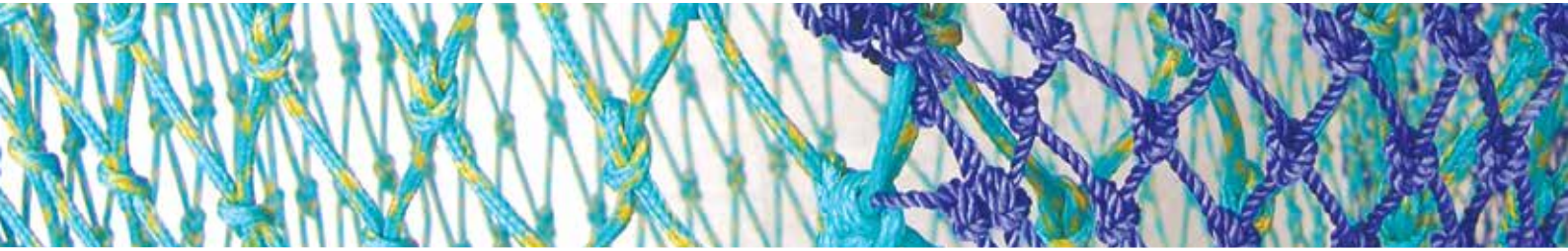

Turtle excluder devices

Technical information guide for commercial fishers and net makers

Australian Government
Fisheries Research and Development Corporation

Queensland Government

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Contents

About this guide

Fisheries Queensland, part of the Department of Agriculture, Fisheries and Forestry, has developed this guide to provide technical information on turtle excluder devices (TEDs).

TEDs allow for the effective escape of turtles and other large non-target species (including sea sponges, sharks and large rays) that interact with trawl gear.

This guide has been developed to ensure TEDs are made to a consistent standard—for fitting to trawl nets used throughout the Queensland east coast trawl fishery.

The guide and the standardised design specifications contained within it will help both net makers (to construct TEDs) and fishers (to fit and use TEDs). This will ensure TEDs effectively reduce bycatch (non-target species) while also retaining catches of target and permitted species.

Introduction

The appropriate use of recognised TEDs has significantly improved the escape of bycatch from codends of trawl nets. The benefits of using TEDs are improved product quality through reduced levels of soft and broken prawns, reduced handling (sorting) of bycatch and increased water flow through commercial trawl nets, which can lead to less drag and improved fuel economy.

Legislation requirements

A recognised TED and a recognised bycatch reduction device (BRD) are mandatory in all otter trawl nets of vessels fishing in the Queensland east coast trawl fishery.

BRDs are also required in all beam trawl nets of vessels fishing in the Queensland east coast trawl fishery.

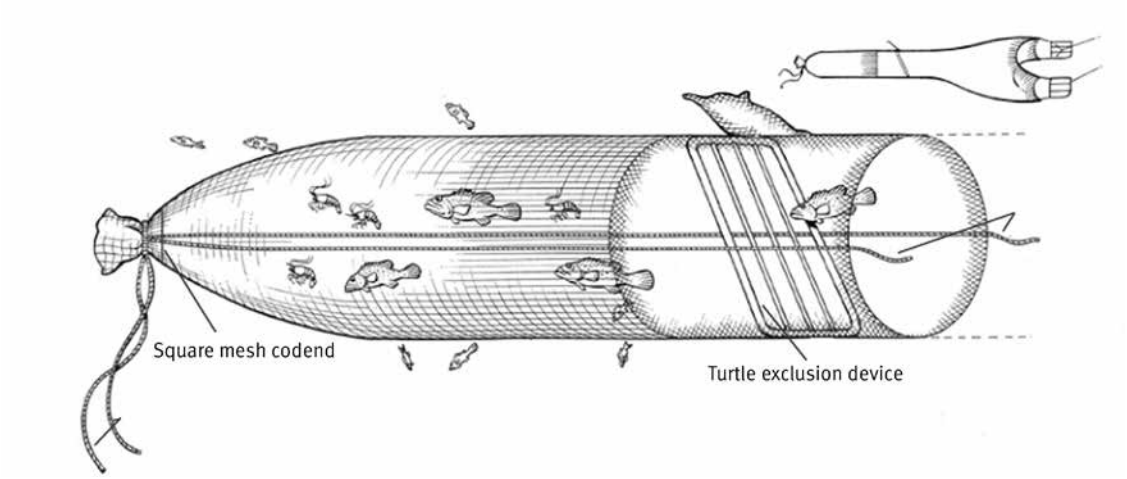


Figure 1. Artist's impression of a TED and a square mesh codend configuration within a net

TED specifications

Grids

TED grids can be any shape but must have the following specifications:

- at least 81 cm wide and at least 81 cm high
- vertical bars extending from the top to the bottom of the grid
- vertical bars no more than 12 cm apart (inside measurement)
- constructed of rigid material
- constructed as a single solid unit with no hinged or collapsible parts
- attached to the entire circumference of the net (preferably with rope or twine)
- installed and maintained at a 30–55° angle in the net.

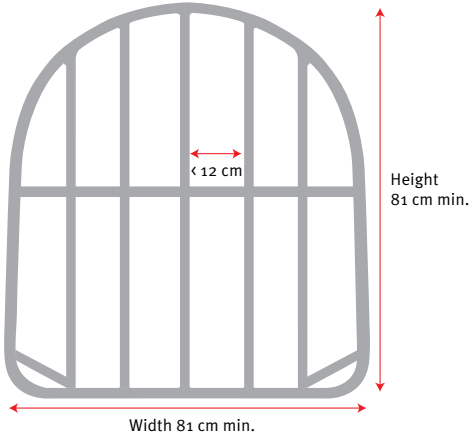


Figure 2. Minimum external TED grid dimensions and maximum bar spacing dimension

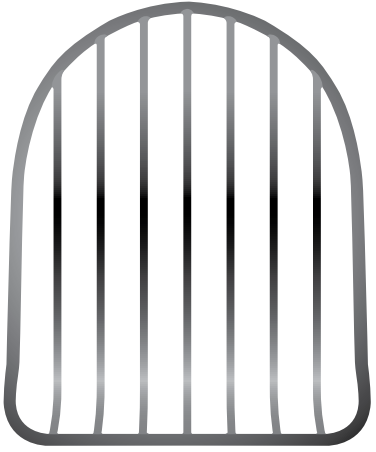


Figure 3. A typical stainless steel TED

Grid angle

The angle at which the TED is installed is crucial for directing large bycatch species to the escape opening. Too steep and animals will jam on the grid; too acute and the nets will collapse and close up (resulting in product loss). The more acute the grid angle the larger the grid needs to be to maintain net height. Figure 4b shows the minimum and maximum grid angles required.

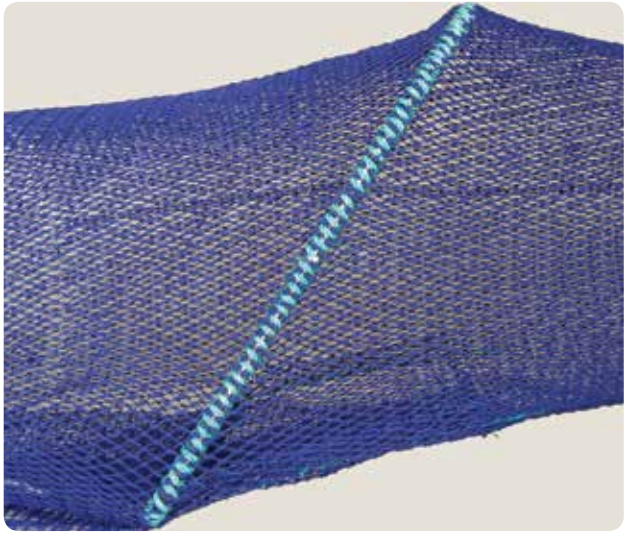


Figure 4a. Acceptable TED installation angle

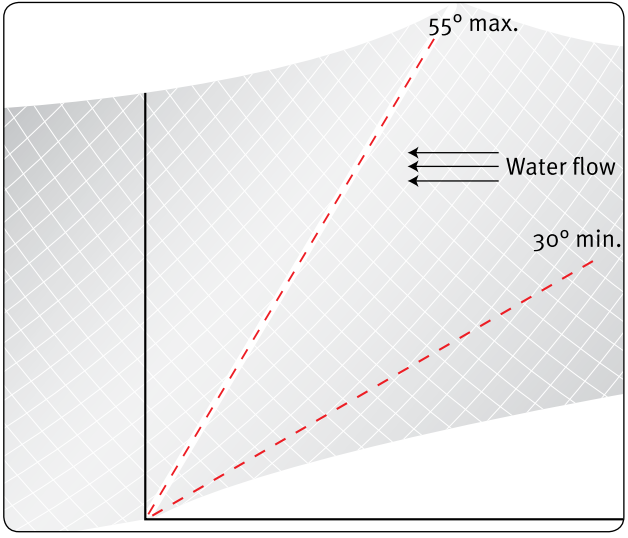


Figure 4b. The TED must be installed in the net at an angle between 30° and 55° from the normal horizontal flow through the net

TED angle formula

To work out the angle of a TED installed in a net, you will need to count the number of meshes difference between the top of the grid and the bottom. Count along a row of meshes from the top of the grid to a point half way around the circumference of the net. The mesh count is the number of meshes between this point and the attachment point of the bottom of the grid (see Figure 5).

Mesh counts provide a guide for the grid's angle of installation and vary according to grid height and mesh size.

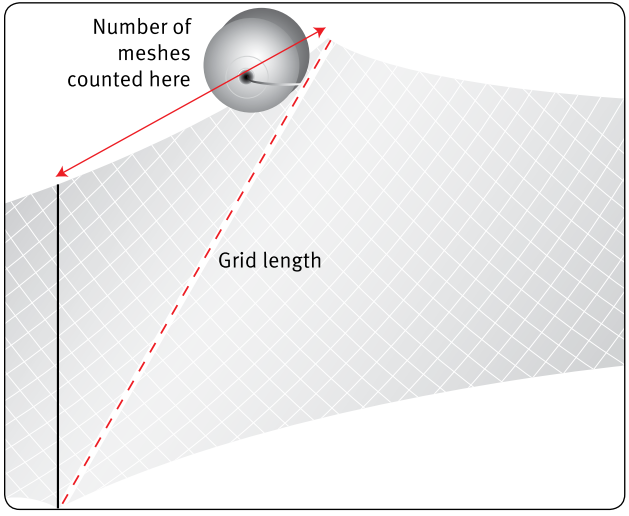


Figure 5. Where to count meshes on a bottom-shooting TED to determine grid angle

$$\text{No. of meshes} = \frac{\text{Grid length} \times \text{Cos angle } (\theta)}{\text{Mesh size}}$$

For example, if a grid measuring 810 mm was inserted at 55° into a codend with a mesh size of 38 mm, the number of meshes required would be:

$$\text{No. of meshes} = \frac{810 \text{ mm} \times \text{Cos } 55}{38 \text{ mm}} = \frac{810 \text{ mm} \times 0.573}{38 \text{ mm}}$$

$$= 12 \text{ meshes}$$

Table 1. Number of meshes required for a 30° and 55° angle TED **(grid size = 810 mm)** layover

		30° angle	55° angle
Mesh size – centre of knot to centre of knot (millimetres)	Mesh size (inches)	(0.866)	(0.574)
28	1.1	25	17
32	1.25	22	15
36	1.4	19	13
38	1.5	18	12
43	1.7	16	11
44	1.75	16	11
48	1.875	15	10
51	2	14	9
57	2.25	12	8
60	2.36	12	8
64	2.5	11	7
75	2.95	9	6
76	3	9	6
89	3.5	8	5
102	4	7	5
		Max. meshes (more = too flat)	Min. meshes (less = too upright)

See Appendix for mesh counts for other grid sizes.

Single flap nets

Escape openings

There are three recognised openings for a single flap net:

1. Rectangle configuration

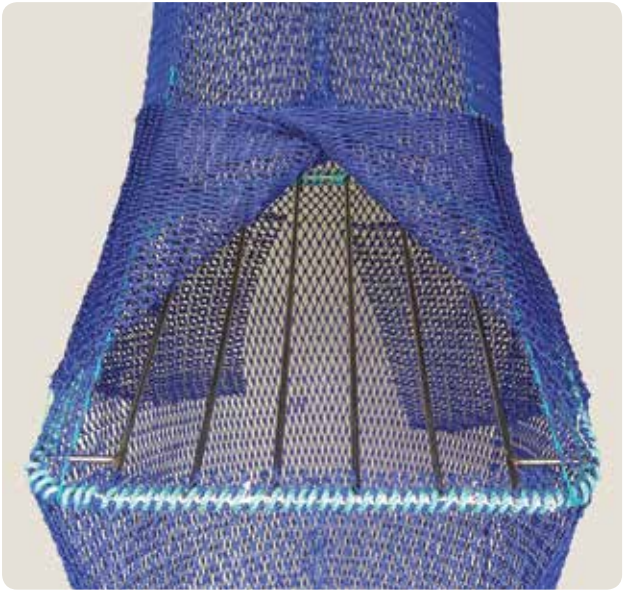


Figure 6a. Single flap, rectangular escape hole opening

Note: Single flap rectangular opening dimensions differ from the double flap rectangular opening dimensions.

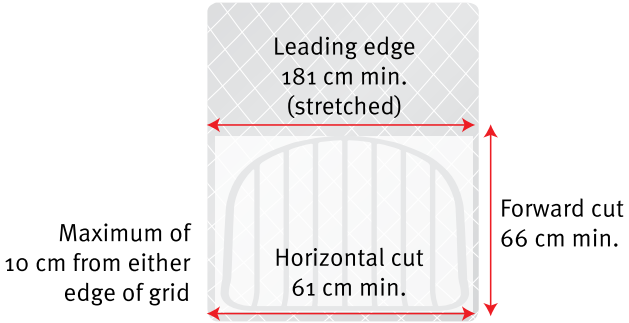


Figure 6b. Minimum requirements for a single flap, rectangular escape hole opening

2. Triangle configuration

- Single and double flap triangle escape opening configurations are identical.

Figure 7a. Single flap, triangle escape hole opening. The TED is attached to the circumference of the net with heavy twine

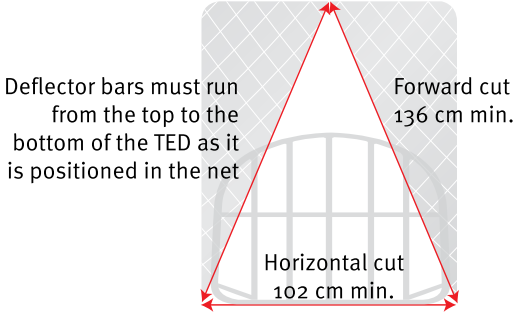


Figure 7b. Minimum requirements for a single flap, triangle escape hole opening

3. Combination configuration

- A horizontal cut immediately forward of the grid that is not narrower than the grid—except for 10 cm at either side of the grid—and a minimum of 61 cm, with two combination forward cuts perpendicular from the grid of not less than 51 cm along all points and not less than 50 cm made as an all bar taper—and a resulting leading edge cut of not less than 40 cm stretched—and a stretched measurement of not less than 181 cm when measured between the forward ends of the all point cut at least 51 cm forward of the grid.

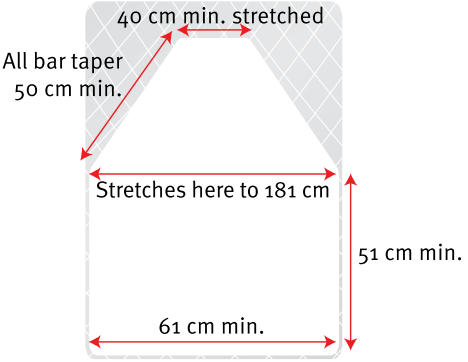


Figure 8. Minimum requirements for a single flap, combination escape hole opening

Single flap

Single flap specifications:

- Must be on the outside of the trawl.
- Must have a maximum mesh size of 50 mm.
- Must be a panel not less than 338 cm x 132 cm, with the 338 cm edge attached to the forward edge of the opening.
- Must not overlap the escape hole cut by more than 13 cm on either side.
- May be sewn down the outside edges no more than 15 cm past the posterior edge of the grid.
- Trailing edge of each panel must not extend more than 61 cm behind the posterior edge of the grid.

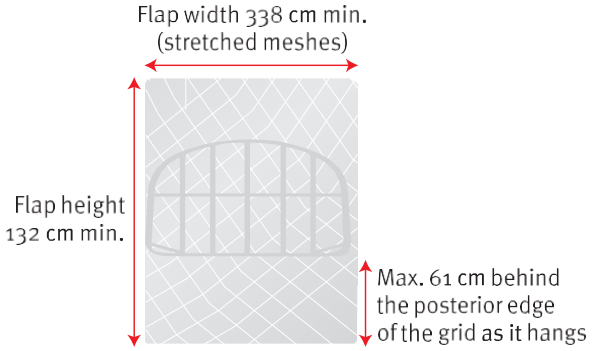


Figure 9a. Minimum flap measurements for a single flap

Figure 9b. Single flap

As a guide, the stretched width of the flaps can be measured by counting meshes. That is, flap size (cm)/ mesh size (cm) = no. of meshes.

338 cm/5 cm = 67 meshes

67 meshes is therefore the minimum number of meshes required in 50 mm mesh to achieve a 338 cm wide (stretched) flap.

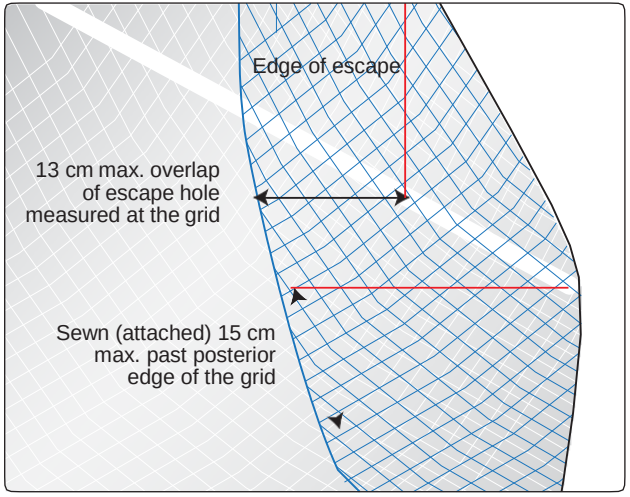


Figure 10a. Maximum flap attachments for a single flap

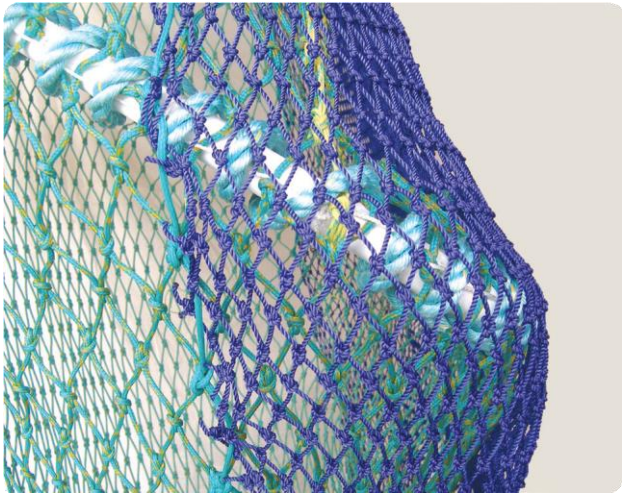


Figure 10b. Single flap

Double flap nets

Escape openings

There are three recognised opening options for a double flap net:

1. Rectangle configuration

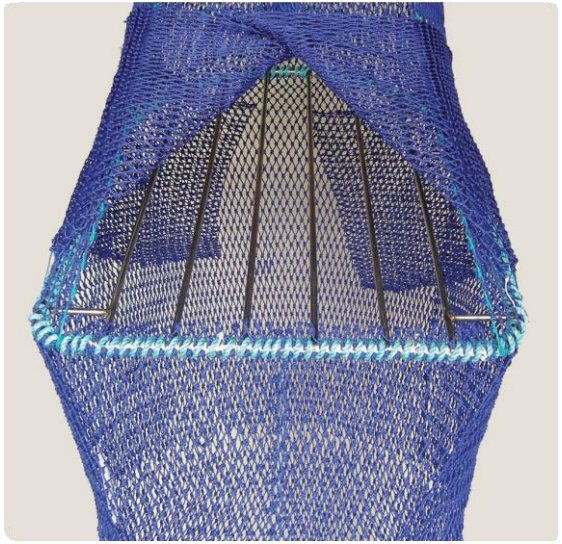


Figure 11a. Rectangular escape opening with double flaps

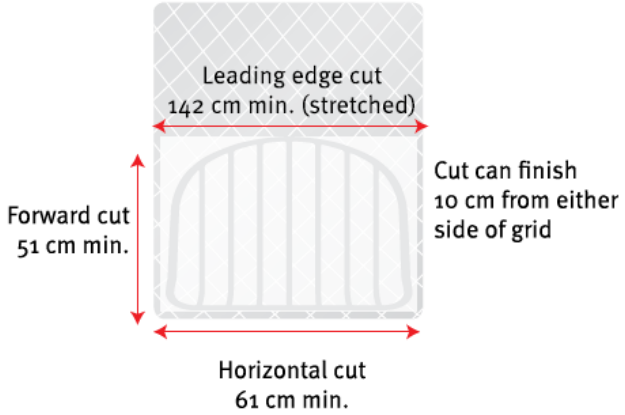


Figure 11b. Measurements for rectangular escape opening with double flaps

2. Triangle configuration
   - Triangle escape openings are identical for single and double flap nets (as shown in Figure 6a).

3. Combination configuration
   - Double flap combination escape openings are similar to single flap openings except they require a stretched measurement of only 142 cm at a position of 51 cm forward of the grid.

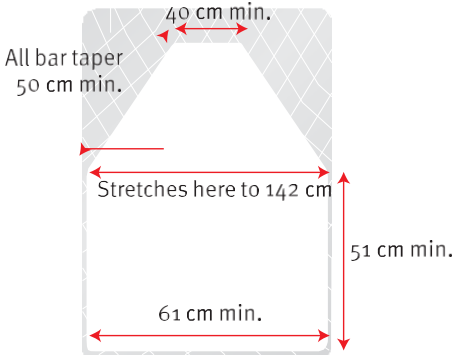


Figure 12. Minimum requirements for a double flap, combination escape hole opening

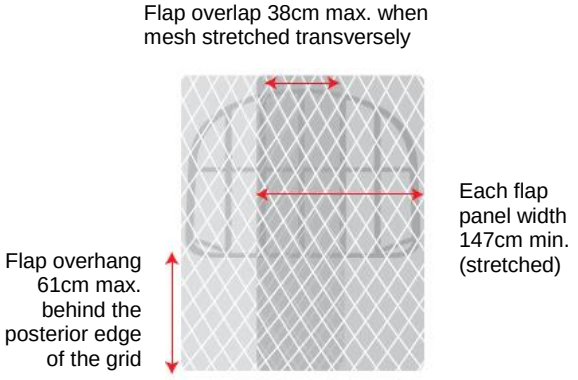


Figure 13a. Measurements for double flap configuration

Double flap

Double flap specifications:

- Must be on the outside of the trawl.
- Must have a maximum mesh size of 50 mm.
- Must have two equal size rectangular panels, each a minimum 147 cm wide.
- Panels may overlap no more than 38 cm when stretched.
- Panels may be sewn together only along the leading edge of the cut.
- Panels may be sewn down the entire length of the outside edge of each panel.
- Trailing edge of each panel must not extend more than 61cm behind the posterior edge of the grid.

Figure 13b. Double flap configuration

Helpful flaps hints

- Larger flap width with smaller mesh size helps to close the flap and retain target species—a result of having more knots for water to flow over. Ideally, flaps should be 1.5–2 times the minimum width. The 38 cm overlap can have as many meshes as required (as it is a physical distance of overlap and isn't restricted by the number of meshes).

- Knot orientation of the escape flaps is important, ensuring a 'snug' fit and reduced product loss. The knots should be oriented so the water pressure forces the escape flaps to sit tightly over the escape opening.
- 'Chunky' knots may result in better flap performance.
- Flaps may be tapered to increase the effective overlap at the grid.

Floatation

Floats **must** be attached to the top half of all grids with bottom escape openings.

- Floats may be attached inside or outside the net but not to the flap.
- Floats attached inside the net must be behind the grid (see Figure 16).
- The floatation requirements must be satisfied by compliance with either the dimension requirements of paragraph (i) or the buoyancy requirements of paragraph (ii) below.

Float dimension requirements

a) For TEDs with a circumference less than or equal to 305 cm, at least:

(i) one ethylene vinyl acetate (EVA) or polyvinyl chloride (PVC) float 17.2 cm in diameter × 2.2 cm in length or two EVA or PVC floats 14.7 cm in diameter × 18 cm in length.

(ii) one hard plastic float 25 cm (10") in diameter or two hard plastic floats 20 cm (8") in diameter or three hard plastic floats 15 cm (6") in diameter.

b) For TEDs with a circumference greater than 305 cm, at least:

(i) two EVA or PVC floats 17.2 cm in diameter x 22.2 cm in length or four EVA or PVC floats 14.7 cm in diameter x 18 cm in length.

(ii) one hard plastic float 25 cm (10") in diameter or two hard plastic floats 20 cm (8") in diameter or three hard plastic floats 15 cm (6") in diameter.

Figure 14. Examples of PVC/EVA floats (left) and hard plastic floats (right)

Buoyancy requirements

a) Where the buoyancy requirement of the TED is satisfied without the need for additional floatation (i.e. plastic grids), the name of the manufacturer of the TED and density of the material used must be clearly and permanently marked on the TED. The marking must identify the density of the TED material to be less than or equal to seawater (<1.025 g/cm^3). Where the density of the material is less than that of seawater, no floats are required.

b) Where floats are required to meet buoyancy requirements, they may be used in any combination of size and buoyancy such that the combined buoyancy of the floats equals or exceeds the weight of the TED.

(i) Floats must be marked in legible raised or recessed lettering that specifies the buoyancy of the float in water (expressed in grams or kilograms).

(ii) TEDs must be marked in legible raised or recessed lettering that specifies the weight of the TED in air (expressed in grams or kilograms).

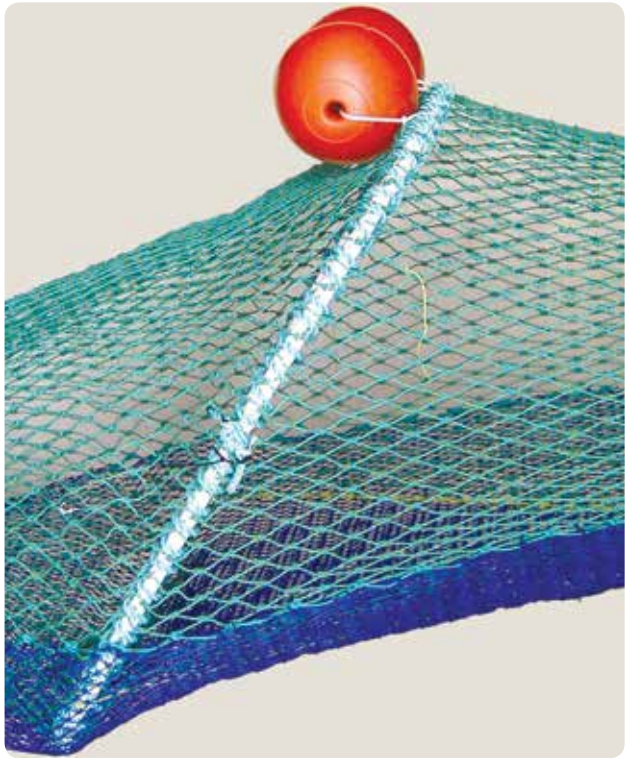


Figure 15. Required attachment and positioning of floats on TEDs. Floats may be attached inside or outside the net but not to the flap

Figure 16. Floats attached inside the net must be behind the grid

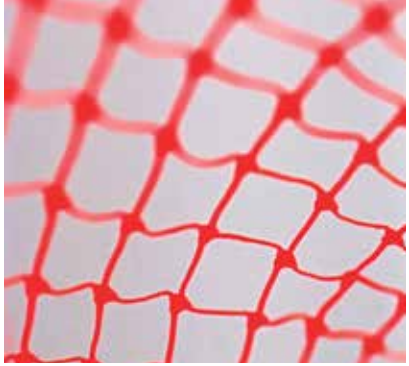
TED maintenance schedule

Table 2. Schedules required to maintain TEDs during the fishing season

Component	Inspection details	Inspection frequency	Suggested action
Grid bars	Bent or damaged bars, bar spacing	Daily	Straighten if possible or replace
Grid angle	Loss of angle	In the first week, daily for new grid then weekly	Reattach grid to codend at correct angle
Grid bindings	Check for abrasion, frayed rope strands and loose bindings	Weekly	Replace or retighten if necessary
Escape opening	Damaged meshes adjacent the opening; mesh slippage around frame of grid	Daily	Repair or reattach adjacent meshes to grid frame
Escape flap	Stretched or worn meshes and attachment to codend	Daily	Replace or reattach to codend
Floats	Check strong attachment to grid or codend	Weekly	Reattach to grid and codend

Optimising TED performance

- Where possible, stretch the meshes around the grid so they remain open during trawling; this has the potential to reduce bycatch and, in the event of a blockage, may prevent water exiting through the escape hole opening. This design may be effective in scallop and deepwater prawn fisheries. To stretch meshes, place the grid in a section of net with a reduced circumference.
- A smaller bar spacing will exclude more bycatch species.
- Bent-bar grids can improve the speed of large animal exclusion and, consequently, reduce product loss.
- Grid orientation can be altered to exclude particular non-targeted groups. For example, downward-excluding grids are most suitable for excluding heavy, negatively buoyant items (such as large sponges or rocks).
- Wrong grid angle can cause prawn and scallop loss or poor bycatch reduction. The relationship between grid angle and size ensures efficient operation. Grid angle should be 30–55°.
- Larger escape openings improve the exclusion speed of large animals and reduce prawn and scallop loss.
- Maintaining the flap material is critical to ensure the flaps close over the escape hole opening effectively.



Further information

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Appendix

Table A. Minimum mesh counts required to meet 55° TED angle. The matrix accounts for variations in grid height and mesh size (centre to centre) and allows the user to calculate the minimum number of meshes required to meet grid angle specifications

Mesh Size (inches)	1 1/2		1 3/4	1 7/8	2	2 1/4		2 1/2	3	3 1/2	4
Mesh Size (mm) (centre of knot)	38	43	44	48	51	57	60	64	76	89	102
TED Height (mm) 810	12	11	11	10	9	8	8	7	6	5	5
820	12	11	11	10	9	8	8	7	6	5	5
830	13	11	11	10	9	8	8	7	6	5	5
840	13	11	11	10	9	8	8	8	6	5	5
850	13	11	11	10	10	9	8	8	6	5	5
860	13	11	11	10	10	9	8	8	6	6	5
870	13	12	11	10	10	9	8	8	7	6	5
880	13	12	11	11	10	9	8	8	7	6	5
890	13	12	12	11	10	9	8	8	7	6	5
900	14	12	12	11	10	9	9	8	7	6	5
910	14	12	12	11	10	9	9	8	7	6	5
920	14	12	12	11	10	9	9	8	7	6	5
930	14	12	12	11	10	9	9	8	7	6	5

Mesh Size (inches)	1 1/2		1 3/4	1 7/8	2	2 1/4		2 1/2	3	3 1/2	4
Mesh Size (mm) (centre of knot)	38	43	44	48	51	57	60	64	76	89	102
940	14	13	12	11	11	9	9	8	7	6	5
950	14	13	12	11	11	10	9	9	7	6	5
960	14	13	13	11	11	10	9	9	7	6	5
970	15	13	13	12	11	10	9	9	7	6	5
980	15	13	13	12	11	10	9	9	7	6	6
990	15	13	13	12	11	10	9	9	7	6	6
1000	15	13	13	12	11	10	10	9	8	6	6
1010	15	13	13	12	11	10	10	9	8	7	6
1020	15	14	13	12	11	10	10	9	8	7	6
1030	16	14	13	12	12	10	10	9	8	7	6
1040	16	14	14	12	12	10	10	9	8	7	6
1050	16	14	14	13	12	11	10	9	8	7	6
1060	16	14	14	13	12	11	10	9	8	7	6
1070	16	14	14	13	12	11	10	10	8	7	6
1080	16	14	14	13	12	11	10	10	8	7	6
1090	16	15	14	13	12	11	10	10	8	7	6
1100	17	15	14	13	12	11	11	10	8	7	6
1110	17	15	14	13	12	11	11	10	8	7	6
1120	17	15	15	13	13	11	11	10	8	7	6

Mesh Size (inches)	1 1/2		1 3/4	1 7/8	2	2 1/4		2 1/2	3	3 1/2	4
Mesh Size (mm) (centre of knot)	38	43	44	48	51	57	60	64	76	89	102
1130	17	15	15	13	13	11	11	10	9	7	6
1140	17	15	15	14	13	11	11	10	9	7	6
1150	17	15	15	14	13	12	11	10	9	7	6
1160	17	15	15	14	13	12	11	10	9	7	7
1170	18	16	15	14	13	12	11	10	9	8	7
1180	18	16	15	14	13	12	11	11	9	8	7
1190	18	16	15	14	13	12	11	11	9	8	7
1200	18	16	16	14	13	12	11	11	9	8	7

Table B. Mesh counts required to meet minimum flap width dimensions for single and double flaps

Flap type	Minimum stretched width (each flap)	Max mesh size (centre to centre)	Minimum number of meshes required in 50 mm mesh
Single flap	338 cm	50 mm	66
Double flaps	147 cm	50 mm	28

Table C. Mesh counts to be used as a guide for determining the minimum width of leading edge cuts for various mesh sizes for single and double flap configurations (the leading edge cannot be selvedged)

		Mesh size (mm) – centre of knot to centre of knot										
Flap configuration	Minimum leading edge width (stretched)	38	43	44	48	51	57	60	64	76	89	102
Single	181 cm	47	42	41	37	35	31	30	28	23	20	17
Double	142 cm	37	33	32	29	27	24	23	22	18	15	13