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**USER HAND BOOK  
FOR  
MINE PLOUGH (TWMP) - T90 S/SK**

AT/SO No: 28244/MP/T-90/GS/WE-15A DATED: 20 JULY 2021

**SUPPLIED BY:**

BEML LIMITED, S.R NAGAR, BANGALORE - 560027

**PUBLISHED BY:**

CONTROLLERRATE OF QUALITY ASSURANCE OF ENGINEERING EQUIPMENT  
AUNDH CAMP, PUNE – 411 027

SEP 2021

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## AMENDMENTS

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**DEMOLITION OF EQUIPMENT TO  
PREVENT ENEMY USE**

The demolition procedure outlined below will be used to prevent the enemy from using or salvaging the equipment. DEMOLITION OF THE EQUIPMENT WILL BE HELD ONLY ON ORDER OF THE COMMANDING OFFICER.

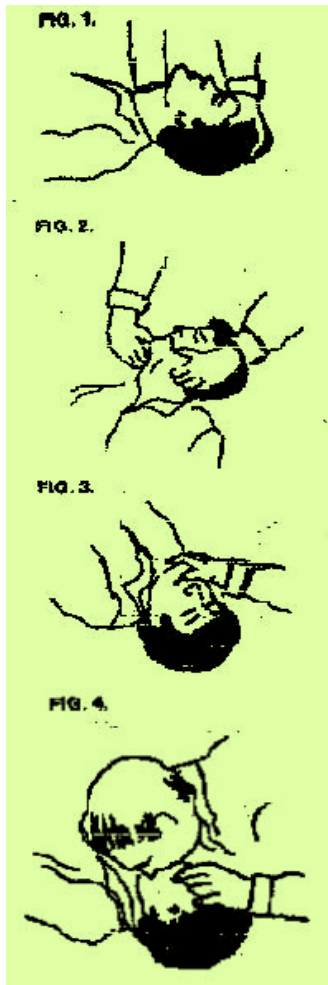
**METHOD OF DESTRUCTION**

*Use any or all the following methods to destroy the equipment.*

- (i) Smash – Smash the Crystals, Controls, Semiconductors, Coils, Switches, Transformers and Headsets, use Sledges, Hand-axes, Pickaxes, Hammers crowbars or heavy tools.
- (ii) Cut – Cut the Cords, Headsets and Wiring: use axes, hand-axes or hatchets.
- (iii) Burn – Burn the Cords, Resistors, Capacitors, Coils, Wiring, Technical Manuals, use Gasoline, Kerosene, Oil, Flamethrowers or Incendiary.
- (iv) Bend – Bend the panels, cabinet and chassis.
- (v) Explosives – If explosives are necessary, use firearms, grenades or TNT.
- (vi) Disposal – Bury or scatter the destroyed parts in slits trenches, fox holes or Other holes, or throw them into streams.

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**RESTRICTED****FIRST AID IN CASE OF ELECTRICAL SHOCK**

- |    |                                                                                                                                                                                                                                                                                                                                                                   |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. | SWITCH OFF. If this is not possible, PROTECT YOURSELF with dry insulating material and pull the victim clear of the conductor. DO NOT TOUCH THE VICTIM WITH YOUR BARE HANDS until he is clear of the conductor, but DO NOT WASTE TIME.                                                                                                                            |
| 2. | (a) Place the victim in the supine position.<br><br>(b) Keep the air passages clear by turning the head to one side, opening the patient's mouth and clearing it of water, saline, mucus or blood, a lot of which might have accumulated in the back of the throat. (Figure 1)                                                                                    |
| 3. | If the jaw is rigid try to force the mouth open by pressure on the gum behind the last molar tooth of the lower jaw. When the upper air passages are thus cleared, tilt the head backward and force the jaw forwards from the angles of the jaw in front of the ears. This would prevent mechanical obstructions to the upper air passages. (Figure 2-3)          |
| 4. | (a) Then hold the chin up and forward with one hand and pinch the nostrils of the victim with the other. (Figure 4)<br><br>(b) Take a very deep breath and apply your mouth to that of the victim and blow into his mouth, until the chest of the victim moves up indicating filling of the lungs. (NEVER ALLOW THE CHIN TO SAG). (Figure 4)                      |
| 5. | When the chest has moved up, withdraw your mouth and allow the chest to sink back. REPEAT this process every three to four seconds until the victim begins to breathe again or until he is taken over by a medical attendant. This method can be continued in an ambulance during transit of the patient from the site of accident to the nearest medical centre. |

**HAVE SOMEONE ELSE AND SEND FOR A DOCTOR.**

**KEEP PATIENT WARM AND LOOSEN HIS CLOTHING.**

**DO NOT GIVE LIQUIDS UNTIL THE PATIENT IS CONSCIOUS.**

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**RESTRICTED****ABBREVIATIONS**

<b>Sr. No.</b>	<b>Abbreviations issued</b>	<b>For</b>
1	A	Amp
2	Amdt	Amendment
3	AMSD	Anti Mine Sweeping Device
4	AP	Anti-Personnel
5	ARO	Authorised Repair Agency
6	AT	Anti-Tank
7	C	Celsius
8	CB	Circuit Breaker
9	Csk	countersink
10	CU	Control Unit
11	dc	direct current
12	EMI	Electro Magnetic Interference
13	FEE	Front End Equipment
14	Fig.	figure
15	Kg	kilogram
16	km/h	Kilometres per hour
17	LED	Light Emitting Diode
18	LH	Left hand
19	l/m.	litres per minute
20	max.	maximum
21	min.	Minimum
22	mm.	Millimetre(s)
23	No.	Number
24	NSN	NATO Stock Number
25	o/c	open circuit
26	Para	paragraph
27	PEL	Pearson Engineering Ltd
28	RH	right hand
29	s/c	short circuit
30	SW	Safe Working Limit
31	TBD	to be determined
32	TWMP (T-90)	Track Width Mine Plough (T-90)
33	V	volts

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**DO'S & DON'TS**

**DO'S**

1. BEFORE PERFORMING ANY FUNCTIONAL TEST OR OPERATION OF THE TWMP (T90) ALL WARNINGS CONTAINED IN THE PRELIMINARY MATERIAL MUST BE READ AND FULLY UNDERSTOOD.
2. THE TWMP (T90) MUST ONLY BE FITTED ON FIRM LEVEL GROUND.
3. BEFORE OPERATION OF THE VEHICLE, MAKE SURE ALL PERSONNEL ARE CLEAR OF THE VEHICLE AND TWMP (T90). MOVE THE VEHICLE FORWARD SLOWLY.
4. BEFORE FITMENT OF THE MOUNTING PINS OR ELECTRICAL HARNESS, MAKE SURE THE VEHICLE TRANSMISSION IS IN NEUTRAL AND THE HANDBRAKE IS SET.
5. THE BLADE ASSEMBLY WEIGHS 611KG. CARE SHALL BE TAKEN WHEN LIFTING THIS ASSEMBLY.
6. THE COMPLETE TWMP (T90) WEIGHS 1500 KG. USE LIFTING EQUIPMENT WITH A S.W.L. RATED ABOVE THE WEIGHT OF THE EQUIPMENT TO BE LIFTED.
7. USE APPROPRIATE PERSONAL PROTECTION EQUIPMENT WHEN WORKING WITH PRESSURISED SYSTEMS.
8. BEFORE USING ANY CONSUMABLE OR HAZARDOUS SUBSTANCE, READ AND UNDERSTAND THE MATERIAL SAFETY DATA SHEET FOR THAT SUBSTANCE.
9. SHARP AND ROUGH EDGES MAY BE PRESENT ON THE TWMP (T90) AS A RESULT OF WEAR OR DAMAGE. DUE CARE MUST BE EXERCISED WHEN CARRYING OUT MAINTENANCE AND REPAIR TASKS ON THE TWMP (T90).
10. THE HYDRAULIC SYSTEM IS PRESSURISED AND WILL PRESENT A DANGER TO PERSONNEL. ENSURE THAT SUITABLE PRECAUTIONS ARE TAKEN WHEN OPENING THE SYSTEM.
11. TAKE CARE WHEN CONNECTING OR DISCONNECTING HYDRAULIC HOSES TO/FROM THE HOST VEHICLE, DUE TO POSSIBLE RESIDUAL PRESSURE.

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12. PRIOR TO CARRYING OUT ANY MAINTENANCE OR REPAIR TASK ON THE TWMP (T90), HYDRAULIC PRESSURE MUST BE RELIEVED BY ALLOWING IT TO LOWER TO THE GROUND UNDER IT'S OWN WEIGHT.
13. DUE CONSIDERATION SHOULD BE GIVEN TO THE HIGHLY FLAMMABLE NATURE OF GASOLINE AND ITS VAPOUR. CARELESSNESS IN ITS USE MAY RESULT IN BURNS.
14. FIRING ARTILLERY AT RANGES OF 460 METRES (500 YARDS) OR LESS, AND FIRING GRENADES OR ANTI-TANK ROCKETS SHOULD BE FROM COVER.
15. MAKE SURE THAT SUITABLE PRECAUTIONS ARE TAKEN AND APPROPRIATE PPE IS WORN WHEN OPERATING THE SYSTEM.
16. REMOVE INCOMING POWER SUPPLY TO CU FROM VEHICLE BEFORE PROCEEDING.
17. A WELDING ARC IS BRIGHT ENOUGH TO DAMAGE EYESIGHT AND CAUSE FLASH BURNS. NEVER LOOK DIRECTLY AT A WELDING ARC WITH UNPROTECTED EYES, ALWAYS USE AN APPROVED WELDING SCREEN OR VISOR AND COVER ALL EXPOSED SKIN BEFORE WELDING.
18. AIR BUBBLE PRESENT IN THE HYDRAULIC SYSTEM OF THE TWMP MAY OPERATE ERRATICALLY AND HAS THE POTENTIAL TO DROP. STAND CLEAR OF THE TWMP WHEN PURGING THE AIR FROM THE HYDRAULIC SYSTEM.
19. ENSURE STAND CLEAR OF MOVING EQUIPMENT TO AVOID INJURY.
20. ALWAYS ENSURE THE TWMP (T90) IS IN THE STOWED POSITION WITH THE TRANSPORT LOCK PINS INSERTED BEFORE PERFORMING ANY INSPECTION OR REPAIR PROCEDURES ON THE TINES.
21. ALWAYS ALLOW A WELD TO COOL BEFORE REMOVING WELDING SLAG.
22. ALWAYS WEAR EYE PROTECTION WHEN USING GRINDING TOOLS OR WHEN REMOVING EXCESS WELDING.
23. HYDRAULIC OIL, PAINT, ETC., MAY PRESENT AN IGNITION SOURCE. BEFORE USING WELDING OR CUTTING EQUIPMENT, FLAMMABLE SUBSTANCES MUST BE REMOVED FROM THE AREA AND THAT A FIRE EXTINGUISHER IS EASILY ACCESSIBLE.

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24. MAKE SURE THE VEHICLE POWER IS SET TO OFF BEFORE PROCEEDING WITH THE TASK OF ANY REPAIR/MAINTENANCE.
25. CARE SHALL BE TAKEN WHILE LIFTING POWERPACK BRACKET, VEHICLE ADAPTOR BRACKET, LIFT CYLINDER, BLADE ASSY., BOOM ASSY, MOUNTING BRACKET, SKID, SKID ADJUSTER, UPPER BLADE.
26. WHILE LIFTING HEAVY WEIGHT MECHANICAL LIFTING OR AT LEAST TWO PERSON LIFTING SHALL BE UTILISED WHERE NECESSARY.
27. THE POWER PACK ASSEMBLY WEIGHS 62KG. CARE SHALL BE TAKEN WHEN LIFTING THIS ASSEMBLY.
28. THE SYSTEM MAY RETAIN RESIDUAL HYDRAULIC PRESSURE AND COULD PRESENT A DANGER TO PERSONNEL. ENSURE THAT SUITABLE PRECAUTIONS ARE TAKEN AND APPROPRIATE PERSONAL PROTECTION EQUIPMENT IS WORN WHEN BREAKING INTO THE HYDRAULIC SYSTEM.
29. THE USE OF COMPRESSED AIR CAN CREATE AIRBORNE PARTICLES THAT MAY ENTER THE EYES. GOGGLES OR EYE SHIELDS MUST BE WORN AND THE PRESSURE OF THE COMPRESSED AIR MUST NOT EXCEED 10 LBF SQ IN.
30. FITTING AND REMOVING OF HEAVY EQUIPMENT MUST ONLY BE PERFORMED ON FIRM, LEVEL GROUND.
31. THE TRAVEL LOCK PINS MUST BE FITTED BEFORE THE TWMP (T90) IS LIFTED OR TRANSPORTED. IF THE LINK ASSEMBLY IS NOT FITTED THE TWMP (T90) MAY COLLAPSE IN ON ITSELF.
32. AFTER PLOUGHING OPERATIONS HAVE FINISHED THOROUGHLY INSPECT THE AREAS IN AND AROUND THE TWMP(T90) FOR UNEXPLODED MUNITIONS AND EXPLOSIVE DEBRIS, BEFORE PERFORMING ANY INSPECTION, ADJUSTMENT, REPAIR OR MAINTENANCE. IF ANY SUSPECT ITEMS, UNEXPLODED MUNITIONS OR EXPLOSIVE DEBRIS ARE FOUND, DO NOT TOUCH THEM, AND INFORM THE APPROPRIATE AUTHORITY.
33. BEFORE PERFORMING ANY FUNCTIONAL TEST OR OPERATION OF THE TWMP, ALL CAUTIONS CONTAINED IN THE PRELIMINARY MATERIAL MUST BE READ AND FULLY UNDERSTOOD.

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34. INGRESS OF DIRT AND DEBRIS. TO PREVENT ANY DAMAGE TO THE EQUIPMENT BY THE INGRESS OF DIRT, DEBRIS AND CONTAMINANTS, MAKE SURE ALL ELECTRICAL AND HYDRAULIC CONNECTIONS ARE SECURELY PLUGGED OR CAPPED.
35. TO PREVENT CONTAMINATION, ENSURE THAT ALL CONNECTIONS ARE CAPPED AFTER DISCONNECTION OR REMOVAL.
36. ENSURE ALL BOLTS, SCREWS AND NUTS ARE PROPERLY TIGHTENED. ONLY STANDARD TOOLS ARE TO BE USED WHEN CHECKING FOR SECURITY OF ATTACHMENT.
37. DURING CLEANING, REMOVE ALL SPOIL AND DEBRIS FROM THE HYDRAULIC HOSES, INCLUDING THOSE PROTECTED BY GUARDS. FAILURE TO DO SO MAY RESULT IN EQUIPMENT FAILURE.
38. BEFORE WELDING OR GRINDING, REMOVE ANY FLAMMABLE MATERIAL FROM THE WELDING/GRINDING ZONE.
39. SURFACE SCORING. ALL TOOLS USED TO REPLACE SEALS SHOULD BE COMPLETELY SMOOTH AND FREE FROM NICKS AND BURRS. CARE SHOULD BE TAKEN NOT TO SCRATCH OR MARK METAL SURFACES, PARTICULARLY SEAL CAVITIES DURING SEAL REPLACEMENT.
40. THE MAJORITY OF HYDRAULIC SYSTEM FAULTS ARE CAUSED BY THE INGRESS OF RUST, SCALE AND OTHER FOREIGN MATTER INTO THE HYDRAULIC SYSTEM DURING INSTALLATION OR MAINTENANCE. A STRICT STANDARD OF CLEANLINESS THEREFORE MUST BE ADOPTED DURING THE ASSEMBLY PROCEDURE.
41. BEFORE FITMENT OF THE MOUNTING PINS OR ELECTRICAL HARNESS, MAKE SURE THE VEHICLE TRANSMISSION IS IN NEUTRAL AND THE HANDBRAKE IS SET.
42. ANY ITEM OF EQUIPMENT IN EXCESS OF 20KG MUST BE LIFTED OR LOWERED USING THE CORRECT MANUAL HANDLING TECHNIQUES OR SUITABLE AVAILABLE LIFTING EQUIPMENT.
43. PRIOR TO CARRYING OUT ANY MAINTENANCE OR REPAIR TASK ON THE TWMP (T-90), HYDRAULIC PRESSURE MUST BE RELIEVED BY ALLOWING IT TO LOWER TO THE GROUND UNDER ITS OWN WEIGHT.
44. THE HYDRAULIC SYSTEM IS PRESSURISED AND WILL PRESENT A DANGER TO PERSONNEL. ENSURE THAT SUITABLE PRECAUTIONS ARE TAKEN WHEN OPENING THE SYSTEM.

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45. TAKE CARE WHEN CONNECTING OR DISCONNECTING HYDRAULIC HOSES TO/FROM THE HOST VEHICLE, DUE TO POSSIBLE RESIDUAL PRESSURE.
46. TO PREVENT ANY DAMAGE TO THE EQUIPMENT BY THE INGRESS OF DIRT, DEBRIS AND CONTAMINANTS, MAKE SURE ALL ELECTRICAL AND HYDRAULIC CONNECTIONS ARE SECURELY PLUGGED OR CAPPED.
47. WEAR THE CORRECT PPE WHILST WORKING ON THE TWMP AS THE WORKING EDGES WILL BE WORN AND SHARP.
48. DURING TRAVEL THE TWMP MUST BE FULLY RAISED AND TRAVEL LOCK PINS MUST BE INSTALLED. THE TWMP MUST NOT BE IN PLOUGH MODE.
49. TO PREVENT CONTAMINATION, ENSURE THAT ALL CONNECTIONS ARE CAPPED AFTER DISCONNECTION OR REMOVAL.
50. DURING CLEANING, REMOVE ALL SPOIL AND DEBRIS FROM THE HYDRAULIC HOSES, INCLUDING THOSE PROTECTED BY GUARDS. FAILURE TO DO SO MAY RESULT IN EQUIPMENT FAILURE.

**DON'TS**

1. DO NOT ATTEMPT TO FIT OR REMOVE THE TWMP (T90) ALONE.
2. NEVER USE COMPRESSED AIR TO "BLOW OUT" THE PISTON ROD ASSEMBLY FROM THE CYLINDER BODY AS THIS WILL HAVE THE POTENTIAL OF MAKING THE PISTON ROD A PROJECTILE.
3. AVOID BLASTING SMALL COMPONENTS, LEADS AND OTHER DELICATE PARTS BY TOO CLOSE AN APPROACH WITH AN AIR JET NOZZLE. USE CARE IN BRUSHING DIRT FROM DELICATE PARTS.
4. DO NOT ALLOW WATER AND GENERAL DETERGENT TO ENTER ANY ELECTRICAL CONNECTIONS.
5. DO NOT OVERFILL THE RESERVOIR. IN A HOT ENVIRONMENT, THE OIL WILL EXPAND CAUSING INCREASED PRESSURE IN THE SYSTEM.

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**CHAPTER 1: EQUIPMENT CHARACTERISTICS AND PERFORMANCE**

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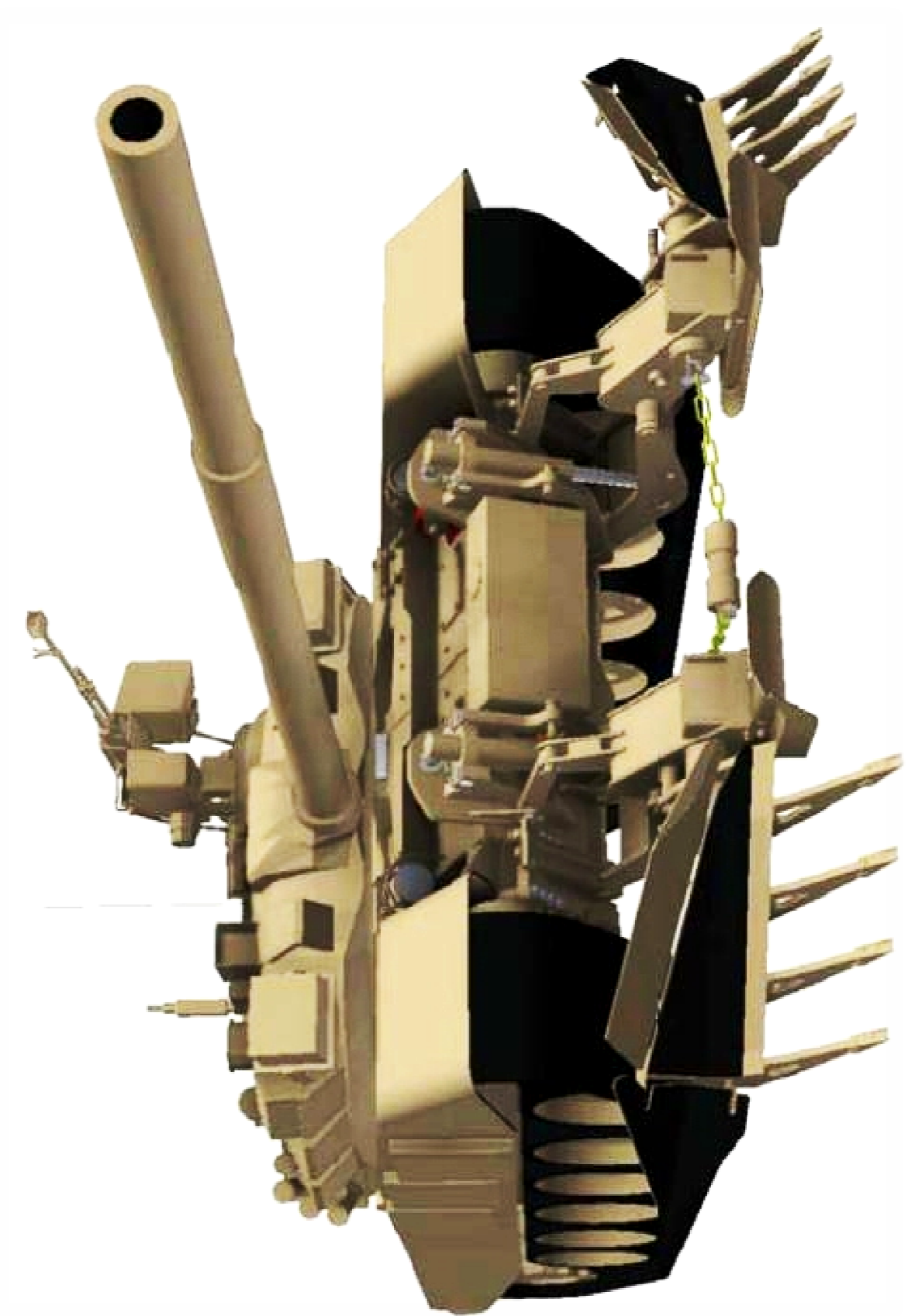
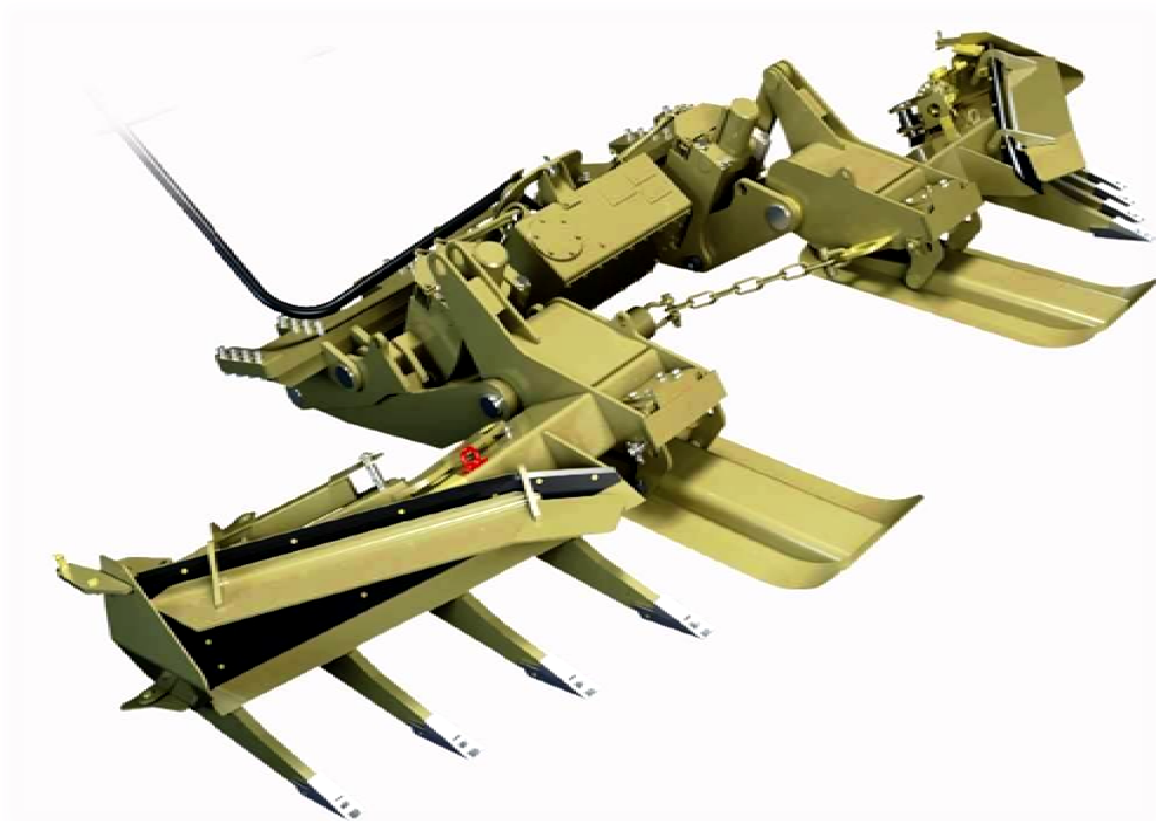


Fig 1.1 General view of TWMP

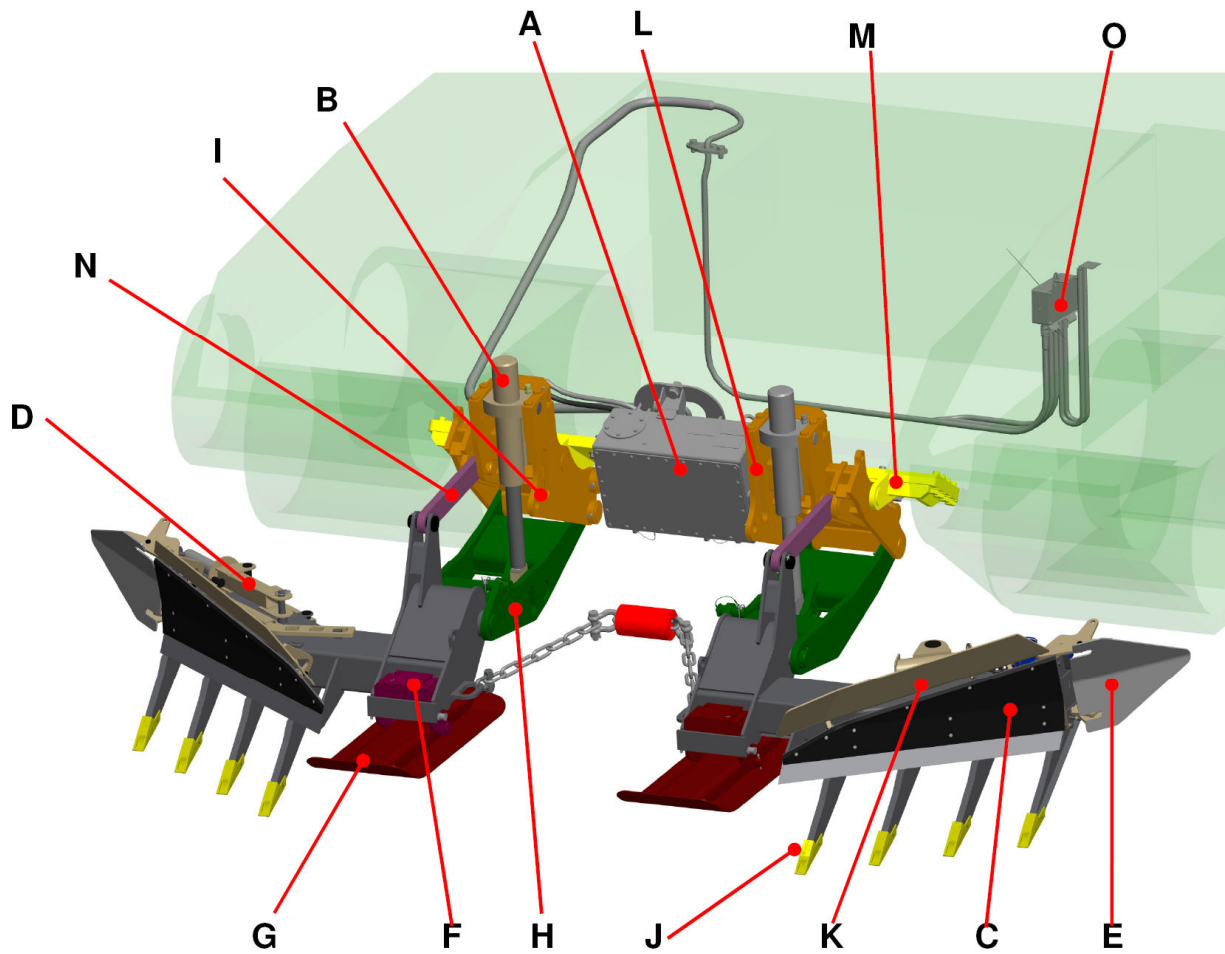
**CHAPTER 1: EQUIPMENT CHARACTERISTICS AND PERFORMANCE**

**EQUIPMENT IDENTITY**

1. Track Width Mine Plough (TWMP) - T-90.
2. The TWMP (T-90) is Designed, Developed and Manufactured by BEML Ltd in collaboration with Pearson Engineering Ltd., Newcastle upon Tyne, England, NE15 6UX.



**Fig 1.2 Track Width Mine Plough**



**Fig 1.3 Assy of Track Width Mine Plough**

A	Hydraulic Power Pack and Mount	B	Hydraulic Cylinder (LH and RH)
C	Blade Assembly (LH and RH)	D	Lifting Equipment
E	Blade Extension (LH and RH)	F	Skid Adjuster (LH and RH)
G	Skid (LH and RH)	H	Boom Assembly (LH and RH)
I	Travel Lock Pin	J	Tine Tip
K	Upper Blade (LH and RH)	L	Mounting Bracket (LH and RH)
M	Vehicle Adaptor Bracket (LH and RH)	N	Top Link (LH and RH)
O	Fitting Kit Assembly		

## **INTRODUCTION**

3. The TWMP (T-90) is designed to remove mines, irrespective of fusing type, from the track width of the host vehicle, thus protecting it from the threat of surface laid or buried anti-tank (AT) or antipersonnel (AP) mines.
4. The TWMP (T-90) gives the host vehicle the ability to rapidly force a passage through mined obstacles by creating a cleared path for its tracks to follow.
5. The equipment is controlled via a Control Unit (CU) which is mounted inside the vehicle.
6. Electrical power to drive the TWMP (T-90) hydraulic and control systems are provided by the vehicle Electrical system, via the Pearson supplied CU.

## **DESCRIPTION OF OPERATION**

7. The vehicle driver, using the CU, controls the operation of the plough.
8. The commander is in charge of fitting and removing of the plough assembly.
9. During normal operations, the blades may be set to two positions, UP and DOWN, in response to commands initiated on the CU by the driver. In the UP position the blades are fully raised. In the DOWN position the blades are fully lowered for mine clearing and the four tines on each blade give a minimum clearing depth of 150mm. Blade extensions are fitted to the outer edge of each blade to sweep the spoil clear of the vehicle. A skid is fitted to the inside edge of each blade to ensure that the blades ride over the ground correctly. An Anti-Mine Sweeping Device (AMSD) is installed between the blades detonates tilt mines that would otherwise pass between the skids.
10. The two boom assemblies connect the blades to the mounting brackets. During ploughing the boom assemblies are under compression as they transfer the forces generated by soil resistance to the mounting brackets. Both boom assemblies are linked to both the mounting brackets and blades by pins. The mounting brackets are secured to the vehicle adaptor plates using mounting pins.
11. Two vehicle adapter brackets are initially installed on to the host vehicle with the fitting kit including the Control Unit and associated harnesses. These two vehicle adapter brackets form the mounting position for the LH and RH blade assemblies and are installed by the maintainer.
12. The power pack bracket secures to the host vehicle between the LH and RH blade assemblies and houses the power pack and is installed by the operator. Refer to Chap 4.



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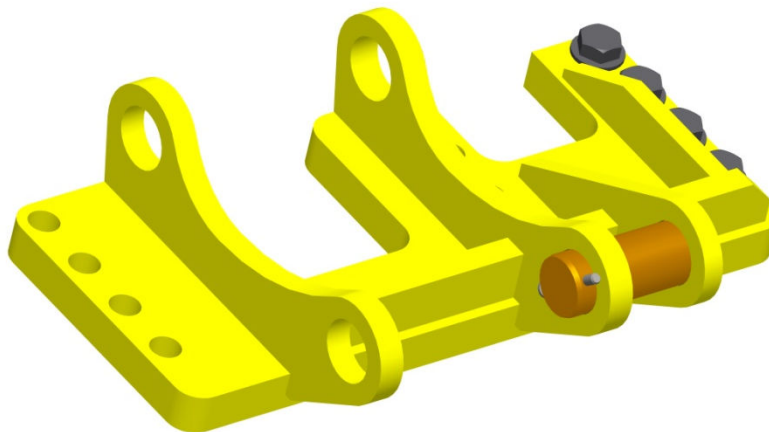
13. The two hydraulic lift cylinders are used to raise and lower the blades. One end of each lift cylinder is attached to the mounting brackets by trunnions, which allows the lift cylinder to pivot. The other end of the lift cylinder is attached to the appropriate boom assembly. Operation of the hydraulic lift cylinders will thus raise or lower the blades.
14. The power pack contains the electro hydraulic components which control the use of the TWMP (T- 90).
15. Each top link connects a blade assembly to the respective mounting bracket.

**INSTALLED EQUIPMENT**

16. The T-90 TWMP (T-90) can be installed onto the T-90 vehicle; without any permanent modifications to the vehicle including any cutting of the armour.
17. The vehicle adaptor brackets are fitted onto the existing tapped pads located on the toe plate. Use of the vehicle self-entrenching device will be possible whilst the T-90 TWMP is installed.
18. The T-90 TWMP can be installed onto the T-90 SK vehicle; however rework is required to the vehicle before the TWMP can be installed.
19. The rework involves drilling an access hole for the harness and welding of tapped pads on the toe plate. This rework is detailed in a separate installation instruction. The modifications will not compromise the overpressure system or the NBC protection system of the tank.
20. The TWMP (T-90) comprises of the following main items/assemblies:

**VEHICLE ADAPTER BRACKETS**

21. The Vehicle Adaptor Brackets are the main structural members that provide the interface for the mounting brackets.



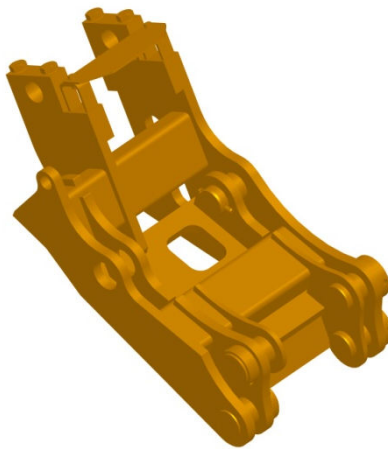
**Fig 1.4 Vehicle Adaptor Bracket**

## **MOUNTING BRACKETS**

22. The LH and RH mounting bracket provide the pinned connection to the LH and RH vehicle adapter brackets which are bolted to the toe plate of the host vehicle.

23. Each mounting bracket houses the fixing points for the:

- Cylinder Trunnion
- Top Link
- Boom
- Travel Lock
- Guard

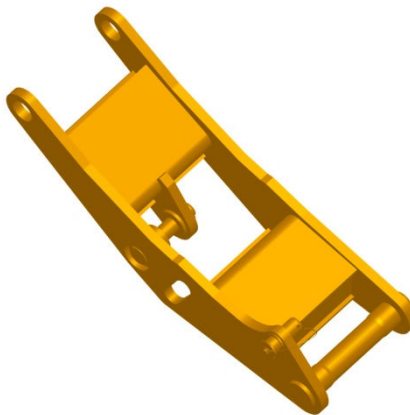


**Fig 1.5 Mounting Bracket**

## **BOOM ASSEMBLIES**

24. The boom assemblies support their respective blades. At the rear end, two lugs form the pivot connection with the mounting brackets. At the front end, two lugs form the pivot connection for the blade assemblies.

25. The boom assemblies also provide the attachment point for the lift cylinders and the travel lock to secure the associated blade in the raised position.



**Fig 1.6 Boom Assemblies**

### **LIFT CYLINDERS**

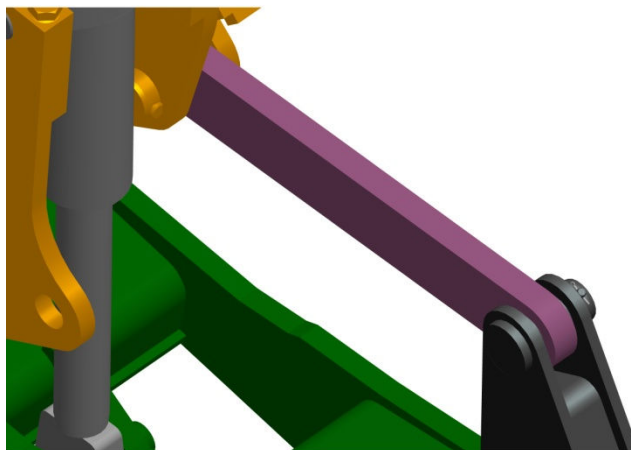
26. Two hydraulic lift cylinders are used to raise and lower the blades. One end of each lift cylinder is attached to the mounting bracket, the other to the appropriate boom assembly. Operation of the hydraulic lift cylinders will raise or lower the blades.



**Fig 1.7 Lift Cylinders**

### **TOP LINK ASSY**

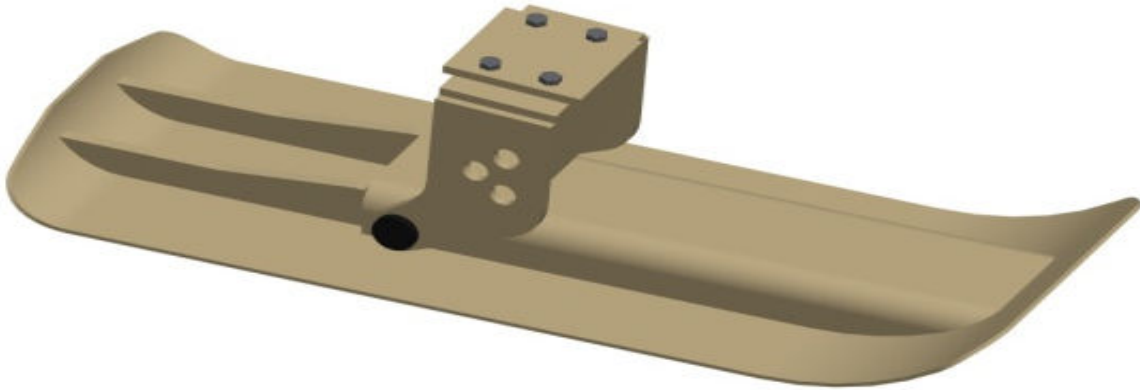
27. The top link assemblies link the blade assemblies to the mounting brackets and hold the blade at the correct angle during ploughing.



**Fig 1.8 Top Link Assembly**

## **SKIDS**

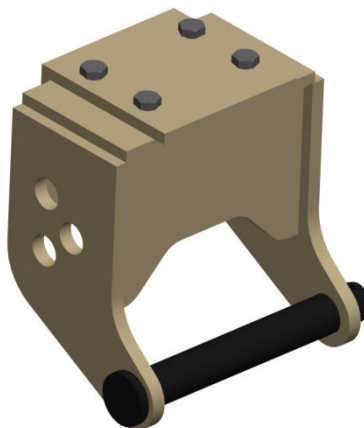
28. The skids are fitted onto the skid adjusters and are used to control the depth of the tine penetration.



**Fig 1.9 Skids**

## **SKID ADJUSTERS**

29. The skid height can be adjusted to alter the ploughing depth of the Track Width Mine Plough. The adjustment range sets a ploughing depth of between 150 mm and 200 mm; in increments of 25mm.



**Fig 1.10 Skid Adjusters**

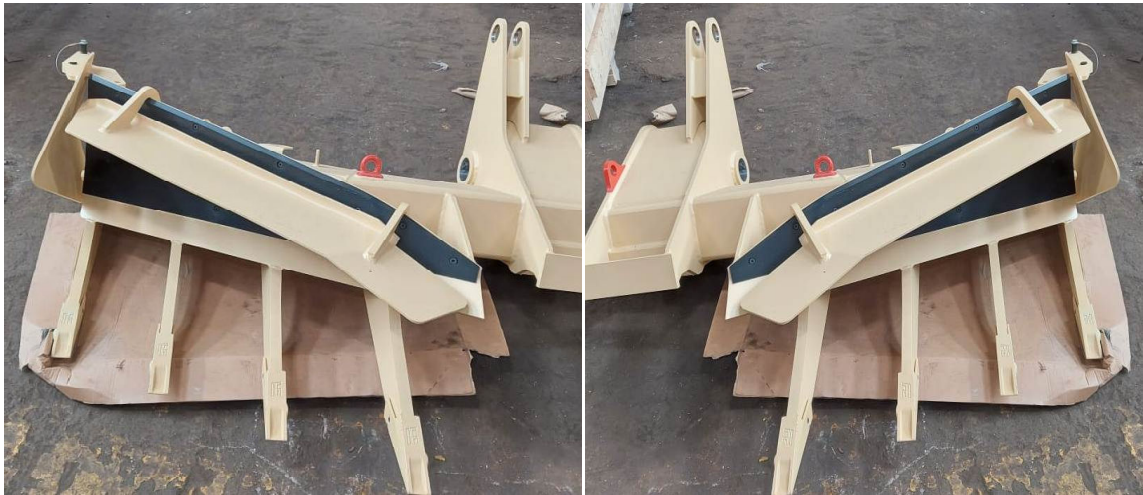
## **BLADE ASSEMBLIES**

31. The blade assemblies form the main structural members that support the tines. At the rear end, a tube forms the pivot connection with the boom assemblies. In normal operation the skids control the depth of tine penetration. When mines are brought to the surface by the tines, the shaped

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mouldboards act as a means of conveying them to the outside of the vehicle path. Blade extensions are fitted to the outer edge of the mouldboards to increase the distance at which the mines are deposited and to shape the spoil to reduce the tendency for mines to roll back.

32. The blade assemblies also provide the attachment point for the skid adjuster and the upper blade extension.



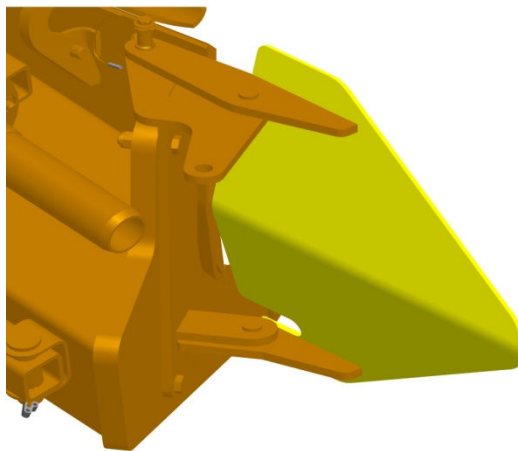
Blade Assembly RH

Blade Assembly LH

**Fig 1.11 Blade Assemblies**

**BLADE EXTENSIONS**

33. The blade extensions pivot from the blade to deposit spoil away from the tracks of the vehicle during ploughing operations.



**Fig 1.12 Blade Extensions**

## **TINES**

34. Attached to the lower edge of each blade are 4 tines. Tine tips are included on the tines to improve wear resistance during ploughing operations.



**Fig 1.13 Tine Tips**

## **POWERPACK ASSEMBLY**

35. The Power pack Assembly contains an electro hydraulic system with in-built oil reservoir and filtration. It also contains the hydraulic control valves that control the operation of the plough blades.
36. The control signals and electrical power enter the power pack through the harness which connects the TWMP to the control unit.
37. The harness connects to a connector on the rear of the power pack compartment through a suppressor assembly where it is distributed around the components in the power pack assembly:
- MPU and reservoir, and manifold combined
  - Contactor
  - Filter

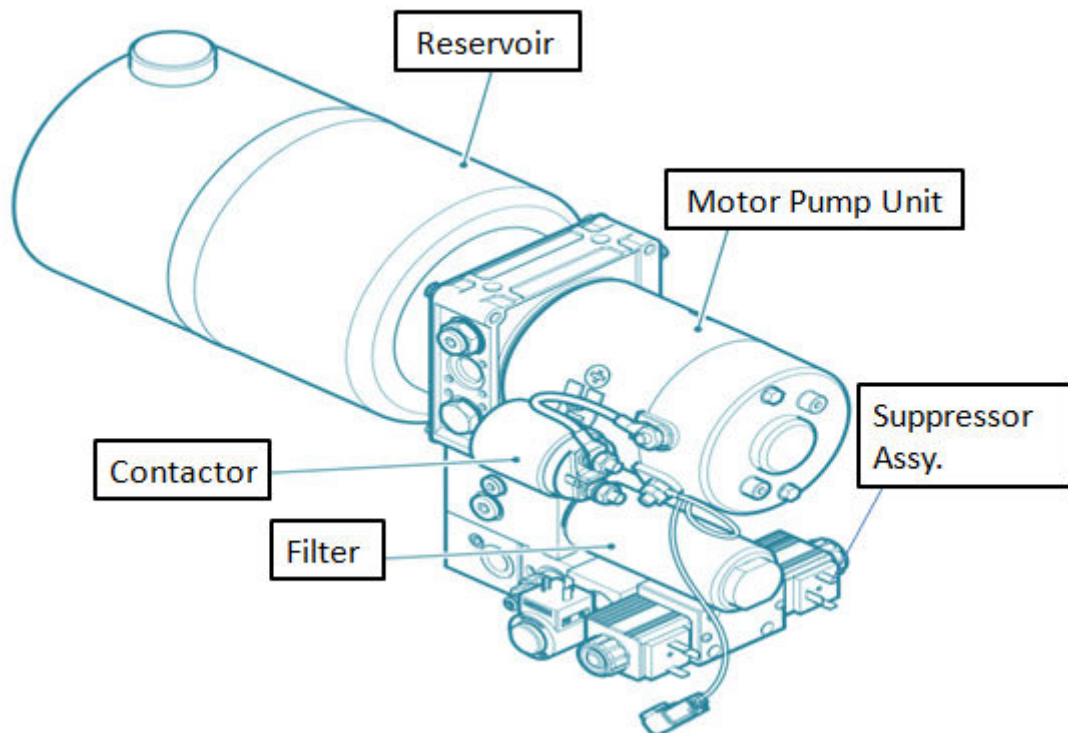


**Fig 1.14 Power Pack Assembly**



### **MOTOR PUMP UNIT**

38. The Motor/Pump Unit (MPU) is located in the power pack assembly.
39. The MPU is a combined electrical motor and hydraulic pump. The electrical motor when initiated drives the hydraulic pump which provides hydraulic oil for the two cylinders.
40. A temperature sensor on the motor warns the operator via the CU FAULT LED if the motor has reached an overheat condition.



**Fig 1.15 Power Pack Component**

### **NOTE**

*The TWMP (T-90) should be limited to a maximum of 20 raise/lower cycles per hour. The recommended maximum number of cycles relates to the TWMP (T- 90) operating at higher ambient temperature and is necessary to prevent motor overheat.*

### **RESERVOIR**

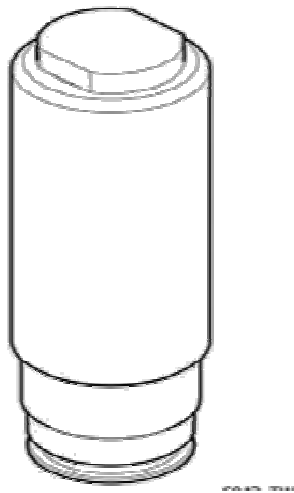
41. The hydraulic reservoir is directly connected to the MPU and has a capacity of 5 litres.
42. The hydraulic reservoir is replenished via a filler cap and the level is checked with a dipstick. The reservoir is drained by a drain plug on the underside of the reservoir.

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- 43. The rear cover plate and gasket on the rear of the power pack provides access to the relief valve and filter blocked switch.
- 44. The side cover plate and gasket on the side of the power pack provides access to the filter.

**FILTER**

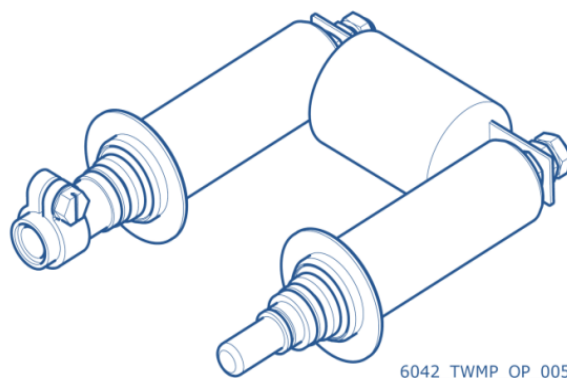
- 45. The pressure filter is located on the power pack assembly. The replaceable 15 micron filter ensures that the hydraulic oil is kept clean for all hydraulic functions. A pressure sensor in the filter warns the operator of a filter blocked condition via the CU FAULT LED.



**Fig 1.16 Filter**

**SUPPRESSOR ASSEMBLY**

- 46. The suppressor assembly electrically suppresses unwanted electrical interference generated by the MPU.

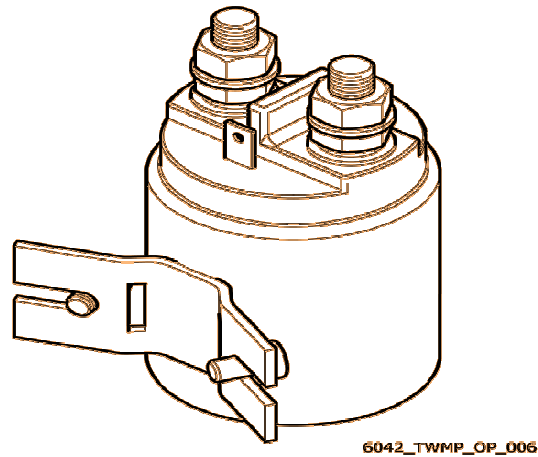


**Fig 1.17 Suppressor Assembly**



**CONTACTOR**

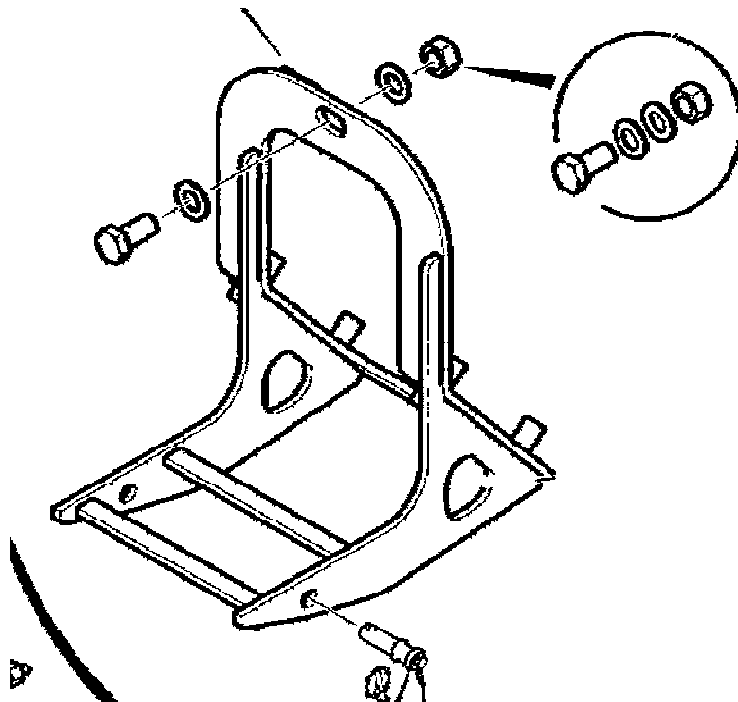
47. The contactor is a relay which permits the control signals from the CU to electrically connect and disconnect power to the MPU.



**Fig 1.18 Contactor**

**POWERPACK BRACKET**

48. The power pack bracket secures the power pack assembly and is bolted the toe plate of the host vehicle between the two blade assemblies.



**Fig 1.19 Power pack Mounting Bracket**

## **FITTING KIT**

49. The fitting kit, installed by a maintainer ,consists of:

- Control Unit,
- Interconnecting Harness
- LH and RH Vehicle Adapter Brackets.

## **CONTROL UNIT**

50. The TWMP (T-90) is operated by the driver using the Control Unit (CU). The CU provides the electrical signals that control the operation of the TWMP (T-90) and is mounted on a bracket located inside the driver's compartment.

51. Toggle switches are provided for the POWER/ON and UP/DOWN functions. The POWER LED is illuminated when the ON/OFF switch is set to ON.

52. Operation of the UP/DOWN switch raises or lowers the blades and a PLOUGH button is used before the vehicle begins to move forward during ploughing.

53. To protect the equipment the electrical power from the battery passes through a replaceable 250 Amp fuse within the CU to the TWMP (T-90). The CU also has a resettable circuit breaker (CB1) to protect critical components.

54. The LEDs can be tested to check that they all operating correctly by using the LED TEST button, and all the LEDs can be dimmed using the brightness control switch.



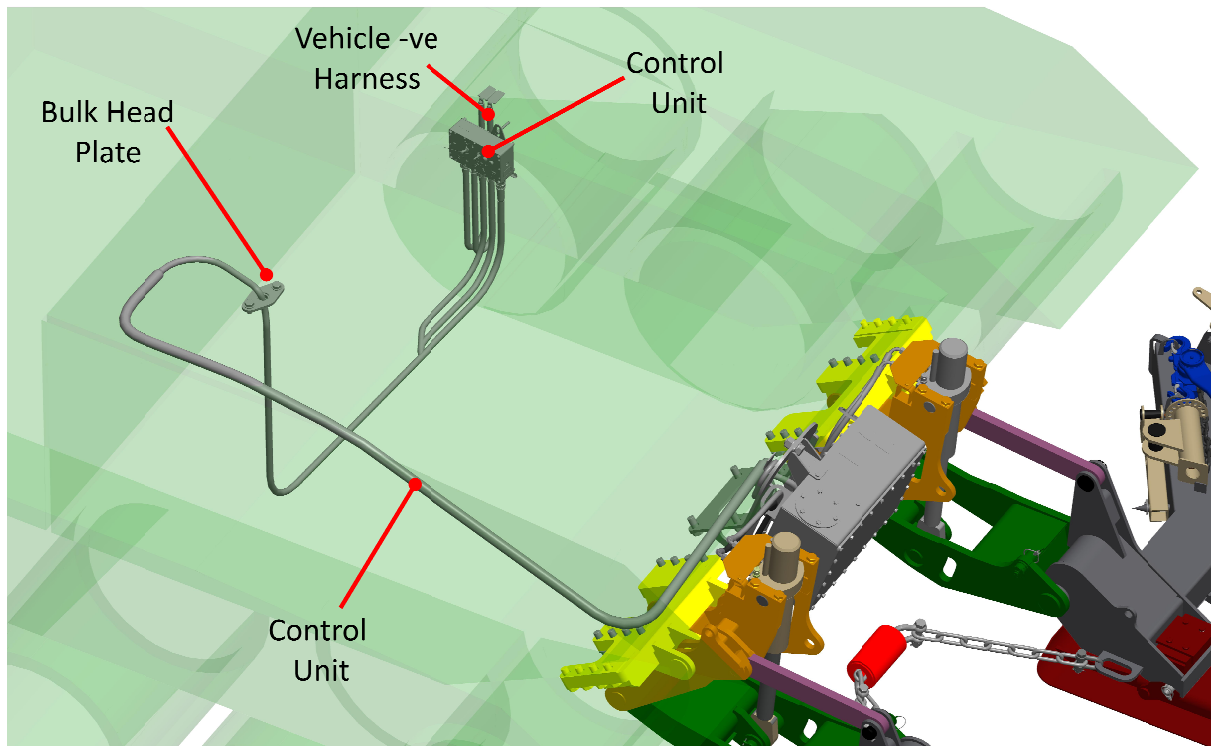
**Fig 1.20 Front view of Control Unit**



**Fig 1.21 Isometric view of Control Unit**

### **FITTING KIT ASSEMBLY**

31. The fitting kit consists of
- a. Control Unit
  - b. Interconnecting Harness
  - c. LH and RH Vehicle Adapter Brackets



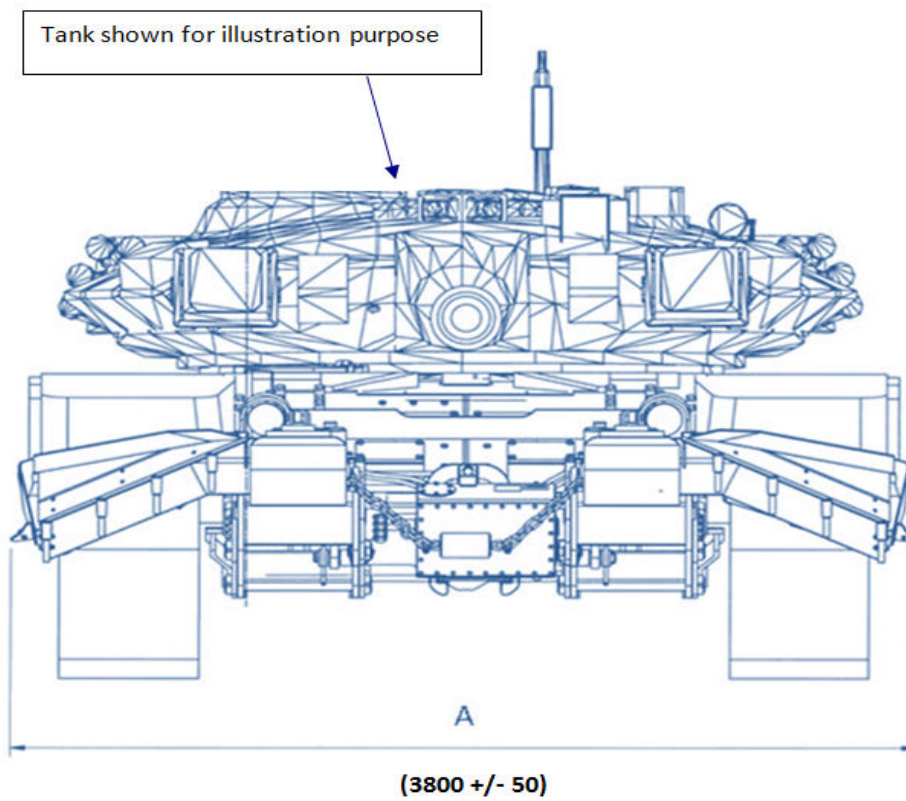
**Fig 1.22 Fitting Kit Assembly**

### **PURPOSE AND ROLE OF THE EQUIPMENT**

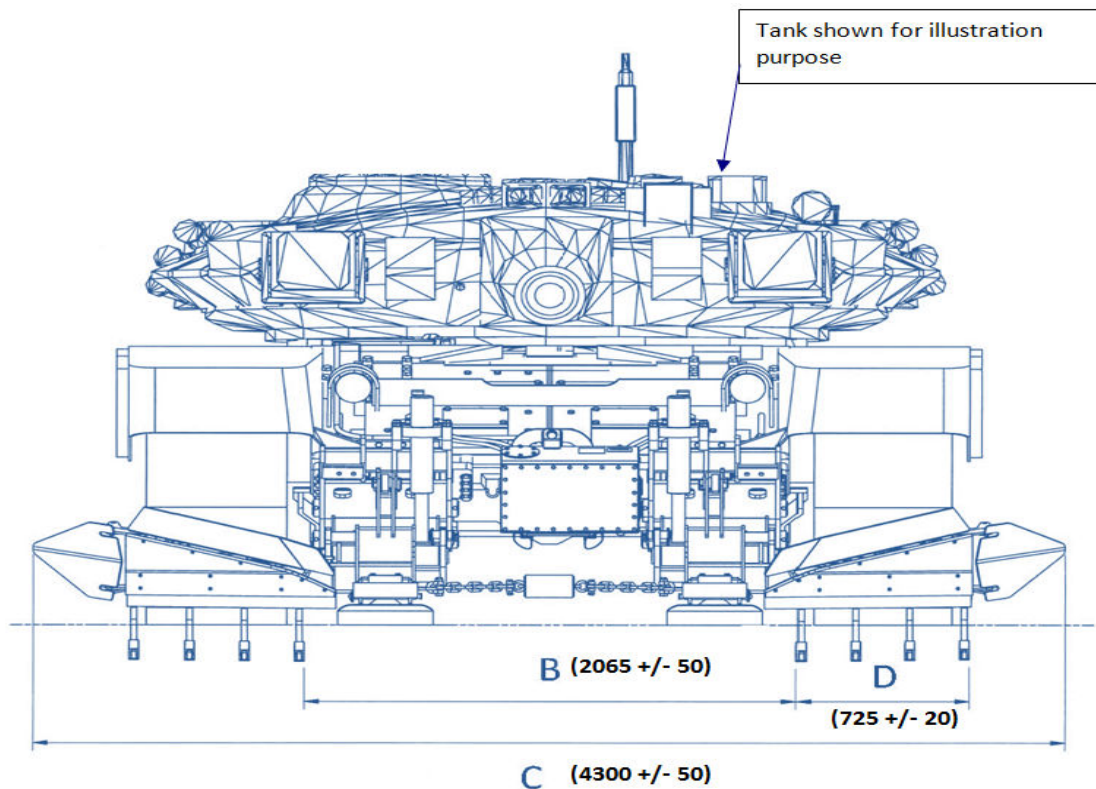
55. The TWMP (T-90) gives the host vehicle the ability to rapidly generate a safe passage through mined obstacles by creating a cleared path for its tracks to follow.
56. The mine free path is prepared by a raking action that brings buried or concealed mines/munitions to the surface and moves them to the side. To achieve the necessary raking action, tines move through the soil at a constant depth.
57. The skids provide the depth control means.

**PRINCIPLE OPERATIONAL CHARACTERISTICS**

- 58. The TWMP (T-90) is a self-contained unit, the only connections to the vehicle are its mounting arrangement onto the toe plate of the host vehicle and connection to the vehicle electrical power system.
- 59. The TWMP (T-90):
- 60. Clears mines from the track width of the vehicle.
- 61. Is designed to operate in a wide range of soils.
- 62. Is designed to minimise the tractive effort required.
- 63. Is designed to minimise the effects of detonating mines.
- 64. Requires minimal maintenance.
- 65. The TWMP (T-90) is comprised of two four-tine blades.
- 66. The TWMP (T-90) is optimised for ploughing at a depth greater than 150mm.
- 67. The TWMP (T-90) has been designed to compactly stow on a T-90 MBT. The approach angle has been maximised without impeding operation of the gun; even when fully depressed.



**Fig 1.23 TWMP T-90 in Stowed Position**



**Fig 1.24 TWMP T-90 in Deployed Position**

**PHYSICAL DATA**

68. The physical data for the TWMP (T-90) is given in Tables 1 to 4.

**Table 1.1 Width of Main Items**

<b>Description</b>	<b>Width</b>
Plough Assembly	4300mm
Plough Assembly (with blade extensions folded in)	3800mm

**Table 1.2 Height of Main Items**

<b>Description</b>	<b>Height</b>
Plough Assembly (on the ground)	800mm max

**Table 1.3 Length of Main Items**

<b>Description</b>	<b>Length</b>
Plough Assembly (not fitted on ground)	2100mm

**Table 1.4 Weight of Main Items**

<b>Description</b>	<b>Weight</b>
Plough Assembly	1365kg
Mounting Brackets (RH & LH)	97kg
Vehicle Adaptor Brackets (RH & LH)	64kg
Powerpack Brackets	15kg
Boom	82kg
Blade Assembly	240kg
Upper Blade	11kg
Powerpack assembly	61kg
Lift Cylinders	29kg
Skids	27kg
Skid Adjusters	10kg

**PERFORMANCE DATA**

**TWMP (T-90) Cleared Lane Width**

69. Two cleared lane widths: 725mm each.

**TWMP (T-90) Uncleared Centre Lane Width**

70. The uncleared centre lane width: 2065mm.

**TWMP (T-90) Cleared Lane Depth**

71. The cleared lane depths are detailed in Table 5.

**Table 1.5 Cutting Depth**

<b>Description</b>	<b>Depth</b>
Shallowest setting	150mm (for mines laid at 125mm depth)
	175mm (for mines laid at 150mm depth)
Deepest setting	200mm (for mines laid at 175mm depth)

**Operating Speed**

72. The operating speed is: 1-15km/h.

73. The minimum recommended safe ploughing radius is 50m.

**NOTE**

*Tighter radius turns may be possible in some soil conditions, but the rear of the tracks will pass through the spoil heap and risk detonation of cleared mines. Only small adjustments to the steering should be made.*

**Operating Times**

74. Time to raise the plough: <20s.

75. Time to lower the plough is: <16s.

76. Fitting time is: <30min.

77. Removal time is: <30min.

**Hydraulic Pressure**

78. System relief pressure: 200±20 Bar.



### **Hydraulic System Filtration**

- 79. Suction line: 90 Microns.
- 80. Pressure line: 15 Microns.

### **Hydraulic System Capacity**

- 81. Reservoir capacity: 5 litres.

## **ENVIRONMENTAL DATA**

### **Ambient Temperature Range**

- 82. The TWMP (T-90) system is designed to operate in an ambient temperature range of -20°C to +55°C.

### **NOTE**

*The TWMP (T-90) should be limited to a maximum of 20 raise/lower cycles per hour. The recommended maximum number of cycles relates to the TWMP (T- 90) operating at higher ambient temperature and is necessary to prevent motor overheat.*

### **Water Immersion**

- 83. The plough assembly is sealed so as not to reduce the fording depth of the host vehicle.

## **TRANSPORTATION DATA**

- 84. Where possible, the TWMP (T-90) should be transported fitted to the host vehicle, however it may be transported as separate units.

### **Road Movement**

- 85. The TWMP (T-90) is transported fitted to the host vehicle. The normal considerations when deciding whether to transport the vehicle on a low-loader trailer or tank trailer still apply.

### **Air Transport Data**

- 86. Following preparation, the complete TWMP (T-90) and host vehicle may be transported by air. Refer to the vehicle publications for details of the vehicle preparation required.

**NOTE**

*To comply with air transport regulations, oil may have to be drained from the complete hydraulic circuit on the plough assembly prior to transport.*

**Rail Loading Data (When Fitted to Vehicle):**

87. The TWMP (T-90) adds less than 1500kg to the host vehicle weight and the vehicle width is increased to 3800mm.

**Bridge Classification**

88. The TWMP (T-90) adds less than 1500kg to the host vehicle weight and the vehicle width is increased to 3800mm.

**MANNING REQUIREMENTS**

**Operating the TWMP (T-90)**

89. The vehicle driver operates the TWMP (T-90) from under armour, using the Control Unit.

**Fitting and Removing TWMP (T-90)**

90. Fitting and removing the TWMP (T-90) is carried out by the vehicle crew using the purpose designed hoist located on the blade assemblies of the TWMP. Refer to Chap 4.

**POWER REQUIREMENTS**

**Operating Voltage**

91. Operating voltage: 24/28V DC.

**Operating Current**

92. Operating current:
- Peak (raising to relief) 150A
  - Ploughing (continuous) 3A.

**Power Source**

93. Power source: Vehicle 24/28V DC electrical system.

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**SPECIAL TOOLS AND TEST EQUIPMENT**

94. The special tools required to complete maintenance on the TWMP are detailed in Table 6:

**Table 1.6 STTE**

<b>NSN</b>	<b>Description</b>
CM11407	Test Stand Assembly
ND39500	Pin Spanner
CM11402	Hydraulic Test Kit
CM11404	Clamping Tool Assembly
CM11403	Tine Wear Gauge
CM11397	Tool Kit

**NOTE**

*The test stand is only used when the equipment is not mounted on the front of a host vehicle for testing (FAT) and maintenance.*

95. The test stand is used to mount the TWMP to carry out testing and or maintenance when a host vehicle is not available.

96. The procedure to install a TWMP onto the test stand is identical to the installation of the TWMP onto a host vehicle with the exception that the TWMP is positioned and aligned with the test stand using a suitable overhead crane.

**CONSUMABLE MATERIALS**

97. Consumables to support maintenance of the TWMP (T-90) plough should be carried on the host vehicle. These are listed in Table 7.

**Table 1.7 Consumable Materials**

<b>NSN</b>	<b>Description</b>
ND37990	Hydraulic Oil OM-15 (20 Litres Tins)
ND39515	Grease Aeroshell 33MS
ND4359	Loctite 243 (Threadlock)
ND7751	Silicon Compound RTV

## **CHAPTER 2: CONTROLS AND INDICATORS**

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## **CHAPTER 2: CONTROLS AND INDICATORS**

### **INTRODUCTION**

1. This chapter describes the function of all controls and indicators on the TWMP (T-90).
2. The following instructions should be read and fully understood by the TWMP operator prior to operating the equipment. This will assist in achieving competence, confidence and a greater understanding of the operational and functional limitations of the equipment only acquired through experience.

### **CONTROLS AND INDICATORS**

3. All controls and indicators required to operate the TWMP (T-90) are located on the Control Unit (CU).

### **CONTROL UNIT**

4. The TWMP (T-90) CU is mounted in the driver's compartment of the T-90 MBT and operated by the vehicle driver.
5. The CU incorporates a main replaceable 250A fuse.
6. The CU routes power to the TWMP (T-90) control system.
7. Each of the controls and indicators are shown in Fig 1 and detailed in the following paragraphs.

### **ON/OFF SWITCH AND LED**

8. The POWER ON/OFF switch is located in the upper LHS of the front panel, with its associated green indicator LED immediately above. When the POWER ON/OFF switch is set to ON the 28V DC power from the vehicle is fed through the CU and the indicator LED will illuminate to indicate the system has power. Note the POWER ON/OFF switch must be set to ON before any of the other controls will function and LED TEST button still works.

### **FAULT LED**

9. The FAULT LED during normal operating conditions is not illuminated. If the FAULT LED illuminates red this indicates that there is a fault with the TWMP (T-90). The CU should be switched OFF and restarted. If the FAULT LED is still illuminated then report the fault to a maintainer.

### **UP/DOWN SWITCH LED**

10. The spring loaded UP/DOWN switch is used to raise or lower the blade assemblies. When the UP/DOWN switch is set to UP both blade assemblies will be raised; when the UP/DOWN switch is set to DOWN both blade assemblies will be lowered. When the UP/DOWN switch is released its spring mechanism will return the switch to its central position and the blade assemblies will be held in the last position selected by the driver.

#### **NOTE**

*The blades will move at different times dependant on the pressure required to move each blade, this is normal and no further action is required.*

### **PLOUGH BUTTON AND LED**

11. The PLOUGH button must be depressed until the PLOUGH LED illuminates, then ploughing can commence.
12. The PLOUGH LED will illuminate when the plough is ready for ploughing. Do not plough if the PLOUGH LED is not illuminated.

#### **NOTE**

*If the PLOUGH button is depressed when the blades are in the raised position, the blades will lower to the ground and will be ready for ploughing.*

### **BRIGHTNESS SWITCH**

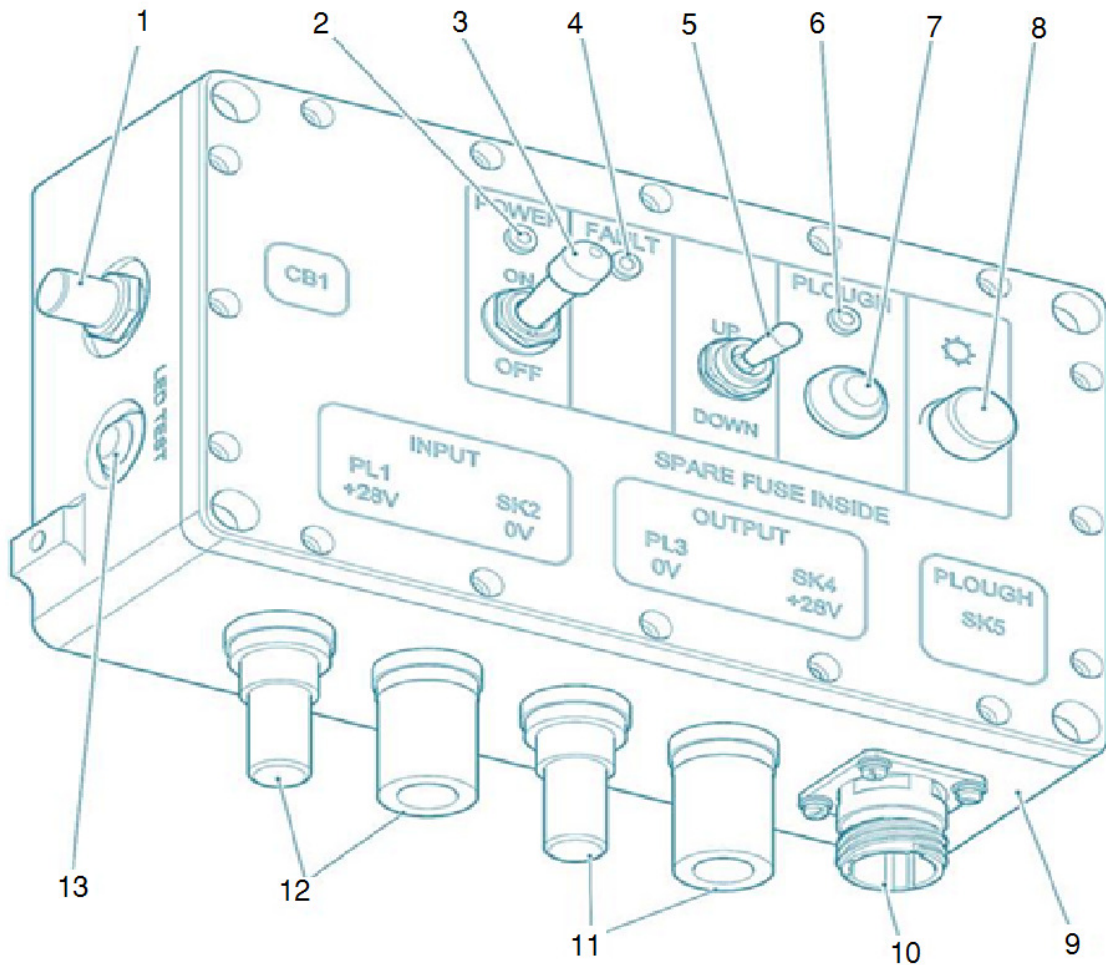
13. The brightness rotary switch adjusts the brightness of the LEDs on the CU.

### **LED TEST**

14. The LED test button when depressed illuminates all the CU LEDs to prove that they are all functioning.
15. LED Test Button will illuminate all the LEDs.

### **CIRCUIT BREAKER 1 (CB1)**

16. The circuit breaker CB1 is located on the left hand side of the CU. The function of CB1 is to provide resettable electrical protection to the TWMP (T-90). If CB1 is unserviceable, or has been tripped and not been reset, the TWMP (T-90) will not function.
17. To reset CB1, depress the CB1 push button.



**Fig 2.1 Control Unit (CU)**

- |    |                               |    |                                  |
|----|-------------------------------|----|----------------------------------|
| 1  | CB1                           | 2  | POWER LED                        |
| 3  | ON/OFF Switch                 | 4  | FAULT LED                        |
| 5  | UP/DOWN Switch                | 6  | PLOUGH END                       |
| 7  | PLOUGH Button                 | 8  | Brightness Control               |
| 9  | CU                            | 10 | Control Harness (to plough)      |
| 11 | Electrical Supply (to plough) | 12 | Electrical Supply (from vehicle) |
| 13 | LED TEST Button               |    |                                  |



**CHAPTER 3: TWMP (T-90) INSTALLATION AND REMOVAL PROCEDURES**

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## **CHAPTER 3: TWMP (T-90) INSTALLATION AND REMOVAL PROCEDURES**

### **INTRODUCTION**

1. This Chapter describes how to install and remove the TWMP (T-90).

### **SPECIAL TOOLS AND TEST EQUIPMENT**

2. The special tools required are detailed in Table 1. There is no requirement for any test equipment.

**Table 3.1 Special Tools and Test Equipment**

	Part No.	Description
1	710 TI 20016	Tool Box Kit

### **MANPOWER AND REQUIREMENTS**

3. The TWMP (T-90) may be fitted and removed by the vehicle crew.

### **RECEIPT MAINTENANCE**

4. If the TWMP (T-90) has been received from long term storage, the Receipt Maintenance procedure described in the Maintenance Schedule must be completed before the fitment procedure.

### **INSTALLATION OF THE TWMP (T-90)**


#### **NOTES**

*The TWMP (T-90) is installed and removed as three individual sections.*

*The initial installation of the LH and RH vehicle adapter brackets, CU and harnesses are a maintainers responsibility and will have been carried out prior to the issue of the TWMP (T-90) assembly to the vehicle crew*

5. Install the TWMP (T-90) as follows:


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<b>WARNING</b>	
	<b>BEFORE PERFORMING ANY FUNCTIONAL TEST OR OPERATION OF THE TWMP (T-90) ALL WARNINGS CONTAINED IN THE PRELIMINARY MATERIAL MUST BE READ AND FULLY UNDERSTOOD.</b>
	<b>THE TWMP (T-90) MUST ONLY BE FITTED ON FIRM LEVEL GROUND</b>
	<b>DO NOT ATTEMPT TO FIT OR REMOVE THE TWMP (T-90) ALONE.</b>
	<b>BEFORE OPERATION OF THE VEHICLE, MAKE SURE ALL PERSONNEL ARE CLEAR OF THE VEHICLE AND TWMP (T-90). MOVE THE VEHICLE FORWARD SLOWLY.</b>

**NOTE**

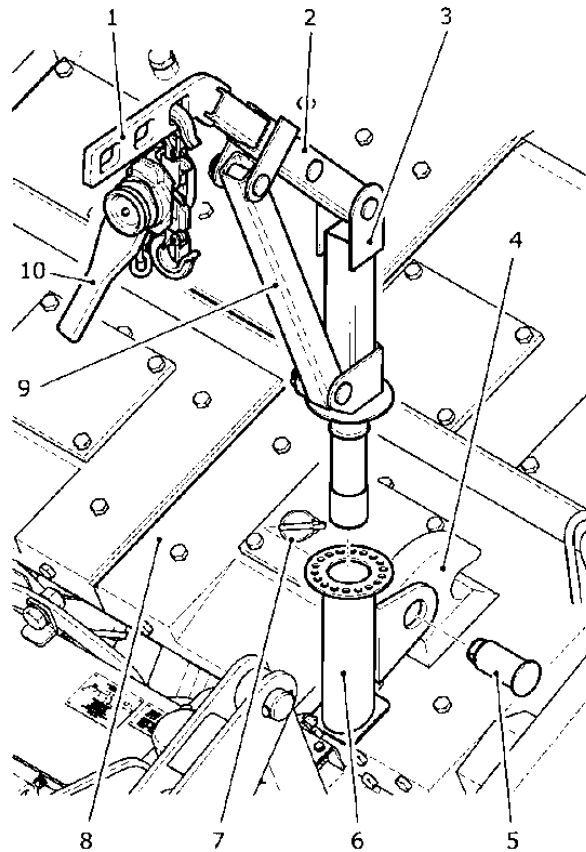
*The installation or removal of the LH or RH blade assembly is an identical procedure.*

6. Start the engine and slowly drive the vehicle forward so that the hoist and lifting equipment will hang directly over a blade assembly when fitted.

<b>WARNING</b>	
	<b>BEFORE FITMENT OF THE MOUNTING PINS OR ELECTRICAL HARNESS, MAKE SURE THE VEHICLE TRANSMISSION IS IN NEUTRAL AND THE HANDBRAKE IS SET.</b>

7. If fitted remove the split pins from the pins in the clevises on the mounting bracket. Withdraw the four pins.
8. Inspect the clevises on the vehicle adapter brackets for damage. Trial fit the pins through the clevises, if the clevises are damaged or the pins do not fit refer the vehicle for maintenance.
9. Locate the foot of the hoist, located on the LH blade assembly, in position on the glasis plate of the host vehicle and secure to the recovery eye using the pin and linch pin.

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**Fig 3.1 Foot Mounting**

1	Jib	2	Jib Base
3	Pivot	4	Recovery Eye
5	Pin	6	Foot
7	Linch Pin	8	Vehicle Glaci Plate
9	Support	10	Hoist Ratchet

10. Remove the pivot from the RH blade assembly and locate in the foot. Install the jib base into the pivot and secure using a pin and linch pin.

11. Fit the support strut between the jib base and the pivot and secure in position using two pins and linch pins.

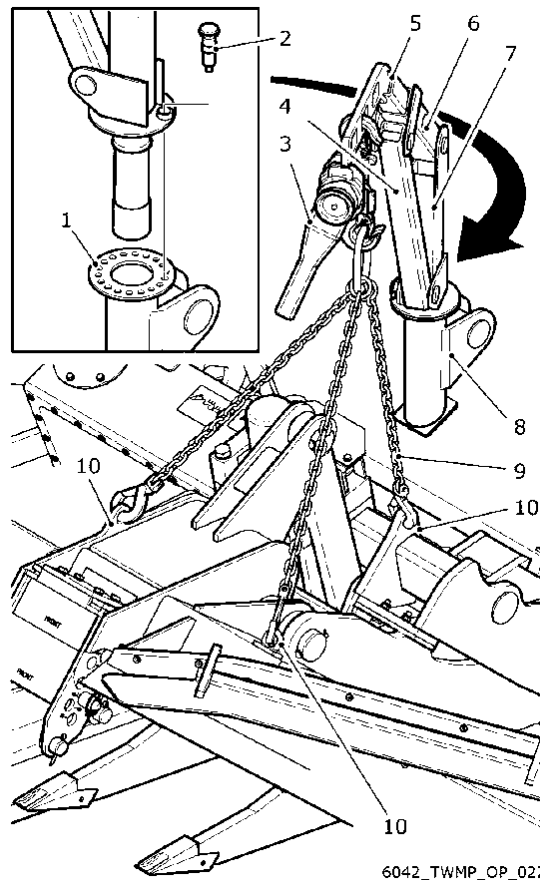
12. Fit the jib into the jib base and secure using a pin and linch pin. Make sure the locking pin is fully inserted into a hole in the foot prior to any lifting operations.

**NOTE**

*The foot has alignment holes to enable the operator to secure the hoist at varying positions to aid fitment of the blade assemblies.*

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13. To rotate the hoist the locking pin is pulled out and rotated which unlocks the pivot. The hoist can then be rotated to the required position. Once set the locking pin must be rotated to lock the hoist in position.
14. Remove from the LH blade assembly and locate the hoist ratchet in the centre hole on the jib. Remove the three lifting chains from the rear of the Powerpack assembly and attach to the ratchet chain.
15. Secure the three chains to the red painted lifting points on the blade assembly.



**Fig 3.2 Attaching the Lifting Equipment**

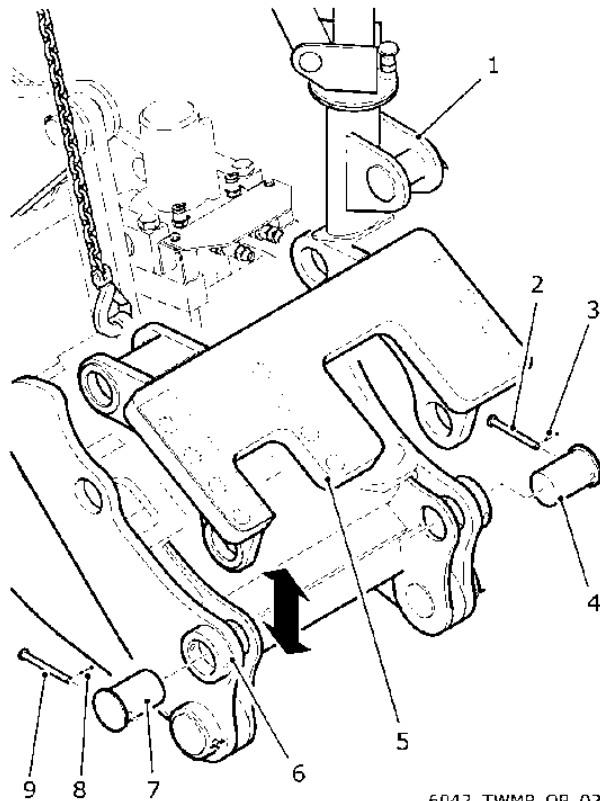
- |   |                 |    |             |
|---|-----------------|----|-------------|
| 1 | Alignment Holes | 2  | Locking Pin |
| 3 | Hoist Ratchet   | 4  | Support     |
| 5 | Jib             | 6  | Jib Base    |
| 7 | Pivot           | 8  | Foot        |
| 9 | Lifting Chains  | 10 | Lifting Eye |



<b>WARNING</b>	
	<b>ANY ITEM OF EQUIPMENT IN EXCESS OF 20KG MUST BE LIFTED OR LOWERED USING THE CORRECT MANUAL HANDLING TECHNIQUES OR SUITABLE AVAILABLE LIFTING EQUIPMENT.</b>

16. Using the hoist ratchet lift blade assembly and align the upper mounting bracket clevises with the vehicle adapter bracket clevises.

17. Noting the position of the holes in the mounting pins secure the mounting bracket to the adapter bracket. Secure the pins using the two clevis pins and split pins.



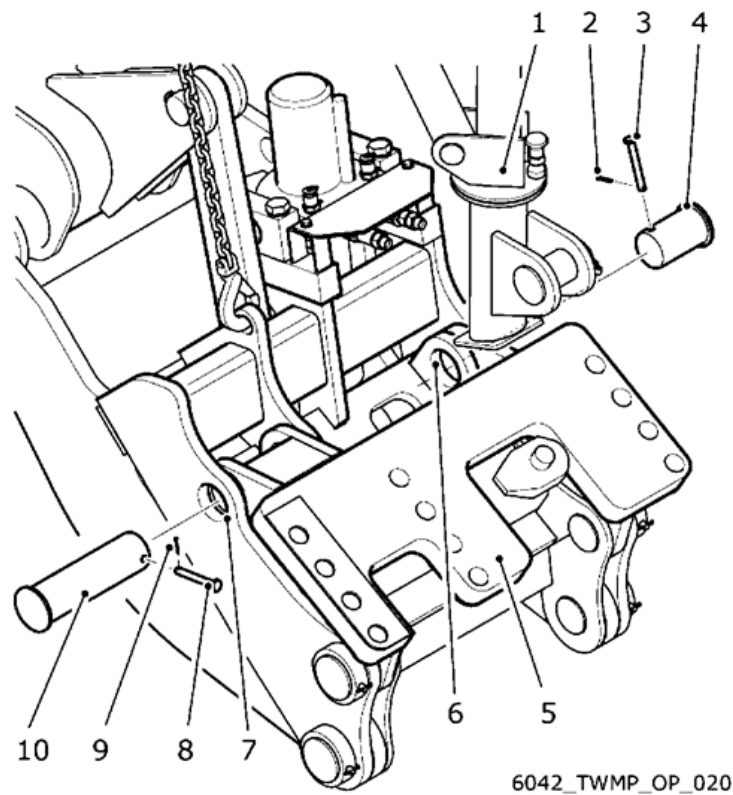
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**Fig 3.3 Securing the Mounting Bracket Lower Pins to the Vehicle Adaptor Bracket  
(Vehicle Removed for Clarity)**

- |   |                         |   |                  |
|---|-------------------------|---|------------------|
| 1 | Hoist                   | 2 | Clevis Pin       |
| 3 | Mounting Pin            | 4 | Split Pin        |
| 5 | Vehicle Adapter Bracket | 6 | Mounting Bracket |
| 7 | Clevis Pin              | 8 | Split Pin        |
| 9 | Mounting Pin            |   |                  |

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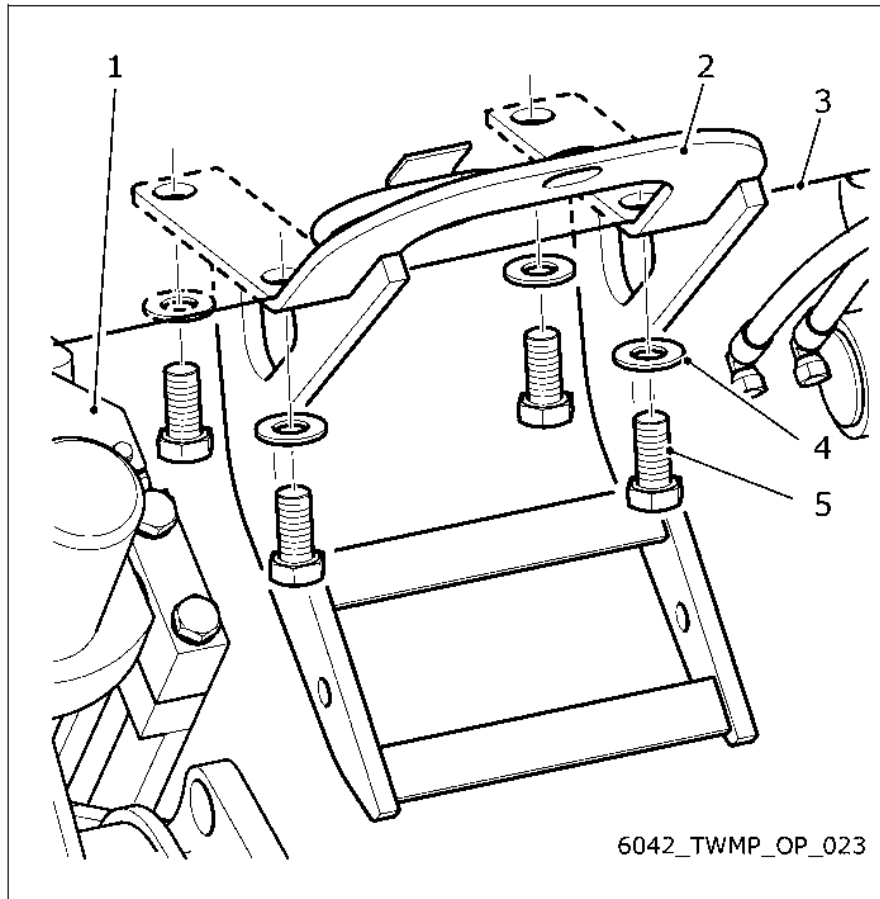
18. Lower the blade assembly using the hoist ratchet. The blade assembly will pivot about the upper mounting bracket pins and will align the lower mounting bracket clevises with the vehicle adapter bracket.
19. Noting the position of the holes in the mounting pins secure the mounting bracket to the vehicle adapter bracket. Secure the pins using the two clevis pins and split pins.
20. Disconnect the lifting chains from the blade assembly.
21. Remove the ratchet and chains from the hoist jib.



**Fig 3.4 Securing the Mounting Bracket Upper Pins to the Vehicle Adaptor Bracket  
(Vehicle Removed for Clarity)**

- |    |                         |    |                                           |
|----|-------------------------|----|-------------------------------------------|
| 1  | Hoist                   | 2  | Clevis Pin                                |
| 3  | Split Pin               | 4  | Inner Mounting Pin                        |
| 5  | Vehicle Adaptor Bracket | 6  | Vehicle Adaptor                           |
| 7  | Lower                   | 8  | Mounting Bracket Clevis<br>Bracket Clevis |
| 9  | Outer Mounting Pin      | 10 | Split Pin                                 |
| 11 | Clevis Pin              | 12 | Upper                                     |


22. Withdraw the hoist locking pin and lift the upper section of the hoist from the foot.
23. Remove the linch pin and pin securing the foot to the recovery eye on the host vehicle.
24. Position the foot on the glacis plate in front of the opposite recovery eye and secure with the pin and linch pin.
25. Lift and position the upper hoist section in the foot mounted on the host vehicle.
26. Align the upper hoist section with the correct alignment hole on the foot and secure using the locating pin.
27. Locate the hoist ratchet in the centre hole on the jib and connect the three lifting chains to the hoist ratchet.
28. Secure the three chains to the blade assembly.
29. Install the blade assembly as detailed in Para's 16 to 23.
30. Align the power pack bracket in position on the toe plate of the vehicle and using a 36mm spanner or socket secures the four mounting bolts to the toe plate.



**Fig 3.5 Power pack Bracket Installation**

- |   |                        |   |                    |
|---|------------------------|---|--------------------|
| 1 | RH Blade Assembly      | 2 | Power pack Bracket |
| 3 | Host Vehicle Toe Plate | 4 | Washer (M24)       |
| 5 | Bolt (M24)             |   |                    |

31. Remove and retain the nut and bolt from the top mount on the bracket.

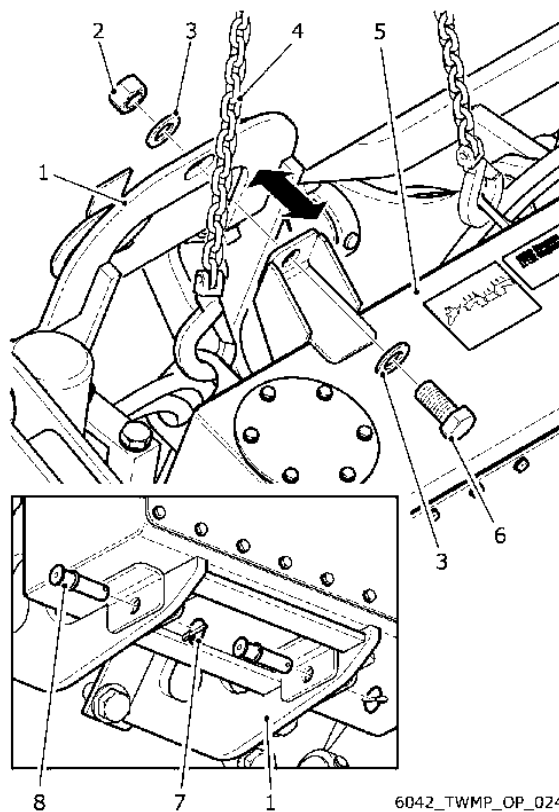
<b>WARNING</b>	
	<b>ANY ITEM OF EQUIPMENT IN EXCESS OF 20KG MUST BE LIFTED OR LOWERED USING THE CORRECT MANUAL HANDLING TECHNIQUES OR SUITABLE AVAILABLE LIFTING EQUIPMENT.</b>

32. Withdraw the locking pin securing the upper section of the hoist to the foot.

33. Rotate the upper section so that the hoist is capable of lifting the power pack.  
Insert the pin.

34. Secure two of the three lifting chains to the power pack.

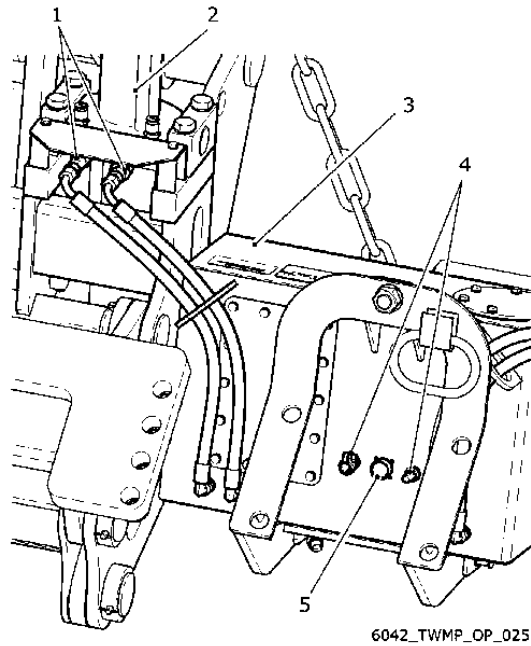
35. Lift and locate the power pack assembly in position on the power pack bracket.  
Secure the base of the power pack to the power pack bracket using two pins and linch pins.
36. Rotate the power pack and secure the top of the power pack to the power pack bracket using the retained nut and bolt.
37. Disconnect the two lifting chains from the power pack and remove the chains from the hoist ratchet.
38. Disassemble the hoist and stow it in position on the blade assemblies.



**Fig 3.6 Securing the Power pack**

- |   |                    |   |                |
|---|--------------------|---|----------------|
| 1 | Power pack Bracket | 2 | Nut            |
| 3 | Washer             | 4 | Lifting Chains |
| 5 | Power pack         | 6 | Bolt (M24)     |
| 7 | Linch Pin          | 8 | Pin            |

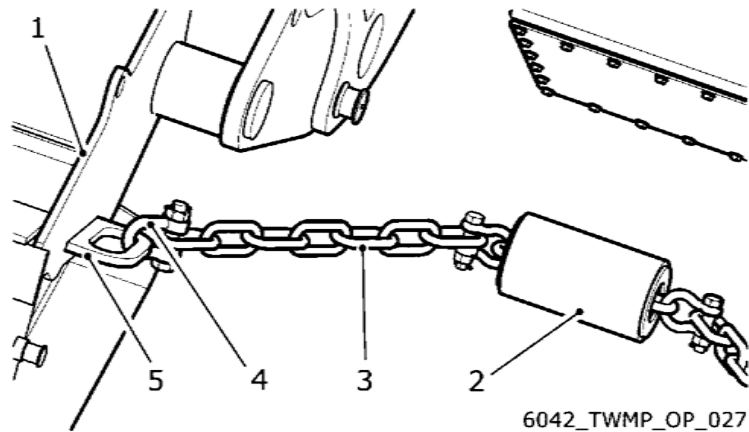
39. Connect the two hydraulic QD connectors to each lift cylinder.
40. Secure the electrical connection and two single pole connections to the rear of the power pack.



**Fig 3.7 Power pack Connections  
(Vehicle Removed for Clarity)**

- |   |                       |   |                        |
|---|-----------------------|---|------------------------|
| 1 | QD Connections        | 2 | Lift Cylinder          |
| 3 | Power pack            | 4 | Single Pole Connectors |
| 5 | Electrical Connection |   |                        |


41. Attach the Anti-Mine Sweeping Device (AMSD) to each side of the blade assemblies by securing the AMSD chain to the blade assemblies using the two shackles.



**Fig 3.8 AMSD Installation**

- |   |                |   |         |
|---|----------------|---|---------|
| 1 | Blade Assembly | 2 | AMSD    |
| 3 | Chain          | 4 | Shackle |
| 5 | Blade          |   |         |

**REMOVAL OF THE TWMP (T-90)**

<b>WARNING</b>	
	<b>THE TWMP (T-90) MUST ONLY BE REMOVED OR FITTED ON FIRM LEVEL GROUND.</b>
	<b>DO NOT ATTEMPT TO FIT OR REMOVE THE TWMP (T-90) ALONE.</b>

**NOTE**

*The installation or removal of the LH or RH blade assembly is an identical procedure.*


42. Removal of the TWMP (T-90) requires a minimum of two people and can be performed by the vehicle crew. The procedure is as follows:
43. Make sure the vehicle is parked on firm level ground with the TWMP (T-90) in the fully raised position with the travel lock pins fitted.
44. Set the TWMP (T-90) CU ON and press the Plough button, this will balance the hydraulic pressure and assist the operator disconnecting the QD connectors.
45. Set the TWMP (T-90) CU to OFF.
46. Turn the host vehicle OFF and ensure the battery power is isolated.
47. Disconnect the two shackles securing the AMSD to the blade assemblies and remove from the TWMP (T-90).
48. Disconnect the two single pole connectors and the electrical connector at the rear of the power pack.
49. Disconnect the two QD connectors at each lift cylinder.
50. Remove the pivot from the RH blade assembly and locate in the foot. Install the jib base into the pivot and secure using a pin and linch pin.
51. Fit the support strut between the jib base and the pivot and secure in position using two pins and linch pins.
52. Fit the jib into the jib base and secure using a pin and linch pin. Make sure the locking pin is fully inserted into a hole in the foot prior to any lifting operations.

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**NOTE**

*The foot has alignment holes to enable the operator to secure the hoist at varying position to aid removal of the blade assemblies.*

53. To rotate the hoist the locking pin is pulled out and rotated which unlocks the pivot. The hoist can then be rotated to the required position. Once set the locking pin must be rotated to lock the hoist in position.
54. Remove from the LH blade assembly and locate the hoist ratchet in the centre hole on the jib. Remove the three lifting chains from the rear of the power pack assembly and attach to the ratchet chain.

WARNING	
	<b>ANY ITEM OF EQUIPMENT IN EXCESS OF 20KG MUST BE LIFTED OR LOWERED USING THE CORRECT MANUAL HANDLING TECHNIQUES OR SUITABLE AVAILABLE LIFTING EQUIPMENT.</b>


55. Secure two of the three lifting chains to the power pack.
56. Supporting the weight of the power pack remove the nut and bolt securing the top of the power pack to the power pack bracket. Retain the nut, bolt and associated washers.
57. Remove the two lynch pins from the two securing pins at the base of the power pack. Remove the two pins. Lift the power pack clear of the adapter bracket and lower to the ground.
58. Using a 36mm spanner or socket remove the four screws securing the power pack bracket to the toe plate. Remove the power pack bracket.
59. Align the pivot with the correct alignment hole on the foot to remove the blade assembly and secure using the locking pin.
60. Secure the three chains to the blade assembly.
61. Using the hoist ratchet take the weight of the blade assembly.
62. Using a pair of pliers remove the split pin from the upper and lower mounting pins. Withdraw the clevis pin from the upper mounting pins. Remove the lower pins.



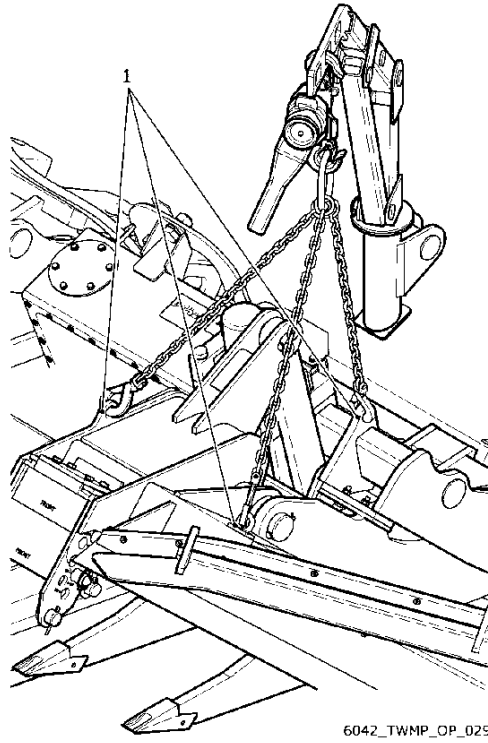
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63. Raise the blade assembly using the hoist ratchet until the upper mounting plate pins are free from the weight of the blade assembly.
64. Withdraw each clevis pin and remove the lower mounting pins.
65. Lower the blade assembly to the ground and remove the lifting equipment.
66. Locate the upper and lower mounting pins in the mounting bracket and secure with the clevis pins and split pins.
67. Repeat this procedure for the opposite side.

**LIFTING THE TWMP (T-90)**

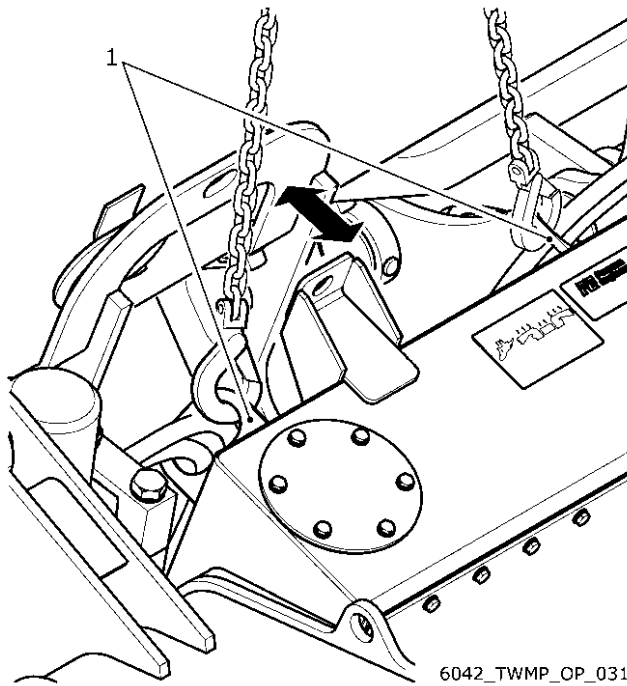
<b>WARNING</b>	
	<b>ANY ITEM OF EQUIPMENT IN EXCESS OF 20KG MUST BE LIFTED OR LOWERED USING THE CORRECT MANUAL HANDLING TECHNIQUES OR SUITABLE AVAILABLE LIFTING EQUIPMENT.</b>
	<b>THE TRAVEL LOCK PINS MUST BE FITTED BEFORE THE TWMP (T-90) IS LIFTED OR TRANSPORTED. IF THE LINK ASSEMBLY IS NOT FITTED THE TWMP (T-90) MAY COLLAPSE IN ON ITSELF.</b>

68. The TWMP (T-90) is lifted as three individual components:
- LH Blade Assembly
  - RH Blade Assembly
  - Powerpack Assembly
69. For fitting and removal by the crew the supplied hoist is to be used, any means of overhead lift can be used as long as it is rated to lift the equipment and the correct lifting eyes are used.



**Fig 3.9 Blade Assembly Lifting Points**

- 1 Lifting Points

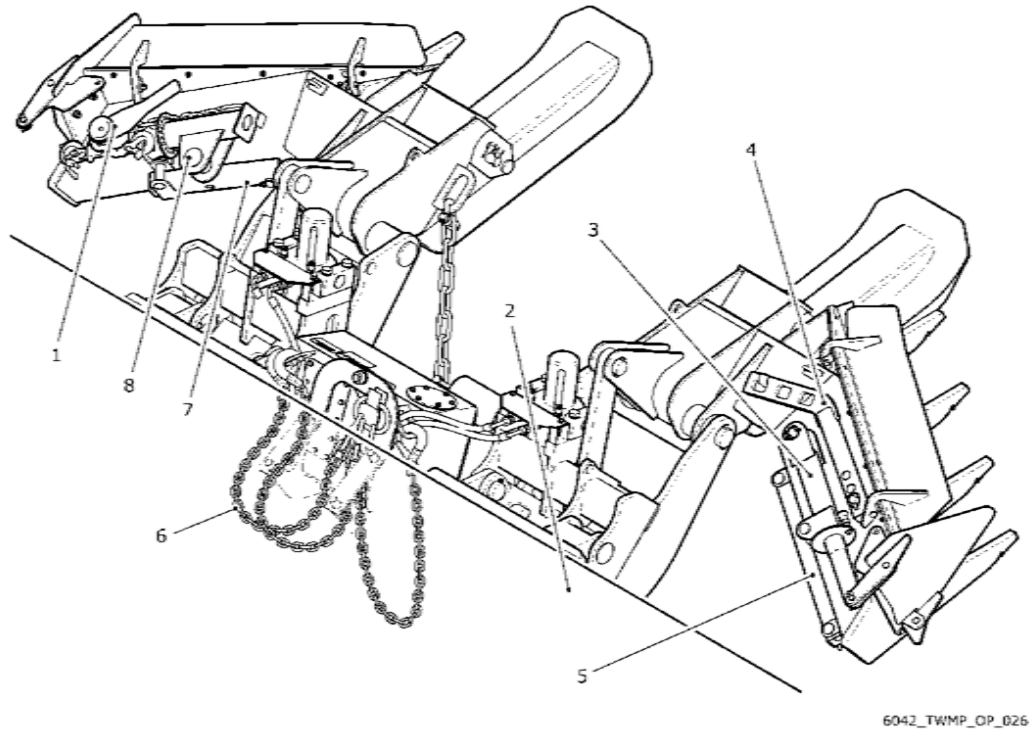


**Fig 3.10 Power pack Lifting Points**

- 1 Lifting Points

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70. The stowage positions for the hoist are on the LH and RH blade assemblies as shown in Fig 11.



**Fig 3.11 Hoist Stowage Position**

1	Hoist ratchet	2	Host Vehicle
3	Pivot	4	Jib
5	Support	6	Lifting Chains
7	Jib Base	8	Foot

**PREPARATION FOR SHIPMENT**


71. The TWMP (T-90) may be transported fitted to; or removed from the host vehicle.

**PRECAUTIONS FOR SHIPMENT**

72. To prevent the ingress of dirt and debris, make sure all electrical and hydraulic connections are securely capped.

73. Lubricate the TWMP (T-90) as described in the Maintenance Schedule 1393-PE-007-601.

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<b>CAUTION</b>	
	<b>INGRESS OF DIRT AND DEBRIS. TO PREVENT ANY DAMAGE TO THE EQUIPMENT BY THE INGRESS OF DIRT, DEBRIS AND CONTAMINANTS, MAKE SURE ALL ELECTRICAL AND HYDRAULIC CONNECTIONS ARE SECURELY PLUGGED OR CAPPED.</b>

**TRANSPORT BY AIR**

74. It is NOT necessary to drain the hydraulic fluid from the TWMP (T-90) before shipping the equipment by air.

**TRANSPORT BY SEA**

75. It is NOT necessary to drain the hydraulic fluid from the TWMP (T-90) before shipping the equipment by sea.

**PACKING**

76. The TWMP (T-90) is packaged in commercial standard crates with sufficient loose material and retaining straps to prevent equipment movement. No special pallets, cradles or containers are required.

77. If the equipment is transported out of a container it must be covered with a clean tarpaulin or similar.

78. Load, Secure, Lash and Unload Requirements

79. The equipment is not required to be lashed or secured if it is transported in a suitable container. It may be handled as normal cargo.

80. If the TWMP (T-90) is transported loose, it must be loaded, unloaded, lashed and secured using suitable points.

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**CHAPTER 4: OPERATIONS**

**INTRODUCTION**

1. Track Width Mine Plough (T-90) (TWMP (T-90)).
2. This chapter describes the function of all controls and indicators on the TWMP (T-90). The controls and indicators for this system are located on the Control Unit (CU) as detailed in chap 2.
3. The following instructions should be read and fully understood by the TWMP operator prior to operating the equipment. This will assist in achieving competence, confidence and a greater understanding of the operational and functional limitations of the equipment only acquired through experience.

**OPERATING INSTRUCTIONS**

	<b>WARNING</b>
	<b>BEFORE PERFORMING ANY FUNCTIONAL TEST OR OPERATION OF THE TWMP ALL WARNINGS CONTAINED IN THE PRELIMINARY MATERIAL MUST BE READ AND FULLY UNDERSTOOD.</b>

	<b>CAUTION</b>
	<b>BEFORE PERFORMING ANY FUNCTIONAL TEST OR OPERATION OF THE TWMP, ALL CAUTIONS CONTAINED IN THE PRELIMINARY MATERIAL MUST BE READ AND FULLY UNDERSTOOD.</b>

**FUNCTIONAL TEST**

4. When the fitting procedure for the TWMP (described in Chap 3) is complete, perform the following test procedure prior to use. All controls and indicators are on the CU unless otherwise stated.
5. Ensure the vehicle parking brake is ON.
6. Verify the mounting pins are fitted and secured with linch pins or split cotter pins as applicable.

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7. Verify all the electrical connections are made and all switches are in the OFF position.
8. Press the LED test button and confirm all the LEDs illuminate. If not, check the brightness control is fully on. If any of the LEDs still do not illuminate, return the CU to Unit Level for repair.
9. Set the POWER ON/OFF switch to ON and verify the POWER ON LED illuminates. If not check the brightness control and reset the circuit breaker CB1. If the POWER ON LED still does not illuminate, check the connections between the vehicle and CU are secure. If the CU POWER ON LED still does not illuminate return the CU to Unit Level for repair.
10. It may not be possible to remove the travel lock pin until the weight of the TWMP is supported by the hydraulic system. Set the UP/DOWN switch to the UP position, then release the switch.
11. On each blade assembly, remove the travel lock pin and its associated linch pin from the travel lock position. Stow each travel lock pin in the stowage hole provided and secure by fitting the associated linch pin.
12. Operate the UP/DOWN switch to DOWN and ensure both blades move. If this is not proven check the hydraulic QD connections on the lift cylinders. If it still does not function return the complete TWMP to Unit Level for repair.

**NOTE**

*It is normal for both blades to move at different speeds due to the pressure required.*

13. Operate the UP/DOWN switch to UP and ensure both blades move. If this is not proven check the hydraulic QD connections on the lift cylinders. If it still does not function return the complete TWMP to Unit Level for repair.
14. Press PLOUGH for more than one second. The PLOUGH LED should illuminate and the TWMP (T-90) should lower to the ground. If it still does not function return the complete TWMP to Unit Level for repair.
15. Raise and refit the travel lock pins unless ploughing is to commence.

**PREPARING THE TWMP (T-90) FOR USE**

16. Before commencing any countermine operations the TWMP must be prepared for use. This preparation should be done in a suitable safe location (eg. in a location that provides cover from enemy observation).
17. Select the required depth of tine penetration by adjusting the skids as described in Para 24.
18. If not already done, remove the travel lock pins as described in Para 34.

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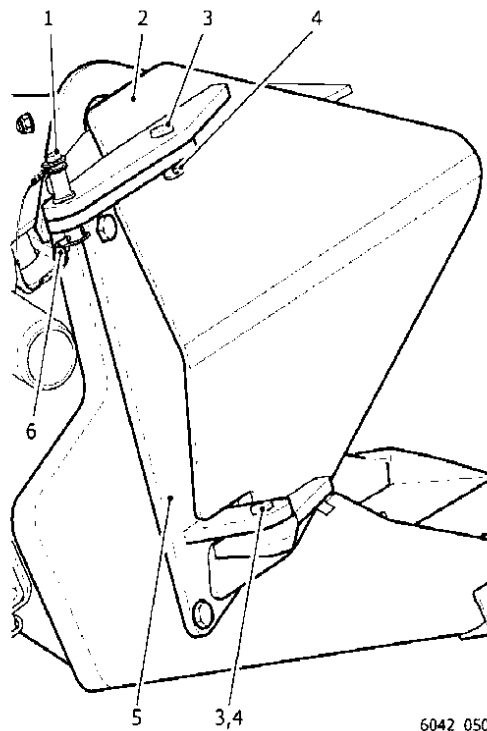


**NOTE**

*Following removal of the travel lock pins there may be a certain amount of hydraulic creep in the TWMP hydraulic system that could cause the blades to slowly drop during cross-country travel. During cross-country travel the CU UP/DOWN switch should therefore be occasionally activated to the UP position to return the blades to the fully stowed position.*

**BLADE EXTENSION OPERATION**

19. The blade extensions need to be opened prior to any ploughing commences.
20. To extend the blade extension, remove the linch pin and pin securing the blade extension in the closed position.
21. Open the blade extension so that it is fully open and secure in place with the pin and linch pin.
22. When ploughing is completed and the blades need to be stowed remove the linch pin and pin securing the blade extension in the open position
23. Close the blade extension and secure in place with the pin and linch pin.



**Fig 4.1 Blade Extension**

1	Pin	2	Blade Extension
3	Pin	4	Split Pin
5	Blade Mount	6	Linch Pin


## **SKID ADJUSTMENT**

24. The penetration depth of the tines may be altered by adjusting the mounting position of the skids. A penetration depth of between 150 and 200 mm, in 25 mm increments, may be selected as required by the ground conditions and predicted mine depth. Before using the Mine Plough the skids should be checked and, if necessary, adjusted to give the required penetration depth. The penetration depth of the tines is measured as the distance between the base of the skid (ground level) and the tips of the tines. The penetration depth for each blade should be taken as the average value for all tines on that blade as penetration depth will vary slightly from one end of the blade to the other. This is important as the penetration depth of each tine alters slightly as the mechanism pivots up and down.
25. The procedure is identical for each skid, therefore only one is described. To adjust the skid adjustment locking plate proceed as follows:
26. Make sure the TWMP assembly is fully raised with the travel lock pins installed. Refer to chap 3. Press PLOUGH.
27. Remove the linch pin securing the skid adjustment pin in position. Withdraw the pin.
28. To increase the ploughing depth the skid must be raised. Insert the pin into the required depth hole and secure in position with the linch pin.

### **NOTE**

*If the skid needs to be raised to its shallowest setting the locking plate needs to be inverted to allow the skid to be locked in position.*

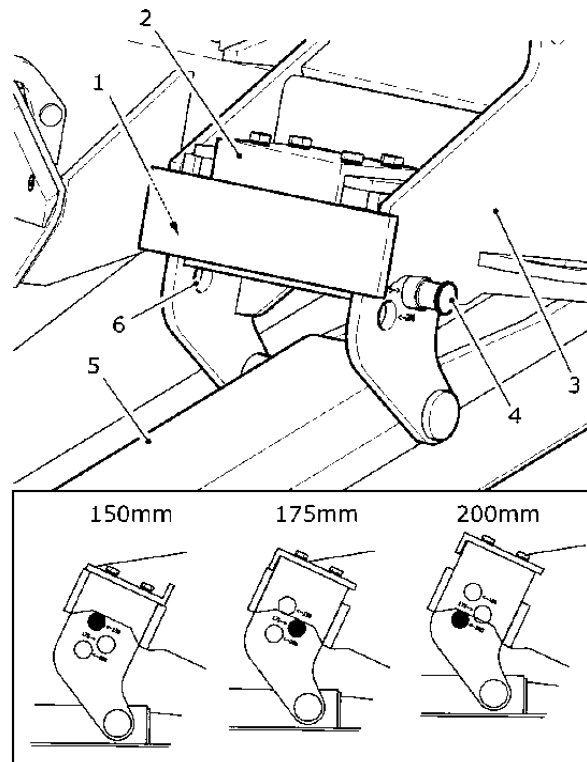
*It may be necessary to remove the skid to facilitate skid depth adjustment.*

<b>WARNING</b>	
	<b>SHARP AND ROUGH EDGES MAY BE PRESENT ON THE SKIDS AS A RESULT OF WEAR OR DAMAGE. DUE CARE MUST BE EXERCISED WHEN CARRYING OUT REPAIR AND MAINTENANCE TASKS ON THE SKIDS.</b>

29. The skid will automatically adjust to the set height when ploughing commences.
30. To decrease the ploughing depth the skid must be raised. Insert the pin into the required depth hole and secure in position with the linch pin.

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31. The skid will automatically adjust to the set height when ploughing commences.
32. Adjust the opposite skid height so that both skid heights are identical before ploughing commences.
33. The skid adjustment procedure is now complete.



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**Fig 4.2 Skid Adjustment**

- |   |                |   |                       |
|---|----------------|---|-----------------------|
| 1 | Linch Pin      | 2 | locking Plate         |
| 3 | Blade Assembly | 4 | Pin                   |
| 5 | Skid           | 6 | Ploughing Depth Holes |

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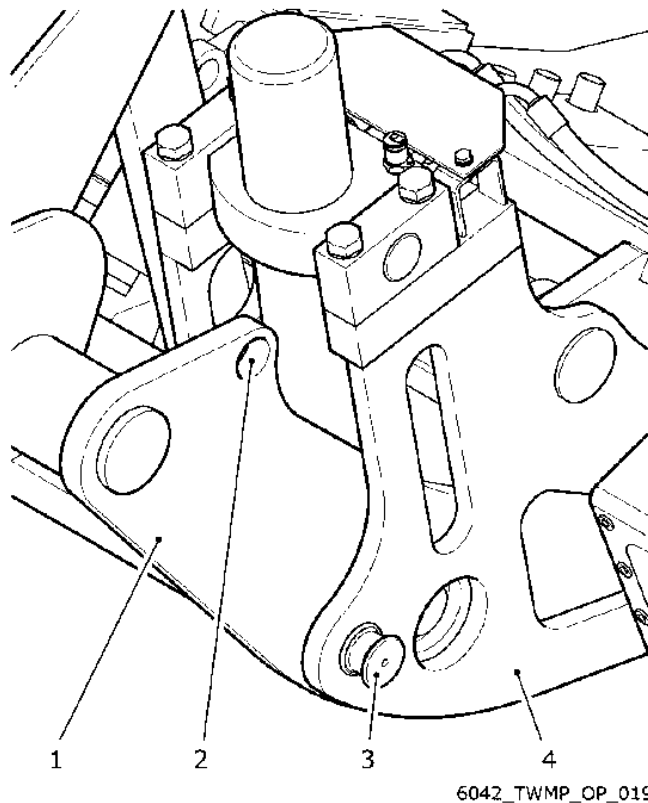
## **TRAVEL LOCK PIN**

### **TRAVEL LOCK PIN REMOVAL**

#### **NOTE**

*The procedure to install or remove the travel lock pin is identical on both the LH and RH blade assemblies. It may be necessary to operate the TWMP to take the weight off of the travel lock pin to aid removal.*

34. Remove the linch pin securing the travel lock pin and withdraw the travel lock pin from the mounting plate.
35. Stow the travel lock pin in the stowed position on the boom and secure with the linch pin.



**Fig 4.3 Travel Lock Pin**

- |   |                                      |   |                                   |
|---|--------------------------------------|---|-----------------------------------|
| 1 | Boom                                 | 2 | Travel Lock<br>(Stowage position) |
| 3 | Travel lock Pin<br>(Locked Position) | 4 | Mounting Bracket                  |

## **TRAVEL LOCK PIN INSERTION**

### **NOTE**

*The procedure to install or remove the travel lock pin is identical on both the LH and RH blade assemblies.*

36. Raise the TWMP and align the boom with the mounting plate to align the travel lock position.
37. Remove the linch pin securing the travel lock pin and withdraw travel lock pin from both the LH and RH booms.
38. Secure the boom to the mounting bracket with the travel lock pin and secure with a linch pin on both the LH and RH blade assemblies.

## **OPERATION**

39. To allow travel lock pin to support TWMP, press PLOUGH on control box and switch off power.
40. Detailed descriptions of how to perform countermine operations lie outside the scope of this manual; operators should refer to the appropriate Service training manuals. Operators should however note the following paragraphs.
41. A successful minefield breaching operation depends largely upon a high degree of skill obtained from practical experience and good judgement on the part of the driver and commander.

## **STARTING THE BREACH**

42. It is assumed that good reconnaissance has established the best route. This is the straightest line possible across the minefield, avoiding natural obstacles such as large boulders, deep holes, waterlogged ground, trees, etc. The route should also be reasonably flat.
43. The tank should be aligned with the chosen route at a distance, as stated in local operating procedures, from the minefield to allow for the initial run-in of the TWMP (T-90).

## **MAKING THE BREACH**


44. Breach the minefield as follows:
45. Close down the tank. Secure all hatches.
46. Lower the TWMP (T-90) blades, press PLOUGH and start moving forward. When the tines enter the ground vehicle power will have to be increased to maintain speed.

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47. When ploughing on good level terrain the ploughing speed can be increased as circumstances dictate. However, it is recommended that the ploughing speed should not exceed 10 km/hr.
48. When ploughing in undulating terrain it is necessary to drive more slowly. The tank may have a tendency to pitch up and down at the front, which will have an adverse effect on TWMP performance. The aim of the driver should be to minimise this pitching as far as possible. To do this the driver should reduce engine revs as he senses the tank beginning to rise, allowing it to move in a more controlled manner.
49. Do not use the TWMP for any lifting procedures.

**FINISHING THE BREACH**

50. Complete the breach as follows:
51. Continue ploughing for at least 15 – 20m beyond the edge of the minefield to ensure all mines are clear of the blades.
52. Stop the tank, and then reverse about 2m to clear the blades of soil.
53. Raise the blades to the stowed position.
54. Drive out of the breach avoiding spoil.
55. When in a safe position, stop and make sure the blade extensions and upper blades are folded in and fit the travel lock pins.
56. If more than one breach is to be carried out, check the tines to ensure they are not clogged with roots, stones, barbed wire or are seriously damaged. Clear away any blockages. This is very important as clogged or seriously damaged tines could affect ground penetration and render the TWMP ineffective.

	<b>WARNING</b>
	<b>MINES AFTER PLOUGHING OPERATIONS HAVE FINISHED THOROUGHLY INSPECT THE AREAS IN AND AROUND THE TWMP (T-90) FOR UNEXPLODED MUNITIONS AND EXPLOSIVE DEBRIS, BEFORE PERFORMING ANY INSPECTION, ADJUSTMENT, REPAIR OR MAINTENANCE. IF ANY SUSPECT ITEMS, UNEXPLODED MUNITIONS OR EXPLOSIVE DEBRIS ARE FOUND, DO NOT TOUCH THEM, AND INFORM THE APPROPRIATE AUTHORITY</b>

**CHAPTER 5: OPERATORS MAINTENANCE**

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**CHAPTER 5: OPERATORS MAINTENANCE**

**INTRODUCTION**

1. This chapter describes the scheduled and preventative maintenance tasks to be performed on the Track Width Mine Plough (T-90) (TWMP (T-90)).

<b>WARNING</b>	
	<b>BEFORE FITMENT OF THE MOUNTING PINS OR ELECTRICAL HARNESS, MAKE SURE THE VEHICLE TRANSMISSION IS IN NEUTRAL AND THE HANDBRAKE IS SET.</b>

<b>CAUTION</b>	
	<b>TO PREVENT CONTAMINATION, ENSURE THAT ALL CONNECTIONS ARE CAPPED AFTER DISCONNECTION OR REMOVAL.</b>
	<b>BEFORE PERFORMING ANY FUNCTIONAL TEST OR OPERATION OF THE TWMP, ALL CAUTIONS CONTAINED IN THE PRELIMINARY MATERIAL MUST BE READ AND FULLY UNDERSTOOD.</b>

2. This Maintenance Schedule is the authority for carrying out all scheduled maintenance tasks on the subject equipment and takes precedence over any other conflicting publication.
3. The person on a unit or formation with delegated responsibility for the specified equipment, who is also competent and experienced in that role, is responsible for ensuring the operations detailed in this Maintenance Schedule are properly carried out. The operations are only to be carried out by personnel who, through either professional trade training or an equipment specific formal training course, are appropriately qualified. The aforementioned responsible person may also order any operation to be carried out more frequently than specified, if conditions under which the equipment operated render it necessary.
4. Scheduled Maintenance is to be recorded in the appropriate equipment document in accordance with the appropriate regulations.
5. Serial numbers left blank in the tables may be taken up by amendment action at a later date.

## **DEFINITIONS**

6. As far as this document is concerned, the following definitions apply:
7. Examine. Carry out a survey of the condition of an item without dismantling, unless specifically instructed to do so in the relevant task requirement. The condition of an item may be impaired by the following:
  - Insecurity of attachment
  - Cracks or fractures
  - Corrosion, contamination or deterioration
  - Distortion
  - Loose or missing fasteners
  - Chafing, fraying, scoring or wear
  - Faulty or broken locking devices
  - Loose clips or packing, obstruction of, or leakage from pipelines
  - Discoloration due to overheating or leakage of fluids
  - Damage due to external sources
8. Visually inspect. Carry out a brief visual inspection to ensure there is no obvious damage or missing equipment.
9. Check. Make a comparison of measurement of time, pressure, temperature, resistance, dimension or other quantity, with a known figure.
10. Operate. As far as possible, ascertain a component or system functions correctly without the use of test equipment or reference to measurement.
11. Replenish. Refill a container to a predetermined level, pressure or quantity. This includes any necessary cleaning of orifices, examination of caps, covers, gaskets and washers, renewal of locking devices and clearing of vents.
12. Replace. Remove an item and then fit a new or reconditioned item.

## **EQUIPMENT MAINTENANCE SCHEDULE**

13. Tables 4 and 5 detail the Operator tasks to be carried out on the TWMP (T-90).

### **NOTE**

*It is permitted to deviate from the specified maintenance periods by up to 10%.*

14. Table 4 Before Use Checks - to be carried out prior to the equipment being used.
15. Table 5 After Use Checks - to be carried out after the equipment being used and at least once in every 24 hours when the equipment is in continuous use.

**NOTE**

*When an 'After Use' check has been carried out within the previous four hours, it is acceptable to use the equipment without carrying out a 'Before Use' check.*

**COMMANDER'S FUNCTIONAL TEST (CFT)**

16. This test is carried out in the months when no inspection is due.

**AIM**

17. The aim of the Commander's Functional Test (CFT) is to enable commanders at all levels to know the general state of the equipment, with particular attention to the following aspects:

18. Safety. Correct functioning and condition of those systems and devices which, if defective, could constitute a danger to the crew and others, e.g.:

- Lubrication system (leaks).
- Electrical system.
- Mechanical system and structure.

19. Performance. Equipment is to be fit for combat. This will include testing of the electrical control system and hydraulic system.

20. Condition of components. General condition of components is such that normal performance may be expected in the future, or that observation or repair is necessary.

21. Appearance. The appearance is of a standard that reflects the role and age of the equipment.

**POINTS CONCERNING THE CFT**

22. The CFT will be carried out by qualified personnel nominated by the Sub-unit Commander in those months when no inspection by maintenance personnel is due. Technical advice should be obtained from maintenance personnel if needed.

23. The equipment to be tested will be detailed from Sub-unit Headquarters.

24. The duration of the test for equipment in average condition will be approximately one hour.

25. The test should be completed in the numerical sequence given in the procedure, to prevent any unnecessary movement of the equipment and crew.

26. The vehicle crew should be available throughout the test.

### **RECORDING**

27. When the test is completed, the date and details should be recorded in the relevant section of the equipment maintenance record. Faults requiring action by maintenance personnel must be reported and rectified as soon as possible.

### **COMMANDER'S FUNCTIONAL TEST**

#### **General**

28. Carry out the Before Use Checks with the exception of the Functional Test which is performed later.

#### **Front of Equipment**

29. Ensure the TWMP (T-90) has been lowered to the ground. Check the following for security, wear and condition:

- Tines (refer Inspection and Repair of Tines).
- Blade extensions.
- Upper blade extensions.
- Skids.
- AMSD.

#### **Sides of Equipment**

30. Check the following for security, wear and condition.


- LEDS
- Vehicle adapter bracket fasteners.
- Travel lock pins.
- Boom pins.
- Blade pins.
- Top link pins.
- Hydraulic lift cylinder pins.
- Mounting bracket pins.
- Hydraulic hoses and connectors
- Power pack bracket fasteners.
- Hoist components on blades.


#### **Operation**

31. Perform a full functional test of the equipment. Record the CFT in the maintenance records.

32. Report all faults to the ARO.


**CLEANING**

<b>WARNING</b>	
	<b>USE APPROPRIATE PERSONAL PROTECTION EQUIPMENT WHEN WORKING WITH PRESSURISED SYSTEMS.</b>
	<b>BEFORE USING ANY CONSUMABLE OR HAZARDOUS SUBSTANCE, READ AND UNDERSTAND THE MATERIAL SAFETY DATA SHEET FOR THAT SUBSTANCE.</b>


<b>CAUTION</b>	
	<b>DURING CLEANING, REMOVE ALL SPOIL AND DEBRIS FROM THE HYDRAULIC HOSES, INCLUDING THOSE PROTECTED BY GUARDS. FAILURE TO DO SO MAY RESULT IN EQUIPMENT FAILURE.</b>
	<b>AVOID BLASTING SMALL COMPONENTS, LEADS AND OTHER DELICATE PARTS BY TOO CLOSE AN APPROACH WITH AN AIR JET NOZZLE. USE CARE IN BRUSHING DIRT FROM DELICATE PARTS.</b>
	<b>DO NOT ALLOW WATER AND GENERAL DETERGENT TO ENTER ANY ELECTRICAL CONNECTIONS.</b>

33. The TWMP (T-90) should be thoroughly washed down before repair, with a water and detergent solution. Ensure soil and debris is removed from around the hydraulic hoses. These components may perish if not cleaned.
34. All harnesses to be reconnected to protect against ingress.
35. Clean and examine the components in accordance with the general instructions detailed in Para 7. In addition, perform the following specific cleaning procedures if the components concerned have been removed.

**Cleaning Plugs and Sockets**


CAUTION	
	<b>DO NOT ALLOW WATER AND GENERAL DETERGENT TO ENTER ANY ELECTRICAL CONNECTIONS.</b>

36. The following cleaning procedure should be used for all plug and socket connectors:
37. Using clean lint-free cloth moistened with degreaser, wipe dust and dirt from the plug and socket bodies, shells and cable clamps. Wipe dry with a clean lint-free cloth.

CAUTION	
	<b>AVOID BLASTING SMALL COMPONENTS, LEADS AND OTHER DELICATE PARTS BY TOO CLOSE AN APPROACH WITH AN AIR JET NOZZLE. USE CARE IN BRUSHING DIRT FROM DELICATE PARTS.</b>

38. Remove dust from inserts with a soft brush and a low-pressure (10 psi maximum) air jet.
39. Moisten a small soft brush with degreaser and wash dirt and any traces of lubricant from the inserts, insulation and contacts.
40. Dry the inserts with a low-pressure (10 psi maximum) air jet.

**Cleaning Mechanical Metal Parts**

CAUTION	
	<b>USE APPROPRIATE PERSONAL PROTECTION EQUIPMENT WHEN WORKING WITH PRESSURISED SYSTEMS.</b>


41. The following cleaning procedure should be used for all mechanical metal parts:
42. Remove any surface grease with a clean rag.
43. Blow dust from surfaces, holes and recesses with a low-pressure (10 psi maximum) air jet.




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44. Immerse the parts to be cleaned in a bath of fresh Degrease and scrub until clean using a non-metallic brush.
45. Remove the parts from the bath and drain.
46. Immerse the parts in a bath of clean degreaser, remove and drain.
47. When cleaning castings, ensure the solvent is not trapped in holes or recess. If necessary, use a low-pressure (10 psi maximum) air jet to blow out any trapped solvent.
48. Radiant heat used in a ventilated enclosure is recommended for drying, particularly where atmospheric humidity is high, after which any bare steel surfaces should be lightly greased with Aeroshell 33MS.

**Cleaning Hydraulic Components**

<b>WARNING</b>	
	<b>PRIOR TO CARRYING OUT ANY MAINTENANCE OR REPAIR TASK ON THE TWMP (T-90), HYDRAULIC PRESSURE MUST BE RELIEVED BY ALLOWING IT TO LOWER TO THE GROUND UNDER ITS OWN WEIGHT.</b>
	<b>TAKE CARE WHEN CONNECTING OR DISCONNECTING HYDRAULIC HOSES TO/FROM THE HOST VEHICLE, DUE TO POSSIBLE RESIDUAL PRESSURE.</b>
	<b>THE HYDRAULIC SYSTEM IS PRESSURISED AND WILL PRESENT A DANGER TO PERSONNEL. ENSURE THAT SUITABLE PRECAUTIONS ARE TAKEN WHEN OPENING THE SYSTEM.</b>
	<b>USE APPROPRIATE PERSONAL PROTECTION EQUIPMENT WHEN WORKING WITH PRESSURISED SYSTEMS.</b>

49. Flush the oil-ways of the hydraulic system with fresh hydraulic fluid.
50. Flush all hydraulic hoses with hydraulic oil.

<b>WARNING</b>	
	<b>BEFORE USING ANY CONSUMABLE OR HAZARDOUS SUBSTANCE, READ AND UNDERSTAND THE MATERIAL SAFETY DATA SHEET FOR THAT SUBSTANCE.</b>
	<b>SHARP AND ROUGH EDGES MAY BE PRESENT ON THE TWMP (T-90) AS A RESULT OF WEAR OR DAMAGE. DUE CARE MUST BE EXERCISED WHEN CARRYING OUT MAINTENANCE AND REPAIR TASKS ON THE TWMP (T-90).</b>

<b>CAUTION</b>	
	<b>DURING CLEANING, REMOVE ALL SPOIL AND DEBRIS FROM THE HYDRAULIC HOSES, INCLUDING THOSE PROTECTED BY GUARDS. FAILURE TO DO SO MAY RESULT IN EQUIPMENT FAILURE.</b>
	<b>DO NOT ALLOW WATER AND GENERAL DETERGENT TO ENTER ANY ELECTRICAL CONNECTIONS.</b>

51. The TWMP (T-90) should be thoroughly cleaned prior to maintenance being carried out. Ensure all soil and debris are removed from the TWMP (T-90), paying particular attention to areas which contain components that may perish if left un-cleaned.

### **LUBRICATION**

52. There is no requirement to lubricate the TWMP (T-90).

### **REPLENISHING THE HYDRAULIC OIL**

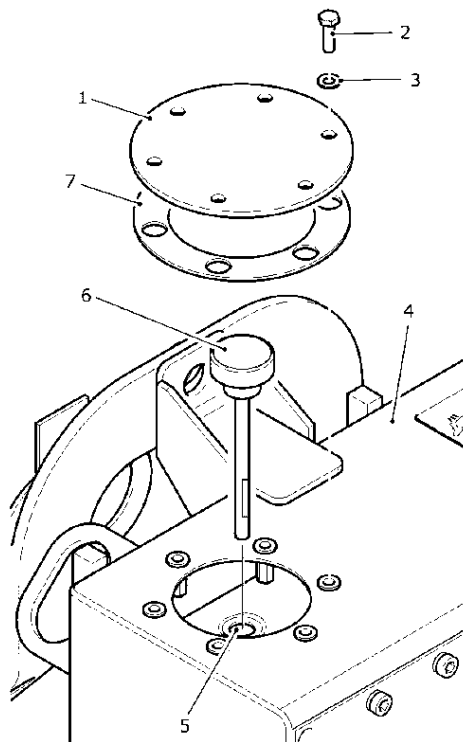
53. Replenish the hydraulic oil as follows:

#### **NOTE**

*Carry out LED check prior to commencing oil change. The TWMP must be in the raised travel position with the travel pins in place before a true oil level reading can be taken.*

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54. To gain access to the dipstick, remove the six screws and washers from the filler cover using a 13mm spanner. Remove the gasket.
55. Unscrew the dipstick and wipe the dipstick clean with a clean rag.
56. Fit the dipstick and then remove it and inspect the oil level. The oil should be visible on the bottom of the dipstick. If necessary, add oil through the dipstick hole and repeat the procedure.
57. When the level is between the MIN and Max markings on the dipstick, the correct level has been reached. Refit the dipstick.
58. Replace the gasket and filler cover to the power pack using the six screws and washers.




**Fig 5.1 Hydraulic Oil Replenishment**

- |   |           |   |            |
|---|-----------|---|------------|
| 1 | Cover     | 2 | Screw      |
| 3 | Washer    | 4 | Power pack |
| 5 | Reservoir | 6 | Dipstick   |
| 7 | Gasket    |   |            |

**INSPECTION OF TINE TIPS**

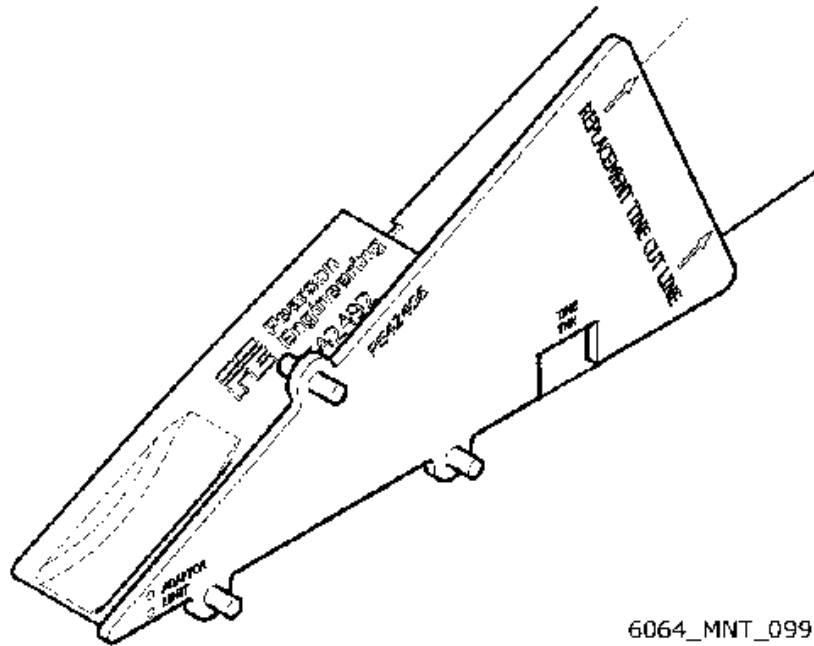
**TINE ATTACHMENT INSPECTION PROCEDURE**

<b>WARNING</b>	
	<b>ALWAYS ENSURE THE TWMP (T-90) IS IN THE STOWED POSITION WITH THE TRANSPORT LOCK PINS INSERTED BEFORE PERFORMING ANY INSPECTION OR REPAIR PROCEDURES ON THE TINES.</b>

59. TWMP (T-90) tines should be regularly inspected for wear at the tip. There is a tine wear gauges available to assist this process. The following is a brief description of the gauges:
60. The tine wear gauge has guides for measuring different types of wear/damage and holes for marking cut lines on worn/damaged tine attachments and for measuring the wear on the side tine tips.

**TINE TIP PROFILE CHECKS**


61. With the TWMP (T-90) locked in the stowed position on the vehicle, apply the tine wear gauge to the side face of each tine tip and tine. Aligning the locating pegs with the outside profile of the tine and tine tip will ensure the gauge locates in the correct position.



**Fig 5.2 Tine Tip Wear**

62. Check the two holes marked 'ADAPTER LIMIT'. If the replaceable tine tip has worn beyond this point, the tine tip will need to be replaced.

**TINE TIP REPLACEMENT**

<b>WARNING</b>	
	<b>WEAR THE CORRECT PPE WHILST WORKING ON THE TWMP AS THE WORKING EDGES WILL BE WORN AND SHARP.</b>

63. Using a hammer and suitable sized drift, remove the roll pin.

64. Remove the tine tip from the tine adapter.

**NOTE**

*Prior to carrying out any fitting procedure, carry out a visual inspection of the main equipment and its securing devices: mounting brackets, pin/linch pins, etc. for damage; repair or replace if necessary.*

65. Fit the replacement tine tip onto the tine adapter aligning the holes.

66. Using a hammer, insert the roll pin into the hole of the tine tip and into the tine adapter.

**CONSUMABLES**

67. The consumables required to maintain and service the TWMP (T-90) are detailed in Table 1.

**Table 5.1 Consumables**

Item	Description	Part No
	<b>OILS</b>	
A	Aeroshell 41	
	<b>DETERGENTS</b>	
B	Detergent pressure wash	
C	General purpose detergent	
	<b>MISCELLANEOUS FLUID</b>	
D	White spirit (thinners)	
E	Corrosion preventive compound PX-1	

**NOTE**

*Only the products listed in Table 1 are to be used on this equipment unless special authority is obtained from higher authority.*

68. Table 2 details the special tools and test equipment required to perform operator level maintenance.

**Table 5.2 Special Tools and Test Equipment**

Part No	Description
710 TI 2022 7	Tine wear gauge

69. Table 3 details the oils required to service the TWMP (T-90).

**Table 5.3 Lubricants and Oils**

System	Product	Capacity
Reservoir replenishment	Aeroshell 41	4 litres
Full system including hydraulic cylinders	Aeroshell 41	6 litres

**NOTE**

*Capacities stated are dry. When refilling after draining, care must be taken to fill to the correct level.*

**Table 5.4 Before Use Checks**

<b>Serial</b>	<b>Maintenance Task</b>	<b>Product</b>
<b>1</b>	<b>GENERAL</b>	
	1.1 Visually inspect the areas between the vehicle adapter plates, power pack bracket, mounting bracket, boom and blade assemblies and around the hydraulic hoses are clear of spoil or debris.	-
	1.2 Visually inspect that vegetation /debris has been removed from the tines and skids.	-
	1.3 Visually inspect the hydraulic oil level and the security of the oil filler cap.	<b>Aeroshell 41</b>
<b>2</b>	<b>LEFT AND RIGHT HAND BLADE ASSEMBLIES</b>	
	2.1 Visually inspect the polyethylene blade facings are secure and undamaged.	-
	2.2 Visually inspect the skids and AMSD are secure and undamaged.	-
	2.3 Visually inspect the blade extensions are secure and undamaged.	-
	2.4 Visually inspect the pins and linch pins are secure.	-
	2.5 Visually inspect the tine tips for wear or damage.	-
	2.6 Visually inspect the upper extensions pins are secure and undamaged.	
	2.7 Visually inspect the hoist components are secure and undamaged.	
<b>3</b>	<b>TOP LINKS</b>	
	3.1 Visually inspect the top links are undamaged and the pins are secure.	-
<b>4</b>	<b>MOUNTING BRACKETS</b>	
	4.1 Visually inspect the hose guards are secure and undamaged.	-
	4.2 Visually inspect the mounting bracket pins are secure, undamaged and free from debris.	-
<b>5</b>	<b>HYDRAULIC CYLINDERS</b>	
	5.1 Visually inspect the rods for wear or damage to working surfaces.	-
	5.2 Visually inspect the hydraulic hoses for splitting, chafing and damage.	-
	5.3 Visually inspect for leakage around the seal between rod and hydraulic cylinder body.	-

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	5.4 Visually inspect the mounting pins, trunnions and associated hardware are secure and serviceable.	-
<b>6</b>	<b>BOOM ASSEMBLIES</b>	
	6.1 Visually inspect that all pins and associated hardware are undamaged and serviceable.	-
<b>7</b>	<b>POWERPACK</b>	
	7.1 Visually inspect that the power pack is undamaged and serviceable.	-
	7.2 Visually inspect power pack access covers and gaskets are undamaged and serviceable.	-
<b>8</b>	<b>POWERPACK BRACKET</b>	
	8.1 Visually inspect that all power pack pins and associated hardware are undamaged and serviceable	-
<b>9</b>	<b>FITTING KIT</b>	
	9.1 Visually inspect the vehicle adapter plates and fasteners are secure and undamaged.	-
	9.2 Visually inspect the TWMP (T-90) harnesses for correct fitting, secure and undamaged.	-
	9.3 Visually inspect that mounting pins are fitted and associated hardware is secure and serviceable.	-
<b>10</b>	<b>CONTROL UNIT (CU)</b>	
	10.1 Visually inspect the CU and harnesses are secure and undamaged.	-
<b>11</b>	<b>FUNCTIONAL TEST</b>	
	11.1 Check the operation of the TWMP (T-90):	-
	11.2 Ensure the vehicle parking brake is applied.	-
	11.3 Start-up the vehicle engine, switch on the vehicle electrical system.	-
	11.4 Press the LED test button and confirm all LEDS illuminate.	-
	11.5 Switch the CU ON.	-
	11.6 Raise the plough by operating the CU UP and remove the transport lock pins. Stow the transport lock pins in their stowage point.	-
	11.7 Ensure all personnel are clear of the vehicle and then set the TWMP (T-90) to DOWN. Check the blades lower to ground.	-
	11.8 Set the TWMP (T-90) to UP and check blades are raised until the stops are reached.	-
	11.9 Fully raise the TWMP (T-90), then lower to a position mid-way between fully up and fully down. The TWMP (T-90) should stay in that position with no creeping downward movement observed.	-

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	11.10 Press PLOUGH and check blades lower to the ground. PLOUGH LED should illuminate.	-
	11.11 Check for any external leakage from the hydraulic system.	<b>Aeroshell 41</b>
	11.12 Raise the plough by operating the CU UP and inset the transport lock pins.	-
	11.13 Switch OFF and isolate CU, switch OFF vehicle engine and vehicle electrical system.	-
	11.14 Report all faults to the ARO.	-

**Table 5.5 After Use Maintenance**

<b>Serial</b>	<b>Maintenance Task</b>	<b>Product</b>
	After Use maintenance is to be performed after the equipment has been used or at least once every 24 hours when the equipment is in continuous use.	
<b>1</b>	<b>GENERAL</b>	
	1.1 Clean the areas between the vehicle adapter plates, powerpack bracket, mounting bracket, boom assemblies and around the hydraulic hoses.	-
	1.2 Remove all vegetation and debris from the tines and skids	-
	1.3 Clean and dry the TWMP (T-90).	-
	1.4 Visually inspect that all the TWMP tools are serviceable and securely fitted.	
<b>2</b>	<b>LEFT AND RIGHT HAND BLADE ASSEMBLIES</b>	
	2.1 Ensure polyethylene blade facings are secure and undamaged. Replace if surface is gouged deeply, or if countersunk fasteners are showing signs of being pulled through.	-
	2.2 Examine the skids and adjusters for damage and security.	-
	2.3 Examine the blade extensions and upper extensions for damage and security.	-
	2.4 Examine the mounting pins and pivot pins for damage and security.	-
	2.5 Check tine tips for wear or damage using the tine wear gauge specific to the LH and RH blade assemblies.	<b>Tine wear Gauge 710 TI 2022 7</b>
<b>3</b>	<b>TOP LINKS</b>	
	3.1 Examine the top links and pins for damage and security.	-
<b>4</b>	<b>MOUNTING BRACKETS</b>	
	4.1 Examine the up-stop and hose guard are secure and	-

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<b>Serial</b>	<b>Maintenance Task</b>	<b>Product</b>
	undamaged.	
	4.2 Examine the mounting bracket pins are secure, undamaged and free from debris.	-
<b>5</b>	<b>HYDRAULIC CYLINDERS</b>	
	5.1 Examine the rods for wear or damage to working surfaces.	-
	5.2 Examine hydraulic hoses for splitting, chafing and mechanical damage.	-
	5.3 Ensure the seal between the rod and hydraulic cylinder body is not leaking.	-
	5.4 Examine the trunnions and mounting pins for damage and security.	-
	5.5 Examine the test points, plugs and seals for damage and security.	-
<b>6</b>	<b>POWERPACK</b>	
	6.1 Visually inspect that the power pack is free of debris, undamaged and serviceable.	-
<b>7</b>	<b>POWERPACK BRACKET</b>	
	7.1 Examine all fasteners and associated hardware for damage and security.	-
<b>8</b>	<b>BOOM ASSEMBLIES</b>	
	8.1 Examine all pins and associated hardware for damage and security.	-
<b>9</b>	<b>FITTING KIT</b>	
	9.1 Visually inspect the vehicle adapter plates and fasteners are secure and undamaged.	-
	9.2 Visually inspect the TWMP (T-90) harnesses for correct fitting, secure and undamaged.	-
	9.3 Visually inspect that mounting pins are fitted and associated hardware is secure and serviceable.	-
<b>10</b>	<b>CONTROL UNIT (CU)</b>	
	10.1 Visually inspect the CU and harnesses are secure and undamaged.	-
<b>11</b>	<b>REPORTING</b>	
	11.1 Report all faults found during the After Use Checks to the ARO.	-

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