Age-corrected MAC[1]

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An open source anaesthesia workstation (Linux)
revision: 2009α

[1] `http://www.nickalls.org/dick/papers/xenon/hand-macage01.pdf`

Chapter 6

Age-corrected MAC

6.1 Introduction

The first implementation of the real-time age-corrected MAC output on the anaesthesia workstation was towards the end of 1996, soon after reading Mappleson's MAC paper (Mapleson 1996). The workstation program at that time was an MS-DOS application (written in QuickBasic 4.5) running in the thoracic theatre at the City Hospital.

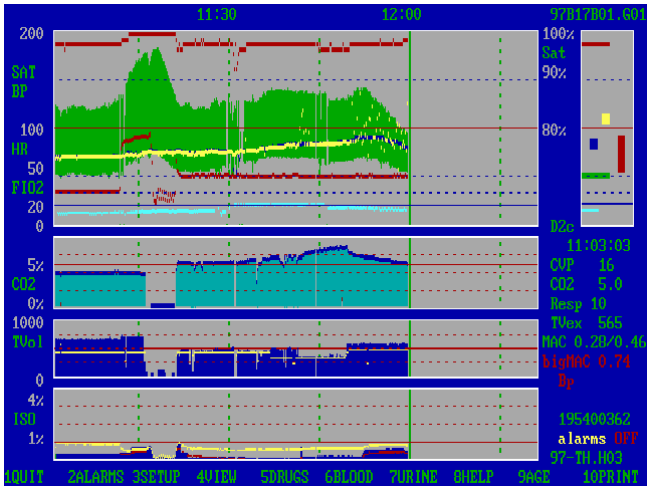

Figure 6.1: Screenshot (November 1997) of the MS-DOS anaesthesia workstation program (version D2c), showing the age-corrected MAC ("bigMAC") value in a red-alert state (only 0·74) on the lower RHS of the screen. Other 'red-alert' states also indicated are for Bp (blood pressure—too low), and alarm sound OFF.

In practice this application was greatly facilitated by the excellent serial-port data stream output by the Datex Cardiocap and Capnomac Ultima series of anaesthesia monitors we then used (detailed in: Nickalls and Ramasubramanian 1995), since the data included agent name and inspired and expired vapour concentrations. Consequently, a practical real-time age-corrected MAC output display was straightforward and simple to implement, since all that was necessary was to write a small subroutine to calculate the value and display the numeric value continuously, and arrange for the value to be displayed in red and also trigger an audible alarm) when less than

a critical value (initially I chose the value 0·86—see the program below).

A significant problem regarding the administration of anaesthesia at that time was the fact that no less than four inhalational anaesthetic vapours were in common use (halothane, isoflurane, desflurane, sevoflurane), it was essentially impossible for *anyone* to remember the appropriate settings for each combination of agent and age. Consequently the prospect of inadvertent awareness was ever present, and anaesthetists generally tended to learn how to use one or two agents for most things even though particular agents may well be more suitable in certain circumstances (eg desflurane with obesity etc).

In view of this problem, the display of age-corrected MAC was particularly since one could now use any agent for any patient irrespective of age, quite safely simply by administering the agent in terms of MAC, and with the great benefit of essentially eliminating the possibility of inadvertent awareness simply by ensuring the age-corrected MAC was greater than a certain critical value—now taken to be 1 MAC (Hardman JG and Aitkenhead AR 2005). In fact we now had a working practical way of giving anaesthetics in terms of MAC units, as originally foreseen by Mapleson many years earlier in his insightful Clover lecture (Mapleson 1979). Our system of displaying real-time age-corrected MAC was at that time almost certainly the only such system in the UK, and possibly in the world.

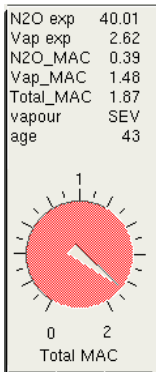

Figure 6.2:
Example of the new real-time age-corrected MAC-widget displayed by the anaesthesia workstation Linux software (© Nickalls RWD and Dales S (1996–2009)) interfaced to the Datex S/5 monitor. If the corrected MAC is too low or too high (as shown in this case—total MAC 1·87) then, in addition to sounding an audible alarm, the dial of the MAC-widget turns red.

The theatre program was later rewritten for the Linux operating system using the new Datex-Ohmeda AS3 monitors, having a much better data-stream (detailed in the Datex chapter). This allowed a nice widget design and hence a much better age-corrected MAC screen display as shown in Figures 6.2, 6.3. This display was intuitive, easy to read and well liked.

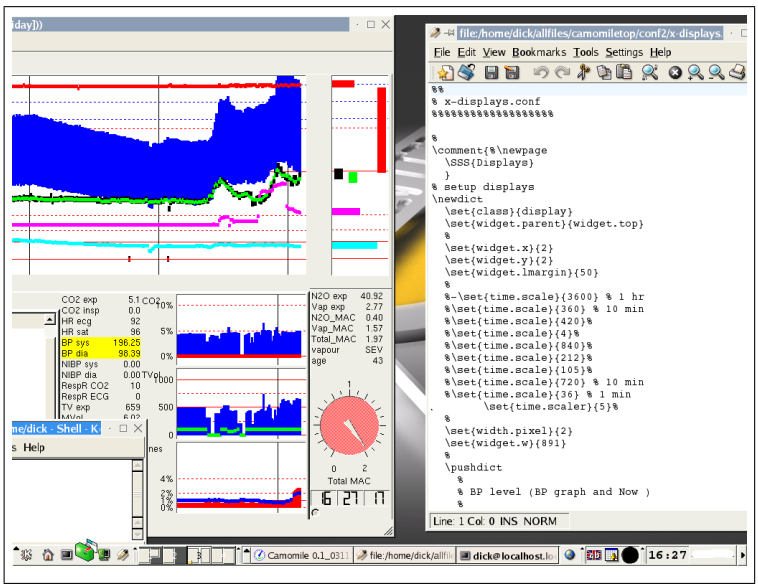

Figure 6.3: Screenshot showing the Linux MAC widget in a red-alert state. Note that the main display screen (pushed to the LHS) is designed so that all the important minute-to-minute data and alarm data is positioned on the RHS of the main display screen, and so allows the main display screen to be moved towards the left in order to view other data, files, or images as required. In this example a file is opened on the RHS of the PC screen.

6.1.1 MAC subroutine (MS-DOS)

The agent name and the end-tidal concentration (output by the Datex monitor) were used as inputs for the calculation, the $\text{MAC}_{age=40}$ values for each agent being stored in simple look-up table in the following subroutine (written in QuickBASIC 4.5).

```
REM MS-DOS program
REM 1996 QuickBASIC 4.5
SUB mac (n2opercent, vapourname$, etvapour,
    ageofpatient%, bmac)
REM ----------
REM Determines the current value of MAC
REM using the recent paper by Mapleson (BJA, 1996, vol
    76, p 179-185)
REM Effect of age on MAC in humans: a meta-analysis
REM ----------
REM new MAC sub using etn2o
REM returns the value of BIGMAC (bmac)
REM this is the newMAC which works correctly
REM ---------
IF etvapour < 0 THEN etvapour = .001
n2o = n2opercent
v$ = vapourname$
vap = etvapour
A% = ageofpatient%
deltaage% = A% - 40
```

```
BB = -.00269
REM ---------------
REM this MAC sub is called from the end of PLOTVAPOUR
    sub
REM vapour is on Datex Ultima BOO and C04 (13,3) data
    strings
REM vapourcode$= ISO, HAL etc  = "   " when not
    selected
IF v$ = "" THEN mac40 = 0
IF v$ = "HAL" THEN mac40 = .75
IF v$ = "ISO" THEN mac40 = 1.17
IF v$ = "ENF" THEN mac40 = 1.63
IF v$ = "SEV" THEN mac40 = 1.8
IF v$ = "DES" THEN mac40 = 6.6
REM mac40 for N2O = 104
REM ---------------
REM do N2O calculation first
REM restrict n2o to zero or above
IF n2o < 0 THEN n2o = 0
REM eqn   mac=(mac40)*10^(-0.00269* deltaage%)
macn2o = 104 * 10 ^ (BB * deltaage%)
IF macn2o <= 0 THEN
    Fmacn2o = .01: REM changed from 0 to .01  check
    ELSE
    Fmacn2o = n2o / macn2o
END IF
REM ---------------------
REM do VAPOUR calc next
REM eqn   mac=(mac40)*10^(-0.00269* deltaage%)
macvapour = mac40 * 10 ^ (BB * deltaage%)
IF macvapour <= 0 THEN
    totalFmac = Fmacn2o
    ELSE
    Fmacvapour = (vap / macvapour)
    totalFmac = Fmacvapour + Fmacn2o
END IF
REM ------------------------------------------------
REM do not print to screen if printing last 20 mins
    fast data
IF pl20mf$ = "on" THEN GOTO MAClastline
REM ------------------------------------------------
A = Fmacn2o
B = Fmacvapour
c = totalFmac
REM ------------------------------------------------
COLOR green, screenbackcolour
REM cannot print digits with PRINT USING and
REM strings in same PRINT statement, so therefore
REM we have to print them separately (red if vap mac=0)
LOCATE 18, 68: PRINT SPACE$(11)
LOCATE 18, 68: PRINT "MAC ";
    IF B <= 0 THEN
       COLOR red, screenbackcolour
       PRINT USING "#.##"; B;
```

```
        COLOR green, screenbackcolour
    ELSE
        PRINT USING "#.##"; B;
    END IF
    PRINT "/";
    PRINT USING "#.##"; A
REM ---- print in red if bigmac less than .86
IF c < 0.86 THEN
        COLOR red, screenbackcolour
    ELSE
        COLOR green, screenbackcolour
END IF
LOCATE 19, 68: PRINT SPACE$(10)
LOCATE 19, 68: PRINT "bigMAC ";
   PRINT USING "#.##"; c
REM ------------------------------------
REM now return to normal screen colours
COLOR screenforecolour, screenbackcolour
MAClastline:
bmac = c
END SUB
$%
```

6.2 Age corrected MAC charts

Sometime during the next couple of years I started wondering how I could create a paper nomogram-type chart for determining age-corrected MAC for use when I did lists at the QMC, since (a) I was unable then to use my computer program (based in the thoracic theatre at the City Hospital), and (b) it was impossible to use the data presented in the Mapleson 1996 paper in a clinical setting to guide at all accurately the appropriate choice of end-tidal agent concentration for a particular patient.

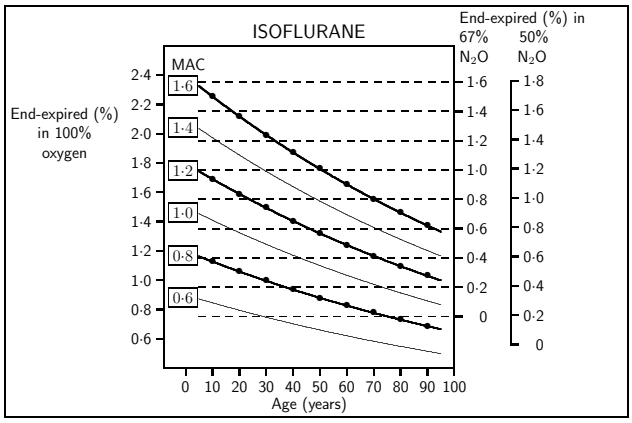

Figure 6.4: One of the first age-corrected iso-MAC charts, drawn using mathsPIC.

The main problem was figuring out how best to incorporate the optional and flexible use of nitrous oxide, since the charts would not be particularly useful clinically unless they easily allowed for the effect of nitrous oxide. The design of such a chart was not straightforward, and it was quite a long time before I formulated a suitable design which allowed nitrous-oxide use (see Figure 6.4). The solution lay in the generally held view that MAC-multiples were additive, and hence the nitrous oxide scale could simply be shifted by an agent-specific amount. Eventually a single chart for each inhalational agent was generated using Perl and mathsPIC (Nickalls 1999, 2000; Syropoulos and Nickalls 2000), and this was then tested clinically over a period of time.

Encouraged by colleagues who tested these charts (one for each of the three main inhalational agents), a paper was submitted to the *British Journal of Anaesthesia* in November 2001. A revised version was submitted in February 2003 and was published later that year (Nickalls and Mapleson 2003). The article was also the subject of an editorial (White, 2003). Since then the these age-corrected iso-MAC charts have been included in the *Oxford handbook of anaesthesia* (Allman and Wilson 2006).

6.3 Generating the charts

The charts were generated using QuickBasic 4.5 (MS-DOS), Perl and mathsPIC. I originally used a QuickBasic program (e.g. `iso-mac.dat`; see below) to generate the agent-specific data-files (for isoflurane, sevoflurane, desflurane) containing the data points for each of the iso-MAC curve (i.e. for the curves associated with the MAC values 0·6, 0·8, 1·0, 1·2, 1·4, 1·6). These data-files were coded with the letters j,k,m,n,p,q For example the following program `iso-mac.bas` generated the isoflurane data-file `isoqdata.dat` (i.e. the data-file for the 'q' (iso-MAC 1·6) curve for isoflurane). In order to generate all the different data-files (a total of 3×6 different data-files) the program was run many times, each run having different values enabled for agent and MAC etc.

```
REM new  iso-mac.bas
COLOR 15, 1
CLS
REM IF ageofpatient% < 1 THEN ageofpatient% = 1
REM ----------------
REM this MAC sub is called from the end of PLOTVAPOUR
    sub
REM vapour is on BOO and C04 (13,3) data strings
REM vapourcode$= ISO, HAL etc  = "   " when not
    selected
REM IF v$ = "   " THEN mac40 = 0
REM IF v$ = "HAL" THEN mac40 = .75
REM IF v$ = "ISO" THEN mac40 = 1.17
REM IF v$ = "ENF" THEN mac40 = 1.63
REM IF v$ = "SEV" THEN mac40 = 1.8
REM IF v$ = "DES" THEN mac40 = 6.6
REM mac40 for N2O = 104
REM ----------------
REM  etn2o = 100 - (eto2 + etco2 + etvap)
REM ----------------------------
REM do N2O calculation first
REM restrict n2o to zero or above
REM IF n2o < 0 THEN n2o = 0
REM eqn   mac=(mac40)*10^(-0.00269* deltaage%)
REM ----------------
```

```
REM q = 1.6 mac = 1.17
REM p = 1.4 mac = 1.17
REM n = 1.2 mac = 1.17
REM m = 1 mac = 1.17
REM k = 0.8 mac = 1.17
REM j = 0.6 mac = 1.17

OPEN "isoqdata.dat" FOR OUTPUT AS #1
n = 1.6
code$ = "q"

mac40 = 1.17: REM isoflurane

REM ----------------
PRINT #1, "%% " + code$ + "= mac40(iso) * "; n
FOR j = 5 TO 95 STEP 5
REM j = age
deltaage = j - 40
BB = -.00269
 mac = (n * mac40) * 10 ^ (BB * deltaage)
PRINT j, mac
PRINT #1, "point(" + code$; j; "){"; j; ","; mac; "}"
s$ = s$ + code$ + STR$(j) + SPACE$(1)
NEXT j

PRINT #1,
PRINT #1, "drawline(" + s$ + ")"
REM $----------
```

6.3.1 A data file for a single iso-MAC curve

The following output data-file (`isoqdata.dat`) was generated by the above program. This data-file contained the mathsPIC code for drawing the iso-MAC 1·6 curve ('q') for the agent isoflurane. This file was then one of the input files for another mathsPIC program which drew the whole graph.

```
%% isoqdata.dat
%% q= mac40(iso) *  1.6
point(q 5 ){ 5 , 2.325176} %% manual
point(q 10 ){ 10 , 2.25427 }
point(q 15 ){ 15 , 2.185525 }
point(q 20 ){ 20 , 2.118877 }
point(q 25 ){ 25 , 2.054262 }
point(q 30 ){ 30 , 1.991617 }
point(q 35 ){ 35 , 1.930882 }
point(q 40 ){ 40 , 1.872 }
point(q 45 ){ 45 , 1.814913 }
point(q 50 ){ 50 , 1.759567 }
point(q 55 ){ 55 , 1.705909 }
point(q 60 ){ 60 , 1.653887 }
point(q 65 ){ 65 , 1.603451 }
point(q 70 ){ 70 , 1.554554 }
point(q 75 ){ 75 , 1.507148 }
```

```
point(q 80 ){ 80 , 1.461187 }
point(q 85 ){ 85 , 1.416628 }
point(q 90 ){ 90 , 1.373428 }
point(q 95 ){ 95 , 1.331545 }

drawline(q 5 q 10 q 15 q 20 q 25 q 30 q 35 q 40 q 45 q
    50 q 55 q 60 q 65 q 70 q 75 q 80 q 85 q 90 q 95 )
drawpoint(q 10  q 20  q 30  q 40  q 50  q 60  q 70  q
    80  q 90 )
```

6.3.2 mathsPIC script for drawing the whole graph

Once having generated all the different data-files (above), a mathsPIC script was written to draw the axes, and to draw the graph by inputting all the relevant data-files. For example, the following mathsPIC script (`mac-iso7.m`) inputs each of the various data-files (one for each iso-MAC curve) and draws the complete isoflurane graph, outputting the LaTeX form of the graph.

For those not familiar with TeX and LaTeX the complete process to be run through is roughly as follows: we first process the mathsPIC script via the mathsPIC program (a Perl program) to generate the TeX (`.mt`) output file, and then we LaTeX this file to generate the (`.dvi`) output file. Next we generate a PostScript version (using the `dvips` utility, and then define the Bounding Box (BB) (using GhostScript) and form the EPS version (i.e. by including the BB coordinates and then renaming the file). Finally we generate the associated (`.pdf`) files using the `epstopdf` utility.

Note that the particular mathsPIC program used at that time was actually an early β version of the final mathsPIC program (Syropoulos A and Nickalls RWD 2005), so that the following mathsPIC script contains instances of the old `\variable(){}` commands which were still being used (eventually changed to the Perl-like format `\var(){}`).

```
%% mac-iso7.m (modified from mac-iso5.m)
%% Feb 1st 2003
%% final graph/chart for the bja
%% wih decimals ($\cdot$) and \fbox{}
%% new curves for anaesthesia
% mathsPIC

\documentclass[a4paper,12pt]{article}
\usepackage{pictexwd}
\begin{document}
\thispagestyle{empty}%% to avoid page nos
\oddsidemargin=-17mm
%\framebox{%
\beginpicture
%-----------------

%% use sf font for figures for BJA
\fontfamily{cmss}\selectfont\normalsize
\linethickness=0.9pt %% = normalsize  (my manual p 23)

     %% structure copied from mac-des.m
%%-------
%% ISOflurane Delta for N2O = 0.75 = (66.6666/104)*1.17
pointnumber(200)
%% y units = 12cm/2.2 = 5.454545
```

```
%paper{units(mm,5.454545cm) xrange(-5,100)
    yrange(0.4,2.6) axes(L) ticks(10,0.2)}
paper{units(0.7mm,3.818181cm) xrange(-8,100)
    yrange(0.4,2.6) axes(T)}

%-------------------
%% want to print only some of the L axis scale
    (0.6-2.4), so do it manually
\axis left
\      ticks withvalues      0{$\cdot$}6   0{$\cdot$}8
    1{$\cdot$}0   1{$\cdot$}2   1{$\cdot$}4
    1{$\cdot$}6
\             1{$\cdot$}8  2{$\cdot$}0   2{$\cdot$}2
    2{$\cdot$}4  /
\             at   0.60  0.80  1.00  1.20  1.40
\             1.60  1.80  2.00 2.20  2.40   / /
%-------------------------
\axis bottom
\  ticks withvalues  0  10  20  30  40  50  60  70  80
     90  100 /
\  at                0  10  20  30  40  50  60  70  80
     90  100 / /
%-------------------------
\axis right
%%%    {using N2O  67%}} shift = 0.7523
\      ticks withvalues   0   0{$\cdot$}2   0{$\cdot$}4
      0{$\cdot$}6
\                        0{$\cdot$}8  1{$\cdot$}0
    1{$\cdot$}2   1{$\cdot$}4
\                       1{$\cdot$}6  /
\           at 0.7523  0.9523  1.1523  1.3523  1.5523
    1.7523  1.9523 2.1523
\              2.3523 / /

%-------------------------------------
%% extra 50% right axis  shift = 0.5614
%% since this axis is off the graph then need new paper
     command
%% but do not use axis() option
paper{units(0.7mm,3.818181cm) xrange(-8,121)
    yrange(0.5614,2.3614) }
\axis right   %% seconds right axis for 50% oxygen
    shift = 0.5614
\      ticks withvalues   0     0{$\cdot$}2
    0{$\cdot$}4      0{$\cdot$}6     0{$\cdot$}8
\      1{$\cdot$}0    1{$\cdot$}2    1{$\cdot$}4
    1{$\cdot$}6  1{$\cdot$}8 /
\                    at 0.5614  0.7614  0.9614   1.1614
     1.3614
\      1.5614 1.7614 1.9614  2.1614 2.3614 / /
%-------------------------------------

%%beginSKIP
\newcommand{\thickline}{\setplotsymbol({\Large .})}%
```

```
\newcommand{\thinline}{\setplotsymbol({\tiny .})}%

\thickline%
inputfile(isoqdata.dat)  %1.6
\thinline%
inputfile(isopdata.dat)  %1.4
\thickline%
inputfile(isondata.dat)  % 1.2
\thinline%
inputfile(isomdata.dat)  % 1
\thickline%
inputfile(isokdata.dat)  % 0.8
\thinline%
inputfile(isojdata.dat)  %0.6
%%endSKIP
%-------------------------------
%%from mac-des.m
variable(x){-1}
variable(x2){x, advance(2)}
point(h){x2,2.475}
text(MAC){h}
%% vertical diff = 0.29 units %% 0.28
variable(d){0.29}

variable(h6){0.88}  %0.9
text(\fbox{$0{\cdot}6$}){x,h6}

variable(h8){h6, advance(d)}
text(\fbox{$0{\cdot}8$}){x,h8}

variable(h10){h8, advance(d)}
text(\fbox{$1{\cdot}0$}){x,h10}

variable(h12){h10, advance(d)}
text(\fbox{$1{\cdot}2$}){x,h12}

variable(h14){h12, advance(d)}
text(\fbox{$1{\cdot}4$}){x,h14}

variable(h16){h14, advance(d)}
text(\fbox{$1{\cdot}6$}){x,h16}

%-----------------------
\newcommand{\myleft}{%
%\framebox{
\begin{minipage}{29mm}\centering%
\ End-expired (\%)\\%
\ in 100\% \\%
\ oxygen\\
\end{minipage}%
%\ }%
\ }%

text(\myleft){-45, 2.0}
```

```
%-------------------------------
\newcommand{\myrightb}{%
    %\fbox{%
\     \begin{minipage}{4cm}%
\     End-expired (\%) in\\
\     67\%\hspace{8mm}50\%\\
\     N$_2$O\hspace{7.5mm}N$_2$O
\     \end{minipage}
%   }%
\     }% end of newcommand
text(\myrightb){102, 2.657}[l]  %% was 2.6
%-------------------------------

\newcommand{\mybottom}{Age (years)}%
text(\mybottom){46, 0.15}

%%text(\copyright\ RWD Nickalls\ 2001){22,0.5}

text(\large ISOFLURANE){46, 2.7}  %% 80

%-------------------------------
% draw horizontal dashed lines
%%\linethickness=0.4pt %% equivalent to {\tiny .}
\linethickness=0.6pt %% half way between tiny and
    normalsize
\setdashes
variable(x5){5}      %% Left X value
variable(x6){100}    %% Right X value
variable(y16){2.3523}
variable(y14){2.1523}
variable(y12){1.9523}
variable(y10){1.7523}
variable(y08){1.5523}
variable(y06){1.3523}
variable(y04){1.1523}
variable(y02){0.9523}    %% = 0.7523 + 0.2
variable(y00){0.7523}    %% = 0.7523

point(L16){x5, y16}
point(R16){x6, y16}

point(L14){x5, y14}
point(R14){x6, y14}

point(L12){x5, y12}
point(R12){x6, y12}

point(L10){x5, y10}
point(R10){x6, y10}

point(L08){x5, y08}
point(R08){x6, y08}
```

```
point(L06){x5, y06}
point(R06){x6, y06}

point(L04){x5, y04}
point(R04){x6, y04}

point(L02){x5, y02}
point(R02){x6, y02}

point(L00){x5, y00}
point(R00){x6, y00}

%% draw the dashes from Left to Right
%% (so have small gap at right axis)
drawline(L16R16, L14R14, L12R12, L10R10,L08R08, L06R06,
     L04R04, L02R02, L00R00)

\endpicture
%\ } %framebox
\end{document}
```

The following example is the TEX code output by the above mathsPIC program.

```
%* ------------------------------------------------------
%* mathsPIC 2.1g1
%* Copyright (c) RWD Nickalls 1999-2002
%* Email: dicknickalls@compuserve.com
%* Date (m/d/y) : 02-02-2003  16:22:19
%* Command Line: /b/s MAC-ISO7.M
%* Input Filename: MAC-ISO7.M
%* Output Filename: MAC-ISO7.MT
%* ------------------------------------------------------
%% mac-iso7.m (modified from mac-iso5.m)
%% Feb 1st 2003
%% final graph/chart for the bja
%% wih decimals ($\cdot$) and \fbox{}
%% new curves for anaesthesia
% mathsPIC
\documentclass[a4paper,12pt]{article}
\usepackage{pictexwd}
\begin{document}
\thispagestyle{empty}%% to avoid page nos
\oddsidemargin=-17mm
\framebox{%
\beginpicture
%-----------------
%% use sf font for figures for BJA
\fontfamily{cmss}\selectfont\normalsize
\linethickness=0.9pt %% = normalsize  (my manual p 23)
     %% structure copied from mac-des.m
%%-------
%% ISOflurane Delta for N2O = 0.75 = (66.6666/104)*1.17
%% pointnumber(200)
%% y units = 12cm/2.2 = 5.454545
```

```
%paper{units(mm,5.454545cm) xrange(-5,100)
    yrange(0.4,2.6) axes(L) ticks(10,0.2)}
%%
    paper{units(0.7mm,3.818181cm)xrange(-8,100)yrange(0.4,2.6)axes(T)}
\setcoordinatesystem units < .7mm, 3.818181cm>
%% ... note: xunits & yunits are different
\setplotarea x from -8 to  100, y from  .4 to  2.6
\axis top /
%-----------------
%% want to print only some of the L axis scale
    (0.6-2.4), so do it manually
\axis left
      ticks withvalues      0{$\cdot$}6   0{$\cdot$}8
          1{$\cdot$}0   1{$\cdot$}2   1{$\cdot$}4
          1{$\cdot$}6
              1{$\cdot$}8  2{$\cdot$}0   2{$\cdot$}2
                  2{$\cdot$}4  /
             at   0.60  0.80  1.00  1.20  1.40
             1.60  1.80  2.00 2.20  2.40   / /
%-------------------------
\axis bottom
   ticks withvalues  0  10  20  30  40  50  60  70  80
        90  100 /
   at                0  10  20  30  40  50  60  70  80
        90  100 / /
%-------------------------
\axis right
%%%    {using N2O  67%}} shift = 0.7523
      ticks withvalues   0   0{$\cdot$}2   0{$\cdot$}4
           0{$\cdot$}6
                     0{$\cdot$}8  1{$\cdot$}0
                         1{$\cdot$}2   1{$\cdot$}4
                     1{$\cdot$}6  /
            at 0.7523  0.9523  1.1523  1.3523  1.5523
                1.7523  1.9523 2.1523
               2.3523 / /
%---------------------------------
%% extra 50% right axis  shift = 0.5614
%% since this axis is off the graph then need new paper
    command
%% but do not use axis() option
%%
    paper{units(0.7mm,3.818181cm)xrange(-8,121)yrange(0.5614,2.3614)}
\setcoordinatesystem units < .7mm, 3.818181cm>
%% ... note: xunits & yunits are different
\setplotarea x from -8 to  121, y from  .5614 to
    2.3614
\axis right   %% seconds right axis for 50% oxygen
    shift = 0.5614
      ticks withvalues   0     0{$\cdot$}2
          0{$\cdot$}4      0{$\cdot$}6     0{$\cdot$}8
      1{$\cdot$}0    1{$\cdot$}2    1{$\cdot$}4
          1{$\cdot$}6  1{$\cdot$}8 /
                   at 0.5614  0.7614  0.9614   1.1614
```

```
                        1.3614
      1.5614 1.7614 1.9614  2.1614 2.3614 / /
%-----------------------------------
%%beginSKIP
\newcommand{\thickline}{\setplotsymbol({\Large .})}%
\newcommand{\thinline}{\setplotsymbol({\tiny .})}%
\thickline%
%% inputfile(isoqdata.dat)  %1.6
%% ... start of file <isoqdata.dat>
%% q= mac40(iso) *  1.6
%% point(q5){5,2.325176}  ( 5 , 2.325176 )  %% manual
%% point(q10){10,2.25427}  ( 10 , 2.25427 )
%% point(q15){15,2.185525}  ( 15 , 2.185525 )
%% point(q20){20,2.118877}  ( 20 , 2.118877 )
%% point(q25){25,2.054262}  ( 25 , 2.054262 )
%% point(q30){30,1.991617}  ( 30 , 1.991617 )
%% point(q35){35,1.930882}  ( 35 , 1.930882 )
%% point(q40){40,1.872}  ( 40 , 1.872 )
%% point(q45){45,1.814913}  ( 45 , 1.814913 )
%% point(q50){50,1.759567}  ( 50 , 1.759567 )
%% point(q55){55,1.705909}  ( 55 , 1.705909 )
%% point(q60){60,1.653887}  ( 60 , 1.653887 )
%% point(q65){65,1.603451}  ( 65 , 1.603451 )
%% point(q70){70,1.554554}  ( 70 , 1.554554 )
%% point(q75){75,1.507148}  ( 75 , 1.507148 )
%% point(q80){80,1.461187}  ( 80 , 1.461187 )
%% point(q85){85,1.416628}  ( 85 , 1.416628 )
%% point(q90){90,1.373428}  ( 90 , 1.373428 )
%% point(q95){95,1.331545}  ( 95 , 1.331545 )
%%
    drawline(q5q10q15q20q25q30q35q40q45q50q55q60q65q70q75q80q85q90q95)
\plot   5  2.325176     10  2.25427 /  %% q5q10
\plot   10  2.25427     15  2.185525 /  %% q10q15
\plot   15  2.185525     20  2.118877 /  %% q15q20
\plot   20  2.118877     25  2.054262 /  %% q20q25
\plot   25  2.054262     30  1.991617 /  %% q25q30
\plot   30  1.991617     35  1.930882 /  %% q30q35
\plot   35  1.930882     40  1.872 /  %% q35q40
\plot   40  1.872     45  1.814913 /  %% q40q45
\plot   45  1.814913     50  1.759567 /  %% q45q50
\plot   50  1.759567     55  1.705909 /  %% q50q55
\plot   55  1.705909     60  1.653887 /  %% q55q60
\plot   60  1.653887     65  1.603451 /  %% q60q65
\plot   65  1.603451     70  1.554554 /  %% q65q70
\plot   70  1.554554     75  1.507148 /  %% q70q75
\plot   75  1.507148     80  1.461187 /  %% q75q80
\plot   80  1.461187     85  1.416628 /  %% q80q85
\plot   85  1.416628     90  1.373428 /  %% q85q90
\plot   90  1.373428     95  1.331545 /  %% q90q95
%% drawpoint(q10q20q30q40q50q60q70q80q90)
\put {$\bullet$} at  10  2.25427  %% q10
\put {$\bullet$} at  20  2.118877  %% q20
\put {$\bullet$} at  30  1.991617  %% q30
\put {$\bullet$} at  40  1.872  %% q40
```

```
\put {$\bullet$} at  50  1.759567  %% q50
\put {$\bullet$} at  60  1.653887  %% q60
\put {$\bullet$} at  70  1.554554  %% q70
\put {$\bullet$} at  80  1.461187  %% q80
\put {$\bullet$} at  90  1.373428  %% q90
%% ... end of file  <isoqdata.dat>
\thinline%
%% inputfile(isopdata.dat)  %1.4
%% ... start of file <isopdata.dat>
%% p= mac40(iso) *  1.4
%% point(p5){5,2.034529}  ( 5 , 2.034529 )  %% manual
%% point(p10){10,1.972486}  ( 10 , 1.972486 )
%% point(p15){15,1.912335}  ( 15 , 1.912335 )
%% point(p20){20,1.854018}  ( 20 , 1.854018 )
%% point(p25){25,1.797479}  ( 25 , 1.797479 )
%% point(p30){30,1.742665}  ( 30 , 1.742665 )
%% point(p35){35,1.689522}  ( 35 , 1.689522 )
%% point(p40){40,1.638}  ( 40 , 1.638 )
%% point(p45){45,1.588049}  ( 45 , 1.588049 )
%% point(p50){50,1.539621}  ( 50 , 1.539621 )
%% point(p55){55,1.49267}  ( 55 , 1.49267 )
%% point(p60){60,1.447151}  ( 60 , 1.447151 )
%% point(p65){65,1.40302}  ( 65 , 1.40302 )
%% point(p70){70,1.360235}  ( 70 , 1.360235 )
%% point(p75){75,1.318754}  ( 75 , 1.318754 )
%% point(p80){80,1.278539}  ( 80 , 1.278539 )
%% point(p85){85,1.23955}  ( 85 , 1.23955 )
%% point(p90){90,1.201749}  ( 90 , 1.201749 )
%% point(p95){95,1.165102}  ( 95 , 1.165102 )
%%
    drawline(p5p10p15p20p25p30p35p40p45p50p55p60p65p70p75p80p85p90p95)
\plot   5  2.034529     10  1.972486 /  %% p5p10
\plot   10  1.972486     15  1.912335 /  %% p10p15
\plot   15  1.912335     20  1.854018 /  %% p15p20
\plot   20  1.854018     25  1.797479 /  %% p20p25
\plot   25  1.797479     30  1.742665 /  %% p25p30
\plot   30  1.742665     35  1.689522 /  %% p30p35
\plot   35  1.689522     40  1.638 /  %% p35p40
\plot   40  1.638     45  1.588049 /  %% p40p45
\plot   45  1.588049     50  1.539621 /  %% p45p50
\plot   50  1.539621     55  1.49267 /  %% p50p55
\plot   55  1.49267     60  1.447151 /  %% p55p60
\plot   60  1.447151     65  1.40302 /  %% p60p65
\plot   65  1.40302     70  1.360235 /  %% p65p70
\plot   70  1.360235     75  1.318754 /  %% p70p75
\plot   75  1.318754     80  1.278539 /  %% p75p80
\plot   80  1.278539     85  1.23955 /  %% p80p85
\plot   85  1.23955     90  1.201749 /  %% p85p90
\plot   90  1.201749     95  1.165102 /  %% p90p95
%% ... end of file  <isopdata.dat>
\thickline%
%% inputfile(isondata.dat)  % 1.2
%% ... start of file <isondata.dat>
%% n= mac40(iso) *  1.2
```

```
%% point(n5){5,1.743882}  ( 5 , 1.743882 )  %% manual
%% point(n10){10,1.690702}  ( 10 , 1.690702 )
%% point(n15){15,1.639144}  ( 15 , 1.639144 )
%% point(n20){20,1.589158}  ( 20 , 1.589158 )
%% point(n25){25,1.540697}  ( 25 , 1.540697 )
%% point(n30){30,1.493713}  ( 30 , 1.493713 )
%% point(n35){35,1.448162}  ( 35 , 1.448162 )
%% point(n40){40,1.404}  ( 40 , 1.404 )
%% point(n45){45,1.361185}  ( 45 , 1.361185 )
%% point(n50){50,1.319675}  ( 50 , 1.319675 )
%% point(n55){55,1.279432}  ( 55 , 1.279432 )
%% point(n60){60,1.240415}  ( 60 , 1.240415 )
%% point(n65){65,1.202589}  ( 65 , 1.202589 )
%% point(n70){70,1.165916}  ( 70 , 1.165916 )
%% point(n75){75,1.130361}  ( 75 , 1.130361 )
%% point(n80){80,1.09589}  ( 80 , 1.09589 )
%% point(n85){85,1.062471}  ( 85 , 1.062471 )
%% point(n90){90,1.030071}  ( 90 , 1.030071 )
%% point(n95){95,.9986587}  ( 95 , .9986587 )
%%
    drawline(n5n10n15n20n25n30n35n40n45n50n55n60n65n70n75n80n85n90n95)
\plot   5  1.743882     10  1.690702 /  %% n5n10
\plot   10  1.690702     15  1.639144 /  %% n10n15
\plot   15  1.639144     20  1.589158 /  %% n15n20
\plot   20  1.589158     25  1.540697 /  %% n20n25
\plot   25  1.540697     30  1.493713 /  %% n25n30
\plot   30  1.493713     35  1.448162 /  %% n30n35
\plot   35  1.448162     40  1.404 /  %% n35n40
\plot   40  1.404     45  1.361185 /  %% n40n45
\plot   45  1.361185     50  1.319675 /  %% n45n50
\plot   50  1.319675     55  1.279432 /  %% n50n55
\plot   55  1.279432     60  1.240415 /  %% n55n60
\plot   60  1.240415     65  1.202589 /  %% n60n65
\plot   65  1.202589     70  1.165916 /  %% n65n70
\plot   70  1.165916     75  1.130361 /  %% n70n75
\plot   75  1.130361     80  1.09589 /  %% n75n80
\plot   80  1.09589     85  1.062471 /  %% n80n85
\plot   85  1.062471     90  1.030071 /  %% n85n90
\plot   90  1.030071     95  .9986587 /  %% n90n95
%% drawpoint(n10n20n30n40n50n60n70n80n90)
\put {$\bullet$} at  10  1.690702  %% n10
\put {$\bullet$} at  20  1.589158  %% n20
\put {$\bullet$} at  30  1.493713  %% n30
\put {$\bullet$} at  40  1.404  %% n40
\put {$\bullet$} at  50  1.319675  %% n50
\put {$\bullet$} at  60  1.240415  %% n60
\put {$\bullet$} at  70  1.165916  %% n70
\put {$\bullet$} at  80  1.09589  %% n80
\put {$\bullet$} at  90  1.030071  %% n90
%% ... end of file  <isondata.dat>
\thinline%
%% inputfile(isomdata.dat)  % 1
%% ... start of file <isomdata.dat>
%% m= mac40(iso) * 1
```

```
%% point(m5){5,1.453235}  ( 5 , 1.453235 )
%% point(m10){10,1.408918}  ( 10 , 1.408918 )
%% point(m15){15,1.365953}  ( 15 , 1.365953 )
%% point(m20){20,1.324298}  ( 20 , 1.324298 )
%% point(m25){25,1.283914}  ( 25 , 1.283914 )
%% point(m30){30,1.244761}  ( 30 , 1.244761 )
%% point(m35){35,1.206802}  ( 35 , 1.206802 )
%% point(m40){40,1.17}  ( 40 , 1.17 )
%% point(m45){45,1.134321}  ( 45 , 1.134321 )
%% point(m50){50,1.099729}  ( 50 , 1.099729 )
%% point(m55){55,1.066193}  ( 55 , 1.066193 )
%% point(m60){60,1.033679}  ( 60 , 1.033679 )
%% point(m65){65,1.002157}  ( 65 , 1.002157 )
%% point(m70){70,.9715963}  ( 70 , .9715963 )
%% point(m75){75,.9419674}  ( 75 , .9419674 )
%% point(m80){80,.9132419}  ( 80 , .9132419 )
%% point(m85){85,.8853925}  ( 85 , .8853925 )
%% point(m90){90,.8583924}  ( 90 , .8583924 )
%% point(m95){95,.8322156}  ( 95 , .8322156 )
%%
    drawline(m5m10m15m20m25m30m35m40m45m50m55m60m65m70m75m80m85m90m95)
\plot   5  1.453235      10  1.408918 /  %% m5m10
\plot   10  1.408918      15  1.365953 /  %% m10m15
\plot   15  1.365953      20  1.324298 /  %% m15m20
\plot   20  1.324298      25  1.283914 /  %% m20m25
\plot   25  1.283914      30  1.244761 /  %% m25m30
\plot   30  1.244761      35  1.206802 /  %% m30m35
\plot   35  1.206802      40  1.17 /  %% m35m40
\plot   40  1.17      45  1.134321 /  %% m40m45
\plot   45  1.134321      50  1.099729 /  %% m45m50
\plot   50  1.099729      55  1.066193 /  %% m50m55
\plot   55  1.066193      60  1.033679 /  %% m55m60
\plot   60  1.033679      65  1.002157 /  %% m60m65
\plot   65  1.002157      70  .9715963 /  %% m65m70
\plot   70  .9715963      75  .9419674 /  %% m70m75
\plot   75  .9419674      80  .9132419 /  %% m75m80
\plot   80  .9132419      85  .8853925 /  %% m80m85
\plot   85  .8853925      90  .8583924 /  %% m85m90
\plot   90  .8583924      95  .8322156 /  %% m90m95
%% ... end of file  <isomdata.dat>
\thickline%
%% inputfile(isokdata.dat)  % 0.8
%% ... start of file <isokdata.dat>
%% k= mac40(iso) *  .8
%% point(k5){5,1.162588}  ( 5 , 1.162588 )  %% manual
%% point(k10){10,1.127135}  ( 10 , 1.127135 )
%% point(k15){15,1.092763}  ( 15 , 1.092763 )
%% point(k20){20,1.059439}  ( 20 , 1.059439 )
%% point(k25){25,1.027131}  ( 25 , 1.027131 )
%% point(k30){30,.9958085}  ( 30 , .9958085 )
%% point(k35){35,.9654412}  ( 35 , .9654412 )
%% point(k40){40,.936}  ( 40 , .936 )
%% point(k45){45,.9074566}  ( 45 , .9074566 )
%% point(k50){50,.8797836}  ( 50 , .8797836 )
```

```
%% point(k55){55,.8529544}  ( 55 , .8529544 )
%% point(k60){60,.8269435}  ( 60 , .8269435 )
%% point(k65){65,.8017257}  ( 65 , .8017257 )
%% point(k70){70,.7772771}  ( 70 , .7772771 )
%% point(k75){75,.7535739}  ( 75 , .7535739 )
%% point(k80){80,.7305936}  ( 80 , .7305936 )
%% point(k85){85,.708314}  ( 85 , .708314 )
%% point(k90){90,.6867139}  ( 90 , .6867139 )
%% point(k95){95,.6657725}  ( 95 , .6657725 )
%%
    drawline(k5k10k15k20k25k30k35k40k45k50k55k60k65k70k75k80k85k90k95)
\plot   5  1.162588     10  1.127135 /  %% k5k10
\plot   10  1.127135     15  1.092763 /  %% k10k15
\plot   15  1.092763     20  1.059439 /  %% k15k20
\plot   20  1.059439     25  1.027131 /  %% k20k25
\plot   25  1.027131     30  .9958085 /  %% k25k30
\plot   30  .9958085     35  .9654412 /  %% k30k35
\plot   35  .9654412     40  .936 /  %% k35k40
\plot   40  .936     45  .9074566 /  %% k40k45
\plot   45  .9074566     50  .8797836 /  %% k45k50
\plot   50  .8797836     55  .8529544 /  %% k50k55
\plot   55  .8529544     60  .8269435 /  %% k55k60
\plot   60  .8269435     65  .8017257 /  %% k60k65
\plot   65  .8017257     70  .7772771 /  %% k65k70
\plot   70  .7772771     75  .7535739 /  %% k70k75
\plot   75  .7535739     80  .7305936 /  %% k75k80
\plot   80  .7305936     85  .708314 /  %% k80k85
\plot   85  .708314     90  .6867139 /  %% k85k90
\plot   90  .6867139     95  .6657725 /  %% k90k95
%% drawpoint(k10k20k30k40k50k60k70k80k90)
\put {$\bullet$} at  10  1.127135  %% k10
\put {$\bullet$} at  20  1.059439  %% k20
\put {$\bullet$} at  30  .9958085  %% k30
\put {$\bullet$} at  40  .936  %% k40
\put {$\bullet$} at  50  .8797836  %% k50
\put {$\bullet$} at  60  .8269435  %% k60
\put {$\bullet$} at  70  .7772771  %% k70
\put {$\bullet$} at  80  .7305936  %% k80
\put {$\bullet$} at  90  .6867139  %% k90
%% ... end of file  <isokdata.dat>
\thinline%
%% inputfile(isojdata.dat)  %0.6
%% ... start of file <isojdata.dat>
%% j= mac40(iso) *  .6
%% point(j5){5,.871941}  ( 5 , .871941 )  %% manual
%% point(j10){10,.8453511}  ( 10 , .8453511 )
%% point(j15){15,.819572}  ( 15 , .819572 )
%% point(j20){20,.794579}  ( 20 , .794579 )
%% point(j25){25,.7703483}  ( 25 , .7703483 )
%% point(j30){30,.7468564}  ( 30 , .7468564 )
%% point(j35){35,.7240809}  ( 35 , .7240809 )
%% point(j40){40,.702}  ( 40 , .702 )
%% point(j45){45,.6805924}  ( 45 , .6805924 )
%% point(j50){50,.6598377}  ( 50 , .6598377 )
```

```
%% point(j55){55,.6397159}  ( 55 , .6397159 )
%% point(j60){60,.6202077}  ( 60 , .6202077 )
%% point(j65){65,.6012943}  ( 65 , .6012943 )
%% point(j70){70,.5829578}  ( 70 , .5829578 )
%% point(j75){75,.5651804}  ( 75 , .5651804 )
%% point(j80){80,.5479452}  ( 80 , .5479452 )
%% point(j85){85,.5312355}  ( 85 , .5312355 )
%% point(j90){90,.5150355}  ( 90 , .5150355 )
%% point(j95){95,.4993294}  ( 95 , .4993294 )
%%
    drawline(j5j10j15j20j25j30j35j40j45j50j55j60j65j70j75j80j85j90j95)
\plot   5  .871941     10  .8453511 /  %% j5j10
\plot   10  .8453511     15  .819572 /  %% j10j15
\plot   15  .819572     20  .794579 /  %% j15j20
\plot   20  .794579     25  .7703483 /  %% j20j25
\plot   25  .7703483     30  .7468564 /  %% j25j30
\plot   30  .7468564     35  .7240809 /  %% j30j35
\plot   35  .7240809     40  .702 /  %% j35j40
\plot   40  .702     45  .6805924 /  %% j40j45
\plot   45  .6805924     50  .6598377 /  %% j45j50
\plot   50  .6598377     55  .6397159 /  %% j50j55
\plot   55  .6397159     60  .6202077 /  %% j55j60
\plot   60  .6202077     65  .6012943 /  %% j60j65
\plot   65  .6012943     70  .5829578 /  %% j65j70
\plot   70  .5829578     75  .5651804 /  %% j70j75
\plot   75  .5651804     80  .5479452 /  %% j75j80
\plot   80  .5479452     85  .5312355 /  %% j80j85
\plot   85  .5312355     90  .5150355 /  %% j85j90
\plot   90  .5150355     95  .4993294 /  %% j90j95
%% ... end of file  <isojdata.dat>
%%endSKIP
%-----------------------------------
%%from mac-des.m
%% variable(x){-1}  (-1 )
%% variable(x2){x,advance(2)}  ( 1 )
%% point(h){x2,2.475}  ( 1 , 2.475 )
%% text(MAC){h}
\put {MAC} at  1  2.475
%% vertical diff = 0.29 units %% 0.28
%% variable(d){0.29}  ( .29 )
%% variable(h6){0.88}  ( .88 )  %0.9
%% text(\fbox{$0{\cdot}6$}){x,h6}
\put {\fbox{$0{\cdot}6$}} at -1  .88
%% variable(h8){h6,advance(d)}  ( 1.17 )
%% text(\fbox{$0{\cdot}8$}){x,h8}
\put {\fbox{$0{\cdot}8$}} at -1  1.17
%% variable(h10){h8,advance(d)}  ( 1.46 )
%% text(\fbox{$1{\cdot}0$}){x,h10}
\put {\fbox{$1{\cdot}0$}} at -1  1.46
%% variable(h12){h10,advance(d)}  ( 1.75 )
%% text(\fbox{$1{\cdot}2$}){x,h12}
\put {\fbox{$1{\cdot}2$}} at -1  1.75
%% variable(h14){h12,advance(d)}  ( 2.04 )
%% text(\fbox{$1{\cdot}4$}){x,h14}
```

```
\put {\fbox{$1{\cdot}4$}} at -1  2.04
%% variable(h16){h14,advance(d)}  ( 2.33 )
%% text(\fbox{$1{\cdot}6$}){x,h16}
\put {\fbox{$1{\cdot}6$}} at -1  2.33
%-------------------------
\newcommand{\myleft}{%
%\framebox{
\begin{minipage}{29mm}\centering%
  End-expired (\%)\\%
  in 100\% \\%
  oxygen\\
\end{minipage}%
%\ }%
  }%
%% text(\myleft){-45, 2.0}
\put {\myleft} at -45  2
%-------------------------
\newcommand{\myrightb}{%
   %\fbox{%
     \begin{minipage}{4cm}%
     End-expired (\%) in\\
     67\%\hspace{8mm}50\%\\
     N$_2$O\hspace{7.5mm}N$_2$O
     \end{minipage}
%  }%
    }% end of newcommand
%% text(\myrightb){102, 2.657}[l]  %% was 2.6
\put {\myrightb} [l]  at  102  2.657
%-------------------------
\newcommand{\mybottom}{Age (years)}%
%% text(\mybottom){46, 0.15}
\put {\mybottom} at  46  .15
%%text(\copyright\ RWD Nickalls\ 2001){22,0.5}
%% text(\large ISOFLURANE){46, 2.7}  %% 80
\put {\large ISOFLURANE} at  46  2.7
%-------------------------------
% draw horizontal dashed lines
%%\linethickness=0.4pt %% equivalent to {\tiny .}
\linethickness=0.6pt %% half way between tiny and
    normalsize
\setdashes
%% variable(x5){5}  ( 5 )  %% Left X value
%% variable(x6){100}  ( 100 )  %% Right X value
%% variable(y16){2.3523}  ( 2.3523 )
%% variable(y14){2.1523}  ( 2.1523 )
%% variable(y12){1.9523}  ( 1.9523 )
%% variable(y10){1.7523}  ( 1.7523 )
%% variable(y08){1.5523}  ( 1.5523 )
%% variable(y06){1.3523}  ( 1.3523 )
%% variable(y04){1.1523}  ( 1.1523 )
%% variable(y02){0.9523}  ( .9523 )  %% = 0.7523 + 0.2
%% variable(y00){0.7523}  ( .7523 )  %% = 0.7523
%% point(L16){x5,y16}  ( 5 , 2.3523 )
%% point(R16){x6,y16}  ( 100 , 2.3523 )
```

```
%% point(L14){x5,y14}  ( 5 , 2.1523 )
%% point(R14){x6,y14}  ( 100 , 2.1523 )
%% point(L12){x5,y12}  ( 5 , 1.9523 )
%% point(R12){x6,y12}  ( 100 , 1.9523 )
%% point(L10){x5,y10}  ( 5 , 1.7523 )
%% point(R10){x6,y10}  ( 100 , 1.7523 )
%% point(L08){x5,y08}  ( 5 , 1.5523 )
%% point(R08){x6,y08}  ( 100 , 1.5523 )
%% point(L06){x5,y06}  ( 5 , 1.3523 )
%% point(R06){x6,y06}  ( 100 , 1.3523 )
%% point(L04){x5,y04}  ( 5 , 1.1523 )
%% point(R04){x6,y04}  ( 100 , 1.1523 )
%% point(L02){x5,y02}  ( 5 , .9523 )
%% point(R02){x6,y02}  ( 100 , .9523 )
%% point(L00){x5,y00}  ( 5 , .7523 )
%% point(R00){x6,y00}  ( 100 , .7523 )
%% draw the dashes from Left to Right
%% (so have small gap at right axis)
%%
    drawline(L16R16,L14R14,L12R12,L10R10,L08R08,L06R06,L04R04,L02R02,L00R00)
\putrule from   5  2.3523 to  100  2.3523  %% L16R16
\putrule from   5  2.1523 to  100  2.1523  %% L14R14
\putrule from   5  1.9523 to  100  1.9523  %% L12R12
\putrule from   5  1.7523 to  100  1.7523  %% L10R10
\putrule from   5  1.5523 to  100  1.5523  %% L08R08
\putrule from   5  1.3523 to  100  1.3523  %% L06R06
\putrule from   5  1.1523 to  100  1.1523  %% L04R04
\putrule from   5  .9523 to  100  .9523  %% L02R02
\putrule from   5  .7523 to  100  .7523  %% L00R00
\endpicture
\ } %framebox
\end{document}
%*
    ------------------------------------------------------------------------
%* PointNumber = 200
%* Number of points/variables used = 153
%* ------------------------
```

6.3.3 Final mathsPIC program for making the charts

This version of the mathsPIC program (`mac-iso8t.m`) incorporated axis legend rotation (using LaTeX and PostScript), and generated the version used by the *Oxford handbook of anaesthesia*.

```
%% mac-iso8T.m (TEST version modified from mac-iso8.m)
%% Jan 10, 2006
%% mathsPICperl  version
%% final graph/chart for the bja
%% wih decimals ($\cdot$) and \fbox{}
%% new curves for anaesthesia
% mathsPIC

%% to test rotation legend on axes
%%-------------------
```

```
%% \\$--> $
%%  \\% --\% for percent
%% enter the Y2 Y1 values in ET units
%% adjust \oddsidemargin
%% ? adjust linethickness
%% adjust minipage-->3.6cm
%% adjust possn of MAC
%% remove isoflurane word from ylegend
%% push Isoflutane title up
%% push age down

%%-----------------
\documentclass[a4paper,12pt]{article}
\usepackage{mathspic}
\usepackage{decimal,rotating}

\begin{document}
% \oddsidemargin=-17mm
%%\framebox{%
\beginpicture
%-----------------

%% use sf font for figures for BJA
\fontfamily{cmss}\selectfont\normalsize
\linethickness=1.1pt %% = normalsize  (was 0.9 for
    BJA) (my manual p 23)

     %% structure copied from mac-des.m
%%--------
%% ISOflurane Delta for N2O = 0.75 = (66.6666/104)*1.17
%% y units = 12cm/2.2 = 5.454545
%paper{units(mm,5.454545cm) xrange(-5,100)
    yrange(0.4,2.6) axes(L) ticks(10,0.2)}
paper{units(0.7mm,3.818181cm) xrange(-8,100)
    yrange(0.4,2.6)}

%-----------------
%% want to print only some of the L axis scale
    (0.6-2.4), so do it manually
\axis left
\      ticks withvalues     0{$\cdot$}6   0{$\cdot$}8
    1{$\cdot$}0   1{$\cdot$}2   1{$\cdot$}4
    1{$\cdot$}6
\             1{$\cdot$}8  2{$\cdot$}0   2{$\cdot$}2
    2{$\cdot$}4  /
\             at   0.60  0.80  1.00  1.20  1.40
\             1.60  1.80  2.00 2.20  2.40   / /
%-------------------------
\axis bottom
\  ticks withvalues  0  10  20  30  40  50  60  70  80
     90  100 /
\  at                0  10  20  30  40  50  60  70  80
     90  100 / /
%-------------------------
```

```
\axis right
%%%    {using N2O  67%}} shift = 0.7523
\      ticks withvalues   0   0{$\cdot$}2   0{$\cdot$}4
       0{$\cdot$}6
\                         0{$\cdot$}8  1{$\cdot$}0
    1{$\cdot$}2   1{$\cdot$}4
\                        1{$\cdot$}6  /
\            at 0.7523  0.9523  1.1523  1.3523  1.5523
    1.7523  1.9523 2.1523
\               2.3523 / /

%-----------------------------------
%% extra 50% right axis  shift = 0.5614
%% since this axis is off the graph then need new paper
     command
%% but do not use axis() option
paper{units(0.7mm,3.818181cm) xrange(-8,121)
    yrange(0.5614,2.3614) }
\axis right   %% seconds right axis for 50% oxygen
    shift = 0.5614
\      ticks withvalues   0      0{$\cdot$}2
    0{$\cdot$}4       0{$\cdot$}6      0{$\cdot$}8
\      1{$\cdot$}0     1{$\cdot$}2     1{$\cdot$}4
    1{$\cdot$}6  1{$\cdot$}8 /
\                     at 0.5614  0.7614  0.9614   1.1614
     1.3614
\      1.5614 1.7614 1.9614  2.1614 2.3614 / /
%-----------------------------------

%%beginSKIP
\newcommand{\thickline}{\setplotsymbol({\Large .})}%
%\newcommand{\thinline}{\setplotsymbol({\tiny .})}%  =
    BJA graphs
%% make thin line a bit thicker for the OUP graphs
\newcommand{\thinline}{\setplotsymbol({\large .})}%

\thickline%
inputfile(isoqdata8.dat)  %1.6
\thinline%
inputfile(isopdata8.dat)  %1.4
\thickline%
inputfile(isondata8.dat)  % 1.2
\thinline%
inputfile(isomdata8.dat)  % 1
\thickline%
inputfile(isokdata8.dat)  % 0.8
\thinline%
inputfile(isojdata8.dat)  %0.6
%%endSKIP
%-----------------------------------
%%from mac-des.m
var  x=-1
var  x2=x + 2
point(h){x2,2.55}%  2.475
```

```
text(MAC){h}
%% vertical diff = 0.29 units %% 0.28
var  d=0.29

var  h6=0.88
text(\fbox{$0{\cdot}6$}){x,h6}

var  h8=h6+d
text(\fbox{$0{\cdot}8$}){x,h8}

var  h10=h8 + d
text(\fbox{$1{\cdot}0$}){x,h10}

var  h12=h10 +d
text(\fbox{$1{\cdot}2$}){x,h12}

var  h14 = h12+d
text(\fbox{$1{\cdot}4$}){x,h14}

var  h16=h14 +d
text(\fbox{$1{\cdot}6$}){x,h16}

%%=======new rotated legends from
    macATdes2.pl====================
var y2=2.6
var y1=0.4

%-----------------------
\newcommand{\ylegend}{\sf End-tidal (\%) in 100\,\%
    oxygen/air}%
%---determine string length --> Yunits etc--------
\newlength{\ylength}%
\settowidth{\ylength}{\ylegend}%
%%%text(answer ylength = \number\ylength){37,-0.4}
%% halflength/3.818=0.777 y units %%
text(\turnbox{90}{\ylegend}){-25, y1+((y2-y1)/2) -
    0.777}
%----------------

beginSKIP
%----------------
\newcommand{\rightylegend}{\sf End-tidal (\%) in
    N$_2$O}\%
\newlength{\rylength}%
\settowidth{\rylength}{\rightylegend}%
text(answer rylength = \number\rylength){37,-1.0}
%% halflength/3.818=0.7188 y units %%
text(\turnbox{270}{\rightylegend}){140, y1+((y2-y1)/2)
    + 0.7188}
%
endSKIP
%%================================
beginSKIP
%--------------------
```

```
\newcommand{\myleft}{%
%\framebox{
\begin{minipage}{29mm}\centering%
\ End-expired (\%)\\%
\ in 100\% \\%
\ oxygen\\
\end{minipage}%
%\ }%
\ }%

text(\myleft){-45, 2.0}
endSKIP
%-------------------------------
\newcommand{\myrightb}{%
   %\fbox{%
\    \begin{minipage}{3.5cm}%  3.8cm
\    End-expired (\%) in\\
\    \hspace*{9mm}67\%\hspace{8mm}50\%\\
\    \hspace*{9mm}N$_2$O\hspace{7.5mm}N$_2$O
\    \end{minipage}
%  }%
\    }% end of newcommand
text(\myrightb){89.143, 2.657}[l]
%-------------------------------

%%\    End-expired (\%) in\\
%%\    67\%\hspace{8mm}50\%\\
%%\    N$_2$O\hspace{7.5mm}N$_2$O


%%=========================


\newcommand{\mybottom}{Age (years)}%
text(\mybottom){46, 0.12} % 0.15

text({\footnotesize\copyright\ RWD Nickalls\
    2003}){19,0.5}

text(\large ISOFLURANE){46, 2.8}  %% 80

%-------------------------------
% draw horizontal dashed lines
%%\linethickness=0.4pt %% equivalent to {\tiny .}
\linethickness=0.6pt %% half way between tiny and
    normalsize
\setdashes
var  x5=5     %% Left X value
var  x6=100   %% Right X value
var  y16=2.3523
var  y14=2.1523
var  y12=1.9523
var  y10=1.7523
var  y08=1.5523
```

```
var   y06=1.3523
var   y04=1.1523
var   y02=0.9523    %% = 0.7523 + 0.2
var   y00=0.7523    %% = 0.7523

point(L16){x5, y16}
point(R16){x6, y16}

point(L14){x5, y14}
point(R14){x6, y14}

point(L12){x5, y12}
point(R12){x6, y12}

point(L10){x5, y10}
point(R10){x6, y10}

point(L08){x5, y08}
point(R08){x6, y08}

point(L06){x5, y06}
point(R06){x6, y06}

point(L04){x5, y04}
point(R04){x6, y04}

point(L02){x5, y02}
point(R02){x6, y02}

point(L00){x5, y00}
point(R00){x6, y00}

%% draw the dashes from Left to Right
%% (so have small gap at right axis)
drawline(L16R16, L14R14, L12R12, L10R10,L08R08, L06R06,
     L04R04, L02R02, L00R00)

\endpicture
%%\ } %framebox
\end{document}
```

6.3.4 Output `mac-iso8t.mt` code from the previous mathsPIC program

```
%* ------------------------------------------------------------
%* mathspic (Perl version 1.00 Feb 14, 2005)
%* A filter program for use with PiCTeX
%* Copyright (c) 2005 A Syropoulos & RWD Nickalls
%* Command line: /usr/local/bin/mpic100.pl mac-iso8t.m
%* Input filename : mac-iso8t.m
%* Output filename: mac-iso8t.mt
```

```
%* Date & time: 2006/01/13     09:19:33
%* ---------------------------------------------------------
%% mac-iso8T.m (TEST version modified from mac-iso8.m)
%% Jan 10, 2006
%% mathsPICperl  version
%% final graph/chart for the bja
%% wih decimals ($\cdot$) and \fbox{}
%% new curves for anaesthesia
% mathsPIC
%% to test rotation legend on axes
%%-----------------------
%% \\$--> $
%%  \\% --\% for percent
%% enter the Y2 Y1 values in ET units
%% adjust \oddsidemargin
%% ? adjust linethickness
%% adjust minipage-->3.6cm
%% adjust possn of MAC
%% remove isoflurane word from ylegend
%% push Isoflutane title up
%% push age down
%%-----------------
\documentclass[a4paper,12pt]{article}
\usepackage{mathspic}
\usepackage{decimal,rotating}
\begin{document}
% \oddsidemargin=-17mm
%%\framebox{%
\beginpicture
%-----------------
%% use sf font for figures for BJA
\fontfamily{cmss}\selectfont\normalsize
\linethickness=1.1pt %% = normalsize  (was 0.9 for
    BJA) (my manual p 23)
     %% structure copied from mac-des.m
%%-------
%% ISOflurane Delta for N2O = 0.75 = (66.6666/104)*1.17
%% y units = 12cm/2.2 = 5.454545
%paper{units(mm,5.454545cm) xrange(-5,100)
    yrange(0.4,2.6) axes(L) ticks(10,0.2)}
%% paper{units(0.7mm,3.818181cm) xrange(-8,100)
    yrange(0.4,2.6)}
\setcoordinatesystem units <0.7mm,3.818181cm>
\setplotarea x from -8.00000 to 100.00000, y from
    0.40000 to 2.60000
%-----------------
%% want to print only some of the L axis scale
    (0.6-2.4), so do it manually
\axis left
      ticks withvalues     0{$\cdot$}6   0{$\cdot$}8
          1{$\cdot$}0   1{$\cdot$}2   1{$\cdot$}4
          1{$\cdot$}6
               1{$\cdot$}8  2{$\cdot$}0   2{$\cdot$}2
                   2{$\cdot$}4  /
```

```
              at   0.60   0.80   1.00   1.20   1.40
              1.60   1.80   2.00 2.20   2.40    / /
%-------------------------
\axis bottom
   ticks withvalues  0  10  20  30  40  50  60  70  80
        90  100 /
   at                0  10  20  30  40  50  60  70  80
        90  100 / /
%-------------------------
\axis right
%%%    {using N2O  67%}} shift = 0.7523
       ticks withvalues   0   0{$\cdot$}2   0{$\cdot$}4
            0{$\cdot$}6
                       0{$\cdot$}8  1{$\cdot$}0
                           1{$\cdot$}2   1{$\cdot$}4
                      1{$\cdot$}6  /
             at 0.7523  0.9523  1.1523  1.3523  1.5523
                 1.7523  1.9523 2.1523
                2.3523 / /
%-------------------------------
%% extra 50% right axis  shift = 0.5614
%% since this axis is off the graph then need new paper
     command
%% but do not use axis() option
%% paper{units(0.7mm,3.818181cm) xrange(-8,121)
    yrange(0.5614,2.3614) }
\setcoordinatesystem units <0.7mm,3.818181cm>
\setplotarea x from -8.00000 to 121.00000, y from
    0.56140 to 2.36140
\axis right   %% seconds right axis for 50% oxygen
    shift = 0.5614
      ticks withvalues   0     0{$\cdot$}2
          0{$\cdot$}4      0{$\cdot$}6     0{$\cdot$}8
      1{$\cdot$}0    1{$\cdot$}2    1{$\cdot$}4
          1{$\cdot$}6  1{$\cdot$}8 /
                   at 0.5614  0.7614  0.9614   1.1614
                       1.3614
      1.5614 1.7614 1.9614  2.1614 2.3614 / /
%-------------------------------
%%beginSKIP
\newcommand{\thickline}{\setplotsymbol({\Large .})}%
%\newcommand{\thinline}{\setplotsymbol({\tiny .})}%  =
    BJA graphs
%% make thin line a bit thicker for the OUP graphs
\newcommand{\thinline}{\setplotsymbol({\large .})}%
\thickline%
%% inputfile(isoqdata8.dat)  %1.6
%% ... start of file <isoqdata8.dat> loop [1]
%%% Iteration number: 1
%% q= mac40(iso) *  1.6
%% point(q5){5,2.325176} %% manual      q5 = (5.00000,
    2.32518)
%% point(q10){10,2.25427}       q10 = (10.00000,
    2.25427)
```

```
%% point(q15){15,2.185525}        q15 = (15.00000,
    2.18553)
%% point(q20){20,2.118877}        q20 = (20.00000,
    2.11888)
%% point(q25){25,2.054262}        q25 = (25.00000,
    2.05426)
%% point(q30){30,1.991617}        q30 = (30.00000,
    1.99162)
%% point(q35){35,1.930882}        q35 = (35.00000,
    1.93088)
%% point(q40){40,1.872}           q40 = (40.00000,
    1.87200)
%% point(q45){45,1.814913}        q45 = (45.00000,
    1.81491)
%% point(q50){50,1.759567}        q50 = (50.00000,
    1.75957)
%% point(q55){55,1.705909}        q55 = (55.00000,
    1.70591)
%% point(q60){60,1.653887}        q60 = (60.00000,
    1.65389)
%% point(q65){65,1.603451}        q65 = (65.00000,
    1.60345)
%% point(q70){70,1.554554}        q70 = (70.00000,
    1.55455)
%% point(q75){75,1.507148}        q75 = (75.00000,
    1.50715)
%% point(q80){80,1.461187}        q80 = (80.00000,
    1.46119)
%% point(q85){85,1.416628}        q85 = (85.00000,
    1.41663)
%% point(q90){90,1.373428}        q90 = (90.00000,
    1.37343)
%% point(q95){95,1.331545}        q95 = (95.00000,
    1.33154)
%% drawline(q5 q10 q15 q20 q25 q30 q35 q40 q45 q50 q55
    q60 q65 q70 q75 q80 q85 q90 q95)
\plot 5.00000 2.32518   10.00000 2.25427 / %% q5q10
\plot 10.00000 2.25427  15.00000 2.18553 / %% q10q15
\plot 15.00000 2.18553  20.00000 2.11888 / %% q15q20
\plot 20.00000 2.11888  25.00000 2.05426 / %% q20q25
\plot 25.00000 2.05426  30.00000 1.99162 / %% q25q30
\plot 30.00000 1.99162  35.00000 1.93088 / %% q30q35
\plot 35.00000 1.93088  40.00000 1.87200 / %% q35q40
\plot 40.00000 1.87200  45.00000 1.81491 / %% q40q45
\plot 45.00000 1.81491  50.00000 1.75957 / %% q45q50
\plot 50.00000 1.75957  55.00000 1.70591 / %% q50q55
\plot 55.00000 1.70591  60.00000 1.65389 / %% q55q60
\plot 60.00000 1.65389  65.00000 1.60345 / %% q60q65
\plot 65.00000 1.60345  70.00000 1.55455 / %% q65q70
\plot 70.00000 1.55455  75.00000 1.50715 / %% q70q75
\plot 75.00000 1.50715  80.00000 1.46119 / %% q75q80
\plot 80.00000 1.46119  85.00000 1.41663 / %% q80q85
\plot 85.00000 1.41663  90.00000 1.37343 / %% q85q90
\plot 90.00000 1.37343  95.00000 1.33154 / %% q90q95
```

```
%% drawpoint(q10  q20  q30  q40  q50  q60  q70  q80
    q90)
\put {$\bullet$} at 10.00000 2.25427 %% q10
\put {$\bullet$} at 20.00000 2.11888 %% q20
\put {$\bullet$} at 30.00000 1.99162 %% q30
\put {$\bullet$} at 40.00000 1.87200 %% q40
\put {$\bullet$} at 50.00000 1.75957 %% q50
\put {$\bullet$} at 60.00000 1.65389 %% q60
\put {$\bullet$} at 70.00000 1.55455 %% q70
\put {$\bullet$} at 80.00000 1.46119 %% q80
\put {$\bullet$} at 90.00000 1.37343 %% q90
%% ... end of file <isoqdata8.dat> loop [1]
\thinline%
%% inputfile(isopdata8.dat)  %1.4
%% ... start of file <isopdata8.dat> loop [1]
%%% Iteration number: 1
%% p= mac40(iso) *  1.4
%% point(p5){5,2.034529}  %% manual      p5 = (5.00000,
    2.03453)
%% point(p10){10,1.972486}       p10 = (10.00000,
    1.97249)
%% point(p15){15,1.912335}       p15 = (15.00000,
    1.91233)
%% point(p20){20,1.854018}       p20 = (20.00000,
    1.85402)
%% point(p25){25,1.797479}       p25 = (25.00000,
    1.79748)
%% point(p30){30,1.742665}       p30 = (30.00000,
    1.74266)
%% point(p35){35,1.689522}       p35 = (35.00000,
    1.68952)
%% point(p40){40,1.638}          p40 = (40.00000,
    1.63800)
%% point(p45){45,1.588049}       p45 = (45.00000,
    1.58805)
%% point(p50){50,1.539621}       p50 = (50.00000,
    1.53962)
%% point(p55){55,1.49267}        p55 = (55.00000,
    1.49267)
%% point(p60){60,1.447151}       p60 = (60.00000,
    1.44715)
%% point(p65){65,1.40302}        p65 = (65.00000,
    1.40302)
%% point(p70){70,1.360235}       p70 = (70.00000,
    1.36024)
%% point(p75){75,1.318754}       p75 = (75.00000,
    1.31875)
%% point(p80){80,1.278539}       p80 = (80.00000,
    1.27854)
%% point(p85){85,1.23955}        p85 = (85.00000,
    1.23955)
%% point(p90){90,1.201749}       p90 = (90.00000,
    1.20175)
```

```
%% point(p95){95,1.165102}       p95 = (95.00000,
    1.16510)
%% drawline(p5 p10 p15 p20 p25 p30 p35 p40 p45 p50 p55
    p60 p65 p70 p75 p80 p85 p90 p95)
\plot 5.00000 2.03453   10.00000 1.97249 / %% p5p10
\plot 10.00000 1.97249  15.00000 1.91233 / %% p10p15
\plot 15.00000 1.91233  20.00000 1.85402 / %% p15p20
\plot 20.00000 1.85402  25.00000 1.79748 / %% p20p25
\plot 25.00000 1.79748  30.00000 1.74266 / %% p25p30
\plot 30.00000 1.74266  35.00000 1.68952 / %% p30p35
\plot 35.00000 1.68952  40.00000 1.63800 / %% p35p40
\plot 40.00000 1.63800  45.00000 1.58805 / %% p40p45
\plot 45.00000 1.58805  50.00000 1.53962 / %% p45p50
\plot 50.00000 1.53962  55.00000 1.49267 / %% p50p55
\plot 55.00000 1.49267  60.00000 1.44715 / %% p55p60
\plot 60.00000 1.44715  65.00000 1.40302 / %% p60p65
\plot 65.00000 1.40302  70.00000 1.36024 / %% p65p70
\plot 70.00000 1.36024  75.00000 1.31875 / %% p70p75
\plot 75.00000 1.31875  80.00000 1.27854 / %% p75p80
\plot 80.00000 1.27854  85.00000 1.23955 / %% p80p85
\plot 85.00000 1.23955  90.00000 1.20175 / %% p85p90
\plot 90.00000 1.20175  95.00000 1.16510 / %% p90p95
%% ... end of file <isopdata8.dat> loop [1]
\thickline%
%% inputfile(isondata8.dat)  % 1.2
%% ... start of file <isondata8.dat> loop [1]
%%% Iteration number: 1
%% n= mac40(iso) *  1.2
%% point(n5){5,1.743882}  %% manual      n5 = (5.00000,
    1.74388)
%% point(n10){10,1.690702}       n10 = (10.00000,
    1.69070)
%% point(n15){15,1.639144}       n15 = (15.00000,
    1.63914)
%% point(n20){20,1.589158}       n20 = (20.00000,
    1.58916)
%% point(n25){25,1.540697}       n25 = (25.00000,
    1.54070)
%% point(n30){30,1.493713}       n30 = (30.00000,
    1.49371)
%% point(n35){35,1.448162}       n35 = (35.00000,
    1.44816)
%% point(n40){40,1.404}          n40 = (40.00000,
    1.40400)
%% point(n45){45,1.361185}       n45 = (45.00000,
    1.36119)
%% point(n50){50,1.319675}       n50 = (50.00000,
    1.31967)
%% point(n55){55,1.279432}       n55 = (55.00000,
    1.27943)
%% point(n60){60,1.240415}       n60 = (60.00000,
    1.24042)
%% point(n65){65,1.202589}       n65 = (65.00000,
    1.20259)
```

```
%% point(n70){70,1.165916}        n70 = (70.00000,
    1.16592)
%% point(n75){75,1.130361}        n75 = (75.00000,
    1.13036)
%% point(n80){80,1.09589}         n80 = (80.00000,
    1.09589)
%% point(n85){85,1.062471}        n85 = (85.00000,
    1.06247)
%% point(n90){90,1.030071}        n90 = (90.00000,
    1.03007)
%% point(n95){95,0.9986587}       n95 = (95.00000,
    0.99866)
%% drawline(n5 n10 n15 n20 n25 n30 n35 n40 n45 n50 n55
    n60 n65 n70 n75 n80 n85 n90 n95)
\plot 5.00000 1.74388   10.00000 1.69070 / %% n5n10
\plot 10.00000 1.69070  15.00000 1.63914 / %% n10n15
\plot 15.00000 1.63914  20.00000 1.58916 / %% n15n20
\plot 20.00000 1.58916  25.00000 1.54070 / %% n20n25
\plot 25.00000 1.54070  30.00000 1.49371 / %% n25n30
\plot 30.00000 1.49371  35.00000 1.44816 / %% n30n35
\plot 35.00000 1.44816  40.00000 1.40400 / %% n35n40
\plot 40.00000 1.40400  45.00000 1.36119 / %% n40n45
\plot 45.00000 1.36119  50.00000 1.31967 / %% n45n50
\plot 50.00000 1.31967  55.00000 1.27943 / %% n50n55
\plot 55.00000 1.27943  60.00000 1.24042 / %% n55n60
\plot 60.00000 1.24042  65.00000 1.20259 / %% n60n65
\plot 65.00000 1.20259  70.00000 1.16592 / %% n65n70
\plot 70.00000 1.16592  75.00000 1.13036 / %% n70n75
\plot 75.00000 1.13036  80.00000 1.09589 / %% n75n80
\plot 80.00000 1.09589  85.00000 1.06247 / %% n80n85
\plot 85.00000 1.06247  90.00000 1.03007 / %% n85n90
\plot 90.00000 1.03007  95.00000 0.99866 / %% n90n95
%% drawpoint(n10  n20  n30 n40 n50 n60 n70 n80 n90)
\put {$\bullet$} at 10.00000 1.69070 %% n10
\put {$\bullet$} at 20.00000 1.58916 %% n20
\put {$\bullet$} at 30.00000 1.49371 %% n30
\put {$\bullet$} at 40.00000 1.40400 %% n40
\put {$\bullet$} at 50.00000 1.31967 %% n50
\put {$\bullet$} at 60.00000 1.24042 %% n60
\put {$\bullet$} at 70.00000 1.16592 %% n70
\put {$\bullet$} at 80.00000 1.09589 %% n80
\put {$\bullet$} at 90.00000 1.03007 %% n90
%% ... end of file <isondata8.dat> loop [1]
\thinline%
%% inputfile(isomdata8.dat)  % 1
%% ... start of file <isomdata8.dat> loop [1]
%%% Iteration number: 1
%% m= mac40(iso) *  1
%% point(m5){5,  1.453235}        m5 = (5.00000, 1.45324)
%% point(m10){10,1.408918}        m10 = (10.00000,
    1.40892)
%% point(m15){15,1.365953}        m15 = (15.00000,
    1.36595)
```

```
%% point(m20){20,1.324298}       m20 = (20.00000,
    1.32430)
%% point(m25){25,1.283914}       m25 = (25.00000,
    1.28391)
%% point(m30){30,1.244761}       m30 = (30.00000,
    1.24476)
%% point(m35){35,1.206802}       m35 = (35.00000,
    1.20680)
%% point(m40){40,1.17}   m40 = (40.00000, 1.17000)
%% point(m45){45,1.134321}       m45 = (45.00000,
    1.13432)
%% point(m50){50,1.099729}       m50 = (50.00000,
    1.09973)
%% point(m55){55,1.066193}       m55 = (55.00000,
    1.06619)
%% point(m60){60,1.033679}       m60 = (60.00000,
    1.03368)
%% point(m65){65,1.002157}       m65 = (65.00000,
    1.00216)
%% point(m70){70,0.9715963}      m70 = (70.00000,
    0.97160)
%% point(m75){75,0.9419674}      m75 = (75.00000,
    0.94197)
%% point(m80){80,0.9132419}      m80 = (80.00000,
    0.91324)
%% point(m85){85,0.8853925}      m85 = (85.00000,
    0.88539)
%% point(m90){90,0.8583924}      m90 = (90.00000,
    0.85839)
%% point(m95){95,0.8322156}      m95 = (95.00000,
    0.83222)
%% drawline(m5 m10 m15 m20 m25 m30 m35 m40 m45 m50 m55
    m60 m65 m70 m75 m80 m85 m90 m95)
\plot 5.00000 1.45324   10.00000 1.40892 / %% m5m10
\plot 10.00000 1.40892  15.00000 1.36595 / %% m10m15
\plot 15.00000 1.36595  20.00000 1.32430 / %% m15m20
\plot 20.00000 1.32430  25.00000 1.28391 / %% m20m25
\plot 25.00000 1.28391  30.00000 1.24476 / %% m25m30
\plot 30.00000 1.24476  35.00000 1.20680 / %% m30m35
\plot 35.00000 1.20680  40.00000 1.17000 / %% m35m40
\plot 40.00000 1.17000  45.00000 1.13432 / %% m40m45
\plot 45.00000 1.13432  50.00000 1.09973 / %% m45m50
\plot 50.00000 1.09973  55.00000 1.06619 / %% m50m55
\plot 55.00000 1.06619  60.00000 1.03368 / %% m55m60
\plot 60.00000 1.03368  65.00000 1.00216 / %% m60m65
\plot 65.00000 1.00216  70.00000 0.97160 / %% m65m70
\plot 70.00000 0.97160  75.00000 0.94197 / %% m70m75
\plot 75.00000 0.94197  80.00000 0.91324 / %% m75m80
\plot 80.00000 0.91324  85.00000 0.88539 / %% m80m85
\plot 85.00000 0.88539  90.00000 0.85839 / %% m85m90
\plot 90.00000 0.85839  95.00000 0.83222 / %% m90m95
%% ... end of file <isomdata8.dat> loop [1]
\thickline%
%% inputfile(isokdata8.dat)  % 0.8
```

```
%% ... start of file <isokdata8.dat> loop [1]
%%% Iteration number: 1
%% k= mac40(iso) *  .8
%% point(k5){5,1.162588} %% manual      k5 = (5.00000,
    1.16259)
%% point(k10){10,1.127135}       k10 = (10.00000,
    1.12713)
%% point(k15){15,1.092763}       k15 = (15.00000,
    1.09276)
%% point(k20){20,1.059439}       k20 = (20.00000,
    1.05944)
%% point(k25){25,1.027131}       k25 = (25.00000,
    1.02713)
%% point(k30){30,0.9958085}      k30 = (30.00000,
    0.99581)
%% point(k35){35,0.9654412}      k35 = (35.00000,
    0.96544)
%% point(k40){40,0.936}          k40 = (40.00000,
    0.93600)
%% point(k45){45,0.9074566}      k45 = (45.00000,
    0.90746)
%% point(k50){50,0.8797836}      k50 = (50.00000,
    0.87978)
%% point(k55){55,0.8529544}      k55 = (55.00000,
    0.85295)
%% point(k60){60,0.8269435}      k60 = (60.00000,
    0.82694)
%% point(k65){65,0.8017257}      k65 = (65.00000,
    0.80173)
%% point(k70){70,0.7772771}      k70 = (70.00000,
    0.77728)
%% point(k75){75,0.7535739}      k75 = (75.00000,
    0.75357)
%% point(k80){80,0.7305936}      k80 = (80.00000,
    0.73059)
%% point(k85){85,0.708314}       k85 = (85.00000,
    0.70831)
%% point(k90){90,0.6867139}      k90 = (90.00000,
    0.68671)
%% point(k95){95,0.6657725}      k95 = (95.00000,
    0.66577)
%% drawline(k5 k10 k15 k20 k25 k30 k35 k40 k45 k50 k55
    k60 k65 k70 k75 k80 k85 k90 k95)
\plot 5.00000 1.16259   10.00000 1.12713 / %% k5k10
\plot 10.00000 1.12713  15.00000 1.09276 / %% k10k15
\plot 15.00000 1.09276  20.00000 1.05944 / %% k15k20
\plot 20.00000 1.05944  25.00000 1.02713 / %% k20k25
\plot 25.00000 1.02713  30.00000 0.99581 / %% k25k30
\plot 30.00000 0.99581  35.00000 0.96544 / %% k30k35
\plot 35.00000 0.96544  40.00000 0.93600 / %% k35k40
\plot 40.00000 0.93600  45.00000 0.90746 / %% k40k45
\plot 45.00000 0.90746  50.00000 0.87978 / %% k45k50
\plot 50.00000 0.87978  55.00000 0.85295 / %% k50k55
\plot 55.00000 0.85295  60.00000 0.82694 / %% k55k60
```

```
\plot 60.00000 0.82694  65.00000 0.80173 / %% k60k65
\plot 65.00000 0.80173  70.00000 0.77728 / %% k65k70
\plot 70.00000 0.77728  75.00000 0.75357 / %% k70k75
\plot 75.00000 0.75357  80.00000 0.73059 / %% k75k80
\plot 80.00000 0.73059  85.00000 0.70831 / %% k80k85
\plot 85.00000 0.70831  90.00000 0.68671 / %% k85k90
\plot 90.00000 0.68671  95.00000 0.66577 / %% k90k95
%% drawpoint(k10  k20 k30 k40 k50 k60 k70 k80 k90)
\put {$\bullet$} at 10.00000 1.12713 %% k10
\put {$\bullet$} at 20.00000 1.05944 %% k20
\put {$\bullet$} at 30.00000 0.99581 %% k30
\put {$\bullet$} at 40.00000 0.93600 %% k40
\put {$\bullet$} at 50.00000 0.87978 %% k50
\put {$\bullet$} at 60.00000 0.82694 %% k60
\put {$\bullet$} at 70.00000 0.77728 %% k70
\put {$\bullet$} at 80.00000 0.73059 %% k80
\put {$\bullet$} at 90.00000 0.68671 %% k90
%% ... end of file <isokdata8.dat> loop [1]
\thinline%
%% inputfile(isojdata8.dat)  %0.6
%% ... start of file <isojdata8.dat> loop [1]
%%% Iteration number: 1
%% j= mac40(iso) *  .6
%% point(j5){5,0.871941}  %% manual      j5 = (5.00000,
    0.87194)
%% point(j10){10,0.8453511}      j10 = (10.00000,
    0.84535)
%% point(j15){15,0.819572}       j15 = (15.00000,
    0.81957)
%% point(j20){20,0.794579}       j20 = (20.00000,
    0.79458)
%% point(j25){25,0.7703483}      j25 = (25.00000,
    0.77035)
%% point(j30){30,0.7468564}      j30 = (30.00000,
    0.74686)
%% point(j35){35,0.7240809}      j35 = (35.00000,
    0.72408)
%% point(j40){40,0.702}          j40 = (40.00000,
    0.70200)
%% point(j45){45,0.6805924}      j45 = (45.00000,
    0.68059)
%% point(j50){50,0.6598377}      j50 = (50.00000,
    0.65984)
%% point(j55){55,0.6397159}      j55 = (55.00000,
    0.63972)
%% point(j60){60,0.6202077}      j60 = (60.00000,
    0.62021)
%% point(j65){65,0.6012943}      j65 = (65.00000,
    0.60129)
%% point(j70){70,0.5829578}      j70 = (70.00000,
    0.58296)
%% point(j75){75,0.5651804}      j75 = (75.00000,
    0.56518)
```

```
%% point(j80){80,0.5479452}      j80 = (80.00000,
    0.54795)
%% point(j85){85,0.5312355}      j85 = (85.00000,
    0.53124)
%% point(j90){90,0.5150355}      j90 = (90.00000,
    0.51504)
%% point(j95){95,0.4993294}      j95 = (95.00000,
    0.49933)
%% drawline(j5 j10 j15 j20 j25 j30 j35 j40 j45 j50 j55
    j60 j65 j70 j75 j80 j85 j90 j95)
\plot 5.00000 0.87194   10.00000 0.84535 / %% j5j10
\plot 10.00000 0.84535  15.00000 0.81957 / %% j10j15
\plot 15.00000 0.81957  20.00000 0.79458 / %% j15j20
\plot 20.00000 0.79458  25.00000 0.77035 / %% j20j25
\plot 25.00000 0.77035  30.00000 0.74686 / %% j25j30
\plot 30.00000 0.74686  35.00000 0.72408 / %% j30j35
\plot 35.00000 0.72408  40.00000 0.70200 / %% j35j40
\plot 40.00000 0.70200  45.00000 0.68059 / %% j40j45
\plot 45.00000 0.68059  50.00000 0.65984 / %% j45j50
\plot 50.00000 0.65984  55.00000 0.63972 / %% j50j55
\plot 55.00000 0.63972  60.00000 0.62021 / %% j55j60
\plot 60.00000 0.62021  65.00000 0.60129 / %% j60j65
\plot 65.00000 0.60129  70.00000 0.58296 / %% j65j70
\plot 70.00000 0.58296  75.00000 0.56518 / %% j70j75
\plot 75.00000 0.56518  80.00000 0.54795 / %% j75j80
\plot 80.00000 0.54795  85.00000 0.53124 / %% j80j85
\plot 85.00000 0.53124  90.00000 0.51504 / %% j85j90
\plot 90.00000 0.51504  95.00000 0.49933 / %% j90j95
%% ... end of file <isojdata8.dat> loop [1]
%%endSKIP
%-----------------------------------
%%from mac-des.m
%% var  x=-1
%% x = -1
%% var  x2=x + 2
%% x2 = 1
%% point(h){x2,2.55}%  2.475     h = (1.00000, 2.55000)
%% text(MAC){h}
\put {MAC} at 1.000000 2.550000
%% vertical diff = 0.29 units %% 0.28
%% var  d=0.29
%% d = 0.29
%% var  h6=0.88
%% h6 = 0.88
%% text(\fbox{$0{\cdot}6$}){x,h6}
\put {\fbox{$0{\cdot}6$}} at -1.000000 0.880000
%% var  h8=h6+d
%% h8 = 1.17
%% text(\fbox{$0{\cdot}8$}){x,h8}
\put {\fbox{$0{\cdot}8$}} at -1.000000 1.170000
%% var  h10=h8 + d
%% h10 = 1.46
%% text(\fbox{$1{\cdot}0$}){x,h10}
\put {\fbox{$1{\cdot}0$}} at -1.000000 1.460000
```

```
%% var  h12=h10 +d
%% h12 = 1.75
%% text(\fbox{$1{\cdot}2$}){x,h12}
\put {\fbox{$1{\cdot}2$}} at -1.000000 1.750000
%% var  h14 = h12+d
%% h14 = 2.04
%% text(\fbox{$1{\cdot}4$}){x,h14}
\put {\fbox{$1{\cdot}4$}} at -1.000000 2.040000
%% var  h16=h14 +d
%% h16 = 2.33
%% text(\fbox{$1{\cdot}6$}){x,h16}
\put {\fbox{$1{\cdot}6$}} at -1.000000 2.330000
%%=======new rotated legends from
    macATdes2.pl====================
%% var y2=2.6
%% y2 = 2.6
%% var y1=0.4
%% y1 = 0.4
%-------------------
\newcommand{\ylegend}{\sf End-tidal (\%) in 100\,\%
    oxygen/air}%
%---determine string length --> Yunits etc-------
\newlength{\ylength}%
\settowidth{\ylength}{\ylegend}%
%%%text(answer ylength = \number\ylength){37,-0.4}
%% halflength/3.818=0.777 y units %%
%% text(\turnbox{90}{\ylegend}){-25, y1+((y2-y1)/2) -
    0.777}
\put {\turnbox{90}{\ylegend}} at -25.000000 0.723000
%---------------
%%beginSKIP
%%endSKIP
%%================================
%%beginSKIP
%%endSKIP
%-----------------------------
\newcommand{\myrightb}{%
   %\fbox{%
     \begin{minipage}{3.5cm}%  3.8cm
     End-expired (\%) in\\
     \hspace*{9mm}67\%\hspace{8mm}50\%\\
     \hspace*{9mm}N$_2$O\hspace{7.5mm}N$_2$O
     \end{minipage}
%  }%
    }% end of newcommand
%% text(\myrightb){89.143, 2.657}[l]
\put {\myrightb} [l] at 89.143000 2.657000
%-----------------------------
%%\    End-expired (\%) in\\
%%\    67\%\hspace{8mm}50\%\\
%%\    N$_2$O\hspace{7.5mm}N$_2$O
%%=======================
\newcommand{\mybottom}{Age (years)}%
%% text(\mybottom){46, 0.12} % 0.15
```

```
\put {\mybottom} at 46.000000 0.120000
%% text({\footnotesize\copyright\ RWD Nickalls\
    2003}){19,0.5}
\put {{\footnotesize\copyright\ RWD Nickalls\ 2003}} at
     19.000000 0.500000
%% text(\large ISOFLURANE){46, 2.8}  %% 80
\put {\large ISOFLURANE} at 46.000000 2.800000
%-----------------------------------
% draw horizontal dashed lines
%%\linethickness=0.4pt %% equivalent to {\tiny .}
\linethickness=0.6pt %% half way between tiny and
    normalsize
\setdashes
%% var  x5=5     %% Left X value
%% x5 = 5
%% var  x6=100   %% Right X value
%% x6 = 100
%% var  y16=2.3523
%% y16 = 2.3523
%% var  y14=2.1523
%% y14 = 2.1523
%% var  y12=1.9523
%% y12 = 1.9523
%% var  y10=1.7523
%% y10 = 1.7523
%% var  y08=1.5523
%% y08 = 1.5523
%% var  y06=1.3523
%% y06 = 1.3523
%% var  y04=1.1523
%% y04 = 1.1523
%% var  y02=0.9523   %% = 0.7523 + 0.2
%% y02 = 0.9523
%% var  y00=0.7523   %% = 0.7523
%% y00 = 0.7523
%% point(L16){x5, y16}  L16 = (5.00000, 2.35230)
%% point(R16){x6, y16}  R16 = (100.00000, 2.35230)
%% point(L14){x5, y14}  L14 = (5.00000, 2.15230)
%% point(R14){x6, y14}  R14 = (100.00000, 2.15230)
%% point(L12){x5, y12}  L12 = (5.00000, 1.95230)
%% point(R12){x6, y12}  R12 = (100.00000, 1.95230)
%% point(L10){x5, y10}  L10 = (5.00000, 1.75230)
%% point(R10){x6, y10}  R10 = (100.00000, 1.75230)
%% point(L08){x5, y08}  L08 = (5.00000, 1.55230)
%% point(R08){x6, y08}  R08 = (100.00000, 1.55230)
%% point(L06){x5, y06}  L06 = (5.00000, 1.35230)
%% point(R06){x6, y06}  R06 = (100.00000, 1.35230)
%% point(L04){x5, y04}  L04 = (5.00000, 1.15230)
%% point(R04){x6, y04}  R04 = (100.00000, 1.15230)
%% point(L02){x5, y02}  L02 = (5.00000, 0.95230)
%% point(R02){x6, y02}  R02 = (100.00000, 0.95230)
%% point(L00){x5, y00}  L00 = (5.00000, 0.75230)
%% point(R00){x6, y00}  R00 = (100.00000, 0.75230)
%% draw the dashes from Left to Right
```

```
%% (so have small gap at right axis)
%% drawline(L16R16, L14R14, L12R12, L10R10,L08R08,
    L06R06, L04R04, L02R02, L00R00)
\putrule from 5.00000 2.35230 to 100.00000 2.35230 %%
    L16R16
\putrule from 5.00000 2.15230 to 100.00000 2.15230 %%
    L14R14
\putrule from 5.00000 1.95230 to 100.00000 1.95230 %%
    L12R12
\putrule from 5.00000 1.75230 to 100.00000 1.75230 %%
    L10R10
\putrule from 5.00000 1.55230 to 100.00000 1.55230 %%
    L08R08
\putrule from 5.00000 1.35230 to 100.00000 1.35230 %%
    L06R06
\putrule from 5.00000 1.15230 to 100.00000 1.15230 %%
    L04R04
\putrule from 5.00000 0.95230 to 100.00000 0.95230 %%
    L02R02
\putrule from 5.00000 0.75230 to 100.00000 0.75230 %%
    L00R00
\endpicture
%%\ } %framebox
\end{document}
```

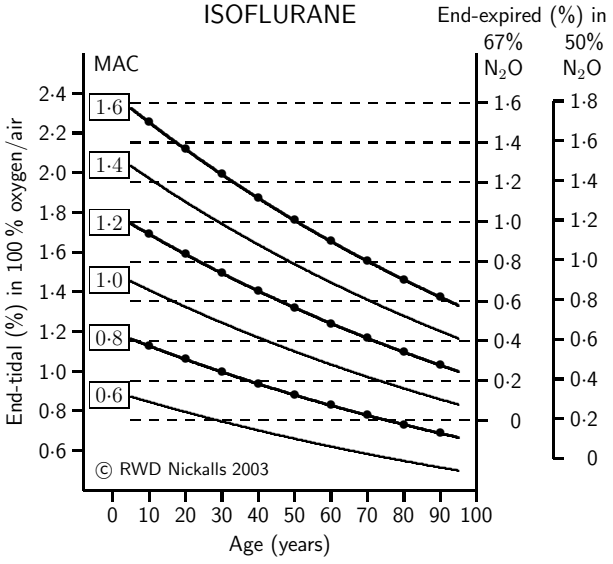

Figure 6.5: The isoflurane version (`mac-iso8t.m`) generated for the *Oxford Handbook of Anaesthesia* with rotated LHS-axis legend.

6.4 References

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