# Operating Manual for EMD Chemicals
# MAS-100*Eco*™ Air Sampler (1.09227.0002)

## Microbial Air Monitoring System
## for the food industry and environmental monitoring



MAS-100*Eco*™ is a trademark of MBV /Switzerland

EMD Chemicals Inc.
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1-800-222-0342

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## 1 Introduction

Air monitoring is becoming increasingly important in a number of areas, notably in the pharmaceutical and cosmetic industries, the food trade and the environment, because airborne microorganisms have the propensity to contaminate or otherwise affect industrial products and processes and also to impact on human health.

A number of monitoring methods are available, most are based on the principle of impaction. During development of the MAS-100*Eco*™ air monitoring system the prime objective was to build a compact, easy to use, reliable, no nonsense sampler for use with standard 100mm petri dishes.

The aspirated volume is 100 liters per minute, allowing up to 1000 liters of air to be collected per cycle. This performance enables sampling to be carried out in line with the strict demands of monitoring in sterile and "clean" areas [1]. The sampling time should be kept to less than 10 minutes, otherwise there is a risk of the agar surface dehydrating.

The impaction velocity (speed at which airborne microorganisms hit the surface of the agar) is approximately 11 meters per second, equivalent to stage 5 of the Andersen Sampler [3]. This velocity guarantees that all particles > 1 µm are collected. The air sampler system was compared with other methods [2] and no significant differences were found in the yield of microorganisms.

## 2 Basic principles

The MAS-100*Eco*™ is a high-performance instrument that utilizes the principle of the Andersen air sampler [3], drawing air through a perforated plate. The particle-bearing airflow is directed onto a standard 100mm Petri dish containing agar. On completion of the collection cycle, the Petri dish is incubated and the total colony count determined. The MAS-100*Eco*™ operates with a high-performance suction device.

The MAS-100*Eco*™ can be calibrated with the DA-100™ digital anemometer; the airflow is regulated to exactly 100 liters per minute.

## 3 Major advantages of the MAS-100*Eco*™

- Use of standard 100 mm Petri dish
- Simple calibration and airflow checking with the DA-100™ Digital Anemometer (approx. 30 seconds)
- Electronic low-flow detection
- Time and date displayed
- Compact and easy to use
- Electronic calibration reminder (programmable from 1 to 12 months)
- Adjustable sampling head        (0-45°) using the handle
                                  (0-90°) using a tripod
- NiMH rechargeable batteries, environment friendly, no memory effect
- Power                          100-240 VAC, 47-63 Hz or battery operation (NiMH rechargeable batteries)

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## 4 <u>Functions</u>

### 4.1 General

The MAS-100*Eco*™ has built-in dialog software. With the "yes" button you accept a parameter or command. With the "no" button you are presented with another option. The program guides automatically from one step to the next. Once the aspirated volume and delay has been set, the program moves to the "START ?" prompt. If you press "yes", the MAS-100*Eco*™ will start to sample the pre-set volume of air. A green light indicates the instrument is operating. A dark bar in the display represents the amount of air to be aspirated. The bar decreases with the air volume already collected. "END" appears on the display once the pre-set volume has been sampled. The Petri dish may then be removed and the MAS-100*Eco*™ is ready for the next sampling cycle.

### 4.2 Battery charging

When the battery charger is connected to the MAS-100*Eco*™, the lamp next to the charging socket is lit. It goes off when the charger is disconnected. A complete recharging cycle takes about 9 hours. With the batteries fully charged, the instrument has a total capacity of approximately 18,000 liters of air, equivalent to about 180 readings @ 100 liters. Please clean contacts with 70% alcohol before charging.

### 4.3 Battery replacement

The NiMH batteries are located under the base plate of the MAS-100*Eco*™. The base plate can be removed with the aid of the perforated lid. Lift off the perforated lid and place it over the base plate. Ensure that the perforated lid properly fits to the three slots in the base plate. Rotate counterclockwise and remove the base plate. Take out NiMH batteries. Clean contacts with 70% alcohol.
**Important: Only use the perforated lid to remove the base plate!**

2 new NiMH rechargeable batteries can now be inserted. Use the battery charger to charge the MAS-100*Eco*™ to enable its maximum capacity of 18,000 liters of aspirated air. If it is not possible to recharge the MAS-100*Eco*™ on site, you may insert freshly charged rechargeable batteries.

**IMPORTANT: Only use rechargeable NiMH batteries and the MAS-100***Eco*™ **battery charger for recharging. DO NOT USE REGULAR C-BATTERIES !**

Air can be sampled while charging batteries.

Important: With time while not in use, rechargeable batteries will lose their charge. It is recommended to recharge the MAS-100*Eco*™ overnight before running tests. This guarantees full battery capacity.

### 4.4 Low battery indicator

The message "LOW BATT" on the display during operation indicates that the batteries are becoming exhausted. The current sampling cycle will be completed without interruption. At this point, recharge the NiMH batteries or insert new ones.

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### 4.5 Impeded airflow ("AIRBLOCK")

An electronic sensor indirectly monitors the 100 liters per minute airflow. If this value is not maintained, the message "AIRBLOCK" appears in the display and the red and green LEDs flash. Possible causes are: the Petri dish is too full, the perforated lid is blocked, or the dust cover was not removed. Remove the Petri dish and start a new test. Press "yes" or "no" to cancel the error message.witching on the MAS-100*Eco*™

### 4.6 Switching on the MAS-100*Eco*™

Press "yes" to turn on the MAS-100*Eco*™. The display will start by showing the software version number, followed by the date and time.
The MAS-100*Eco*™ shuts off automatically after approximately 100 seconds if no button was pressed during this time. This extends battery life.

### 4.7 Last volume

If you press the "yes" button, the program will prompt with the volume most recently used, which you can accept by pressing the "yes" button again or decline by pressing the "no" button.

If you press "no", you may select another pre-set volume of between 1 and 1000 liters (see Pre-set volumes).

### 4.8 Delay function

If the delay function is enabled, the option "DELAY ON" will appear following the start command. If you press "yes" at this prompt, the pre-set delay time will be activated and "DELAY" will appear in the display together with a dark bar. Throughout the delay period the red "stop" LED will flash. Then the MAS-100*Eco*™ will start to aspirate the pre-set volume.
By answering "no" at the "DELAY ON" prompt, you can over-ride the delay function so the MAS-100*Eco*™ can start immediately.

### 4.9 Start ?

To start sampling, press "yes". The MAS-100*Eco*™ starts immediately. A dark bar in the display indicates the volume that is still to be aspirated. The bar becomes smaller as the sampled volume increases. When sampling is complete, the pre-set volume and "END" appear in the display.

### 4.10 Pre-set volumes

The MAS-100*Eco*™ is supplied with volumes pre-set as follows:

V1:     10 liters          V2:     20 liters          V3:     50 liters
V4:     100 liters                  V5:     200 liters                  V6:     500 liters

Each of these volumes may be reset to a figure of between 1 and 1000 liters. Refer to chapter 5.2 "Customizing the volume".

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## 5    Set up menu

### 5.1    General

To access the set up menu, depress the "no" button for 5 seconds at the "START ? Y/N" prompt. From the set up menu, you can set or change the date, time, aspirated volume, delay time and calibration reminder.

### 5.2    Customizing the volume

V1: XXXX is the first pre-set volume. You can choose between a total of 6 pre-set volumes. The factory settings are as follows:

V1:    10 liters         V2:    20 liters          V3:    50 liters
V4:    100 liters                V5:    200 liters                V6:    500 liters

Each of these volumes may be set or changed to any figure between 1 and 1000 liters. By setting one or more volumes to 0 liters, you can blank it from the screen. This allows you to display just the sampling volumes of interest to your company.
Resetting the volume to between 1 and 1000 liters causes it to be displayed again on the screen.
Pressing "yes" takes you to the next prompt. After the V6 volume the next menu option is displayed.

### 5.3    Delay

The MAS-100*Eco*™ includes a menu that allows a delay time to be set before the instrument starts sampling. The delay time may be set as follows: every minute from 0 to 20 minutes, then every 10 minutes from 10 to 60 minutes.

Setting the "DELAY" to "OFF" with the "no" button disables the delay function in the user menu. It may be enabled again at any time in the set up menu.

### 5.4    Selecting EU/US date format

The first prompt in the set up menu is "DATE EU" or "DATE US". Press "no" to toggle between the options: EU for European or US for American date format. Press "yes" to accept the displayed format and move on to the next prompt.

### 5.5    Changing the date and time

Next, the date is displayed in the selected format. Press the "no" button to display, in sequence, the year, month and day. Repeatedly pressing the "no" button increments the displayed value until it matches the one you want. Pressing "yes" takes you to the next prompt.

### 5.6    Exiting the set up menu

The last item in the set up menu is the "EXIT ?" prompt.
Press "yes" to exit the menu or "no" to return to the first prompt.

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# 6    Operation

## 6.1    Switching on the MAS-100*Eco*™

Press "yes" to turn on the MAS-100*Eco*™. The display will start by showing the software version number, followed by the date and time.
**Important**: The MAS-100*Eco*™ shuts off automatically after approximately 100 seconds if no button was pressed during this time.

## 6.2    Petri dish support

6.2.1    Before using the MAS-100*Eco*™ for the fist time you will need to adjust the blue Petri dish support.
6.2.2    Place a Petri dish on the dish support. Use the 3 mm Allen key (located in the battery compartment) to adjust the three blue jaws until the Petri dish is securely supported.

## 6.3    Air sampling

6.3.1    Place the MAS-100*Eco*™ on a firm support.
6.3.2    Open the perforated lid (with attached dust cover) by rotating to the left.
6.3.3    Place a closed 100-mm agar Petri dish on top of the dish support.
6.3.4    Take the lid off the Petri dish.
6.3.5    Close the MAS-100*Eco*™ perforated lid by rotating to the right.
6.3.6    By moving the carry handle, adjust the sampling head to any angle from horizontal to vertical airflow direction.
6.3.7    Program the MAS-100*Eco*™ as instructed (refer to chapter 5.).
6.3.8    Remove the dust cover and press "yes" at the "Start ?" prompt to commence sampling.
6.3.9    At the end of the sampling cycle the total volume will appear in the display together with "END".
6.3.10   Open the sampling head, place the Petri dish lid back on the Petri dish and remove the dish from the instrument.
6.3.11   The Petri dish is now ready for incubation.
6.3.12   Proceed as instructed by the manufacturer of the culture medium.

## 6.4    Switching off the MAS-100*Eco*™

At the end of the sampling cycle the total volume will appear in the display together with "END".
The MAS-100*Eco*™ shuts off automatically after approximately 100 seconds if no button was pressed during this time. To switch off the MAS-100*Eco*™ immediately, depress the "no" button for about 2-3 seconds.

## 6.5    Switching off the MAS-100 *Eco* during air sampling

Pressing "yes" or "no" will stop the MAS-100*Eco*™. The display will show the volume selected and the message "STOPPED", and the green and red LEDs will light to indicate that sampling has been stopped. The instrument will remain in this state for approximately 100 seconds, after which it will automatically shut off; alternatively, you may press "yes" to proceed to the start prompt. Pressing "no" returns you to the volume selection menu.

## 7    Quick reference

| Function | Action | Description |
|---|---|---|
| | | |
| 1. Switching on | Press the "yes" button | The name MAS-100*Eco*™ is briefly displayed together with the software version number X.X. This is followed by the date and time. |
| 2. Selecting the sampling volume | Press the "yes" or "no" button after the date and time have been displayed | The volume last used is displayed. If it is to be changed, press the "no" button until the desired volume appears in the display. Altogether, there are 6 pre-set sampling volumes:<br>V1:  20<br>V2:  50<br>V3: 100<br>V4: 200<br>V5: 250<br>V6: 500<br>NB: These volumes may be customized in the set up menu. Refer to chapter 5.2. |
| 3. Starting the sampling cycle | Press the "yes" button | The "START ?" prompt appears in the display. Press the "yes" button to start the sampling cycle or "no" to return to the volume selection menu. |
| 4. During the sampling cycle | None | The selected volume is displayed together with a time bar which becomes smaller as the sampled volume increases.<br>"END" appears when sampling is complete. |
| 5. Further sampling | Pressing "yes" takes you to the next sampling cycle | "START ?" appears again in the display. Proceed to 3. |
| 6. Switching off | Depress the "no" button for about 2-3 seconds | The MAS-100 *Eco*™ shuts off and the display goes blank. The MAS-100*Eco*™ shuts off automatically after approximately 100 seconds unless the "no" button was pressed during this time. |
| 7. AIRBLOCK | None | If "AIRBLOCK" appears in the display, either the dust cover was not removed or the airflow is impeded. |
| 8. Battery charging | Connect the MAS-100*Eco*™ battery charger to the MAS-100*Eco*™ | Allow to charge overnight. Make sure only NiMH rechargeable batteries are used ! |

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## 8 <u>Interpreting the results</u>

First, the total microbial count is corrected based on FELLER's statistical correction table (see Appendix chapter 17), then it is converted to organisms per cubic meter.
The correction table is based on the principle that as the number of organisms per sampling increases, there is also a greater chance that several organisms will enter the same hole in the perforated lid.
(A laminated table of statistical corrections according to FELLER for the MAS-100*Eco*™ is also provided with each MAS-100*Eco*™ Instrument).

## 9 <u>Calibration certificate</u>

The MAS-100*Eco*™ is factory calibrated to 100 liters per minute. For further calibration details please refer to the calibration certificate that came with the instrument.

Only authorized personnel may change any mechanical part of the instrument or change any of the software settings in the "Service" menu.
The manufacturer recommends that the instrument be calibrated at least once per year.

## 10 <u>Calibration with the DA-100 digital anemometer</u>

### 10.1 Accessing the calibration menu

With the MAS-100*Eco*™ turned off (blank display), press the "yes" and "no" buttons simultaneously (for about 5 seconds) until the air pump is heard to turn on. The display shows CAL:, and then in the top line of the display the current K3 calibration value. The DA-100™ Digital Anemometer is positioned on the sampling head of the MAS-100*Eco*™ and the airflow measured (for further information on calibration with the DA-100 Digital Anemometer please refer to the DA-100™ Operators Manual). The "yes" button can be used to increase the K3 value, or the "no" button to decrease the K3 value. The "EXIT ?" menu appears after approximately 60 seconds. Press "yes" to proceed to the next prompt or "no" to return to the K3 value. The next prompt is displayed after approximately 120 seconds if no button was pressed during this time.

### 10.2 Setting the calibration reminder

After the calibration menu with "EXIT?" comes the calibration reminder menu. By using "no" select a time between 0 and 12 months, after which the calibration reminder shall appear. If no reminder is required, set 0 months. Confirm the setting with "yes".
When the time is expired, the calibration reminder "CAL. NOW" will appear on the display. It will disappear after 5 seconds, but will appear again every time the system is switched on, until a new calibration reminder time will be programmed. To reset the calibration reminder, enter the calibration reminder menu as described above.

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## 11   <u>Technical specifications</u>

| | |
|---|---|
| Material | anodized aluminum |
| Height with handle | 18 cm |
| Height without handle | 14 cm |
| Diameter | 11 cm |
| Weight | 1.4 kg |
| Nominal airflow | 100 liters / min. ± 4% |
| Airflow regulation | electronic |
| Sampling volume | pre-set values: 10, 20, 50, 100, 200, 500 liters<br>Each volume can be customized to any value between 1 to 1,000 liters. |
| Petri dish support | for standard Petri dishes |
| Tripod adapter | optional accessory for attachment to carry handle (standard photographic tripod thread) |
| Rechargeable batteries | NiMH rechargeable batteries, 1.2 V |
| Battery charger | 100-240 VAC, 47-63 Hz, output 5 V DC/500 mA |
| Motor | 6 V DC |
| Display | alphanumeric liquid crystal display, 2 x 8 characters |
| RTC battery | RTC (real time clock) battery |
| Operating conditions | temperature 0 to 40°C<br>humidity 0 to 80% RH |
| CE approval | EN 50081-1:1992 + EN 50082-1:1997<br>EN 50081-2:1993 + EN 50082-2:1995 + prEN 500082-2:1996 |

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## 12  Package contents

The MAS-100*Eco*™ comes in a complete package with the following contents:

1 MAS-100*Eco*™, complete system with perforated lid, dust cover, 2 rechargeable NiMH batteries
1 battery charger
1 Allen key (3mm) for centering Petri dish (located in the battery compartment under the base plate)
1 laminated "table of statistical corrections according to FELLER" and "software flow diagram"
1 calibration certificate
1 Operators Manual

## 13  Accessories

| | | | |
|---|---|---|---|
| | Battery charger w/ cable for MAS-100*Eco*™<br><br>1.09128.0002 | | Shoulder bag (blew) for MAS-100*Eco*™<br><br>1.09126.0001 |
| | Dust cover (anodized aluminium, autoclavable) for perforated lid<br>1.09084.0002 | | DA-100 Digital Anemometer (calibration device for MAS-100*Eco*™<br><br>1.09228.0002 |
| | Perforated lid (anodized aluminium, autoclavable)<br><br>1.09088.0002 | | |

## 14  Care and maintenance

The MAS-100*Eco*™ should be periodically calibrated (see 9.).
The perforated lid and dust cover are autoclavable (15 min/121°C). When the MAS-100*Eco*™ is being moved to a sterile or "clean" area, we suggest that it be wiped with a suitable disinfectant (e.g. 70% alcohol or 70% isopropanol). DO NOT USE $H_2O_2$.
Between sampling cycles the lid may be cleaned with disinfectant. Make sure that the holes in the perforated lid are not clogged.

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## 15  Warranty

The MAS-100*Eco*™ has a 1 year warranty against failure due to malfunction of electrical and electronic components (see invoice date).

The MAS-100*Eco*™ is a laboratory instrument and should only be used by qualified personnel.

## 16  References

[1]     The Rules Governing Medicinal Products In The European Community
        Vol. IV: Guide to Good Manufacturing Practice for Medicinal Products, 1992

[2]     Qualification of air sampler systems: The MAS-100
        Meier R. and Zingre H., Swiss Pharma 1-2/00

[3] New Sampler for the Collection, Sizing, and Enumeration of Viable Airborne Particles,
        A. Andersen, U.S. Army Chemical Corps Proving Ground, Dugway, Utah, 1958

[4] Feller, W. An introduction to the probability theory and its application, p. 175.
        John Wiley and Sons, Inc., New York, 1950

## 17  Appendix

### 17.1  Table of statistical corrections according to FELLER

The table below is based on the principle that, as the number of viable particles being impinged on a given plate increases, the probability of the next particle going into an "empty hole" decreases.
This can be corrected statistically by using the conversion formula of Feller [4]:

$$P_r = N [1/N + 1/N\text{-}1 + 1/N\text{-}2 + ..... 1/N\text{-}r\text{+}1]$$

N is the number of holes (400) in the sampling head.
For easy use of this formula please refer to the table in chapter 17.2
For each colony count **r** a statistically corrected total count **Pr** can be easily seen in the table.

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### 17.2 Positive hole conversion table for all MAS-100 air monitoring systems

**r** = number of colony forming units counted on 100 mm petri dish   **Pr** = probable statistical total count

| r | Pr | r | Pr | R | Pr | R | Pr | R | Pr | r | Pr | R | Pr | R | Pr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 51 | 54 | 101 | 116 | 151 | 189 | 201 | 279 | 251 | 394 | 301 | 557 | 351 | 836 |
| 2 | 2 | 52 | 56 | 102 | 118 | 152 | 191 | 202 | 281 | 252 | 397 | 302 | 561 | 352 | 844 |
| 3 | 3 | 53 | 57 | 103 | 119 | 153 | 193 | 203 | 283 | 253 | 400 | 303 | 565 | 353 | 853 |
| 4 | 4 | 54 | 58 | 104 | 120 | 154 | 194 | 204 | 285 | 254 | 402 | 304 | 569 | 354 | 861 |
| 5 | 5 | 55 | 59 | 105 | 122 | 155 | 196 | 205 | 287 | 255 | 405 | 305 | 573 | 355 | 870 |
| 6 | 6 | 56 | 60 | 106 | 123 | 156 | 197 | 206 | 289 | 256 | 408 | 306 | 578 | 356 | 879 |
| 7 | 7 | 57 | 61 | 107 | 124 | 157 | 199 | 207 | 291 | 257 | 411 | 307 | 582 | 357 | 888 |
| 8 | 8 | 58 | 63 | 108 | 126 | 158 | 201 | 208 | 293 | 258 | 413 | 308 | 586 | 358 | 897 |
| 9 | 9 | 59 | 64 | 109 | 127 | 159 | 202 | 209 | 295 | 259 | 416 | 309 | 591 | 359 | 907 |
| 10 | 10 | 60 | 65 | 110 | 128 | 160 | 204 | 210 | 297 | 260 | 419 | 310 | 595 | 360 | 917 |
| 11 | 11 | 61 | 66 | 111 | 130 | 161 | 206 | 211 | 299 | 261 | 422 | 311 | 599 | 361 | 927 |
| 12 | 12 | 62 | 67 | 112 | 131 | 162 | 207 | 212 | 301 | 262 | 425 | 312 | 604 | 362 | 937 |
| 13 | 13 | 63 | 68 | 113 | 133 | 163 | 209 | 213 | 304 | 263 | 428 | 313 | 608 | 363 | 947 |
| 14 | 14 | 64 | 70 | 114 | 134 | 164 | 211 | 214 | 306 | 264 | 431 | 314 | 613 | 364 | 958 |
| 15 | 15 | 65 | 71 | 115 | 135 | 165 | 212 | 215 | 308 | 265 | 433 | 315 | 618 | 365 | 969 |
| 16 | 16 | 66 | 72 | 116 | 137 | 166 | 214 | 216 | 310 | 266 | 436 | 316 | 622 | 366 | 981 |
| 17 | 17 | 67 | 73 | 117 | 138 | 167 | 216 | 217 | 312 | 267 | 439 | 317 | 627 | 367 | 992 |
| 18 | 18 | 68 | 74 | 118 | 140 | 168 | 218 | 218 | 314 | 268 | 442 | 318 | 632 | 368 | 1005 |
| 19 | 19 | 69 | 76 | 119 | 141 | 169 | 219 | 219 | 317 | 269 | 445 | 319 | 637 | 369 | 1017 |
| 20 | 20 | 70 | 77 | 120 | 142 | 170 | 221 | 220 | 319 | 270 | 449 | 320 | 642 | 370 | 1030 |
| 21 | 22 | 71 | 78 | 121 | 144 | 171 | 223 | 221 | 321 | 271 | 452 | 321 | 647 | 371 | 1043 |
| 22 | 23 | 72 | 79 | 122 | 145 | 172 | 224 | 222 | 323 | 272 | 455 | 322 | 652 | 372 | 1057 |
| 23 | 24 | 73 | 80 | 123 | 147 | 173 | 226 | 223 | 325 | 273 | 458 | 323 | 657 | 373 | 1071 |
| 24 | 25 | 74 | 82 | 124 | 148 | 174 | 228 | 224 | 328 | 274 | 461 | 324 | 662 | 374 | 1086 |
| 25 | 26 | 75 | 83 | 125 | 150 | 175 | 230 | 225 | 330 | 275 | 464 | 325 | 667 | 375 | 1102 |
| 26 | 27 | 76 | 84 | 126 | 151 | 176 | 232 | 226 | 332 | 276 | 467 | 326 | 673 | 376 | 1118 |
| 27 | 28 | 77 | 85 | 127 | 153 | 177 | 233 | 227 | 335 | 277 | 471 | 327 | 678 | 377 | 1134 |
| 28 | 29 | 78 | 87 | 128 | 154 | 178 | 235 | 228 | 337 | 278 | 474 | 328 | 684 | 378 | 1152 |
| 29 | 30 | 79 | 88 | 129 | 156 | 179 | 237 | 229 | 339 | 279 | 477 | 329 | 689 | 379 | 1170 |
| 30 | 31 | 80 | 89 | 130 | 157 | 180 | 239 | 230 | 342 | 280 | 480 | 330 | 695 | 380 | 1189 |
| 31 | 32 | 81 | 90 | 131 | 158 | 181 | 241 | 231 | 344 | 281 | 484 | 331 | 701 | 381 | 1209 |
| 32 | 33 | 82 | 92 | 132 | 160 | 182 | 242 | 232 | 346 | 282 | 487 | 332 | 706 | 382 | 1230 |
| 33 | 34 | 83 | 93 | 133 | 161 | 183 | 244 | 233 | 349 | 283 | 491 | 333 | 712 | 383 | 1252 |
| 34 | 35 | 84 | 94 | 134 | 163 | 184 | 246 | 234 | 351 | 284 | 494 | 334 | 718 | 384 | 1276 |
| 35 | 37 | 85 | 95 | 135 | 164 | 185 | 248 | 235 | 353 | 285 | 497 | 335 | 724 | 385 | 1301 |
| 36 | 38 | 86 | 97 | 136 | 166 | 186 | 250 | 236 | 356 | 286 | 501 | 336 | 730 | 386 | 1327 |
| 37 | 39 | 87 | 98 | 137 | 167 | 187 | 252 | 237 | 358 | 287 | 504 | 337 | 737 | 387 | 1356 |
| 38 | 40 | 88 | 99 | 138 | 169 | 188 | 254 | 238 | 361 | 288 | 508 | 338 | 743 | 388 | 1387 |
| 39 | 41 | 89 | 101 | 139 | 171 | 189 | 255 | 239 | 363 | 289 | 511 | 339 | 749 | 389 | 1420 |
| 40 | 42 | 90 | 102 | 140 | 172 | 190 | 257 | 240 | 366 | 290 | 515 | 340 | 756 | 390 | 1456 |
| 41 | 43 | 91 | 103 | 141 | 174 | 191 | 259 | 241 | 368 | 291 | 519 | 341 | 763 | 391 | 1496 |
| 42 | 44 | 92 | 104 | 142 | 175 | 192 | 261 | 242 | 371 | 292 | 522 | 342 | 769 | 392 | 1541 |
| 43 | 45 | 93 | 106 | 143 | 177 | 193 | 263 | 243 | 373 | 293 | 526 | 343 | 776 | 393 | 1591 |
| 44 | 47 | 94 | 107 | 144 | 178 | 194 | 265 | 244 | 376 | 294 | 530 | 344 | 783 | 394 | 1648 |
| 45 | 48 | 95 | 108 | 145 | 180 | 195 | 267 | 245 | 378 | 295 | 534 | 345 | 791 | 395 | 1715 |
| 46 | 49 | 96 | 110 | 146 | 181 | 196 | 269 | 246 | 381 | 296 | 537 | 346 | 798 | 396 | 1795 |
| 47 | 50 | 97 | 111 | 147 | 183 | 197 | 271 | 247 | 384 | 297 | 541 | 347 | 805 | 397 | 1895 |
| 48 | 51 | 98 | 112 | 148 | 185 | 198 | 273 | 248 | 386 | 298 | 545 | 348 | 813 | 398 | 2028 |
| 49 | 52 | 99 | 114 | 149 | 186 | 199 | 275 | 249 | 389 | 299 | 549 | 349 | 820 | 399 | 2228 |
| 50 | 53 | 100 | 115 | 150 | 188 | 200 | 277 | 250 | 391 | 300 | 553 | 350 | 828 | | |

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### 17.3 Software flow diagram for the MAS-100*Eco*™

**Flow Diagram for MAS-100*Eco*™**



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