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Subject *HYDROLOGY*

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SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

TEXAS ENGINEERING TECHNICAL NOTE

No.: 210-18-TX1

HYDROLOGY

EMERGENCY SPILLWAY AND FREEBOARD HYDROGRAPH DEVELOPMENT

INTRODUCTION

This technical note gives data and procedures for preparing the design hydrograph needed in determining emergency spillway capacities that meet the criteria given in Technical Release No. 60. Development of the hydrographs is based upon procedures and examples shown in Chapter 21, SCS National Engineering Handbook, Section 4, Hydrology.

It is recognized that the computer programs generally are used to develop and route emergency spillway design hydrographs. The hydrologic data needed for these programs are contained in this technical note.

DESIGN STORM

Rainfall

Table 1 establishes the minimum design precipitation amounts by dam class. The maps, Figures 1 and 2, are to be used to establish the 100-year and the probable maximum precipitation (PMP).

The 100-year areal rainfall will be obtained by adjusting point rainfall with the use of Figure 4. The humid and subhumid climate and the arid and semiarid climate curves are shown. Where average annual rainfall is 25 inches or more, the humid and subhumid climate curve will be used. Where average annual rainfall is 15 inches or less, the arid and semiarid climate curve adjustment will be applied. For areas of the State where annual rainfall is from 15 to 25 inches, the adjustment will be interpolated between the two climate curves. Annual rainfall can be obtained from Figure 5.

The Probable Maximum Precipitation (PMP) for 10 square miles and 6-hour duration can be obtained from Figure 2. The areal adjustment factor for larger drainage areas can be obtained from Figure 3A.

The storm duration will be 6 hours, except when the T_c is greater than 6 hours, in which case a storm duration at least equal to T_c will be used. See Figure 3B to determine relative increase in rainfall amounts when T_c exceeds 6 hours.

All precipitation adjustment factors for drainage areas larger than 100 square miles and T_c's greater than 48 hours require a special study.

Runoff

Determine the hydrologic soil-cover complex number of the watershed. Form TX-WS-224 (Table 2) is set up so that present and future soil-cover complex data can be recorded. The appropriate runoff curve numbers are taken from Tables 3 and 3A.

The weighted II condition curve number is computed on Table 2 by the summation of products of curve number and the precent of the total watershed represented by each curve number.

Studies of hydrologic basic data indicate that antecedent moisture condition II is not the average throughout the state. Based on considerable investigations it appears that the average condition ranges from antecedent moisture condition I in West Texas to between condition II and III in East Texas (Figure 5A).

The average runoff condition curve number for the emergency spillway and freeboard hydrographs will be obtained by applying the adjustment shown on Figure 5A. When the adjustment, by Figure 5A, results in a runoff curve number less than 60, the curve number of 60 will be selected as the minimally applicable number. If the unadjusted curve number is less than 60, that number will be used without adjustment by Figure 5A.

The average runoff condition curve number (the adjusted curve number) associated with the freeboard hydrograph, and the resulting pool head created by passage of that hydrograph, will determine the minimum freeboard requirements. Additional freeboard, as a dry freeboard above the minimum requirement, should be applied on important dams and structures that are designed by less than high hazard criteria. When an additional freeboard is applied, the magnitude of that addition should have hydrologic significance and should not be an arbitrary vertical dimension for any and all sizes of structures. An additional "dry" freeboard requirement may be depicted by the influence of a greater storm runoff. The hydrologic significance of a selected dry freeboard will be treated by the hydrologic and hydraulic results of the runoff with an increased runoff curve number. For dimensioning dry freeboard, the following will apply:

Depth of Areal Rainfall Associated with the Freeboard Hydrograph	Addition to the Average (Adjusted) Runoff CN, to Depict Dry Freeboard
6 inches or less	CN + 2
6 to 10 inches	CN + 3
10 to 12 inches	CN + 4
12 to 14 inches	CN + 6
14 or more	CN + 7

The dry freeboard requirement, by the above means, will not ordinarily be applied when the average runoff condition curve number (the adjusted curve number) plus the dry freeboard curve number addition is greater

than the soil cover complex condition II curve number, or when the hydrograph or hydrographs being considered are those associated with the "c" classification criteria.

The use of the procedure is explained in the following example:

Example - Find average runoff curve number for structure located in Lubbock County. The soil-cover complex curve number is 75.

1. From Figure 5A find the isogram labeled I which passes through the area.

2. From Table 3B find that the condition I curve number 57 corresponds to condition II curve number 75.

3. The average condition curve number 57 is less than 60 Thus 60 would be used for emergency spillway design.

The volume of runoff (Q) will be obtained by use of Figure 6 (Sheets 1 and 2) and the areal amount of rainfall. Tables in Technical Release 16 will give identical results and may be used.

Hydrograph Computation

Generally, the emergency spillway design hydrograph development and routings will be performed by computer programs. Otherwise, Hydrograph Computation Form SCS-319 will be used to record basic data and to show the hydrograph coordinates. These forms are available on request to the State Office. Figure 7 illustrates the use of Form SCS-319.

The hydrograph family number will be based on the attached Figure 8 (ES-1011) from NEH-4.

An example of the development of the freeboard hydrograph for a floodwater retarding structure in Lubbock County, Texas, is shown in the following step procedure. The structure drainage area is 21.85 square miles; antecedent moisture condition II runoff curve number 75; class (a) structure and product of storage and effective height of dam is greater than 30,000. Tabulate data on Form SCS-319, as shown on Figure 7, and then use the following steps to complete the form:

1. Determine the time of concentration T_c

   Length of watershed: 10 miles
   Average width of watershed: 21.85/10 or 2.2 miles
   Length/width ratio: 10.0/2.2 or 4.5 Also Length^2/Area or $10^2/21.85$
   Length/width ratio factor (Figure 9): 2.2
   Land Resource Area (Figure 10): RR
   T_c (Where L/W = 1.0) (Figure 9) is 1.6 hours
   T_c = (2.2) (1.6) = 3.5 hours

Other methods of determining T_c are acceptable The use of stream hydraulics where available is preferred.

2. Determine the 6-hour freeboard storm rainfall amount (P) in inches.

Table 1 shows the minimum emergency spillway hydrologic criteria. The freeboard hydrograph for the illustrated structure is determined by the equation:

$$P_{100} + 0.26\ (PMP - P_{100})$$

Where P_{100} = 5.0 and PMP = 26.0 (Figures 1 and 2)

The drainage area of the watershed exceeds 10 square miles, thus, an area adjustment should be applied to the point rainfall. Figure 5 shows that the average annual rainfall for the watershed is 21 inches. The adjustment factor for the 100-year storm will need to be read directly from Figure 4. The factor for 21.85 square miles and 21 inches average annual rainfall is .91. Areal 100-year storm is (5.0) (.91) = 4.55 inches. The areal adjustment factor for the PMP storm (Figure 2A) over 21.85 square miles is .94. Areal PMP storm rainfall is (26) (.94) = 24.44 inches

3. Make the duration adjustment of rainfall amount.

(Reference Figures 2B for rainfall adjustment factors.)

Because the time of concentration is not over 6 hours, no adjustment is made. Hence, use storm duration of 6 hours. An example showing necessary adjustment of duration to use when T_c exceeds 6 hours is presented in Chapter 21, NEH-4. The Freeboard storm rainfall = 4.55" + .26 (24.44" - 4.55") = 9.72"

4. Determine the runoff amount Q.

Enter Figure 6, Sheet 1 of 2 or Sheet 2 of 2 (or use Technical Release 16) with P = 9.72 and CN = 60 and find Q = 4.68 in.

5. Determine the hydrograph family.

Enter Figure 8 (ES-1011) with CN = 60 and P = 9.72 inches, read hydrograph family 3.

6. Compute the initial value of T_p.

to peak, $T_p = 0.7\ T_c = .7 \times 3.5 = 2.45$ hours.

7 Determine the duration of excess rainfall.

Enter Figure 11 (ES-1012) with P = 9.72 inches on CN = 60, Read T_o 4.50.

8. Compute ratio T_o/T_p.

Ratio $T_o/T_p = 4.50/2.45 = 1.84$.

9. Select a revised T_o/T_p ratio from Table 4.

This table shows the hydrograph families and T_o/T_p ratios for which dimensionless hydrographs are listed in Table 5. Enter Table 4 with the computed ratio of Step 8 and select the tabulated ratio nearest it. For this example, the selected ratio is 2.0.

10. Compute revised T_p.

$$\text{Revised } T_p = \frac{T_o}{\text{Used } T_o/T_p} = 4.50/2.0 = 2.25 \text{ hours}$$

11 Compute q_p.

$$q_p = \frac{484\ A}{\text{Rev } T_p} = \frac{(484)\ (21.85)}{2.25} = 4700 \text{ cfs}$$

12. Compute Qq_p.

$Qq_p = (4.68)\ (4700) = 22{,}000$ cfs

13. Compute the times at which the hydrograph rates will be computed

Multiply the revised T_p value of 2.25 computed in Step 10 by the t/T_p values in Table 5, Sheet 7 of 15, (Hydrograph family 3 under heading $T_o/T_p = 2$) to obtain time t in hours for column 2 of Figure 7. Time t for line 2, Figure 7 = t/T_p (Table 5) x Revised T_p = (.30)(2.25) = 0.675 hrs

14. Compute the hydrograph rate.

Multiply Qq_p of 22,000 by the values of qc/q_p shown in Table 5, Sheet 4 of 15, (Hydrograph family 3 under heading $T_o/T_p = 2$). The computed rates are shown in column 3 of Figure 7. The q in cfs for Line 2, Figure 7 = 22,000 x .012 = 264 cfs.

15. Check the total runoff of the computed hydrograph.

Use equation $Q = \frac{(\Delta t)\ (\Sigma q)}{645\ A}$. To obtain Δt, divide the total time of 14.96 hours by the number of lines excluding the first line in column 2, Figure 7. Compute 14.96/22 = 0.68 hour. Σq is the sum of all q's in column 3 of Figure 7 and equals 99506 cfs. By the equation,

$$Q = \frac{(0.68)\ (99{,}506)}{(645)\ (21.85)} = 4.80 \text{ inches}$$

This approximates the actual Q of 4.68 inches and indicates that no gross errors occurred in the hydrograph calculations.

16. Plot or tabulate the hydrograph for flood routing.

EMERGENCY SPILLWAY HYDROGRAPH DESIGN PROGRAM (RESIN)

This ADP program is widely used for hydrologic studies. Figure 12 is an example of the input form.

Chapter 16, NEH-4, explains the proportioning of the Soil Conservation Service dimensionless curvilinear hydrograph. It is shown that ΔD (duration of unit excess rainfall) is $.2T_p$ (time to peak) and is $.133\ T_c$ (time of concentration). It is stated that a small variation in ΔD is permissible; however, it should be no greater than $.25\ T_p$. Thus the maximum value of ΔD should not be greater than $.172\ T_c$.

The program uses a ΔD of .25 unless another time increment is used by responding to footnote 9 on the input form. The use of a disproportionate time increment and T_c can result in considerable error in the routed results. This is especially true when little detention capacity is available.

The error can be avoided by responding to footnote 9. The following time increments should be used.

T_c	Time Increment
.3 to .6	.05
.6 - .9	.10
.9 - 1.2	.15
1.2 - 1.5	.20
1.5 +	.25

TABLE 1

MINIMUM EMERGENCY SPILLWAY HYDROLOGIC CRITERIA

Class of Dam	Product of Storage x Effective Height	Existing or Planned Upstream Dams	Precipitation Data for [1]	
			Emergency Spillway Hydrograph	Freeboard Hydrograph
(a) [2]	less than 30,000	none	P_{100}	$P_{100} + 0.12\ (PMP - P_{100})$
	greater than 30,000	none	$P_{100} + 0.06\ (PMP - P_{100})$	$P_{100} + 0.26\ (PMP - P_{100})$
	all	any [3]	$P_{100} + 0.12\ (PMP - P_{100})$	$P_{100} + 0.40\ (PMP - P_{100})$
(b)	all	none or any	$P_{100} + 0.12\ (PMP - P_{100})$	$P_{100} + 0.40\ (PMP - P_{100})$
(c)	all	none or any	$P_{100} + 0.26\ (PMP - P_{100})$	PMP

[1] P_{100} = Precipitation for 100-year return period. PMP = Probable maximum precipitation.

[2] Dams involving industrial or municipal water are to use minimum criteria equivalent to that of class (b).

[3] Applies when the upstream dam is located so that its failure could endanger the lower dam.

Form TX-WS-224
Rev. 6/72

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service

Watershed Duck Creek

SOIL COVER COMPLEX

Site or Sample No. 5
Area, Acres 13984

Cover	Practice	Condition or Rotation	II - Curve Number A	B	C	D	Present Area A	B	C	D	Future Area A	B	C	D
Rowcrops	St. Row	poor	72	81	88	91								
	St. Row	good	67	78	85	89								
	Contoured	poor	70	79	84	88								
	Contoured	good	65	75	82	86						1720		
*	C&T	poor	66	74	80	82								
	C&T	good	62	71	78	81								
Small grains *	St. Row	poor	65	76	84	88								
	St. Row	good	63	75	83	87						1802		
	C&T	poor	61	72	79	82								
	C&T	good	59	70	78	81								
Legumes or rotation * meadow	St. Row	poor	66	77	85	89								
	St. Row	good	58	72	81	85								
	C&T	poor	63	73	80	83								
	C&T	good	51	67	76	80								
Native range or pasture		poor	68	79	86	89								
		fair	49	69	79	84						4212	6250	
		good	39	61	74	80								
Woods		poor	45	66	77	83								
		fair	36	60	73	79								
		good	25	55	70	77								
Meadow (Perm.)		good	30	58	71	78								
Farmsteads			59	74	82	86								
	Dirt		72	82	87	89								
	Hard Surface		74	84	90	92								

* Contoured and Terraced (Includes less than 1% slope)
** Includes Rights-of-way

Present _____
Future 75
Date 4-20-65
A.B.

Table 2

Table 3

Runoff curve numbers for hydrologic Soil-Cover Complexes
For Watershed Condition II, and $I_a = 0.2(S)$

Land Use or Cover	Treatment or Practice	Hydrologic Condition	Hydrologic Soil Group A	B	C	D
Fallow	Straight row		77	86	91	94
Row crops	"	Poor	72	81	88	91
	"	Good	67	78	85	89
	Contoured	Poor	70	79	84	88
	"	Good	65	75	82	86
	" and terraced	Poor	66	74	80	82
	" " "	Good	62	71	78	81
Small grain	Straight row	Poor	65	76	84	88
		Good	63	75	83	87
	Contoured	Poor	63	74	82	85
		Good	61	73	81	84
	and terraced	Poor	61	72	79	82
		Good	59	70	78	81
Close-seeded legumes 4/ or rotation meadow	Straight row	Poor	66	77	85	89
	" "	Good	58	72	81	85
	Contoured	Poor	64	75	83	85
	"	Good	55	69	78	83
	" and terraced	Poor	63	73	80	83
	" and terraced	Good	51	67	76	80
Pasture or range		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
	Contoured	Poor	47	67	81	88
	"	Fair	25	59	75	83
	"	Good	6	35	70	79
Meadow (permanent)		Good	30	58	71	78
Woods (farm woodlots)		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	25	55	70	77
Farmsteads			59	74	82	86
Roads (dirt) 5/		----	72	82	87	89
(hard surface) 5/		----	74	84	90	92

4/ Close-drilled or broadcast
5/ Including right-of-way.

Table 3A

Runoff Curve Numbers for Hydrologic Soil-Cover Complexes 1/

Part 1. Commercial or national forest, for watershed condition II, and $I_a = 0.2(S)$

Hydrologic Condition Class	Hydrologic Soil Group A	B	C	D
I (Poorest)	56	75	86	91
II (Poor	46	68	78	84
III (Medium)	36	60	70	76
IV (Good)	26	52	62	69
V (Best)	15	44	54	61

Part 2. Forest-range areas in western United States, for watershed condition III, and $I_a = 0.2(S)$ 1/

Cover	Condition	Soil Groups A	B	C	D
Herbaceous	Poor		90	94	97
	Fair		84	92	95
	Good		77	86	93
Sagebrush	Poor		81	90	
	Fair		66	83	
	Good		55	66	
Oak-Aspen	Poor		80	86	
	Fair		60	73	
	Good		50	60	
Juniper	Poor		87	93	
	Fair		73	85	
	Good		60	77	

(Note that this table is for Condition III.)

1/ Data supplied by Forest Service, June 1956

Table 3B. Curve numbers (CN) and constants for the case $I_a = 0.2\ S$

1	2	3	4	5	1	2	3	4	5
CN for condition II	CN for conditions I	CN for conditions III	S values*	Curve* starts where P =	CN for condition II	CN for conditions I	CN for conditions III	S values*	Curve* starts where P =
			(inches)	(inches)				(inches)	(inches)
100	100	100	0	0	60	40	78	6.67	1.33
99	97	100	.101	.02	59	39	77	6.95	1.39
98	94	99	.204	.04	58	38	76	7.24	1.45
97	91	99	.309	.06	57	37	75	7.54	1.51
96	89	99	.417	.08	56	36	75	7.86	1.57
95	87	98	.526	.11	55	35	74	8.18	1.64
94	85	98	.638	.13	54	34	73	8.52	1.70
93	83	98	.753	.15	53	33	72	8.87	1.77
92	81	97	.870	.17	52	32	71	9.23	1.85
91	80	97	.989	.20	51	31	70	9.61	1.92
90	78	96	1.11	.22	50	31	70	10.0	2.00
89	76	96	1.24	.25	49	30	69	10.4	2.08
88	75	95	1.36	.27	48	29	68	10.8	2.16
87	73	95	1.49	.30	47	28	67	11.3	2.26
86	72	94	1.63	.33	46	27	66	11.7	2.34
85	70	94	1.76	.35	45	26	65	12.2	2.44
84	68	93	1.90	.38	44	25	64	12.7	2.54
83	67	93	2.05	.41	43	25	63	13.2	2.64
82	66	92	2.20	.44	42	24	62	13.8	2.76
81	64	92	2.34	.47	41	23	61	14.4	2.88
80	63	91	2.50	.50	40	22	60	15.0	3.00
79	62	91	2.66	.53	39	21	59	15.6	3.12
78	60	90	2.82	.56	38	21	58	16.3	3.26
77	59	89	2.99	.60	37	20	57	17.0	3.40
76	58	89	3.16	.63	36	19	56	17.8	3.56
75	57	88	3.33	.67	35	18	55	18.6	3.72
74	55	88	3.51	.70	34	18	54	19.4	3.88
73	54	87	3.70	.74	33	17	53	20.3	4.06
72	53	86	3.89	.78	32	16	52	21.2	4.24
71	52	86	4.08	.82	31	16	51	22.2	4.44
70	51	85	4.28	.86	30	15	50	23.3	4.66
69	50	84	4.49	.90					
68	48	84	4.70	.94	25	12	43	30.0	6.00
67	47	83	4.92	.98	20	9	37	40.0	8.00
66	46	82	5.15	1.03	15	6	30	56.7	11.34
65	45	82	5.38	1.08	10	4	22	90.0	18.00
64	44	81	5.62	1.12	5	2	13	190.0	38.00
63	43	80	5.87	1.17	0	0	0	infinity	infinity
62	42	79	6.13	1.23					
61	41	78	6.39	1.28					

*For CN in column 1.

TABLE 4

Table 4 - Hydrograph families and T_o/T_p ratios for which dimensionless hydrograph ratios are given in Table 5.

Hydrograph Family	T_o/T_p 1	1.5	2	3	4	6	10	16	25	36	50	75
1	*	*	*	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*	*
3	*	*	*	*	*	*	*	*	*	*	*	*
4	*	*	*	*	*	*	*	*	*	*	*	
5	*	*	*	*	*	*	*	*	*	*	*	

Asterisks signify that dimensionless hydrograph tabulations are given in Table 5.

Table 5 --Time and discharge ratios for dimensionless hydrographs
Sheet 1 of 15

Hydrograph family 1

T_o/T_p = 1			T_o/T_p = 1.5			T_o/T_p = 2			T_o/T_p = 3		
Line No.	t/T_p	q_c/q_p	Line No.	t/T_p	q_c/q_p	Line No.	t/T_p	q_c/q_p	Line No.	t/T_p	q_c/q_p
1	0.00	.000	1	0.00	.000	1	0.00	.000	1	0.00	.000
2	0.28	.029	2	0.32	.012	2	0.29	.007	2	0.35	.005
3	0.56	.150	3	0.64	.118	3	0.58	.035	3	0.70	.027
4	0.84	.472	4	0.96	.377	4	0.87	.164	4	1.05	.101
5	1.12	.798	5	1.28	.711	5	1.16	.432	5	1.40	.302
6	1.40	.901	6	1.60	.815	6	1.45	.669	6	1.75	.563
7	1.68	.776	7	1.92	.719	7	1.74	.740	7	2.10	.650
8	1.96	.568	8	2.24	.526	8	2.03	.680	8	2.45	.576
9	2.24	.389	9	2.56	.352	9	2.32	.561	9	2.80	.460
10	2.52	.258	10	2.88	.225	10	2.61	.441	10	3.15	.374
11	2.80	.173	11	3.20	.143	11	2.90	.319	11	3.50	.290
12	3.08	.115	12	3.52	.090	12	3.19	.212	12	3.85	.201
13	3.36	.078	13	3.84	.057	13	3.48	.140	13	4.20	.127
14	3.64	.052	14	4.16	.037	14	3.77	.094	14	4.55	.078
15	3.92	.036	15	4.48	.024	15	4.06	.063	15	4.90	.047
16	4.20	.024	16	4.80	.015	16	4.35	.042	16	5.25	.028
17	4.48	.016	17	5.12	.008	17	4.64	.028	17	5.60	.016
18	4.76	.009	18	5.44	.004	18	4.93	.017	18	5.95	.009
19	5.04	.005	19	5.76	.002	19	5.22	.011	19	6.30	.005
20	5.32	.002	20	6.08	.001	20	5.51	.007	20	6.65	.003
21	5.60	.001	21	6.40	.000	21	5.80	.004	21	7.00	.002
22	5.88	.000				22	6.09	.002	22	7.35	.001
						23	6.38	.001	23	7.70	.000
						24	6.67	.000			

Table 5
Sheet 2 of 15

Hydrograph family 1

T_o/T_p = 4			T_o/T_p = 6			T_o/T_p = 10			T_o/T_p = 16		
Line No.	t/T_p	q_c/q_p	Line No.	t/T_p	q_c/q_p	Line No.	t/T_p	q_c/q_p	Line No.	t/T_p	q_c/q_p
1	0.00	.000	1	0.00	.000	1	0.00	.000	1	0.00	.000
2	0.35	.003	2	0.44	.003	2	0.56	.002	2	0.66	.001
3	0.70	.015	3	0.88	.013	3	1.12	.013	3	1.32	.006
4	1.05	.049	4	1.32	.041	4	1.68	.027	4	1.98	.015
5	1.40	.122	5	1.76	.084	5	2.24	.047	5	2.64	.027
6	1.75	.298	6	2.20	.176	6	2.80	.071	6	3.30	.037
7	2.10	.528	7	2.64	.386	7	3.36	.115	7	3.96	.047
8	2.45	.585	8	3.08	.497	8	3.92	.278	8	4.62	.062
9	2.80	.518	9	3.52	.430	9	4.48	.394	9	5.28	.092
10	3.15	.413	10	3.96	.335	10	5.04	.322	10	5.94	.223
11	3.50	.334	11	4.40	.258	11	5.60	.235	11	6.60	.309
12	3.85	.273	12	4.84	.202	12	6.16	.174	12	7.26	.243
13	4.20	.231	13	5.28	.164	13	6.72	.136	13	7.92	.171
14	4.55	.185	14	5.72	.139	14	7.28	.110	14	8.58	.124
15	4.90	.128	15	6.16	.124	15	7.84	.092	15	9.24	.097
16	5.25	.080	16	6.60	.100	16	8.40	.079	16	9.90	.081
17	5.60	.047	17	7.04	.060	17	8.96	.073	17	10.56	.070
18	5.95	.028	18	7.48	.033	18	9.52	.068	18	11.22	.061
19	6.30	.017	19	7.92	.018	19	10.08	.065	19	11.88	.055
20	6.65	.010	20	8.36	.009	20	10.64	.053	20	12.54	.050
21	7.00	.006	21	8.80	.005	21	11.20	.027	21	13.20	.047
22	7.35	.004	22	9.24	.003	22	11.76	.012	22	13.86	.045
23	7.70	.003	23	9.68	.002	23	12.32	.006	23	14.52	.044
24	8.05	.002	24	10.12	.001	24	12.88	.003	24	15.18	.043
25	8.40	.001	25	10.56	.000	25	13.44	.002	25	15.84	.040
26	8.75	.000				26	14.00	.001	26	16.50	.034
						27	14.56	.000	27	17.16	.020
									28	17.82	.008
									29	18.48	.004
									30	19.14	.002
									31	19.80	.001
									32	20.46	.000