MICRONAIR

APPLICATION MONITOR

Operator's Handbook

and

Parts Catalogue

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1. INTRODUCTION

The Micronair Application Monitor is a complete monitoring system for any agricultural spray aircraft. The equipment consists of three main parts: a microprocessor-based electronic unit, a flowmeter turbine to measure the output of chemical from the aircraft and optional transducers to measure the rotational speed of up to 10 atomisers.

The flowmeter turbine is fitted in the main feed to the spray equipment after the control valve. The turbine is supplied complete with all necessary pipework and hardware to enable it to be installed in a standard spray system. The turbine is manufactured from stainless steel and has tungsten carbide bearings for maximum resistance to abrasive and corrosive agricultural chemicals. The full-flow design of the turbine ensures accuracy over a wide range of chemicals with varying viscosity.

The electrical output from the turbine is fed to the electronic unit which uses this, together with the swath width and ground speed, to compute the following parameters:

- Chemical Flow Rate
- Total Volume A
- Total Volume B
- Application Rate
- Area Sprayed/minute
- Total Area Sprayed
- Total Spray Time
- Atomiser RPM for up to 10 atomisers

The information is shown on a large liquid crystal display that can be back-illuminated for night use. The front panel incorporates a touch keyboard which is used to enter information and to select functions.

The electronic unit may be programmed to operate in metric, US or British units. The display is automatically adjusted to show the text for the units being used.

An Application Printer is also available to provide a permanent printed record of each spray job. The Application Printer can either be supplied with the Application Monitor or may be added at a later date as an optional extra.

2. SPECIFICATION – APPLICATION MONITOR

Flow range:	Depends upon flowmeter turbine used – see table below.
Liquid viscosity:	1 – 40 centistokes.
Accuracy:	+/- 2%
Supply voltage:	10 – 28V DC (no adjustment necessary).
Current consumption:	100mA max.
Dimensions	
Electronic Unit:	7.6" wide x 2.3" high x 1.3" deep (193 mm x 58mm x 33mm) excluding bracket, leads, etc.
Cable to flowmeter turbine:	11.5 ft (3.5m)
Cable to RPM transducer:	25 ft (7.5m) each.

Weights in lb (kg)

Kit part no	EX3271	EX3272	EX3273	EX3274	EX3275	EX3276
Electronics:	1.5 (0.7)	1.5 (0.7)	1.5 (0.7)	1.5 (0.7)	1.5 (0.7)	1.5 (0.7)
Turbine:	0.9 (0.4)	1.1 (0.5)	1.3 (0.6)	1.5 (0.7)	2.4 (1.1)	3.0 (1.4)
Pipework:	1.2 (0.5)	1.0 (0.4)	1.3 (0.6)	2.0 (0.9)	2.5 (1.1)	2.8 1.3)
TOTAL:	3.6 (1.6)	3.6 (1.6)	4.1 (1.9)	5.0 (2.3)	6.4 (2.9)	7.3 (3.4)

Optional RPM transducers, leads etc: 3.0 (1.4) each

NOTE: Weights are subject to change when non-standard turbines and/or pipework are supplied.

2.1 Flow Ranges Available

The Application Monitor is available with a range of turbines to suit all spraying operations. Stock sizes are shown in the table below:

Kit Part No.	**Turbine Part No.**	**Range Litres/Min**	**Range USG/Min**
EX3271	EX2027	1 – 8	0.3 – 2.1
EX3272	EX524	5 – 40	1.3 – 11.0
EX3273	EX525	18 – 140	4.7 – 37.0
EX3274	EX526	34 – 270	9.0 – 72.0
EX3275	EX527	50 – 410	13.0 – 111.0
EX3276	EX2532	114 – 1130	30.0 – 300.0

In addition to these sizes, turbines are available for lower and higher flow rates if required.

To increase the flow range, two turbines can be supplied with the Application Monitor. Dual pipework is available for this installation. The dual pipework incorporates isolating valves to select the required turbine.

3. SPECIFICATION – APPLICATION PRINTER

Supply Voltage:	10 – 28V DC (no adjustment necessary).
Current Consumption:	250mA standby, 1.5A max when printing.
Dimensions	
Electronic Unit:	4" wide x 4.5" deep x 2" high (100mm x 115mm x 50mm)
Input cable:	10 ft (3.1m) long
Weight:	1.5 lb (0.7kg)
Paper used:	Plain paper roll 1.75" (44mm) wide.

4. INSTALLATION OF APPLICATION MONITOR

Before installing the Application Monitor kit, IT IS VITAL THAT THIS ENTIRE MANUAL IS READ THOROUGHLY and that the working of the unit is understood.

4.1 Pre-installation Checks

Before starting the installation, check the following points:

1. Are the flowmeter turbine(s) the correct size(s)? The range of the turbine(s) must match the required output rates from the aircraft.

2. Is the pipework correct? Unless specified otherwise, the kit is supplied with pipework to suit 2 inch outside diameter pipework. This may have to be modified for some non-standard installations.

3. Is there a filter upstream of the turbine? Many aircraft are equipped with a filter in this position. If no filter is installed, one should be fitted. Lack of adequate filtration can lead to blockage and excessive wear of the turbine, resulting in incorrect readings.

4.2 Installation of Turbine

The turbine must be installed as shown in Fig. 1 in the feedpipe from the flow control valve (normally a 3-way valve) to the spray system. It must be fitted after any by-pass line.

IMPORTANT: The turbine must be horizontal and the flow must be in the direction of the arrow on the body.

Sharp bends before the turbine must be avoided and the pipe on either side of the flowmeter should be straight for at least 10 x the diameter upstream and 5 x the diameter downstream. The connection to the turbine is by nipples with a 30 degree cone and the bore of the pipe must match the size of the turbine.

The turbine is supplied with pipework which meets these requirements and this should be used if possible. The ends of the pipework are beaded to take a flexible hose for connection to the rest of the system. There should be sufficient flexibility in the pipework for the turbine to be removed for inspection and cleaning - see the Maintenance section of this Handbook.

The turbine should be secured in such a way as to prevent vibration. The bracket (EX426) supplied with the pipework should always be used. The T shaped end of this must be bolted to a secure structure in line with the pipework. The P clip must be fitted round the inlet pipe and bolted to the bracket through a hole drilled in a suitable position.

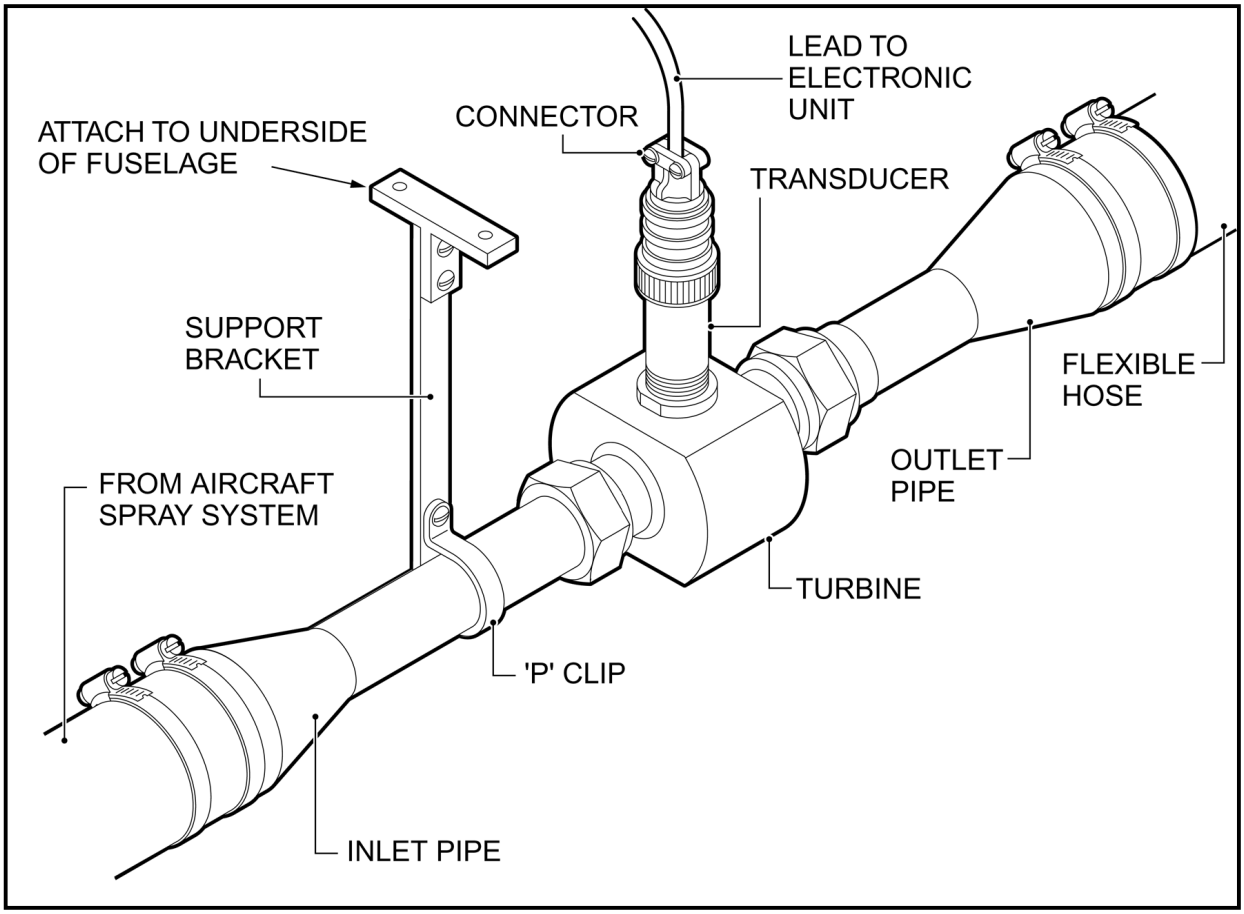


Fig. 1 – Installation of Flowmeter Turbine

IMPORTANT: The transducer of the flowmeter turbine is factory pre-set to a critical position. Do not disturb the transducer during installation or maintenance.

4.3 Installation of Electronic Unit

It is vital that the electronic unit is installed in a position that is both safe and convenient for the pilot. Ideally, the unit should be as close as possible to the normal line of the pilot's view but should not impair his safety if he is thrown forward in an accident. Other possible positions are immediately below the instrument panel or in a panel cut-out (similar to many radio installations). Always ensure that the pilot can both read the display and reach the keyboard with minimum movement.

The display of the Application Monitor is designed to be read from above the horizontal. The unit should not be mounted in such a position that the display is viewed from below. The installation kit includes a mounting bracket which is fitted to the sides of the unit by knurled locking knobs. The electronic unit can be tilted in the bracket if required to give the best viewing angle.

The installation procedure is as follows:

1. Mount the Application Monitor bracket, using at least two screws through the holes provided or in new holes drilled as required.

2. Fit the Application Monitor in the bracket and lock in position.

3. Connect the BLACK ground wire from the electronic unit to the airframe. Use an existing ground point if possible, otherwise make a new connection. Ensure that the ground wire is not connected to a painted or removable panel.

4. Fit or select a suitable circuit breaker for the power lead to the Application Monitor. This should preferably be a 2 – 5 A circuit breaker installed for the purpose but an existing circuit breaker can be used. Its rating must be suitable to protect the wiring used. The circuit breaker must not feed an essential load and an additional 1A must be able to be drawn without overload.

5. Connect the circuit breaker in (4) above to the fuseholder on the RED lead from the Application Monitor. The connecting wire should be soldered to the eyelet in the free end of the fuseholder.

6. Re-assemble the fuseholder, making certain that it is fitted with a 1 A fuse.

7. Insert the 25 pin 'D' plug on the flowmeter lead into the 25 pin 'D' socket on the black lead from the Application Monitor.

8. Feed the green 2 pin connector on the opposite end of the flowmeter lead through a suitable opening in the aircraft skin.

9. Connect the lead to the transducer of the flowmeter turbine.

10. If a hole has been cut for (8) above, fit the blanking grommet (CBP447) supplied to seal the hole around the lead.

11. Secure all wiring with cable ties or by other approved means. Ensure that all wires are clear of sharp edges or moving parts. Pay particular attention to the turbine lead outside the aircraft. This must be well supported and must not be able to move in the airflow.

4.4 Alternative Power Supply Connections

The Application Monitor will lose totals of volume, area, time etc when the power is switched off (set-up data such as swath, speed, turbine calibration etc will always be retained). In some applications, it may be desirable for the power supply to the Application Monitor not to be interrupted when the master switch is turned off, thus preventing job totals being lost.

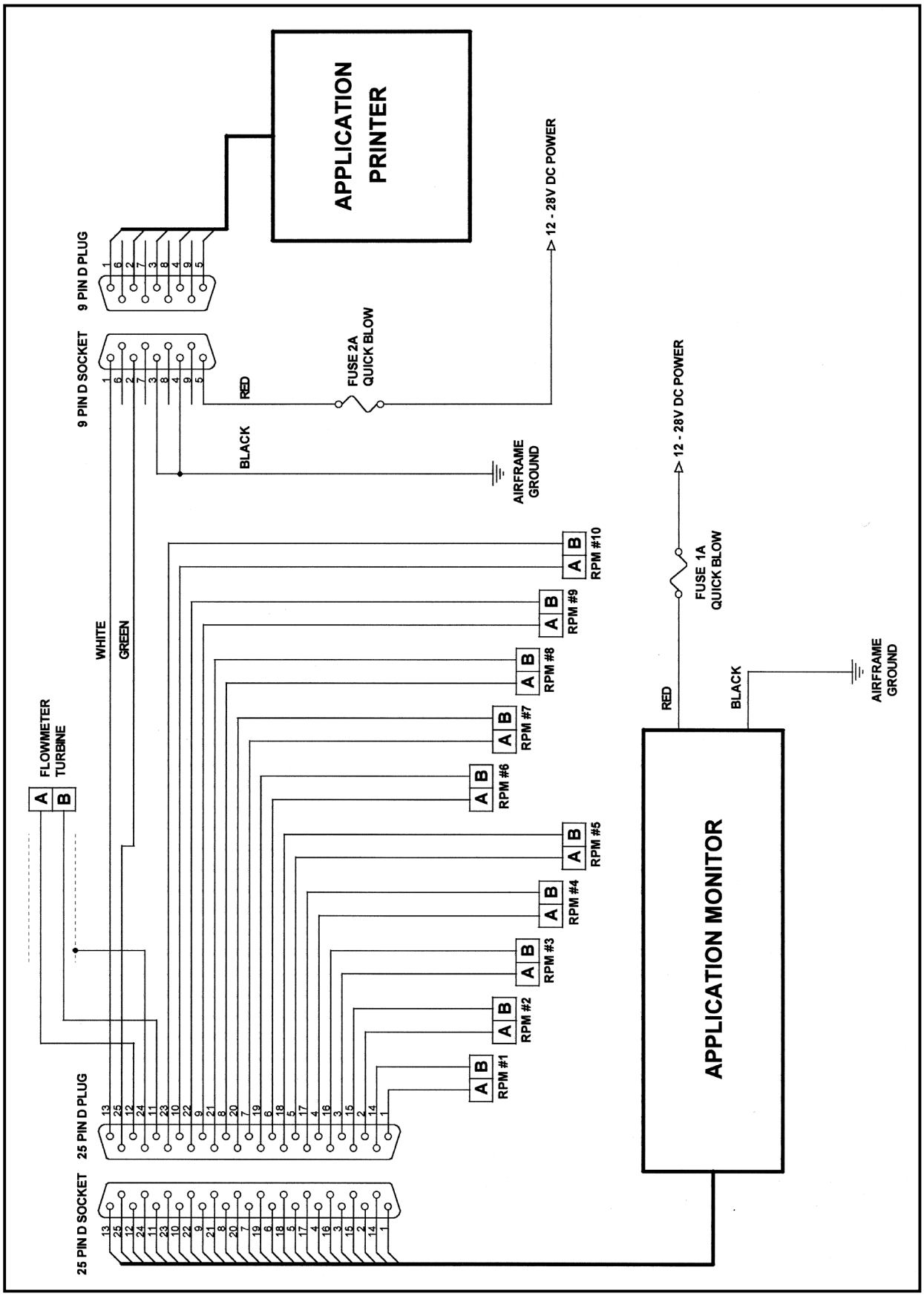


Fig. 2 – Schematic of Application Monitor Installation

To keep the unit on, it must be 'hot wired' to the battery via a switch and fuse. The switch can be used to turn the Application Monitor on and off independent of the master switch.

The wiring from the battery to the Application Monitor must be protected by a fuse at the battery. In some cases this fuse will already exist (e.g. for an electric clock). If a fuse is not available, one must be fitted adjacent to the master or ground power solenoid fuse. DO NOT under any circumstances connect the Application Monitor to the master solenoid fuse.

In some cases it may be necessary to prevent unauthorised personnel switching the Application Monitor off and thus clearing the VOL B and printer set-up figures. This can be achieved by 'hot wiring' the Application Monitor as described above and using a key-operated on/off switch instead of a standard toggle switch.

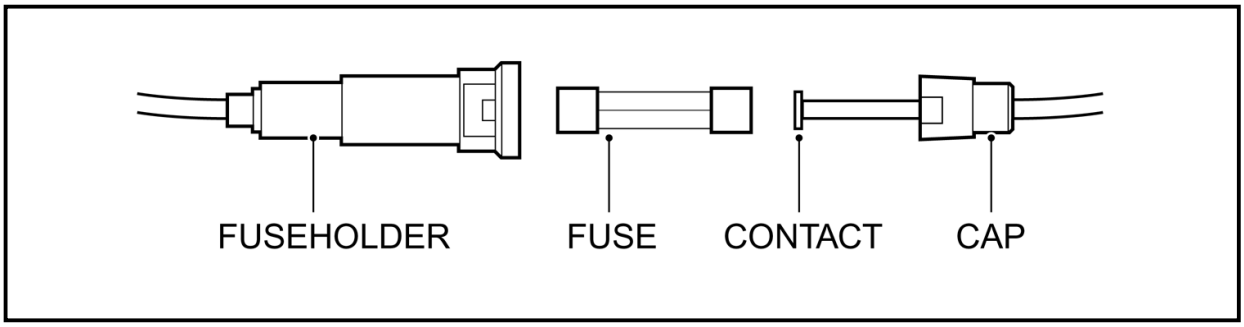


Fig. 3 – Connection of Fuseholder

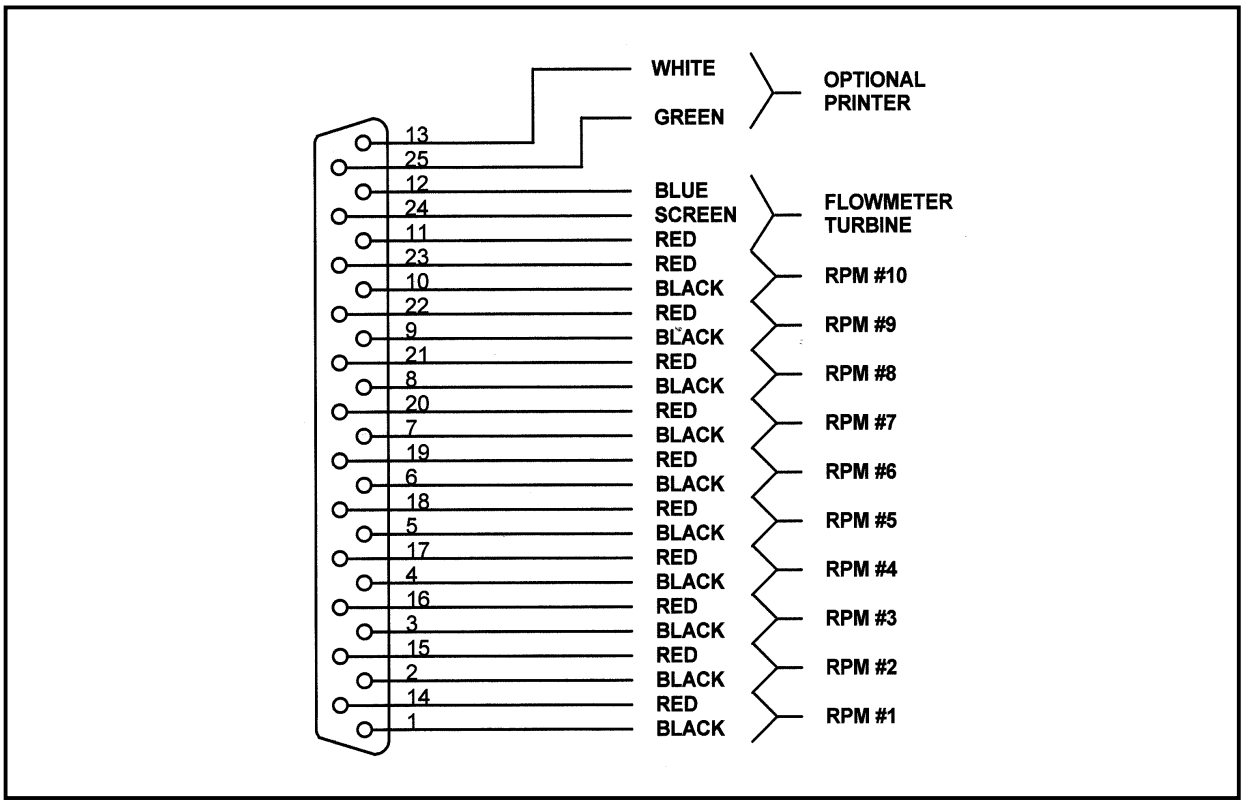


Fig. 4 – Pin Numbers on Application Monitor Input Connector

5. INSTALLATION OF RPM INDICATOR

The Application Monitor may be used to measure the rotational speed of each of up to 10 atomisers. These may be Micronair AU3000, AU4000, AU5000 or AU7000 units. In order to do this, each atomiser must be provided with a transducer and associated wiring etc. These parts may be ordered with the Application Monitor or may be added later. The following instructions assume that the necessary parts are to hand and that the Application Monitor is already installed in the aircraft.

The installation procedure is as follows:

1. Fit transducer mounting bracket:

   i) AU3000 or AU4000 on EX2857 mounting block:

   Fit the bracket (EX193) in place with the four 8-32 screws and washers provided as shown in Fig. 5. On EX2968 mounting blocks drill and tap four 8-32 holes in the end of the block and fit bracket as above. Note that the face of the bracket with the large hole should be towards the atomiser.

   ii) AU3000 or AU4000 on cast mounting clamps:

   Secure the transducer mounting bracket (EX1792) as shown in Fig. 6, using the two 8-32 countersunk screws provided. Ensure that the screws are tight.

   iii) AU5000 or AU7000:

   Remove the atomiser from its mounting clamp. Fit the transducer mounting bracket (EX1793 for AU5000 or EX2651 for AU7000) over the atomiser spindle as shown in Fig. 7. Ensure that the spindle passes through the smaller of the two holes in the bracket and that the bracket is positioned so that the bend faces away from the atomiser, giving maximum clearance between transducer flange and atomiser hub.

2. Fit sensing tabs or plate to atomiser:

   i) AU3000 or AU4000:

   Fit one sensing tab under the head of each clamp ring securing bolt in place of the existing washer. Ensure that the radius at the corner of the tab is positioned to allow the tab to move back if it should touch the transducer whilst the atomiser is rotating (see Fig. 7).

   ii) AU5000 or AU7000:

   Remove all clamp ring securing bolts and fit a sensing plate (EX1794 for AU5000 or EX2652 for AU7000) against the front face of the clamp ring. Replace the securing bolts.

IMPORTANT: Do not over-tighten the clamp ring securing bolts when replacing them - see Atomiser Handbook for full details.

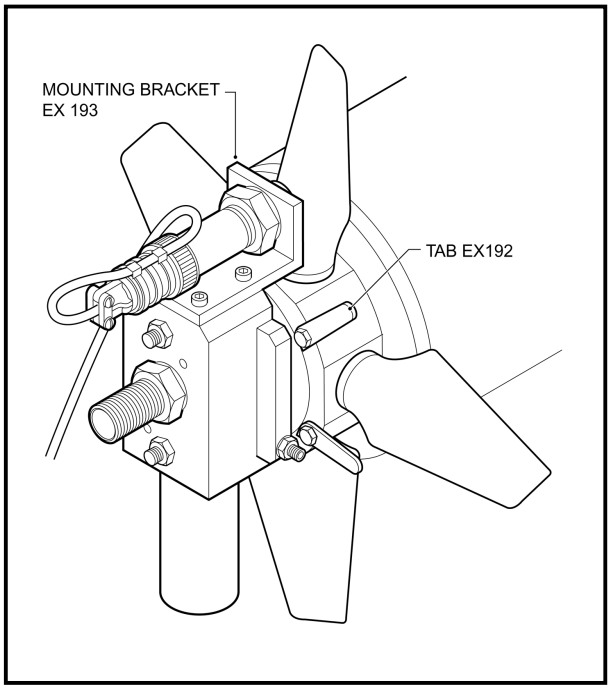


Fig. 5 – AU3000/4000 Mounting Block

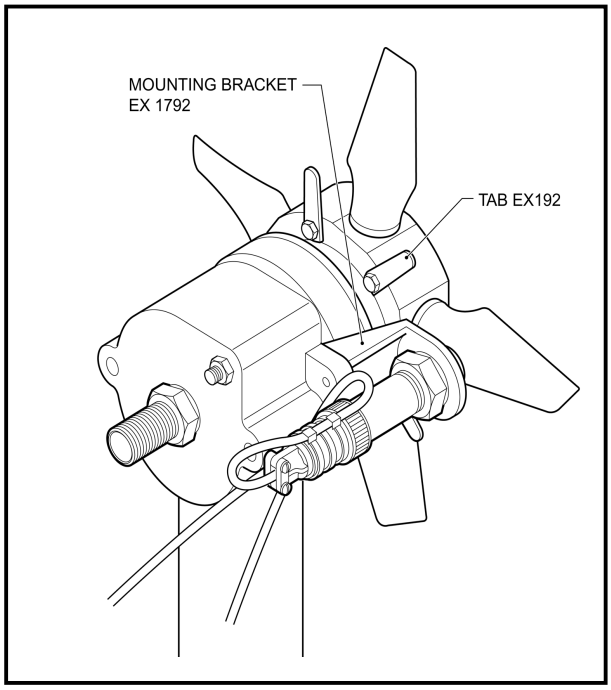


Fig. 6 – AU3000/4000 Cast Clamp

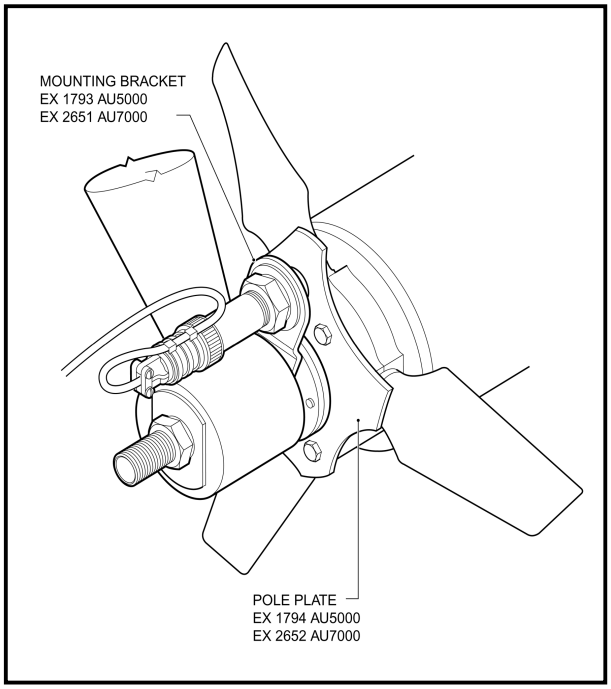


Fig. 7 – AU5000/7000 Cast Clamp

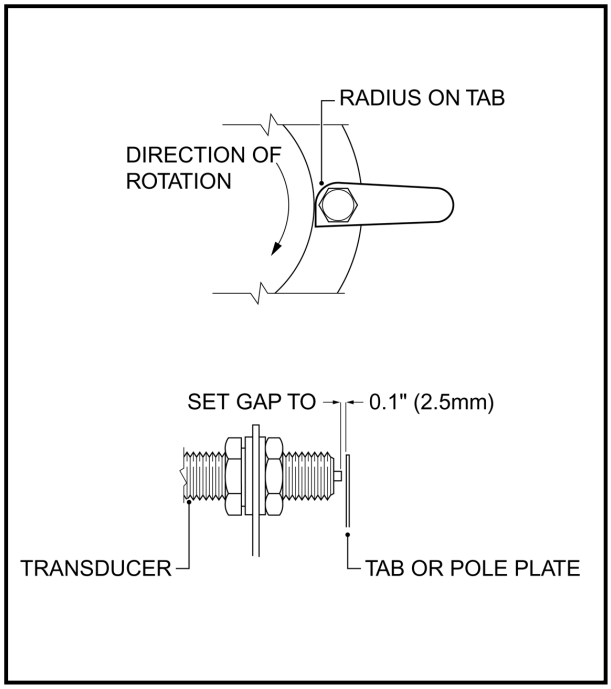


Fig. 8 – Transducer Adjustment

3. Replace the atomiser in its mounting if removed for steps (1) and (2). Do not tighten at this stage.

4. Fit a RPM transducer into the mounting bracket. Ensure that the two plastic bushes (EX356) are in position on either side of the bracket. For AU3000 and AU4000 installations with the EX198 mounting angle, the smaller end of each bush should fit into the hole in the bracket. For all other brackets, one bush should fit into the bracket and the other should be fitted to act as a washer with the smaller end away from the bracket. See Figs. 4 and 5.

5. For AU5000 and AU7000 atomisers only: rotate the bracket on the spindle so that the transducer is about 1/2" (12 mm) away from the mounting bracket. Tighten the atomiser securing nut.

6. Adjust the two nuts on the transducer body until the gap between the pip on the end of the transducer and tabs or 'finger' plate is 0.1" (2.5 mm) as shown in Fig. 7. Lock the transducer firmly in position.

7. Ensure that the gap set in (6) is the same for all tabs or 'fingers' of the plate. If necessary, bend the tabs or 'fingers' slightly to adjust the gap.

8. Connect a pre-prepared lead assembly (EX3291) to the RPM transducer. Identify the other end of the lead with a piece of tape marked with the atomiser number. It is normal to number the left (port) outboard atomiser No. 1 and to count towards the right (starboard) outboard unit. Protect the two pins on the end of the lead by wrapping them in a piece of tape during installation.

9. Wire (safety) lock the two transducer securing nuts and the connector to the transducer bracket, using the holes provided. If the atomiser has been removed, ensure that the securing nut is tight and wire (safety) lock the securing nut, diaphragm check valve and feed pipe as described in the atomiser handbook.

IMPORTANT: All parts of the RPM transducer installation must be wire (safety) locked to eliminate the possibility of a component coming loose and damaging the atomiser.

10. Feed the lead along the boom or structure and through a suitably protected opening into the fuselage. Route the lead to the Application Monitor.

11. Repeat Steps (1) – (10) for all atomisers.

12. Starting from the outboard atomiser on each side, secure the leads with cable ties or other approved means. The lead from each connector should be formed into an S - shaped loop alongside the connector body and secured with two cable ties. This ensures that the lead cannot flex at the point where it enters the connector and allows sufficient length to remove the connector if necessary. Ensure that all leads are secured tightly to the boom and cannot move in the airflow.

13. Remove the 25 pin 'D' plug from the socket on the black lead from the Application Monitor.
14. Open the housing of the 25 pin 'D' plug and remove the cable clamp. Take the connector and flowmeter lead out of the housing.

15. Note the numbers adjacent to the holes in the rear (cable entry) face of the plug.

16. Take the lead from atomiser 1 and remove any protective tape from the two pins. Insert the pin on the RED or BLUE wire into hole 1. Press firmly on the wire until the pin clicks into place. Insert the pin on the BLACK wire into hole 14.

17. Repeat (16) for all other leads. The correct pin numbers are shown in Fig. 8, which shows the view on the rear (cable entry) face of the plug.

18. Re-assemble the connector housing. It may be necessary to cut the plastic bushing away from the flowmeter lead to allow adequate space under the cable clamp. For 8 or 10 unit installations it may also be necessary to enlarge the cable entry hole with a round file. If this is done, take care not to leave any sharp edges which could cut the cables.

19. Plug the assembled connector into the socket on the Application Monitor lead and secure in position with the two locking screws.

20. Coil any excess lengths of lead neatly away and secure to the airframe or to existing wiring.

21. Check the entire installation, paying particular attention to the routing of leads, which must be clear of sharp edges, moving parts, controls etc.

22. Switch on the Application Monitor and select the RPM function and atomiser 1. Rotate atomiser 1 quickly by hand for about 5 seconds and ask another person in the cockpit to confirm that the display shows a reading.

23. Select the other atomisers in sequence and repeat step (22) for each.

6. INSTALLATION OF PRINTER

The Application Printer is an optional device that may be permanently installed in the aircraft or may be plugged into the system only when a printout is required. In either case, the socket into which the printer is plugged must be installed in the aircraft. These instructions assume that the Application Monitor is already installed.

The installation procedure is as follows:

7. If the Application Printer is to be permanently installed, select a suitable location for the unit. It should be away from sources of contamination and heat, whilst being easily accessible to remove the printouts and to change the paper and ribbon. The lead is long enough to enable the unit to be mounted in the rear of the cockpit or in the luggage bay if required. The Application Printer should be mounted by means

of the U-shaped bracket supplied. The lid of the printer should preferably be horizontal but may be vertical, provided that the hinge is at the top.

2. The printer socket assembly (EX3292) must always be permanently installed. This socket provides both the power and the data input for the printer. Note that the socket has four wires coming from it. These are:

RED	–	+10/28V DC Power
BLACK	–	Ground
WHITE	–	Printer Data
GREEN	–	Printer Data Return

3. Disconnect the 25 pin 'D' plug from the socket on the Application Monitor lead. Open the plug housing and remove the cable clamp bar.

4. Insert the pin on the WHITE wire into hole 13. Press firmly on the wire until the pin clicks into place.

5. Insert the pin on the GREEN wire into hole 25, using the same procedure as (4) above.

6. Re-assemble the connector housing and cable clamp, ensuring that the newly installed wires are gripped by their black outer sleeve.

7. Plug the assembled connector into the socket on the Application Monitor lead and secure in position with the two locking screws.

8. Connect the BLACK wire to the airframe. Use an existing ground point if possible, otherwise make a new connection. Check that the ground is not connected to a painted or removable panel.

9. Select a suitable circuit breaker for the power feed to the Application Printer. This can either be the same circuit breaker that feeds the Application Monitor or can be another, provided its rating is suitable to protect the wiring used. It must not feed an essential load. Ensure that an additional 2A can be drawn without overload.

10. Connect the circuit breaker selected in (9) above to the fuseholder on the RED lead from the printer socket, using suitable wire soldered to the eyelet in the free end of the fuseholder.

11. Re-assemble the fuseholder, ensuring that it is fitted with a 2A fuse (the fuse for the Application Monitor is 1A).

12. Plug the Application Printer into the socket.

13. Secure all wiring with cable ties or by other approved means. Check that all wires are well clear of sharp edges or moving parts.

14. Open the lid of the Application Printer and check that the paper roll and ink ribbon cartridge are in position.

15. Switch on power to the Application Monitor and Printer.

16. Press the TEST button inside the printer. The printer should produce a test pattern which ends with a block of squares.

17. Select the PRINT command on the Application Monitor and initiate a printout. DO NOT use a reference number of 0 as this will not produce an immediate printout (see Operation section). The DATA light should flash between each line of text printed.

18. Should the paper not feed smoothly, re-check the position of the paper roll and press the FEED button to feed the paper out until it is correctly centred in the printer mechanism.

19. Close the lid of the Application Printer. The unit is now ready for use.

7. OPERATION

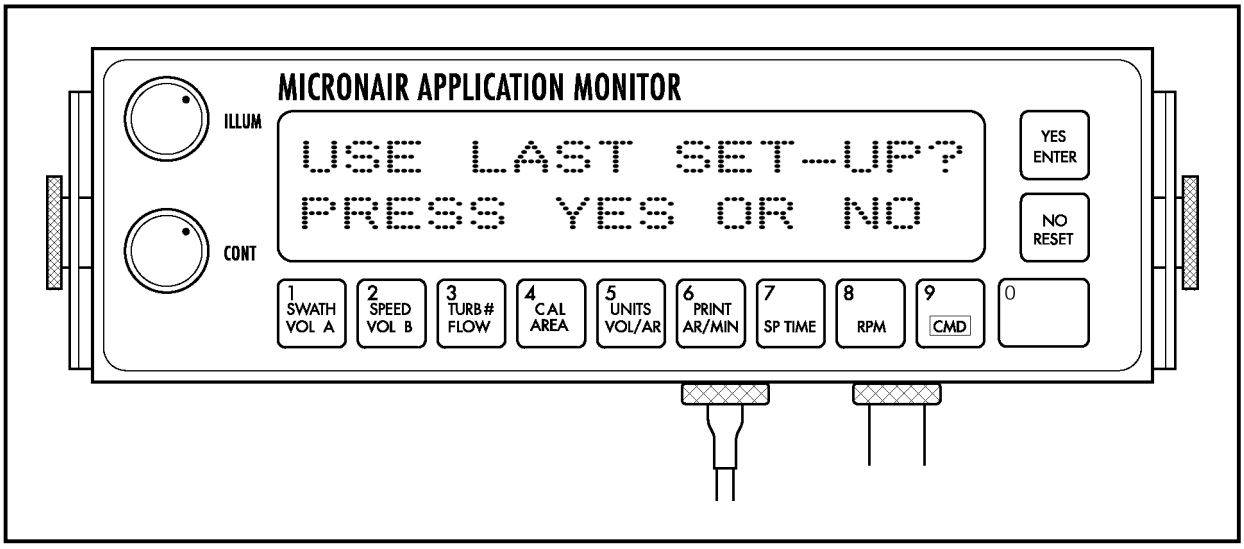


Fig. 10 – Front Panel of Application Monitor

7.1 General Principles

The display and all controls for the Application Monitor are on the front panel as shown in Fig. 10. There are no switches or adjustments inside the unit.

The liquid crystal display has two lines, each showing 16 characters. The unit is very simple to operate as the display gives full information on each function and shows prompts whenever an input is needed.

The keyboard is touch-sensitive and is designed to respond to firm finger pressure. It will not respond to a light touch, thus preventing errors due to accidental contact with the keyboard.

The keys are arranged in two groups: a line of keys below the display and ENTER and RESET keys to the right. The keys below the display are used to enter numbers (in the same way as on a calculator) and to select functions and commands.

Numbers (such as swath width) are entered by pressing the appropriate keys in sequence followed by ENTER. If you make a mistake whilst keying in a number, it can be corrected by pressing RESET or by pressing 0 several times until the display shows all 0s.

The ENTER and RESET keys are also marked YES and NO. These should be pressed in response to questions on the display (e.g. whether to accept a number).

The Application Monitor can display any of eight FUNCTIONS (chemical flow rate, application rate, time, etc). It will also respond to six COMMANDS.

A command is a request to DO something (e.g. change the swath width), whereas a function merely SHOWS something without changing anything.

Functions are selected by pressing one of the keys below the display. The names of the functions (FLOW, AREA, etc.) are shown on the keys in BLACK.

To activate a command, first press the CMD key, then select the command by pressing the key with the name of the command (SWATH, SPEED, etc.) in BLUE. Should you press the CMD key by mistake, you can cancel it by pressing RESET before pressing any other key.

7.2 Display Adjustment

The liquid crystal display of the Application Monitor is designed to be viewed from above the horizontal. The contrast of the display should be adjusted to suit the position of the unit and the lighting conditions.

To adjust the display, first switch on the unit and then slacken the knurled knob at either side of the bracket. Tilt the unit for the most comfortable viewing angle and lock the unit in place by tightening the knobs. Next, adjust the CONT (contrast) control to the left of the panel until the display shows dark characters against a light background with good contrast.

If the Application Monitor is being used in poor light or at night, the display can be back-lit by adjusting the ILLUM (illumination) knob above the CONT control. This should be used in the same way as the aircraft instrument panel light dimmer. The display should be readable but not excessively bright at night.

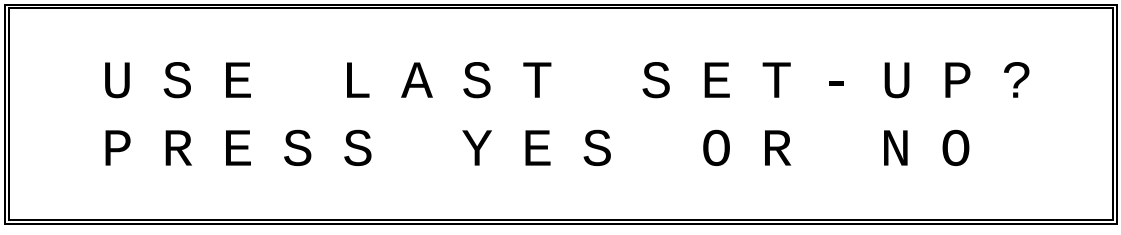
The CONT and ILLUM controls should always be adjusted together so as to give the clearest display under the prevailing lighting conditions.

7.3 Initial Set-Up

Before use, the Application Monitor must be set up for the working conditions. When a new unit is received, it may also be necessary to select the system of units to be used (Metric, US or British).

The set-up procedure for a new unit is as follows:

1. Switch on power. After about 1 second the display should show:



If the display appears blank or is dark refer to the Display Adjustment section 7.2 above.

2. Respond by pressing the NO key. The display should show:

```
SWATH  099  METRE
ACCEPT?  [YES/NO]
```

3. This will probably not be the swath width that you will be using, so respond with NO. The display will show:

```
SWATH  0000  METRE
ENTER  NEW  DATA
```

Enter the correct swath width (in feet or metres as appropriate) and press ENTER.

4. The display will show:

```
SPEED  0099  Km/HR
ACCEPT?  [YES/NO]
```

Enter the correct groundspeed (in MPH or Km/hour).

5. Finally, the display will show:

```
TURBINE   1  SEL
ACCEPT?  [YES/NO]
```

6. When the set-up is complete, the display will change to:

```
SELECT  FUNCTION
```

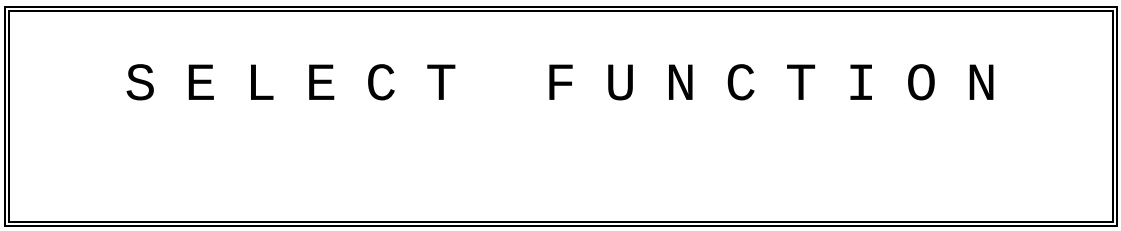
The Application Monitor is calibrated to work with either of two possible turbines. If the unit has been supplied with one turbine, you should select turbine 1 by pressing YES. If the unit has been supplied with two turbines and you wish to use the larger size (calibrated as turbine 2), you should press NO and then select turbine 2.

7. The unit is now ready for use.

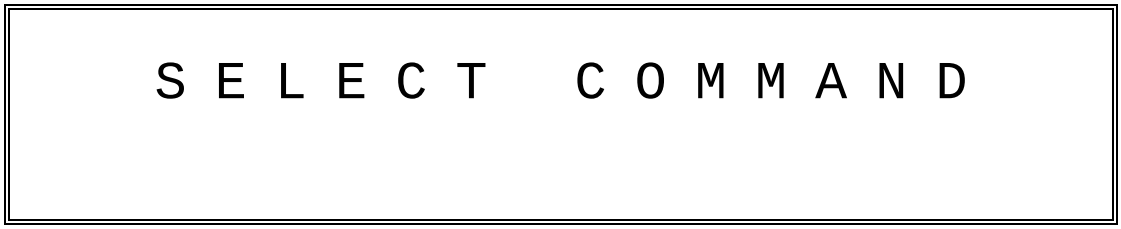
7.4 Changing Units

The Application Monitor is delivered pre-set for the normal system of units for your country. However, you can set it to operate in Metric, US or British (Imperial) units as required. To change the units, proceed as follows:

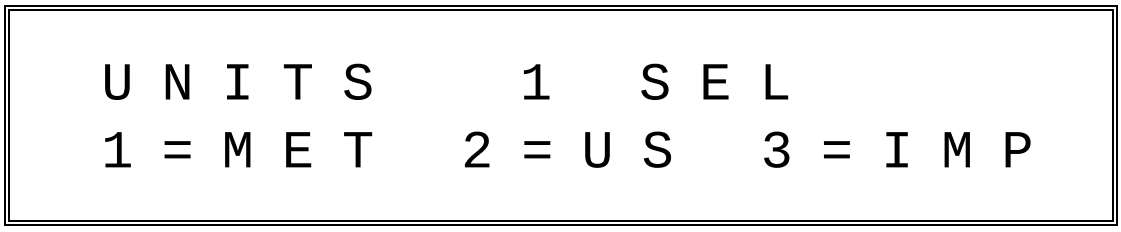
1. Switch on power and press the YES key to accept the previous set-up. The display will show:



2. Press the CMD key. The display will change to:



7. Press the UNITS command key (key 5). The display should show:



1 corresponds to Metric units, 2 to US units and 3 to British (Imperial) units. Press 1, 2, or 3 as required and then press ENTER key.

3. The unit will prompt you to enter the swath width, groundspeed and turbine number for the new units.

The units can only be changed before you start spraying (it would be meaningless to change the units part-way through a job). If you press CMD-UNITS after spraying has started the display will show:

```
C A N ' T   C H A N G E   N O W
```

for as long as the UNITS key is pressed. It will then change to:

```
S E L E C T   F U N C T I O N
```

and nothing will have been altered.

The Application Monitor automatically re-calibrates itself when the units are changed. You do not need to alter the turbine calibration as this is always in pulses/litre (see Calibration section).

7.5 Normal Operation

When the Application Monitor is switched on, the display will show:

```
U S E   L A S T   S E T - U P ?
P R E S S   Y E S   O R   N O
```

If the previous swath width and groundspeed are to be used, respond by pressing YES. If you wish to change the swath width and/or groundspeed press NO followed by the new data. The display will show:

```
S E L E C T   F U N C T I O N
```

Any of the functions may now be selected.

7.6 Functions

The two lines of the display normally show two functions at the same time. The volume of the chemical sprayed is shown on the lower line whilst the upper line shows the function which has been selected.

The functions are as follows:

VOL A – This is the volume of chemical that has been sprayed.

The display shows:

```
V O L   C A N   B E   R E S E T
V O L   A   0 0 0 0   L I T R E
```

The volume can be reset to 0 by pressing the RESET key. This function can be used to monitor the chemical which has been used on each spray run, field, etc. The volume always starts from 0 when the unit is switched on.

VOL B – This is a non-resetable total volume which starts from 0 when the unit is switched on and continues counting regardless of how many times VOL A has been reset. The only way of clearing VOL B is to switch the unit off and on again. VOL B is normally used to check the total amount of chemical used in one load or for an entire job.

FLOW – This is the flow rate of chemical from the aircraft in litres or gallons/minute.

VOL/AR – (VOLUME/AREA) – This is the application rate of chemical in litres/hectare or gallons/acre. The figure is calculated from the flow rate and the swath width and groundspeed entered into the unit.

AR/MIN – (AREA/MINUTE) – This is the work rate (or coverage) of the aircraft in hectares or acres/minute. It is calculated from the swath width and groundspeed entered into the unit. It is important to realise that this is the work rate WHILST SPRAYING; the figure does not take into account time lost in turns etc.

SP TIME – (SPRAY TIME) – This is the time for which the aircraft has been spraying in minutes and seconds. The timer runs whilst chemical is flowing from the aircraft and stops automatically when the flow of chemical is turned off at the end of each spray run. The time can be reset to 0 by pressing RESET whilst SP TIME is being displayed.

AREA – This is the total area in hectares or acres sprayed by the aircraft. It is based on the swath width, groundspeed and spray time. The area will only match the field area if the spray is turned on and off exactly over the ends of the field. Any over-run will result in a greater area being sprayed and a greater

area being shown on the display. The area can be reset by pressing RESET whilst AREA is being displayed. Resetting SP TIME has no effect on AREA.

RPM – Pressing this key puts the Application Monitor into the RPM mode. The display will show the rotational speed of any one of up to 10 Micronair atomisers, provided that they have been fitted with the necessary transducers.

The display will show:

```
# 1      0 0 0 0 0   R P M
S E L   A T #   O R   R E S E T
```

The atomiser which has been selected is shown at the left-hand end of the top line after the # symbol and its speed is displayed to the nearest 10 RPM.

To select another atomiser, press the key corresponding to its number (1, 2, 3, etc). To select atomiser 10, either press 1 and then 0 or just 0.

It is normal to connect the atomisers so that number 1 is the left (port) outboard unit and to count from left to right so that the highest number is the right (starboard) outboard atomiser.

To leave the RPM mode, press the RESET key and then select the required function.

7.7 Commands

Commands are entered by first pressing the CMD key. The display will show:

```
S E L E C T   C O M M A N D
```

The command is then selected by pressing the appropriate key. The commands are as follows:

SWATH – This enables the swath width to be checked and changed if necessary. The display will show:

```
SWATH  0099  METRE
ACCEPT?  [YES/NO]
```

If you wish to change the swath width, press NO. The display will change to:

```
SWATH  0000  METRE
ENTER  NEW  DATA
```

Enter the new swath width and press ENTER. This new figure will be stored in the non-volatile memory in place of the previous swath width.

SPEED – This command works in exactly the same way as SWATH. The display will show:

```
SPEED  0099  Km/HR
ACCEPT?  [YES/NO]
```

The speed can be either accepted or changed by pressing YES or NO.

TURB # – (TURBINE NUMBER) – The Application Monitor can hold the calibration figures for two flowmeter turbines (or two different calibration figures for the same turbine – see Calibration section). These are shown as TURBINE 1 and TURBINE 2. Turbine 1 is normally the smaller (lower flow rate) of the two.

The display will show:

```
TURBINE  1SEL
ACCEPT?  [YES/NO]
```

If you wish to change to the other turbine, enter 1 or 2 as appropriate. The unit will then re-calibrate itself for the new turbine and all further readings will be based on this new figure.

1 and 2 are the only valid turbine numbers. Any other entries will be rejected.

CAL – (TURBINE CALIBRATION) – This command is used to store the calibration figure(s) (in pulses/litre) for the turbine(s) being used with the Application Monitor. The display will show:

```
TURB  1  0999  P/L
ACCEPT?  [YES/NO]
```

Refer to the Calibration section for full details of the calibration procedure.

IMPORTANT: Do not change the calibration figures unless you have a full understanding of the calibration procedure. If you select this command by mistake, press YES twice to leave the figures unchanged.

UNITS – This command changes the system of units in which the Application Monitor operates. This command is normally only used to set up a new Application Monitor. See the Initial Set-Up section for full details.

The UNITS command will not function unless VOL B is zero (i.e. no chemical has been sprayed). This ensures that the units cannot be changed accidentally whilst the Application Monitor is being used.

PRINT – This command is only used if the Application Monitor is being used with the optional Application Printer. See the Printer section 7.8 for full details.

Should the print command be selected when a printer is not connected, the unit will still go through the printer routine, after which the display will show:

```
***  PRINTING  ***
```

for about 20 seconds. At the end of this time it will return to normal operation.

7.8 Printer

The Application Monitor is supplied ready for use with the optional Micronair Application Printer. Refer to the Printer Installation section (6) if the printer is being installed and used for the first time.

The Application Printer provides a permanent record of each spray job, together with the date, the time and a reference number. A printout may be made at any time, either in flight or on the ground after landing. You can make as many printouts as you wish during a job.

In order to identify the individual printouts, each has a heading showing the date, the time and a reference number. The information for these must be entered into the Application Monitor before the first printout is made. Once entered, the information will automatically be updated and it will not be necessary to re-enter the data until the Application Monitor is switched off and on again.

The procedure for operating the printer is as follows:

1. Press CMD (command) followed by PRINT. The display will show:

```
YEAR  0000
ENTER NEW DATA
```

2. Enter the year, either in full or as the last two digits. The display will change to:

```
DATE  0000
ENTER NEW DATA
```

3. Enter the day and month in either European or American format. For example 17 January could be entered as either 1701 or 0117. The display will change to:

```
TIME  0000
ENTER NEW DATA
```

4. Enter the time according to the 24 hour clock. For example enter 0815 for 8.15 am or 1520 for 3.20 pm. This time will be loaded into the Application Monitor's internal clock and all subsequent printouts will show the correct time.

   Note that, once entered, the date, time and reference number CANNOT BE CHANGED without switching the unit off and on again. This is an important feature when the printouts are being used as proof of work carried out.

   The display will change to:

```
R E F #   0 0 0 0
E N T E R   N E W   D A T A
```

5. This is the starting reference number for the printouts. For example, if you enter 101, the first printout will have a reference number of 0101, the second 0102 and so on in sequence.

   If you enter a reference number of 0, the Application Monitor will not make an immediate printout. Instead, it will store all the information that has been entered and will be ready to make a printout the next time CMD-PRINT are pressed. The reference number for the printouts will start from 0001.

   This feature enables you to enter all the printer set-up data on the ground and then to initiate a printout in flight by pressing only CMD-PRINT.

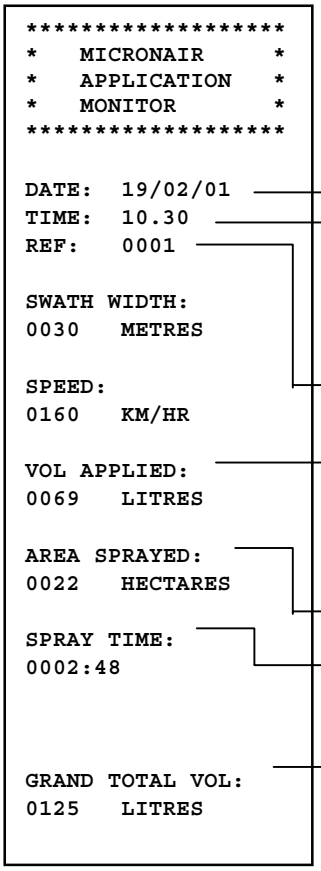
IMPORTANT: If entering a reference number of 0, press the 0 key before the ENTER key.

If you wish to set up the printer on the ground for a starting reference number other than 0001, enter a reference number of one less than that required and discard the first printout. For example, if you want the first printout in flight to be numbered 1234, enter 1233 on the ground. This will produce a printout numbered 1233 which you should ignore. The next printout will then have the correct number of 1234.

Finally, the display will change to:

```
* * *   P R I N T I N G   * * *
```

The printout will appear as shown below:



The date entered from the keyboard. The date does not roll over at midnight. This is important in night spraying operations as all printouts will have the STARTING date of the job, even if it continues beyond midnight. For example, if printout 21 were made at 23:59 on 12.11, printout 22 at 00:01 would also be dated 12/11.

The actual time according to the 24 hour clock and is based on the starting time entered from the keyboard. You can choose to use either local time or GMT.

The sequence number of the printout and will start from either 0001 or a specified number (see above).

The same as the figure shown by the VOLUME A function. If VOLUME A is reset, the VOLUME APPLIED figure will also be reset.

The same as the figure shown by the AREA function.

The total spray time in minutes and seconds and is the same as the figure shown by the TIME function. It is independent of actual (clock) time.

The same as the VOLUME B function and is a non-resetable total of all chemical sprayed since the Application Monitor was first switched on.

IMPORTANT: The printouts from the Application Printer reflect the same figures as shown by the various functions. Because of this, you should always reset VOL A, AREA and SPRAY TIME in such a way as to avoid ambiguous printouts.

7.9 Using the Printer as Proof of Work Done

The Application Printer is a valuable aid to recording the exact details of a spray job for commercial or environmental reasons. Once set up, the date, actual time, reference number sequence and grand total volume of chemical cannot be altered. The only way of changing these is to switch the unit off and on again. In some cases it may be desirable to 'hot wire' the unit to the aircraft battery or an independent power source and to use a key-operated on/off switch. See the Installation section 4.4 for full technical details of this arrangement.

8. REPLACEMENT OF PRINTER PAPER ROLL AND RIBBON

8.1 Replacement of Paper Roll

The paper roll should be changed when a red band starts to appear on the printout.

The procedure to change the roll is as follows:

1. Open the lid of the printer and switch on the power.

2. Tear the paper behind the printer mechanism and remove the used roll and the centre spindle.

3. Press the PAPER FEED button until the remaining length of paper is ejected from the printer.

4. Fit the new roll of paper on the spindle and position in the holder so that the free end comes FORWARD off the TOP of the roll.

5. Ensure that the end of the paper is square. Feed the end into the back of the printer mechanism whilst pressing the PAPER FEED button until the end emerges from the top. Press the TEST button to initiate the test sequence. Ensure that the paper feeds smoothly through the mechanism and that the printing is clear. If the characters are faint, the ribbon should also be changed (see section 8.2).

6. Close the lid of the printer.

Note that the printer uses standard paper rolls, NOT heat or electro-sensitive types as used in some calculators. Replacements can be ordered from Micronair (part number CBP957) or obtained from most office supply companies. The roll is 1.75" (44 mm) wide and must not exceed 1.5" (38mm) diameter. Larger diameter rolls can be used if the excess paper is removed before installation.

8.2 Replacement of Printer Ribbon

The printer ribbon is in a sealed cartridge that clips onto the top of the printer mechanism. The procedure to replace the ribbon is as follows:

1. Press down on the cartridge at the point marked PRESS. This will eject the cartridge from the mechanism.

2. Place the new cartridge on top of the mechanism, ensuring that the paper passes between the ribbon and the body of the cartridge.

3. Apply even downward pressure on the cartridge until it snaps into position.

4. Take up any slack in the ribbon by turning the knurled feed button in the direction shown by the arrow on the cartridge.

5. Initiate a printer test to ensure that the ribbon is correctly positioned.

Note that the printer uses a widely available Epson print ribbon. This may be ordered from Micronair (part number CBP958). Alternatively, it is available from many calculator stockists as Epson part number ERC-05/F601353000 (Black or Blue).

9. CALIBRATION

Each Application Monitor kit is supplied pre-calibrated and can be expected to give accurate readings in most installations. However, factors such as bends in the pipework or extremes of viscosity may affect the accuracy of the system to a point where re-calibration is desirable.

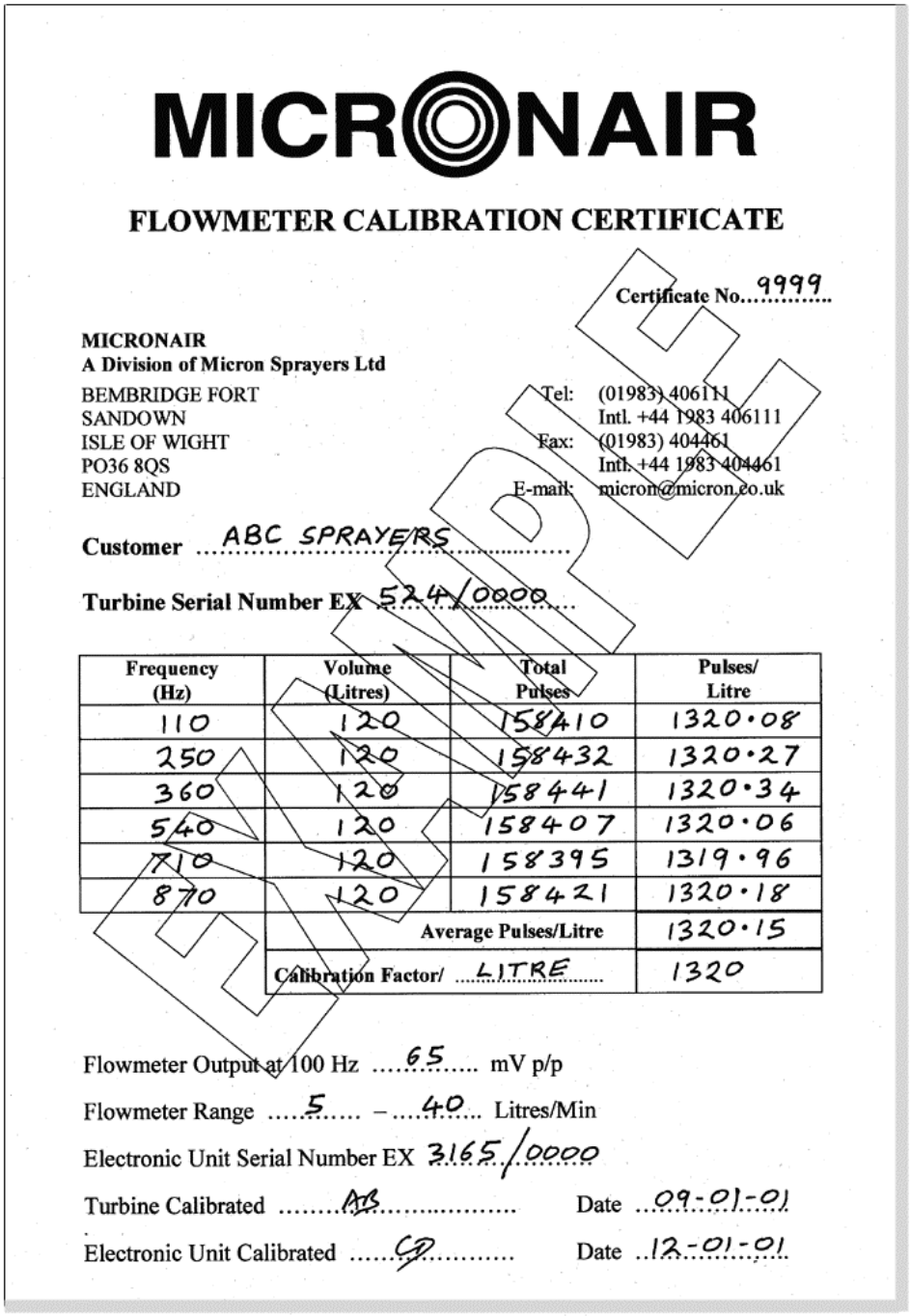
As every turbine is individually calibrated, it will normally be necessary to re-calibrate the electronic unit if a new turbine is fitted.

The system operates by counting electrical pulses from the turbine. Each turbine produces a constant number of pulses for every litre of chemical that passes through it. This is known as the calibration factor and is shown on the Calibration Certificate supplied with each turbine. The Certificate actually shows the number of pulses/litre at various flow rates and the calibration factor is the average of these, as written in the Average Pulses/Litre box (see sample in Fig. 11).

The number of pulses/litre for each turbine must be stored in the non-volatile memory of the Application Monitor. This memory can store the calibration factor for two turbines, shown as TURB1 and TURB2. These would normally be two turbines of different sizes for different flow ranges (e.g. ULV and LV). However, the two calibration factors can be set to different figures for the same turbine to compensate for errors due to, for example, extremes of viscosity or flow range. In installations with only one turbine and when only one calibration factor is used, both TURB1 and TURB2 should normally be set to the same calibration factor to avoid ambiguity if TURB2 is selected in error.

The calibration factors are entered by pressing CMD-CAL. This displays the calibration for turbine 1. If you wish to change this, press NO and enter the new calibration factor in pulses/litre. The display will then show the calibration for turbine 2. Again, this can be changed if required.

IMPORTANT: The calibration factor is always entered in pulses/litre, regardless of whether the unit is operating in metric, US or British units.



MICRONAIR

FLOWMETER CALIBRATION CERTIFICATE

Certificate No. 9999

MICRONAIR
A Division of Micron Sprayers Ltd
BEMBRIDGE FORT
SANDOWN
ISLE OF WIGHT
PO36 8QS
ENGLAND

Tel: (01983) 406111
Intl. +44 1983 406111
Fax: (01983) 404461
Intl. +44 1983 404461
E-mail: micron@micron.co.uk

Customer ABC SPRAYERS

Turbine Serial Number EX 524/0000

Frequency (Hz)	Volume (Litres)	Total Pulses	Pulses/ Litre
110	120	158410	1320·08
250	120	158432	1320·27
360	120	158441	1320·34
540	120	158407	1320·06
710	120	158395	1319·96
870	120	158421	1320·18
	Average Pulses/Litre		1320·15
	Calibration Factor/ LITRE		1320

Flowmeter Output at 100 Hz 65 mV p/p

Flowmeter Range 5 – 40 Litres/Min

Electronic Unit Serial Number EX 3165/0000

Turbine Calibrated AB Date 09-01-01

Electronic Unit Calibrated CD Date 12-01-01

Fig. 11 – Sample Calibration Certificate

To set the unit to work with a different turbine, it is only necessary to read the number of pulses/litre from the Calibration Certificate and to use the CAL command to load this number into the memory of the Application Monitor as described above.

The system must always be checked after any changes have been made to ensure that it is accurate.

If, however, the system is not giving accurate readings it may be re-calibrated as follows:

1. Ensure that the turbine is correctly installed and is clean (see Maintenance section).

2. Ensure that the system is operating in the correct units. Note that a system set up for British units would appear to have an error of about 20% if it were being wrongly used for US gallons.

3. If everything else appears to be correct, carry out the following procedure:

   i) Carry out the initial set-up procedures.

   ii) Select VOL A.

   iii) Press RESET to clear the display to 0000.

   iv) Run a MEASURED volume of the chemical being used through the turbine. The greater the volume used the better.

   v) Record the actual (measured) volume and the volume indicated by the Application Monitor.

   vi) Press RESET again.

   vii) Repeat (iii – vi) two or more times.

   viii) For each set of readings, calculate the percentage error as follows:

$$\% \text{ Error} = \frac{\text{Actual Vol - Indicated Vol}}{\text{Actual Vol}} \times 100$$

   ix) Calculate the AVERAGE percentage error for all sets of readings.

   x) Use the CAL command to find the number of pulses/litre for which the Application Monitor is programmed for the turbine being used.

   xi) Using the error from (ix), increase or decrease the number of pulses/litre by the percentage error.

   If the unit was over-reading, the number of pulses/litre must be INCREASED. If the unit was under-reading, the number of pulses/litre must be DECREASED.

   xii) Use the CAL command to change the calibration of the unit to the new corrected figure.

The unit should read correctly when it is next used.

Example:

For 200 l (actual measured volume) the unit reads (VOL A) 210, 212 and 209 litres on three trials.

The percentage errors are:

$$\text{Trial 1:} \quad \frac{200 - 210}{200} \times 100 = 5.0\%$$

$$\text{Trial 2:} \quad \frac{200 - 212}{200} \times 100 = 6.0\%$$

$$\text{Trial 3:} \quad \frac{200 - 209}{200} \times 100 = 4.5\%$$

$$\text{Average error} = \frac{5.0 + 6.0 + 4.5}{3} = 5.17\%$$

The calibration for TURB1 was 1236 pulses/litre.

This figure must be INCREASED by 5.17%, so that the new calibration setting is:

$$1236 + \frac{1236 \times 5.17}{100} = 1300$$

10. MAINTENANCE

10.1 Electronic Unit

The electronic unit requires no regular preventative maintenance. However, it should be kept clean by wiping with a SLIGHTLY damp cloth. DO NOT use solvent cleaners or aviation fuel. It is particularly important to keep the keyboard and display window clean.

10.2 Turbine

The turbine must be kept clean and free of chemical residues at all times.

IMPORTANT: It is vital that the system is flushed out after each day's work.

In addition to this flushing out, the turbine must be removed and cleaned regularly. The time between cleaning will be determined by the type of chemical being used and will vary from a few days with certain wettable powders to many weeks with some oil-based or ULV formulations.

The procedure to clean a turbine is as follows:

1. Remove the electrical connector from the turbine.

IMPORTANT: Do not disturb the transducer adjustment.

2. Remove the pipe union from each end of the turbine and remove the turbine from the system.

3. Remove the white retaining cone from the DOWNSTREAM end of the body. Note: If the cone has become stuck, it can be eased out with the blade of a knife inserted between the cone and the body.

4. Withdraw the downstream stator and the rotor.

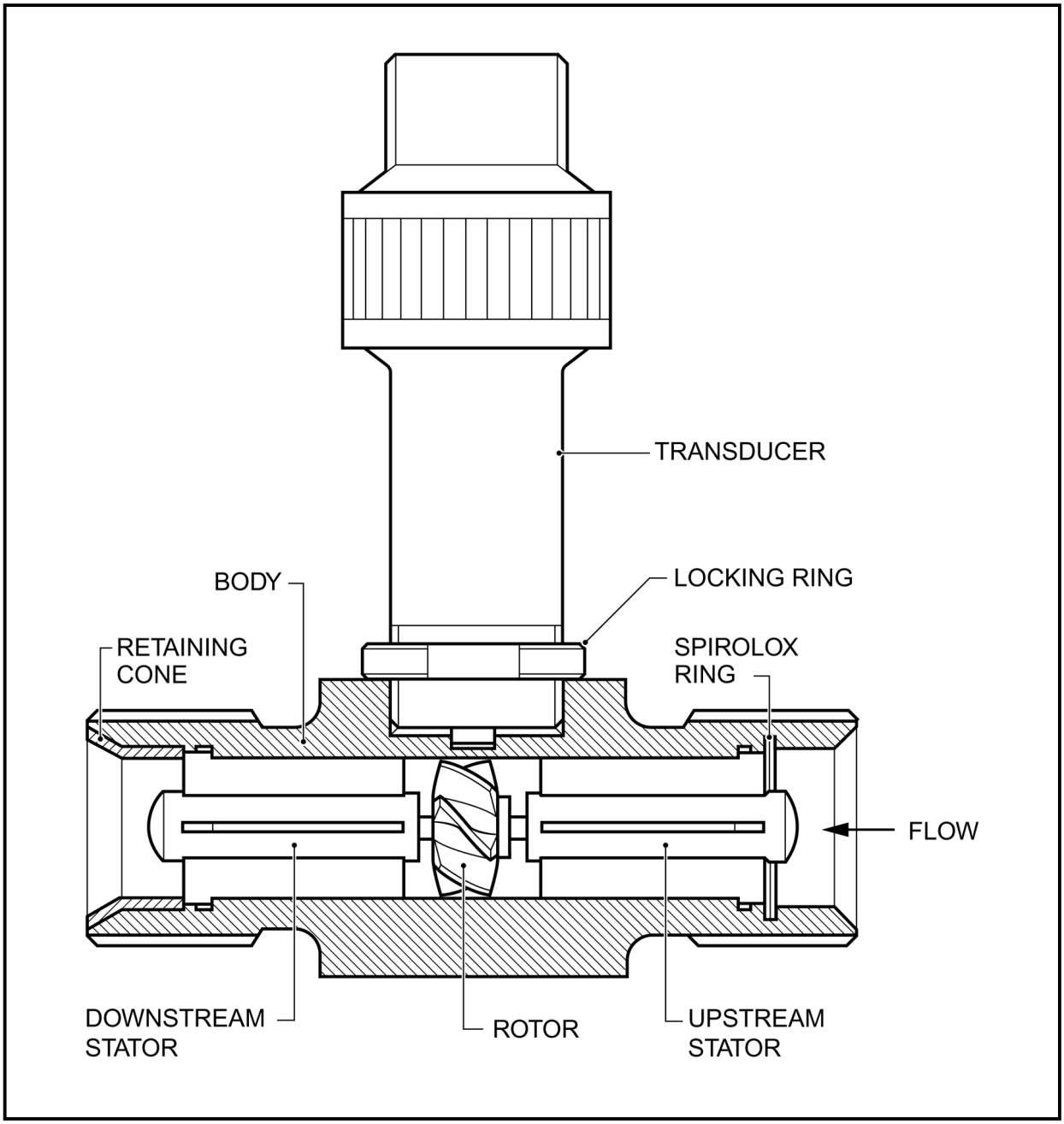
5. Wash all components in a suitable solvent and remove all traces of chemical residue. Pay particular attention to the turbine bearings and the bore of the body.

6. Place the rotor on the downstream stator and re-fit in the body. Ensure that the vanes of the stator align with the slots inside the body.

7. Note: The 1/2" turbine (EX2027) has a bearing pin passing through the rotor and a bearing bush in both stators. The rotor must be fitted so that the centre boss faces UPSTREAM (see Fig. 12). The pin must enter the upstream bearing during assembly.

8. Re-fit the white retaining cone in the downstream end of the turbine.
9. Re-install the turbine in the pipework and replace the connector.

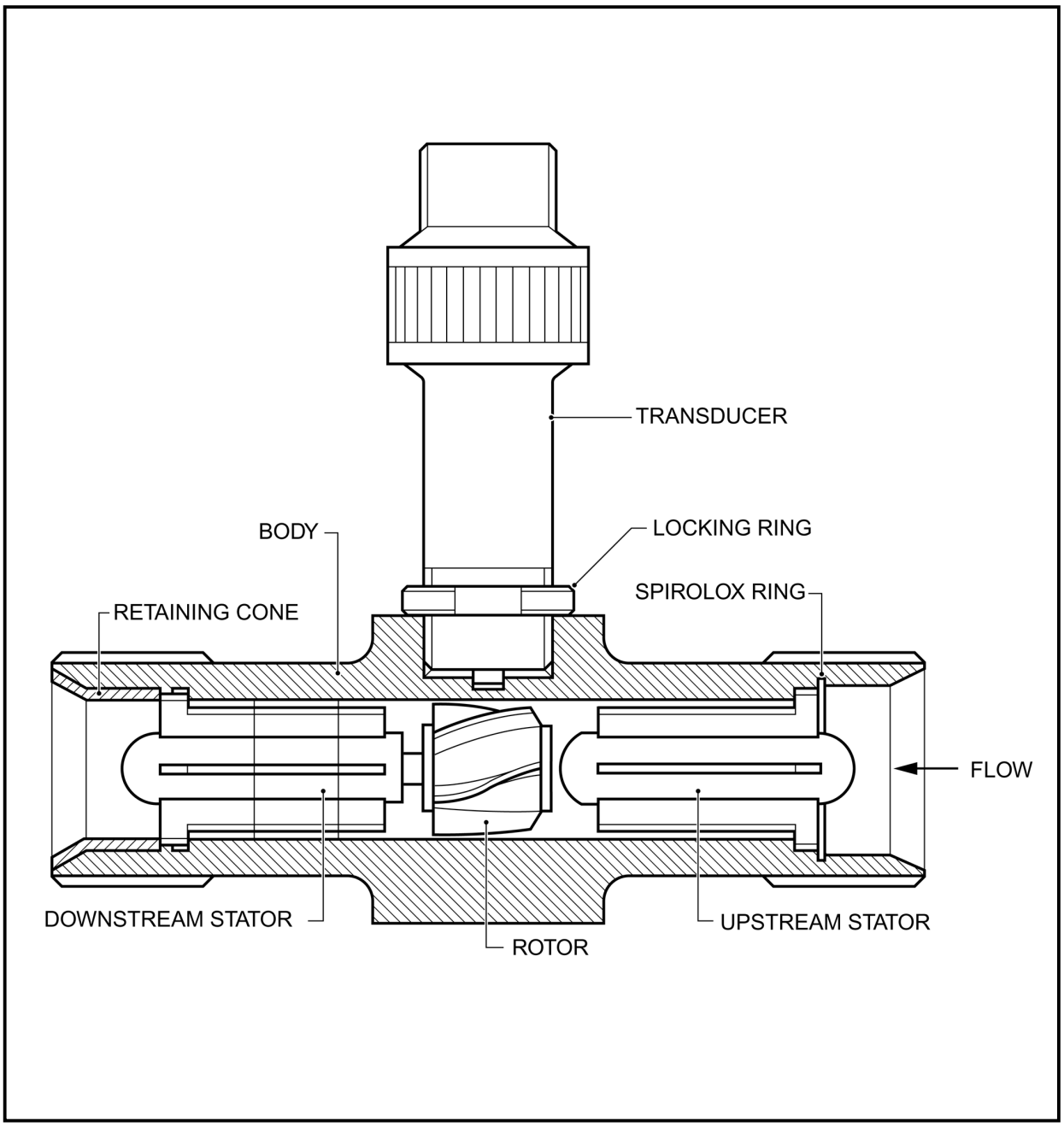
IMPORTANT: Ensure that the chemical flow is in the direction of the arrow on the body.



PARTS LIST

Turbine Assy	EX2027
Body	EX2028
Upstream Stator Assy	EX2031
Downstream Stator Assy	EX2031
Rotor Assy	EX2033
Spirolox Ring	CBP739
Retaining Cone	EX2029
Transducer	EX1152

Fig. 12 – Construction of Flowmeter Turbine EX2027



PARTS LIST

Turbine Assy	EX524	EX525	EX526	EX527	EX2532
Body	EX1265	EX520	EX521	EX522	EX2525
Upstream Stator Assy	EX520/1	EX520/1	EX521/1	EX522/1	EX2528
Downstream Stator Assy	EX520/2	EX520/2	EX521/2	EX522/2	EX2529
Rotor Assy	EX1328	EX520/3	EX521/3	EX522/3	EX2527
Spirolox Ring	CBP338	CBP338	CBP358	CBP362	CBP955
Retaining Cone	EX528	EX528	EX529	EX530	EX2530
Transducer	EX1152	EX1152	EX1152	EX1152	EX1152

Fig. 13 – Construction of Flowmeter Turbines EX524 and Larger

11. FAULT FINDING

The Application Monitor is a factory sealed unit and contains no adjustments or user-serviceable parts. Should the unit malfunction, it is likely to be due to a simple external problem. This section is intended to help operators and technicians identify such problems.

SYMPTOM	PROBABLE CAUSE	SUGGESTED REMEDY
Display blank, illumination not functioning	Power not reaching at unit	Check power supply voltage at fuse and contacts. Test for ground continuity between grounding point of unit and airframes.
Display blank or dark illumination working	Wrongly adjusted contrast control	Adjust the CONTRAST control until characters can be seen clearly on the display.
Display changes back to "USE LAST" SET-UP?" message while in use	Interruption of power to unit	Check connections as in (1). Check master Solenoid and condition of battery. The unit will automatically reset if the supply voltage falls below 8V.
Flow reading not zero when spray valve closed.	Electrical Interference	Check condition and routing of lead to flowmeter turbine and adjacent wiring. Strong electric magnetic fields can cause interference. Re-route wiring if necessary.
	'Suck back' of chemical through turbine	Incorrect adjustment of the Venturi 'suck back' incorporated in many 3-way valves can cause chemical to flow backwards through the flowmeter turbine and cause an unexpected reading. Check adjustment of 'suck back'. If this fails, fit micro-switch on valve linkage to connect pins A and B of transducer connector together when valve is closed.

Display functioning but flow and RPM functions both read zero	Input cable dis-connected	Check 25 pin connector on lead from unit.
Flow reading zero or erratic	Dirty or blocked flowmeter turbine	Dismantle and clean turbine. Ensure filter is fitted in system.
	Wrongly installed flowmeter turbine.	Check that the flow through the turbine is in the direction of arrow on body.
	Damaged lead or connector	Check condition of lead and connector to flowmeter trans-ducer. Carry out continuity check at 25 pin plug. Impedance between pins 11 and 12 should be 0.5-1.5 k ohms and both should be isolated from ground (>10M ohms).
Steady but low RPM reading for one or more atomisers	Wrongly adjusted transducer	Check gap setting between transducer and each tab. (See Fig. 7).
	Bent or missing sensing tab	Check that all five tabs 'fingers' are in position and are passing in front of the RPM transducer. (See Fig. 6).

12. PART NUMBERS

Application Monitor

Application Monitor Electronic Unit	EX3165
Application Monitor Mounting Bracket	EX3197
Securing Knob	EX3202
Friction Washer	EX3201
Turbine Lead Assy	EX3293
Spare Fuse for Application Monitor (1A)	CBP456

Turbines	EX2027	EX524	EX525	EX526	EX527	EX2532
Inlet Pipe	EX564	EX414	EX414	EX430	EX432	EX1736
Outlet Pipe	EX565	EX415	EX415	EX431	EX433	EX1737

Flowmeter Transducer	EX1152

RPM Indicator

RPM Transducer Lead Assy	EX3291
RPM Transducer	EX2373
RPM Transducer Bush	EX356

RPM Transducer Mounting Brackets:	
AU3000/4000 on EX2968 Block	EX193
AU3000/4000 on Cast Clamps	EX1792
AU5000	EX1793
AU7000	EX2651

RPM Sensing Tabs/Plates:	
AU3000/4000	EX192
AU5000	EX1794
AU7000	EX2652

Printer

Printer Electronic Unit	EX2533
Printer Mounting Bracket	EX2534
Printer Socket Lead Assy	EX3292
Spare Paper Roll	CBP957
Spare Ink Ribbon	CBP958
Spare Fuse for Printer (2A)	CBP1352

13. CONVERSION FACTORS

1 yard	= 3 feet	= 0.91 metre
1 metre	= 39.37 inches	= 1.09 yards
1 statute mile	= 0.87 nautical mile	= 1.61 kilometres
1 nautical mile	= 1.15 statute mile	= 1.85 kilometres
1 kilometre	= 0.62 statute mile	= 0.54 nautical mile
1 statute mile	= 1760 yards	= 5280 feet
1 nautical mile	= 2027 yards	= 6081 feet
1 kilometre	=1094 yards	= 3282 feet
1 metre/sec	= 2.237miles per hr	= 196.9 ft/min
1 acre	= 43560 sq feet	= 4840 sq yards
1 acre	= 4047 sq metres	= 0.40 hectare
1 hectare	= 107600 sq feet	= 11955 sq yards
1 hectare	= 10000 sq metres	= 2.47 acres
1 sq mile	= 640 acres	= 259 hectares
1 sq kilometre	= 247 acres	= 100 hectares
1 US gal	= 0.83 Imp gal	= 3.78 litres
1 Imp gal	= 1.20 US gals	= 4.54 litres
1 litre	= 0.26 US gal	= 0.22 Imp gal
1 US pint	= 16 US fl ounces	= 0.47 litre
1 Imp pint	= 20 Imp fl ounces	= 0.57 litre
1 US gal/acre	= 8 US pints/acre	= 9.45 litre/hectare
1 Imp gal/acre	= 8 Imp pints/acre	= 11.35 litre/hectare
1 litre/hectare	= 0.11 US gal/acre	= 0.081 Imp gal/acre
1 pound	= 16 ounces	= 0.45 kilogram
1 kilogram	= 2.20 pounds	= 35.3 ounces
1 ounce	= 28.35 grams	
1 pound/sq inch	= 0.068 atmosphere	= 0.067 bar
1 atmosphere	= 14.70 pounds/sq in	= 1.01 bars
1 bar	= 14.50 pounds/sq in	= 0.98 atmosphere
1 kilopascal	= 0.01 bar	= 0.145 pounds/sq in