

US EPA ARCHIVE DOCUMENT

**DATA EVALUATION RECORD
FRESHWATER FISH EARLY LIFE-STAGE TEST
GUIDELINE 72-4 (A)**

1. **CHEMICAL:** Hydrogen Cyanamid Shaughnessey #: 014002

2. **TEST MATERIAL:** Technical Purity: 50%

3. **CITATION:**

Authors: Rhodes, Jon E.

Title: Early Life Stage Toxicity of Hydrogen Cyanamide to the Rainbow Trout (*Onchorhynchus mykiss*) Under Flowthrough Conditions

Study Completion Date: April 18, 1995

Laboratory: ABC Laboratories, Inc. Columbia MO.

Laboratory Report ID: Study #41943

Sponsor: SKW Trostberg AG, Trostberg, Germany

MRID No.: 44076701

4. **REVIEWED BY:**

Brian Montague, Fisheries Biologist
Ecological Effects Branch, EFED

Signature: *Brian Montague*

Date: 10/1/96

5. **APPROVED BY:**

Les W. Touart, PhD, Section Supervisor
Ecological Effects Branch, EFED(7507C)

Signature: *LWT*

Date: 10/4/96

6. **CONCLUSIONS:**

Synopsis of Results:

LOEC: <0.507 ppm for growth effects and <4.03 ppm for reproduction

NOEC: <0.507 ppm for growth effects and 2.03 ppm for reproduction

Parameters Effected (Dose Level): weight, length, days to hatch, days to swimup, hatch survival

Concentrations: Measured

Study Duration: 96 Days

7. **ADEQUACY OF THE STUDY:**

A. Classification: Supplemental

B. Rationale: The laboratory has not established a true LOEC, nor has the study determined an NOEC for effects to growth of rainbow trout. The study does provide the Agency with an NOEC for effects to reproduction.

C. Repairability: Not Repairable



2026767

8. **MAJOR GUIDELINE DEVIATIONS:** No serious deviations in methodology were noted that would have effected the outcome of the study. The failure to utilize concentrations low enough to produce an NOEC and LOEC were more related to a failure of the range finding process to predict which concentrations should have been used.
9. **MATERIALS AND METHODS:**
- A. **Biological System:**

Guideline Criteria	Reported Information
Species: Rainbow trout	<i>Onchorhynchus mykiss</i>
Source	Mt. Lassen Trout Farms, Red Bluff, CA.
Age at beginning of test:	Fertilized Eggs \leq 4 hours old
Replicates: Minimum:20 embryos per replicate cup, 4 replicates per concentration. Minimum of 30 fish per treatment for post-hatch exposure.	25 embryos/replicate cup 4 Replicates/concentration 100 eggs/concentration level and controls 50 additional eggs used to measure fertilization success
Post Hatch: % of embryos that produce live fry must be \geq 50% in each control; % hatch in any control embryo cup must be no more than 1.6 times that in another control cup.	95% of dilution control eggs hatched by day 36 Day 36: Control Cups contained 20, 22, 21, 20 live fry.
Feeding:	Food introduced on day 50 (14 days posthatch). Food introduced 2-3 times/day
Counts:	After hatch sac fry were thinned to 15 per chamber (60 per concentration) and observed and counted daily
Control Survival:	Control Survival= 93 % in all chambers at termination
Solvent Controls:	Not required

DP Barcode D206924

MRID No.:00126344

Comments:No comments on the biological systems

B. Physical System:

Guideline Criteria	Reported Information
Test Water:	Dilution water was obtained from deep well and was naturally hard. Water was pre-screened for contaminants, mechanically filtered, UV sterilized and blended with reverse osmosis filtered well water to reduce hardness.
Dilution Water Characteristics	Hardness:140-158 mg/L CaCO ₃ pH: 8.04-8.49
Test Temperature:	Target Range:8.5-11.5°C Actual Range:9.7-10.6°C
Photoperiod: Recommended: 16L/8D.	16D/8N at 49-59 footcandle intensity(water surface)
Dosing Apparatus: Intermittent flow proportional diluters or continuous flow serial diluters recommended. Minimum toxicant concentrations: 5	2L Proportional Diluter (Mount and Brungs type) with intermittent solution introduction via syringe. Five concentrations delivered to flowsplitters and mixing chambers.
Toxicant Mixing:	Plate Glass mixing chambers with glass feeder tubes utilized. Mixing: By mechanical methods Volumetric Accuracy: checked, Diluter samples: measured
Test Vessels: All glass or glass with stainless steel frame recommended	Glass with silicone adhesive
Embryo Cups: 120 ml glass jars with bottoms replaced with 40 mesh stainless steel or nylon screen.	Glass cups constructed from 9 cm diameter flint glass jars Bottoms replaced with 16 mesh Nitex screen

Guideline Criteria	Reported Information
<p>Flow Rate: Flow rates to larval cups should provide 90% replacement in 8-12 hours. Flow rate must maintain DO at above 75% of saturation and maintain the toxicant level.</p>	<p>Flow Rate: Chilled water provided at 86.5L/day per replicate= 7.2 volume replacements/day initially. Later flow increased to 107L/rep/day=8.9 vol.repl./day</p>
<p>Aeration: Dilution water should be aerated to insure DO concentration at or near 100% saturation prior to mixing.</p>	<p>Incoming diluter water not aerated.</p>

Comments: No comments.

C. Chemical System:

Guideline Criteria	Reported Information
<p>Concentrations: Required:5 concentrations and a control, all replicated, plus solvent control if appropriate. -Toxicant concentration measured in one tank at each toxicant level every week. -LOEC and NOEC should occur</p>	<p>5 Nominal Concentrations: 0.5, 1.0, 2.0, 3.0, 4.0 mg/L Measurements: Days -3, 0, 1, 8, and weekly thereafter using HPLC methodology</p>
<p>Other Water Quality Measurements:</p>	<p><u>pH:</u>Day 0, 1, 8, and weekly <u>DO:</u>Day 0, 1, 8, and weekly <u>Temperature:</u>Day 0, 1, 8 and weekly-continuous(1 chamber) <u>Alkalinity & Hardness:</u> Days 0, 8, and weekly thereafter <u>Conductivity:</u> Same as pH</p>
<p>Solvents:</p>	<p>Not used</p>

Comments: A 36 Day Range Test was conducted at 0.95, 1.9, 3.8, 7.5, and 15 mg ai/L test concentrations prior to

definitive test.

10. **REPORTED RESULTS:**

Guideline Criteria	Reported Information
Data Endpoints must include: - Number of embryos hatched; - Time to hatch; - Mortality of embryos, larvae, and juveniles; - Time to swim-up; - Measurement of growth - Visual Observations	Reported Data Includes: % Viability and Egghatch Daily Pre and Post Hatch Data Sac Fry Survival Fry length(35 and 60 day) Fry wet weight (60D posthatch) Daily Observations
Raw data:	Included

Effects Data: Mean values for effects are summarized below for all 4 replicates

Toxicant Concentra. (mg ai/L)		Mean Percent Hatch	Days to Hatch/Swimup	% Survival 35 Day/60 Day	Length (mm) 35D/60D	Wet weight (gm) 60 Day
Nom.	Meas.	A/B/C/D	A/B/C/D	A/B/C/D	A/B/C/D	A/B/C/D
Ctrl		92.4%	36D/50D	93%/93%	33.3/46.8	1.535
0.50	0.507	97.9%	36D/50D	100%/98%	32.4/45.4	1.403
1.0	1.01	95.7%	36D/52D	90%/88%	32.1/45.6	1.261
2.0	2.01	100%	36D/52D	90%/88%	30.2/40.6	0.986
4.0	4.03	98.9%	37D/56D	85%/83%	28.0/37.0	0.734
8.0	7.95	98.9%	37D/64D	78%/64%	24.2/31.2	0.430

Toxicity Observations: Numbers of mortalities increased with increasing concentrations. Mortality was 4, 1, 7, 7, 10, and 21 larvae for control, 0.5, 1.0, 2.0, 4.0, and 7.95 ppm test concentrations, respectively.

Body curvature was observed at 2.01 ppm for one developing fry.

Bottom Resting was observed at 2.0 and 7.95 ppm

Orange pigmentation around fins and jaws seen in all concentration levels, though slightly less intense at 7.95 ppm.

Statistical Results:

DP Barcode D206924

MRID No.: ~~00126344~~

Statistical Method: Williams' Test

NOEL: <0.507 ppm LOEC: Not Determined but <0.507 ppm

Most sensitive endpoint: Growth (length and weight)

Comments: None

11. Reviewer's Statistical Results:

Statistical Method:

NOEL: <0.507 ppm LOEC: <0.507PPM MATC: Not determinable

Most sensitive endpoint: Growth

Comments: Time to swimup, days to hatch, and eggs hatched were effected at concentrations >2.01 ppm but <4.03 ppm

12. COMPLETION OF ONE-LINER FOR STUDY: Forwarded to DBF coordinator.

Hydrogen Cyanamid % Hatch -Rainbow Trout

Control

91.3
95.7
95.7
87.0

0.507 PPM

95.7
100
95.7
100

1.01 PPM

100
82.6
100
100

2.01 PPM

100
100
100
100

4.03 PPM

100
100
100
95.7

7.95 PPM

95.7
100
100
100

Hydrogen Cyanamid Days to Hatch
 File: A:hyCyatrt.DTH Transform: NO TRANSFORM

SUMMARY STATISTICS ON TRANSFORMED DATA TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Control	3	36.000	37.000	36.333
2	0.507	4	36.000	36.000	36.000
3	1.01	4	36.000	37.000	36.250
4	2.01	4	36.000	37.000	36.250
5	4.03	4	37.000	37.000	37.000
6	7.95	4	37.000	38.000	37.250

Hydrogen Cyanamid Days to Hatch
 File: A:hyCyatrt.DTH Transform: NO TRANSFORM

SUMMARY STATISTICS ON TRANSFORMED DATA TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM
1	Control	0.333	0.577	0.333
2	0.507	0.000	0.000	0.000
3	1.01	0.250	0.500	0.250
4	2.01	0.250	0.500	0.250
5	4.03	0.000	0.000	0.000
6	7.95	0.250	0.500	0.250

Hydrogen Cyanamid Days to Hatch
 File: A:hyCyatrt.DTH Transform: NO TRANSFORM

ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	4.822	0.964	5.605
Within (Error)	17	2.917	0.172	
Total	22	7.739		

Critical F value = 2.81 (0.05,5,17)
 Since F > Critical F REJECT Ho:All groups equal

Hydrogen Cyanamid Days to Hatch
 File: A:hyCyatrt.DTH Transform: NO TRANSFORM
 DUNNETTS TEST

***** WARNING *****

This data set has unequal replicates. The Bonferroni T-test should be used instead of the Dunnetts test.

Hydrogen Cyanamid Days to Hatch
 File: A:hyCyatrt.DTH Transform: NO TRANSFORM
 DUNNETTS TEST - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	Control	36.333	36.333		
2	0.507	36.000	36.000	1.052	
3	1.01	36.250	36.250	0.263	
4	2.01	36.250	36.250	0.263	
5	4.03	37.000	37.000	-2.105	
6	7.95	37.250	37.250	-2.894	

Dunnett table value = 2.42 (1 Tailed Value, P=0.05, df=17,5)

Hydrogen Cyanamid Days to Hatch
 File: A:hyCyatrt.DTH Transform: NO TRANSFORM

DUNNETTS TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	Control	3			
2	0.507	4	0.767	2.1	0.333
3	1.01	4	0.767	2.1	0.083
4	2.01	4	0.767	2.1	0.083
5	4.03	4	0.767	2.1	-0.667
6	7.95	4	0.767	2.1	-0.917

Hydrogen Cyanamid Days to Hatch
 File: A:hyCyatrt.DTH Transform: NO TRANSFORM
 ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	4.822	0.964	5.605
Within (Error)	17	2.917	0.172	
Total	22	7.739		

Critical F value = 2.81 (0.05,5,17)
 Since F > Critical F REJECT Ho:All groups equal

Hydrogen Cyanamid Days to Hatch
 File: A:hyCyatrt.DTH Transform: NO TRANSFORM

BONFERRONI T-TEST - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	Control	36.333	36.333		
2	0.507	36.000	36.000	1.052	
3	1.01	36.250	36.250	0.263	
4	2.01	36.250	36.250	0.263	
5	4.03	37.000	37.000	-2.105	
6	7.95	37.250	37.250	-2.894	

Bonferroni T table value = 2.57 (1 Tailed Value, P=0.05, df=17,5)

Hydrogen Cyanamid Days to Hatch
 File: A:hyCyatrt.DTH Transform: NO TRANSFORM

BONFERRONI T-TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	Control	3			
2	0.507	4	0.813	2.2	0.333
3	1.01	4	0.813	2.2	0.083
4	2.01	4	0.813	2.2	0.083
5	4.03	4	0.813	2.2	-0.667
6	7.95	4	0.813	2.2	-0.917

Hydrogen Cyanamid Days to Hatch
 File: A:hyCyatrt.DTH Transform: NO TRANSFORM

WILLIAMS TEST (Isotonic regression model) TABLE 1 OF 2

GROUP	IDENTIFICATION	N	ORIGINAL MEAN	TRANSFORMED MEAN	ISOTONIZED MEAN
1	Control	3	36.333	36.333	36.143
2	0.507	4	36.000	36.000	36.143
3	1.01	4	36.250	36.250	36.250
4	2.01	4	36.250	36.250	36.250
5	4.03	4	37.000	37.000	37.000
6	7.95	4	37.250	37.250	37.250

Hydrogen Cyanamid Days to Hatch

File: A:hycyatrtr.DTH Transform: NO TRANSFORM

WILLIAMS TEST (Isotonic regression model) TABLE 2 OF 2

IDENTIFICATION	ISOTONIZED MEAN	CALC. WILLIAMS	SIG P=.05	TABLE WILLIAMS	DEGREES OF FREEDOM
Control	36.143				
0.507	36.143	0.602		1.74	k= 1, v=17
1.01	36.250	0.263		1.82	k= 2, v=17
2.01	36.250	0.263		1.85	k= 3, v=17
4.03	37.000	2.107	*	1.87	k= 4, v=17
7.95	37.250	2.898	*	1.87	k= 5, v=17

s = 0.414

Note: df used for table values are approximate when v > 20.

Hydrogen Cyanamid Rainbow Trout-Days to Swimup
File: hycyatrtr.sup Transform: NO TRANSFORM

SUMMARY STATISTICS ON TRANSFORMED DATA TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Controls	4	50.000	50.000	50.000
2	0.507	4	50.000	50.000	50.000
3	1.01	4	50.000	53.000	51.750
4	2.01	4	50.000	54.000	51.500
5	4.03	4	53.000	58.000	56.000
6	7.95	4	61.000	65.000	63.500

Hydrogen Cyanamid Rainbow Trout-Days to Swimup
File: hycyatrtr.sup Transform: NO TRANSFORM

SUMMARY STATISTICS ON TRANSFORMED DATA TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM
1	Controls	0.000	0.000	0.000
2	0.507	0.000	0.000	0.000
3	1.01	1.583	1.258	0.629
4	2.01	3.000	1.732	0.866
5	4.03	4.667	2.160	1.080
6	7.95	3.000	1.732	0.866

Hydrogen Cyanamid Rainbow Trout-Days to Swimup
File: hycyatrtr.sup Transform: NO TRANSFORM

ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	549.208	109.842	53.791
Within (Error)	18	36.750	2.042	
Total	23	585.958		

Critical F value = 2.77 (0.05,5,18)
Since F > Critical F REJECT Ho:All groups equal

Hydrogen Cyanamid Rainbow Trout-Days to Swimup
File: hycyatrtr.sup Transform: NO TRANSFORM

DUNNETTS TEST - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	Controls	50.000	50.000		
2	0.507	50.000	50.000	0.000	
3	1.01	51.750	51.750	-1.732	
4	2.01	51.500	51.500	-1.484	
5	4.03	56.000	56.000	-5.938	
6	7.95	63.500	63.500	-13.360	

Dunnett table value = 2.41 (1 Tailed Value, P=0.05, df=18,5)

Hydrogen Cyanamid Rainbow Trout-Days to Swimup
 File: hycyatrt.sup Transform: NO TRANSFORM
 DUNNETTS TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	Controls	4			
2	0.507	4	2.435	4.9	0.000
3	1.01	4	2.435	4.9	-1.750
4	2.01	4	2.435	4.9	-1.500
5	4.03	4	2.435	4.9	-6.000
6	7.95	4	2.435	4.9	-13.500

Hydrogen Cyanamid Rainbow Trout-Days to Swimup
 File: hycyatrt.sup Transform: NO TRANSFORM
 ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	549.208	109.842	53.791
Within (Error)	18	36.750	2.042	
Total	23	585.958		

Critical F value = 2.77 (0.05,5,18)
 Since F > Critical F REJECT Ho:All groups equal

Hydrogen Cyanamid Rainbow Trout-Days to Swimup
 File: hycyatrt.sup Transform: NO TRANSFORM
 BONFERRONI T-TEST - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	Controls	50.000	50.000		
2	0.507	50.000	50.000	0.000	
3	1.01	51.750	51.750	-1.732	
4	2.01	51.500	51.500	-1.484	
5	4.03	56.000	56.000	-5.938	
6	7.95	63.500	63.500	-13.360	

Bonferroni T table value = 2.55 (1 Tailed Value, P=0.05, df=18,5)

Hydrogen Cyanamid Rainbow Trout-Days to Swimup
 File: hycyatrt.sup Transform: NO TRANSFORM
 BONFERRONI T-TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	Controls	4			
2	0.507	4	2.580	5.2	0.000
3	1.01	4	2.580	5.2	-1.750
4	2.01	4	2.580	5.2	-1.500
5	4.03	4	2.580	5.2	-6.000
6	7.95	4	2.580	5.2	-13.500

Hydrogen Cyanamid Rainbow Trout-Days to Swimup
 File: hycyatrt.sup Transform: NO TRANSFORM
 WILLIAMS TEST (Isotonic regression model) TABLE 1 OF 2

GROUP	IDENTIFICATION	N	ORIGINAL MEAN	TRANSFORMED MEAN	ISOTONIZED MEAN
1	Controls	4	50.000	50.000	50.000
2	0.507	4	50.000	50.000	50.000
3	1.01	4	51.750	51.750	51.625
4	2.01	4	51.500	51.500	51.625
5	4.03	4	56.000	56.000	56.000
6	7.95	4	63.500	63.500	63.500

Hydrogen Cyanamid Rainbow Trout-Days to Swimup
 File: hycyatrt.sup Transform: NO TRANSFORM
 WILLIAMS TEST (Isotonic regression model) TABLE 2 OF 2

IDENTIFICATION	ISOTONIZED MEAN	CALC. WILLIAMS	SIG P= .05	TABLE WILLIAMS	DEGREES OF FREEDOM
Controls	50.000				
0.507	50.000	0.000		1.73	k= 1, v=18
1.01	51.625	1.608		1.82	k= 2, v=18
2.01	51.625	1.608		1.85	k= 3, v=18
4.03	56.000	5.938	*	1.86	k= 4, v=18
7.95	63.500	13.362	*	1.87	k= 5, v=18

s = 1.429
 Note: df used for table values are approximate when v > 20.

Hydrogen Cyanamid-Rainbow trout 35 D Survival
 File: Hycyatrt.35D Transform: NO TRANSFORM

SUMMARY STATISTICS ON TRANSFORMED DATA TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Control	4	93.300	93.300	93.300
2	0.507	4	100.000	100.000	100.000
3	1.01	4	80.000	100.000	90.000
4	2.01	4	86.700	93.300	90.000
5	4.03	4	80.000	86.700	85.025
6	7.95	4	66.700	100.000	78.325

Hydrogen Cyanamid-Rainbow trout 35 D Survival
 File: Hycyatrt.35D Transform: NO TRANSFORM
 SUMMARY STATISTICS ON TRANSFORMED DATA TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM
1	Control	0.000	0.000	0.000
2	0.507	0.000	0.000	0.000
3	1.01	73.927	8.598	4.299
4	2.01	14.520	3.811	1.905
5	4.03	11.222	3.350	1.675
6	7.95	218.483	14.781	7.391

Hydrogen Cyanamid-Rainbow trout 35 D Survival
 File: Hycyatrt.35D Transform: NO TRANSFORM
 ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	1080.303	216.061	4.075
Within (Error)	18	954.455	53.025	
Total	23	2034.758		

Critical F value = 2.77 (0.05,5,18)
 Since F > Critical F REJECT Ho:All groups equal

Hydrogen Cyanamid-Rainbow trout 35 D Survival
 File: Hycyatrt.35D Transform: NO TRANSFORM
 DUNNETTS TEST TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	Control	93.300	93.300		
2	0.507	100.000	100.000	-1.301	
3	1.01	90.000	90.000	0.641	
4	2.01	90.000	90.000	0.641	
5	4.03	85.025	85.025	1.607	
6	7.95	78.325	78.325	2.908	*

Dunnnett table value = 2.41 (1 Tailed Value, P=0.05, df=18,5)

Hydrogen Cyanamid-Rainbow trout 35 D Survival
 File: Hycyatrt.35D Transform: NO TRANSFORM
 DUNNETTS TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	Control	4			
2	0.507	4	12.409	13.3	-6.700
3	1.01	4	12.409	13.3	3.300
4	2.01	4	12.409	13.3	3.300
5	4.03	4	12.409	13.3	8.275
6	7.95	4	12.409	13.3	14.975

Hydrogen Cyanamid-Rainbow trout 35 D Survival
 File: Hycyatrt.35D Transform: NO TRANSFORM
 ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	1080.303	216.061	4.075
Within (Error)	18	954.455	53.025	
Total	23	2034.758		

Critical F value = 2.77 (0.05,5,18)
 Since F > Critical F REJECT Ho:All groups equal

Hydrogen Cyanamid-Rainbow trout 35 D Survival
 File: Hycyatrt.35D Transform: NO TRANSFORM
 BONFERRONI T-TEST - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	Control	93.300	93.300		
2	0.507	100.000	100.000	-1.301	
3	1.01	90.000	90.000	0.641	
4	2.01	90.000	90.000	0.641	
5	4.03	85.025	85.025	1.607	
6	7.95	78.325	78.325	2.908	*

Bonferroni T table value = 2.55 (1 Tailed Value, P=0.05, df=18,5)

Hydrogen Cyanamid-Rainbow trout 35 D Survival
 File: Hycyatrt.35D Transform: NO TRANSFORM
 BONFERRONI T-TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	Control	4			
2	0.507	4	13.145	14.1	-6.700
3	1.01	4	13.145	14.1	3.300
4	2.01	4	13.145	14.1	3.300
5	4.03	4	13.145	14.1	8.275
6	7.95	4	13.145	14.1	14.975

Hydrogen Cyanamid-Rainbow trout 35 D Survival
 File: Hycyatrt.35D Transform: NO TRANSFORM
 WILLIAMS TEST (Isotonic regression model) TABLE 1 OF 2

GROUP	IDENTIFICATION	N	ORIGINAL MEAN	TRANSFORMED MEAN	ISOTONIZED MEAN
1	Control	4	93.300	93.300	96.650
2	0.507	4	100.000	100.000	96.650
3	1.01	4	90.000	90.000	90.000
4	2.01	4	90.000	90.000	90.000
5	4.03	4	85.025	85.025	85.025
6	7.95	4	78.325	78.325	78.325

Hydrogen Cyanamid-Rainbow trout 35 D Survival
 File: Hycyatrt.35D Transform: NO TRANSFORM
 WILLIAMS TEST (Isotonic regression model) TABLE 2 OF 2

IDENTIFICATION	ISOTONIZED MEAN	CALC. WILLIAMS	SIG. P=0.05	TABLE WILLIAMS	DEGREES OF FREEDOM
Control	96.650				

0.507	96.650	0.651	1.73	k= 1, v=18
1.01	90.000	0.641	1.82	k= 2, v=18
2.01	90.000	0.641	1.85	k= 3, v=18
4.03	85.025	1.607	1.86	k= 4, v=18
7.95	78.325	2.908	1.87	k= 5, v=18

s = 7.282

Note: df used for table values are approximate when v > 20.

Hydrogen Cyanamid-Trout-60 Day Posthatch Survival
File: Hycyatrt.60D Transform: NO TRANSFORM

SUMMARY STATISTICS ON TRANSFORMED DATA TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Control	4	93.300	93.300	93.300
2	0.507	4	93.300	100.000	98.325
3	1.01	4	80.000	93.300	88.325
4	2.01	4	86.700	93.300	88.350
5	4.03	4	80.000	86.700	83.350
6	7.95	4	53.300	85.700	64.750

Hydrogen Cyanamid-Trout-60 Day Posthatch Survival
File: Hycyatrt.60D Transform: NO TRANSFORM

SUMMARY STATISTICS ON TRANSFORMED DATA TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM
1	Control	0.000	0.000	0.000
2	0.507	11.222	3.350	1.675
3	1.01	40.483	6.363	3.181
4	2.01	10.890	3.300	1.650
5	4.03	14.963	3.868	1.934
6	7.95	234.970	15.329	7.664

Hydrogen Cyanamid-Trout-60 Day Posthatch Survival
File: Hycyatrt.60D Transform: NO TRANSFORM

ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	2698.728	539.746	10.362
Within (Error)	18	937.585	52.088	
Total	23	3636.313		

Critical F value = 2.77 (0.05,5,18)

Since F > Critical F REJECT Ho:All groups equal

Hydrogen Cyanamid-Trout-60 Day Posthatch Survival
File: Hycyatrt.60D Transform: NO TRANSFORM

DUNNETTS TEST

TABLE 1 OF 2

Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	Control	93.300	93.300		
2	0.507	98.325	98.325	-0.985	
3	1.01	88.325	88.325	0.975	
4	2.01	88.350	88.350	0.970	
5	4.03	83.350	83.350	1.950	
6	7.95	64.750	64.750	5.594	*

Dunnett table value = 2.41 (1 Tailed Value, P=0.05, df=18,5)

Hydrogen Cyanamid-Trout-60 Day Posthatch Survival
File: Hycyatrt.60D Transform: NO TRANSFORM

DUNNETTS TEST

TABLE 2 OF 2

Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	Control	4			
2	0.507	4	12.299	13.2	-5.025
3	1.01	4	12.299	13.2	4.975
4	2.01	4	12.299	13.2	4.950
5	4.03	4	12.299	13.2	9.950
6	7.95	4	12.299	13.2	28.550

Hydrogen Cyanamid-Trout-60 Day Posthatch Survival
 File: Hycyatrt.60D Transform: NO TRANSFORM
 ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	2698.728	539.746	10.362
Within (Error)	18	937.585	52.088	
Total	23	3636.313		

Critical F value = 2.77 (0.05,5,18)
 Since F > Critical F REJECT Ho:All groups equal

Hydrogen Cyanamid-Trout-60 Day Posthatch Survival
 File: Hycyatrt.60D Transform: NO TRANSFORM
 BONFERRONI T-TEST TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	Control	93.300	93.300		
2	0.507	98.325	98.325	-0.985	
3	1.01	88.325	88.325	0.975	
4	2.01	88.350	88.350	0.970	
5	4.03	83.350	83.350	1.950	
6	7.95	64.750	64.750	5.594 *	

Bonferroni T table value = 2.55 (1 Tailed Value, P=0.05, df=18,5)

Hydrogen Cyanamid-Trout-60 Day Posthatch Survival
 File: Hycyatrt.60D Transform: NO TRANSFORM
 BONFERRONI T-TEST TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	Control	4			
2	0.507	4	13.029	14.0	-5.025
3	1.01	4	13.029	14.0	4.975
4	2.01	4	13.029	14.0	4.950
5	4.03	4	13.029	14.0	9.950
6	7.95	4	13.029	14.0	28.550

Hydrogen Cyanamid-Trout-60 Day Posthatch Survival
 File: Hycyatrt.60D Transform: NO TRANSFORM
 WILLIAMS TEST (Isotonic regression model) TABLE 1 OF 2

GROUP	IDENTIFICATION	N	ORIGINAL MEAN	TRANSFORMED MEAN	ISOTONIZED MEAN
1	Control	4	93.300	93.300	95.813
2	0.507	4	98.325	98.325	95.813
3	1.01	4	88.325	88.325	88.338
4	2.01	4	88.350	88.350	88.338
5	4.03	4	83.350	83.350	83.350
6	7.95	4	64.750	64.750	64.750

Hydrogen Cyanamid-Trout-60 Day Posthatch Survival
 File: Hycyatrt.60D Transform: NO TRANSFORM
 WILLIAMS TEST (Isotonic regression model) TABLE 2 OF 2

IDENTIFICATION	ISOTONIZED MEAN	CALC. WILLIAMS	SIG P=.05	TABLE WILLIAMS	DEGREES OF FREEDOM
Control	95.813				
0.507	95.813	0.492		1.73	k= 1, v=18
1.01	88.338	0.972		1.82	k= 2, v=18
2.01	88.338	0.972		1.85	k= 3, v=18
4.03	83.350	1.950	*	1.86	k= 4, v=18
7.95	64.750	5.594	*	1.87	k= 5, v=18

s = 7.217
 Note: df used for table values are approximate when v > 20.

Hydrogen Cyanamid-Trout-60 Day Length
 File: Hycyatrt.wt Transform: NO TRANSFORM

SUMMARY STATISTICS ON TRANSFORMED DATA TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Control	4	45.900	47.900	46.825
2	0.507	4	44.000	46.400	45.350
3	1.01	4	44.100	45.200	44.450
4	2.01	4	39.800	41.200	40.550
5	4.03	4	36.800	37.300	37.050
6	7.95	4	30.700	31.800	31.275

Hydrogen Cyanamid-Trout-60 Day Length
 File: Hycyatrt.wt Transform: NO TRANSFORM

SUMMARY STATISTICS ON TRANSFORMED DATA TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM
1	Control	0.876	0.936	0.468
2	0.507	1.157	1.075	0.538
3	1.01	0.257	0.507	0.253
4	2.01	0.497	0.705	0.352
5	4.03	0.043	0.208	0.104
6	7.95	0.202	0.450	0.225

Hydrogen Cyanamid-Trout-60 Day Length
 File: Hycyatrt.wt Transform: NO TRANSFORM

ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	700.378	140.076	277.378
Within (Error)	18	9.095	0.505	
Total	23	709.473		

Critical F value = 2.77 (0.05,5,18)
 Since F > Critical F REJECT Ho:All groups equal

Hydrogen Cyanamid-Trout-60 Day Length
 File: Hycyatrt.wt Transform: NO TRANSFORM

DUNNETTS TEST - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T-STAT	SIG
1	Control	46.825	46.825		
2	0.507	45.350	45.350	2.935	*
3	1.01	44.450	44.450	4.726	*
4	2.01	40.550	40.550	12.488	*
5	4.03	37.050	37.050	19.453	*
6	7.95	31.275	31.275	30.946	*

Dunnnett table value = 2.41 (1 Tailed Value, P=0.05, df=18,5)

Hydrogen Cyanamid-Trout-60 Day Length
 File: Hycyatrt.wt Transform: NO TRANSFORM

DUNNETTS TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	Control	4			
2	0.507	4	1.211	2.6	1.475
3	1.01	4	1.211	2.6	2.375
4	2.01	4	1.211	2.6	6.275
5	4.03	4	1.211	2.6	9.775
6	7.95	4	1.211	2.6	15.550

Hydrogen Cyanamid-Trout-60 Day Length
 File: Hycyatrt.wt Transform: NO TRANSFORM

ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	700.378	140.076	277.378
Within (Error)	18	9.095	0.505	
Total	23	709.473		

Critical F value = 2.77 (0.05,5,18)
 Since F > Critical F REJECT Ho:All groups equal
 Hydrogen Cyanamid-Trout-60 Day Length
 File: Hycyatrt.wt Transform: NO TRANSFORM
 BONFERRONI T-TEST - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	Control	46.825	46.825		
2	0.507	45.350	45.350	2.935	*
3	1.01	44.450	44.450	4.726	*
4	2.01	40.550	40.550	12.488	*
5	4.03	37.050	37.050	19.453	*
6	7.95	31.275	31.275	30.946	*

Bonferroni T table value = 2.55 (1 Tailed Value, P=0.05, df=18,5)

Hydrogen Cyanamid-Trout-60 Day Length
 File: Hycyatrt.wt Transform: NO TRANSFORM
 BONFERRONI T-TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	Control	4			
2	0.507	4	1.283	2.7	1.475
3	1.01	4	1.283	2.7	2.375
4	2.01	4	1.283	2.7	6.275
5	4.03	4	1.283	2.7	9.775
6	7.95	4	1.283	2.7	15.550

Hydrogen Cyanamid-Trout-60 Day Length
 File: Hycyatrt.wt Transform: NO TRANSFORM
 WILLIAMS TEST (Isotonic regression model) TABLE 1 OF 2

GROUP	IDENTIFICATION	N	ORIGINAL MEAN	TRANSFORMED MEAN	ISOTONIZED MEAN
1	Control	4	46.825	46.825	46.825
2	0.507	4	45.350	45.350	45.350
3	1.01	4	44.450	44.450	44.450
4	2.01	4	40.550	40.550	40.550
5	4.03	4	37.050	37.050	37.050
6	7.95	4	31.275	31.275	31.275

Hydrogen Cyanamid-Trout-60 Day Length
 File: Hycyatrt.wt Transform: NO TRANSFORM
 WILLIAMS TEST (Isotonic regression model) TABLE 2 OF 2

IDENTIFICATION	ISOTONIZED MEAN	CALC. WILLIAMS	SIG P=.05	TABLE WILLIAMS	DEGREES OF FREEDOM
Control	46.825				
0.507	45.350	2.935	*	1.73	k= 1, v=18
1.01	44.450	4.725	*	1.82	k= 2, v=18
2.01	40.550	12.484	*	1.85	k= 3, v=18
4.03	37.050	19.448	*	1.86	k= 4, v=18
7.95	31.275	30.937	*	1.87	k= 5, v=18

s = 0.711
 Note: df used for table values are approximate when v > 20.

Hydrogen Cyanamid-Trout-60 Day Wet Weight
 File: hycyatrt.wt Transform: NO TRANSFORM
 SUMMARY STATISTICS ON TRANSFORMED DATA TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Control	4	1.459	1.597	1.535
2	0.507	4	1.295	1.503	1.401
3	1.01	4	1.200	1.332	1.262
4	2.01	4	0.927	1.030	0.985
5	4.03	4	0.698	0.790	0.734
6	7.95	4	0.406	0.455	0.432

Hydrogen Cyanamid-Trout-60 Day Wet Weight
 File: hycyatrt.wt Transform: NO TRANSFORM
 SUMMARY STATISTICS ON TRANSFORMED DATA TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM
1	Control	0.004	0.060	0.030
2	0.507	0.012	0.109	0.055
3	1.01	0.003	0.055	0.028
4	2.01	0.003	0.053	0.026
5	4.03	0.002	0.039	0.020
6	7.95	0.000	0.020	0.010

Hydrogen Cyanamid-Trout-60 Day Wet Weight
 File: hycyatrt.wt Transform: NO TRANSFORM
 ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	3.559	0.712	178.000
Within (Error)	18	0.070	0.004	
Total	23	3.629		

Critical F value = 2.77 (0.05,5,18)
 Since F > Critical F REJECT Ho:All groups equal
 Hydrogen Cyanamid-Trout-60 Day Wet Weight
 File: hycyatrt.wt Transform: NO TRANSFORM
 DUNNETTS TEST - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	Control	1.535	1.535		
2	0.507	1.401	1.401	2.996	*
3	1.01	1.262	1.262	6.104	*
4	2.01	0.985	0.985	12.304	*
5	4.03	0.734	0.734	17.916	*
6	7.95	0.432	0.432	24.675	*

Dunnnett table value = 2.41 (1 Tailed Value, P=0.05, df=18,5)

Hydrogen Cyanamid-Trout-60 Day Wet Weight
 File: hycyatrt.wt Transform: NO TRANSFORM
 DUNNETTS TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	Control	4			
2	0.507	4	0.108	7.0	0.134
3	1.01	4	0.108	7.0	0.273
4	2.01	4	0.108	7.0	0.550
5	4.03	4	0.108	7.0	0.801
6	7.95	4	0.108	7.0	1.104

Hydrogen Cyanamid-Trout-60 Day Wet Weight
 File: hycyatrt.wt Transform: NO TRANSFORM
 ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	3.559	0.712	178.000
Within (Error)	18	0.070	0.004	
Total	23	3.629		

Critical F value = 2.77 (0.05,5,18)
 Since F > Critical F REJECT Ho:All groups equal

Hydrogen Cyanamid-Trout-60 Day Wet Weight
 File: hycyatrt.wt Transform: NO TRANSFORM
 BONFERRONI T-TEST - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	Control	1.535	1.535		
2	0.507	1.401	1.401	2.996	*
3	1.01	1.262	1.262	6.104	*
4	2.01	0.985	0.985	12.304	*
5	4.03	0.734	0.734	17.916	*
6	7.95	0.432	0.432	24.675	*

Bonferroni T table value = 2.55 (1 Tailed Value, P=0.05, df=18,5)

Hydrogen Cyanamid-Trout-60 Day Wet Weight
 File: hycyatrt.wt Transform: NO TRANSFORM
 BONFERRONI T-TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	Control	4			
2	0.507	4	0.114	7.4	0.134
3	1.01	4	0.114	7.4	0.273
4	2.01	4	0.114	7.4	0.550
5	4.03	4	0.114	7.4	0.801
6	7.95	4	0.114	7.4	1.104

Hydrogen Cyanamid-Trout-60 Day Wet Weight
 File: hycyatrt.wt Transform: NO TRANSFORM
 WILLIAMS TEST (Isotonic regression model) TABLE 1 OF 2

GROUP	IDENTIFICATION	N	ORIGINAL MEAN	TRANSFORMED MEAN	ISOTONIZED MEAN
1	Control	4	1.535	1.535	1.535
2	0.507	4	1.401	1.401	1.401
3	1.01	4	1.262	1.262	1.262
4	2.01	4	0.985	0.985	0.985
5	4.03	4	0.734	0.734	0.734
6	7.95	4	0.432	0.432	0.432

Hydrogen Cyanamid-Trout-60 Day Wet Weight
 File: hycyatrt.wt Transform: NO TRANSFORM
 WILLIAMS TEST (Isotonic regression model) TABLE 2 OF 2

IDENTIFICATION	ISOTONIZED MEAN	CALC. WILLIAMS	SIG P=.05	TABLE WILLIAMS	DEGREES OF FREEDOM
Control	1.535				
0.507	1.401	3.038	*	1.73	k= 1, v=18
1.01	1.262	6.190	*	1.82	k= 2, v=18
2.01	0.985	12.477	*	1.85	k= 3, v=18
4.03	0.734	18.168	*	1.86	k= 4, v=18
7.95	0.432	25.021	*	1.87	k= 5, v=18

s = 0.062

Note: df used for table values are approximate when v > 20.