ARTC REMOTE PLOUGHING SYSTEM

OPERATIONS AND USERS MANUAL

GEMCO RAIL

ARTC REMOTE CONTROLLED BALLAST PLOUGH

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1. INTRODUCTION

This introduction is to provide the fundamental information for the safe and effective operation of the Ballast Plough. It is a basic guide to the operator who must acquire complete familiarity with safety precautions, maintenance procedures and operational sequences.

CAUTION

It is the operator's interest to keep in mind these points:

- Before commencing any operation, check that there will be no subsequent danger to any person.
- Be sure that all routine machine maintenance has been carried out, including visual checks for wear, fluid levels and leaks or damage.
- Be aware of the surrounding environment to ensure that the ensuring machine operation will not cause any damage to other equipment or to the machine being operated.
- Read this Manual and understand its contents.

The system is designed to operate the plough blades of a ballast plough. There are 2 plough blades centrally mounted between the bogies on each ballast plough ie:

1 Plough Blade A End
2 Plough Blade B End

Each individual plough blade operates independently.

The air supply available from each locomotive is stored in a 98L air receiver.

The power available from compressed air is used to drive an air motor connected to a hydraulic pump. The hydraulic power is then used to drive the hydraulic motors and raise / lower the plough blades.

The available air is also used to drive the control valves.

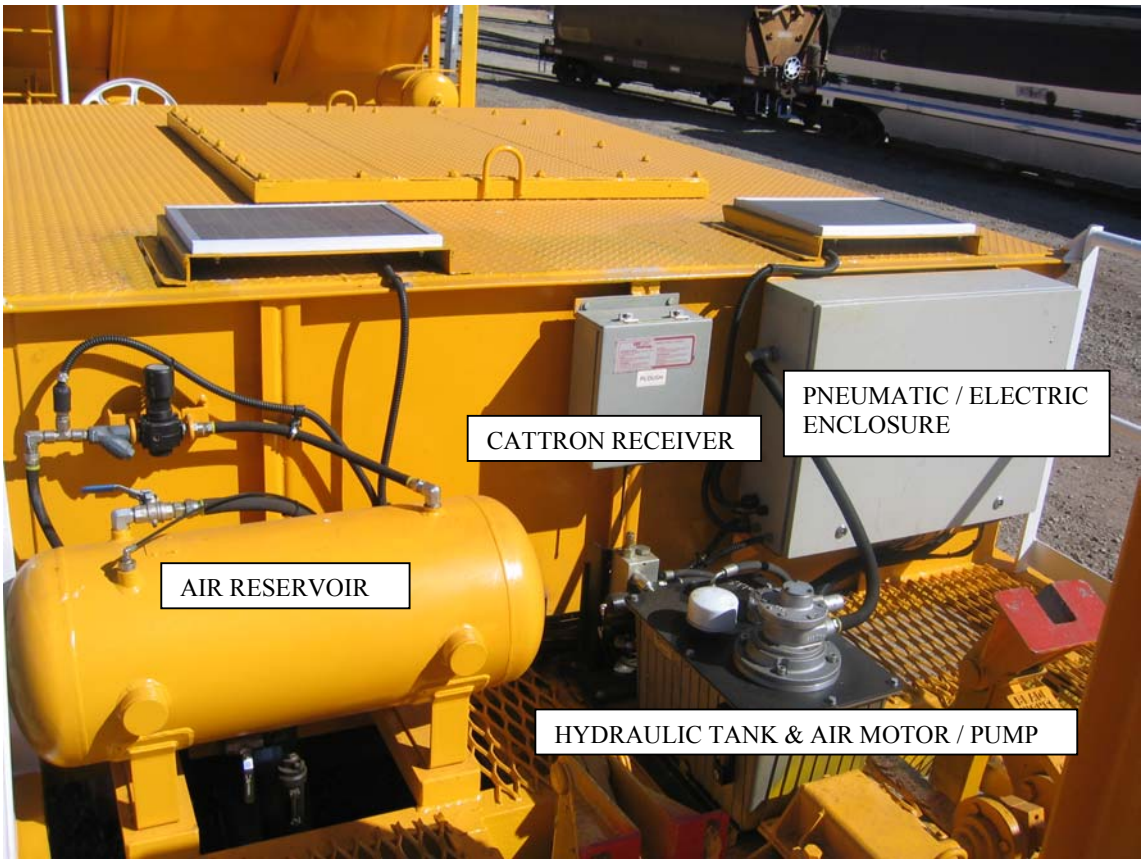
The plough blades can be operated using a Hand Held Radio transmitter or manual lever valves centrally mounted, mid position on the top of the ballast plough.

The Plough Blade Operating System for each Ballast Plough consists of three major functional areas:

First being the Hydraulic Power Unit to SUPPLY hydraulic power to the system.

Second being the Pneumatic Valves Cabinet that CONTROLS the system.

Third being the Electrical Cabinet & Radio Receiver/Transmitter to ACTUATE the required function.



GENERAL DESCRIPTION

1.1. Overview

The GEMCO RAIL design utilises compressed air from the Locomotive to power Hydraulic systems on each ballast plough. This system can be operated from a distance of up to 90 metres by a radio transmitter that sends commands to raise and lower either of the two plough blades on each unit.

The main advantage of the GEMCO RAIL system is that ploughing operations can be directed by a person within a 90m radius and has a clear view of the unit. The operator of the transmitter can change positions to stay away from dust and debris during active ploughing. The flexibility gained for the operator with the GEMCO RAIL remotely controlled system will increase the safety and efficiency of ploughing activities over a wide variety of terrain and track conditions and better use of track time and ballast material will be realised as ballast personnel become familiar with the automated ballast plough.

1.2. System Description

The main components of the system are the mechanical connections and the activation connections. The mechanical connections include the gearboxes, axles or levers added to raise and lower the plough blades. The activation connections are individual systems that combine compressed air, hydraulics and the high frequency radio signals from the remote transmitter to direct the movement of the plough blades. Details of the activation connections (Air, Hydraulic and Electrical systems) are given below. A simplified diagram and a detailed schematic diagram of the air, hydraulic and electrical systems making up the activation connections of the car are shown in Section Fourteen.

1.2.1. Air System

A door pipe running from one end to the other of each wagon connects the air receiver of each wagon to a common line, so each wagon can draw air from any other wagon in the train.

1.2.2. Hydraulic System

As the pump cycles, it pressurises the hydraulic system with oil from the 25 litre reservoir. The pressurised oil powers the movement of the hydraulic motors as directed by the solenoid operated flow control valves. If the pressure in the air line is below 60 psi, the hydraulic system will operate only during the period when the remote transmitter is activated.

The Control Valve Assembly contains a bank of four control valves connected to the pump and reservoir of the car. Each valve controls the hydraulic motors coupled to the gearboxes to provide motion to the plough blades.

1.2.3. Electrical System

The electrical system is used to power the receiver/decoder that allows each car to operate individually. An external pressure switch operates the power to the electrical system once the air supply is present above 30 psi.

Solar panels located on the central position of the ballast plough, recharging the system require only sun exposure to recharge the battery.

OPERATING INSTRUCTIONS

1.3. Safety Instructions

- The system hydraulic pressure can reach 1700 psi. ***Wear stipulated personal protection equipment during the operation of this equipment.*** Handle tubing and hoses with care.

- The ballast plough blades are remote controlled and can raise and lower quickly and powerfully. ***Keep clear of plough blades during their operation.***

- ***No welding can be done on the car*** **until the Radio Receiver has been removed from the car, the Receiver Cable has been disconnected, and the Negative terminal of the 12 volt battery has been disconnected from the ground. For those cars equipped with solar panel recharging, the solar panel should be covered during welding operations within the line-of-sight of the panel.**

- The air lines hold high pressure during use, and the high pressure air can be trapped in the lines when ball valves are closed. When disengaging the couplings connecting the air lines between cars, ***hold both of the hose ends firmly when breaking the connection to avoid kickback of couplings.*** After disconnecting, always stow the loose couplers to prevent drag damage and contamination of the air system.

- To prevent unnecessary battery discharge, always drain air from ploughs when ballast operations are complete. This can be achieved by venting one of the end wagon bypass door pipe end cocks.

- The solar panel can produce up to 42 volts. Precautions must be taken when working with the electrical system to avoid static shock.

1.4. Automatic Operation

Step One

Connect the wagon brake, main reservoir and door pipes to the next wagon in the train. The door pipe end lock of the ballast wagons located at the ends of the ballast wagon train must remain closed, so as not to allow the air to drain to atmosphere.

Step Two

Open the ½" ball valves (2 off) located between the pneumatic control system and the air receiver, the main reservoir pipe and the air receiver.

Step Three

To perform ballasting operations:

a) Locate transmitter to use in the ballasting operation.

b) On the transmitter are three dials (Figure One). Set them to the last three digits of the car number (Receiver/Decoder Number).

c) Select the desired plough blade to be used.

d) Insert the attached key in the lock on the side of the transmitter, pressing and turn it clockwise (Figure Two). The unit 'chirps' when it is activated.

e) Start the train in motion at the desired speed.

f) Lower the plough blade, that is in the direction of travel until the desired height setting has been reached.

Step Four

To conclude ploughing operations:

a) Make sure all plough blades are raised and locked.

b) Dial out the current car number on the transmitter to prevent accidental activation of the doors.

c) Turn the transmitter POWER key counterclockwise and remove the key to conserve the battery pack.

Note: All plough blades must be completely raised and locked on each car for transport.

1.5. Manual Operation

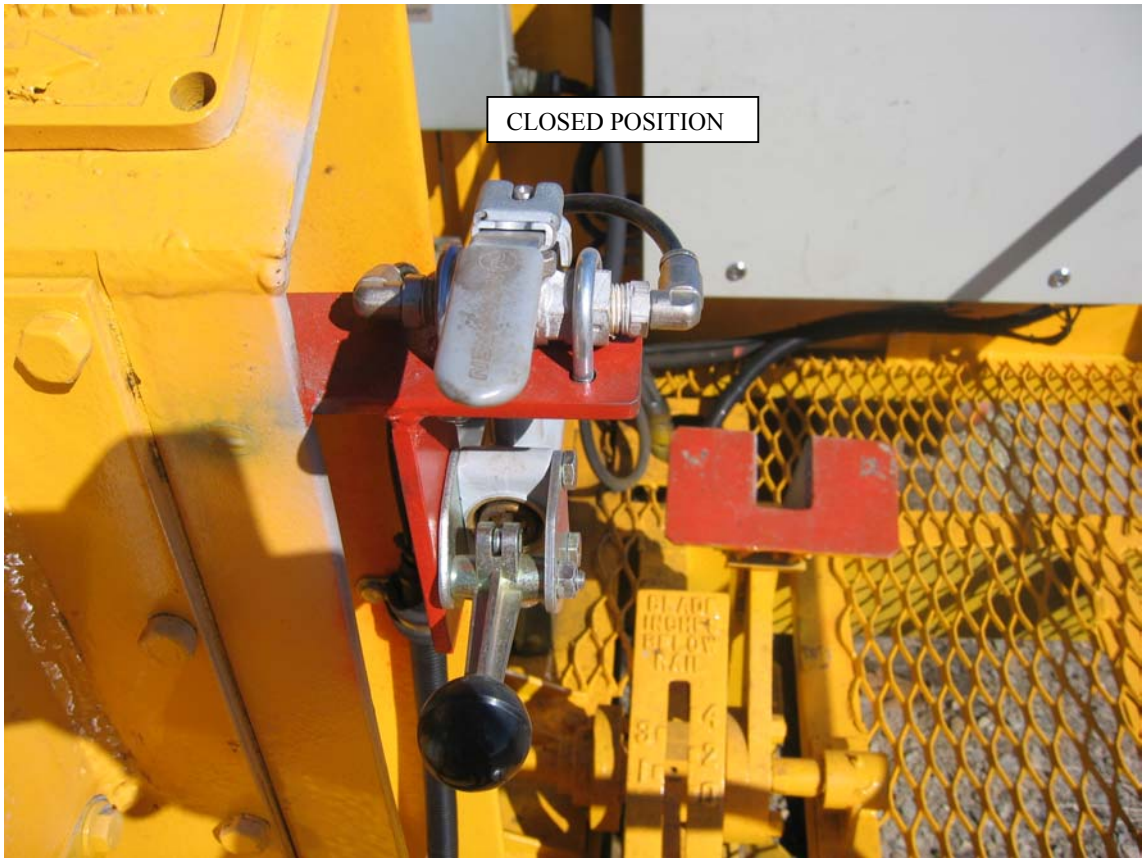
If there is no electric power or a radio failure, then the plough blades can be operated manually. It is possible to operate the plough blades manually by use of the manual control valves. There are two manual control valves, mounted centrally on the car.

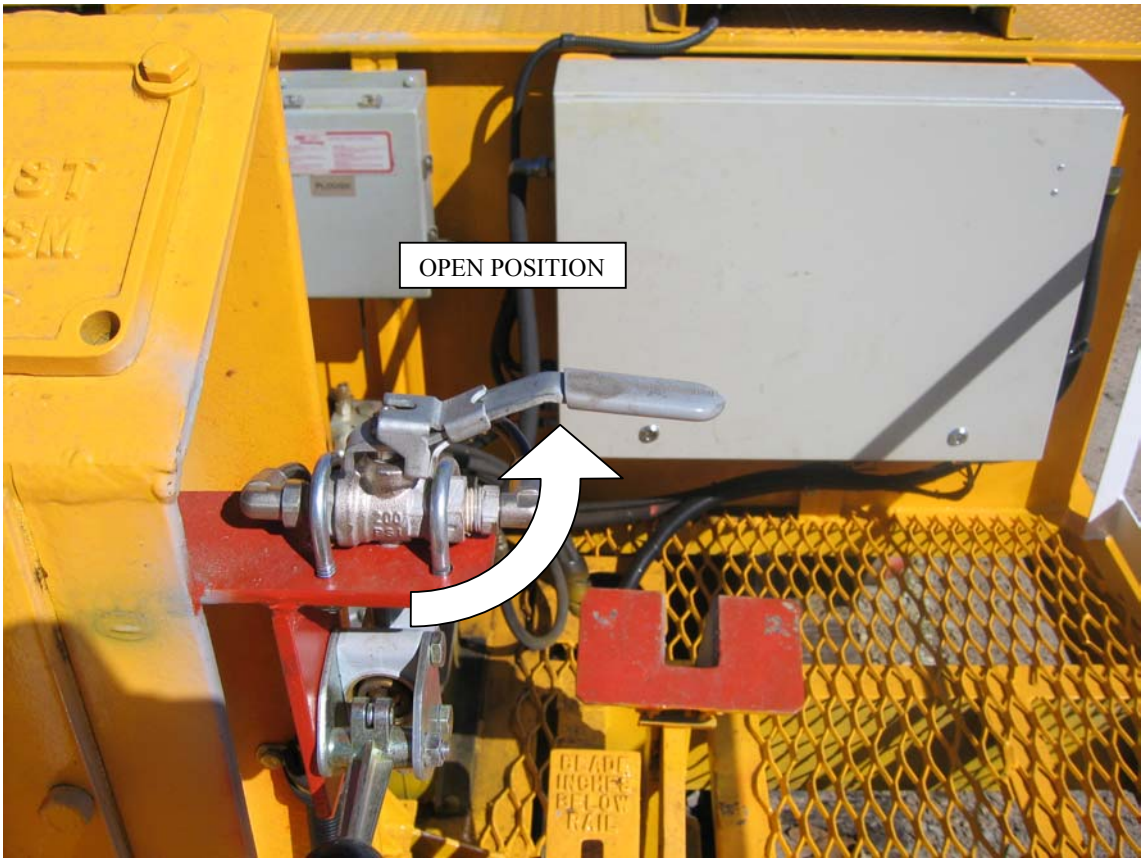
Step One

Start the train in motion at the desired speed.

Step Two

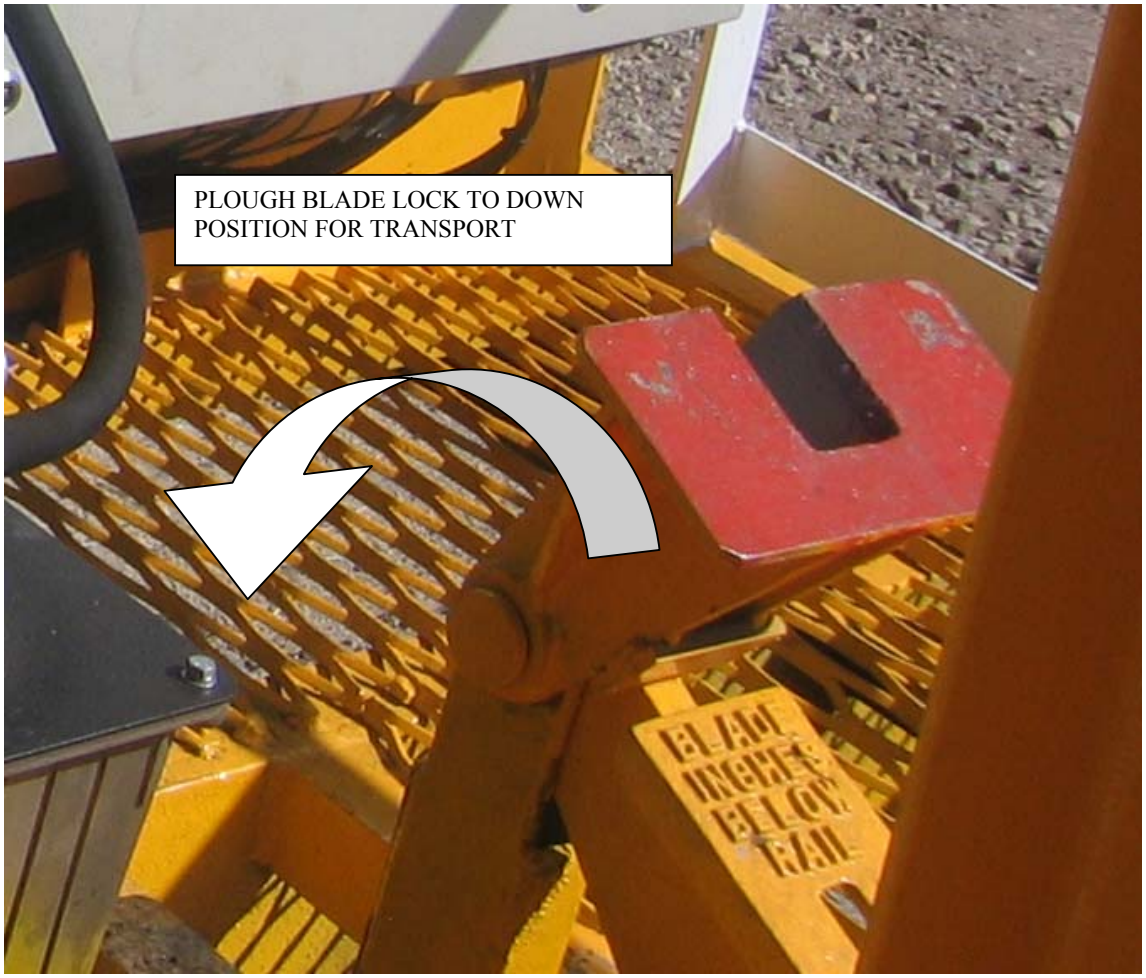
Shift the ball valve from the closed position to the open position to enable use of the manual control valve.


CLOSED POSITION


OPEN POSITION

Step Three

Operate the manual control valve of the desired plough blade. Note: Lowering the valve handle will lower the plough blade, allowing the handle to spring return to neutral and the blade will stop lowering and remain in position. To raise the plough blade, the valve handle must be raised.



Step Four

After ploughing, raise all ballast ploughs before stopping train and return ball valve to closed position. Note: All plough blades must be completely raised and locked on each wagon for transport.

OVERVIEW OF SYSTEM SPECIFICATIONS

Type of System:	Fixed Displacement pump powered by air motor and controlled by radio remote control or Manual lever valves.
Type of Fluid Used:	HYSPIN AWH100 or Donax TC 30 (Shell)
Oil Tank Volume:	25 Litres
Pump Type:	1 off Gear Pump
System Pressure:	Operating 110 bar (1600 psi)
Relief Setting:	120 bar (1750 psi)
Prime Movers:	1 off Air motor
Filtration:	Return Filters – 10 micron Breathers – 03 micron
Air Pressure on Regulators:	Pump: 700kPa Main Control: 450kPa

HYDRAULICS

HYDRAULIC POWER PACKS

Nominal Outputs

- Flow = 6.5Lpm
- Air consumption = 45 litres per second @ 550 kPa pressure drop across the motor giving 2200 rpm.
- Pressure = 120 Bar
- Input power required = 1.55 kW
- Reservoir capacity = nominal 25 litres when 75% filled.

Air Motor

- Maximum speed = 3000 rpm
- Maximum pressure = 700 kPa
- Maximum output = 3 kW

Hydraulic Pump

- Type – submersed gear
- Displacement = 3.15 cc/rev
- Maximum pressure = 250 bar
- Maximum speed = 3500 rpm

Drive Coupling

- Type = 3 piece with replaceable flexible element
- Rating = 12 kW @ 3000 rpm

Return Filter

- Rating = 10 micron nominal
- Surface area = 550 CM sq.
- Maximum flow = 40 lpm
- Maximum pressure = 300 kPa
- Bypass setting = 170 kPa
- Clogging indicator style = visual

Suction Strainer

- Rating = 125 micron nominal
- Maximum flow = 25 lpm

2. FUNCTIONAL DESCRIPTION OF SYSTEM COMPONENTS

2.1. Power Unit Functional Description

The Hydraulic Power Unit provides hydraulic power to the valves and actuators in the system. The Pneumatic power available from each Locomotive is converted to hydraulic power through air motor and hydraulic pump. The hydraulic power is then used to drive hydraulic motors to raise/lower the plough blades.

2.1.1. Hydraulic Tank

Description:	25 Litre fluid capacity
Part Number:	Castrol HySpin AWH 100 or Shell Donax TC30
Function:	To store hydraulic fluid, to settle particles and turbulence in the fluid.

2.1.2. Level Gauges

Description:	Level Gauge
Part Number:	514428
Function:	To indicate level of oil in tank fluid level switch.

2.1.3. Air Motor

Description:	Air Motor 8 Vane, 3 Kw, 3000 rpm motor
Part Number:	514422
Function:	Prime mover for Gear Pump

2.1.4. Pump/Motor Mounting

Description:	Bell Housing, Coupling
Part Number:	Bell Housing - 514421 Coupling – 514418, 514419, 514420
Function:	To couple pumps and support air motors

2.1.5. Filtration

The complete filtration system can be divided into two areas:

1. Return Filtration
2. Reservoir Breathers

The filters listed below have been selected to reduce the operating costs of running the system, by minimising the system damage and wear caused by contaminated fluid.

Description:	Return Filter
Part Number:	514426
Function:	To clean the oil coming back to Tank from system

Description:	Filler and Breather Unit
Part Number:	514427
Function:	To fill oil in the Tank and prevent contamination from entering Tank.

2.1.6. Hydraulic Manifold Block Assembly

Description/ Part Number:	Manifold block D.C. Valve – 514413 P.O. Check Valve – 514435 Relief Valve – 514431
Function:	To control the direction of flow and maximum pressure in the system. P.O. Check valve would prevent the plough blade creeping.

2.1.7. Minimess Test Point

Description:	Minimess Test Coupling
Part Number:	514430
Function:	To allow measurement of pressure in hydraulic system.

2.2. Pneumatic Control Cabinet

The Pneumatic Cabinet houses the Air Filter / Regulator, Lubricator and the pneumatic solenoid valves. It receives the command signal from Electrical control cabinet and Manual Lever valves. This is then used to actuate the air motor and the Hydraulic D.C. valves. The main components are:

2.2.1. Cabinet

Description:	Steel cabinet – 900 x 600
Function:	To house all the pneumatic and Electrical components.

2.2.2. Filter / Regulator

Description:	Air Filter / Regulator
Part Number:	514443
Function:	To filter and control the maximum pressure of air going to air motor.

2.2.3. Filter / Regulator

Description:	Air Filter / Regulator
Part Number:	514444
Function:	To filter and control and maximum pressure of air going to control circuit i.e. solenoid valves and manual lever valves.

2.2.4. Lubricator

Description:	Air Lubricator
Part Number:	514445
Function:	To lubricate the air going to air motor.

2.2.5. Solenoid Valves

Description/ Part Number:	Solenoid Operated D.C. valve – 514446 Solenoid – PS1E2302J – 514447
Function:	Solenoid valves receive electrical signal from Radio Controller (through Electrical cabinet) and actuate the air motor and hydraulic D.C. Valve.

2.2.6. Logic Valves

Description/ Part Number:	Logic Valve “OR” Valve “AND”
Function:	Send the pilot signal to air motor and hydraulic valve as per circuit logic.

5.3. Electricals

This part consists of Radio Transmitter, Radio Receiver and Electrical Cabinet. This is the main controlling element of plough blade operating system. The main components are as follows:

5.3.1 Electrical Cabinet (Item 40)

Description:	Steel cabinet – 900 x 600
Function:	To house 12V battery and terminal strips. Radio Receiver is connected to Electrical cabinet through M.S. Connector.

5.3.2 Radio Transmitter

Description:	Cattron Radio Transmitter – 472.05 MHZ
Part Number:	514124
Function:	To remotely actuate the plough blades. It is a hand held unit and is supplied with rechargeable batteries. It sends radio signal to the radio receiver, which in turn, actuate the solenoid valves. Radio Transmitter has a selector switch to select the particular wagon.

5.3.3 Radio Receiver

Description:	Cattron Radio Receiver – RD 16 BC 472.05MHZ
Part Number:	514130
Function:	To remotely actuate the plough blades. It receives the radio signal from Radio Transmitter and actuates the solenoid valve.

5.3.4 Misc. Electricals (Item 42)

Description/ Part No:	12V, 10Ah Battery
Function:	It supplies power to the Radio Receiver and Solenoid Valves. Battery is charged through solar panel in the sunlight.

5.3.5 Solar Panel (Item 93)

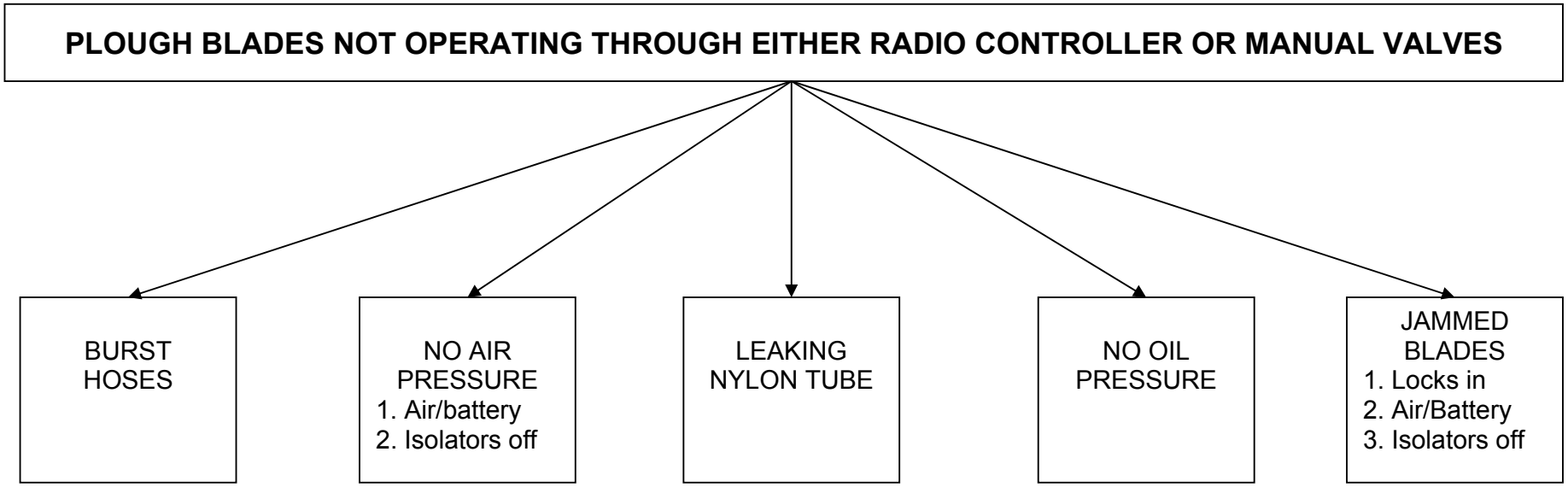
Description:	12V, 11watt Solar Panel
Part Number:	514452
Function:	To charge main battery.

6 TROUBLESHOOTING

Troubleshooting the ballast plough operating system requires basic understanding of Hydraulic, Pneumatic and Electrical sub-systems. The troubleshooting is divided into two parts to quickly isolate the problem in the system.

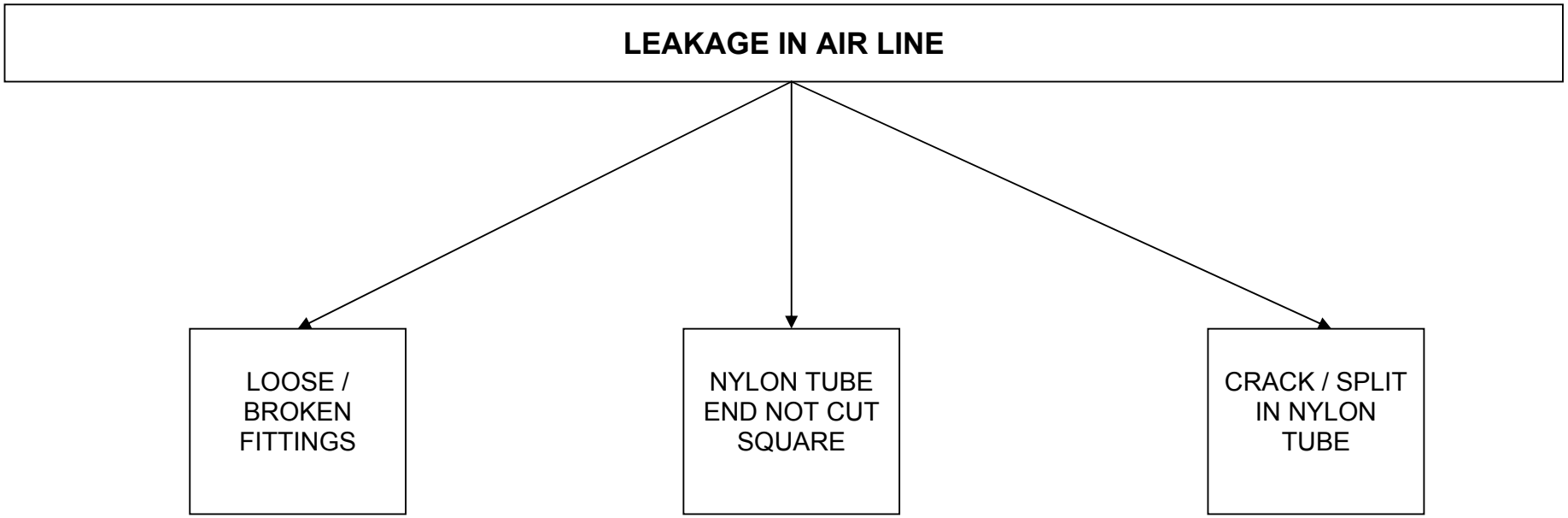
First part explains the problem and possible cause with respect to the whole system.

Second part explains the problem and possible cause with respect to individual components in the system.



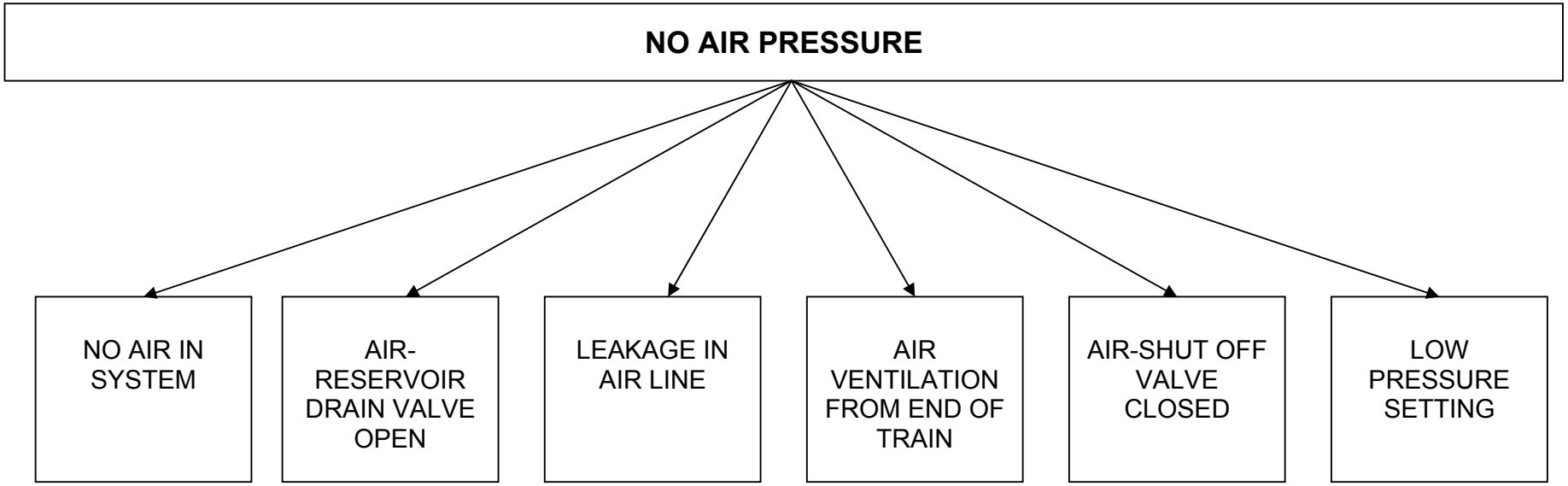
Steps:

1. Check for any burst hose.
2. Check air pressure (through air pressure gauge mounted on regulator).
3. Check for any leaking nylon tubes.
4. Check hydraulic pressure (through test point provided on manifold block).
5. Unlock blades.



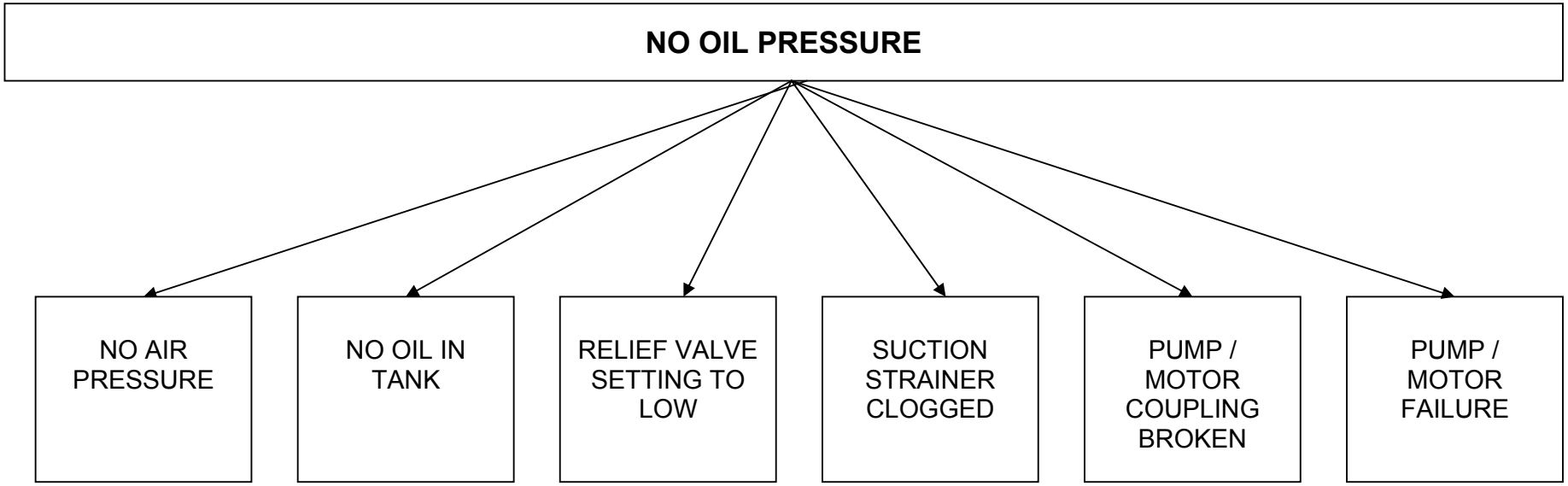
Reasons:

1. Loose / broken air fittings.
2. Nylon tube end not square (this in the most common cause).
3. Crack / kink in the nylon tube.
4. Failed / broken pneumatic shuttle valves.



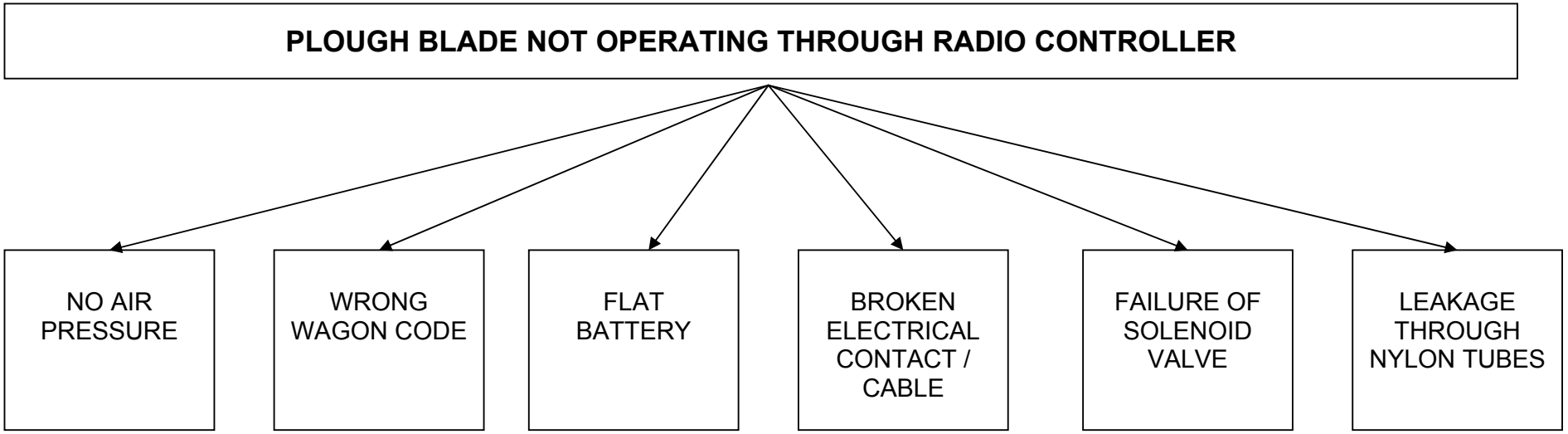
Reasons:

1. Main air-line not connected.
2. Main line ball valve closed.
3. Air-reservoir drain valve open.
4. Leakage in the air line.
5. Air shut off valve not open (due to loss of pilot air pressure).
6. Filter regulator setting too low.



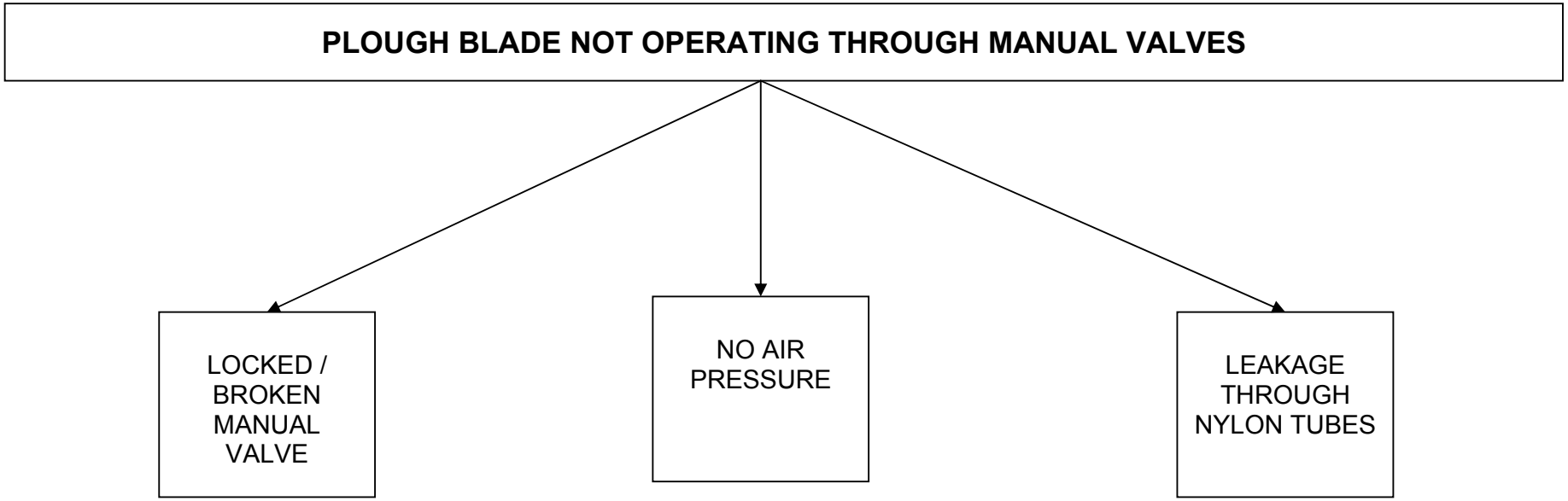
Reasons:

1. No air pressure.
2. Burst hoses or leaking fittings.
3. No oil in tank.
4. Relief valve setting too low.
5. Clogged suction strainer.
6. Pump / Motor coupling broken.
7. Pump or Motor failure.
8. Jammed hydraulic D.C. valve.
9. Check air supply



Reasons:

1. Wrong wagon code.
2. Flat battery.
    - Broken contact / cable between solar panel to battery.
    - Broken solar panel.
    - Broken / loose battery contact points.
3. Broken electrical contact / cable between battery and solenoid valves.
4. Solenoid valve failure.
5. Leakage through nylon tubes.
6. Check air supply.



Reasons:

1. Broken / malfunctioning manual valves.
2. Leakage through nylon tubes.
3. Check air supply.

7 TROUBLESHOOTING GUIDE

7.1 Pressure Control Valves

PROBLEM	POSSIBLE CAUSE	REMEDY
Relief Valve – Low or no pressure	Incorrect adjustment	Check pressure with gauge and re-adjust
	Contaminants holding valve partially open	Disassemble valve and inspect for burrs and other contaminants. Crocus seat and valve spool to remove burrs. Drain and flush the system. Refill with filtered recommended fluid.
	Worn or damaged seat, poppet or spool	Replace damaged parts
	Plugged orifice	Disassemble and clean
	Broken spring	Replace spring if necessary
	Valve spool scored	Remove and replace

PROBLEM	POSSIBLE CAUSE	REMEDY
System overheating	Leaking at valve seat	Remove and inspect for contamination and/or burrs. Remove and repair or replace seat. Drain and flush system of contamination. Refill with filtered recommended fluid. Check valve spool for misalignment.
	Fluid viscosity too high or too low	Drain, flush and refill with filtered recommended fluid.
	Working pressure of system same as relief setting	Set relief valve to specified pressure. If relief valve continues to blow, identify mechanical fault causing high working pressure. Check hydraulic valves to ensure they are functioning correctly.

PROBLEM	POSSIBLE CAUSE	REMEDY
Excessive noise or chatter	Main pressure setting too close to remote pressure	Set relief valve to specified pressure. If relief valve continues to blow, identify mechanical fault causing high working pressure. Check hydraulic valves to ensure they are functioning correctly.
	Viscosity of fluid too low	Drain, flush and refill with recommended filtered fluid.
	Worn or faulty seat, spool or poppet	Remove and replace.
	Wrong spring on spool	Select valve with proper spring rate.
	Pressure fluctuation in tank return line	Check other return lines for fluctuation. Remove return line. Check for restriction.

7.2 Pump Problems

We have seen how the fluid contamination and incorrect pump applications can damage the pump. The following charts are designed to help you recognise and remedy some of these problems.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Pump makes excessive noise	Air leaks in the suction side of pump	Install a vacuum gauge in inlet on a naturally aspired reservoir. If indicates zero, air leakage may exist. Replace fitting and/or line. Replace pump shaft seal. Check fluid level. Check pump housing for cracks. Check torque of pump housing bolts.
	Aeration of fluid in reservoir	Return lines terminate above fluid level. Check fluid level. Too low causing excessive heat and foam. Check fluid for foam by drawing a sample from reservoir.
	Plugged or restricted suction line, suction line, suction strainer or filter	Check for proper suction line size. Check for proper filter or strainer size. Remove, clean or replace filter or stainer.
	Plugged reservoir filter/breather filler neck strainer.	Remove, clean or replace.

	Fluid viscosity too high	Drain system and fill with fluid
	Worn or stuck pump parts	Check for burrs or solid contaminants. If burrs, remove, clean and/or replace parts as necessary. If contamination, flush system thoroughly and filter fluid at refill. Pump housing bolts improperly torqued. Loosen and retorque to proper specification.
	Improper installation	Check alignment with drive mechanism. Check vane cartridge for "backward" vanes. Check rotation. Check pump rpm. Check relief valve or unloading valve for proper setting.

PROBLEM	POSSIBLE CAUSE	POSSIBLE REMEDY
Pump fails to deliver fluid	Low fluid in reservoir	Check fluid level, fill to proper level
	Pump intake restricted or plugged	Check for proper suction line size Check for proper filter or strainer size Remove, clean or replace filter and/or strainer
	Air leak in suction line and/or air lock	Repair leaks Check pump housing drain port for improper positioning, allowing air to be trapped in housing. Bleed pump inlet.
	Pump shaft turning slowly	Check prime mover's RPM. Increase speed to recommended specification. If belt driven (mobile), check belt tension.
	Oil viscosity too high or too low	Drain, flush and fill with filtered fluid recommended by pump manufacturer.
	Pump shaft or parts broken or worn	Remove and replace broken or worn parts.
	Dirt or sludge in the pump	Disassemble and clean pump. Flush system thoroughly and fill with clean, filtered fluid.

	Improperly adjusted variable volume adjustment mechanism pressure compensator	Check and set adjustment properly.
	Wrong rotation	Check rotation on pump and prime mover.

PROBLEM	POSSIBLE CAUSE	POSSIBLE REMEDY
Oil leakage around pump	Shaft seal worn	Remove and replace. Check shaft for scratches and grooves. Replace if necessary.
	Suction or pressure line connection loose or broken	Tighten or replace connections.
	Pump housing bolts loose or improperly torqued	Disassemble and inspect seals for damage. Retorque to specification. Follow manufacturer's torquing procedure.
	Case drain line too small or restricted (Shaft seal leaking)	Check for proper line and fitting size. Eliminate kinks and bends. Check case pressure against manufacturers specifications.
	Cracked housing Over-pressurised	Check relief valve pressure setting. Replace pump. Follow pump manufacturer's recommendations for pump start-up procedure.

PROBLEM	POSSIBLE CAUSE	POSSIBLE REMEDY
Pump does not develop pressure	Pump not delivering fluid	See corresponding trouble-shooting chart.
	Vane(s) in vane pump sticking. Piston(s) in piston pump sticking.	Disassemble and inspect for burrs and/or varnishing. Replace and/or repair as necessary. Flush system thoroughly and refill with filtered fluid.
	System relief valve unloading or compensator malfunction.	Check each for broken, worn or sticking parts.

PROBLEM	POSSIBLE CAUSE	POSSIBLE REMEDY
Low or erratic pressure	Cold fluid	Operate machine to raise temperature of fluid to normal operating temperature. Check pressure again.
	Wrong fluid viscosity	Drain and refill system with filtered recommended fluid.
	Aeration or cavitation	See Excessive Noise trouble-shooting chart.
	Excessive pump wear	See corresponding trouble-shooting chart.
	Sticking pump parts	Disassemble and repair as necessary. Check for varnish and/or sludge. Clean parts thoroughly, flush and filter entire system.
	Pump speed to slow	Check rpm and adjust speed, but do not exceed pump specifications.

PROBLEM	POSSIBLE CAUSE	POSSIBLE REMEDY
Excessive pump wear	Abrasive dirt in the hydraulic fluid	Drain and flush system thoroughly. Replace filter elements.
	High water content fluid incompatibility	Check manufacturers recommendation about the use of High Water Content Fluid (HWCF) in the pump.
	System pressure exceeding pump rating	Check for possible relief malfunction. Check for other pressure regulator failures.
	Oil viscosity too high or too low	Drain, flush and refill system with proper viscosity fluid.
	Pump misalignment or belt drive too tight	Check pump alignment with motor and adjust as needed. Check belt tension. Check for thrust loads.
	Aeration and cavitation	See Excessive Noise trouble-shooting chart. Check parts for the severity of wear and replace if necessary.

PROBLEM	POSSIBLE CAUSE	POSSIBLE REMEDY
Pump parts inside housing broken	Seizure due to lack of fluid	Check for cavitation or aeration. Check for too low or too high an oil level. Check viscosity of fluid.
	Excessive system pressure above maximum pump rating	Check pressure controls for possible malfunctions. Repair or replace as necessary.
	Excessive torquing of housing bolts	Repair or replace parts as necessary. Reassemble following manufacturers procedures.
	Solid matter contamination being drawn in from the reservoir seizing pump parts.	Check suction strainer for damage repair or replace. Check suction filter for bypass condition. Replace element. Disassemble pump, repair and/or replace parts as needed. Clean up fluid in system by filtering through a filter cart system or by adding filters to the system.

7.3 Noise in system

PROBLEM	POSSIBLE CAUSE	POSSIBLE REMEDY
Noticeable increase in overall noise level at fittings, pipes, valves and pump or motor (usually accompanied by spongy or jumping operation of actuators in the system)	Aeration	Find and repair source air leak at suction side of pump.
	Cavitation	Find and repair source of oil restriction at suction side of pump. Collapsed lines.

	Foaming oil in reservoir	Check flow velocity in return lines. Analyse hydraulic fluid for proper anti-foam additive. Correct fluid level. Check return line terminating above fluid level.

PROBLEM	POSSIBLE CAUSE	POSSIBLE REMEDY
Pump motor, or valves make loud rattling or clanking noises under load when load first started up. But, noise disappears shortly.	Cold oil is too viscous.	Warm up the system with a pre-heater. Run unit under no-load until operating temperature is achieved.

PROBLEM	POSSIBLE CAUSE	POSSIBLE REMEDY
Pump, motor or valves for no apparent reason start making loud rattling or clanking noises. Accompanied by erratic operation of actuators.	Cavitation	Find obstruction (restriction) in line and correct it. Clean suction filter.
	Aeration	Find and repair suction leak. Check fluid level in reservoir.

PROBLEM	POSSIBLE CAUSE	POSSIBLE REMEDY
Single loud "pop" or "clank" repeating at regular intervals in pump or hydraulic motor.	Aeration	Fill reservoir if low on fluid. Tighten all connections.

PROBLEM	POSSIBLE CAUSE	POSSIBLE REMEDY
Increased noise from pump or hydraulic motor. Usually accompanied by sluggish performance.	Worn parts	Replace or repair pump or motor. Flush system to remove wear particles.
	Too thin an oil	Check oil temperature. Cooler may need to be added. Check fluid viscosity. If incorrect, flush system and refill with proper viscosity fluid. Check for cavitation or aeration. Remove restrictions and/or repair air leak.

PROBLEM	POSSIBLE CAUSE	POSSIBLE REMEDY
Increased noise from valves, usually chattering sound, sometimes sticking or erratic performance	Worn spools or orifices	Replace worn parts or entire valve. Flush entire system to remove wear particles and other contaminants.
	Electro-hydraulic valve cavitation	Check for erratic electronic signals. Replace worn parts or entire valve.

NOISE AREA	HOW TO CURE / CHECK	POTENTIAL REDUCTION
Coupling between pump and motor (high)	Shim where necessary, realign to 0.003” T.I.R. or less	1-2

NOISE AREA	HOW TO CURE / CHECK	POTENTIAL REDUCTION
Coupling noise only	Change to type with rubber interfacing.	

NOISE AREA	HOW TO CURE / CHECK	POTENTIAL REDUCTION
Pipes and fittings (noise and vibration)	Change to flexible hose with correct psi ratings throughout the system. Insert hose in sharp bend areas and at pump	

NOISE AREA	HOW TO CURE / CHECK	POTENTIAL REDUCTION
Pipes or hoses (rattling noises)	Stabilise with absorbent mounts at frequently spaced intervals	

NOISE AREA	HOW TO CURE / CHECK	POTENTIAL REDUCTION
Mounting plate of pump/motor (vibration)	Install 1" or heavier pump/motor bed plate: heavy isolators between plan and reservoir and/or stiffen mount.	

NOISE AREA	HOW TO CURE / CHECK	POTENTIAL REDUCTION
Oil reservoir ("loud thrumming")	Add rubber washers under reservoir and under pump / motor mounting plate.	

7.4 Hydraulic Fluid

Troubleshooting hydraulic fluid is done by sight, feel, smell and analysis. The following charts will present some of the more common fluid problems.

PROBLEM	PROBABLE CAUSE
Contaminated fluid	Components not properly cleaned after servicing. Inadequate screening in fill pipe. (Too large a mesh). Tank air breather removed. (No breather provided). Open end of pipe lined and/or hoses not properly covered while servicing machine. Improper tank baffles not providing settling basin for heavy materials. Inadequate filtration or bypassing filter. Contaminated fluid being added to the reservoir. Excessive component wear.
Foaming fluid	Fluid return line not below fluid level. Inadequate or broken baffles in reservoir. Leak at suction side of pump. Lack of anti-foaming additive. Excessive flow to tank though tank return line. Too high a velocity flow through tank return line. Worn pump shaft seal.

Excessive water in petroleum base fluid	Tank cooling coils not below fluid level. Cold water lined fastened directly against hot tank causing condensation within tank. Filler pipe left open. Water in cans used to replace fluid in tank. Extreme temperature differential in certain geographical locations. Drain not provided at lowest point in tank to remove water collected over possible long operating periods.
Overheating of system fluid	Water shutoff or heat exchanger clogged. Continuous flow over relief valve: stalling under load etc, fluid viscosity too high or low. Excessive slippage or internal leakage at pump or valve(s). Reservoir size too small. Reservoir assembled without baffling or sufficient baffling. Case drain line from pump returning oil too close to suction line. Pipe, tube or hose I.D. too small causing high turbulence. Valving too small, causing high turbulence. Poor air circulation around reservoir. System relief valve set too high.

7.5 Filters

Many times problems with the hydraulic system can be traced to the specific filtering system being used.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Slow component operation	Restricted return filter	Check for bypass of element. Replace element.
	Improper size element	Replace element with proper size.
	Restricted suction filter	Check for high vacuum reading. Replace or clean filter element.
	Restricted pressure	Check for high differential across filter. Replace element.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Pump makes excessive noise	Restricted suction filter (cavitation)	Check for high inlet vacuum. Replace or clean element.
	Loose filter housing cover (aeration)	Check for loose mounting bolts on cover. Check for and replace worn cover gasket.
	Low fluid level (aeration)	Check fluid level in tank. Refill to proper level with clean fluid.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Fluid contains contamination	Improper type of filter element	Determine if the micron rating of element is correct for application. Check for bypass condition.
	Plugged element	Replace or clean element.
	Filter change interval too long	Decrease time between filter change period. Add bypass indicators to filters.
	Pressure differential too high	Check for high inlet pressure. Replace element with a high pressure element and housing.
	Ruptured element	Check for stuck bypass; repair or replace. Replace element.
	No element	Install proper element.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Bypass indicator always reads "bypass"	Fluid viscosity too high	Check for recommended fluid viscosity.
	Broken spring or weak spring	Remove and replace bypass spring.
	Plugged element	Replace or clean element.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Bypass indicator reads "Filter is clean"	No element is installed	Install element.
	Ruptured element	Replace element. Refer to ruptured element problem.
	Broken spring	Remove and replace bypass spring.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Broken filter housing	Too high pressure	Check for pressure surges and correct. Check suitability of housing for application.
	Shock pressures	Install shock suppressor (accumulator)

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Ruptured element	Bypass not installed or stuck close	Check housing for installed bypass. Check for broken spring or guide stem. Replace bypass.
	Too high pressure	Check suitability of element for application.
	Change interval too long	Decrease time between filter change period. Add bypass indicator to filter application.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Filter indicator reads "Bypass" upon start up	Oil viscosity high during cold start up	Run system until it reaches normal operating temperature.
	Highly contaminated system (If new system has not been flushed, it's common to load a filter with dirt within minutes of initial start up	In new systems, flush with low viscosity fluid at high velocities. Replace filter element several times until fluid is cleaned up. In existing systems, consult specialist and replace filter element(s).

	Filter bypass setting too low relative to filter pressure drop with a clean element installed (for given conditions)	Select a higher bypass setting if available and if circuit conditions will permit. Replace filter with a larger one with a lower pressure drop.
	Wrong element installed (filter mesh too fine and/or pressure drop too high)	Replace wrong element with correct one.
	Filter indicator out of calibration	Check indicator, most will read "CLEAN" when system is shut down and there is no flow through filter. Replace or calibrate indicator.

7.6 Valves

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Valve spool will not return to centre	Pilot drain plugged	Check internal or external drain ports for blockage. Check external drain line for kinks or collapsed line.
	Pilot valve stuck in one position	Check for solenoid burnout or seizure. Remove and clean pilot valve spool. Check pilot valve springs for proper tension.
	Return spring(s) weak or broken	Remove and replace.
	Contamination and/or burr on spool	Remove, disassemble and clean valve. Remove burr with crocus cloth or stone. Replace valve body or entire valve. Clean and flush entire system.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Valve spool does not shift	Low or no pilot pressure	Check the pilot pressure source. Check and clean pilot orifices. Check for collapsed external pilot supply line.
	Pilot valve spool sticking	Remove and clean pilot valve spool. Check for improper valve torque. Check for and remove burrs.

	Valve body distortion	Loosen mounting bolts and retorque. Loosen rigid piping to remove strain.
	Valve spool sticking	Remove and clean. Remove burr(s) on spool and/or in housing. Clean and flush system.
	Contamination	Clean and flush system thoroughly.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Valve spool slow In shifting	Too high an oil viscosity	Change proper oil viscosity. Use tank pre-heater. Warm oil by dumping over relief valve.
	Restricted pilot drain	Check internal drain for restriction and clean. Check external drain for collapsed or restricted line. Check for high return-to-tank back pressure.
	Pilot pressure too low	Check pilot source pressure. Switch from internal to external pilot supply.
	Valve body distorted	Loosen mounting bolts and retorque. Realign piping to remove strain.
	Contamination	Clean and flush system thoroughly.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Incorrect actuator response when valve is shifted	Improperly installed air motor connections	Check air connections.
	Improperly installed hose or pipe connections	Check piping diagram and re-plumb.
	Improperly assembled valve	Check assembly procedure and rebuild.
	Spool end for end	Remove spool, reverse and re-install.

One final comment about solenoids, servos and valves. These items are designed to do specific jobs under specific operating conditions of voltage, load, heat, pressure, oil etc. If these conditions are efficiently maintained, checked and controlled, the components and entire system will have significant service life. A no maintenance system is costly in downtime and trouble-shooting hours.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Variations in flow (Door Speed)	Insufficient pressure differential across the orifice.	Increase system pressure. Decrease system load.
	Fluid viscosity too high or too low (needle valve and pressure compensated valve)	Warm oil to normal operating temperature. Change fluid to recommended SSU. Change valve to temperature pressure compensated valve.
	Leakage at or inside actuator	Repair external or internal leakage of actuator.
	Erratic pilot pressure	Check cause of pilot pressure drops.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Fluid is overheating	Excess flow over relief valve	Adjust pump gpm (variable volume pump). Reduce pump rpms. Change to smaller gpm pump.
	System pressure too high	Lower system pressure.
	Contamination	Drain, clean and flush system.
	Improper valve size	Check for proper valve capacity. Remove valve and replace with larger valve.
	Fluid is forced to travel both ways through needle valve	Add check valve to system. Check valve stuck close.
	Needle valve installed backwards	Reverse connections.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
No flow through valve	Broken spring	Disassemble and replace spring.
	Valve installed backwards	Reverse connection. Check free-flow direction indicator.
	No pump flow	See Trouble-shooting pump section.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Actuator drifts	Seat or poppet damaged	Replace or refinish seat. Replace poppet. Check for excessive back pressure shock.
	Erosion of seat area	Drain, clean and flush system. Refill system with filtered fluid.
	Excessive leakage	Check leakage at cylinder at actuator or motor. See Trouble-Shooting Cylinders and Motors sections.

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
No reverse flow through pilot operated valve	No or low pilot pressure	Check system pressure, increase as necessary. Check for collapsed pilot line.
	Leakage at plunger piston seal	Disassemble and repair or replace.
	Plunger piston binding	Disassemble and clean valve. Check for burrs on piston and/or bore.

8 GENERAL MAINTENANCE

8.1 Overview

General maintenance should be done on every trip before ploughing or during idle time for the train to prevent problems. Cleanliness is vital and determines the life of these powered systems. Introduction of contaminants during their use or maintenance may damage the systems. Contaminants are any materials foreign to the air or fluid components (even the Teflon tape used to seal pipe threads). Some guidelines for general maintenance:

- Use only approved fluids in the system (see list in Section 8.2 below). Any substitutions must be approved by GEMCO RAIL in advance.
- Filter all hydraulic oil that is added to the system to at least 25 microns. New oil out of the barrel is not 'clean' oil.
- Do not allow disconnected couplers to drag on the ground. They can be damaged and collect dirt. Clean out dirty couplers before running the system.
- Turn on the air to the system only when ballasting. Turn off during breaks, meals etc. Supply air to sections of the train only as need to save air and the system lubricants and reduce pump wear.
- Drain systems air, to conserve battery.

GEMCO RAIL recommends that Preventative Maintenance (PM) be performed on each car at least once every six months. This PM includes draining and filtering of the hydraulic fluid, cleaning or replacing all filters and servicing the battery**.** A sample PM checklist is shown in Appendix B.

8.2 Necessary Equipment

- AWS 32 air lube oil for Lubricators / Shell Tellus 32
- Castrol Hyspin AWH100 / Shell Donax TC 30
- Soapy water (to clean solar panel)

8.3 Pump Power Unit

8.3.1 Check the fluid levels.

- Check the reservoir for the Hydraulic oil level. The level is shown in the sight glass on the side of the reservoir.

To refill the reservoir:

a) Remove the Breather Cap on the top of the reservoir.

b) Fill with Castrol Hyspin AWH100 or Shell Donax TC 30 Hydraulic Oil (filtered to 25 microns or better). Use the sight glass to monitor oil level.

c) Replace the breather cap.

8.3.2 Examine the Hydraulic Oil Filter:

- The Hydraulic Filter is on the Return line mounted on top of the Reservoir.

- Check if the cartridge is installed correctly. If it is missing or leaks, replace with a CR40-10 Replacement Cartridge.

8.4 Electrical Power Unit

8.4.1 Check Battery

- Disconnect the battery terminals from any external circuit. Using a voltmeter, check the voltage of the battery across the terminals. If the battery voltage is less than 12.4 volts, remove the battery for recharge and replace is with a freshly-charged battery (voltage 12.65 or 13). Low voltage is an indication of a problem with the recharge system, unless the unit has been inactive for a long period of time (See Section 6.0, page 19).

- Connect the battery to circuit after checking.

8.4.2 Solar Panel

- Connect the terminal of the solargizer to the battery after checking.

- Voltage regulator check procedure. Always ensure the battery is connected to the voltage regulator when testing voltage input and output. Failure to do this will give false readings. Take readings across battery +/- terminals on regulator, and battery + and solar – to attain results.

8.5 Hydraulic Valve Assembly

Make a visual inspection of the areas around the valves for indication of leaks. Leaks are indicated by large dirty areas as dust tends to stick to the leak zone. Report any leaks that cannot be properly serviced to a Maintenance Facility so that the car can be repaired and to minimise oil loss and system damage. If an extensive leak is found, bad order the car immediately.

8.6 Mechanical

Grease all pivots weekly when in use or at start of trip after wagon has been standing for an extended period.

9 PREVENTATIVE MAINTENANCE

This section contains the minimum preventative maintenance requirements necessary to keep your machine in safe operating condition. Careful performance of these maintenance services will assure long machine life.

The maintenance chart provides a listing of the major maintenance services with recommended time schedules. All time intervals are based on standard operating conditions. When operating under extreme weather conditions, the time interval must be adjusted accordingly.

CAUTION

It is very important that the proper oil level be maintained. If the level is low, air may become entrained in the hydraulic oil, resulting in pump captivation and spongy cylinder action.

DAILY	
Check the hydraulic oil level	Maintain the oil level as indicated by the sight gauge on the reservoir.
WEEKLY	
Check the hydraulic system for leaks.	
TWO MONTHLY	
Lubricate all grease nipples with Shell EP2 or equivalent if applicable.	See the Oils, Lubricants and Greasing Points instruction sheet (Section 11 page 42).
ANNUALLY	
Change oil.	Drain oil from hydraulic reservoir and replace oil with correct grade.

10 HYDRAULIC OIL RECOMMENDATIONS

The oil in the hydraulic system serves both as a lubricant for the system and for transmission of power. The careful selection of a fluid with the assistance of a reputable supplier is very important for the proper functioning of the hydraulic system.

Some factors are especially important in the selection of a hydraulic fluid are as follows:

- The oil must contain the necessary additives to ensure high anti-wear characteristics. Some hydraulic fluids do not contain these additives.
- The oil must have the proper viscosity for the operating temperature range. Choose an oil with the proper viscosity for the outside air temperature in which the machine will be running. Refer to the oil chart.
- Castrol Hyspin AWH 100 or Shell Donax TC30, Hydraulic Tank Capacity 25 Litres.

11 LUBRICATION PRECAUTIONS

11.1 General

In order to obtain optimum performance and long life from your machine, it is very important that all lubrication and preventative maintenance procedures described in this section be carefully followed. All lubrication and maintenance intervals are based on average operating conditions. When unusual operating conditions such as extremely dusty conditions are encountered, the lubrication and maintenance intervals must be shortened accordingly. Only you know the conditions under which the machine is operating, and you must shorten the service intervals based on your knowledge.

11.2 Important

Under no circumstances should the recommended lubrication and maintenance intervals be exceeded. Any increase in these intervals will be considered negligence on your part, and will void the warranty of the machine.

11.3 Lubrication

Keeping the machine well lubricated is one of the most effective ways to prevent costly repairs. A well lubricated machine can provide years of dependable service.

11.3.1 Keep all lubricants and lubricating equipment clean and free of foreign matter both while in use and in storage.

11.3.2 Wipe off all fittings before applying grease gun. Dirt on the fitting can be forced through the opening in the fitting and cause premature bearing failure.

11.3.3 Wipe off any excess lubricants that spill or overflow. Oily or greasy surfaces tend to collect dirt and foreign matter which can work its way into the bearings and gears.

11.3.4 Under extremely dusty or dirty conditions, sufficient grease should be added to flush out contaminated grease.

LUBRICANTS		
• Hydraulic Oil	Castrol AWH 100 or Shell Donax TC30	SAE30, ISO68
• Grease	Castrol EPL 2 or Shell EP2	NLGI 2

FILTERS		
• Hydraulic Filter	Return line element	P/N: CR40-10
• Hydraulic Filter	Suction Strainer	P/N SF64A-34GO

12 ROUTINE MAINTENANCE INSTRUCTIONS

12.1 Hydraulic Circuit

SNO	CHECK FOR	ACTION
1	Check oil level in oil tank	Fill with Hyspin AWH100 or Shell Donax TC30(if required)
	Drain and clean inside of oil tank every twelve months	Fill with Hyspin AWH100 or Shell Donax TC30
2	Check filter clog indicator (return line)	Replace filter element if indicator is in red zone
3	Check condition of air breather	Replace air breather if required
4	Check condition of suction strainer	Clean/replace section strainer

12.2 Pneumatic Circuit

SNO	CHECK FOR	ACTION
1	Check oil level in lubricator	Fill with Hyspin AWS32 (if required)
	Check oil flow out from lubricator	Set it for 1 drop/20 sec
2	Replace main air line filter element every six months	Use element part no. PS802P
	Check air pressure setting in above	Set it for 700Kpa
3	Replace pilot air line filter element every six months	
	Check air pressure setting in above	Set it for 450 Kpa

13. HOW TO ORDER SPARE PARTS

When ordering spare parts, please give:

- Quantity required;
- Part number and description of the part;
- Serial number of the machine and/or owner's name and date of purchase.

Order direct from your Dealer. Correctly ordered spares will avoid unnecessary delays. For this reason this list should be carefully preserved for handy reference.

All items and part numbers in this list are correct at the time of publication, but we reserve the right to alter or withdraw items in the course of future development.

Head Office	860 – 870 Abernethy Road FORRESTFIELD Western Australia 6058
Postal Address	PO Box 1133 CLOVERDALE Western Australia 6985
Telephone	(+61) 8 9454 9666
Facsimile	(+61) 8 9454 9777

APPENDIX A

FIGURE DRAWINGS

APPENDIX B

SAMPLE OF PREVENTATIVE MAINTENANCE CHECKLIST

GEMCO RAIL REMOTE BALLASTING SYSTEM

PREVENTATIVE MAINTENANCE INSPECTION CHECKLIST

CAR NUMBER:_____

INSPECTION DATE:_____ INSPECTED BY:_____

RECORD ALL REPAIRS AND/OR REPLACEMENTS – TAG FAILED PARTS WITH REJECTION TAG – DESCRIBE REASON PART FAILED AND CAR NUMBER.

NOTE: MARK COMPLETED ITEMS WITH OK AND FAILED WITH X

CYLINDER OPERATION	A/B GATES OUTSIDE	A/B GATES INSIDE	C/D GATES OUTSIDE	C/D GATES INSIDE
Cycle system to assure proper operation				
Timing two door open/close seconds				
Timing four door open/close seconds				

INSPECTION OF HYDRAULIC POWER UNIT	NOTES			
Inspection operation of pump				Replace Pump
Inspect pump unit cover and bolts	Loose:	Missing:	Broken Out:	
Inspect air lines for leaks				
Check operation of filter/regulator, lubricator and Parker filter. Drain filter/regulator and Parker filter bowls as required.				
Ensure filter bowl collars are firmly tightened.				
Regulator settings: pump pressure 700Kpa, Control air pressure 450 Kpa				
Lubricator Flow: 1 drop per 2 seconds				
Check muffler for excessive oil				
Hydraulic pump pressure – 170 BAR				
Check return filter				
Tank oil level				

GEMCO RAIL REMOTE BALLASTING SYSTEM

PREVENTATIVE MAINTENANCE INSPECTION CHECKLIST

CAR NUMBER:_____

INSPECTION DATE:_____ INSPECTED BY:_____

RECORD ALL REPAIRS AND/OR REPLACEMENTS – TAG FAILED PARTS WITH REJECTION TAG – DESCRIBE REASON PART FAILED AND CAR NUMBER.

NOTE: MARK COMPLETED ITEMS WITH OK AND FAILED WITH X

INSPECTION OF ELECTRICAL POWER UNIT	NOTES	
Inspect Cattron Receiver / Decoder for damage		Replace Cattron
Inspect Electrical Cabinet		
Check Solar Panel		
Wipe down Solar Panel with soapy water		
Check Solar Panel and Solargizer-Surface and Wiring Undamaged and Connected		
Wiring harness secured to components		
Check battery condition, charge and water level		

FITTING CHECK – (NOTE ANY LEAKING OR LOOSE FITTINGS)	A/B GATES OUTSIDE	A/B GATES INSIDE	C/D GATES OUTSIDE	C/D GATES INSIDE
Check tube clamps (note location)				
a) weld broken or missing				
b) bolts loose				
Inner cylinder				
Outer cylinder				
Cylinder hose connection (4 per gate)				
Flow Dividers				
Control valve stack inlet and outlet				

GEMCO RAIL REMOTE BALLASTING SYSTEM

PREVENTATIVE MAINTENANCE INSPECTION CHECKLIST

CAR NUMBER:_____

INSPECTION DATE:_____ INSPECTED BY:_____

RECORD ALL REPAIRS AND/OR REPLACEMENTS – TAG FAILED PARTS WITH REJECTION TAG – DESCRIBE REASON PART FAILED AND CAR NUMBER.

NOTE: MARK COMPLETED ITEMS WITH OK AND FAILED WITH X

PREVENATIVE MAINTENANCE CHECKLIST	NOTES
Inspect and replace Air Filter Cartridge as needed (at least annually)	
Pre-fill the Air Motor Lubricator with Hyspin AWS 32 Oil 10W air lube oil Shell Tellus 22 (Note: do not fill above sight glass)	
Check Pump Lubricator Setting – 1 drop per 2 seconds	
Cycle all doors 5 minutes to run oil through suction filter	
Drain the Hydraulic Oil from Reservoir and replace (annually with AWH 100 Hyspin	
Install new Oil Filter Cartridge	
Remove from Reservoir, inspect and clean Suction Filter	
Check all Electrical Wiring Connections and secure	

APPENDIX C

TERMINATION PROGRAM

APPENDIX D

POWER PACK AND HYDRAULICS

APPENDIX E

CATTRON REMOTE CONTROL

APPENDIX F

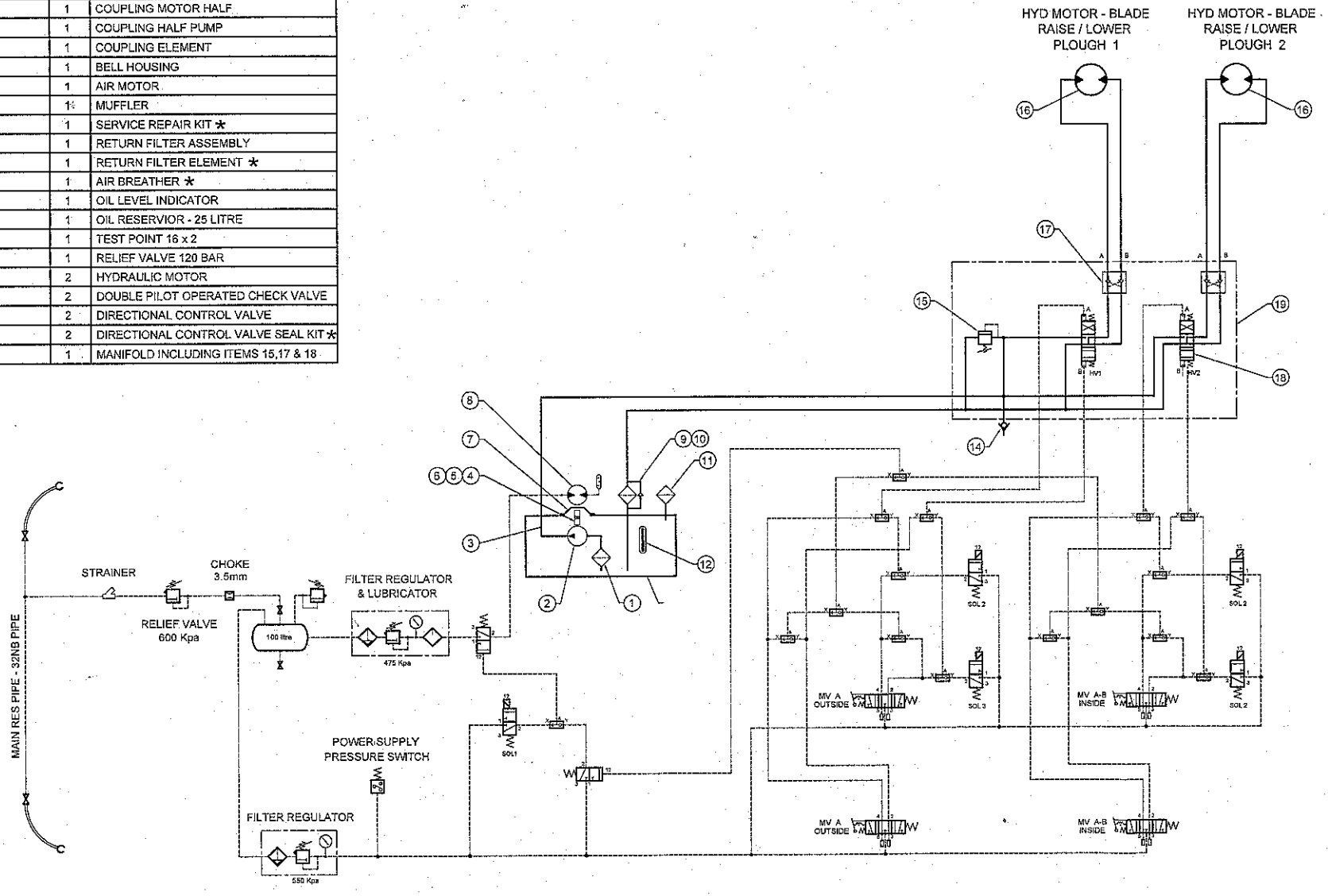
PNEUMATIC AND ELECTRICAL ENCLOSURE

APPENDIX G

DRAWINGS

ITEM	PART NUMBER	QTY	DESCRIPTION
1	SF64A-34GO	1	SUCTION STRAINER
	1SPAA32D1099	1	PUMP
3	T26A-T204-0312-T204-0612-470 O/A	1	HOSE ASSEMBLY
4	ND65A	1	COUPLING MOTOR HALF
5	ND65PU1P	1	COUPLING HALF PUMP
6	R62	1	COUPLING ELEMENT
7	LSE20BDF1	1	BELL HOUSING
8	6AM-ARV-55	1	AIR MOTOR
8A	MB004B	1	MUFFLER
8B	K281B	1	SERVICE REPAIR KIT *
9	OMTF40AN	1	RETURN FILTER ASSEMBLY
10	CR40-10	1	RETURN FILTER ELEMENT *
11	SGB-090-03-B	1	AIR BREATHER *
12	RLG05	1	OIL LEVEL INDICATOR
13	CP25G	1	OIL RESERVIOR - 25 LITRE
14	R1620-BP04	1	TEST POINT 16 x 2
15	RV08-20A-O-N-33	1	RELIEF VALVE 120 BAR
16		2	HYDRAULIC MOTOR
17	DC08-40-0-N	2	DOUBLE PILOT OPERATED CHECK VALVE
	OP3-A-C1-3AO	2	DIRECTIONAL CONTROL VALVE
18A		2	DIRECTIONAL CONTROL VALVE SEAL KIT *
19		1	MANIFOLD INCLUDING ITEMS 15,17 & 18

NOTE:-
DESCRIPTIONS SHOWN WITH * SUFFIX
ARE RECOMMENDED SPARE PARTS.



17.10.06	FIRST ISSUE	0	GM		
DATE	DESCRIPTION / ECO	REV	DRN	CKD	APD

GEMCO RAIL PTY LTD
860-870 Abernethy Road - Access Park
Rail Marshalling Yards
Forrestfield WA 6058
Ph +61 8 9454 9666. Fax +61 8 9454 9777.

TITLE
HYDRAULIC/PNEUMATIC CIRCUIT DIAGRAM FOR ARTC BALLAST PLOUGH CONVERSION

CAD FILE 17573001

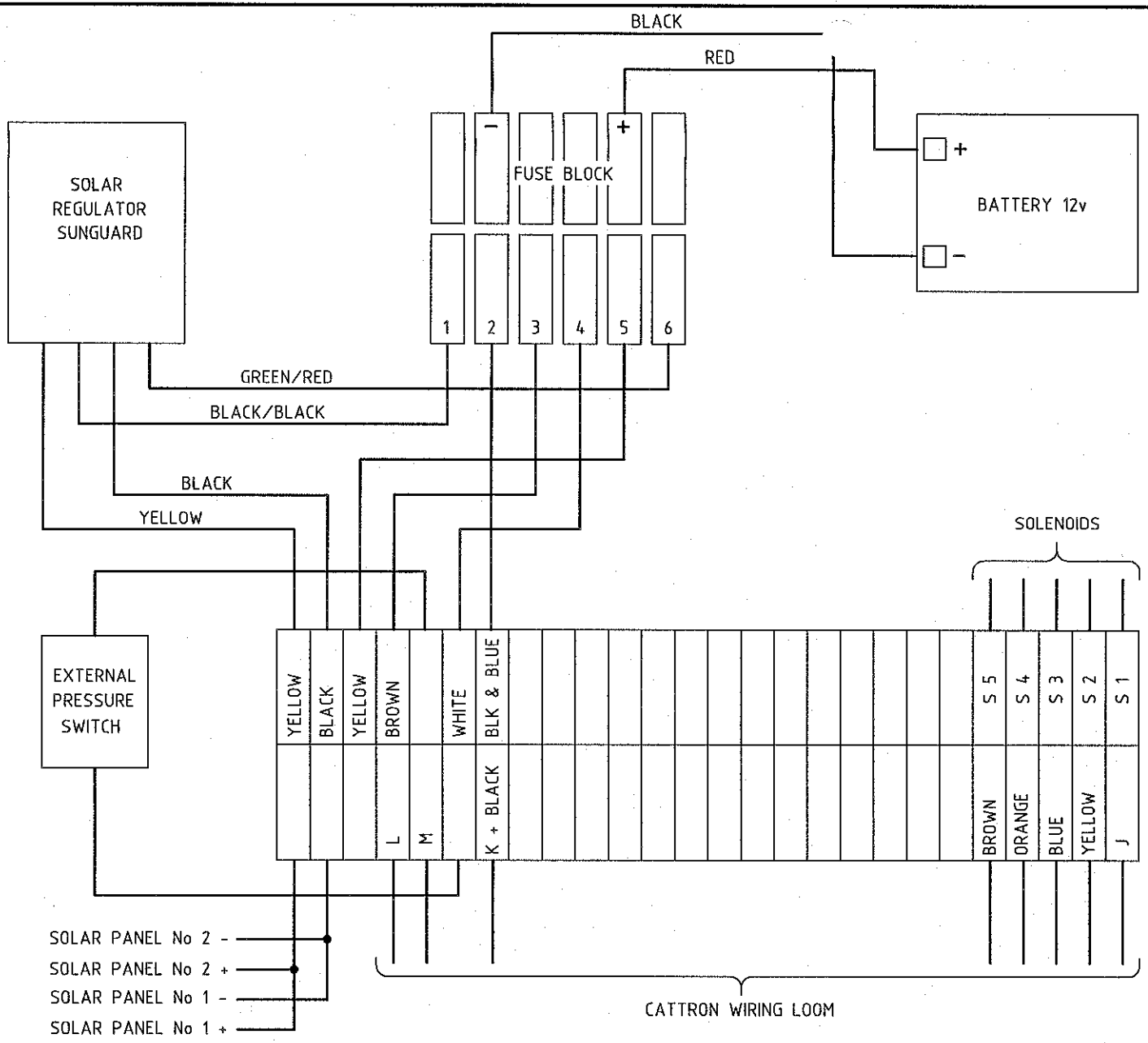
PROJECT ARTC BALLAST WAGON

SIZE	DRG. No.	REV
A3	517573	0

SHEET 1 OF 1

3rd ANGLE PROJECTION

SCALE



CONTROLLED

DATE	DESCRIPTION / ECO	REV	DRN	CKD	APD
15.2.07	FIRST ISSUE	0	GM		

GEMCO RAIL PTY LTD
860-870 Abernethy Road - Access Park
Rail Marshalling Yards
Forrestfield WA 6058
Ph +61 8 9454 9666. Fax +61 8 9454 9777.

TITLE
ELECTRICAL CIRCUIT
TERMINAL BOX LAYOUT
ARTC BALLAST PLOUGH

CAD FILE 17929001

PROJECT

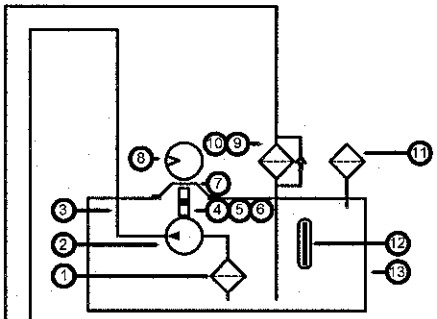
SIZE	DRG. No.	REV
A3	517929	0

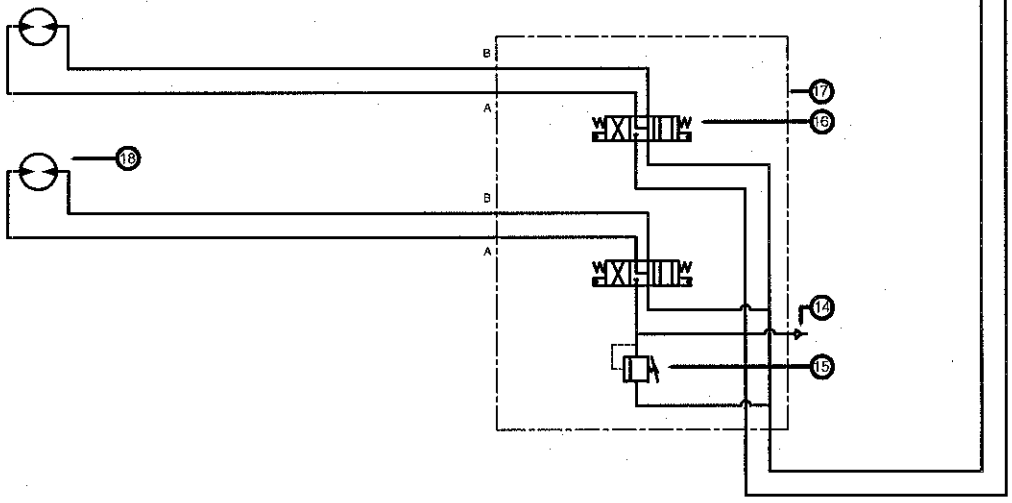
SHEET 1 OF 1

3rd ANGLE PROJECTION

SCALE

DWG No 600 06





ITEM	PART NUMBER	QTY	DESCRIPTION
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4	ND65A	1	COUPLING MOTOR HALF
5	ND65PU1P	1	COUPLING PUMP HALF
6	R62	1	COUPLING ELEMENT
7	LSE20BDF1	1	BELL HOUSING
8	6AM-ARV-55	1	AIR MOTOR
8A	MB004B	1	MUFFLER
8B	K281B	1	SERVICE REPAIR KIT
9	OMTF40AN	1	RETURN FILTER ASSEMBLY
10	CR40-10	1	RETURN FILTER ELEMENT
11	SGB-090-03-B	1	AIR BREATHER
12	RLG05	1	OIL LEVEL INDICATOR
13	CP25G	1	OIL RESERVIOR
14	R1620-BP04	1	16X2 TEST POINT
15	RV10-26-A-0-N-30	1	RELIEF VALVE 120BAR
16	OP3-A-C1-3AO	2	DIRECTIONAL CONTROL VALVE
17	OP 112-2-R	1	MANIFOLD
18	MS 160 CO	2	MOTOR
19			

ISS.	CHANGE RECORD	DATE

NOTE: ALL DIMENSIONS ARE INDICATIVE ONLY AND SUBJECT TO NORMAL MANUFACTURING TOLERANCES. PLEASE NOMINATE ALL DIMENSIONS CRITICAL TO YOUR APPLICATION AND SPECIFY TOLERANCE REQUIRED.

CUSTOMER APPROVAL

NAME: DATE:

SIGNATURE:

DRAWN ET

CHECKED

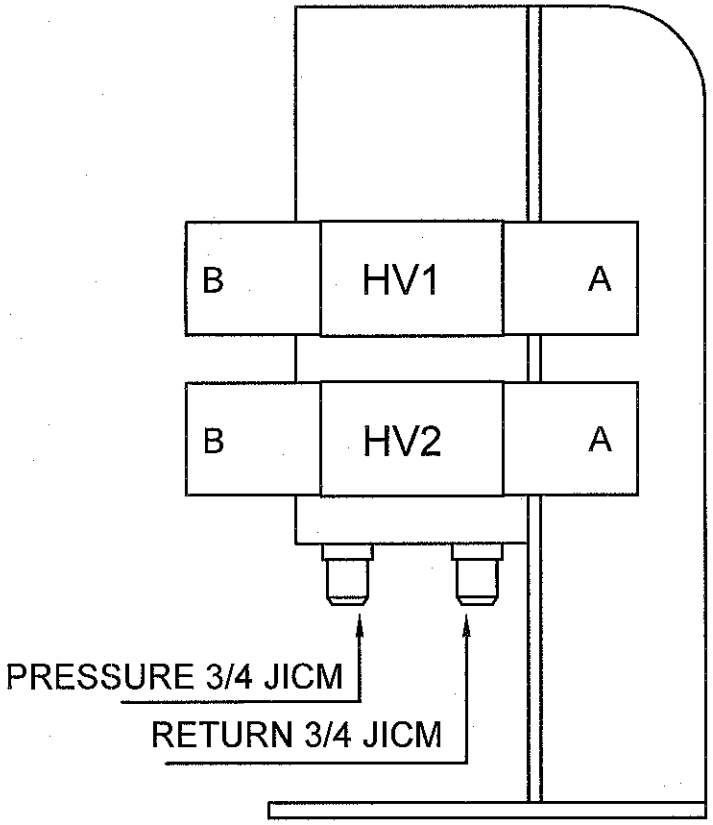
DATE 27/03/2007

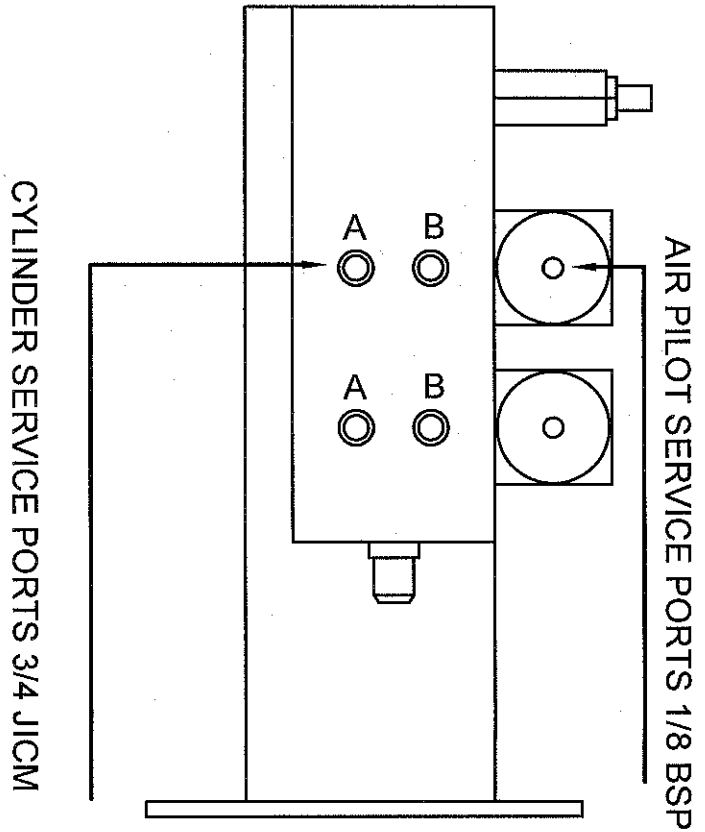
TITLE

GEMCO ARTC PLOUGH CIRCUIT

GERRARD hydraulics
Hydraulic Equipment Sales and Service
39 Sorbonne Crescent Canning Vale Western Australia 6155
Ph (08) 9455 2344 Fax (08) 9455 2045

DWG No 600 05





ISS.	CHANGE RECORD	DATE

NOTE: ALL DIMENSIONS ARE INDICATIVE ONLY AND SUBJECT TO NORMAL MANUFACTURING TOLERANCES. PLEASE NOMINATE ALL DIMENSIONS CRITICAL TO YOUR APPLICATION AND SPECIFY TOLERANCE REQUIRED.

CUSTOMER APPROVAL

NAME: DATE:

SIGNATURE:

DRAWN ET

CHECKED

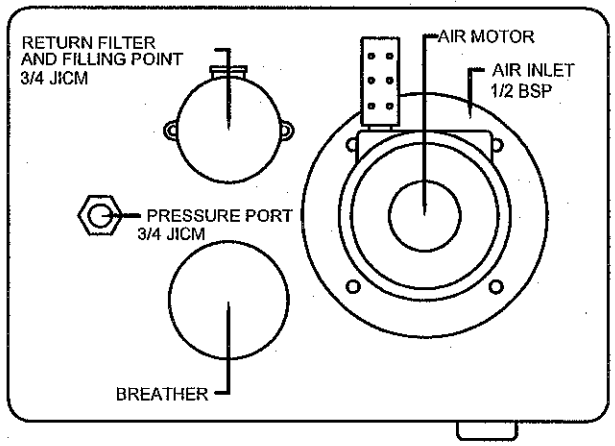
DATE 27/03/2007

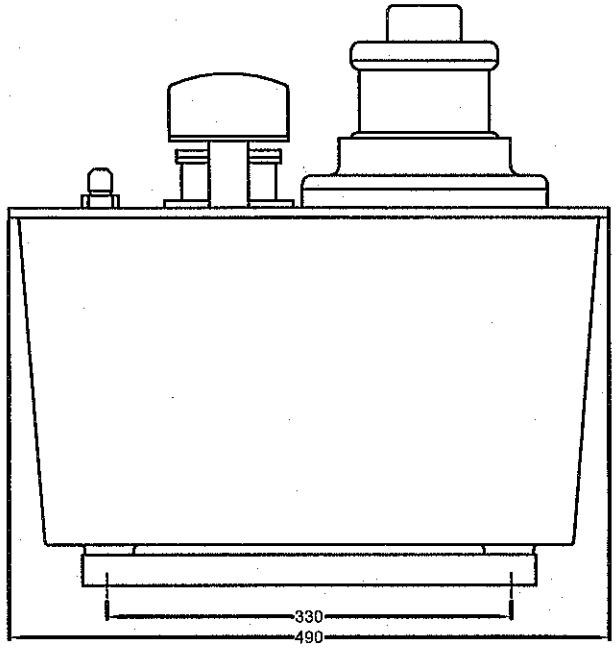
TITLE

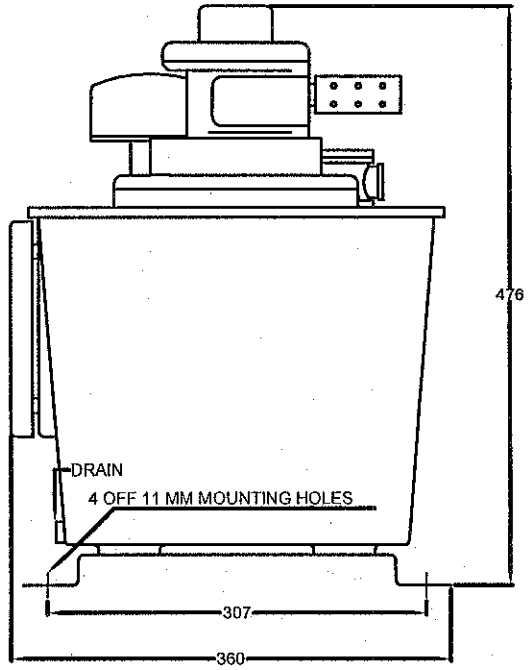
PLOUGH
MANIFOLD & STAND
CONNECTION DETAIL

GERRARD hydraulics
Hydraulic Equipment Sales and Service
39 Sorbonne Crescent Canning Vale Western Australia 6155
Ph (08) 9455 2344 Fax (08) 9455 2045

DWG No 60[illegible]63







ISS.	CHANGE RECORD	DATE

NOTE: ALL DIMENSIONS ARE INDICATIVE ONLY AND SUBJECT TO NORMAL MANUFACTURING TOLERANCES. PLEASE NOMINATE ALL DIMENSIONS CRITICAL TO YOUR APPLICATION AND SPECIFY TOLERANCE REQUIRED.

CUSTOMER APPROVAL

NAME: DATE:

SIGNATURE:

DRAWN ET

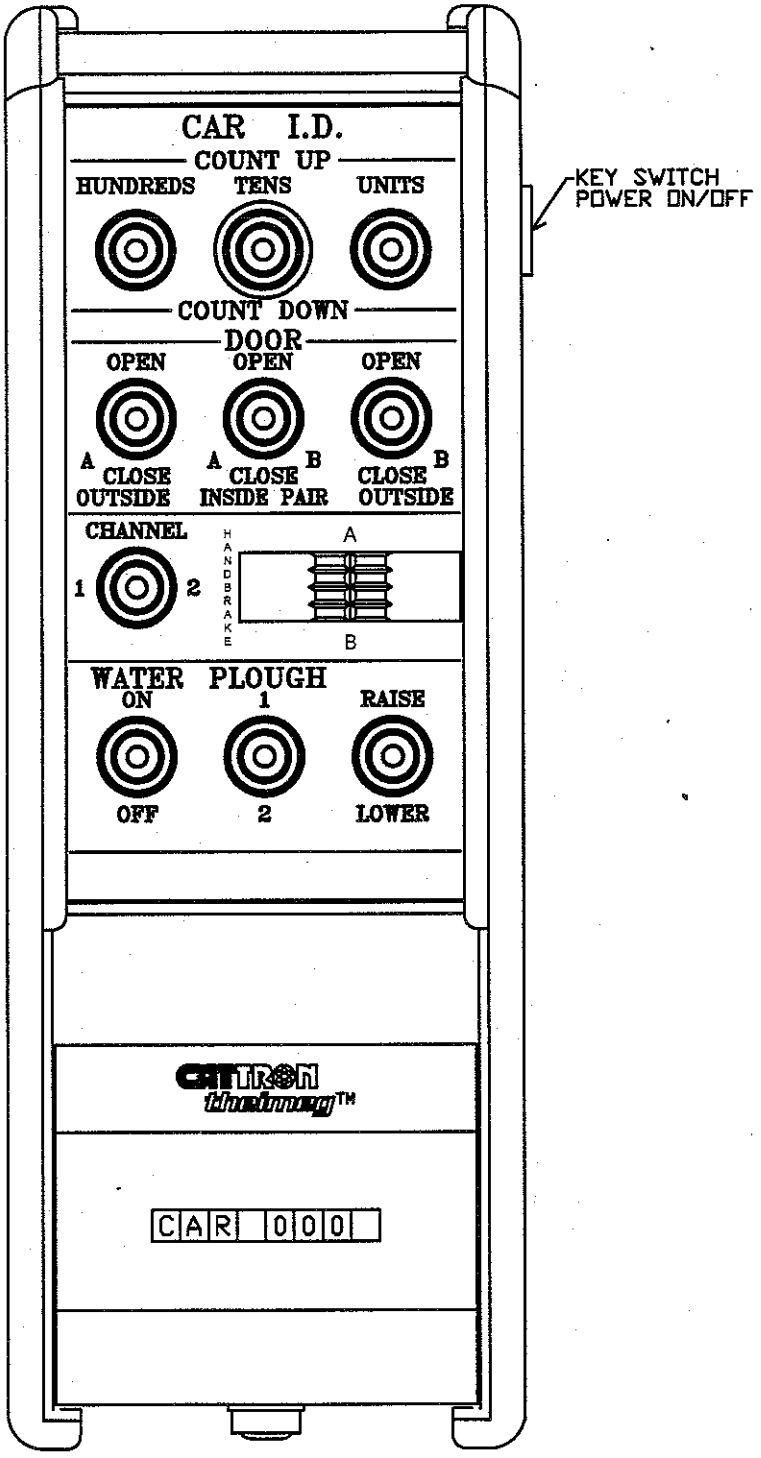
CHECKED

DATE 17/02/2006

TITLE

4000 SERIES AIR DRIVEN POWER PACK

GERRARD hydraulics
Hydraulic Equipment Sales and Service
39 Sorbonne Crescent Canning Vale Western Australia 6155
Ph (08) 9455 2344 Fax (08) 9455 2045



REV	
0	INITIAL ISSUE

MATERIAL
TYPE: ENGRAVING MATERIAL
COLOR: CLEAR SILVER

TEXT STYLE
FUNCTION: FUTURE
DIRECTION: FUTURE
UNIT ID: ARTSCRYB

TEXT COLOR
FUNCTION: BLUE
DIRECTION: BLACK
UNIT ID.: BLACK

FILE NAME
TEXT: T
CUT: C
LASER: Z
FILE: 68806F01

DIMENSIONS:
5.660" X 3.090"

S/N:
68806001-006

USER:
ARTC - AUSTRALIA

CUST:
GEMCO RAIL

DATE	DRFM	ENGR
11-21-06	TEB	

DECODER SERIAL NUMBERS	PROM PART NUMBER RECEIVER	PROM PART NUMBER DECODER	PROM ID NUMBER DECODER	FREQUENCY	SYS. ADD. (HEXADECIMAL) RX.	CAR TYPE -ID
68806007, 015	51S-R1	51S-DR32-D10	1GEMPL4E	472.0750-S	4E-4F	PLOUGH
68806024, 025	51S-R1	51S-DR32-D10	1GEMPL4E	472.0750-S	4E-4F	PLOUGH

RECEIVER/DECODER FOR S/N	68806001-006
ORIGINAL REFERENCE DRAWING NUMBER	68806001
ORIGINAL END USER NAME	ARTC

JPS 01-26 2007

CATTRON thelmeg™

TITLE RD16BC REMOTE CONTROL
SYSTEM INFORMATION

USER ARTC - AUSTRALIA
CUST GEMCO RAIL

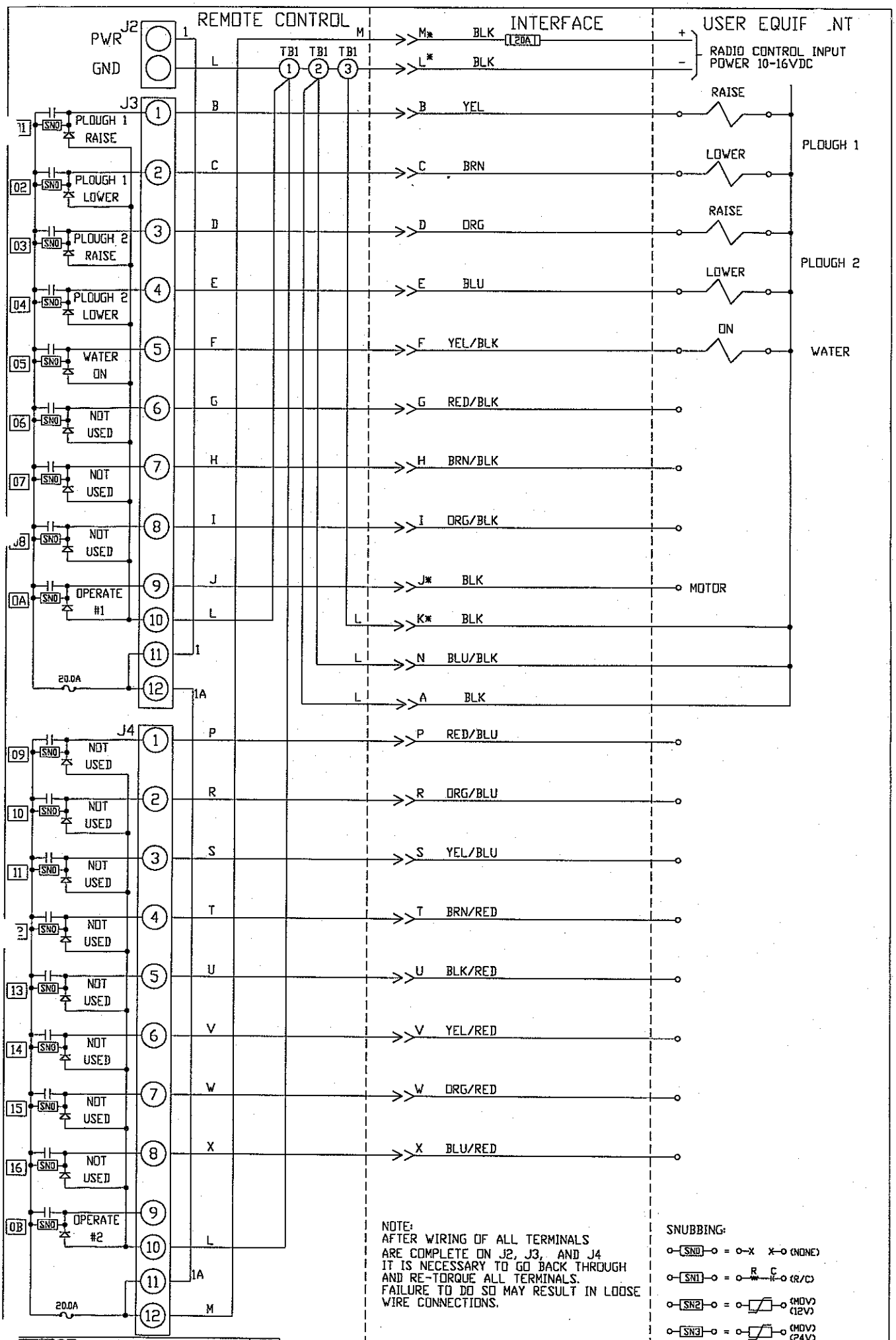
EQUIP TYPE PLOUGH CAR

SHEET 01 OF 05

DWG & SERIAL NUMBER 68806007

REV 0 INITIAL ISSUE

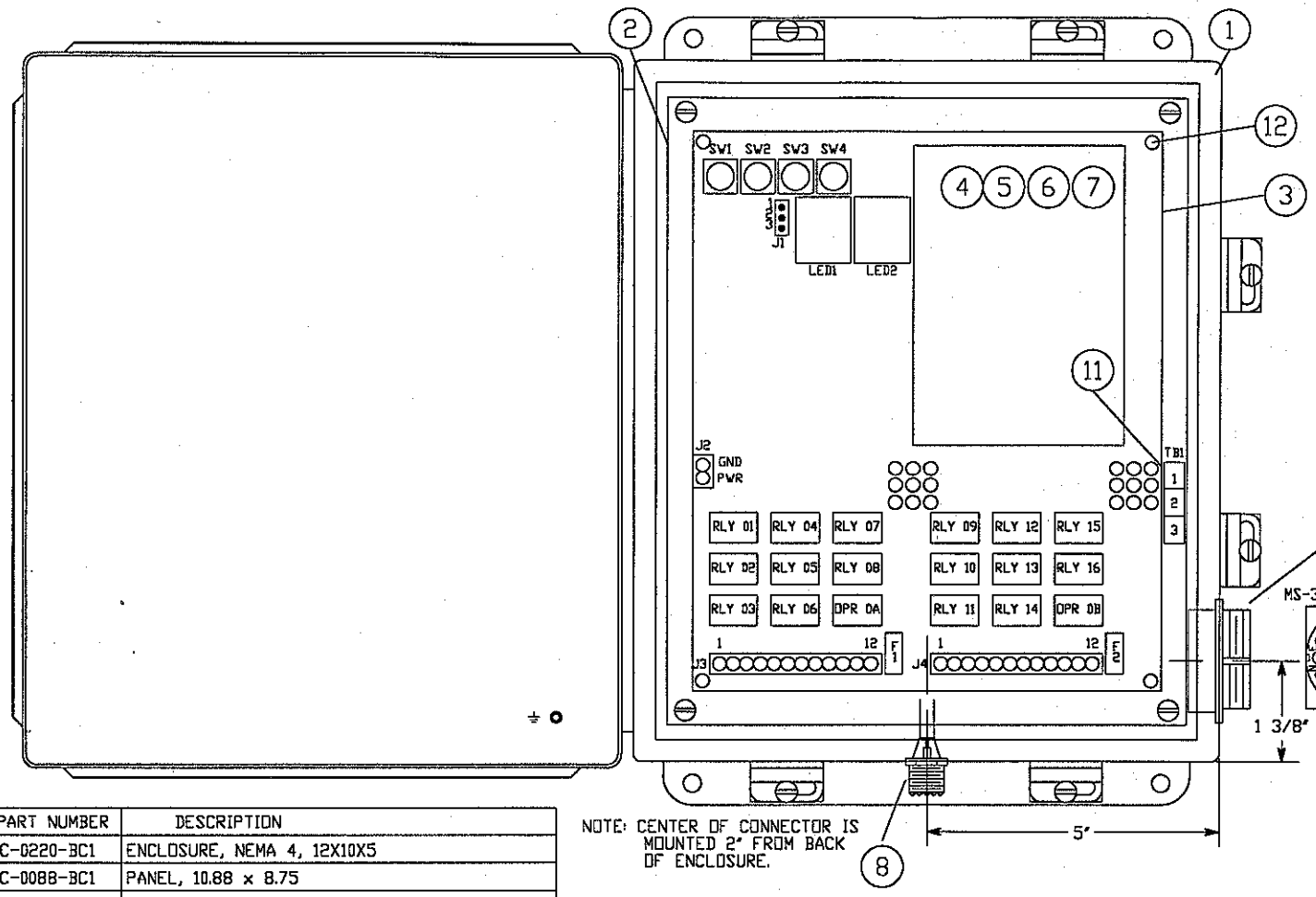
DRFM JPS | ENG | INST | TECH | FINAL



NOTE:
AFTER WIRING OF ALL TERMINALS ARE COMPLETE ON J2, J3, AND J4 IT IS NECESSARY TO GO BACK THROUGH AND RE-TORQUE ALL TERMINALS. FAILURE TO DO SO MAY RESULT IN LOOSE WIRE CONNECTIONS.

NOTE:
*-WIRES J,K,L,M NOT PART OF MAIN CABLE. THEY ARE INDIVIDUAL WIRES.

JPS 11-28 2006	
TITLE	RD16BC REMOTE CONTROL CONNECTION WIRING DIAGRAM
USER	ARTC - AUSTRALIA
CUST	GEMCO RAIL
EQUIP TYPE	PLOUGH CAR
DWG & SERIAL NUMBER	68806007
SHEET	02 OF 05
INITIAL ISSUE	



DISPLAY
J1 INSTALLED BETWEEN 1 & 2 ENABLES THE DISPLAY
J1 INSTALLED BETWEEN 2 & 3 ENABLES THE POWERSAVE OPTION
J1 NOT INSTALLED DISABLES THE DISPLAY

POWERSAVE OPTION PUTS DECODER INTO A SLEEP MODE AND DISABLES THE DISPLAY. EVERY 5 SECONDS THE DECODER WILL WAKE UP AND LOOK TO SEE IF A CONTROLLER IS ADDRESSING IT. IF A CONTROLLER IS ADDRESSING IT THE DECODER WILL OPERATE AS NORMAL.

SUB-ADDRESS
SW1 - NOT USED
SW2 - HUNDREDS DIGIT
SW3 - TENS DIGIT
SW4 - ONES DIGIT

MS-3102R-28-11P

1 3/8"

NOTE: CENTER OF CONNECTOR IS MOUNTED 1 3/4" FROM BACK OF ENCLOSURE.

NOTE: CENTER OF CONNECTOR IS MOUNTED 2" FROM BACK OF ENCLOSURE.

5'

NOTE:
DRIP LOOP MUST BE PROVIDED WHEN INSTALLING REMOTE CONTROL EQUIPMENT ON BALLAST CARS.

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	16C-0220-BC1	ENCLOSURE, NEMA 4, 12X10X5
2	1	16C-0088-BC1	PANEL, 10.88 x 8.75
3	1	DR16001	DECODER/RELAY BOARD
4	1	R1HN	RECEIVER, SYNTHESIZED, 12.5 KHZ CH SPACING
5	4	43C-0087	STANDOFFS
6	8	03-1930	SCREWS
7	4	04-7683	LOCKWASHERS
8	1	CPA-0156SYNSP	ANTENNA CABLE, INTERNAL W/PL259 - 2 FOOT
9	1	85C-0035	ANTENNA, 450MHZ
10	1	01C-28C-0048	CONNECTOR, BOX MOUNT, 22P, MALE
11	1	31C-0009	TERMINAL BLOCK, 3 POSITION
	4	43C-0058	STANDOFFS
13	1	CPA-0335	CABLE ASSEMBLY, RECEIVER TO DECODER
14	1	54C-0092	LABEL, CATTRON-THEIMEG

CONFORMAL COATING
NOT REQUIRED_____ ☐
RECEIVER & DECODER
BOARD ONLY_____ ☐
ALL CTI MANUFACTURED
BOARDS_____ ☒

JPS 11-28 2006

TITLE RD16BC REMOTE CONTROL
PHYSICAL DIAGRAM

USER ARTC - AUSTRALIA
CUST GEMCO RAIL

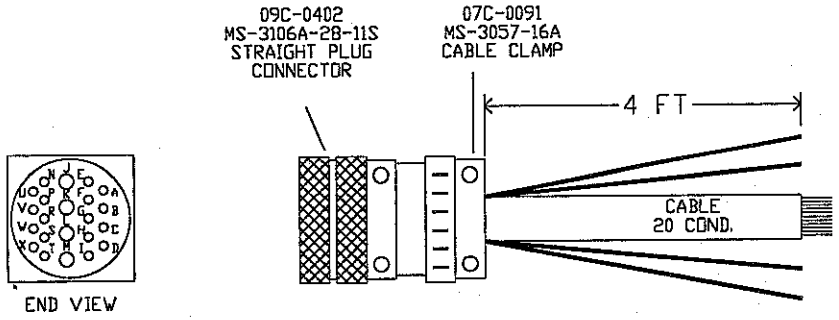
EQUIP TYPE PLOUGH CAR

DWG & SERIAL NUMBER 68806007

REV INITIAL ISSUE D

DRFM JPS | ENG | INST | TECH | FINAL

01C-09C-0402-4
CABLE ASSEMBLY



PIN	COLOR	FUNCTION
A	BLACK	VALVE BANK GROUND
B	YELLOW	PLOUGH 1 RAISE
C	BROWN	PLOUGH 1 LOWER
D	ORANGE	PLOUGH 2 RAISE
E	BLUE	PLOUGH 2 LOWER
F	YEL/BLK	WATER ON
G	RED/BLK	-
H	BRN/BLK	-
I	ORG/BLK	-
J	* BLACK	MOTOR
K	* BLACK	VALVE BANK GROUND
L	* BLACK	TO SUPPLY (-)
M	* BLACK	TO SUPPLY (+)
N	BLU/BLK	VALVE BANK GROUND
P	RED/BLU	-
R	ORG/BLU	-
S	YEL/BLU	-
T	BRN/RED	-
U	BLK/RED	-
V	YEL/RED	-
W	ORG/RED	-
X	BLU/RED	-

* INDIVIDUAL 12 GAUGE WIRES
ON RADIO SIDE ONLY.

16 FT 10C-0119 WIRE, 12 GA(LABELED), 4 PIECE X 4' EACH
4 FT 30C-0052 CABLE, 20 COND, 16 GA (COLOR CODED)

ITEMS SHIPPED LOOSE
1 67C-0016 FUSE HOLDER
1 65C-0210 FUSE, 20 AMP

PURCHASED

JPS 11-28 2006

CATTRON thelmeg™

TITLE RD16BC REMOTE CONTROL
CABLE ASSY, 20 CONDUCTOR

USER ARTC - AUSTRALIA
CUST GEMCO RAIL

EQUIP TYPE PLOUGH CAR

DWG & SERIAL NUMBER 68806007

REV 0 INITIAL ISSUE

DRFM	ENG	INST	TECH	FIN
JPS				

CONTROLLER DESCRIPTION

ROTARY SWITCH ON LEFT -- HUNDREDS DIGIT
ROTARY SWITCH IN CENTER -- TENS DIGIT
ROTARY SWITCH ON RIGHT -- ONES DIGIT
USED TO SELECT CAR ID # 000-999

KEYLOCK SWITCH -- TURNS POWER ON & OFF

DOOR SWITCES OPEN/CLOSE -- SENDS OPEN OR CLOSE COMMAND FOR THE SELECTED DOOR(S)

PLOUGH SWITCHES -- SENDS COMMAND TO THE PLOUGH CAR DECODER

CHANNEL 1/2 -- SELECTS RADIO CHANNEL
EACH OPERATOR MUST HAVE A DIFFERENT SETTING

DECODER DESCRIPTION

OPERATE CONTACT REMAINS CLOSED FOR TWO SECONDS AFTER LAST COMMAND IS SENT
SEE MANUAL FOR OTHER DESCRIPTIONS

ROTARY SWITCHES ON DECODER USED TO SET CAR ID# 000-FFF
SW2 -- HUNDREDS DIGIT
SW3 -- TENS DIGIT
SW4 -- ONES DIGIT

ASD TEST IS DISABLED ON ALL OUTPUT RELAYS

RECEIVER DESCRIPTION

ROTARY SWITCH ON RX CAN BE IN ANY POSITION

EPROM OUTPUT DESCRIPTION

	OUTPUT
PLOUGH 1 RAISE	B
PLOUGH 1 LOWER	C
PLOUGH 2 RAISE	D
PLOUGH 2 LOWER	E
WATER ON	F

Any time a conflicting Raise / Lower command is received for a plough the decoder will not output any command for that plough.

STATUS DISPLAY SUMMARY

FOR MORE INFORMATION REFER TO THE MAINTENANCE SECTION IN MANUAL

- [0][0] SYSTEM OK DISPLAYED BETWEEN VALID RECEIVED MESSAGES
- [E][S] BAD SYNC CHARACTER
- [E][A] BAD ADDRESS RECEIVED-NOT MATCHED WITH DECODER CODE PLUG
- [E][b] BAD BCH COMPARISON RECEIVED -MESSAGE BCH NOT EQUAL TO THE TRANSMITTED BCH
- [E][C] BAD COMMAND-COMMAND FIELD ERROR
- [E][F] FRAMING ERROR-STOP BIT INVALID (SUB ADDRESS DOES NOT MATCH XMTR)
- [E][E] EMERGENCY STOP MESSAGE RECEIVED
- [F][b] WATCHDOG TIMER FAILURE-WON'T CYCLE PROPERLY, FAILED TEST
- [F][C] OPR FAILED-MAIN OUTPUT FAILED ON
- [F][d] CPU TIMED OUT-DISABLES OUTPUTS AWAITING NEW XMTR MESSAGE
- [F][E] CODE PLUG INVALID MISSING OR NOT PROGRAMMED
- [F][F] PROCESSOR IN RESET

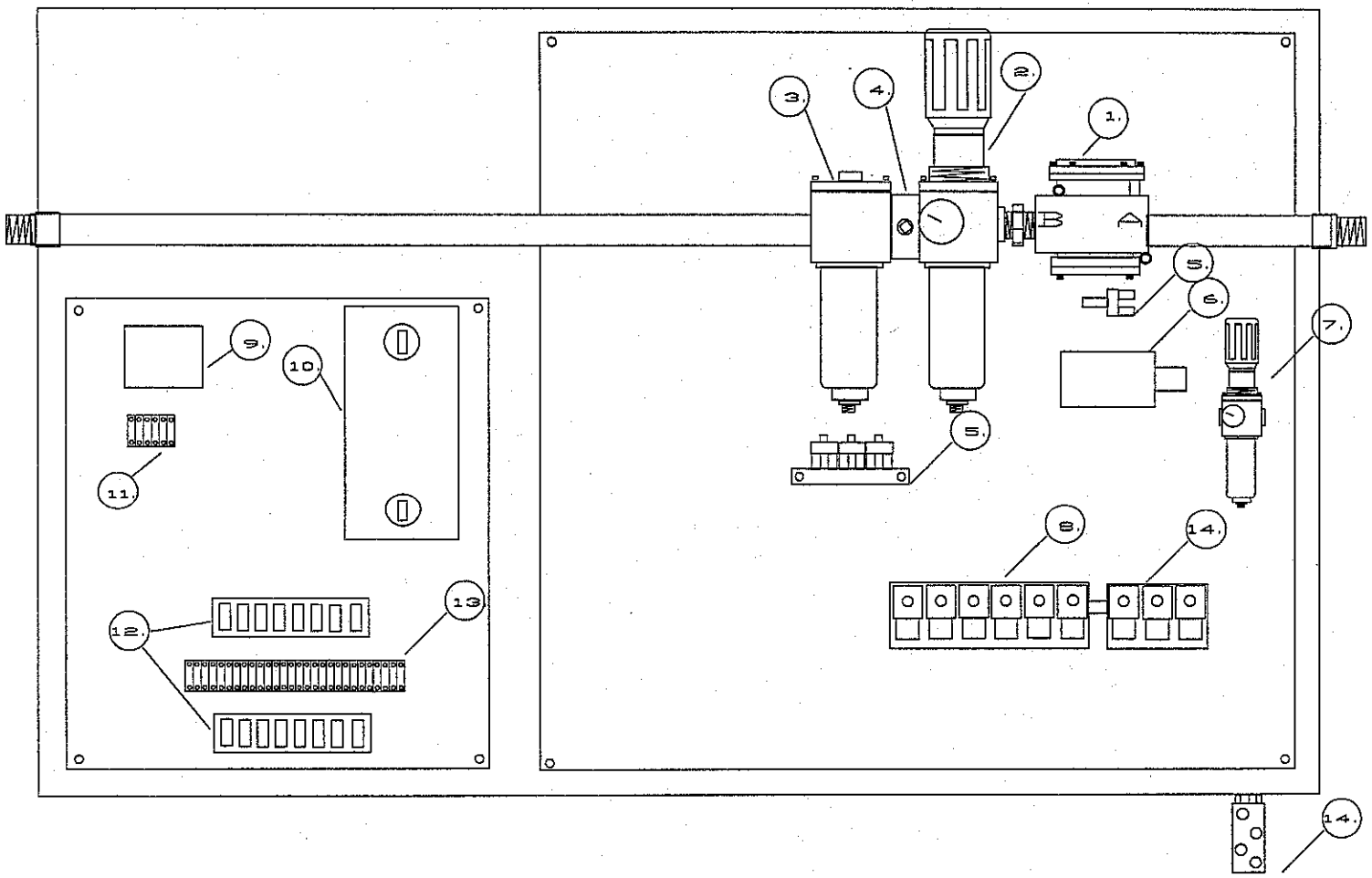
UPON POWER-UP DISPLAY WILL SHOW AS FOLLOWS:
- SYSTEM PROGRAMMED ADDRESSES
- CAR ID# [ ] & HUNDREDS DIGIT
  TENS & ONES DIGIT
- Fd AWAITING NEW XMTR MESSAGE

JPS 11-28 2006 | CATTRON theimeg™ |

INITIAL ISSUE REV 0

TITLE RD16BC REMOTE CONTROL OPERATIONAL DESCRIPTION
USER ARTC - AUSTRALIA
CUST GEMCO RAIL
EQUIP TYPE PLOUGH CARS
DWG & SERIAL NUMBER 68806007

DRFM JPS	ENG	INST	TECH	FINAL



SEE KEY DRAWING RW030407C

REF	QTY	PART NUMBER	DESCRIPTION

PERTH OFFICE:- 176 CAMPBELL ST BELMONT W.A.

phone:- 94782900

DRAWN BY	APPROVED BY	SCALE	REFERENCE No.
R.W.		N.T.S.	

NORGREN

REV	DATE	DESCRIPTION OF CHANGE	CHECKED BY	APPROVED BY

TITLE ARTC BALLAST & PLOUGH CABINET LAYOUT SYSTEM 816231 & 816229

CLIENT GEMCO RAIL

DRAWING No. RW030407B

1. AA015CAA PROSPECTOR VALVE
2. B74G4GKAD3RMN FILTER REGULATOR
3. L74M-4GP-QDN LUBRICATOR
4. 4314-52 WALL BRACKET
5. 81-540-001 "OR VALVE"
6. 03041302 3/2 VALVE
7. B07-201-A1KG FILTER REGULATOR C/W BRACKET
8. DM/49/MAZ/12VDC/T6 <0.8WATTS> 3/2 6 STATION VALVES
9. 12VDC BATTERY REGULATOR
10. 12VDC BATTERY
11. TERM STRIPS
12. CABLE CONDUIT
13. TERM STRIPS
14. DM/49/MAZ/12VDC/T3 <0.8WATTS> 3 STATION 3/2 VALVES

REF	QTY	PART NUMBER	DESCRIPTION

PERTH OFFICE:- 176 CAMPBELL ST BELMONT W.A.

phone:- 94782900

DRAWN BY	APPROVED BY	SCALE	REFERENCE No.
R.V.		N.T.S.	

NORGREN

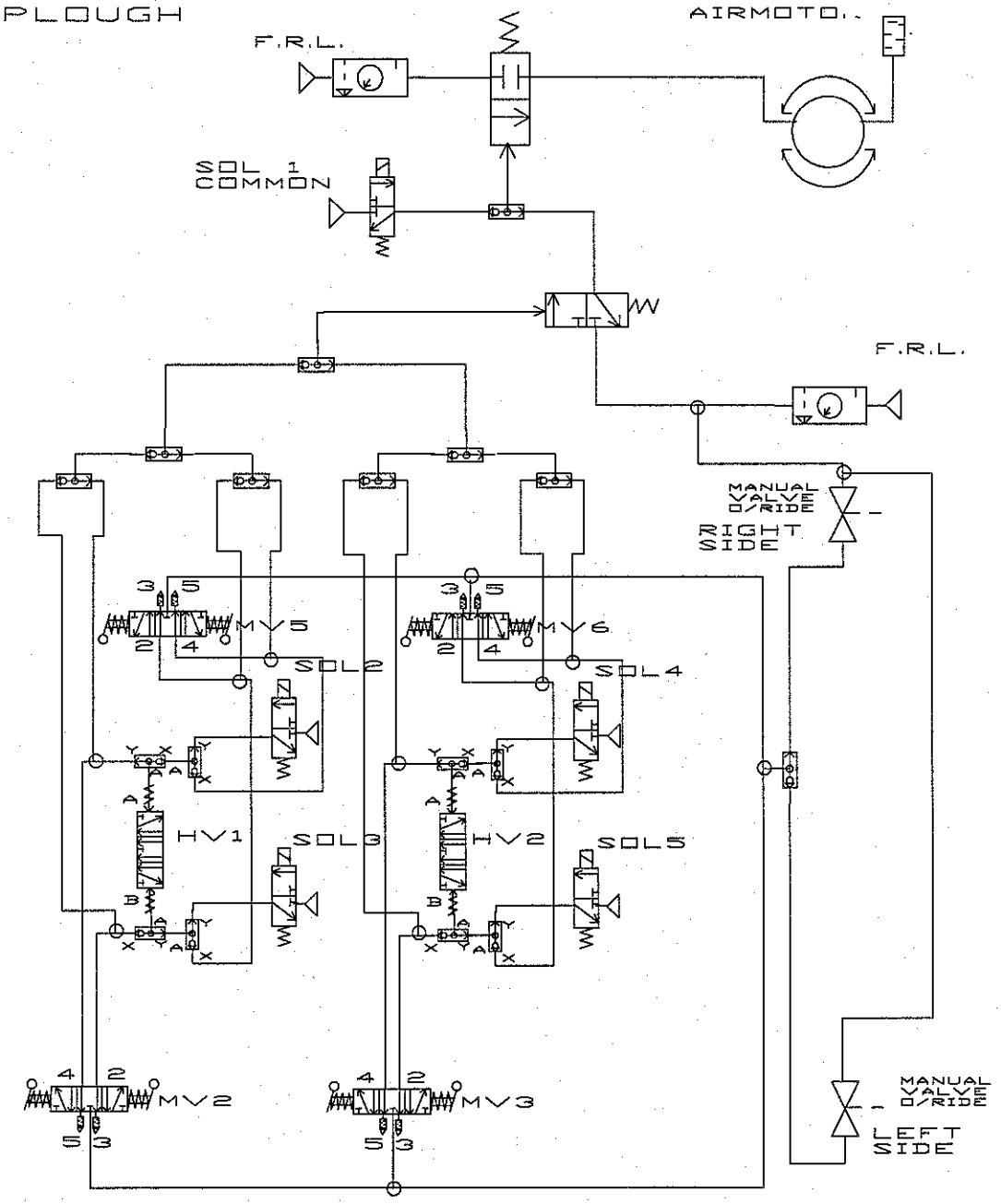
REV	DATE	DESCRIPTION OF CHANGE	CHECKED BY	APPROVED BY

TITLE ARTC KEY TO DRAWING RW030407B system 816231

CLIENT GEMCO RAIL

DRAWING No. RW030407C

ARTC BALLAST PLOUGH SYSTEM 816229



PERTH OFFICE:- 176 CAMPBELL ST BELMONT W.A.

phone:- 94782900

DRAWN BY	APPROVED BY	SCALE	REFERENCE No.
R.W.		N.T.S.	

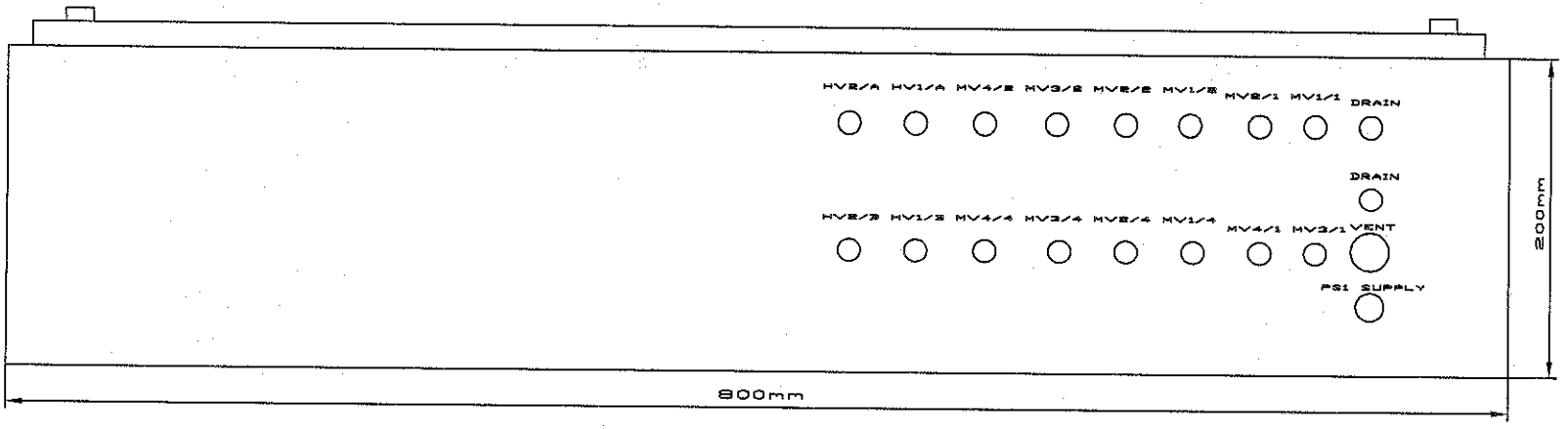
NORGREN

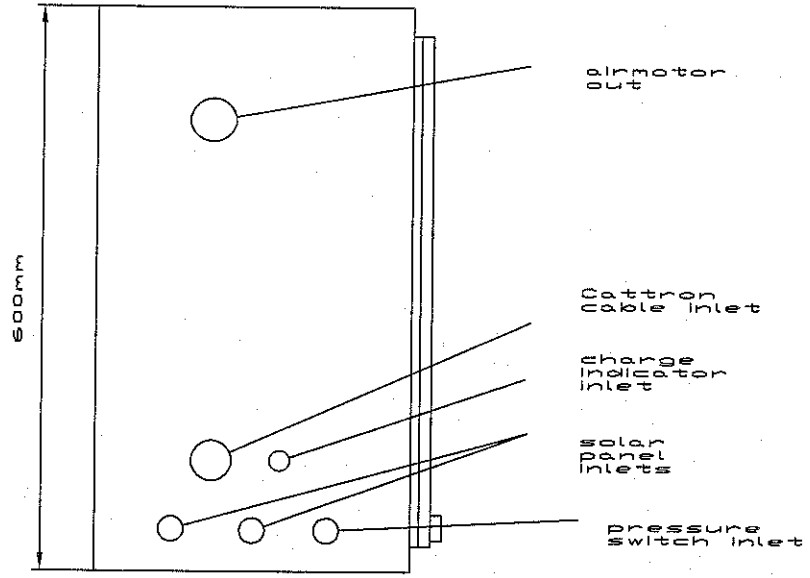
REV	DATE	DESCRIPTION OF CHANGE	CHECKED BY	APPROVED BY

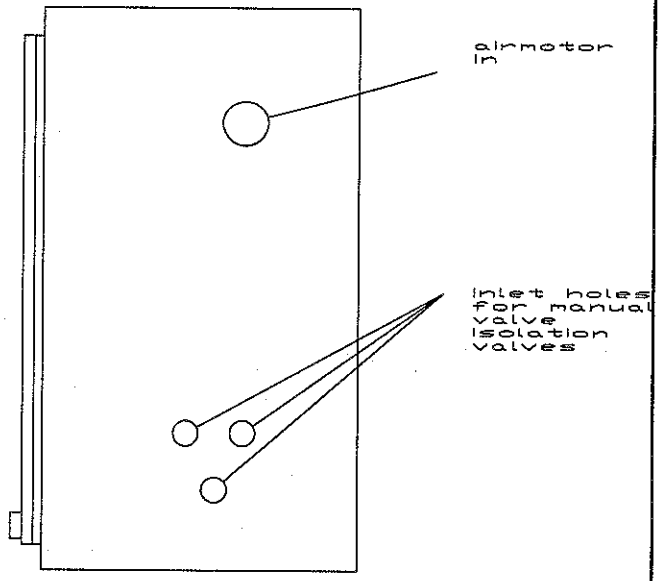
TITLE: A.R.T.C. PLOUGH WAGON SYSTEM 816229

CLIENT: GEMCO RAIL

DRAWING No.: RW310107C







STEEL POWDER COATED I.P.66 CABINET

REF	QTY	PART NUMBER	DESCRIPTION

PERTH OFFICE:- 176 CAMPBELL ST BELMONT W.A.

phone:- 94782900

DRAWN BY	APPROVED BY	SCALE	REFERENCE No.
R.W.		N.T.S.	

NORGREN

REV	DATE	DESCRIPTION OF CHANGE	CHECKED BY	APPROVED BY

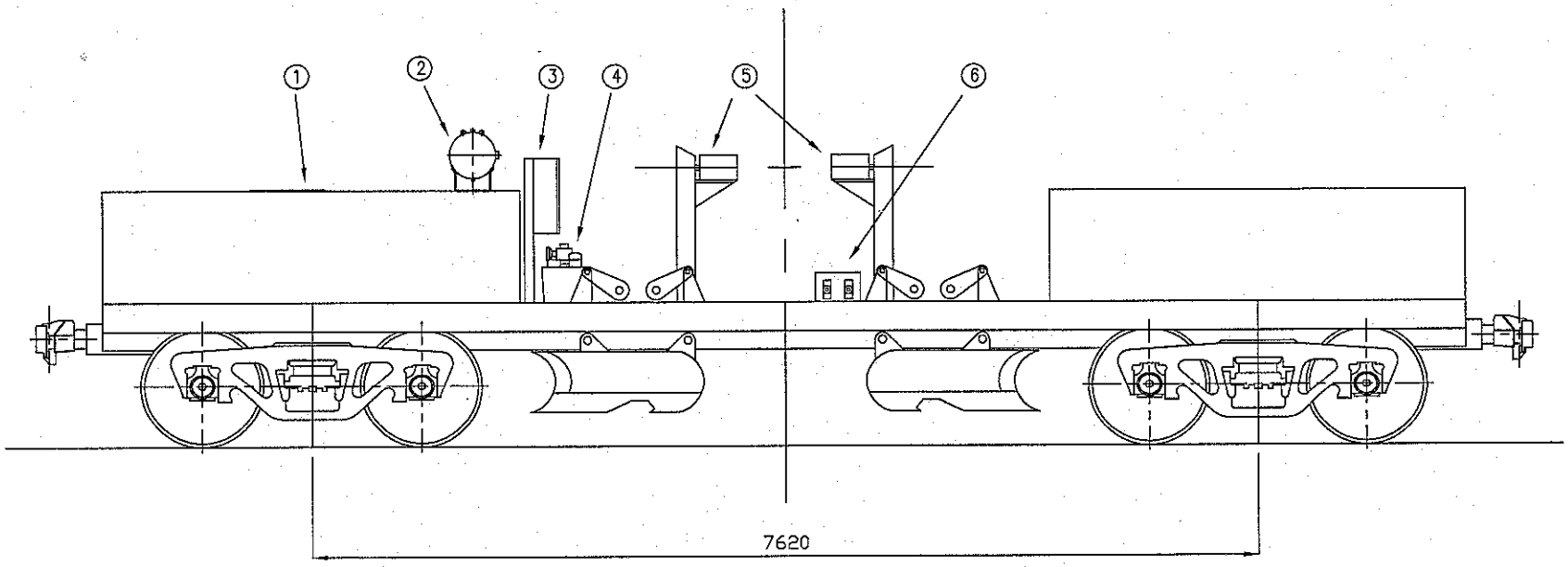
TITLE ARTC BALLAST PLOUGH CABINET LAYOUT SYSTEM NUMBER 816229

CLIENT GEMCO RAIL

DRAWING No. RW030407

TOLERANCES TO AS 1100 UNO		
NOM DIM	MACHINED	OTHER
0.5 – 6	±0.1	±0.3
>6 – 30	±0.2	±0.5
>30 – 120	±0.3	±0.8
>120 – 315	±0.5	±1.2
>315 – 1000	±0.8	±2.0
>1000 – 2000	±1.2	±3.0
>2000 – 4000	±2.0	±4.0

ALL DIMENSIONS IN mm U
SURFACE FINISH 3.2 UNO
WELDING TO AS1554.1 GP
BREAK SHARP EDGES



NOTES: –

1. MANUAL CONTROL VALVES ARE FITTED TO BOTH SIDES OF WAGON FOR USE IN THE EVENT OF RADIO FAILURE.
2. MANUAL CONTROL VALVES ARE BEHIND A LOCKABLE COVER TO PREVENT UNAUTHORIZED USE.
3. MANUAL CONTROL VALVE COVERS AND PNEUMATIC/ ELECTRICAL ENCLOSURE ARE KEYED ALIKE.
4. PLOUGH INDIVIDUALLY OPERATED

ITEM	PART No	DESCRIPTION	QTY	REMARKS	Wt kg
6		MANUAL CONTROL VALVE	1		
5		HYDRAULIC MOTOR	2	1 FITTED AT EACH END	
4		VALVE AND MANIFOLD ASSEMBLY	1		
3		PNEUMATIC/ELECTRIC ENCLOSURE	1		
2		AIR RECIEVER	1		
1		SOLAR PANEL	2		

DATE	DESCRIPTION / ECO	REV	DRN	CKD	APD
3/10/06	FIRST ISSUE	A1	MG		

GEMCO RAIL PTY LTD
860–870 Abernethy Road – Access Park
Rail Marshalling Yards
Forrestfield WA 6058
Ph +61 8 9454 9666. Fax +61 8 9454 9777.

TITLE: CONCEPT DRAWING ARTC BALLAST PLOUGH

CAD FILE 9999–1A

PROJECT

SIZE	DRG. No.	REV
A3	517576	0

SHEET 1 OF 1

3rd ANGLE PROJECTION

SCALE NTS