NSCV PART C SUB-SECTION 3 – CONSTRUCTION – CONSTRUCTION OF VESSELS USING WELDED POLYETHYLENE

NOTE: NOTE: This GES was endorsed by Peer Advisory Network on 16 November 2010 and originally published by the NMSC as GES 2010-02, GES 2010-03 and Circular 10-01.

Application

(a) This equivalent solution is available for the design of new vessels up to 13m in measured length for operational areas C, D and E, subject to the following limitations.

- This equivalent solution is only available for the design of new vessels until 1 October 2016.

  Reason: This equivalent solution is intended as an interim measure during the initial implementation of NSCV C3. The current editions of AS 4132 Parts 1,2 and 3 were published in 1993 and Standards Australia has no plans to keep these standards up to date. Therefore, an indefinite recognition of the Australian Standards as an equivalent solution is not deemed appropriate.

- This equivalent solution is not available for fast craft.

  Reason: There have been instances of cracking and other problems with fast craft designed to AS 4132.

- This equivalent solution is not available for novel craft.

  Reason: The equivalence is based on the track record of existing vessel designs currently in service; however, its suitability for new applications is uncertain.

(b) This equivalent solution is available for the design and construction of new vessels up to 13m in measured length for Operational Areas C, D and E using fabricated high density polyethylene, subject to the following limitations.

- This equivalent solution is only available for the design of new vessels until 1 October 2016 and is subject to the other limitations of application set out in Application (A) above.

  Reason: This equivalent solution relies upon the limitations and equivalent solution provided for in (A), which in turn, is based on the use of AS 4132.

- This equivalent solution is only available for vessels using outboard motors for propulsion.

  Reason: It does not take account of the loads imposed by inboard mounted engines.

- This equivalent solution is only available for vessels operating in water temperatures not less than 10°C and air temperature not normally greater than 40°C.

  Reason: Temperature affects the physical properties of HDPE.

Requirement

*Clause **3.2.2 Deemed-to-satisfy alternatives to class** refers to a range of options set out in **Table 1 – Deemed-to-satisfy alternative construction standards for vessels not in class and less than 35m in measured length**.*

Equivalent solution and specifications

(A) In addition to the options listed in Table 1, the use of AS 4132 *Boat and ship design and construction*: Part 1 - *Design loadings*, in conjunction with either Part 2 - *Aluminium construction* or Part 3 - *Fibre-reinforced plastics construction* is deemed to satisfy the required outcomes for vessels ≤13m in measured length. This equivalent solution applies to both light and robust operations, but is subject to the limitations set out in Application (A).

(B) In addition to the options listed in Table 1, the use of AS 4132 *Boat and ship design and construction*: Part 1 - *Design loadings*, in conjunction with Part 2 - *Aluminium construction* and the specifications below is deemed to satisfy the required outcomes for vessels ≤13m in measured length fabricated from high density polyethylene components. This equivalent solution applies to both light and robust operations, but is subject to the limitations set out in Application (B) above.

Specifications relating to Application (B):

These specifications provide for the design and construction of vessels from welded polyethylene in sheet and pipe form. The allowable stresses are based on limited testing of welds and may be modified with changes in weld procedure and welding equipment. It makes reference to the following Australian Standards:

AS 4132 *Boat and ship design and construction*

Part 1 - *Design loadings, in conjunction*

Part 2 - *Aluminium construction*

Part 3 - *Fibre-reinforced plastics construction*

SOLUTION

A: Design Loads

A.1 Design Pressures

The design pressures shall be calculated in accordance with AS 4132.1

B: Allowable stresses

B.1 Working stress design

B.1.1 Static loading – The allowable stresses for static loading shall be calculated on the basis of the long-term allowable stress for the material.

Allowable tensile stress 0.33 x Fy

Allowable compressive stress 0.33 x Fy modified for slenderness ratio in accordance with Appendix B of AS 4132.2

Allowable shear stress 0.15 x Fy

B.1.2 Dynamic loading - allowable stresses for dynamic loading may be calculated by multiplying allowable static stresses by a factor of 1.8.

Note: This is intended to allow for creep effects of long term loading of plastics, slamming loads for planing craft are short term and can be allowed for with a higher allowable stress.

C: Calculated stress and deflection

C.1 Stresses and deflections shall be calculated in accordance with Sections 4.5 & 4.6 of AS 4131.2.

C.2 Limiting deflections shall be:

Framing members, bulkheads, decks span / 75

Hull plating span / 50

Note: The allowable deflection is increased from the requirements of AS 4132.2 because the flexibility of the material would make the requirement of span / 100 difficult to achieve.

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D: Welds in polyethylene material

D.1 Butt welds

D.1.1 Full penetration butt welds

For full penetration butt welds:

(a) Fyt = the lesser of
0.83 x Fy ; and
0.83 x Fuw

Where:

Fuw = the yield stress of the weld material
Fy = the yield stress of the parent material
Fyt = the assumed strength of weld

(b) The allowable stresses in welds shall be:
Tension 0.6 x Fyt
Compression 0.6 x Fyt
Shear 0.45 x Fyt

The allowable stress shall be based on testing where the strength of downhand welds is significantly lower than other welding positions.

D.1.2 Partial penetration butt welds

Partial penetration butt welds shall not be used.

D.1.3 Location of welds

(a) Butt welds in continuous plating and structural members shall be located between 15% and 30% of the span from the nearest supporting member.

(b) Butt welds in plating and structural members terminating at a support shall be located between 70% and 80% of the span from the terminating support.

Special consideration shall be required for butts located outside these zones.

D.2 Fillet welds

D.2.1 General

The maximum allowable shear stress in a fillet weld shall be 0.33 x Fy

D.2.2 Longitudinal fillet welds

(a) For equal leg fillet welds, the maximum permissible longitudinal shear flow shall be:

$$P_l = 0.33 \times \frac{F_y \times t_w}{\sqrt{2}}$$

Where:
Pl = the permissible longitudinal shear flow
tw = the leg length of weld
Fy = the yield stress of the parent material

(b) For equal leg fillet welds, the maximum permissible transverse shear flow (Pt) shall be:

$$P_t = \sqrt{1.5} \times P_l$$

Weld size (mm)		**Weld orientation**	
t_w	t_t	P_l	P_t
4	2.8	22.4	27.4
6	4.2	33.6	41.2
8	5.7	44.8	54.9
10	7.1	56.0	68.6
12	8.5	67.2	82.3
14	9.9	78.4	96.0
16	11.3	89.6	109.8
18	12.7	100.8	123.5
20	14.1	112.0	137.2

Table 1:
Permissible loads for fillet welds for F_y = 24 Mpa

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D.3.0 Intermittent welds

D.3.1 The required length and spacing of intermittent welds shall be based on calculation of predicted shear stress for each case.

Note: When design/construction characteristics for this type of construction are established, a weld schedule similar to Appendix A of AS 4132.2 can be developed.

D.3.2 All members that are crossed by or carry the ends of structural members shall have a pair of matched intermittent welds on each side of each such intersection.

D.3.3 Unbracketed stiffeners of shell, watertight and oil-tight bulkheads and deckhouse fronts shall have double continuous welds for not less than 10% of their length at each end.

Note: The 10% requirement may be reviewed depending on calculated values for shear stress in the stiffeners.

Unbracketed stiffeners of non-watertight structural bulkheads, deckhouse sides and after ends shall have a pair of matched intermittent welds at each end.

D.3.4 Frames shall have double continuous welds adjacent to brackets.