RENOLD
Gears & Variable Speed
Station Road
Milnrow
Rochdale
OL16 3LS

Telephone +44 (0) 1706 751000
Fax +44 (0) 1706 751001
Email **carter@renold.com**

WEB www.renold.com

RENOLD
Gears & Variable Speed

MA Carter Variator

INSTALLATION & MAINTENANCE INSTRUCTIONS

INSTALLATION, STARTING UP AND ROUTINE MAINTENANCE INSTRUCTIONS

INITIAL STARTING
Before any attempt is made to run the Carter Variator, it must be filled with the appropriate quantities and grades of CLEAN oil as detailed overleaf.

Set the speed control to zero scale setting. If a V-Belt drive is used to drive the input shaft of the Carter Variator, check the tension in accordance with table opposite.

Rotate the input shaft a few revolutions by hand. Now replace the V-belt pulley or coupling guard. Set speed control to No.5 scale setting. Switch on the main drive motor and apply a light load to the output shaft. Run the variator for a few minutes, working the speed control through its full range. It should now be capable of driving under full load conditions. IF, HOWEVER, THE VARIATOR HAS BEEN ALLOWED TO STAND FOR A LONG PERIOD (ONE MONTH OR MORE), air may have entered the hydraulic system. If so, its output speed will tend to be erratic and it will emit a groaning note of varying pitch and frequency accompanied by a rattling sound. Continuing with the above procedure should remove the air, but if it persists for more than 5 minutes, stop the variator. After 10 minutes the control should be reset at No.5 and the above procedure repeated.

WEEKLY MAINTENANCE
Examine oil levels and 'top-up' as required. If it is found that oil has to be added regularly, then input and output shaft oil seals and all external fastenings should be checked for leaks.

OIL CHANGES
Under normal conditions of temperature and environment, the oil should be changed every 2500 hours or 12 months, whichever is sooner. Where other working conditions apply consult your oil supplier. Take care to ensure that dirt does not enter the variator whilst changing the oil. The oil will flow more freely if it is warm (after the drive has been running) and if the oil filler cap is removed.

OIL LEAKAGE
Failure of the INPUT SHAFT OIL SEAL will not only result in oil leakage but may also allow air to enter the hydraulic system. This will affect the variator performance resulting in: the variator losing output speed and even stopping; failure to start-up after a period of rest; unstable output speed or excessive noise.

It is, therefore, essential to replace the seal immediately a leak becomes apparent. Oil leaks from the OUTPUT SHAFT OIL SEAL will generally have no effect on the variator performance unless the oil level in the sump falls so low that the hydraulic system is starved of oil, thus causing eventual drive failure.

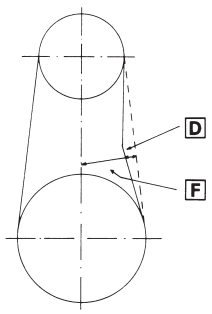
Checking the oil level weekly should prevent this and give an early indication of oil leakage. NOTE: Upon completion of any renewal of oil sealing components, it is essential that the instructions given under the heading 'INITIAL STARTING' are carried out.

MA TYPE CARTER VARIATOR

MAJOR OVERHAUL
The Carter Variator, correctly applied and maintained, will give many years of reliable service. Should it eventually require overhauling we recommend this is carried out at our works where all variators are thoroughly tested before despatch. Where this is impracticable, detailed instructions for the required procedure are given in our service manual, which is available on request.

For overseas installations, our agents are, in general, equipped to carry out examinations and repairs.

INPUT V-BELT DRIVE TENSION



Gear Size	Deflection D mm	Spring Balance Force F Kg
MA3	11	4 to 5
MA4	13	4 to 5
MA26	13	4 to 5
MA5	14, 5	4 to 5
MA6	16	4 to 5
MA42	17, 5	4 to 5

Carter Variators are precision built machines and are subjected to thorough testing before despatch. If the correct size of variator is selected and installed and careful attention is given to the following instructions, then reliable service can be expected.

MOUNTING

MA type Variators must be rigidly mounted with feet and shafts horizontal. Where it is desired to mount the drive in any other plane, then full details of the proposed application and mounting should be forwarded for our approval. In all MA type Variators, an out-of-balance force revolves around the shaft centre line at output speed. The magnitude of this force varies as the square of input speed; hence the higher the input, the more essential the need to provide a rigid mounting. Where drives are enclosed within structures or guards, adequate ventilation must be provided to ensure a reasonable ambient temperature. Large flat areas of thin metal should be stiffened to prevent undue amplification of noise.

OVERLOAD PROTECTION

Where there is a known, or suspected, risk of severe and/or sudden shock loads or dead stops an external overload protection device should be fitted. e.g. A shear pin coupling, slipping coupling or similar device fitted into the drive train at the output side of the Carter Variator. **NB:** Driving motor trips do **NOT** provide adequate overload protection for the Carter Variator.

INPUT DRIVE

The input shaft can be driven in either direction within the following speed limits.

	MA3	MA4	MA26	MA5	MA6
	rev/min	rev/min	rev/min	rev/min	rev/min
Max	1870	1660	1570	1250	1050
Min	700	700	700	700	700

OUTPUT DRIVE

Output drive ratios (whatever type of power transmission equipment is used) should be arranged so that the maximum output speed of the variator coincides with the required maximum machine shaft speed, thus ensuring maximum power transmission and speed control efficiency. The direction of output rotation is determined by the direction of input rotation.

SHAFT FITTING RECOMMENDATIONS

Couplings, pinions and pulleys should incorporate taper bushes or be bored a light keying fit to ensure that during fitting, **no heavy driving force is applied to the variator input or output shafts.** Similarly end thrust during operation should be avoided but if this proves impractical, please apply to our works for recommendations. If the variator is to be directly coupled to either the driving or driven shaft, a flexible coupling must be used with ample clearance between shaft ends. Alignment of shafts should be carefully checked. Any mis-alignment puts unnecessary loading upon the whole drive and, in particular, the bearings and oil seals.

OVERHUNG LOADS

Belt drives, spur gears or chain drives etc., may be used in conjunction with MA type Variators, but consideration must be given to the overhung loads that these drives impose on the input and output shafts. This may be calculated as follows:

$$\text{Load (N)} = \frac{\text{TORQUE (Nm)} \times 10^3 \times F}{\text{RADIUS (mm)}} \qquad \text{LOAD (lbf)} = \frac{\text{TORQUE (lbf.in)} \times F}{\text{RADIUS (in)}}$$

Where: RADIUS = Pitch circle radius of chain sprocket spur gear or belt pulley.
and F = Application Factor i.e.

Chain sprocket	- 1,00	Vee/Wedge pulley	- 1,50
Spur Gear	- 1,25	Flat Belt pulley	- 2,00

The maximum permissible shaft loads are given in the tables below, and are concentrated loads imposed at the centre of the keyway, midway along the shaft length. Any deviation from this position will increase or decrease the amount that can be safely applied.

CARTER VARIATOR

Maximum overhung loads (Newtons)

1 Newton = 0,2248 lbf

	Carter Variator size						
	MA3	**MA4**	**MA26**	**MA5**	**MA6**	**MA42**	**MA50**
Input shaft	809	1103	1472	1883	3159	3352	5353
Output shaft	989	1324	1748	2676	2676	4631	6117

RS SERIES REDUCTION UNIT

Maximum overhung loads (Newtons)

Maximum output	RS series size		
speed (rev/min)	**GM3/D**	**GM4/T**	**GMU/D**
1200 to 601	3780		10 230
600 to 501	3910		10 450
500 to 401	4140		10 900
400 to 351	4450		11 650
350 to 301	4510		12 190
300 to 251	4600		12 720
250 to 201	4710		13 610
200 to 181	4890	13 340	14 590
180 to 161	5070	13 340	15 390
160 to 141	5250	13 340	16 190
140 to 121	5510	13 340	16 550
120 to 101	5780	13 340	17 440
100 to 91		12 990	18 550
90 to 81		12 630	19 660
80 to 71		12 280	20 550
70 to 61		11 920	21 530
60 to 51		11 560	22 240
50 to 41		11 210	23 350
40 to 31		10 850	25 580

SPEED CONTROLS

Speed control settings are adjustable with the variator running or stationary and frequent or infrequent speed changes can be made without detriment to the unit. The control can be used to positively accelerate or dynamically brake the driven load, providing the main driving motor remains energised.

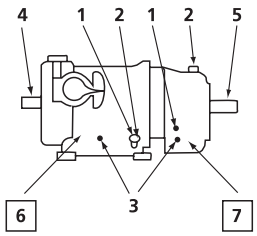
Speed controls are usually set up and tested prior to despatch. However, to avoid damage during transit, combined handwheel and speed indicator controls are packed in a protective carton and supplied loose.

Electric remote and electronic controls should be set up in accordance with the appropriate technical data sheets supplied.

OIL LEVELS

When installing MA type Variators fitted with flange mounted RS Series Reduction Gears, it is important to remember that these have SEPARATE OIL SUMPS (see FIG 1) and require DIFFERENT GRADES OF OIL.

FIG 1



1 OIL LEVEL INDICATORS
2 OIL FILLER APERTURES
3 OIL DRAIN PLUGS
4 INPUT SHAFT
5 OUTPUT SHAFT
6 CARTER DRIVE
7 RS SERIES UNIT

APPROXIMATE OIL QUANTITIES

Carter Variator	Oil Capacity (approx)			Associated RS Series Unit	Oil Capacity (approx)		
	Litres	Imperial pints	US pints		Litres	Imperial pints	US pints
MA3	4,00	7	5.75	GM3/D	2,0	3.5	2.90
				GM4/T	3,0	5.3	4.40
MA4	4,50	8	6.50	GM3/D	2,0	3.5	2.90
				GM4/T	3,0	5.3	4.40
MA26	8,50	15	12.50	GM3/D	2,0	3.5	2.90
		15	12.50	GM4/T	3,0	5.3	4.40
MA5	8,50		12.50	GM6/D	5,1	9.0	7.42
MA6	11,50	20	16.50	GM6/D	5,1	9.0	7.42
MA42	32,00	56	47.00	GM6/D	5,1	9.0	7.42
MA50	81,80	144	118.80	-	-	-	-

RECOMMENDED GRADES OF OIL

Use a straight mineral oil of good quality, preferably with anti-oxidant, anti-foaming, anti-rust, film strength improvement and low pour point additives and with a flat viscosity curve to ensure ease of starting when cold. COMPOUND OILS MUST NOT BE USED. A range of standard brands are listed below. Other brands may be used provided they conform to the specification relevant to site conditions. Details available on request.

In exceptional conditions such as extremes of temperature, high humidity, corrosive atmospheres etc., consult your oil supplier for recommendations. These should be based on the oils listed for normal conditions.

MA TYPE CARTER VARIATOR

HOT CONDITIONS - Site temp 30°C (86°F) - 43°C (110°F)

Shell Companies	Tellus 150
Mobil Oil Company Ltd	Mobil DTE Extra Heavy (VG 150)
	Mobil DTE 19M
Esso Petroleum Company Ltd	Teresso V150 or 150
BP Oil Ltd	Energol HP 150

NORMAL CONDITIONS - Site temp 13°C (55°F) - 30°C (86°F)

Shell Companies	Tellus 100
Mobil Oil Company Ltd	Mobil DTE Heavy
	Mobil DTE 18M
Esso Petroleum Company Ltd	Teresso 100
BP Oil Ltd	Energol HLP 100

COLD CONDITIONS - Site temp 2°C (35°F) - 13°C (55°F)

Shell Companies	Tellus 68
Mobil Oil Company Ltd	Mobil DTE Heavy/Medium (VG 68)
	Mobil DTE 16M
Esso Petroleum Company Ltd	Teresso 68
BP Oil Ltd	Energol HLP 68

FLANGE MOUNTED RS SERIES REDUCTION UNITS

Shell Companies	Omala Oil 320
Mobil Oil Company Ltd	Mobil Gear 632
Esso Petroleum Company Ltd	Spartan EP320
BP Oil Ltd	Energol GR-XP320