MILJØstyrelsen

hcl/Kemikalier
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Zink (CAS nr. 7440-66-6). Fastsættelse af vandkvalitetskriterier

Vandkvalitetskriterie, ferskvand: 7,8 µg/l tilføjet
(Evt. kan BLM model benyttes, se tekst)
Vandkvalitetskriterie, ferskvand blødt vand (H< 24 mg $CaCO_3$/l): 3,1 µg/l tilføjet

Vandkvalitetskriterie, saltvand: 7,8 µg/l tilføjet

Korttidsvandkvalitetskriterie: 8,4 µg/l tilføjet

English Summary

PNECs from the draft EU-risk assessment report (EU-RAR) are used as water quality standards (WQS) for fresh water and salt water. AS the WQS may get close to the natural background level the added approach is applied. Thus the WQS are values that may be added to the natural background level. In accordance with EU-RAR, a BLM model may also be applied if data are available for a given freshwater body for at least DOC, Ca, pH and Zn.
The maximum acceptable concentration (MAC) has been calculated as the median 5th percentile from the species sensitivity distribution (EC50) deriving a Kp value to which a factor 5 has been applied.
As Zn is effectively regulated in living organisms it has not been possible to establish a BCF value, and a $PNEC_{secondary\ poisoning\ water}$ cannot be calculated. The latter value thus cannot be used as an upper limit for the WQS.

$WQS_{freshwater}$:	7.8 µg/l added
$WQS_{freshwater,\ soft(<24\ mg\ CaCO3/l)}$:	3.1 µg/l added
$WQS_{salt\ water}$:	7.8 µg/l added
MAC:	8.4 µg/l added

Brug af stoffet:

Følgende tabel over brugen af metallisk zink er taget fra udkastet til EU-risikovurdering, sept. 2006:

*Table **Fejl! Ingen tekst med den anførte typografi i dokumentet.**.1 Industrial and use categories of zinc metal in the EU*

Industrial category	**EC no.**	**Use category**	**EC no**
Chemical Industry: basic chemicals	2		
Chemical industry: chemicals used in synthesis	3	Intermediates Laboratory chemicals	33 34
Electrical/electronic engineering industry	4	Conductive agents	12
Personal/domestic	5	Absorbents and adsorbents	1
Metal extraction, refining and processing industry	8	Electroplating agents Others: Production of brass and other zinc alloys	17 55
Paints, lacquers and varnishes industry	14	Absorbents and adsorbents Colouring agents Corrosion inhibitors Reprographic agents	1 10 14 45
Others: Basic metal used in metal industry	15	Corrosion inhibitors Others: Pyrotechnical use	14 55

Opløselighed i vand: Følgende opløselighed er angivet for fint zinkpulver i udkastet til EU-risikovurdering:

Table 1.1 Measured and calculated dissolved zinc ion concentration after 8 and 7 days, respectively, at loading rates of 1, 10 and 100 mg zinc powder/l (LISEC, 1997).

Very fine zinc powder Particle size: 6.85 µm[1]	**Measured concentration after 8 days (mg/l)**	**Calculated concentration after 7 days (mg/l)** [2,3]
Loading rate (mg/l)		
1	0.422	0.459
10	0.949	0.95
100	2.137	-[4]

1. Test was conducted in sterilised algae medium (OECD 201).

2. The time-dependent concentration (C_t) was calculated with the following first-order equation: $C_t = C_\infty(1-e^{(-kt)})$, C_∞ is the steady-concentration , k is a first-order rate constant, and t is time. The parameters of this formulae were determined by statistical analysis of the results.

3. The calculated concentrations after 7 days are slightly higher than the measured concentrations after 8 days; due to variation in the experimental data points not every point will be exactly predicted.

4. The results could not be fitted in a first order model because of the great variations in the measured dissolved zinc ion concentrations.

Giftighed overfor vandorganismer (EC_{50}, NOEC, EC_x, PNEC osv.):
Følgende data for akut giftighed er taget fra udkastet til EU-risikovurdering, 2006:

TABLE 1: SHORT-TERM AQUATIC TOXICITY OF ZINC TO ALGAE, CRUSTACEANS AND FISH (accepted studies)

Species	anal.	Test type	test subst[1]	Purity[2]	pH	hardness	test water	exp. time	Criterion	value (mg/l)[3]	reference [4]
Algae											
Selenastrum capricornutum	Y	S	ZnO**	99.4%	7.5	24	am	72 h	E_rC_g50	0.136	Van Ginneken, 1994a
Selenastrum capricornutum	Y	S	Zn Powder	98.4%	7.4	24	am	72 h	E_rC_g50	0.150	Van Woensel, 1994a
Crustacea											
Daphnia magna	Y	F		-	6.95	130	dt	48 h 96 h	LC50 LC50	0.80 0.068	Attar & Maly, 1982
Daphnia magna	Y	S		rg	7.7	45.3	-	48 h	LC50	0.10	Biesinger & Christensen, 1972
Daphnia magna	Y	S s		rg	7.55	45	dt	48 h	LC50	0.28	Cairns et al., 1978
Daphnia magna	Y	S s	ZnBr2	ag	8.5	180-200	-	48 h	LC50	0.86	Magliette et al., 1995
Daphnia magna	N	S s		-	7.2-7.4	45	nw	48 h	LC50	0.068	Mount & Norberg, 1984
Daphnia magna	N	-		rg	8.4	52	-	72 h	LC50	0.14	Paulauskis & Winner, 1988
Daphnia magna	N	-		rg	8.3	102	-	72 h	LC50	0.21	Paulauskis & Winner, 1988
Daphnia magna	N	-		rg	8.3	197	-	72 h	LC50	0.34	Paulauskis & Winner, 1988
Daphnia magna	Y	S s	Zn	98.4%	7.7	262	-	48 h	EC50	0.15-0.5	Vos, 1994

Species	anal.	Test type	test subst[1]	Purity[2]	pH	hardness	test water	exp. time	Criterion	value (mg/l)[3]	reference [4]
			powder								
Daphnia pulex	Y	S s			7.55	45	dt	48 h	LC50	0.50	Cairns et al., 1978
Daphnia pulex	N	S s			7.2-7.4	45	nw	48 h	LC50	0.107	Mount & Norberg, 1984
Ceriodaphnia reticulata	N	S			7.2-7.4	45	nw	48 h	LC50	0.076 b	Mount & Norberg, 1984
Ceriodaphnia dubia	N	S			6-6.5	280-300	rw	48 h	LC50	> 0.530 b	Schubauer-Berigan et al., 1993
Ceriodaphnia dubia	N	S			7-7.5	280-300	rw	48 h	LC50	0.360 b	Schubauer-Berigan et al., 1993
Ceriodaphnia dubia	N	S			8-8.5	280-300	rw	48 h	LC50	0.095 b	Schubauer-Berigan et al., 1993
Pisces											
Cyprinus carpio	Y	S			8.0	55	-	96 h	LC50	7.8	WHO, 1996
Oncorhynchys kisutch, 0.47 g	N	S		rg	7.1-8.0	41	rw	96 h	LC50	0.82	Buhl & Hamilton, 1990
Oncorhynchys kisutch, 0.63 g	N	S		rg	7.1-8.0	41	rw	96 h	LC50	1.81	Buhl & Hamilton, 1990
Oncorhynchys kisutch, 0 94 g	N	S		rg	7.1-8.0	41	rw	96 h	LC50	1.65	Buhl & Hamilton, 1990
Oncorhynchus mykiss, 0.6 g	N	S		rg	7.1-8.0	41	rw	96 h	LC50	0.17	Buhl & Hamilton, 1990

Species	anal.	Test type	test subst[1]	Purity[2]	pH	hardness	test water	exp. time	Criterion	value (mg/l)[3]	reference [4]
Oncorhynchus mykiss, juve-nile	N	F			7.1	23	-	96 h	LC50	0.136	WHO, 1996
Oncorhynchus mykiss, juve-nile	N	F			6.8	26	-	96 h	LC50	0.43	WHO, 1996
Oncorhynchus mykiss 25-70 g,	Y	F			7.3	137	-	96 h	LC50	2.6	WHO, 1996
Oncorhynchus mykiss, 160-290 g	Y	F			7.1	143	-	96 h	LC50	2.4	WHO, 1996
Pimephales promelas	N	S			6-6.5	280-300	rw	96 h	LC50	0.780	Schubauer-Berigan & Dierkes, 1993
Pimephales promelas	N	S			7-7.5	280-300	rw	96 h	LC50	0.330	Schubauer-Berigan & Dierkes, 1993
Pimephales promelas	N	S			8-8.5	280-300	rw	96 h	LC50	0.500	Schubauer-Berigan & Dierkes, 1993
Pimephales promelas, 0.0 8 g	N	F			7.8	220	-	96 h	LC50	2.61	WHO, 1996
Thymallus arcticus, 0.20 g	N	S			7.1-8.0	41	rw	96 h	LC50	0.14	Buhl & Hamilton, 1990
Thymallus arcticus, 0.85 g	N	S			7.1-8.0	41	rw	96 h	LC50	0.17	Buhl & Hamilton, 1990

1. If not indicated otherwise the tests were performed with either zinc chloride or zinc sulphate.
2. Purity is not checked for all studies.
3. The L(E)C50s are based on dissolved zinc.
4. References are listed in Annex 1.3.2 b

* Red seal grade

** EPM-grade

a: temperature 10 °C, Daphnia species originating from alpine lake

b: Assumed that dissolved zinc concentration in culture conditions were similar to test conditions.
ag: analytical grade;
rg: reagent grade
nw: natural water
rw: reconstituted water
am: artificial medium
dt: dechlorinated tap water
g: growth (r= growth rate; b = biomassa)
s: conducted according to standard test method, i.e EPA or OECD
S: static test
F: flow through test
Y: yes
N: no

Følgende data for kronisk giftighed i ferskvand er fra udkastet til EU-risikovurdering, 2006:

Table 3.3.2.a. Chronic toxicity of zinc to freshwater organisms: NOEC values

Part I: Studies useful for freshwater $PNEC_{add,\ aquatic}$ derivation

Organism & life stage	A	Test-type	Test-comp.	Test-water	pH	Hard-ness	Exp.-time	Criterion	Result (µg Zn/l)
Algae (unicellular)									
Pseudokirchneriella subcapitata	+	S	Zn powder	art. (OECD; no EDTA)	7.4	24	3-d	$NOEC_g$	**50** (actual) Van Woensel '94a [56]
Pseudokirchneriella subcapitata	+	S	ZnO (EPM-grade)	art. (OECD; no EDTA)	7.5	24	3-d	$NOEC_g$	**24** (actual) Van Ginneken '94a [57b,58,59]
Pseudokirchneriella subcapitata (code: Na-2.7 nM)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	7.5	24	3-d	$NOEC_g$[e]	**5.4** (actual) [64a] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: Ca-1.0 mM)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	7.5	112	3-d	$NOEC_g$[e]	**5.2** (actual) [64b] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: Ca-1.5 mM)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	7.5	162	3-d	$NOEC_g$[e]	**5.5** (actual) [64c] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: Ca-2.0 mM)	+	S	$ZnCl_2$ (OECD;	art. no EDTA)	7.5	212	3-d	$NOEC_g$[e]	**5.5** (actual) [64d] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: Mg-0.5 mM)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	7.5	62	3-d	$NOEC_g$[e]	**5.2** (actual) [64e] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: Mg-1.0 mM)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	7.5	112	3-d	$NOEC_g$[e]	**8.6**(actual) [64f] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: Mg-1.5 mM)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	7.5	162	3-d	$NOEC_g$[e]	**7.7** (actual) [64g] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: Mg-2.0 mM)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	7.5	212	3-d	$NOEC_g$	**8.5**(actual) [64h] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (fcode: Na-3.2 mM)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	7.5	24	3-d	$NOEC_g$[e]	**6.8**(actual) [64i] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: Na-3.7 mM)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	7.5	24	3-d	$NOEC_g$[e]	**7.9**(actual) [[64j] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: Na-4.7 mM)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	7.5	24	3-d	$NOEC_g$	**7.4**(actual) [64k] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella	+	S	$ZnCl_2$	art.	7.5	24	3-d	$NOEC_g$[e]	**4.9**(actual) [64l]

subcapitata (code: Na-7.2 mM)				(OECD; no EDTA)					De Schamphelaere et al.,'03 [64]	
Pseudokirchneriella subcapitata (code: pH-6.2)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	6.2	24	3-d	$NOEC_g$	**124**	(actual) [64m] De Schamphelaere et al.,'03 [64]

Organism & life stage	A	Test-type	Test-comp.	Test-water	pH	Hard-ness	Exp.-time	Criterion	Result (µg Zn/l)
Algae (unicellular) (continued)									
Pseudokirchneriella subcapitata (code: pH-6.8)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	6.8	24	3-d	$NOEC_g$	**74** (actual) [64n] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: pH-7.1)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	7.1	24	3-d	$NOEC_g$	**41** (actual) [64o] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: pH-7.4)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	7.4	24	3-d	$NOEC_g$[c]	**15** (actual) [64p] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: pH-7.7)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	7.7	24	3-d	$NOEC_g$	**10** (actual) [64q] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: pH 7.8)	+	S	$ZnCl_2$	art. (OECD; no EDTA)	7.8	24	3-d	$NOEC_g$	**9.4**(actual) [64r] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: Brisy-R)	+	S	$ZnCl_2$	river (DOC: 2.9 mg/l)	6.2	28	3-d	$NOEC_g$	**58** (actual) [64s] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: Brisy-N)	+	S	$ZnCl_2$	river (DOC: 2.5 mg/l)	6.3	27	3-d	$NOEC_g$	**91** (actual) [64t] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: Voyon-R)	+	S	$ZnCl_2$	river (DOC: 3.7 mg/l)	6.4	27	3-d	$NOEC_g$	**73** (actual) [64u] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: Markermeer-R)	+	S	$ZnCl_2$	lake (DOC: 5.9 mg/l)	8.0	239	3-d	$NOEC_g$[c]	**27** (actual) [64v] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata (code: Ankeveen-R)	+	S	$ZnCl_2$	ditch (DOC: 22 mg/l)	7.4	144	3-d	$NOEC_g$	**105** (actual) [64w] De Schamphelaere et al.,'03 [64]
Pseudokirchneriella subcapitata					(n =25)			geometric mean $NOEC_g$	**17**	(actual)
Algae (multicellular)									
Cladophora glomerata 1 cm fragments	-	S	-	art.	8.4	>35	3-d	$NOEC_g$	**60**	(Cn) Whitton '67 [13]

Poriferans

Ephydatia fluviatilis cells → sponges	-	S	$ZnCl_2$	art. (M4)	8	250	7-d	$NOEC_d$ Van de Vyver, '01 [61]	**43** (Cn)
Ephydatia muelleri cells → sponges	-	S	$ZnCl_2$	art. (M4)	8	250	7-d	$NOEC_d$ Van de Vyver, '01 [61]	**43** (Cn)
Spongilla lacustris cells → sponges	-	S	$ZnCl_2$	art. (M4)	8	250	7-d	$NOEC_d$ Van de Vyver, '01 [61]	**65** (Cn)
Eunapius fragilis cells → sponges	-	S	$ZnCl_2$	art. (M4)	8	250	7-d	$NOEC_d$ Van de Vyver, '01 [61]	**43** (Cn)

Organism & life stage	A	Test-type	Test-comp.	Test-water	pH	Hard-ness	Exp.-time	Criterion	Result (µg Zn/l)
Molluscs									
Dreissena polymorpha length 1.6-2.2 cm	+	R	$ZnCl_2$	lake	7.9	270 (Ca)	10-w	$NOEC_f$ $NOEC_s$ $NOEC_g$ Kraak et al' 94 [48]	100 (Cn) (actual: 101) **400** (Cn) (actual: 382) ≥1,400 (Cn) (actual: 1,266)
Potamopyrgus jenkinsi juveniles (length 1.7 ± 0.1 cm)	+	R	$ZnCl_2$	lake	8.0	160 (Ca)	16-w	$NOEC_g$ Dorgelo et al '95 [49]	**75** (Cn) (actual: 72)
Crustaceans									
Ceriodaphnia dubia P < 1 d → F_1 [lc]	+	R	-	river (N)	6	81	1-w	$NOEC_r$ Belanger & Cherry '90 [22]	**25** (Cn)
Ceriodaphnia dubia P < 1 d → F_1 [lc]	+	R	-	river (N)	8	81	1-w	$NOEC_r^e$ Belanger & Cherry '90 [22]	**25** (Cn) [17]
Ceriodaphnia dubia P < 1 d → F_1 [lc]	+	R	-	river (N)	9	81	1-w	$NOEC_r$ Belanger & Cherry '90 [22]	**25** (Cn)
Ceriodaphnia dubia P < 1 d → F_1 [lc]	+	R	-	river (A)	6	118	1-w	$NOEC_r^e$ Belanger & Cherry '90 [22]	**40** (Cn) [18]
Ceriodaphnia dubia P < 1 d → F_1 [lc]	+	R	-	river (A)	8	118	1-w	$NOEC_r$ Belanger & Cherry '90 [22]	**50** (Cn)
Ceriodaphnia dubia P < 1 d → F_1 [lc]	+	R	-	river (A)	9	118	1-w	$NOEC_r^e$ Belanger & Cherry '90 [22]	**45** (Cn) [19]
Ceriodaphnia dubia P < 1 d → F_1 [lc]	+	R	-	river (C)	6	168	1-w	$NOEC_r^e$ Belanger & Cherry '90 [22]	**29** (Cn) [20]
Ceriodaphnia dubia P < 1 d → F_1 [lc]	+	R	-	river (C)	8	168	1-w	$NOEC_r$ Belanger & Cherry '90 [22]	**50** (Cn)
Ceriodaphnia dubia P < 1 d → F_1 [lc]	+	R	-	river (C)	9	168	1-w	$NOEC_r^e$ Belanger & Cherry '90 [22]	**33** (Cn) [21]
Ceriodaphnia dubia P 3 d → F_1 [lc]	-	R	$ZnCl_2$	river	8.0	169	4-d	$NOEC_r^e$ $NOEC_s^e$ Masters et al., 1991 [51]	**50** (Cn) 50 (Cn)

Ceriodaphnia dubia P 3 d → F_1 [lc]	-	R	$ZnCl_2$	river	8.0	169	4-d	$NOEC_r^e$ $NOEC_s^e$ Masters et al., 1991 [51]	**14** (Cn) 50 (Cn)
Ceriodaphnia dubia P < 1 d → F_1 [lc]	-	R	$ZnCl_2$	river	8.0	169	7-d	$NOEC_r^e$ $NOEC_s^e$ Masters et al., 1991 [51]	**50** (Cn) 29 (Cn)
Ceriodaphnia dubia P < 1 d → F_1 [lc]	-	R	$ZnCl_2$	river	8.0	169	7-d	$NOEC_r^e$ $NOEC_s^e$ Masters et al., 1991 [51]	**100** (Cn) 100 (Cn)
Ceriodapnia dubia					(n = 13)	geometric mean		$NOEC_r$	**37** (Cn)

Organism & life stage	A	Test-type	Test-comp.	Test-water	pH	Hard-ness	Exp.-time	Criterion	Result (µg Zn/l)
Crustaceans (continued)									
Daphnia magna P < 1 d → F_1 (lc)	+	R	$ZnCl_2$	well	7.5	52	21-d	$NOEC_{r,s}$ Chapman et al. '80	**97** (actual)
Daphnia magna P < 1 d → F_1 (lc)	+	R	$ZnCl_2$	well	7.7	104	21-d	$NOEC_{r,s}$ Chapman et al. '80 [52]	**43** (actual)
Daphnia magna P < 1 d → F_1 (lc)	+	R	$ZnCl_2$	well	8.4	211	21-d	$NOEC_{r,s}$ Chapman et al. '80 [52]	**42** (actual)
Daphnia magna P < 1 d → F_1 [lc]	-	R	$ZnSO_4$ $.7H_2O$	pond	8.4	52	7-w	$NOEC_r^e$ Paulauskis & Winner '88 [23]	**31** (Cn)
Daphnia magna P < 1 d → F_1 [lc]	-	R	$ZnSO_4$ $.7H_2O$	pond (+ DOC: 0.75 mg /l)	8.4	52	7-w	$NOEC_r^e$ Paulauskis & Winner '88 [23]	**33** (Cn)
Daphnia magna P < 1 d → F_1 [lc]	-	R	$ZnSO_4$ $.7H_2O$	pond (+ DOC: 1.5 mg /l)	8.4	52	7-w	$NOEC_r$ Paulauskis & Winner '88 [23]	**84** (Cn)
Daphnia magna P < 1 d → F_1 [lc]	-	R	$ZnSO_4$ $.7H_2O$	pond	8.3	102	7-w	$NOEC_r$ Paulauskis & Winner '88 [23]	**83** (Cn)
Daphnia magna P < 1 d → F_1 [lc]	-	R	$ZnSO_4$. $.7H_2O$	pond	8.3	197	7-w	$NOEC_r$ Paulauskis & Winner '88 [23]	**159** (Cn)
Daphnia magna P < 1 d → F_1 [lc]	-	R	$ZnSO_4$. $.7H_2O$	pond (+ DOC: 1.5 mg/l)	8.3	197	7-w	$NOEC_r$ Paulauskis & Winner '88 [23]	**208** (Cn)
Daphnia magna P < 1 d → F_1 [lc]	+	R	$ZnCl_2$	lake	7.7	45	3-w	$NOEC_r^e$ Biesinger & Christensen '72 [24]	**35** (Cn)
Daphnia magna P < 1 d → F_1 [lc]	+	R	$ZnCl_2$	lake	7.7	45	3-w	$NOEC_r$ Biesinger et al. '86 [25]	**74** (actual)

Daphnia magna P < 1 d → F_1 [lc]	+	R	$ZnCl_2$	lake	8.1	225	3-w	$NOEC_g$ $NOEC_{s,r}$ Enserink et al.'91 [28]	37 (Cn) [26] **310** (Cn) [26]
Daphnia magna P + F	+	F	$ZnCl_2$	lake	8.1	225	17-d	$NOEC_{s,r}$ [e] Enserink et al.'91 [28]	**420** (Cn) [27]
Daphnia magna P < 2 d → F_1 [lc] (population "I")	+	R	-	lake	7.7	65	3-w	$NOEC_{s,r}$ Münzinger & Monicelli '91 [30]	**100** (Cn)
Daphnia magna P < 2 d → F_1 [lc] (population L")	+	R	-	lake	7.7	65	3-w	$NOEC_{s,r}$ Münzinger & Monicelli '91 [30]	**100** (Cn)
Daphnia magna P < 2 d → F_1 [lc] (population "P")	+	R	-	lake	7.7	65	3-w	$NOEC_r$ [e] $NOEC_s$ Münzinger & Monicelli '91 [30]	**25** (Cn) [29] 100 (Cn)

Organism & life stage	A	Test-type	Test-comp.	Test-water	pH	Hard-ness	Exp.-time	Criterion	Result (µg Zn/l)
Crustaceans (continued)									
Daphnia magna P < 1 d → F_1 [lc] (code: CA-0.25; MG-0.25; NA-2)	+	R	$ZnCl_2$	art.	6.6	50	3-w	$NOEC_{r,s}$ De Schamphelaere et al.,'03 [65]	**82** (actual) [65a]
Daphnia magna P < 1 d → F_1 [lc] (code: CA-05)	+	R	$ZnCl_2$	art.	6.6	75	3-w	$NOEC_{r,s}$ De Schamphelaere et al.,'03 [65]	**50** (actual) [65b]
Daphnia magna P < 1 d → F_1 [lc] (code: CA-1)	+	R	$ZnCl_2$	art.	6.6	125	3-w	$NOEC_{r,s}$ De Schamphelaere et al.,'03 [65]	**54** (actual) [65c]
Daphnia magna P < 1 d → F_1 [lc] (code: CA-2)	+	R	$ZnCl_2$	art.	6.6	225	3-w	$NOEC_{r,s}$ De Schamphelaere et al.,'03 [65]	**92** (actual) [65d]
Daphnia magna P < 1 d → F_1 [lc] (code: MG-05)	+	R	$ZnCl_2$	art.	6.6	75	3-w	$NOEC_{r,s}$ De Schamphelaere et al.,'03 [65]	**48** (actual) [65e]
Daphnia magna P < 1 d → F_1 [lc] (code: MG-1)	+	R	$ZnCl_2$	art.	6.6	125	3-w	$NOEC_{r,s}$ De Schamphelaere et al.,'03 [65]	**152** (actual) [65f]
Daphnia magna P < 1 d → F_1 [lc] (code: MG-1.5)	+	R	$ZnCl_2$	art.	6.6	175	3-w	$NOEC_{r,s}$ De Schamphelaere et al.,'03 [65]	**155** (actual) [65g]
Daphnia magna P < 1 d → F_1 [lc] (code: MG-2)	+	R	$ZnCl_2$	art.	6.6	225	3-w	$NOEC_{r,s}$ De Schamphelaere et al.,'03 [65]	**156**(actual) [65h]
Daphnia magna P < 1 d → F_1 [lc] (code: NA-6)	+	R	$ZnCl_2$	art.	6.6	50	3-w	$NOEC_{r,s}$ De Schamphelaere et al.,'03 [65]	**143** (actual) [65i]
Daphnia magna	+	R	$ZnCl_2$	art.	6.6	50	3-w	$NOEC_{r,s}$	**136** (actual) [65j]

P < 1 d → F_1 [lc] (code: NA-9)								De Schamphelaere et al.,'03 [65]	
Daphnia magna P < 1 d → F_1 [lc] (code: NA-12)	+	R	$ZnCl_2$	art.	6.6	50	3-w	$NOEC_{r,s}$ **143** (actual) [65k] De Schamphelaere et al.,'03 [65]	
Daphnia magna					(n = 27)	geometric mean		$NOEC_r$ **88**	
Hyalella azteca P < 1 w → F_1 [lc]	+	R	-	tap	7.9-8.6	130	10-w	$NOEC_{r,s}$ **42** (actual) (Cn: 100) $NOEC_g$ ≥316 (actual) (Cn: 560) Borgmann et al. '93 [50]	
Hyalella azteca < 1 w	+	S	$ZnCl_2$	tap	7.9-8.6	130	4-w	$NOEC_s$ 166 (actual) 49 (actual-Cb) $NOEC_g$ ≥208 (actual) ≥91 (actual-Cb) Borgmann & Norwood 97 [55]	
Hyalella azteca								$NOEC_r$ **42** (actual)	
Organism & life stage	A	Test-type	Test-comp.	Test-water	pH	Hard-ness	Exp.-time	Criterion	Result (µg Zn/l)
Insects									
Chironomus tentans P (newly hatched larvae) → F_1 [lc]	+	R	$ZnCl_2$	lake	7.7	45	8-w	$NOEC_{s,g,e,r}$ 166 (actual) **137**(actual-Cb) Sibley et al. '96 [54]	
Fish									
Brachydanio rerio eggs < 4 hr → larvae	-	R	$ZnSO_4$.$7H_2O$	art.	7.5	100	2-w	$NOEC_h$ **2,900** (Cn) $NOEC_s$ 5,800 (Cn) Dave et al. '87 [32]	
Brachydanio rerio eggs < 4 hr→ larvae	-	R	$ZnSO_4$.$7H_2O$	art.	7.5	100	2-w	$NOEC_h$ **180** (Cn) $NOEC_s$ 5,800 (Cn) Dave et al. '87 [32]	
Brachydanio rerio eggs < 4 hr → larvae	-	R	$ZnSO_4$.$7H_2O$	art.	7.5	100	2-w	$NOEC_h$ **720** (Cn) $NOEC_s$ 5,800 (Cn) Dave et al. '87 [32]	
Brachydanio rerio eggs < 4 hr → larvae	-	R	$ZnSO_4$.$7H_2O$	art.	7.5	100	2-w	$NOEC_h$ **180** (Cn) $NOEC_s$ 5,800 (Cn) Dave et al. '87 [32]	
Brachydanio rerio eggs < 4 hr → larvae	-	R	$ZnSO_4$.$7H_2O$	art.	7.5	100	2-w	$NOEC_h$ **180** (Cn) $NOEC_s$ 2,900 (Cn) Dave et al. '87 [32]	
Brachydanio rerio eggs < 4 hr → larvae	-	R	$ZnSO_4$.$7H_2O$	art.	7.5	100	2-w	$NOEC_h$ **180** (Cn) $NOEC_s$ 5,800 (Cn) Dave et al. '87 [32]	
Brachydanio rerio eggs < 4 hr → larvae	-	R	$ZnSO_4$.$7H_2O$	art.	7.5	100	2-w	$NOEC_h$ **2,900** (Cn) $NOEC_s$ 2,900 (Cn) Dave et al. '87 [32]	

Brachydanio rerio eggs < 4 hr → larvae	-	R	$ZnSO_4$ $.7H_2O$	art.	7.5	100	2-w	$NOEC_h$ $NOEC_s$ Dave et al. '87 [32]	< 720 5,800	(Cn) (Cn)
Brachydanio rerio eggs < 4 hr → larvae	-	R	$ZnSO_4$ $.7H_2O$	art.	7.5	100	2-w	$NOEC_h$ $NOEC_s$ Dave et al. '87 [32]	**2,900** 11,500	(Cn) (Cn)
Brachydanio rerio eggs < 4 hr → larvae	-	R	$ZnSO_4$ $.7H_2O$	art.	7.5	100	2-w	$NOEC_h$ $NOEC_s$ Dave et al. '87 [32]	**1,400** 11,500	(Cn) (Cn)
<u>Brachidanio rerio</u>					(n = 9)		<u>geometric mean</u>	$NOEC_h$	**<u>660</u>**	(Cn)
Jordanella floridae P (larvae) → F_1 (larvae) [lc] 1-d (from unexposed eggs)	+	F	$ZnSO_4$ $.7H_2O$	lake	7.5	44	14-w	$NOEC_g$ $NOEC_s$ $NOEC_{r,h}$ Spehar, '76 [34]	**26** 51 ≥85	(actual) [33a] (actual) (actual)
Jordanella floridae P (larvae) → F_1 (larvae) [lc] 1-d (from exposed eggs)	+	F	$ZnSO_4$ $.7H_2O$	lake	7.5	44	14-w	$NOEC_{g,r}$ $NOEC_s$ $NOEC_h$ Spehar, '76 [34]	**75** 139 ≥139	(actual) [33b] (actual) (actual)
<u>Jordanella floridae</u>					(n = 2)		<u>geometric mean</u>	$NOEC_g$	**<u>44</u>**	

Organism & life stage	A	Test-type	Test-comp.	Test-water	pH	Hard-ness	Exp.-time	Criterion	Result (µg Zn/l)
Fish (continued)									
Oncorhynchus mykiss eyed eggs → fish untill sexual maturity	+	F	$ZnSO_4$	tap	6.8	26	± 2-yr?	$NOEC_s$ $NOEC_g$ Sinley et al. '74 [40]	**130** ≥535	(actual - Cb) (actual - Cb)
Oncorhynchus mykiss "fish" (unexposed as eggs)	+	F	$ZnSO_4$	tap	6.8	26	25-d	$NOEC_s$ Sinley et al. '74 [41]	**25**	(actual - Cb)
Oncorhynchus mykiss eggs → early juveniles	+	F	$ZnCl_2$	well	7.0	27	72-d	$NOEC_s$ Cairns and Garton '82 [42]	**440**	(actual)
Oncorhynchus mykiss Early juveniles (5-6 w) (code: RF-B; MG-B)	+	F	$ZnCl_2$	art.	7.5	30	30-d	$NOEC_s$ De Schamphelaere et al.,'03 [66]	**39**	(actual) [66a]
Oncorhynchus mykiss Early juveniles (5-6 w) (code: RF-NA5)	+	F	$ZnCl_2$	art.	7.5	30	30-d	$NOEC_s$ De Schamphelaere et al.,'03 [66]	**95**	(actual) [66b]
Oncorhynchus mykiss Early juveniles (5-6 w) (code: MG-0.2)	+	F	$ZnCl_2$	art.	7.7	45	30-d	$NOEC_s$ De Schamphelaere et al.,'03 [66]	**45**	(actual) [66c]
Oncorhynchus mykiss Early juveniles (5-6 w) (code: MG-1)	+	F	$ZnCl_2$	art.	7.7	139	30-d	$NOEC_s$ De Schamphelaere et al.,'03 [66]	**151**	(actual) [66d]

Oncorhynchus mykiss Early juveniles (5-6 w) (code-MG-2)	+	F	$ZnCl_2$	art.	7.7	229	30-d	$NOEC_s$ **159** (actual) [66e] De Schamphelaere et al.,'03 [66]	
Oncorhynchus mykiss Early juveniles (5-6 w) (code: PH-6.5)	+	F	$ZnCl_2$	art.	6.7	29	30-d	$NOEC_s$ **256** (actual) [66f] De Schamphelaere et al.,'03 [66]	
Oncorhynchus mykiss Early juveniles (5-6 w) (code: PH-7.5)	+	F	$ZnCl_2$	art.	7.6	28	30-d	$NOEC_s$ **157** (actual) [66g] De Schamphelaere et al.,'03 [66]	
Oncorhynchus mykiss Early juveniles (5-6 w) (code: CA-2)	+	F	$ZnCl_2$	art.	7.9	190	30-d	$NOEC_s$ **974** (actual) [66h] De Schamphelaere et al.,'03 [66]	
Oncorhynchus mykiss Early juveniles (5-6 w) (code: ANK)	+	F	$ZnCl_2$	ditch (DOC: 23 mg/l)	7.8	104	30-d	$NOEC_s$ **771** (actual) [66i] De Schamphelaere et al.,'03 [66]	
Oncorhynchus mykiss Early juveniles (5-6 w) (code: MAR)	+	F	$ZnCl_2$	lake (DOC: 6.2 mg/l)	8.1	176	30-d	$NOEC_s$ **696** (actual) [66j] De Schamphelaere et al.,'03 [66]	
Oncorhynchus mykiss Early juveniles (5-6 w) (code: VOY)	+	F	$ZnCl_2$	river (DOC: 3.9 mg/l)	6.8	28	30-d	$NOEC_s$ **324** (actual) [66k] De Schamphelaere et al.,'03 [66]	
Oncorhynchus mykiss Early juveniles (5-6 w) (code: BIH)	+	F	$ZnCl_2$	river (DOC: 4.3 mg/l)	6.2	23	30-d	$NOEC_s$ **370** (actual) [66l] De Schamphelaere et al.,'03 [66]	
Oncorhynchus mykiss						(n = 15)		geometric mean $NOEC_s$ **189**	

Organism & life stage	A	Test-type	Test-comp.	Test-water	pH	Hard-ness	Exp.-time	Criterion	Result (µg Zn/l)
Fish (continued)									
Phoxinus phoxinus mature	+	F	$ZnNO_3$. .$4H_2O$	tap	7.5	70	5-m	$NOEC_{s,g}$ Bengtsson '74 [45]	130 (actual)
Phoxinus phoxinus yearlings	+	F	$ZnNO_3$. .$4H_2O$	tap	7.5	70	5-m	$NOEC_{s,g}$ Bengtsson '74 [45]	**50** (actual)
Pimephales promelas eggs < 1d → larvae [els]	+	F	$ZnSO_4$.$7H_2O$	lake	7.7	47	32-d	$NOEC_s$ $NOEC_g$ Norberg-King '89 [46]	129 (actual) ≥129
Pimephales promelas newly hatched larvae	+	R	$ZnSO_4$.$7H_2O$	lake	7.7	47	7-d	$NOEC_g$ $NOEC_s$ Norberg-King '89 [46]	128 (actual) ≥128
Pimephales promelas newly hatched larvae	+	R	$ZnSO_4$.$7H_2O$	lake	7.7	47	7-d	$NOEC_{s,g}$ Norberg-King '89 [46]	117 (actual)
Pimephales promelas newly hatched larvae	+	F	$ZnSO_4$.$7H_2O$	lake	7.7	47	7-d	$NOEC_g$ $NOEC_s$ Norberg-King '89 [46]	129 (actual) ≥129

Pimephales promelas newly hatched larvae	+	F	$ZnSO_4$.$7H_2O$	lake	7.7	47	7-d	$NOEC_{s,g}$ 277 (actual) Norberg-King '89 [46]
Pimephales promelas newly hatched larvae	+	F	$ZnSO_4$.$7H_2O$	lake	7.7	47	7-d	$NOEC_{s,g}$ 291 (actual) Norberg-King '89 [46]
Pimephales promelas newly hatched larvae	+	R	$ZnSO_4$.$7H_2O$	lake	7.7	47	5-d	$NOEC_g$ 128 (actual) $NOEC_s$ ≥128 Norberg-King '89 [46]
Pimephales promelas newly hatched larvae	+	R	$ZnSO_4$.$7H_2O$	lake	7.7	47	5-d	$NOEC_s$ 117 (actual) $NOEC_g$ ≥117 Norberg-King '89 [46]
Pimephales promelas newly hatched larvae (< 1 d)	+	R	-	lake	7.5	48	7-d	$NOEC_s$ 85 (actual) $NOEC_g$ 184 (actual) Norberg & Mount '85 [36]
Pimephales promelas embryos (gastrula) → larvae	+	R	$ZnSO_4$.$7H_2O$	art.	7.0	100	6-d	$NOEC_d$ 120 **(**Cn) Dawson et al.'88 [35]
Pimephales promelas P → F_1 [lc] (eggs < 1 d) → (larvae 2 m)	+	F	$ZnSO_4$.$7H_2O$	lake	7-8	46	± 8-m	$NOEC_r$ **78** (actual) $NOEC_{s,h,,d}$ 145 (actual) $NOEC_m$ 295 (actual) $NOEC_g$ ≥575 (actual) Benoit & Holcombe '78 [37]
Pimephales promelas								$NOEC_r$ **78** (actual)

Organism & life stage	A	Test-type	Test-comp.	Test-water	pH	Hard-ness	Exp.-time	Criterion	Result (µg Zn/l)
Fish (continued)									
Salvelinus fontinalis P → F_2 [lc] [3-gen.] (yearlings) → (F_2 larvae 12 w)	+	F	$ZnSO_4$.$7H_2O$	lake	7.0-7.7	45	3-yr	$NOEC_h$ **530**(actual) $NOEC_{s,g,r}$ ≥1360(actual) Holcombe et al.'79 [43]	
Salvelinus fontinalis eggs 6 hr → larvae 12 w [els]	+	F	$ZnSO_4$.$7H_2O$	lake	7.2-7.9	45	>12 -w	$NOEC_s$ 720 (actual) $NOEC_g$ ≥2,060 (actual) Holcombe et al.'79 [44]	
Salvelinus fontinalis newly hatched larvae → larvae 12 w (from exposed eggs)	+	F	$ZnSO_4$.$7H_2O$	lake	7.2-7.9	45	12-w	$NOEC_s$ 720(actual) $NOEC_g$ ≥2,060 (actual) Holcombe et al.'79 [44]	
Salvelinus fontinalis newly hatched larvae → larvae 12 w (from unexposed eggs)	+	F	$ZnSO_4$.$7H_2O$	lake	7.2-7.9	45	>12 -w	$NOEC_s$ 1,370 (actual) $NOEC_g$ ≥2,060 (actual) Holcombe et al.'79 [44]	
Salvelinus fontinalis larvae 4 w → larvae 12 -w (from unexposed eggs)	+	F	$ZnSO_4$.$7H_2O$	lake	7.2-7.9	45	8-w	$NOEC_s$ 720(actual) $NOEC_g$ ≥2,060 (actual) Holcombe et al.'79 [44]	
Salvelinus fontinalis								$NOEC_h$ **530**	

Følgende data for kronisk giftighed i saltvand er taget fra udkastet til EU-risikovurdering:

Table 3.3.2.b. Chronic toxicity of zinc to saltwater organisms: NOEC values
Part I: Studies useful for saltwater $PNEC_{add,\ aquatic}$ derivation

Organism & life stage	A	Test type	Test-comp	Test water	Salinity °/oo	Exp.-time	Criterion	Result (µg Zn/l)	
Algae (unicellular)									
Amphidinium carteri	-	S	$ZnSO_4$	asw	-	9-d	$NOEC_g$ Braek et al.'76	**100**	(Cn) [1]
Asterionella japonica clone AST N1.1	-	S	$ZnSO_4$	nsw (BS)	35	3-d	$NOEC_g$ Fisher & Jones '81	**30**	(Cn) [2]
Asterionella japonica clone AST C2 or N1.1	-	S	$ZnSO_4$	nsw (BS)	35	3-d	$NOEC_g^e$	**7**	(Cn) [2,3]
Asterionella japonica clone AST C2 or N1.1	-	S	$ZnSO_4$	nsw (CB)	35	3-d	$NOEC_g^e$	**20**	(Cn) [2,4]
Asterionella japonica clone AST N1.1	-	S	$ZnSO_4$	nsw (BS)	35	3-d	$NOEC_g^e$	**7**	(Cn) [5,6]
Asterionella japonica clone AST N1.1	-	S	$ZnSO_4$	nsw (CB)	35	3-d	$NOEC_g^e$	**7**	(Cn) [5,7]
Asterionella japonica clone AST C4	-	S	$ZnSO_4$	nsw (BS)	35	3-d	$NOEC_g$	**20**	(Cn) [2]
Asterionella japonica clone AST C4	-	S	$ZnSO_4$	nsw (CB)	35	3-d	$NOEC_g$ Fisher & Frood '80	**40**	(Cn [2]
Asterionella japonica							$NOEC_g$	**15**	geom. mean
Chaetoceros compressum clone Chaet C2	-	S	$ZnSO_4$	nsw (BS)	35	3-d	$NOEC_g^e$ Fisher & Frood '80	**10**	(Cn) [2,8]
Gymnodinium splendens	-	S	$ZnSO_4$	nsw	32	5-w	$NOEC_g$ Kayser '77 [10]	**500**	(Cn) [9]
Nitzschia closterium clone Nitz C.1	-	S	$ZnSO_4$	nsw (BS)	35	3-d	$NOEC_g$	**40**	(Cn) [2]
Nitzschia closterium clone Flag 8.4	-	S	$ZnSO_4$	nsw (BS)	35	3-d	$NOEC_g^e$ Fisher & Frood '80	**10**	(Cn) [2,11]
Nitzschia closterium							$NOEC_g$	**20**	geom. mean
Phaeodactylum tricornutum	+	F	$ZnCl_2$	nsw	-	2-w	$NOEC_g$ Jensen et al.'74 [12]	**10,000**	(Cn)
Phaeodactylum tricornutum	-	S	$ZnSO_4$	asw	-	10-d	$NOEC_g$	**4,000**	(Cn) [13]
Phaeodactylum tricornutum	-	S	$ZnSO_4$	asw	-	10-d	$NOEC_g$ Braek et al.'76 [1]	**500**	(Cn) [14]
Phaeodactylum tricornutum							$NOEC_g$	**2,700**	geom. mean
Prorocentrum micans	-	S	$ZnSO_4.2H_2O$	nsw	32	5-w	$NOEC_g$ Kayser '77 [10]	**100**	(Cn)
Rhizosolenia spp.	+	S	-	nsw	-	12/24-h	$NOEC_g$	**15**	(Cn)

								Davies & Sleep '79 [15]		
Schroederella schroederi	-	S	$ZnSO_4.2H_2O$	nsw	32	11-d	$NOEC_g$	**10**	(Cn)	[9] Kayser '77 [10]
Organism & life stage	A	Test type	Test-comp	Test water	Salinity °/oo	Exp.-time	Criterion	Result (µg Zn/l)		
Algae (unicellular) (continued)										
Scrippsiella faeroense	-	S	$ZnSO_4.7H_2O$	nsw	32	7-w	$NOEC_g$	**100**	(Cn)	[9] Kayser '77 [10]
Skeletonema costatum clone Skel-5	+	F	$ZnCl_2$	nsw	-	2-w	$NOEC_g$	**25**	(Cn)	[9] Jensen et al.'74 [12]
Skeletonema costatum Clone Skel-5	-	S	$ZnSO_4$	asw	-	10-d	$NOEC_g$	**50**	(Cn)	
Skeletonema costatum clone Skel-0	-	S	$ZnSO_4$	asw	-	10-d	$NOEC_g$	**100**	(Cn)	Break et al.'76 [1]
Skeletonema costatum clone Skel C7	-	S	$ZnSO_4$	nsw (BS)	35	3-d	$NOEC_g$	**20**	(Cn)	[2]
Skeletonema costatum clone Skel C7	-	S	$ZnSO_4$	nsw (BS)	35	3-d	$NOEC_g$ [c]	**7**	(Cn)	[5,16]
Skeletonema costatum clone Skel C7	-	S	$ZnSO_4$	nsw (CB)	35	3-d	$NOEC_g$ [e]	**7**	(Cn)	[5,17]
Skeletonema costatum clone Skel C6	-	S	$ZnSO_4$	nsw (BS)	35	3-d	$NOEC_g$ [e]	**30**	(Cn)	[2,18] Fisher & Frood '80
Skeletonema costatum	-	-	-	-	-	10/14-d	$NOEC_g$	**200**	(Cu)	MARITOX 9761 [19]
Skeletonema costatum	-	-	-	-	-	10/14-d	$NOEC_g$	**50**	(Cu)	MARITOX 9761 [19]
Skeletonema costatum							$NOEC_g$	**32**	geom. mean	
Thalassiosira pseudonana	+	F	$ZnCl_2$	nsw	-	14-d	$NOEC_g$	**100**	(Cn)	[9] Jensen et al.'74 [12]
Thalassiosira pseudonana	-	S	$ZnSO_4$	asw	-	9-d	$NOEC_g$	**200**	(Cn)	Break et al.'76 [1]
Thalassiosira pseudonana							$NOEC_g$	**140**	geom. mean	
Thalassiosira rotula	-	S	$ZnSO_4.7H_2O$	nsw	32	14-d	$NOEC_g$	**10**	(Cn)	[20] Kayser '77 [10]
Thalassiosira guillardii	-	-	-	-	-	10/14-d	$NOEC_g$	**200**	(Cu)	MARITOX 9761 [19]
Algae (multicellular)										
Laminaria hyperborea zoospores --> sporophytes	-	R	$ZnSO_4$	nsw	-	4-w	$NOEC_g$	**100**	(Cn)	Hopkins & Kain '71 [21]
Coelenterates										

Eirene viridula	-	R	$ZnSO_4$	nsw	30	3-m	$NOEC_{mc}$ **300**	(Cn)
							Karbe '72 [22]	

Organism & life stage	A	Test type	Test-comp	Test water	Salinity °/oo	Exp.-time	Criterion	Result (µg Zn/l)
Annelids								
Capitella capitata	-	-	-	-	-	25/40-d ?	$NOEC_r$ **320**	(Cu)
							MARITOX 51618 [19]	
Ctenodrilus serratus P --> F [lc]	-	S	$ZnSO_4.7H_2O$	nsw	-	3-w	$NOEC_{s,r}$ **100**	(Cn)
							Reish & Carr '78 [23]	
Ctenodrilus serratus	-	-	-	-	-	28/31-d	$NOEC_r$ **100**	(Cu)
							MARITOX 51618 [19]	
Ctenodrilus serratus							$NOEC_r$ **100**	geom. mean
Nereis arenaceodentata	-	-	-	-	-	4-m?	$NOEC_r$ **100**	(Cu)
							MARITOX 51618 [19]	
Ophryotrocha diadema P --> F [lc]	-	S	$ZnSO_4.7H_2O$	nsw	-	3-w	$NOEC_{s,r}$ **100**	(Cn)
							Reish & Carr '78 [23]	
Ophryotrocha diadema	-	-	-	-	-	4-w	$NOEC_r$ **100**	(Cu)
							MARITOX 51618 [19]	
Ophryotrocha diadema							$NOEC_r$ **100**	geom. mean
Molluscs								
Crassostrea gigas eggs --> larvae	+	R	$ZnSO_4$	nsw	29	5-d	$NOEC_{d,g}$ **50**	(Cn)
							Brereton et al.'73 [24]	
Haliotis refescens	-	-	-	-	-	9-d	$NOEC_r$ **19**	(Cu)
							MARITOX 50173 [19]	
Mercenaria mercenaria 2-d old larvae	-	R	$ZnCl_2$	nsw	24	8-d	$NOEC_{s,g}$ **50**	(Cn)
							Calabrese et al. '77 [25]	
Scrobicularia plana length 4-5 cm	+	R	$Zn(NO_3)_2$	nsw	31	14-d	$NOEC_s$ **1,000**	(Cn)
							Akberali et al '81 [26]	
Crustaceans								
Callianassa australiensis	-	-	-	-	-	14-d	$NOEC_s$ **440**	(Cu)
							MARITOX 15338 [19]	
Holmesimysis costata 9-d old juveniles	+	R	$ZnSO_4.7H_2O$	nsw	35	7-w	$NOEC_{s,g}$ **18**	(actual)
							Martin et al., '89 [27]	
Mysidopsis bahia	-	-	-	-	-	-	$NOEC_r$ **120**	(Cu)
							MARITOX 51549[19] (U.S EPA study)	

Echinoderms

Arbacia lixula	-	-	-	-	-	4-d	$NOEC_r$	**10**	(Cu)
	-	-	-	-	-	20-d	$NOEC_s$	1000	(Cu)

MARITOX 51385 [19]

Følgende mesocosmosforsøg er fra udkastet til EU-risikovurdering :

Table 3.3.2.i – Part A: Field studies: NOEC and LOEC values

Taxa / organisms	Test comp.	Test system and water characteristics	Exp. time	Criterion	Result (µg Zn/l)	
Periophyton, Zooplankton, Invertebrates **Several single species and multiple species studies, see below.**	**$ZnSO_4$**	**Field-located artificial streams (holding capacity 20 L)** **New river water,** **pH 8.1-8.4;** **hardness 66-89 mg/l** **Flow-through system**	**30-d**	**NOEC (MS)** **LOEC (MS)**	**25 Cn (actual: ≤20) *** **50 Cn (actual: 34-87)** Overall results, based on Belanger et al., 1986 Farris et al., 1989 Farris et al., 1994 Genter et al., 1987, see below.	**Total Zn**
Corbicula sp. (adults, juveniles) Several tests, in different seasons	$ZnSO_4$	Field-located artificial streams (holding capacity 20 L) New river water, pH 8.1-8.4; hardness 66-89 mg/l Flow-through system	30-d	$NOEC_g$ (SS) $LOEC_g$ (SS) $NOEC_s$ (SS)	25 Cn (actual: ≤20) * 50 Cn (actual: 43-87) 500 Cn (actual: ≥504) Belanger et al., 1986 [1]	Total Zn
Corbicula sp.	$ZnSO_4$	Field-located artificial streams (holding capacity 20 L) New River water pH 8.3; hardness 71 mg/l	30-d	$LOEC_{g,e}$ (SS) $LOEC_s$ (SS)	50 Cn (actual: 34) 1000 Cn (actual: 1100) Farris et al., 1989 [2]	Total Zn
Corbicula fluminea (clam); *Mudalia dilatata* (snail) Several tests, in different seasons	$ZnSO_4$	Field-located artificial streams (holding capacity 20 L) untreated New River water pH 8.1-8.4; hardness 67-89 mg/l	30-d	$NOEC_e$ (SS) $LOEC_e$ (SS)	25 Cn (actual: ≤20) 50 Cn (actual: 35-87) Farris et al., 94 [3]	Total Zn
Periphyton, Algae Several tests, in different seasons	$ZnSO_4$	Field-located artificial streams New River water pH 8.1 - 8.4; hardness 70 - 89 mg/l	30-d	LOEC (MS) **	50 Cn (actual: 35-87) ** Genter et al., 1987 [4]	Total Zn
Algae, cladocera, copepoda, rotifera	**not reported**	**In situ tests in Lake Michigan, 18 L carboys with or without Zn treatment were suspended in the lake.** **Hardness Lake Michigan water: ± 70 mg/l**	**14-d**	**LOEC (MS)** **	**15 Cn (actual: 17)** ** Marshall et al., 1983 [5]	**Total Zn,** but 94% dissolved at this concentration.

* In the tests performed in the fall of 1984, the actual total-Zn concentration in the control was 94 µg/l, wich is an outlier compared with the ≤ 20 µg/l (i.e. at or usually below the detection limit of 20 µg/l) measured in the other seasons (spring and summer) in which further

tests were performed.
** LOEC = lowest concentration used in the test; A NOEC can not be derived. .

NOEC (SS) and LOEC (SS): single-species NOEC and LOEC
NOEC (MS) and LOEC (SS) = multiple-species NOEC and LOEC
n.r. = not reported
Enhdpoints: g = growth, e = enzyme activity (cellulolytic activity, which is a general stress indicator), s = survival
Hardness (mg/l): total (Ca + Mg) hardness, as mg $CaCO_3$

Table 3.3.2.i – Part B: Laboratory studies: NOEC and LOEC values

Taxa / organisms	Test comp.	Test system and water characteristics	Exp. time	Criterion	Result (µg Zn/l)	
Periphyton	**$ZnSO_4$**	**Polyethylene tanks containing 7.5 L dechlorinated tap water (pH 7.8; hardness 74 mg/l) and peryphyton from Pandapas pond (pH 7.1; hardness 13 mg/l); flow-through system**	**21-d**	**LOEC (MS) **** (primary production and community respiration)	**50 Cn (actual: 73) ****	**Dissolved Zn** (acid-labile fraction)
				NOEC (MS) (species richness of protozoans)	50 Cn (actual: 73) *(= overall MS NOEC according to Versteeg et al., 1999)*	
				LOEC (MS) (species richness of protozoans)	225 Cn (actual: 172)	
					Niederlehner & Cairns, 1993 [6]	
Microbial communities	**$ZnSO_4$**	**Polyethylene tanks containing 7.5 L dechlorinated tap water (pH 8.0; hardness 65 mg/l) and microbial communities from Pandapas pond (pH 7.1; hardness 13 mg/l) flow-through system**	**28-d**	**LOEC (MS)` ** (total P, total biomass and and DO)**	**3 Cn (actual: 4.2) ****	**Dissolved Zn** (acid-labile fraction)
				NOEC (algal biomass)	3 Cn (actual: 4.2)	
				NOEC (MS) (species richnes of protoans)	10 (actual: 11)) *(= overall MS NOEC accordingt to Versteeg et al., 1999)*	
					Pratt et al., 1987 [7]	
Periphyton	**$ZnCl_2$**	**Glass aquaria containing water and periphyton from river Göta Älv (pH 6.1-7.1; hardness ± 24 mg/l, i.e. soft water); flow-through system**	**28-d**	**NOEC (MS)**	**7.8 (bacterial activity)** 9.8 (total biomass) 11 (photosynthesis) 27 (algal biomass: chlorophyll *a)* 27 (species richness) 117 (species composition) Paulsson *et al*., 2000 [8]	**Total Zn** (Actual concentration)
Phytoplankton	**$ZnCl_2$**	**Samples of water and phytoplankton from Lake of**	**1-d**	**NOEC (MS) LOEC (MS)**	**14 Cn 27 Cn**	**Total Zn** (Nominal

Alpnach (pH 7.6-8.7; hardness 280-340 mg/l); static system	**(photosynthesis)**		concentration).
Samples of water and phytoplankton from Lake of Lucerne (pH 7.6-8.7; hardness 170-220 mg/l); static system	**NOEC (MS)** **LOEC (MS)**	**11 Cn** **21 Cn** Gächter, 1976 [9]	

** LOEC = lowest concentration used in the test; A NOEC can not be derived. .

NOEC (MS) and :LOEC (SS) = multiple-species NOEC and LOEC

Hardness (mg/l): total (Ca + Mg) hardness, as mg $CaCO_3$

Giftighed overfor pattedyr og fugle (NOEC, NOAEL, $PNEC_{oral}$ ($PNEC_{føde}$), hormonforstyrrende effekter osv.):
Fra EU-risikovurderingen, sundhedsdelen, 2004 (http://ecb.jrc.it/existing-chemicals/) haves følgende laveste NOAEL-værdi for zinkionen:

"Repeated dose toxicity":

Rotter, 13 uger NOAEL = 13,3 mg/kg legemsvægt

Der var også en NOAEL på 6,8 mg/kg lgv, men dette var højeste afprøvede koncentration, og det fremgik ikke af undersøgelsen om der var brugt $ZnSO_4$ eller $ZnSO_4$, $7H_2O$, så denne værdi bruges ikke.

NOAEL = 13,3 svarer til NOEC = NOAEL*8,3 (TGD tabel 22) = 13,3*8,3 = 110,4 mg/kg føde

Til beregning af PNEC-føde bruges en faktor på 90: PNECføde = 110,4 mg/kg føde:90 = 1,2 mg/kg føde.

Zink er ikke klassificeret for sundhedsfare.

Afsmag i fisk, skaldyr o.l.:
Ingen oplysninger

Nedbrydelighed:
Ikke nedbrydeligt

Bioakkumulering (log Kow, BCF, BMF):
Zink er et essentielt metal, som er nødvendigt for organismen, og mennesker og dyr kan regulere stoffet indenfor relativt vide rammer. Målte BCF værdier varierer meget og ved lave kon-

centrationer i vand vil der formentlig ske en aktiv optagelse, som resulterer i meget høje BCF værdier.

I udkastet til EU-risikovurdering betragtes stoffet for ikke at være bioakkumulerende.

Medianen af BCF-værdier i dyr fundet i USA's miljøstyrelses (US EPA) database ECOTOX er på 128.

Naturlig forekomst:
I udkastet til EU-risikovurdering (sept. 2006) er angivet følgende baggrundsværdier for Zn opløst i vandet: Nordsøen 1µg/l, Tyskland 1 µg/l (gennemsnit), Frankrig 3-13 µg/l, Finland 1,5-25 µg/l, Norge 1,2 µg/l, Nederlandene 2,8 µg/l. For nogle af landene dækker spandet formentlig også forurenede områder eller områder med særligt store forekomster af Zn.

Vandkvalitetskriterie, inkl. argumentation og kvalitetsvurdering af udslagsgivende undersøgelse:
I udkastet til EU-risikovurdering er der blevet lavet Biotic Ligand Modeller (BLM), der tager hensyn til bl.a. tilgængeligheden af Zn-ioner under forskellige forhold. Da sammenhængen mellem giftigheden og forskellige abiotiske faktorer er tvivlsom eller svag, har man ikke brugt BLM direkte.

Udkastet til EU-risikovurdering har brugt artsfølsomhedsfordeling ("species sensitivity distribution" (SSD)) til at beregne en 5% percentil på 15,6 µg/l. PNEC er beregnet med en usikkerhedsfaktor på 2: 15,6 µg/l:2 = 7,8 µg/l.

For blødt vand (hårdhed mindre 24 mg $CaCO_3$/l) har EU-risikovurderingen beregnet en PNEC = 3,1 µg/l.

PNEC værdierne fra EU risikovurderingen er "added", dvs. tilføjet den naturlige baggrundskoncentration.

EU rapporten bruger samme PNEC for fersk- og saltvand.

Der er for ferskvand udviklet en model, der tager højde for biotilgængeligheden, "Biotic Ligand Model", BLM. Hvis man for et givent vandområde har målinger af opløst organisk kulstof (DOC), calcium (eller hårdhed), pH og zink og andre metaller, kan det beregnes, hvor meget zink, der er tilgængeligt, og dette kan så sammenlignes med VKK, idet der gås udfra, at der har været fuld tilgængelighed af stoffet i laboratorieforsøgene. Dette er den anbefaling, der er givet i EU risikovurderingen. Der er udviklet et på internettet tilgængeligt brugervenligt BLM program(http://bio-met.net/), der kan benyttes, hvor der kun behøves data for DOC, Ca, pH og Zn. Beregningerne er en approximation af den "fulde" BLM model, men det skønnes at der næppe vindes meget ved at lave en fuld BLM med inkorporering af alle de abiotiske fak-

torer. Den brugervenlige model har en VKK-tilgængelig på 10 µg/l. Hvor denne værdi kommer fra er usikkert og det anbefales at følge risikovurderingsrapportens værdi på 7,8 µg/l. Når BLM anvendes bruges værdien ikke længere som en tilføjet værdi.

Da zink optagelsen reguleres af kroppen afhængig af behov og stoffet ikke betragtes som bioakkumulerende kan en $PNEC_{secondary\ poisoning\ water}$ ikke beregnes og bruges som en maksimal værdi for VKK.

De i EU-rapporten foreslåede PNEC-værdier bruges hér direkte som VKK.

Der er 33 EC50 værdier for 10 forskellige arter repræsenterende fisk, krebsdyr og alger. Korttidskvalitetskriteriet (KVKK) baseres på artsfølsomhedsfordeling (medianen for 5% percentilen, Kp) med en usikkerhedsfaktor på 5.

$Kp = e^{(lnmid-s*k)}$, hvor lnmid = middel af de ln transformerede EC50-værdier, s = standardafvigelsen af de ln transformerede tal, k = ekstrapoleringsfaktor (findes i tabel i Aldenberg, T. & J.b Jaworska 2000, Ecotoxicology and Environmental Safety 46:1-18)

lnmid = -0,95602
N = 33
s = 1,3341
k = 1,662
Kp = 0,041864 mg/l = 41,86 µg/l

KVKK = 41,86 µg/l:5 = 8,4 µg/l tilføjet

Værdierne gælder opløst Zn.

VKK, ferskvand: 7,8 µg/l føjet til naturlige baggrundskoncentration(evt. BLM)

VKK, ferskvand, blødt vand (H< 24 mg $CaCO_3$/l): 3,1 µg/l føjet til naturlige baggrundskoncentration

VKK, saltvand: 7,8 µg/l føjet til naturlige baggrundskoncentration

KVKK = 8,4 µg/l føjet til naturlige baggrundskoncentration