

# I. Fibre Reinforced Plastic (FRP)

## Contents

I.	Fibre Reinforced Plastic (FRP) .....	1
I.1	General.....	2
I.2	Detailed Requirements .....	3
J.	Appendix 1, Recommended Procedure for the Survey of FRP Hulls During Manufacture.....	4
J.1	This procedure shall be read in conjunction with sub-section Fibre Reinforced Plastic .....	4
J.2	The recommended procedure for the survey of FRP hulls:.....	4
J.3	The surveyor shall inspect the hull at each stage of fabrication to ensure that: .....	4
J.4	FRP Construction Survey Report.....	4
J.5	FRP Hull Thickness Report.....	4
J.6	The glass content and the mass/m <sup>2</sup> reinforcement of the laminate shall be determined using the following equations: .....	5
K.	Appendix 2, Alternative Survey Procedures for FRP Vessels .....	8
K.1	This procedure shall be read in conjunction with sub-section FIBRE REINFORCED PLASTIC .	8
K.2	Vessels holding a valid certificate of class .....	8
K.3	Vessels originally constructed to class.....	8
K.4	Vessels that have not held a valid certification of class.....	8
K.5	Samples of laminate for quality assessment .....	8
K.6	Laminate quality assessment.....	9
K.7	Repairs on hull where samples are removed.....	9
K.8	Inspections .....	10
K.9	Vessels failing to meet survey requirements.....	10

## I.1 General

I.1.1 All requirements in this sub-section are for vessels that are constructed partially or fully from fibre reinforced plastic (FRP) that require survey.

I.1.2 A certificate of survey may be issued to FRP vessels less than 6 metres in length subject to:

- Drawings and specifications of the lay-up with specifications showing that the vessel construction meets the requirements.
- An affidavit from the vessel manufacturer, declaring that the vessel has been laid up in accordance with the provided drawing specifications.
- A report being submitted by an AUSCLASS surveyor following the final inspection of the completed vessel.

I.1.3 A certificate of survey shall only be issued in respects to an FRP vessel of measured length 6 metres and over, where the vessel has been surveyed by AUSCLASS in accordance to appendix 3 or may permit the survey of the vessel in accordance with appendix 4.

I.1.4 A vessel that is 6 metres or over but less than 10 metres in measure length that is forming a production series of vessels may be issued a certificate of survey, subject to:

- Drawings and specifications of the lay-up with specifications showing that the vessel construction meets the requirements

and either,

- The prototype vessel, and at minimum every sixth vessel shall be surveyed in accordance to this code, including thickness gauging after being removed from the mould before fitting out commences.
- The manufacturer in respects the vessels has in place an assurances scheme in accordance to the relevant AS/NZS ISO 9000 (Quality management systems – Fundamentals and vocabulary) series standards.

or

- The prototype vessel, and at minimum every sixth vessel shall be surveyed in accordance to this code.
- An affidavit from the vessel manufacture stating that all other vessels of the series have been laid in in the same manner as stated in the drawing specifications.
- A report that meets AUSCLASS satisfaction by a surveyor post an inspection and thickness gauging of the vessel once removed from the mould and prior to fitting out.

I.1.5 In order identify FRP hulls constructed under survey, each hull shall include a permanent identification mark to the satisfaction of AUSCLASS. For vessel surveys in accordance with 4.1 and 5.3 of Appendix 2 of Section 14 shall be marked with a letter “E” following the identification mark.

I.1.6 The required plans submitted to AUSCLASS shall include the transitions between different sections of the vessel, this shall include but not limited to, deck to side shall, transom the deck, transom the side shall, coaming to deck.

## I.2 Detailed Requirements

I.2.1 The detailed requirements for FRP shall be the Australian Standard AS.4132 Part 3 “Boat and Ship Design and Construction – Fibre-Reinforced Plastics Construction”.

I.2.2 The word “should”, where used in AS.4132 Part 3, is to be interpreted as if it read “shall, to the satisfaction of AUSCLASS”.

I.2.3 All materials used in construction shall be examined and tested by AUSCLASS or with a report and affidavit by the manufacturer to ensure product quality and manufacturing reliability, this may be determined through service experience or by being previously approved by AUSCLASS.

I.2.4 In the case where a vessel does not come within the scope of AS.4132 Part 3, the applicable requirements for the vessel shall be determined by AUSCLASS.

DRAFT

# J. Appendix 1, Recommended Procedure for the Survey of FRP Hulls During Manufacture

- J.1 This procedure shall be read in conjunction with sub-section Fibre Reinforced Plastic (FRP)
- J.2 The recommended procedure for the survey of FRP hulls:
- Each vessel shall be inspected at the stage of layup
  - The manufacture of the vessel shall record all masses of all reinforcement and resin used in the lamination of the hull, deck and the superstructure. The quantities shall be recorded in the FRP Construction Survey Report.
  - Once the vessel has been removed from the mould, a thickness shall be gauged at the centre of each panel at a minimum and where additional reinforcement has been added, e.g. chine, bottom, keel. The gauge reading shall be recorded in the FRP Construction Survey Report.
- J.3 The surveyor shall inspect the hull at each stage of fabrication to ensure that:
- The reinforcement has been uniformly impregnated and thoroughly wetted throughout with no resin rich areas
  - The reinforcement is in intimate contact with the gel coat or preceding plies
  - The resin is correctly catalysed
  - There are no significant air inclusions
  - There is no foreign material in the laminate
  - There is no uneven distribution of the reinforcement due to excessive pressure being used whilst rolling-out
  - The appropriate overlap is used at joints between plies of reinforcement

Any deficiency shall be recorded, and action taken to fix deficiency.

## J.4 FRP Construction Survey Report

The vessel builder shall complete this report in duplicate, the builder shall keep one copy and submit the other to AUSCLASS at the completion of laminating. The builder shall notify AUSCLASS when an inspection is required, at the completion of inspection the surveyor shall sign the appropriate section of the construction survey report, and the builder shall countersign. The next lamination stage may then commence. To determine that the quantity of reinforcement is sufficient, the builder must record the number of coils of roving and the area of woven roving mat used in square metres. The drum of resin may be placed on a weighing machine at commencement and weighed before commencing and after finishing the lamination, these shall be recorded in the report.

## J.5 FRP Hull Thickness Report

This report shall be completed by AUSCLASS in duplicate. One copy shall be provided to the builder and the other retained by AUSCLASS. Any areas of laminate which are less than the required thickness shall be fixed to meet standards.

J.6 The glass content and the mass/m<sup>2</sup> reinforcement of the laminate shall be determined using the following equations:

$$\text{Glass content} = \frac{\text{total mass of glass}}{(\text{Total mass of resin} * 0.93) + \text{total mass of glass}}$$

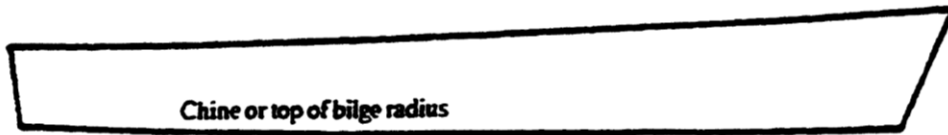
$$\text{Laminate reinforcement} = \frac{3000 * \text{glass content}}{2.55 - (1.35 * \text{glass content})} \text{ g/m}^2$$

DRAFT

NAME OF VESSEL					
OWNER					
BUILDER					
HULL LAY-UP	BOTTOM				
	SIDE				
	DECK				
	SUPERSTRUCTURE				
FRAME LAY-UP		WEB FRAMES		LONGITUDINAL FRAMES/GIRDERS	
		BOTTOM	SIDE	BOTTOM	SIDE
HEIGHT (mm)					
FACE AREA (mm <sup>2</sup> )					
WEB THICKNESS (mm)					
MATERIALS		TYPE	MANUFACTURER	WEIGHT USED (kg)	
				HULL	DECK AND S/STRUCTURE
GELCOAT					
RESIN					
CS MAT					
WOVEN ROVINGS					
CHOPPED ROVINGS					

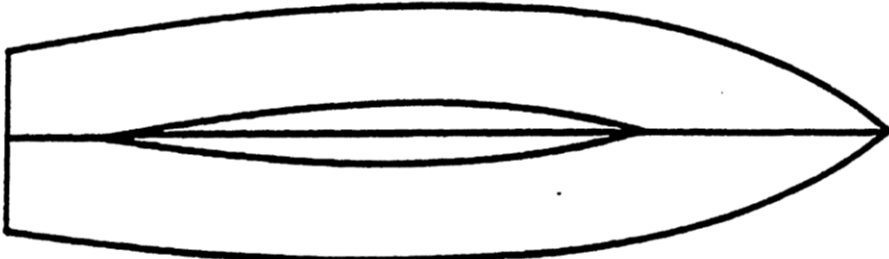
**INSPECTION OF HULL DECK SUPERSTRUCTURE LAY-UP**

ON COMPLETION OF:	DATE	TEMP (°C)	HUMID (%)	SATIS-FACTORY	SURVEYOR	BUILDER
HULL						
GELCOAT & 1ST CSM/CR						
1ST CR-WR-CR						
2ND CR-WR-CR						
3RD CR-WR-CR						
WEB FRAMES						
LONGITUDINAL FRAMES						
TRANSVERSE FRAMES						
LONGITUDINAL GIRDERS						
DECK						
GELCOAT & 1ST CSM/CR						
1ST CR-WR-CR						
2ND CR-WR-CR						
3RD CR-WR-CR						
DECK GIRDERS						
BEAMS & BEAM SHELF						
SUPERSTRUCTURE						
GELCOAT & 1ST CSM/CR						
1ST CR-WR-CR						
2ND CR-WR-CR						
BEAMS & KNEES						

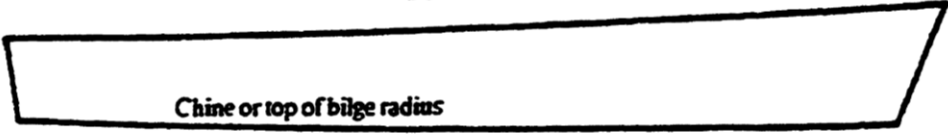


Chine or top of bilge radius

PORT SIDE

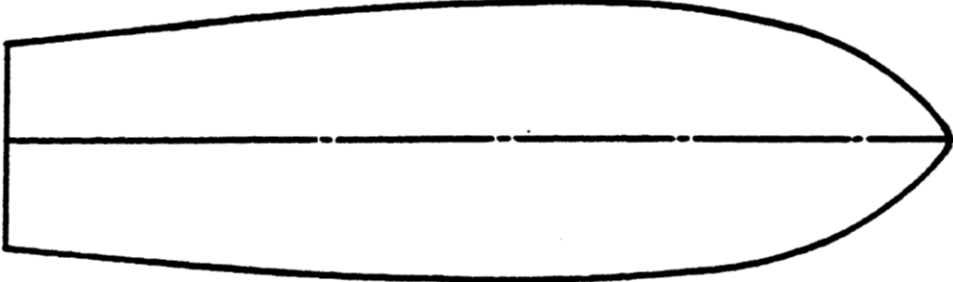


BOTTOM

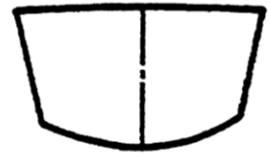
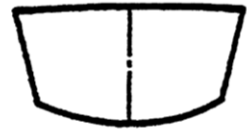
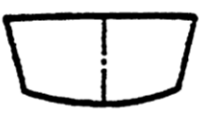


Chine or top of bilge radius

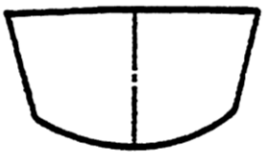
STARBOARD SIDE



DECK



Location: TRANSOM



TRANSOM BULKHEAD

Approved thicknesses (mm)		
BOTTOM	CHINE BOTTOM	NAME/IDENT. PLAN No. BUILDER OWNER SURVEYOR DATE SIGNED
TOPSIDE		
TRANSOM		
KEEL		
STEM		

## K. Appendix 2, Alternative Survey Procedures for FRP Vessels

- K.1 This procedure shall be read in conjunction with sub-section FIBRE REINFORCED PLASTIC (FRP)
- K.2 **Vessels holding a valid certificate of class**
- K.2.1.1 For a vessel to obtain a valid AUSCLASS certificate of class, all approved plans and certificates that the vessel holds may be required to be submitted to AUSCLASS and have the vessel surveyed by AN AUSCLAS surveyor to ensure that the vessel is in compliance.
- K.3 **Vessels originally constructed to class**
- K.3.1 Where a vessel was originally constructed to class and has held a valid certificate of class that has lapsed, for the certificate of class to be reinstated, the owner may follow either the procedure set out in 2 of this appendix or alternatively may elect to have the vessel surveyed in accordance with the procedures in C.4.
- K.4 **Vessels that have not held a valid certification of class**
- K.4.1.1 The owner shall submit plans and specification including details of the layup and requirements in sub-section 1 to AUSCLASS for review. The vessel shall undergo sample testing off the hull in accordance with the procedure in part C.5 if AUSCLASS determines that the scantlings are of adequate strength and construction. Where the vessel hull is deemed acceptable, AUSCLASS shall survey the vessel to ensure that it complies with the rules.
- K.5 **Samples of laminate for quality assessment**
- K.5.1 Each laminate sample should be as flat as possible for practical purposes and be able to contain a 260mm by 65mm rectangle, the sample shall be of only basic laminate and not include any gelcoat.
- K.5.2 In the case where a vessel is constructed to AUSCLASS approved plans prior to construction and an application for survey has been received by AUSCLASS, but no inspections have been conducted as required by appendix 1. The builder may produce sample laminates that are laid up to the same specifications as the bottom laminate during the same period of the vessels moulding. If a sample laminate is not available, samples shall be from the vessel in accordance to C.5.3. the builder shall provide an affidavit stating that the sample laminate was laid up in accordance with approved plans.



K.5.3 Where a vessel is constructed to plans that were neither submitted nor approved before construction by AUSCLASS, the vessel will require several samples to be removed from its hull. The required number of samples shall never be less than three and can be determined by dividing the measured length by 5 and rounding down to the nearest non decimal number. At least one sample shall be taken from bottom and each side shell laminate, with the locations of the samples to be determined by the surveyor, who shall identify each sample.

## K.6 Laminate quality assessment

K.6.1.1 For vessel that have not previously held a valid certification of class shall require the hull thickness to be gauged. For reinforced hulls the thickness shall be gauged at the centre of each panel and for vessels with unstiffened hulls, the surveyor shall nominate the sections, areas of where additional reinforcement are required under the sub-section Fibre Reinforced Plastic, shall be gauged. The gauged thicknesses shall be recorded in the FRP hull thickness report as required in appendix 1.

K.6.2 The samples as required by 5 of this appendix shall be tested in accordance with the following:

- Tensile strength and modulus of elasticity  $E_s$  established in accordance with ISO/RR 527-1966
- Bending strength and modulus of elasticity  $E_b$  established in accordance with ISO 178-1975
- Glass reinforcement content in cured laminate measured in accordance with ISO 1172-1975, except that, upon approval by AUSCLASS, the number of tests may be reduced to two.

K.6.3 Where the shell of the vessels hull is constructed of isotropic glass reinforced plastic, the mechanical properties measured according to 6.2, based on a mass of reinforcement material of 430 g/m<sup>2</sup> per mm of laminate thickness, shall be at least:

- Tensile strength of 80 MPa and modulus of elasticity  $E_s$  of 7000 MPa
- Bending strength of 120 MPa and modulus of elasticity  $E_b$  of 7000 MPa
- Glass content of between 28.5% and 40% by mass, with variation between individual samples shall not to vary by more than 4%.

K.6.3.1 Where the shell material used in construction of the vessels hull differs from that previously stated, there shall be evidence provided to AUSCLASS in which shows that the material used has at minimum the same strength as that required in C.6.3.

K.6.3.2 The testing of material shall be in accordance with the sub-section Fibre Reinforced Plastics and the laminates mechanical properties shall meet the requirements set out in the same sub-section.

## K.7 Repairs on hull where samples are removed

K.7.1 Samples may be removed from a vessel hull as required in C.5.3, information shall be submitted to AUSCLASS in relation to the repair of the vessel, all repairs shall be undertaken to the satisfactory of a surveyor.

## K.8 Inspections

K.8.1 Where a vessel is not constructed under the survey of AUSCLASS or another Classification Society, the vessel shall require inspections to be carried out during the first five years of survey. These inspections shall take place as follows:

- Out of water after 3 months
- In the water after 6 months
- Out of water after 12 months
- And thereafter at intervals specified by AUSCLASS.

## K.9 Vessels failing to meet survey requirements

K.9.1 A vessel that fails to meet survey requirements of AUSCLASS regarding the hull moulding shall prevent the vessel being considered for commercial service by AUSCLASS and other Authorities. Where a vessel fails survey, the relevant information shall be forwarded to the Governing State.

DRAFT