RULES FOR
CLASSIFICATION OF

SHIPS

NEWBUILDINGS

SPECIAL EQUIPMENT AND SYSTEMS
ADDITIONAL CLASS

PART 6 CHAPTER 10

VAPOUR CONTROL SYSTEMS

JANUARY 2003
This booklet includes the relevant amendments and corrections shown in the January 2004 version of Pt.0 Ch.1 Sec.3.

CONTENTS PAGE

DET NORSKE VERITAS

Veritasveien 1, NO-1322 Høvik, Norway Tel.: +47 67 57 99 00 Fax: +47 67 57 99 11

CHANGES IN THE RULES

General

This booklet is a reprint of the previous edition and apart from clarifications of text and the inclusion of amendments and corrections, published in the July 2002 edition of Pt.0 Ch.1 Sec.3, no other changes have been made.

This chapter is valid until superseded by a revised chapter. Supplements will not be issued except for an updated list of minor amendments and corrections presented in Pt.0 Ch.1 Sec.3. Pt.0 Ch.1 is normally revised in January and July each year.

Revised chapters will be forwarded to all subscribers to the rules. Buyers of reprints are advised to check the updated list of rule chapters printed in Pt.0 Ch.1 Sec.1 to ensure that the chapter is current.

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CONTENTS

SECTION 1
GENERAL REQUIREMENTS

A. Classification

A 100 Application

101 The rules in this chapter apply to shipboard systems for control of vapour emissions from liquid cargoes.

102 The rules in this chapter are applicable to ships assigned one of the following class notations:

— **Tanker for chemicals**
— **Tanker for oil products**
— **Tanker for oil**

A 200 Class Notations

201 Ships fitted with systems for control of vapour emission from cargo tanks may be given one of the following additional class notations:

VCS-1 Installations meeting the requirements of this chapter except Section 3 B200 and Section 4.

VCS-2 Installations meeting all requirements of this chapter except Section 4.

VCS-3 Installations for onboard vapour processing. Requirements for such installations of the reabsorption and of the reliquefaction type are found in Classification Note No. 61.1. Other types of installations will be subject to special consideration.

202 Ships meeting requirements for vapour balancing according to Sec.4 will have the letter **B** added to the **VCS-1** or **VCS-2** class notations.

A 300 Scope

301 Ships assigned the notation **VCS-1** are considered meeting the requirements of IMO MSC/CIRC. 585.

302 Ships assigned the notation **VCS-2** are considered meeting 301 and in addition USCG's regulations for vapour control systems CFR 46 Part 39.

303 Installations for onboard vapour processing with a minimum recovery rate of 78% of NMVOC (Non Methane VOC) will be assigned the notation **VCS-3**.

B. Definitions.

B 100 Terms

101 *Diluted*: The condition in which the concentration of a flammable gas in a flammable gas/air mixture is less than 50% of the lower explosive limit of the gas.

102 *Flammable cargoes*: Cargoes of crude oils, petroleum products, and chemicals having a flashpoint not exceeding 60°C (closed cup test), as determined by an approved flashpoint apparatus, and a Reid vapour pressure which is below atmospheric pressure and other liquid products having a similar fire hazard.

103 *Inerted*: The condition in which the oxygen content in a flammable gas/air mixture is 8% or less by volume.

104 *Independent*: As applied to two systems means that one system will operate with a failure of any part of the other system except power sources and electrical feeder panels.

105 *Maximum allowable transfer rate*: The maximum volumetric rate at which a tanker may receive cargo or ballast.

106 *Tanker vapour connection*: The point in a tanker's fixed vapour collection system where it connects to a vapour collection hose or arm.

107 *Terminal vapour connection*: The point in a terminal's vapour collection system where it connects to a vapour collection hose or a vapour collection arm.

108 *Vapour balancing*: The transfer of vapour displaced by incoming cargo from the tank of a tanker receiving cargo into a tank of a facility delivering cargo via a vapour collection system.

109 *Vapour collection system*: An arrangement of piping and hoses used to collect vapour emitted from a tanker's cargo tanks and transport the vapour to a vapour processing unit.

110 *Vapour recovery unit*: A vapour processing unit that recovers cargo vapour by a non-destructive means such as lean oil absorption, carbon bed absorption, or refrigeration.

C. Documentation

C 100 Plans and Particulars

101 The following plans and particulars are to be submitted:

1) A diagrammatic drawing of the vapour piping systems giving information about material, dimensions, pressure rating etc. Information about penetrations, joining etc. to be submitted as well.
2) A diagrammatic drawing of the gauging and overfill protection equipment showing:
   — working principle
   — location of electrical equipment in gas dangerous area
   — single line diagram of intrinsically safe equipment
   — use of explosion protected equipment with reference to drawing together with certificates.
3) A diagrammatic drawing of the venting system (I.G.S. system as well if relevant) including necessary data for verifying venting capacities of the P/V valves.
4) Pressure drop calculations comparing cargo transfer rate to pressure drop from the farthest tank to the vapour connection, including any hoses used. Calculation to be made for each cargo handled at the maximum transfer rate and lower. See also Sec. 2 C.
5) Overfill alarm calculations showing time available between alarm setting and overfill at max. loading rate for each tank.
6) Conclusions on max. load rate(s) determined.
7) Fitting and test certificate for detonation flame arrester, if relevant.
8) Specification of typical cable penetrations.
9) Details of insulating flange, if relevant.
10) Instruction Manual.

102 The following control and monitoring systems shall be approved by the Society:

— cargo tank level monitoring system
— vapour Pressure monitoring system.

For requirements to documentation, see Pt.4 Ch.9.

SECTION 2
VAPOUR PIPING SYSTEMS

A. Material

A 100 Permanent Piping

101 Piping material to be as required for cargo tank venting system.

A 200 Flexible Hoses

201 Material of hoses to be resistant to vapours handled.

202 The hoses are to be capable of withstanding at least 0.14 bar vacuum without collapsing and have design burst pressure of at least 2.0 bar.

203 The hoses are to be electrically continuous with a maximum resistance of 10.000 ohms.

B. Vapour Collection Piping

B 100 General

101 Each chemical-, product- or crude carrier is to have vapour collection piping which is permanently installed, with a tanker vapour connection located as close as practical to the loading manifold. In lieu of permanent piping, chemical tankers are permitted to have a permanent vapour connection at each cargo tank for connection to a vapour hose which should be kept as short as practicable, and in no case longer than 3 metres.

102 If a tanker simultaneously collects vapours from cargoes, which react in a hazardous manner with other cargoes, it is to keep these incompatible vapours separate throughout the entire vapour collection system.

103 Means are to be provided to eliminate liquid condensate which may collect in the system, such as draining and collecting liquid from each low point in the line.

104 Vapour collection piping is to be electrically bonded to the hull and to be electrically continuous.

105 When inert gas distribution piping is used for vapour collection piping, means to isolate the inert gas supply from the vapour collection system is to be provided. The inert gas main isolation valve required in Pt.5 Ch.3 Sec.11 C603 may be used to satisfy this requirement.

106 The vapour collection system is not to disable the proper operation of the cargo tank venting system. However, a vapour collection piping may be common or partly common with the vent piping and/or the IGS piping.

B 200 Vapour Manifold

201 See also OCIMF's «Recommendations for Oil Tanker Manifolds and Associated Equipment» (latest edition).

202 An isolation valve capable of manual operation is to be provided at each tanker vapour connection. The operating position of this valve is to be readily determined visually (open/closed indication).

203 The end of each vapour collection pipe or vapour collection hose is to be readily identifiable to prevent misconnection.

204 In order to prevent the possible misconnection of the vapour manifold to a shoreside terminal liquid loading line, each vapour connection flange is to conform to the applicable industry standard (OCIMF). This provision is applicable regardless of the size of the ship.

205 Number and Position

Four vapour connections are to be provided, two on each side of the ship, with presentation flanges at the same height above the deck as the cargo manifold. One vapour connection is to be located forward of the manifold and one located aft of the manifold on each side of the ship.

206 Labelling

The first 1,0 metre inboard of each manifold is to be painted on its exterior surfaces, excluding flange faces. The painted area is to be divided into three bands with the outboard and inboard bands being red and 100mm wide and the centre band being yellow.

C. Capacity

C 100 Pressure Drop Calculations

101 The capacity of the vapour collection system is to be documented through pressure drop/flowrate curves. When calculating pressure drop the following is to be used:

— Vapour growth rate, (VGR) i.e. increase of flowrate due to vapourization of the cargo:

$$VGR = 1 + 0,25 \frac{P_{V,45}}{86,2}$$

$P_{v,45}$ = saturated vapour pressure at 45°C in kPa abs.

— Density of the cargo vapour and air/inert gas mixture ($\delta_{va,45}$):

$$\delta_{va,45} = [\ SG_v\ V_{v,45} + V_{a,45}\ ]\ 0,0324\ P_{p/v}$$

SG_v = specific gravity of cargo vapour.

$V_{v,45}$ = partialvolume of vapour at $45^oC = \frac{P_{v,45}}{P_{t,45}}$

$P_{t,45}$ = total vapour air pressure at 45°C in kPa abs.

$V_{a,45}$ = partial volume of air at 45°C = 1 - $V_{v,45}$

$P_{p/v}$ = cargo tank P/V valve pressure setting in kPa abs.

— Maximum cargo tank pressure of 80% of opening pressure of the P/V valves.

Guidance note:

- For oil carriers calculations using mixture density of 3,0 kg/m^3 and vapour growth rate of 1,25 will cover all cargoes the ship may carry.
- For chemical carriers mixture density of 3,6 kg/m^3 and vapour growth rate of 1,2 will cover all chemicals except those with a Reid's vapour pressure above atmospheric (IBC Code 15.14). For these cargoes additional calculations are needed using values applicable for the actual cargoes. See Appendix B.

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Guidance note:

Appendix B lists density and vapour growth values for a range of actual cargoes.

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SECTION 3
INSTRUMENTATION

A. Cargo Gauging

A 100 Cargo Tank Gauging Equipment

101 Each cargo tank of a tanker that is connected to a vapour collection system is to be equipped with a cargo gauging device which:

— provides a closed gauging arrangement that does not require opening the tank to the atmosphere during cargo transfer;
— allows the operator to determine the liquid level in the tank for the full range of liquid levels in the tank;
— indicates the liquid level in the tank, at the location where cargo transfer is controlled.

(This requirement will be complied with if a corresponding requirement elsewhere in the Rules is satisfied).

B. Cargo Tank Level Alarms

B 100 High level alarm

101 Each cargo tank of a tanker is to be equipped with a high level alarm system.

102 The high level alarm system required by 101 is to:

— be independent of the cargo gauging system (for notation **VCS-1, VCS-2** and **VCS-3**). For **VCS-2**, a high level alarm system integral with the cargo gauging system is accepted. Ref. also to Pt.5 Ch.3 Sec.9 C100.
— come into operation when the normal tank loading procedures fail to stop the tank liquid level exceeding the normal full condition;
— give a visual and audible tank high level alarm to the ship's operator;
— have alarms fitted in the cargo control room, where provided, but in each case in such a position that they are immediately received by responsible members of the crew;
— alarm in the event of loss of power to the alarm system or failure of the electrical circuitry to the tank level sensor;
— be able to be function tested at the outside of the tank for proper operation prior to each transfer or contain an electronic self-testing feature which monitors the condition of the alarm circuitry and sensor.

B 200 Overfill Alarm

201 Each cargo tank of a tanker is to be equipped with an overfill alarm system (High-high level).

202 The overflow control system required by 201 is to:

— be independent of the cargo gauging system and the high level alarm system.
— come into operation after the high level alarm, but early enough to allow for action to prevent tank overflow.
— give a visual and audible tank overfill alarm to the ship's operator.
— have alarms fitted in the cargo control room, where provided, and in the cargo deck area.
— alarm in the event of loss of power to the alarm system or failure of the electrical circuitry to the tank level sensor;
— be able to be checked at the tank for proper operation prior to each transfer or contain and electronic self-testing feature which monitors the condition of the alarm circuitry and sensor.

C. Vapour Pressure Alarms

C 100 General

101 Each tank ship vapour collection system is to be fitted with a pressure sensing device that senses the pressure in the main vapour collection line, which:

— has a pressure indicator located on the vessel where the cargo transfer is controlled;
— has a high pressure and a low pressure alarm that:
  — Is audible and visible on the vessel where cargo transfer is controlled;
  — Alarms at a high pressure of not more than 90 percent of the lowest pressure relief valve setting in the cargo tank venting system;
  — Alarms at a low pressure of not less than 100 mm WG for an inerted tankship, or the lowest vacuum relief valve setting in the cargo tank venting system for a non-inerted tankship.

102 Pressure sensors fitted in each cargo tank are acceptable as equivalent to pressure sensors fitted in each main vapour collection line.

SECTION 4
VAPOUR BALANCING

A. General

A 100 Application

101 Requirements in this section apply to ship's engaged in the transportation of bulk liquid cargoes between a facility and another ship and vice versa.

A 200 Definitions

201 Definition of *"service vessel"*

A service vessel is a vessel, which in a lightering operation transports products between another vessel and a facility or vice versa.

B. Design and Equipment

B 100 General

101 If the cargo tanks on a ship discharging cargo and a ship receiving cargo are inerted, the service vessel must:

— have a means to inert the vapour transfer hose prior to transfering cargo vapour;

— have an oxygen analyser with a sensor or sampling connection fitted within 3 metres of the ship vapour connection which:

  — activates an audible and visible alarm at a location on the service vessel where cargo transfer is controlled when the oxygen content in the vapour collection system exceeds 8 percent by volume;
  — has an oxygen concentration indicator located on the service vessel where the cargo transfer is controlled;
  — has a connection for injecting a span gas of known concentration for calibration and testing of the oxygen analyser. (The installation of the oxygen analyser is to be specially considered).

102 If the cargo tanks on a ship discharging cargo are not inerted the vapour collection line on the service vessel is to be fitted with an approved detonation arrester located within 3 metres of the ship vapour connection.

103 An electrical insulating flange or one length of non- conductive hose is to be provided between the ship vapour connection on the vessel and the vapour connection on the ship being lightered or topped-off.

SECTION 5
OPERATIONAL INSTRUCTIONS

A. Instruction Manual

A 100 Operational Instruction

101 Each tanker utilizing a vapour emission control system is to be provided with written operational instructions covering the particular system installed on the tanker. The instructions are to encompass the purpose and principles of operation of the vapour emission control system and provide an understanding of the equipment involved and associated hazards. In addition the instructions are to provide an understanding of operating procedures, piping connection sequence, start-up procedures, normal operations and emergency procedures. Instructions are also to include an understanding of the shoreside terminal equipment and operating procedures. The instructions are to be available in English.

102 Instructions are to contain information on the tanker's vapour collection system including:

— a line diagram of the tanker's vapour collection piping indicating the locations and purpose of all control and safety devices;
— the maximum allowable transfer rate as limited by the venting capacity of the pressure or vacuum relief valves, or any other factor which would limit the transfer rate;
— the maximum pressure drop in the ship's vapour collection system for various transfer rates,
— the relief settings of each pressure and vacuum relief valve;
— pre-transfer procedures,
— procedures to be followed in the event of a fault during vapour collection operations.

103 In Appendix A important operational limitations and conditions are given which are to be reflected in the Instructions.

APPENDIX A
OPERATIONAL LIMITATIONS AND CONDITIONS TO BE REFLECTED IN THE INSTRUCTION MANUAL

A. General

A 100 Procedures

101 Established industry guidelines are to be observed, as applicable, with regard to preparation for transfer, and transfer of cargo and of ballast into cargo tanks.

102 The rate of cargo transfer is not to exceed the maximum allowable transfer rate as determined by the lesser of the following:

— the venting capacity of the pressure relief valves in the cargo tank venting system divided by a factor of at least 1,25
— the vacuum relieving capacity of the vacuum relief valves in the cargo tank venting system
— the rate based on pressure drop calculations for a given pressure at the facility vapour connection, such that the pressure in any cargo tank connected to the vapour collection system does not exceed 80% of the opening set pressure of any pressure relief valve in the cargo tank venting system.

Guidance note:

When the venting capacity is dimensioned for thermal breathing only, we regard the capacity of a P/V breaker required by SOLAS for IG systems, as the basis for venting in the determination of the total permissible loading rate.

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103 A cargo tank is not to be filled higher than the level at which the overfill alarm is set.

104 A cargo tank is not to be opened to the atmosphere for gauging or sampling while the tanker is connected to a vapour emission control system unless loading to the tank is stopped, the tank is isolated from any other tank which is in the process of being loaded, and precautions are taken to reduce any pressure in the cargo tank vapour space and prevent an electrostatic spark from occurring.

105 If the tanker is equipped with an inert gas system the isolation valve required in Pt.5 Ch.3 Sec.11 C603 is to remain closed during vapour transfer.

106 Unless equipped with an automatic self-test and circuit monitoring feature, each tank level alarm system required by Section 3B on a cargo tank being loaded, is to be tested at the tank for proper operation prior to the start of cargo transfer.

APPENDIX B
LIST OF CARGOES — VAPOUR CONTROL

A. General

A 100 List of Cargoes

101 This list covers a range of cargoes normally carried, and gives vapour pressure and specific gravity, as well as density of vapour/air mixture and vapour growth rate at 45°C.

Chemical name	*Vapour pressure 45° C kPa, abs.*	*Vapour specific gravity*	*Vap/air density 45° C (kg/m^3)*	*Vapour growth rate*
Acetic acid	6,34	2,07	1,413	1,02
Acetic anhydride	2,76	3,50	1,414	1,01
Acetone	68,95	2,00	2,098	1,20
Acetone cyanohydrin	2,76	2,90	1,396	1,01
Acetonitrile	0,21	1,41	1,339	1,00
Acrylic acid	2,76	2,48	1,383	1,01
Acrylonitrile	34,47	1,80	1,642	1,10
Adiponitrile	0,07	3,73	1,340	1,00
Allyl alcohol	12,41	2,00	1,475	1,04
Allyl chloride	73,08	2,64	2,660	1,21
Aminoethylethanolamine	0,07	3,59	1,340	1,00
Amyl acetate (commercial, iso-, n-, sec-)	2,34	4,50	1,429	1,01
Amyl acetate (iso-)	2,34	4,50	1,429	1,01
Amyl acetate (n-)	2,34	4,50	1,429	1,01
Aniline	0,28	3,22	1,345	1,00
Benzene (50/50 mix air)	31,03	2,80	2,542	1,09
Benzene, Toluene, Xylene mixture (10% Benzene or more)	50,33	2,80	2,337	1,15
Benzyl chloride	0,62	4,36	1,361	1,00
Butyl acetate (n-)	5,52	4,00	1,521	1,02
Butyl acetate (iso-, n-)	4,14	4,00	1,475	1,01
Butyl acetate (sec-)	10,34	4,00	1,680	1,03
Butyl acrylate (iso-, n-)	4,14	4,42	1,494	1,01
Butyl alcohol (iso-)	6,21	2,60	1,448	1,02
Butyl alcohol (n-)	3,45	2,60	1,399	1,01
Butyl alcohol (sec-)	8,96	2,60	1,496	1,03
Butyl alcohol (tert-)	19,31	2,60	1,679	1,06
Butyl benzyl phtalate	0,07	10,80	1,346	1,00
Butyl ether (n-)	2,76	4,50	1,445	1,01
Butyl methacrylate	2,00	4,90	1,424	1,01
Butylamine (all isomers) (vap. press. varies betw. 3.2 - 15)	68,95	2,50	2,479	1,20
Butylene glycol	0,07	3,10	1,340	1,00
Butylene oxide (1,2-)	49,64	2,49	2,154	1,14
Butyraldehyde (iso-, n-)	55,16	2,48	2,238	1,16
Butyraldehyde (n-, crude)	55,16	2,48	2,238	1,16
Butyraldehydes (crude)	55,16	2,48	2,238	1,16
Butyric acid	0,48	3,04	1,349	1,00
Caprolactam solutions	4,83	3,90	1,492	1,01
Carbon disulfide	3,45	2,67	1,400	1,01
Carbon tetrachloride	37,23	5,49	3,181	1,11
Chlorobenzene	5,52	3,88	1,513	1,02
Chloroform	62,05	4,25	3,562	1,18
Chlorosulfonic acid	0,55	4,00	1,356	1,00
Creosote (all isomers)	0,07	3,72	1,340	1,00
Creosote (cole tar)	0,07	3,72	1,340	1,00
Creosote (wood)	0,07	3,72	1,340	1,00
Cresols	0,41	3,72	1,351	1,00
Crotonaldehyde	13,79	2,41	1,552	1,04
Cumene	4,14	4,20	1,484	1,01
Cyclohexane	31,03	2,90	1,988	1,09
Cyclohexanol	1,38	3,50	1,376	1,00
Cyclohexanone	1,38	3,40	1,375	1,00
Cyclohexylamine	4,27	3,42	1,452	1,01
Cymene (para)	3,17	4,62	1,465	1,01
Decaldehyde (iso-)	0,41	5,38	1,358	1,00
Decyclo-pentadiene	1,72	4,55	1,406	1,01
Decyl alcohol (all isomers)	0,07	5,30	1,341	1,00
Decyl alcohol (iso-)	0,07	5,30	1,341	1,00
Decyl alcohol (n-)	0,07	5,30	1,341	1,00
Decyl acrylate (iso-, n-)	0,07	7,30	1,343	1,00
Diacetone alcohol	0,69	4,00	1,361	1,00
Dibutylamine	1,24	4,46	1,385	1,00
Dichlorobenzene (all isomers)	0,69	5,07	1,369	1,00
Dichloroethane (1,1-)	68,26	3,41	3,152	1,20

Chemical name	*Vapour pressure 45° C kPa, abs.*	*Vapour specific gravity*	*Vap/air density 45° C (kg/m3)*	*Vapour growth rate*
Dichloroethyl ether (2,2-)	0,28	4,90	1,350	1,00
Dichloro-methane	131,00	3,00	4,227	1,38
Dichlorophenol (2,4-)	0,07	5,60	1,342	1,00
Dichloropropane (1,2-)	17,24	3,89	1,887	1,05
Dichloro-propene (1,3-)	37,92	3,84	2,526	1,11
Diethanolamine	0,07	3,65	1,340	1,00
Diethylamine	6,89	2,50	1,452	1,02
Diethylbenzene	0,55	4,62	1,360	1,00
Diethylene glycol	0,07	3,66	1,340	1,00
Diethylene glycol butyl ether	0,07	5,50	1,342	1,00
Diethylene glycol ethyl ether	0,07	4,62	1,341	1,00
Diethylene glycol methyl ether	0,14	4,14	1,343	1,00
Diethylenetriamine	0,28	3,48	1,346	1,00
Diethylethanolamine	1,03	4,03	1,373	1,00
Diisobutyl ketone	3,31	4,90	1,480	1,01
Diisobutylamine	3,17	4,46	1,459	1,01
Diisobutyl-carbinol	0,69	4,98	1,368	1,00
Diisobutylene	15,17	3,97	1,835	1,04
Diisopropanolamine	0,07	4,59	1,341	1,00
Diisopropylamine	25,51	3,50	2,041	1,07
Diethylamine solution (45% or less)	70,33	1,55	1,765	1,20
Dimethylformamide	2,07	2,51	1,373	1,01
Dioctyl phtalate	0,07	13,45	1,348	1,00
Dioxane (1,4-)	12,41	3,00	1,612	1,04
Diphenyl, Diphenyl ether mixture	0,07	5,87	1,342	1,00
Diphenylmethane diisocyanate	0,07	8,50	1,344	1,00
Dipropyl-ene glycol	0,48	4,63	1,357	1,00
Dipropyl-ene glycol dibenzoate	0,07	8,50	1,344	1,00
Dodecene	0,14	5,81	1,345	1,00
Dodecyl-benzene	32,41	8,40	3,982	1,09
Epichloro-hydrin	6,89	3,19	1,505	1,02
Ethanol-amine	0,21	2,10	1,341	1,00
Ethoxy triglycol (crude)	0,07	6,14	1,342	1,00
Ethyl acetate	31,03	3,04	2,036	1,09
Ethyl acrylate	13,79	3,50	1,718	1,04
Ethyl alcohol	24,13	1,60	1,498	1,07
Ethyl butanol	0,97	3,40	1,364	1,00
Ethyl ether	158,58	2,55	4,049	1,46
Ethyl hexanol (2-)	0,14	4,50	1,343	1,00
Ethyl methacrylate	6,89	3,94	1,562	1,02
Ethyl-3-propylacro-lein (2-)	0,83	4,35	1,369	1,00
Ethylamine	281,31	1,55	3,044	1,82
Ethylamine solution (72% or less)	106,87	1,56	1,998	1,31
Ethylben-zene	4,14	3,56	1,455	1,01
Ethylbuty-lamine (n-)	8,27	3,50	1,566	1,02
Ethylene chlorohyd-rine	3,03	2,78	1,398	1,01
Ethylene cyanohyd-rin	0,07	2,45	1,339	1,00
Ethylene dibromide	0,48	6,50	1,367	1,00
Ethylene dichloride	27,58	3,42	2,074	1,08
Ethylene glycol	0,07	2,21	1,339	1,00
Ethylene glycol butyl ether	22,08	4,07	2,085	1,06
Ethylene glycol ethyl ether	1,17	3,10	1,365	1,00
Ethylene glycol methyl ether	4,14	2,62	1,412	1,01
Ethylenediamine	6,21	2,10	1,413	1,02
Ethylhexyl acrylate (2-)	0,14	6,35	1,346	1,00
Ethylidene norbornene	2,28	4,10	1,416	1,01
Formalde-hyde solution (37% to 50%)	1,03	1,03	1,338	1,00
Formic acid	14,48	1,60	1,434	1,04
Furfural	1,03	3,31	1,364	1,00
Furfuryl alcohol	0,69	3,37	1,356	1,00
Gasoline blending stocks: Alkylates (50/50 mix air)	86,18	3,40	2,944	1,25
Gasoline blending stocks: Reformates (50/50 mix air)	86,18	3,40	2,944	1,25
Gasolines: Automotive (< 4,23 grams lead/gallon) (50/50 mix air)	86,18	3,40	2,944	1,25
Gasolines: Aviation (< 4,86 grams lead/gallon) (50/50 mix air)	86,18	3,40	2,944	1,25
Gasolines: Casinghead (natural) (50/50 mix air)	86,18	3,40	2,944	1,25

Chemical name	*Vapour pressure 45° C kPa, abs.*	*Vapour specific gravity*	*Vap/air density 45° C (kg/m3)*	*Vapour growth rate*
Gasolines: Polymer (50/50 mix air)	86,18	3,40	2,944	1,25
Gasolines: Straight run (50/50 mix air)	86,18	3,40	2,944	1,25
Glycerine	0,07	3,17	1,340	1,00
Heptane (all isomers)	17,24	3,45	1,804	1,05
Heptane (n-)	17,24	3,45	1,804	1,05
Hexamethylenediami-ne solution	0,07	1,00	1,338	1,00
Hexane (all isomers) (average vap. press., real: 7 - 9)	55,16	3,00	2,555	1,16
Hexane (average vap. press., real: 7 - 9)	55,16	3,00	2,555	1,16
Hexanol (1-)	6,89	3,52	1,530	1,02
Hydrochloric acid	72,39	1,26	1,546	1,21
iso-Butyraldehyde	55,16	2,48	2,238	1,16
iso-Propylamine	159,27	2,04	3,165	1,46
Isophorone	0,07	4,75	1,341	1,00
Isoprene	158,58	2,35	3,699	1,46
Kerosene	1,03	4,50	1,378	1,00
Light virgin Naphta	96,53	0,66	0,976	1,28
Mesityl oxide	4,62	3,50	1,465	1,01
Methacrylic acid	0,69	2,50	1,350	1,00
Methacrylo-nitrile	74,46	1,17	1,478	1,22
Methyl acetate	42,06	2,60	2,080	1,12
Methyl acrylate	28,27	3,00	1,962	1,08
Methyl alcohol	48,26	1,11	1,397	1,14
Methyl ethyl ketone	31,03	2,50	1,851	1,09
Methyl isobutyl ketone	8,27	3,45	1,562	1,02
Methyl methacrylate	13,93	3,45	1,714	1,04
Methyl-5 -ethyl-pyridine (2-)	1,10	4,18	1,377	1,00
Methyl-6 -ethyl-aniline (2-)	0,07	4,67	1,341	1,00
Methylamine solution, 40%	89,63	1,07	1,407	1,26
Methylamyl acetate	2,34	5,00	1,441	1,01
Methylamyl alcohol	2,76	3,50	1,414	1,01
Methylpyridine (2-)	3,45	3,20	1,422	1,01
Methylstyrene (alpha-)	2,76	4,08	1,432	1,01

Chemical name	*Vapour pressure 45° C kPa, abs.*	*Vapour specific gravity*	*Vap/air density 45° C (kg/m3)*	*Vapour growth rate*
Mineral spirits (average vapour s.g.)	1,38	4,15	1,386	1,00
Morpholine	5,52	3,00	1,460	1,02
Naphthalene (molten)	0,07	4,42	1,341	1,00
Nitric acid (70% or less)	24,82	2,17	1,658	1,07
Nitrobenzene	0,14	4,24	1,343	1,00
Nitropropane (1- or 2-)	7,24	3,06	1,503	1,02
Nitrotoluene (o-, p-)	0,14	4,72	1,344	1,00
Nonane	2,76	4,41	1,442	1,01
Nonene	2,41	4,30	1,426	1,01
Nonyl phenol	0,07	7,59	1,343	1,00
Octyl alcohol (iso-)	0,21	4,50	1,346	1,00
Octyl nitrates (all isomers)	2,14	6,00	1,456	1,01
Oil, edible: Castor	1,03	10,00	1,441	1,00
Oil, misc.: Crude	1,03	1,00	1,338	1,00
Oleum	0,07	2,76	1,339	1,00
Paraldehyde	57,23	4,55	3,578	1,17
Pentadiene (1,3-)	117,62	2,36	3,102	1,34
Pentane (all isomers)	144,79	2,48	3,701	1,42
Pentane (iso-)	186,16	2,48	4,376	1,54
Perchloroethylene	8,48	5,83	1,790	1,02
Phenol, or solutions with 5% or more Phenol	4,14	3,24	1,440	1,01
Phosphoric acid	0,07	3,38	1,340	1,00
Phthalic anhydride (molten)	0,07	5,10	1,341	1,00
Propanolamine (iso-, n-)	0,55	2,59	1,348	1,00
Propionaldehyde	96,53	2,00	2,402	1,28
Propionic acid	2,07	2,56	1,374	1,01
Propionic anhydride	0,07	4,49	1,341	1,00
Propionitrile	16,55	1,40	1,411	1,05
Propyl acetate (iso-)	21,37	3,52	1,932	1,06
Propyl acetate (n-)	13,10	3,52	1,702	1,04
Propyl alcohol (iso-)	20,68	2,07	1,582	1,06
Propyl alcohol (n-)	8,27	2,07	1,436	1,02
Propylamine (n-)	92,39	2,04	2,398	1,27
Propylene oxide	151,68	2,00	3,011	1,44
Pyridine	8,96	2,72	1,508	1,03
Sodium hydrosulfide solution (45% or less)	10,41	1,17	1,358	1,03

Chemical name	*Vapour pressure 45° C kPa, abs.*	*Vapour specific gravity*	*Vap/air density 45° C (kg/m$^{3)}$*	*Vapour growth rate*
Sorbitol solution	0,07	3,20	1,340	1,00
Styrene	2,76	3,60	1,417	1,01
Styrene (crude)	2,76	3,60	1,417	1,01
Sulfuric acid	0,07	3,40	1,340	1,00
Tetrachloroethane (1,1,2,2-)	6,89	5,80	1,703	1,02
Tetraethylene glycol	0,07	6,70	1,342	1,00
Tetraethylenepentamine	0,07	6,80	1,343	1,00
Tetrahydrofuran	58,61	1,35	1,564	1,17
Tetrahydronaphtalene	0,28	4,55	1,349	1,00
Toluene	10,34	3,14	1,582	1,03
Toluene diisocyanate	0,07	6,00	1,342	1,00
Trichlorobenzene (1,2,4-)	0,07	6,26	1,342	1,00
Trichloroethane (1,1,1-)	33,78	4,60	2,679	1,10
Trichloro-ethylene	24,13	4,54	2,280	1,07
Trichloropropane (1,2,3-)	1,03	5,60	1,391	1,00
Tricresyl phosphate (1% or more of ortho isomer)	0,07	12,70	1,347	1,00
Tricresyl phosphate (less than 1% of ortho isomer)	0,07	12,70	1,347	1,00
Tridecanol	0,07	6,70	1,343	1,00
Triethanolamine	0,07	5,14	1,341	1,00
Triethylamine	17,24	3,49	1,811	1,05
Triethylbenzene	0,34	5,60	1,356	1,00
Triethylene glycol	0,07	5,17	1,341	1,00
Triethylene glycol methyl ether	0,07	5,66	1,342	1,00
Triethylenetetramine	0,07	5,04	1,341	1,00
Tripropylene glycol	0,07	6,63	1,342	1,00
Turpentine	0,28	4,84	1,350	1,00
Valeraldehyde (iso-, n-)	12,41	2,96	1,606	1,04
Valeraldehyde (n-)	12,41	2,96	1,606	1,04
Vinyl acetate	39,99	2,97	2,207	1,12
Vinyl ethyl ether	143,41	2,49	3,694	1,42
Vinylidene chloride	165,47	3,34	5,608	1,48
Vinyltoluene	0,83	4,08	1,366	1,00
Xylene (m-)	3,52	3,66	1,441	1,01
Xylene (p-)	3,52	3,66	1,441	1,01
Xylene (o-)	2,76	3,66	1,419	1,01