Uber Boat
by thames clippers

HAMMERSMITH TEMPORARY FERRY

FIRE SAFETY STRATEGY

BECKETT RANKINE
Marine Consulting Engineers

MAY 2021
2048-BRL-02-XX-RP-C-2200

CONTROLLED DOCUMENT STATUS

CLIENT	Uber Boat by Thames Clippers
PROJECT TITLE	Hammersmith Temporary Ferry
SUBJECT	Consents & Planning
DOCUMENT TITLE	Fire Safety Strategy
DOCUMENT REF	2048-BRL-02-XX-RP-C-2200

REVISION RECORD

REV	STATUS	DATE	SUMMARY OF CHANGES	PREP	CHK	APP
P01	S2 – Suitable for Information	19/05/2021	-	NS	TKHB	TKHB

CONTENTS

1 INTRODUCTION

1.1 General

1.1.1 This fire safety strategy has been prepared by Beckett Rankine (BR) on behalf of Uber Boat by Thames Clippers (UBTC) in support of the Hammersmith Temporary Ferry planning and marine consent applications. It aims to address the London Plan Fire Safety Policy D12 A, identifying how both piers shall adhere to the requirements of this regulation.

1.1.2 Figure 1.1 shows the proposed development plan – for further information of the project background and aims, refer to the Design and Access Statement (ref. 2048-BRL-02-XX-RP-C-3000) and other supporting documentation.

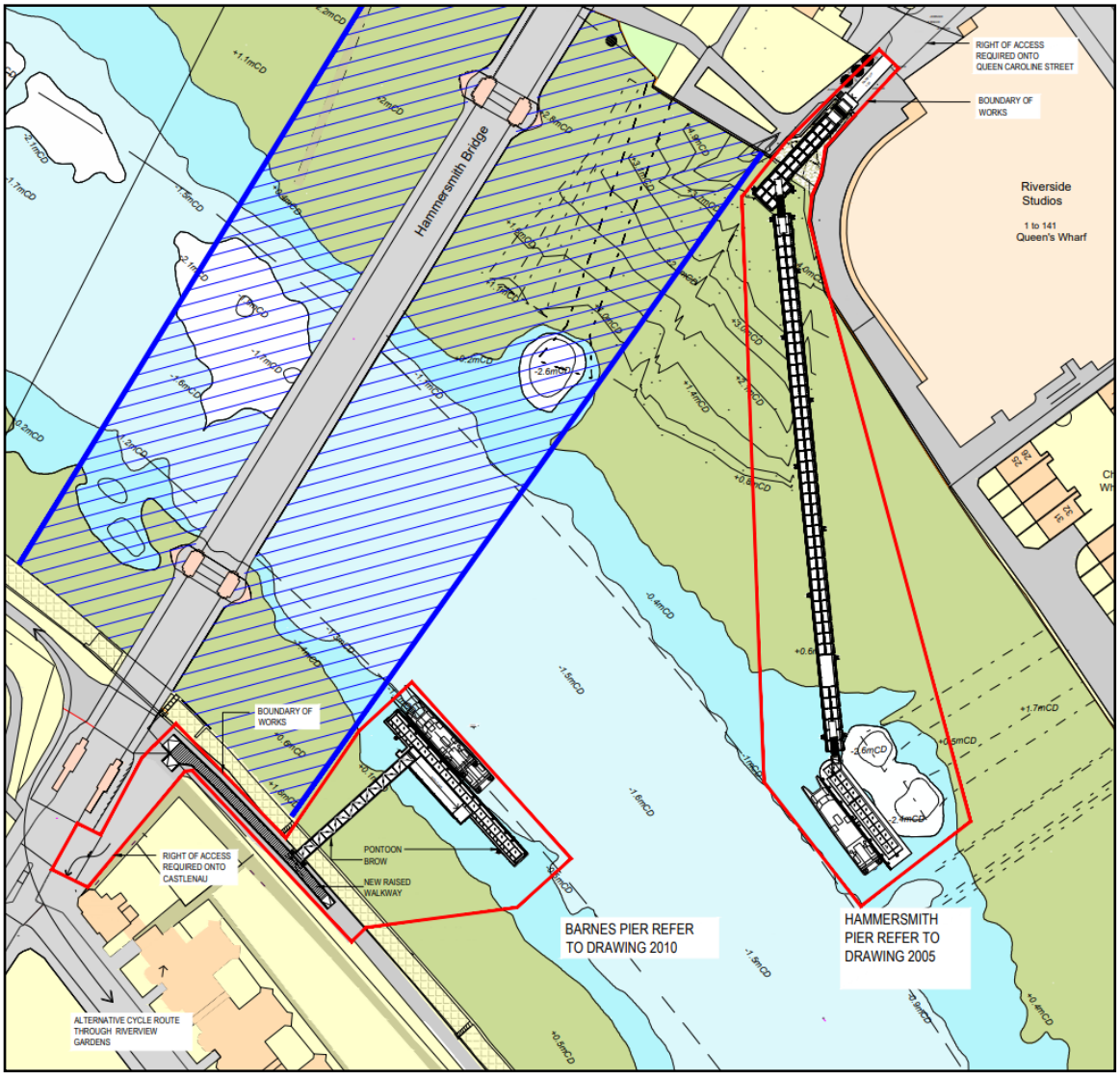


Figure 1.1: Proposed Development Plan

1.2 London Plan Fire Safety Policy D12 A

1.2.1 The London Plan Fire Safety Policy D12 A states the following:

"In the interests of fire safety and to ensure the safety of all building users, all development proposals must achieve the highest standards of fire safety and ensure that they:

1. *identify suitably positioned unobstructed outside space:*
    i. *for fire appliances to be positioned on*
    ii. *appropriate for use as an evacuation assembly point*
2. *are designed to incorporate appropriate features which reduce the risk to life and the risk of serious injury in the event of a fire; including appropriate fire alarm systems and passive and active fire safety measures*
3. *are constructed in an appropriate way to minimise the risk of fire spread*
4. *provide suitable and convenient means of escape, and associated evacuation strategy for all building users*
5. *develop a robust strategy for evacuation which can be periodically updated and published, and which all building users can have confidence in*
6. *provide suitable access and equipment for firefighting"*

1.2.2 Neither pier has any enclosed space and neither is classified as a 'building' under the Building Regulations 2010; as such, they do not need to adhere with the requirements of Policy 12 for buildings. Further, the piers' location within the river where the pier pontoons are permanently afloat means that if a fire were to occur, it would be limited in its nature.

1.2.3 Despite this, the below technical note summarises reasonable exception statements (RES) for each of the above points, as well as highlighting the relevant design codes considered alongside the experience and qualifications of the authors.

1.2.4 Note that the vessels to be used for the operation of the temporary ferry fall under the classification of the Maritime and Coastguard Agency (MCA) code of practice,

and are therefore compliant with the specified fire safety measures stipulated by the MCA.

1.3 Author Experience

Table 1-1: Author Experience

Name	Role	Exp. (yrs)	Qualification
Tim Beckett	Project Director	40	BSc CEng FICE MCIWEM
Harry Palmer	Senior Engineer	7	MEng CEng MICE
Nathan Smith	Engineer	2	MEng (Hons) GMICE

1.3.1 Note that years of experience refers to designing passenger piers on the River Thames.

1.4 Design Codes

1.4.1 The following design codes have been adhered to in the design of the Hammersmith Temporary Ferry:

- BS EN 1993-1-1, NA to BS EN 1993-1-1 Eurocode 3. Design of steel structures. General rules and rules for buildings
- BS EN 1990:2002 Basis of Structural Design
- BS EN 1991-1-1, NA to BS EN 1991-1-1 Eurocode 1. Actions on structures. General actions. Densities, self-weight, imposed loads for buildings
- BS EN 1991-1-2:2002 General Actions – Actions on structures exposed to fire
- BS EN 1991-1-3:2002 General Actions – Actions on structures exposed snow loads
- BS EN 1991-1-4, NA to BS EN 1991-1-4 Eurocode 1. Actions on structures. General actions. Wind actions
- BS EN 1991-1-5, NA to BS EN 1991-1-5 Eurocode 2: Actions on structures. General actions. Thermal actions.

- BS EN 1992-1-1, NA to BS EN 1992-1-1 Eurocode 2: Design of concrete structures. General rules and rules for buildings
- BS EN 1993-1-1, NA to BS EN 1993-1-1 Eurocode 3. Design of steel structures. General rules and rules for buildings
- BS EN 1993-1-9, NA to BS EN 1993-1-9 Eurocode 3. Design of Steel Structures. Fatigue
- BS EN 1998-1-1, NA to BS EN 1998-1-1 Eurocode 8. Design of aluminium structures. General rules and rules for buildings
- BS6349 Part 1 Maritime structures: General Criteria
- BS6349 Part 1-1 Maritime works – General – Code of practice for planning and design for operations
- BS6349 Part 1-3 Maritime works – General – Code of practice for geotechnical design
- BS6349 Part 1-4 Maritime works – General – Code of practice for materials
- BS6349 Part 2 Maritime works. Code of practice for the design of quay walls, Jetties and dolphins
- BS6349 Part 4 Maritime structures: Code of practice for design of fendering and mooring systems
- BS6349 Part 5 Maritime structures. Code of practice for dredging and land Reclamation.
- BS6349 Part 6* Maritime Structures: Design of inshore mooring and floating structures. (*BS 6349-Part 6 is temporarily withdrawn pending revision but remains appropriate to assess wind loads on waterborne vessels.)
- BS6349 Part 8 Maritime structures: Code of practice for the design of Ro-Ro ramps, linkspans and walkways
- BS5400 Part 2 Steel concrete and composite bridges: Specification for loads
- BS EN 1997-1 NA to BS EN 1997-1 Geotechnical Design – Part 1: General Rules
- CIRIA C518 Safety in Ports – ship-to-shore linkspans and walkways
- CIRIA C551 Manual on scour at bridges and other hydraulic structures

- CIRIA C683 The Use of Rock in Hydraulic Engineering
- Lloyd's Rules and Regulations for the Classification of Linkspans
- Lloyd's Rules and Regulations for the Classification of Ships
- PD 6484:1979 Commentary on corrosion at bimetallic contacts and its alleviation
- London River Services: River Infrastructure Guidelines 2014

2 LONDON PLAN FIRE SAFETY POLICY D12 A COMPLIANCE

2.1 Fire Appliances and Evacuation Assembly

2.1.1 The piers being installed will be constructed from flame retardant and/or non-combustible material, and so no additional risk of fire will be imposed by implementing either pier. This combined with the other measures discussed in section 2.2 make it unlikely that a fire severe enough to warrant the use of fire appliances would ever occur on either pier. However, should it be necessary, London Fire Bridge would mobilise one of their firefighting boats from Lambeth River Fire Station which are able to access either pier at any state of the tide.

2.1.2 Should evacuation be required, the muster points for both piers are as shown below.

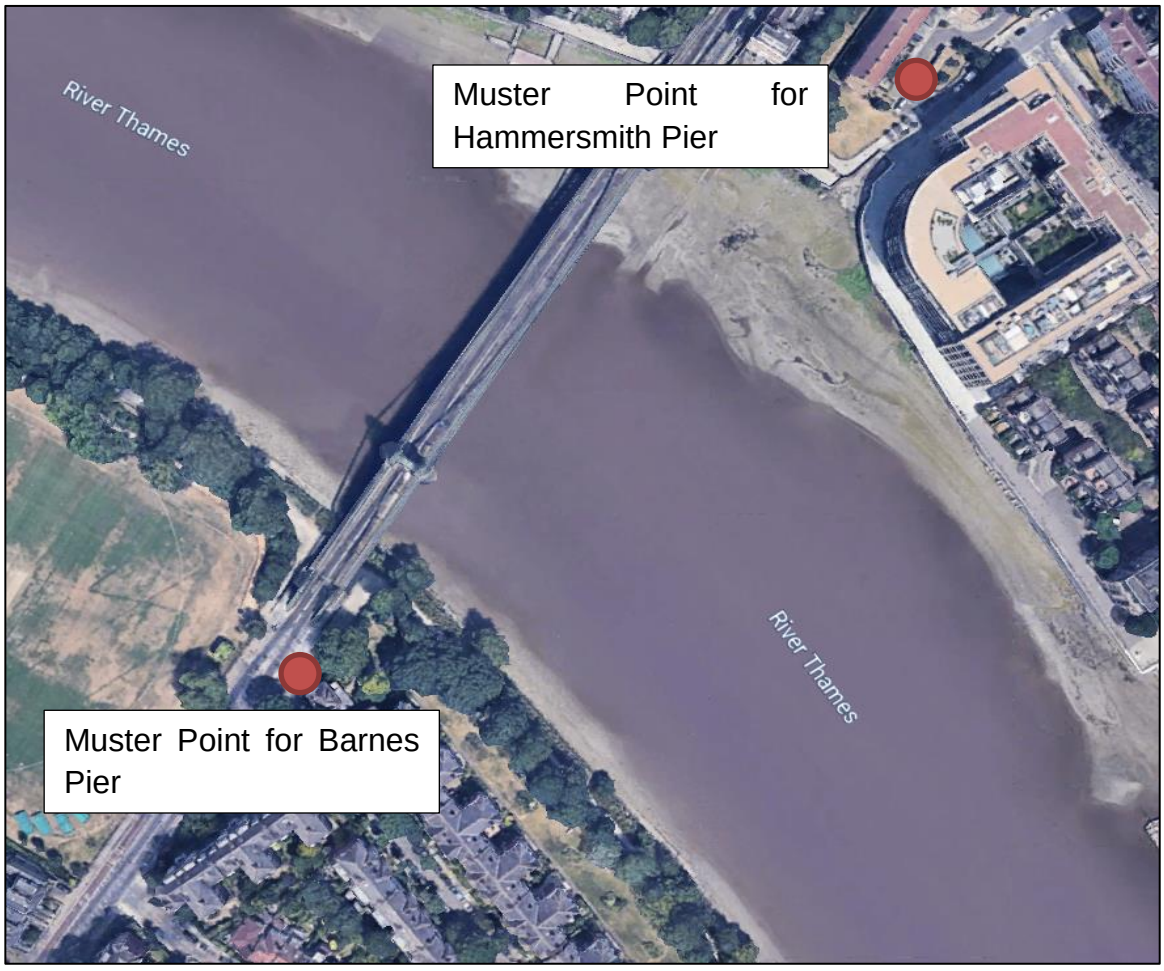


Figure 2.1: Location of Muster Points

2.2 Fire Alarm Systems & Passive and Active Fire Safety Measures

2.2.1 Passive fire safety measures accounted for in the design of both piers include:

- The selection of flame retardant materials throughout (i.e. steel, aluminium, resin bound surfaces etc);
- A no-smoking policy on all parts of the service;
- Limited ignition sources;
- No waste or fuel storage or other combustible materials will be stored on the piers; and
- No enclosed spaces.

2.2.2 Active fire safety measures accounted for in the design of both piers include:

- Implementation of fire extinguishers on both piers; and
- Staffing of both piers during all operational hours with a minimum of two fire-safety trained operatives on each pier.
- The operatives will be equipped with hand-held radios to communicate with each other, and with the vessel crews.

2.2.3 Should a fire occur, the trained operative's role, as well as reducing the risk as far as safely practicable for both themselves and users, would also involve informing the relevant authorities.

2.2.4 Both piers will be locked when out of use to prevent unsupervised access. Security personnel will be present whenever the vessel crews are not on site.

2.3 Construction Techniques

2.3.1 For further details of how fire will be combated during construction, refer to the Risk Assessment and Method Statement for the project (ref. R7M-520038-MST-001-C0).

2.4 Means of Escape & Evacuation Strategy

2.4.1 Normal escape routes would be the same as the access routes for both piers. Should escape by this route be prevented then escape via the vessels would be implemented.

2.4.2 Should evacuation be required, the standard UBTC evacuation procedure will be implemented (see Appendix A) – this would be supervised by the on-site operatives. This procedure is updated as required, with muster points specific to each pier (see section 2.1).

2.5 Firefighting Equipment

2.5.1 One CO2 fire extinguishers will be placed on each pier as shown in below:

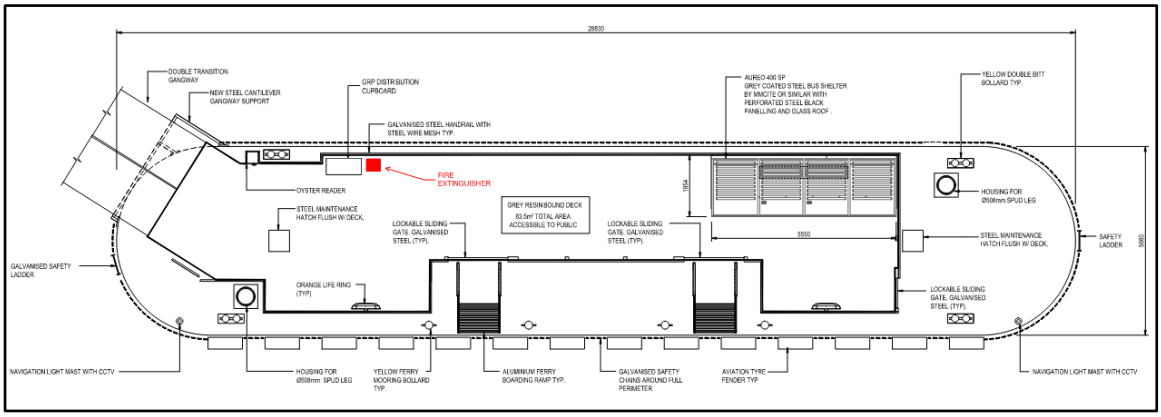


Figure 2.2: Deck Layout - Hammersmith Pier

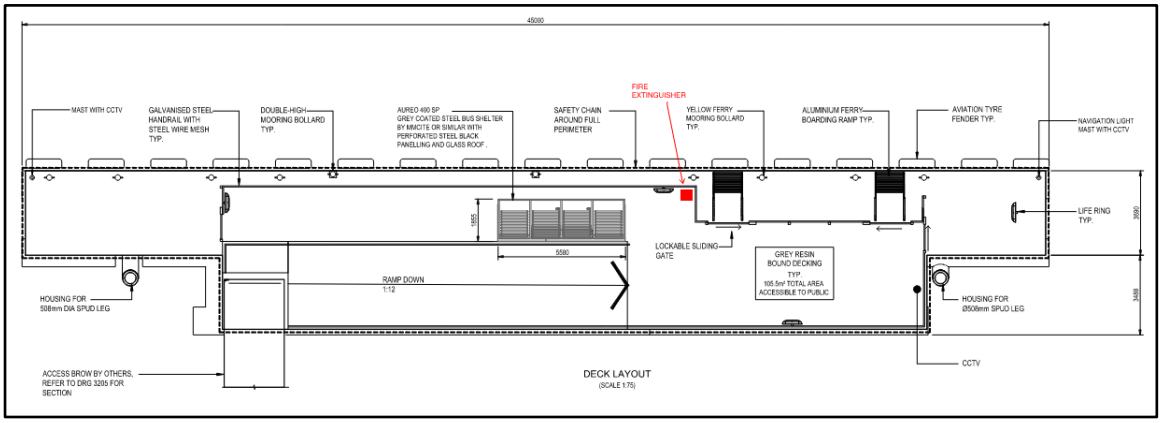


Figure 2.3: Deck Layout - Barnes Pier

2.6 Other

2.6.1 As there are to be no ignition sources present on the piers the main risk of combustion is through vandalism.

2.6.2 The most combustible area in the scheme is the pontoon walkways - these are constructed from a polyester resin whose certification states that this is a yellow card material according to the UL94 horizontal burn test (see Appendix B). In order to receive this type of certification, the material cannot burn at a rate greater than 75mm/min if the test specimen is less than 3mm thick and not more than 40mm/min if the specimen is between 3 and 13mm in thickness. Given the 7.9mm thickness of the pontoons, this material is classed as flame retardant so combustion would be slow allowing generous time for escape.

3 CONCLUSION

3.1.1 While they are not buildings, the design, construction and operation of the Hammersmith Temporary Ferry Scheme complies with the requirements of the London Plan Fire Safety Policy D12 A.

APPENDIX A UBTC FIRE EVACUATION PROCEDURE

Uber Boat by thames clippers

Thames Clipper Piers
Fire Instructions for Staff and Passengers

The fire alarm is a continuous siren

When the fire alarm sounds you must leave the building

Actions upon hearing the fire alarm

- **Leave the building/pier immediately *by the nearest exit,* do not delay to collect any personal belongings**
- **Go straight to the assembly area, which is located outside at area --**
- **Do not stand in the roadway as the fire brigade will need to get access**
- **Under no circumstances re enter the building/pier unless you have been told it is safe by the fire service**

Actions to be taken if you discover a fire

- **Raise the alarm by breaking the call point glass or shouting**
- **Upon hearing the alarm a member of staff will contact the fire brigade by dialling 999 if it is safe to do so.**
- **Then make your way to the fire exit**
- **Do not attempt to fight the fire unless you have been trained in the use of fire extinguishers**
- **If the call has not been made then use a mobile phone when outside the building or off the pier**
- **Report to the designated person who is at the muster point --**

VESSEL
EMERGENCY PROCEDURES
FIRE

ENGINE ROOM FIRE

Select CCTV
Ensure no person in engine room.
Batten down engine room – (Fire doors / flaps shut/ventilation off)
Close fuel shut off valves
Inject extinguishment
Boundary Cooling

PASSENGER SPACE FIRE

Evacuate Passengers to safe area (taking lifejackets)
Batten Down
Boundary Cooling

WHEEL HOUSE FIRE

Remove Handheld VHF
Batten Down
Boundary Cooling

Example Announcement:

Ladies and Gentlemen, may I have your attention please
We have a serious situation in the ……
The situation is being dealt with by the crew; you are in no immediate danger.
Emergency services have been notified and are on route to assist us.
We are proceeding to the nearest Pier where you will be disembarked
Please remain seated until further instructed by the crew.

CONSIDER THE FOLLOWING

Remove Passengers away from the source of fire
Passengers Mustered
Passenger Count
Lifejackets On
Nearest Landing Platform
Request assistance from nearby vessels
LIFERAFTS Deployed (Last resort)

AIDE-MEMOIR

Number of Passengers on board and contact details……
Number of Crew.
Vessel's Location.
Nature of medical emergency.
Inform: London VTS VHF Channel 14
Inform Fleet Control VHF P Zero
Inform Designated Person 07813 707878 Derek Mann
Complete Incident Report (Witness, Photographic evidence)
Complete MAIB/PLA report as required

APPENDIX B EZ DOCK MATERIAL SPECIFICATION

EZ Dock General Specifications *(Revision 09-03-09)*

1. Float and Deck Design Standard

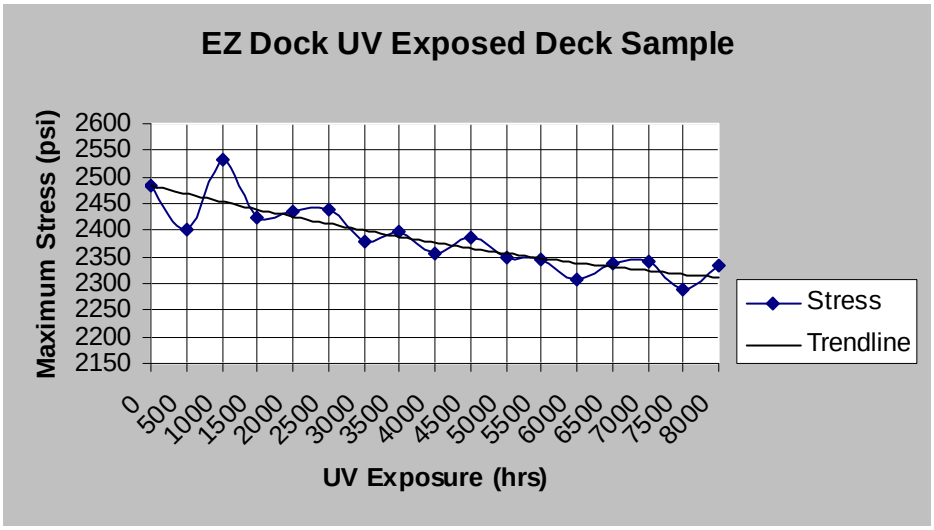
1.0 The individual dock section shall consist of decking surface and the float structure, which are to be constructed as a single, integrated component. Each section shall provide for the support of the dead load plus a specified live load of **62.5 pounds per square foot** (lb/ft^2). This shall be accomplished without the use of foam for either structural integrity or floatation. The dock sections shall be manufactured by a rotational molding process and each dock section shall be subject to the specific parameters of the particular model.

1.1 The individual dock section shall consist of a specified number of interior, air filler pylons. These pylons shall provide for flotation in the event of a breach of an exterior wall of the dock section; as well as the structural support for the deck portion of the float. Each pylon shall support the dead load plus a live load of 55 pounds (lb) The volume of each pylon shall be no less that 1540 cubic inches (in^3).

1.2 The individual dock sections shall be constructed of the following materials with the following general properties:

a. Virgin Polymer, Thermoplastic, Rotational Molding Grade **Linear Low Density Polyethylene**- (LLDPE)

b. An ultraviolet inhibitor system (UV-8) or better spectrometer specification. Laboratory testing conducted for 8000 hours yielded a 6.5% decrease in mechanical properties. The chart to the right shows the UV degradation trend line in relationship to mechanical property decrease over time. After the first 8000 hours the rate of decay is reduced significantly. Theoretical data indicated that the period of time between 8000 and 16000 hours yields an additional 0.7% decrease in mechanical properties.



(Real life scenario- 8000 hours of UV exposure can be related to approximately 9 years and 16000 hours related to 18 years of outdoor usage in southern Florida. These results show that a life expectancy in excess of 30-40 years is attainable.

c. A standard color of beige (or optional other) colorant in accordance with rotomolding standards.

d. The **density** of the section shall be approximately .932 grams per cubic centimeter (g/cm^3) or .0338 pounds per cubic inch (lbs/in^3) , per ASTM 792-00.

e. The dock section shall have a cold **brittleness** temperature equal to, or less than, -130° Fahrenheit (F), per ASTM D-746.

1.3 The properties of the exterior **wall thickness** of the dock sections shall be as follows:

a. The mean exterior material thickness shall be no less that .310 inches (in).

b. The corners shall be no less than .650 inches (in).

c. The exterior edge thickness shall be no less than 0.50 inches (in) at any particular point.

d. The walls of the dock sections shall resist a **shear** of no less that 1900 pounds per square inch (lb/in^2), per ASTM D-732, as well as having the capability of resisting a minimum **impact** of no less than 220 foot pounds (ft-lb), per ASTM D5420.

e. The **tensile strength** at failure shall be no less that 2630 pounds per square inch (lb/in^2) with 12 **elongation** at yield, per ASTM D-638.

1.4 The decking surface shall be composed of a textured or “orange peel” surface with a grid pattern for added adhesion during dry conditions. Drainage of the decking surface shall be accomplished through the use of troughs, which shall have a width of no more than 0.5 inches (in) and a depth of no more than 0.5 inches (in). The drainage troughs shall extend over the width of the dock and shall be positioned at intervals of no less that 4.5 inches (in) and no greater than 6.5 inches (in) over the entire length of the deck

a. The deck shall have an approximate **coefficient of friction** equal to 0.35 during dry conditions and 0.61 during wet conditions. Simply put, the decking surface is 37% less slick when wet than when dry per ASTM D2394.

b. The properties of the decking surface shall be as follows:

c. The mean deck thickness shall be no less that 0.315 inches (in).

d. The deck thickness shall be no less than 0.290 inches (in) at any particular point.

e. The deck shall resist a punching shear which is no less that 1900 pounds per square inch (lb/in^2), per ASTM D-732.

f. The deck shall resist a minimum impact of no less that 120 foot pounds (ft-lb) near the center, or at the point where the deck is thinnest, per ASTM D-3029.

g. The deck shall resist a minimum impact of no less that 150 foot pounds (ft-lb) within 16 inches (in) of the outside of the dock, per ASTM D-3029.

2. Floating Dock Structure

2.0 The dock structure, as a whole, shall consist of the individual sections, which are to be coupled together in the specific configuration desired by the purchaser. Any material used in the dock structure shall provide for resistance to rust, corrosion, and the effects of any fuel or gasoline. All material designed and selected for marine environment and the conditions there of.

2.1 A 2-D or 3-D layout drawing of the final configuration, including any accessories, shall be supplied for the purchaser if desired. Recommendations for anchorage can also be provided.

2.2 The dock structure shall act as one unit when assembled, so that wave and/or wind action shall produce a minimum amount of motion. The structure shall be secured with either piles, spuds, bottom anchors, or stiff arms. The securing shall allow the structure to rise and fall freely with any water level changes and allow the structure to span waves from crest to crest, while providing a stable walking surface.

3. Connections of Dock Sections

3.0 Each dock section shall have molded-in female-type pockets spaced symmetrically along the top and bottom edges, around the entire perimeter of the dock section. These pockets shall be spaced at 19.5 inch (in) intervals, center line to center line, from each other. *All un-used pockets are to be filled with supplied EZ Dock pocket filler (PN # 201030).*

3.1 The molded-in female-type pockets shall accept a male-type coupler which shall be secured into the female pocket with the use of a 0.5 inch (in) X 13 inch (in) coupler bolt and nut.

3.2 The purpose of such connections is to provide for simple assembly and disassembly, as well as providing for the securing of one section to another. The connection will also provide for the ability to attach EZ Dock accessories to the dock sections.

3.3 Each connection point shall allow for some slippage in the event that an extreme stress is applied. This slippage will allow for disconnection without causing damage either to the male-type couplers or the female-type pockets.

3.4 The dock sections shall be connected at increments of 19.5 inches (in), in relation to each other. These connections may be made from any one side of any dock section to any other side of another dock section. These connections may also be used to connect dock sections of differing dimensions and shall provide for ease of assembly, whether the sections are to be assembled on land or in the water.

3.5 The male-type coupler shall be constructed of no less than 90% post/pre-consumer recycled tire rubber.

3.6 Each male-type coupler shall withstand a pullout force of no less than 2500 pounds (lb) before failure of coupler occurs.

3.7 Each of the molded in female connection pockets shall provide for a pullout strength of no less than 3500 pounds (lb), before damage is caused to the dock section.

3.8 The accessories shall be connected to the dock system through the use of molded in coupler pockets around the perimeter of the dock sections by the use of either male or female type half-couplers. The male-type half-coupler (hardware connector, PN # S21140SS) shall have a 3.625 inch "T"–bolt embedded within it. The female type half-coupler (hardware connector, PN # S21141SS) shall have a 3.625 inch "T"–nut embedded within it Both types of half-coupler shall withstand a pullout force of no less that 2600 pounds (lb) before failure occurs.

4. Cleats

4.0 The tie up cleats shall be constructed of nylon 6,6 and shall have a length of 8-1/16 inches (in) and a height of 1-1/2 inches (in). The cleats shall be connected to the dock sections by two 5/16 inch (in) stainless steel bolts that are threaded into two stainless steel "T" nuts which are molded directly into the dock section. Each of the "T" nuts shall provide for a pull out force of no less that 2000 pounds (lb), so that the cleat may withstand a force of no less that 4000 pounds (lb).

4.1 T-nuts shall be molded in the dock sections in sets of two, with the distance between the two "T" nuts being 2-1/4 inches (in).

4.2 There shall be three sets of "T" nuts placed along the length of each side of the dock section. The sets of "T" nuts shall be placed at equal distances between the first and second pockets, between the third and fourth pockets, and between the fifth and sixth pockets, along both sides of the dock section.

4.3 There shall be one set of "T" nuts at one end of the 40 inch (in) wide dock section placed at equal distances between the two pockets.

4.4 There shall be two sets of “T” nuts at one end of the 60 inch (in) wide dock section placed at equal distances between the three pockets.

4.5 There shall be two sets of “T” nuts at both ends of the 80 inch (in) wide dock section. These “T” nuts shall be places at equal distance between the first and second pockets, and between the third and fourth pockets.

5. Anchorage

5.0 The dock system shall be designed to allow for the use of piling of various sizes, spud pipes, cables, or chains attached to a bottom anchor, or stiff-arm attachments for anchorage. Calculations can be supplied at purchaser’s request to support designed anchorage with the assumption that all collected data is accurate. Calculations, permitting, and licensed engineering design available at customers expense.

6. Hand Railing Attachment

6.0 The dock structure shall have the ability to accept railing which is constructed to meet the standards established by the Americans with Disabilities Act (ADA), States Organization for Boating Access (SOBA) and the National Uniform Building Code (NUBC). The railing shall be constructed of 1.5 inch (in) O. D., 14 gauge steel tubing. The steel tubing shall be finished either by a 0.003 inch (in) Hot-Dip Galvanizing or by powder coating painting process.

7. Gangways and Access

7.0 All construction is to be accordance with the minimum provisions of States Organizations for Boating Access (SOBA) and the guidelines stated by, “Marinas and Small Craft Harbors”. Gangways will be offered in several different material options but the offerings for loads, handrails, guardrails, transition plates, float mounts, shore mounts, and general designs will remain constant. Environmental conditions will influence the accessibility. Design layouts and advice can be supplied at request.

7.1 Gangways and Access Ramps shall be designed to support 90 pounds per linear foot (lbs/ftln). The deck and structural components shall be designed to support a concentrated load of 400 applied to any 12 inch X 12inch square. Lateral designed wind loads shall not exceed 77MPH.

7.2 Handrails shall be continuous along both sides of the of the walking surface and shall extend 12 inch past the walking surface on both ends. The top rail portion shall not be less than 34 inches nor more than 38 inches above the walking surface. The ends of the handrails shall be returned into the handrail body or terminate with no sharp or catching edges. The mounting and components of the handrails shall be capable of withstanding a lateral load of 50 pounds per linear foot.

7.3 Decking shall be per project specification and be skid resistant and made from marine grade appropriate materials.

8. Main Docks

8.0 The main docks are the walkways which are subjected to the most amount of traffic. These should be designed to provide for comfortable and easy walking widths. Design of the dock system for such things as pumps, power supplies, storage boxes, etc. to be attached to them, the overall width of the dock sections should have a minimum width of 60 inch (in) wide This will provide ample width for pedestrian traffic.

9. Finger Docks

9.0 The finger widths should be designed to allow for safe and comfortable walking widths. For boat or vessel mooring, a 40 inch (in) wide dock is sufficient to provide for finger stability as well as pedestrian safety for finger lengths up to 20 feet (ft) long. If the length of the finger exceeds 20 feet (ft) long, the 60 inch (in) or 80 inch (in) wide docks should be strongly considered.

10. Wind Exposure

10.0 Boat Profile Height – According to the American Society of Civil Engineers (ASCE) manual published in 1969, for the average height profile compared to the length of the boat, the following will apply.

- For a 10 foot (ft) long boat:
  ASCE average height is 3 feet (ft).
  For future considerations, will assume average heights up to 6 feet (ft).
- For a 20 foot (ft) long boat:
  ASCE average height is 3.5 feet (ft).
  For future considerations, will assume average heights up to 7 feet (ft).
- For a 25 foot (ft) long boat:
  ASCE average height is 3.6 feet (ft).
  For future considerations: will assume average heights up to 7.2 feet (ft).
- For all calculations done using the average boat profile heights, it will be considered that 100% of the boats using the dock will be twice the ASCE average profile.

10.1 Maximum Wind Exposure – From studies it has shown that forces caused by the maximum wind exposure comes from an angle to the boat, instead of directly to the side or to the front of the boat. Due to the non-feasibility of designing a dock system to handle a maximum tornado wind gust, it is suggested that a reasonable wind speed should be chosen. According to the design standards set up by the

Army Corps of Engineers, the dock system should be designed to withstand wind speeds of up to 77 miles per hour (mph) or 15 pounds per square foot (lb/ft^2).

10.2 Hidden Boats – It is a common practice to use load factors of 10% to 15% for each hidden boat affected by wind force. That is, every boat that is shielded by another boat, either in front of, or on the side of, will have a decrease in the amount of force which is applied to that boat due to the affect of the shielding boat. The use of a force factor of 15% per hidden boat shall be used in any calculations.

10.3 Load From Various Directions – In the designing of the boat dock system, if piles are to be used as the means of support, it is necessary to take into account the force being applied in the direction of the maximum wind exposure only. However; if chains, cables, or deadweights are to be used as the means of support, it would be necessary to take into account the wind exposure from all directions, when designing the dock system.

11. Load Design

11.0 **Dead Load**

a. The dead load shall consist of the entire dock system plus any additional attachments to the dock system.
b. Each dock section, without additional attachments, shall provide a **freeboard** of approximately 12.75” inches (in).
c. The surfaces of adjacent deck surfaces shall have an elevation difference of no more than 0.125 inches (in).
d. The ends of the fingers shall have an elevation of no more that 1 inch (in) above that of the main dock.
e. The deck surface of each dock section shall not slope more than 0.5 inches (in) over the 10 foot (ft) length of the dock section.
f. The deck surface of each 80 inch (in) X 10 foot (ft) dock section shall not slope more that 0.35 inches (in) over the width of the dock section.
g. The deck surface of each 60 inch (in) X 10 foot (ft) dock section shall not slope more than 0.25 inches (in) over the width of the dock.
h. The deck surface of each 40 inch (in) X 10 foot (ft) dock section shall not slope more than 0.15 inches (in) over the width of the dock section.

11.1 Live Load Due To Vertical Loads

a. Under dead load conditions plus an additional 30 pounds per square foot (lb/ft^2) of uniform live load, flotation shall provide for a minimum of 7 inches (in) of freeboard.

b. The dock structure shall support a concentrated vertical load of up to 400 pounds (lb)

at any particular point on the surface of the deck. The structure shall accomplish this while maintaining flotation.

11.2 Live Load Due To Horizontal Loads

a. The dock system shall sustain the stated design loads applied by normal current and/or debris which are normal to a particular location. (In extreme conditions other procedures such as additional anchorage, anchorage release, and/or dock system removal may be necessary.)

b. The dock system shall be capable of sustaining continuous wave action of up to 1 foot and occasional wave action not in excess of 3 feet during storm conditions.

c. The dock sections shall sustain any loads applied by non-moving ice without damage.

d. The dock system shall be compatible for the use of any boat or vessel size with a properly designed anchorage/mooring system. Boats or vessels over 35ft should be moored directly to the anchorage system.

e. The dock system and anchorage shall be capable of withstanding sustained wind loads of 77 miles per hour (mph), or 15 pounds per square foot (lb/ft^2), at 100% boat occupancy, unless otherwise specified.

f. The dock system shall be capable of withstanding the impact force caused by a 35 foot boat striking the end of a finger at a speed of 2 miles per hour (mph) and at an angle of 10^O off center.

12. Designing for Layout

The dock system, anchorage, and connections shall be designed according to the recommendations of the American Society of Civil Engineers Manual and Report on Engineering Practice Number 50, “Planning and Design Guidelines for Small Craft Harbors”, the revised edition.

****

Works Cited:

Cambridge Materials Testing Limited: Laboratory #: 476905-08, June 5, 2008, Cambridge, Ontario

Toboasspm, P.E, Bruce O, and Kollmeyer, Ph.D., Ronald C. *Marinas and Small Craft Harbors.* New York: Van Nostrand Reinhold, 1991. Print.

Terry Boyd, John McPherson, Jill Murphey, Tim Bazley, Bobby Edwards, Mike Hough, Kent Skarr. *Design Handbook for Recreational Boating and Fishing Facilities:* Second Edition, 2006. Print

For more information and technical assistance contact:

Chevron Phillips Chemical Company LP
P.O. Box 4910
The Woodlands, TX 77387-4910
800.231.1212

PREMIUM EXTRUSION AND RIGID PACKAGING RESINS

Marlex® HMN TR-935 / HMN TR-935G

MEDIUM DENSITY POLYETHYLENE

These hexene copolymers are tailored for rotational molding applications that require:

- Wide process windows
- Excellent impact strength
- Good flow
- Excellent ESCR

Typical applications for HMN TR-935 and HMN TR-935G include items such as:

- Recreational and agricultural equipment
- Toys and carts

These resins are available in:

- Pellet form - HMN TR-935
- 35 US mesh powder - HMN TR-935G

These resins meet these specifications:

- ASTM D4976 - PE 223
- FDA 21 CFR 177.1520(c) 3.2a, use conditions B through H per 21 CFR 176.170(c) Table 2. Single use articles contacting food types I, II, IV-B, VI-A, VI-B, VII-B, and VIII. Repeated use articles contacting all food types defined in 21 CFR 176.170(c) Table 1.
- NSF / ANSI Standard 61 for potable water (CLD 23)
- NSF / ANSI Standard 51 for any food contact (MTU 100 °C)
- UL94HB yellow card per UL file E349283
- UL746C (f1) yellow card per UL file E349283
- FMVSS.302 burn test
- AS/NZS 4020:2005 (contact with drinking water)
- Long term UV stabilization – ASTM 2565 (Cycle 1): Greater than **UV-16**

NOMINAL PHYSICAL PROPERTIES[1], [2]	English	SI	Method
Density	---	0.936 g/cm^3	ASTM D1505
Melt Index, 190/2.16	---	6.0 g/10 min	ASTM D1238
ESCR, Condition A (100% Igepal), F_{50}	>1,000 h	>1,000 h	ASTM D1693
ESCR, Condition A (10% Igepal), F_{50}	130 h	130 h	ASTM D1693
Durometer Hardness, Type D (Shore D)	59	59	ASTM D2240
Vicat Softening Temperature, Loading 1, Rate A	231 °F	110 °C	ASTM D1525
Brittleness Temperature, Type A, Type I specimen	-103 °F	-75 °C	ASTM D746
Melting Temperature	263 °F	128 °C	ASTM D3418
Crystallization Temperature	234 °F	112 °C	ASTM D3418
ROTATIONAL MOLDED PROPERTIES[1], [3]	**English**	**SI**	**Method**
Impact Strength, 1/8" (3.2 mm) thickness, -40 °C	75 ft·lb	102 J	ARM Impact
Impact Strength, 1/4" (6.35 mm) thickness, -40 °C	175 ft·lb	237 J	ARM Impact
Tensile Strength at Yield, 2 in/min, Type IV bar	2,400 psi	16.5 MPa	ASTM D638
Elongation at Break, 2 in/min, Type IV bar	750 %	750 %	ASTM D638
Flexural Modulus, Tangent - 16:1 span:depth, 0.5 in/min	110,000 psi	760 MPa	ASTM D790
Flexural Modulus, 1% Secant - 16:1 span:depth, 0.5 in/min	90,000 psi	620 MPa	ASTM D790
Heat Deflection Temperature, 66 psi, Method A	136 °F	58 °C	ASTM D648
Heat Deflection Temperature, 264 psi, Method A	106 °F	41 °C	ASTM D648

1. The nominal properties reported herein are typical of the product, but do not reflect normal testing variance and therefore should not be used for specification purposes. Values are rounded.
2. The physical properties were determined on compression-molded specimens that were prepared in accordance with Procedure C of ASTM D4703, Annex A1.
3. Properties were measured on rotational molded samples with 1/8" (3.17 mm) average thickness, unless otherwise noted. The average peak internal air temperature during molding was above 400 °F.

Revision Date September, 2014