acp Partline
Integrated Data Processing of Particle Measurements

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Abstract

Particle contamination has a decisive influence on production success and is therefore an important focal point in the monitoring of "clean" productions.

In order to control contamination, data has to be recorded, evaluated in a defined way and be further processed. Modern measurement software can be extremely useful, provided that it integrates the individual process steps and gives the user a flexible evaluation of his raw data adapted to his requirements.
The Fraunhofer Institute for Manufacturing Engineering and Automation in Stuttgart has developed an integrated software package which offers a holistic solution, even to complex contamination tests.

State of the Art

From the past to the present date, it has been shown that particle measuring technology represents a valuable instrument for process and product optimization, but which however still requires a high operative / manual work load (Figure 1) [1].

As well as the classical measurement data evaluation in the field of cleanroom monitoring, more and more special solutions are required for specific applications often with complex analysis criteria and in the most varied of fields.

At present, the handling of particle measurement data for quality assurance is characterized by a whole variety of commercial particle measurement equipment and data processing systems.

Most factory-wide data processing systems e.g. LIMS / CAQ, have not been designed for the direct integration of particle measurement equipment [2]. The Fraunhofer IPA has specialized in closing this gap and creating software for the unification and simplification of the various particle measurement applications for contamination control.

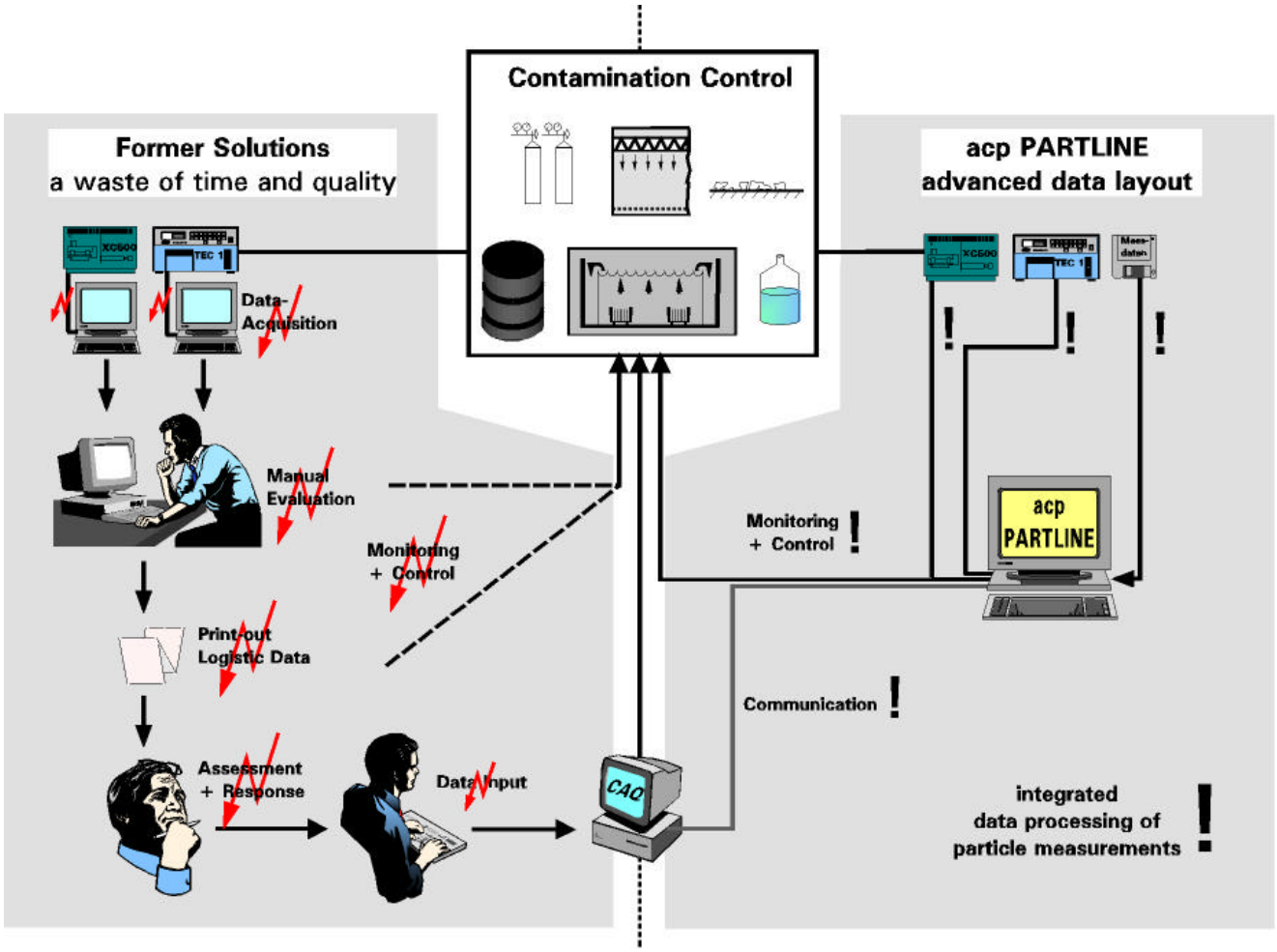


Fig. 1: The process of contamination control

Various Applications - One Tool

The following concept describes a software tool which is compatible with all of the optical particle counters on the market (irrespective of whether they are liquid, gas or surface particle counters either in on-line operation or batch measurement), and provides the benefit of a unified data format and reporting structure as well as easy handling.

Compatibility, fields of application

Each type of sensor has its own interface protocol. This often results in a data acquisition software which can only be used with the relevant types of device made by the same manufacturer. The software platform 'acp Partline' (Figure 2) guarantees the total function independent of the type of sensor, because the data communication is adjusted to each specific device.

Data is evaluated which can either be selected from on-line operation acquisition, or from earlier measurements and then scanned into a data carrier. Furthermore, the possibility exists to manually enter data from particle counters which do not possess a direct PC interface (RS232 or RS485), and

to evaluate them in a standardized form. As a result, the software is flexible for any measurement task within manufacturing and which can also be directly implemented at the customer's / supplier's.

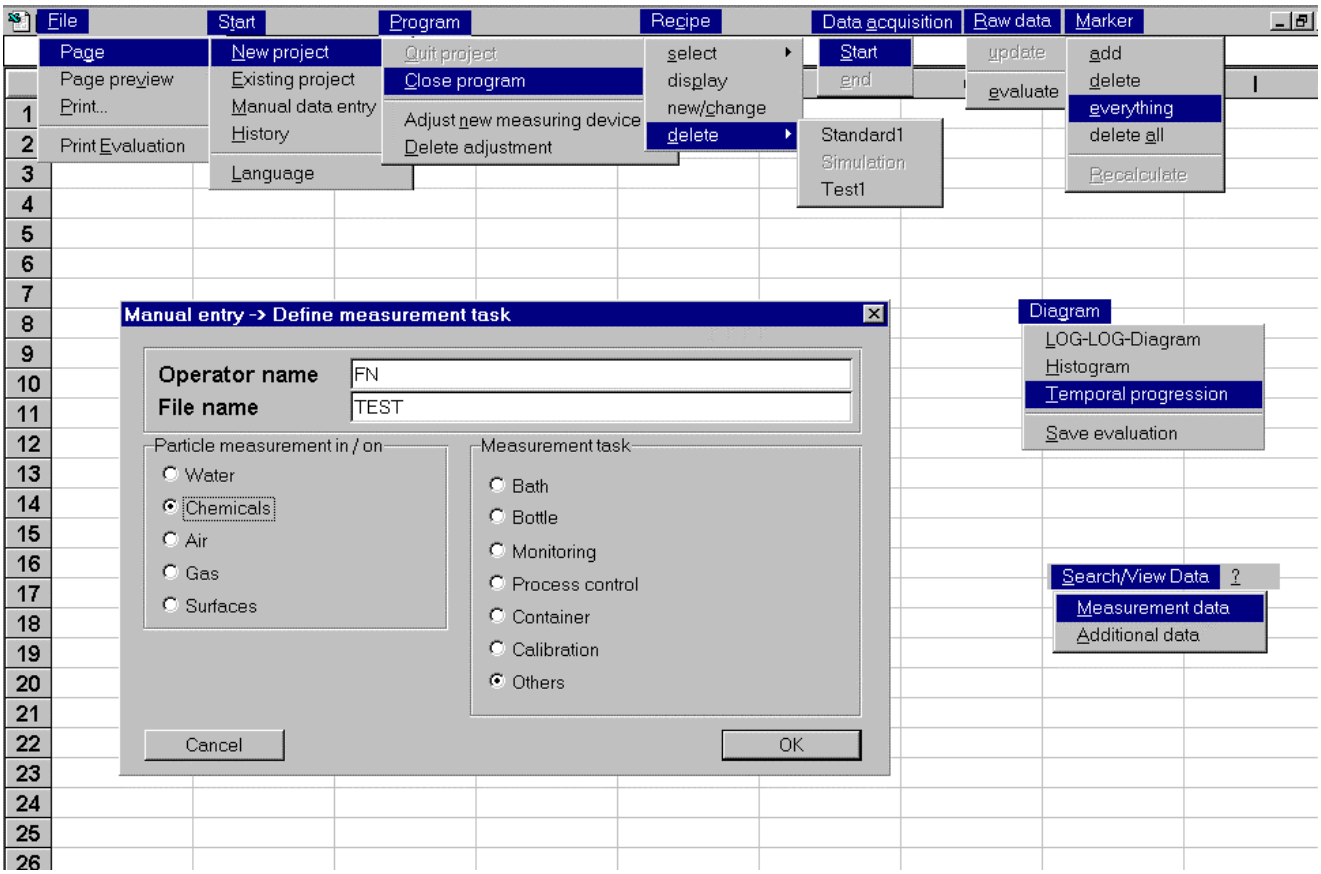


Fig. 2: Screen shot acp Partline - functionality

The program can be operated using Windows 95 or Windows NT. Additional Excel functions remain completely preserved [3].

Data acquisition

A further problem which often goes unrecognized is the interface communication itself. Due to differing clock rates from interfaces to sensors and data computers, transfers may take place incorrectly. Data from these transfer errors require careful working over by specialists.

'acp Partline' offers an error-free measurement data transfer with its new interface programming, an essential requirement for rational data processing and a correct assessment of the results.

Recipes - the first step towards standardization

Company-specific marginal parameters of a measurement (medium, process number, sampling device, etc.) and also information concerning the measurement task and the measuring device itself

are memorized in recipes. Standard recipes serve as models and only need to be entered or altered by the administrator (Figure 3).

Using these standard recipes as a basis, recipes can be created by the operator for recurrent measurement tasks, simplifying future measurement processes and making on-line evaluation possible. Finally the particle measurement results could be easily summarized afterwards in a standardized report.

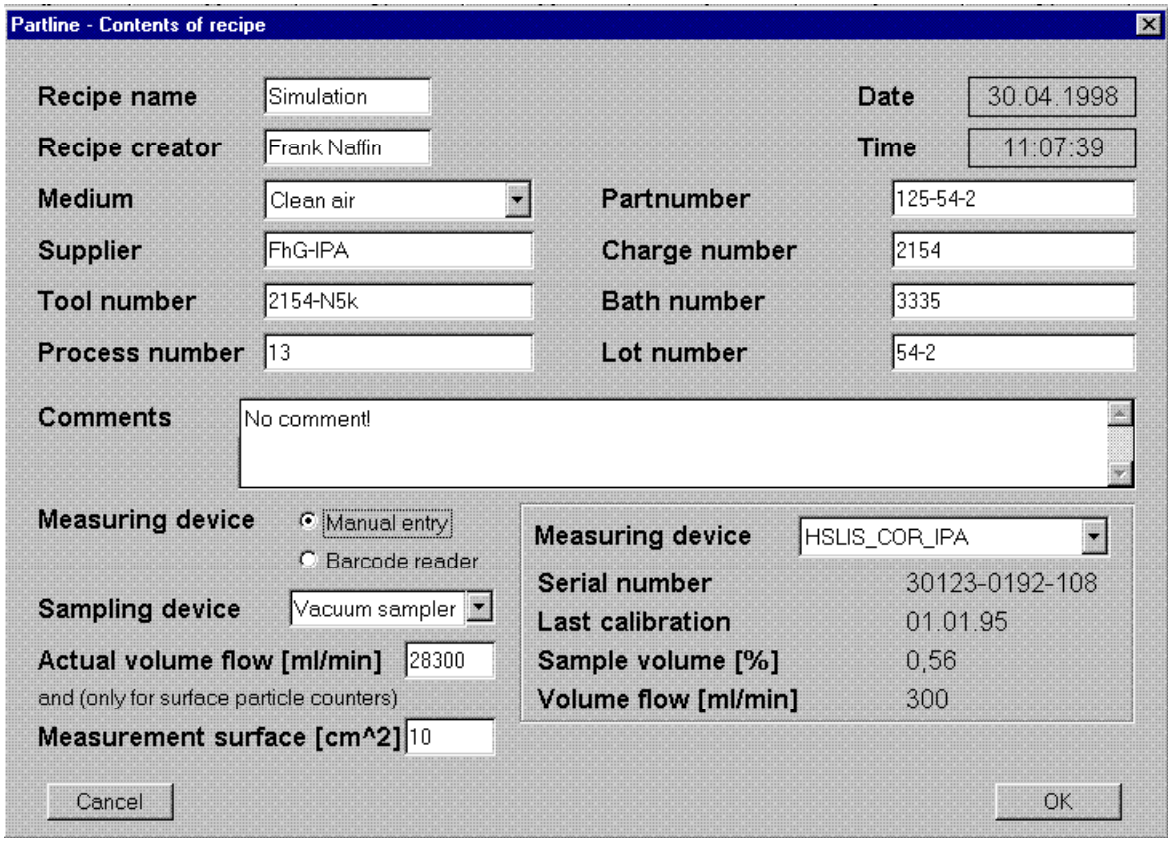


Fig. 3: acp Partline - recipe mask

Measurement analysis

An important section of measurement software is the data evaluation (Figure 4,5). Conditions for universal implementation in practice are flexibility, the strict adherence to current norms and ,of course, data security during evaluation (with a view to the validity of the program, e.g. for the pharmaceutical industry). The automated evaluation considerably reduces error susceptibility and the high work load involved in manual or partially manual evaluation.

The flexibility is supported by the variable selection and marking of measurement data. Only these data will be considered during evaluation. As a result, several evaluations from the most varied segments of a measurement can be shown simultaneously in a final report. A further increase in

flexibility is attained by taking the measurement task into account in the scoring algorithms.

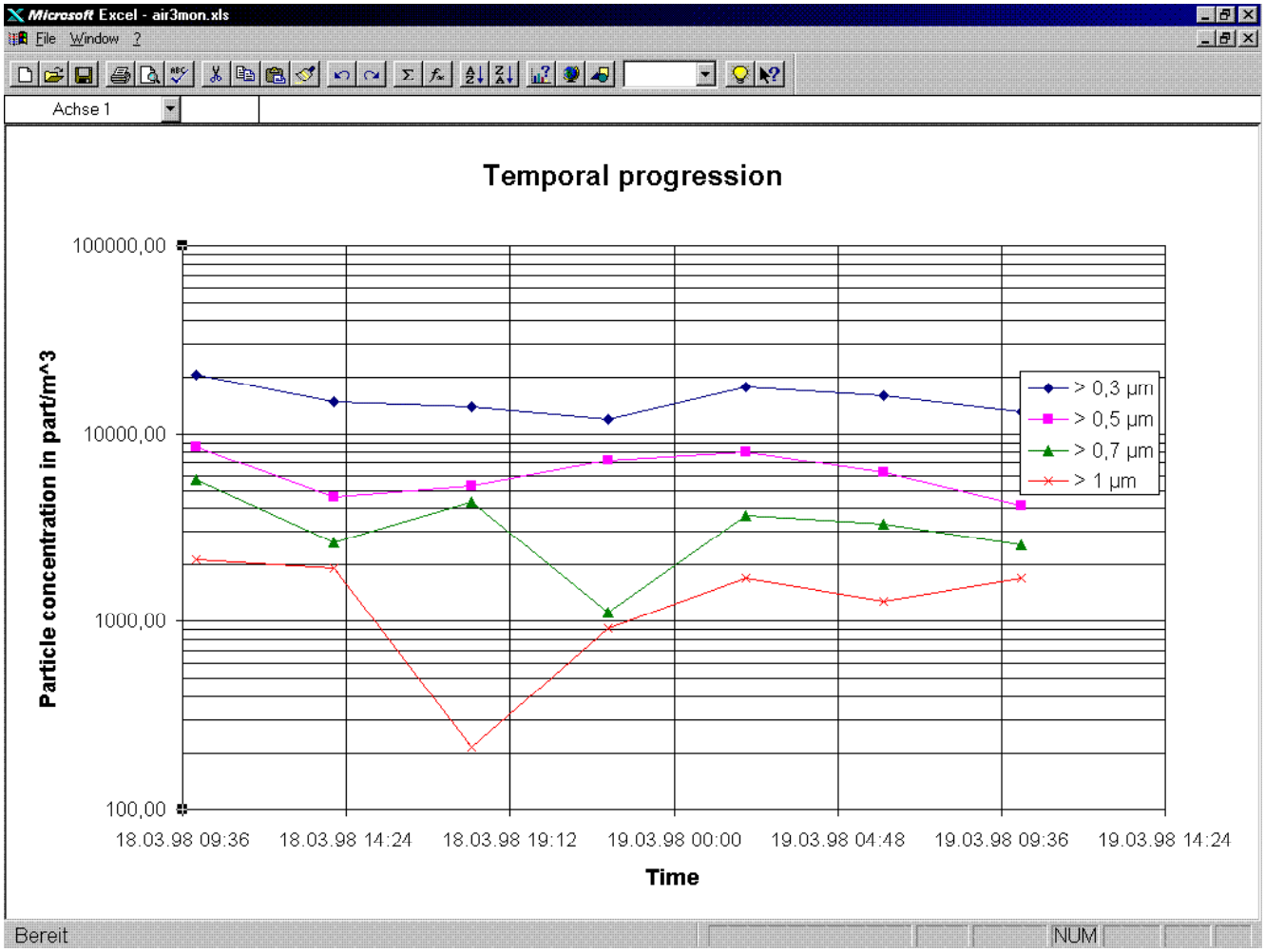


Fig. 4: Screen shot measurement analysis - temporal progression

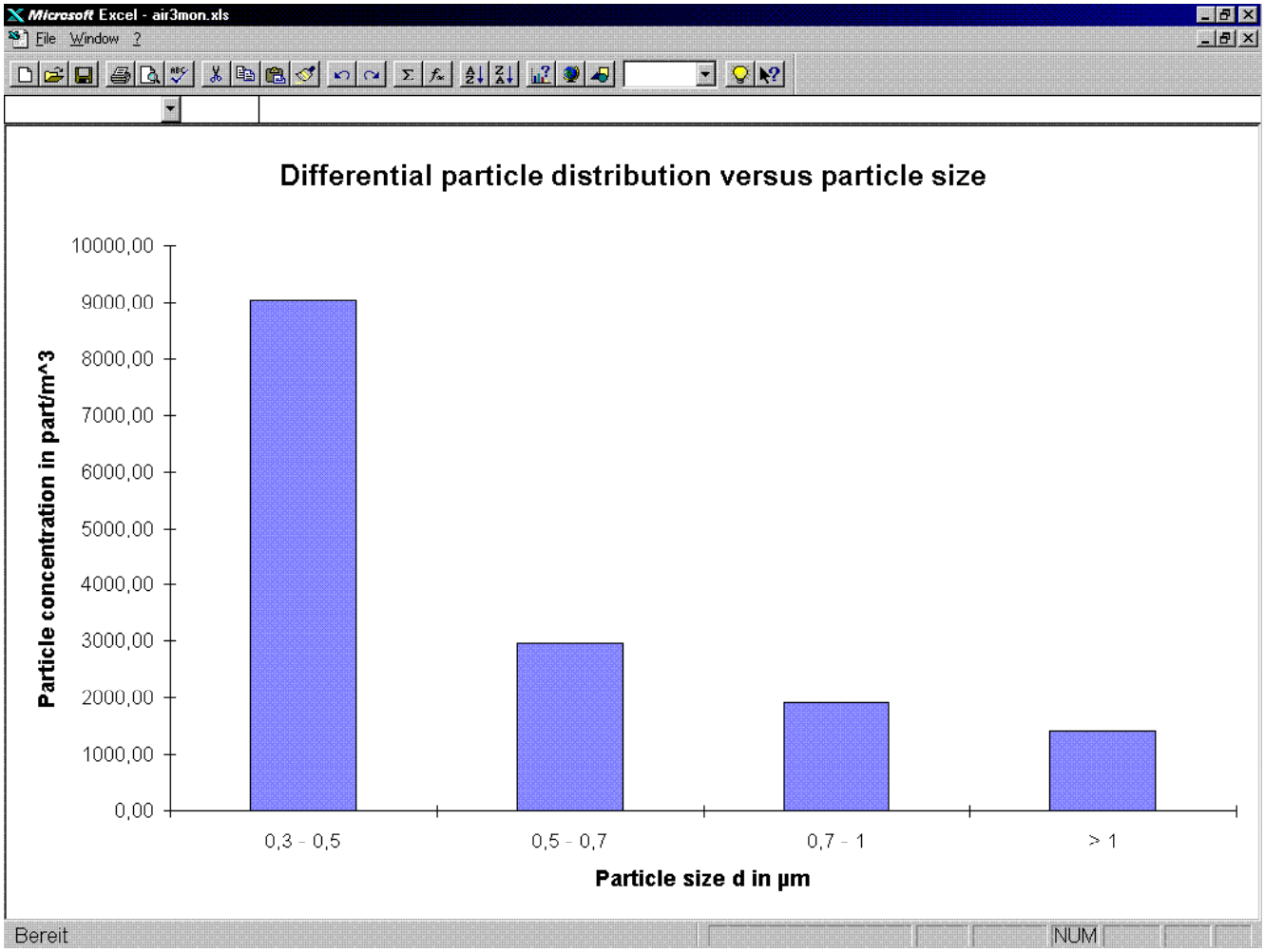


Fig. 5: Screen shot measurement analysis - differential particle distribution

In order to simplify the representation of the results for international use, it is possible to freely select a language during the measurement data evaluation. At the moment, 3 languages are available (German, English and French). In on-line operation, the menu margin, messages, dialog boxes and labels (e.g. on diagrams) can be directly converted into the chosen language. If desired, other languages may be used at short notice.

In the field of particle measurement, norms (e.g. Fed. Standard; VDI; company-own guidelines, etc.) exist for each measurement task (air, water, gases, chemicals and surfaces). These norms contain regulations for the measurements themselves, the preparation of data and the standardized representation of the results. These regulations are implemented in the software and the operator or customer decides which norm to use (Figure 6).

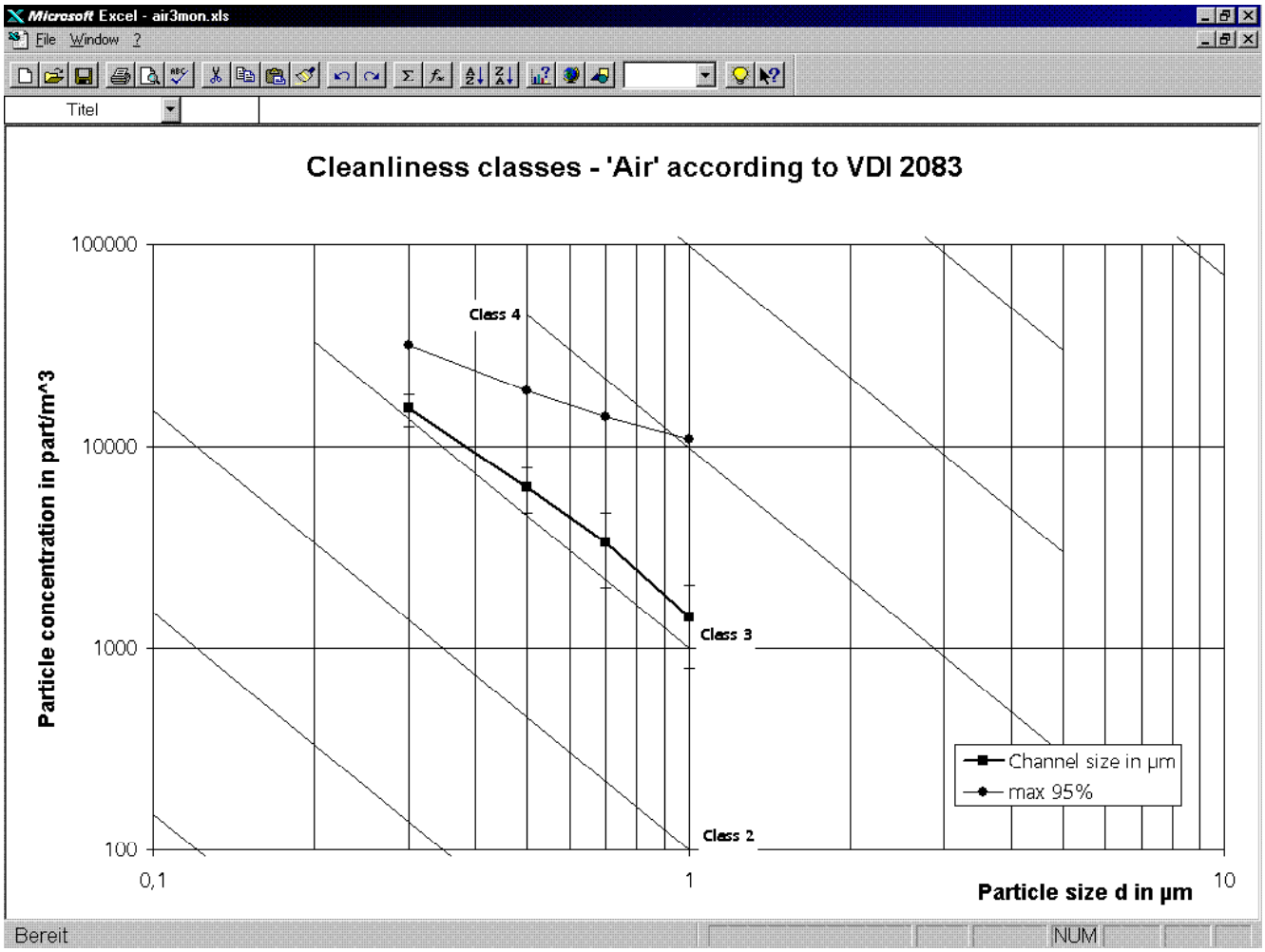
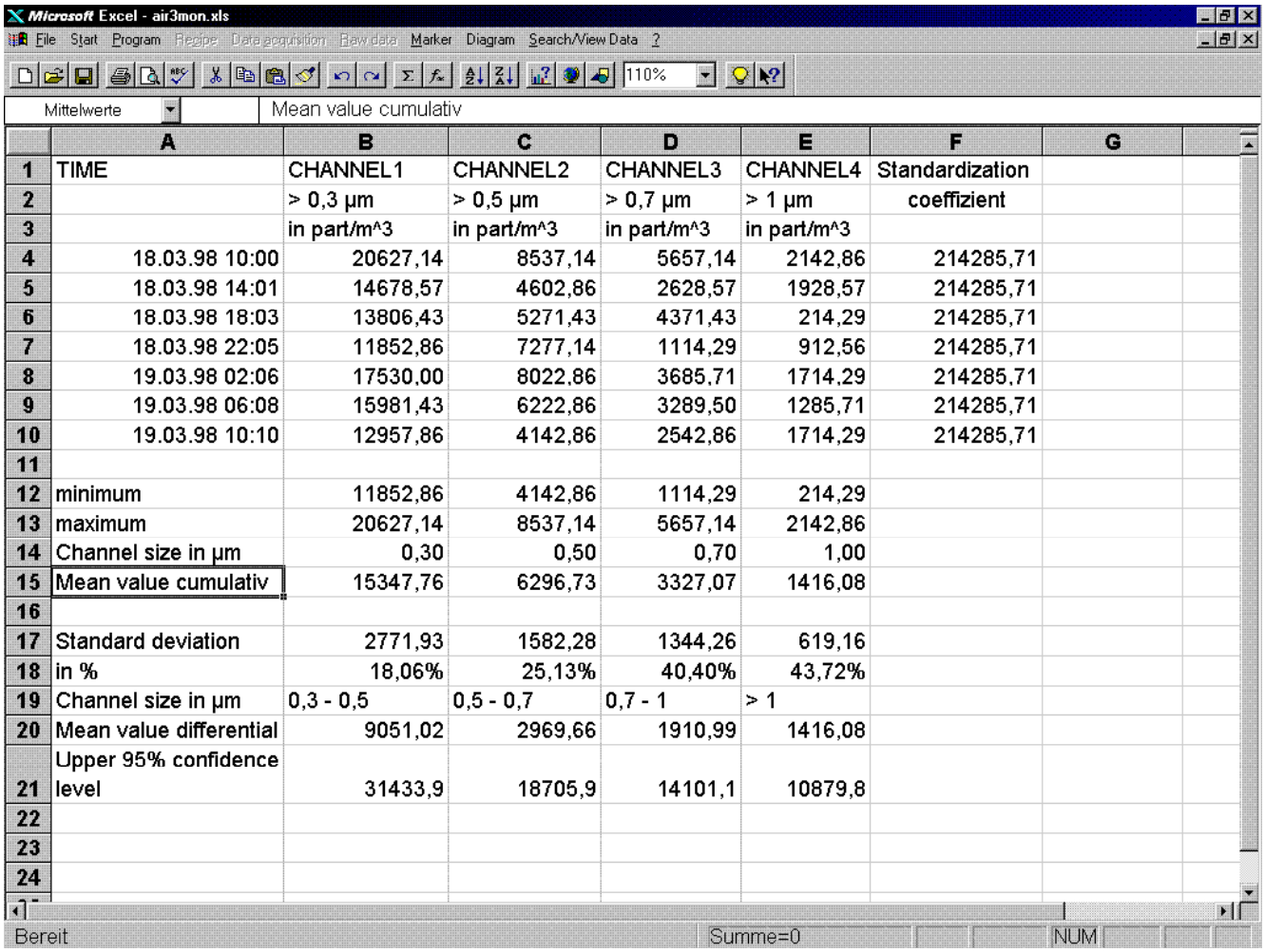


Fig. 6: Screen shot measurement analysis - cleanliness classification

On the basis of these norms, 3 standard diagrams (cleanliness classification diagram, bar chart and the temporal measurement progression) are drawn up and may be used in the final report. Further representations, particularly diagrams with definable limit curves and overall views, may also be added if desired.

Due to the separate memorizing of the raw data from a measurement, optimal data security (Figure 7) is ensured. An additional password protection in the table increases consistency when processing data, but does not impair in any way the flexibility of the evaluation.



Microsoft Excel - air3mon.xls

File Start Program Recipe Data acquisition Raw data Marker Diagram Search/View Data ?

110%

Mittelwerte | Mean value cumulativ

	A	B	C	D	E	F	G
1	TIME	CHANNEL1	CHANNEL2	CHANNEL3	CHANNEL4	Standardization	
2		> 0,3 µm	> 0,5 µm	> 0,7 µm	> 1 µm	coeffizient	
3		in part/m^3	in part/m^3	in part/m^3	in part/m^3		
4	18.03.98 10:00	20627,14	8537,14	5657,14	2142,86	214285,71	
5	18.03.98 14:01	14678,57	4602,86	2628,57	1928,57	214285,71	
6	18.03.98 18:03	13806,43	5271,43	4371,43	214,29	214285,71	
7	18.03.98 22:05	11852,86	7277,14	1114,29	912,56	214285,71	
8	19.03.98 02:06	17530,00	8022,86	3685,71	1714,29	214285,71	
9	19.03.98 06:08	15981,43	6222,86	3289,50	1285,71	214285,71	
10	19.03.98 10:10	12957,86	4142,86	2542,86	1714,29	214285,71	
11							
12	minimum	11852,86	4142,86	1114,29	214,29		
13	maximum	20627,14	8537,14	5657,14	2142,86		
14	Channel size in µm	0,30	0,50	0,70	1,00		
15	Mean value cumulativ	15347,76	6296,73	3327,07	1416,08		
16							
17	Standard deviation	2771,93	1582,28	1344,26	619,16		
18	in %	18,06%	25,13%	40,40%	43,72%		
19	Channel size in µm	0,3 - 0,5	0,5 - 0,7	0,7 - 1	> 1		
20	Mean value differential	9051,02	2969,66	1910,99	1416,08		
21	Upper 95% confidence level	31433,9	18705,9	14101,1	10879,8		
22							
23							
24							

Bereit | Summe=0 | NUM

Fig. 7: Screen shot measurement analysis - data sheet and statistics

The safeguard (password protection) in the table is only confined to the area of measurement data and statistics actually in use, so that free cells are still available for manual entries (e.g. remarks about the structuring of the measurement) (Figure 7).

Integration into the company's own data fields

The particle control software can be utilized for both stand-alone units and can also be directly integrated into a QM-environment. Standardized interfaces enable a simple data output. An additional data bank can be integrated which facilitates the flexible combination of any data records.

Adjustment / extension of the system

In the past, the Fraunhofer IPA has also created a number of specific adaptations and solutions for measurement data processing, especially in the field of applied particle measurement. As a competent contract research partner we will be able to meet your requirements and create the software to solve your problems in applied particle measurement.

Summary and future outlook

A step is being taken in the right direction towards scientifically-based measuring and information systems (expert systems) for the future, with the feature of an increase in performance in measurement technology and process control. At the same time, this system gives you a transfer of experience with comfortable user prompting. A Summary of acp Partline specifications is shown in figure 8.

acp Partline Specifications	
Development	Fraunhofer Institute for Manufacturing Engineering and Automation
Objective	high adaptability to specific requirements while simultaneously maintaining the highest possible user-friendliness and being able to meet all technical requirements
Fields of application	• standard particle measurement tasks • on-line process control and • quality assurance
Most important features	• compatible with all particle counters • error-free on-line data acquisition • raw data acquisition/input: manual, disc, on-line • recipe masks can be specifically adapted to user/firm requirements • awarding of various rights to admission • selective data evaluation possible • on-line help for the operator for all functions • defined and unified reporting structure and data format • compatible with win95 and winNT • use-guide and help menu • on-line data acquisition visualization and analysis • defined data analysis and compression routine • easy to handle (e.g. barcode option) • prepared for FDA validation
System requirements	minimum: PC Pentium / 90MHz 16 MB RAM
Software requirements	Windows 95 or Windows NT , Microsoft-Excel 7.0
Further options	Further options on request (e.g. measuring device management; remote control for the measuring device; SOP's, acquisition of additional sensory analysis (pressure, temperature, humidity, etc.)
Worldwide Distribution	Distributed by acp - advanced clean production GmbH, Nobelstraße 15, D-70569 Stuttgart

Fig. 8: Summary of acp Partline specifications

References

[1] Bitterle / Retter, "Meßdatenerfassung und Verarbeitung mit dem PC", Franzis Verlag

[2] Pfeiffer,T., "Qualitätsmangement, Strategien - Methoden - Techniken", München Wien, Carl Hanser Verlag 1993

[3] Kofler, Michael, "Anwendungsprogrammierung mit Excel", Verlag Addison-Wesley

About the authors

Frank Naffin has been engaged as a Scientist at the Department of Microproduction at Fraunhofer IPA in Stuttgart since 1994. He is currently working in the fields of information technology focusing on production control, lot tracking and data processing in clean productions. He obtained his engineering degree at the Aachen University of applied sciences studying Aerospace Technology.

Christian Ernst joined the Fraunhofer Society Stuttgart in 1990. He obtained his university degree at the Stuttgart University studying Chemical Engineering and is currently working as project manager in the major fields of qualification, production optimization, cleaning technology and contamination control.

Peter Fode is the general manager of the company acp - advanced clean production GmbH. He obtained his university degree in mechanical engineering at the Stuttgart University and has more than 7 years of experience in the area of clean production.
acp operates in the field of ultra-pure and cleanroom consulting, engineering, service and distribution. The company works in close cooperation with the Fraunhofer Institute of Manufacturing Engineering and Automation in several areas.

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