To obtain alignment within ·003 in. and to obtain a total thickness of shims between ·003 in. and $\frac{1}{16}$ in. with steps not greater than ·003 in., it is necessary to have available shims of the following thickness and quantity for each individual foot on the Engine Reverse Gear Unit.

4 off shims ·003 in. thick
3 ,, ,, ·007 in. ,,
2 ,, ,, ·032 in. ,,

With these shims it is possible to obtain a total thickness as per the table below.

Total Thickness of Shims	QUANTITY OF SHIMS TO BE USED			Total Thickness of Shims	QUANTITY OF SHIMS TO BE USED		
	·003″	·007″	·032″		·003″	·007″	·032″
·003″	1	–	–	·035″	1	–	1
·006″	2	–	–	·038″	2	–	1
·007″	–	1	–	·039″	–	1	1
·009″	3	–	–	·041″	3	–	1
·010″	1	1	–	·042″	1	1	1
·012″	4	–	–	·044″	4	–	1
·013″	2	1	–	·045″	2	1	1
·014″	–	2	–	·046″	–	2	1
·016″	3	1	–	·048″	3	1	1
·017″	1	2	–	·049″	1	2	1
·019″	4	1	–	·051″	4	1	1
·020″	2	2	–	·052″	2	2	1
·021″	–	3	–	·053″	–	3	1
·023″	3	2	–	·055″	3	2	1
·024″	1	3	–	·056″	1	3	1
·026″	4	2	–	·058″	4	2	1
·027″	2	3	–	·059″	2	3	1
·030″	3	3	–	·062″	3	3	1
·032″	–	–	1	·064″	–	–	2
·033″	4	3	–				

Location of Shims	Dimensions of Shim	Drawing No.	Number of Supporting Feet	Total number of Shims to be supplied per each Engine Reverse Gear Unit				
				2LW	3LW	4LW	5LW	6LW
Eng. Side Supporting Feet	4″ × 2⅛″ × ·003″	J7253	2	–	–	8	8	8
	4″ × 2⅛″ × ·007″	J7254		–	–	6	6	6
	4″ × 2⅛″ × ·032″	J7255		–	–	4	4	4
	3¼″ × 2¼″ × ·003″	J7259	2	8	8	–	–	–
	3¼″ × 2¼″ × ·007″	J7260		6	6	–	–	–
	3¼″ × 2¼″ × ·032″	J7261		4	4	–	–	–
Reversing Gear Supporting Feet	5⅞″ × 2″ × ·003″	J7256	2	8	8	8	8	8
	5⅞″ × 2″ × ·007″	J7257		6	6	6	6	6
	5⅞″ × 2″ × ·032″	J7258		4	4	4	4	4

It is of prime importance that the engine and reverse gear or the engine with reverse and reduction gears be carefully and accurately aligned with the propeller shafting when initially installed. This alignment should also be very fully checked periodically and corrected as necessary by the fitting of suitable thickness

packings (i.e. shims as above mentioned) between the engine unit and engine bearers. Serious damage can occur in the reverse gear or reduction gear if correct alignment is not maintained and to facilitate adjustment of alignment all supporting feet on 2LW to 6LW marine engines are tapped to receive $\frac{7}{16}$" B.S.F. jacking screws.

Alignment of the shafting is made in the usual manner by splitting the engine half-coupling from the shafting half-coupling and testing by feeler gauge to ensure that both faces meet solidly and spigot diameters enter freely when drawn together by hand, also that no gap is evident by testing with feeler gauge irrespective of position of shafting couplings, when rotated separately to any position through one or more complete turns.

When adjusting the shim packings beneath the engine and reverse gear supporting feet it is most important that all feet are carrying their proper proportion of the total weight. When checking the shaft alignment the craft should, of course, be afloat and on an even keel.

3. **Sterngear: Shaft and Propeller Sizes.**—To conform to Lloyd's Rules (1953), intermediate and tail shaft diameters are to be not less than the dimensions quoted in the following table. The sizes quoted are for shafts not fitted with continuous liners and made from ordinary mild steel, having an ultimate tensile strength of 28 to 32 tons per sq. in.

STEEL SHAFT SIZES TO CONFORM TO LLOYD'S RULES (1953)

Engine	B.H.P.	DIRECT DRIVE			2:1 REDUCING GEAR			3:1 REDUCING GEAR		
		R.P.M.	Intermediate Shaft	Tail Shaft	R.P.M.	Intermediate Shaft	Tail Shaft	R.P.M.	Intermediate Shaft	Tail Shaft
2LW	28	1,300	1·121″	1·354″	663	1·404″	1·715″	439	1·610″	1·985″
3LW	42	1,300	1·283″	1·548″	663	1·606″	1·955″	439	1·843″	2·280″
4LW	56	1,300	1·413″	1·705″	663	1·768″	2·155″	439	2·029″	2·500″
5LW	70	1,300	1·495″	1·810″	663	1·872″	2·290″	439	2·147″	2·675″
6LW	84	1,300	1·566″	1·892″	663	1·959″	2·383″	439	2·248″	2·780″
2LW	31	1,500	1·106″	1·331″	756	1·353″	1·651″	507	1·588″	1·958″
3LW	47	1,500	1·271″	1·524″	756	1·590″	1·939″	507	1·824″	2·247″
4LW	62	1,500	1·393″	1·672″	756	1·744″	2·120″	507	2·000″	2·460″
5LW	78	1,500	1·478″	1·770″	756	1·855″	2·252″	507	2·121″	2·617″
6LW	94	1,500	1·549″	1·856″	756	1·939″	2·355″	507	2·224″	2·750″
4LW	71	1,700	1·398″	1·668″	866	1·711″	2·077″	574	2·006″	2·460″
5LW	89	1,700	1·481″	1·768″	866	1·855″	2·248″	574	2·126″	2·610″
6LW	107	1,700	1·552″	1·852″	866	1·943″	2·350″	574	2·227″	2·740″

Intermediate shafts having lengths in excess of 6 ft. should be supported by a plummer block. The plummer block should be positioned not less than 4 ft. from the reducing or reversing gear intermediate shaft half-coupling.

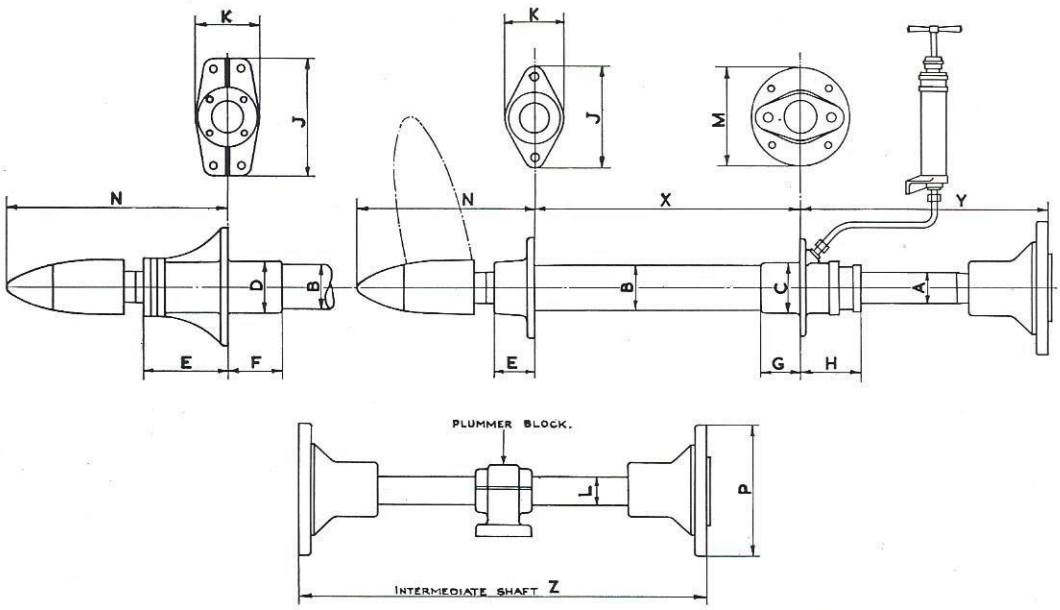
Reduction gears referred to as 2:1 and 3:1 are actually 1·962:1 and 2·960:1, respectively.

GARDNER

LW

MARINE DIESEL ENGINES

The following are the approximate dimensions of bronze Sterngear with white metal bearings for wooden vessels. Confirmation and precise dimensions must be obtained from the Works before installation.



STERNGEAR SIZES

ENGINE	DESCRIPTION	A Tail Shaft	B	C	D	E	F	G	H	J	K	L	M	N	P
2LW	DIRECT DRIVE	1½″ Dia.	2⅛″	2½″	—	2¼″	—	2¼″	3″	5⅛″	3″	1¼″	4½″	9″	6½″
	2:1 RED. GEAR	1¾″ ,,	2½″	2¾″	—	2½″	—	2⅝″	3⅜″	5⅞″	3¼″	1½″	5″	9⅞″	8½″
	3:1 ,, ,,	2⅛″ ,,	3″	3⅜″	3⅜″	6″	4⅜″	3⅞″	4⅛″	7⅝″	4¼″	1¾″	7⅛″	16″	8½″
3LW	DIRECT DRIVE	1⅝″ Dia.	2⅜″	2¾″	—	2½″	—	2⅝″	3″	5¼″	3⅛″	1⅜″	5″	9½″	6½″
	2:1 RED. GEAR	2″ ,,	2¾″	3¼″	3¼″	5¾″	4¼″	3⅛″	3⅞″	7⅝″	5″	1⅝″	6¼″	14½″	8½″
	3:1 ,, ,,	2⅜″ ,,	3⅜″	3⅞″	3⅞″	5½″	6¼″	4″	4″	7″	4⅞″	2″	7⅜″	15¼″	8½″
4LW	DIRECT DRIVE	1¾″ Dia.	2½″	2¾″	—	2½″	—	2⅝″	3⅜″	5⅞″	3¼″	1½″	5″	9⅞″	6½″
	2:1 RED. GEAR	2¼″ ,,	3″	3½″	3½″	5½″	5½″	3¾″	4⅛″	7½″	4⅞″	1¾″	7″	14½″	8½″
	3:1 ,, ,,	2⅝″ ,,	3½″	4″	4″	6½″	6⅜″	5¼″	5″	9″	5″	2¼″	7¾″	17¼″	8½″
5LW	DIRECT DRIVE	1⅞″ Dia.	2⅝″	3″	—	2⅝″	—	2⅜″	3⅞″	6¼″	3½″	1⅝″	6¼″	10⅞″	6½″
	2:1 RED. GEAR	2⅜″ ,,	3⅜″	3⅞″	3⅞″	5½″	6¼″	4″	4″	7″	4⅞″	1⅞″	7⅜″	15¼″	8½″
	3:1 ,, ,,	2¾″ ,,	3½″	3⅞″	3⅞″	6½″	6⅞″	5¼″	5″	8⅞″	5″	2⅜″	7¾″	17½″	8½″
6LW	DIRECT DRIVE	2″ Dia.	2¾″	3¼″	3¼″	5¾″	4½″	3⅛″	3⅞″	7⅝″	5″	1¾″	6½″	14½″	6½″
	2:1 RED. GEAR	2½″ ,,	3⅜″	3¾″	3¾″	6¼″	6″	4⅜″	4⅛″	8½″	5″	2″	7⅞″	16½″	8½″
	3:1 ,, ,,	2⅞″ ,,	3¾″	4¼″	4¼″	7″	7″	5¼″	4⅝″	8″	5½″	2½″	8½″	18¾″	8½″

PROPELLER SIZES

ENGINE	ENGINE SPEED r.p.m.	3 BLADE PROP. DIAM. (in.)		
		Direct	2 : 1	3 : 1
2LW	1300	17·5	24	29·5
	1500	17	23	29
	—	—	—	—
3LW	1300	20	27	34
	1500	19	27	33
	—	—	—	—
4LW	1300	22	30	37
	1500	21	29	36
	1700	20	28	35
5LW	1300	24	32	40
	1500	22	31	39
	1700	21	30	38
6LW	1300	25	33	42
	1500	23	32	41
	1700	22	31	40

Dimensions X and Y must be supplied by clients when ordering sterngear, also dimension Z if intermediate shaft is required. Propeller sizes are approximate and may vary according to the lines of the vessel. Four blade propellers can be supplied but are not recommended for shaft speeds above 700/800 r.p.m. Direct Drive Engines require L.H. propellers, engines with Reducing Gears require R.H. propellers.

4. **Ventilation of Engine Room—Marine Installations.**—In many boats it has been observed that the engine-room ventilation is inadequate. It is of importance that provision be made to permit hot air to pass out and cool air to pass into the engine-room thus assisting in general cooling and ventilation; also allowing the required quantity of air to enter the engine compartments.
Inlet and outlet cowls and trunks creating natural draft accomplish this in some vessels. In others, electrically-driven extractor fans will change the engine-room air some 30 to 35 times per hour.
In fishing vessels and similar craft some degree of ventilation can be provided by a simple and inexpensive arrangement of placing the silencer inside a funnel which can be fitted either inside or outside the deck-house. In addition to the engine exhaust gases creating a suction effect within the funnel and thus extracting hot air from the engine room, the convection currents around the silencer assist in reducing the engine-room temperature. These arrangements are shown on litho drawings Nos. 4394F and 4396F on pages 31 and 32.
Installation drawings are also available upon request from the Works, and we shall be pleased to give any further advice that may be required in this connection. It must be remembered that adequate engine-room ventilation is also vital for the well-being of the hull.

5. **Closed Circuit Fresh Water Cooling Systems.**—In order that corrosion scale and silt formation, etc., within the cooling system of marine propelling and marine auxiliary type engines shall be held to a minimum, it has long been our established practice to recommend a closed circuit fresh water system in preference to the circulation and discharge overboard of sea water.
Such a system may comprise:—
    1. A heat exchanger system with engine-driven sea water pump.
    2. A keel cooler system.
    3. An air-cooled radiator with engine-driven fan.

6. **Heat Exchanger Systems.**—An inboard mounted heat exchanger system with engine-driven sea water circulating pump, strainer, valves, etc., have been widely used and represents sound practice. In addition, it remains the only reasonably practicable closed circuit fresh water system for the cooling of engines in marine craft which have to operate at full power with the vessel at rest, except for an air cooled radiator system which is advantageous for certain applications only.
Diagrammatic arrangement drawings of fresh water cooling systems comprising Heat Exchanger, engine-driven Centrifugal Sea Water Pump and engine-mounted Fresh Water Header Tank, etc., for LW marine engines are shown on pages 24 and 25. These drawings show arrangements for engines having a dry exhaust system, and for engine installations with a quenched (water cooled) exhaust system.

7. **Keel Cooler Systems.**—On page 26 will be found diagrammatic arrangement drawings of the closed circuit fresh water cooling system employing a Keel Cooler. It consists of a series of pipes of selected length and diameter mounted externally and running fore and aft on the hull of the vessel through which is passed the engine (fresh) cooling water by means of the inbuilt engine circulating pump.
Accordingly there has been established a range of complete Gardner keel cooling equipment matching the complete range of Gardner marine propulsion engine units for temperate and tropical conditions possessing the following advantages:—
    1. The provision of a fresh water system at minimum expense, of minimum weight, minimum bulk and maximum simplicity.
    2. The provision of a system free from silting and corrosion.
    3. The provision of a system of maximum reliability independent of sea water circulation by separate pump and strainer equipment, etc.

The pipes, respective skin fittings and support bracket, which are of suitable material in order to avoid so far as be possible electrolytic or corrosive action, may be protected from grounding, etc., by hull features.
On page 27 will be seen our Drawing No. 4225F showing diagrammatically two suggested arrangements of keel cooler and pipes. The inside diameter and total length of pipe is dependent on the size of the