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Hygienic Filling Machines for Liquid and Viscous Foods – Classification and Typical Fields of Application

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Contents

This code of practice is the English translation of a publication drawn up by the VDMA Working Party for “Interface Problems in Aseptic Plants”.

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A list of publications of the working party on the subject of near-sterile and aseptic filling can be requested from the above address. This list and all publications are also available for downloading from the internet free of charge. (WWW.VDMA.ORG/PACKTECH, heading: Technik-Aseptik).

Preliminary remark on the second edition

This VDMA document was revised six years after the first edition had been published. In doing so experiences with the classification of hygienic filling machines were considered as well as feed back to the stated shelf life for typical products.

1 Introduction

Since time immemorial producers of food have striven to protect their product against premature spoilage. In the field of filling technology such efforts take the form of employing the right machinery appropriate to the product. In choosing the machinery attention has to be paid first of all to the systematic implementation of hygienic design criteria. Furthermore, depending on the application, the machines may be equipped with additional functions for improving product protection. At the upper end of the scale are the aseptic machines whose capabilities among other things are described in VDMA Documents Food Processing Machinery and Packaging Machinery No.11. Below this level of performance there has so far been no uniform terminology for machine concepts. Various terms such as “semiaseptic”, “clean or ultraclean designs” are used by machine manufacturers for comparable machine concepts. Sometimes, however, the same term means different machine concepts for different manufacturers. This was the starting point for a working party within the Packaging Machines Division of the VDMA to develop a classification of hygienic filling machines on the basis of the features with which the machines are equipped. The aim is to provide the user with a reference base for comparing the machine concepts of different manufacturers. By enumerating typical fields of application of each category of machine the user should also be helped to select the machine category suitable for a particular product to be packaged. It may, however, be pointed out here that a unique assignment of products to machine categories is often difficult on account of the diversity and variability of product characteristics. Accordingly, the hygiene accessories required for the filling machine should always be established for the specific application in question.

2 Definitions and abbreviations

Aseptic packaging machines	Filling machines operating in aseptic manner (aseptic plants) are packaging machines which fill a sterile product (e.g. food) without recontamination into a sterile pack meeting the minimum requirements of appendix A of document no. 11 of the VDMA-Documents Food Processing Machiners and Packaging Machinery publication series. (FS NuV Nr. 11/2006).The sterilization of the containers to be filled usually takes place within the aseptic filling machine.
Sterile zone of the machine interior	That region in the interior of an aseptic filling machine which after completion of sterilization must be kept free of germs in order to prevent recontamination of the sterile product during filling.
sterile	In the sense of this working paper: Free of microorganisms capable to reproduce under conditions of intended operation: Conditions of intended operation of filling machines of VDMA class IV: Product to be filled: pH ≤ 4,5 (high acid products) Distribution and storage at ambient temperatur Conditions of intended operation of filling machines of VDMA class V: Product to be filled: pH > 4,5 (low acid products) Distribution and storage at ambient temperatur
FS NUV	Fachverbandsschriften Nahrungsmittelmaschinen und Verpackungsmaschinen (VDMA-Documents Foodprocessing Machinery and Packaging Machinery)

3 Categories of hygienic filling machines for liquid and viscous foods

Machine fittings	**I**	**II**	**III**	**IV**	**V**[1]
Design in line with DIN EN 1672-2	**x**	**x**	**x**	**x**	**x**
cleaning in place (CIP) of parts in contact with product	optional	**x**	**x**	**x**	**x**
Disinfection/sterilization of the filler	optional	Disinfection or sterilization[2]	Disinfection or sterilization[2]	Disinfection or sterilization according to FS NuV 10/2005 Appendix A	Sterilization according to FS NuV 11/2005 Appendix A.1
Recontamination protection of parts in contact with product	**-**	**x**	**x**	Maintenance of sterile condition[3]	Maintenance of sterile condition
Requirements to be met by the control system	**-**	Monitoring of parameters relevant to • CIP • Disinfection/ sterilization of filler	Automatic control of parameters relevant to • CIP • Disinfection/sterilization of filler • Packaging sterilization[4]	Automatic control of parameters relevant to • CIP • Disinfection/sterilization of filler • Packaging sterilization[5]	According to FS NuV 11/2005 Appendix A.2
Packaging sterilization[6] and recontamination protection of sterilized packaging until filling	**-**	**-**	**x**	According to FS NUV 10/2005 Appendix A	According to FS NuV 11/2005 Appendix A.1
Cleaning & sterilization plus recontamination protection of the sterile zone of the machine interior[7]	**-**	**-**	**-**	According to FS NuV 10/2005, Appendix A	According to FS NuV 11/2005 Appendix A.1

[1] Aseptic packaging machines fort he food industry in accordance with VDMA FS NuV No. 11/2005
[2] Insofar as sterilization of the filling machine is necessary, the requirements set out in VDMA FS NuV No. 11/2005 Appendix A1 should be met.
[3] In the case of filling a sterile product.
[4] The CIP-process may be monitored and controlled by the central CIP facility.The monitoring of parameters of concentration of cleaning and disinfection agents are usually not included in the automatic monitoring and control system.
[5] The CIP-process may be monitored and controlled by the central CIP facility.The monitoring of parameters of concentration of cleaning and disinfection agents are usually not included in the automatic monitoring and control system.
[6] Alternatively, the packaging sterilized outside the packaging machine may also be fed into the filling machine without recontamination. The requirements for packaging sterilization in this case are the same as for packaging sterilization inside the packaging machine.
The required sterilization performance of the packaging machine has to be interpreted as a function of the application. Influencing factors to be taken into consideration in doing this include the perishability of the product, the desired shelf life of the product, the distribution channel, the microbial level in the product, the initial microbial level in the packaging and the microbial level of the machine environment.
If a sterilization performance has to be agreed contractually it is recommended that this be done in terms of a count reduction rate which relates both to the sterilization process in question as well as to the test microorganism suitable for the application. VDMA FS NuV Nr. 10/2005 Anhang A states some test microorganism appropriate for different systems for disinfection of packaging used in filling machines of VDMA class IV.
[7] Including parts in contact with product.

4 Typical fields of application of hygienic filling machines

Typical products which are filled on hygienic filling machines are listed below. These products are characterized with regard to the criteria of “microbiological state”, “pH”, “distribution channel” and “minimum shelf life data (examples from practice)”. In this way the reader is given some assistance with classifying products which are not listed. It has to be pointed out with regard to the criterion “minimum shelf life data (examples from practice)” that these are values taken from packaging practice. Microbiological reasons are not always the limiting factors determining minimum shelf life. Organoleptic reasons, for example, may also be decisive in establishing the minimum shelf life data. No precise shelf life predictions can be made for individual products with regard to the microbiological deterioration of the product. Due to the multiplicity of factors in production, filling, distribution and storage affecting deterioration of the product it is in the final analysis left to the business policy of the filling company to establish which shelf life data are justifiable. This explains why only time periods can be specified in the “minimum shelf life” column.

4.1 VDMA Class I - Machines

Machine class	Product examples	Microbiological state of product	pH	Distribution channel	Minimum shelf life (examples from practice)[8]
I	Edible oil	Largely germ-free (no growth at water content < 0.5 %)	-	chilled	several months
	Margarine (80 % fat), in tub	Largely germ-free	≤ 4.5	temperature-controlled to 15-18 °C	up to 3 months
	Fruit juice, hot filling (carton or glass bottle)	Free of viable microorganisms	≤ 4.5	ambient temperature	> 6 months
	Crushed tomatoes in tins (with post-pasteurization)	Free of viable microorganisms (after postpasteuri-zation)	≤ 4.5	ambient temperature	> 1 year
	Condensed milk (with post-sterilization)	Germ-free (after poststerili-zation)	approx. 6.2	ambient temperature	> 1 year
	Spirits, alcohol content > 32 %	Free of viable microorganisms	-	ambient temperature	> 1 year
	White wine, < 4g sugar/l, glass bottle	Largely germ-free	< 3.4	ambient temperature	> 1 year
	Creamery butter		> 6.4	chilled to ≤ 7 °C	< 50 days (tub or 250g portion) < 90 day (butter in small portions)
	Meat pies (with post-sterilization)			ambient temperature	> 1 year
	Petfood (with post-sterilization)			ambient temperature	> 1 year

[8] Data on minimum shelf life of products drawn from practice. For many products microbiological reasons are not limiting for determining minimum shelf life.

4.2 VDMA Class II - Machines

Machine class	Product examples	Microbiological state of product	pH	Distribution channel	Minimum shelf life (examples from practice)[9]
II	Natural yogurt	Desired acid-forming cultures	≤ 4.5	chilled	12-15 days
	Curd cheese	Desired acid-forming cultures	≤ 4.5	chilled	12-15 days
	Certified milk, pasteurized	Largely germ-free	approx. 6.6	chilled	8 days
	Fresh cream, pasteurized	Largely germ-free	Up to 6.6	chilled	2-3 weeks
	Low-acidity apple juice spritzer, CO_2 content < 4g/l, in glass bottles and then pasteurized	Largely germ-free	≤ 4.5	ambient temperature	> 6 months
	Cider, alcohol content 2% by vol., CO_2 content < 4g/l, in glass bottles then pasteurized	Largely germ-free	≤ 4.5	ambient temperature	> 6 months
	White wine > 4g sugar/l, filled in glass bottles, not pasteurized after filling	Largely germ free	≤ 4.5	ambient temperature	> 1 year
	Red wine filled in rinsed glass bottles	Largely germ free	> 3,4	ambient temperature	> 1 year
	Beer, alc. content appr. 5% by volume CO_2 content > 5g/l	Largely germ free	≤ 4.5	ambient temperature	> 6 months
	Nonalcoholic beer CO_2 content > 5g/l poststerilized	Largely germ free	≤ 4.5	ambient temperature	> 6 months
	Delicatessen salads with preservatives	Free of spoiling microorganisms	≤ 4.5	chilled	< 40 days

[9] Data on minimum shelf life of products drawn from practice. For many products microbiological reasons are not limiting for determining minimum shelf life.

	Delicatessen salads without preservatives	Free of spoiling microorganisms	≤ 4.5	chilled	< 25 days
	Jam, hot filled or pasteurized after filling	Free of viable microorganisms (after filling or pasteurization)	≤ 4.5	ambient temperature	> 12 months
	Ketchup, savoury sauces, hot filled	Free of viable microorganisms	≤ 4.5	ambient temperature	> 6 months
	Sparkling water	Free of viable microorganisms	≤ 4.5	ambient temperature	> 6 months
	Softdrinks, carbonated		≤ 4.5	ambient temperature	> 6 months
	Mayonnaise with preservatives	Largely germ-free	≤ 4.5	ambient temperature	appr. 6 months
	Ready to cook soups, filled cold and then sterilized		> 4.5	ambient temperature	> 6 months

4.3 VDMA Class III - Machines

Machine class	Product examples	Micro-biological state of product	pH	Distribution channel	Minimum shelf life (examples from practice)[10]
III	Natural yogurt	Desired acid-forming cultures	≤ 4.5	chilled	2-4 weeks
	Carbonated drinking yogurt, CO_2 content < 4g/l, in Al can	Pasteurized	≤ 4.5	chilled	> 6 months
	Curd cheese	Desired acid-forming cultures	≤ 4.5	chilled	2-4 weeks
	Fresh cream, pasteurized	Largely germ-free	6.6	chilled	up to 3 weeks
	Fruit yogurt	Desired acid-forming cultures	≤ 4.5	chilled	2-4 weeks
	Jam, cold filled	Largely germ-free	≤ 4.5	ambient temperature	12 months
	Apple juice spritzer CO_2 content < 4g/l with preser-vatives or cold sterilized (e.g. with CMDC), not pasteurized after filling	Largely germ-free	≤ 4.5	ambient temperature	> 6 months
	Wine, nonalcoholic	Largely germ-free	≤ 4.5	ambient temperature	> 12 months
	Cider alcohol-content 2% by volume CO_2 content < 4g/l not pasteurized after filling	Largely germ-free	≤ 4.5	ambient temperature	> 6 months
	Margarine (<60% fat) in tub[11]	Largely germ-free	≤ 4.5	chilled	up to 3 months
	Mayonnaise without preservatives cold fiilling	Free of viable microorganisms	≤ 4.5	ambient temperature	< 6 months

[10] Data on minimum shelf life of products drawn from practice. For many products microbiological reasons are not limiting for determining minimum shelf life.
[11] If the microbial load of the tub is high it may be necessary to use machines of VDMA class V.

4.4 VDMA Class IV - Machines

Machine class	Product examples	Microbiological state of product	pH	Distribution channel	Minimum shelf life (examples from practice)[12]
IV	Natural yogurt	Desired acid-forming cultures	≤ 4.5	chilled	appr. 30 days
	Curd cheese	Desired acid-forming cultures	≤ 4.5	chilled	appr. 30 days
	Stirred fruit yoghurt	Free of spoiling microorganisms	≤ 4.5	chilled	appr. 4 weeks
	Fruit yogurt, heat-treated[13]	Free of viable microorganisms	≤ 4.5	ambient temperature	approx. 6 weeks
	Crushed tomatoes, cold-filled	Free of viable microorganisms	≤ 4.5	ambient temperature	> 6 months
	Ice tea, CO2-free	Free of viable microorganisms	≤ 4.5	ambient temperature	> 6 months
	ESL milk[14]	Free of vegetative microorganisms	6.6 – 6.8	chilled	> 2 weeks
	Pudding chilled (with and without cream)	Free of vegetative microorganisms	> 6.5	chilled	4-6 weeks
	Wine (in cup or carton)	Largely germ-free	≤ 4.5	ambient temperature	approx. 1 year
	Fruit juice, Cold-filled[15]	Germ-free	≤ 4.5	ambient temperature	several months
	Mixed milk drinks	Largely germ--free	> 4,5	chilled	appr. 4 weeks
	Non carbonated soft drinks cold filled	Largely germ free	≤ 4.5	ambient temperature	< 6 months
	Low-acidity apple juice spritzer, without pre-servatives, not cold sterilized, not pasteurized after filling	Free of viable microorganisms	≤ 4.5	ambient temperature	> 6 months
	Dressings fat content < 50%	Free of viable microorganisms	≤ 4.5	ambient temperature	> 6 months
	Ketchup, cold filled (oxygen-proof package)	Free of viable microorganisms	≤ 4.5	ambient temperature	> 6 months
	Savoury sauces, cold filled	Free of viable microorganisms	≤ 4.5	ambient temperature	> 6 months
	Delicatessen salads, without preservatives	Free of spoiling microorganisms	< 4.5	chilled	< 40 days

[12] Data on minimum shelf life of products drawn from practice. For many products microbiological reasons are not limiting for determining minimum shelf life.
[13] Sour milk product according to the German Labeling Directive.
[14] ESL: Extended Shelf Life. ESL milk can, for example, be subjected to ultrapasteurization
[15] In the case of critical products it may be necessary to use machines of class V.

4.5 VDMA Class V - Machines (aseptic packaging machines according to FS NuV No. 11/2006)

Machine class	Product examples	Microbiological state of product	pH	Distribution channel	Minimum shelf life (examples from practice)[16]
V	UHT cream	Germ-free	6.6	ambient temperature	>. 3 months
	UHT milk	Germ-free	6.6	ambient temperature	> 3 months
	Condensed milk	Germ-free	6.5	ambient temperature	up to 9 months
	Mineral water, not carbonated	Largely germ-free as per the German Mineral Water Ordinance	> 6	ambient temperature	12 to 18 months
	Ice tea, not carbonated	Germ-free	> 4.5	ambient temperature	approx. 12 months
	Café au lait,	Germ-free	approx. 6.7	ambient temperature	several months
	Pudding, UHT-heated	Germ-free	approx. 6.7	ambient temperature	up to 12 months
	Sauces, soups	Germ-free	6-7	ambient temperature	several months
	Mixed milk drinks	Germ-free	> 4.5	ambient temperature	> 3 months
	Soya milk	Germ-free	> 4.5	ambient temperature	> 3 months
	Vegetable juice	Germ-free	> 4.5	ambient temperature	> 3 months
	Non carbonated soft drinks	Germ-free	> 4.5	ambient temperature	Several months
	Fruit yogurt	Germ-free	> 4.5	ambient temperature	> 3 months

[16] Data on minimum shelf life of products drawn from practice. For many products microbiological reasons are not limiting for determining minimum shelf life.

5 References

Publications cited are available as downloadable file from www.vdma.org/packtech if not stated otherwise. For English editions please consult the database 'publications'. For German editions please select the German website of VDMA and consult within the section 'Datenbanken' the option 'Publikationen'.

VDMA 8742
Aseptic Packaging Machines for the Food Industry - Minimum Requirements and Basic Conditions for the Intended Operation
German and English
Superseded by VDMA-Fachverbandsschrift Nr. 11/2006
Frankfurt, Germany 2006

Checklist "Quality Assurance and Maintenance" for aseptic filling machines for the food industry
German and English
VDMA-Fachverbandsschriften Nahrungsmittelmaschinen und Verpackungsmaschinen Nr. 3 (English)
Frankfurt, Germany 1997 (Eglish edition 2000)

Two Methods for the Determination of Peroxide - residues in Empty Cups at the filling Machine"
VDMA-Fachverbandsschriften Nahrungsmittelmaschinen und Verpackungsmaschinen Nr. 1
German and English
Frankfurt, Germany 2000

Aseptic Production Lines: Unsterility Risks in Product and Feed Lines - Planning and Installation Faults
VDMA-Fachverbandsschriften Nahrungsmittelmaschinen und Verpackungsmaschinen Nr. 4
German and English
Frankfurt, Germany 2002 (English edition 2003)

Signal exchange for aseptic filling machines - Minimum requirements for safe operation
VDMA-Fachverbandsschriften Nahrungsmittelmaschinen und Verpackungsmaschinen Nr. 5
German and English
Frankfurt, Germany 2002 (English edition 2003)

Code of Practice
Testing the Effectiveness of Aseptic Plants Fitted with Packaging Sterilization Devices
VDMA-Fachverbandsschriften Nahrungsmittelmaschinen und Verpackungsmaschinen Nr. 6
German and English
Frankfurt, Germany 2002 (English edition 2003)

What is HACCP?
VDMA-Fachverbandsschriften Nahrungsmittelmaschinen und Verpackungsmaschinen Nr. 7
German and English
Frankfurt, Germany 2002 (English edition 2003)

Code of Practice
Testing Aseptic Plants: Sterilizing the Sterile Zone in a Machine Interior
VDMA-Fachverbandsschriften Nahrungsmittelmaschinen und Verpackungsmaschinen Nr. 8
German and English
Frankfurt, Germany 2003 (English edition 2004)

Hygienic Filling Machines of VDMA Class IV for Liquid and Viscous Foods
Minimum requirements and basic conditions for operation in accordance with specification
VDMA-Fachverbandsschriften Nahrungsmittelmaschinen und Verpackungsmaschinen Nr. 10
German and English
Frankfurt, Germany 2005

Aseptic Packaging Machines for the Food Industry - Minimum Requirements and Basic Conditions for the Intended Operation
VDMA-Fachverbandsschriften Nahrungsmittelmaschinen und Verpackungsmaschinen Nr. 11
supersedes VDMA 8742
German and English 06
Code of Practice
Frankfurt, Germany 2006

Testing Hygienic Filling Machines of VDMA Class V
External Sterilization of Packaging Materials
VDMA-Fachverbandsschriften Nahrungsmittelmaschinen und Verpackungsmaschinen Nr. 14
German and English
Frankfurt, Germany 2006 (English edition 2007)