

**ROPE BRAKE**  
**OPERATOR INSTRUCTIONS**  
**AND**  
**REPAIR MANUAL**

UNCONTROLLED WHEN PRINTED

Cusp Engineering Pty Ltd  
7 Lassie Street  
OXLEY QLD 4075.

Telephone (07) 3716 0175  
Facsimile (07) 3716 0909

© July 2003

# CONTENTS.

CONTENTS.....	2
LIST OF FIGURES .....	3
1. <u>TECHNICAL DESCRIPTION</u> .....	6
1.1. <u>General</u> .....	6
1.2. <u>Rope Brake Operation - General Description</u> .....	7
1.3. <u>Specification</u> .....	19
2. <u>OPERATION OF THE ROPE BRAKE</u> .....	20
2.1. <u>Free spool rope release</u> .....	20
2.2. <u>Winch out with the rope unloaded</u> .....	20
2.3. <u>Winch out with the rope loaded</u> .....	21
2.4. <u>Winching in with no load applied to the free end of the rope</u> .....	21
2.5. <u>Winching with a rope under load</u> .....	21
3. <u>ASSEMBLY AND DIS-ASSEMBLY</u> .....	22
3.1. <u>Assembly</u> .....	22
3.1.1. <u>Winch rope removal</u> .....	23
3.1.2. <u>Assembly of the universal joint</u> .....	23
3.1.3. <u>Fitting the folded lug and universal joint to the hanger</u> .....	23
3.1.4. <u>Fitting the arms and drag rollers</u> .....	23
3.1.5. <u>Fitting the buffer, swing-stop and springs</u> .....	25
3.1.6. <u>Set-up</u> .....	25
3.2. <u>Dis-assembly</u> .....	26
4. <u>MAINTANENCE</u> .....	26
4.1. <u>Servicing</u> .....	26
4.1.1. <u>Lubrication</u> .....	27
4.1.1.1. <u>Pivot pin lubrication</u> .....	27
4.1.1.2. <u>Release roller lubrication</u> .....	27
4.1.1.3. <u>Oil lubrication</u> .....	27
4.1.2. <u>Visual check</u> .....	27
4.1.3. <u>Annual service</u> .....	28
4.2. <u>Fault diagnosis</u> .....	29
4.3. <u>Inspection and Repair</u> .....	30
4.3.1. <u>Drag rollers and axles</u> .....	30
4.3.1.1. <u>Short and long axles</u> .....	30
4.3.1.2. <u>Drag roller (complete)</u> .....	31
4.3.1.2.1. <u>Drag roller inspection</u> .....	31
4.3.1.2.2. <u>Drag roller bearing removal and replacement</u> .....	32
4.3.1.2.3. <u>Drag roller seal replacement</u> .....	32
4.3.2. <u>Release roller and axle</u> .....	32
4.3.2.1. <u>Release roller axle</u> .....	33
4.3.2.2. <u>Release roller (complete)</u> .....	33
4.3.2.2.1. <u>Release roller inspection</u> .....	33
4.3.2.2.2. <u>Release roller bearing removal and replacement</u> .....	34
4.3.2.2.3. <u>Release roller seal replacement</u> .....	34
4.3.3. <u>Universal joint</u> .....	34
4.3.3.1. <u>Universal joint block and cap</u> .....	35
4.3.3.2. <u>Bolt sleeves</u> .....	35
4.3.4. <u>Shear links</u> .....	35
4.3.5. <u>Scraper/wear plates</u> .....	35
4.4. <u>Adjustment</u> .....	35
4.4.1. <u>Release roller position</u> .....	35
4.4.2. <u>Swing stop position</u> .....	36
4.5. <u>Wear and damage limits</u> .....	38
ANNEX A.....	40
Tools.....	40
ANNEX B.....	41
Fastener Tightening Torques.....	41
WARRANTY AND REPAIR.....	42

# LIST OF FIGURES

Figure 1. Rope Brake Fitted to MRV Fairlead.....6  
Figure 2. Rope Brake Assembly (Right Hand Rope Brake shown in inverted position) ..... 11  
Figure 3. Universal Joint [(assembly number 5003-500-005) shown in inverted position]. ..... 13  
Figure 4. Drag Roller (assembly number 5003-500-008). ..... 14  
Figure 5. Release Roller (assembly number 5003-500-013). ..... 15  
Figure 6. Rope Brake Assembly (Right Hand Rope Brake shown in installed position). ..... 17

UNCONTROLLED WHEN PRINTED

LIST OF TABLES

Table 1. Rope Brake Specifications..... 19  
Table 2. Typical Drag Roller and Axle Interchange Sequence..... 28  
Table 3. Fault Diagnosis..... 29  
Table 5. Rope Brake Component Wear Limits..... 38  
Table A- 1. Tools Required for Assembly and Disassembly..... 40  
Table B- 1. Recommended Fastener Tightening Torques..... 41

UNCONTROLLED WHEN PRINTED

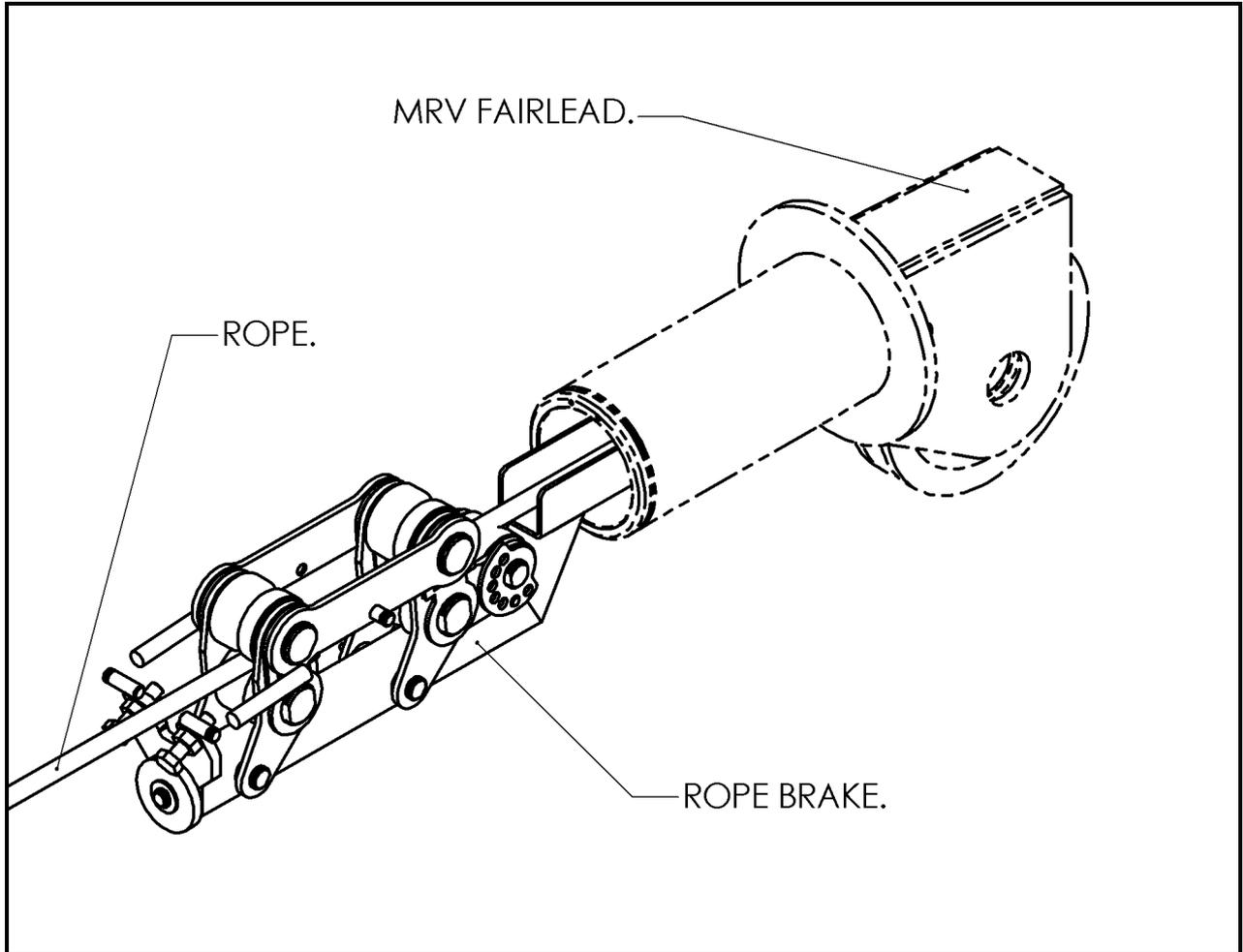
## **DEFINITIONS.**

Left hand side	Left-hand side relative to the vehicle forward direction.
MRV	Australian Army - Medium Recovery Vehicle.
Right hand side	Right-hand side relative to the vehicle forward direction.
Free spooling	For the MRV, refer to the Operators Handbook – para 2.59 Operator’s procedure.
Arms	These are the left front, left rear, right front and right rear Rope Brake side plates.
Shear Link	Overload protection device.

# 1. TECHNICAL DESCRIPTION.

## 1.1. General.

The Rope Brake is designed to automatically apply tension to an otherwise slack rope when a rope is being winched onto a winch drum. An example of a Rope Brake fitted to the Medium Recovery Vehicle (MRV), between the fairlead and the recovery winch is shown at Figure 1.



**Figure 1. Rope Brake Fitted to MRV Fairlead.**

A correctly adjusted Rope Brake can apply a uniform resistance of approximately 50 kilograms to the rope when winching in. The Rope Brake applies a maximum braking resistance when the rope is being winched in without a load on the free end (Casualty End). The Rope Brake is in the neutral position (no applied resistance) when the winch rope between the casualty load and the winch is tensioned too greater than 80 kilograms.

The reverse occurs as the load on the casualty end decreases; the Rope Brake automatically starts to apply a progressively increasing resistance to the rope as the casualty load being winched in reduces below 80 kilograms. When the load on the casualty end is fully released the Rope Brake is considered to be applying full resistance on the winch rope.

**NOTE:**

**When ‘free spooling’ the winch rope manually (For the MRV, refer to the Operators Handbook para 2.59), a slight increase (approx 5 kg) in resistance is felt by the operator, due to the winch rope being pulled through the Rope Brake drag rollers which are resting in the neutral position.**

**CAUTION:**

THE ROPE BRAKE IS *NOT* A SUBSTITUTE FOR MONITORING THE LAYING-ON OF THE WINCH ROPE ONTO THE WINCH DRUM, HOWEVER, IT DOES ASSIST IN LAYING THE ROPE ONTO THE DRUM BY APPLYING A UNIFORM TENSION.

**CAUTION:**

THE ROPE BRAKE OPERATES IN CLOSE PROXIMITY TO THE SPARE WHEEL COVER. SERIOUS DAMAGE TO THE ROPE BRAKE, THE WHEEL COVER AND OTHER EQUIPMENT WILL RESULT IF A LOOSE OR DAMAGED COVER IS GRASPED BY THE ROPE BRAKE. ENSURE THAT THE WHEEL COVER IS SECURED CLEAR OF THE ROPE BRAKE AT ALL TIMES.

**1.2. Rope Brake Operation - General Description.**

The Rope Brake is assembled around the winch rope and is mounted inside the hollow barrel of the fairlead assembly. The universal joint (Figure 3 and Figure 2, item 9) is bolted to the recovery systems’ fairlead. The Rope Brake is self-aligning with the winch rope for all fairlead positions. The Rope Brake rotates around the winch rope as the fairlead rotates in the direction of the winching task.

The hanger (Figure 2, item 1) extends from the universal joint through the barrel of the fairlead towards the winch. Brake components that control the resistance on the rope are mounted from the hanger, clear of the fairlead and adjacent boom structure.

The front arms (Figure 2, item 2) and rear arms (Figure 2, item 6 and 11) pivot on grease lubricated pivot pins (Figure 2, item 3) that pass through bushes in the hanger. Grease nipples (Figure 2, item 23) are press fitted to the pivot pins.

The Rope Brake applies the resistance to the rope through four (4) drag rollers (Figure 2, item 10) mounted in pairs. Each roller rotates on an axle. A long axle (Figure 2, item 7) is fixed in the end of the arms and a short axle (Figure 2, item 4) is located in a slot at the mid-length of the arms. The drag roller assembly consists of a hardened roller (Figure 4, item 1), fitted with a special composite bearing (Figure 4, item 2). The bearing is self-lubricating and is protected from dirt, water and excess oil or grease ingress at each end by two nitrile rubber lip seals (Figure 4, item 3). Each seal is fitted so that the rubber lips face outwards. A minute quantity of grease applied between the two seals is sufficient to provide lubrication of the seal lips.

The front and rear arms are connected by a link, at the ends furthest from the hanger, (Figure 2, item 12) which forms a parallelogram mechanism. Each link pivots on the ends

of two long axles, one each in the front and rear arms. When an unloaded rope is pulled through the Rope Brake towards the winch, friction between the rollers and their axles causes the arms to rotate in unison towards the winch. In doing so the rope deflects around the four rollers. This increases the friction between the rollers and axles, further increasing the force that rotates the arms. The roller to rope reaction force and friction is carried between the drag roller and its axle by the bearing, which ensures that a roller rotates on its shaft before the rope slides in the roller groove.

The resistance to rotation by the rollers is overcome by the tension induced in the rope as it is winched onto the winch drum. The front drag roller pair provides significantly more braking force to the rope than the rear roller pair.

The arrangement of the rollers and arms is such that when the rope is pulled towards the winch the mechanism engages the rope once an initial small force is induced between the rollers and the rope. This initial small force is provided by two tension springs (Figure 2, item 30) attached between the hanger and the link connecting the front and rear arms. The rotation of the arms in the direction of the winch, relative to the hanger, is limited by a screw (Figure 2, item 29) and locknut (Figure 2, item 28) on each side of the hanger end. The extent of the arm rotation controls the deflection of the rope around the rollers, and the maximum amount of resistance that can be generated by the Rope Brake

The long axle in each arm is fixed relative to the arm end. Short axles have parallel flats on the ends, which are fitted between the sides of the slotted hole in each arm. A shear link (Figure 2, item 8) fitted on the outside of each arm locates the short axle relative to the adjacent long axle and hence determines the spacing between the rollers attached to the arm. Each pair of shear links carries the force, which acts to separate a roller pair. Excessive force between a pair of rollers due to a damaged rope, debris or incorrect operation of the Rope Brake will break the shear link(s) allowing the short axle(s) to move away from the long axle(s). The shear links are not repairable.

A release roller assembly (Figure 2, item 14) that rotates on an axle (Figure 2, item 15) supported by the rear arms, deflects an unloaded rope away from the hanger as it enters the rear roller pair. The release roller assembly is grease lubricated and runs on a replaceable bearing (Figure 5, item 2) protected on both ends by a nitrile rubber lip seal (Figure 5, item 3). A grease nipple (Figure 2, item 23) is press fitted to the release roller axle. The force exerted between the release roller and the rope increases as the tension on the free end of the rope increases (for example, due to a recovery task) and acts to rotate the release roller away from the winches. Rotation of the release roller away from the winches decreases the deflection of the rope by the drag rollers and therefore the friction force on the rope.

Adjustment of the setting disks (Figure 2, item 16) varies the position of the release roller relative to the rear arms and hence the amount of resistance that the drag rollers exert on a completely taught rope as it moves towards the winch.

When the rope is being released from the winch drum the friction forces between the drag rollers and their axles move the Rope Brake towards the neutral position. This stretches the preload springs and rotates the arms away from the screws in the hanger and the winch. This allows the rope to be released from the winch drum by manually pulling the rope out.

Contact between the drag rollers and the sides of the rear arms is prevented by scraper/wear plates (Figure 2, item 18) fitted between the arm side and the roller. The shape of the scraper/wear plates ejects dirt from between the rollers and side plates. Compaction of dirt between the roller and the arm side will result in seal wear and drag roller bearing damage.

**WARNING:**

DO NOT OPERATE THE WINCH WHILE THE ROPE BRAKE IS BEING FITTED TO THE RECOVERY EQUIPMENT

**WARNING:**

SMALL CLEARANCES, LARGE FORCES AND RAPID MOVEMENT OCCUR IN THE MECHANISM OF THE ROPE BRAKE. THE ROPE BRAKE MAY CAUSE SERIOUS INJURY IF BODY PARTS OR CLOTHING ARE GRASPED BY THE MACHINE. DO NOT TOUCH AN OPERATING ROPE BRAKE.

**CAUTION:**

THE ROPE BRAKE WILL NOT IN-ITSELF ENSURE THAT THE ROPE IS CORRECTLY LAID ONTO THE DRUM. THE ROPE BRAKE IS NOT A 'LEVEL WINDING' DEVICE.

**CAUTION:**

THE LEVEL OF TENSION APPLIED BY THE ROPE BRAKE IS NOT SUFFICIENT TO PREVENT THE ROPE SUBSEQUENTLY PULLING THROUGH LOWER LAYERS OF ROPE ON THE WINCH DRUM IF A HIGH ROPE TENSION IS APPLIED DURING A RECOVERY TASK.

Blank Page

ITEM NO.	QTY	PART NO.	DESCRIPTION
1	1	5003_500_003	HANGER
2	2	5003_510_055	FRONT ARM
3	2	5003_510_012	ARM PIVOT PIN
4	2	5003_510_004	SHORT AXLE
5	12	P30x42x1 DIN988	WASHER
6	1	5003_500_011	REAR ARM, LEFT HAND
7	2	5003_510_005	LONG AXLE
8	4	5003_510_035	SHEAR LINK
9	1	5003_500_005	UNIVERSAL JOINT ASSEMBLY
10	4	5003_500_008	DRAG ROLLER ASSEMBLY
11	1	5003_500_009	REAR ARM, RIGHT HAND
12	2	5003_500_007	ARM LINK
13	1	5003_510_031	FOLDED LUG.
14	1	5003_500_013	RELEASE ROLLER ASSEMBLY
15	1	5003_510_049	RELEASE ROLLER AXLE
16	2	5003_510_056	SETTING DISK
17	1	5003_510_059	BUFFER DISK
18	4	5003_510_048	SCRAPER/WEAR PLATE
19	8	EXTERNAL DIA. 30 DIN471	CIRCLIP
20	2	EXTERNAL DIA 20 DIN471	CIRCLIP
21	4	EXTERNAL DIA 16 DIN471	CIRCLIP
22	1	EXTERNAL DIN 12 DIN471	CIRCLIP
23	3	6mm DRIVE FIT	GREASE NIPPLE
24	4	M6X20 SCKT BUTN HD SCR.	SCREW
25	4	WASHER, M6 PLAIN, ZP	WASHER
26	4	NUT, NYLOC, M6 TYPE P	HEX NUT, NYLOC
27	1	WASHER, M12 PLAIN, ZP	WASHER
28	2	NUT, M10X1.5 CLASS 8 ZP	NUT
29	2	M10X1.5X35, CLASS 8.8,	MACHINE SCREW
30	2	E0500-049-3500	EXTENSION SPRING

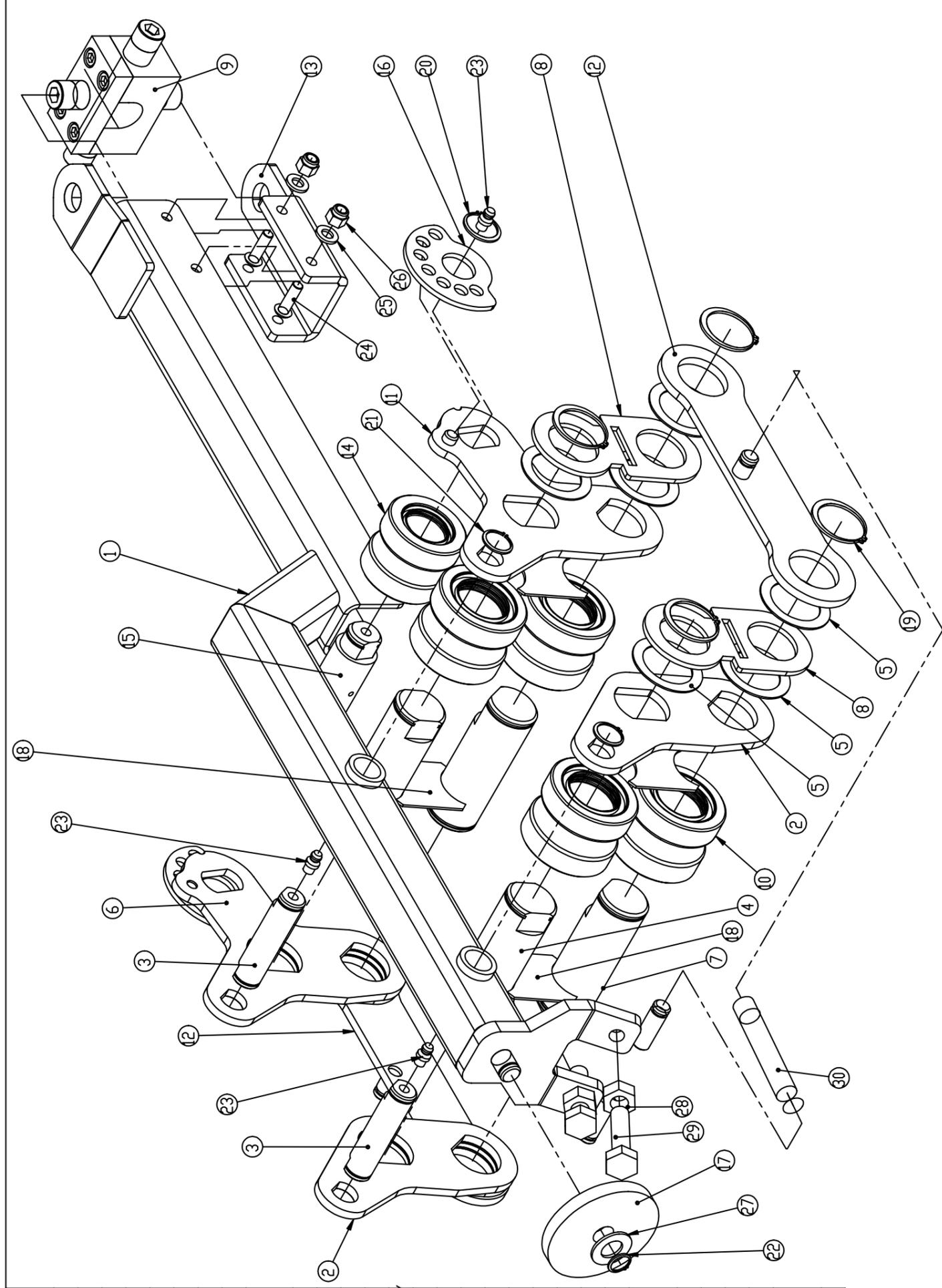


Figure 2. Rope Brake Assembly (Right Hand Rope Brake shown in inverted position).

**Blank Page**

ITEM NO.	QTY	PART NO.	DESCRIPTION
1	1	5003 510_018	UNIVERSAL BLOCK
2	1	5003 510_017	UNIVERSAL CAP
3	2	5003 510_050	BOLT SLEAVE, SHORT.
4	2	5003 510_019	BOLT SLEAVE, LONG.
5	4	SCKT LOW HD CAP SCR, M6X20, ZP	SCREW
6	2	SCKT HD CAP SCREW, M10X20	SCREW, ZP
7	2	SCKT HD CAP SCREW, M10X25	SCREW, ZP

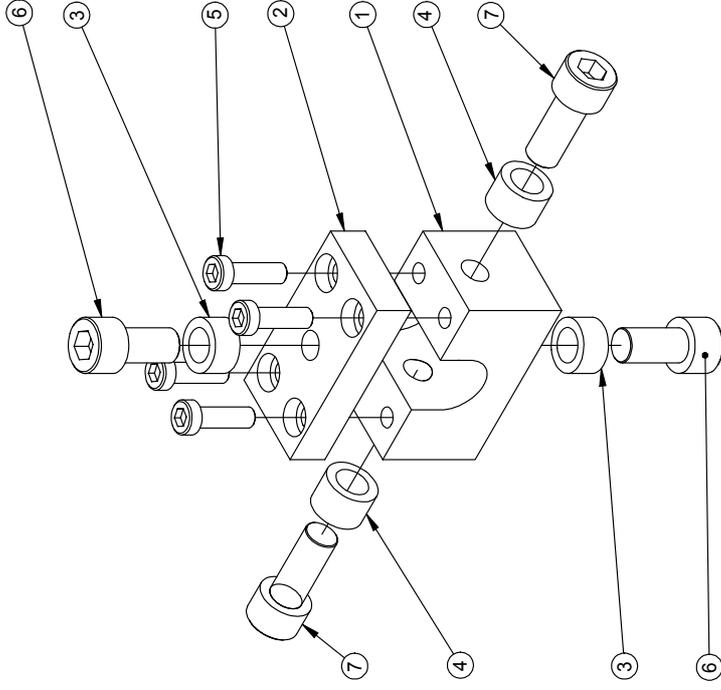


Figure 3. Universal Joint [(assembly number 5003-500-005) shown in inverted position].

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	5003_510_003	DRAG ROLLER
2	1	5003_510_039	BEARING
3	4	NAK40X30X4VC	SEAL, NAK

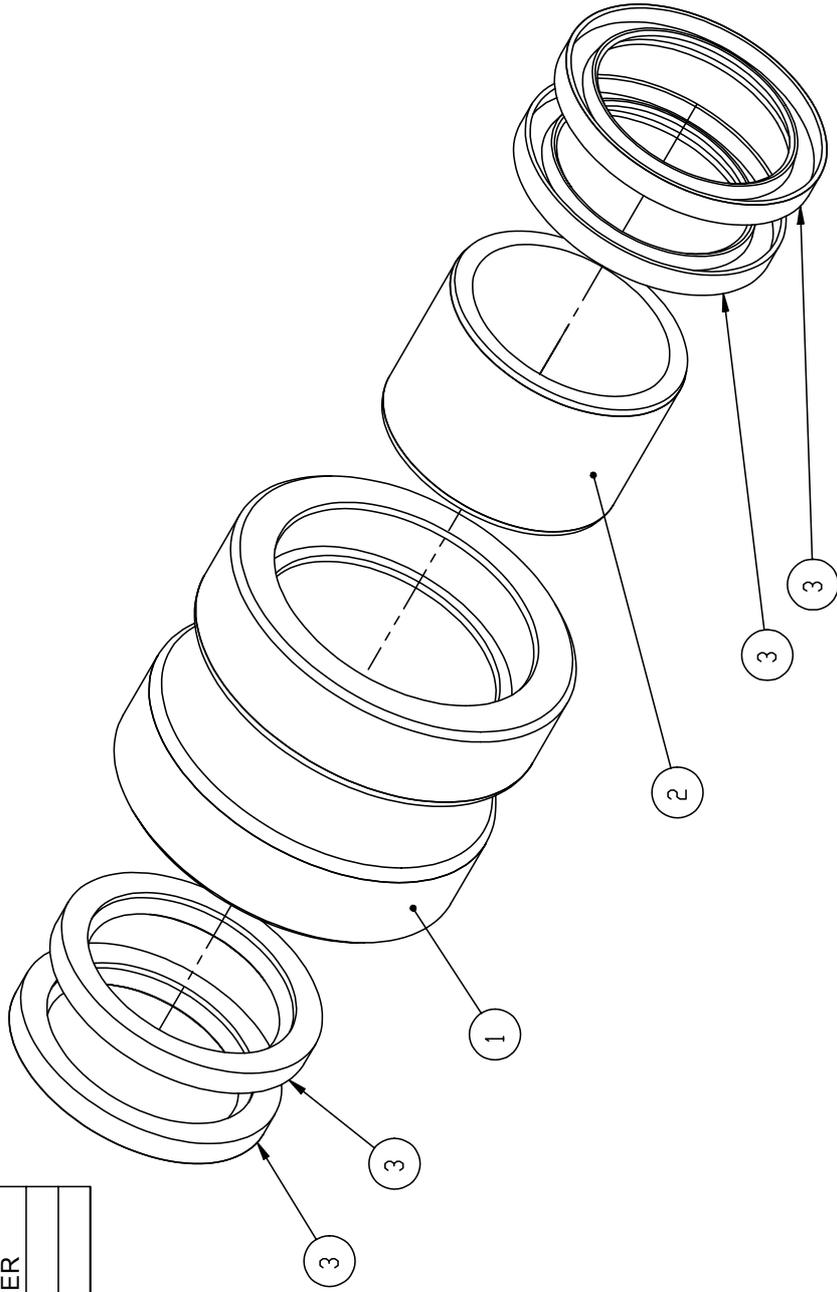
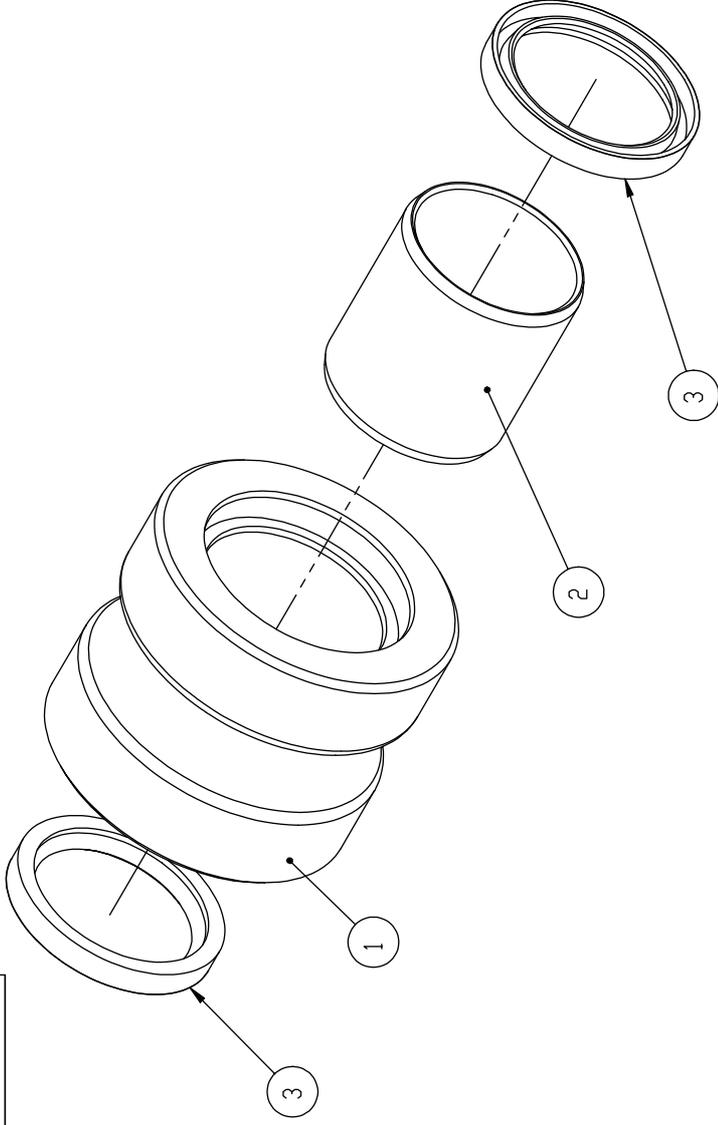


Figure 4. Drag Roller (assembly number 5003-500-008).

ITEM NO.	QTY	PART NO.	DESCRIPTION
1	1	5003_510_045	RELEASE ROLLER.
2	1	PM2530DX_GLACIER	BEARING
3	2	NAK32X25X4VC	SEAL, NAK.



**Figure 5. Release Roller (assembly number 5003-500-013).**

UNCONTROLLED WHEN PRINTED

**Blank Page**

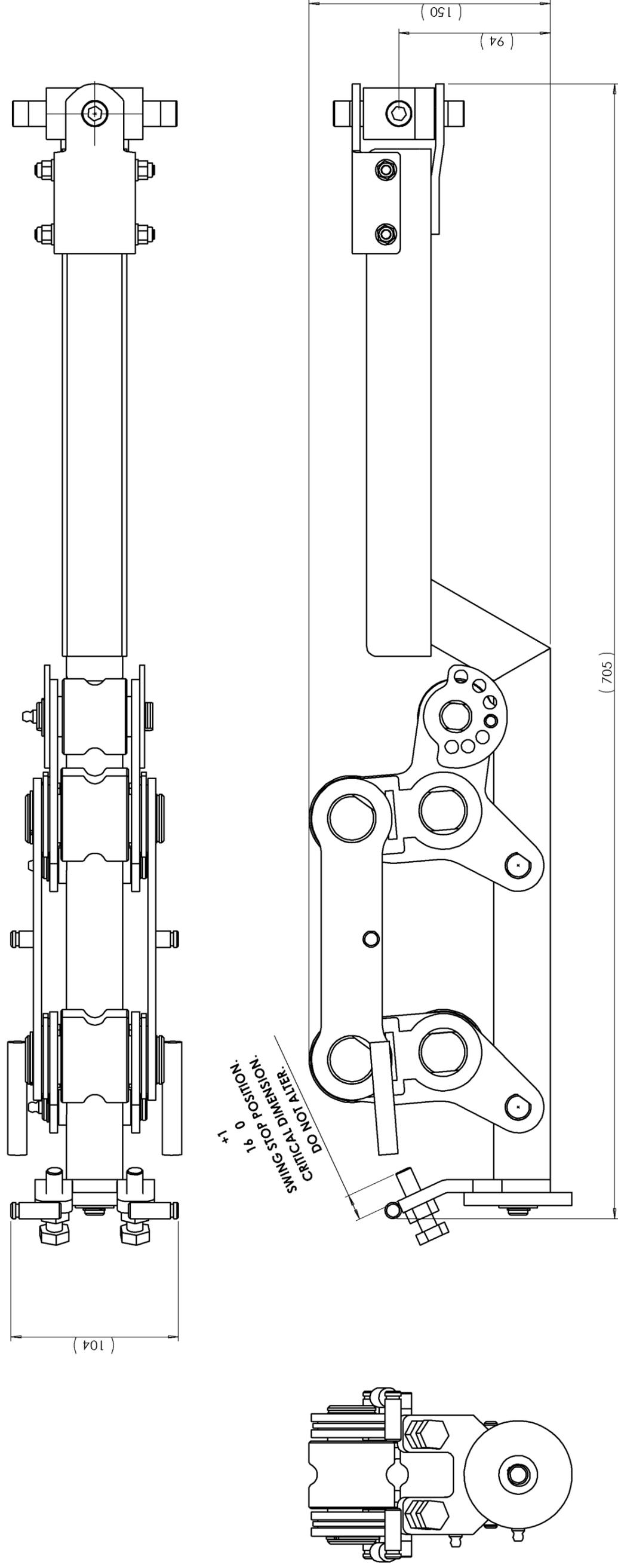


Figure 6. Rope Brake Assembly (Right Hand Rope Brake shown in installed position).

**Blank Page**

### 1.3. Specification.

The Rope Brake specifications are detailed in Table 1.

**Table 1. Rope Brake Specifications.**

Rope type:	Nominal 13mm Dia. Casar Superplast. Acceptable rope 13mm Dia. → 13.65mm Dia.	
Resistance (Fully Engaged):	50-80kg.	
Resistance (Disengaged):	Rope pullout force approximately 5kg.	
Envelope, fairlead in vertically down position:	Below Rope centre line: 140mm Above rope centreline: 60mm Width: 105mm. Length (including mounting): 705mm.	
Lubrication:	Standard LG2 (e.g. Shell Retinex LX2) grease lubrication through automotive type grease nipples (3 off) Light oiling of universal joint pivots and side link plates with 20W-50 automotive lubricating oil or OMD115.	
Fasteners:	Cap screws. Hexagonal head screws. Plain nuts and Nyloc nuts.	Class 10.9, zinc plated Class 8.8, zinc plated. Class 8, zinc plated.
Surface finish:	Electrolytic zinc plating (8 micron) with black chromate conversion passivation.	
Tools for assembly and maintenance:	See Annex A.	
Mass:	Approximately 9kg.	

## 2. OPERATION OF THE ROPE BRAKE.

### 2.1. *Free spool rope release.*

The Rope may be pulled through the Rope Brake from the winch (configured to free spool) using the following procedure:

- a. Engage the winch free spool control.
- b. Grasp the rope at a convenient location where it exits the rope guide, and pull the rope from the winch.
- c. If rope cannot be pulled from the winch.
  - I. Use the winch controls (For the MRV, refer to the Operators Handbook – para 2.59 Operator’s procedure) to release the tension in the rope between the winch drum and the Rope Brake.
  - II. Alternatively grasp the rope between the Rope Brake and the winch drum and deflect it sideways, therefore pulling a small amount of rope through the Rope Brake towards the winch and allowing the Rope Brake to dis-engage more easily.
- d. When the required amount of rope has been released, dis-engage the winch free spool control.

**CAUTION:**

WHEN PAYING OUT WINCH ROPE, ALWAYS ENSURE THAT A MANUAL LOAD IS APPLIED TO REDUCE THE RISK OF THE ROPE ACCUMULATING BETWEEN THE WINCH DRUM AND ROPE BRAKE ASSEMBLY. DAMAGE TO EQUIPMENT AND INJURY TO PERSONNEL CAN RESULT ON ‘WINCH IN’, IF THIS CONDITION IS NOT MONITORED.

**CAUTION:**

WHEN MANUAL HANDLING OF A WINCH ROPE IS REQUIRED, ENSURE THAT THE APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT (PPE) IS USED SUCH AS GLOVES AND OR WHERE CONSIDERED NECESSARY A WINCH ROPE HANDLING TOOL. NEVER ALLOW THE ROPE TO SLIP/SLIDE THROUGH A GLOVED OR OPEN HAND AS SERIOUS INJURY CAN OCCUR FROM BROKEN WIRES OR DAMAGED ROPE.

### 2.2. *Winch out with the rope unloaded.*

The Rope may be unwound from the winch through the Rope Brake and fairlead using the following procedure:

- a. Apply a load to the rope at its free end or manually at a convenient location after it exits the rope guide.
- b. Using the winch controls, unwind the rope from the winch drum, ensuring that the load applied is sufficient to pull the rope through the Rope Brake and fairlead.

- c. When unwinding the rope observe the area between the Rope Brake and the winch drum to ensure that slack rope is not accumulating. If slack accumulates, stop the winch and pull the rope through the fairlead to remove the slack.

### **2.3. Winch out with the rope loaded.**

A loaded rope will freely run out through the Rope Brake using the following procedure:

- a. Visually inspect the Rope Brake to ascertain that the load on the free end of the rope has disengaged the brake. If the brake has not disengaged, use the winch control to release approximately 100mm of rope, and visually check the Rope Brake for disengagement.
- b. Using the winch controls, unwind rope from the winch drum.
- c. If the load on the rope end cannot be maintained, use the procedure recommended in paragraph 2.2.

### **2.4. Winching in with no load applied to the free end of the rope.**

The Rope Brake is designed to automatically apply a braking force to the rope when there is less than approximately 80 kg tension on the free end of the rope:

- a. Using the winch controls, engage the winch and wind the rope onto the winch drum.
- b. Visually inspect the Rope Brake to ensure correct operation.
- c. Visually inspect the laying-on of the rope onto the winch drum.

#### **CAUTION:**

WINCHING IN AN UNLOADED WINCH ROPE (90 METRES) AT HIGH SPEED WITH LESS THAN 15-MINUTE INTERVALS MAY LEAD TO OVERHEATING. PERMANENT DAMAGE TO DRAG ROLLER BEARINGS AND SEALS MAY RESULT.

### **2.5. Winching with a rope under load.**

The Rope Brake is designed to automatically dis-engage when a force above approximately 80 kg loads the free end of the rope. The Rope Brake may engage and dis-engage if the load on the free end of the rope is less than 80 kg and varying:

- a. Using the winch controls, engage the winch and wind the rope onto the winch drum.
- b. Visually inspect the Rope Brake to ensure that the brake is disengaged, and that the drag rollers do not deflect the rope.
- c. Visually inspect the laying-on of the rope onto the winch drum.

#### **CAUTION:**

ENGAGEMENT BY THE ROPE BRAKE OF A ROPE TENSIONED ABOVE 2000kg MAY RESULT IN PERMANENT DAMAGE TO THE ROPE BRAKE AND THE ROPE. CEASE WINCHING IMMEDIATELY AND ADJUST THE ROPE BRAKE IF THIS OCCURS.

### 3. ASSEMBLY AND DIS-ASSEMBLY.

The following descriptions for assembly and dis-assembly assume that the operator has familiarized themselves with the components of the Rope Brake and their relative positions, as illustrated in Figure 1, Figure 2, Figure 3, Figure 4 and Figure 5. Servicing of roller and release roller sub-assemblies are described separately, in Section 4.3.1.2 and Section 4.3.2.2.

All components must be clean and dry, and free of all lubricants prior to assembly. Particular attention must be given to the cleanliness of threaded blind holes. Lubrication of components and sub-assemblies must only be carried out as instructed in this and following sections.

Recommended fastener torque values are contained in ANNEX B.

#### 3.1. Assembly.

**WARNING:**

DO NOT OPERATE THE WINCH WHILE THE ROPE BRAKE IS BEING FITTED TO THE RECOVERY EQUIPMENT.

**WARNING:**

DO NOT OPERATE THE WINCH WHEN A DAMAGED OR INCOMPLETE ROPE BRAKE IS FITTED TO THE RECOVERY EQUIPMENT.

**NOTE:**

**Do not remove the rollers from their axles prior to assembly unless required for inspection and repair procedures (refer section 4.3).**

**NOTE:**

**Although the Rope Brake can be assembled around the winch rope without removing the rope from the winch drum, it is recommended to fit the assembled rope brake to the fairlead after removing the winch rope from the drum. Where rope damage or rope failure precludes the above recommendation, disassembly of the Rope Brake from the rope is recommended. Failure to observe the difference in rope condition when removing the rope brake may damage the link plates, or rope brake or both.**

**CAUTION:**

BEFORE FITTING THE ASSEMBLED ROPE BRAKE TO THE FAIRLEAD ASSEMBLY, ENSURE THAT THE WINCH ROPE HAS BEEN REMOVED FROM THE WINCH DRUM IN ACCORDANCE WITH THE PROCEDURES DETAILED IN THE OPERATORS HANDBOOK.

### 3.1.1. Winch rope removal.

Remove the winch rope from the recovery winch using the procedures recommended in the recovery system Operators Handbook (para 2.101).

### 3.1.2. Assembly of the universal joint.

- a. Using an 8mm Allen key, remove the four (4) M10 socket head cap screws (Figure 3, item 6, 7) from the universal joint assembly.
- b. Using a 5mm Allen key, remove the four (4) M6 socket low head cap screws (Figure 3, item 5) from the universal joint block and free the cap from the block.
- c. If the universal joint is a used component being re-fitted, inspect the block and cap for wear due to passage of the rope, and orient so that the most worn features are located towards the rear of the vehicle.
- d. Fasten the cap to the block using the four (4) M6 socket low head cap screws. Apply Loctite 242 to the screw threads.

### 3.1.3. Fitting the folded lug and universal joint to the hanger.

- a. Locate the folded lug (Figure 2, item 13) over the hanger channel, aligning the holes in the lug and channel.
- b. Using a 4mm Allen key and a 10mm AF spanner, fit the four (4) M6 socket button head cap screws with nuts and washers, (Figure 2, item 24, 25, 26) with the screw heads INSIDE the channel.

**NOTE:**

**Failure to fit the screws as specified will result in major damage to the rope and Rope Brake.**

- c. Locate the universal joint within the hanger end, specifically noting the orientation of the universal joint relative to the hanger (Figure 2, item 1).
- d. Apply Loctite 242 sparingly to the threads of the two (2) M10x20mm socket head cap screws (Figure 3, item 6). Fit each with a short bolt sleeve (Figure 3, item 3). Fasten the universal joint to the hanger. Loctite must not be allowed to bond the bolt sleeve to the bolt.
- e. Lightly oil the joint between the lug and bolt sleeves.

### 3.1.4. Fitting the arms and drag rollers.

- a. For a right hand side Rope Brake, fit a left hand rear arm (Figure 2, item 6) to the plain end of an arm pivot pin (Figure 2, item 3). Secure with a 16mm circlip.
- b. For a left hand side Rope Brake, fit a right hand rear arm (Figure 2, item 11) to the plain end of an arm pivot pin (Figure 2, item 3). Secure with 16mm circlip.
- c. Fit a front arm (Figure 2, item 2) to the plain end of a pivot pin (Figure 2, item 3). Secure with a 16mm circlip.
- d. Fit the arm pivot pins to the hanger so that the grease nipples point outwards from the vehicle centre line.
- e. Fit 16mm external circlips to the arm pivot pins.

- f. Check the fitment of the bearings and seals to the four (4) drag rollers prior to assembly on the axles. If removal or fitting of these items is required, refer to Section 4.3 (Inspection and Repair). Move the drag rollers (Figure 2, item 10) to the centre of their respective axles (Figure 2, item 4, 7).
- g. Align the flats on the short axle with the flats in the hole in the front arm and fit the axle to the arm.
- h. Fit a scraper/wear plate (Figure 2, item 18) to the short axle, and hold in place while fitting the adjacent long axle to the side plate.

**NOTE:**

**The design of the short axle and its hole allows it to slide away from the long axle.**

- i. Fit a 30x40x1 washer (Figure 2, item 5) over the end of each axle adjacent to the front arm.
- j. Fit a shear link with the rectangular slot closest to the long axle and secure with a 30mm circlip on the short axle.

**NOTE:**

**The shear link can be damaged if it is forced over one or both axles. With the rollers and arm correctly positioned, the shear link can be pushed onto the axles by hand. Ensure that the shear link is parallel to the arm face at all times.**

- k. Fit the drag rollers and scraper/wear plate to the rear arm.
- l. Fit the washers and shear link to the rear arm, fasten with a 30mm circlip on the short axle.
- m. Check the release roller bearing is seated correctly before lightly lubricating the release roller assembly (Figure 2, item 14) with grease, and assemble onto the release roller axle (Figure 2, item 15).
- n. Fit the release roller axle into the rear arm, so that the grease nipple points outwards from the vehicle centre line.
- o. Fit a setting disk (Figure 2, item 16) to the release roller axle end, without engaging the pin in a disk hole, and secure using a 20mm external circlip.

**CAUTION:**

**ENSURE THAT A 16MM CIRCLIP IS NOT MISTAKENLY FITTED TO THE 20MM AXLE END.**

- p.
- q. Locate a scraper/wear plate between the free ends of the front long and short axles and then fit the remaining front arm over the ends.
- r. Fit the washers and shear link as for the inner side, and secure the pivot pin and short axle with the appropriate circlips.

- s. Fit the second rear arm, including the second scraper/wear plate in the assembly sequence. Fit the washers, shear link and setting disk; secure the pivot pin, release roller shaft, and short axles with the appropriate circlips.
- t. Fit the 30x40x1 washers to the end of each of the long axles, abutting the upper end of the shear links.
- u. Link the front arm and rear arms together using a link (Figure 2, item 12) on each side with the grooved pin facing outwards and closest to the hanger.
- v. Using the 30mm circlips, secure the links.

### 3.1.5. Fitting the buffer, swing-stop and springs.

- a. Locate the buffer disk (Figure 2, item 17) over the front (central) spigot on the hanger. Fit an M12 flat washer (Figure 2, item 27) and retain with a 12mm external circlip (Figure 2, item 22).
- b. Thread one (1) M12 nut (Figure 2, item 28) approximately half way along each swing stop M10 machine screw (Figure 2, item 29). Fit the machine screws to the threaded holes in the front of the hanger.

#### CAUTION:

THE POSITION OF THE SWING STOP SCREWS MUST BE SET TO THE DIMENSION SHOWN ON FIGURE 6 USING THE PROCEDURE SPECIFIED IN SECTION 4.4.2.

- c. Hook the loop at one end of the extension spring (Figure 2, item 30) into the groove of the pin in the arm link (Figure 2, item 12). Hook the other end of the spring into the groove of the pin at the front end of the hanger, adjacent to the backstop screw. Repeat on the other side of the Rope Brake using the second spring.

### 3.1.6. Set-up

- a. Lubricate (Refer Section 4.1.1) and inspect (Refer Section 4.1.2) the Rope Brake;
- b. After removing the winch rope from the drum and before fitting the rope brake assembly to the fairlead, pass the rope through the Rope Brake universal joint, over the release roller, and between each pair of drag rollers. Ensure that the winch rope is routed correctly through the rope support bracket (under the personnel kit platform) and back to the winch drum.
- c. Locate the universal joint between the fairlead cheek-plates; align the universal joint side hole with the 16mm diameter hole in the fairlead.
- d. Apply Loctite 242 sparingly to the threads of the two (2) M10x25mm socket head cap screws (Figure 3, item 7). Fit each with a long bolt sleeve (Figure 3, item 4). Fasten the hanger to the fairlead. Loctite must not be allowed to bond the bolt sleeve to the bolt.
- e. Lightly oil the joint between the lug and bolt sleeves.
- f. Refit the winch rope to the drum in accordance with the Operators Manual (para 2.101); and

**CAUTION:**

THE WINCH ROPE MUST BE ATTACHED TO THE WINCH DRUM AND BEDDED IN USING THE PROCEDURES IN THE RECOVERY SYSTEM OPERATORS MANUAL (2.101).

**CAUTION:**

THE ROPE BRAKE WILL NOT PROVIDE SUFFICIENT TENSION TO BED IN THE WINCH ROPE ON THE WINCH DRUM.

**NOTE:**

**The roller and arm assemblies should be free to rotate. Passage of the rope between the roller pairs should be unhindered when the arms are swung towards the rear of the recovery equipment, and firmly gripped between the roller pairs when the arms are swung towards the front of the vehicle.**

- g. Adjust the Rope Brake in accordance with the procedures referred to in Section 4.4

**3.2. Dis-assembly.**

The Rope Brake should be removed from the recovery system only after the winch rope is detached from the winch drum and carefully withdrawn back through the Rope Brake assembly.

- a. For removal of the winch rope from the recovery winch; refer to the recovery system Operators Manual for the winch rope removal procedure.

**CAUTION:**

ENSURE THAT ANY DAMAGED PORTIONS OF ROPE AND ALSO THE TAPERED AND WELDED END OF THE ROPE TOGETHER WITH ANY AREAS DEFORMED DUE TO ATTACHMENT OF THE ROPE TO THE WINCH DRUM ARE VISUALLY MONITORED DURING THEIR PASSAGE THROUGH THE ROPE BRAKE. IF NECESSARY, ROTATE THE ROPE SUCH THAT THE LEAST DIMENSION PASSES BETWEEN THE ROLLERS. CHECK THAT THE SHEAR LINKS ARE NOT DAMAGED AFTER REMOVAL OF A DEFORMED ROPE.

- b. Dis-assembly procedures for the Rope Brake down to a component part or sub-assembly level are the reverse of the assembly sequence detailed in Section 3.1 above. Drag roller and release roller assembly and dis-assembly are detailed in Sections 4.3.1 and 4.3.2.

**4. MAINTANENCE.****4.1. Servicing.**

Rope Brake performance and bearing life is severely degraded by excessive dirt build-up. Dirt may be removed with a soft brush and washing off with fresh water. Cleaning with high-pressure air or water cleaners will result in damage to the Rope Brake.

Recommended inspection and maintenance tasks are detailed in the following sections.

#### 4.1.1. Lubrication.

If used daily the Rope Brake should be lubricated and inspected on a weekly basis. All dirt and grease accumulations must be removed prior to lubrication. Clean all grease nipples prior to use.

##### 4.1.1.1. Pivot pin lubrication.

- a. Using a manual grease gun, grease each pivot pin while oscillating the arms back and forth. Removal of the extension springs will facilitate this process. Lubricate with grease until clean grease flows from both sides of the hanger bush. It may be necessary to displace the arms to one side then the other to achieve clean grease flow from both sides.
- b. Remove excess grease from between the arms and the hanger. A small bead of grease left between the arm and hanger will assist in preventing dirt entering the hanger bush.

##### 4.1.1.2. Release roller lubrication.

- c. Using a manual grease gun, apply grease to the release roller axle while rotating the roller, until grease flows from inside the roller seals.

**NOTE:**

**Rapid pumping of grease into the release roller axle may force the seals from the roller.**

- d. Remove excess grease from between the release roller and the arms.

##### 4.1.1.3. Oil lubrication.

- a. Remove all dirt between the drag rollers and arms, and from the seal faces. Apply several drops of oil at the ends of the short and long axles, between the arms and the shear links.
- b. Apply several drops of oil to the two (2) bolt sleeves on the universal joint that are within the fairlead, and to the two (2) bolt sleeves that are located in the universal joint side plates.

#### 4.1.2. Visual check.

A visual inspection is to be carried out whilst lubricating the equipment to verify the following characteristics:

- a. Free and smooth operation of all drag rollers and the release roller;
- b. Absence of flat spots in the groove of the drag rollers;
- c. Full articulation of the universal joint, with minimal free play in the pivots;
- d. Check all fasteners to verify that they are present and fully inserted;
- e. No dirt is compacted between the roller ends and the arms;
- f. All joints are adequately lubricated; and
- g. There is no visible stretching of the shear links.

### 4.1.3. Annual service.

The Rope Brake must be removed from the fairlead, dis-assembled, and inspected annually. Inspection and repair procedures are described in Section 4.3. Components that are cracked or damaged in ways not described by the wear limits in Table 5 must be replaced.

**NOTE:**

**Characteristics of the Rope Brakes' design results in higher wear on the front pair of drag rollers. It is recommended that rollers and axle combinations be interchanged regularly to maximize the performance of the Rope Brake. Do not separate the rollers from their axles prior to evaluation.**

The wear limits of the drag rollers and their shafts should be evaluated using the criteria in Section 4.3.1. A typical interchange sequence is given in Table 2.

**Table 2. Typical Drag Roller and Axle Interchange Sequence.**

<b>Initial roller drag roller position, rope guide vertically down.</b>	<b>New roller drag roller position.</b>
Rear top.	Front bottom.
Rear bottom.	Front top.
Front top.	Rear bottom
Front bottom.	Rear top.

After inspection, assembly and lubrication, the release roller adjustment must be checked (Refer Section 4.4)

UNCONTROLLED WHEN PRINTED

## 4.2. Fault diagnosis.

Typical causes of poor Rope Brake performance and corrective action are described in Table 3.

**Table 3. Fault Diagnosis.**

<b>Fault.</b>	<b>Diagnosis.</b>	<b>Rectification.</b>
Poor braking performance.	1. Shear links damaged.	Disassemble Rope Brake, inspect shear links.  Inspect rope for kinked or squashed strands, and broken wires. Rope damage can cause shear link damage.
	2. Drag roller and/or axles worn.	Disassemble Rope Brake, inspect drag roller assembly (Refer Section 4.3.1), scraper/wear plates (Refer Section 4.3.5)
	3. Oil contamination of bearings.	Disassemble Rope Brake; inspect roller drag roller assembly (Refer Section 4.3.1), clean bearings and seals.
	4. Release roller incorrectly positioned.	Adjust release roller position (Refer Section 4.4.1)
	5.	
Braking force when winching unloaded rope varies.	1. Worn or damaged drag rollers.	Disassemble Rope Brake; inspect drag roller assembly (Refer Section 4.3.1).
Rope Brake does not release when rope end is loaded.	1. Release roller incorrectly positioned.	Adjust release roller position (Refer Section 4.4.1)
Rope Brake does not engage on unloaded rope.	1. Extension springs defective.	Replace springs.
	2. Shear links damaged.	Disassemble Rope Brake, inspect shear links.  Inspect rope for kinked or squashed strands, and broken wires. Rope damage can cause shear link damage.
	3. Lubricant contamination of bearings.	Disassemble Rope Brake; inspect drag roller assembly (Refer Section 4.3.1), clean bearings and seals.
	4. Drag roller and/or axles worn.	Disassemble Rope Brake, inspect drag roller assembly (Refer Section 4.3.1), scraper/wear plates (Refer Section 4.3.5)

### 4.3. Inspection and Repair.

The following procedures describe the recommend inspection and repair sequences.

#### 4.3.1. Drag rollers and axles.

The drag rollers and their axles should initially be inspected while fitted together so that the condition of the seals is easily evaluated. Subsequent inspections of the components themselves may then be carried out. The following procedures describe the removal, inspection and replacement of the roller and axle combination:

- a. Remove each axle and its drag roller from the Rope Brake as an assembly.
- b. Remove all dirt and debris from the rollers, seals and axles.
- c. Inspect the roller and axle combination for obvious indications of damaged seals and excessive wear (Refer Section 4.3.1.2.1). Do not further disassemble the axle/roller combination unless necessary.
- d. Rotate the roller relative to the axle while gently withdrawing the roller from its axle. This action allows the seal lips to pass easily over the axle shoulders and grooves.

**NOTE:**

**Failure to rotate the rollers sufficiently while withdrawing the axles will result in seal damage.**

- e. Inspect and repair the axles and rollers (Refer Sections 4.3.1.1, 4.3.1.2).
- f. Wipe the equivalent of approximately five drops of grease between the seal lips on each side of the drag rollers, ensuring that the seal lips themselves are wetted. DO NOT apply grease to the bearing within the roller or onto the axles.

**NOTE:**

**Wetting the axles and roller assembly bearings with grease will degrade the braking performance of the Rope Brake.**

- g. Insert the axle into the roller end at a slight angle and gently push the roller onto the axle while rotating the axle. Reduce the axle inclination, and repeat to pass the second seal over the axle flats and grooves.

**NOTE:**

**Failure to rotate the rollers sufficiently whilst inserting the axles will result in seal damage.**

- h. Push the axle through the drag roller bearing, taking care not to gouge it with the axle end.
- i. Manipulate the second set of seals over the axle end; note that inclination of the axle relative to the roller is not possible at this stage.

#### 4.3.1.1. Short and long axles.

The axles are manufactured from ground heat-treated alloy steel, with a hardened surface. They are not repairable.

A smooth cylindrical surface on the axles is critical to the effectiveness of the Rope Brake, and the life of the drag roller bearings. Where there is some doubt about the condition of the axles, it is recommended that the axles be replaced.

- a. Clean the axle of dirt and debris.
- b. Measure axle diameters at the drag roller wear marks using appropriate vernier callipers or micrometers. Compare the diameters with the wear limits in Table 5; replace the axle if the wear limit is exceeded.
- c. Replace axles that have damaged circlip grooves, or bearing surfaces containing dents, nicks or scratches.

#### **4.3.1.2. Drag roller (complete).**

The rollers are manufactured from heat-treated alloy steel, with a hardened surface. They are not repairable.

The following procedure assumes that a complete drag roller assembly is removed from the Rope Brake and presented for inspection and repair.

##### **4.3.1.2.1. Drag roller inspection.**

- a. Clean the roller, noting the extent and type of any debris deposited within the seal lips and on the internal bearing surface. Worn or damaged seals or a worn bearing will allow dirt to accumulate between the seals and enter the bearing. In-appropriate daily maintenance may result in the debris consisting of dirt aggregated with quantities of oil or grease.
- b. Measure the diameter of the bottom of the rope groove in the roller using appropriate vernier callipers, and inspect the groove for any local damage or flat spots. If flat spots are observed, diameters must be measured at the corresponding location(s). Compare the diameter(s) with the wear limit in Table 5 to determine the suitability of the roller for further use.
- c. Measure the width of the roller, and compare with the wear limit in Table 5 to determine the suitability of the roller for further use.
- d. Using a flat tip screwdriver (Refer ANNEX A.), carefully pry an outer seal from one side of the roller assembly. Repeat with the second seal on the same side, taking care not to damage the edge of the bearing.
- e. Using appropriate vernier callipers or internal micrometers measure the internal diameter of the drag roller bearing at the outer 5mm of the bearing length at a minimum of two locations oriented 90° apart. Compare the diameters with the wear limits in Table 5.
- f. If both the roller and bearing exceed the specified wear limits, replace the complete assembly.
- g. If the bearing is suitable for further use, fit the roller to an axle, and push the bearing against the axle surface to create the maximum possible eccentricity between the roller and the axle. Check for clearance between the seal lips and the axle on the side opposite to where the contact has been made between the bearing and axle. If the clearance is observed, replace all seals.
- h. Inspect the seal lips for wear and cracking.
- i. Remove and replace all damaged or worn seals. Refer to section 4.3.1.2.3 for seal replacement procedure.

#### **4.3.1.2.2. Drag roller bearing removal and replacement.**

**NOTE:**

**It is NOT recommended that bearings be removed and then refitted to the same or other rollers for further use.**

Use of a hydraulic press to remove and fit the bearings is recommended.

- a. Support the roller outside the diameter of the seal groove.
- b. Using the appropriate bearing removal/replacement tool (Refer ANNEX A.) or a suitable alternative tool, press the bearing from the roller taking care not to damage the roller bores or corners.
- c. Remove any dirt or debris from the roller.
- d. Fit a new bearing to the removal/replacement tool and align the bearing with the roller bore. Ensure that the bearing is kept aligned with the roller bore during fitting.
- e. Press the bearing into the roller until the upper edge is flush with the step in the roller bore. Inspect the bearing for damage.

#### **4.3.1.2.3. Drag roller seal replacement.**

**NOTE:**

**It is NOT recommended that seals be removed and then refitted to the same or other rollers for further use.**

Seals should be fitted without the use of impact or press tools:

- a. Apply a very light coat of clean automotive lubricating oil (OMD 115) to the outer diameter of the seal. Fit the seal to the appropriate seal replacement tool with the seal lip adjacent to the shoulder on the tool.
- b. Align the shaft of the tool with the bore of the drag roller bearing and push the seal into the roller until it contacts the bottom of the counter-bored hole.
- c. Repeat the procedure with the other three (3) seals.
- d. Using a clean lint free cloth, remove any traces of oil from the roller bores.

#### **4.3.2. Release roller and axle.**

The release roller and axle should initially be inspected while fitted together so that the condition of the seals is easily evaluated. Subsequent inspections of the components themselves may then be carried out. The following procedures describe the removal, inspection and replacement of the roller and axle combination:

- a. Remove the axle and its roller from the Rope Brake as an assembly.
- b. Remove all dirt and debris from the roller, seals and axle.
- c. Withdraw the roller from its axle.
- d. Inspect and repair the axle and roller (Refer Sections 4.3.2.1, 4.3.2.2).
- e. Wipe a very light film of oil (OMD 115) over the seal lips.

- f. Insert the axle into the roller end at slight angle, and gently push the roller onto the axle while rotating the axle. Push the axle through the bearing, taking care not to gouge it with the axle end.
- g. Manipulate the second seal over the shaft end noting that inclination of the axle relative to the roller is not possible at this stage.

#### **4.3.2.1. Release roller axle.**

The axle is manufactured from ground heat-treated alloy steel, with a hardened surface. It is not repairable.

A smooth cylindrical surface on the axle is important for long life of the release roller bearing. Where there is some doubt about the condition of the axle, it is recommended that it be replaced.

- a. Clean the axle of dirt and debris, noting the extent and type of any debris deposited on the axle surface.
- b. Measure axle diameter at the release roller wear marks using appropriate vernier callipers or micrometers. Compare the diameters with the wear limits in Table 5; replace the axle if the wear limit is exceeded.
- c. Replace axles that have damaged circlip grooves, or bearing surfaces containing dents, nicks or scratches.

#### **4.3.2.2. Release roller (complete).**

The roller is manufactured from heat-treated alloy steel, with a hardened surface. It is not repairable.

The following procedure assumes that a complete roller assembly is removed from the Rope Brake and presented for inspection and repair.

##### **4.3.2.2.1. Release roller inspection.**

- a. Clean the roller, noting the extent and type of any debris deposited within the seal lips and on the internal bearing surface. Worn or damaged seals or a worn bearing will allow dirt to accumulate inside the seals and enter the bearing.
- b. Measure the diameter of the bottom of the roller rope groove using appropriate vernier callipers, and inspect the groove for any local damage or flat spots. If flat spots are observed, diameters must be measured at the corresponding location(s). Compare the diameter(s) with the wear limit in Table 5 to determine the suitability of the roller for further use.
- c. Using a flat tip screwdriver (Refer ANNEX A.), carefully pry a seal from one side of the roller assembly.
- d. Using appropriate vernier callipers or internal micrometers measure the internal diameter of the roller bearing at the outer 5mm of the bearing length at a minimum of two locations oriented 90° apart. Compare the diameters with the wear limit in Table 5.
- e. If both the roller and bearing exceed the specified wear limits, replace the complete assembly.
- f. If the bearing is suitable for further use, fit the roller to the axle, and push the bearing against the axle surface to create the maximum possible eccentricity between the roller and the axle. Check for clearance between the seal lip and the axle on the side opposite to where the contact between the bearing and axle has been made. If clearance is observed, replace both seals.

- g. Inspect the seal lips for wear and cracking.
- h. Remove all damaged or worn seals.

#### **4.3.2.2.2. Release roller bearing removal and replacement.**

Use of a hydraulic press to remove and fit the bearings is recommended:

- a. Support the roller outside the diameter of the seal groove.
- b. Using the appropriate bearing removal/replacement tool (Refer ANNEX A.) or a suitable alternative tool, press the bearing from the roller taking care not to damage the roller bores or corners.
- c. Remove any dirt or debris from the roller.
- d. Fit a new bearing to the removal/replacement tool and align the bearing with the roller bore. Ensure that the bearing is kept aligned with the roller bore during fitting.
- e. Press the bearing onto the roller until the upper edge is flush with the step in the roller bore. Inspect the bearing for damage.

#### **4.3.2.2.3. Release roller seal replacement.**

**NOTE:**

**It is NOT recommended that seals be removed and then refitted to the same or other rollers for further use.**

Seals should be fitted without the use of impact or press tools:

- a. Apply a very light coat of clean automotive lubricating oil (OMD 115) to the outer diameter of the seal. Fit the seal to the appropriate seal replacement tool with the seal lip adjacent to the shoulder on the tool.
- b. Align the shaft of the tool with the bore of the drag roller bearing, and push the seal into the roller until it contacts the bottom of the hole.
- c. Repeat the procedure on the other side of the roller.

#### **4.3.3. Universal joint.**

Universal joint components must be removed from the Rope Brake prior to inspection. The removal and replacement procedure is described as follows:

- a. Using an 8mm Allen key, remove the two (2) M10 socket head cap screws (Figure 3, item 7) and the corresponding bolt sleeves (Figure 3, item 4) from the fairlead.
- b. Hold the Rope Brake in the dis-engaged position, and withdraw from the fairlead barrel until the universal joint is clear of the barrel end.
- c. Using an 8mm Allen key, remove the two (2) M10 socket head cap screws (Figure 3, item 6) and the corresponding bolt sleeves (Figure 3, item 3) from the universal joint. Withdraw the joint from the Rope Brake lugs.
- d. Using a 5mm Allen key, remove the four (4) M6 socket low head cap screws (Figure 3, item 5) from the Rope Brake universal joint block.
- e. Separate the universal cap (Figure 3, item 2) from the universal block (Figure 3, item 1).
- f. Inspect the universal joint parts. Refer section 4.3.3.1.

- g. Reassemble the universal joint using the procedure in Section 3.1.1. Apply Loctite 242 to the M10X1.5X25 socket head cap screws after adjustment of the Rope Brake (Section 4.4).

#### **4.3.3.1. Universal joint block and cap.**

The universal joint block and cap are machined from mild steel and are not repairable.

- a. Measure the minimum thickness between the top of the universal block and the radius cutout in the block using appropriate vernier callipers. Discard if wear exceeds that specified in Table 5.
- b. Measure the minimum thickness at the mid-length of the universal block cap using appropriate vernier callipers. Discard if wear exceeds that specified in Table 5.

#### **4.3.3.2. Bolt sleeves.**

The bolt sleeves are machined from alloy steel and are not repairable.

- a. Inspect the bolt sleeves for cracks and scour marks. Replace the sleeve if cracks or scour marks are present.
- b. Measure the smallest outside diameter using appropriate vernier callipers. Compare the diameter(s) with the wear limit in Table 5 to determine the suitability of the sleeve for further use.

#### **4.3.4. Shear links.**

The shear links are precision cut from steel sheet and are not repairable.

- a. Inspect the shear link. Discard the component if the bridge connecting the ends of the link, adjacent to the rectangular hole, is pitted by corrosion or if the link is bent or twisted.
- b. Using an appropriate set of vernier callipers, measure the extreme distance between the sides of the two axle holes. Discard the component if the wear limits of Table 5 are exceeded.

#### **4.3.5. Scraper/wear plates.**

The scraper/wear plates are precision cut from high tensile steel sheet and are not repairable.

- a. Replace bent or twisted plates or those where the ends are blunted.
- b. Measure the minimum thickness of the scraper/wear plates, preferably with suitable vernier callipers.
- c. Where the wear is significantly greater on one end of the plate, and the location and orientation was observed on dis-assembly (Refer Section 4.3), the plate may be re-used in the alternative orientation. Alternatively, replace the component.

### **4.4. Adjustment.**

#### **4.4.1. Release roller position.**

The position of the release roller relative to the rear arm controls the engagement of the Rope Brake and the neutral position of the Rope Brake, when a recovery load tensions the rope. The following procedure describes how the Rope Brake is set up to maximise its effectiveness and life:

- a. Anchor the free end of the rope, and using the winch controls winch in the rope until it is taught with tension of greater than 400kg. Ensure that the rope between the fairlead barrel and the winch is in good condition, with no crushed or kinked strands and no broken wires.
- b. Using an 8mm Allen key, remove the two (2) M10 socket head cap screws (Figure 3, item 7) and long bolt sleeves (Figure 3, item 4).
- c. Withdraw the Rope Brake from the fairlead, and slide it towards the winch approximately 1m.
- d. Grasp the hanger adjacent to the universal joint, and attempt to manually slide the Rope Brake towards the fairlead. Ensure the universal joint does not rotate and jamb on the rope. Repeat steps 'c' and 'd' several times if necessary. The Rope Brake should require approximately 20kg to pull it along the rope towards the fairlead.
- e. To increase the tension on the rope:
  - I. Note the orientation of the setting disks (Figure 2, item 16), and which hole is occupied by the locating pin on the rear arms (Figure 2, item 6 and 11). Using circlip pliers, remove the release roller axle circlips (Figure 2, item 20);
  - II. Remove the setting disks, and reposition them with the locating pin on the rear arms positioned in the setting disk hole that is adjacent to the initial, but located closer to the release roller axle (Figure 2, item 15). The radial spacing between each adjacent hole is 1mm; and
  - III. Replace the circlips, and retest the Rope Brake tension using steps 'c' and 'd'.
- f. To decrease the tension on the rope:
  - I. Note the orientation of the setting disks (Figure 2, item 16), and hole that is occupied by the locating pin on the rear arms (Figure 2, item 6 and 11). Using circlip pliers, remove the Release roller axle circlips (Figure 2, item 20);
  - II. Remove the setting disks, and reposition them with the locating pin on the rear arms positioned in the setting disk hole that is adjacent to the initial, but located farther from the release roller axle (Figure 2, item 15). The radial spacing between each adjacent hole is 1mm; and
  - III. Replace the circlips, and retest the Rope Brake tension using steps 'c' and 'd'.
- g. When the Rope Brake cannot be adjusted to provide the specified tension, inspect the drag roller assemblies (Refer Section 4.3.1).

#### 4.4.2. Swing stop position.

##### CAUTION:

DAMAGE TO THE ROPE WILL RESULT IF THE SWING STOP SCREW ENDS (FIGURE 2, ITEM 28) ARE SET AT LESS THAN THE SPECIFIED PROTRUSION FROM THE REAR FACE OF THE HANGER END PLATE.

Adjustment of the swing stop screws is not required unless they have been removed or arms and links have been replaced. .

The position of the swing stop screws limits the maximum deflection of the rope (by the drag rollers) that occurs when the Rope Brake is fully engaged. Adjustment of the swing stops is used to ensure that both sides of the brake mechanism are equally supported when the rope brake is fully engaged. Incorrect adjustment of the screws may also accelerate wear on the drag rollers and place unnecessary side loads on other rope brake components. The adjustment procedure is as follows:

- a. Using the recovery system winch controls, provide approximately three (3) metres of slack rope behind the fairlead. Ensure that the rope is in good condition, with no crushed or kinked strands and no broken wires.
- b. Use a steel rule to measure the extension of one swing stop screw (Figure 2, item 29) from the rope hanger end plate, and adjust to provide **16mm** as shown on Figure 6. While preventing rotation of the screw, use a 17mm spanner to secure the lock nut (Figure 2, item 28) against the hanger end plate.
- c. Use a 17mm spanner to loosen the other swing stop screw lock nut and withdraw the screw so that its end is forward of the locked screw.
- d. Using the winch controls, slowly winch the rope in, observing the engagement of the Rope Brake and the clearance between the front arm and the secured swing stop screw. Cease winching when the swing arm is one (1) mm from the screw end.
- e. By hand, screw the unsecured swing stop screw in until its end is positioned at the same distance from its adjacent arm as the locked screw.
- f. While preventing rotation of the screw, lock its position with the lock nut.
- g. Operate the Rope Brake several times while observing the operation of the Rope Brake.

#### 4.5. Wear and damage limits.

Recommended measurable wear limits are specified in Table 5. Damage, wear and repair of components not specified in Table 5 may adversely affect operation of the Rope Brake. Evaluate all unspecified wear and damage.

**Table 4. Rope Brake Component Wear Limits.**

Serial.	Part No.	Description.	Variable.	Limits.
1	5003_500_003	HANGER	Arm pivot hole internal diameter.	16.2mm 16.4mm
			Universal joint pivot hole internal diameter.	16.1mm 16.3mm
2	5003_510_055	FRONT ARM.	Flatness.	1mm out of plane
3	5003_510_012	ARM PIVOT PIN	Outside diameter.	16.0mm 15.8mm
4	5003_510_004	SHORT AXLE.	Outside diameter.	30.0mm 29.9mm
5	5003_500_011	REAR ARM, LEFT HAND	Flatness.	1mm out of plane
6	5003_510_005	LONG AXLE	Outside diameter.	30.0mm 29.9mm
7	5003_510_035	SHEAR LINK	Length (extreme distance between 30mm Dia. holes).  Flatness.	87.4mm  1mm out of plane.
8	5003_510_018	UNIVERSAL BLOCK	Thickness, arc cutout to outer surface.	12mm 10mm
9	5003_510_017	UNIVERSAL CAP	Thickness.	10mm
10	5003_510_050	BOLT SLEEVE, SHORT.	Diameter.	16.0mm 15.8mm
11	5003_510_019	BOLT SLEEVE, LONG.	Diameter.	16.0mm 15.8mm
12	5003_510_003	DRAG ROLLER	Diameter.  Width.	43.0mm 42.7mm  42.0mm 41.5mm
13	5003_510_039	BEARING	Inside diameter, fitted to roller.	25.5mm 25.1mm
14	NAK40X30X4VC	SEAL, NAK		See section 4.3.1
15	5003_500_009	REAR ARM, RIGHT HAND	Flatness.	1mm out of plane
16	5003_500_007	SWING ARM LINK	Flatness.  Hole diameter.	2mm out of plane  30.25mm 30.10mm
17	5003_510_031	FOLDED LUG.	Pivot hole diameter.	16.3mm

UNCONTROLLED WHEN PRINTED

				16.0mm
18	5003_510_045	RELEASE ROLLER.	Diameter.  Width.	39.00mm 38.25mm  40.0mm 38.5mm
19	PM2530DX, GLACIER	BEARING.	Inside diameter, fitted to roller.	25.25mm 25.10mm
20	NAK32X25X4VC	SEAL, NAK.		See Section 4.3.2
21	5003_510_049	RELEASE ROLLER SHAFT	Diameter.	25.0mm 24.85mm
22	5003_510_048	SCRAPER/WEAR PLATE.	Thickness.	1.6mm 1.1mm
23	Circlips DIN 471 external	Diameters 12, 16 and 20, 30mm	Diameter.	No stretch permissible.
24	E0500-049-3500	EXTENSION SPRING	Free length.	95mm

## ANNEX A.

### **Tools.**

The Rope Brake can be assembled and dis-assembled using the tools detailed in Table A-1.

**Table A- 1. Tools Required for Assembly and Disassembly.**

<b>Serial.</b>	<b>Tool.</b>	<b>Application.</b>
1.	8mm hexagonal socket wrench. (Allen key)	Placement of M10 socket head cap screws.
2.	5mm hexagonal socket wrench. (Allen key)	Placement of M6 socket low head cap screws.
3.	4mm hexagonal socket wrench. (Allen key).	Placement of M6 socket button cap screws.
4.	10mmAF ring spanner.	Fastening of M6 'Nyloc' prevailing torque nuts.
5.	External circlip pliers, medium.	Suitable for 30mm external circlips.
6.	External circlip pliers, small.	Suitable for 12, 16 and 20mm external circlips.
7.	17mm ring spanner + 17mm open ended spanner.	Adjusting and securing swing stops.
8.	Flat tip screwdriver, 4mm width.	Extraction of shaft seals from rollers.
9.	Seal and bearing placement drifts.	Removing and replacing bearings in Rope Brake rollers.

## **ANNEX B.**

### ***Fastener Tightening Torques.***

The fastener tightening torques required to conduct routine maintenance on the Rope Brake are listed in Table B-1.

**Table B- 1. Recommended Fastener Tightening Torques.**

<b>Fastener.</b>	<b>Torque (Nm).</b>
M6	9
M10	22

## WARRANTY AND REPAIR.

### Warranty Provisions.

1. The Rope Brake and Spare Parts as fitted to the Medium Recovery Vehicle Fleet, is warranted for defect or fault for a period of twelve months from the Commonwealth's acceptance of the equipment on Form SG1 or recorded site fitment date. (A summary of these dates will be forwarded to DCAuP at the completion of the Program).
2. The defect or fault should be reported via the Defence RODUM system, and the *faulty parts or components held* for contractor (OEM), or authorised representative inspection or investigation.
3. Alterations, unauthorised repairs, incorrect adjustments or incorrect maintenance techniques are *not* covered under warranty.
4. Consequential damages resulting from the operation of the rope brake will not be accepted under any circumstances.
5. The warranty period for all rope brakes and spares is due to expire on the 30<sup>th</sup> November 2004.
6. All other warranty provisions for the Rope Brake are the same as for the warranty described in the Head Contract and Section 1 of the Operator's Handbook, NSN 2320-66-145-0422.

NOTES.

UNCONTROLLED WHEN PRINTED