

OPERATING MANUAL**RANGER 405D****Part No. KA1453**Multi Process DC Welder & three phase 15 kVA
Auxiliary Power Generator - Diesel Engine driven
Engine - Kubota / Perkins**SAFETY DEPENDS ON YOU**

Lincoln Electric welders are designed and built with safety in mind. However, your overall safety can be increased by proper installation and thoughtful operation on your part. Read and observe the general safety precautions on page 2 and follow specific installation and operating instructions included in this manual. Most importantly, think before you act and be careful.

**THE LINCOLN ELECTRIC COMPANY
(AUSTRALIA) PTY. LTD. A.B.N. 36 000 040 308
SYDNEY, AUSTRALIA**

A Subsidiary of

THE LINCOLN ELECTRIC CO. U.S.A.

Associated Subsidiaries in Australasia, Asia, Canada, Europe, North and South America.

THE WORLD'S LEADER IN WELDING AND CUTTING PRODUCTS

PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. READ AND UNDERSTAND BOTH THE SPECIFIC INFORMATION GIVEN IN THE OPERATING MANUAL FOR THE WELDER AND/OR OTHER EQUIPMENT TO BE USED AS WELL AS THE FOLLOWING GENERAL

ARC WELDING SAFETY PRECAUTIONS



ELECTRIC SHOCK can kill

1. a. The electrode and work (or ground) circuits are electrically "hot" when the welder is on. Do not touch these "hot" parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.
- b. In semi-automatic and automatic wire welding, the electrode, electrode reel, welding head and nozzle or semi-automatic welding gun are also electrically "hot".
- c. Insulate yourself from work and ground using dry insulation. When welding in damp locations, on metal framework such as floors, gratings or scaffolds, and when in positions such as sitting or lying, make certain the insulation is large enough to cover your full area of physical contact with work and ground.
- d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.
- e. Ground the work or metal to be welded to a good electrical (earth) ground.
- f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.
- g. Never dip the electrode holder in water for cooling.
- h. Never simultaneously touch electrically "hot" parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.
- i. When working above floor level, protect yourself from a fall should you get a shock.
- j. Also see items 4c and 6.



FUMES AND GASES can be dangerous

2. a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. When welding on galvanised, lead or cadmium plated steel and other metals which produce toxic fumes, even greater care must be taken.
- b. Do not weld in locations near chlorinated hydrocarbon vapours coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapours to form phosgene, a highly toxic gas, and other irritating products.
- c. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to ensure breathing air is safe.
- d. Read and understand the manufacturer's instructions for this equipment and the consumables to be used, including the material safety data sheet (MSDS) and follow your employer's safety practices.
- e. Also see Item 7b.



ARC RAYS can burn

3. a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to AS 1674.2-1990 standards.
- b. Use suitable clothing made from durable flame resistant material to protect your skin and that of your helpers from the arc rays.
- c. Protect other nearby personnel with suitable non flammable screening and/or warn them not to watch the arc or expose themselves to the arc rays or to hot spatter or metal.



WELDING SPARKS can cause fire or explosion

4. a. Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Have a fire extinguisher readily available.
- b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to AS1674 Parts 1 & 2 "Safety in Welding and Allied Processes", WTIA Technical Note 7 "Health and Safety in Welding" and the operating information for the equipment being used.
- c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.
- d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapours from substances inside. These can cause an explosion even though the vessel has been "cleaned". For information purchase AS 1674-1990.
- e. Vent hollow castings or containers before heating, cutting or welding. They may explode.
- f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.
- g. Connect the work cable to the work as close to the welding area as possible. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.
- h. Also see Item 7c.



CYLINDER may explode if damaged

5. a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators, designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.
- b. Always keep cylinders in an upright position and securely chained to an undercarriage or fixed support.
- c. Cylinders should be located :
 - Away from areas where they may be struck or subjected to physical damage.
 - A safe distance from arc welding or cutting operations and any other source of heat, sparks or flame.
- d. Never allow the electrode, electrode holder, or any other electrically "hot" parts to touch a cylinder.
- e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.
- f. Valve protection caps should always be in place and hand-tight except when the cylinder is in use or connected for use.
- g. Read and follow the instructions on compressed gas cylinders and associated equipment, and AS 2030 Parts 1 & 2.



FOR ELECTRICALLY powered equipment

6. a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.
- b. Install equipment in accordance with the SAA Wiring Rules, all local codes and the manufacturer's recommendations.
- c. Ground the equipment in accordance with the SAA Wiring Rules and the manufacturer's recommendations.



FOR ENGINE powered equipment

7. a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.



- b. Operate engines in open, well ventilated areas or vent the engine exhaust fumes outdoors.



- c. Do not add fuel near an open flame, welding arc or when the engine is running. Stop the engine and allow it to cool before refuelling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.



- d. Keep all equipment, safety guards, covers and devices in position and in good repair. Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

- e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.

- f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.

- g. To prevent accidentally starting petrol engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.



- h. To avoid scalding do not remove the radiator pressure cap when the engine is hot.

HAVE ALL INSTALLATIONS, OPERATION, MAINTENANCE AND REPAIR WORK PERFORMED BY QUALIFIED PEOPLE

For more detailed information it is strongly recommended that you purchase a copy of "Safety in Welding and Cutting - ANSI Standard Z 49.1" and WTIA Technical Note 7. All WTIA publications and ANSI/AWS Standards are available from the Welding Technology Institute of Australia, P.O. Box 6165, Silverwater NSW 2128. For copies of various Australian Standards contact your local S.A.A. office.

HOW TO ORDER REPLACEMENT PARTS

To ensure that you receive the correct replacement part the following procedure should be followed:

1. Quote Serial Number and Code Number.
2. Quote the Description, Item Number and Parts List Number of the desired part. When ordering parts for items carrying brand names of other companies, such as fan motors, drive shafts, etc., be sure to include the other company's name and part number and other relevant information.
3. Should the primary cord be damaged, a special cord is required, and is available from Lincoln Electric.
4. Parts should be ordered from Lincoln, its offices or the nearest Authorised Field Service Shop. (The "Lincoln Service Directory" listing these shops geographically is available on request.)

Note: "Hardware" in the Lincoln Parts Lists are not Lincoln stock items but can be obtained via the Field Service Shop network.

Component parts of assemblies such as stator coils or armature coils, etc., which require electrical testing or locating fixtures are not considered replaceable items. This is to ensure that the customer receives parts which will keep the welder in the best operating condition.

BUY ONLY GENUINE REPAIR PARTS

VRD - VOLTAGE REDUCTION DEVICES

What are VRD & ROCV Devices?

VRD's are gaining popularity as a "must have" safety accessory especially where welding applications are being carried out in an environment with a high-risk of electric shock such as wet areas and hot humid sweaty conditions.

VRD & ROCV are the abbreviations of two different naming conventions used to describe safety device fitted to welding power source to help protect the operator from electric shocks.

VRD stands for 'Voltage Reduction Device' and ROCV stands for 'Reduced Open Circuit Voltage' both devices are either fitted as an after market addition or part of the integral design of a machine. They reduce the voltage at the welding output terminals whilst not welding to a no load voltage of no more than 35V for dc welding and for AC welding 35V peak 25V a.c. rms, when the resistance of the output circuit is below 200 Ω (ohms). The lower reactivation resistance is of the device the higher the safety level but also requires that the welding cable connections be kept in good electrical condition.

Having good electrical connections also limit the possibility of other safety issues such as heat-generated damage, burns and fires.

Welding Power Sources

Welding power sources generally have an Open Circuit Voltage (i.e. the voltage at the welding output terminals whilst not welding) in the ranges of 35 – 115VDC. Welding machines for stick welding (MMAW) and similar constant current (CC) processes, supply a higher open circuit voltage between the electrode and the work when the welding machine is switch on and ready to commence welding. These welding machines have a drooping characteristic, with the open circuit voltage higher (typically 60-80V) than when the arc is established and welding current is drawn (20-35V).

Consequently, the greatest danger occurs when handling the electrodes and the electrode holder between welding operations, such as when changing electrodes.

Welding machines for MIG (GMAW & FCAW) have a flat constant voltage (CV) characteristic, generally with a lower open circuit voltage (30-60V). Also, the current is turned on & off by a gun trigger, which also controls the wire feed. Therefore, the welder is not exposed to open circuit voltage, unless the trigger is turned on and the wire is feeding. Also, electrodes are not changed as frequently as for stick welding (MMAW).

For these reasons VRD/ROCV's are more commonly incorporated into the stick welding mode (CC) of welding machines being used in environments with high-risk of electric shock.

This reduction of the voltage supplies a safer level of voltage when an arc is not being struck or when an electrical resistance less than the welder's body resistance have been detected.

All VRD's are only an aid to safety and personal protective equipment and safe working practices must be observed at all times. The risk of electric shock during welding from a correctly installed and maintained welding machine is negligible, provided that sensible precautions are taken by the user and correct safe working procedures are followed. All parts of the output circuit should be considered electrically alive, and consequently welders should ensure that no part of their body is placed in such a position as would complete a path through it for the passage of electric current. Safe working procedures should always be followed whether a VRD is fitted or not.

Operation

Due to inherit low voltage safety features of the VRD's to reduce the possibility of electric shock to the operator. A very slight delay during striking of the electrode may be experienced. The high voltage that is available on units without VRD's allows them to penetrate and burn through dirty, painted and heavily mill scale plate. Units fitted with VRD's cannot penetrate and are required to register the correct resistance, which switches the safety device into weld mode. Unlike other VRD's Lincoln uses micro processor control to monitor and establish the arc without the sticking and shorting of the electrode to the job as seen in many other VRD installations. Due to the requirement of the resistance in the circuit to be low for a VRD to operate, a good metal-to-metal contact must be made between the metal core of the electrode and the job. A damaged or poor connection anywhere in the output circuit may limit the operation of the VRD.

Some electrodes form a cone at the end of the electrode after the welding arc has been broken, particularly iron powder and low hydrogen electrodes. This cone will need to be broken off in order to have the metal core of the electrode to make contact.

Safe working procedures should always be followed whether a VRD is fitted or not.



WARNING

All multi-process CC/CV machines which are fitted with VRD's do not offer low voltage protection in CV modes. If the multi-process machine has a "WELD TERMINAL ENABLE SWITCH" enabled, the weld output terminals will be electrically 'HOT' and potentially High Voltage present.

Only 'ACROSS THE ARC' type wire feeders with a internal contactor fitted should be used in this configuration.

Arc air gouging is not recommended in CV. Due to 'CV MODE' not offering VRD protection.

WELDING, EMF & PACEMAKERS

All welders should follow safe practices that minimise their exposure to electric and magnetic fields (EMF).

For welders wearing implanted pacemakers, safe welding practices are particularly important and additional procedures should be followed by those who have decided to continue to weld. (Hopefully in keeping with a doctor's advice).

The following procedures will not eliminate exposure to EMF or the possibility of arc welding having an effect on a pacemaker, however if followed, they will significantly reduce exposure to electric and magnetic fields. Electric and magnetic fields are created any time electric current flows through a conductor, however it is not clear whether such exposure affects ones health.

Some researchers have reported that exposure to EMF may cause leukemia or other illnesses. These claims originally arose in relation to high voltage electric power lines and are very much in dispute in the medical and scientific arena, however the best advice is to minimise your exposure to EMF to protect your health should doctors eventually decide there is a risk.

There are four fundamental facts about EMF:

- With direct current (DC), the field strength is relatively constant and does not change.
- With alternating current (AC), the field strength constantly changes.
- The greater the current flow, i.e. the higher the amps, the stronger the field created by the current
- The closer the conductor or electrical device is to the body, the greater the exposure to the field.

Minimising exposure

All welders should use the following procedures to minimise EMF exposure.

- Route electrode or gun and work cables together. Secure them with tape if possible.
- Never coil the electrode lead around your body.
- Do not place your body between the electrode and work cables. If your electrode cable is on your right side the work cable should also be on your right side.
- Connect the work cable to the work piece as close as possible to the area being welded. (This is also a good practice to eliminate a common problem on welding - a poor work connection.
- Do not work next to the welding power source.

Welders with pacemakers

There is no question that the fields in arc welding can interfere with a pacemakers function. Generally the interference does not permanently damage the pacemaker. Once the wearer leaves the arc welding environment or stops welding, the pacemaker returns to normal functioning. The welding arc has little or no effect on the operation of some pacemakers, especially designs that are bi-polar or designed to filter out such interference.

For a welder or anyone working around electrical equipment the selection of a pacemaker is very important. Get a doctor's advice about which pacemaker is the least sensitive to interference from welding while still being medically suitable.

In addition to the normal safety precautions, the following additional procedures should be adopted by welders with pacemakers.

- Use gas welding when the application is suitable.
- Use the lowest current setting appropriate for the application. Do not exceed 400 amps. Low current (75-200 amps) direct current (DC) welding should be used if arc welding is necessary. Do not TIG weld with high frequency.
- Do not use repeated, short welds. Wait about ten seconds between stopping one weld and starting the next. When having difficulty starting an electrode, do not re-strike the rod repeatedly.
- If you feel light headed, dizzy or faint, immediately stop welding. Lay the electrode holder down so that it does not contact the work and move away from any welding being performed. Arrange your work in advance so that, if you become dizzy and drop the electrode holder, the electrode holder will not fall on your body or strike the work.
- Do not work on a ladder or other elevated position or in a cramped, confined place.
- Do not work alone. Work only in the presence of an individual who understands these precautions and the possible effect welding may have on your pacemaker.
- Do not work near spot welding equipment.
- If you have a pacemaker and wish to continue arc welding, discuss this and any other questions you may have with your physician and follow his or her advice. The doctor may wish to contact the pacemaker manufacturer for a recommendation. As mentioned before, the design of the pacemaker significantly affects the degree to which it is subject to interference from a welding circuit. Do not rely on the fact that you know another welder with a pacemaker who has welded for years without experiencing a problem. That welder and his or her pacemaker may be quite different from you and your pacemaker.

INSTRUCTIONS FOR ELECTROMAGNETIC COMPATIBILITY



WARNING

This welding machine must be used by trained operators only. Read this manual carefully before attempting to use the welding machine.

Conformance

Products displaying the C-Tick mark are in conformity with Australian/New Zealand requirements for Electromagnetic Compatibility (EMC). They are:

- manufactured in conformity with Australian/New Zealand Standard (Emission):- AS/NZS 3652 'Electromagnetic Compatibility - Arc Welding Equipment' (Identical to and reproduced from British Standard EN 50199)
- for using with other Lincoln Electric/LiquidArc equipment.
- designed for industrial and professional use.

Introduction

All electrical equipment generates small amounts of electromagnetic emission. Electrical emission may be transmitted through power lines or radiated through space, similar to a radio transmitter. When emissions are received by other equipment, electrical interference may result. Electrical emissions may affect many kinds of electrical equipment: other nearby welding equipment, radio and TV transmitters and receivers, numerical controlled machines, telephone systems, computers, etc. Be aware that interference may result and extra precautions may be required when a welding power source is used in a domestic establishment.

Installation and Use

The purchaser/user is responsible for installing and using the welding equipment according to the manufacturer's instructions. If electromagnetic disturbances are detected then it shall be the responsibility of the purchaser/user of the welding equipment to resolve the situation with the technical assistance of the manufacturer. In some cases this remedial action may be as simple as earthing (grounding) the welding circuit (see note below). In other cases it could involve constructing an electromagnetic screen enclosing the power source and the work complete with associated input filters. In all cases electromagnetic disturbances must be reduced to the point where they are no longer troublesome.

Note: The welding circuit may or may not be earthed for safety reasons according to national codes. Changing the earthing arrangements should only be authorised by a person who is competent to assess whether the changes increase the risk of injury, eg. by allowing parallel welding current return paths which may damage the earth circuits of other equipment.

Assessment of Area

Before installing welding equipment the purchaser/user shall make an assessment of potential problems in the surrounding area.

The following shall be taken into account:

- a. Other supply cables, control cables, signalling and telephone cables above, below and adjacent to the welding equipment;
- b. Radio and television transmitters and receivers;
- c. Computer and other control equipment;
- d. Safety critical safety equipment, eg. guarding of industrial equipment;
- e. The health of people around, eg. the use of pacemakers and hearing aids;;
- f. Equipment used for calibration or measurement;

- g. The immunity of other equipment in the environment. The purchaser/user shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures;
- h. The time of the day that welding or other activities are to be carried out.

The size of the surrounding area to be considered will depend on the structure of the building and other activities that are taking place. The surrounding area may extend beyond the boundaries of the premises.

Methods of Reducing Emissions

Mains Supply

Welding equipment should be connected to the mains supply according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering the mains supply. Consideration should be given to shielding the supply cable of permanently installed welding equipment in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the welding power source so that good electrical contact is maintained between the conduit and the welding power source enclosure.

Maintenance of the Welding Equipment

The welding equipment should be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the welding equipment is in operation. The welding equipment should not be modified in any way except for those changes and adjustment covered in the manufacturer's instructions. In particular, the spark gaps of arc initiation and stabilising devices should be adjusted and maintained according to the manufacturer's recommendations.

Welding Cables

The welding cables should be kept as short as possible and should be positioned close together, running at or close to the floor level.

Equipotential Bonding

Bonding of all metallic components in the welding installation and adjacent to it should be considered. However, metallic components bonded to the work piece will increase the risk that the operator could receive a shock by touching these metallic components and the electrode at the same time. The operator should be insulated from all such bonded metallic components.

Earthing of the workpiece

Where the workpiece is not bonded to earth for electrical safety, nor connected to earth because of its size and position, eg. ship's hull or building steelwork, a connection bonding the workpiece to earth may reduce emissions in some, but not all instances. Care should be taken to prevent the earthing of work pieces increasing the risk of injury to users, or damage to other electrical equipment. Where necessary, the connection of the workpiece to earth should be made by direct connection to the workpiece, but in some countries where direct connection is not permitted, the bonding should be achieved by suitable capacitance, selected according to national regulations.

Screening and Shielding

Selective screening and shielding of other cables and equipment in the surrounding area may alleviate problems of interference. Screening of the entire welding installation may be considered for special applications.*

* Portions of the preceding text are contained in AS/NZS3652: 'Electromagnetic Compatibility - Arc Welding Equipment'.

Certificate of Compliance

EMC Technologies Report No: T10609

Test Sample Name: Engine Driven Welding Power Source
Model Number: WF 135
Serial Number: N5N

Manufacturer: The Lincoln Electric Co (Aust) Pty Ltd


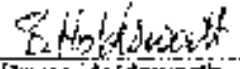
Tested For: The Lincoln Electric Co (Aust) Pty Ltd
Address: 35 Bryant St
 Padstow NSW 2211


Phone: 02 9772 7222
Fax: 02 9702 1387
Responsible Party: Steve Wigley


Test Standard/s: EN50199:1998
*Electromagnetic Compatibility (EMC) – Product Standard
 for Arc Welding Equipment*

Result of Test: The test sample complied with EN50199:1998
 Refer to Report T10609 for full details.

Test Dates: 05/06/2001, 06/06/2001, 07/06/2001 and 14/06/2001

Testing Officers:

 Sebastian Beier
 
 Bruce Holdsworth


 Judie Foyle

Authorised Signature:

 Les Oskanson
 Sydney Manager
 EMC Technologies Pty Ltd

Issued by EMC Technologies Pty Ltd, U of NSW (Quakstone Road, Castle Hill NSW 2154, Australia,
 Phone: +61 2 9559 4099 Fax: +61 2 9559 4019



This document must not be copied or reproduced, except in full without the written
 permission of the Manager, EMC Technologies Pty Ltd
www.emctech.com.au

PRODUCT DESCRIPTION

The Ranger 405D is a diesel engine driven alternator power source for multi-process DC welding and for 115/230-240/400-415VAC auxiliary* and standby power. It is housed in a sound reduced enclosure for quiet operation.

* Auxiliary outlets and circuit breakers depend on model purchased.

THE RANGER 405D IS NOT RECOMMENDED FOR PIPE THAWING

Technical Specifications

Machine Specifications - Welding

| Part Number | KA1453-1, KA1453-2, KA1453-3, KA1453-4, KA1453-5, KA1453-6, KA1453-7, KA1453-20 |
|--|---|
| DC Constant Current – Current Range | 30 to 405 Amps |
| Maximum OCV – Reduced OCV (VRD) Arc Force Control | 62 Volts – Reduced < 8 Volts Factor x 1 to x 2.6 |
| DC Constant Voltage – Open Circuit Range | 15 to 49 Volts |
| Ratings:- Low Inductance Receptacle | 400 Amp @ 20 Volt 30% Duty Cycle 350Amp @ 30Volt 60% Duty Cycle 300Amp @ 32Volt 100% Duty Cycle |
| High Inductance Receptacle | 335Amp @ 30Volt 50% Duty Cycle 250Amp @ 30Volt 100% Duty Cycle |

Auxiliary Power - (When welding, maximum available auxiliary power is reduced)

| Part Number | KA1453-1,-4, -7 & -20 | KA1453-2 & -5 | KA1453-3 & -6 |
|--|---|---|--|
| Ratings (Factory set) voltage regulation is within +/-7% @ all loads up to rated capacity) | 415V (3 Ph) & 240V (1 Ph) | 400V (3 Ph) & 230V (1 Ph) | 230V (1 Ph) & 400V (3 Ph) 115V (Centre Tapped Earth) |
| Total Loading (100% Duty Cycle) | 15kVA @ Unity 12kW @ 0.8pf | 14.4kVA @ Unity 11.5kW @ 0.8pf | 14.4kVA @ Unity 11.5kW @ 0.8pf |
| Wire Feeder Supply | 115V @ 5 Amps AC & 42V @ 10 Amps AC | 115V @ 5 Amps AC & 42V @ 10 Amps AC | 115V @ 5 Amps AC 42V @ 10 Amps AC |
| Frequency | 50Hz | 50Hz | 50Hz |
| Automatic Electronic Voltage Regulator (AVR) Factory set for | 240/415V Output | 230/400V Output | 115/230/400V 115V Output |
| Protection & Receptacles Residual Current Device (RCD) | 4 Pole, 25 Amp, (30mA Trip Current) | 4 Pole, 25 Amp, (30mA Trip Current) | 4 Pole, 25 Amp (30mA Trip Current) |
| Thermal / Magnetic Circuit Breakers | 3 Ph 20 Amp x 1 & 1 Ph 16 Amp x 3 | 3 Ph 20 A, x 1 & 1 Ph 16 Amp x 2 | 3 Ph 20 Amp x 1 1 Ph 16 Amp x 1 2 Ph 20 Amp x 1 |
| Receptacles | 415V (3 Ph) x 1 240V (1 Ph) x 3 14 pin Amphenol x 1 | 400V (3 Ph) x 1 230V (1 Ph) x 2 14 pin Amphenol x 1 | 400V (3 Ph) x 1 230V (1 Ph) x 1 115V (1Ph) x 3 14 pin Amphenol x 1 |
| Dimensions approx. L x W x H | 1600 x 733 x 970 | 1665 x 733 x 970 | 1665 x 733 x 970 |
| Weight approx. | 550 kg | 550kg | 550kg |

Engine Specifications

| Make / Model | Kubota / D1105 | Perkins / 403C-11 |
|--|---|--|
| Type | 3 Cyl., Water cooled, 4 Cycle, Diesel | |
| Combustion Chamber | Spherical type; 3 Vortex Combustion System | Naturally aspirated Indirect injection |
| Bore & Stroke | 78 x 78.4mm | 77 x 81mm |
| Displacement | 1124cc | 1131cc |
| Power (SAE, J1349 net intermittent) | 18.6kW @ 3000rpm | 19.6kW @ 3000rpm |
| Electrical System | 12V Battery & Starter, Key Start & Stop, Glow Plugs, Alternator Battery Charger (internal regulator) | |
| Governor Type | Centrifugal (flywheel high speed mechanical) | |
| Lubrication | Forced feed full flow oil filter | |
| Cooling System | Pressurised (0.9 kg/cm ²) Radiator. Pump forced circulation, capacity is 4L and an overflow reservoir bottle. | |
| Fuel System | Indirect injection pre fitted to fuel filter with shut off, lift pump, bypass valve for easy bleeding. | |
| Fuel Tank Capacity | 45 litres | |
| Air Cleaner | Heavy Duty, 2 Stage dry cartridge type | |
| Engine Idler | Automatic (with manual over-ride) | |
| Muffler | Low Noise | |
| Engine Protection System with 'First Alarm' latched LED indication | Shutdown on - High electricals temperature, High coolant temperature, Low oil pressure, welding output failure | |
| Operating Speeds (approximate) | High Idle - 3130rpm Low Idle - 1580rpm Full Load - 3000rpm | |

Before Starting your Welder



Pre-Operation Service

READ the engine operating and maintenance instructions supplied with this machine.

Oil

The Ranger 405D is shipped with the engine crankcase filled with the correct grade oil for the run-in period. Check the oil level before starting the engine. If it is not up to the full mark on the dip stick, add oil as required. Check the oil level every four hours of running time during the first 35 running hours. Refer to the engine Operator's Manual for specific oil recommendations and run-in information.

Fuel - use diesel fuel only

| | |
|---|---|
|  WARNING | |
|  DIESEL fuel can cause fire or explosion | <ul style="list-style-type: none">• Stop engine when fuelling.• Do not smoke when fuelling.• Remove cap slowly to release pressure.• Do not overfill tank.• Wipe up spilled fuel and allow fumes to clear before starting engine.• Keep sparks and flame away from tank. |

Fill the fuel tank with clean, fresh diesel fuel. The capacity is 45 litres. See engine Operator's Manual for specific fuel recommendations. Do not allow the Ranger 405D to run out of fuel. This necessitates bleeding the injector system.

Engine Coolant

| | |
|--|---|
|  WARNING | |
|  | HOT COOLANT CAN BURN SKIN Do not remove cap if radiator is hot. |

The welder is shipped with the engine and radiator filled with engine coolant. Before starting the engine check coolant level in the radiator, add more pre-mixed coolant if required. See Maintenance Section and engine Operator's Manual for more information on coolant.

Battery

Important: In order that control electronics will function correctly, the Ranger 405D must always have its battery connected whenever its engine is running. The battery must be in good condition, and fully charged.

| | |
|--|----------------|
|  | WARNING |
|--|----------------|

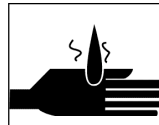


GASES FROM BATTERY CAN EXPLODE.

- Keep sparks, flame and cigarettes away from battery.

To prevent Explosion when:

- **Installing a new battery** - disconnect negative cable from old battery first and connect to new battery last
- **Connecting a battery charger** - remove battery from welder by disconnecting negative cable first, then positive cable and battery clamp. When reinstalling, connect negative cable last. Keep well ventilated.
- **Using a booster** - connect positive lead to battery first then connect negative lead to the chassis/engine strap.

| | |
|---|---|
|  | Battery acid can burn eyes and skin <ul style="list-style-type: none">•Wear gloves and eye protection and be careful when working near battery.•Follow instructions printed on battery. |
|---|---|

THE RANGER 405D IS FURNISHED WITH A WET CHARGED BATTERY

Battery Connection Instructions

The Ranger is shipped with the negative battery cable disconnected. Before you operate the machine, make sure the Key Switch is in the OFF position and attach the disconnected cable securely to the negative (-) battery terminal.

Note: This machine is furnished with a wet charged battery; if unused for an extended time, the battery may require a booster charge. Be sure to use the correct polarity when charging the battery. (If the battery terminal voltage is less than 12.47 volts, then it will need recharging *before* use).

Important Note: Battery must not be filled or "topped up" whilst it is in normal operating position - always remove from machine.

| | |
|---|----------------|
|  | WARNING |
|---|----------------|

- Battery electrolyte contains sulphuric acid which is corrosive to skin and clothing.
- Batteries also discharge explosive gases.
- When charging provide adequate ventilation to allow the safe escape of explosive gases.
- Do not do anything to cause sparks near the battery. Keep naked flames and cigarettes away from battery.
- If acid contacts eyes or skin flush immediately with large quantities of clean drinking water.
- In case of acid contacting eyes, consult a doctor immediately.
- After use wash out empty electrolyte bottles with water and dispose of carefully - do not use empty electrolyte bottles for any other purpose.
- Always keep batteries and electrolyte out of reach of children.
- Dispose of old batteries carefully.

Angle of Operation

Engines are designed to run in the level condition which is where the optimum performance is achieved. The maximum angle of operation for the Kubota engine and Perkins engine is 20° continuously in any direction. If the engine must be operated at an angle, provisions must be made for checking and maintaining the oil level at the normal (FULL) oil capacity in the crankcase.

When operating the welder at an angle, the effective fuel capacity will be slightly less than the specified 45 litres.

High Altitude Operation

At higher altitudes, output derating may be necessary. As a rule of thumb, derate the welder output 0.4% for every 30m above 150m.

Contact Kubota/Perkins Service Representative for any engine adjustments that may be required.

Optional Field Installed Accessories

KA1373 Power Plug Kit (suits KA1453-1, -4, -7 & -20 415/240V Australian plugs)

KA1373-3 Power Plug Kit (suits KA1452-5 400/380/230/220V)

Provides a plug for each auxiliary power receptacle.

KIT400 Accessory Kit

Includes:- Electrode Holder, ground clamp, flip front Headshield, supervisibility lens, Non-spatter lens, wire brush, chipping hammer.

KIT1600T Lead Kit

Includes:- One 10m & one 9m length of 50mm² cable with one Twistmate connector fitted to each.

K857 Remote Control (Weld Control)

Portable control provides same dial range as the output control on the welder from a location up to away from the welder. Has convenient plug for easy connection to the welder. (Requires K864 or K876 Adapter).

Refer Optional Equipment Section in this manual for cable length and plug options.

K864 Remote Control Adapter

Plugs into the 14 pin remote output control plug base mounted on the machine. It provides a 14 pin and a 6 pin remote output connection. e.g. Used for K857 remote control and 'plug' cable LN-7 connections.

K876 Remote Control Adapter

Plugs into the 14 pin remote output control plug base mounted on the machine. It provides a 6 pin connector. e.g. Used for K857 remote control.

K867 Universal Adapter Plug

Plugs into the 14 pin remote output control plug base mounted on the machine. It provides flying leads for connection to 'lugged' control cables. e.g. Used for K775 remote control and 'lugged' cable LN-7 connections.

K930-2 Hi-Freq TIG Module

High frequency unit with gas valve for TIG welding. Rating is 250 amp @ 80% duty cycle.

INSTALLATION INSTRUCTIONS



WARNING

Do not attempt to use this equipment until you have thoroughly read the engine manufacturer's manual supplied with your welder. It includes important safety precautions, detailed engine starting, operating and maintenance instructions, and parts lists.

Location / Ventilation



ELECTRIC SHOCK can kill

Do not touch electrically live parts such as output terminals or internal wiring



ENGINE EXHAUST can kill

Use in open, well ventilated areas or vent exhaust outside.

- Do not operate with doors open or guards off.
- Stop engine before servicing.



MOVING PARTS can injure

Keep away from moving parts.

Only qualified personnel should install, use, or service this equipment.

The welder should be located to provide an unrestricted flow of clean, cool air to the cooling air inlets and to avoid heated air coming out of the back of the welder recirculating back to the cooling air inlets. Also, locate the welder so that the engine exhaust fumes are properly vented to an outside area.

Machine Earthing

Standards Australia advise that "There is no need for an earth electrode to be used with an engine driven welding power service" E W Robson Projects Manager Committee EL/1 (7th September 1998).



WARNING

FALLING EQUIPMENT CAN CAUSE INJURY



- Do not lift this machine using lift bale if it is equipped with a heavy accessory such as trailer or gas cylinder.
- Lift only with equipment of adequate lifting capacity.
- Be sure machine is stable when lifting

High Frequency Generator for TIG Welding Applications

The K930-2 TIG Module is suitable for use with the Ranger 405D. The Ranger 405D and any high frequency generating equipment must be properly grounded. See the K930-2 Operating Manual for completed instructions on installation, operation, and maintenance.

A T12246 BYPASS CAPACITOR ASSEMBLY MUST BE INSTALLED IN THE RANGER 405D TO PROTECT THE RANGER 405D FROM DAMAGE.

Standby Power Connections

The Ranger 405D is suitable for temporary, standby or emergency power using the engine manufacturer's recommended maintenance schedule.

The Ranger 405D can be permanently installed as a standby power unit for:-

KA1453-1, -4 & -7 415/240V - 20 Amp service,
 KA1453-2 & -5 400/230V - 20 Amp service
 KA1453-3 & -6 400/230 and 115V (Centre Tapped Earth) - 20 Amp service.

Connections must be made by a licensed electrician who can determine how the connections can be made to adapt to particular installations and comply with all applicable electrical codes, eg Australian Standard AS3000 Wiring Rules, and maintain operation of the Residual Current Device.

Welding Output Cables

With the engine off, connect the electrode and work cables to the appropriate receptacles.

Copper cables sizes listed below are recommended for the rated current and duty cycle. Lengths stipulated are the distance from the welder to work and back to the welder again. Cable sizes are increased for greater lengths primarily for the purpose of minimising cable voltage drop.

| AMPS | DUTY CYCLE | TOTAL COMBINED LENGTH OF ELECTRODE & WORK CABLE | | | | |
|------|------------|---|-------------------|-------------------|-------------------|-------------------|
| | | 0 - 15 m | 15 - 30 m | 30 - 45 m | 45 - 60 m | 60 - 75 m |
| 250 | 40 | 35mm ² | 35mm ² | 50mm ² | 50mm ² | 50mm ² |
| 250 | 100 | 50mm ² | 50mm ² | 50mm ² | 50mm ² | 50mm ² |
| 300 | 40 | 50mm ² | 50mm ² | 50mm ² | 50mm ² | 50mm ² |
| 300 | 60 | 50mm ² | 50mm ² | 50mm ² | 50mm ² | 70mm ² |
| 300 | 100 | 70mm ² | 70mm ² | 70mm ² | 95mm ² | 95mm ² |
| 350 | 60 | 50mm ² | 50mm ² | 70mm ² | 70mm ² | 95mm ² |
| 400 | 30 | 50mm ² | 50mm ² | 50mm ² | 70mm ² | 70mm ² |



Remote Output Control

The Ranger 405D is fitted with a 14 pin remote control receptacle. This receptacle is mounted between the output studs on the control panel and is used for connection remote equipment, eg. The control cable for an LN-21 wire feeder. When remote output control is used the 'local/remote' toggle switch must be set at the 'REMOTE' position, otherwise set it at 'LOCAL' position for control at machine nameplate.

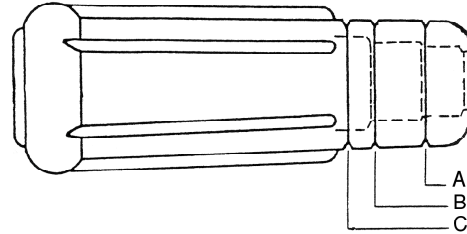
Twist-Mate Welding Cable Plug

Installation Instructions

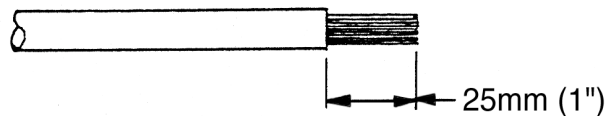
Turn the engine "OFF" before connecting or disconnecting plugs to welding power source.

1. The connector is suitable for cable sizes 25 to 95mm².
2. Trim rubber boot as required (see diagram).

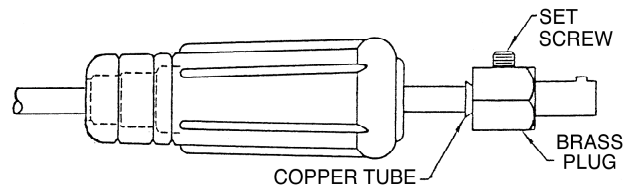
25/35mm² Cable: No trim
 50mm² Cable: Trim at "A"
 70mm² Cable: Trim at "B"
 95mm² Cable: Trim at "C"



3. Slide rubber boot on to cable end (soap or other lubricant may be required to help slide the boot over the cable).
4. Strip the outer sheath of the welding cable 25mm.



5. Slide the copper tube into the brass plug. (Use only the largest dia. tube for 95mm² cable. Use both tubes for all other cable sizes).
6. Insert cable into copper tube.



7. Tighten set screw to collapse copper tube. Screw must apply pressure against welding cable. The top of the set screw will be well below the surface of the brass plug after tightening.
8. Slide rubber boot over brass plug. The rubber boot must be positioned to completely cover all electrical surfaces after the plug is locked into the receptacle.



Connection of Lincoln Electric Wire Feeders

- Do not operate with covers removed.
- Disconnect power source before servicing.
- Do not touch electrically live parts.
- Only qualified persons should install, use or service this machine.

Note:- The (-)ve "High Inductance" output receptacle is for stick welding only, all other cases covered in this section use the "Low Inductance" receptacle.

OPERATING INSTRUCTIONS

Safety Instructions

Read and understand this entire section before operating your Vantage.



WARNING

Do not attempt to use this equipment until you have thoroughly read all operating and maintenance manuals supplied with your machine. They include important safety precautions, detailed engine starting, operating and maintenance instructions and parts lists.

ELECTRIC SHOCK can kill.



- Do not touch electrically live parts such as output terminals or internal wiring.
- Insulate yourself from the work and ground.
- Always wear dry insulating gloves.



ENGINE EXHAUST can kill.

- Use in open, well ventilated areas or vent exhaust outside.
- Do not stack anything near the engine.



MOVING PARTS can injure.

- Do not operate with doors open or guards off.
- Stop engine before servicing.
- Keep away from moving parts.

Only qualified personnel should operate this equipment.

VRD (Voltage Reduction Device)

Welding power sources generally have an Open Circuit Voltage (i.e. the voltage at the welding output terminals whilst not welding) in the ranges of 35-115VDC. Welding machines for stick welding (MMAW) and similar constant current (CC mode) processes, supply a higher open circuit voltage between the electrode and the work when the welding machine is switch on and ready to commence welding. These welding machines have a drooping characteristic, with the open circuit voltage higher (typically 60-80V) than when the arc is established and welding current is drawn (20-35V).

Consequently, the greatest danger occurs when handling the electrodes and the electrode holder between welding operations, such as when changing electrodes.

Welding machines for MIG (GMAW & FCAW) have a flat constant voltage (CV) characteristic, generally with a lower open circuit voltage (30-60V). Also, the current is turned on & off by a gun trigger, which also controls the wire feed. Therefore, the welder is not exposed to open circuit voltage, unless the trigger is turned on and the wire is feeding. Also, electrodes are not changed as frequently as for stick welding (MMAW).

For these reasons VRD/ROCV's are more commonly incorporated into the stick welding mode (CC) of welding machines being used in environments with high-risk of electric shock.

Safety

This reduction of the voltage supplies a safer level of voltage when an arc is not being struck or when an electrical resistance less than the welder's body resistance have been detected. All VRD's are only an aid to safety and personal protective equipment and safe working practices must be observed at all times. The risk of electric shock during welding from a correctly installed and maintained welding machine is negligible, provided that sensible precautions are taken by the user and correct safe working procedures are followed. All parts of the output circuit should be considered electrical alive, and consequently welders should ensure that no part of their body is placed in such a position as would complete a path through it for the passage of electric current. Safe working procedures should always be followed whether a VRD is fitted or not.

Additional Safety Precautions

Always operate the welder with the hinged door closed and the side panels in place as these provide maximum protection from moving parts and insure proper cooling air flow.

Engine Operation

Engine Control – Function and Operation

Key Switch

The key switch incorporates:

- 'Pre heat' position:- Turn the key anticlockwise and hold for 15 seconds (30 seconds if temperature is below 0°C).



WARNING

Under no circumstances should ether or other starting fluids be used in this engine.

- OFF position:- the vertical position where the key can be inserted & removed, shown "OFF". When in this position the fuel flow to the injector pump is stopped to shut the engine down.
- "RUN" position:- turn the key clockwise to position shown "RUN". When in this position the fuel solenoid & other electrical accessories are energised.
- 'Start' position:- turn key clockwise past the on position. When in this position the starter motor is energised. Hold in this position until the engine starts and then release the key. Do not engage this position while the engine is running as this can cause damage to the ring gear and/or starter motor.

(Also see 'Starting and Stopping the Engine' section in this manual).

Battery charge light



The yellow battery charger light is off when battery charging system is functioning normally. If the light turns on while the engine is running, the fan belt may be broken or the alternator/regulator may be defective.

Engine Hour Meter

Allows machine maintenance procedures to be adhered to by recording engine operating hours.





Fuel Gauge

Provides indication of the amount of fuel in the fuel tank.

Engine Protection and Engine Idler

Engine Protection

System

- +  Oil pressure light
- +  Water temperature light
- +  Welding Output failure
- +  Electrical temperature light.

(Also see 'Welder Control' section of this manual.)

If any of the above red lights are illuminated a fault has been detected in that area of engine/alternator operation and the engine shuts down automatically.

The first light to come on remains illuminated until the key switch is turned to the "off" position*. This enables the operator to determine what initiated the engine shut down.

* The electrical temperature light remains illuminated until the thermostat resets.

The engine protection system is over-ridden for the first 10 seconds (approx) after the engine is started, to enable the oil pressure to build up. Therefore if a fault is still present the engine will stop again after approx 10 seconds.

The key switch turned to the start position 'resets' the oil pressure fault light. If the engine stops again after the timer period check the oil in the engine.

**WARNING**

**HOT COOLANT CAN BURN SKIN**
Do not remove cap if radiator is hot.

• Have qualified personnel do maintenance and troubleshooting work

• If possible, turn the engine off and disconnect the battery before working inside the machine

• Remove guards only when necessary to perform maintenance, and replace them when the maintenance requiring their removal is complete

• Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts

• If fan guards are missing from a machine, obtain replacements from a Lincoln Distributor. (See Operating Manual Parts List.)


• Read the Safety Precautions in front of this manual and the engine instruction manual before working on this machine


Engine Idler System

Upon starting the engine the "idler" holds the engine speed at low idle for (approx) 10 seconds. Then, depending on the idler switch position low idle is held or high idle speed is engaged.

"Idler" Switch

The idler switch has two positions, "High" and "Auto".

When in "High" () idle position, the unit operates continuously at high idle.

When in "Auto" () idle position, the idler operates as follows:

- a) Auxiliary Power:- At low idle speed the Auxiliary output voltages are approximately half of their rated values. Drawing a current of 0.5amp or greater will cause the engine to accelerate to high idle. (Note if using Aux Power with the output contactor switch in the "I" (output on) position, the welder terminals will be "hot" in constant voltage mode only. In constant current the ROCV device maintains less than 8v across the output studs. They will also be "hot" if the output contactor switch is in the remote switching "L" position and

the the wire feeder gun trigger is pressed).

High idle speed is maintained until approx 12 seconds after the Auxiliary load is removed (providing no welding load is applied).

Note:- If two phase Aux power is used the idler may not sense automatically. If this happens, change to another combination of two phases.


- b) Welding:- At low idle speed the welding OCV is approx 8V DC. Drawing a current of 20 amps or more will cause the engine to accelerate to high idle. This is accomplished by striking the electrode to the work.

High idle speed is maintained until approx 12 seconds after the welding load is removed (providing no auxiliary load is applied).

Also see section "Connection of Lincoln Electric Wire Feeders" in this manual to determine idler switch settings.

Starting & Stopping the Engine

Starting

- 1) Check for proper oil level on dip stick & check for proper coolant level in radiator reservoir bottle. Check fuel gauge to ascertain fuel level in fuel tank (never allow Ranger 405D to run out of fuel). Be sure engine compartment door is closed.
- 2) Be sure all auxiliary loads are turned off.
- 3) Set "Idler" switch to  position.
- 4) Turn the key to the "preheat" position. Observe that the battery charging light is on.

Preheat for 15 seconds, (30 seconds if below 0°C). Maximum allowable preheat time is 30 seconds.

- 5) Turn the key to the "start" position then release when the engine starts, the key will automatically return to the "RUN" position
- 6) If the engine doesn't start after 30 seconds of cranking, release key switch, wait 2 minutes then repeat steps (4) & (5). Don't crank longer than 30 seconds & allow at least 2 minutes between crankings to allow the starter motor to cool. Excessive cranking may overheat and damage the Ranger 405D electrical system. If the engine fails to start on second attempt, check fuel supply to make sure the fuel system has been properly primed. Consult trouble shooting guide if engine still will not start.
- 7) After 10 seconds running, check that battery charge light is off. If not, stop engine to check for the fault.
- 8) Allow the engine to warm up at low idle for several minutes before applying a load and/or switching to high idle. Allow a longer warm up time in cold weather.
- 9) Never disconnect the battery after starting as the controlling PCBs may not function correctly (or at all).

Note: If at any time during starting the engine the "Welding Output Failure" light illuminates, immediately return the key switch to the "OFF" position before continuing to crank the engine.

Stopping

Return engine to the idle position for several minutes before stopping.

Turn the key switch to the "off" position. This turns off the voltage to the stop solenoid mounted in the engine injector pump.

Running-in

All diesel engines require some additional care for about the first 50 hours of operation. While maximum load can be applied to a new engine as soon as it is put into service and the coolant temperature has reached at least 60°C, care should be taken that the engine is not run at very light loads (say less than 2.4kVA, or a 10 amp radiator) for extended periods, as this can lead to glazing of the cylinder bores. Do not operate at high speeds without a load, and do not overload the engine. Cylinder glazing can lead to excessive oil consumption and smoky exhaust, while overloading during the first few hours can lead to excessive wear and shorten the life of the engine.

Welder Operation



ELECTRIC SHOCK can kill

- Do not touch electricity live parts or electrode with skin or wet clothing.
- Insulate yourself from work and ground.
- Always wear dry insulating gloves.



FUMES AND GASES can be dangerous

- Keep your head out of fumes.
- Use ventilation or exhaust fan to remove fumes from breathing zone.



WELDING SPARKS can cause fire or explosion

- Keep flammable material away.
- Do not weld upon containers which have held combustibles.



ARC RAYS can burn

- Wear eye, ear and body protection.



WARNING

Health aspects of the use of thoriated tungsten electrodes

Thorium oxides are found in thoriated tungsten electrodes up to 4.2%. Thorium is radioactive and may present hazards by external and internal exposure. If alternatives are technically feasible, they should be used, however several studies carried out on thoriated electrodes have shown that due to the type of radiation generated, external radiation risks - during storage, welding and disposal of residues - are negligible under normal conditions of use.

On the contrary, during grinding of electrode tips there is generation of radioactive dust, with the risk of internal exposure. It is therefore necessary to use local exhaust ventilation to control the dust at its source, complimented if necessary by respiratory protective equipment. The risk of internal exposure during welding is considered negligible since the electrode is consumed at a very slow rate.

Precautions must also be taken to control any risk of exposure during the disposal of dust from any grinding devices.

Wire Feed (Constant Voltage) Welding

Connect a wire feeder to the Ranger 405D and set welder controls according to the instructions under the heading "Connection of Lincoln Electric Wire Feeders".

The Ranger 405D permits use of a broad range of Innershield, Outershield & solid wire electrodes within the rating of the machine.

Stick/TIG (Constant Current) Welding

Connect welding cables to the positive and negative output studs as appropriate to process being performed. The high inductance negative output receptacle "M" is for stick/TIG welding. The rating of this receptacle is 335amps @ 50% duty cycle. Thermal protection is provided for this output. Start the engine, set the idler switch to the desired operating mode, and set the C.V./C.C. switch to C.C. Set the "Output Control" dial to the desired welding current and the machine is ready for welding. Adjustment of the welding current can be made with the "Output Control" dial or a "Remote Output Control" using K857 and K864 remote control kit.

While in Constant Current Mode the Open Circuit Voltage (OCV) is held to a value less than 8 volts for added operator safety. Refer to "Welder Controls – Function & Operation ROCV" for further details

Stick Welding

The Ranger 405D can be used with any DC stick electrode within the rating of the unit.

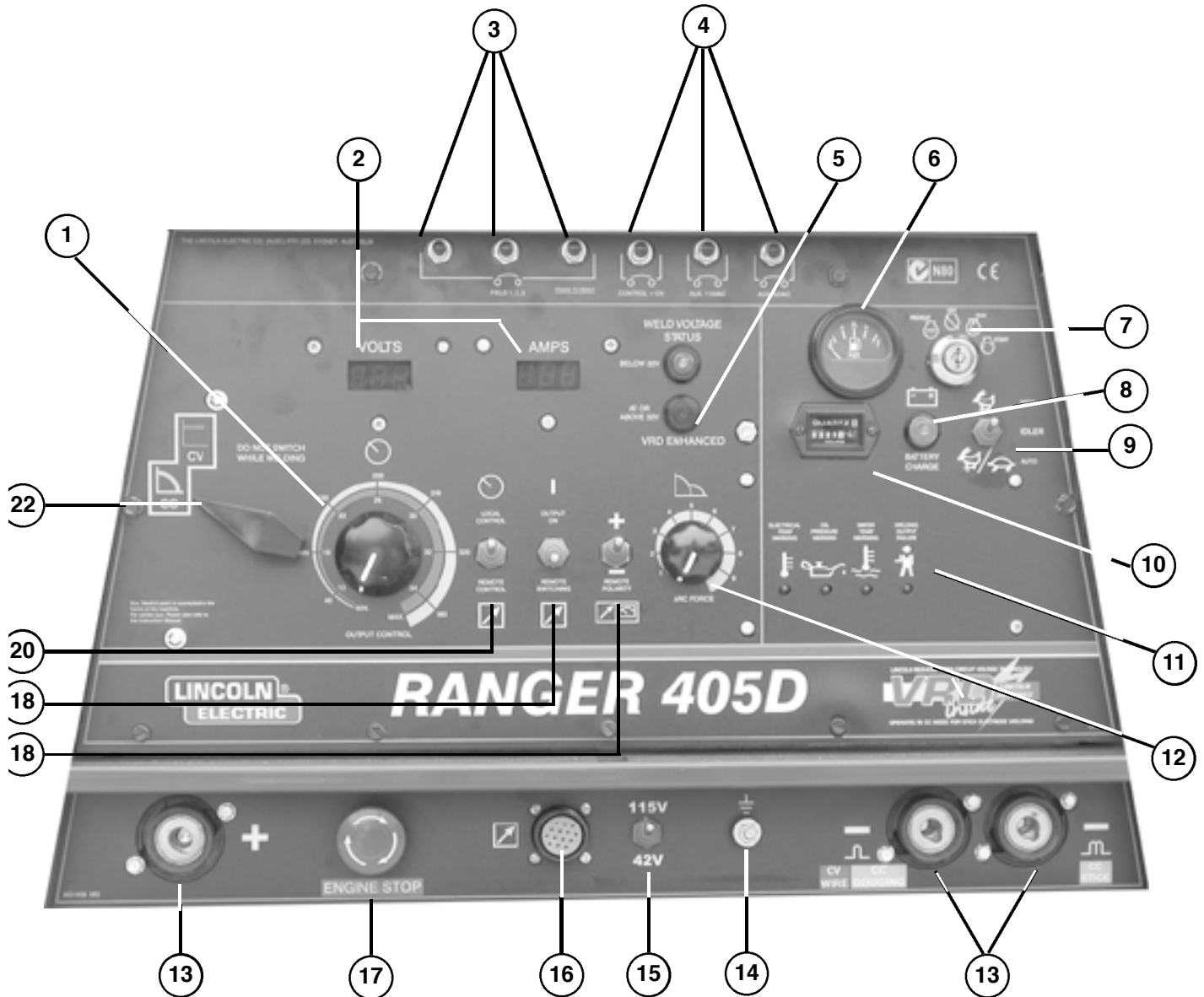
TIG Welding

The Ranger 405D can be used for a variety of DC tungsten inert gas (TIG) welding applications. Arc initiation may be by "scratch" starting, or by use the K930 Hi-Freq unit. Scratch starting is not recommended for critical work, because of the risk of tungsten inclusions in the weld, and there is also a risk of damage to the tungsten electrode. For more information on TIG, (or GTAW welding, as it is sometimes called) refer to JFLF 834, a Guidebook on Gas Tungsten Arc Welding, available from The Lincoln Electric Company.

The Hi-Freq unit must be installed per instructions in Installation Instructions Section of this manual, and the Ranger 405D should be set for High Idle for proper operation.

Controls and Settings

All welder and engine controls are located on the case front panel. Refer to diagram and the explanations that follow.



1. Output Control Dial



Increase/Decrease of output “ ” (Voltage or Current)
The output control on the control panel is a continuous control of the machine output. The control may be rotated from minimum to maximum while under load to adjust the machine output.

2. Volt-Amp Meter Module and Switch

Output stud voltage is displayed on the Volt Meter Module. Output current Amps is displayed on the Amp Meter Module (where fitted).

3 & 4. Circuit Breaker



Five circuit breakers are mounted on the top of the control panel. If they are activated, press them to reset. Refer trouble shooting guide if tripping occurs. Their functions are (left to right looking at the control panel).

- 1, 2 & 3) Field winding protection
- 4) Control +12V
- 5) Auxiliary 115/42V

5. VRD Operation Indicator

On the front panel of the Ranger 405D are two indicator lights. A red light when lit indicates voltage >32V and a green light when lit indicates voltage <32V.

These lights monitor the OCV at all times. In the CC mode when the welding arc has stopped the green light will illuminate indicating that the VRD has reduced the OCV to less than 32V. During welding the red and green light may flicker on and off. This is normal operation as the welding voltage depending on the process and type of the electrodes being used may produce less than 32V.

Should the red light remain illuminated after stopping welding in the CC mode. Please refer to your local field service shop for service.

6. Fuel Level Gauge



Displays the level of diesel fuel in the fuel tank. The operator must watch the fuel level closely to prevent running out of fuel and possibly having to bleed the system.

7. Switch: PREHEAT STOP RUN START



Toggle to preheat position to energize the glow plugs, then toggle through to the start position and hold to crank the engine; release as the engine starts. To stop the engine, toggle to the stop position.

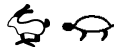
Note: When starting the engine the engine stop button must be released. If the engine stop button is used to stop the engine, the key switch must also be toggled to the stop position otherwise the battery may be drained.

8. Battery Charging Light



The yellow engine alternator light is off when battery charging system is functioning normally. If light turns on the alternator or the voltage regulator may not be operating correctly. The light will remain on when the engine is stopped and the run/stop switch is in the run position.

9. Idler Switch



Has two positions as follows:

- A) In the "High" position, the engine runs at the high idle speed controlled by the governor.
- B) In the "Auto" position, the idler operates as follows:
 - a. When switched from "High" to "Auto" or after starting the engine, the engine will operate at full speed for approximately 12 seconds and then go to low idle speed.
 - b. When the electrode touches the work or power is drawn for lights or tools (approximately 100 Watts minimum) the engine accelerates and operates at full speed.
 - c. When welding ceases and the AC power load is turned off, a fixed time delay of approximately 12 seconds starts.
 - d. If the welding or AC power load is not restarted before the end of the time delay, the idler reduces the engine speed to low idle speed.
 - e. The engine will automatically return to high idle speed when the welding load or A.C. power load is reapplied.

Idler Operational Exceptions

When the WELDING TERMINALS switch is in the "Remotely Controlled" position the idler will operate as follows:

- When the triggering device (Amptrol, Arc Start Switch, etc.) is pressed the engine will accelerate and operate at full speed provided a welding load is applied within approximately 12 seconds.
- If the triggering device remains pressed but no welding load is applied within approximately 12 seconds the engine will return to low idle speed.
- If the triggering device is released or welding ceases the engine will return to low idle speed after approximately 12 seconds.

10. Hour Meter

The hour meter displays the total time that the engine has been running. This meter is a useful indicator for scheduling preventive maintenance.

11. Engine Protection

The engine protection lights remain off with proper oil pressure and under normal operating temperatures. If a light turns on the engine protection system will stop the engine. The illuminated light will indicate the reason for the engine shutdown. Low oil pressure, high coolant temperature, high electrical temperature or electrical fault.

Welder Thermal Protection Light

The thermal protection light will be lit if either of the two electrical protection thermostats have opened. This circuit is combined with the engine protection circuit so that if over temperature is sensed the engine is shut down. The engine will restart & run for only approx 10 seconds if the high temp light is still illuminated.

Welding Output Failure

Incorrect voltages and / or welding output malfunction will cause the Welding Output Failure light to be illuminated. The engine will not restart and run if the "Welding Output Failure" light is still illuminated.

Oil Pressure Light

This circuit is combined with the engine protection circuit so that if low oil pressure is sensed the engine will shut down. The engine will restart and run for approx 10 seconds if the low oil light is illuminated.

12. Arc Force Control (effective only in C.C. mode)

Increase/Decrease short circuit current 

The arc force dial should be set at approx mid-range for most welding. Adjustments up or down can then be made depending on the electrode, procedures and operator preference. Higher settings will provide more short circuit current giving a more forceful arc. Excessive spatter may result if the control setting is too high. For most TIG welding applications adjust this control to minimum for best operating characteristics.

13. Weld Output Terminals + and -

These Twistmate plugs and sockets provide welding connection points for the electrode and work cables. For positive polarity welding the electrode cable connects to the "+" terminal and the work cable connects to this "-" terminal. For negative polarity welding the work cable connects to the "+" terminal and the electrode cable connects to this "-" terminal.


14. Earth Connection

An earthing stud is provided on the control panel. Refer to Installation Instructions Section this manual. "Machine Earthing" and local regulations eg. Australian Standard AS3000.

15. 42V / 115V Wire Feeder Voltage Switch

Toggles output of 14-pin connector to voltage requirement of Wire Feeder.

16. Remote Control Receptacle


Amphenol Receptacle 

The Ranger 405D has one 14pin amphenol located on the control panel. The receptacle is for connecting wire feeders, it allows the welder output to be controlled at the wire feeder, when the wire feeder includes this feature, and includes 115V AC 5amp & 42V AC 10amp auxiliary supplies. These supplies are protected by a circuit breaker mounted on the control panel.

17. Engine Stop Button



When depressed stops and disables restarting of the engine by removing the power supply to the engine injection pump solenoid.

18. Remote Polarity Switch

Remote Voltmeter 
Positive Electrode +
Negative Electrode -


The remote voltmeter polarity switch allows the electrode polarity to be set for the remote (No. 21) work sensing lead of automatic or semi-automatic equipment. Set '+' for electrode positive and '-' for electrode negative.


19. Output Terminal Switch (output contactor) (effective only in CV mode)

Output (Voltage) "  "
ON " | "
Remote Switching "  "

The output terminals toggle switch controls the solid state output contactor. Switched to the "I" position the contactor is closed and the output studs are "hot" all the time. Switched to the "⏏" position the output studs only become "hot" when wires No. 2 & 4 are shorted together using the wire feeder gun trigger.


20. Output Control "Local-Remote" Switch


Remote Output Voltage or Current Control "  "

Local Output Voltage or Current Control "  "

The Local/Remote switch, mounted beside the output control dial, gives the operator the option of controlling the output at the machine control panel or at a remote station. For control at the machine, switch to "⏏" position. For remote control, switch to "⏏" position, in this position control is at the wire feeder (if so constructed) or at a K857 control connected to the amphenol on the control panel. (See 'Optional Field Installed Accessories').

21. Weld Mode Selector Switch

Constant Voltage position is shown as "  ", 'CV'.

Constant Current position is shown as "  ", 'CC'.

Caution:- Never change the CV/CC switch setting while welding. This will cause severe damage to the switch and other electrical components.



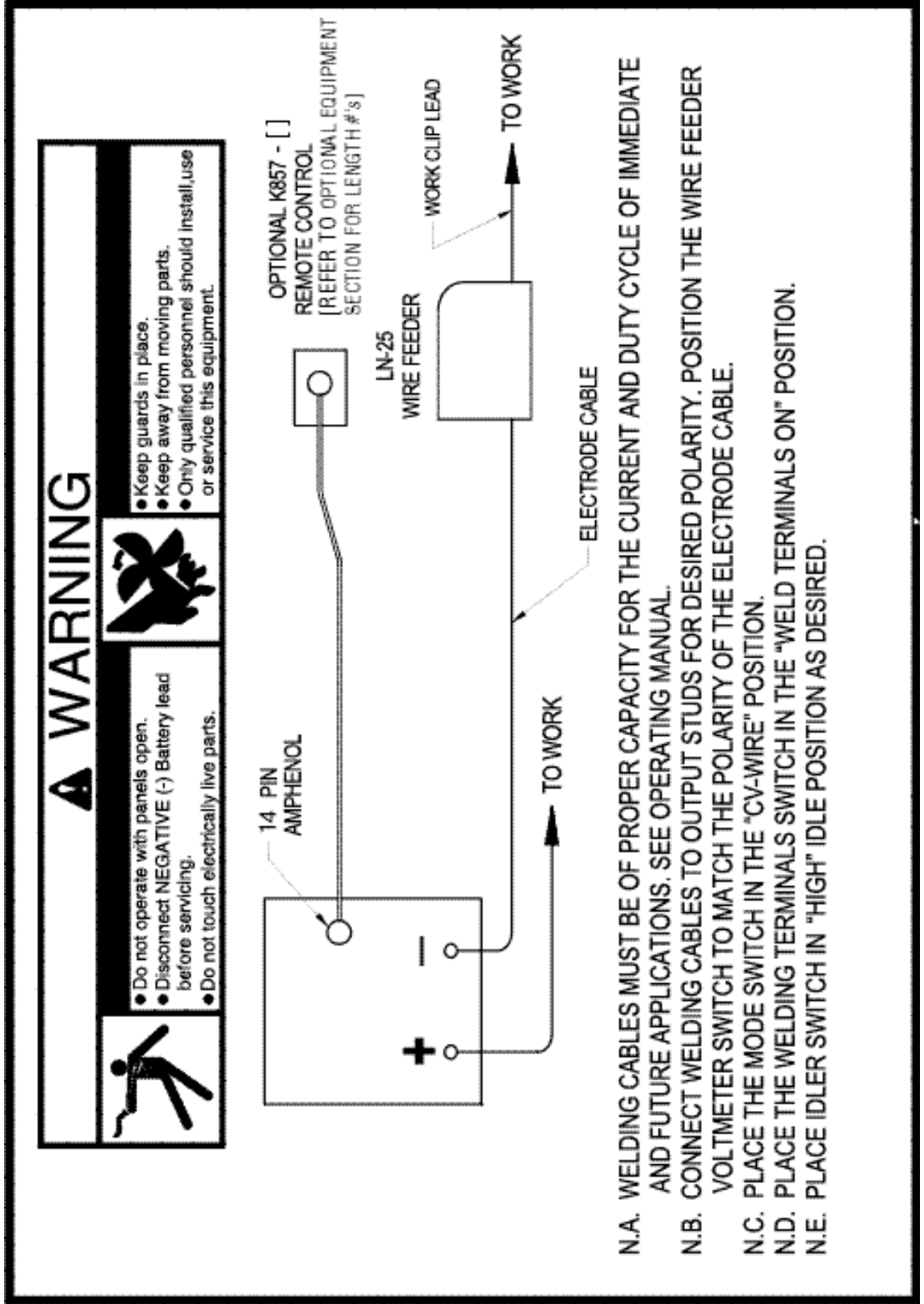
WARNING

There is no VRD protection in the CV mode.

With the toggle switch in the "WELD TERMINAL ON" position the voltage at the output terminal maybe up to 60V.

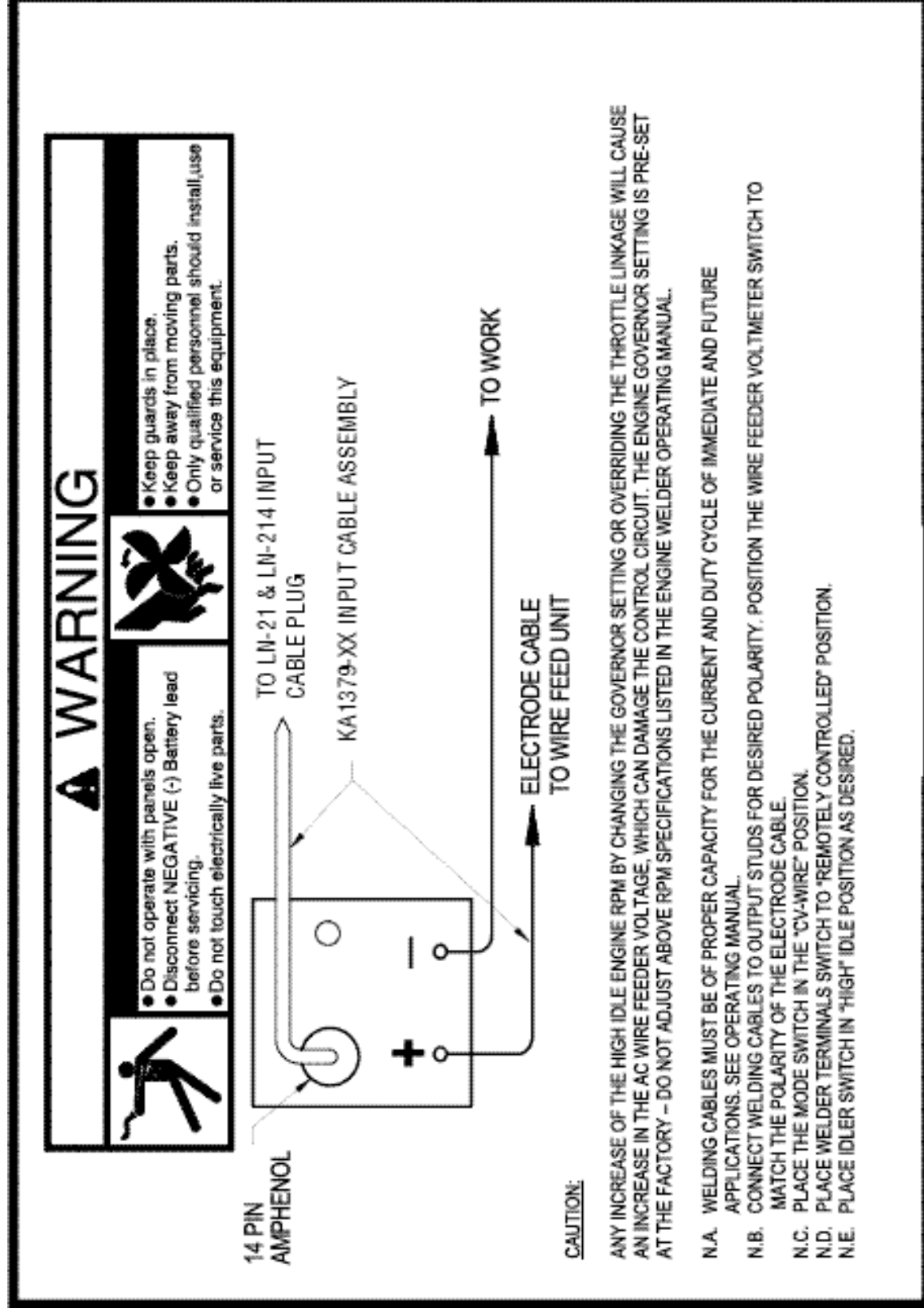
ENGINE WELDERS / LN-25 ACROSS THE ARC CONNECTION DIAGRAM

INSTALLATION INSTRUCTIONS



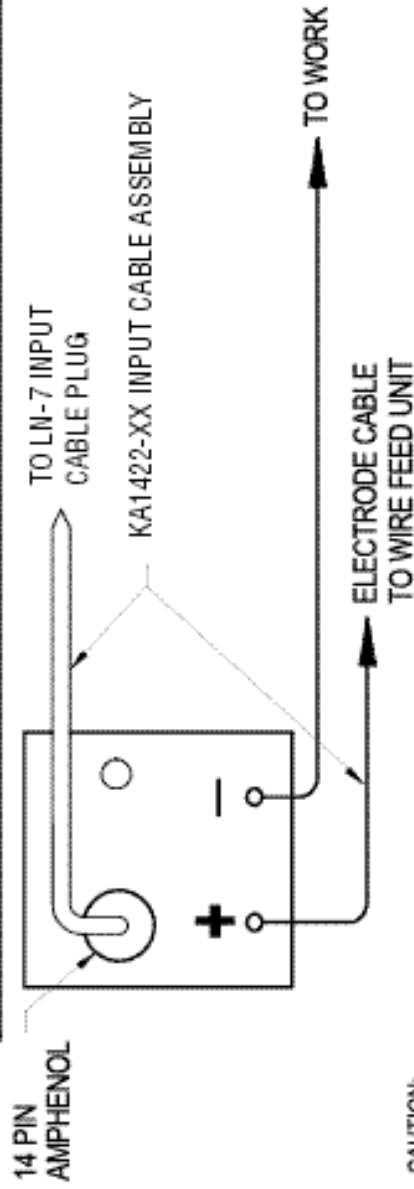
- N.A. WELDING CABLES MUST BE OF PROPER CAPACITY FOR THE CURRENT AND DUTY CYCLE OF IMMEDIATE AND FUTURE APPLICATIONS. SEE OPERATING MANUAL.
- N.B. CONNECT WELDING CABLES TO OUTPUT STUDS FOR DESIRED POLARITY. POSITION THE WIRE FEEDER VOLT/METER SWITCH TO MATCH THE POLARITY OF THE ELECTRODE CABLE.
- N.C. PLACE THE MODE SWITCH IN THE "CV-WIRE" POSITION.
- N.D. PLACE THE WELDING TERMINALS SWITCH IN THE "WELD TERMINALS ON" POSITION.
- N.E. PLACE IDLER SWITCH IN "HIGH" IDLE POSITION AS DESIRED.

RANGER 405D / LN-21 & LN-214 CONNECTION DIAGRAM



RANGER 405D / LN-7 CONNECTION DIAGRAM

| | | |
|---|----------------|--|
|  | WARNING |  |
| <ul style="list-style-type: none">• Do not operate with panels open.• Disconnect NEGATIVE (-) Battery lead before servicing.• Do not touch electrically live parts. | | <ul style="list-style-type: none">• Keep guards in place.• Keep away from moving parts.• Only qualified personnel should install, use or service this equipment. |



CAUTION:

ANY INCREASE OF THE HIGH IDLE ENGINE RPM BY CHANGING THE GOVERNOR SETTING OR OVERRIDING THE THROTTLE LINKAGE WILL CAUSE AN INCREASE IN THE AC WIRE FEEDER VOLTAGE, WHICH CAN DAMAGE THE CONTROL CIRCUIT. THE ENGINE GOVERNOR SETTING IS PRE-SET AT THE FACTORY -- DO NOT ADJUST ABOVE RPM SPECIFICATIONS LISTED IN THE ENGINE WELDER OPERATING MANUAL.

N.A. WELDING CABLES MUST BE OF PROPER CAPACITY FOR THE CURRENT AND DUTY CYCLE OF IMMEDIATE AND FUTURE APPLICATIONS. SEE OPERATING MANUAL.

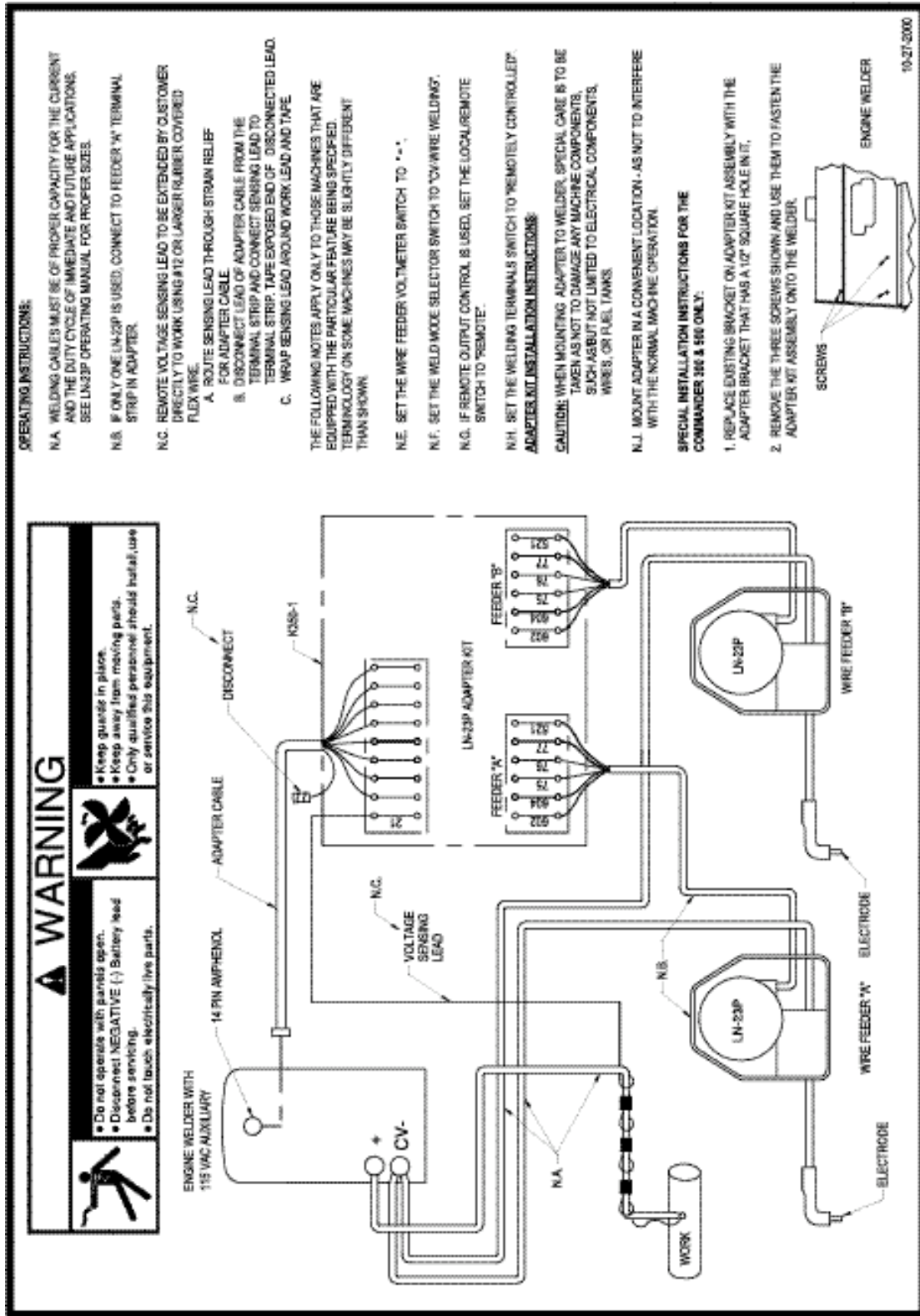
N.B. CONNECT WELDING CABLES TO OUTPUT STUDS FOR DESIRED POLARITY. POSITION THE WIRE FEEDER VOLTMETER SWITCH TO MATCH THE POLARITY OF THE ELECTRODE CABLE.

N.C. PLACE THE MODE SWITCH IN THE 'CV-WIRE' POSITION.

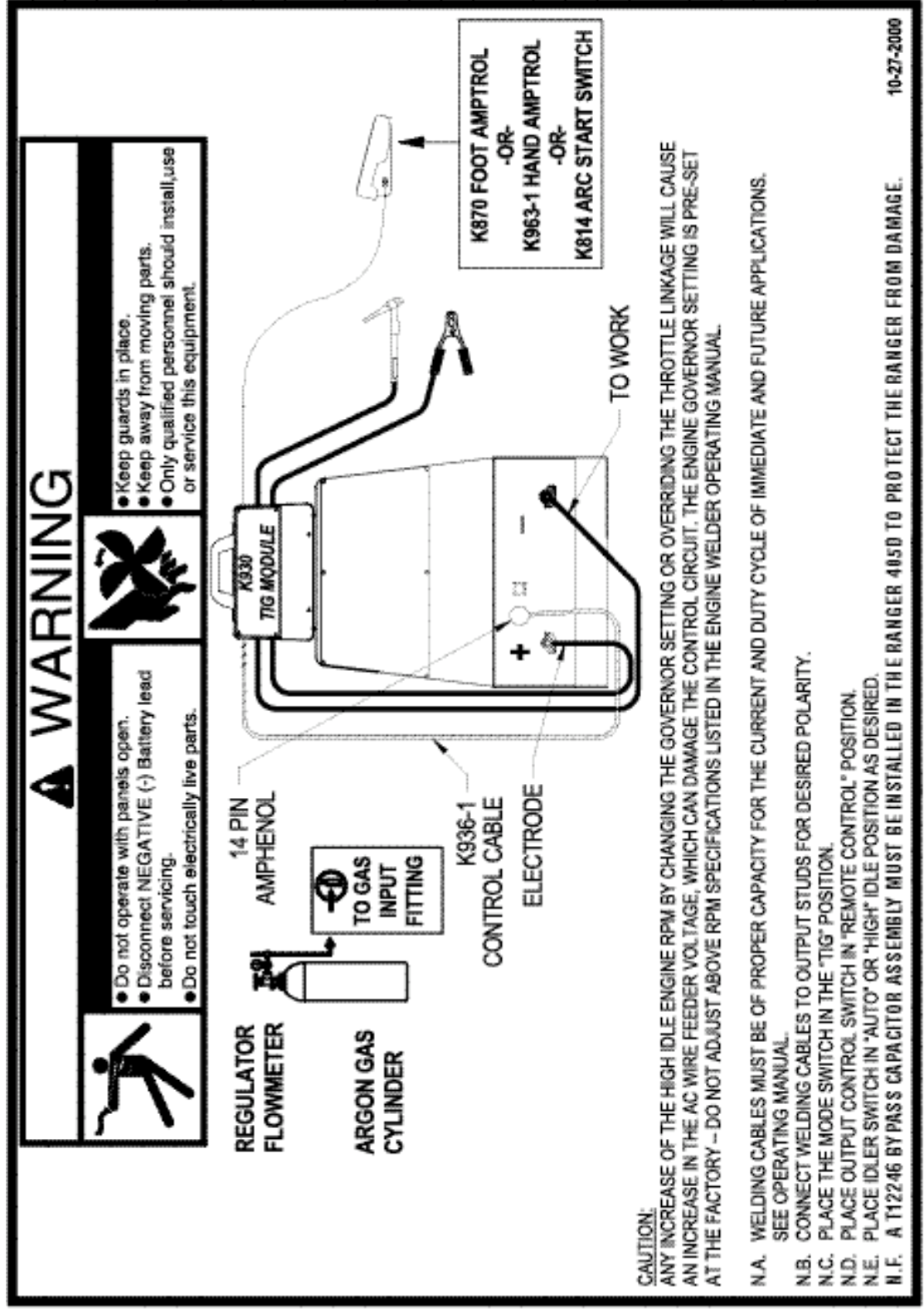
N.D. PLACE WELDER TERMINALS SWITCH TO 'REMOTELY CONTROLLED' POSITION.

N.E. PLACE IDLER SWITCH IN 'HIGH' IDLE POSITION AS DESIRED.

CONNECTION DIAGRAM: ENGINE WELDER COMPATIBLE



RANGER 405D / K930 TIG MODULE / CONNECTION DIAGRAM



Electrical Design

The General Purpose Outlets (GPO's) fitted to the Ranger 405D's internal wiring systems are designed in accordance with the requirements of AS/NZS3000. The Ranger 405D is design with the MEN System of earth protection strategy which should generally be maintained throughout the electrical installation. The Ranger 405D has the MEN LINK connection point within the generators design this includes a RCD (25A-30mA) device protecting each GPO and an Earth stud mounted on the front panel. Therefore, the Ranger 405D can be safely used when using multiple appliances and fixed equipment connected to the generator supply.

Machine Grounding

Because this portable engine driven welder creates its own power, it is not necessary to connect its frame to an earth ground, unless the machine is connected to premises wiring (home, shop, etc.)



To prevent dangerous electric shock, other equipment to which the Ranger 405D welder supplies power must:

- **Be grounded to the frame of the welder using a grounded type plug.**
- **Be double insulated.**
- **Do not ground the Ranger 405D to a pipe that carries explosive or combustible material.**

When the Ranger 405D is mounted on a truck or trailer, its frame must be electrically bonded to the metal frame of the vehicle. Use a 10mm (#8) or larger copper wire connected between the machine grounding stud and the frame of the vehicle. When the Ranger 405D is connected to premises wiring such as that in a home or shop, its frame must be connected to the system earth ground. See further connection instructions in the section entitled "Standby Power Connections". In general, if the machine is to be grounded, it should be connected with a 10mm (#8) or larger copper wire to a solid earth ground such as a metal water pipe going into the ground for at least 3 meters (10 feet) and having no insulated joints, or to the metal framework of a building which has been effectively grounded. A machine grounding stud marked with the symbol is provided on the front of the welder. In areas where an earth stake cannot be used due to the ground conditions, and there are other structures available such as conveyor gantries or building frames, then an earth will need be placed from the welding machine or generator to the structure frame.

Standby Power Connections

The Ranger 405D is suitable for temporary, standby or emergency power using the engine manufacturer's recommended maintenance schedule. The machine can be permanently installed as a standby power unit for 415/400 20amp three phase and/or 240/230VAC 16amp single phase 50Hz, service.

Connections must be made by a licensed electrician who can determine how the power can be adapted to the particular installation and comply with all applicable electrical codes.

AS3010 applies where the electrical installation is a building.

Take necessary steps to assure load is limited to the capacity of the Ranger 405D.

Important Note: The Ranger 405D supply and the Authorities supply cannot be connected in parallel. Adequately rated and properly connected isolation switches must be used to keep both supplies separated.



- **Only a licensed, certified, trained electrician should install the machine to a premises or residential electrical system. Be certain that:**
- **The installation complies with the National Electrical Code and all other applicable electrical codes.**
- **The premises is isolated and no feedback into the utility system can occur. Certain laws require the premises to be isolated before the generator is linked to the premises. Check your local requirements.**

Connection of Appliances

For your safety all auxiliary equipment, extension cords, appliance cords, plugs, plug sockets & appliances should be in good condition & correctly wired and connected. All earth wires, where used, must be continuous. [Extension cords with three wires should be used except for double insulated appliances. (Single phase applications only)].

.



Do not touch electrically live parts

- Stop engine before servicing

Auxiliary Power Operation

Start the engine and set the idler switch to the desired operating mode. The machine is now ready to supply Auxiliary Power.

(Note: - If two phase is required the automatic idler sensing circuit may not operate. Change to another combination of two phases to regain automatic idling).

The auxiliary power supply in the Ranger 405D consists of a 415/400V 3 phase supply, tapped to give a 115V 3 phase supply and 3 x 240/230V single phase supplies. Depending on the model purchased the auxiliary outlets are:

KA1453-7 & -20, 1 x 415V 3Ø & 3 x 240V 1Ø outlets

KA1453-5, 1 x 400V 3Ø & 2 x 230V 1Ø outlets

KA1453-6, 1 x 400V 3Ø, 1 x 230V & 1 x 115V 1Ø outlets

The maximum phase current is 20 Amps. Each receptacle is circuit breaker protected and the overall system has a Residual Current Device (RCD) for earth protection

The ratings listed in the Technical Specifications are with no welding load. Simultaneous welding and power loads are permitted per the following table.

| Welding Current | Aux Current per phase |
|-----------------|-----------------------|
| 0 - 50 amps | 20 amps |
| 50 - 150 amps | 15 amps |
| 150 - 250 amps | 10 amps |
| 250 - 350 | 5 amps |
| 350 - Max | none |

* Each of the 3 phases can have the load indicated i.e. at 0-50 amps weld (20 x 3) amps Auxiliary can be drawn.

Note: The single phase receptacles are on separate phases and cannot be paralleled under any circumstances.



Caution: Certain electrical devices need some extra care so they can be powered by the Ranger 405D. Refer to Table for these devices.

| Type | Common Electrical Devices | Possible Concerns |
|------------------------|--|---|
| Resistive | Heaters, toasters, incandescent light bulbs, electric range, hot pan, skillet, coffee maker. | NONE |
| Capacitive | Radios, microwaves, appliances with electronic control. | Voltage spikes or high voltage regulation can cause the capacitive elements to fail. Surge protection, transient protection, and additional loading is recommended for 100% fail-safe operation. |
| Inductive | Single-phase induction motors, drills, well pumps, grinders, small refrigerators, weed and hedge trimmers. | These devices require large current inrush for starting. Some synchronous motors may be frequency sensitive to attain maximum output torque, but they SHOULD BE SAFE from any frequency induced failures. |
| Capacitive / Inductive | Computers, television sets, other electronic equipment. | An inductive type line conditioner along with transient and surge protection is recommended. |

The Lincoln Electric Company is not responsible for any damage to electrical components improperly connected to the Ranger 405D.

MAINTENANCE



**MOVING PARTS
can injure**

- Have qualified personnel do maintenance and troubleshooting work.
- If possible, turn the engine off and disconnect the battery before working inside the machine.
- Remove guards only when necessary to perform maintenance, and replace them when the maintenance requiring their removal is complete.
- If fan guards are missing from a machine, obtain replacements from a Lincoln Distributor. (See Operating Manual Parts List.)

Read the Safety Precautions in front of this manual and the engine instruction manual before working on this machine.

Keep all equipment safety guards, covers and devices in position and in good repair. Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing the equipment.

Routine Maintenance

- 1) At the end of each day's welding, check the crankcase oil level and refill the fuel tank to minimise moisture condensation in the tank.

If the engine runs out of fuel, air will be entrapped in the fuel distribution system. If this happens, bleeding of the fuel system is necessary. See the engine Operator's manual for bleeding instructions.

- 2) Blow out the welder with low pressure air periodically. In particularly dirty locations, this may be required once a week.
- 3) Refer to the "Periodic Checks" section of the engine operator's manual for the recommended maintenance schedule of the following:

- Engine Oil and Filter
- Air Cleaner
- Fuel Filter and Delivery System
- Fan Belt
- Battery
- Cooling System

Engine Maintenance Items

| Filter Type | Part Number | |
|------------------|---------------|------------|
| | Kubota | Perkins |
| Air Cleaner | K815741-11081 | P26510362 |
| Oil Filter | K15241-3209 | P2651117 |
| re-Fuel Filter | K12581-43012 | P140517050 |
| Main-Fuel Filter | K15221-43172 | P080109049 |

Engine Maintenance Intervals

| FREQUENCY & MAINTENANCE REQUIRED | |
|--|---|
| Daily Or Before Starting Engine | |
| <ul style="list-style-type: none"> • Fill fuel tank. • Check oil level. • Check coolant level. • Check air cleaner element and housing for dirty, loose or damaged parts. • Check air intake hose for cracks or loose connections. • Check air intake; exhaust areas and radiator for dirt. Clean as necessary. • Check alternator belt for tension and wear. | |
| Service Intervals | |
| Observe the following for service and maintenance. The lubricating oil change intervals listed in the table below are for oils of API classification with a low sulfur fuel in use. If the CF-4 or CG-4 lubricating oils are used with a high-sulfur fuel, change the lubricating oil at shorter intervals than recommended in the table below depending on the operating condition. | |
| Every 200 hours | |
| <ul style="list-style-type: none"> • Change of engine oil • Change oil filter cartridge • Check the fan belt tightness • Check the radiator and hose clamps • Inspect/Clean air cleaner element • Check the radiator and hose clamps • Check of fuel lines and clamps • Check battery electrolyte level | <ul style="list-style-type: none"> • ◊ • • • ◊ 1, 2 • ◊ • • |
| Every 400 hours | |
| <ul style="list-style-type: none"> • Replacement of fuel filter element • Cleaning of Air Filter element • Check the intake air lines | <ul style="list-style-type: none"> ◊ ◊ *1 ◊ *2 |
| Every 600 hours | |
| <ul style="list-style-type: none"> • Replacement of fan belt • Cleaning / flushing of radiator • Remove sediment in fuel Tank | |
| Every 1 or 2 months | |
| <ul style="list-style-type: none"> • Recharging of battery | |
| Every 800 hours | |
| <ul style="list-style-type: none"> • Check valve clearance | *3 |
| Every Year | |
| <ul style="list-style-type: none"> • Replacement of air filter element • Check of damaged wiring and loose connections | ◊ |
| Every 1600 hours | |
| <ul style="list-style-type: none"> • Check the fuel injection nozzle injection pressure | ◊ *3 |
| Every 3000 hours | |
| <ul style="list-style-type: none"> • Check of injection pump • Check of fuel injector timer | <ul style="list-style-type: none"> *3 ◊ *3 |
| Every 2 Years | |
| <ul style="list-style-type: none"> • Replacement of battery • Replacement of radiator hoses and clamp band • Replacement of fuel pipes and clamps • Change the radiator coolant (L. L. C.) • Replacement of intake air line | <ul style="list-style-type: none"> *1 ◊ *3 ◊ *4 |

IMPORTANT

- These jobs should be done after the first 50 hours of operation.
- *1 Air cleaner should be inspected/cleaned more often in dusty environments
- *2 Follow Service Instructions and Installation Tips in manual
- *3 Consult your local KUBOTA/PERKINS Dealer for this service.
- *4 Replace only if necessary.
- *5 Every Year or every 6 times of cleaning
- ◊ Emission related critical part. Owner is responsible for proper maintenance
Please see Engine Owners Manual for Warranty Statement in detail.



CAUTION

During run-in period, subject the Ranger 405D to moderate loads. Avoid long periods running at idle. Before stopping the engine, remove all loads and allow the engine to cool several minutes.

Run-In Period

Any engine will use a small amount of oil during its "run-in" period. For the diesel engine on the Ranger 405D, run-in is about 50 running hours.

Check the oil every four hours during run-in.

Change the oil after the first 50 hours of operation, every 200 hours thereafter. Change the oil filter at the second oil change.

Engine Oil Change

Drain the engine oil while the engine is warm to assure rapid and complete draining. It is recommended that each time the oil is changed the oil filter be changed as well.

- Be sure the unit is off. Disconnect the negative battery cable to ensure safety.
- Locate oil drain hose in bottom of base.
- Remove the plug from the drain socket and drain the oil into a suitable container for disposal.
- Replace the drain plug.
- Refill the crankcase to the upper limit mark on the dipstick with the recommended oil (see engine operation manual OR below). Replace and tighten the oil filler cap securely.
- Reconnect negative battery cable and close doors before restarting unit. Wash your hands with soap and water after handling used motor oil. Please dispose of used motor oil in a manner that is compatible with the environment.

We suggest you take it in a sealed container to your local service station or recycling centre for reclamation.

DO NOT throw it in the trash; pour it on the ground or down a drain.

Engine Oil Refill Capacity

With oil filter replacement:

- 5L (1.35 US. gals)

Use motor oil designed for diesel engines that meet requirements for API service classification CC/CD/CE/CF/CF-4/CG-4 or CH-4. ACEA E1/E2/E3. Always check the API service label on the oil container to be sure it includes the letters indicated. (Note: An S-grade oil must not be used in a diesel engine or damage may result. It IS permissible to use oil that meets S and C grade service classifications.)

SAE 10W30 is recommended for general, all temperature use, -15C to 40C (5F to 104F).

See engine owner's manual for more specific information on oil viscosity recommendations.

Oil Filter Change

- Drain the oil.
- Remove the oil filter with an oil filter spanner and drain the oil into a suitable container. Discard the used filter. Note: Care should be taken during filter removal not to disrupt or damage in any way the fuel lines.
- Clean the filter mounting base and coat the gasket of the new filter with clean engine oil.
- Screw the new filter on by hand until the gasket contacts the mounting base. Using an oil filter spanner, tighten the filter an additional 1/2 to 7/8 of a turn.
- Refill the crankcase with the specified amount of the recommended engine oil. Reinstall the oil filler cap and tighten securely.
- Start the engine and check for oil filter leaks.

Stop the engine and check the oil level. If necessary, add oil to the upper limit mark on the dipstick.

AIR CLEANER



WARNING

Never use gasoline or low flash point solvents for cleaning the air cleaner element. A fire or explosion could result.



CAUTION

Never run the engine without the air cleaner. Rapid engine wear will result from contaminants, such as dust and dirt being drawn into the engine.

The diesel engine is equipped with a dry type air filter. Never apply oil to it. The air filter canister is located behind the engine door on top of the stator. Open the rubber evacuator valve once a week under ordinary conditions or daily in a dusty environment. This will remove large particles of dust and dirt.

Cleaning the Element

When dry dust adheres to the element, blow compressed air from the inside turning the element. Keep air pressure below 680kPa (99psi)

When carbon or oil adhere to the element soak the element in detergent for 15 minutes, then rinse several times in clean water and allow drying naturally. Once dry inspect element for damage before reinstalling.

Replace the element every year of operation or after six (6) times of cleaning (sooner under dusty conditions).

Air Cleaner Replacement Instructions

1. Release the Seal Carefully

Unlatch and remove the service cover of the air cleaner. Make certain the latches are folded back against the cover so that they don't hinder filter removal/installation. Most latches are spring loaded to fold back then open.

The filter fits tightly over the outlet tube, creating the critical seal on the inside diameter of the filter end cap. The filter should be removed gently to reduce the amount of dust dislodged. There will be some initial resistance, similar to breaking the seal on a jar. Gently move the end of the filter back and forth to break the seal.

2. Avoid Dislodging Dust from the Filter

Gently pull the filter off the outlet tube and out of the housing. Avoid knocking the filter against the housing.

3. Clean Sealing Surface of the Outlet Tube

Use a clean cloth to wipe the sealing surface. Dust on the outside diameter of the outlet tube could hinder an effective seal and cause leakage.

Make sure that all contaminant is removed before the new filter is inserted.

4. Clean the inside of the Outlet Tube

Carefully wipe the inside of the outlet tube with a clean cloth. Dirt accidentally transferred to the inside of the outlet tube will reach the engine and cause wear. (Engine manufacturers say that it takes only a few grams of dirt to damage an engine!) Be careful not to damage the sealing area on the tube.

5. Check the old Filter for Leak Clues

Visually inspect the old filter for any signs of leaks. A streak of dust on the clean side of the filter is a telltale sign.

Remove any cause of leaks before installing new filter.

6. Inspect New Filter for Damage

Inspect the new filter carefully, paying attention to the inside of the open end, which is the sealing area.

NEVER install a damaged filter.

7. Insert the New Filter by Hand RadialSeal

Insert carefully. Seat the new filter by hand making certain it is completely into the air cleaner housing before latching the cover in place. If the cover hits the filter before it is fully in place, remove the cover and push (by hand) the filter further into the air cleaner and try again. The cover should go on with no extra force.

Never use the latches on the cover to force the filter into the air cleaner! It is tempting to assume the cover will do the job of seating the filter in but it will not! Using the latches to push the filter in could cause damage to the housing and will void the warranty.

8. Check Connections for Tight Fit

Make sure that all clamps, bolts, and connections in the entire air intake system are tight. Check for holes in piping, and repair if needed.

COOLING SYSTEM

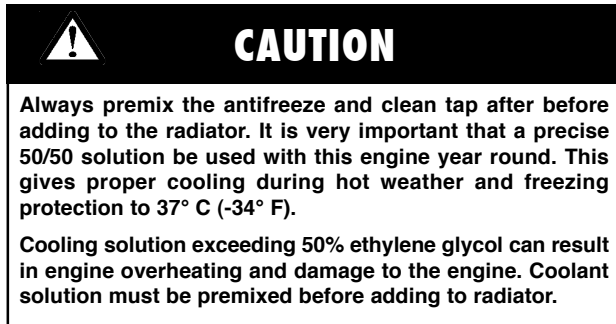


The Ranger 405D is shipped with coolant in the radiator. Check the coolant level by observing the level in the radiator and recovery bottle. Add 50/50 antifreeze / water solution if the level is close to or below the "LOW" mark. do not fill above the "FULL" mark.

Remove radiator cap and add coolant to radiator. Fill up to the top of the tube in the radiator filler neck which includes a connecting hose coming from the thermostat housing.

To drain the coolant, remove the plug in the side of the chassis and open the petcock on the engine block which is located below and to the left of the starter motor. Open the radiator cap to allow complete drainage.

Tighten the petcock, replace the chassis plug and refill with 50/50 antifreeze/water solution. Use automotive grade (low silicate) ethylene glycol antifreeze. The cooling system capacity is 4 litres (1 US.gals). Squeeze upper and lower radiator hoses while filling to bleed air from system coolant. Replace and tighten the radiator cap.



Periodically remove the dirt from the radiator fins.

Periodically check the fan belt and radiator hoses.

Replace if signs of deterioration are found.

Tightening the Fan Belt

If the fan belt is loose, the engine can overheat and the battery loses its charge. Check tightness by pressing on the belt midway between the pulleys. It should deflect about 6mm (.25 in) under a load of 9 Kg (20 lbs).

FUEL

At the end of each day's use, refill the Ranger 405D fuel tank to minimize moisture condensation and dirt contamination in the fuel line. Do not overfill; leave room for the fuel to expand.

Use only fresh, No. 2 grade DIESEL fuel. Do not use kerosene.

See the Engine Operator's Manual for instructions on replacing the fuel filter.

Bleeding the Fuel System

You may need to bleed air from the fuel system if the fuel filter or fuel lines have been detached, the fuel tank has been ran empty or after periods of long storage.

It is recommended that the fuel shutoff valve be closed during periods of non-use.

The Kubota D1105 Perkins 403C-11 engine supplied with the Ranger 405D is equipped with an automatic bleeding mechanism that functions when the fuel pump is actuated. It is generally not necessary to open a vent screw or fuel line fitting to bleed the fuel system.

To avoid personal injury, do not bleed a hot engine. This could cause fuel to spill onto a hot exhaust manifold, creating a danger of fire.

Bleed the fuel system as follows:

1. Fill the fuel tank with fuel.
2. Open the fuel shut off valve (vertical position of handle) on the Fuel Filter.
3. Press and hold the glow plug button for 10 to 20 seconds
4. Check to see that fuel is flowing through both fuel filters
5. Follow the normal STARTING procedures.

Fuel Filter

1. Check the fuel filter and fuel pre-filter for water accumulation or sediment.
2. Replace the fuel filter if it is found with excessive water accumulation or sediment.

Empty the fuel pre-filter.

Engine Adjustment

Adjustments to the engine are to be made only by a Lincoln Service Centre or an authorised Field Service Shop.

BATTERY MAINTENANCE

To access the battery disconnect the Negative and then Positive battery cables. Remove the 2 nuts from the battery bracket using an 11mm (7/16") spanner or socket. Slide the battery out and remove from welder

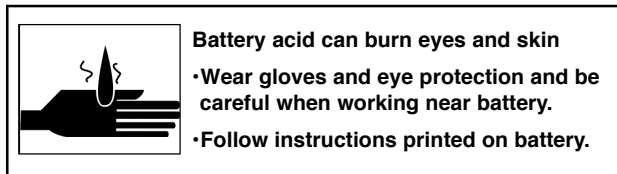


GASES FROM BATTERY CAN EXPLODE.

- **Keep sparks, flame and cigarettes away from battery.**

To prevent Explosion when:

- **Installing a new battery** - disconnect negative cable from old battery first and connect to new battery last
- **Connecting a battery charger** - remove battery from welder by disconnecting negative cable first, then positive cable and battery clamp. When reinstalling, connect negative cable last. Keep well ventilated.
- **Using a booster** - connect positive lead to battery first then connect negative lead to negative battery lead at engine foot.



Cleaning the Battery

Keep the battery clean by wiping it with a damp cloth when dirty. If the terminals appear corroded, disconnect the battery cables and wash the terminals with an ammonia solution or a solution of 100g (1/4 pound) of baking soda and 1L (1 US quart) of water. Be sure the battery vent plugs (if equipped) are tight so that none of the solution enters the cells. After cleaning, flush the outside of the battery, the battery compartment, and surrounding areas with clear water. Coat the battery terminals lightly with petroleum jelly or a non-conductive grease to retard corrosion.

Keep the battery clean and dry. Moisture accumulation on the battery can lead to more rapid discharge and early battery failure.

Checking the Electrolyte Level

If battery cells are low, fill them to the neck (approximately 10mm above plates) of the filler hole with distilled water and recharge. If one cell is low, check for leaks.

Charging the Battery

When you charge, jump, replace, or otherwise connect battery cables to the battery, be sure the polarity is correct. Improper polarity can damage the charging circuit. The Ranger 405D positive (+) battery terminal has a red marking.

If you need to charge the battery with an external charger, disconnect the negative cable first, then the positive cable before you attach the charger leads. After the battery is charged, reconnect the positive battery cable first and the negative cable last. Failure to do so can result in damage to the internal charger components.

Follow the instructions of the battery charger manufacturer for proper charger settings and charging time.

Servicing Spark Arrestors

Clean every 100 hours.



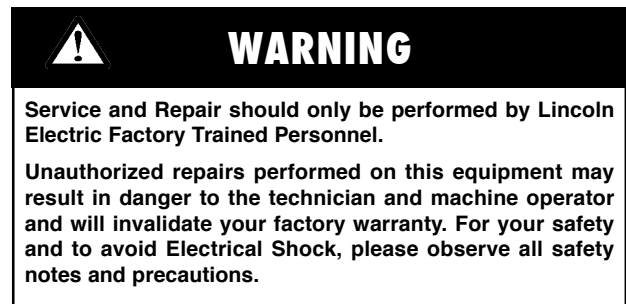
- **Muffler may be hot**
- **Allow engine to cool before installing the spark arrester.**
- **Do not operate engine while installing the spark arrester.**

WELDER / GENERATOR MAINTENANCE

STORAGE: Store the Ranger 405D in clean, dry protected areas.

CLEANING: Blow out the generator and controls periodically with low pressure air. Do this at least once a week in particularly dirty areas.

BRUSH REMOVAL AND REPLACEMENT: It is normal for the brushes and slip rings to wear and darken slightly. Inspect the brushes when a generator overhaul is necessary.



Engine Service Validations

The first mechanical service is due at 50 hours then every 200 hours thereafter.

The "Maintenance Plan" for your welder has been developed for convenience of the owner / operator who would operate the equipment in a normal environment and who would operate the welder at least 200 hour in a six month period.

If you operate the welder less than 200 hours some oils will have to be changed more frequently than specified. The oils deteriorate with age.

Abnormal Operating Conditions

If your welder is operated under any of the abnormal conditions listed below it is recommended that some of the service items be service more frequently than shown in the master plan.

If you consider that further servicing is required due to the type of environment you are operating your welder please discuss this with the service manager of your local Lincoln agent.

- Operating less than 200 hours in 6 month period
- Dusty, dirty environments
- Wet, humid environments
- Corrosive environments
- Cold weather (below 5 °C for extended periods)
- Hot weather (above 40 °C for extended periods)
- Extreme heavy or light loads

Electrical Service & Inspection

To meet AS1674.2 2003 Electrical Safety in Welding a Safety Inspection of a welder power source including an Insulation Resistance Test and an Earthing Resistance Test of welders shall be carried out:

- For Transportable Equipment
 - Every 3 months.
- For Fixed Equipment
 - Every 12 months

The owner of the power source is required to keep a suitable record of the periodic test results and implement a system of tagging that includes the date of the most recent inspection and the name of the service agent that performs the inspection.

| Minimum Insulation Resistance | Min MΩ Result |
|---|---------------|
| Between input and output terminals | 10 |
| Between all live parts connected together and the case, frame or exposed metal | 1 |
| Between any welding circuit and any other auxiliary circuit which operates at a voltage exceeding extra low voltage | 10 |
| Between any welding circuit and any other auxiliary circuit which operates at a voltage not exceeding extra low voltage | 1 |
| Between separate welding circuits | 1 |

Service Records

To assist in meeting the above requirements your service records can be recorded in the Service Validation section at the end of this manual. When each service is performed, check that the service validation has been completed by the service agent. This is important as it not only meets the Australian Standards requirement it assists in determination of warranty claims and enhances the value of the welder when reselling.

Lincoln Service Agent

Remember that your authorised Lincoln Service Agent has the trained personnel and specialised equipment to correctly service your welding equipment. The Lincoln Service Agent invites you to return for all your service needs both during and after the warranty period.

The safety, performance and reliability of your welder cannot be assured unless regular maintenance is performed and the Lincoln Authorised Service Network of agents is the biggest worldwide and are the best people to maintain your welder in peak condition.

Warranty & Service

All maintenance services listed in this manual and replacement of service items are the responsibility of the owner and as such are NOT considered to be rectification of defective material and/or workmanship. Items which may require servicing due to fair wear and tear are carried out at the owner's cost.

Failure to have proper maintenance services carried out by an authorised Lincoln Service Agent will void your new welder warranty if the work is not carried out in accordance with Lincoln's specifications.

VRD - Voltage Reduction Device

The VRD device has no user serviceable parts and doesn't require any routine maintenance.

Slip Rings

A slight amount of darkening and wear of the slip rings and brushes is normal. Brushes should be inspected when a general overhaul is necessary.

Before fitting replacement brushes, twist the brush pigtail at its entrance to the brush until the strands are tightly packed and no part of the pigtail protrudes beyond the brush surface in the pigtail slot. When the brush is placed in the holder, clear the pigtail from the side of the holder to allow free radial movement of the brush.

Sand new brushes by placing a piece of sandpaper between the brushes and the slip ring with the abrasive side against the brushes. With light finger pressure on the brushes, pull the sandpaper around the circumference of the rings, in the direction of rotation, only until brushes are properly seated. Stone the slip rings with a 320 grit sanding stone. Slip rings must be clean and free from oil and grease.

ENGINE SERVICE RECORD FOR RANGER 405D SERIAL

| 50 HOUR 1ST SERVICE | | |
|--------------------------------------|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Check the fan belt tightness | | |
| • Check the radiator and hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check battery electrolyte level | | |
| • Check of fuel lines and clamp | | |
| Notes: | | Signed by |

| 800 HOUR SERVICE | | |
|---|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Change fuel filter element | | |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Replace fan belt | | |
| • Clean & flush radiator & check hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check battery electrolyte level | | |
| • Remove sediment from fuel tank check clamps | | |
| Notes: | | Signed by |

| 200 HOUR SERVICE | | |
|--------------------------------------|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Check the fan belt tightness | | |
| • Check the radiator and hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check battery electrolyte level | | |
| • Check of fuel lines and clamp | | |
| Notes: | | Signed by |

| 1000 HOUR SERVICE | | |
|--------------------------------------|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Check the fan belt tightness | | |
| • Check the radiator and hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check battery electrolyte level | | |
| • Check of fuel lines and clamp | | |
| Notes: | | Signed by |

| 400 HOUR SERVICE | | |
|--------------------------------------|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Change fuel filter element | | |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Check the fan belt tightness | | |
| • Check the radiator and hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check of fuel lines and clamp | | |
| Notes: | | Signed by |

| 1200 HOUR SERVICE | | |
|---|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Change fuel filter element | | |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Replace fan belt | | |
| • Clean & flush radiator & check hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check battery electrolyte level | | |
| • Remove sediment from fuel tank check clamps | | |
| Notes: | | Signed by |

| 600 HOUR SERVICE | | |
|---|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Replace fan belt | | |
| • Clean & flush radiator & check hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check battery electrolyte level | | |
| • Remove sediment from fuel tank check clamps | | |
| Notes: | | Signed by |

| 1400 HOUR SERVICE | | |
|--------------------------------------|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Check the fan belt tightness | | |
| • Check the radiator and hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check battery electrolyte level | | |
| • Check of fuel lines and clamp | | |
| Notes: | | Signed by |

ENGINE SERVICE RECORD FOR RANGER 405D SERIAL

| 1600 HOUR SERVICE | | |
|---|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Check fuel injection nozzle pressure | | |
| • Change fuel filter element | | |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Replace fan belt | | |
| • Clean & flush radiator & check hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check battery electrolyte level | | |
| • Remove sediment from fuel tank check clamps | | |
| Notes: | | |
| | | Signed by |

| 2400 HOUR SERVICE | | |
|---|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Replace fan belt | | |
| • Clean & flush radiator & check hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check battery electrolyte level | | |
| • Remove sediment from fuel tank check clamps | | |
| Notes: | | |
| | | Signed by |

| 1800 HOUR SERVICE | | |
|---|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Replace fan belt | | |
| • Clean & flush radiator & check hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check battery electrolyte level | | |
| • Remove sediment from fuel tank check clamps | | |
| Notes: | | |
| | | Signed by |

| 2600 HOUR SERVICE | | |
|--------------------------------------|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Change fuel filter element | | |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Check the fan belt tightness | | |
| • Check the radiator and hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check of fuel lines and clamp | | |
| Notes: | | |
| | | Signed by |

| 2000 HOUR SERVICE | | |
|--------------------------------------|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Change fuel filter element | | |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Check the fan belt tightness | | |
| • Check the radiator and hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check of fuel lines and clamp | | |
| Notes: | | |
| | | Signed by |

| 2800 HOUR SERVICE | | |
|--------------------------------------|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Check the fan belt tightness | | |
| • Check the radiator and hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check the radiator and hose clamps | | |
| • Check of fuel lines and clamp | | |
| Notes: | | |
| | | Signed by |

| 2200 HOUR SERVICE | | |
|--------------------------------------|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Check the fan belt tightness | | |
| • Check the radiator and hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check battery electrolyte level | | |
| • Check of fuel lines and clamp | | |
| Notes: | | |
| | | Signed by |

| 3000 HOUR SERVICE | | |
|---|-----------|---------------------------|
| Agent Name | | |
| Date | Hourmeter | |
| | | Tick completed operations |
| • Check fuel injection pump | | |
| • Check fuel injection timing | | |
| • Change fuel filter element | | |
| • Change of engine oil | | |
| • Change engine oil filter cartridge | | |
| • Replace fan belt | | |
| • Clean & flush radiator & check hose clamps | | |
| • Inspect/clean air cleaner element | | |
| • Check battery electrolyte level | | |
| • Remove sediment from fuel tank check clamps | | |
| Notes: | | |
| | | Signed by |

INSULATION & RESISTANCE RECORD FOR RANGER 405D SERIAL

| Agent Name | |
|---|--------------------------------|
| Date | |
| INSULATION TESTING | |
| Record Test Results | |
| • Earth continuity (< 1Ω) | Ω |
| • Auxiliary and Earth (>10MΩ) | MΩ |
| • Welding Output and Earth (>10MΩ) | MΩ |
| • Welding and Auxiliary circuit (>10MΩ) | MΩ |
| ELECTRICAL INSPECTION | |
| | Tick item if passed inspection |
| • Indication devices operation | |
| • Weld Cable insulation | |
| • Weld Cable Terminations | |
| • Electrode Holder | |
| • Work Clamp | |
| • Auxiliary Outlets | |
| • Auxiliary Plugs | |
| • Attach an inspection tag | |
| ADDITIONAL SERVICE PERFORMED | |
| Notes: | |
| Signed by Service Manager | |

| Agent Name | |
|---|--------------------------------|
| Date | |
| INSULATION TESTING | |
| Record Test Results | |
| • Earth continuity (< 1Ω) | Ω |
| • Auxiliary and Earth (>10MΩ) | MΩ |
| • Welding Output and Earth (>10MΩ) | MΩ |
| • Welding and Auxiliary circuit (>10MΩ) | MΩ |
| ELECTRICAL INSPECTION | |
| | Tick item if passed inspection |
| • Indication devices operation | |
| • Weld Cable insulation | |
| • Weld Cable Terminations | |
| • Electrode Holder | |
| • Work Clamp | |
| • Auxiliary Outlets | |
| • Auxiliary Plugs | |
| • Attach an inspection tag | |
| ADDITIONAL SERVICE PERFORMED | |
| Notes: | |
| Signed by Service Manager | |

| Agent Name | |
|---|--------------------------------|
| Date | |
| INSULATION TESTING | |
| Record Test Results | |
| • Earth continuity (< 1Ω) | Ω |
| • Auxiliary and Earth (>10MΩ) | MΩ |
| • Welding Output and Earth (>10MΩ) | MΩ |
| • Welding and Auxiliary circuit (>10MΩ) | MΩ |
| ELECTRICAL INSPECTION | |
| | Tick item if passed inspection |
| • Indication devices operation | |
| • Weld Cable insulation | |
| • Weld Cable Terminations | |
| • Electrode Holder | |
| • Work Clamp | |
| • Auxiliary Outlets | |
| • Auxiliary Plugs | |
| • Attach an inspection tag | |
| ADDITIONAL SERVICE PERFORMED | |
| Notes: | |
| Signed by Service Manager | |

| Agent Name | |
|---|--------------------------------|
| Date | |
| INSULATION TESTING | |
| Record Test Results | |
| • Earth continuity (< 1Ω) | Ω |
| • Auxiliary and Earth (>10MΩ) | MΩ |
| • Welding Output and Earth (>10MΩ) | MΩ |
| • Welding and Auxiliary circuit (>10MΩ) | MΩ |
| ELECTRICAL INSPECTION | |
| | Tick item if passed inspection |
| • Indication devices operation | |
| • Weld Cable insulation | |
| • Weld Cable Terminations | |
| • Electrode Holder | |
| • Work Clamp | |
| • Auxiliary Outlets | |
| • Auxiliary Plugs | |
| • Attach an inspection tag | |
| ADDITIONAL SERVICE PERFORMED | |
| Notes: | |
| Signed by Service Manager | |

INSULATION & RESISTANCE RECORD FOR RANGER 405D SERIAL

| Agent Name | |
|---|--------------------------------|
| Date | |
| INSULATION TESTING | |
| Record Test Results | |
| • Earth continuity (< 1Ω) | Ω |
| • Auxiliary and Earth (>10MΩ) | MΩ |
| • Welding Output and Earth (>10MΩ) | MΩ |
| • Welding and Auxiliary circuit (>10MΩ) | MΩ |
| ELECTRICAL INSPECTION | |
| | Tick item if passed inspection |
| • Indication devices operation | |
| • Weld Cable insulation | |
| • Weld Cable Terminations | |
| • Electrode Holder | |
| • Work Clamp | |
| • Auxiliary Outlets | |
| • Auxiliary Plugs | |
| • Attach an inspection tag | |
| ADDITIONAL SERVICE PERFORMED | |
| Notes: | |
| Signed by Service Manager | |

| Agent Name | |
|---|--------------------------------|
| Date | |
| INSULATION TESTING | |
| Record Test Results | |
| • Earth continuity (< 1Ω) | Ω |
| • Auxiliary and Earth (>10MΩ) | MΩ |
| • Welding Output and Earth (>10MΩ) | MΩ |
| • Welding and Auxiliary circuit (>10MΩ) | MΩ |
| ELECTRICAL INSPECTION | |
| | Tick item if passed inspection |
| • Indication devices operation | |
| • Weld Cable insulation | |
| • Weld Cable Terminations | |
| • Electrode Holder | |
| • Work Clamp | |
| • Auxiliary Outlets | |
| • Auxiliary Plugs | |
| • Attach an inspection tag | |
| ADDITIONAL SERVICE PERFORMED | |
| Notes: | |
| Signed by Service Manager | |



| Agent Name | |
|---|--------------------------------|
| Date | |
| INSULATION TESTING | |
| Record Test Results | |
| • Earth continuity (< 1Ω) | Ω |
| • Auxiliary and Earth (>10MΩ) | MΩ |
| • Welding Output and Earth (>10MΩ) | MΩ |
| • Welding and Auxiliary circuit (>10MΩ) | MΩ |
| ELECTRICAL INSPECTION | |
| | Tick item if passed inspection |
| • Indication devices operation | |
| • Weld Cable insulation | |
| • Weld Cable Terminations | |
| • Electrode Holder | |
| • Work Clamp | |
| • Auxiliary Outlets | |
| • Auxiliary Plugs | |
| • Attach an inspection tag | |
| ADDITIONAL SERVICE PERFORMED | |
| Notes: | |
| Signed by Service Manager | |

| Agent Name | |
|---|--------------------------------|
| Date | |
| INSULATION TESTING | |
| Record Test Results | |
| • Earth continuity (< 1Ω) | Ω |
| • Auxiliary and Earth (>10MΩ) | MΩ |
| • Welding Output and Earth (>10MΩ) | MΩ |
| • Welding and Auxiliary circuit (>10MΩ) | MΩ |
| ELECTRICAL INSPECTION | |
| | Tick item if passed inspection |
| • Indication devices operation | |
| • Weld Cable insulation | |
| • Weld Cable Terminations | |
| • Electrode Holder | |
| • Work Clamp | |
| • Auxiliary Outlets | |
| • Auxiliary Plugs | |
| • Attach an inspection tag | |
| ADDITIONAL SERVICE PERFORMED | |
| Notes: | |
| Signed by Service Manager | |

TROUBLESHOOTING GUIDE

| PROBLEM / TROUBLE | POSSIBLE CAUSE | REMEDY |
|--|---|---|
| A: Engine will not start. 1. Starter motor not operating 2. Engine cranking but not firing 3. Engine starts, runs for approx 10 seconds and then stops | I) Faulty or flat battery II) Dirty battery terminals III) Faulty wiring IV) Faulty key switch V) Faulty starter motor I) Out of fuel II) Fuel solenoid faulty III) Engine protective relay R3 not being activated by idler/watcher PCB IV) R3 relay faulty V) Faulty engine fuel system VI) Idle/throttle setting incorrect VII) Output Failure light illuminated I) Engine protection alarm on. Check front panel LED lights: a) Oil pressure (too low) b) Water temperature (too high) c) Welding Output Failure II) Welder over temperature a) Stator winding too hot b) Choke winding too hot III) Fuel system IV) Faulty idler/watcher PCB | Replace or recharge Clean Repair/replace Replace Repair/replace Refuel & bleed per engine operating manual Replace Refer to PCB Troubleshooting page 18 Replace Refer engine operating manual Repair/replace Turn key switch to 'OFF' position and then immediately retry to start. If light persists repair/replace failed output components Check oil level Check fan belt, radiator restriction, clear machine cooling air passages Take to Authorised Field Service Shop. Clear machine cooling air passages, check Duty Cycle exceeded Duty Cycle exceeded Refer engine operating manual Refer to PCB Trouble Shooting page 18 |
| B: No weld output and no auxiliary power output. | I) Faulty wiring II) Faulty brushes III) Circuit breakers tripped IV) Faulty rotor control / weld control PCB V) Faulty rotor (rotor resistance \approx 11 ohms) | Repair/replace (refer wiring diagram) Replace Reset Refer PCB Trouble Shooting page 18 Replace |
| C: No weld output but auxiliary power functions correctly. | I) OCV Output Control Switch in 'Welding Output OFF' position II) OCV Output Control - switched to welding output 'off' position III) Output terminal switch in 'I' position with switch. no remote control connected IV) Faulty wiring V) Faulty Rotor/weld control PCB VI) Faulty rectifier VII) Faulty choke/inductor VIII) Faulty stator | Switch to 'Welding Output ON' position Switch to 'on' position Switch to 'I' position or connect a remote Repair/replace (refer wiring diagram) Refer PCB Trouble Shooting page 18 Replace Replace Replace |
| D: No auxiliary power but weld output functions correctly. | I) RCD tripped II) Circuit breaker tripped III) Faulty stator IV) Faulty wiring/connections | Correct leakage fault & reset Correct fault & reset Replace Repair/replace (refer wiring diagram) |
| E: Engine won't accelerate to high idle speed. | I) Not enough welding current being drawn II) Not enough auxiliary current being drawn III) Faulty idle switch IV) Faulty wiring V) Faulty aux current sensor PCB VI) Faulty idler solenoid VII) Faulty throttle linkages VIII) Faulty engine protection/idler PCB IX) Faulty relay R1 and/or R2 X) Faulty Rotor/weld control PCB | Increase current or switch to 'I' position Increase current or switch 'I' position Replace Repair/replace (refer wiring diagram) Refer PCB Trouble Shooting page 18 Replace Repair/replace Refer PCB Trouble Shooting page 18 Replace Refer PCB Trouble Shooting page 18 |
| F: Engine fails to drop to low idle speed after current stops (a 12 sec delay is built in). | I) Current still remains flowing in aux or weld circuits II) Idler switch in 'I' position III) Faulty aux current sensor PCB IV) Faulty engine protection/idler PCB V) Faulty rotor/weld control PCB VI) Faulty relay R1 and/or R2 VII) Faulty idler solenoid VIII) Faulty throttle linkages | Idle only takes place when all loads are removed Switch to 'I' position Refer PCB Trouble Shooting page 18 Refer PCB Trouble Shooting page 18 Refer PCB Trouble Shooting page 18 Replace Repair/replace Repair/replace |

TROUBLESHOOTING GUIDE

| PROBLEM / TROUBLE | POSSIBLE CAUSE | REMEDY |
|--|--|--|
| G: Battery doesn't stay charged. | I) Key switch left on with engine stopped II) Faulty battery III) Faulty wiring IV) Faulty key switch V) Faulty alternator/regulator | Be sure key switch is off when engine not running Replace Repair/replace (refer wiring diagram) Replace Repair/replace (refer to engine operating manual) |
| H: Weld output doesn't switch off when output terminal switch is operated. (CV mode only) | I) Faulty switch II) Faulty rotor/weld control PCB III) Faulty rectifier | Replace Refer PCB Trouble Shooting page 18 Replace |
| I: Output control potentiometer on welder not functioning. | I) Output control switch in 'Remote'  position II) Faulty output control switch III) Faulty output control potentiometer IV) Faulty wiring V) Faulty weld control PCB | Switch to Local '⊙' position Replace Replace Check leads 75, 76, 77, 75A, 76A, 77A Refer PCB Trouble Shooting page 18 |
| J: Remote control potentiometer not functioning. | I) Output control switch in 'Local' '⊙' position II) Faulty wiring III) Remote control leads broken in control cable IV) Faulty Rotor/weld control PCB | Switch to  position Check leads 75, 76, 77, 75B, 76B & 77B Repair/replace Refer PCB Trouble Shooting page 18 |
| K: Weld characteristics not correct. | I) CC/CV switch in wrong position II) Faulty rotor/weld control PCB III) Faulty choke/inductor IV) Faulty reactors (one per each weld phase) V) Faulty capacitors | Switch to appropriate position Refer PCB Trouble Shooting page 18 Repair/replace Repair/replace Replace all 4 capacitors at one time |

PCB TROUBLESHOOTING

Brief Operating Description

The Ranger 405D has 5 separate PCBs. These are:

- 1) Watcher/Idler PCB – mounted on the rear of the control panel.
- 2) Auxiliary Current Sensor PCB – mounted on the rear of the Auxiliary output module.
- 3) Rotor / Weld Control PCB – mounted behind the control panel.
- 4) VRD PCB - mounted behind the control panel.
- 5) Volt and Amp meter model PCBs mounted on the rear of the control panel (where fitted).

When fault finding the PCBs ensure that all connecting plugs are fully inserted in their respective sockets and that all connector pins are in good, clean condition.

A general knowledge of the PCB's operation is required before attempting to fault find. Light emitting diodes (LEDs) are used on the following PCBs to indicate the boards operational status.

1) Watcher/Idler PCB

The engine watcher/idler PCB is powered from the 12 volt battery (negative ground). Note, never disconnect the battery after starting the engine, as control voltage to the PCBs will be lost. This PCB is activated when the keyswitch is on. Correct operation of this PCB provides a ground return for relay [R3] to be activated. Relay [R3] switches the supply voltage to the fuel solenoid and the rotor control PCB. LED [L4] illuminates to confirm fuel & rotor control "OK".

LEDs L5, L6, L7 & L8 are visible through to the nameplate. They are normally "off" and indicate the engine and electrical temperature/fault alarms. The first engine alarm will inhibit the others from indicating and remains illuminated until the key switch is turned to the 'off' position. Turning the key switch to "start" position initiates a 10 seconds over-ride timer allowing the engine to start.

LED 5 is illuminated when the over-ride timer/alarm inhibit circuits are active in the "shutdown" condition. If a fault condition still exists, the engine will again be shut down after the 10 seconds over-ride period expires.

LEDs L2 & L3 indicate the engine idler functions. LED 3 illuminates representing a 1 second pulse to Relay [R1] which energises the "pull in" winding in the idler solenoid. LED 2 confirms energisation of Relay [R2] and then the "hold" winding in the idler solenoid.

The idler control section of the PCB uses an input signal from the rotor/weld control PCB and/or an input signal from the auxiliary current sensor PCB to determine when the engine is to go to high idle speed. When the input signals cease a 12 second timer is initiated and times out before the engine goes to low idle speed.

The "idler" switch on the front panel when switched to '🔌' position bypasses the idler circuitry so that the engine runs continuously at high idle speed.

2) Auxiliary Current Sensor PCB

This PCB uses a "Hall Effect" device to sense the magnetic field generated in the Auxiliary supply leads when a current passes through them. It is powered from the watcher/Idler PCB and returns a signal back to this PCB.

3) Rotor / Weld Control PCB

The rotor/weld control PCB supplies 12V to the rotor for 'flashing' and initialising the Automatic Voltage Regulator (AVR). The AVR is factory set to maintain a nominal 230V/400V auxiliary voltage output.

The AVR monitors the 3 stator field windings and then regulates a 'half controlled 3 phase bridge rectifier' which supplies the rotor DC voltage. LED's (L4) (L5) & (L6) should illuminate to the same brilliance to verify each phase is operating equally.

The weld control circuitry has 2 modes of operation Constant Current (CC) and Constant Voltage (CV).

- i. In CC mode, feed back to the control circuitry is provided by a 400 Amp to 50mV shunt, thus maintaining the required set output current value. An Arc Force Control operates when the weld voltage falls below a set value, a factor of up to 2.5 times the current is progressively applied.

The high Inductance -ve output stud is normally used.

- ii. In CV mode, feed back to the control circuitry is provided by sensing the output voltage, thus maintaining the required set output voltage value.

The low Inductance -ve output stud is normally used.

LED [L1] indicates an over current condition in the weld circuit. The over-current sensor will time out to "phase back" the SCRs to a pre set output current. This state is held until zero current is sensed passing through the shunt.

LED [L2] indicates the latched state of the "phase back" circuitry. LED [L3] indicates current flow sensed by the shunt. This "current flow" signal is also optically isolated and sent to the Engine Watcher/Idler PCB to initiate switching to "high idle" speed.

4) Reduced Open Circuit Voltage PCB

Constant Voltage (CV)

CV welding is unchanged. The wire feeder gun trigger, for units with a control cable, initiates operation and for 'across the arc' units eg LN-25 & LN-22 the 'Output Terminal Switch' must be turned on. (ie the "I" position).

Constant Current (CC)

VRD CC welding has a reduced OCV (less than 8 volts). When a resistance 20 ohms or less is sensed between the output studs (ie striking the electrode to the job), the machine returns to normal welding operation. While 20 amps or more is detected the operation will be as standard. Less than 20 amps (ie breaking the arc) the OCV returns to less than 8 volts after a maximum of 1 second. (The '20 Amp' signal is derived from the Rotor / Weld Control PCB).

The 'Output Terminal Switch' is inoperative in CC mode.

Operation is the same in both high and low speed (Idler) conditions.

Note: A fault in the machine, (eg short circuited SCR), that causes more than 9 volts across the output terminals this VRD will cause the engine to be shut down and the 'Welding Output Failure' LED on the control panel will be illuminated.

5) Volt and Amp Module PCBs

These modules are powered from the pilot transformer and shows Weld Voltage Output and Weld Amps Output.

Any replacement or exchanging of PCBs should be done with extreme caution as fault conditions elsewhere in the machine may cause instant and permanent damage to a PCB.

Procedure for Replacing PC Boards

When a PC Board is to be replaced, the following procedure must be followed:

Visually inspect PC Board in question.

1. Are any of the components damaged?
2. Is a conductor on the back side of the board damaged?
3. If there is no damage to the PC Board, insert a new PC Board and see if this remedies the problem. If the problem is remedied, reinstall the old PC Board and see if the problem still exists with the old PC Board.
 - a. If the problem does not exist with the old board, check the PC Board lead harness plugs.
 - b. Check leads in the harness for loose connections.

RANGER 405D

Model Index

NUMBERS IN THE TABLE BELOW INDICATE WHICH COLUMN TO USE IN EACH PARTS LIST FOR EACH INDIVIDUAL CODE NUMBER.

DO NOT attempt to use this Parts List for machine if its code number is not listed. Contact the Service Department for any code numbers not listed. (Only those suffixes which require distinction from the basic codes are shown.)

| SUB ASSEMBLY PAGE NAME | Optional Equipment | Casework Assembly | General Assembly | Front End Frame Module | Control Panel Assembly | Control Panel Assembly | Output Rectifier | Auxiliary Output Box | Rotor Assembly | | |
|------------------------|--------------------|-------------------|------------------|------------------------|------------------------|------------------------|------------------|----------------------|----------------|--|--|
| PARTS LIST NO. → | AP-210B | AP-210C | AP-210D | AP-210F | AP-210G | AP-210G3 | AP-210H | AP-210J | AP-210K | | |
| CODE NO. ↓ | | | | | | | | | | | |
| 1636 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | | |
| 1637 | 1 | 1 | 1 | 1 | 1 | - | 1 | 2 | 1 | | |
| 1638 | 1 | 1 | 1 | 1 | 1 | - | 1 | 3 | 1 | | |
| 1663 | 1 | 1 | 2 | 1 | 1 | - | 1 | 1 | 1 | | |
| 1671 | 1 | 1 | 2 | 1 | 1 | - | 2 | 2 | 1 | | |
| 1672 | 1 | 1 | 2 | 1 | 1 | - | 2 | 3 | 1 | | |
| 1689 | 1 | 1 | 2 | 1 | 1 | - | 2 | 2 | 1 | | |
| 1690 | 1 | 1 | 2 | 1 | 1 | - | 2 | 3 | 2 | | |
| 1691 | 1 | 1 | 2 | 1 | 1 | - | 2 | 1 | 2 | | |
| 70001 | 1 | 2 | 3 | 2 | - | 3 | 3 | 3 | 2 | | |
| 70005 | 1 | 2 | 3 | 3 | - | 3 | 3 | 2 | 2 | | |
| 70006 | 1 | 2 | 3 | 3 | - | 3 | 3 | 1 | 2 | | |
| 70007 | 1 | 2 | 3 | 3 | - | 3 | 3 | 3 | 2 | | |
| 70015 | 1 | 2 | 3 | 3 | - | 3 | 3 | 1 | 2 | | |
| 70032 | 1 | 2 | 3 | 3 | - | 3 | 3 | 1 | 2 | | |
| 70042 | 1 | 3 | 3 | 3 | - | 3 | 3 | 4 | 2 | | |
| 70043 | 1 | 3 | 3 | 3 | - | 3 | 3 | 5 | 2 | | |
| 70044 | 1 | 3 | 3 | 3 | - | 3 | 3 | 1 | 2 | | |
| 70048 | 1 | 3 | 3 | 3 | - | 3 | 3 | 1 | 2 | | |
| 70057 | 1 | 4 | 4 | 4 | - | 3 | 3 | 1 | 2 | | |

Operating ManualIMA 608D

Indicates a change this printing

RANGER 405D

Model Index

NUMBERS IN THE TABLE BELOW INDICATE WHICH COLUMN TO USE IN EACH PARTS LIST FOR EACH INDIVIDUAL CODE NUMBER.

DO NOT attempt to use this Parts List for machine if its code number is not listed. Contact the Service Department for any code numbers not listed. (Only those suffixes which require distinction from the basic codes are shown.)

| SUB ASSEMBLY PAGE NAME | Miscellaneous Items | Idle Solenoid | Wiring Diagrams | | | | | | | |
|------------------------|---------------------|---------------|-----------------|--|--|--|--|--|--|--|
| | AP-210L | AP-210M | AP-210W | | | | | | | |
| PARTS LIST NO. → | | | | | | | | | | |
| CODE NO. ↓ | | | | | | | | | | |
| 1636 | 1 | 1 | AG1437-4 | | | | | | | |
| 1637 | 1 | 1 | AG1437-4 | | | | | | | |
| 1638 | 1 | 1 | AG1437-4 | | | | | | | |
| 1663 | 1 | 2 | AG1438-1 | | | | | | | |
| 1671 | 1 | 2 | AG1438-2 | | | | | | | |
| 1672 | 1 | 2 | AG1438-3 | | | | | | | |
| 1689 | 1 | 2 | AG1438-2 | | | | | | | |
| 1690 | 1 | 2 | AG1438-3 | | | | | | | |
| 1691 | 1 | 2 | AG1438-4 | | | | | | | |
| 70001 | 1 | 2 | AG1438-6 | | | | | | | |
| 70005 | 1 | 3 | AG1438-5 | | | | | | | |
| 70006 | 1 | 3 | AG1438-7 | | | | | | | |
| 70007 | 1 | 3 | AG1438-6 | | | | | | | |
| 70015 | 1 | 3 | AG1438-7 | | | | | | | |
| 70032 | 1 | 3 | AG1438-7 | | | | | | | |
| 70042 | 1 | 3 | AG1438-5 | | | | | | | |
| 70043 | 1 | 3 | AG1438-6 | | | | | | | |
| 70044 | 1 | 3 | AG1438-7 | | | | | | | |
| 70048 | 1 | 3 | AG1438-7 | | | | | | | |
| 70057 | 1 | 3 | AG1438-7 | | | | | | | |

Optional Equipment

Operative: AP-210B
Jul 2004
Supersedes: Feb 2002

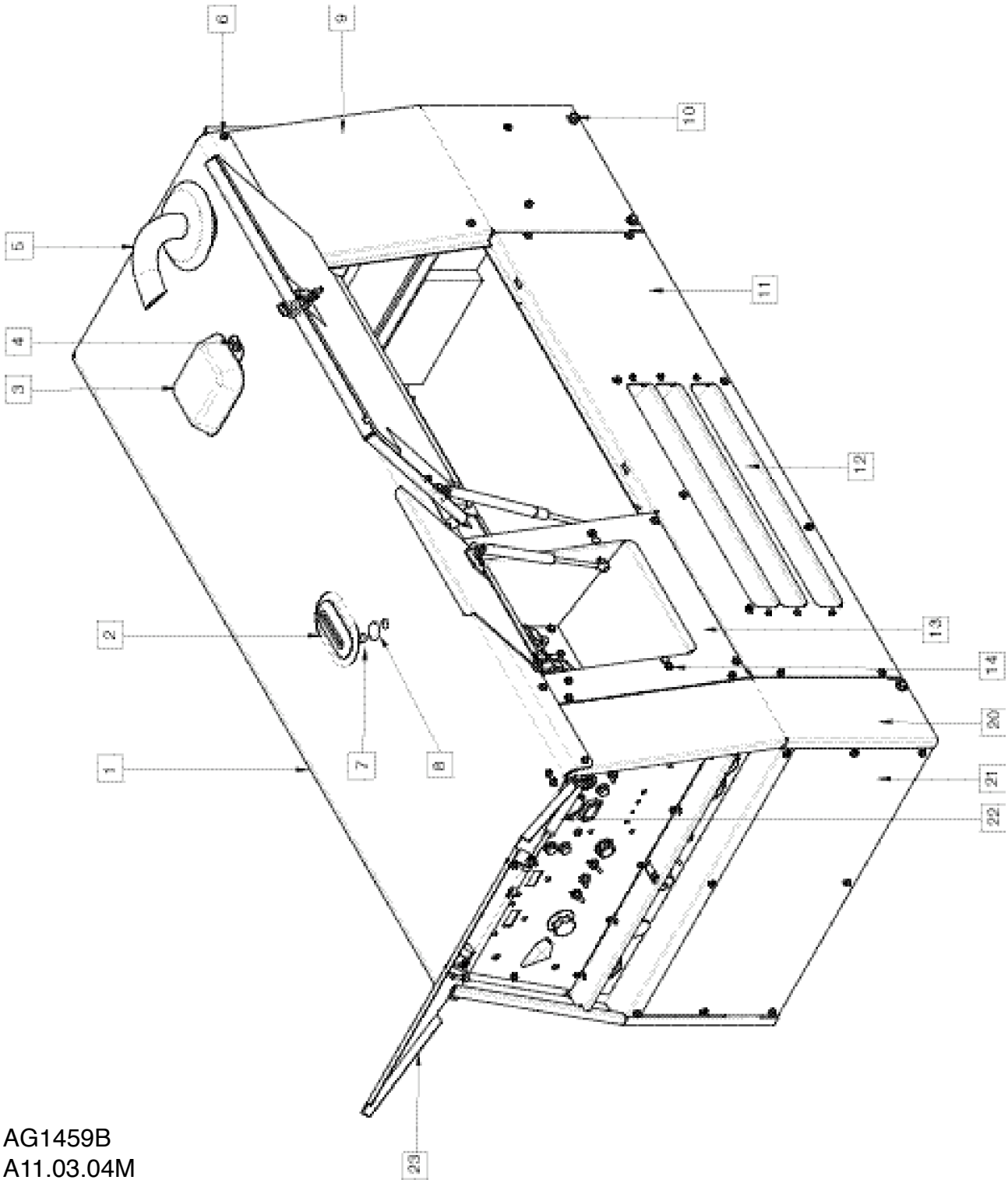
Miscellaneous Options Available for your machine are listed below:

Indicates a change this printing.

| DESCRIPTION | PART NO. |
|---|------------------|
| Power Plug Kit | Order KA1373 |
| Accessory | Order KIT400 |
| Lead Kit (10m Leads & Twistmates) | Order KIT1600T |
| Remote Control (Weld Control) 6 pin 8.5 metre | Order K857-8.5-6 |
| Remote Control (Weld Control) 6 pin 20 metre | Order K857-20-6 |
| Remote Control (Weld Control) 14 pin 20 metre | Order K857-20-14 |
| Remote Control (Weld Control) 14 pin 30 metre | Order K857-30-14 |
| Remote Control Adapter (Y Adapter 14pin to 6pin & 14pin) | Order K864 |
| Remote Control Adapter (14pin to 6pin) | Order K876 |
| Universal Adapter Plug (14pin to Lugged leads) | Order K867 |
| Hi-Freq TIG Module | Order K930-2 |

Casework Assembly

Operative: AP-210C
Supersedes: Jul 2004
Feb 2002



AG1459B
A11.03.04M

Ø Obsolete item.

Indicates a change this printing.

* Items not illustrated.

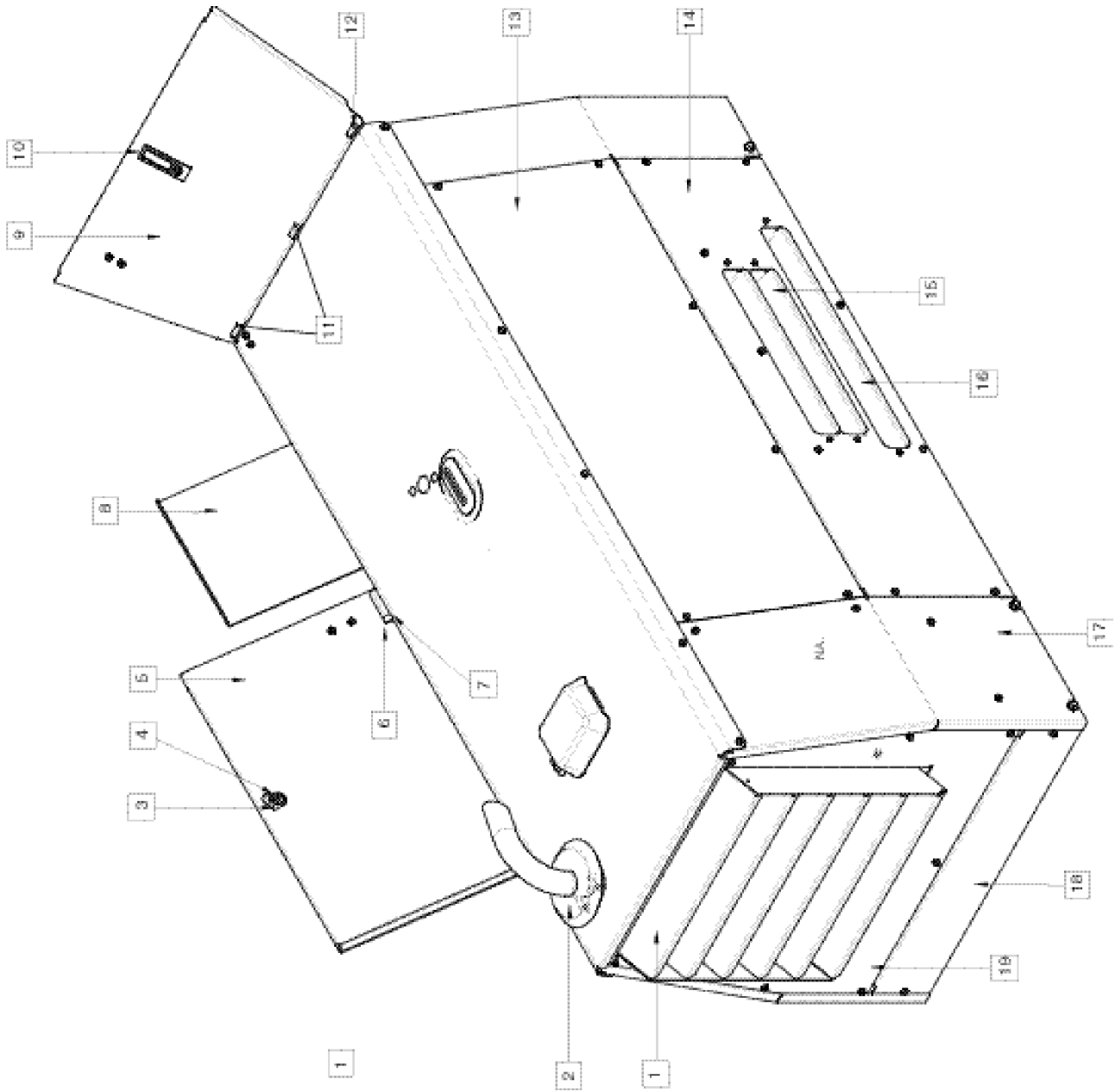
Use only the parts marked "X" in the column under the heading number called for in the model index page.

Recommended Spare Parts are highlighted in bold

| ITEM | DESCRIPTION | PART NO. | QTY. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|--|-----------|------|---|---|---|---|---|---|---|---|---|
| 1 | Canopy | AG1385-2 | 1 | x | - | - | - | | | | | |
| | Canopy | AG1385-4 | 1 | - | x | - | - | | | | | |
| | Canopy | AG1385-5 | 1 | - | - | x | - | | | | | |
| | Canopy | AG1385-W | 1 | - | - | - | x | | | | | |
| 2 | Cover Seal | S12934 | 1 | x | x | x | - | | | | | |
| 3 | Radiator Cap Cover Assy(R405D) | AM3511 | 1 | x | x | x | x | | | | | |
| 4 | 1/4 Turn Fastener - Screw | AS4800 | 1 | x | x | x | x | | | | | |
| 5 | Exhaust Pipe Elbow (WP405) | AM3527-2 | 1 | x | x | x | x | | | | | |
| 6 | 1/4UNC x 5/8 Black Zinc | AS1733-4B | 69 | x | x | x | x | | | | | |
| 7 | Grommet Buffer (B71) | AS4404-4 | 1 | x | x | x | x | | | | | |
| 8 | Grommet 25mm Blind (M194) | AS3086-20 | 1 | x | x | x | x | | | | | |
| 9 | Casework End Frame (Door Side) | AL2556 | 1 | x | x | x | - | | | | | |
| | Casework End Frame (Door Side) | AL2556W | 1 | - | - | - | x | | | | | |
| 10 | Thread Cutting Screw | S9225-28 | 1 | x | x | x | - | | | | | |
| 11 | Lower Side Panel (RHS) | AG1379 | 1 | x | x | x | - | | | | | |
| | Lower Side Panel (RHS) | AG1379W | 1 | - | - | - | x | | | | | |
| 12 | Side Panel Louvre (Large) | AL2610 | 1 | x | x | x | - | | | | | |
| 13 | Side Panel (Output Box) | AL2572-1 | 1 | x | - | - | - | | | | | |
| | Side Panel (Output Box) | AL2572 | 1 | - | x | x | - | | | | | |
| | Side Panel (Output Box) | AL2572W | 1 | - | - | - | x | | | | | |
| 14 | Rubber Buffer | AS4404-1 | 2 | x | x | x | x | | | | | |
| 15 | Gas Strut Bracket | AS4730 | 2 | - | x | x | x | | | | | |
| 16 | Gas Strut (Small) | AM3614-1 | 1 | - | x | x | x | | | | | |
| 17 | Gas Strut (Large) | AM3614 | 1 | x | x | x | x | | | | | |
| 18 | Pull Tab - Door Key Lock | AM3466-2A | 1 | x | x | x | x | | | | | |
| 19 | Door Key Lock | AM3466-2 | 1 | x | x | x | x | | | | | |
| 20 | End Frame Welded Assembly | AL2550-3 | 1 | x | x | - | - | | | | | |
| | End Frame Welded Assembly UK Codes 70001 & 70007 Only | AL2550-4 | 1 | - | x | - | - | | | | | |
| | End Frame Welded Assembly | AL2550-5 | 1 | - | - | x | - | | | | | |
| | End Frame Welded Assembly | AL2550-5W | 1 | - | - | - | x | | | | | |
| 21 | Lower Front Panel | AM3505 | 1 | x | x | x | - | | | | | |
| 22 | Gas Strut (Small) | AM3614-1 | 1 | - | - | x | x | | | | | |
| 23 | Control Panel Door (Drop down) | AM3542 | 1 | x | - | - | - | | | | | |
| | Control Panel Door (Lift Up) | AM3542-1 | 1 | - | x | - | - | | | | | |
| | Control Panel Door (Gas Strut) | AM3542-3 | 1 | - | - | x | - | | | | | |
| | Control Panel Door (Gas Strut) | AM3542-3W | 1 | - | - | - | x | | | | | |

Casework Assembly

Operative: AP-210C.2
Jul 2004
Supersedes: Feb 2002



AG1459B
A11.03.04M

- Ø Obsolete item.
- # Indicates a change this printing.
- * Items not illustrated.

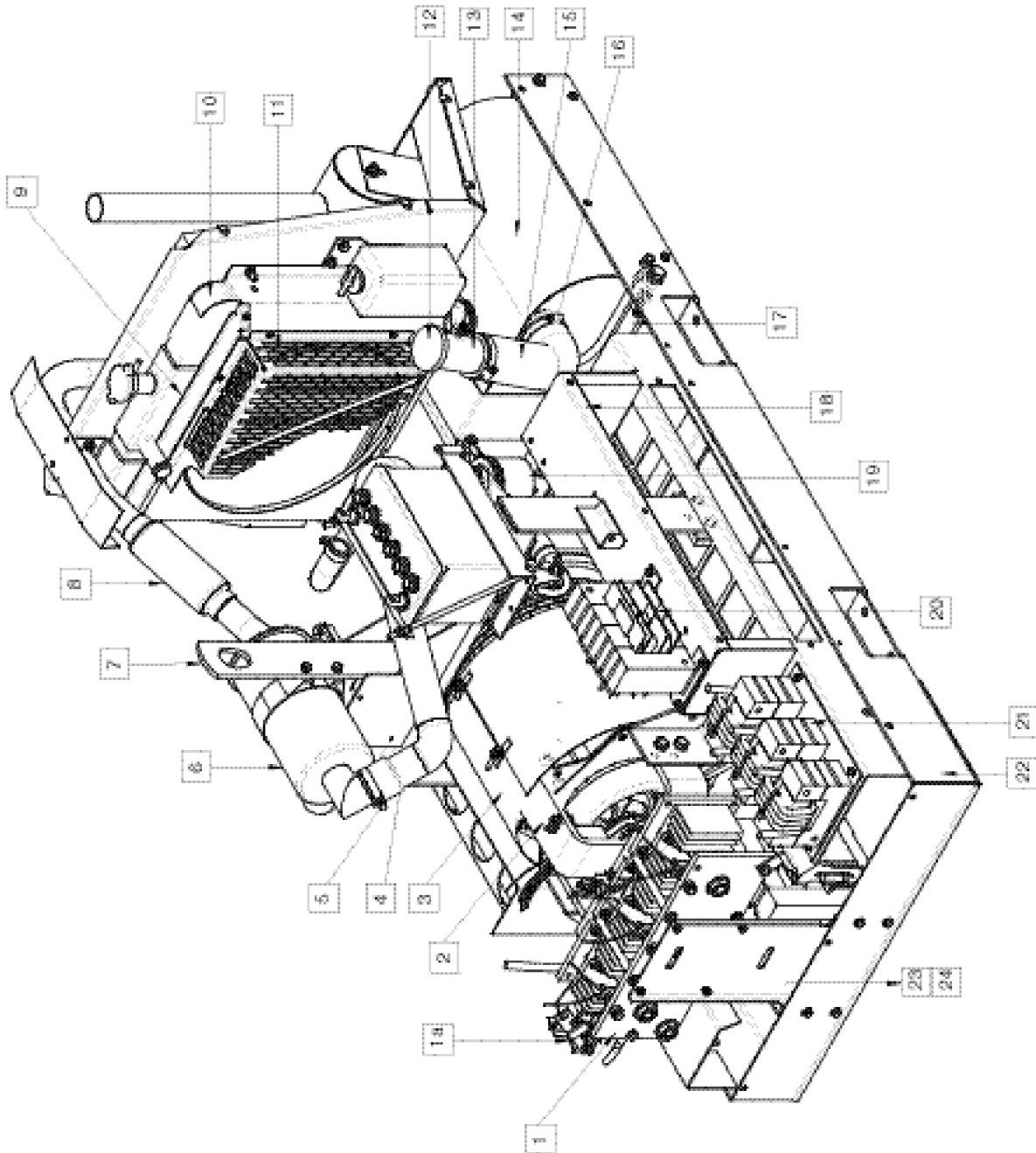
Use only the parts marked "X" in the column under the heading number called for in the model index page.

Recommended Spare Parts are highlighted in bold

| ITEM | DESCRIPTION | PART NO. | QTY. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|------------------------------------|------------|------|---|---|---|---|---|---|---|---|---|
| 1 | Louvre Assembly | AL2644 | 1 | x | - | - | - | | | | | |
| | Louvre Assembly | AL2644-1 | 1 | - | x | x | x | | | | | |
| 2 | Exhaust Pipe Clamp 1.875" | AT3192-2 | 1 | x | x | x | x | | | | | |
| 3 | Pull Tab - Door Key Lock | AM3466-2A | 1 | x | x | x | x | | | | | |
| 4 | Door Key Lock | AM3466-2 | 1 | x | x | x | x | | | | | |
| 5 | Access Door | AL2573-2SP | 1 | x | - | - | - | | | | | |
| | Access Door | AL2573-4 | 1 | - | x | x | - | | | | | |
| | Access Door | AL2573-4W | 1 | - | - | - | x | | | | | |
| 6 | Door Hinge Spacer | AS4537 | 2 | x | x | x | x | | | | | |
| 7 | Right Hand Hinge Offset | AS4536-1 | 2 | x | x | x | x | | | | | |
| | Left Hand Hinge Offset | AS4536-2 | 2 | x | x | x | x | | | | | |
| 8 | Output Door & Strip Assy | AS4664 | 1 | x | - | - | - | | | | | |
| | Output Door & Strip Assy | AS4664-1 | 1 | - | x | x | - | | | | | |
| | Output Door & Strip Assy | AS4664-1W | 1 | - | - | - | x | | | | | |
| 9 | Control Panel Door Assy (includes) | AM3542 | 1 | x | - | - | - | | | | | |
| | Door Paddle Latch | AM3466-1 | 1 | x | - | - | - | | | | | |
| | Rubber Buffer | AS4404-1 | 1 | x | - | - | - | | | | | |
| | Fastener Button | T14659-1 | 2 | - | - | - | - | | | | | |
| 9 | Control Panel Door Assy (includes) | AM3542-1 | 1 | - | x | - | - | | | | | |
| | Control Panel Door | AL2721 | 1 | - | x | - | - | | | | | |
| | Weather Strip | NSS | 1 | - | x | - | - | | | | | |
| | Hinge | NSS | 1 | - | x | - | - | | | | | |
| 9 | Control Panel Door Assy (includes) | AM3542-3 | 1 | - | - | x | - | | | | | |
| | Control Panel Door | AL2721-2 | 1 | - | - | x | - | | | | | |
| | Gas Strut Bracket | AS4730-2 | 1 | - | - | x | - | | | | | |
| | Door Paddle Latch | AM3466-1 | 1 | - | - | x | - | | | | | |
| | Right Hand Hinge Offset | AS4536-3 | 1 | - | - | x | - | | | | | |
| | Left Hand Hinge Offset | AS4536-4 | 1 | - | - | x | - | | | | | |
| 9 | Control Panel Door Assy (includes) | AM3542-3W | 1 | - | - | - | x | | | | | |
| | Control Panel Door | AL2721-2W | 1 | - | - | - | x | | | | | |
| | Gas Strut Bracket | AS4730-2 | 1 | - | - | - | x | | | | | |
| | Door Paddle Latch | AM3466-1 | 1 | - | - | - | x | | | | | |
| | Right Hand Hinge Offset | AS4536-3 | 1 | - | - | - | x | | | | | |
| | Left Hand Hinge Offset | AS4536-4 | 1 | - | - | - | x | | | | | |
| 10 | Door Paddle Latch | AM3466-1 | 1 | x | x | x | x | | | | | |
| 11 | Right Hand Hinge Offset | AS4536-3 | 1 | - | - | x | x | | | | | |
| 12 | Left Hand Hinge Offset | AS4536-4 | 1 | - | - | x | x | | | | | |
| 13 | Side Access Panel | AM3460 | 1 | - | - | x | - | | | | | |
| | Side Access Panel | AM3460W | 1 | - | - | - | x | | | | | |
| 14 | Lower Left Hand Side Panel | AG1380 | 1 | x | x | x | - | | | | | |
| | Lower Left Hand Side Panel | AG1380W | 1 | - | - | - | x | | | | | |
| 15 | Small Side Panel Louvre | AL2610 | 2 | x | x | x | x | | | | | |
| 16 | Large Side Panel Louvre | AL2610-1 | 4 | x | x | x | x | | | | | |
| 17 | Left Hand End Frame Panel | AL2555 | 1 | x | x | x | - | | | | | |
| | Left Hand End Frame Panel | AL2555W | 1 | - | - | - | x | | | | | |
| * | Right Hand End Frame Panel | AL2556 | 1 | x | x | x | - | | | | | |
| * | Right Hand End Frame Panel | AL2556W | 1 | - | - | - | x | | | | | |
| 18 | Lower Chassis End Panel | AM3447 | 1 | x | x | x | - | | | | | |
| | Lower Chassis End Panel | AM3447W | 1 | - | - | - | x | | | | | |
| 19 | Radiator End Cover Panel | AL2560-2 | 1 | x | - | - | - | | | | | |
| | Radiator End Cover Panel | AL2560-4 | 1 | - | x | x | - | | | | | |
| | Radiator End Cover Panel | AL2560-4W | 1 | - | - | - | x | | | | | |

General Assembly

Operative: AP-210D
Jul 2004
Supersedes: Feb 2002



AG1459A
A24.3.04M

- Ø Obsolete item.
- # Indicates a change this printing.
- * Items not illustrated.

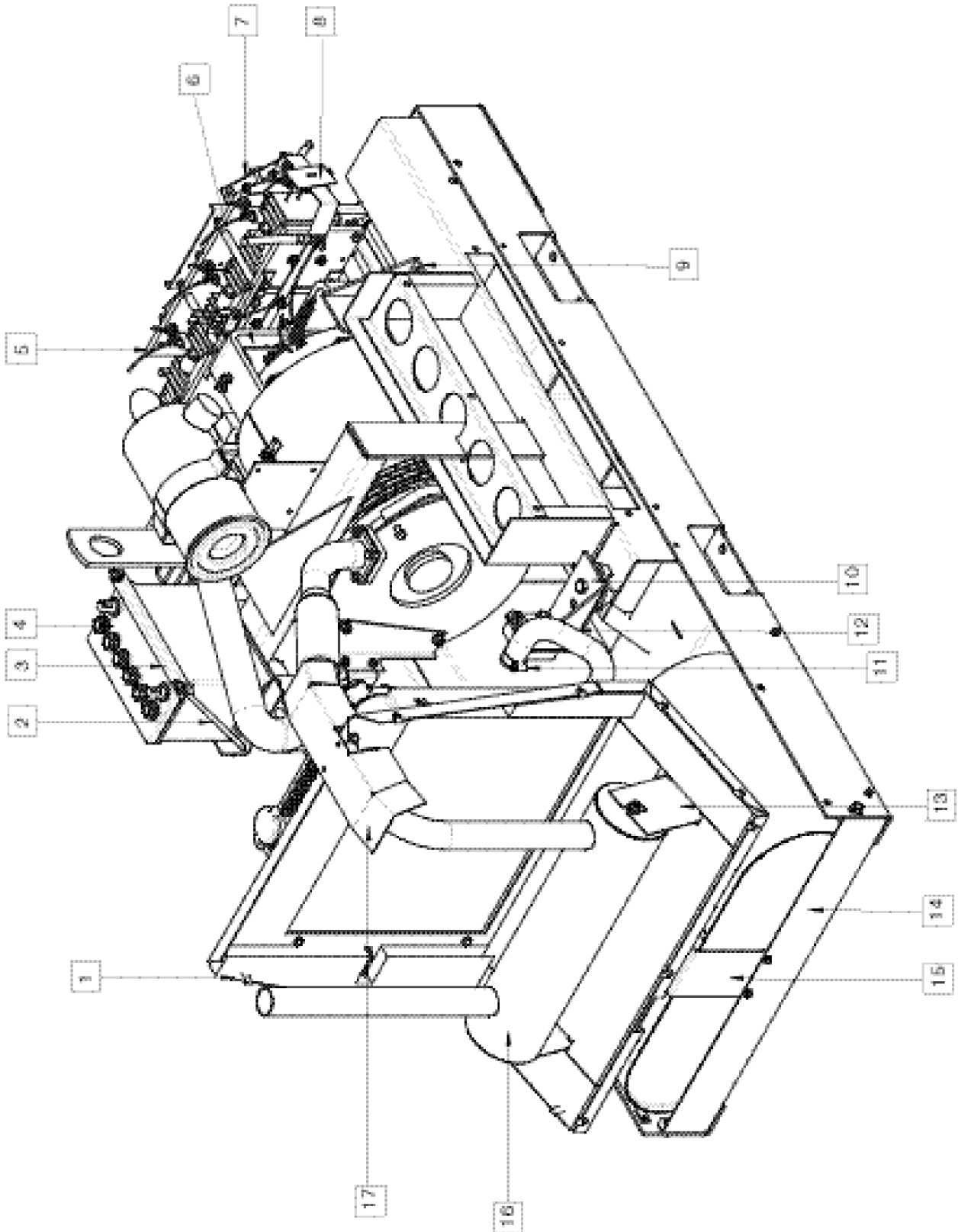
Use only the parts marked "X" in the column under the heading number called for in the model index page.

Recommended Spare Parts are highlighted in bold

| ITEM | DESCRIPTION | PART NO. | QTY. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|--|----------------------------------|---------------|------|---|---|---|---|---|---|---|---|---|
| 1 | Rectifier Assembly (see Note 1) | AL2463-4 | 1 | x | x | x | x | | | | | |
| 1a | Shunt & Lead Assembly | S19588 | 1 | x | x | x | x | | | | | |
| 2 | Machined Stator Assy | AT4100-6 | 1 | x | x | x | x | | | | | |
| 3 | Stator Cover Assy | AM3098-2 | 1 | x | x | x | x | | | | | |
| 4 | Air Cleaner Hose (Kubota) | AL2620 | 1 | x | x | x | - | | | | | |
| | Air Cleaner Hose (Perkins) | AL2742 | 1 | - | - | - | x | | | | | |
| 5 | Air Cleaner Hose Clamp | AT3061 | 1 | x | x | x | x | | | | | |
| 5a | Air Cleaner Hose Clamp (Eng End) | AT3061-6 | 1 | x | x | x | x | | | | | |
| 6 | Air Cleaner Element (Kubota) | K815741-11083 | 1 | x | x | x | - | | | | | |
| | Air Cleaner Element (Perkins) | P26510362 | 1 | - | - | - | x | | | | | |
| 7 | Liftbale Assembly | AL2625-1 | 1 | x | x | - | - | | | | | |
| | Liftbale Assembly | AL2625-2 | 1 | - | - | - | x | | | | | |
| | Liftbale Assembly | AL2625-3 | 1 | - | - | - | x | | | | | |
| 8 | Exhaust Pipe Assy (Kubota) | AM3509-1 | 1 | x | x | x | - | | | | | |
| | Exhaust Pipe Assy (Perkins) | AM3509-2 | 1 | - | - | - | x | | | | | |
| | Heat Shield | AM3676 | 1 | - | - | x | x | | | | | |
| 9 | Radiator Sealing Strap | AM3464 | 2 | x | x | x | x | | | | | |
| 10 | Radiator Assy (See Note 2) | AG1381 Ø | 1 | x | x | - | x | | | | | |
| | Radiator Assy | AG1381-3 | | - | - | x | x | | | | | |
| 11 | Fan Guard Assy | AM3506 | 1 | x | x | - | x | | | | | |
| | Fan Guard Assy | AM3665-1 | | - | - | x | x | | | | | |
| 12 | Fuel Tank Cap | AT3024 | 1 | x | x | x | x | | | | | |
| 13 | Filler Pipe & Fitting Assy | AS3702-1 | 1 | x | x | x | x | | | | | |
| 14 | Fuel Tank Assembly | AL2630-1 | 1 | x | x | x | x | | | | | |
| 15 | Fuel Filler Hose | AS4370-1 | 1 | x | x | x | x | | | | | |
| 16 | Hose Clamp | AT3061-5 | 2 | x | x | x | x | | | | | |
| 17 | Radiator Drain Hose x .4m | AE1166-1 | 1 | x | x | x | x | | | | | |
| 18 | R.H. Air Duct & Foam Assy | AL2545-1 | 1 | x | x | x | x | | | | | |
| 19 | Fuel Filter (Kubota) | K15221-43172 | 1 | x | x | x | - | | | | | |
| | Fuel Filter (Perkins) | P2651117 | 1 | - | - | - | x | | | | | |
| 20 | Control Transformer (Use PT0068) | PT0065 Ø | 1 | x | x | - | x | | | | | |
| | Control Transformer | PT0068 | 1 | - | - | x | x | | | | | |
| 21 | Reactors & Plate Assy | AM3493-1 | 1 | x | x | x | x | | | | | |
| 22 | Chassis & Foam | AG1372-1 | 1 | x | x | x | x | | | | | |
| 23* | Base Cover Plate | AL2574 | 1 | x | x | x | x | | | | | |
| 24 | Choke & Bracket Assy | AL2698-1 | 1 | x | x | x | x | | | | | |
| <div style="border: 1px solid black; padding: 10px; margin: 0 auto; width: 80%;"> <p>Note 1 Earlier Codes will need to use the gate harness off the original Rectifier Assembly</p> <p>Note 2 Order AG1381-3 Radiator plus AM3665-1, AM3464 x 2, AS1733-3Z x 10</p> </div> | | | | | | | | | | | | |

General Assembly

Operative: AP-210D.3
Jul 2004
Supersedes: Feb 2002



AG1459A
A24.3.04M

- Ø Obsolete item.
- # Indicates a change this printing.
- * Items not illustrated.

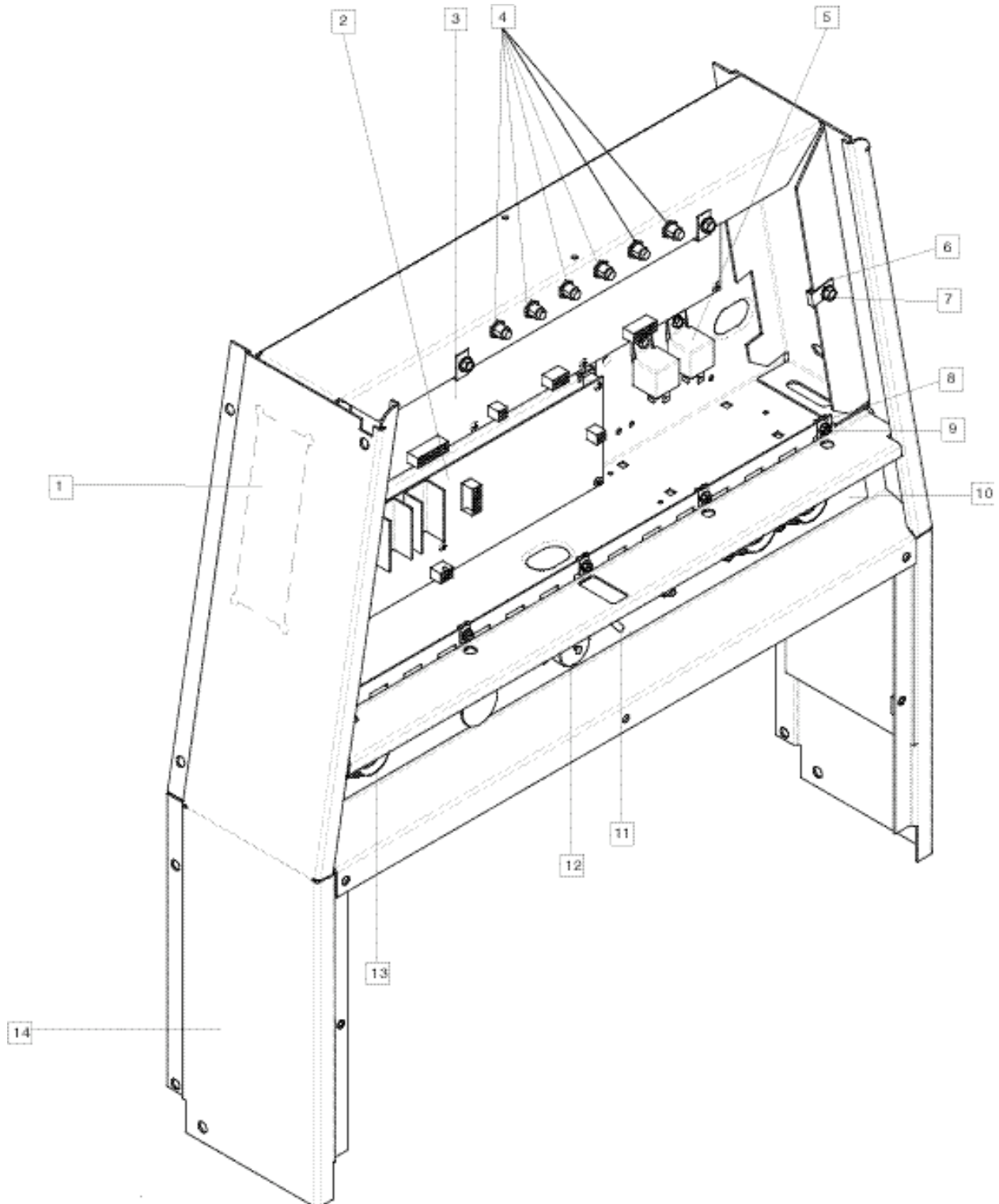
Use only the parts marked "X" in the column under the heading number called for in the model index page.

Recommended Spare Parts are highlighted in bold

| ITEM | DESCRIPTION | PART NO. | QTY. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|-------------------------------------|--------------|------|---|---|---|---|---|---|---|---|---|
| 1 | Radiator Baffle Panel(Kubota) | AG1378 | 1 | x | x | x | - | | | | | |
| | Radiator Baffle Panel (Perkins) | AG1378-1 | 1 | - | - | - | x | | | | | |
| | Radiator Louvre Assy | AM3502 | 1 | x | x | - | x | | | | | |
| 2 | Battery Stud | AT2146Z | 2 | x | x | x | x | | | | | |
| 3 | Battery Clamp | AS4644 | 1 | x | x | x | x | | | | | |
| 4 | Battery 12V | AS3553-2A | 1 | x | x | x | x | | | | | |
| 5 | Rectifier Assembly (see Note 1) | AL2463-4 | 1 | x | x | x | x | | | | | |
| 6 | Brushholder Assembly (includes) | AM3116-2 | 1 | x | x | x | x | | | | | |
| | Carbon Brush | AT3081 | 2 | x | x | x | x | | | | | |
| 7 | Shunt & Lead Assy | S19588 | 1 | x | x | x | x | | | | | |
| 8 | Reed Switch Assy (includes) | AS4767 | 1 | x | x | x | x | | | | | |
| | Copper Lead | AM3646 | 1 | x | x | x | x | | | | | |
| | Reed Switch Plate | S11797-14 | 1 | x | x | x | x | | | | | |
| | Reed Switch | S12334-50 | 1 | x | x | x | x | | | | | |
| | Clamp | T8970-17 | 2 | x | x | x | x | | | | | |
| 9 | Engine & Stator Foot Assy | AM3436 | 2 | x | x | x | x | | | | | |
| 10 | Engine & Stator Foot Assy (Kubota) | AM3436 | 2 | x | x | x | - | | | | | |
| | Engine & Stator Foot Assy (Perkins) | AM3436-1 | 2 | - | - | - | x | | | | | |
| 11 | Radiator Hose Clamp | AT3061-1 | 4 | x | x | x | x | | | | | |
| 12 | Bottom Radiator Hose (Kubota) | AS4541 | 1 | x | x | x | - | | | | | |
| | Bottom Radiator Hose (Perkins) | AL2741 | 1 | - | - | - | x | | | | | |
| 13 | Muffler Bracket | AM3504 | 2 | x | x | x | x | | | | | |
| 14 | Fuel Tank Tray Assy | AM3438 | 1 | x | x | x | x | | | | | |
| 15 | Fuel Tank Strap | AM3443 | 1 | x | x | x | x | | | | | |
| 16 | Muffler Assy (Vertical outlet) | AG1402-3 | 1 | x | x | x | x | | | | | |
| 17 | Heat Shield | AM3676 | 1 | - | - | x | x | | | | | |
| 18* | Exhaust Clamp | AT3192-2 | 1 | x | x | x | - | | | | | |
| 19* | Exhaust Gasket | AT3820-1 | 1 | x | x | x | - | | | | | |
| 20* | Top Radiator Hose (Kubota) | K16266-72941 | 1 | x | x | x | - | | | | | |
| | Top Radiator Hose (Perkins) | AL2740 | 1 | - | - | - | x | | | | | |

Front End Frame Module

Operative: AP-210F
Supersedes: Jul 2004
Feb 2002



AG1403-7
A27.8.03M

- Ø Obsolete item.
- # Indicates a change this printing.
- * Items not illustrated.

Use only the parts marked "X" in the column under the heading number called for in the model index page.

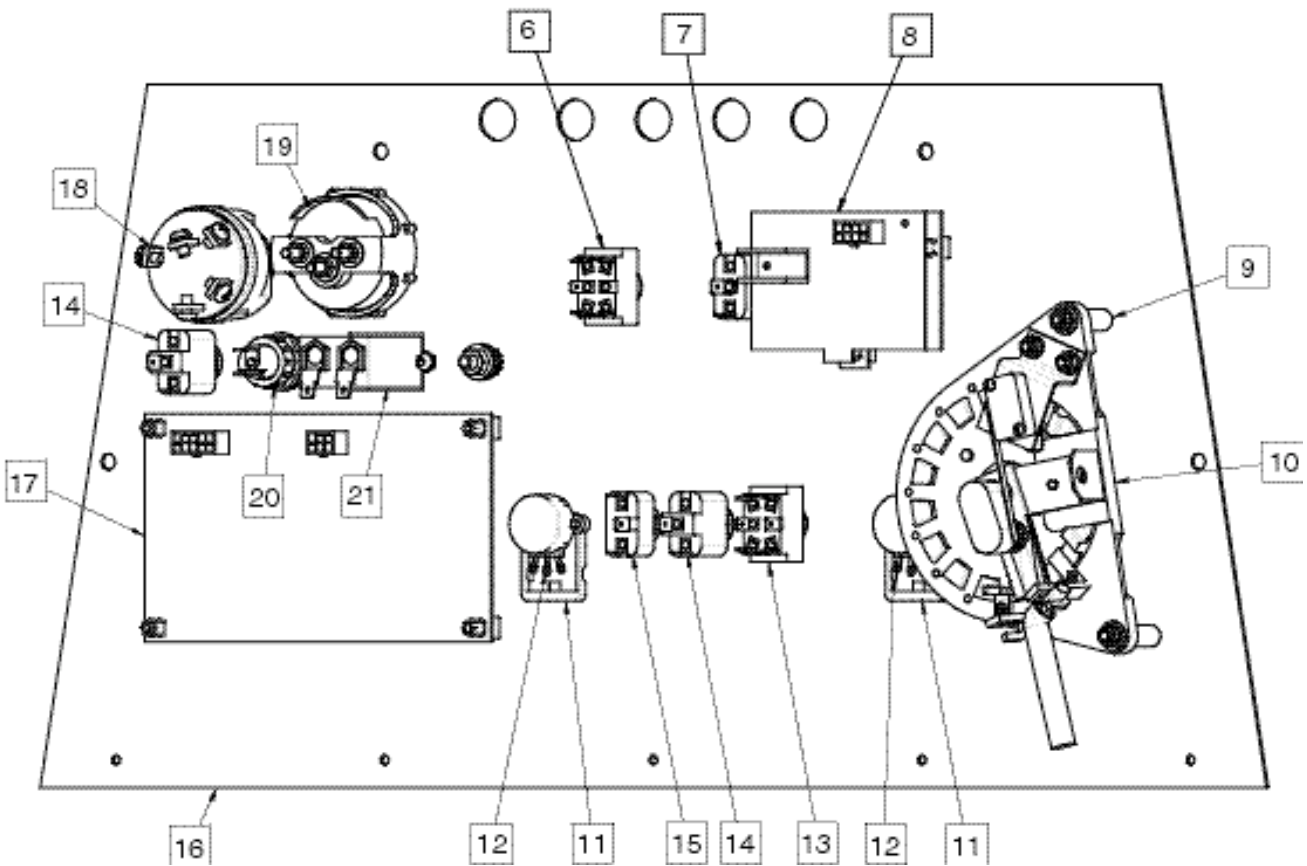
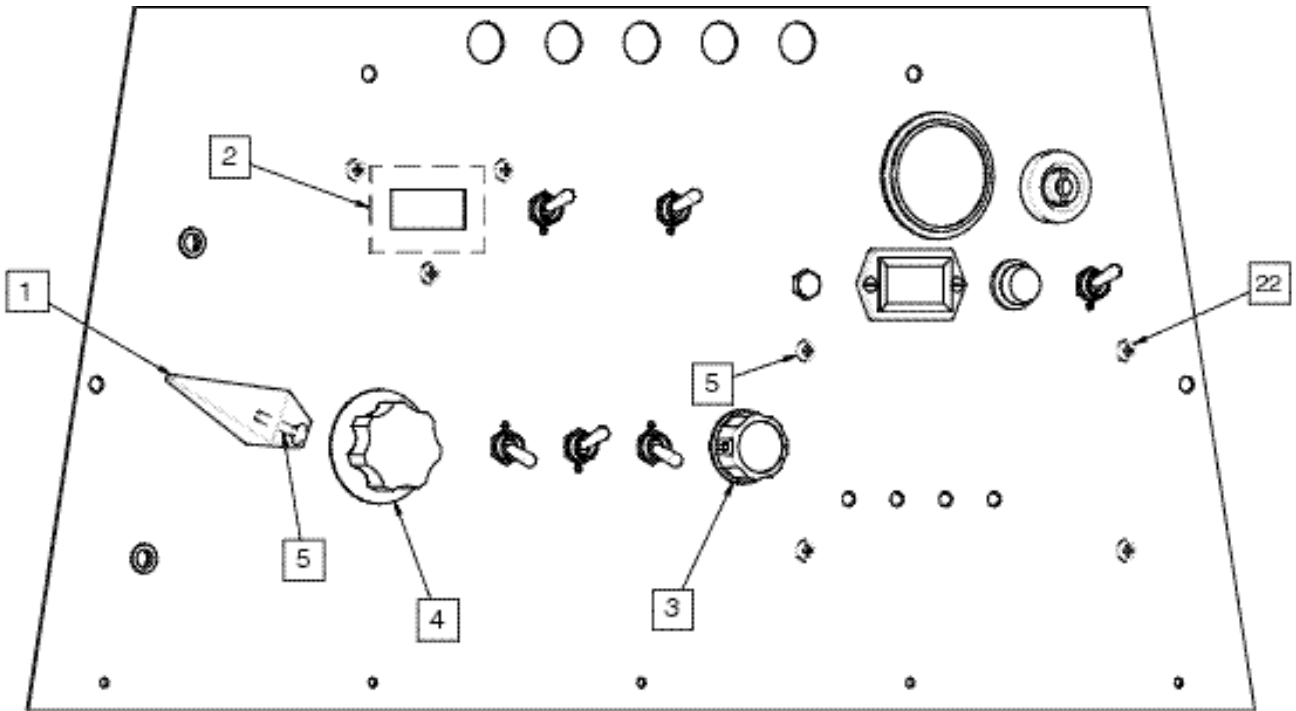
Recommended Spare Parts are highlighted in bold

| ITEM | DESCRIPTION | PART NO. | QTY. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|---|-----------|------|---|---|---|---|---|---|---|---|---|
| 1 | OCV PCB | G4407-1 | 1 | - | - | x | x | | | | | |
| 2 | ROCV PCB Assy | AL2696-1A | 1 | x | x | x | x | | | | | |
| * | ROCV PCB Bracket | AL2694 | 1 | x | x | x | x | | | | | |
| 3 | Control Board Assy (codes below 1663) | G3163-1 | 1 | x | - | - | x | | | | | |
| | Control PCB Assy (incl AL269601A) (codes 1663 & above) | G4140-1 | 1 | - | x | x | x | | | | | |
| | | | | - | - | - | x | | | | | |
| 4 | 10A Circuit Breaker | T12287-20 | 4 | x | x | x | x | | | | | |
| | 15A Circuit Breaker | T12287-22 | 1 | x | x | - | x | | | | | |
| 5 | 12V S/Pole Relay | AT3632 | 3 | x | x | x | x | | | | | |
| 6 | Speed Nut | T11525-5 | 4 | x | x | x | x | | | | | |
| 7 | 1/4" Canopy Screw - Black Zinc | AS1733-4B | 4 | x | x | x | x | | | | | |
| 8 | Speed Nut #10-24 | T11525-1 | 5 | - | x | x | x | | | | | |
| 9 | Self Tapping Screw | S8025-92 | 5 | - | x | x | x | | | | | |
| 10 | Output Panel Nameplate | AM3610 | 1 | x | x | - | x | | | | | |
| | Output Panel Nameplate | AG1458 | | - | - | x | x | | | | | |
| 11 | Toggle Switch | T10800-39 | 1 | - | - | x | x | | | | | |
| 12 | 14 Pin Connector Base | S12021-40 | 1 | x | x | x | x | | | | | |
| | Connector Cap | S17062-3 | 1 | - | x | x | x | | | | | |
| 13 | Output Terminal Assy | M13896-3 | 3 | x | x | x | x | | | | | |
| 14 | End Frame | AL2550-3 | 1 | x | - | - | - | | | | | |
| | End Frame | AL2550-5 | 1 | - | x | - | - | | | | | |
| | End Frame | AL2550-5 | 1 | - | - | x | - | | | | | |
| | End Frame | AL2550-5W | 1 | - | - | - | x | | | | | |

Control Panel Assembly for Codes 1691 & below)

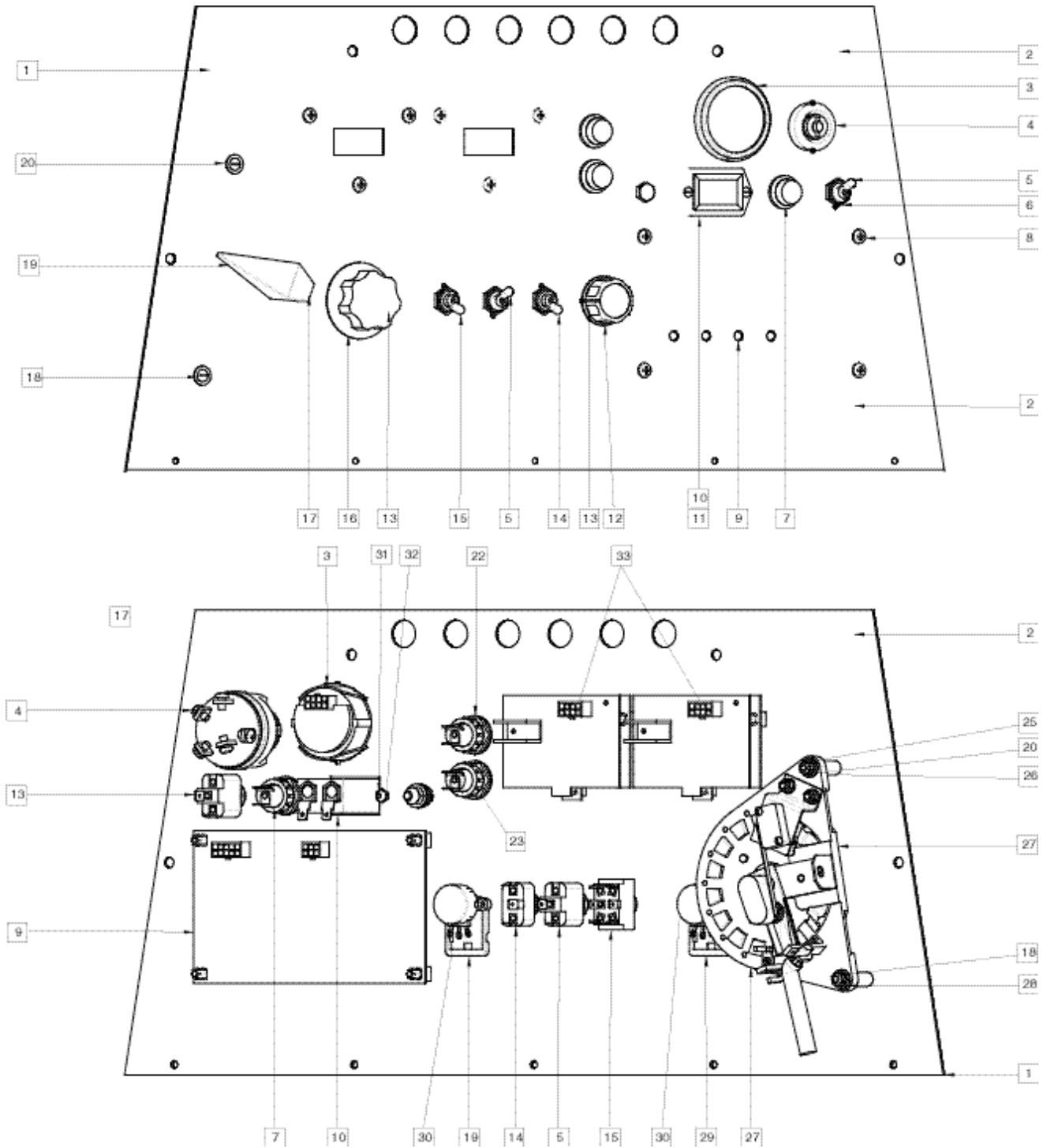
Operative:
Supersedes:

AP-210G
Feb 2002



Control Panel Assembly (for Codes 70001 & above)

Operative: AP-210G
 Jul 2004
 Supersedes: Feb 2002



AL2616-5
 A03.09.03M

- Ø Obsolete item.
- # Indicates a change this printing.
- * Items not illustrated.

Use only the parts marked "X" in the column under the heading number called for in the model index page.

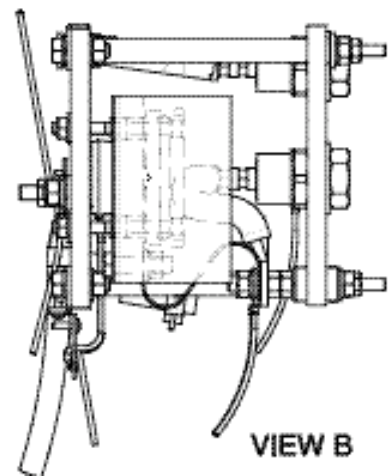
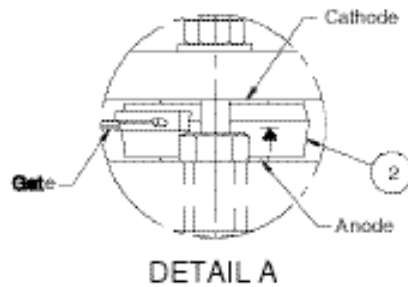
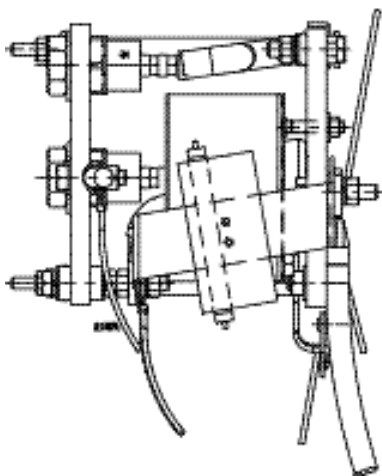
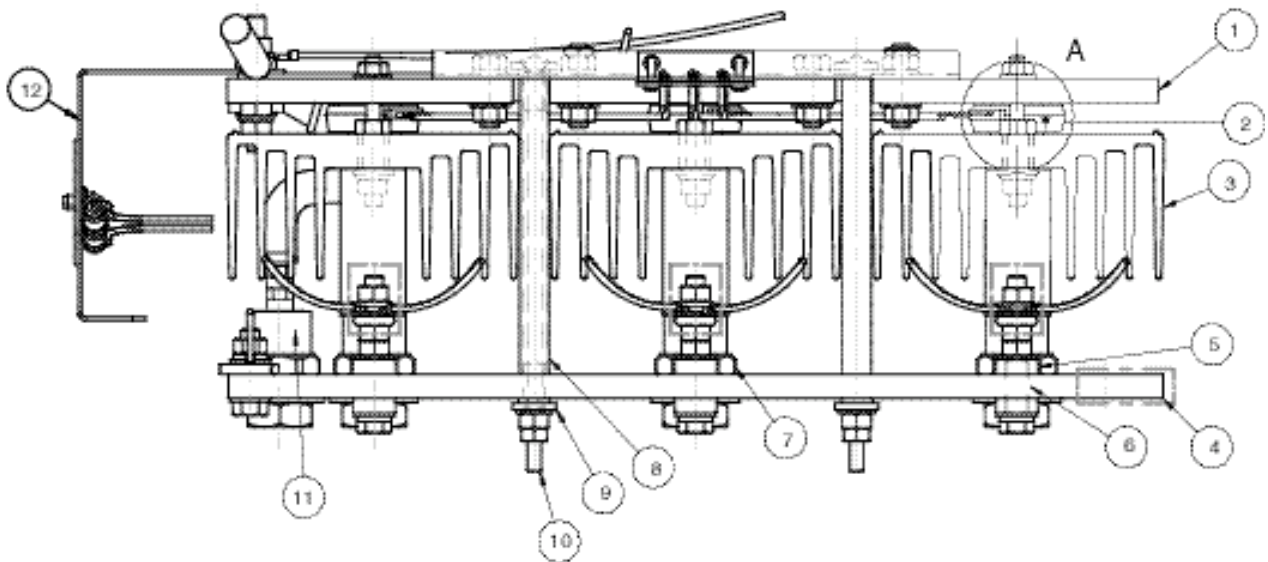
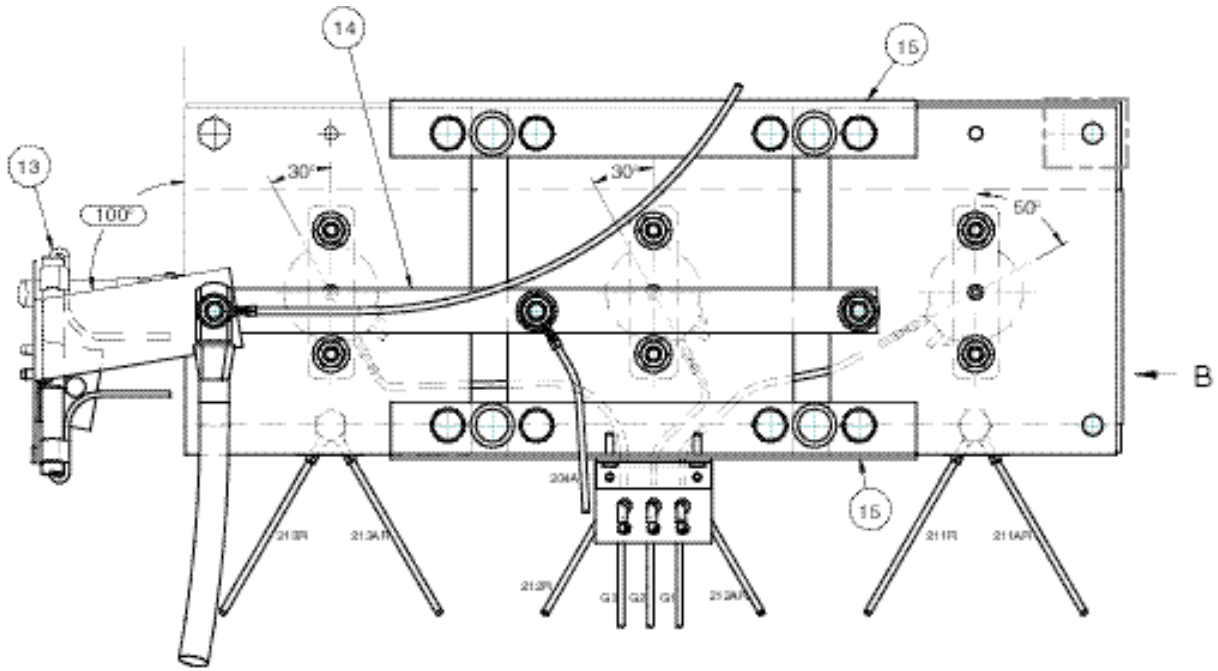
Recommended Spare Parts are highlighted in bold

| ITEM | DESCRIPTION | PART NO. | QTY. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|--------------------------------------|-------------|------|---|---|---|---|---|---|---|---|---|
| 1 | Front Panel | AL2575-9 | 1 | - | - | x | | | | | | |
| 2 | Nameplate Decal | AG1455 | 1 | - | - | x | | | | | | |
| 3 | Fuel Gauge | S17585-1 | 1 | - | - | x | | | | | | |
| 4 | Key Switch | K66706-5512 | 1 | - | - | x | | | | | | |
| 5 | SPST Toggle Switch | T10800-55 | 2 | - | - | x | | | | | | |
| 6 | Toggle Switch Sealing Boot | S22061-4 | 4 | - | - | x | | | | | | |
| 7 | Warning Light Assy (Amber) | AT2996-3 | 1 | - | - | x | | | | | | |
| 8 | S/T Pan Hd Screw | S8025-15 | 10 | - | - | x | | | | | | |
| 9 | PC Board Assembly | L10558-1AA | 1 | - | - | x | | | | | | |
| 10 | Hourmeter | S17475-3 | 1 | - | - | x | | | | | | |
| 11 | Screw (Supp'd with Hourmeter) | NSS | 2 | - | - | x | | | | | | |
| 12 | Knob 1.5" Dia. | T10491 | 1 | - | - | x | | | | | | |
| 13 | O Ring | T13483-7 | 2 | - | - | x | | | | | | |
| 14 | SPDT Toggle Switch | T13562 | 1 | - | - | x | | | | | | |
| 15 | DPDT Toggle Switch | T10800-39 | 1 | - | - | x | | | | | | |
| 16 | Knob Black 2in Dia | T10491-1 | 1 | - | - | x | | | | | | |
| 17 | S/T C/sunk Screw | S8025-78 | 1 | - | - | x | | | | | | |
| 18 | 3/16"Whit x 1.75" R.H. Screw | AM3053-131 | 2 | - | - | x | | | | | | |
| 19 | Selector S/W Handle | S13207 | 1 | - | - | x | | | | | | |
| 20 | 3/16" Flatwasher | S9262-27 | 4 | - | - | x | | | | | | |
| 21 | Filter Lens | T14807-4 | 2 | - | - | x | | | | | | |
| 22 | Warning Light Assy (Green) | AT2996-4 | 1 | - | - | x | | | | | | |
| 23 | Warning Light Assy (Red) | AT2996-2 | 1 | - | - | x | | | | | | |
| 24 | 1/4"UNC x 1" Hex Screw | AM3053-177 | 1 | - | - | x | | | | | | |
| 25 | 3/16"UNC Hex Nut | AM3055-76 | 2 | - | - | x | | | | | | |
| 26 | Spacer Tube | AT1932 | 2 | - | - | x | | | | | | |
| 27 | Selector Switch | AM3312-2 | 1 | - | - | x | | | | | | |
| 28 | 3/16" Springwasher | E106A1 | 2 | - | - | x | | | | | | |
| 29 | Potentiometer Spacer | S18280 | 2 | - | - | x | | | | | | |
| 30 | Potentiometer | T10812-40 | 2 | - | - | x | | | | | | |
| 31 | Hex Nut (Supplied with Hourmeter) | Supplied | 2 | - | - | x | | | | | | |
| 32 | Lockwasher (Supplied with Hourmeter) | Supplied | 2 | - | - | x | | | | | | |
| 33 | Digital PCB Rework | AS4728-1 | 2 | - | - | x | | | | | | |

Output Rectifier Assembly

Operative:
Supersedes:

AP-210H
Jul 2004
Feb 2002



- Ø Obsolete item.
- # Indicates a change this printing.
- * Items not illustrated.

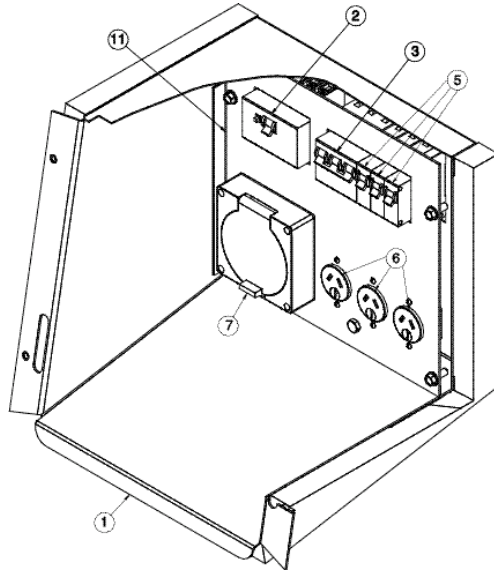
Use only the parts marked "X" in the column under the heading number called for in the model index page.

Recommended Spare Parts are highlighted in bold

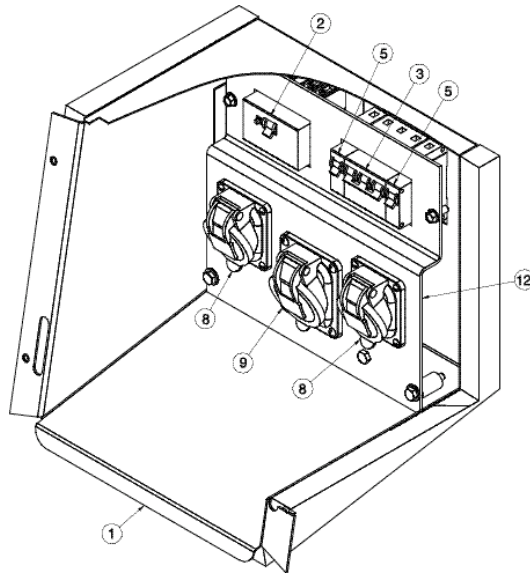
| ITEM | DESCRIPTION | PART NO. | QTY. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|--|---|------------|------|---|---|---|---|---|---|---|---|---|
| | Rectifier Assy (code below 1663) Note 1 | AL2463-2 Ø | 1 | x | - | | | | | | | |
| | Rectifier Assy (code 1663 to 700015) | AL2463-3 Ø | 1 | - | x | | | | | | | |
| | Rectifier Assy Includes | AL2463-4 | 1 | x | x | x | | | | | | |
| 1 | Cathode Heat Sink | AM2435-1 | 3 | x | x | x | | | | | | |
| 2 | SCR | M12283-10 | 3 | x | x | x | | | | | | |
| 3 | Aluminium Heat Sink | M12314-3 | 3 | x | x | x | | | | | | |
| 4 | Rectifier Heat Sink | L5824 | 1 | x | x | x | | | | | | |
| 5 | Insulating Tube | T7028-135 | 6 | x | x | x | | | | | | |
| 6 | Insulating Tube | T7028-133 | 3 | x | x | x | | | | | | |
| 7 | Diode | M9661-31 | 3 | x | x | x | | | | | | |
| 8 | 5/16" UNC x 2.5" Hex Screw | NSS | 3 | x | x | x | | | | | | |
| 9 | Insulating Bushing | S16860 | 8 | x | x | x | | | | | | |
| 10 | 1/4" UNC 7" Carriage Bolt | T11827-31 | 4 | x | x | x | | | | | | |
| 11 | Diode | M9661-1 | 1 | x | x | x | | | | | | |
| 12 | Reed Switch Assy (includes) | AS4767 | 1 | x | x | x | | | | | | |
| 13 | Reed Switch | S12334-50 | 1 | x | x | x | | | | | | |
| | Clamp | T8970-17 | 2 | x | x | x | | | | | | |
| 14 | Copper Lead | AM3646 | 1 | x | x | x | | | | | | |
| | Reed Switch Plate | S11797-14 | 1 | x | x | x | | | | | | |
| 15 | Support Bracket | M13430 | 2 | x | x | x | | | | | | |
| <div style="border: 1px solid black; padding: 10px; width: fit-content; margin: 0 auto;"> <p>Note 1 Use AL2463-4. Earlier codes will need to use the Gate Harness of original Rectifier Assy.</p> </div> | | | | | | | | | | | | |

Auxiliary Output Box Module

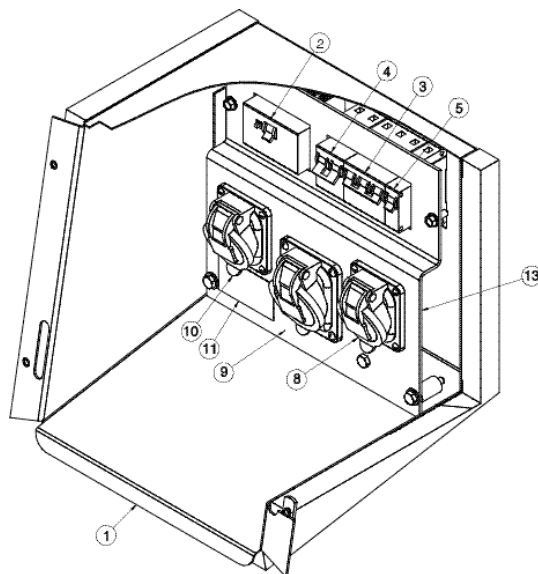
Operative: AP-210J
Revised: Jul 2004
Revised: Feb 2002



Australian Model
Ref. AL2614-4



European Model
Ref. AL2614-1



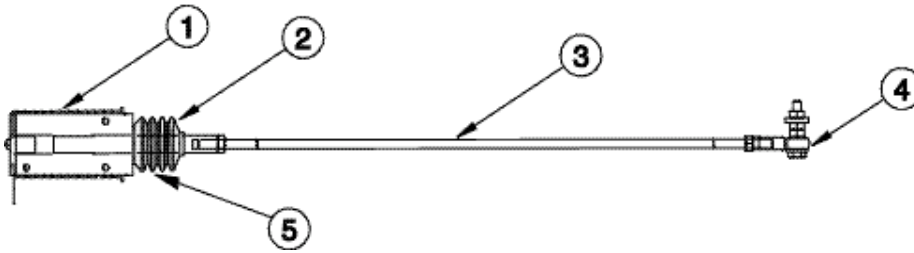
UK Model
Ref. AL2614-2

- Ø Obsolete item.
- # Indicates a change this printing.
- * Items not illustrated.

U210J.1se only the parts marked "X" in the column under the heading number called for in the model index page.

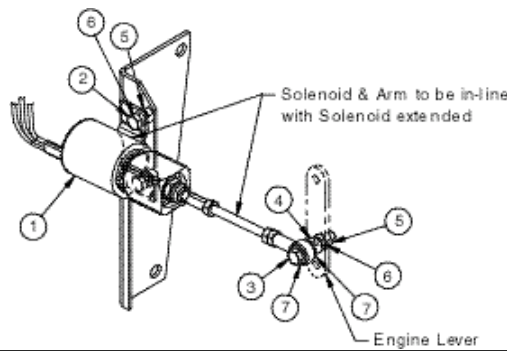
Recommended Spare Parts are highlighted in bold

| ITEM | DESCRIPTION | PART NO. | QTY. | | | | | | | | | | | |
|------|--|----------------------|------|---|---|---|---|---|---|---|---|---|--|--|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | |
| 1 | Output Box & Foam | AM3521-23 | 1 | x | x | x | x | x | | | | | | |
| 2 | RCD 25A4 Pole | AS4345-1 | 1 | x | x | x | x | x | | | | | | |
| 3 | Circuit Breaker 20A3phase | AS4344-1 | 1 | x | x | x | x | x | | | | | | |
| 4 | Circuit Breaker 2 Pole 20A | AS4684-2 | 1 | - | - | x | - | - | | | | | | |
| 5 | Circuit Breaker 16A Single Phase | AS4343-1 | 3 | x | x | x | x | x | | | | | | |
| 6 | Plug Base 240V 15A | AT1875-5 | 3 | x | - | - | - | - | | | | | | |
| 7 | Plug Base 415V 5 pin | AM3313-1 | 1 | x | - | - | - | - | | | | | | |
| 8 | Plug Outlet 3 Pin 200/250V | AM3567-1 | 1 | - | x | x | x | x | | | | | | |
| 9 | Plug Outlet 4 Pin 380/415V Plug Outlet 5 Pin 400V | AM3567-2 AM3567-3 | 1 | - | - | x | - | x | | | | | | |
| 10 | Plug Outlet 3 Pin 110/130V | AM3567-4 | 1 | - | - | x | - | x | | | | | | |
| 11 | Output Box Panel | AM3515-1 | 1 | x | - | - | - | - | | | | | | |
| 12 | Output Box Panel & Tube | AM3566-1 | 1 | - | x | - | x | - | | | | | | |
| 13 | Output Box Panel & Tube | AM3566-2 | 1 | - | - | x | - | x | | | | | | |
| 14* | Aux Sensor PCB | M18765-1AA | 1 | x | x | x | x | x | | | | | | |
| 15 | Outlet Caution Decal | AT4135 | 1 | - | - | x | - | x | | | | | | |



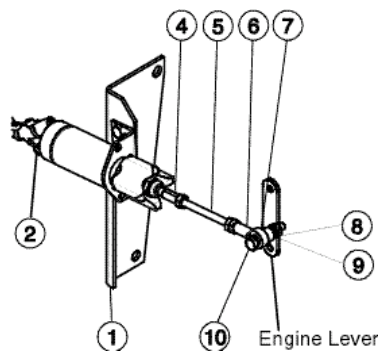
**Throttle
 Attachment Detail
 Codes below 1663**

| ITEM | DESCRIPTION | PART NO. | QTY. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|---------------------------------|----------|------|---|---|---|---|---|---|---|---|---|
| | USE SOLENOID UPGRADE KIT | AS4833 | 1 | x | - | - | | | | | | |
| 1 | Engine Idler Solenoid Assy Ø | | 1 | x | - | - | | | | | | |
| 2 | Solenoid Plunger | AS4562Z | 1 | x | - | - | | | | | | |
| 3 | Throttle Rod | AS4324-9 | 1 | x | - | - | | | | | | |
| 4 | Rod End | AT4090 | 1 | x | - | - | | | | | | |
| 5 | Rubber Sealing Boot | AS4561 | 1 | x | - | - | | | | | | |



**Throttle
 Attachment Detail
 Code 1663-70001**

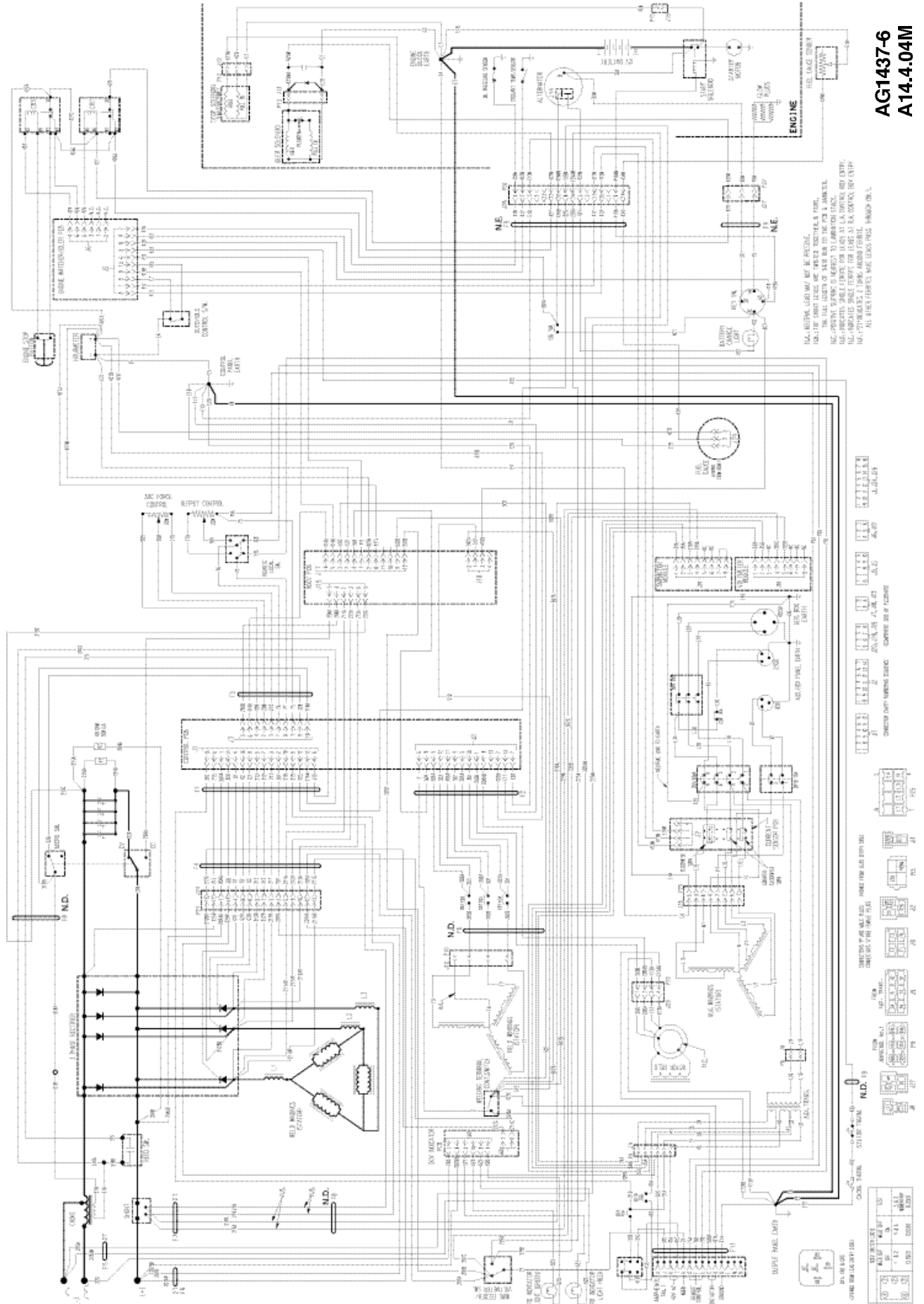
| ITEM | DESCRIPTION | PART NO. | QTY. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|---------------------------------|------------|------|---|---|---|---|---|---|---|---|---|
| | USE SOLENOID UPGRADE KIT | AS4833 | 1 | - | x | - | | | | | | |
| 1 | Idler Solenoid Assy Ø | | 1 | - | x | - | | | | | | |
| 2 | 1/4" UNC x 5/8" Hex Screw | AM3053-180 | 2 | - | x | - | | | | | | |
| 3 | 1/4" UNC x 1.5" Hex Screw | AM3053-180 | 1 | - | x | - | | | | | | |
| 4 | Spacer | AT4137Z | 1 | - | x | - | | | | | | |
| 5 | 1/4" UNC Hex Nut | AM3055-90 | 3 | - | x | - | | | | | | |
| 6 | 1/4" Springwasher | E106A2 | 3 | - | x | - | | | | | | |
| 7 | 1/4" Flatwasher | S9262-98 | 2 | - | x | - | | | | | | |



**Idler Solenoid
 Codes 70005
 and above**

| ITEM | DESCRIPTION | PART NO. | QTY. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|--------------------------|------------|------|---|---|---|---|---|---|---|---|---|
| 1 | Idle Solenoid Mtg Brkt | AM3660 | 1 | - | - | x | | | | | | |
| 2 | Idler Solenoid Assy. | AM3661-1 | 1 | - | - | x | | | | | | |
| 3 | 1/4"UNC x 5/8" Hex Screw | AM3053-174 | 2 | - | - | x | | | | | | |
| 4 | In-Line Swivel | S22070 | 1 | - | - | x | | | | | | |
| 5 | Throttle Rod | AS4324-14 | 1 | - | - | x | | | | | | |
| 6 | Female Rod End 1/4" UNF | AT4090 | 1 | - | - | x | | | | | | |
| 7 | Spacer | AT4137Z | 1 | - | - | x | | | | | | |
| 8 | 1/4"UNC Hex Nut | AM3055-90 | 15 | - | - | x | | | | | | |
| 9 | 1/4" Springwasher | E106A2 | 11 | - | - | x | | | | | | |
| 10 | 1/4"UNC x 1.5" Hex Screw | AM3053-180 | 3 | - | - | x | | | | | | |

Wiring Diagram

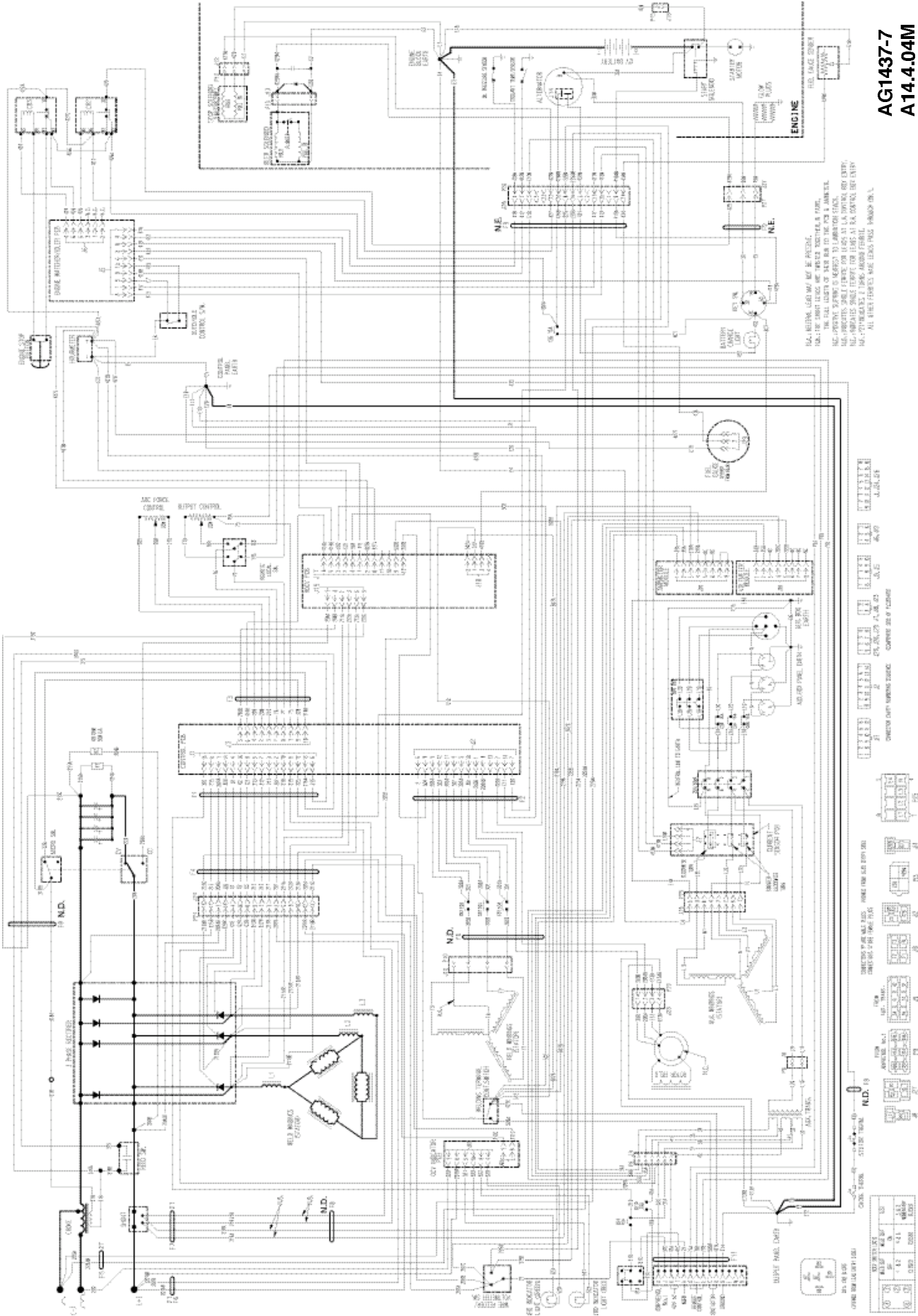


ALL METERS, LIGHTS AND RELAYS ARE 12V DC.
 ALL WIRE LEADS ARE WELDED TO THE BATTERY.
 ALL WIRE LEADS ARE WELDED TO THE ALTERNATOR.
 ALL WIRE LEADS ARE WELDED TO THE FUSE BLOCK.
 ALL WIRE LEADS ARE WELDED TO THE ENGINE.
 ALL WIRE LEADS ARE WELDED TO THE BODY.

AG1437-6
A14.4.04M

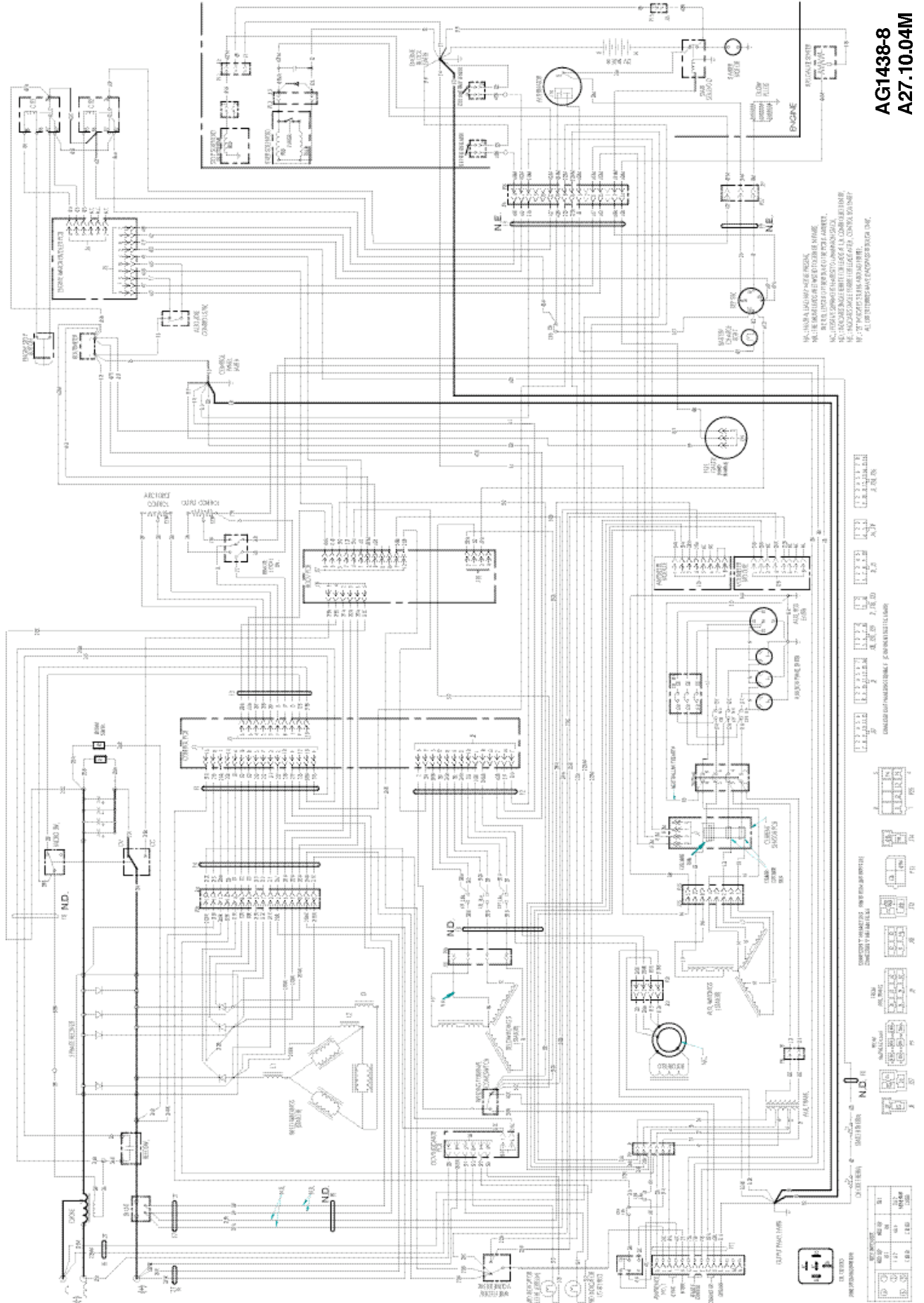
| WIRE NO. | TERMINAL | DESCRIPTION |
|----------|----------|-----------------|
| 1 | 1 | BATTERY (+) |
| 2 | 2 | BATTERY (-) |
| 3 | 3 | IGNITION SWITCH |
| 4 | 4 | IGNITION SWITCH |
| 5 | 5 | IGNITION SWITCH |
| 6 | 6 | IGNITION SWITCH |
| 7 | 7 | IGNITION SWITCH |
| 8 | 8 | IGNITION SWITCH |
| 9 | 9 | IGNITION SWITCH |
| 10 | 10 | IGNITION SWITCH |
| 11 | 11 | IGNITION SWITCH |
| 12 | 12 | IGNITION SWITCH |
| 13 | 13 | IGNITION SWITCH |
| 14 | 14 | IGNITION SWITCH |
| 15 | 15 | IGNITION SWITCH |
| 16 | 16 | IGNITION SWITCH |
| 17 | 17 | IGNITION SWITCH |
| 18 | 18 | IGNITION SWITCH |
| 19 | 19 | IGNITION SWITCH |
| 20 | 20 | IGNITION SWITCH |
| 21 | 21 | IGNITION SWITCH |
| 22 | 22 | IGNITION SWITCH |
| 23 | 23 | IGNITION SWITCH |
| 24 | 24 | IGNITION SWITCH |
| 25 | 25 | IGNITION SWITCH |
| 26 | 26 | IGNITION SWITCH |
| 27 | 27 | IGNITION SWITCH |
| 28 | 28 | IGNITION SWITCH |
| 29 | 29 | IGNITION SWITCH |
| 30 | 30 | IGNITION SWITCH |
| 31 | 31 | IGNITION SWITCH |
| 32 | 32 | IGNITION SWITCH |
| 33 | 33 | IGNITION SWITCH |
| 34 | 34 | IGNITION SWITCH |
| 35 | 35 | IGNITION SWITCH |
| 36 | 36 | IGNITION SWITCH |
| 37 | 37 | IGNITION SWITCH |
| 38 | 38 | IGNITION SWITCH |
| 39 | 39 | IGNITION SWITCH |
| 40 | 40 | IGNITION SWITCH |
| 41 | 41 | IGNITION SWITCH |
| 42 | 42 | IGNITION SWITCH |
| 43 | 43 | IGNITION SWITCH |
| 44 | 44 | IGNITION SWITCH |
| 45 | 45 | IGNITION SWITCH |
| 46 | 46 | IGNITION SWITCH |
| 47 | 47 | IGNITION SWITCH |
| 48 | 48 | IGNITION SWITCH |
| 49 | 49 | IGNITION SWITCH |
| 50 | 50 | IGNITION SWITCH |
| 51 | 51 | IGNITION SWITCH |
| 52 | 52 | IGNITION SWITCH |
| 53 | 53 | IGNITION SWITCH |
| 54 | 54 | IGNITION SWITCH |
| 55 | 55 | IGNITION SWITCH |
| 56 | 56 | IGNITION SWITCH |
| 57 | 57 | IGNITION SWITCH |
| 58 | 58 | IGNITION SWITCH |
| 59 | 59 | IGNITION SWITCH |
| 60 | 60 | IGNITION SWITCH |
| 61 | 61 | IGNITION SWITCH |
| 62 | 62 | IGNITION SWITCH |
| 63 | 63 | IGNITION SWITCH |
| 64 | 64 | IGNITION SWITCH |
| 65 | 65 | IGNITION SWITCH |
| 66 | 66 | IGNITION SWITCH |
| 67 | 67 | IGNITION SWITCH |
| 68 | 68 | IGNITION SWITCH |
| 69 | 69 | IGNITION SWITCH |
| 70 | 70 | IGNITION SWITCH |
| 71 | 71 | IGNITION SWITCH |
| 72 | 72 | IGNITION SWITCH |
| 73 | 73 | IGNITION SWITCH |
| 74 | 74 | IGNITION SWITCH |
| 75 | 75 | IGNITION SWITCH |
| 76 | 76 | IGNITION SWITCH |
| 77 | 77 | IGNITION SWITCH |
| 78 | 78 | IGNITION SWITCH |
| 79 | 79 | IGNITION SWITCH |
| 80 | 80 | IGNITION SWITCH |
| 81 | 81 | IGNITION SWITCH |
| 82 | 82 | IGNITION SWITCH |
| 83 | 83 | IGNITION SWITCH |
| 84 | 84 | IGNITION SWITCH |
| 85 | 85 | IGNITION SWITCH |
| 86 | 86 | IGNITION SWITCH |
| 87 | 87 | IGNITION SWITCH |
| 88 | 88 | IGNITION SWITCH |
| 89 | 89 | IGNITION SWITCH |
| 90 | 90 | IGNITION SWITCH |
| 91 | 91 | IGNITION SWITCH |
| 92 | 92 | IGNITION SWITCH |
| 93 | 93 | IGNITION SWITCH |
| 94 | 94 | IGNITION SWITCH |
| 95 | 95 | IGNITION SWITCH |
| 96 | 96 | IGNITION SWITCH |
| 97 | 97 | IGNITION SWITCH |
| 98 | 98 | IGNITION SWITCH |
| 99 | 99 | IGNITION SWITCH |
| 100 | 100 | IGNITION SWITCH |

Wiring Diagram



AG1437-7
A14.4.04M

Wiring Diagram



AG1438-8
A27.10.04M

1. 12 VDC
2. 24 VDC
3. 28 VDC
4. 32 VDC
5. 36 VDC
6. 40 VDC
7. 44 VDC
8. 48 VDC
9. 52 VDC
10. 56 VDC
11. 60 VDC
12. 64 VDC
13. 68 VDC
14. 72 VDC
15. 76 VDC
16. 80 VDC
17. 84 VDC
18. 88 VDC
19. 92 VDC
20. 96 VDC
21. 100 VDC
22. 104 VDC
23. 108 VDC
24. 112 VDC
25. 116 VDC
26. 120 VDC
27. 124 VDC
28. 128 VDC
29. 132 VDC
30. 136 VDC
31. 140 VDC
32. 144 VDC
33. 148 VDC
34. 152 VDC
35. 156 VDC
36. 160 VDC
37. 164 VDC
38. 168 VDC
39. 172 VDC
40. 176 VDC
41. 180 VDC
42. 184 VDC
43. 188 VDC
44. 192 VDC
45. 196 VDC
46. 200 VDC
47. 204 VDC
48. 208 VDC
49. 212 VDC
50. 216 VDC
51. 220 VDC
52. 224 VDC
53. 228 VDC
54. 232 VDC
55. 236 VDC
56. 240 VDC
57. 244 VDC
58. 248 VDC
59. 252 VDC
60. 256 VDC
61. 260 VDC
62. 264 VDC
63. 268 VDC
64. 272 VDC
65. 276 VDC
66. 280 VDC
67. 284 VDC
68. 288 VDC
69. 292 VDC
70. 296 VDC
71. 300 VDC
72. 304 VDC
73. 308 VDC
74. 312 VDC
75. 316 VDC
76. 320 VDC
77. 324 VDC
78. 328 VDC
79. 332 VDC
80. 336 VDC
81. 340 VDC
82. 344 VDC
83. 348 VDC
84. 352 VDC
85. 356 VDC
86. 360 VDC
87. 364 VDC
88. 368 VDC
89. 372 VDC
90. 376 VDC
91. 380 VDC
92. 384 VDC
93. 388 VDC
94. 392 VDC
95. 396 VDC
96. 400 VDC
97. 404 VDC
98. 408 VDC
99. 412 VDC
100. 416 VDC

STATEMENT OF LIMITED WARRANTY

The Lincoln Electric Company (Australia) Pty Limited ("Lincoln") warrants all new machinery and equipment ("goods") manufactured by Lincoln against defects in workmanship and material subject to certain limitations hereinafter provided.

This warranty is void if Lincoln or its Authorised Service Facility finds that the equipment has been subjected to improper installation, improper care or abnormal operations.

PERIOD OF WARRANTY "LINCOLN BRANDED GOODS"

The period from the commencement of the warranty in respect of goods covered by this warranty shall be as follows:

Three Years

All Lincoln welding machines, wire feeders and plasma cutting machines unless listed below.

Two Years

All Weldanpowers, Rangers, Invertec V140-S, V160-S, V160-T, V160-TP, V205-T, V270S & TP, V305T, Pro-Cut 25.

One Year

Invertec PC100, PC60.

- All water coolers (internal and external).
- Arc welding and cutting robots and robotic controllers.
- All stick electrodes, welding wires and fluxes.
- All Environmental Systems equipment, including portable units, central units and accessories. (Does not include consumable items listed under 30-day warranty).
- All welding and cutting accessories including wire feed modules, undercarriages, field installed options that are sold separately, unattached options, welding supplies, standard accessory sets, replacement parts. (Does not include expendable parts and guns/torches listed under 90 and 30 day warranties)
- All "Pro Torch" TIG torches.

90 Days

- All Gun and Cable Assemblies (manufactured by Lincoln) and Spool guns.
- All MIG, TIG and Plasma Torches

30 Days

- All consumable items that may be used with the environmental systems described above. This includes hoses, filters, belts and hose adapters.
- Expendable Parts - Lincoln is not responsible for the replacement of any expendable part that is required due to normal wear.

ENGINE WARRANTY

To the extent permitted by law Lincoln shall be entitled to in its absolute discretion repair all engines and engine accessories however Lincoln shall not be held responsible for any such repair which shall be the sole responsibility of the engine manufacturer which provides for warranties for the period and subject to any limitations provided for by those manufacturers of the respective engines and engine accessories.

Three Years*

Deutz 912 Engine and Accessories
(Warranty service can only be carried out an authorised Deutz service dealer)

*Subject to conditions imposed by Deutz.

Cummins B3.3 Engine and Accessories
(Warranty service can only be carried out an authorised Cummins service dealer)

*Subject to conditions imposed by Cummins

Two Years

Perkins Engines and Accessories
(The Perkins Distributor Organisation provides all warranty service (accessories included) for the Perkins Engines powering goods manufactured by Lincoln.

*Subject to conditions imposed by Perkins

Briggs & Stratton Vanguard Engines and Accessories. (Warranty service can only be carried out by an authorised Briggs & Stratton service dealer).

*The Magnetron ignition system is warranted by Briggs & Stratton for 5 years.

Kubota Engines and Accessories
(Warranty service can only be carried out an authorised Kubota service dealer)

*Subject to conditions imposed by Kubota.

One Year*

Ruggerini Engines and Accessories
(Warranty service can only be carried out by authorised Lincoln Field Service Shop or the engine distributors authorised by the Lincoln branch office).

BATTERY WARRANTY

Lincoln supplies certain batteries in connection with its supply of goods and the purchaser acknowledges that any such battery is warranted by its manufacturer and any claim in respect of such a battery whether as to a defect in the battery or as to damage consequential upon a defect in a battery shall be made by the purchaser to the manufacturer of the battery and the purchaser shall not hold Lincoln in any way liable for the operation, non-operation or malfunction of any such battery.

CONDITION OF WARRANTY

TO OBTAIN WARRANTY COVERAGE:

The purchaser must contact Lincoln or Lincoln's Authorised Service Facility about any defect claimed under Lincoln's warranty.

Determination of warranty on welding and cutting equipment will be made by Lincoln or Lincoln's Authorised Service Facility.

WARRANTY REPAIR

If Lincoln or Lincoln's Authorised Service Facility confirms the existence of a defect covered by this warranty, the defect will be corrected by repair or replacement at Lincoln's option.

At Lincoln's request, the purchaser must return, to Lincoln or its Authorised Service Facility, any "Goods" claimed defective under Lincoln's warranty.

FREIGHT COSTS

The purchaser is responsible for shipment to and from the Lincoln Authorised Service Facility.

WARRANTY LIMITATIONS

Certain conditions warranties and obligations are implied by law (for example under the Trade Practices Act 1974) and cannot be excluded or modified ("the statutory warranties").

Where the statutory warranties do apply then any express warranties given by Lincoln (the "express warranties") are given in addition and without derogation from the statutory warranties. Apart from the express warranties and (in cases where they apply by law but not otherwise) the statutory warranties Lincoln gives no warranties whether express or implied by operation of law or otherwise in respect of any goods manufactured or supplied by Lincoln or by its authorised distributor.

Any warranty whether express or statutory and the term of any such warranty as set out herein commences on the date Lincoln or Lincoln's authorised distributorship forwards the goods from the premises of Lincoln or Lincoln's authorised distributor to the purchaser.

In respect of any claim under the warranty herein provided a purchaser must furnish Lincoln with written notice of any claim under the warranty within the time period of the warranty as further specified herein.

The extent of Lincoln's warranty whether express or statutory is limited to a liability to repair, replace or pay to the purchaser an amount equal to:

- a) The cost of replacing the goods;
- b) The cost of obtaining equivalent goods; or
- c) The cost of having the goods repaired whichever remedy in its absolute discretion Lincoln chooses.

Upon request by Lincoln the purchaser must permit Lincoln to inspect the goods the subject of any claim under this warranty and Lincoln may at its absolute discretion repair or replace the goods F.O.B. at its own premises or at such other premises as Lincoln may designate provided that all freight charges to and from Lincoln's premises or such other premises as Lincoln may designate shall be paid by the purchaser.

Subject to the express and statutory warranties hereinbefore provided Lincoln provides no other warranties in respect of the manufacture or sale of goods and in particular Lincoln shall have no responsibility or liability in respect of:

- a) Repairs done to Lincoln's goods and undertaken by the purchaser outside Lincoln's premises without written authority from Lincoln obtained prior to any such repair;
- b) Any damage or failure of the goods as a result of normal wear and tear or the neglect misuse abuse or failure to properly service goods by any purchaser.

The liability of Lincoln is limited as hereinbefore provided and Lincoln shall not be liable for any incidental special or consequential damage suffered by a purchaser whether or not arising out of circumstances known or foreseeable known by Lincoln and in particular arising out of the supply of goods to a purchaser or the use of goods by a purchaser whether based on breach of contract negligence or tort.

CUSTOMER ASSISTANCE POLICY

The business of The Lincoln Electric Company is manufacturing and selling high quality welding equipment, consumables, and cutting equipment. Our challenge is to meet the needs of our customers and to exceed their expectations. On occasion, purchasers may ask Lincoln Electric for advice or information about their use of our products. We respond to our customers based on the best information in our possession at that time. Lincoln Electric is not in a position to warrant or guarantee such advice and assumes no liability, with respect to such information or advice. We expressly disclaim any warranty of any kind, including any warranty of fitness for any customer's particular purpose, with respect to such information or advice. As a matter of practical consideration, we also cannot assume any responsibility for updating or correcting any such information or advice once it has been given, nor does the provision of information or advice create, expand or alter any warranty with respect to the sale of our products.

Lincoln Electric is a responsive manufacturer, but the selection and use of specific products sold by Lincoln Electric is solely within the control of, and remains the sole responsibility of the customer. Many variables beyond the control of Lincoln Electric affect the results obtained in applying this type of fabrication methods and service requirements.

In Australia, Lincoln Technical Sales Representatives are located in, Mackay, Brisbane, Newcastle, Sydney, Melbourne, Adelaide and Perth. To contact your local Lincoln Technical Sales Representative, call 1300 728 720 (for the cost of a local call). Lincoln products are sold primarily through its distributors. Our Regional Office locations are:

Northern Region: Unit 1/15 Westgate St, Wacol, Qld, 4076 (07) 3271 3000
Central Region: 35 Bryant Street, Padstow, NSW, 2211 (02) 9772 7222
Southern Region: 52b Winterton Rd, Clayton, VIC, 3168 (03) 9543 9399
Western Region: 25 Barker Street, Belmont, WA, 6104 (08) 9277 8744
New Zealand: 5-7 Westech Place, Kelston, Auckland (9) 813 3422
Singapore: 11 Pandan Crescent, Singapore (65) 6773 6689



**The Lincoln Electric Company
(Australia) Pty. Ltd.** A.B.N. 36 000 040 308

35 Bryant Street, Padstow, Sydney 2211, Australia

Telephone: (02) 9772-7222 Fax: (02) 9792-2420

International: Ph: +61 2 9772-7222 Fax: +61 2 9792-2420

THE LINCOLN ELECTRIC CO.

Cleveland, Ohio, U.S.A. - Subsidiary companies established in Australasia, Asia, Canada, Europe, North and South America.