ART ANDERSON

TECHNICAL MEMORANDUM

Date:	October 19, 2020	**AAA Ref:**	FWPOB103.004
To:	James Weaver	**Client Ref:**	
Cc:	Fred Salisbury, Brian Robinson		
From:	Patrick Vasicek, P.E.		
Subject:	Turner Joy Marker Buoy Replacement and Requirement for Additional Mooring System Upgrades.		

Attachments

1. Neptune Quote dated 14 October 2020
2. Neptune 48" Float Ball – Assembly Drawing
3. Molding HDPE Copolymer Specifications
4. Elastopor Rigid Urethane Foam System Specifications
5. ROM Replace Four Marker Buoys – Construction Cost Estimate

References

A. Lake Union Drydock Company, letter of 31 March 2017
B. Seattle Diving Services Letter of November 2018
C. Art Anderson Associates Technical Memorandum of 15 June 2020.

Introduction

The Historical Ship, USS Turner Joy, which serves as the northern portion of the breakwater for the Bremerton Marina, was temporarily removed and drydocked for a period of 30 days in February – March 2017, as documented in Reference A. In November 2018, per Reference B, an underwater inspection of the USS Turner Joy Mooring system was conducted, finding considerable corrosion of chain and tackle and depletion of protective anodes after less than 2 years of service. In June 2020, Art Anderson Associates conducted an initial site visit and developed a concept assessment report, in Reference C. which identified a number of causes for the corrosion and made specific recommendations regarding prevention of galvanic corrosion caused by dissimilar metals used in construction and for improvements required to the Impressed Current Corrosion Protection system.

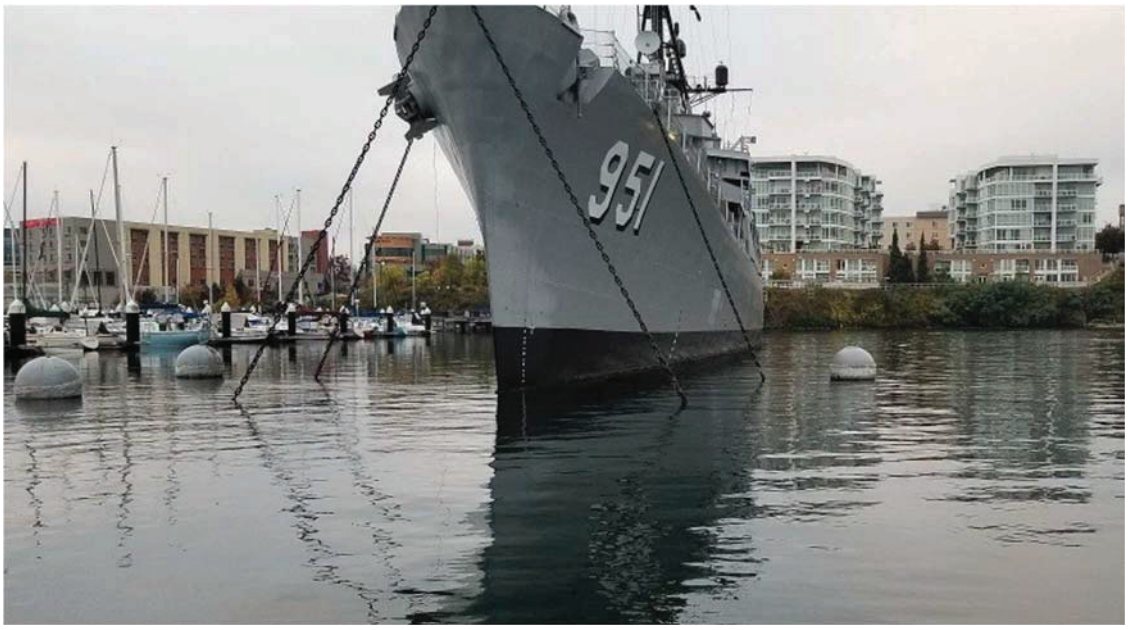


Figure 1 – Current Marker Buoy Situation

Marker Buoy Replacement Analysis and Recommendations

Since the marker buoys have had a pattern of breaking loose over the last 3 years, and since they are dented and leaking in some cases, the Port of Bremerton staff offered a suggestion regarding the possible use of non-metallic instead of steel buoys. This possibility will be examined with the following considerations:

1. Availability and cost of appropriate size and shape buoys made of a suitable non-metallic material.
2. Durability of the non-metallic buoy considering the environmental conditions and the potential for impacts by debris at the site.
3. Buoyant capacity of the buoy

The original design drawing for the USS Turner Joy Mooring system, dated 14 May 1990, shows the original marker buoys to be 42" in diameter and supported by a ¾" chain. Reference A states that the

existing buoys are 58" in diameter and are supported by a 1" chain. It remains questionable as to what is the actual diameter of the existing buoys, but it is estimated that they are probably 48-52" in diameter.

~~A comprehensive search of the availability of non metallic buoys was carried out with the discovery of several potential sources for this type of buoy. The most suitable material for the external surface of a buoy available in the marketplace was High Density Polyethylene (HDPE). The Port staff also provided Art Anderson with some information obtained from Neptune Floatation in Indianapolis, Indiana regarding an HDPE spherical buoy system. We entered into discussions with Neptune and obtained a quote for a 48" HDPE buoy (Attachment 1), buoy drawings (Attachment 2), Molding HDPE Copolymer Specifications (Attachment 3) and Elastopor Rigid Urethane Foam System Specifications (Attachment 4). In addition, the sales representative stated that these buoys are routinely used for flotation systems in Alaskan rivers that are subject to ice flows on an annual basis. There have not been any failures or warranty claims for these buoys over many years.~~

~~HDPE is a common and suitable material for use in float construction and is a very durable product. The HDPE copolymer used in the Neptune buoy (Attachment 3) is an excellent material for this buoy application as it is a non tearing and very rigid material which would probably out-perform steel with no corrosion potential. Based on this information, our judgement is that it would be acceptable to replace the existing steel buoys with 48" HDPE Neptune buoys. An additional advantage of these HDPE buoys is that th~~ **NOTE: NEW HDPE BUOYS INSTALLED IN 2020 AND REFLECTED IN REDLINE TEXT.**

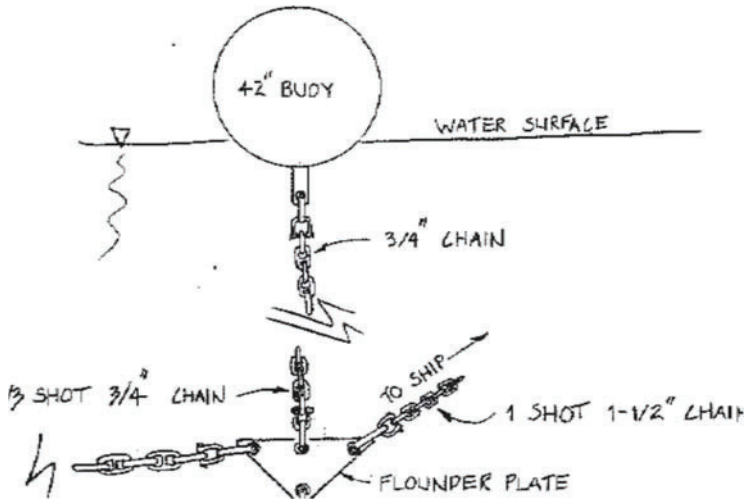
2021 BID PROPOSAL FOR REMAINING HIGHLIGHTED MAINTENANCE TASKS.

~~retain its buoyant capacity even i ecute this project in 2020, a cons nent 5.~~

~~It may be feasil m on the existing 1" chains. The n Drydock (when the Turner Joy inimal corrosion, per the dive in be handled by a smaller vessel or via rigging to the existing buoys, rather than via a crane barge, the following requirements would need to be included in the contract for the installation of the new buoys:~~

1. ~~Port of Bremerton to purchase 48" Neptune HDPE buoys and 1" shackles – ensure no dissimilar metals~~
2. ~~Remove existing shackles and replace with new shackles using same alloy of steel as the chain. And alternative option offered by the Port Staff is to use a High Modulus Polyethylene (HMPE) line section (Such as Amsteel Blue), in lieu of a shackle, for buoy connection. This is considered a viable option as long as the line splice is as strong as the line itself.~~ If this option is used, we recommend coating the metal elements (buoy pad eye and chain) with TEMCOAT 3000, but it is not necessary to cost the HMPE line section.
3. Clean marine growth from existing chain down to the mud line
4. ~~Ensure the buoy connection pad eye system is the same alloy of steel as the shackle and chain~~.
5. Use cotter pin locking wire that is the same alloy of steel as all other components
6. Coat entire chain, shackles, and buoy connection completely with Trenton TEMCOAT 3000

7. Installation would follow the detail of the original design shown below:



In the event the above scenario is not acceptable, please advise if you would like Art Anderson to develop a more detailed drawing and specification package for this construction contract.

ICCP System Improvement Recommendations

The Impressed Current Corrosion Protection system currently installed on the USS Turner Joy is an essential component of the overall corrosion protection system for the entire vessel, the mooring systems, and the marker buoys. Based on the preliminary site inspection conducted on 5 June 2020, it was noted that the system as currently installed is not protecting the ship in a symmetrical fashion, and in fact, could be causing galvanic corrosion to accelerate in many locations, instead of protecting the entire vessel and its mooring systems.

While it was requested in Reference C that as-built drawings for the existing ICCP system be provided if available, these drawings may be of limited value, even if found. Based on our initial site visit, it appears that significant changes have been made to this system, and that it is not wired according to code, suggesting the need for conducting an as built survey of the existing system in order to make recommendations that will provide the comprehensive protection required to prevent both vessel and mooring system corrosion issues in the future. Any documentation that can be found will still be useful as a baseline for the purpose of documenting the changes discovered during this new site visit.

Please advise if it would be acceptable to submit a proposal for this site visit and the subsequent comprehensive design package for upgrades to the ICCP system.

Buoy Replacement Construction Cost Estimate

Using the approach discussed above, the estimated cost of repairs is $40,000. A ROM cost breakdown is included as Attachment 5 to this report.

ATTACHMENT 1

Neptune™ Flotation

Suspension Floats

www.pipefloat.com

SIZES AVAILABLE:
13" to 48"
Custom Floats Available, ask us!

Suspension Floats
Great for Suspending pipe under the water surface!

PART NUMBER	DESCRIPTION	DIAMETER	WEIGHT (Lbs)	BUOYANCY @ 50% SUBMERSION (Lbs)	Pricing		
					1-9	10-49	50+
SUBMERSION (Lbs)							
BF13-GALV	13 Inch Ball Float with 1/2" Galv. Rod and 1 eye	13"	6	15	$ 132	$ 115	$ 104
BF16-GALV	16 Inch Ball Float with 1/2" Galv. Rod and 1 eye	16"	13	31	$ 151	$ 132	$ 120
BF18-GALV	18 Inch Ball Float with 1/2" Galv. Rod and 1 eye	18"	13	45	$ 181	$ 158	$ 143
BF21-GALV	21 Inch Ball Float with 1/2" Galv. Rod and 1 eye	21"	21	70	$ 272	$ 239	$ 217
BF25-GALV	25 Inch Ball Float with 1/2" Galv. Rod and 1 eye	25"	27	110	$ 312	$ 273	$ 248
BF30-GALV	30 Inch Ball Float with 1/2" Galv. Rod and 1 eye	30"	40	226	$ 479	$ 418	$ 380
BF36-GALV	36 Inch Ball Float with 1/2" Galv. Rod and 1 eye	36"	64	407	$ 571	$ 500	$ 455
BF48-GALV	48 Inch Ball Float with 1/2" Galv. Rod and 1 eye	48"	100	996	$ 785	$ 687	$ 623

GREAT FEATURES:

- Tough, crack resistant, UV inhibiting polymer resin ensures a long life
- Very customizable and versatile

OTHER USES:

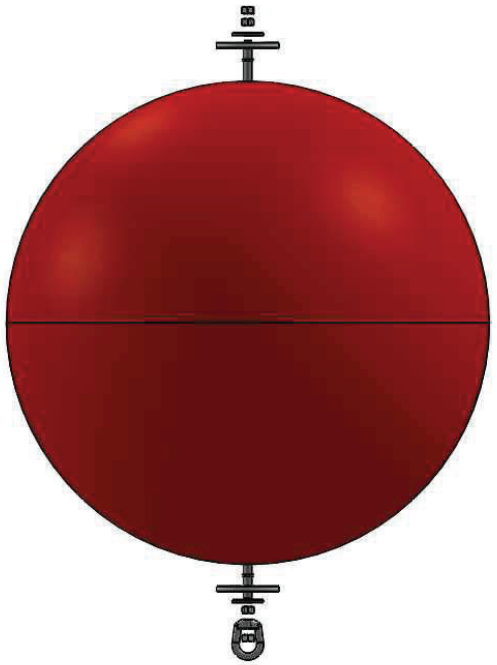
- **Suspend a Pump**
- **Boat Traffic Control**
- **Mooring Buoys**

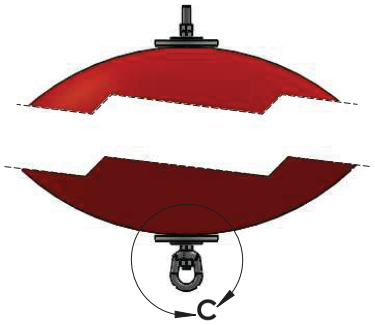
View a copy of our warranty at www.pipefloat.com/warranty

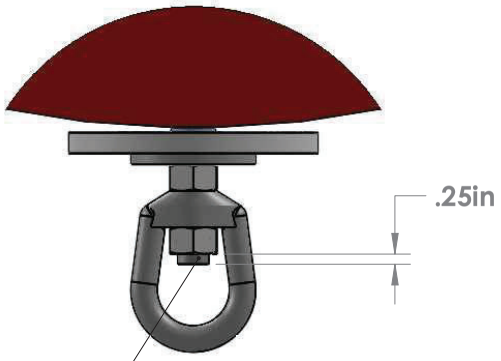
Neptune Flotation
Phone: 317-588-3600 Fax: 317-588-3700 Email: sales@pipefloat.com

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	48 Inch Float Ball	48 Inch Float Ball with Urethane Foam	1
2	Plastic Washer Plate Nationwide Plastic # 26004520	PE Plastic Washer cut from plate	2
3	McMaster #98970A150	Hot Dipped Galvanized Washer for Screws 3/4"; OD = 3"	2
4	Threaded Steel Rod	Threaded 3/4"-10 Hot Dipped Galvanized Rod Thread 3/4"-10; Length = 54"	1
5	McMaster # 3019T21	Hot Dipped Galvanized Eye Nut; Thread 3/4"-10	1
6	Hose Washer MCMaster # 5456K7	Neopren Washer 1-1/16"OD-x 5/8"ID x 1/8"	2
7	McMaster # 90371A055	Hot Dipped Galvanized Hex Nut; Thread 3/4"-10	4

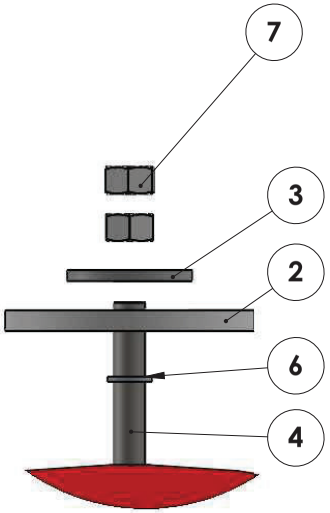
ATTACHMENT 2



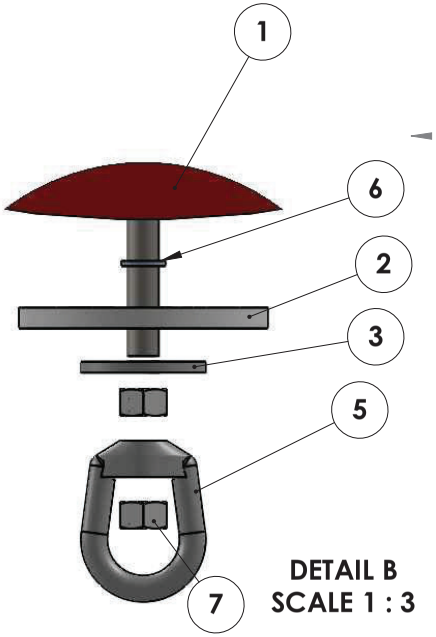




DETAIL C
SCALE 1 : 3



DETAIL A
SCALE 1 : 3



DETAIL B
SCALE 1 : 3

NOT IN SCALE	DRAWN BY	DATE
STATUS: CONCEPT	AB	08/08/2019

NEPTUNE FLOTATION

www.pipefloat.com
Phone +1 317-588-3600

TOLERANCES
ANGULAR = ±1/2°
LINEAR = ±1% OF DIMENSION

TITLE: Assembly of 48" Float Ball

REVISION 0

SHEET 1 OF 2

PART NO.

ENG. ID 48 Inch Float Ball Assembly

ExxonMobil HD 8660
Rotational Molding HDPE

ExxonMobil Chemical

Material Description
HD 8660 is a high density hexene copolymer designed to offer superior toughness and stiffness. This resin is ideally suited for applications that require the optimum balance of low temperature toughness, creep resistance, stiffness, ESCR, and tear properties.

Typical Applications
Large agricultural tanks
Intermediate bulk containers
Industrial products

HD 8660.29 Pellet Form; Long term UV8 stabilization
HDP8660.29 35 US Mesh Powder; Long term UV8 stabilization

Resin Properties	Test Based On[4]	Units	Typical Value[1]
Melt Index	ASTM D-1238	g/10 min.	2.0
Density	ASTM D-4883 or ASTM D-1505	g/cm^3	0.942
Melting Point	ExxonMobil Method	°C (°F)	129 (264)
Molded Properties[2]			
Tensile Strength at Yield[3]	ASTM D-638	MPa (psi)	20.3 (2950)
Tensile Break Elongation	ASTM D-638	%	> 1000
Flexural Modulus 1% Secant	ASTM D-790 Procedure B	MPa (psi)	888 (129,000)
Impact Strength @ -40°C	ARM	J ($ft\text{-}lbs_f$)	
1/8" (3.17 mm) thickness			108 (80)
1/4" (6.35 mm) thickness			244 (180)
Environmental Stress Crack Resistance (ESCR), F_{50}	ASTM D-1693 Condition A	hr	
100% Igepal			550
10% Igepal			48
Deflection Temperature	ASTM D-648	°C (°F)	
@ 66 psi (455 Kpa)			67 (153)
@ 264 psi (1820 Kpa)			41 (106)

1. Values given are typical and should not be interpreted as specifications. Values may change with future development.
2. All physical properties were measured on rotomolded samples, except for ESCR, which was measured on compression molded samples.
3. Tensile testing was conducted at a crosshead speed of 50 mm/min. The tensile strength reported refers to the maximum stress reached during the test.
4. ASTM test procedures may be modified to accommodate operating conditions or facility limitations.
5. Grades have NSF and UL recognition. Contact your ExxonMobil representative for details.

Food Packaging
Grades have FDA compliance. Restrictions may apply, contact your ExxonMobil representative for more details.

12/01

BASF
The Chemical Company

Technical Product Data

Urethane Specialties

ELASTOPOR® P 15390R RESIN/ELASTOPOR® P 1001U ISOCYANATE RIGID URETHANE FOAM SYSTEM

DESCRIPTION

ELASTOPOR® P 15390R Resin/ELASTOPOR® P 1001U Isocyanate is a two-component polymeric MDI based system utilizing water and HFC-245fa as blowing agents.

ELASTOPOR® P 15390R RESIN COMPONENT

Appearance	Amber liquid
Odor	Amine
Density, @ 55°F	9.06 lbs/gal
Viscosity, @ 73°F	360 cps
Flash Point, ASTM 3278-89	>200°F
HFC-245fa, % Resin	7.6%

ELASTOPOR® P 1001U ISOCYANATE COMPONENT

Appearance	Dark brown liquid
Odor	Slight Amine
Density, @77°F	10.2 lbs/gal
Viscosity, @77°F	200 cps
Flash Point	>400°F
Vapor Pressure, at 20°C	0.00016 mm Hg

APPLICATION

Mix Ratio: Parts by weight 92 Resin/100 Isocyanate

Foam Reactivity & Density	Handmix	High-Pressure
Jiffy Mixer RPM	1720	--
Component Pressures, Resin/Isocyanate	--	1500psi/1500psi
Component Temps, Resin/Isocyanate	55°F / 70°F	70°F / 70°F
Mix time, seconds	8	--
Cream time, seconds	24	5
Gel time, seconds	100	60
Tack Free time, seconds	210	140
Free Rise Density, #10 Cup, lb/ft^3	2.0	2.0

BASF Corporation
1419 Biddle Avenue
Wyandotte, Michigan 48192-3799
(734) 324-6100
(734) 324-6482 (Fax)

Revision Date: 1/03/2006

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Urethane Specialties

ELASTOPOR® P 15390R RESIN/ELASTOPOR® P 1001U ISOCYANATE RIGID URETHANE FOAM SYSTEM

TYPICAL PHYSICAL PROPERTIES		ASTM
Molded Panel		
Core Density, pcf	2.6	D-1622
Parallel:		
Compressive Strength @10% deflection, psi	43	D-1621
Compressive Modulus, psi	1086	D-1621
Perpendicular:		
Compressive Strength @10% deflection, psi	28	D-1621
Compressive Modulus, psi	669	D-1621
Tensile Strength, psi	52	D-1623
Elongation, %	11	D-1623
Tensile Modulus, psi	661	D-1623
Flexural Strength, psi	51	D-790
Flexural Modulus, psi	1148	D-790
Water absorption, lbs./sq. f	0.032	D-2842
Water absorption, %	1.8	D-2842
Closed Cells, % (uncorrected)	88	C-6226
K Factor, BTU-IN/HR-FT2-°F		
Initial	0.154	C-518
UL® 94 Flame Class (File E112987)	HBF	

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Dimensional Stability, % Volume Change		ASTM
158°F/100% RH 28 days	-1.0	D-2126
200°F 28 days	-1.0	D-2126
-20°F 28 days	-0.5	D-2126

CERTIFICATION

US COAST GUARD: (CGD 75- 168) Flotation Material
Rigid polyurethane samples prepared from Elastopor® P 15390 chemicals have been tested at an independent laboratory. Molded samples have passed the U.S. Coast Guard immersion tests (CGD 75-168), and meet or exceed Performance criteria set out in D.O.T. – Coast Guard – Flotation Materials, Par. 183.114, Federal Regulatations Volume 43, No. 233, 1/5/2005

US COAST GUARD: (CITE: 33CFR183.516) Encase Fuel Tanks. Rigid polyurethane foam samples has been tested by an independent laboratory. Molded samples have passed the ASTM D-471 and Military specification MIL P-21929B sections of 33CFR183.516. 12/23/2005.

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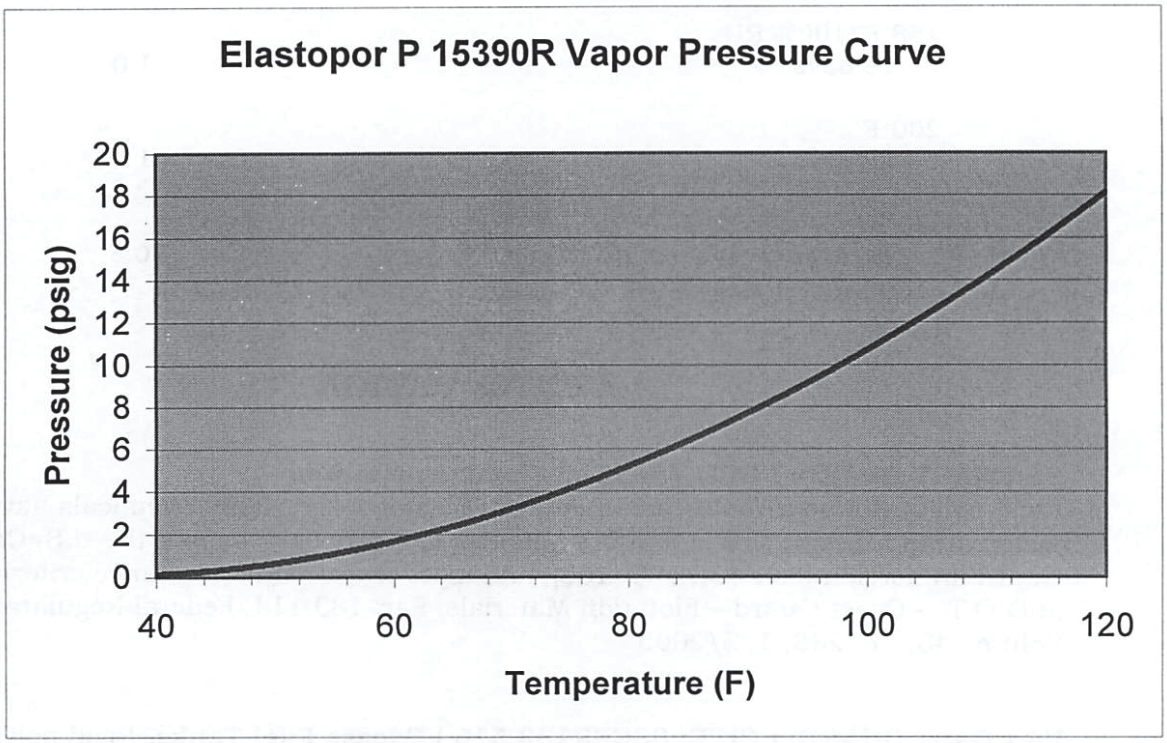

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ATTACHMENT 4

BASF
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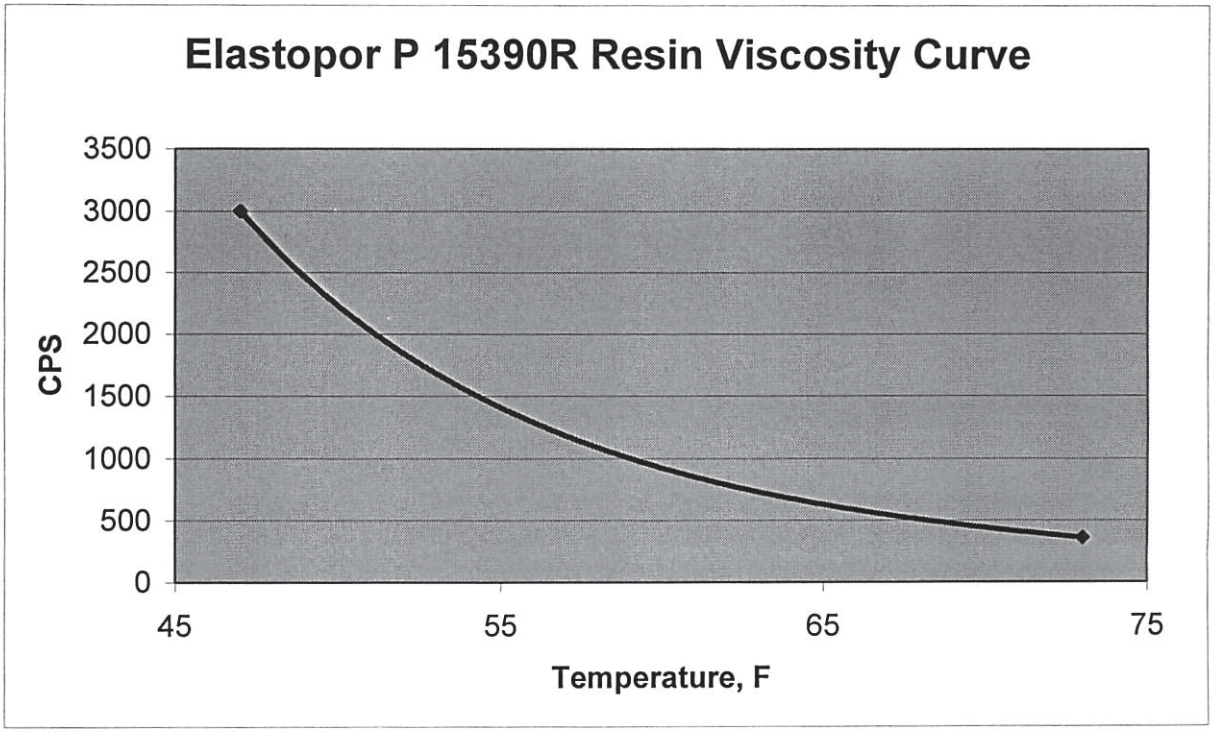
Technical Product Data

Urethane Specialties

ELASTOPOR® P 15390R RESIN/ELASTOPOR® P 1001U ISOCYANATE RIGID URETHANE FOAM SYSTEM



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Revision Date: 1/03/2006

ATTACHMENT 5

ROM Cost Estimate

ART ANDERSON ASSOCIATES

ESTIMATED BY: AAA	PROJECT No.	**FWPOB103.004**
PROJECT & CITY: Port of Bremerton USS Turner Joy Marker Buoy Replacement	CONTRACT No.	
DATE: October 20, 2020	PURPOSE	**ROM Est**
EST. VALID TO: ROM = N/A	SHEET 1	OF 1

SCOPE OF WORK:

SCOPE OF WORK:

Replace Existing Steel Marker Buoys with HDPE Buoys

LS = Lump Sum Allowance value used

LINE ITEMS	QUANTITY		LINE ITEM COST			TOTALS
DESCRIPTION OF WORK	#	UNIT	UNIT($)	SUM TOT ($)		SUM TOTS ($)
HDPE Buoys	4	Ea.	$785.00	$3,140		$3,140
Mobilization	1	LS	$3,000.00	$3,000		$3,000
Barge/Vessel Rental	1	LS	$4,500.00	$4,500		$4,500
Dive Team - one day	1	LS	$5,000.00	$5,000		$5,000
Locate and Rig Chains for cleaning (Missing buoy)	1	LS	$1,000.00	$1,000		$1,000
Clean marine growth from chains	1	LS	$1,500.00	$1,500		$1,500
Remove three buoys and install 4 new buoys	1	LS	$2,000.00	$2,000		$2,000
Coat entire installation with TEMCOAT 3000	1	LS	$2,000.00	$2,000		$2,000
				$0		$0
				$0		$0
				$0		$0
				$0		$0
				$0		$0
				$0		$0
				$0		$0
				$0		$0
				$0		$0
				$0		$0
Demobilize	1	LS	$2,000.00	$2,000		$2,000
				$0		$0
				$0		$0
LINE ITEM SUBTOTAL						**$24,140**

GENERAL CONDITIONS ITEMS	QUANTITY			COST		
Description of Item	#	UNIT	UNIT($)	SUM TOT ($)		SUM TOTS ($)
SUBTOTAL						**$24,140**
CONTRACTOR'S OVERHEAD	15%					$7,242
CONTRACTOR'S PROFIT	10%					$5,552
Sales Tax (on above subtotals+OH/P)	9.00%					$5,497
CONTRACTOR'S BONDS & INSURANCE	5%					$1,847
SUBTOTAL						**$36,934**
CONTINGENCY						
DESIGN + CONSTRUCTION CONTINGENCY	5%	0	$0.00	$0.00	$0.00	**$3,054**
ESCALATION CONTINGENCY (Assume 2020)	0%	0	$0.00	$0.00	$0.00	**$0**
CONSTRUCTION COST TOTAL						**$39,988**
DESIGN & ENGINEERING (Repair/Replacement Design)						
DESIGN & ENGINEERING (Permit Docs) - Use NWP-3	10%					
						$0
SUBTOTAL						**$39,988**
GRAND TOTAL						**$39,988**