
X.XX = ± 0.01	FRACT. ± 1/16	SCALE: nts
X.XXX = ±0.005	ANGLES: ± .5°	

CPI Marine Division
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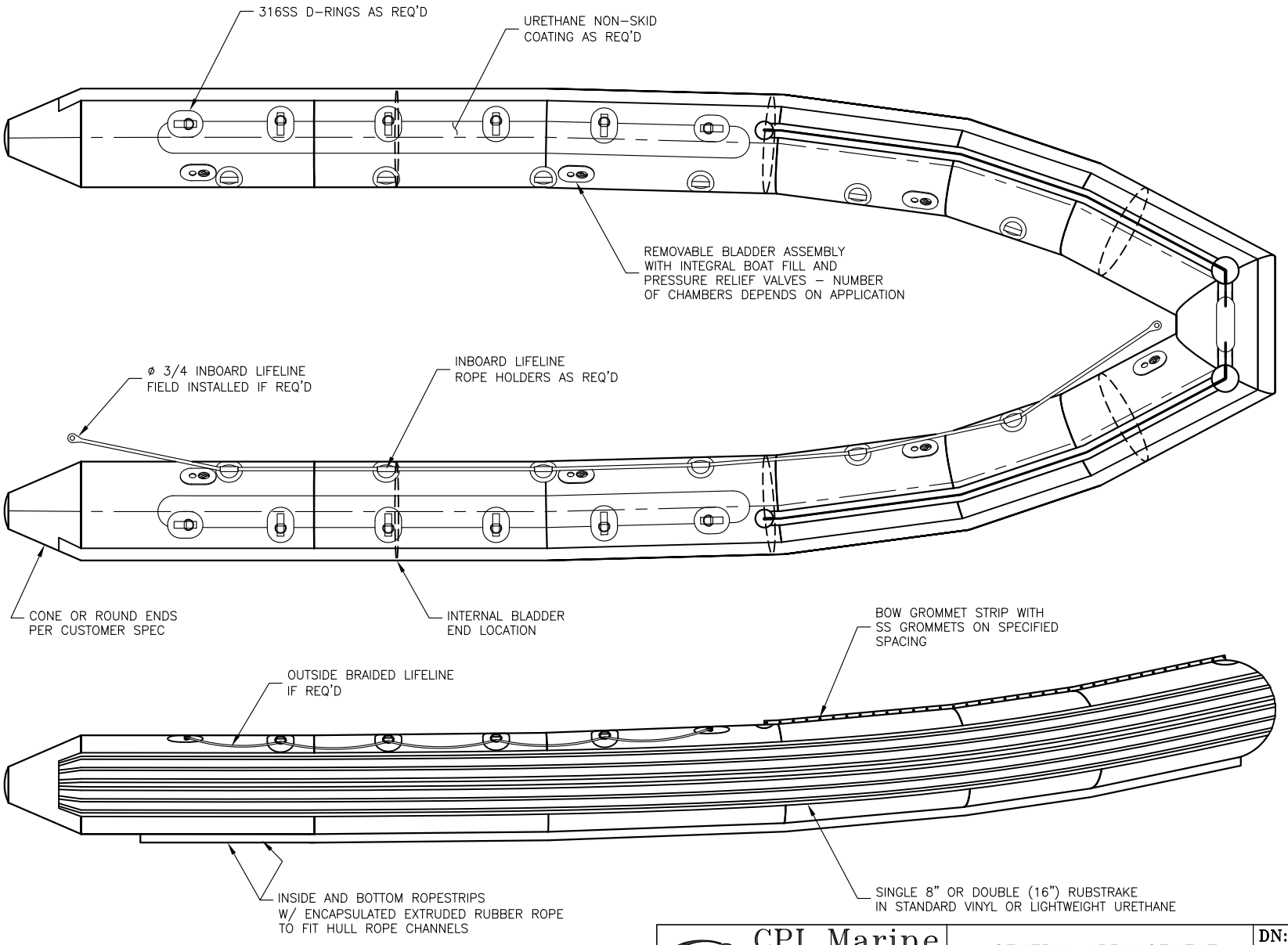
CPI STANDARD
RIB ATTACHMENT DETAIL
RIGID INFLATABLE BOAT COLLAR

DN: KW	DATE: 12/20/05
CHK: KW	DATE: 1/3/06
REV: –	
DWG: RIB–STD–ATTACH	

INSTRUCTIONAL VIDEO
BLADDER REMOVAL AND REPLACEMENT

CPI MARINE AIR COLLARS WITH REMOVABLE BLADDERS



STANDARD TOLERANCES (U.N.O)	
X.XX = ± 0.01	FRACT. ± 1/16
X.XXX = ±0.005	ANGLES: ± .5°

UNITS: INCHES
SCALE: nts

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GENERAL ARRANGEMENT INFLATABLE RIB COLLAR EXAMPLE 7M RIB

DN: KW	**DATE:** 1/17/05
CHK: KW	**DATE:** 1/18/05
REV: A	
DWG: RIB-AIR	

PRODUCT DATA SHEET

TPU - 2041

TEST & METHOD	TYPICAL CHARACTERISTICS	
	STANDAD	**METRIC**
Fabric, Type	Polyester 1500 Den 14.4 oz/yd²	Polyester 1670 Dtx 490 gr/m²
Total Weight ASTM D 751	40 oz/yd²	1380 gr/m²
Type of Coating	Polyurethane	
Breaking Strength (Strip) ASTM D 751 procedure B	780 / 670 lbs/inch	700 / 600 Kg/5 cm
Tear Strength ASTM D 751 procedure B	55 lbs	25 Kg
Coating Adhesion (HF Welding) ASTM D 751 Dry Wet(24 hours in 3% Saline Solution) After Hydrolysis(42 days @ 160°F)	 22 lbs/inch 21 lbs/inch 20 lbs/inch	 20 Kg/5 cm 19 Kg/5 cm 18 Kg/5 cm
Abrasion Resistance (Taber H-22 Wheel 1 Kg load) ASTM D 3389	<30 mg /1000 cycles >12,000 cycles to expose the fabric	
Air Porosity B.S 4F 100 clause 32.1	Pass (10 min at 7 psi)	
Cold Crack / Bend Din 53361	-58°F	-50°C
Blocking Resistance ASTM D 751	# 1	
Puncture Resistance Fed. Std. 101-2031	420 lbs	190 Kg

Update: July 2003

Recommended end use: Boats.

We believe this information is the best currently available.
It is subject to revision once additional know-how is gained. We make no guarantee of results and assume no obligation liability whatsoever in connection with this information.

Appendix: Weathering Data on Various Colors

General: the various colors was tested at a QUV equipment with the following details:

Standard: ASTM G-53 , UVA

Test Cycle: UVA - 8 hrs 60ºC , 4 hrs. Cond. 50ºC

Color	0 ÷ 2000 hr.	2000 ÷ 4000 hr.	4000 ÷ 6000 hr.
Grey	A	A-B	B
Orange	A	A-B	B
Black	A	A	A

Legend

A - No Change

B – Minor Change

C – Major Change

Remark: Correlation between QUV hours and years at service:

There isn't direct correlation and we could only estimate as follows:

- 4000 hrs. at QUV is estimated as 3 to 4 years in field service.
- 6000 hrs. at QUV is estimated as 5 to 6 years in field service.

WORTHEN PERFORMANCE FILMS

Product Code	WEF / POLYETHER FILM
Gauge Range (Mils)	1 Mil to 40 Mil / 1 to 7 Mil on paper or PE Carrier
Widths (Inches)	10” to 62” Custom Slitting Available
Color	All Colors And Custom Colors Available
Lubricants Available	Glycolube / Superfloss / Acrawax

BENEFITS AND FEATURES

- Tough And Abrasion Resistant
- UV Stabilized
- Excellent Clarity
- Contains Internal Lubricant

TYPICAL PHYSICAL PROPERTIES

PHYSICAL PROPERTIES	TEST METHOD	ENGLISH UNITS (Typical Values)
Specific Gravity	ASTM D- 792	1.12
Shore Hardness	ASTM D- 2240	85A
Tensile Strength	ASTM D- 412/D-638	5500 psi
Modulus @ 100% Elongation	ASTM D- 412/D-638	1000 psi
Modulus @ 300% Elongation	ASTM D- 412/D-638	1700 psi
Ultimate Elongation	ASTM D- 412/D-638	580%
Tensile Set @ 200% Elongation	ASTM D- 412	21%
Compression Set 22 Hours @ 23 Deg C 22 Hours @ 70 Deg C	ASTM D- 395	 23% 72%
Glass Transition Temperature	DSC **	 -51 Deg F
Vicat Softening Point	ASTM D- 1525	201 Deg F
Tear Strength	ASTM D- 624, Die C	435 lb/in
Split Strength	ASTM D- 470	140 lb/in
Flexural Modulus @ 23 Deg C	ASTM D- 790	6190 psi
Taber Abrasion CS-17 Wheel 1000g Load	ASTM D- 1044	5.0 mg/1000 Cycles
Modulus Of Rigidity @ 23 Deg C @ 0 Deg C @ -20 Deg C @ -40 Deg C @ -50 Deg C	ASTM D- 1053	 1080 psi 1200 psi 2160 psi 18000 psi 46000 psi

C.P.I.

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RIB BLADDER REMOVAL AND REPLACEMENT INSTRUCTIONS

Removal:

1. Lock the fill valve in the open position on the bladder that is to be removed by depressing the plunger of the valve and twisting with finger.
2. Lower the air pressure in bladders on either side of bladder to be removed, but do not completely deflate.
3. Push air valve assembly down into the cavity in the collar.
4. Starting from one end of bladder, carefully remove bladder through the opening in the collar. The use of soapy water will aid in the removal of the bladder.

Replacement:

1. Remove all air from bladder to be installed. A vacuum pump is useful.
2. With air valve locked to the open position, roll bladder lengthwise very tightly. (The diameter of the tightly rolled bladder must be able to fit into the valve opening in the collar.)
3. Insert the bladder by twisting (in the same direction it is rolled so that it does not unravel) into the valve opening in the collar. The use of soapy water will aid in the installation of the bladder.
4. Once the bladder is inside the collar, unroll the bladder and position the inflation valve in line with the opening.
5. Ensure that the bladder is not twisted, kinked, or folded inside the collar.
6. Pull one side of the valve assembly up through the opening and use a blunt prying tool to carefully work the valve assemble lip out through the opening.
7. Once the valve assembly is in position and with the valve locked open, slowly add air to re-inflate the bladder. Ensure the bladder position inside the collar is maintained.
8. Inflate bladder and release air two or three times to allow the bladder to completely unfold.
9. Un-lock air fill valve to the closed position and re-inflate bladders to proper pressure.
10. After installation is complete, check pressure in all bladders around collar to ensure pressure is equal.

Note: Air trapped between bladder and the inside collar wall may release. This is not a leak and is normal.

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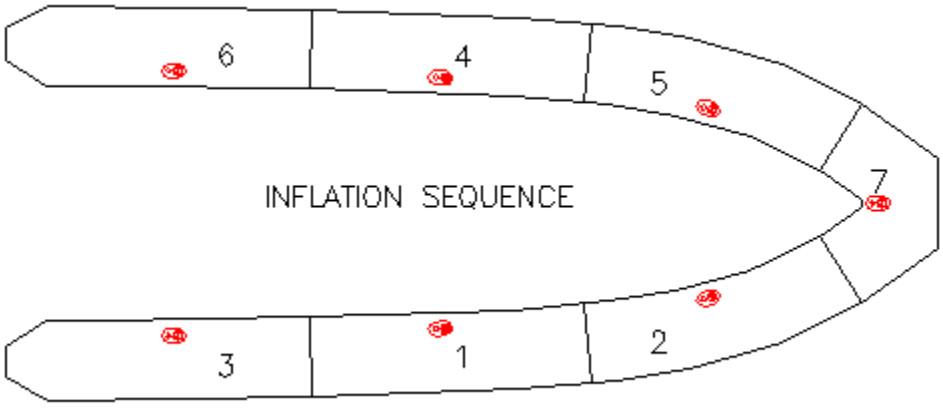
Rib Inflation Instructions

1. Start at the center chamber of one side and inflate until chamber takes shape (about 1/2 psi).
2. Inflate chambers in front and in back of center chamber until they take shape.
3. Repeat steps 1 &2 on opposite side of RIB.
4. Inflate nose chamber until it take shape (about 1/2 psi).
5. In the same order, continue filling chambers in 1/2 psi increments until all chambers are filled to operating pressure.

OPERATING PRESSURE IS 2.5 PSI TO 3 PSI



**** CHECK PRESSURE DAILY ****

**** CAUTION ****
DO NOT INFLATE OVER 3 PSI
PRESSURE RELIEF VALVE SET AT 3.0-3.2 PSI

PRESSURE WILL INCREASE AS TEMPERATURE INCREASES, ESPECIALLY IF RIB IS IN DIRECT SUNLIGHT.

INSPECT ALL TIE DOWNS DAILY

C.P.I.

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Urethane Repair Kit Instructions

BEFORE PROCEEDING WITH REPAIR,
READ ALL INFORMATION THOROUGHLY.

PREPARATION:

1. CLEAN BOTH SURFACES WITH M.E.K. SOLVENT.

2. ALLOW TO DRY FOR FIVE MINUTES MINIMUM.

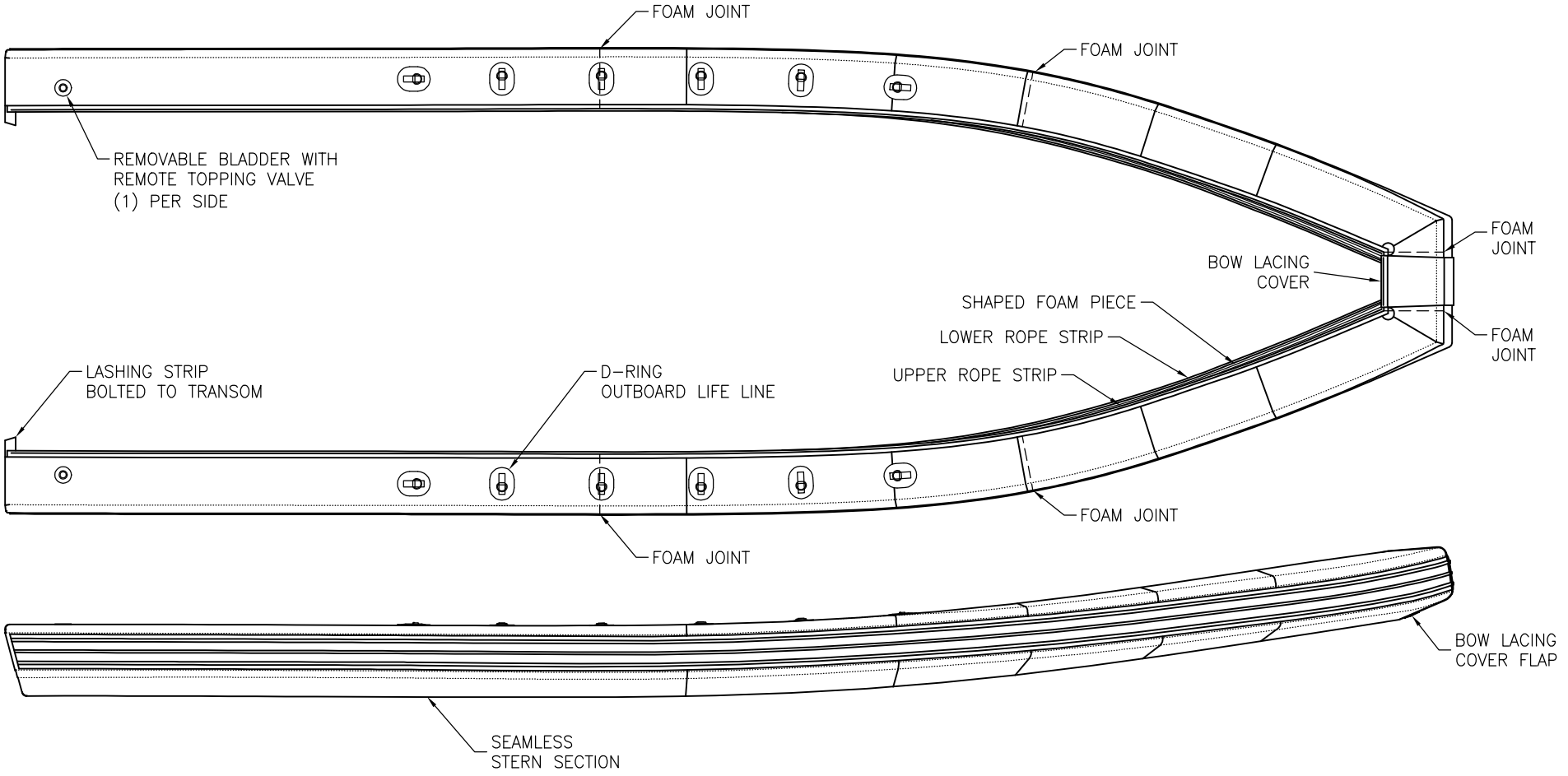
3. FOLLOW GLUE INSTRUCTIONS ON ADHESIVE CONTAINER.

4. JOIN THE SURFACES AND APPLY PRESSURE WITH A HAND ROLLER.

ALLOW A MINIMUM OF 12 HOURS TO CURE
BEFORE PUTTING BACK INTO SERVICE

DO ALL GLUING & REPAIRS IN A WELL VENTILATED AREA
OUT OF DIRECT SUNLIGHT

AIR -BACKED FOAM COLLAR SYSTEM



STANDARD TOLERANCES (U.N.O)		UNITS: INCHES
X.XX = ± 0.01	FRACT. ± 1/16	
X.XXX = ±0.005	ANGLES: ± .5°	SCALE: nts

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Tel (512) 295-2683 Fax (512) 295-2245

HYBRID RIB COLLAR OVERVIEW & GENERAL ARRANGEMENT AIR/FOAM HYBRID COLLAR

DN: KW	DATE: 9/9/05
CHK: KW	DATE: 9/9/05
REV: 0	
DWG: RIB-HYB	

Air-Backed Foam “Hybrid” Boat Collars

Outer Fabric

- 40 oz/sq yd (1.36 kg/sq m) urethane-coated polyester fabric;
- Heat welded & double-taped seams;
- ½ Inch diameter (25mm) solid-braid rope strips (attachment flaps) standard;
- Attachment flaps with different rope diameters or without rope are available;
- Standard Colors:
    - Gray
    - Orange
    - Black
    - Red and Yellow available by special order
    - Other custom colors available in large order quantities.

Foam

- 2.2 lbs/cu ft (35.2 kg/cu m) closed-cell polyethylene (PE) foam;
- Natural color (off-white);
- Water absorption:
    - Less than 0.3 lbs/sq ft exposed (1.5 kg/sq m)
    - Less than 3% by volume
    - Per ASTM D3575-Suffix V, EN 28301, ISO 2581 tests;
- Buoyancy: 58 lbs/cu ft (930 kg/cu m);
- Completed foam sections heat-welded (not glued) and hot-wire shaped to finished profile.

Air bladder

- Heavy-duty and wear-resistant urethane film construction;
- Heat welded seams;
- Usually one or two bladders per side of boat;
- Remote topping valve accessible from outside of collar standard;
- Other valve arrangements or configurations available to meet your application or upon request.

Options/Miscellaneous

- Rubstrake (rub strip/wear strip):
    - Materials: vinyl & non-marking urethane;
    - Urethane also recommended for high wear resistance and/or weight critical applications;
    - Colors: Black or gray;
    - Vinyl & urethane both 8 inch wide (203mm) with raised ribs;

    - Urethane also available in 4 inch wide (102mm) flat strip (black);
    - May be doubled, tripled, quadrupled, etc. to fully protect outside surface of collar or in critical wear areas;
- Lifelines:
    - Attached with D-rings, grommet strips, or fabric loops;
    - Black braided nylon rope;
    - Various rope sizes available (typically 5/8 inch (16mm) braided);
- Anti-skid coating:
    - Black urethane coating provides anti-slip tread and/or extra coating in wear critical areas;
    - May also be stenciled on in the shape of a customer-supplied logo;
- Attachment methods:
    - Typical: ½ inch diameter (25mm) rope strip slid into dual rope strip channels fabricated in boat.
    - Please feel free to contact CPI at (512) 295-2683 as soon as possible in the development process with any attachment questions you may have.

Density	2.2 pcf (35.2 kg/m³)
Maximum Loading	2.5 psi (17.5 kPa)
Color	Black, Natural

ETHAFOAM™ packaging products

ETHAFOAM™ 220 Polyethylene Foam

ETHAFOAM™ 220 polyethylene foam is a strong, resilient, medium-density 2.2 pcf (35.2 kg/m³), closed-cell foam. It is ideally suited as a material for cushioning components in packaging applications for loadings up to 2.5 psi (17.5 kPa) and as a component material in products requiring a shock absorbing, vibration dampening, insulating and/or buoyancy component.

Resilient ETHAFOAM 220 polyethylene foam has outstanding recovery characteristics that provide optimal cushioning protection against repeated impacts. It is ideal for cushion packaging and material handling applications in the automotive, computer and medical device industries. In addition to reducing shock and vibration damage, ETHAFOAM protects against scratching. It performs well in high and low temperatures and is durable, reusable and recyclable.

Sizes Available in Black (Planks):
2" x 48" x 108"
4" x 48" x 108"

Sizes Available in Natural (Planks):
1.5" x 48" x 108"
2" x 48" x 108"
2.5" x 48" x 108"
3" x 48" x 108"
4" x 24" x 108"
4" x 48" x 108"

Product Features

ETHAFOAM™ 220 polyethylene foam is a durable, lightweight, flexible, solid extruded product. As the properties listed on reverse suggest, ETHAFOAM 220 polyethylene foam offers excellent strength, resistance to creep under load, vibration and shock absorbency, and water resistance characteristics.

ETHAFOAM 220 polyethylene foam is produced with Dow's patented *RapidRelease* manufacturing process. This process technology incorporates a patented CFC- and HCFC-free blowing agent system and an accelerated curing system that reduces residual blowing agents in ETHAFOAM polyethylene foam products to trace amounts. *RapidRelease* technology delivers a higher quality product with improved dimensional stability and safety.

ETHAFOAM 220 polyethylene foam is easily fabricated, impervious to most chemicals, non-abrasive and performs consistently over a wide range of temperatures.

ETHAFOAM 220 polyethylene foam is also reusable and completely recyclable because it is made out of non-crosslinked polyethylene.

Flammability

ETHAFOAM™ 220 polyethylene foam has successfully passed FMVSS 302 flammability testing, conducted according to the U.S. Code of Federal Regulations, CFR 49.

CAUTION: ETHAFOAM™ 220 polyethylene foam is combustible and should not be exposed to flame or other ignition sources.

ETHAFOAM Product Information

See reverse for properties.

Physical Properties of ETHAFOAM™ 220 Polyethylene Foam			
Physical Properties†	**Test Method**	**Direction**	**Value**
Density	ASTM D3575, Suffix W, Method B; ISO 845		**pcf (kg/m³)** 2.2 (35.2)
Compression Set	ASTM D3575, Suffix B (50% compr.); EN/ISO 1856 (23°C, 25% compr.)	Vertical	< 20% < 10%
Compressive Creep (1000 hrs @ 73°F [23°C])	ASTM D3575, Suffix BB	Vertical	< 10% @ 2.5 psi (17.5 kPa)
Compressive Deflection @ 10% @ 25% @ 50%	ASTM D3575, Suffix D	Average	**psi (kPa)** 7 (50) 9 (65) 18 (124)
Thermal Stability	ASTM D3575, Suffix S; ISO 2796		< 1.5% < 2%
Thermal Conductivity @ 75°F (24°C) @ 23°F (-5°C)	ASTM D3575, Suffix V; EN 28301; ISO 2581	Vertical	**BTU•in/hr•ft²•°F (W/m°K)** 0.42 (0.06) 0.37 (0.05)
Water Absorption	ASTM D3575, Suffix L; ISO 2896; ASTM C272		**lb/ft² (kg/m²)** 0.3 (1.5) < 3 vol %
Buoyancy	ASTM D3575, Suffix AA		**pcf (kg/m³)** 58 (930)
Tensile Strength @ peak	ASTM D3575, Suffix T; ISO 1798	Average	**psi (kPa)** 32 (220)
Tensile Elongation	ASTM D3575, Suffix T; ISO 1798	Average	50%
Tear Strength	ASTM D3575, Suffix G	Average	**lb/in (N/mm)** 10 (1.75)

†The data presented for this product are for unfabricated ETHAFOAM polyethylene foam products. While values shown are typical of the product, they should not be construed as specification limits.

Additional Information or Technical Support

For information on products, design assistance and testing services available from Dow, call:
1-866-PKG-FOAMS

ETHAFOAM
Product Information

THE DOW CHEMICAL COMPANY
200 Larkin Center • Midland, MI 48674 • USA
www.ethafoam.com

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Improved daily.

Printed in U.S.A.
Form No. 172-01379X-1105P&M

Test

Bladder Elongation Trial

Summary

This test will determine how much a standard bladder will lengthen after loss of pressure in the surrounding bladders. The second bladder from the stern is tested, as it is in between two bladders and is straight. The straight portion of the collar should minimize any effect the curvature of the boat may have.

Setup

- Prototype 7m RIB tube (with a diameter of 22") with all internal bladders installed and inflated at the beginning of the test.
- 0-5 psi air gauge fitted with quick-attach fitting for Hulky-Roberts boat valve.
- Compressed air hose with air gun nozzle for boat valve.

Trial Conditions

1. Date of test: 12/16/03
2. Ambient temperature at onset of testing was 61.7°F. Final temperature was 62.8°F.
3. Ambient atmospheric pressure at time of testing was 33.33 inches Hg and falling.
4. Trial took place indoors with no direct sunlight.

Test Procedure

1. Inflate bladders to approximate final shape starting at the stern and working forward until all bladders are to shape. Continue filling bladders to full operating pressure (3psi) starting from stern and working forward.
2. Select the second bladder (bladder 2) from the stern as the test bladder.
3. Record the internal pressure of the test bladder.
4. Locate both ends of the test bladder and mark them clearly on the outside of the collar with a temporary marker or marked tape.
5. Deflate the surrounding bladders (1 & 3) by twisting the fill valves to the open position. Do not deflate the test bladder or disturb it in any way.
6. Record the internal pressure of the test bladder immediately after deflation.
7. Allow the test bladder to normalize at room temperature for 30 minutes.
8. Locate the ends of the test bladder and mark them clearly on the outside of the collar in the same manner as the reference mark made in step 4.
9. Measure the elongation of the test bladder on both ends using the exterior reference marks.
10. Record the internal pressure of the test bladder after it has expanded.

Results

Table 1 – Bladder Elongation Results

Initial pressure from step 3	3 psi
Deflation pressure from step 6	2 psi
Pressure after 30 minutes from step 10	2 psi
Elongation, stern end	7/8”
Elongation, bow end	3/4”

The bladder remained stable once pressure was lost and initial growth occurred. Although there was a 1 psi pressure drop immediately following the release of pressure on the surrounding bladders, no noticeable change in pressure occurred in the next 30 minutes.

The end seams of the bladder moved outward an average of 13/16”, but the ends of the bladder were rounded off instead of perpendicular to the centerline of the tube and flat (as they were when they were butted against the other two inflated bladders).

Conclusions

The pressure data shows that all change in volume occurred immediately following the loss of pressure in surrounding bladders. There is no concern that the bladder would continue to grow and deform unchecked without the support from the surrounding bladders.

The elongation numbers were less than expected, but do not tell the entire story. Instead of elongating only by stretching the length of the cylinder, the ends of the bladder themselves became more hemispherical in shape and rounded. This rounding was approximately 2-1/2 to 3” per end in additional length. This effectively increased the volume of the bladder significantly without any plastic (permanent) deformation occurring. Because of the location we chose to mark for the start and end lengths (the seam between the end and body of the bladder), the numbers don’t fully demonstrate the corresponding change in volume that occurred.

The test demonstrates that the bladders have additional reserve capacity once the surrounding bladders are deflated and it has room to expand with no permanent damage. The amount of expansion is small (a total of 8” over a 72” long bladder), and it is not permanent. Once the bladder is deflated, and care is taken that the surrounding bladders are not caught underneath the expanded ends of the test bladder, all the bladders can be re-inflated and the bladder ends will be back to approximately their original positions.

Test 2

Over-Inflation Trial

Summary

This test will determine whether the pressure relief valve (PRV) will release pressure before the bladder becomes over-inflated and fails. Also determine that supply cannot fill bladder faster than PRV can vent it.

Setup

- Prototype 7m RIB tube (with a diameter of 22") with all internal bladders installed and deflated at the beginning of the test.
- 0-5 psi air gauge fitted with quick-attach fitting for Halkey-Roberts boat valve.
- Compressed air hose (3/8" x 50') with air gun nozzle for boat valve and with in-line adjustable pressure regulator.
- Mild soap and water solution to detect air leaking from PRV valve.

Trial Conditions

1. Date of test: 12/16/03
2. Ambient temperature at time of testing was 62.8°F.
3. Ambient atmospheric pressure at time of testing was 33.31 inches Hg and steady.
4. Trial took place indoors with no direct sunlight.
5. The 3/8" compressed air supply line was regulated to 60 psi.

Test Procedure

1. Select one of the intermediate bladders (not the bow or stern bladders) of the boat as the test bladder.
2. Deflate the surrounding bladders if not already done.
3. Inflate the test bladder ONLY to the proper inflation level of 3 psi.
4. Continue filling up the boat in ½ psi increments until PRV releases. Record the pressure that caused the PRV to open.
5. Allow 5 minutes for the bladder to normalize pressure and record the final pressure.
6. Fully deflate the bladder.
7. Re-inflate the bladder, but instead of stopping at 3psi, continue filling until PRV pops open. Record the pressure that the PRV popped open.
8. Allow 5 minutes for the bladder to normalize pressure and record the final pressure.
9. Fully deflate the bladder again.

10. Re-inflate the bladder as in Step 7 but continue filling the bladder for 30 seconds after the PRV valve popped open.
11. Immediately record the internal pressure of the bladder.
12. Allow 5 minutes for the bladder to normalize pressure before recording the final pressure.

Results

Table 2 – Over-inflation Results

Pressure to pop PRV (all tests)	Just over 3 psi
Closing pressure	Just under 3 psi
Pressure after 30 second overfill, step 11	3.4 psi.
Pressure after 5 minutes of venting, step 12	Just over 3 psi (but still venting slowly)

An attempt to raise the pressure inside the bladder above the 3 psi level was not successful before the PRV popped open. This was the case filling both a full bladder at 3 psi and a deflated bladder at 0 psi. The pressure gauge showed only slightly higher than 3 psi at pressure release, but the accuracy of the gauge (marked in ¼ increments of a psi) used did not allow us to measure the precise pressure. After a very mild bleed-off, the valve closed and remained at just under 3 psi (again, an immeasurable difference from 3 psi).

The test with the compressed air line performed as expected. Once the valve popped off, air continued to flow into the bladder and out the PRV with no noticeable change to the bladder (increased length over normal, etc.), even though this represented a great deal more airflow than would be used to fill the valves.

Conclusions

From the test we can conclude that overfilling of the bladders is not a problem, especially using a foot pump as will normally be used. The PRV had repeatable results, although venting was sometimes a slow process. The weak spring required to operate at such a low pressure was a culprit, as well as the small amount of pressure difference between the inside of the bladder and atmospheric pressure. The valve may vent for a long time, but it produces very little sound and is not noticeable at low pressures (around the 3 psi pop-off point) unless a soapy solution is applied to the valve.

The PRV allows the correct pressure to be applied to the bladders (around 3 psi) without fear of overfilling should the person neglect to stop filling the bladder after it is full.

Test 3

Bladder Test to Failure

Summary

Determine actual pressure that causes a failure of the internal bladder. The amount of damage will also be noted, as will damage to the surrounding collar and whether the damage is repairable. The bladder ends are allowed to move freely so that the strength of one bladder alone is tested. This test was performed with two different materials of construction, first with urethane film as produced by Deerfield and then using film as produced by Worthen Performance Films.

Setup

- Prototype 7m RIB tube (with a diameter of 22") with all internal bladders installed and deflated at the beginning of the test.
- 3-way tee adapter with quick-attach fitting for Halkey-Roberts boat valve on one side and quick attach couplings on the other ends.
- 0-15 psi air gauge fitted to quick attach coupling.
- Compressed air hose (3/8" x 50') with in-line adjustable pressure regulator and quick attach couplings on both ends.

Trial Conditions

1. Date of test: 12/16/03 for 1st test (Deerfield), 12/17/03 for 2nd test (Worthen)
2. Ambient temperature at time of first test was 62.8°F. Ambient temperature at time of second test was 69.6°F.
3. Ambient atmospheric pressure at time of first test was 33.31 inches Hg and steady. No atmospheric data available for second test.
4. Trials took place indoors with no direct sunlight.

Test Procedure

1. Remove the bladders on either side of the test bladder if not already done. **The test bladder remains inside the collar.**
2. Disable the pressure relief valve (PRV) of the test bladder so that no air can be vented out of the bladder once it is over-inflated.
3. Fill the bladder to 3 psi.
4. Increase the pressure in ½ psi increments until the bladder fails.
5. Record the approximate pressure at which the bladder fails.
6. Inspect and note the damage to the bladder and to the surrounding collar, if any.

Results

Air was initially shut off in the main line. The pressure regulator was opened slowly to allow the air in the line and bladder to equalize and give a more accurate reading of internal bladder pressure on the attached air gauge.

The first test with the Deerfield material began to grow beyond elastic limits once 14 psi was achieved. The ends of the bladder began to migrate out slowly, growing at a slightly faster pace until the growth slowed down and was followed by catastrophic failure of the material. Total growth in length was around 8-10" per end for a total length increase of around 16-20".

There was no damage to the outer portions of the RIB collar. The only effect that the rupture had on the outer collar was to inflate it quickly when the air escaped from the bladder. Since none of this air was in the bladders, it soon bled off through the bladder openings throughout the RIB collar.

Removal of the first bladder showed that the ends were discolored from plastic expansion. The flat ends had become more hemispherical in shape. The bow end of the bladder had ruptured in an approximately 12" gash. The end seam to end seam length of the bladder increased from 72" to 74". A good deal of the expansion on each end was recovered upon deflation.

The second test was performed with the Worthen material. It was taken to 15 psi with no exteriorly visible effects. The test was stopped and the bladder removed without failure.

Inspection of the second bladder showed plastic deformation of the ends similar to the first, but much less pronounced and without rupture. The decision to inflate the bladder outside of the raft in an attempt to rupture it yielded spectacular results. Without the collar to restrain it, the bladder grew well over 400% in size without failure. Not all of the growth resulted in plastic deformation; a good deal of it was elastic and recovered upon deflation. The test was discontinued, without ever having destroyed the second bladder made of the Worthen material.

Conclusions

Although the Deerfield material in the first test did not perform as well as the Worthen material, 14 psi still represents a huge leap above the normal operating pressure of 3 psi. Even with complete failure of the pressure relief valve, it would be difficult for a person not to notice that the bladder was (over)full in the time it would take them to fill the bladder to 14 psi with a foot pump. It may be very difficult to get a bladder up to 14 psi in the field due to leakage in the pump itself and the fittings required to mate with the fill valve.

Certainly, expansion from heat would not be an issue as it would take a huge change in temperature (and concurrent failure of the PRV) to reach 14 psi. The material may be more pliable at that temperature, as well, increasing its ability to change volume to keep pressure down.

Cryogenic Plastics Inc.
CPI MARINE WARRANTY

RIB COLLAR WARRANTY

CPI warrants it's Rigid Inflatable Boat Collars to be free of defects in workmanship and/or material under proper use and service for 1 year (One Year) from the date of purchase. CPI'S obligation under this warranty is limited solely to repairing or replacing parts. In case of component part (s) which is/are not manufactured by CPI, the warranty shall be that of the manufacturer.

CPI does not assume any responsibility for property loss and/or damage of any nature resulting from the use of its products. Warranty will be void if unauthorized service or material is used to repair our products.

All warranty shipments are F.O.B. Kyle, Texas.

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Highlights

- ♦ All service is performed in house
- ♦ CPI stands behind its work 100%
- ♦ All inquiries are responded to in a timely fashion

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