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Find the *Particle Sizing Systems 770-1* at our website: ***Click HERE***

[F6]: Display Distributions

Printout 6: Distribution Channels

Six latex standards: 3.00, 5.01, 9.87, 20.5, 50.2 and 100 microns
File Name = 6PEAKS.1

Diameter (microns)	# Part.	Cum Num Sized	Num % > Diam.	Vol %	Cum Num % > diam.	Cum Vol % > diam.
3.22	11934	168606	5.53	0.01	78.10	99.99
3.40	7772	156672	3.60	0.00	72.57	99.98
3.58	3542	148900	1.64	0.00	68.97	99.98
3.78	2623	145358	1.21	0.00	67.33	99.98
3.99	2788	142735	1.29	0.00	66.11	99.98
4.21	3015	139947	1.40	0.00	64.82	99.97
4.45	3680	136932	1.70	0.00	63.43	99.97
4.69	5445	133252	2.52	0.01	61.72	99.97
4.96	8798	127807	4.08	0.01	59.20	99.96
5.23	10439	119009	4.84	0.02	55.12	99.94
5.52	12084	108570	5.60	0.03	50.29	99.92
5.83	8557	96486	3.96	0.02	44.69	99.89
6.15	3995	87929	1.85	0.01	40.73	99.87
6.49	2348	83934	1.09	0.01	38.88	99.86
6.85	2294	81586	1.06	0.01	37.79	99.85
7.23	2255	79292	1.04	0.01	36.73	99.84
7.63	2079	77037	0.96	0.01	35.68	99.83
8.05	1721	74958	0.80	0.01	34.72	99.81
8.50	1691	73237	0.78	0.01	33.92	99.80
8.97	1677	71546	0.78	0.02	33.14	99.79
9.47	3365	69869	1.56	0.04	32.36	99.77
9.99	11059	66504	5.12	0.15	30.80	99.73
10.55	8758	55445	4.06	0.14	25.68	99.58
11.13	2488	46687	1.15	0.05	21.62	99.43
11.75	1570	44199	0.73	0.04	20.47	99.39
12.40	1053	42629	0.49	0.03	19.75	99.35
13.09	468	41576	0.22	0.01	19.26	99.32
13.82	216	41108	0.10	0.01	19.04	99.31
14.58	186	40892	0.09	0.01	18.94	99.30
15.39	182	40706	0.08	0.01	18.85	99.29
16.24	99	40524	0.05	0.01	18.77	99.28
17.14	87	40425	0.04	0.01	18.72	99.28
18.10	322	40338	0.15	0.03	18.68	99.27
19.10	1053	40016	0.49	0.10	18.53	99.24
20.16	4383	38963	2.03	0.50	18.05	99.14
21.28	11780	34580	5.46	1.58	16.02	98.64
22.46	5856	22800	2.71	0.92	10.56	97.07
23.70	1009	16944	0.47	0.19	7.85	96.14
25.01	294	15935	0.14	0.06	7.38	95.96
26.40	116	15641	0.05	0.03	7.24	95.89
27.87	45	15525	0.02	0.01	7.19	95.86
29.41	44	15480	0.02	0.02	7.17	95.85
31.04	67	15436	0.03	0.03	7.15	95.83
32.76	62	15369	0.03	0.03	7.12	95.81
34.58	36	15307	0.02	0.02	7.09	95.78
36.50	7	15271	0.00	0.00	7.07	95.75
38.52	2	15264	0.00	0.00	7.07	95.75
40.66	6	15262	0.00	0.01	7.07	95.75
42.91	18	15256	0.01	0.02	7.07	95.74

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[F6]: Display Distributions

Printout 8: Print Summary

```
                    PARTICLE SIZING SYSTEMS
                    Santa Barbara, California

                       Model 770 AccuSizer


Six latex standards: 3.00, 5.01, 9.87, 20.5, 50.2 and 100 microns
File Name = 6PEAKS.1      Time Date =  07:09 6/21/1990
Sensor Model: HRLD-400    S/N: 9110-009   Cal. File:

Elapsed Time of Data Collection (min:sec)= 0:30
Background File = NONE
Actual No. of Particles Sized = 215895
Calculated Total No. of Particles in Sample = 586522
Dilution Factor = 2.717
Fluid Volume Sampled = 30.1 ml              No. of Channels = 128
Num-Wt Mean = 11.55   um Mode = 5.52     Median = 5.52
Vol-Wt Mean = 94.51   um Mode = 107.40   Median = 107.40 (0.000 % Threshold)


Summary of  POPULATION DISTRIBUTION

  5 % of total particle number <    1.70 microns
 10 % of total particle number <    2.38 microns
 15 % of total particle number <    2.79 microns
 20 % of total particle number <    3.05 microns
 25 % of total particle number <    3.23 microns
 30 % of total particle number <    3.44 microns
 35 % of total particle number <    4.07 microns
 40 % of total particle number <    4.74 microns
 45 % of total particle number <    5.10 microns
 50 % of total particle number <    5.39 microns
 55 % of total particle number <    5.65 microns
 60 % of total particle number <    6.11 microns
 65 % of total particle number <    7.72 microns
 70 % of total particle number <    9.81 microns
 75 % of total particle number <   10.36 microns
 80 % of total particle number <   11.85 microns
 85 % of total particle number <   20.92 microns
 90 % of total particle number <   22.10 microns
 95 % of total particle number <   54.03 microns
 99 % of total particle number <   107.97 microns

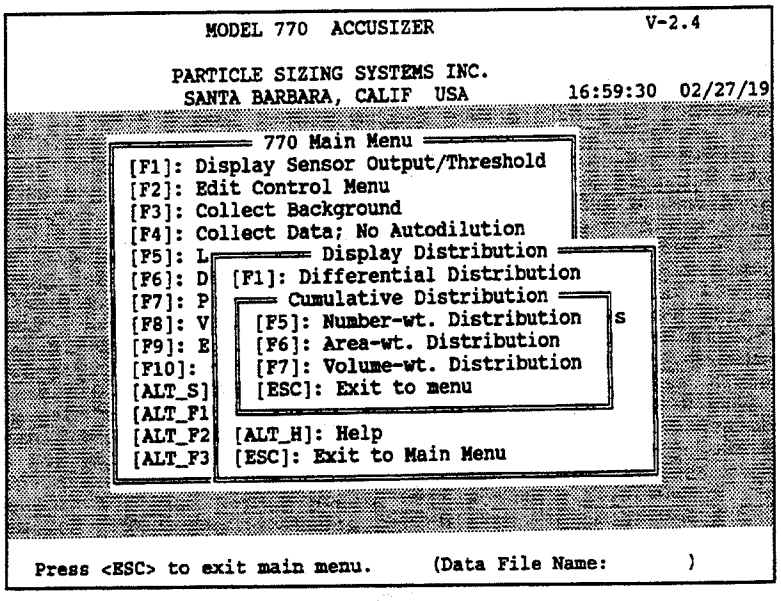
User-identified Peaks:
```


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[F6]: Display Distributions

[F2]: Cumulative Distribution

This option is used to request PSDs which are expressed as **cumulative** distributions. When key **F2** is pressed, the **Cumulative Distribution** menu will display, as shown:



Screen 18: Cumulative Distributions Menu

There are *three* types of **cumulative** distributions which can be displayed or printed: **Number-wt., Area-wt.** and **Volume-wt. distributions**. As in the case of **differential** distributions, these three types of **cumulative** distributions are selected using keys **F5**, **F6** and **F7**, respectively. The set of key commands are the same as those discussed above for **differential** distributions. Examples of Number-wt, Area-wt and Volume-wt Distributions are shown below. They correspond to the same data file which was used above to produce the four examples of **differential** distributions.

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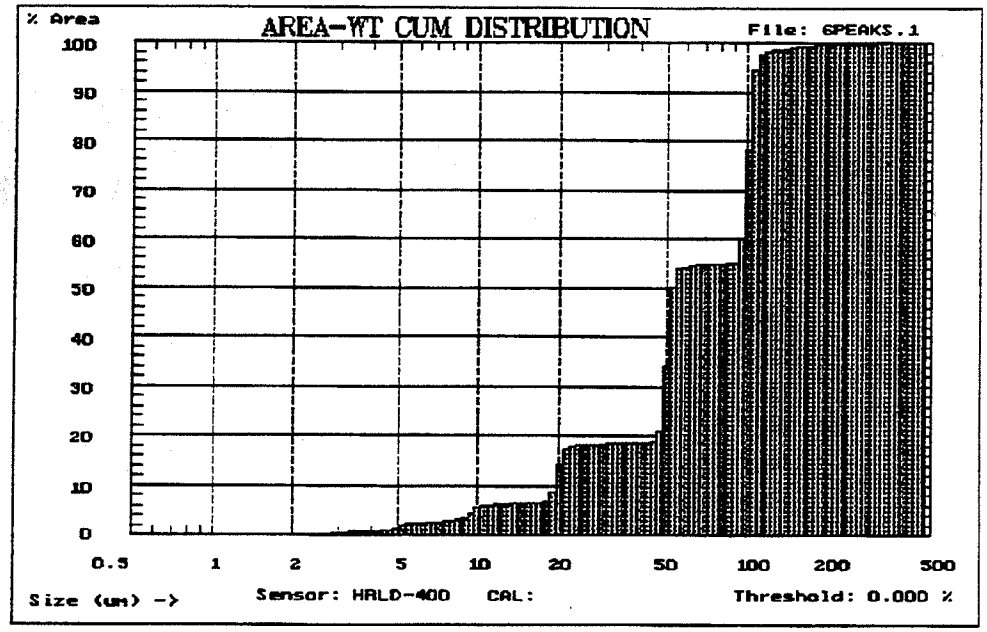
[F6]: Display Distributions

PARTICLE SIZING SYSTEMS
Santa Barbara, California

Model 770 AccuSizer

Six latex standards: 3.00, 5.01, 9.87, 20.5, 50.2 and 100 microns
File Name = 6PEAKS.1 Time Date = 07:09 6/21/1990
Sensor Model: HRLD-400 S/N: 9110-009 Cal. File:

Elapsed Time of Data Collection (min:sec)= 0:30
Background File = NONE
Actual No. of Particles Sized = 215895
Approximate Total No. of Particles in Sample = 586522
Dilution Factor (approx.) = 2.717
Total Fluid Volume Sampled = 30.1 ml
Number of Diameter Channels = 128
Num. Wt. Mean = 11.55 um Vol. Wt. Mean = 94.51 um (0.000 % Threshold)



File Name: 6PEAKS.1

Printout 10: Area-wt. Cumulative Distribution

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[F6]: Display Distributions

[F3]: Display Distribution Channels

The "raw data" of a distribution corresponding to a selected data file can be displayed using this option. Each channel diameter has a listing of the number of particles counted/sized and the cumulative number of particles which are greater than that diameter. Cases in which Autodilution was used, have additional information listed. This includes the estimated total number of particles of a given diameter in the original sample (i.e. added to the dilution chamber), and also the cumulative total number of particles in the sample which are greater than or equal to that diameter. In addition, the particle count in each channel/diameter is shown as a percentage of either the total number or total volume of all particles in the sample.

A representative example of the sample channel data which results from pressing **F3** will display (from just the first screen). Additional channels can be displayed by using the **UP** and **DOWN ARROW** keys or the **PAGE UP** and **PAGE DOWN** keys.

Bin Range

The bin range is used to calculate the number-wt. , length-wt., area-wt. and volume-wt mean diameter, standard deviation, coefficient of skewness and coefficient of kurtosis on the Statistical Summary printout. Please refer to Appendix D for the equations used for these calculations.

a. Press **F10** while in the Display Distribution Channels. The diameter column will display as a diameter range in terms of microns.

b. Press **P** to print the page.

c. Press **ESC** to return the Distribution Menu.

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[F6]: Display Distributions

[F5]: Save Distribution ASCII File

Use this option to save the data collected for a particular sample to an ASCII file format. The data can then be imported to a spreadsheet program for presentation.

To create new files in standard **ASCII** format to export data files into other software packages (e.g. spreadsheets), for manipulation of the original data follow these steps:

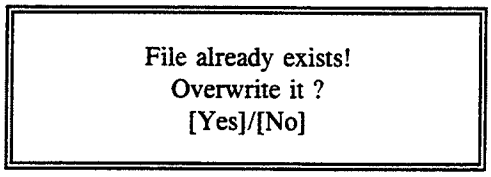
a. Select a data file.

b. Press **ALT** and **S** simultaneously. The following message will display:



c. Change this "default" filename to the desired one (including a new file extension (.**EXT**), if desired).

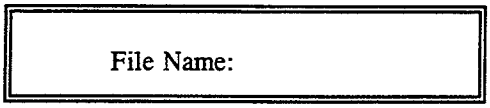
d. Press **ENTER**. A new file in **ASCII** format will be created and stored in the Data Directory (specified in line #1 of the **Control Menu**). If the same filename already exists, the following message will appear:



[Yes]: the existing **ASCII** file having the same filename will be erased, and the new one stored in its place.

[No]: no new file will be stored.

e. Press **F5**. The following prompt will display:



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[F6]: Display Distributions

[ALT][F6]: Edit Display Threshold

a. Press **F6**. The following prompt displays:

> Display Threshold (#Particles/Ch.)
> as percent of Peak Value = 0.000%

b. Enter the percent.

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[F6]: Display Distributions

[ALT][H]: Help

Please refer to the C770 Help Menu Section of this manual.

[ESC]: Exit to Main Menu

a. Press **ESC** to return to the 770 Main Menu.

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[F6]: Display Distributions

Printout Description (continued):

Approximate Total No. of Particles in Sample

The calculated total number of particles in the sample based on the amount that the sample was diluted.

Dilution Factor

The dilution factor is the amount by which the sample was diluted to achieve a useable concentration for sizing and counting the particles one at a time.

Total Fluid Volume Sampled

Indicates the volume of diluent used in sizing the sample.

Number of Diameter Channels

Indicates the number of channels in which data for the sample run was collected.

Num-Wt Mean

Indicates the mean diameter of the number weighted distribution. This covers the whole range of the measurement.

Vol-Wt Mean

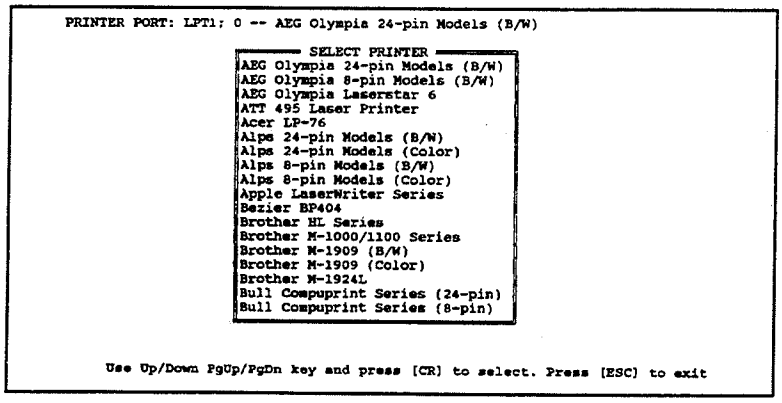
Indicates the mean diameter of the volume weighted distribution. This covers the whole range of the measurement.

0.000% Threshold

Used as a filter to remove the effects of a few large particles in the volume weighted distribution. It removes counts based on a percentage of the mode of the population weighted distribution.

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[F7]: Printer Config. Setup

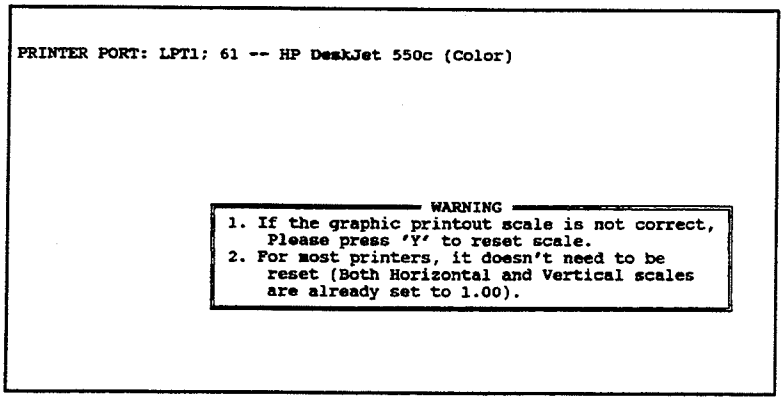


Screen 20: Select Printers

d. Change the **Printer Port** using the **UP** and **DOWN ARROW** keys or **PAGE UP** or **PAGE DOWN** keys to place the highlight bar over the desired printer selection.

e. Press **ENTER**.

f. Press **ESC** to return to the AccuSizer Main Menu. The following warning may display:



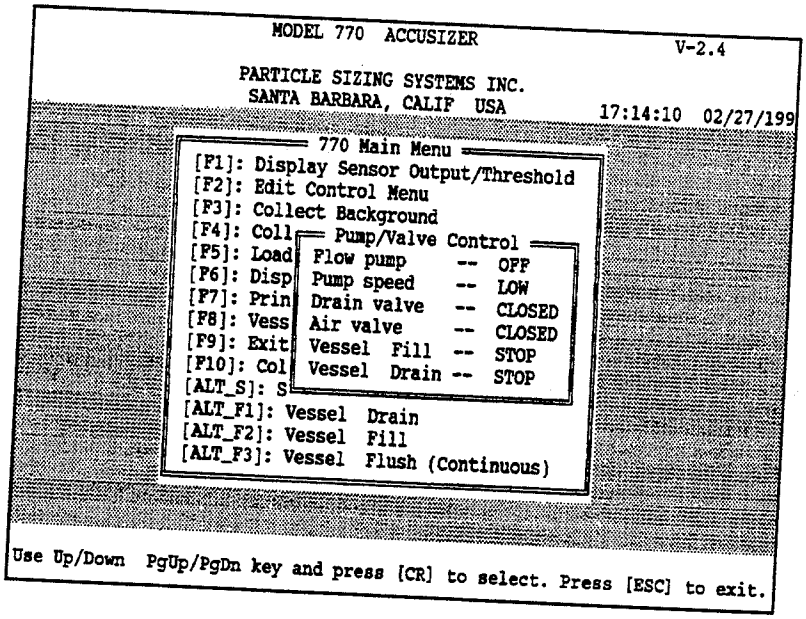
Screen 21: Printer Scale Warning

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[F8]: Vessel Drain, Fill, Flush

The Pump/Valve Control functions which are related to the fluidics of the **770A Autodiluter** may be tested using this option.

a. Press **F8**. The **Pump/Valve Control** screen will display:



Screen 23: Pump/Valve Control Screen

b. Move the highlight bar to the desired function, using the **UP** and **DOWN ARROW** keys.

c. Press **ENTER**. The status of each function will be toggled with each press of the **ENTER** key.

The **Flow Pump** can be changed from **ON** to **OFF**; the **Pump speed**, from **LOW** to **HIGH**; the **Drain valve**, from **CLOSED** to **OPEN**; the **Air valve**, from **CLOSED** to **OPEN**; the **Vessel Fill**, from **STOP** to **START**; and the **Vessel Drain** from **STOP** to **START**.

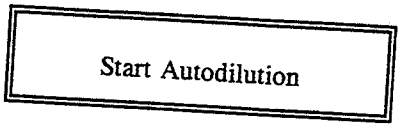
Please refer to the **[F5]: Load/Calibrate Sensor** section of this manual for additional Pump/Valve Control information.

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[F10]: Autodilution: Start Measurement

Begin collecting data using the proprietary Autodilution technique (U.S. Patent # 4,794,806; foreign patents pending) using this option.

a. Press **F10**. The following message will display:



The automatic dilution of the sample then begins. The **DRAIN VALVE** is switched to **OPEN**, the **AIR VALVE** remains **CLOSED**, and the **PUMP** switches to **ON (LOW SPEED)**. Fresh, filtered diluent then flows into the dilution chamber at a steady flow rate (as indicated on the flow gauge on the front panel of the 770A unit). The relatively concentrated particle suspension flows out of the dilution chamber and through the sensor at the same flow rate.

The instantaneous count rate of particles flowing through the sensor is determined and displayed at the bottom of the screen. When the concentration (expressed as particles/cc) falls below the value which was preset in the **Control Menu**, the screen will momentarily become blank and the **Population Distribution** will display. The particle size distribution is then displayed in real time. When the elapsed time reaches the value which was preset in the **Control Menu**, the distribution results are stored in memory (either automatically or manually, depending on the choice made in the **Control Menu**) and another cycle begins, if appropriate.

Refer to the **[F2]: Edit Control Menu** section of this manual, which describes the choice of options which will influence an automatic measurement using key **F10**.

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[ALT_F1]: Vessel Drain

Draining the contents of the dilution chamber of the **770A Autodiluter** can be accomplished using this option.

a. Press keys **ALT** and **F1** simultaneously. The **DRAIN VALVE** will switch to **OPEN** and the **AIR VALVE** will also switch to **OPEN**. The liquid contents of the dilution chamber will then flow out to the drain by the force of gravity alone. The computer will monitor the particle count rate; when the count rate drops to zero for an appreciable length of time, signalling that the flow of liquid has stopped, the system will switch both the **DRAIN VALVE** and **AIR VALVE** to the **CLOSED** state.

b. Press **ESC**. The **Vessel Drain** operation can be terminated at any time.

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[ALT_F3]: Vessel Flush (Continuous)

Automatic flushing of the dilution chamber with fresh, filtered diluent can be achieved using this option.

Pressing keys **ALT** and **F3** will cause the **DRAIN VALVE** to switch to **OPEN**, the **AIR VALVE** to remain **CLOSED** and the **PUMP** to switch to **ON** (at **LOW** speed). This set of conditions is the same as those which occur during **Autodilution [F10]**. All that is different is that data will not be collected or displayed.

IMPORTANT: *This function is intended to be used for flushing the dilution chamber between sample runs. After a sample measurement follow these steps:*

a. Press **ALT** and **F1** simultaneously to perform a **Vessel Drain** operation.

b. Press **ALT** and **F2** simultaneously to perform a **Vessel Fill** operation.

c. Press **ALT** and **F3** simultaneously to perform a **Vessel Flush** operation. Monitor the progress which has been made in cleaning the contents of the dilution chamber, by observing the current concentration (particles/cc) displayed at the bottom of the screen. If the concentration is too high, repeat these steps.

System will only flush for the interval of time indicated in the **Control Menu.** Please see the **[F2]: Edit Control Menu** section of this manual.

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C770 HELP MENU

C770 Command Keys

The following set of commands will display any time Alt_H (HELP) is accessed while operating the 770 software. These command keys have been provided on a three tier template for convenience.

[A]: File Addition

Data from sample runs may be added together using this option provided the same sensor calculation curve, number of bins and distribution format are the same. If they are not error messages will display and alternative actions may be exercised.

a. Press **L** to display the data distribution on the screen in Line Mode.

b. Press **A**. A pop-up window of data files will display and the following prompt will display under the distribution:

Select Data File ... to be added (file name of distribution displayed)

c. Press the **UP** and **DOWN ARROW** keys to position the highlight bar over the file to be added to the file displayed.

d. Press **ENTER**. An asterisk (*) will display to the left of the file name currently displayed. Once a file has been selected an asterisk will also display to the left of the file name. Up to eight files may be added together.

e. Press **ESC** for the addition of the data to be completed. The following screen will display:

Save File on Disk ? [Yes]/[No]

[Yes]: will save the data file on disk after a file name has been provided at the prompt.

[No]: will not save the data file and will display the addition of the two files on the screen.

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C770 Command Keys

[L]: Line Graphic Display

The format in which data displays can be changed from bar mode (default) to line mode.

[M]: Defined Peaks Range and cal. mean

Used to obtain information such as Num-Wt Mean, Std. Dev., # of Part., Skewness, Kurtosis, Mode and Median information for a user isolated region of the sample distribution.

The following commands display at the bottom of the screen:

[F1]/[F2]: Inc/Dec Cursor Speed

Controls the speed of the cross-hair marker that allows isolation of the sample peak.

[LEFT]/[RIGHT]: Move Cursor

Controls the direction in which the cross-hair marker allows isolation of the sample peak.

[ENTER]: Select Start Point

A red vertical line displays to isolate a side of the sample distribution.

Total#

Indicates the total number of particles that were sized in that particular bin of the sample distribution.

Size (um)

Indicates the size of the particles that were sized in the bin.

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C770 Command Keys

[P]: Print Plot/Summary/Detail Channels

The following printout types may be selected to print using this option.

Print Distribution Channels: Channel information including diameter, particle size, and cumulative diameter display in a numerical format.

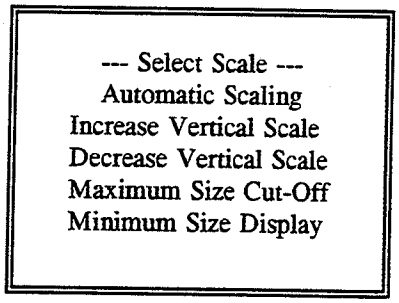
Print Summary: Number-weighted differential distribution in numerical format.

Edit Printout Caption: The printout caption can be edited prior to printing. This eliminates having to return to the **[F2]: Edit Control Menu** to edit a print caption.

Start to Print: Commences printing of the print selections.

[S]: Change Scale

The following screen displays:



Increase Vertical Scale:

Increases the vertical scale of the Y-axis by a factor of two.

Decrease Vertical Scale:

Decreases the vertical scale of the X-axis by a factor of two.

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C770 Command Keys

[W]: Change Weighting

The format in which the sample data displays may be changed to:

- Population Distribution
- Number-Wt Diff Distribution
- Area-Wt Diff Distribution
- Volume-Wt Diff Distribution

Please refer to [F6]: Display Distribution of this manual for a brief discussion of these distributions.

[F5]: Save Data File

Used to save the data file being reviewed under a file name.

a. Press **F5**. The following prompt displays:

Enter file name:

b. Enter the file name under which the data will be stored.

c. Press **ENTER**. The file will be stored in the directory indicated in the [F2]: Control Menu.

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C770 HELP MENU

C770 Command Keys

[CNTL_A]: Show Cumulative Summary

Displays the summary of number weighted cumulative distribution information for the data file displayed.

[CNTL_B]: Change Number of Bins

Allows the number of channels , or "bins", that the data will be reviewed in to be changed. These bins are spaced uniformly on a logarithmic diameter scale.

[CNTL_V]: Mark Sample Volume Cal. Range

Used to determine the percent volume of the selected portion of the particle size distribution. Please refer to [F2]: Edit Control Menu - Sample Volume (Volume Balance) of this manual.

[CNTL_W]: Mark Sample Mass Cal. Range

Used to determine the percent mass of the selected portion of the particle size distribution. Please refer to [F2]: Edit Control Menu - Sample Weight (Mass Balance) of this manual.

[CNTL_F]: Print Files

Allows for the printing of data files.

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SAMPLE ANALYSIS

Sample Run

POWER UP & SOFTWARE ACCESS

1. Power up the PC controller and monitor.

2. Access the software by typing the following commands at the C-prompt:

   a. cd C770

   b. Press **ENTER**

   c. Type C770

   d. Press **ENTER**

   The AccuSizer 770 Main Menu will display.

3. Power-up the Autosampler. The Autodiluter will automatically power-up once the Autosampler has power.

RUNNING THE SYSTEM

1. Press **F2** [Edit Control Menu]. Review the directory name where the sample runs will be stored in computer memory. Change the name of the directory by using the arrows keys to position the cursor where the name is to be altered. Use the **DELETE** key to eliminate characters and type to add in characters.

2. Press **ENTER** when editing is complete.

   IMPORTANT: *If the directory has not been created in DOS first it will not be accepted for use. Use the ALT_S [Suspend to DOS] option to first create the directory.*

3. Type a new file name under which the sample runs will be saved. It is a good idea to use the file extension .700 to indicate that a particular sample was tested on the AccuSizer 770. This file distinction will later help in discerning samples run on the NICOMP™ Model 370 from the 770.

4. Press **ENTER** to advance to the next field.

5. Edit the printout caption that will appear on all printouts and screen displays for this sample. There is an 80 character limit.

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Sample Run

22. Press **ALT** and **F2** [Vessel Fill] simultaneously to fill the vesicle mounted on the top of the Autodiluter.

23. Press **ESC** when filled.

24. Press **F3** [Collect Background] to obtain a background of the deionized water.

    When this run completes a secondary screen will display prompting for a file name. The file name consists of eight (8) alphanumeric positions. The file extension must be **.BKG**.

25. Press **ENTER** after entering the filename.

    The background will later be subtracted from the sample run eliminating the particle counts that result only from the deionized water. A background subtraction is not needed when zero counts exist for the background file.

    A background of the diluent should only be taken at the beginning of the testing day. There is no need to take a background for each sample run since the background taken for a single container of diluent is highly reproducible. Another background should be collected and used when changing the diluent source container or refilling an existing container.

26. Press **F2** [Edit Control Menu].

27. Press **ENTER** until the cursor reaches the Select Background file field.

28. Press **ENTER** again. A pop-up window displays with all of the background file names displayed.

29. Press the **UP** and **DOWN ARROW** keys to position the highlight bar over the filename of the background just collected.

30. Press **ENTER**. This filename will now display in the Subtract Background file field on the F2 menu.

31. Press **ALT** and **F2** [Vessel Fill] simultaneously to fill the dilution chamber.

32. Press **ESC** to stop when full.

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SAMPLE ANALYSIS

PRINT SAMPLE RESULTS

1. Press **P** [Print].
2. Press the **UP** and **DOWN ARROW** keys to position the highlight bar over the print selections.
3. Press **ENTER**. An asterisk (*) displays to the left of each print selection made. When printing has finished the cursor returns to the screen and the distribution re-displays.

NEW SAMPLE

1. Press **ALT** and **F1** [Vessel Drain], simultaneously, to completely drain the dilution chamber.
2. Press **ALT** and **F2** [Vessel Fill], simultaneously, to fill the dilution chamber.
3. Press **ALT** and **F3** [Vessel Flush: (Continuous)], simultaneously, to review particle counts at bottom of the screen. Allow the system to flush for approximately 1 minute. If particle counts are over 50 counts/ml repeat cleaning procedure.

POWER DOWN OF THE SYSTEM

1. Check to see that the system is clean. Do not power-down system dirty. Please refer to the System Maintenance section of this manual.
2. Press **F9** to Exit to DOS.
3. Press **Y** to exit the software. The C-prompt displays.
4. Turn power off to the Counter.
5. Turn power off to the computer, monitor and printer.

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SYSTEM MAINTENANCE

INTRODUCTION

Preventive maintenance for the AccuSizer Model 770 can and should be performed on a daily basis.

MAINTENANCE

The following steps must be followed in order to maintain the AccuSizer Model 770.

1. Always flush the system adequately to achieve the same baseline in counts per second as was present before the particle size analysis.

2. Always leave the system with fluid in the sensor chamber.

3. If the normal operation of the instrument includes long periods (3 or more days) of down-time between analysis this procedure must be followed. This only applies when water is the diluent.

    a. Pull the input line out of the dilution chamber and drain the system of all of the water in the lines and in the filter.

    b. Remove the top cap off of the dilution chamber and fill the dilution chamber with Iso-propyl alcohol (IPA).

    c. Push drain valve button open and drain at least 10 mL of solution through the sensor with the top cap remove from the dilution chamber.

    d. Close the drain valve.

    e. Replace the top cap on the dilution chamber.

    f. Power down the system. This will ensure that the dilution chamber remains wet and there is no water in the tubing for bacteria to grow and cause the system to get dirty.

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SYSTEM MAINTENANCE

9. Adjustments can be made to the flow rate by adjusting the pump control dial on the front panel of the Autodiluter. Raising the value will increase flow and lowering will produce the opposite effect.

10. The filter should be checked on a weekly basis for any signs of discoloration due to bacteria growth, leaks or cracks on the filter body. If any of these signs appear, the filter should be replaced. Please refer to the AccuSizer Parts List section of this manual.

11. The dilution chamber should be visually monitored on a daily basis for signs of discoloration, cracking, internal film build-up etc. If any of these signs appear, clean the dilution chamber or replace it.

12. The system fluidics should be monitored on a daily basis for the presence of contaminate dirt particles. This is performed by draining and filling the dilution chamber a minimum of 2 times and then using the Alt_F3 command flushing the system and monitoring the count rate on the bottom of the main menu screen. If the count rate remains high then visual inspection of the components of the dilution system should be checked and replaced as needed.

A complete maintenance check of the system should be made on a yearly basis. This information should also be kept in a maintenance log book.

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SENSOR MAINTENANCE

Sensor Cleaning

The following steps should be followed when cleaning the sensor of the AccuSizer Model 770. If problems are encountered while cleaning or re-installing the sensor please contact Particle Sizing Systems for assistance.

1. Drain the dilution chamber.
2. Exit the AccuSizer 770 system software.
3. Power down the system.
4. Remove the white Delrin injection port top.
5. Remove the dilution chamber from the top of the Autodilutor by loosening the black knob screws from the white Delrin bracket.
6. Support the dilution chamber with your hand.
7. Gently twist the dilution chamber so that luer tip releases from the tubing mounted below top of the unit.
8. Remove the back panel of the Autodilutor by loosening the four (4) screws and rings with a Phillips-head screwdriver.
9. Lean the back panel away from the unit. Be sure not to crimp the tubing leading out of the back.
10. Lay the panel, screws and rings out of the way.
11. Unscrew the black knobs that connect the sensor to the mounting bracket while supporting sensor with the other hand.
12. Gently pull the sensor away from the mounting bracket.
13. Unscrew the silver fitting that holds the tubing that supports the luer tip of the dilution chamber.
14. Remove the tubing from the bottom of the sensor.

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Sensor Cleaning

29. Replace the black knob screws.

30. Snug the bracket around the dilution chamber.

31. Re-attach the injection port cap.

32. Power up the CPU.

33. Access the software.

34. Fill the dilution chamber with plain diluent.

35. Press Alt and F3 simultaneously and look at the particle counts in the lower left-hand corner of the screen. If no particle count appears call the main office of Particle Sizing Systems.

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SENSOR CALIBRATION

Follow these steps to calibrate and load the system sensor.

1. Press **F5** [Load/Calibrate Sensor].
2. Press **F1** [Sensor Calibration].
3. Enter the **Sensor Model** name.
4. Press **ENTER**.
5. Enter the **Sensor Serial Number** which may be found on the sensor itself.
6. Press **ENTER**.
7. Enter the **Flow Rate** for the sensor if other than 60cc/min.
8. Press **ENTER**.
9. Enter the **File Name**. The filename consists of a maximum of 8 alphanumeric positions. The file extension must remain as .SNS for the software to recognize the file.
10. Press **ENTER**.
11. Enter the **Sample Period (seconds)**. This is the amount of time that the system will collect data.
12. Press **ESC**.
13. Inject some of the latex standard into the injection port mounted on the top of the Delrin cap.
14. Press **F2** [Start Calibration; Autodilution]. The following message will display:

Start Autodilution

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TROUBLE-SHOOTING

Special Do's and Don'ts when using the 770

1. Do not allow the sensor to run dry. The residue from the sample will build up a film on the cell of the sensor that will effect the baseline noise level and particle sizing capabilities of the sensor.

2. Always flush the system after every run and make sure that it returns to a clean baseline. Leaving chemicals in the cell can ruin the optical path.

3. Whenever using a solvent always check to make sure it is compatible with all of the tubing and components inside the system. If any doubt exists concerning how the solvent will effect the tubing check by submerging a small piece of tubing in the solvent and monitoring its physical properties.

4. After using a solvent always clean and flush the system with proper materials to return to a water based system.

5. If the system will be stored for a long period of time use an alcohol and water mixture to keep all of the major sensor components wet.

6. Always use clean grades of diluents when performing particle size analysis. There is no concrete number when it comes to background counts but if the maximum count rate of the sensor is 10,000 particles per mL and the background is hovering around 1000 counts per mL then your signal to noise ratio is 10 to 1 or 10%. This may be fine for some applications but if the analysis calls for identifying small amounts of material on the tail of a distribution this background level will not be acceptable. It is always true that cleaner is better but one has to weigh the benefits versus the time needed to further clean the diluent when making an analysis. In most cases backgrounds below 100 particles per mL are acceptable.

7. NEVER REMOVE THE SENSOR PLUG FROM THE BACK OF THE ACCUSIZER MODEL 770 COUNTER WITHOUT SHUTTING OFF THE POWER FIRST. THIS CAN RUIN THE SENSOR. It will result in a major failure and a major repair.

8. Avoid running the pump dry. Running the pump dry for extensive periods will ruin the seals inside.

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2. Chamber empties during Autodilution:

Either the air line is open and the gravity drain is pulling the diluent out faster than the pump is pushing it into the dilution chamber, or the Delrin plug on top of the dilution chamber is not making a good seal. In the case where there is a syringe port make sure that a syringe is inserted in place and there are no air leaks.

3. The threshold set on the main menu is lower than the lower limit of the sensor.

On occasion, when exiting and entering the C770 program, the system will reset the lower threshold of the sensor to the lowest limit on the X-axis scale. To readjust this simply move the value up and down by using the UP and DOWN ARROW keys to make the proper adjustments.

4. System background does not come down.

This is usually an indication that the system's dilution chamber and sensor are dirty. This can be rectified by cleaning the dilution chamber by flushing and using multiple fill and drain cycles to clean the diluent glassware. This problem usually arises when the dilution chamber is overfilled and the particles come in contact with the ground glass section where they lodge and slowly strip off. It is important to note to not use any paper products to clean the inside of the dilution chamber. Commonly used hand towels shed a tremendous number of particles when applied to a surface.

Removal of the sensor may be required to clean the optical path. This is not a difficult task, however care must be taken to ward against dropping the sensor. Particle Sizing System accepts no liability in case of sensor damage during cleaning.

5. Water comes out of air line on the bottom of the unit.

This is a common problem faced when the system is manually filled using the Alt_F2 key. The operator forgets that the system is filling, gets caught up with their work and overfills the system so much that the excess water hits the counter through the air line.

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7. Water comes out of the air line.

When manually filling the system be sure not to overfill the dilution chamber. Doing so will result in diluent exiting out of the air line and out of the bottom of the autodiluter. If this occurs drain the air line by removing the top cap opening up the air valve and letting the line gravity drain. Then replace the top cap and close the air valve the system will be ready to operate.

8. Top Cap pops off.

a. Excess pressure exists in the dilution chamber.

It can occur when pumping diluent into the chamber manually and not opening the air valve, a clog in the air line or drain line during the flush cycle. The top cap pops off at very low pressures ensuring that the system will not build up pressure and crack the glass. Note the top cap is not to be forced on to the glass with a great deal of pressure, it should be placed into the ground glass joint and secured with slight pressure.

b. The drain may be clogged and the fluid may not be able to exit the system. By continuing to pump diluent into the dilution chamber during a flush or autodilution run cycle the pressure in the dilution chamber builds up and the top cap bursts off.

9. No signal on the F1 menu:

The **F1** [Sensor/Output Threshold] key on the main menu turns the AccuSizer Model 770 counter into a oscilloscope/pulse height analyzer. This mode can be used to look at the electronic pulses that are being generated by the sensor.

The first thing to check when there is no signal is to make sure that the sensor is plugged into the right port on the back of the AccuSizer Counter Module and that the ribbon cable between the counter and the computer is in place with a good connection. Secondly, make sure that the instrument is monitoring the sensor port into which the sensor is plugged. The **F5** and **F6** keys switch the sensor input between Sensor 1 and Sensor 2.

Also when using the **F1** and **F2** keys in the **F1** menu be sure that the sensor output pulse line is on scale.

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ACCUSIZER MODEL 770 PARTS LIST

PART	DESCRIPTION	PART NUMBER
PUMPS		
Pump Head	Micro Pump	1800-000-316/81725
Motor, Pump	Micro Pump	O/C 000-336-00/400045
Gear Service Kit	Micro Pump	O/C 000-336-00/81728
O RINGS		
Top Cap (Dilution Chamber)	Viton, Size -211	
Outside (Dilution Chamber)	Buna Size 2-322	
Sensor Fitting (Inlet/Outlet Fitting)	Viton, Size -010	
Above Filter	Viton, Size -005	
FILTERS*		
0.2 μm, Millipore	Hydrophobic filter	KTGR04NP3
DILUTION CHAMBERS		
50 mL	Luer Tip Bottom	PSS
100 mL	Luer Tip Bottom	PSS
150 mL	Luer Tip Bottom	PSS
200 mL	Luer Tip Bottom	PSS

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ACCUSIZER MODEL 770 PARTS LIST

PART	DESCRIPTION	PART NUMBER
ASSEMBLIES		
PCB, Relay	Relay for 770 Counter	PSS
PCB, Counter	770 A/D Counter	PSS
PCB, Pulse	Pulse Analyzer, in PC	PSS
CABLES		
DB 25 Pin to 25 Pin	4' Shield Ribbon Cable	PSS
POWER SUPPLIES		
Assembly	+12, +5, +/-15 VDC,	PSS
Prep Injector	1/8" Stainless Steel	3725-038 (Rheodyne)

* - Must replace red silicone O rings (2) with Viton size -005.

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Appendix A

DOS Commands

Disk Operating System (DOS) manages the flow of information to and from the various parts of the computer system. Work with DOS by typing or choosing commands, which will direct the system to perform needed tasks. MS-DOS includes commands that you can use to perform tasks:

- Manage files and directories
- Maintain disks
- Configure hardware
- Optimize the use of memory
- Speed up programs
- Customize MS-DOS

ORGANIZING FILES INTO DIRECTORIES

Directories are used as a way to organize software programs and files in the computer hard disk (memory). Directories can be thought of as categories. For instance, the word processing program installed on the hard disk is one category while a spreadsheet program is considered another. Categories are used to separate the word processing program software and files from the spreadsheet program and files. All of this organization is helpful when trying to access a software program and its related files.

A disk, whether it be the hard disk (resident memory in the computer) or an external disk (floppy disk) can hold several hundred or even thousands of files, depending on its size. To keep track of data files, use DOS commands to group related files into directories by assigning each directory a unique name so that the data may be distinguished.

Sub-directories

When directories become too large, use DOS commands to create additional directories to organize data files. A directory within another directory is a *sub-directory*.

The organization of directories, sub-directories, and files is called the directory tree. When a disk is formatted, DOS creates one large directory, called the root directory.

Using the DOS *dir* (directory) command will display a list of files and subdirectories in a directory.

The following pages contain the most used DOS commands required to maintain and manipulate files stored in computer memory. By no means is this a complete guide for DOS commands, please refer to the DOS Manual supplied with the personal computer being used

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Appendix A

DOS Commands

CHANGE DIRECTORY [CD]

Changing between directories can be accomplished using this command. Before executing commands that are not pathed to, first change into the directory that contains the command. A directory must be created prior to changing to or copying files to it.

1. Type CD and the directory name to change to:

   C:\>CD [directory]

2. Press ENTER. Continue changing to directories until the needed one is reached. Each time a change to directory is executed the C-prompt will return with the directory name as part of the prompt.

3. Type CD.. each time to back out of a directory.

4. Press ENTER. The prompt will return without the directory name displayed. Continue typing CD.. until the directory needed is reached.

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Appendix A

DOS Commands

DATE

The internal system date is stored in the computer memory. The date will display on the AccuSizer 770 Main Menu. This date will also be assigned to all files and subdirectories saved whether on the hard drive or on disk.

1. Type **DATE** at the C-prompt.

2. Press **ENTER**. The following will display:

   Current date is Mon 02-06-95.
   Enter new date (mm-dd-yy):

3. Type in the new date starting with the month, then the day and the year. These values must be separated by periods (.), hyphens (-), or slash marks (/). Valid values are as follows:

   mm: 01-12
   dd: 01-31
   yy: 80-99

4. Press **ENTER**. The C-prompt will re-display.

   DOS is programmed to change months and years correctly, whether the month has 28, 29, 30, or 31 days. Also, the year will automatically be incremented by one at the end of the twelve month cycle.

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Appendix A

DOS Commands

DIRECTORY [Dir]

Display or print the stored files and sub-directories in memory or on disk.

1. Change to the directory or sub-directory to be displayed. Refer to CD commands for help.

2. Type **DIR**.

3. Press **ENTER**. A listing of filenames and sub-directories will quickly display.

Examples:

DIR	: lists all files in a directory.
DIR\p	: allows for a list of files to display one screen at a time.
DIR *.BAT	: allows all files with the file extension .BAT to display.

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Appendix A

DOS Commands

FORMAT

A diskette is usually purchased unformatted and must be formatted before any data can be written or backed up to it. Formatting is the method by which the computer defines sectors on a disk. Sectors are used to store and retrieve data on disks. Think of sectors as addresses where information will be stored and later retrieved from the computer memory. Bad sectors will be pointed out during the format process.

> **IMPORTANT:** Do not format the hard drive. Doing so will delete all software programs and files permanently from memory. Re-installation of all software would have to be complete if formatting were to be executed on the hard drive.

Formatting a Diskette

1. Place diskette into the disk drive.

2. Type the following at the C-prompt:

   FORMAT [drive:]

   [drive:] may be the A-drive or the B-drive.

3. Press **ENTER**. The following will display:

   Insert new diskette for drive a:
   and press ENTER when ready...

   Checking existing disk format.
   Saving UNFORMATTED information.

   Verifying * (* will be the disk size)
   ** percent completed (** percentage that is formatted)

   Format complete.

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Appendix A

DOS Commands

PATH

A path specifies the locations of file categories in the computer memory. Paths are defined in the *AUTOEXEC.BAT*. The paths are initially set up by the computer manufacturer during software installation. When installing new software packages the *AUTOEXEC.BAT* is, in most cases, automatically updated to add the new path that will lead to the new software.

1. Type **PATH** at the C-prompt.

2. Press **ENTER**. The following is an example of what may display:

   Path=C:\;C:\DOS;C:\WINDOWS;

   This indicates that a path is defined to lead to the root directory C: and the sub-directories DOS and WINDOWS.

   Once the path displays the C-prompt will re-display.

REMOVE DIRECTORY [RD]

Delete directories using this command. A directory must be empty, meaning containing no files, prior to removing it from memory. If removal of a directory containing files is attempted the following message will display:

Invalid path, not directory
or directory not empty

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Appendix A

DOS Commands

TIME

Use this command to change the internal system time that is stored in computer memory. The time will display on the AccuSizer 770 Main Menu. The time will also be assigned to all files and sub-directories once created and edited whether on hard-drive or disk in DOS.

1. Type **TIME** at the C-prompt.

2. Press **ENTER**. The following will display:

   Current time is 5:19:43:11p
   Enter new time:

3. Type in the new time starting with the hour, then the minutes and the seconds. The following is the order in which the time must be entered:

   time[hours:[minutes[:seconds[.hundredths]]][a/p]]

5:	19	:43	.11	p

hours:	00-23
minutes:	00-59
seconds:	00-59
hundredths:	00-99
a/p:	specifies am or pm

4. Press **ENTER**. The C-prompt will re-display.

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Appendix A

XCOPY

This command is similar to the COPY command. In addition, to copying the disk, all of the directory structures will be copied.

1. Type the following at the C-prompt:

   C:\XCOPY [drive:] [drive:\] [directory]

2. Press ENTER. The files being copied along with the directories will display:

   Reading source file(s)...
   [drive:]

   # File(s) copied.

   (# indicates the number of files copied)

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Appendix B

Solvent Compatibility

The identification of chemicals and the sensor configurations required for operation.

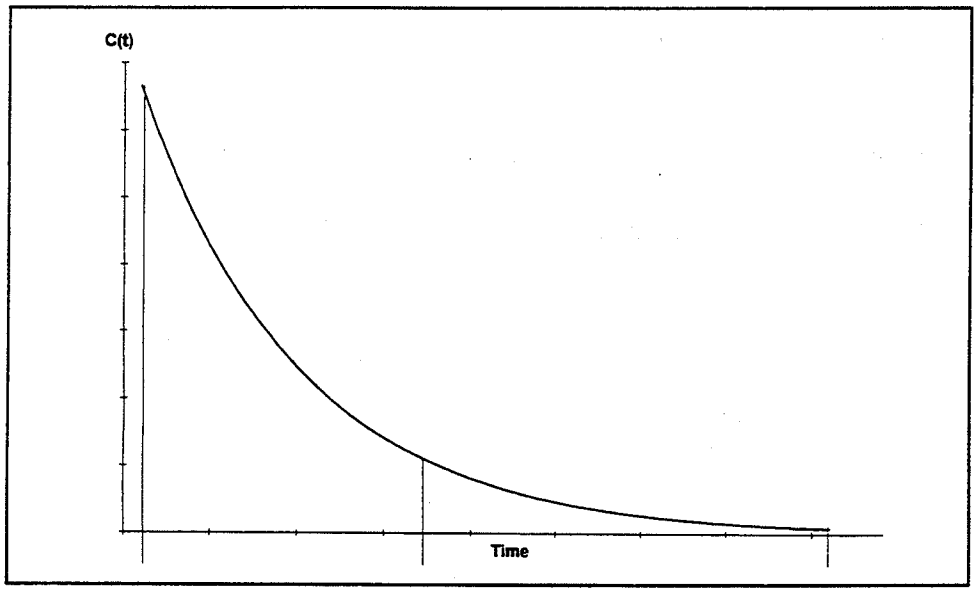
CHEMICAL	SAPPHIRE COMMENTS	QUARTZ COMMENTS
Acetone	Compatible	Compatible
Ammonium Hydroxide		Compatible
BOE(Buffered Oxide Etch)	Compatible	Compatible
Developers		Compatible
Dimethyl Formamide	Compatible	Compatible
Ethylene Glycol Monethyl Ether Acetate	Compatible	Compatible
H_3PO_4/HNO_3/Acetic Acid	Compatible $\leq$ 50°C	Compatible
Hydrochloric Acid (< 37% concentration)	Compatible (Liquid)	Compatible (Liquid)
Hydrofluoric Acid	Compatible	
Hydrogen Peroxide	Compatible	Compatible
Isopropyl Alcohol (IPA)	Compatible	Compatible
n-Butyl Acetate	Compatible	Compatible
n-mothyl Pyrilidone (NMP)	Compatible	Compatible
Nitric Acid	Compatible	Compatible
Phosphoric Acid	Compatible $\leq$ 50°C	Compatible (All Temps.)
Potassium Hydroxide		Compatible
Propyl Glycol Monethyl Ether Acetate	Compatible $\leq$ 50°C	Compatible
Sodium Hydroxide		Compatible
Sulfuric Acid	Compatible	Compatible
Tetramethylammonium Hydroxide	Compatible	Compatible
Xylene	Compatible	Compatible

If questions arise concerning the chemical compatibility of a chemical or a chemical blend, contact **Particle Sizing Systems** prior to performing sample analysis.

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Appendix C

Mass Balance Derivation



$$C(t) = C_o e^{-t/T}$$

where:

$C(t)$ = concentration in dilution flask at time t

C_o = concentration in dilution flask at time t_o

$C(t_o) = C(0)$

t_o = start autodilution

t_s = start data collection

t_e = end data collection

T = autodilution time constant

$= \frac{V}{F}$

V = volume in dilution flask

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Appendix C

Mass Balance Derivation

Consider the experimental population distribution:

$N_1, N_2, N_3, \ldots\ldots\ldots\ldots, N_i, \ldots\ldots\ldots, N_{511}, N_{512}$

where:

N_i = number of particles in channel i with diameter d_i

so:

$$P = \sum_{i=1}^{512} N_i$$

assuming the following:

$$P_o = \text{(Dilution Factor) } P$$

$$= \sum_{i=1}^{512} \text{(Dilution Factor) } N_i$$

which should be true for a large particle count.

The volume of counted particles is:

$$V = \sum_{i=1}^{512} N_i V_i$$

where:

V_i = the volume of one particle in channel i with diameter d_i

so,

$$v = \sum_{i=1}^{512} N_i \frac{4\Pi}{3} \left(\frac{d_i}{2}\right)^3$$

$$= \sum_{i=1}^{512} N_i \frac{1\Pi}{6} d_i^3$$

$$= \frac{1}{6} \Pi \sum_{i=1}^{512} N_i d_i^3$$

if the density of solids is known then,

$$M = P_{solids} V = P_{solids} \frac{1}{6} \Pi \sum_{i=1}^{512} N_i d_i^3$$

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Appendix D

Statistical Summary Calculations

Number-wt. Distribution Moments:

a. Mean Diameter:

$$D^{\#} = \sum_{i=1}^{k} N_i D_i \; / \; \sum_{i=1}^{k} N_i$$

b. Standard Deviation

$$S^{\#} = \left\{ \sum_{i=1}^{k} N_i (D_i - D^{\#})^2 / N^{\#} \right\}^{1/2}$$

c. Moment Coefficient of Skewness

$$a^{\#}_3 = \frac{m^{\#}_3}{(s^{\#})^3} \qquad \text{where } m^{\#}_3 = \sum_{i=1}^{k} N_i(D_i - D^{\#})^3 / N_{\#}$$

d. Moment Coefficient of Kurtosis

$$a^{\#}_4 = \frac{m^{\#}_4}{(s^{\#})^4} \qquad \text{where } m^{\#}_4 = \sum_{i=1}^{k} N_i(D_i - D^{\#})^4 / N_{\#}$$

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Appendix D

Statistical Summary Calculations

Area-wt. Distribution Moments

a. Mean Diameter:

$$D^A = \sum_{i=1}^{k} N_i D_i^2 \bullet D_i \Big/ \sum_{i=1}^{k} N_i D_i^2$$

b. Standard Deviation

$$S^A = \left\{ \sum_{i=1}^{k} N_i D_i^2 (D_i - D^A)^2 / N^A \right\}^{1/2}$$

c. Moment Coefficient of Skewness

$$a^A_3 = \frac{m^A_3}{(s^A)^3} \quad \text{where } m^A_3 = \sum_{i=1}^{k} N_i D_i^2 (D_i - D^A)^3 / N_A$$

d. Moment Coefficient of Kurtosis

$$a^A_4 = \frac{m^L_4}{(s^A)^4} \quad \text{where } m^A_4 = \sum_{i=1}^{k} N_i D_i^2 (D_i - D^A)^4 / N_A$$

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