# NASCOR SERIES 2 HIGH DEPENDENCY MONITOR

User instructions

Version 8
March 1998

## INTRODUCTION

The Nascor Series 2B Monitor has been designed and manufactured to the highest possible standard. It will give years of trouble-free operation. It is designed for use in many different clinical environments and can handle a fair amount of rough treatment without affecting its function.
To clean, wipe with hospital grade disinfectant. However, do not use solvents to clean the case, front or back screen, as this may well cause permanent damage. Do not immerse the monitor in any fluid.
For electrical power use only the recommended plug pack with the correct polarity.
The monitor has two rechargeable batteries inside the unit to supply power for portable use. These are automatically kept charged when the plug pack is used.
If the unit is damaged a rapid repair/ replacement service is available trom your local service agency or NASCOR. It is recommended that this unit be returned to the service agents annually for checking. This can be arranged at a nominal charge.

## FUNCTIONS

This monitor has been primarily designed for the intensive care of the baby in maternity or neonatal units. However, it may be used appropriately in many other situations and patients,

| | |
|---|---|
| eg.SIDS monitoring, | adult intensive care, |
| air or ground transport, | geriatrics, |
| general medical patients, | rehabilitation, |
| post-operative care, | emergency care at the roadside. |

However this monitor is not designed for cardiac diagnosis where a screenbased system is more appropriate.

The unit monitors 5 parameters:

1. Heart rate
2. Respiratory rate
3. Temperature
4. Oxygen analysis
5. Oxygen Saturation.

It can be programmed to alarm at or on:

1. High or low heart rates
2. Apnoea of 15 or 20 secs.
3. Cardio-respiratory coincidence.
4. Loose chest leads.
5. Variations in ambient oxygen concentration.
6. High or Low oxygen saturation

It may be used in 'Full Function Mode' - when the monitor detects an ECG lead attached to the patient - or in 'Oximeter Mode'. This is automatically selected if a patient lead is not detected or a 'leads-off' alarm situation is allowed to continue for more than 30 seconds.

NOTE: Electronic equipment such as the NASCOR Series 2B Monitor is designed to complement close patient surveillance by qualified Nurslng staff. It should not be used to replace such surveillance or to lower nurse/ patient ratios.

## QUICK SETUP
## FOR THE NASCOR SERIES 2B HIGH DEPENDENCY MONITOR

1) Select the back panel DIP switches appropriate for the age group of the patient. Switches 1 & 2 select the alarm settings and respiratory sensitivity.

| SWITCH | 1 | 2 | BR ADY | TACHY | RESP SENS | HIGH $SpO_2$ | LOW $Spo_2$ |
|---|---|---|---|---|---|---|---|
| NEONATAL | OFF | OFF | **90** | **220** | **1** | no | 90 |
| INFANT | ON | OFF | **70** | **200** | **2** | no | 90 |
| ADULT | EITHER | ON | **40** | **160** | **3** | no | 90 |

2) Plug in (Cat. No. S2A513 only) plug-pack to wall outlet and insert DC plug into socket in back panel of the monitor.

3) If **ECG / RESPIRATION** monitor is to be used place electrodes in the appropriate location on the patient's chest (see diagram on lid of monitor) and insert the ECG cable into the socket in the back panel of the monitor.

4) Switch on the monitor using the On/Off switch on the back panel.

5) Monitor will self-test and green light on front panels will show heart beat (left side of panel and respirations (right side). Digital displays will show heart rate on the left side side. On power up the right side will automatically show oxygen saturation. To see respiratory rate press'RR' button.

6) To use **OXIMETER**, attach appropriate oximeter probe to patient and insert into socket of oximeter extension cable. This cable is attached to the $SpO_2$ socket in the back panel of the monitor. To show oxygen saturation press '$SpO_2$' button. Check default selected alarm limits by pressing SET button.

7) If no ECG cable attached to a patient is detected after 30 seconds, the monitor will enter **'OXIMETER MODE'**.The 'LEADS OFF' and 'APNOEA' alarms will silence though their alarm lights will remain on. The heart rate in the left digital display will be from the pulse of the oximeter and the low and high heart rate alarms will respond to the pulse rate.

8) **To silence alarms**: Press the ALARM OFF / RESET buttons. The left side button to silence HR, LEADS OFF, APNOEA, and the OXYGEN ANALYSER, the right button to silence $SpO_2$. The alarms will re-arm in 30 seconds. To disable the auditory alarm press and hold the appropriate alarm button for 5 seconds. The amber light in the button will flash repeatedly to indicate disarming of the alarm sound. Only re-pressing the button (or re-powering up the monitor) will then re-arm the alarm sound. **N.B. Remember to re-arm the alarm sounder before leaving patient.**

10) To use **TEMPERATURE** monitor. see page 8 of this manual.

11) To use **OXYGEN ANALYSER**. See page 8 of this manual.

# HEART RATE MONITOR

Though the monitor works well with the heart rate detected by 2 electrodes placed on either side of the chest (in the Left Arm/ Right Arm ECG positions), for high reliability monitoring a third lead (in the Right Leg position) should also be used.

## *The Circuit*

Pregelled electrodes are placed on the chest wall and are connected via the patient cable to the input socket on the back of the unit. The signal is then amplified and filtered to remove noise and electrical interference. The filtering system is designed to eliminate the possibility of double-beating and to make the placement of the electrodes less critical. Following this stage the signal is converted to digital impulse and processed in the microprocessor. This passes its signal to the left hand digital display on the front of the unit.

## *Placement of Electrodes*

Use alcohol to prepare the skin before placing pregelled electrodes.
Use the correct colour-coding when attaching electrodes to patient cable.
*Right Arm* WHITE *Left Arm* BLACK *Right Leg* GREEN
*(Remember:* WHITE to the RIGHT)
We recommend the placement of electrodes in the LA-RA position on the chest. In the neonate it is most effective to place the LA electrode on a line from below the outer third of the clavicle to the apex of the heart, the RA electrode in the anterior axillary line on the lower chest. The Right leg lead should be placed on the outer thigh.

*Trouble Shooting*
If you have an irregular or over-rapid flashing heart indicator light:
CHECK CHEST ELECTRODES
· Is electrode gel dried out?
· Are electrodes stuck down properly or lifting with respiration?
· Are electrodes placed correctly? If not: replace; if so, try switching LA - RA electrodes.

**IMPORTANT It is good practice to replace chest electrodes every 5or 6days to avoid skin irritation and because the electrode gel tends to dry up giving poor electrical contact.**

*Displays*

The heart rate may be selected for display by pressing the 'HR' button which will also illuminate the green indicator light.
The cardiac signal is indicated by a flashing green light on the left hand side of the front panel of the unit.
The cardiac signal is also available as an auditory `beep' from the internal sounder. The volume of this signal may be adjusted by the 'beep volume' control on the rear panel.

*The Alarms* ·

An alarm will sound and the 'RATE ALARM' light will switch on if the heart rate goes outside the set alarm limits.
Alarms for high or low heart rate may be selected in two ways:
1. Using Front Panel Buttons,
2. Using Back Panel Switches.

*Using Front Panel Buttons*:

**STEP 1**. Press the `SET' button in the middle of the front panel,the left-hand display will indicate the levels already set automatically on power-up.Pressing the `SET' button will toggle the 'alarm set' mode on and off.
e.g. LO 90 (repeated 3times)
HI 220 (repeated 3times)
then back to LO 90

**STEP 2.** Press the 'HR' buttons.To alter the settings for bradycardia,press 'HR' button when the `LO' or its number is in the display.To alter the tachycardia setting, press the 'HR' button when the `HI' or its number is in the display.
Tachycardia options: 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220.
Bradycardia options: 40, 50, 60, 70, 75, 80, 85, 90, 95, 100.
**STEP 3.** Pressing the 'SET' button again will set the alarms.
**STEP 4**. To check the settings press the 'SET' button and they will appear in the display.If the 'SET' button is not pressed again after the alarms have been set, the displays will automatically return to normal display in 30seconds.

*Using the Back Panel Switches*:

In the middle of the back panel there are 4 small 'DIP' switches.Switches 1& 2 set the alarms that will be set on power up.This is so the monitor may be used in various departments in the hospital without the need to reset the alarms in any one department.

| SWITCH | 1 | 2 | BR ADY | TACHY | RESP SENS | HIGH $SpO_2$ | LOW $Spo_2$ |
|---|---|---|---|---|---|---|---|
| NEONATAL | OFF | OFF | **90** | **220** | **1** | no | 90 |
| INFANT | ON | OFF | **70** | **200** | **2** | no | 90 |
| ADULT | EITHER | ON | **40** | **160** | **3** | no | 90 |

*To Silence Alarms* :

To silence this alarm, briefly press the button marked 'HR/RR ALARM OFF / RESET'. An amber light will illuminate in the button.Pressing the button again will reactivate the alarm sounder.If this is not done it will automatically reactivate itself after 30seconds.If it is required to silence the alarms for longer the `HR/RR ALARM OFF / RESET' button may be pressed and held for **5 SECONDS**.The button light will then flash, and the alarms will now not sound until the ' HR/RR ALARM OFF / RESET' button is pressed.This button also silences the 'LEADS OFF', 'RCC' and '$O_2$' alarm.

*Reset Alarms*

When a rate (or leads-off) alarm status corrects,the audible alarm will cease but the warning light will remain on until reset by pressing the 'HR/RR ALARM OFF / RESET' button once. No amber light will illuminate as the alarms will remain active.

*`Leads-Off' Alarm*

If the electrodes become detached from the chest, unplugged from the patient lead or electrode contact is very poor: an alarm will sound, the 'LEADS OFF' indicator light will switch on and the digital displays,when indicating the HR or RR, will show 'Ld0' on both sides.The alarm may be silenced or reset by pressing the ' HR/RR ALARM OFF / RESET' button. If the leads-off situation is not corrected for 30 seconds the auditory alarm will cease and the monitor enter 'OXIMETER MODE'.

OXIMETER MODE

This mode is automatically selected if a patient lead is not detected or a 'leads-off' alarm situation is allowed to continue for more than 30 seconds. The heart rate display, alarm LED and auditory alarm respond to the **pulse** signal from the oximeter rather than the ECG and the apnoea monitor is inactivated. The apnoea and leads off alarm LED's will be illuminated and not be resettable until an ECG lead is reattached.

## RESPIRATORY RATE MONITOR

The two pregelled chest electrodes used for cardiac monitoring also serve to sense respiratory movement.

### *Placement of Electrodes*

Obviously the usual place for electrodes is the same as for the cardiac impulse (LA-RA).
However, occasionally some neonates may breathe mostly with the diaphragm with very little chest movement. Under these circumstances, placing the electrodes where there is adequate respiratory excursion would be appropriate for a good respiratory response. It should be kept in mind that the heart's location should, if possible, lie between the electrodes for good signal reception. Even if this is not possible there is still every likelihood that an adequate signal will be received to activate the monitor.

## *The Circuit*

The two electrodes sense the electrical impedance of the chest which varies with each respiratory movement. The impulse is rectified, demodulated and amplified. Following this, it is passed to the microprocessor. Output is sent to the right hand digital display.

*Displays*

The respiratory rate may be selected on the front of the unit by pressing the button marked 'RR'. The respiratory rate signal is displayed by a green light on the bottom right hand of the front panel of the unit.

*The Alarm*

The apnoea alarm is preset so that if no respiratory movement is detected after 15 or 20 seconds, the alarm is activated. The'APNOEA' light will illuminate and 'APN' will appear in the right hand display. To select the apnoea period Switch 3 in the middle of the back panel should be located.

SWITCH 3 OFF 15 sec period
ON 20 sec period

*To Silence Alarms*

Press the button marked with `HR/RR ALARM OFF / RESET'. An amber light will illuminate in the button and the auditory alarm will cease. Pressing the button again will reactivate the alarm sounder. If this is not done, it will automatically re-activate itself after 30seconds. If it is required to silence the alarms for longer the'HR/RR ALARM OFF / RESET' button may be pressed for 5 seconds.The button light will then flash,and the alarm will now not sound until the 'HR/RR ALARM OFF / RESET' button is pressed. This button also silences the Respiratory Cardiac Coincidence, the 'Leads Off' and the '$O_2$' Alarms.

*Reset Alarms*

When an apnoea alarm status corrects,the audible alarm will cease but the warning light will remain on until reset by pressing the'HR/RR ALARM OFF / RESET' button once. No amber light will illuminate as the alarms will remain active.

RESPIRATORY SENSITIVITY SETTING

There are three levels of respiratory sensitivity selectable.
**STEP 1.** The `RR' button is pressed to show the respiratory rate in the right hand display window.
**STEP 2.** The 'SET' button is pressed,this will show `S-1','S-2',or `S-3' in the display window.
**STEP 3.** Pressing the ' RR' button repeatedly will scroll through these choices. The last shown when the 'SET' button is re-pressed will be selected.
For neonates: S-1or S-2 is appropriate.
For children: Use S-2 or S-3.
For adults: Use S-3.
**STEP 4.** Pressing the `SET' button will show the level selected.To check the setting, press the'SET' button and it will appear in the display. If the 'SET' button is not pressed again after the sensitivity has been set,the displays will automatically return to normal display in 30seconds.

## RESPIRATORY-CARDIAC COINCIDENCE ALARM

Under unusual situations there is always a possibility that the respiratory circuit might pick up heart or blood flow movement and interpret it as a respiration.For instance,this may occasionally happen

1. If the electrodes are placed too close together on the front of the chest.
2. If the respiratory sensitivity is set too high.
3. the baby develops an unusually dynamic circulation such as in the presence of a patent ductus arteriosus.
4. The patient is breathing at his heart rate (this is a transient reflex in some babies).

To guard against this,the monitor will alarm and the message `RCC' will appear in the right hand display.This alarm automatically resets when the alarm condition rectifies.

*To Silence this Alarm*

Press the 'HR/RR ALARM OFF / RESET' button.

*To Switch off this Alarm*

Occasionally a patient may breathe at the heart rate. When this occurs for any length of time the respiratory/cardiac coincidence alarm may be switched off.

**STEP 1.** Press SET.

**STEP 2.** Press the `HR/RR ALARM OFF/RESET' button and the alarm will be toggled on and off. The displays will show 'RCC OFF' or 'RCC ON'.

## TEMPERATURE SENSOR

A jack plug socket is situated on the back panel to accept YSI temperature probes Series 400.
The 409B skin probe is ideal for all age-groups.
No calibration is required for the electronic circuitry.
Temperature Range· 29 - 45 degrees Celsius. Accuracy: 0.1 degrees Celsius.

*To use temperature monitor.*

Plug in the temperature probe and place in the desired location.The left hand digital read out will display the temperature for 10 seconds if the $T^o$ button is pressed. If the temperature lies outside the range the display will indicate this by 'ut' (under temperature) or 'ot' (over temperature).

## OXYGEN ANALYSER

A socket is situated on the back panel for a Teledyne R17 oxygen sensor and cable.Under this socket there is an oxygen analyser calibration knob.

*To use oxygen analyser*

The ambient oxygen level can be displayed on the left hand digital read-out and may be displayed by pressing the button marked '$0_2$'.
The oxygen sensor plug should be inserted in the appropriate socket.

**STEP 1.** Plug an Teledyne R17 oxygen sensor (or equivalent) to the oxygen cable.

**STEP 2.** Select the oxygen analyser on the right-hand digital display by pressing the '$0_2$' button.

**STEP 3**. Expose the sensor to an environment of 100% oxygen.Wait 3 minutes then adjust the reading on the digital display using the calibration knob located on the back panel.

**STEP 4.** Expose the sensor to room air and adjust the reading to 21%.

**STEP 5**. For measuring high concentrations of oxygen above 50%, now re-expose the sensor to 100% and re-adjust if necessary.For the measurement of lower concentrations this may be omitted.

**STEP 6.** Insert the sensor into the headbox or ventilator circuit. Accuracy: 2%.

*Oxygen Alarm*

Once the concentration of oxygen has stabilised at the desired level,and the sensor is inserted into the environment,the oxygen alarm may be set.

**STEP 1**. Press the '$O_2$' button to select the oxygen display in the right hand display window.

**STEP 2.** Press the 'SET' button,the window will indicate 'OFF' (alarm is not set).

**STEP 3.** Press the '$O_2$' button.The oxygen level set will appear alternating with 'on'.

From then,if the oxygen concentration deviates more than 2% from this level,this will cause the monitor to alarm ('bip-beep..bip-beep') and the oxygen level will be forced up into the left display, over-riding other readings.

**STEP 4.** Re-press the 'SET' button to return to normal mode (or wait 30 seconds for this to occur automatically).

*To Silence the Alarm:*

Press the HR/RR ALARM OFF / RESET button

*To Switch off the Alarm*

**STEP 1.** Press the `SET' button.

**STEP 2.** Press the '$O_2$' button. This will switch off the alarm.

If no sensor is attached and an attempt is made to set the alarm, 'OFF' will continue to appear in the display.

## OXIMETRY ($SpO_2$)

The Nellcor(R) pulse oximeter incorporated in to the monitor accurately, noninvasively and continuously measures functional oxygen saturation of arterial haemoglobin and pulse rate

Measurements of SpO2 are displayed in the right digital display. and are updated with each pulse beat. Pulse amplitude is displayed in a cascade of LED's to the right of the display. . If the oxygen saturation level falls outside adjustable upper or lower limits, both visible and audible alarms activate.

Because measurements are made from the pulsatile arteriolar component of blood, the instrument's accuracy is not affected by tissue or bone. The oximeter does not provide a measurement unless perfusion is sufficient to supply the data necessary for accuracy.

*NELLCOR*(R) sensors, which arc available in various sizes and configurations, allow the instrument to be used on patients ranging from neonates to adults in a variety of clinical settings. These sensors are lightweight and completely noninvasive, with no heat source that could burn a patient. Noninvasive *NELLCOR*(R) sensors obtain measurements by optical means alone, using two light emitting diodes (LEDs) as light sources. Specific sensors are available for use on neonates, infants, children, and adults.

## OPERATION OF THE OXIMETER

**STEP 1**. Select an appropriatc *NELLCOR*(R) sensor and apply it to the patient, following the instructions in the sensor directions for use. Plug the sensor into the $SpO_2$ socket on the back panel either directly or via an extension cable (supplied).
**STEP 2.** Press the $SpO_2$ button on the front panel.
**STEP 3**. Check the alarm limits by pressing the 'SET' button. If necessary, adjust thcm to suit the needs of the patient. Re-press the $SpO_2$ button.
**STEP 4.** Observe the pulse signal strength display for the amplitude of pulse signal / perfusion indicator. Adjust the sensor if the signal is poor.
**STEP 5.** The $SpO_2$ will appear in the right digital display, the value is followed by a dot (to avoid confusion with respiratory rate).
**STEP 6.** If no ECG cable is connected, the pulse rate will appear in the left digital display followed by a dot. The green Heart Rate light will not illuminate.

'OXIMETER MODE'

This mode is automatically selected if a patient lead is not detected or a 'leads-off' alarm situation is allowed to continue for more than **30 seconds**. The heart rate display, alarm LED and auditory alarm respond to the **pulse** signal from the oximeter rather than the ECG and the apnoea monitor is inactivated. The apnoea and leads off alarm LED's will be illuminated and not be resettable until an ECG lead is reattached.

*The Alarms*

An alarm will sound and the '$SpO_2$ ALARM' light will illuminate if the oxygen saturation level goes outside the set alarm limits.

Alarms for the high and low $SpO_2$ may be selected in two ways:
1. Using the Front Panel Buttons.
2. Using the Back Panel Switches.

*Using Front Panel Buttons*

**STEP 1**. Press the `SET' button in the middle of the front panel,the right-hand display will indicate the levels already set automatically on power-up.Pressing the `SET' button will toggle the 'alarm set' mode on and off.
e.g. LO 90 (repeated 3times)
HI no (repeated 3times)
then back to LO 90
**STEP 2.** Press the '$SpO_2$' buttons.To alter the settings for low saturation, press '$SpO_2$' button when the `LO' or its number is in the display.To alter the high saturation setting, press the '$SpO_2$' button when the `HI' or its number is in the display.

High saturation options: ($SpO_2$): 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, no.
Low saturation options: ($SpO_2$): 60, 65, 70, 75, 80, 85, 86, 87, 88, 89, 90, 92.

**STEP 3.** Pressing the 'SET' button again will set the alarms.
**STEP 4**. To check the settings press the 'SET' button and they will appear in the display.If the 'SET' button is not pressed again after the alarms have been set, the displays will automatically return to normal display in 30seconds.

*Using the Back Panel Switches*:
In the middle of the back panel there are 4 small 'DIP' switches.Switches 1& 2 set the alarms that will be set on power up.This is so the monitor may be used in various departments in the hospital without the need to reset the alarms in any one department.

| SWITCH | 1 | 2 | BR ADY | TACHY | RESP SENS | **HIGH SpO2** | **LOW Spo2** |
|---|---|---|---|---|---|---|---|
| NEONATAL | OFF | OFF | 90 | 220 | 1 | **no** | **90** |
| INFANT | ON | OFF | 70 | 200 | 2 | **no** | **90** |
| ADULT | EITHER | ON | 40 | 160 | 3 | **no** | **90** |

*To Silence Alarms* :
Press the button marked 'HR/RR $SpO_2$ OFF / RESET'.
An amber light will illuminate in the button.Pressing the button again will reactivate the alarm sounder.If this is not done it will automatically reactivate itself after 30seconds. If it is required to silence the alarms for longer the '$SpO_2$ ALARM OFF/RESET' button may be pressed for 5 seconds.The button light will then flash, and the alarms will now not sound until the ' $SpO_2$ ALARM OFF/ RESET' button is pressed.

*Reset Alarms*
When a rate (or leads-off) alarm status corrects,the audible alarm will cease but the warning light will remain on until reset by pressing the ' $SpO_2$ ALARM OFF/RESET' button once. No amber light will illuminate as the alarms will remain active.

Warning: Oximeters are intended for use only as an adjunct in patient assessment. This instrument must be used in conjunction with patient clinical signs and symptoms.

Warning: Carefully read the directions for use provided with each *NELLCOR*$_{(R)}$ sensor for complete description, instructions, warnings, cautions, and specifications.

## OTHER INDICATORS

*Low Battery Signal*

When batteries are running low the digital displays will automatically switch to low battery mode. The displays will alternate `Bat Lo' with the displayed values.
When the batteries are depleted,the digital display will read 'Bat ded'.In addition a continuous alarm will sound.

*High Battery Warning:*

If there is a malfunction in the battery recharging circuit,the circuit will automatically shut down and the'power' light will not illuminate when the plug-pack is used.In addition 'Bat Hi' will appear in the displays.Unplug the monitor and seek biomedical advice or return to dealer for servicing.

*`Power' Light*

When the plug pack is powering the monitor,a green light at the bottom left side of the front panel will illuminate.If the power light does not illuminate when the plug-pack is used check the power supply,the plug-pack and connections before assuming high battery shut down (see above).

*`Recharged' Light*

When the batteries are fully charged, a green 'recharged' light above the 'power' light on the front panel will illuminate.

## BEEP VOLUME CONTROL

On the rear panel is a knob labelled 'BEEP VOLUME'. This controls the volume of the heartrate beep, allowing it to be easily heard or completely silenced.

## ALARM VOLUME

Switch 4, in the middle of the back panel, sets the volume of the alarms and the maximum beep volume. UP (soft) DOWN (loud).

## INTERNAL DIP SWITCH OPTIONS

On the left hand side of the motherboard there is a bank of four switches.
These select software options that do not need to be accessed by users;
however biomedical staff may like to use them after discussion with the medical and nursing staff.

*Switch 1*

This selects whether the Respiratory-Cardiac Coincidence alarm needs to be re-set manually or is automatic.

OFF automatically re-set
ON requires manually re-setting

*Switch 2*

This alters the RCC alarm window: do not use.

*Switch3*

Lower Temp Alarm Setting *(2A only)*

OFF $35.5^{o}C$
ON $36^{o}C$

*Switch 4*

This selects whether all other cardio-respiratory alarms (apnoea, heart-rate high or low, leads-off) need to be reset manually or are automatic.

OFF require manual resetting.
ON automatically reset

# SPECIFICATIONS

Power Requirements

110 - 130 VAC, 220 - 240 VAC / 9V DC 750mA double insulated plugpack.
**USE ONLY PLUG-PACKS CODED 'S2A513' WITH THIS MONITOR.**

Operating Temperature

$0^{o}C$ to $40^{o}C$

ECG

| | |
|---|---|
| Input | Differential,isolated. |
| Minimum signal | 0.1 mV |
| Sensitivity adjustment | Automatic |
| Frequency Range | 6 - 30 Hz |
| Input impedance | 10 Mohms |
| Defib Shock Protection | > 5KV, 500J discharge. |
| 'Leads-off' Threshold | 2.5 K ohms |
| Range | 40 - 255 BPM |
| Accuracy | +/- 1% |
| Resolution | 1 bpm |

RESPIRATION

| | |
|---|---|
| Principle | Impedance Pneumography |
| Frequency | 49K Hz |
| Patient auxiliary current | 6.3 microamps |
| Minimum signal | 0.15 ohm |
| Apnoea period | 15 or 20 sec |
| Sensitivity adjustment | Switchable, 3 levels |
| Cardio-respiratory coincidence | 5 secs to alarm |
| Accuracy | +/- 1% |
| Resolution | 1 bpm |

OXYGEN ANALYSER

| | |
|---|---|
| Sensor | Teledyne R17 |
| Accuracy | 1% |
| Alarm | > 2% from set level. |
| Fuel cell life | > 1 year with normal usage |

TEMPERATURE

| | |
|---|---|
| Probe | YSI 400 Series or equivalent |
| Temperature range | 29 - 45 degrees Celsius |
| Accuracy | 0.1 degrees Celsius |
| Alarm limits (2A only) | $> 37^{o}C$ or $< 35.5^{o}$ or C36.$0^{o}C$ |

OXIMETER

| | | |
|---|---|---|
| Oximeter unit | NELLCOR$_{(R)}$MP 204P Module | |
| Saturation | 0 - 100% | |
| Pulse rate | 20 - 250 bpm | +/- 3 bpm |
| Saturation Accuracy | Adults: 70-100% | +/- 2 digits |
| | 50-69% | +/- 3 digits |
| | 0 -49% | unspecified |
| | Neonates:70-95% | +/- 3 digits |
| SENSORS | Compatible with NELLCOR$_{(R)}$ sensors including OXISENSOR$_{(R)}$ II, OXIBAND$_{(R)}$, and DURA-Y$_{(R)}$. OXISENSOR $_{(R)}$ II oxygen transducers are particularly recommended for this equipment. | |

PATIENT SAFETY SYSTEM

Enclosure, earth leakages, patient connection leakage current and mains contact current, are within the TYPE CF limits.

It is classified as CLASS II equipment

with:

1) CARDIO-RESPIRATORY: type CF defibrillator-proof applied parts

2) PULSE OXIMETRY: type CF applied part

3) TEMPERATURE: type CF applied part

Complies with : AS 3200.1 -1990.
IEC 601 /1 (2nd edition) 1988,

**USE THIS MONITOR ONLY WITH 'S2A513' CODED PLUG-PACKS WHICH ARE NON-REWIRABLE. FOR REPLACEMENTS PLEASE CONTACT NASCOR DIRECT OR YOUR LOCAL NASCOR AGENT.**

EMC TESTING

This monitor complies with EN55011:1991 (Group 1, Class A) and
EN55082-1:1992, (IEC 801-2:1991-04, IEC 801-3:1984, IEC 801-4:1988).

BATTERY POWER

Two rechargeable, lead-acid 6V.1.3Ah batteries

Operating life 4 - 6 hrs

Recharge time 18 hrs

## DEFAULT SWITCHES

These settings will be activated on power-up.

| SWITCH | 1 | 2 |
|---|---|---|
| | ALARMS AND RESPIRATORY SENSITIVITY | |
| NEONATAL | UP | UP |
| INFANT | DOWN | UP |
| ADULT | EITHER | DOWN |
| SWITCH | 3 | 4 |
| UP | APNOEA 15 SECONDS | SOFT ALARMS |
| DOWN | APNOEA 20 SECONDS | LOUD ALARMS |

# OPERATOR'S MANUAL

## *NELLCOR*(R) Pulse Oximeter

## incorporated into the

## NASCOR SERIES 2B MONITOR

Nellcor Puritan Bennett
4280 Hacienda Drive
Pleasanton CA 94588

Nascor P/L
133-135 Alexander St
CROWS NEST
NSW 2065 AUSTRALIA

## SAFETY INFORMATION

### WARNINGS

DANGER! Explosion hazard. Do not use in the presence of flammable anesthetics.

Carefully read this operators manual, accessory directions for use, all precautionary information (which is set in boldface type), and specifications before application and use of the equipment.

The monitor is intended only as an adjunct in patient assessment. It must be used in conjunction with clinical signs and symptoms.

**Do not silence the audible alarm if patient safety could be compromised**.

Tissue damage can be caused by incorrect application or use of a sensor (e.g., wrapping the sensor too tightly, applying supplemental tape, or failing to inspect the sensor site periodically).

Loss of pulse signal can occur if:

- the sensor is too tight;
- there is excessive illumination: e.g., a surgical or bilirubin lamp or sunlight;

the sensor is placed on an extremity with a blood pressure cuff, arterial catheter, or intravascular line;

- the patient is in shock, has hypotension, severe vasoconstriction or anemia, hypothermia, arterial occlusion proximal to the sensor, or cardiac arrest.

Inaccurate measurements may be caused by:

- Incorrect application or use of a sensor;
- significant levels of dysfunctional hemoglobins, such as carboxyhemoglobin or methemoglobin;
- significant levels of indocyanine green, methylene blue or other intravascular dyes;
- exposure to excessive illumination, such as surgical lamps, especially ones with a xenon light source; bilirubin lamps; fluorescent lights; infrared heating lamps; or direct sunlight;
- excessive patient movement;
- venous pulsations;
- electrosurgical interference;
- placement of the sensor on an extremity that has a blood pressure cuff, arterial catheter, or intravascular line.

Do not use the pulse oximeter or *NELLCOR*$_{(R)}$ oximetry sensors during magnetic resonance imaging (MRI) scanning., Conducted current could potentially cause burns. Also, the *NELLCOR*$_{(R)}$ pulse oximeter may affect the MRI image, and the MRI unit may affect the accuracy of oximetry measurements.

Do not use a damaged sensor or one with exposed electrical contacts. Do not immerse in liquids. Do not sterilize by irradiation, steam or ethylene oxide.

## PRINCIPLES OF OPERATION

PULSE OXIMETRY SUBSYSTEM

The monitor is based on the principles of spectrophotometry and plethysmography. It includes an electro-optical sensor and a microprocessor-based monitor.The sensor has two low-voltage light-emitting diodes (LEDs) as light sources and one photodiode as a photodetector.One LED emits red light (nominal 660nm) and the other emits infrared (nominal 920nm).When the light from the LEDs passes through the sensor site,part of it is absorbed.The photodetector measures the light that passes through,which indicates red and infrared absorption.
With each heartbeat,a pulse of oxygenated arterial blood flows to the sensor site.Oxygenated hemoglobin differs from deoxygenated hemoglobin in its relative red and infrared absorption,and the monitor measures red and infrared absorption to determine the percentage of functional hemoglobin that is saturated with oxygen.
Light absorption that is measured when pulsatile blood is not present reflects absorption by tissue and nonpulsatile blood-absorption that does not change substantially during the pulse. This is analogous to the reference measurement of a spectrophotometer. Absorption is also measured when pulsatile, arterial blood is in the tissue. The monitor then corrects this measurement for absorption when the pulsatile blood is not present. The ratio of the corrected absorption at each wavelength determines arterial oxygen saturation ($Sp0_2$).

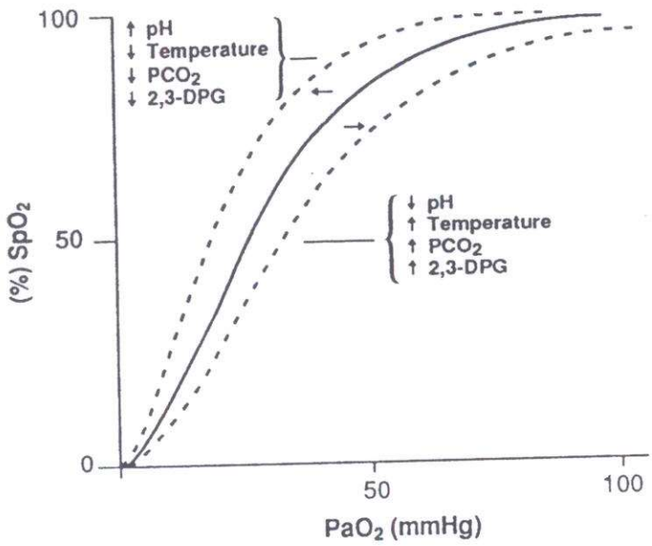
**Automatic Calibration**
The oximetry subsystem incorporates automatic calibration mechanisms. It is automatically calibrated each time it is turned on, at periodic intervals thereafter, and whenever a new sensor is connected. Also, the intensity of the sensor's LEDs is adjusted automatically to compensate for differences in tissue thickness.
Each sensor is calibrated when manufactured: the effective mean wavelength of the red LED is determined and eneoded into a calibration resistor in the sensor plug. The instrument's software reads this calibration resistor to determine the appropriate calibration coefficients for the measurements obtained by that sensor.

**Functional versus Fractional Saturation** :
Because the monitor measures functional $Sp0_2$, it may produce measurements that differ from those of instruments that measurefractional $Sp0_2$. Functional $Sp0_2$ is oxygenated hemoglobin expressed as a percentage of the hemoglobin that is capable of transporting oxygen. Because the monitor uses two wavelengths, it measures oxygenated and deoxygenated hemoglobin, yielding functional $Sp0_2$. It does not detect dysfunctional hemoglobin, such as carboxyhemoglobin or methemoglobin.
In contrast, some laboratory instruments such as the Instrumentation Laboratory 282 CO-Oximeter report fractional $Sp0_2$-oxygenated hemoglobin expressed as a percentage of all measured hemoglobin, whether or not that hemoglobin is available for oxygen transport. Measured dysfunctional hemoglobins are included.
Consequently to compare this monitor's measurements directly with those of another instrument, that other instrument must measure functional $Sp0_2$. If it measures fractional $Sp0_2$,those measurements can be converted using the following equation:

$$\text{functional saturation} = \text{fractional saturation} \times \frac{100}{100-(\%\ \text{carboxyhaemoglobin}+\%\ \text{methaemoglobin})}$$

**Measured versus Calculated Saturation**

When $Sp0_2$ is calculated from a blood gas measurement of the partial pressure of arterial oxygen ($Pa0_2$), the calculated value may differ from the monitor's $Sp0_2$ measurement. This is because the calculated $Sp0_2$ may not have been corrected for the effects of variables that shift the relationship between $Pa0_2$ and $Sp0_2$ (see Figure below): temperature, pH, the partial pressure of carbon dioxide ($PaCO_2$), and the concentrations of 2,3-DPG and fetal hemoglobin.




Oxyhemoglobin Dissociation Curve

## NELLCOR(R) SENSORS

**WARNING:**

**Use only *NELLCOR* oxygen transducers. Use of other oxygen transducers may cause improper oximeter performance.**

WARNING:

**Tissue damage or inaccurate measurements may be caused by incorrect sensor application or use, such as wrapping it too tightly, applying supplemental tape, failing to inspect the sensor site periodically, or failing to position it appropriately. Carefully read the sensor directions for use, the Series 2B operating instructions, and all precautionary information (which is set in boldface type) before use.**

WARNING:

**Excessive ambient light may cause inaccurate measurements. Cover the sensor site with opaque material.**

Nellcor provides a family of sensors suitable for a wide variety of clinical settings and patients. Specific sensors have been developed for neonates, infants, children, and adults. *OXISENSOR*(R), oxygen transducers are sterile adhesive sensors with optical components mounted on adhesive tape. *OXIBAND*(R), oxygen transducers and the *DURAFORM*(R), oxygen transducer system are reusable sensors that are applied with disposable adhesive. The *DURASENSOR DS-IOOA* adult digit oxygen transducer is a reusable sensor with its optical components mounted in a plastic casing.

SELECTING A SENSOR

Sensors are designed for specific sites on patients within designated weight ranges. To select the appropriate sensor, consider the patient's weight, level of activity, adequacy of perfusion, which sensor sites are available, whether sterility is required, and the anticipated duration of monitoring.

CLEANING AND REUSE

Do not immerse any *OXISENSOR*(R), *DURASENSOR*(R), *OXIBAND*(R), *or DURAFORM*(R), oxygen transducer, or any Nellcor adhesive in water or cleaning solution. Clean *DURASENSOR, OXIBAND,* and *DURAFORM* oxygen transducers, by wiping with a disinfectant such as 70% alcohol. Do not sterilize by irradiation, steam, or ethylene oxide. Use a new *OXIBAND* adhesive wrap or *FORM-A* adhesive bandage for each patient. Do not resterilize *OXISENSOR* oxygen transducers.

PERFORMANCE

To ensure optimal performance, use an appropriate sensor, apply it as directed, and observe all warnings and cautions.

If excessive ambient light is present, cover the sensor site with opaque material. Failure to do so may result in inaccurate measurements.
Light sources that can affect performance include surgical lights, especially those with a xenon light source, bilirubin lamps, fluorescent lights, infrared heating lamps, and direct sunlight.

If poor perfusion affects instrument performance,and the patient weighs more than 50kg,consider using the *OXISENSOR* R-15 adult nasal oxygen transducer.Because the R-15 obtains its measurements from the nasal septal anterior ethmoid artery,an artery supplied by the internal carotid,this sensor may obtain measurements when peripheral perfusion is relatively poor.

If patient movement presents a problem:

- Verify that the sensor is properly and securely applied.
- Use a new sensor with fresh adhesive backing.
- Move the sensor to a less active site.
- Use a type of sensor that tolerates some patient motion, such as the *OXISENSOR D-25, D-20, or N-25*, oxygen transducer.