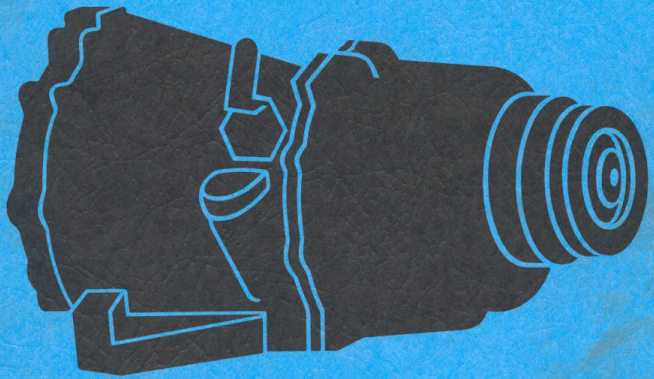
BORG WARNER

Velvet Drive Marine Transmission Reduction Gear Service Manual 1.523:1 Ratio



Warner Gear
Division of Borg-Warner Corporation

PRICE $1.50

Velvet Drive Marine Transmission Reduction Gear Service Manual 1.523:1 Ratio

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Division of Borg-Warner Corporation
P.O. Box 2688, Muncie, Indiana 47302
Telephone: 317/286-6100 Telex: 27-491

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BORG WARNER

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DESCRIPTION

The 1.52:1.00 reduction gear box operates in conjunction with any of the following models: 70, 70R, 70CR, 71, 71R, 71C, 71CR, 72, 72R, 72C and 72CR. The reduction planetary gear set reduces the revolutions by a fixed 1.52:1.00 ratio. The output shaft rotates in the same direction as the input shaft when forward is selected in all 1.52:1.00 reduction units.

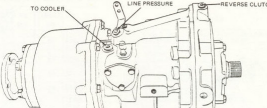


FIG. 1 DIRECT DRIVE TRANSMISSION WITH 1.52:1.00 REDUCTION UNIT

1.52:1.00 REDUCTION UNITS

NEW TRANS. ASSEMBLY NUMBER	TRANS. ASSEMBLY NUMBER	INPUT TO OUTPUT SPEED RATIO		ROTATION (1)			PUMP SETTING (2)	PROPELLER REQUIRED (3)	OIL CAPACITY (4)				APPROXIMATE TRANS. WEIGHT	
				INPUT	OUTPUT SHAFT				15° INCLINED		LEVEL			
		FORWARD	REVERSE	SHAFT	FORWARD	REVERSE			U.S. QTS.	LITERS	U.S. QTS.	LITERS	POUNDS	KILOGRAMS
	AS2-70C	1.52:1	1.52:1	CW	CW	CCW	L.H.	R.H.	2.7	2.6	2.5	2.4	142	64.4
	AS2-70CR	1.52:1	1.52:1	CCW	CCW	CW	R.H.	L.H.	2.7	2.6	2.5	2.4	142	64.4
10-17-006-005	AS2-71C	1.52:1	1.52:1	CW	CW	CCW	L.H.	R.H.	2.7	2.6	2.5	2.4	145	65.8
10-17-006-006	AS2-71CR	1.52:1	1.52:1	CCW	CCW	CW	R.H.	L.H.	2.7	2.6	2.5	2.4	145	65.8
10-18-006-003	AS12-72C	1.52:1	1.68:1	CW	CW	CCW	L.H.	R.H.	2.8	2.7	2.7	2.6	154	69.9
10-18-006-004	AS12-72CR	1.52:1	1.68:1	CCW	CCW	CW	R.H.	L.H.	2.8	2.7	2.7	2.6	154	69.9

(1) Input and output shaft rotation is described as clockwise (CW) or counter clockwise (CCW) when the observer is standing behind transmission coupling facing towards front or input shaft end of transmission.

(2) Pump rotation is described when the observer is standing in front of transmission facing the pump. The arrow located nearest the top of pump face must point in the direction pump will be driven by the input shaft. IT SHOULD BE REALIZED THAT INDEXING THE PUMP FOR OPPOSITE ROTATION DOES NOT CAUSE OUTPUT SHAFT ROTATION TO BE REVERSED, but does permit the transmission to be used behind an opposite rotating engine.

(3) The propeller is described when the observer is standing behind the boat looking forward. A right hand (R.H.) prop will move the boat forward when rotated clockwise.

(4) Transmission oil capacity only is given. Additional oil will be required for filling oil cooler and cooler lines.

10-17 & 10-18 UNITS

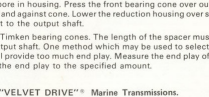
The forward and reversing portion of the reduction units of the 10-17 and 10-18 units is the same as the 71C and 72C units which they replaced. The reduction portion of the 10-17 and 10-18 units was changed to include a sleeve between the two tapered bearing components. A bearing retainer is not used and the rear oil seal is pressed into the reduction housing.

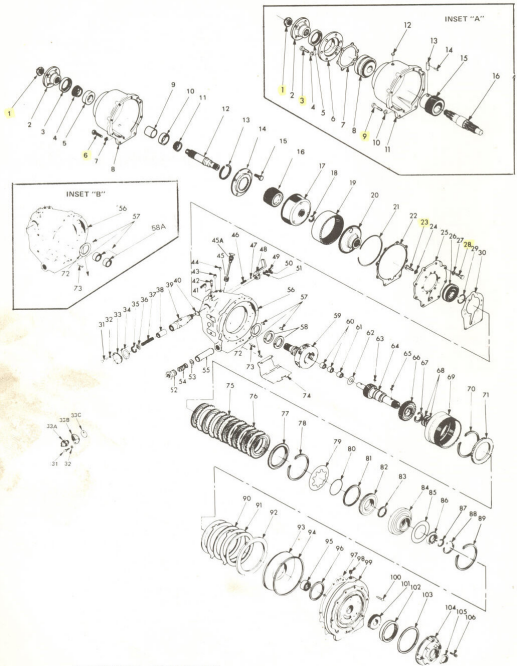
The reduction sun gear is pinned to the housing of 71C and 72C, 1.52:1 units. The snap ring holds the sun gear to an adapter plate which is bolted ot the reduction housing of 10-17 and 10-18 reduction units.

Press two bearing cups into the reduction housing. Place rear bearing cone into the rear bearing cup. Press the oil seal into the reduction housing until rear face of oil seal is flush with rear face of bore in housing. Press the front bearing cone over output shaft and against face of shaft. Assemble the bearing sleeve over shaft and against cone. Lower the reduction housing over shaft components. Grease lips of oil seal and install the coupling and nut to the output shaft.

One of the new solid bearing spacers is assembled between the two Timken bearing cones. The length of the spacer must be selected to obtain .000-.005 inch (0.00-0.13 mm) end play of the output shaft. One method which may be used to select the length of the spacer is to first install the longest solid spacer. This will provide too much end play. Measure the end play of the output shaft and then select and install a shorter spacer to reduce the end play to the specified amount.

The following are the identification marking for the Warner Gear "VELVET DRIVE"® Marine Transmissions.





10-17-000-005 — 10-17-000-006
10-18-000-003 — 10-18-000-004
1.523:1.00

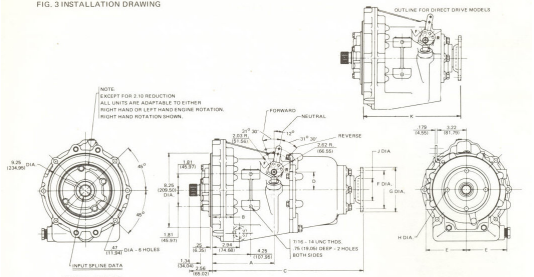
1.523:1.00 PARTS LIST

INDEX NO.	W.G. PART NO.	DESCRIPTION	NO. REQ.
1	10-00-149-024	Coupling Nut - Flanged	1
	4776G	Coupling Nut	1
2	4041AY	Coupling 5" (12.7 mm) 10 Spline (72C)	1
	4047BA	Coupling 4" (10.6 mm) 10 Spline (70C & 71C)	1
	10-000-031-001	Coupling 5" (12.7 mm) 24 Spline (10-17 & 10-18)	1
	71C-110	Oil Seal (70C, 71C & 72C)	1
4	10-00-133-002	Bearing Cone (10-17 & 10-18)	1
5	10-00-133-001	Bearing Cup (10-17 & 10-18)	1
6	0000179884	7/16-14 x 1-3/4 Hex. Head Bolt	2
7	0000133322	7/16 Lockwasher	2
8	10-17-085-001	Reduction Housing (10-17 & 10-18)	1
	LA-1A	Reduction Housing (70C, 71C & 72C) - use this housing & LA-8B to replace LA-1 housing	1
9	10-17-053-002	Solid Spacer - .820-.821" (20.83-20.85 mm)	*
	10-17-053-003	Solid spacer - .829-.830" (21.06-21.08 mm)	*
	10-17-053-004	Solid Spacer - .832-.833" (21.13-21.16 mm)	*
	10-17-053-005	Solid Spacer - .835-.836" (21.21-21.23 mm)	*
	10-17-053-006	Solid Spacer - .838-.839" (21.29-21.31 mm)	*
	10-17-053-007	Solid Spacer - .841-.842" (21.36-21.39 mm)	*
	10-17-053-008	Solid Spacer - .844-.845" (21.44-21.46 mm)	*
	10-17-053-009	Solid Spacer - .847-.848" (21.51-21.54 mm)	*
	10-17-053-010	Solid Spacer - .850-.851" (21.59-21.62 mm)	*
		*Use as required on 10-17 & 10-18 units - may be used to replace the collapsible spacer.	
10	10-00-133-009	Bearing Cup (10-17 & 10-18)	1
11	10-00-133-010	Bearing Cone (10-17 & 10-18)	1
12	10-13-111-001	Reduction Unit Mainshaft (10-17 & 10-18)	1
	LA-2	Reduction Unit Mainshaft (70C, 71C & 72C)	1
13	10-00-139-013	Snap Ring (10-17 & 10-18)	1
14	10-17-119-001	Sun Gear Hub (10-17 & 10-18)	1
15	4716B	3/16-14 x 7/8 Hex. head Lock Bolt (10-17 & 10-18)	1
16	10-17-165-001	Sun Gear (10-17 & 10-18)	1
	LA-A	Sun Gear (70C, 71C & 72C)	1
17	LA-A150	Pinion Cage Assembly	1
18	4734	Snap Ring	1
19	L3-0	Ring Gear	1
20	LA-1B	Input Gear	1
21	4786D	Snap Ring	1
22	LA-140	Front Reduction Housing Adapter Gasket	1
23	4853D	7/16-14 x 1 Lock Bolt	8
24	0000115550	7/16 Lockwasher	8
25	LA-8B	Reduction Unit Adapter Use LA-8B and LA-1A to replace LA-8 adapter on early units	1
26	8111AG	Annular Bearing	1
27	0000133321	7/16 Lockwasher	6
28	0000179840	3/8-16 x 1-7/8 Hex. Head Bolt	6
29	4766	Snap Ring	1
30	LA-145	Front Reduction Adapter Gasket	1
31	0000179793	1/4-20 x 5/8 Hex. Head Bolt (for valve cover)	2
	0000179796	1/4-20 x 7/8 Hex. Head Bolt (for neutral switch)	2
32	0000133319	1/4 Lockwasher	3
33	71-4	Valve Cover	1
33A	10-00-640-004	Neutral Switch & "O" Ring Assembly (NOTE: Items 33B and 33A must be used together when replacing early switch)	1
33B	10-16-008-001	Valve Cover	1
33C	10-16-009-001	Switch Cam	1
34	71-14	Valve Cover Gasket	1
35	4821	Snap Ring	1
36	71-246	Valve Spring Retainer	1
37	71-242	Spring (used with bushing in case)	1
38	71-243	Pressure Regulator Valve	1
39	71-244A	Forward & Reverse Shift Valve	1
40	4604X	"O" Ring	1
41	10-00-131-002	3/8 Plastic Shipping Plug	1
42	A4740Q	Breather - Current	1
	4740B	Breather - Early Units-Drive in	1
	AJ2-87	Breather - Early Units-Screw in	1
43	0000444866	3/8-18 Pipe Plug	1
44	0000444867	1/8-27 Pipe Plug	1
45	10-06-034-002	Dipstick Tube	1
45A	10-06-033-001	Dipstick (used with tube)	1
	71-1A195	Dipstick (tube not required)	1
46	71-42	Poppet Spring	1
47	0000483362	5/16 Steel Ball	1
48	71-198	Forward & Reverse Shift Lever	1
49	0000115729	5/16-24 Hex. Nut	1
50	0000100579	5/16 Lockwasher	1
51	0000103340	Control Lever Washer	1
52	4885B	Bushing	1
53	28-143	Flat Washer	1
54	52-223	Spring	1
55	72C-98	Oil Inlet Shield	1
56	72-A1A	Trans. Case with Bushings (72C & 10-18)	1
	71-A1A	Trans. Case with Bushings (71C & 10-17)	1
	71-A1L	Trans. Case with Bushings (70C)	1
	10-18-005-003	Trans. Case without Bushings (10-18)	1
	10-17-005-003	Trans. Case without Bushings (10-17)	1
57	71-87	Dowel Pin (70C with Fiber Plate)	2
	71-81A	Dowel Pin (70C with Metallic Plate)	3
	86-177	Dowel Pin (71C & 10-17)	3
	4632E	Dowel Pin (72C & 10-18)	3
58	4826D	Sealing Rings (10-17 & 10-18)	4
58A	A4807VX	Two Pressed Bushings (See Inset "B")	1
59	10-17-658-002	Pinion Cage & Output Shaft (70C, 71C & 10-17)	1
	10-18-658-002	Pinion Cage & Output Shaft (72C & 10-18)	1
	10-17-658-020	Pinion Cage & Output Shaft (10-17 with seal rings)	1
	10-18-658-014	Pinion Cage & Output Shaft (10-18 with seal rings)	1
60	A4867DD	Two Pressed Bushings in Kit - One kit for current unit - Two for early units	1
61	A4887DD		1
62	71-17	Thrust Washer	1
63	0000124893	Woodruff Key (72C & 10-18)	1
	0000118211	Woodruff Key (70C, 71C & 10-17)	1
64	72C-2A35	Drive Gear & Plug Assembly (72C & 10-18)	1
	71C-2A35	Drive Gear & Plug Ass'y (70C, 71C & 10-17)	1
65	4873	Woodruff Key	1
66	72-40	Forward Clutch Hub (72C & 10-18)	1
	71-40	Forward Clutch Hub (70C, 71C & 10-17)	1
67	4656	Snap Ring	1
68	4808J	Sealing Ring	1
69	72-6	Ring Gear (72C & 10-18)	1
	71-6	Ring Gear (70C, 71C & 10-17)	1
70	4198	Snap Ring-.050-.054" (1.27-1.37 mm)-Green	*
	4198A	Snap Ring-.074-.078" (1.88-1.98 mm)-Orange	*
	4198B	Snap Ring-.096-.100" (2.44-2.54 mm)-White	*
	10-00-139-018	Snap Ring-.062-.066" (1.57-1.68 mm)-Pink	*
	10-00-139-048	Snap Ring-.033-.037" (0.84-0.94 mm)-Yellow	*
	10-00-139-049	Snap Ring-.050-.054" (1.27-1.37 mm)-Pink	*
71	SL-87	Clutch Pressure Plate	1
72	10-17-193-001	Thrust Washer (used with sealing ring)	1
	71-158	Thrust Washer (used with bushings)	1
73	71-97	Pressure Plate Spring	12
74	71-140	Oil Baffle	1
75	12-A66	Clutch Friction Plate (72C & 10-18)	7
		Clutch Friction Plate (71C & 10-17)	5
		Clutch Friction Plate (70C)	3
	SC-A66A	Bronze Clutch Plate (Optional in place of 12-A66)	1
76	3-115	Steel Clutch Plate (72C & 10-18)	6
		Steel Clutch Plate (71C & 10-17)	4
		Steel Clutch Plate (70C)	2
77	SC-115A	Clutch Pressure Plate	1
78	4799	Clutch Spring Snap Ring	1
79	3-37	Clutch Spring	1
80	62-33	Clutch Spring Bearing ring	1
81	SL-35	Clutch Sealing Ring	1
82	10-16-124-001	Clutch Piston	1
83	SM-122	Sealing Ring	1
84	72-75	Forward Clutch Cylinder (72C & 10-18)	1
	71-75	Forward Clutch Cylinder (71C & 10-17)	1
85	71-158	Thrust Washer	1
86	8109A	Annular Bearing (72C & 10-18)	1
	8107A	Annular Bearing (70C, 71C & 10-17)	1
87	4559A	Snap Ring (72C & 10-18)	1
	473A	Snap Ring (70C, 71C & 10-17)	1
88	4768B	Snap Ring (72C & 10-18)	1
	[illegible]	Snap Ring (70C, 71C & 10-17)	1
89	4822	Ring Gear Snap Ring	1
90	10-17-866-001	Reverse Clutch Plate (72C & 10-18)	3
		Reverse Clutch Plate (71C & 10-17)	2
	72-866A	Bronze Clutch Plate (Used interchangeably with 10-17-866-001)	
	72-866	Thin Bronze Clutch Plate (This plate is required for a few early units and two of these plates must be used with one steel plate to replace the fiber plate (1-86).	
91	72-115	Steel Clutch Plate (72C & 10-18)	2
		Steel Clutch Plate (71C & 10-17)	1
92	71-71	Reverse clutch Pressure Plate	1
93	71-26	Reverse Clutch Piston	1
94	4805A	Sealing Ring	1
95	4862D	Needle Bearing	1
96	4804Q	Sealing Ring	1
97	71-144B	Case & Adapter Gasket	1
98	0000444658	1/4 Pipe Plug	1
99	72C-A8	Forward & Reverse Adapter	1
100	4811	3/8-16 x 1-1/4 Cap Screw	4
101	Order Assembly	Pump Drive Gear	1
102	Order Assembly	Pump Driven Gear	1
103	3-61	Pump Gasket	1
104	Order Assembly	Pump Housing	1
105	10-00-044-014	Oil Seal Assembly	1
	71C-63A	Oil Seal Assembly (Optional with 10-00-044-014)	1
106	10-00-183-321	5/16-18 x 1-3/8 Hex. Head Bolt (Current Units)	4
	0000179822	5/16-18x1½ Hex. Head Bolt(used with early pumps)	4
		SEE INSET "A"	
1	4776L	Coupling Nut	1
2	4847AY	Coupling 5" - 10 Spline (72C)	1
	4847BA	Coupling 4" - 10 Spline (70C & 71C)	1
3	0000179880	7/16-14 x 1-1/4 Hex. Head Bolt	8
4	0000133322	7/16 Lockwasher	8
5	71C-110	Oil Seal	1
6	L4-7	Bearing Retainer	1
7	L4-147	Bearing Retainer Gasket	1
8	4823A	Bearing	1
9	0000179884	7/16-14 x 1-3/4 Hex. Head Bolt	2
10	0000133322	7/16 Lockwasher	2
11	L4-1A	Reduction Housing	1
12	0000133891	Expansion Plug	1
13	L4-151	Pinion Cage Drive Pin	1
14	4808	Spring Pin	1
15	L4-4	Sun Gear	1
16	L4-2	Mainshaft	1

*Use as required.

PLE/5.87

FIG. 3 INSTALLATION DRAWING



NOTE: Parenthetical dimensions are in millimeters.

MODEL	A	B	C	D	E	F DIA	G DIA	H DIA	J DIA	K
70C	6.81 (172.97)	2.38 (60.45)	16.88 (428.75)	2.00 (50.80)	4.50 (114.30)	3.25 (82.55)	4.00 (101.60)	.39-4 holes (9.91)	2.50 (63.50)	10.50 (266.70)
71C					4.50 (114.30)	4.25 (107.95)	5.00 (127.00)	.45-4 holes (11.43)		
72C	7.75 (196.85)	2.62 (66.55)	17.81 (452.37)	2.00 (50.80)	4.50 (114.30)	4.25 (107.95)	5.00 (127.00)	.45-4 holes (11.43)	2.50 (63.50)	11.44 (290.58)
73C	7.50 (190.50)	3.08 (78.23)	19.45 (494.03)	4.38 (111.25)	4.75 (120.65)	4.75 (120.65)	5.75 (146.05)	.52-6 holes (13.21)	3.00 (76.20)	13.47 (342.14)

GENERAL SPECIFICATIONS

MODEL	MAXIMUM SAE HP INPUT GASOLINE	MAXIMUM SAE HP INPUT DIESEL	AVAILABLE RATIOS	OUTPUT ROTATION	DRY WEIGHT DIRECT DRIVE	DRY WEIGHT REDUCTION
70C	180 @ 4200 rpm	75 @ 3200 rpm	1.00, 1.52, 1.91*, 2.10, 2.57, 2.91 to 1.00	ENGINE	92 lb. (41.7 kg.)	143 lb. (63.4 kg.)
71C	255 @ 4200 rpm	145 @ 3200 rpm			95 lb. (43.1 kg.)	145 lb. (65.8 kg.)
72C	380 @ 4200 rpm	205 @ 3200 rpm			109 lb. (49.4 kg.)	153 lb. (69.4 kg.)
73C	560 @ 4200 rpm	400 @ 3200 rpm	1.00, 1.50, 2.00*, 3.00 to 1.00	ENGINE	135 lb. (61.2 kg.)	185 lb. (83.9 kg.)

* Rotation is opposite engine

NOTE: All specifications and descriptive data are nominal and subject to change without notice. Specific installations should be referred to Warner Gear/Warner-Motive for application assistance.

TRANSMISSION INSTALLATION

An oil cooler must be properly connected into the cooler circuit of all Velvet Drive transmissions; otherwise, high pressure and overheating will cause damage to the transmission. The oil cooler should be of sufficient size to prevent transmission sump temperature from exceeding the recommended maximum 190°F. or 88°C. Over cooling is better than insufficient cooling; however the transmission will operate better when the minimum temperature is above 140°F. or 60°C.

Cooler lines should have a minimum inside diameter of .41 inch or 10.4 mm. Cooler line fittings should not restrict oil flow.

The location for oil leaving the transmission to the cooler is a 3/8-18 pipe tapped opening located just behind the selector valve at the top rear of the forward and reverse transmission. Do not confuse this outlet with the 3/8-18 line pressure opening which is forward and to the left of the cooler outlet.

The cooler oil has been returned to two different locations on 1.52:1.00 reduction units. Connect the cooler oil return line to the lower right side of the reduction housing if an opening is located at this point; otherwise, return cooler oil to the pipe bushing located on the right side near the front of the forward and reverse transmission case.

All transmissions leaving the factory now have red plastic plugs in the "to cooler" and "from cooler" locations to identify these locations. An arrow and the words "to cooler" are now cast on the case of current units.

OIL CIRCUIT VARIATIONS

Three circulation systems have been used for cooler and lubrication oil flow to the reduction gear set and rear bearing of 1.52:1 reduction transmissions. Units which have the earlier circulation system have cooler oil returned to a tapped hole located on the lower right side of the reduction housing (Figure 5).

Transmissions which have cooler oil returned through a bushing in the drain plug opening of the forward and reverse transmission will either have the second or third circulation system. Units which have the second system have a crooked track on the reduction adapter front face. Units which have the third system have two short straight tracks on the reduction adapter front face. A visual inspection of the adapter front face will be required to determine which of these two systems is being used (Figure 4).

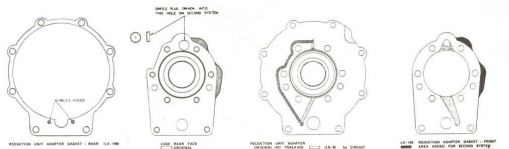


FIG. 4 PARTS REQUIRED FOR THE VARIOUS CIRCULATION SYSTEMS

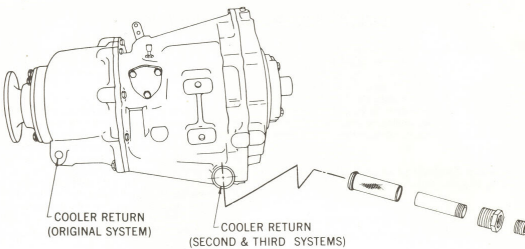


FIG. 5 VARIOUS COOLER RETURN LOCATIONS WITH PARTS USED WITH SECOND & THIRD SYSTEMS SHOWN.

HYDRAULIC FLUID RECOMMENDATIONS

TRANSMISSION FLUID

Dexron®II, Type F, and other hydraulic transmission fluids which meet the Detroit Diesel Allison Type C3 specifications are recommended for use in all Velvet Drive® marine transmissions.

Lubricating oils which are recommended for use in diesel engines and also meet Detroit Allison Type C3 specifications may be used if the engine speed does not exceed 3000 RPM. SAE #30 is preferred. SAE #40 is acceptable if high operating temperatures are to be encountered. Multiviscosity oils such as 10W-40 are not acceptable. The first choice is an oil which falls in the SAE-API service Class "CD." The second choice would be an oil which falls in the SAE-API service Class "CC."

The equivalent DOD mil specs are:

"CD" Mil-L-21048
"CC" Mil-L-45199

The new C3 specifications were developed by Detroit Diesel Allison Division of General Motors to outline the requirements of an oil suitable for use in their heavy duty hydraulic automatic and powershift transmissions. the oil companies should be able to provide information as to the suitability of their product for use in a given application.

OPERATION

Except in an emergency, shifts into forward or reverse should be made with the engine operating below 1000 RPM, otherwise severe damage to the engine or marine gear may occur.

Short periods of free wheeling can be tolerated. Extended period of free wheeling at higher speeds may cause the transmission to overheat; therefore, it is recommended that transmission sump temperature should be monitored and free wheeling should be discontinued whenever the maximum recommended 230ºF. or 110ºC. is reached. The transmission may then be cooled by operating the engine to circulate the transmission oil and cooler water. Free wheeling can be continued after the transmission has been cooled to a safe temperature. The transmission should be in good condition and full of fluid anytime free wheeling is permitted.

A suitable propeller shaft locking device is recommended and may be found advantageous on installations requiring extended periods of free wheeling.

PARTS INTERCHANGEABILITY

TRANSMISSION CASE

The original case can only be used with the first oil circulation system. The revised case, first used with the second system, may be used for all systems. The part number remains the same and only revised cases will be furnished for service parts. The revised case has the rear face area increased as shown in Figure 4, Item B.

ORIFICE PLUG

An orifice plug (part number 4572X) was driven into the case rear face upper hole (Figure 4, Item B) only on units having the second system. This plug should be omitted when any other system is used.

REDUCTION HOUSING

The original reduction housing (part number L4-1) was drilled and tapped to return cooler oil to the lower right side of the housing (Figure 5). This housing can only be used with the first system.

Reduction housing (part number L4-1A) was used with the second and third system and had no place to return cooler oil into the reduction housing. This housing can only be used with units having either the second or third system.

REDUCTION ADAPTER GASKET—REAR

Two small holes (Figure 4, Item A) were added to reduction adapter gasket-rear (L4-146) for use with the second circulation system. This gasket with the two small holes may be used for all replacements. The gaskets without the two small holes should no longer be available, but should never be used except with the first circulation system.

REDUCTION ADAPTER GASKET—FRONT

The reduction adapter gasket-front (L4-145) was changed twice by first adding material to cover the crooked track in adapter front face and later the gasket was cut to match the straight track used with the third system (Figure 4, Item D). The latest gasket may be used for all systems and will be the only gasket supplied for service.

REDUCTION UNIT ADAPTER

The original adapter (L4-8) was used with the first system and did not have a track on its front face. This adapter cannot be used with other systems.

The second adapter (L4-8A) was used with the second system and has a curved track on its front face. The adapter used with the third system has two short straight tracks connected by an undercut on the case face and the part number was not changed.

Only the latest adapter (L4-8B) will be furnished for service parts; however, it may be possible to obtain the earliest adapter until the current supply is depleted.

The reduction unit adapter (L4-8B) used with the third circulation system has two short straight oil tracks on the front face and can only be used with an annular bearing (B111AG) which has a snap ring groove around bearing O.D. The snap ring groove permits lube oil to flow from the upper track, around bearing groove and into lower lube track of adapter. This new grooved bearing (B111AG) may be used with all three systems and will be the only bearing supplied for service.

The oil strainer, annular gasket, and drain plug, illustrated in (Figure 6), can only be used with cases having the case face machined to seal on the annular gasket.

Parts illustrated in (Figure 5) are used with the second and third circulation systems. The oil strainer with an open end is also used as a service replacement part to replace the strainer illustrated in (Figure 6) for use with the first circulation system.

The pipe bushing illustrated in (Figure 5) replaced the annular gasket and drain plug. Case threads are different for each plug, therefore these plugs are not interchangeable.

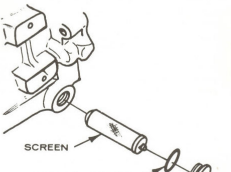


FIG. 6 EARLY SCREEN & DRAIN PLUG

DISASSEMBLY OF TRANSMISSION

REMOVE REDUCTION HOUSING AND ATTACHED PARTS

1) Place transmission upright on a clean bench and loosen the main shaft nut.

2) Place an inch thick block under the rear of forward and reverse transmission just forward of reduction unit adapter so that reduction unit will clear bench.

3) Remove the two 7/16 inch bolts (9) and the six 3/8 bolts (28) from reduction housing and adapter. Slide reduction housing with attached parts rearward from forward and reverse transmission.

REMOVE REDUCTION ADAPTER AND ATTACHED PARTS

4) Remove the six lock bolts (23) through access holes in input gear. Pull adapter, ring gear, input gear and bearing rearward from forward and reverse transmission.

5) Support the adapter on a clean flat surface under an arbor press, remove the snap ring (29) and press the bearing off by using a suitable tool to apply pressure on the small diameter of the input gear.

6) The snap ring (21) and the input gear may be removed from the ring gear.

REMOVE PARTS FROM REDUCTION HOUSING

7) Remove the snap ring (18) and pull pinion cage from main shaft splines.

8) Remove main shaft nut (1) and coupling (2), then pull main shaft forward from housing.

9) Remove the bolts (3) and bearing retainer (6).

10) Remove rear bearing cup, then support reduction housing rear face on a clean flat surface under an arbor press. Replace the main shaft (16) and press bearing outer race and front cone from reduction housing by pressing on main shaft.

11) Drive the spring pin (14) from pinion cage drive pin (13).

12) Remove pinion cage drive pin and sun gear from housing.

DISASSEMBLE FORWARD AND REVERSE TRANSMISSION

13) Follow procedure given in Velvet Drive Hydraulic Transmission Service Manual for either Model 70C & 71C or 72C for disassembly of the forward and reverse transmission.

INSPECTION AND GENERAL INSTRUCTIONS

1) Cleanliness is absolutely necessary during assembly to insure proper functioning of transmission. Transmission case passages should always have plugs removed to allow for thorough cleaning. When available, use compressed air to dry parts before they are assembled. Do not wipe parts with rags to clean or dry them as lint from the cloth may cause erratic valve action.

2) Inspect all parts for damage or wear. Replace defective parts.

3) All gaskets, oil seals and rubber sealing rings should be replaced except in relatively new units. Judgement should then be exercised as to the need for replacing these parts.

4) Oil seals and bearings are best installed by using an arbor press, suitable fixtures, and tools to properly align parts being assembled. Hammering seals and bearings into position can severly damage parts.

5) Transmission fluid of the type to be used in the unit should be used to lubricate parts as they are assembled. Petroleum jelly may be used on gaskets or other parts that must be held in position during assembly. All parts will assemble more freely if lubricated.

ASSEMBLY OF TRANSMISSION

1) Place the reduction housing on its front face and set rear face of transmission case on reduction housing. This will permit pinion cage and output shaft to extend from rear of case during forward and reverse transmission assembly.

2) Coat the steel back of thrust washer (72) with petroleum jelly. Install thrust washer on inside thrust surface of case with washer tang positioned in cast recess of case.

3) Install pinion cage and output shaft flush against the thrust washer. Do not rotate pinion cage and output shaft assembly as it tends to unseat the washer tang from the recess.

4) Complete forward and reverse transmission assembly by following instructions given in either service manual for Model 70C & 71C or 72C Velvet Drive Hydraulic Transmissions as required.

ASSEMBLY OF REDUCTION UNIT

ASSEMBLE RING GEAR, INPUT GEAR AND ADAPTER

5) Assemble the input gear (20) into splines of ring gear (19) and assemble the snap ring (21) firmly in groove of ring gear.

6) Place ring gear on rear face under an arbor press.

7) Place reduction unit adapter (25), front face up, over input gear. Lubricate input gear and bearing inside diameter. Press on bearing inner race to seat bearing firmly against shoulder of input gear.

8) Assemble the snap ring (29) firmly into groove of input gear.

9) Place front adapter gasket (30) on rear face of transmission case.

10) Engage input gear splines with output shaft splines as adapter and ring gear are assembled to rear face of the forward and reverse transmission.

11) Assemble the six bolts (23) with lockwashers (24) through the two holes provided in the input gear. It will be necessary to align the input gear with bolt holes to permit assembling two bolts at a time. Before tightening the six bolts, assemble the two 7/16 bolts (9) to insure alignment of all bolt holes in adapter and gasket. Tighten the six bolts evenly to the specified torque then remove the two 7/16 inch bolts.

ASSEMBLE SUN GEAR TO REDUCTION HOUSING

12) Align pin hole in sun gear with hole in housing as the sun gear (15) is assembled into reduction housing.

13) Slide the drive pin (13) into housing and sun gear aligning the holes to permit installation of the spring pin. Drive the spring pin (14) into the reduction housing and through the drive pin until flush with the casting.

14) Assemble the expansion plug (12) into reduction housing. Use a large punch and hammer to expand plug, swagging it firmly into the housing recess.

PRESS BEARING INTO REDUCTION HOUSING

15) Place the reduction housing front face on a clean flat surface under an arbor press.

NOTE: *Bearings are received in matched sets and matchmarks must check: One bearing cone will have a number with an "A" suffix, the other will have the same number without the "A" suffix. The outer race will have the same number with the suffix "A" on one end and no number on the other end. The parts with the "A" suffix should be placed together and the end of the outer race with no number should be placed with the bearing cone without the "A" suffix.*

16) Place the front cone of the tapered bearing so that the outer ring rests against the shoulder in the reduction housing.

17) Lubricate the outer race with transmission fluid and press it into the reduction housing until seated on shoulder.

18) Place the rear bearing cone into outer race.

ASSEMBLE BEARING RETAINER

19) Place the gasket (7) on reduction housing (11) aligning the slot in the gasket with the oil hole in the housing.

20) Press a new oil seal (5) into bearing retainer until rear face of seal is flush with rear face of the retainer. A sealer such as Permatex on outside diameter of seal will prevent leakage from around seal.

21) Align oil passages of bearing retainer to housing and gasket and install six 7/16-14 x 1-1/4 hex head bolts (3) with lockwashers (4) and tighten evenly to the specified torque.

ASSEMBLE MAIN SHAFT, PINION CAGE AND COUPLING

22) Assemble the main shaft through the sun gear and into the bearing.

23) Inspect the coupling sealing diameter to make sure there are no burrs or sharp edges which might damage the seal or

prevent proper sealing, replace if damaged. Lubricate the sealing diameter and assemble the coupling to the main shaft.

24) Assemble the main shaft nut to main shaft. A sealer such as Permatex should be used under the main shaft nut to prevent fluid from leaking around the shaft splines.

25) Align splines of pinion cage with splines of the main shaft and assemble pinion cage over sun gear and agasint shoulder on main shaft.

26) Assemble the snap ring (18) firmly in the groove in main shaft to hold pinion cage.

ASSEMBLE REDUCTION HOUSING TO FORWARD AND REVERSE TRANSMISSION

27) Position the forward and reverse transmission to permit easy assembly of reduction components and assemble the rear reduction adapter gasket (22) on gasket face.

28) Assemble the reduction housing and attached parts onto the forward and reverse unit by mashing the pinion gears into the ring gear and then engaging the pilot diameter of the main shaft into the bushing diameter of the pinion cage and output shaft.

29) Assemble two 7/16-14 x 1-3/4 hex head bolts (9) with lockwashers and six 3/8-16 x 1-1/8 hex head bolts (28) with lockwashers. Tighten the bolts to specified torque.

PLANETARY SERVICE KITS

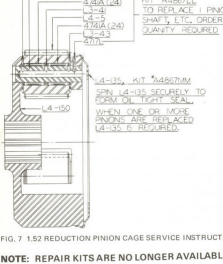


FIG. 7 1.52 REDUCTION PINION CAGE SERVICE INSTRUCTION

NOTE: REPAIR KITS ARE NO LONGER AVAILABLE. PARTS MAY BE ORDERED INDIVIDUALLY.

These repair kits make possible the replacement of individual pinions and related parts of the planetary gear sets and eliminate the necessity of replacing the entire planetary assembly.

The parts shown in Kit Number A4867LL, figure 7, show the parts required to replace only one pinion in the 1.52 reduction planetary assembly. Separate kits must be ordered for each pinion which is to be replaced.

NOTE: *In disassembling the individual gear sets the pinion shaft pin retaining the pinion pin should be removed intact after the removal of the oil collector ring. The pinion shaft pin should not be removed by pounding on the end of the pinion pin to break the retaining pin, as this distorts the immediate area of the pinion carrier and will produce a damaged thrust surface and improper pinion end clearance when the planetary is reassembled.*

After assembly of the individual pinions in the planetary, the oil collector ring must be assembled and securely fastened to the planetary carrier. The oil collector ring which was removed to repair the planetary assembly should always be discarded and replaced with a new part, A4867MM.

Assembly instructions when required are supplied in the various kits.

TORQUE SPECIFICATIONS

PART NO.	DESCRIPTION	APPLICATION	LBS. FT.	Nm
179840	3/8-16 x 1-1/8 HEX HEAD BOLT	REDUCTION UNIT ADAPTER TO REDUCTION HOUSING	27-32	36.6-43.4
179860	7/16-14 x 1-1/4 HEX HEAD BOLT	BEARING RETAINER TO REDUCTION HOUSING	42-50	56.9-67.8
179864	7/16-14 x 1-3/4 HEX HEAD BOLT	REDUCTION HOUSING AND ADAPTER TO CASE	42-50	56.9-67.8
4853D	7/16-14 x 1 HEX HEAD BOLT, LOCKING	REDUCTION UNIT ADAPTER TO CASE	42-50	56.9-67.8
4775L	1-20 NUT	OUTPUT SHAFT NUT	100-200	135.5-271.2
10-00-149-034	1-20 NUT	OUTPUT SHAFT NUT	100-260	135.5-352.5