MINIRAE 2000 & MULTIRAE PRE-PROGRAMMED COMPOUND LIBRARIES

This technical note lists the preprogrammed library gas selections available on the MiniRAE 2000, ppbRAE, MultiRAE and AreaRAE. Included are the formal chemical names, the instrument abbreviations, and the default span values and alarm limits. If no abbreviation is listed, the formal name is used in the instrument. TWA and STEL values were taken from the 1997 ACGIH list of TLVs when given; otherwise the values were estimated. None of these values should be construed as regulatory limits.

Table 1. MiniRAE 2000 and ppbRAE PID compound libraries.

MiniRAE 2000 & ppbRAE Compound	Instrument Abbreviation	CF 9.8 eV	CF 10.6 eV	CF 11.7 eV	Pre-set PID Span & Alarm Settings				
					Span	High	Low	TWA	STEL
Custom		1.00	1.00	1.00	100	100	50	10	25
Acetaldehyde		-	6	3.3	25	25	10	10	25
Acetic acid		-	14	2.5	20	15	10	10	15
Acetone		1.2	1.1	1.4	100	500	250	500	750
Acrylonitrile		-	-	1.2	10	5	2	2	5
Acrolein		42	3.9	1.4	10	5	2	0.1	0.3
Allyl alcohol		-	2.4	1.7	10	4	2	2	4
Ammonia		-	9.7	5.7	50	50	25	25	35
Aniline		0.50	0.48	0.47	5	5	2	2	5
Benzene		0.55	0.53	0.60	5	5	2	0.5	2.5
Bromoform		-	2.5	0.50	10	5	2	0.5	1
Butadiene		-	0.85	1.1	10	10	5	2	5
n-Butane	Butane n-	-	-	1.2	100	2000	800	800	2000
n-Butanol	Butanol n-	70	4.7	1.4	50	50	30	30	50
n-Butyl acetate	Butyl acetate n	-	2.6	-	100	500	200	200	500
Butyl cellosolve		1.8	1.2	0.62	50	50	25	25	50
Carbon disulfide		4.0	1.2	0.44	10	50	20	10	25
Carbon tetrachloride	Carbon tetraCl	-	-	1.7	10	20	10	5	10
Chlorine		-	-	1.0	10	5	2	0.5	1
Chlorobenzene		0.44	0.40	0.39	20	20	10	10	20
Chloroform		-	-	3.5	50	20	10	10	20
Crotonaldehyde		1.5	1.1	1.0	10	5	2	2	5
Cumene		0.58	0.54	0.40	100	100	50	50	100
Cyclohexane		3.3	1.4	0.64	100	500	300	300	500
Cyclohexanone		1.0	0.9	0.7	25	50	25	25	50
Decane		4.0	1.4	0.35	100	500	300	300	500
1,2-Dibromomethane	DiBrEthane 1 2-	-	1.7	0.64	25	25	10	10	25
1,2-Dichloroethane	DiClEthane 1 2-	-	-	0.60	25	25	10	10	25
trans-1,2- Dichloroethylene	DiClEthene t1 2-	-	0.50	0.30	10	400	200	200	400
o-Dichlorobenzene	DiClBenzene o-	0.54	0.47	0.38	25	50	25	25	50
Dichloromethane		-	-	0.89	25	50	25	25	50

Table 1. MiniRAE 2000 and ppbRAE PID compound libraries.

MiniRAE 2000 & ppbRAE Compound	Instrument Abbreviation	CF 9.8 eV	CF 10.6 eV	CF 11.7 eV	Pre-set PID Span & Alarm Settings				
					Span	High	Low	TWA	STEL
Diesel fuel		-	0.7	0.4	50	30	11	11	30
Diethylamine		-	0.97	-	15	15	10	5	15
Diisopropylamine		0.84	0.74	0.53	15	15	10	5	15
N,N-Dimethylacetamide	DiMeAcetamideNN-	0.87	0.80	0.80	100	50	25	10	25
Epichlorohydrin		-	8.5	1.4	10	50	2	0.5	1
Ethanol		-	12	8	100	2000	1000	1000	2000
Ethylene	Ethene	-	10	3	100	2000	1000	1000	2000
Ethyl acetate		-	4.6	-	100	1000	400	400	1000
Ethylbenzene		0.52	0.52	0.51	100	125	100	100	125
Ethyl ether		-	1.1	-	100	500	400	400	500
Ethyl (S)-(-)-lactate	EthylS(-)lactate	13	3.2	1.6	100	125	100	100	125
Ethyl sulfide		-	0.51	-	100	100	50	10	25
Furfural		-	0.92	0.80	10	5	2	2	5
Gasoline vapors		-	0.85	-	100	500	300	300	500
Gasoline whole		1.3	1.0	0.47	100	500	300	300	500
n-Heptane	Heptane n-	45	2.8	0.60	100	500	400	400	500
1,1,1,3,3,3-Hexamethyldisilazane	HexaMe-disilazan	-	0.24	0.19	10	10	5	5	10
n-Hexane	Hexane n-	-	4.3	0.50	100	75	50	50	75
Hydrogen Sulfide		-	3.3	1.5	50	15	10	10	15
Isobutane		-	-	1.2	100	2000	800	800	2000
Isobutanol		19	3.8	1.5	100	100	50	50	100
Isobutyl acrylate	Isobutyl acrylat	-	1.5	0.6	100	250	100	100	250
Isobutylene		1.0	1.0	1.0	100	100	50	10	25
Isoprene		0.69	0.63	0.60	100	250	100	100	250
Isopropanol		-	6.0	2.7	100	500	400	400	500
Jet fuel JP-4		-	0.99	0.42	50	50	30	30	50
Jet fuel JP-5		-	0.60	0.46	50	30	15	15	30
Jet fuel JP-8		-	0.60	0.32	50	30	15	15	30
Mesitylene		0.36	0.35	0.32	100	250	100	100	250
Methanol		-	-	2.5	100	250	100	100	250
Methyl bromide	Me bromide	-	1.7	1.3	5	5	2	1	3
Methyl chloride	Me chloride	-	-	0.74	100	100	50	50	100
Methyl cyclohexane	Me cyclohexane	1.6	0.97	0.53	100	500	400	400	500
Methylene chloride — Listed as Dichloromethane		-	-	0.89	25	50	25	25	50
Methyl ethyl ketone	Me ethyl ketone	0.86	0.86	1.1	100	300	200	200	300
Methyl isobutyl ketone	Me iBut ketone	0.9	0.80	0.6	100	75	50	50	75
Methyl iodide	Me iodide	0.21	0.22	0.26	10	10	5	2	5
Methyl methacrylate	Me methacrylate	2.7	1.5	1.2	100	250	100	100	250
Methyl propyl ketone	Me propyl ketone	-	0.93	0.79	100	250	200	200	250
Methyl sulfide	Me sulfide	0.49	0.44	0.46	100	100	50	10	25
Methyl t-butyl ether	Me t-butyl ether	-	0.91	-	100	100	400	400	100

Table 1. MiniRAE 2000 and ppbRAE PID compound libraries.

MiniRAE 2000 & ppbRAE Compound	Instrument Abbreviation	CF 9.8 eV	CF 10.6 eV	CF 11.7 eV	Pre-set PID Span & Alarm Settings				
					Span	High	Low	TWA	STEL
Mineral spirits		1.0	0.7	0.39	100	250	100	100	250
Napthalene		0.45	0.42	0.40	100	150	100	100	150
Nitric oxide		-	5.2	2.8	50	50	25	25	50
Nitrobenzene		2.6	1.9	1.6	10	10	5	1	5
N-Methyl pyrrolidinone	NMP	1.0	0.79	0.93	100	100	50	10	25
N-Vinyl pyridine	NVP	1.0	0.80	0.92	100	100	50	10	25
n-Octane	Octane n-	13.3	1.8	-	100	375	300	300	375
n-Pentane	Pentane n-	80	8.4	0.70	100	750	600	600	750
Perchloroethene		0.69	0.57	0.31	50	100	25	25	100
Propylene glycol methyl ether	PGME	2.4	1.5	1.1	100	150	100	100	150
Propylene glycol methyl ether acetate	PGMEA	1.65	1.0	0.82	100	100	50	50	100
Phenol		1.0	1.0	0.9	10	10	5	5	10
a-Pinene	Pinene a-	-	0.31	0.47	100	250	100	100	250
b-Pinene	Pinene b-	0.37	0.37	0.38	100	250	100	100	250
Propane		-	-	1.8	100	5000	2500	2500	5000
Propene		-	1.4	1.6	100	5000	2500	2500	5000
n-Propyl bromide	Propyl bromide n	-	1.5	0.6	100	100	50	50	100
Propyleneimine		1.5	1.4	1.0	10	10	5	2	5
Pyridine		0.78	0.68	0.70	10	10	5	5	10
Styrene		0.45	0.40	0.4	50	40	20	20	40
Tetrahydrofuran		1.9	1.7	1.0	100	250	200	200	250
1,1,2,2-Tetrachloroethane	TetrClEthan 1122	-	-	0.6	5	5	2	1	2
Tetrachloroethylene — Listed as Perchloroethene		0.69	0.57	0.31	50	100	25	25	100
Therminol		0.90	0.68	-	5	5	2	1	2
Toluene		0.54	0.50	0.51	100	100	50	50	100
1,1,1-Trichloroethane	TriClEthane 111	-	-	0.98	100	450	350	350	450
Trichloroethylene	Trichloroethene	0.62	0.54	0.43	100	100	50	50	100
Vinyl chloride		-	2.0	0.64	10	10	5	5	10
VOC		1.00	1.00	1.00	100	100	50	10	25
m-Xylene	Xylene m-	0.50	0.43	0.40	100	150	100	100	150
o-Xylene	Xylene o-	0.57	0.59	0.69	100	150	100	100	150
p-Xylene	Xylene p-	-	0.45	0.62	100	150	100	100	150

Table 2. MultiRAE and AreaRAE PID and LEL compound libraries.

MultiRAE & AreaRAE Compound	Instrument Abbreviation		CF 10.6 eV	CF 11.7 eV	CF LEL
	English	German			
Custom gas		Anwender Komp.	1.00	1.00	1.00
Acetaldehyde		Acetaldehyd	6	3.3	1.8
Acetic acid		Essigsaeure	22	2.6	3.4
Acetone		Aceton	1.1	1.4	2.2

Table 2. MultiRAE and AreaRAE PID and LEL compound libraries.

MultiRAE & AreaRAE Compound	Instrument Abbreviation		CF 10.6 eV	CF 11.7 eV	CF LEL
	English	German			
Acrylonitrile		Acrylnitril	-	1.2	-
Allyl alcohol		Allylalkohol	2.4	1.7	-
Ammonia		Ammoniak	9.7	5.7	0.8
Benzene		Benzol	0.53	0.60	2.2
Butadiene		Butadien	0.85	1.1	2.5
n-Butane	Butane n-	Butan, n-	-	1.2	2.0
n-Butyl acetate	Butyl acetate n	Butylacetat n-	2.6	-	-
Carbon disulfide		Kohlendisulfid	1.2	0.44	-
Carbon monoxide		Kohlenmonoxid	-	-	1.2
Carbon tetrachloride	Carbon tetraCl	Tetraclormethan	-	1.7	-
Chlorine		Chlor	-	1.0	-
Cyclohexane		Cyclohexan	1.4	-	2.5
Cyclohexanone		Cyclohexanon	0.9	0.7	-
1,2-Dichloroethane	DiCl-ethane 1,2-	DiCl-ethan 1,2-	-	0.60	-
Dichloromethane		Dichloromethan	-	0.89	1.0
Diesel fuel		Diesel	0.7	0.4	-
Diethylamine		Diethylamin	0.97	-	-
Epichlorohydrin		Epichlorhydrin	8.5	1.4	-
Ethanol		Ethanol	12	8	1.7
Ethylene	Ethene	Ethen	10	3	1.4
Ethyl acetate		Ethyl acetat	4.6	-	2.2
Ethylbenzene		Ethylbenzen	0.52	0.51	2.8
Ethyl ether		Ethylether	1.1	-	2.3
Ethyl sulfide		Ethylsulfide	0.51	-	-
Gasoline vapors		Benzin-dampf	0.85	-	-
Gasoline whole		Benzin, ges	1.0	0.47	2.1
n-Heptane	Heptane n-	Heptan n-	2.8	0.60	2.4
1,1,1,3,3,3- Hexamethyldisilazane	HexaMedisilazan	HexaMedisilazan	0.24	0.19	-
n-Hexane	Hexane, n-	Hexan, n-	4.3	0.50	2.3
Hydrogen		Wasserstoff	-	-	1.1
Hydrogen Sulfide		Schwefelwasserstoff	3.3	1.5	-
Isobutane		Isobutan	-	1.2	1.8
Isobutylene		Isobuten	1.0	1.0	1.5
Isopropanol		Isopropanol	6.0	2.7	2.6
Jet fuel JP-4		Kerosin JP-4	0.99	0.42	-
Jet fuel JP-5		Kerosin JP-5	0.60	0.46	-
Jet fuel JP-8		Kerosin JP-8	0.60	0.32	-
Methane		Methan	-	-	1.0
Methanol		Methanol	-	2.5	1.5
Methylene chloride — listed as Dichloromethane			-	0.89	1.0
Methyl ethyl ketone	MeEtketone	MeEtketon MEK	0.86	1.1	2.6

Table 2. MultiRAE and AreaRAE PID and LEL compound libraries.

MultiRAE & AreaRAE Compound	Instrument Abbreviation		CF 10.6 eV	CF 11.7 eV	CF LEL
	English	German			
Methyl isobutyl ketone	Me iBut ketone	Me-iBut-keton	0.8	0.6	-
Methyl methacrylate	Me methacrylate	Me methacrylat	1.5	1.2	-
Methyl t-butyl ether	Me-butyl-ether	Me t-butylether	0.91	-	-
Nitric oxide		Stickst.monoxid	5.2	2.8	-
n-Octane	Octane, n-	Oktan, n-	1.8	-	2.9
n-Pentane	Pentane, n-	Pentan, n-	8.4	0.70	2.2
Perchloroethene		Perchloroethene	0.57	0.31	-
a-Pinene	Pinene a-	Pinen, a-	0.31	0.47	-
b-Pinene	Pinene b-	Pinen, b-	0.37	0.37	-
Propane		Propan	-	1.8	1.6
Propene		Propen	1.4	1.6	1.5
Styrene		Styrol	0.40	0.4	-
Tetrahydrofuran		Tetrahydrofuran	1.7	1.0	-
Toluene		Tolulol	0.50	0.51	2.6
1,1,1-Trichloroethane	TriCl-ethane 111	TiCl-Ethan 111	-	0.98	-
Trichloroethylene	Trichloroethene	Trichloroethen	0.54	0.43	-
Vinyl chloride		Vinyl chlorid	2.0	0.64	1.8
m-Xylene	Xylene, m-	Xylol, m-	0.43	0.40	2.7
o-Xylene	Xylene, o-	Xylol, o-	0.59	0.69	3.0
p-Xylene	Xylene, p-	Xylol, p-	0.45	0.62	2.8

Table 3. Default span and alarm settings for meters with combustible gas(LEL) and electrochemical (EC) sensors

MultiRAE, AreaRAE & VRAE Compound	Formula	Pre-set Sensor Span & Alarm Settings				
		Span	High	Low	TWA	STEL
Carbon Monoxide	CO	50	200	35	35	100
Hydrogen Sulfide	H_2S	10	20	10	10	15
Ammonia	NH_3	50	50	25	25	35
Phosphine	PH_3	5	2	1	3	1
Hydrogen Cyanide	HCN	10	50	4.7	4.7	4.7
Hydrogen Chloride	HCl	10	5	2	1	5
Chlorine	CL_2	10	5	0.5	0.5	1
Chlorine Dioxide	ClO_2	0.5	0.5	0.2	0.1	0.3
Sulfur Dioxide	SO_2	5	10	2	2	5
Nitrogen Oxide	NO	25	50	25	25	25
Nitrogen Dioxide	NO_2	5	10	1	1	1
Carbon Dioxide	CO_2	5000	8000	5000	5000	5000
LEL (% LEL)	CH_4	50	20	10	NA*	NA
VOL (% Vol)	CH_4	20	20	10	NA	NA
Oxygen (% Vol)	O_2	20.9	23.5	19.5	NA	NA
VOC (Isobutylene)	C_4H_8	100	100	50	10	25

* NA = Not applicable

COMPOUND SELECTION IN THE MULTIRAE AND AREARAE SERIES INSTRUMENTS

The MutliRAE and AreaRAE Series monitors allow independent selection of the calibration gas and measurement gas, for both PID and LEL sensors. First, enter the program mode Calibration Menu and select the calibration gas from the compound library. Do not adjust the Correction Factor. Next, move to the Sensor Configuration Menu and select the measurement gas. The monitor automatically displays an adjusted Correction Factor equal to the CF for the calibration gas, divide by the CF for the measurement gas. For exam ple, if hexane were usedas the calibration gas for a MultiRAE with a 10.6 eV lamp, and the measurement gas were set to octane, the new CF would be 1.8/4.3 = 0.42. The instrument automatically displays the new Correction Factor and applies it to the measurements to read the true concentration of octane. Do not reset the CF to 1.8 for octane in the Sensor Configuration menu, or the concentrations will be incorrect.

SPAN VALUES AND ALARM LIMITS

In the MultiRAE and AreaRAE Series monitors, the span values and alarm limits are not changed when a new gas is called up from the library. The user should adjust them to the desired values. In the MiniRAE 2000 and ppbRAE, the alarm limits and span values are automatically set to those in the first table for the particular compound selected. It is a good idea to review these values after a new compound has been called up, in order to verify that they are set at the desired values.

CALIBRATION MEMORIES OF THE MINIRAE 2000

The MiniRAE 2000 and ppbRAE monitors provide 8 calibration memories. These calibration memories allow the user to store calibration and alarm data for up to 8 different gases. During regular operation, the user can easily switch between these calibration memories and obtain direct readings for the corresponding gases. Below is a more detailed description of the calibration memories and how they are used.

To calibrate and measure with a specific gas of interest, change the memory to that gas and calibrate that memory with the desired gas. This is the most accurate method of calibration.

To calibrate with isobutylene and measure a different gas, applying a library correction factor, use either of the following two methods:

1. Calibrate Memory #0 with isobutylene and set the measurement gas of Memory #0 to the desired gas
2. Calibrate Memory #0 with isobutylene and then change the Memory # to the desired gas, but do not calibrate that memory.

Calibration Memory Curves

There are total 8 calibration memories inside the non-volatile memory of the MiniRAE 2000 and ppbRAE. Each calibration memory contains following information:

Gas parameters:

a. Gas name

b. 3 response factors for 9.8, 10.6 and 11.7 eV lamp

c. Span value

d. High alarm limit

e. Low alarm limit

f. STEL alarm limit

g. TWA alarm limit

Calibration data:

h. Calibration flag (0=not calibrated, 1=calibrated)

i. Lamp type: 10.6 eV, 11.7 eV or 9.8 eV

j. Calibration data

k. Calibration Date

l. Others

These calibration memories are numbered from 0 to 7. The user can pick any one of the 8 gas memories as the **"current"** gas and the MiniRAE 2000 monitor will use the selected gas for measurement and alarm limits.

When the unit is shipped from the factory, the calibration memories are pre-loaded with following 8 gases:

Cal Memory #1	Gas Name
0	Isobutylene
1	Hexane
2	Xylene
3	Benzene
4	Styrene
5	Toluene
6	Vinyl Chloride
7	Custom

These gas names are simply place holders and can be changed to any compound inthe library (See Modify Cal Mem below).

Select a Calibration Memory:

To select a calibration memory, enter programming mode (press [N]and [MODE] keys together for 3 seconds), press [Y] to the question "Calibrate / Select Gas?". Press the [N] key until the display shows "Select Cal Memory?". Press [Y] and the display will show the current gas name and calibration memory number, e.g. "Gas=Isobutylene, Mem #0?". To change to a different calibration memory, press [N] and the gas name and calibration memory number will be displayed (if the gas you need is not shown under the 8 calibration memories, then please reference the section "Change Calibration Memory"). Press[N] until the desired calibration memory number is displayed. Then press [Y]. The unit will ask to confirm the selection. When [Y] is pressed, the display will either show "CF=xx.x" or "Last calibrated xx/xx/xx".

If the display shows "CF=xx.x", it means that this calibration memory has not been calibrated before with an actual gas. Therefore, a library **correction factor** of the selected gas will be automatically downloaded and applied to calculate the gas reading based on the calibration data obtained from memory #0. This is the appropriate sequence when calibration is done with isobutylene in Memory #0 and the user wants to shift to read a different gas without re-calibrating.

If the display shows "Last calibrated xx/xx/xx", then the selected calibration memory has been calibrated with an actual gas on the date of xx/xx/xx. In this case, the gas reading will be calculated based on the **actual calibration data** stored in this calibration memory . The measurement and calibration gas should be the same. For exam ple, if you are using calibration Memory #2 and it is set to xylene, then if you calibrate Memory #2 you must use xylene gas. If you want to use Memory #2 while it is set to xylene but you want to calibrate on isobutylene, then prior to calibrating you must select Memory #0 (Isobutylene), perform the calibration and then reselect calibration Memory #2 after calibration.

Calibrate a Calibration Memory:

To calibrate a calibration memory, select the calibration memory first, as described in section 3 above. Then perform a Span Calibration using the specific gas for that memory. After the span calibration, the selected calibration memory will store the actual calibration data. The calibration flag in the cal memory will be turned on. The real time gas reading will be calculated based on the actual calibration data stored in this calibration memory from then on.

Modify a Calibration Memory:

To modify a calibration memory, select the calibration memory first, as described in section 3 above. Then modify the gas parameters, such as span value, alarm limits and correction factors following the programming menus. All the modifications will be stored in the calibration memory until they are changed again later.

You can also **change to a different gas** for each calibration memory. To do so, select the calibration memory first, as described in section 3 above. Press [Y] when "Modify cal memory?" is displayed. The display will show the current memory number and the current gas name for this memory with a question mark at the end. To change to a different gas, press [N] and the display will ask the user to copy a new gas from the built-in library. Press [Y] to copy one gas name from the 100 built-in gases to replace the current gas for this memory. Otherwise, press [N] to enter a custom gas name (up to 8 characters) for this memory.

BUILT-IN GAS LIBRARY:

There are a total of 100 gases stored in the gas library of the MiniRAE 2000. Each gas memory contains the following information:

Gas parameters

a. Gas Name

b. Response factor for 9.8, 10.6 and 11.7 eV lamp

c. Span value

d. High limit

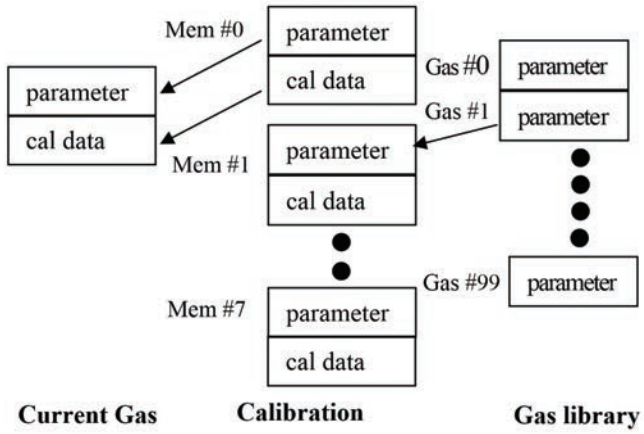
e. Low limit

f. STEL limit

g. TWA limit

h. Others

Any one of the gases in this library can be copied to one of the 8 calibration memories as described in the previous section. When a new gas is copied from the gas library into a calibration memory, the gas parameters in the calibration memory are updated. The calibration flag is reset to off to flag that this memory has not been calibrated with an actual gas.



Special Handling of Calibration Memory #0:

Calibration memory #0 is different from other 7 calibration memories because 1) the type of calibration gas cannot be changed from isobutylene and 2) the measurement gas can be different from isobutylene. If a different measurement gas is selected, the gas reading will be calculated based on the correction factor of the selected gas and the calibration data of isobutylene gas in this memory.

For calibration memories #1 to #7, the calibration and measurement gases **must be the same**. If the selected gas is used to calibrate, then the calibration flag will be turned on and the gas readings will be based on the actual calibration data for this memory. Otherwise, the calibration flag will remain off and the gas readings will be calculated using the correction factor of the selected gas and the calibration data for isobutylene from memory#0.

SUMMARY:

- Calibration memories #1 to #7 are intended to be used to calibrate and read with the same gas to be measured. This is the preferred method of calibration as it gives the best accuracy.
- Calibration memory #0 is intended to be used to calibrate with isobutylene and measure either total VOC as isobutylene equivalents or measure any other compound using an applied correction factor. The use of correction factors gives lower accuracy, but is simpler and more convenient when no standard is readily available for the compound of interest (see topic #7 "Special Handling of Calibration Memory#0").

Note: the current revision of firmware V1.07 includes all the features described in this document. Older version of firmware does not include the special handling of calibration memory #0 described in section 7. In addition, when you select a new calibration memory which has not been calibrated before, the message was "Not Cal'ed", instead of the "CF=xx.x".