TUFF™

PERSONAL AIR SAMPLING PUMPS
& 'INSIGHT' PUMP MANAGEMENT SOFTWARE
(I.S. and Non I.S. Versions)

Go to Contact Details

OPERATOR'S MANUAL

HB3343-05

PRINTED IN ENGLAND

CONTACT DETAILS

CASELLA CEL
Regent House,
Wolseley Road,
Kempston,
Bedford,
MK42 7JY, U.K.
Phone: +44 (0) 1234 844 100
Fax: +44 (0) 1234 841 490
E-mail: info@casellamaesurement.com
Web: www.casellameasurement.com

To find your local distributor please visit www.casellameasurement.com

Go to Index

TABLE OF CONTENTS

PLEASE READ WARNINGS and SAFETY PRECAUTIONS BEFORE ATTEMPTING TO OPERATE THIS INSTRUMENT.

SECTION	TITLE	PAGE
1	Introduction	6
2	Charging the Tuff Unit / Batteries	7
3	Operation Symbols	8
4	Operation	9
5	Configuration	14
6	Calibration	17
7	Renew Inlet Adapter Filter	19
8	Servicing	20
9	Fault Finding	21
10	Pump Management Software	22
11	Technical Information/Certification	23

WARNINGS and SAFETY PRECAUTIONS

The TUFF™ series of air sampling pumps are designed to be robust, however they should not be dropped or subjected to mechanical shock. Do not suck in water, or highly saturated or corrosive gases. Failure to comply will render the warranty invalid.

The air sampling pumps contain no user serviceable parts and if a fault is suspected the instrument must be returned immediately to Casella CEL or to a Casella CEL Approved Agency for repair.

The warranty does not extend to cleaning or general servicing of the instrument.

Pumps which are not in regular use, or those which have been left on the shelf for several days, when switched on, may not display a true indication of the current battery charge status. To ensure accurate battery condition monitoring and charge status displays, it is advisable to perform one or two complete charge and discharge cycles prior to use.

Warnings for Intrinsically Safe Versions:

The following warnings should be observed for intrinsically safe versions of the TUFF Pump:-

- **DO NOT** attempt to download data via the I.R port in a hazardous area.
- Use only the following **CASELLA APPROVED Intrinsically Safe** battery packs:-
  - Part No 197140B (4.8 V, 1.7Ah Nickel Metal-Hydride IECEX & ATEX Mining M1, MASC)
  - Part No 197141B (4.8 V, 2.7Ah Nickel Metal-Hydride IECEX & ATEX Mining M1, MASC)
  - Part No 197150B (4.8 V, 1.7Ah Nickel Metal-Hydride IECEX and ATEX)
  - Part No 197151B (4.8 V, 2.7Ah Nickel Metal-Hydride IECEX and ATEX)
- **DO NOT** use Non-intrinsically safe battery pack versions within a Hazardous area.
- **DO NOT** Connect or Remove battery packs in a hazardous area.
- **DO NOT** use the battery charger in a hazardous area.
- **DO NOT** use the equipment if the outer case of the instrument or the battery pack is cracked as this invalidates the intrinsically safe certification.
- The user **MUST ENSURE** that the I.S. rating of the pump to be used is suitable for the I.S. rating of the intended hazardous area.
- **DO NOT** service while in a hazardous area.

Repair of this equipment shall only be carried out by the manufacturer or an authorised representative in accordance with the applicable code of practice.

The certification of this equipment relies on the following materials used in its construction:-

High Impact PC- ABS/ Clear Polycarbonate/Acrylic.

If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised. (Aggressive substances e.g. solvents that may affect polymeric materials.) Suitable precautions e.g. regular checks as part of routine inspections or establishing from the material's data sheet that it is resistant to specific chemicals.

Instructions specific to hazardous area installations:-

- The equipment may be used with flammable gases and vapours with apparatus Groups IIA, IIB and with temperature classes T1, T2 and T3.
- The equipment is certified only for use in ambient temperatures in the range -20°C to +41°C and should not be used outside this range.
- The certification marking and classification is displayed on the battery pack label.

NOTE:

FOR I.S. MINING OPERATION, **USE ONLY** CERTIFIED BATTERY PACKS Prt. No 197140B or 197141B IN CONJUCTION WITH A PUMP BODY BEARING A LABEL IDENTIFYING THESE I.S. CERTIFIED BATTERY PACKS.

FOR NON-MNING I.S. OPERATION, **USE ONLY** CERTIFIED BATTERY PACKS Prt. No: 197150B or 197151B IN CONJUCTION WITH A PUMP BODY BEARING A LABEL IDENTIFYING THESE I.S. CERTIFIED BATTERY PACKS.

Back to Index

1. INTRODUCTION

The TUFF™ air sampling pump is produced in three models, the TUFF Standard, TUFF Plus and TUFF Pro.

This handbook covers the entire range of TUFF™ air sampling pumps.

The TUFF™ was developed to provide sampling capabilities between 5 ml/min and 4.5 l/min (free air), suitable for a wide range of applications including solvent fumes, asbestos clearance and personal sampling of dusts. TUFF™ pumps are ideally suited to many of the "Total" and "Respirable" dust sampling techniques detailed in the U.K. Health and Safety Executive's publication MDHS14, and in other international reference methods.

The information contained in this handbook relates only to the operation of Casella CEL sampling equipment and is not intended to advise or influence your adopted sampling strategy. For advice on appropriate sampling methods, refer to local legislation and guidelines as dictated by the relevant national and regional health and safety organisations.

Please make sure the TUFF™ and associated equipment supplied by Casella are not damaged and the Inlet Nozzle is not restricted before attempting to use this instrument.

Figure 1 TUFF™ Air Sampling Pump

Back to Index

2. CHARGING THE TUFF PUMPS / BATTERIES

There are two methods of charging the battery.

1. When the battery is attached to the pump.
2. The battery on its own.

This section details both methods.

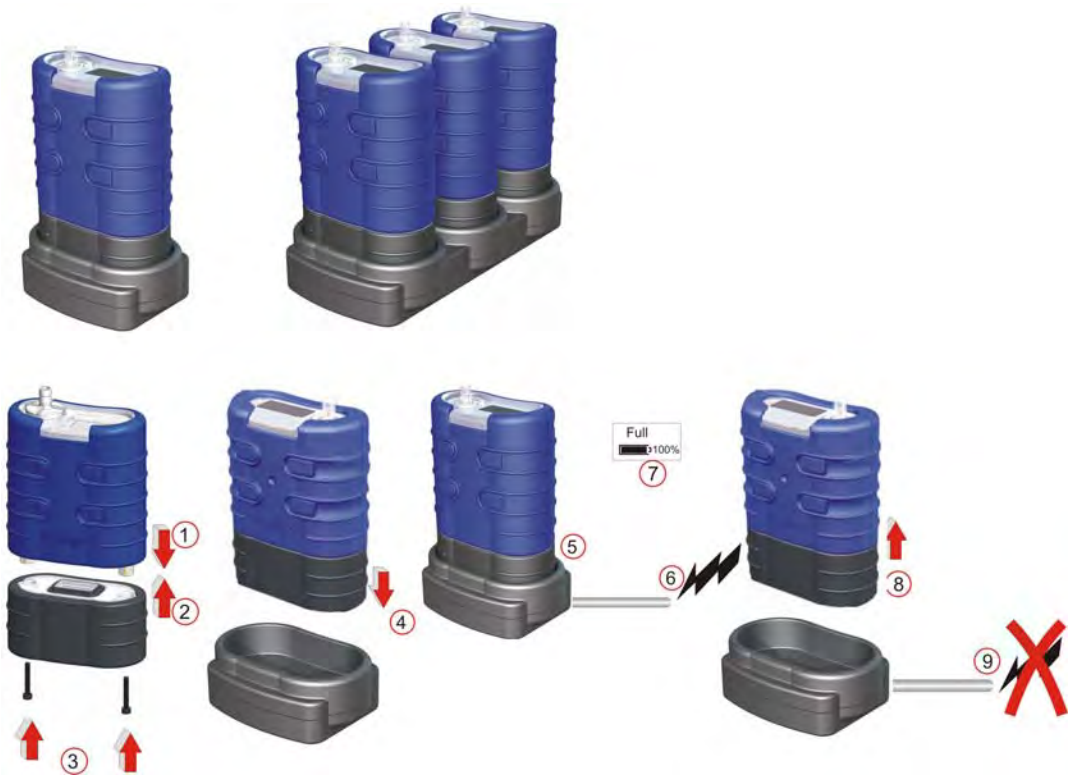
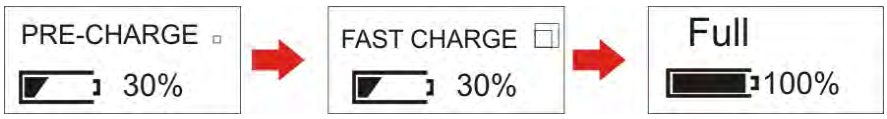


Figure 2 Fit Battery to Pump and then to the Charger

- Insert pump into charging cradle as shown above.
- Fast charge starts and the red LED on the pump flashes.
- When fully charged the blue LED will illuminate. The pump can be left in the cradle on trickle charge or may be removed.
- Individual battery packs can also be charged / stored in the cradle. The battery pack's own red LED will indicate that charging is in progress.



Battery Charge Mode

Note: Make sure all pumps are fully charged before use.

Figure 3 Insert Battery in Charger

- Insert battery into the charging cradle.
- Slow charge (>8-14 hours) starts. Red LED on battery illuminates.
- Battery fully charged. LED on battery holds steady illumination. The battery can be left in cradle on trickle charge or removed. The battery charger will power down after 5 seconds.

3. SYMBOLS DISPLAYED DURING OPERATION

During a sampling run symbols are displayed on the screen to indicate the pump Running /Stopped status.

The symbol in the top left hand corner of the screen displays the pump mode.

Pump Running.

Pump Stopped.

Pump Paused.

The operating keys can be set in a Partial Lock Mode or Locked Mode.

Partial Lock Mode. This can be activated in Stop Mode and Run Mode. In this mode the pump can only be started and stopped. Press the ON/OFF key three times within 3 seconds to enter Partial Lock Mode. Repeat once to unlock in Stop Mode, repeat twice to unlock in Run mode.

Fully Locked Mode. This can only be activated in Run Mode. In this mode all keys are disabled. From Partial Lock Mode press the ON/OFF key three times within 3 seconds to enter Locked Mode. Repeat to unlock.

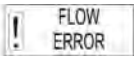
BATTERY GAUGE

TUFF Standard models – Battery gauge shows approximate estimate of available battery capacity.

TUFF Plus Model- Here the battery status bar indicates approximate % remaining.

PRO only - This screen shows the estimated life remaining based on the current battery loading.

ERROR MESSAGES



The pump stops and an error condition is indicated by a flashing '!' and red LED. Low Battery and Flow Blockage are shown here. After 1 minute stoppage the pump will try restart. All error messages are displayed for 4 hours before the pump turns off.

This symbol is displayed if the Run Time exceeds 2500hrs or exceeds 600 charge cycles.

Back to Index

4. OPERATION

A. POWER ON

Note: To Set Language go to Configuration Chapter 5.

To start the pump, press and release the ON/OFF Key. The Firmware will run through the initialisation screens and then automatically go to the Main Menu.

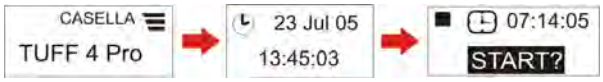


Figure 4 Power ON Screens

B. MAIN MENU (Fig. 5)

When on the Sampler will scroll through the Main Menu Options. The information displayed on the screens will be the saved data from the last time the pump was used. **Press the ENTER key on any screen to start the pump.** (Volume and Flow not displayed on Standard Model.)

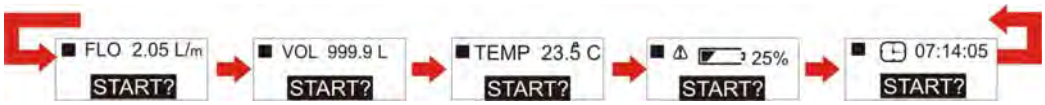


Figure 5 Main Menu

C. RUN MODE MAIN MENU (Fig. 6)

When the pump is running the Sampler will scroll through the Run Mode Menu options and the blue led will be flashing. Current run data will be displayed. To stop the pump, press and hold the ENTER key on any screen until the countdown is complete.

Note: PRO Model Only - Screen (Z) is the remaining run time available based on the current flow and pressure loading. The **Plus** model displays the % of remaining battery capacity only. **Standard** model only displays battery status bar and elapsed run time only. No flow rate or sampled volume are displayed.

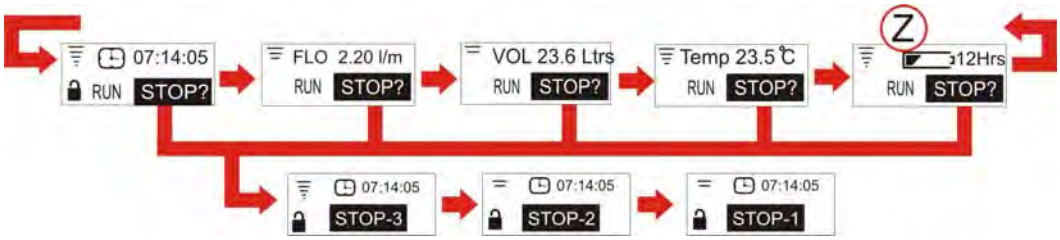


Figure 6 Run Mode Main Menu

D. STOPPED MODE MENU OPTIONS (Fig. 7)

Use the UP/DOWN keys to step through the Menu Options. Press ENTER to access a Menu Option when it is displayed. Menu option not available in partial lock mode.

Figure 7 Menu Options

E.TIME WEIGHTED AVERAGE (TWA) PRO ONLY (Fig. 8) (Only activated when advanced mode is selected-see configuration chapter)

This mode allows the user to allow a known volume of sample to be taken over a selectable time period (for example 120L over 8 hours.). In this instance if the pump was set to 2l/min flow rate, it would only need to sample for 60 minutes over the whole 8 hour sampling duration. The pump will automatically switch on/off spreading the sample on time over the whole duration evenly.

Use the UP/DOWN keys to step through the Menu Options until the TWA screen is displayed.

Press ENTER to continue to the TWA Run screen. Use the UP/DOWN keys to set the total sampling duration, e. g 8 hours.

Press ENTER to continue to the Exposure time setting. Use the UP/DOWN keys to set the Exposure Time, e. g 1 hour.

The settings entered will provide 1 hours exposure time evenly spaced over the 8 hours running time.

Press ENTER to Start.

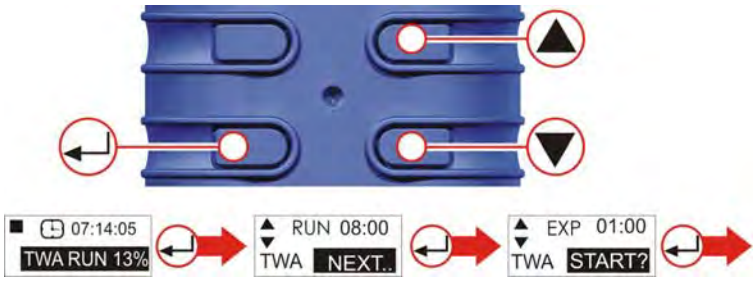


Figure 8 Time Weighted Average

To exit the program at any time press and hold ENTER. The display will count down 3, 2, 1 and default to the Main Menu.

F. RUN DURATION (**PRO and PLUS ONLY)** (Fig. 9)

Allows a pre set sampling duration time to be set e.g 6 hours.

Press ENTER to access Run Duration setup screen.

Use the UP/DOWN keys to set run duration in hours and minutes.

Press ENTER again to start the pump. The duration will be counted down and indicate time remaining. The pump will stop when the duration end time is reached.

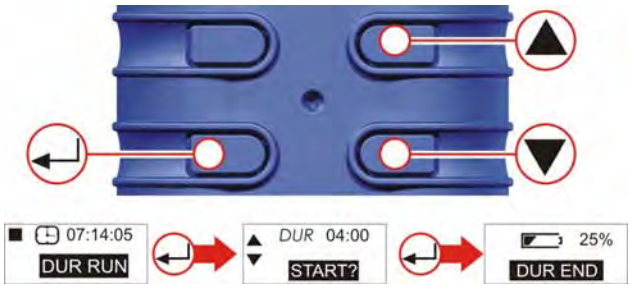


Figure 9 Run Duration

G. PROGRAM MODE (PRO ONLY) (Fig. 10)

Note: The Advanced Mode must be selected ON to enable this feature.
The program is configured on a PC and then uploaded into the pump. Refer to chapter 10 for details.

Note: If the pump is programmed to start sampling at 08:00 on Monday and the pump is not switched ON until 08:10 on Monday it will not run until the **next** Monday at 08:00.
This example assumes the intention is to run the pump for 4 hours, then pause for 1 hour, and then resume running for another 4 hours. Use the UP/DOWN keys to step through the Stop Mode Menu Options (See Fig. 14 for details) until PRG1 screen is displayed.
Press ENTER to continue to the 'ON 1' screen. Use the UP/DOWN keys to review the program set parameters. ON1 is 08:00. OFF1 is 12:00. PAUSE is 12:00 – 13:00. START2 is 13:00. PROGRAM END is 17:00.
When pump is running, to exit Program Mode at any time press and hold ENTER. The MAIN MENU's will count own 3, 2, 1 and default to the Main Menu.

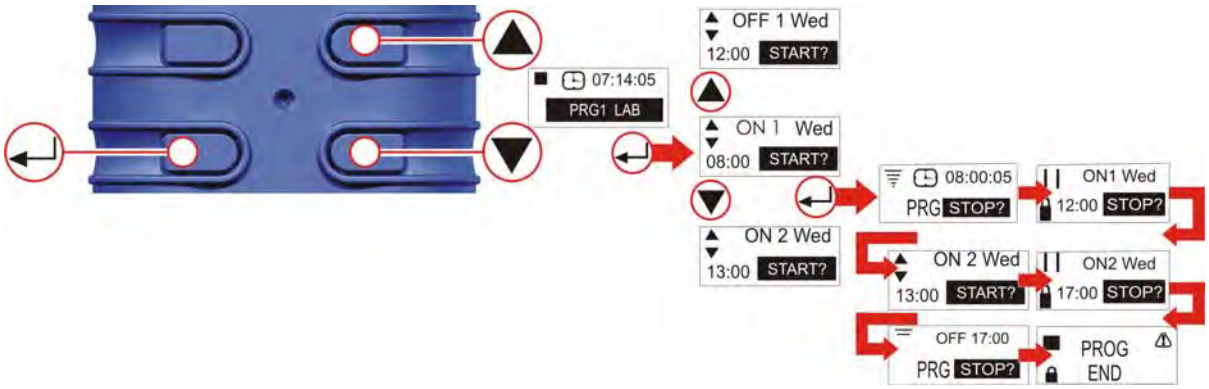


Figure 10 Program Mode

H. RESET (Fig. 11)

(Used to reset all the previous run details from display. If run details are required, please make a note of these before reseting).

Press and hold ENTER. Release ENTER when counter is at zero.

Note: If the counter is already at zero, the Reset option is not displayed.

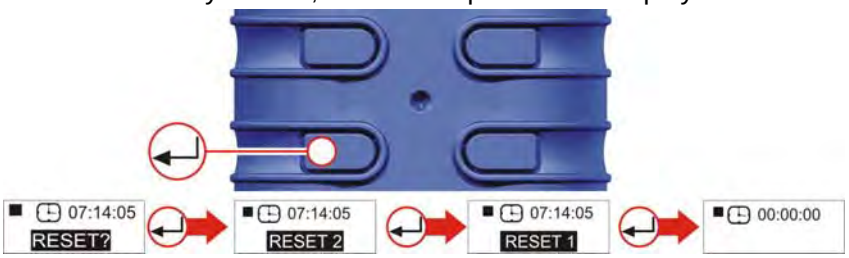


Figure 11 Reset Function

I. SET REQUIRED FLOW RATE (Fig. 12)

Note: “Set Flow” and “Reset” options are not available in Partial Lock mode.

From main menu, press UP or DOWN arrow to go to SET FLOW. Press ENTER to access Set Flow options. Use UP/DOWN keys to adjust the flow setting in 0.5 l/min increments. (Please note Tuff 3 will only adjust to maximum of 3l/min whilst Tuff 4 models will adjust up to 4.5L/min *free air.)

Press ENTER to continue. Cal Flow will be displayed.

Pump should then be connected to external flow calibration device.

Use the UP/DOWN keys to adjust the flow indicated on external calibration device until required value is reached. Press Enter when flow indicated is equal to your required flow rate.

For External Calibration details refer to Chapter 6.

Use UP/DOWN keys to calibrate the pump flow setting.

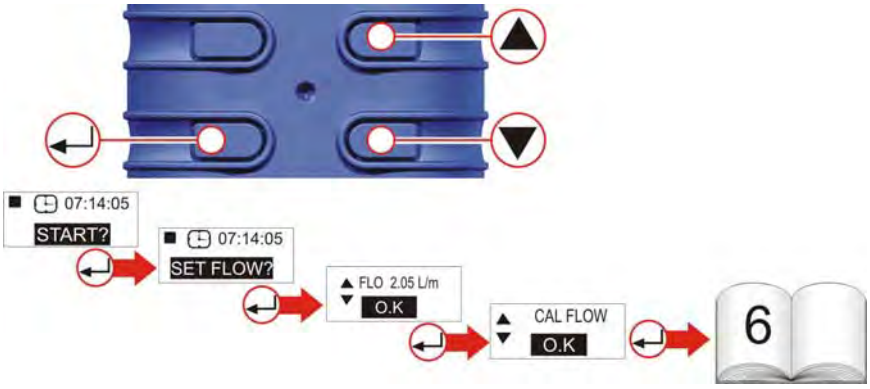


Figure 12 Calibration Screens

J. POWERING OFF (Fig. 13)

To stop the pump at any time, press and hold press the ON/OFF Key. A “countdown” will be displayed and the pump will switch off.

Figure 13 Power OFF Screens

K.USE WITH LOW FLOW ADAPTOR (Fig 14)

This enables the instrument to be used with sorbent tubes at flows down to 5 ml/min.
1. Connect the inlet of a pump to a flow meter such as the Defender or Dry flow meter and calibrate the flow rate to 1.5 l/min.
2. Stop the pump and disconnect the flowmeter.
3. Starting from the TUFF inlet, connect the following: constant pressure regulator, low flow adaptor, sorbent tube holder and a flow meter such as the Dry Flow or Dry Cal shown in Figure 14.
4. Break both ends off a sorbent tube and put it in the holder with the arrow pointing towards the pump.
5. Start the pump and adjust the flow to the required rate using the screw on the side of the low flow adaptor.
6. Perform the measurements using a fresh sorbent tube.

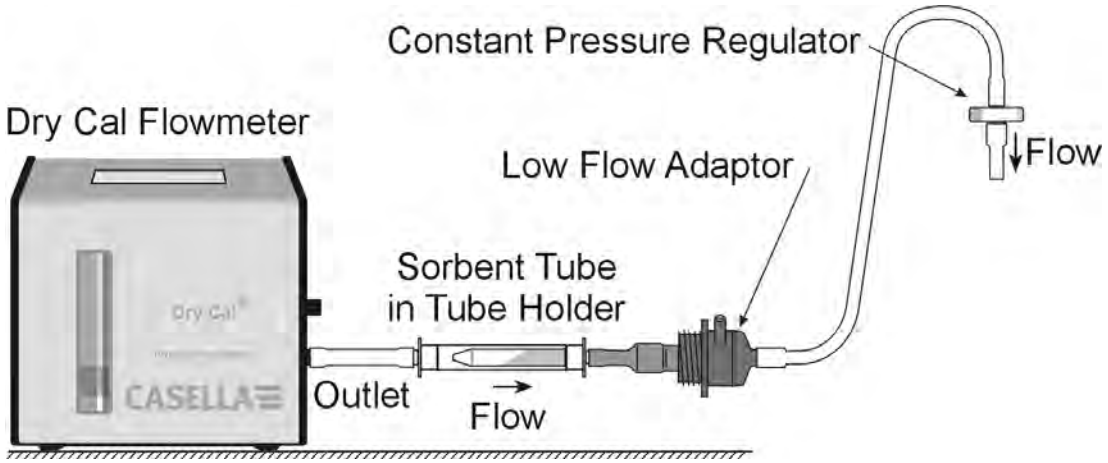


Figure 14 Use with Low Flow Adapter

Back to Index

5. CONFIGURATION

This allows basic settings such as display language and measurement units to be changed, gives access to Calibration and Duration modes, plus the additional modes available to Tuff Pro models.

Configuration Mode can be activated only while switching the instrument on.

A. ACCESS CONFIGURATION SCREENS (Fig. 15)

When powering up, simultaneously press and hold the UP arrow. This allows access to the configuration screens. After approximately 8 seconds the Set Language screen is displayed.

Figure 15 Access Configuration Screens

B. SET LANGUAGE (Fig. 16)

Use UP/DOWN keys to select a language. Press ENTER to load the language and continue setup.

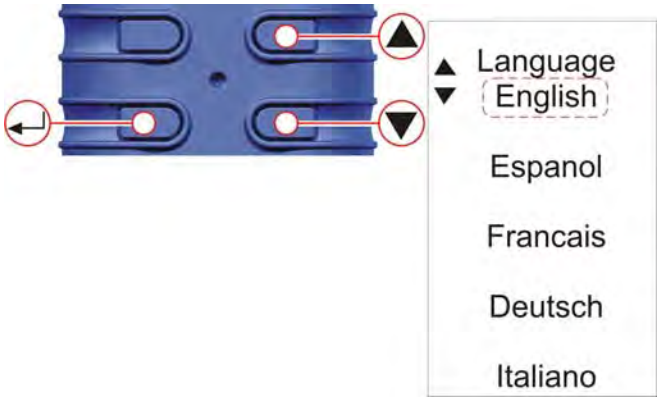


Figure 16 Set Language

C. CONTRAST (Fig. 17)

Use UP/DOWN keys to adjust the contrast. Press ENTER to save.

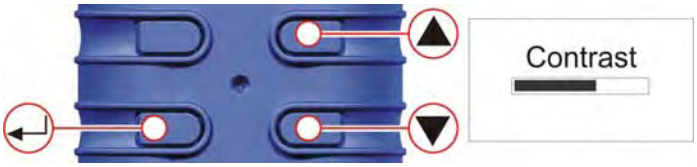


Figure 17 Set Contrast

D. TEMPERATURE (Fig. 18)

Use UP/DOWN keys to select the required unit for displaying the ambient air temperature (˚C or ˚F) then press ENTER.

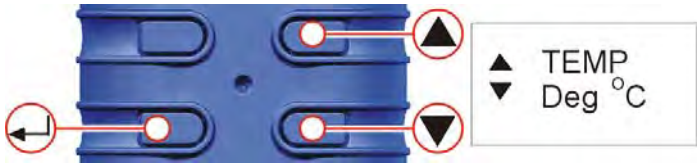


Figure 18 Set Temperature

E. VOLUME (Fig. 19)

TUFF PLUS AND PRO ONLY - Use UP/DOWN keys to select the preferred units to display the sampled volume (i.e. always cubic metres (m3) or AUTO to change automatically from Litres to m^3), then press ENTER.

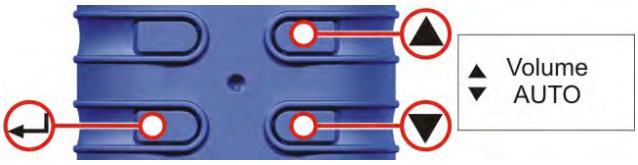


Figure 19 Set Volume

F. ADVANCED MODE (Fig. 20)

Note: This feature is only available on the 'Plus' and 'Pro' Models and is used to run Program (PRG) 1 and 2 and the TWA mode.

Use UP/DOWN keys to set the Advanced Mode **ON** and **OFF**. Press ENTER to save the Advanced Mode setting.

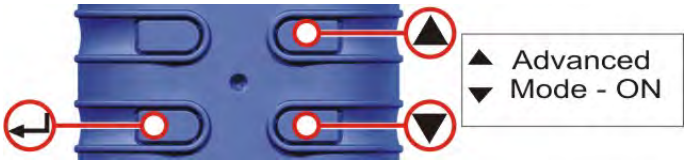


Figure 20 Advanced Mode

G. SERVICE LIFE AND SERIAL NUMBER (Fig. 21)

The 'Life' shown is the accumulated run time in hours. The Serial number is the unique number assigned to the pump. Press ENTER to continue.

Figure 21 Service Life and Serial Number Screen

H. CALIBRATE YES / NO (Default Calibration / Tuff Plus and Pro Only) (Fig.: 22)

Use UP/DOWN keys to SELECT Yes/No.

Activates Calibration Mode, which allows the entire calibration for the pump to be reset, based on a two point calibration. The instrument will have been accurately calibrated at the factory prior to delivery. (Tuff Standard models cannot be adjusted via this facility.) Therefore it is recommended that this operation be performed only as part of a routine service or when a suspected error has occurred (see chapter 9).

ONLY ALTER THESE SETTINGS AFTER DISCUSSIONS WITH CASELLA SERVICE DEPARTMENT OR DISTRIBUTORS.

NO – The operating system will take you back to the MAIN MENU.

YES – The system will prepare the unit for 2 point calibration.

Connect the pump to the calibration equipment (Refer to Chapter 6)

ENTER - Press ENTER to continue.

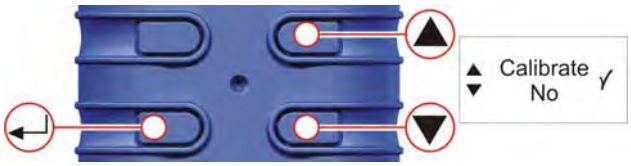


Figure 22 Calibrate Screen

I. ADJUSTMENT OF LOW SET POINT (Fig. 23)

Use UP/DOWN keys to alter the low set point in l/min. Press ENTER to continue. The pump will start.

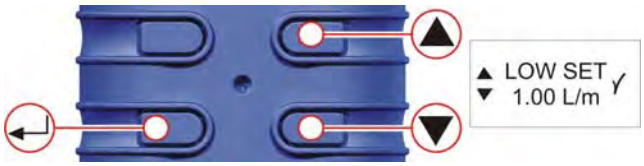


Figure 23 Low Set Screen

J. CALIBRATION OF LOW SET POINT (Fig. 24)

Check the external calibrator reading equals the low set point value. Use UP/DOWN keys to adjust the flow rate until they are equal. Press ENTER to save the new setting and continue.

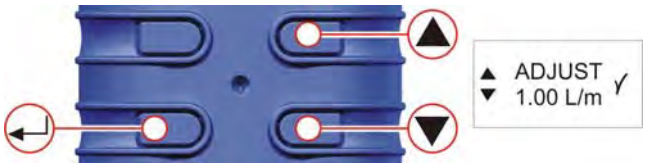


Figure 24 (Low Set) Adjust Screen

K. ADJUSTMENT OF HIGH SET POINT (Fig. 25)

Use UP/DOWN keys to alter the high set point in l/min. Press ENTER to continue.

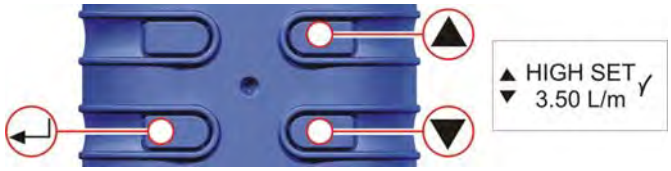


Figure 25 High Set Screen

L. CALIBRATION OF HIGH SET POINT (Fig. 26)

Check the external calibrator reading equals the high set point value. Use UP/DOWN keys to adjust the flow rate until they are equal. Press ENTER to save the new setting and continue.

The pump will stop and the unit will default to the MAIN MENU.

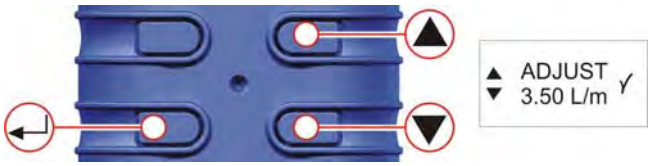


Figure 26 (High Set) Adjust Screen

Back to Index

6. CALIBRATION

Perform Single Point Calibration (Set Flow) Figs 27, 28, 29 and 30. This allows the user to set the required flow rate for the sample to be taken and check with an external flow calibration device.

Note: “Flow Set” and “Reset” options are not available in Partial Lock mode.

From Main Menu , press UP/DOWN keys to go to SET FLOW. Press ENTER to access Set Flow options. Use UP/DOWN keys to adjust the flow setting required. Press ENTER to continue.

PRO and PLUS ONLY - Use UP/DOWN keys to calibrate the Sampler flow setting.

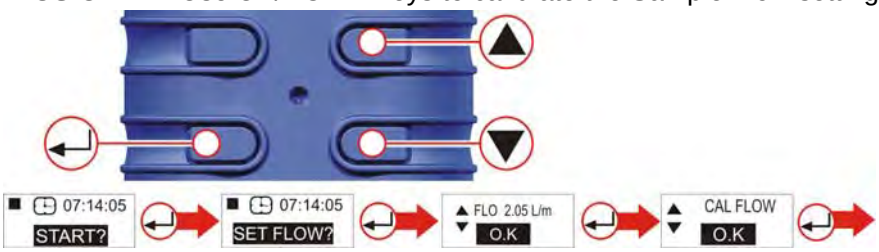


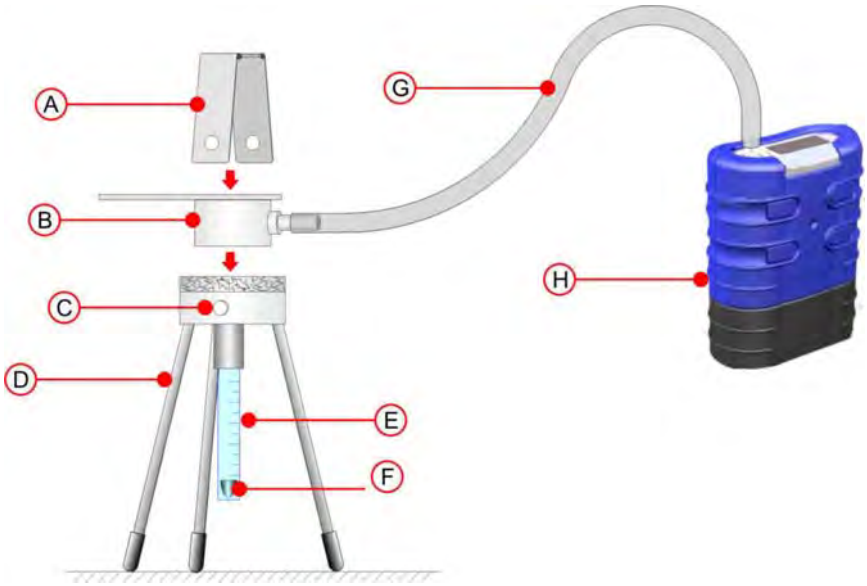
Figure 27 Set Up Calibration

WARNING: Only set CAL FLOW when connected to an external calibration device to prevent false flow rates being set.

Attach a sampling head and flow tube or other flow-measuring device to the pump’s inlet nozzle to measure the actual flow as shown in Figures 28, 29 and 30. Press the UP/ DOWN keys to adjust the flow rate until the value shown on the flow measuring device agrees with the required flow rate.

(Note Tuff standard models do not show the flow rate on the pump display. Use UP/DOWN keys to alter flow shown on calibration device until the required flow rate is reached.)

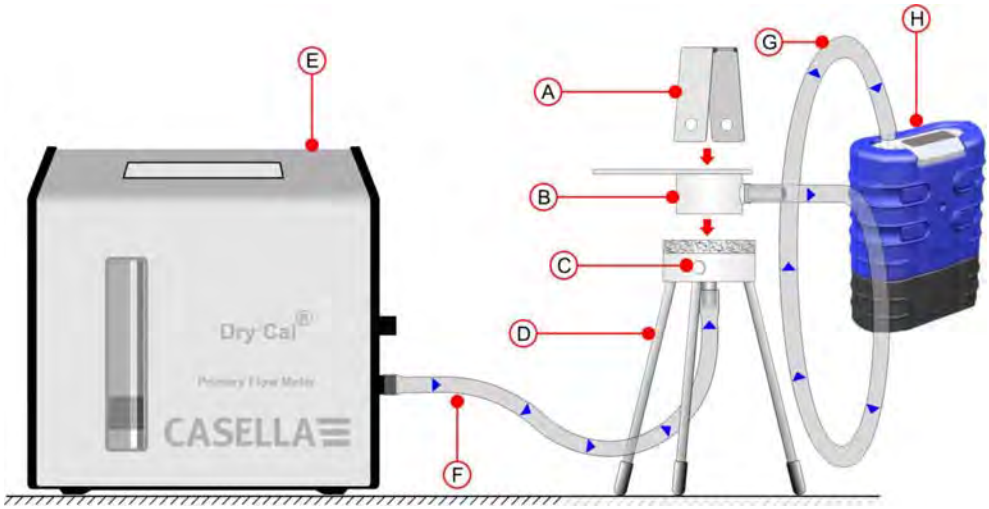
Press ENTER to set the flow rate and return to the Main Menu.



A. Clamp B. Sampling Head C. Clamping Studs D. Flowmeter Stand
E. Rotameter Tube F. Rotameter Float (Read Flow Rate from Top of Float)
G. Hose (Nominal Diameter 5mm) H. TUFF^{TM} Pump

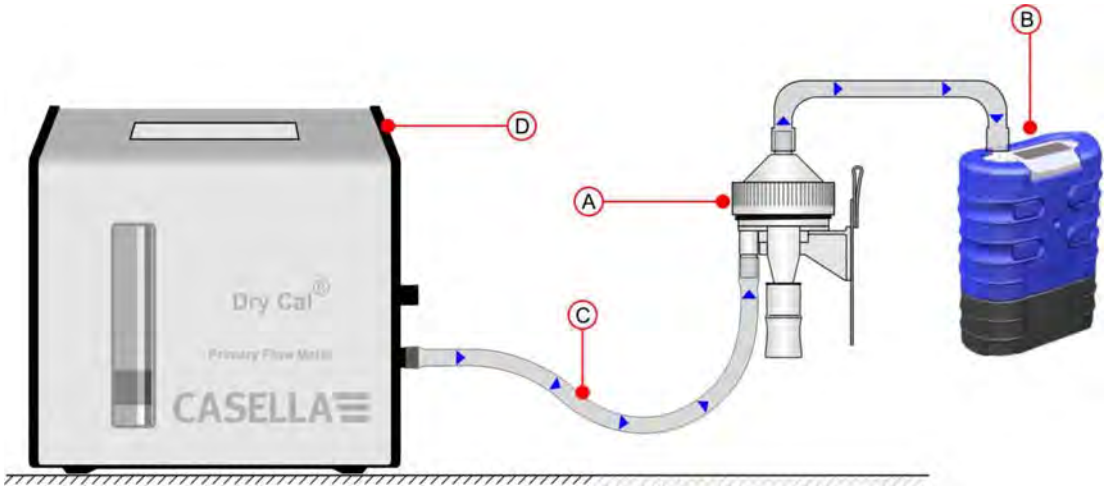
Figure 28 Calibration with Rotameter

Note: With Bios Calibrations, due to back pressure, they should only be used below 4L/min.



A. Clamp B. Sampling Head C. Clamping Studs D. Flowmeter Stand
E. (Typical) Digital Calibrator F. Hose (Nominal Diameter 5mm)
G. Hose (Nominal Diameter 5mm) H. TUFF™ Pump

Figure 29 Calibration with Digital Calibrator



A. Cyclone Sampling Head B. TUFF™ Pump C. Hose (Nominal Diameter 5mm) D. (Typical) Digital Calibrator

Figure 30 Calibration with Cyclone Head

Back to Index

7. RENEWING THE INLET FILTER

Note: The filter element should be replaced every 3 months. The pump running time and the operating environment can reduce this time considerably.

1. Remove the Inlet nozzle.
2. Discard the Filter Element.
3. Fit a new Filter Element.
4. Fit and hand tighten the Inlet nozzle.

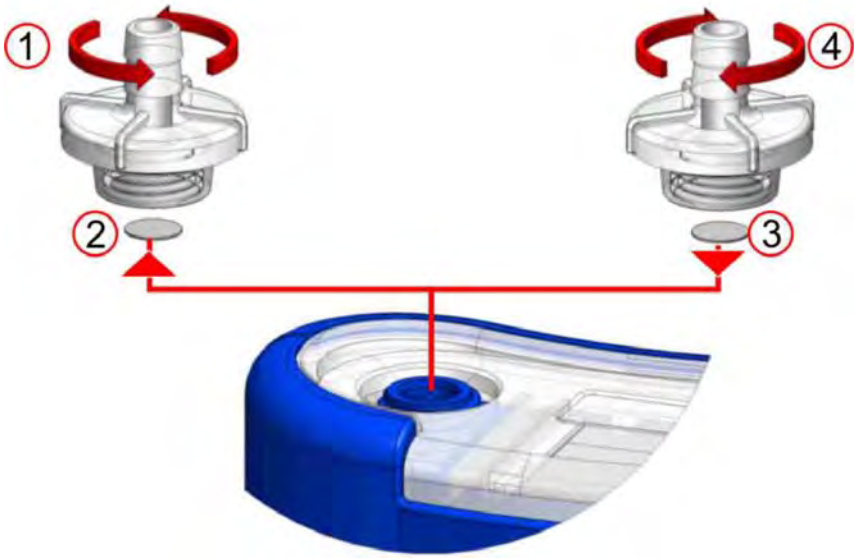


Figure 31 Renewing Inlet Filter

Packs of 5 Inlet Adaptors:	Part number: 197113A.
Filters are available in packs of 10:	Part number: 197114A

Back to Index

8. SERVICING

Casella CEL's in house service department offers a comprehensive range of repair and calibration services designed to maintain a fast and efficient back-up for all our products. The Service Department is operated under the scope of our BSI registration for products manufactured by us. We will however, undertake the repair of other manufacturers equipment.

For further information please contact our service department at our UK headquarters or via approved servicing distributors. We will be happy to provide quotations for individual repairs or provide annual maintenance under contract.

Intrinsically Safe products must only be repaired by Casella or and Authorised body.

We recommend factory service by technicians trained and equipped to repair your instrumentation. Should you wish factory repair assistance, send your equipment in a package equivalent to the original packaging. Insure to full value and ship prepaid. Include a letter giving full details with your packing list and send to the Casella CEL Service Department at Bedford.

For service outside the United Kingdom, please return to our appointed distributor.

MAINTENANCE

Your TUFF™ Personal Air Sampling Pump is designed to provide long and reliable service. Routine maintenance is minimal.

Make sure the battery pack never stays in a discharged condition.

Replace inlet filters regularly (see chapter 7). Keep the instrument body clean.

Do not operate without a filter connected to the inlet. Ingested dirt and dust particles may cause internal damage, malfunction or erratic flow.

Back to Index

9. FAULT FINDING

The following table outlines some possible fault conditions.

SYMPTOM	FAULT	SUGGESTED REMEDY
Failure to switch ON	Battery not charged. Does the red charger LED illuminate?	- Check that the battery is secured. - Clean the battery connectors on the TUFF pump. - Clean the battery connectors on the charger. - Push the TUFF pump firmly into the charger. - Charger fault - return for repair. - Keypad fault - return for repair.
	Software locked up?	Disconnect the battery for a minimum of 20 minutes and then reconnect the battery. If this fails, return for repair.
Pump runs fast	Control error	Damaged flow pressure sensor - return for repair. Water ingress - clean or return for repair. Tubes to sensor squashed or damaged - return for repair. Electrical fault - return for repair. Calibration error - perform fundamental calibration in Configuration Mode.
Poor control response, Non-repeatable flow settings	Leakage	Contamination or damage to valves - return for repair. Check all connections. If internal leakage is suspected - return for repair.
Not getting expected run time from pump	Higher back pressure from filter media	Ensure Tuff is fully charged. Consult filter back pressure tables to calculate correct run time. Often by selecting coarser filter material will offer considerably longer run times.

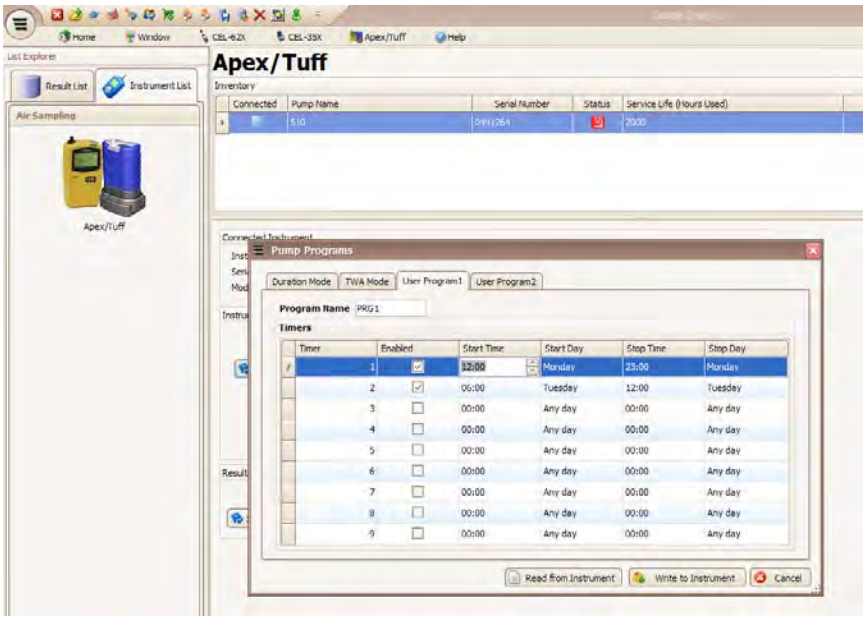
Back to Index

10. PUMP MANAGEMENT SOFTWARE

NOTICE!

CASELLA INSIGHT™ DATA MANAGEMENT SOFTWARE

Tuff Pro and Apex Pro personal air sampling pumps can now be programmed and data downloaded for management purposes via the new Casella Insight™ Data Management Software. Please refer to separate product datasheet and handbook or contact Casella technical support team for further details.



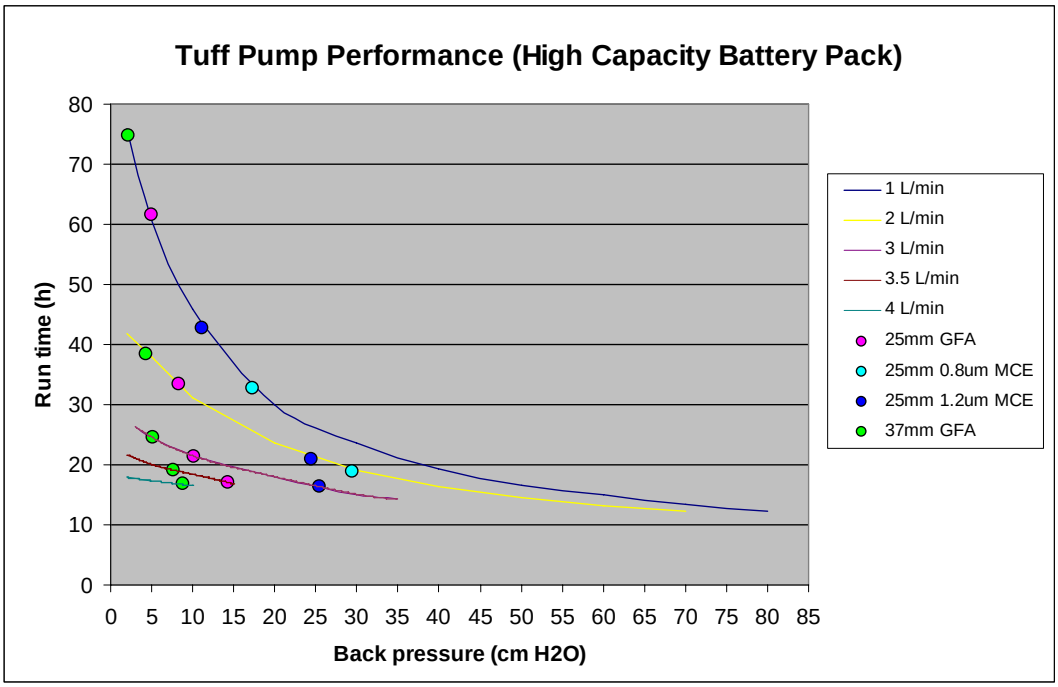
11. TECHNICAL INFORMATION / CERTIFICATION

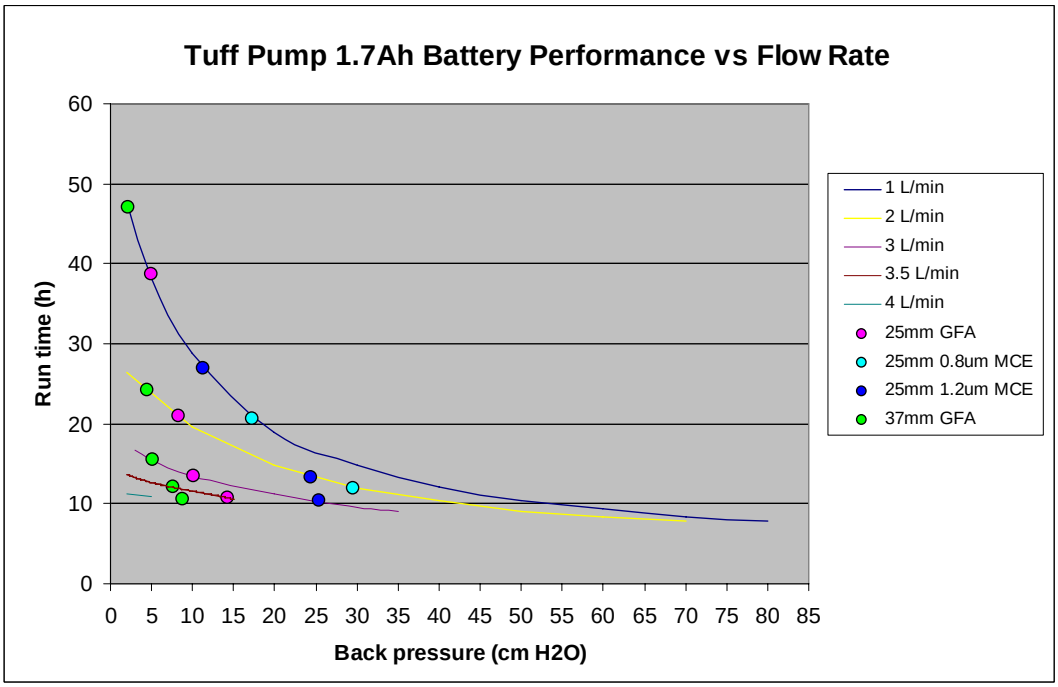
1 PUMP MODEL SPECIFICATION

Flow Range	Tuff 3 : 0.5 to 3.5 l/min, Tuff 4 : 0.5 to 4.5 l/min (free air). (all variants :5 to 850 ml/min with low flow adaptor).
Flow Control Accuracy	<±5% for selected flow, ±3% for calibrated point,
Battery Voltage and Capacity	4.8 V NiMH / 2.7 Ah or 1.7Ah
Inlet Pulsation Ratio	< 10% using Dewell Higgins Cyclone @ 2 L/min approx. 7.5 cm H_2O. Satisfies EN1232 , NIOSH 0600
Displayed Values (model dependant)	Real flow rate, volume sampled, elapsed sample time, temperature, operating mode, program details battery fuel gauge, alarm status
Service Interval	Typically 2500 hrs
Operating Temperature	5^oC to 45^oC
Storage Temperature	-10° to + 50^oC
Charging Technique	Drop-in Intelligent fast charger employing dT/dt termination with safety time out. Standby trickle charge mode to keep pump ready for use.
Typical Charge Time (charge time is dependant upon, ambient temperature, discharged state and condition of batteries)	Typically 3 hours under normal operating conditions.
Memory Protection Time with Main Battery Pack Removed	Approximately 20 minutes
Communications	Infrared transducer (via RS232-infrared computer link)
Recorded Values	Start & stop times, flow rate, average sample temperature, volume sampled and errors.
Dimensions	Approximately 133 x 87 x 47mm
Weight (including battery)	Approximately 475 g

2 **PUMP PERFORMANCE Tuff Variants**

Flow rate (L/min)	Back pressure (cm H2O)	Current (mA)	NiMH 2.7Ah (h)	NiMH1.7Ah (h)
1 L/min	2	32	76	48
	5	40	61	38
	10	53	46	29
	20	81	30	19
	30	103	24	15
	40	126	19	12
	50	146	17	10
	60	163	15	9
	70	182	13	8
	80	197	12	8
1.5 L/min	2	42	58	36
	5	48	51	32
	10	63	39	24
	20	91	27	17
	30	114	21	13
	40	138	18	11
	50	159	15	10
	60	181	13	8
	70	195	12	8
2 L/min	2	58	42	26
	5	64	38	24
	10	78	31	20
	20	103	24	15
	30	128	19	12
	40	148	16	10
	50	168	14	9
	60	184	13	8
	70	197	12	8
2.5 L/min	2	75	32	20
	5	81	30	19
	10	95	26	16
	20	122	20	13
	30	142	17	11
	40	162	15	9
	50	180	14	9
3 L/min	3	92	26	17
	5	99	25	15
	10	113	22	14
	20	135	18	11
	30	161	15	10
	35	170	14	9
3.5 L/min	2	112	22	14
	5	121	20	13
	10	132	18	12
	15	145	17	11
4 L/min	2	136	18	11
	5	140	17	11
	10	170	14	9





Note: All values are calculated. Run times may vary according to local temperature, atmospheric conditions and battery life and status.

3. **INTRINSICALLY SAFE (I.S.) VERSIONS APRROVALS**

To view the current I.S. Approvals Certificates please visit the website at www.casellameasurement.com

Intrinsically safe versions of this pump are covered by certificates:-

Sira 09 ATEX2113
IECEx Certificate : SIR 09.0052

I.S. Versions comply with:

II 1 G
Ex ia IIB T3 Ga
Ta = -20 to +41°C

I.S. Mining Versions additionally comply with:

I M1
Ex ia I Ma.

Tuff Pumps also comply with the following standard:-

EN 1232: 1997 Workplace atmospheres. Pumps for personal sampling of chemical agents. Requirements and test methods

NOTE:

FOR I.S. MINING OPERATION, **USE ONLY** CERTIFIED BATTERY PACKS (i.e. Prt. No's: 197140B & 197141B) IN CONJUCTION WITH A PUMP BODY BEARING A LABEL IDENTIFYING THESE I.S. CERTIFIED BATTERY PACKS.

FOR I.S. OPERATION, **USE ONLY** CERTIFIED BATTERY PACKS (i.e. Prt. No's: 197150B and 197151B) IN CONJUCTION WITH A PUMP BODY BEARING A LABEL IDENTIFYING THESE I.S. CERTIFIED BATTERY PACKS.

Back to Index

DISCLAIMER

Do not attempt to use this equipment until you have read this manual thoroughly, or have been instructed by a Casella CEL engineer.

At the time of writing, this manual was completely up-to-date. However, due to continual improvements, the final operating procedures may differ slightly from the operating procedures given in this manual. If there are any questions, you are encouraged to contact Casella CEL for clarification.

While every care is taken to ensure that the information in this manual is correct, Casella CEL will assume no responsibility for loss, damage or injury caused by any errors in, or omissions from the information given.
We reserve the right to alter specifications at any time.

CASELLA CEL 2010