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**DEVELOPMENT OF SIGNIFICANTLY IMPROVED CATALYSTS
FOR COAL LIQUEFACTION AND UPGRADING OF COAL EXTRACTS**

Quarterly Progress Report No. 3 for April 1—June 30, 1982

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QUARTERLY PROGRESS REPORT NO. 3
APRIL 1 - JUNE 30, 1982

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1. INTRODUCTION

During 1979-80, a new generation of very active, long-lived catalysts for hydrotreating was discovered at the Stamford Research Laboratories of the American Cyanamid Company. The catalysts are based on a unique substrate prepared in bead form from a rehydratable alumina. Their spherical shape, crush strength, and abrasion resistance seem ideally suited for the ebullated bed reactors used in the H-COAL[®] process developed by Hydrocarbon Research, Inc. (HRI). The beads have internal pore structures that are controllable over a wider range than conventional alumina supports, leading to active catalysts that are resistant to poisoning.

In September, 1981, the Department of Energy granted a 3-year contract to the American Cyanamid Company for the development of significantly improved catalysts for coal liquefaction and for upgrading coal extracts, particularly in reactors used in the H-COAL process.

2. OBJECTIVES AND SCOPE

The primary objective of this project is to develop one or more catalysts for coal liquefaction and/or for upgrading coal extracts which will be superior to the best currently known catalysts. The superiority will be judged by considering both the activity and the life of the catalysts. Catalysts will first be screened in a batch reactor to identify promising candidates. The latter will be tested in a continuous aging reactor to evaluate their resistance to deactivation under coal-liquefaction and extract upgrading conditions.

The work of the contract has been divided into the following eight tasks:

Task 1: Project Work Plan

Task 2: State-of-the Art Assessment

Task 3: Cold Flow Ebullation Tests

Task 4: Bead Catalyst Characterization

Task 5: Catalyst Batch Screening

Task 6: Continuous Aging Tests

Task 7: Catalyst Regenerability

Task 8: Analytical Methods Review

Task 1 was completed and reported in Quarterly Progress Report No. 1, for the period October 1 - December 31, 1981.

This Quarterly Progress Report covers work on Tasks 3, 4, 5, 6 and 8 during the period April - June, 1982. Task 7 will not be initiated until 1984.

3. Task 3: COLD FLOW EBULLATION TESTS

3.1 Introduction

The purpose of the cold flow ebullation tests is to compare the behavior of Cyanamid's novel bead catalysts of

various sizes and size distributions with the ebullation characteristics of HDS-1442A and HDS-1442B, the catalysts originally used in developing ebullated bed reactors for coal liquefaction and resid hydrotreating. In the previous Quarterly Report (1) the inter-dependence of catalyst activity, reactor fluid properties, catalyst particle size and ebullation behavior was discussed, and the need for using fluids of different physical properties to simulate the reactor fluids under different conversions and also for examining a wide range of particle sizes was pointed out. Baseline studies of HDS-1442A and HDS-1442B with water, kerosene and a 5cp fluid (kerosene + mineral oil) had also been completed and work with beads had begun. During the period covered by this report ebullation experiments were completed on 9 of the 21 beads-fluid combinations planned.

3.2 Equipment

The equipment is shown schematically in Figure 3.1 and has remained unchanged since March, 1982. The fluidizing liquid is pumped to the bottom of the column where it passes through a section filled with glass beads before entering the test-section through a catalyst retaining screen. Nitrogen is introduced through a sparger immediately above the screen. The sparger has six radial arms with 1/64-inch holes in each arm. The pressure along the column is measured as the differential pressure between any tap and a pressure tap located 9 inches above the screen. The 10 pressure taps are at 6-inch intervals starting with the first tap 3 inches above the screen. The taps are attached to 9 individual manometers. When water was the fluidizing liquid, trichloroethane was used as the manometric fluid; with kerosene and kerosene + mineral oil, water is the manometric fluid.

3.3 Experimental Work

3.3.1 Data Collection: The primary data collected consists of the differential manometric readings which could be used to locate, or define the location of, the fluidized bed interface as explained in Appendix I of Reference 1.

Figure 3.1

SCHEMATIC DIAGRAM OF COLD FLOW EQUIPMENT

Segregation and mixing in the solid phase were recorded photographically to document the stratification with the liquid phase alone and the mixing on the introduction of gas. The behavior of the beads was similar to that of the HDS-1442 extrudates. Catalyst carry-over data were generally not collected, but declining settled bed heights and catalyst dust suspended in the column during the runs indicated a loss of the catalyst due to abrasion. Also, some fine catalyst particles collected in the catalyst retaining screen at the very top of the column during the runs, which also contributed to the loss in the settled bed heights.

3.3.2 Bead-Fluid Combinations: Table 3.1 shows the proposed matrix of bead-fluid combinations to be tested. The mesh sizes are nominal in that the samples did contain finite quantities of material finer than the lower limit set by the higher mesh number. The bead-fluid combinations are identified in Table 3.1 by numbers and those already tested are indicated by check marks (✓) next to the numbers. Mesh sizes -25 +45, -20 +50 and -18 +60 are progressively wider bead distributions centered on a median bead diameter of 0.5mm; mesh sizes -7 +14, -6 +16 and -5 +18 are corresponding distributions centered on a median bead diameter of 2mm, and mesh sizes -10 +18, -8 +20, -7 +25 are centered on 1.3mm beads. Beads with HD suffix are higher density beads representing the state of a catalyst which has been in use in a coal liquefaction reactor for some time and has picked up metals from the coal fed. Originally, it had been planned to use only kerosene and a liquid of viscosity higher than that of kerosene as the fluid in the cold flow ebullation tests. Tests of the 0.5mm beads with kerosene showed, however, that a fluid of lower density and viscosity would yield more meaningful data with these beads, especially since they were intended for use in the upgrading of coal extracts and literature data on coal liquids (from the EDS process, for example) suggested that the viscosity of the coal extract solution would more likely be around 0.4 cp than around 1.4 cp (kerosene). Hence the inclusion of heptane as a candidate fluidizing medium in Table 3.1.

Table 3.1: Proposed Bead-Fluid Combinations

<u>Mesh Size of Beads</u>	<u>Kerosene (1.4 cp)</u>	<u>Kerosene + Mineral Oil, (5cp)</u>	<u>Heptane (0.4 cp)</u>
-25 +45	1 ✓	-	2
-20 +50	3 ✓	-	4
-18 +60	5 ✓	-	6
- 7 +14	7 ✓	8	-
- 6 +16	9 ✓	10	-
- 5 +18	11 ✓	12	-
- 7 +14 HD	13 ✓	-	-
- 6 +16 HD	14	-	-
- 5 +18 HD	15	-	-
-10 +18	16	17	-
- 8 +20	18	19	-
- 7 +25	20	21	-

✓ Indicates combinations tested as of 6/30/82

Table 3.2 presents a more detailed sieve analysis of each bead sample tested and Table 3.3 presents their pertinent physical properties.

3.3.3 Tabulation of Collected Data: The raw manometric data collected through 6/30/82 are included as Appendix I to this report.

3.4 Results and Discussion

3.4.1 Calculated Bed Heights, Liquid + Gas Fractions, and Bed Expansions: The bed heights were calculated from the graphical plot of the manometric data by locating the intersection of the pressure profile in the gas-liquid region of the column with the line joining the manometric points corresponding to the last two pressure taps within the bed. Tables 3.4-3.18 present the calculated bed heights for the bead runs since March, 1982, and also the liquid + gas fractions ($\epsilon_L + \epsilon_G$) and bed expansions derived from the calculated bed heights.

3.4.2 Comparison of Beads with HDS-1442A: The ebullation behavior of the bead catalysts can be compared with that of the HDS-1442A extrudates by plotting $\epsilon_L + \epsilon_G$ against the superficial liquid velocity, U_L , with the superficial gas velocity, U_G , as the third parameter. Figures 3.2, 3.3 and 3.4 show such plots for HDS-1442A, -6 +16 mesh and -7 +14 mesh. The possible equivalence of the 2mm median diam. beads with the 1.6mm diam. x 4.8mm long cylindrical extrudates was suggested by HRI personnel during October, 1981. At their request, samples of nominal -6 +16 mesh, and -7 +14 mesh beads had been submitted to them for ebullation tests. The sieve limits were nominal in the sense that they were not meant to guarantee the exclusion of particles beyond the sizes specified by them, but they were used in preparing the samples for submission from a wider batch. HRI's conclusion was that the submitted -6 +16 mesh distribution was too wide for satisfactory ebullation while the -7 +14 mesh distribution was satisfactory; the -6 +16 mesh beads gave a very diffuse bed interface while the bed interface with the -7 +14 mesh beads was well defined(2). Comparison of Fig. 3.2 with Fig. 3.3 and Fig. 3.4 shows that over the bed expansion range of interest (10 to 100% corresponding to $\epsilon_L + \epsilon_G$ of approx. 0.5 to 0.75) the $\epsilon_L + \epsilon_G$ versus U_L behavior of the -6 +16 mesh beads more closely resembles the behavior of HDS-1442A than the behavior of

Table 3.2: Sieve Analyses of Bead Samples

1. Mesh Size -25 +45, Sample Ident. S14178-18

+25 1.2%, -25 +30 25.4%, -30 +45 33%, -35 +40 20.7%,
-40 +45 19.7%

2. Mesh Size -20 +50, Sample Ident. S14178-17

+20 2.6%, -20 +25 8.8%, -25 +30 18.4%, -30 +35 24.4%,
-35 +40 20.0%, -40 +50 24.5%, -50 1.3%

3. Mesh Size -18 +60 Sample Ident. S14178-16

+18 0.3%, -18 +20 13.7%, -20 +30 35.1%, -30 +40 31.3%,
-40 +50 15.3%, -50 +60 3.4%, -60 0.9%

4. Mesh Size -7 +14 Sample Ident. S13501-31 (SN 5439)

+7 6.4%, -7 +8 20.1%, -8 +10 28.6%, -10 +12 23.5%,
-12 +14 10.1%, -14 11.3%

5. Mesh Size -6 +16 Sample Ident. S13501-31 (SN5440)

+6 0.7%, -6 +7 6.3%, -7+8 18.4%, -8+10 28.7%,
-10 +12 25.5%, -12 +14 10.1%, -14 +16 4.9%, -16 5.5%

6. Mesh Size -5+18 Sample Ident. S13501-35

+5 0.2%, -5 +6 9.4%, -6 +7 19.0%, -7 +8 26.4%,
-8 +10 28.7%, -10 +12 1.5%, -12 +14 3.7%, -14 +16 0.9%,
-16 +18 0.2%

7. Mesh Size -7 +14 HD Sample Ident. S13501-53

+7 1.2%, -7 +8 16.3%, -8 +10 30%, -10 +12 28.9%,
-12 +14 17.4%, -14 6.2%

Table 3.3: Physical Properties of Bead Samples

<u>Mesh Size</u>	<u>Sample Ident.</u>	<u>Median Diameter mm</u>	<u>Pore Volume cm³/gm</u>	<u>Particle Density gm/cm³</u>
-25 +45	S14178-18	0.5	0.74	0.878
-20 +50	S14178-17	0.5	0.79	0.828
-18 +60	S14178-16	0.5	0.76	0.832
- 7 +14	S13501-31 (SN 5439)	2.0	0.66	0.912
- 6 +16	S13501-31 (SN 5440)	2.0	0.66	0.912
- 6 +16	S13501-35 (Dup SN 5440)	2.0	0.68	0.926
-5 +18	S13501-35	2.0	0.68	0.926
-7 +14HD	S13501-53	2.0	0.45	1.34

Table 3.4 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -6 +16 Mesh Beads, 5cp Fluid, Nitrogen

Run No.	Liquid Vel. (Sup.) Ft/Sec	Gas Vel. (Sup.) Ft/Sec	Settld Bed Height In.	Measrd Bed Height In.	Calcd Bed Height In.	Liq.+ Gas Frctn $E_1 + E_2$	Bed Expnsn %
RN	UL	UG	HO	HM	HC	EP SLN	REDEX
362	.017	.000	19.00	21.0	20.40	.456	7.4
363	.136	.000	19.00	57.0	.00	.809	100.0
364	.047	.000	19.00	30.8	28.40	.616	49.5
365	.077	.000	19.00	38.5	32.10	.660	68.9
366	.106	.000	19.00	43.5	37.80	.711	98.9
367	.017	.050	19.00	19.0	23.10	.523	21.6
368	.017	.100	19.00	24.0	24.20	.550	27.4
369	.017	.150	19.00	24.0	25.40	.571	33.7
370	.017	.200	19.00	24.0	26.20	.584	37.9
371	.017	.250	19.00	25.0	26.70	.575	41.6
372	.047	.050	19.00	27.0	28.80	.622	51.6
373	.047	.100	18.00	30.0	30.30	.640	68.3
374	.047	.150	18.00	30.0	32.00	.659	77.8
375	.047	.200	18.00	30.0	33.00	.670	83.3
376	.047	.250	18.00	32.0	33.10	.671	83.9
377	.077	.050	18.00	33.0	31.20	.651	73.3
378	.077	.100	18.00	33.0	32.00	.659	77.8
379	.077	.150	18.00	33.0	32.00	.659	77.8
380	.077	.200	18.00	33.0	34.00	.679	88.9
381	.077	.250	18.00	33.0	34.50	.684	91.7
382	.106	.050	18.00	38.0	36.30	.700	101.7
383	.106	.100	18.00	38.0	36.00	.677	100.0
384	.106	.150	18.00	38.0	35.80	.696	98.9
385	.106	.200	18.00	40.0	39.60	.725	120.0
386	.106	.250	18.00	42.0	39.20	.722	117.8
387	.136	.050	18.00	42.0	41.30	.736	129.4
388	.136	.100	18.00	42.0	41.80	.739	132.2
389	.136	.150	18.00	42.0	41.30	.736	129.4
390	.136	.200	18.00	42.0	43.50	.749	141.7
391	.136	.250	18.00	42.0	44.20	.753	145.6
392	.017	.050	16.25	18.0	22.10	.507	36.0
393	.017	.100	16.25	20.0	23.00	.526	41.5
394	.017	.150	16.25	21.0	21.00	.555	213.8
395	.032	.050	16.25	22.0	23.70	.540	45.8
396	.032	.100	16.25	22.0	23.70	.540	45.8
397	.032	.150	16.25	24.0	25.00	.564	53.8
398	.047	.050	16.25	26.0	29.00	.624	78.5
399	.047	.100	16.25	26.0	29.00	.624	78.5
400	.047	.150	16.25	26.0	30.00	.637	84.6
401	.062	.050	16.25	26.5	29.00	.624	78.5
402	.062	.100	16.25	28.0	30.10	.638	85.2
403	.062	.150	16.25	28.0	31.60	.655	94.5
404	.077	.050	16.25	29.0	30.00	.637	84.6
405	.077	.100	16.25	29.0	30.40	.641	87.1
406	.077	.150	16.25	29.5	32.40	.664	99.4

Table 3.5 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -7 +14 Mesh Beads, 5cp Fluid, Nitrogen

RN	UL	UG	HO	HM	HC	EPSLN	BEDEX
407	.022	.000	18.00	20.0	19.30	.456	7.2
408	.053	.000	18.00	26.0	24.60	.573	36.7
409	.084	.000	18.00	31.0	29.10	.639	61.7
410	.116	.000	18.00	40.0	36.60	.713	103.3
411	.147	.000	18.00	54.0	48.00	.781	166.7
412	.022	.050	18.00	19.0	19.30	.456	7.2
413	.022	.100	18.00	22.0	19.60	.464	8.9
414	.022	.150	18.00	23.0	21.20	.505	17.8
415	.022	.200	17.50	24.0	21.60	.514	23.4
416	.022	.250	17.50	25.0	25.00	.530	42.9
417	.053	.050	17.50	27.0	25.40	.587	45.1
418	.053	.100	17.50	27.0	25.20	.583	44.0
419	.053	.150	17.50	27.0	25.80	.593	47.4
420	.053	.200	17.50	27.0	26.30	.601	50.3
421	.053	.025	17.50	22.0	22.00	.522	25.7
422	.084	.025	17.50	23.0	28.20	.628	61.1
423	.084	.050	17.50	26.0	28.50	.632	62.9
424	.084	.100	17.50	27.0	29.20	.640	66.9
425	.084	.150	17.00	28.0	31.30	.665	84.1
426	.084	.200	17.00	28.0	32.60	.678	91.8
427	.116	.025	17.00	32.0	34.00	.691	100.0
428	.116	.050	17.00	31.0	34.10	.692	100.6
429	.116	.100	17.00	31.0	35.00	.700	105.9
430	.116	.150	17.00	32.0	35.30	.703	107.6
431	.116	.200	17.00	34.0	36.80	.715	116.5
432	.147	.025	17.00	38.0	40.60	.741	138.8
433	.147	.050	17.00	38.0	42.00	.750	147.1
434	.147	.100	17.00	38.0	45.00	.767	164.7
435	.147	.150	17.00	39.0	39.00	.731	129.4
436	.147	.200	17.00	42.0	44.30	.763	160.6

Table 3.6 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -7 +14 Mesh Beads, Kerosene, Nitrogen

RN	UL	UG	HO	HM	HC	EPSLN	REDEX
437	.064	.000	17.00	19.0	17.70	.407	4.1
438	.113	.000	17.00	24.0	22.70	.537	33.5
439	.161	.000	17.00	30.0	28.60	.633	68.2
440	.210	.000	17.00	39.0	34.60	.697	103.5
441	.259	.000	17.00	51.0	46.00	.772	170.6
442	.064	.025	17.00	19.5	19.00	.447	11.8
443	.064	.050	17.00	19.5	19.30	.456	13.5
444	.064	.100	17.00	20.0	20.40	.485	20.0
445	.064	.150	17.00	20.0	20.90	.498	22.9
446	.064	.200	17.00	20.0	21.20	.505	24.7
447	.113	.025	17.00	23.0	23.60	.555	38.8
448	.113	.050	17.00	24.0	24.00	.563	41.2
449	.113	.100	17.00	24.0	24.70	.575	45.3
450	.113	.150	17.00	25.0	25.40	.587	49.4
451	.113	.200	17.00	25.0	26.00	.596	52.9
452	.161	.025	17.00	28.0	28.60	.633	68.2
453	.161	.050	17.00	28.0	28.90	.637	70.0
454	.161	.100	17.00	28.0	29.60	.645	74.1
455	.161	.150	17.00	28.0	30.50	.656	79.4
456	.161	.200	17.00	29.0	31.30	.665	84.1
457	.210	.025	17.00	35.0	34.60	.696	103.5
458	.210	.050	17.00	35.0	34.60	.696	103.5
459	.210	.100	17.00	35.0	34.90	.699	105.3
460	.210	.150	17.00	35.0	35.80	.707	110.6
461	.210	.200	17.00	35.0	36.00	.708	111.8
462	.259	.000	17.00	47.0	46.00	.772	170.6
463	.259	.025	17.00	47.0	46.10	.772	171.2
464	.259	.050	17.00	47.0	46.90	.776	175.9
465	.259	.100	17.00	47.0	47.00	.777	176.5
465	.259	.150	17.00	46.0	46.50	.774	173.5
466	.210	.000	17.00	39.0	36.70	.714	115.9
467	.161	.000	17.00	29.0	28.40	.630	67.1
468	.113	.000	17.00	23.5	22.50	.533	32.4
469	.064	.000	17.00	18.5	17.50	.400	2.9

Table 3.7 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -25 +45 Mesh Beads, Kerosene, Nitrogen

RN	UL	UG	H0	HM	HC	EPSLN	BEDEX
470	.039	.000	18.00	54.0	51.60	.793	186.7
471	.005	.000	18.00	20.3	23.30	.541	29.4
472	.005	.025	18.00	34.0	31.00	.655	72.2
473	.005	.050	18.00	36.0	33.80	.684	87.8
474	.005	.100	18.00	36.0	36.00	.703	100.0
475	.005	.150	18.00	36.0	38.40	.722	113.3
476	.005	.200	18.00	36.0	45.50	.765	152.8
477	.014	.012	18.00	26.0	27.70	.617	55.0
478	.014	.025	18.00	33.0	30.40	.649	68.9
479	.014	.050	18.00	33.0	30.10	.645	67.2
480	.014	.100	18.00	33.0	31.30	.659	73.9
481	.014	.150	17.50	34.0	35.50	.699	102.9
482	.014	.000	17.50	23.0	22.40	.523	28.0
483	.022	.000	17.50	27.0	27.00	.604	54.3
484	.022	.012	17.50	27.0	28.80	.629	64.6
485	.022	.025	17.50	32.0	30.30	.648	73.1
486	.022	.050	17.50	35.0	31.70	.663	81.1
487	.022	.100	17.50	35.0	35.60	.700	103.4
488	.022	.150	17.50	35.0	37.10	.712	112.0
489	.031	.000	17.50	33.3	33.00	.676	88.6
490	.031	.012	17.50	40.0	35.20	.697	101.1
491	.031	.025	17.50	40.0	36.70	.709	109.7
492	.031	.050	17.50	40.0	38.20	.720	118.3
493	.031	.100	17.50	40.0	37.40	.714	113.7
494	.031	.150	17.50	40.0	41.50	.743	137.1
495	.039	.000	17.50	40.0	39.60	.730	126.3
496	.039	.012	17.50	42.0	39.00	.726	122.9
497	.039	.025	17.50	42.0	43.30	.753	147.4
498	.039	.050	17.50	42.0	43.50	.754	148.6
499	.039	.100	17.50	.0	44.50	.760	154.3
500	.039	.000	16.50	42.0	39.50	.730	139.4
501	.031	.000	16.50	35.0	34.00	.686	106.1
502	.022	.000	16.50	28.5	28.70	.628	73.9
503	.014	.000	16.50	24.0	22.70	.530	37.6
504	.000	.000	16.50	17.3	17.10	.375	3.6
505	.045	.000	16.50	54.0	52.30	.796	217.0

Table 3.7 (Cont'd)

RN	UL	UG	HO	HM	HC	EPSLN	BEDX
575	.005	.012	16.50	24.0	23.50	.546	42.4
576	.005	.025	16.50	27.0	24.40	.562	47.9
577	.005	.050	16.50	27.0	25.60	.583	55.2
578	.005	.100	16.50	28.0	27.60	.613	67.3
579	.005	.180	16.50	28.0	27.90	.617	69.1
580	.014	.000	16.50	22.5	22.20	.519	34.5
581	.014	.012	16.50	26.0	23.00	.536	39.4
582	.014	.025	16.50	28.0	24.30	.560	47.3
583	.014	.050	16.50	25.0	26.30	.594	59.4
584	.014	.100	16.00	30.0	27.30	.616	73.8
585	.014	.150	16.00	30.0	27.10	.606	69.4
586	.022	.150	16.00	33.0	29.20	.634	82.5
587	.039	.000	16.50	40.0	37.50	.715	127.3

Table 3.8 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -20 +50 Mesh Beads, Kerosene, Nitrogen

RN	UL	UG	HO	HM	HC	EPSLN	BEDEX
506	.360	.000	18.00	54.0	52.80	.795	193.3
507	.005	.000	18.00	21.0	21.10	.487	17.2
508	.005	.012	18.00	28.0	23.40	.538	30.0
509	.005	.025	18.00	32.0	24.30	.555	35.0
510	.005	.050	18.00	32.0	26.30	.589	46.1
511	.005	.100	18.00	34.0	29.30	.631	62.8
512	.005	.150	18.00	34.0	30.30	.643	68.3
513	.009	.000	18.00	22.0	21.00	.485	16.7
514	.009	.012	18.00	30.0	22.90	.528	27.2
515	.009	.025	18.00	30.0	26.30	.589	46.1
516	.009	.050	18.00	32.0	29.10	.628	61.7
517	.009	.100	18.00	33.0	30.10	.640	67.2
518	.009	.150	18.00	33.0	31.60	.658	75.6
519	.012	.000	18.00	21.0	21.30	.492	18.3
520	.012	.012	18.00	29.0	22.70	.523	26.1
521	.012	.025	18.00	30.0	24.30	.555	35.0
522	.012	.050	18.00	32.0	26.30	.589	46.1
523	.012	.100	18.00	33.0	27.00	.599	50.0
524	.012	.150	18.00	33.0	29.50	.633	63.9
525	.015	.000	17.00	22.0	21.00	.485	23.5
526	.015	.012	17.00	28.0	23.30	.536	37.1
527	.015	.025	17.00	30.0	25.50	.576	50.0
528	.015	.050	17.00	30.0	27.50	.607	61.8
529	.015	.100	17.00	33.0	28.80	.624	69.4
530	.015	.150	17.00	33.0	29.70	.636	74.7
531	.018	.000	17.00	24.8	23.10	.532	35.9
532	.018	.012	17.00	30.0	24.20	.553	42.4
533	.018	.025	17.00	33.0	25.20	.571	48.2
534	.018	.050	17.00	33.0	27.40	.605	61.2
535	.018	.100	17.00	34.0	28.50	.620	67.6
536	.018	.150	17.00	34.0	29.40	.632	72.9
537	.018	.000	17.00	25.5	24.30	.555	42.9
538	.015	.000	17.00	23.0	22.50	.517	32.4
539	.012	.000	17.00	21.5	21.40	.494	25.9
540	.009	.000	17.00	20.0	18.60	.418	9.4
541	.005	.000	17.00	18.5	17.50	.382	2.9

Table 3.8 (Cont'd)

RN	UL	UG	HO	HH	HC	EPSLN	REDEX
623	.029	.000	17.00	40.0	40.00	.744	135.3
624	.029	.012	17.00	42.0	41.40	.753	143.5
625	.029	.025	17.00	42.0	40.50	.748	138.2
626	.029	.050	17.00	42.0	40.80	.750	140.0
627	.029	.100	17.00	42.0	43.20	.763	154.1
628	.029	.150	17.00	42.0	42.00	.757	147.1
629	.018	.000	17.00	26.5	24.90	.590	46.5
630	.018	.012	17.00	27.0	23.90	.572	40.6
631	.018	.025	17.00	28.0	25.00	.591	47.1
632	.018	.050	17.00	30.0	26.60	.616	56.5
633	.018	.100	17.00	31.0	28.80	.645	69.4
634	.018	.150	17.00	31.0	29.60	.655	74.1
635	.022	.000	17.00	29.0	28.80	.645	69.4
636	.022	.012	17.00	29.0	28.50	.641	67.6
637	.022	.025	17.00	29.0	31.00	.670	82.4
638	.022	.050	17.00	30.0	30.90	.669	81.8
639	.022	.100	16.50	32.0	33.60	.696	103.6
640	.022	.150	16.50	32.0	35.00	.708	112.1
641	.025	.000	16.50	32.0	30.50	.665	84.8
642	.025	.012	16.50	33.0	29.90	.658	81.2
643	.025	.025	16.50	33.0	31.10	.671	88.5
644	.025	.050	16.50	34.0	31.70	.678	92.1
645	.025	.100	16.50	34.0	33.70	.697	104.2
646	.025	.150	16.50	35.0	34.60	.705	109.7

Table 3.9 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -18 +60 Mesh Beads, Kerosene, Nitrogen

RN	UL	UG	HO	HM	HC	EPSLN	REDEX
542	.033	.000	19.00	40.0	35.10	.667	84.7
543	.006	.000	19.00	21.0	21.00	.444	10.5
544	.006	.012	19.00	23.0	22.60	.483	18.9
545	.006	.025	19.00	24.0	24.10	.515	26.8
546	.006	.050	19.00	28.0	26.20	.554	37.9
547	.006	.100	19.00	31.0	27.80	.580	46.3
548	.006	.150	19.00	33.0	28.80	.594	51.6
549	.013	.000	19.00	22.0	21.60	.459	13.7
550	.013	.012	19.00	26.0	23.00	.492	21.1
551	.013	.025	19.00	30.0	24.50	.523	28.9
552	.013	.050	19.00	30.0	24.50	.523	28.9
553	.013	.100	19.00	30.0	27.00	.567	42.1
553	.013	.150	17.00	30.0	28.60	.592	68.2
554	.020	.000	19.00	26.0	24.10	.515	26.8
555	.020	.012	19.00	30.0	23.70	.511	25.8
556	.020	.025	19.00	30.0	25.20	.537	32.6
557	.020	.050	19.00	30.0	26.80	.564	41.1
558	.020	.100	19.00	32.0	27.80	.580	46.3
558	.020	.150	17.00	32.0	29.30	.601	72.4
559	.026	.000	17.00	28.5	27.30	.572	60.6
560	.026	.012	17.00	33.0	28.10	.584	65.3
561	.026	.025	17.00	33.0	29.50	.604	73.5
562	.026	.050	17.00	34.0	30.50	.617	79.4
563	.026	.100	17.00	34.0	31.80	.633	87.1
563	.026	.150	17.00	34.0	33.00	.646	94.1
564	.033	.000	17.00	32.0	29.10	.599	71.2
565	.033	.012	17.00	34.0	28.70	.593	68.8
566	.033	.025	17.00	34.0	30.30	.615	78.2
567	.033	.050	17.00	34.0	32.00	.635	88.2
568	.033	.100	17.00	34.0	32.90	.654	93.5
569	.033	.150	17.00	34.0	32.40	.640	90.6
570	.033	.000	17.00	31.5	28.50	.570	67.6
571	.026	.000	17.00	27.3	25.30	.538	48.8
572	.020	.000	17.00	24.5	22.80	.488	34.1
573	.013	.000	17.00	20.5	21.00	.444	23.5
574	.006	.000	17.00	17.8	17.00	.313	.0

Table 3.10 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -6 +16 Mesh Beads, Kerosene, Nitrogen

RN	UL	UG	HO	HM	HC	EPSLN	BEDEX
588	.191	.000	18.00	40.0	39.60	.753	120.0
589	.070	.000	18.00	22.0	21.40	.543	18.9
590	.070	.012	18.00	21.5	21.30	.541	18.3
591	.070	.025	18.00	22.0	22.50	.565	25.0
592	.070	.050	18.00	22.0	23.00	.575	27.8
593	.070	.100	18.00	22.0	23.90	.591	32.8
594	.070	.150	18.00	22.0	25.50	.616	41.7
595	.010	.000	18.00	25.5	23.50	.584	30.6
596	.010	.012	18.00	25.0	25.00	.609	38.9
597	.010	.025	18.00	25.0	24.30	.606	37.8
598	.010	.050	18.00	25.0	25.00	.609	38.9
599	.010	.100	18.00	25.0	25.30	.613	40.6
600	.010	.150	18.00	25.0	26.40	.630	46.7
601	.132	.000	18.00	29.0	27.50	.644	52.8
602	.132	.012	18.00	28.0	28.50	.657	58.3
603	.132	.025	18.00	28.0	28.60	.658	58.9
604	.132	.050	18.00	28.0	29.70	.671	65.0
605	.132	.100	18.00	28.0	29.40	.667	63.3
606	.130	.150	18.00	29.0	30.00	.674	66.7
607	.159	.000	18.00	34.5	33.00	.704	83.3
607	.160	.000	18.00	34.5	33.00	.704	83.3
608	.160	.000	18.00	31.0	34.00	.712	80.9
608	.159	.012	18.00	31.0	34.00	.712	88.9
609	.159	.011	18.00	32.0	34.00	.712	88.9
610	.159	.050	18.00	32.0	34.70	.718	92.8
611	.159	.100	18.00	32.0	35.20	.722	95.6
612	.159	.150	18.00	32.0	36.40	.731	102.2
613	.191	.000	18.00	40.0	39.80	.754	121.1
614	.191	.012	18.00	36.0	39.00	.749	116.7
615	.191	.021	18.00	36.0	39.20	.751	117.8
616	.191	.050	18.00	37.0	39.80	.754	121.1
617	.191	.100	18.00	37.0	40.50	.759	125.0
618	.191	.150	18.00	37.0	41.00	.761	127.8
619	.159	.000	18.00	34.5	33.00	.704	83.3
620	.132	.000	18.00	28.5	27.70	.647	53.9
621	.010	.000	18.00	24.5	22.30	.571	26.7
622	.070	.000	18.00	21.5	21.00	.534	16.7

Table 3.11 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -7 +14 Mesh HD Beads, Kerosene, Nitrogen

RN	UL	UG	HO	HM	HC	EPSLN	REDEX
647	.230	.000	18.00	40.0	37.70	.744	109.4
648	.091	.000	18.00	22.0	21.30	.547	18.3
649	.091	.012	18.00	22.5	21.90	.559	21.7
650	.091	.025	18.00	22.5	22.40	.569	24.4
651	.091	.050	18.00	22.5	22.50	.571	25.0
652	.091	.100	18.00	22.0	23.20	.584	28.9
653	.091	.150	18.00	22.0	23.90	.596	32.8
654	.127	.000	18.00	24.5	23.40	.588	30.0
655	.127	.012	18.00	25.0	24.20	.601	34.4
656	.127	.025	18.00	25.0	24.60	.608	36.7
657	.127	.050	18.00	25.0	25.10	.616	39.4
658	.127	.100	18.00	25.0	25.30	.619	40.6
659	.127	.150	18.00	25.0	25.40	.620	41.1
660	.163	.000	18.00	28.0	26.60	.637	47.8
661	.163	.012	18.00	28.0	27.30	.647	51.7
662	.163	.025	18.00	28.0	27.50	.649	52.8
663	.163	.050	18.00	28.0	27.20	.645	51.1
664	.163	.100	18.00	27.0	27.10	.644	50.6
665	.163	.150	18.00	27.0	27.00	.643	50.0
666	.195	.000	18.00	31.0	29.50	.673	63.9
667	.195	.012	18.00	31.0	30.60	.685	70.0
668	.195	.025	18.00	31.0	30.80	.687	71.1
669	.195	.050	18.00	31.0	30.40	.683	68.9
670	.195	.100	18.00	30.0	30.40	.683	68.9
671	.195	.150	18.00	30.0	30.40	.683	68.9
672	.230	.000	18.00	37.0	35.00	.724	94.4
673	.230	.012	18.00	36.0	35.30	.727	96.1
674	.230	.025	18.00	36.5	36.10	.733	100.6
675	.230	.050	18.00	36.0	34.60	.721	92.2
676	.230	.100	18.00	34.0	34.60	.721	92.2
677	.230	.150	18.00	35.0	35.70	.730	98.3

Table 3.12 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -8 +12 Mesh Beads, Kerosene, Nitrogen

RN	UL	UG	HO	HM	HC	EP/SLN	REDEX
678	.064	.000	8.50	9.5	9.30	.477	9.4
679	.064	.012	8.50	9.5	10.30	.528	21.2
680	.064	.025	8.50	9.5	10.30	.528	21.2
681	.064	.050	8.50	9.0	10.80	.549	27.1
682	.064	.100	8.50	8.5	12.10	.578	42.4
683	.118	.000	8.50	12.5	11.60	.501	36.5
684	.118	.012	8.50	12.0	12.30	.604	44.7
685	.118	.025	8.50	12.0	13.10	.629	54.1
686	.118	.050	8.50	11.5	13.20	.631	55.3
687	.118	.100	8.50	11.5	13.80	.647	62.4
688	.168	.000	8.50	15.5	15.50	.686	82.4
689	.168	.012	8.50	15.0	15.90	.694	87.1
690	.168	.025	8.50	15.0	16.40	.703	92.9
691	.168	.050	8.50	15.0	17.10	.715	101.2
692	.168	.100	8.50	15.0	18.00	.730	111.8
693	.222	.000	8.50	17.5	17.30	.719	103.5
694	.222	.012	8.50	17.0	17.50	.722	105.9
695	.222	.025	8.50	17.0	17.90	.728	110.6
696	.222	.050	8.50	17.0	18.60	.738	118.8
697	.222	.100	8.50	18.0	19.00	.744	123.5
698	.064	.150	8.50	10.0	12.30	.604	44.7
699	.064	.200	8.50	10.0	12.40	.608	45.9
700	.118	.150	8.50	12.0	13.90	.650	63.5
701	.118	.200	8.50	12.0	14.20	.657	67.1
702	.168	.150	8.50	15.0	18.90	.743	122.4
703	.168	.200	8.50	16.0	18.70	.740	120.0
704	.222	.150	8.50	19.0	20.00	.757	135.3
705	.222	.200	8.50	19.0	20.40	.761	140.0

Table 3.13 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -7 +12 Mesh Beads, Kerosene, Nitrogen

RN	UL	UG	HO	HM	HC	EPSLN	BEDEX
706	.073	.000	14.50	16.0	16.10	.502	11.0
707	.073	.050	14.50	16.0	17.30	.537	19.3
708	.073	.100	14.50	16.0	18.00	.555	24.1
709	.073	.150	14.50	18.0	19.10	.580	31.7
710	.073	.200	14.50	19.0	19.50	.589	34.5
711	.123	.000	14.50	21.0	21.00	.618	44.8
712	.123	.050	14.50	21.0	22.30	.640	53.8
713	.123	.100	14.50	21.0	23.10	.653	59.3
714	.123	.150	14.50	22.0	24.00	.666	65.5
715	.123	.200	14.50	22.0	24.30	.670	67.6
716	.172	.000	14.50	25.5	24.30	.670	67.6
717	.172	.050	14.50	26.0	26.10	.693	80.0
718	.172	.100	14.50	26.0	25.90	.690	78.6
719	.172	.150	14.50	26.0	26.70	.700	84.1
720	.172	.200	14.50	26.0	27.60	.709	90.3
721	.222	.000	14.50	33.0	33.00	.757	127.6
722	.222	.050	14.50	33.0	34.10	.765	135.2
723	.222	.100	14.50	33.0	34.70	.769	139.3
724	.222	.150	14.50	33.0	35.10	.772	142.1
725	.222	.200	14.50	33.0	36.50	.780	151.7

Table 3.14 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -6 +12 Mesh Beads, Kerosene, Nitrogen

RN	UL	UG	HO	HM	HC	EPSLN	REDEX
726	.057	.000	17.50	19.0	18.00	.449	2.9
727	.057	.050	17.50	19.5	20.20	.509	15.4
728	.057	.100	17.50	20.0	21.20	.532	21.1
729	.057	.150	17.50	20.0	21.80	.545	24.6
730	.057	.200	17.50	21.0	22.00	.549	25.7
731	.111	.000	17.50	24.0	23.00	.569	31.4
732	.111	.050	17.50	25.0	25.20	.606	44.0
733	.111	.100	17.50	24.0	25.20	.606	44.0
734	.111	.150	17.50	25.0	25.00	.616	47.4
735	.111	.200	17.50	25.0	26.80	.630	53.1
736	.166	.000	17.50	30.0	29.50	.664	68.6
737	.166	.050	17.50	30.0	30.50	.675	74.3
738	.166	.100	17.50	30.0	30.80	.678	76.0
739	.166	.150	17.50	30.0	31.30	.683	78.9
740	.166	.200	17.50	30.0	32.90	.699	88.0
741	.220	.000	17.50	40.0	39.50	.749	125.7
742	.220	.050	17.50	40.0	40.00	.752	128.6
743	.220	.100	17.50	40.0	40.10	.753	129.1
744	.220	.150	17.50	40.0	41.70	.762	138.3
745	.220	.200	17.50	40.0	42.00	.764	140.0

Table 3.15 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -5 +12 Mesh Beads, Kerosene, Nitrogen

RN	UL	UG	HO	HM	HC	EP/SLN	BEDEX
746	.070	.000	19.50	21.5	21.00	.486	7.7
747	.070	.050	19.50	21.5	22.30	.516	14.4
748	.070	.100	19.50	21.5	23.30	.537	19.5
749	.070	.150	19.50	21.5	24.40	.558	25.1
750	.070	.200	19.50	21.5	25.10	.570	28.7
751	.120	.000	19.50	25.0	23.70	.545	21.5
752	.120	.050	19.50	26.0	27.40	.606	40.5
753	.120	.100	19.50	26.0	27.10	.602	39.0
754	.120	.150	19.50	26.0	27.90	.613	43.1
755	.120	.200	19.50	26.0	28.50	.621	46.2
756	.160	.000	19.50	32.0	30.70	.648	57.4
757	.160	.050	19.50	32.0	32.10	.664	64.6
758	.160	.100	19.50	32.0	31.90	.662	63.6
759	.160	.150	19.50	32.0	33.00	.673	69.2
760	.160	.200	19.50	32.0	34.70	.689	77.9
761	.210	.000	19.50	39.0	38.20	.717	95.9
762	.210	.050	19.50	39.0	38.40	.719	96.9
763	.210	.100	19.50	38.0	38.10	.717	95.4
764	.210	.150	19.50	38.0	39.30	.725	101.5
765	.210	.200	19.50	38.0	40.10	.731	105.6

Table 3.16 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -5 +14 Mesh Beads, Kerosene, Nitrogen

RN	UL	UG	HO	HM	HC	EFSLN	BEDEX
766	.060	.000	21.00	23.0	21.80	.456	3.8
767	.060	.050	21.00	23.0	23.50	.495	11.9
768	.060	.100	21.00	23.0	24.20	.510	15.2
769	.060	.150	21.00	22.0	24.80	.522	18.1
770	.060	.200	21.00	22.0	25.80	.540	22.9
771	.118	.000	21.00	27.0	27.20	.564	29.5
772	.115	.050	21.00	28.0	28.70	.587	36.7
773	.118	.100	21.00	28.0	29.40	.597	40.0
774	.118	.150	21.00	28.0	29.80	.602	41.9
775	.118	.200	21.00	28.0	30.10	.606	43.3
776	.170	.000	21.00	37.0	35.40	.635	68.6
777	.170	.050	21.00	36.0	36.20	.672	72.4
778	.170	.100	21.00	36.0	36.70	.677	74.8
779	.170	.150	21.00	36.0	37.40	.683	78.1
780	.170	.200	21.00	36.0	38.50	.692	83.3
781	.227	.000	21.00	49.0	47.30	.749	125.2
782	.227	.050	21.00	48.0	46.70	.746	122.4
783	.227	.100	21.00	48.0	47.10	.748	124.3
784	.227	.150	21.00	48.0	47.40	.750	125.7
785	.227	.200	21.00	48.0	46.90	.747	123.3

Table 3.17 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -5 +18 Mesh Beads, Kerosene, Nitrogen

RN	UL	UG	HO	HM	HC	EP SLN	REDEX
786	.066	.000	21.50	23.5	22.40	.456	4.2
787	.066	.025	21.50	23.0	23.10	.472	7.4
788	.066	.050	21.50	23.0	23.70	.485	10.2
789	.066	.100	21.50	23.0	25.00	.512	16.3
790	.066	.150	21.50	23.0	25.10	.514	16.7
791	.116	.000	21.50	30.0	28.30	.569	31.6
792	.116	.025	21.50	29.0	29.70	.587	38.1
793	.116	.050	21.50	29.0	29.20	.582	35.8
794	.116	.100	21.50	29.0	30.30	.597	40.9
795	.116	.150	21.50	29.0	30.60	.601	42.3
796	.166	.000	21.50	38.0	35.70	.658	66.0
797	.166	.025	21.50	36.0	35.60	.657	65.6
798	.166	.050	21.50	36.0	35.50	.657	65.6
799	.166	.100	21.50	36.0	36.00	.661	67.4
800	.166	.150	21.50	36.0	37.30	.673	73.5
801	.216	.000	21.50	49.0	47.10	.741	119.1
802	.216	.025	21.50	47.0	45.80	.734	113.0
803	.216	.050	21.50	47.0	46.10	.735	114.4
804	.216	.100	21.50	47.0	46.30	.737	115.3
805	.216	.150	21.50	47.0	47.50	.743	120.9

Table 3.18 Calculated Bed Heights, Liquid + Gas Fractions and Bed Expansions for -5 +18 Mesh HD Beads, Kerosene, Nitrogen

RN	UL	UG	HO	HM	HC	EPSLN	REDEX
806	.093	.000	19.00	21.0	21.00	.572	10.5
807	.093	.025	19.00	21.0	21.30	.578	12.1
808	.093	.050	19.00	21.0	21.50	.582	13.2
809	.093	.100	19.00	21.0	22.40	.598	17.9
810	.093	.150	19.00	21.0	23.00	.609	21.1
811	.093	.200	19.00	21.0	23.30	.614	22.6

Figure 3.2 Effect of Liquid & Gas Superficial Velocities on Liquid + Gas Fractions
for HDS-1442, Kerosene, Nitrogen

Figure 3.3 Effect of Liquid & Gas Superficial Velocities on Liquid + Gas Fractions
for -6+16 Mesh Beads, Kerosene, Nitrogen

Figure 3.4 Effect of Liquid & Gas Superficial Velocities on Liquid + Gas Fractions
for -7 + 14 Mesh Beads, Kerosene, Nitrogen

the -7+14 mesh beads. The $\epsilon_L + \epsilon_G$ versus U_L curves for the -7+14 mesh beads fall considerably below the curves for HDS-1442A suggesting that the -7 +14 mesh beads will give lower bed expansions than HDS-1442A under the same liquid and gas flow rates. For example, at a superficial kerosene velocity of 0.16 ft/sec and a nitrogen velocity of 0.10 ft/sec, $\epsilon_L + \epsilon_G$ for HDS 1442-A will be 0.72, for -6 +16 mesh beads it will be 0.72 and for -7 +14 mesh beads it will be 0.645. The experiments of Figures 3.2, 3.3 and 3.4, and runs with an even wider distribution centered on 2mm (-5 +18 mesh), described later in this report, demonstrated convincingly that in the absence of a significant quantity of fines, the bed interface remains well-defined even for a bead particle size distribution as wide as -5 +18 mesh which has a ratio of the limiting sieve openings of 4:1 (i.e., $D_5/D_{18} = 4/1$ where D_5 and D_{18} are sieve openings for the 5 mesh and the 18 mesh sieves). The ratio D_6/D_{16} is 3/1 and D_7/D_{14} is 2/1.

A sieve analysis of a sample of the -6 +16 mesh beads submitted to HRI showed that about 5 percent of the material was -16 mesh in size. When a similar sample was tested at Stamford in a 5cp fluid, a fairly well defined second interface could be distinguished within the bed when liquid alone was used. A bed of fines comprising about 15-20% of the total bed could be clearly distinguished above this intermediate interface. On the introduction of gas the bed of fines made the interface very diffuse, and during the experiments the fines were carried over and removed from the bed. Towards the end of the runs with this batch of beads, the extreme diffuse interface encountered at the start was no longer evident. A sieve analysis of the material in the column at the end of the run showed little change in the distribution over the -6 +16 mesh range except that the -16 mesh fraction had dropped from 5% to about 2% of the total charge. Figures 3.5, 3.6, 3.7 show $\epsilon_L + \epsilon_G$ versus U_L curves for

HDS-1442A, -6 +16 mesh and -7 +14 mesh beads, respectively, with a 5 cp viscosity kerosene + mineral oil mixture as the fluidizing liquid. Although the ebullation characteristics were changing over the duration of the series of runs, comparison of the three figures once again illustrates the similarity of HDS-1442A with the -6 +16 mesh batch. In the figures where similar data were taken two times, the later data are identified by primes near the symbols. The change in ebullation behavior with time is evident from these.

3.4.3 Series with -5 +18 Mesh Beads: In an interesting series of runs during this period, a sample of beads, of median diam. 2mm and of a wide particle size distribution (-5 +18 mesh, $D_5/D_{18} = 4/1$), was first sieved into its component fractions (Table 3.2), data were collected for the central -8+12 mesh fraction and then after each new component fraction had been added to the column. Thus, the size distribution in the column had the following sequence: -8 +12, -7 +12, -6 +12, -5 +12, -5 +14, -5 +18.⁺ The -16 mesh material in this batch formed no more than 0.6% of the total.

Mixing and Segregation: As had been observed before with HDS-1442A and B, and with other complete batches of beads, the particles in this series of runs stratified readily according to size with liquid (kerosene) alone as the fluidizing medium, but the stratification disappeared almost completely in 20-60 seconds when gas was introduced at a superficial velocity as low as 0.05 ft/sec. Figure 3.8 shows the settled bed of -8 +12 mesh beads with the freshly added -7 +8 beads on top. The demarcation of the two batches is obvious. Figure 3.9 shows the top of the bed with liquid flow alone. The expanded bed shows complete stratification with no -7 +8 mesh beads near the top. Figure 3.10 shows the same location at the same liquid flow rate but with nitrogen introduced at a superficial velocity of

Figure 3.5 Effect of Liquid & Gas Superficial Velocities on Liquid + Gas Fractions for HDS-1442A, 5cp Fluid, Nitrogen

Figure 3.6 Effect of Liquid & Gas Superficial Velocities on Liquid + Gas Fractions
for -6 +16 Mesh Beads, Scp Fluid, Nitrogen

Figure 3.7 Effect of Liquid & Gas Superficial Velocities on Liquid + Gas Fractions
for -7 +14 Mesh Beads, 5 cp Fluid, Nitrogen

Figure 3.8 Settled Bed with -7 +8 Beads
on Top of -8 +12 Bed

-7 +8

-8 +12

Figure 3.9 Bed of Figure 3.8 with 0.14 ft/sec Kerosene
No Nitrogen

Figure 3.10 Bed of Figure 3.9 with Same Liquid Flow
and 0.05 ft/sec. Nitrogen

0.05 ft/sec. Large particles in the -7 +8 mesh range are clearly visible at the top well mixed with the -8 +12 mesh beads present there in Figure 3.9. The same behavior was exhibited throughout this series: stratification with liquid alone, mixing on introduction of gas. It is clear that stratification of catalyst particles is not a likely occurrence in an H-COAL ebullated reactor where the diameter ratio of the catalyst particles is less than 4/1 and the distribution is represented by essentially a straight line on a log normal plot.

As mentioned above, the -5 +18 mesh batch contained less than 0.6% material finer than -16 mesh, consequently the interface was not too diffuse with kerosene as the liquid phase and introduction of gas did not result in excessive carry-over of the particles. Thus it appears that the problems encountered by HRI with the nominally -6+16 mesh beads submitted to them were largely due to the -16 mesh content of the batch and not due to the 3/1 diameter ratio of the particle size distribution.

Effect of Adding Larger and Smaller Particles:

Plots of the $\epsilon_L + \epsilon_G$ versus U_L data with U_G as the third parameter show that adding the coarser fractions to the fluid bed, not surprisingly, reduced the $\epsilon_L + \epsilon_G$ value when U_L was held constant. Conversely, adding finer fractions increased $\epsilon_L + \epsilon_G$ for the same liquid and gas flow rates. For the particular distribution tested, because of the decreasing quantities in the fractions further from the mean, the effect of the added fractions on the $\epsilon_L + \epsilon_G$ values became progressively smaller in each direction.

3.4.4 Series with 0.5mm Beads: As shown in Table 3.1 three batches of 0.5mm beads (-25 +45 mesh, -20 +50 mesh, and -18 +60 mesh) were tested with kerosene as the liquid phase. The collected data and the calculated results are available in Appendix 1 and in Tables 3.7, 3.8 and 3.9.

The ebullated beds with the 0.5mm particles appeared diffuse for all three particle size distributions, the

diffuse appearance extending to greater heights for the wider distributions. At bed expansions of about 33 percent there was no stratification of particles for these beads, with or without gas flow. Also data collected under the same conditions with no gas flow at the beginning and the end of a series with each sample showed considerable differences in the ebullation behavior as judged by the $\epsilon_L + \epsilon_G$ vs. U_L plots or the Richardson & Zaki constants which fitted the two sets treated separately. For example, the terminal velocities calculated by the Richardson & Zaki type fit were 0.077 ft/sec and 0.095 ft/sec for the -25 +45 mesh batch for the two sets of data, and for the -18 +60 mesh batch the velocities were 0.27 ft/sec at the beginning of the series and 0.134 ft/sec at the end of the series. These variations could be due to particle carry-over. But the decrease in the terminal velocity of the -18 +60 mesh batch would still be difficult to explain.

It is believed that the viscosity of kerosene is too high for the 0.5mm beads which are intended for use in coal extract upgrading reactors. Further tests with the 0.5mm beads will, therefore, be carried out with heptane, a liquid which is expected to simulate the coal extract liquids under operating conditions more closely than kerosene does. A new cold flow unit is under construction for this purpose.

3.4.5 Richardson-Zaki Type Correlations for Beads: The liquid-solid data for the beads were correlated by the Richardson-Zaki type of correlation,

$$\epsilon_L^n = \frac{U_L}{U_t} \quad (3.1)$$

where ϵ_L is the liquid fraction, U_L is the superficial velocity of the liquid, U_t is the terminal velocity of the particles and n is a correlating parameter which is a function of the terminal Reynolds number and the tube to particle diameter ratio. Richardson and Zaki (3) have presented correlations for n for uniform spherical particles. When correlating the data for particle size distributions rather than a uniform particle size, Equation 3.1 can be looked upon as a two-parameter correlating equation. Table 3.19 lists the values of n and U_t calculated

from the bead data. The variations in n and U_t for the 2mm particles are well within experimental accuracy and do follow the expected trends. The terminal velocities for -6 +16 mesh and -7 +14 mesh particles are virtually identical for the two liquids considered. The differences in n for these two distributions probably reflects the difference in the distributions. For the series from the -5 +18 mesh batch, both the n and U_t values change. Since the mean diameter in that series was not constant from addition to addition, the values cannot be easily compared. In general, the values of n and U_t for the series appear reasonable.

The values of n and U_t for the 0.5mm beads have already been discussed. It is interesting to note, however, that the n and U_t values from data at the end of each series approach each other although the initial values (the two cases for which they are available) were very far apart. The terminal velocities with kerosene are in the neighborhood of 0.1 ft/sec, which would suggest superficial liquid velocities on the order of 0.02-0.05 ft/sec for operating reactors if the reactor fluid viscosity were similar to that of kerosene. For liquids of lower viscosities the allowable fluid velocities would be correspondingly higher.

3.4.6 Calculations for Particle Size Distributions Using the Correlations of Richardson & Zaki:

Literature references (See (4) for a review) on solid-liquid fluidization of mixtures of two distinct size particles mention that the bed expansions can be correlated by treating each particle size independently and adding their expanded volumes, particularly when the terminal velocities of the two particle sizes differs by a factor of 2 or more. Although this latter condition is not satisfied by the successive sieve fractions in a continuous particle size distribution, the same approach could result in a reasonably close agreement with the experimental data with, perhaps, an adjustable parameter to account for the interpenetration of the regions of expansion of the different sieve fractions. The experimental expansions would be expected to be lower than the calculated values because of the

Table 3.19: Exponents and Terminal Velocities for
Beads from Fits of Richardson-Zaki Type Correlation

$$C_L^n = \frac{U_L}{U_t}$$

System Mesh Size-Fluid	Exponent n	Terminal Velocity U _t ft/sec
- 6+16 - 5 cp	4.12	0.38
- 7+14 - 5 cp	3.61	0.39
- 6+16 - 1.4 cp (kerosene)	2.9	0.45
- 7+14 - 1.4cp	2.15	0.44
-25+45 - 1.4cp	Start 2.55 End 3.03	0.077 0.095
-20+50 - 1.4cp	End 3.1	0.114
-18+60 - 1.4cp	Start 4.31 End 2.68	0.27 0.134
-5+18 Fractions - 1.4cp		
-8+12 - 1.4cp	2.91	0.55
-7+12 - 1.4cp	2.80	0.50
-6+12 - 1.4cp	2.66	0.49
-5+12 - 1.4cp	2.77	0.55
-5+14 - 1.4cp	2.68	0.51
-5+18+- 1.4cp	2.46	0.46

interpenetration of the regions of expansion.

To test this additive model for the continuous distribution the following procedure was followed:

- a) For the average particle diameter in each sieve fraction the terminal velocity was calculated from (5):

$$U_t = \left[\frac{4}{225} \cdot \frac{(\rho_s - \rho_L)^2 g^2}{\rho_L \mu} \right]^{1/3} d \quad (3.2)$$

- b) Using the calculated U_t a terminal Reynolds number was calculated and the value of n evaluated from the correlations given by Richardson and Zaki (3).

- c) The average liquid fraction was then calculated from

$$\epsilon_{av} = \frac{\sum_i \frac{M_i}{\rho_{si} A (1 - \epsilon_i)} - \sum_i \frac{M_i}{\rho_{si} A}}{\sum_i \frac{M_i}{\rho_{si} A (1 - \epsilon_i)}} \quad (3.3)$$

where M_i is the weight of the i^{th} fraction, ρ_{si} is its (non-fluid filled) particle density and A is the cross-sectional area of the tube. ϵ_i , the liquid fraction for the i^{th} fraction, is obtained from Equation 3.1.

Calculations following this procedure for four cases gave the results in Table 3.20. The agreement between the calculated and the experimental ϵ_L values is surprisingly good without any adjusting parameters. Further evaluation of this approach will be carried out during the next quarter.

3.4.7 Effect of Gas Flow on Bed Height: Referring back to Figures 3.2 to 3.7, it is evident that the effect of the gas rate on the liquid + void fraction is considerably less than the effect of the liquid rate in the region of interest. Also visual observations of mixing suggest that a superficial gas velocity as low as 0.05 ft/sec accomplishes the desired mixing of the solid phase in the ebullated bed reactor. Even

Table 3.20: Application of Richardson and Zaki Correlations to Polydisperse Systems, Comparison with Experimental Results

Case 1: -7 +14, Kerosene

U_L ft/sec	ϵ_{rw} calculated	ϵ measured
0.064	0.49	0.41
0.113	0.60	0.54
0.161	0.69	0.63
0.210	0.77	0.71
0.259	0.84	0.77

Case 2: -6 +16, Kerosene

U_L ft/sec	ϵ_{rw} calculated	ϵ measured
0.07	0.52	0.54
0.10	0.59	0.58
0.132	0.66	0.65
0.159	0.72	0.70
0.191	0.81	0.75

Case 3: -7 +14, 5cp Fluid

U_L ft/sec	ϵ_{rw} calculated	ϵ measured
0.022	0.44	0.46
0.053	0.59	0.57
0.084	0.68	0.64
0.116	0.76	0.71
0.147	0.82	0.78

Table 3.20: (Cont'd)

Case 4: -6 +16, 5cp Fluid

<u>U_L</u> <u>ft/sec</u>	<u>E_{av}</u> <u>calculated</u>	<u>E</u> <u>measured</u>
0.017	0.42	0.47
0.047	0.58	0.62
0.077	0.68	0.66
0.106	0.77	0.71
0.136	0.94	0.81

if a gas velocity of 0.15 to 0.2 ft/sec is used in the reactor, the $\epsilon_L + \epsilon_G$ values are only about 0.05-0.10 units higher than the ϵ_L with no gas flow when ϵ_L is 0.4-0.5, and 0.0125-0.05 units higher when ϵ_L is 0.7-0.8.

Bed contraction has generally been negligible in the bead runs and, when observed, has been noticed only at superficial gas velocities less than 0.05 ft/sec. Attempts to develop a mathematical correlation to describe the three-phase data continue.

3.5 Conclusions

The following conclusions can be drawn from the cold flow ebullation tests to date with HDS-1442 extrudates and bead catalysts.

1. The ebullation behavior of -6 +16 mesh beads centered on a median diameter of 2mm closely resembles the ebullation behavior of HDS-1442A extrudates.
2. A narrower distribution, such as -7 +14 mesh beads, shows lower bed expansions (or $\epsilon_L + \epsilon_G$) at equal liquid and gas velocities.
3. For bead distributions of 2mm median diameter, even a range as wide as represented by -5 +18 mesh ($D_5/D_{18} = 4/1$) does not give an excessively diffuse interface provided that the distribution has a sharp cut-off at the finer end.
4. Segregation and mixing behavior of the 2mm beads is similar to that of the extrudates. The beads stratify by size with liquid flow alone but are very well mixed at superficial gas velocities as low as 0.05 ft/sec.
5. The 0.5mm beads should be tested with a liquid of viscosity corresponding to the viscosity of coal extract solutions at reactor conditions (0.2 - 0.4cp). Kerosene has a significantly higher viscosity (1.4 cp) and yields a very diffuse bed even at 30-40% bed expansions.
6. Effect of gas velocity (0.05-0.2 ft/sec) on bed height in three phase fluidized beds is considerably less than the effect of comparable liquid velocities. Bed contraction was not found to be a significant phenomenon for the beads under the test conditions.

3.6 References

1. V. T. Sinha, M. Butensky, T. L. Muchnick and D. Hyman, "Development of Significantly Improved Catalysts for Coal Liquefaction and Upgrading of Coal Extracts", Quarterly Progress Report No. 2, 1/1 - 3/31/82.
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4. Task 4: BEAD CATALYST CHARACTERIZATION

4.1 Catalysts for Batch Screening

An experimental design for the initial set of bead catalysts for batch screening has been developed. An array of 29 different catalysts will be tested with Illinois No.6 coal in a total of about 35 experimental runs to determine the main effects of six catalyst characterization factors. In addition, screening runs will be done with scouting samples consisting of the base case from the statistical design and single variable modifications of it. Selection of catalysts for subsequent testing will be made after some of the initial experiments have been completed.

The six factors to be studied are as follows:

1. Support Composition
2. Support Physical Properties
3. Catalyst Molybdenum Level
4. Catalyst Ni and/or Co Level
5. Other Catalyst Promoters
6. Catalyst Preparation Procedure

Each factor contains four or five levels as detailed in Table 4.1. Variables 1 and 2 constitute an exploration of key support properties such as pore size distribution, total pore volume, and surface area. With the bead catalyst, these properties can be varied over a wide range using a variety of proprietary manufacturing techniques. Relevant catalyst properties, varying due to changes in factors 1 and 2, will be determined and reported.

The other factors in the design cover typical catalyst development variables. While many of the effects of these variables have been studied by previous workers (1-6) use of the bead support along with proprietary catalyst preparation procedures may lead to novel results.

Scouting samples to be prepared are shown in Table 4.2. They are designed to test some of the elements of the experimental

Table 4.1Bead Catalyst Experimental Design

<u>Factor</u>	<u>Levels</u>												
1. Support Composition	1. Rehydratable alumina 2. Lower surface area rehydratable alumina 3. 1. + Linde Hydrogen Y Zeolite (approx. 10%) 4. 1. + Silica-alumina 5. 1. + Fine clay silica												
2. Support Physical Properties	5 Types												
3. Molybdenum Level	1. 2% MoO ₃ 2. 5% 3. 10% 4. 15%												
4. Nickel and/or Cobalt Level	<table> <tr> <th><u>NiO</u></th><th><u>CoO</u></th></tr> <tr> <td>1. 3%</td><td>0</td></tr> <tr> <td>2. 0</td><td>3%</td></tr> <tr> <td>3. 1.5%</td><td>1.5%</td></tr> <tr> <td>4. 1.5%</td><td>0</td></tr> <tr> <td>5. 0</td><td>0</td></tr> </table>	<u>NiO</u>	<u>CoO</u>	1. 3%	0	2. 0	3%	3. 1.5%	1.5%	4. 1.5%	0	5. 0	0
<u>NiO</u>	<u>CoO</u>												
1. 3%	0												
2. 0	3%												
3. 1.5%	1.5%												
4. 1.5%	0												
5. 0	0												
5. Other Catalyst Promoters	1. None 2. NaNO ₃ 3. Cr ₂ O ₃ 4. Phosphorus -Technique 1* 5. Phosphorus -Technique 2*												
6. Catalyst Preparation	4 Procedures*												

* Cyanamid confidential information

Table 4.2

Bead Catalyst Scouting Samples

Support Composition	Support Properties	Molybdenum Level	Nickel/Cobalt Level	Other Promoters	Catalyst Preparation
1. Rehydratable Al ₂ O ₃	*	10%	3%NiO	None	+
2. Lower SA Al ₂ O ₃	↓	↓	↓	↓	↓
3. Rehydratable Al ₂ O ₃	**	↓	↓	↓	↓
4. ↓	*	↓	1.5% NiO/1.5%CoO	↓	↓
5. ↓	↓	↓	3% NiO	↓	++

* One type, factor 2 (See Table 4.1)

** Another type, factor 2 (See Table 4.1)

+ One procedure, factor 6 (See Table 4.1)

++ Another procedure, factor 6 (See Table 4.1)

design and provide some interesting combinations not a part of it. In addition, they will be used to refine preparation techniques and to optimize manufacturing conditions.

4.2 Analytical Sampling Plan

The Analytical Sampling Plan for Task 4 has been modified to allow for the calculation of the fluid-filled density of the bead catalysts (important for predicting behavior in an ebullated bed). Measured quantities required for this calculation include void fraction, water pore volume, and compacted bulk density. The void fraction is the volume fraction of interstitial space in a compacted bed of catalyst. It is measured by compacting a sample of (water saturated) beads in a water-filled graduated cylinder. The weight of the water-filled bed is measured and from it is subtracted the weight of water in the pores of the beads (calculated from the water pore volume) and the weight of the dry beads (calculated from the compacted bulk density). This yields the weight of water in the voids. The void fraction is calculated by dividing the volume of water in the voids by the bed volume.

The total bead volume and fluid weight are calculated as follows:

$$V_b = (W_b / CBD) (1 - F_v) \quad (4.1)$$

$$W_f = (W_b) (PV_{\text{water}}) (d) \quad (4.2)$$

Where: V_b = total bead volume

W_b = total bead weight (typically 100 g)

CBD = compacted bulk density of the beads

F_v = void fraction

W_f = fluid weight

PV_{water} = water pore volume

d = fluid density

The fluid filled density d_{ff} can thus be represented as follows:

$$d_{ff} = \frac{W_b + W_f}{V_b} \quad (4.3)$$

The revised Analytical Sampling Plan for Task 4 is shown as follows:

ANALYTICAL SAMPLING PLAN FOR TASK 4

<u>Analysis</u>	<u>Technique</u>
Median size	Screen analysis
Size distribution	Screen analysis
Apparent bulk density	Cylinder
Void fraction	Vibrating cylinder
Water pore volume	Water titration
Compacted bulk density	Vibrating cylinder
Fluid filled density	Calculated (equation 4.3)
Crush strength	1/8" anvil piston or in-house test
Attrition/abrasion resistance	Modified GM test - Air (3.3 CFM, 5 min)
Surface area	N ₂ BET (single point) - ASTM D3663
Pore size distribution	Hg porosimetry-Micromeritics 60,000 psia
Chemical Analyses	X-ray fluorescence-
-Mo	Ortec 6110 Energy Dispersive X-ray Spectrometer
-Co	"
-Ni	"
-SiO ₂	Atomic Absorption - IL 453 Spectrophotometer
-Na ₂ O	"
-Ca	"
-Mg	"
-Fe	"

<u>Analysis</u>	<u>Technique</u>
-P	Colorimetry (Orthophosphate)
-C	High temperature combustion
Metals	Semi-quantitative scan- Ortec 6110 Energy Dispersive X-ray Spectrometer

All analyses with the exception of Co and Ni will be performed on each bead catalyst. Co and Ni analyses will be performed only on those catalysts which contain these added promoters.

4.3 References

1. W. Kawa, S. Friedman, W. R. K. Wu, L. V. Frank, and P.M. Yavorsky, Prepr. Pap. Am. Chem. Soc., Div. Fuel Chem. 19, 192 (1974).
2. R. J. Bertolacini, L. C. Gutberlet, D. K. Kim, and K.K. Robinson, "Catalyst Development for Coal Liquefaction", EPRI Report AF-574, November 1977.
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5. S. G. Hindin, "Catalyst Development for Coal Liquefaction", U.S.D.O.E. Report, FE-2335-T1, January 1979.
6. L. M. Polinski, G. J. Stiegel, R. E. Tischer, "1980 Status Review - Hydroliquefaction of Coal with Supported Catalysts," U.S.D.O.E. Report DOE/PETC/TR-81/2, June 1981.

5. Tasks 5 and 6: CATALYST BATCH SCREENING AND CONTINUOUS AGING TESTS

5.1 Catalyst Batch Screening Unit

The construction of a Batch Screening Unit has been completed and the commissioning has begun. In designing the unit, reference was made to those in operation at the Amoco R&D Center (Amoco) and the Pittsburgh Energy Technology Center (PETC) as well as to available expertise among Cyanamid personnel. Detailed descriptions of the Amoco and PETC units are available in published reports by Brooks et al (1) and Polinski et al (2) respectively.

The Batch Screening Unit is interfaced to the same computer-based control system which has been designed to permit automated operation of the continuous coal liquefaction test unit being constructed for the current program. Initially, the computer's role in the Batch Unit design was limited to data acquisition and temperature control. The versatility and quality of the control system has resulted in a greater degree of automation being incorporated in the design.

The computer control system, CRISP®, has been purchased from Anatec (a Division of Anaconda Company) and is based on a PDP 11/34 computer from Digital Equipment Corporation. Interaction with the computer takes place via a high resolution color CRT which permits continuous monitoring of the process and observation of historical trends of measured variables. Using CRISP the computer can control the operation of solenoid valves, provide a set point for the hydrogen flow (control system), monitor the performance of the ancillary gas supply system as well as control the temperature of the reactor. Since CRISP is a task running under RSX 11M Ver 3.2, the computer operating system, all facilities usually available on the PDP 11/34 can be incorporated in the system configuration. This results in compatibility in the files generated during the data acquisition period with FORTRAN generated files, thus eliminating the need for expensive software to access the data. Full use is being made of the Batch Unit as a training vehicle for the much more involved Continuous System being constructed.

The Batch Unit has been constructed to Class 1, Division 2. Group D requirements with the computer control system installed in an adjoining, non-explosion proof room. A simplified schematic of the Unit is shown in Figure 5.1. For clarity, all manual valves, check valves, pressure regulators, etc., have been omitted. The control features have been included. The unit will be operated as described in some detail below.

The coal slurry/catalyst charge is loaded and the reactor vessel V-1401 sealed. The entire system is then purged with nitrogen and pressure tested with both nitrogen and hydrogen. (To perform these operations, a software bypass procedure has been developed to permit opening and closing solenoid valves.) On start-up, solenoid valves SV-1101 and SV-1401 open under computer control. The hydrogen gas temperature is monitored and its flow rate controlled using a Brooks Flow Control system. The set point for this controller can either be supplied via the computer or by a manual dial. This controller is located inside a box PB-1101 which is continuously purged with nitrogen. The pressure of this box is monitored by the computer which will alarm if the pressure drops below a set limit. The metered gas then passes through SV-1401 to the reactor. The pressure of this stream is monitored using a pressure transducer and alarm limits are defined for computer action.

The reactor itself is provided with a variable speed agitator and cooling coil and is protected by a relief valve on the gas effluent line and by a rupture disc. Water for the cooling coil normally passes via SV-1301 through a rotameter FM-1301. This flow can be augmented in shut down conditions by a quench stream through SV-1302. The water passes through the coil continuously during the run and is dumped to drain. Motor speed is set manually and the motor is monitored using auxiliary contacts.

The reactor is heated with an electrically powered jacket. This jacket and the base of the autoclave are enclosed in another box PB-1401 continuously purged with nitrogen. The pressure in this box is also monitored by the computer. The power load to the heater is cascade controlled via an SCR. The reactor con-

Figure 5.1
AMERICAN CYANAMID COMPANY
BATCH COAL LIQUEFACTION TEST UNIT

tents temperature is used in conjunction with the temperature of the jacket to define the control parameters.

Experimental data is automatically recorded on disk beginning at a user specified reactor contents temperature. Whenever the system pressure and temperatures have passed the defined low limits, the alarm mode is enabled and alarm information is also logged on disk. At a further user specified reactor contents temperature, the reaction run is defined to start and continues for the user specified time. At the end of this time, a controlled shutdown commences. The solenoid valves SV-1101 and SV-1401 close and the power is switched off to the heater. The quench water comes on with the opening of SV-1302. The heater jacket automatically lowers and a quench nitrogen stream is admitted by SV-1601 to the exterior of the autoclave. The contents thus cool in a sealed environment. The reactor pressure drops as cooling occurs and dissolved gases dis-entrain from the liquid. At another user defined temperature, the control system alerts the operator that a gas sample may be taken, if required. The user acknowledges having taken the sample and the computer then begins a nitrogen purge of the reactor by opening SV-1201 and SV-1401. Data collection stops at this point and the operator switches off the agitator. The system is manually de-pressurized. Whenever the batch contents temperature reaches a final user defined temperature the computer communicates this fact. The operator can then isolate the unit and carry out the necessary sampling procedures.

The computer control system software is modular in form and lends itself readily to change if desired. This provides the systems engineer with the means to correct quickly any deficiencies in the program logic. The provision of low and high level alarms and safety interlocks greatly minimizes the risk from potential hazards.

5.2 Conversion Calculations

One of the critical parameters to be determined when evaluating a catalyst for coal liquefaction is the conversion of coal to material soluble in some standard solvent which the catalyst

effects during a liquefaction run. Various approaches to calculating this measure of catalyst performance have been considered.

In fundamental form, % conversion can be expressed as follows:

$$X = \frac{IOM_{in} - IOM_{out}}{IOM_{in}} \times 100 \quad (5.1)$$

Where: X = weight % conversion on a moisture and ash free (maf) basis.

IOM_{in} =insoluble organic material in

IOM_{out} =insoluble organic material out

The terms which comprise IOM_{in} and IOM_{out} are somewhat different for a batch liquefaction test as opposed to a continuous liquefaction test.

5.2.1 Batch Liquefaction

In the batch liquefaction test, a typical product work-up scheme involves initial separation of solid and liquid product by vacuum filtration (3). The solid residue is then extracted (generally with benzene or toluene) and the extract is combined with the filtrate from the initial separation. The solid residue after drying consists of IOM_{out} combined with any insoluble inorganic material present (i.e., catalyst plus ash from the coal plus ash from the slurry solvent). However, ash from the solvent can usually be neglected.

The constituents of IOM_{in} are as follows:

1. (COAL) - (COAL ASH) - (COAL MOISTURE)
2. (SLURRY SOLVENT INSOLUBLES) - (SLURRY SOLVENT ASH)

In general, though, any contributions from slurry solvent insolubles can be neglected because insolubles only arise (precipitate) when the slurry solvent is mixed with the solvent used for

determining conversion (i.e., toluene or benzene). This is so because, for the batch experiment, the slurry solvent will be part of the liquid product removed in the initial separation step before the addition of toluene or benzene. In addition, ash content of slurry solvents are typically quite low. For example, SRC-II heavy distillate (FSN-12) contains only ~0.3 weight % ash.

Equation 5.1 can now be expressed in terms of measurable quantities.

$$X = \frac{W_C + W_{cat} - I}{W_C (1 - A_C)} \times 100 \quad (5.2)$$

Where: X = weight % conversion (maf)
 W_C = dry weight of coal charged
 W_{cat} = dry weight of catalyst charged
 I = weight of toluene insolubles after liquefaction
 A_C = ash content of the coal (weight fraction)

Since the ash content of the coal is contained both in IOM_{in} and IOM_{out} , it is cancelled in the numerator.

5.2.2. Continuous Liquefaction

The treatment of conversion calculations is somewhat more complicated for the continuous liquefaction case. In this test, insolubles are determined by pressure filtration of a sample of the output stream (2,4). This is typically done three times - once each with the tetrahydrofuran, toluene, and hexane. Conversions are then reported for each of the solvents.

There are three areas where the calculation of % conversion for a continuous test differs from the calculation for a batch test.

1. Only an aliquot of the product is taken as a sample. Efficiency of product recovery must be considered.
2. Filtrations are done after mixing the product with the solvent. Any precipitation of slurry solvent will add to insolubles measured, so insolubles in the slurry solvent must be accounted for.

3. The weight fraction of coal in the slurry feed is used instead of the dry weight of coal.

Point 1 has been addressed by investigators at Amoco(5). They concluded that it is valid to assume that overall slurry yield (sic) (slurry out/slurry in) is equal to 1 because pilot plant operation typically resulted in yields between .98 and 1 depending on the measurement used. In addition, a 2 percent error in the assumed yield "will lead to an insignificant error (less than 0.7%) in conversion."

Taking into account insolubles in the slurry solvent, equation 5.1 can be expressed using the constituents of IOM_{in} and IOM_{out} discussed in Section 5.2.1 as follows:

$$X = \frac{[(W_C - W_{ac}) + (W_{is} - W_{as})] - [I - W_{ac} - W_{as}]}{[(W_C - W_{ac}) + (W_{is} - W_{as})]} \times 100 \quad (5.3)$$

Where: X = weight % conversion (maf)

W_C = dry weight of coal charged

W_{ac} = weight of ash from the coal

W_{is} = weight of insolubles from the slurry solvent

W_{as} = weight of ash from the slurry solvent

I = weight of insolubles after liquefaction

After cancelling out the W_{ac} and W_{as} terms in the numerator and expressing equation 5.3 in terms of aliquot sampling X can be expressed as follows:

$$X = \frac{F_C W(1-M_C) + I_S W(1-F_C) - I}{F_C W(1-M_C - A_C) + (I_S - A_S)W(1-F_C)} \times 100 \quad (5.4)$$

Where: X = weight % conversion (maf)
 F_C = weight fraction of coal in the slurry
 W = weight of sample used in microfiltration test
 M_C = weight fraction of moisture in the coal
 I_S = weight fraction of insolubles in the slurry solvent
 I = weight of insolubles from the microfiltration test
 A_C = weight fraction of ash in the coal
 A_S = weight fraction of ash in the slurry solvent

Or alternatively:

$$X = \frac{F_C (1-M_C) + I_S (1-F_C) - I/W}{F_C (1-M_C - A_C) + (I_S - A_S) (1-F_C)} \times 100 \quad (5.5)$$

By ignoring the contributions of insolubles from the slurry solvent (i.e., by setting $I_S = A_S = 0$) equation 5.5 is reduced to the following:

$$X = \frac{F_C (1-M_C) - I/W}{F_C (1-M_C - A_C)} \times 100 \quad (5.6)$$

Equation 5.6 is one form of the equation typically used for calculation of % conversion (2,5).

It is known, however, that (especially with hexane) some slurry solvents have a significant insoluble content. For example, an SRC-II heavy distillate (FSN-12) yields 7.76% insolubles in hexane (6). Because of this, equation 5.5 will be used to calculate % conversion for continuous reactor product until it is demonstrated that slurry solvent insolubles do not contribute significantly to % conversion calculations.

5.3 REFERENCES

1. J. A. Brooks, R. J. Bertolacini, L. C. Gutberlet, D. K. Kim, "Catalyst Development for Coal Liquefaction," EPRI Report AF-190, February 1976.
2. L. M. Polinski, G. J. Stiegel, R. E. Tischer, "1980 Status Review - Hydroliquefaction of Coal with Supported Catalysts U.S.D.O.E Report DOE/PETC/TR-81/2, June 1981, Appendix A.
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4. B. Utz, DOE (PETC), private communication to K. Matsuda, American Cyanamid Co., 3/4/82.
5. R. J. Bertolacini et al, op. cit., p. 123.
6. J. A. Mahoney, "Catalyst Development for Coal Liquefaction," Proceedings of the DOE, H-COAL Research TAC Meeting, September 15, 1981, p. 8-10.

6. Task 8: SPECIAL ANALYTICAL METHODS

6.1 Introduction

Task 8 is concerned with special analytical methods to characterize catalysts prepared for coal liquefaction before and after use in the reactors. Primarily, a combination of surface analytical techniques will be used to characterize the surface of catalysts at both early stages of reaction and subsequent later stages. It is anticipated that information at short reaction time might help elucidate the paths of catalyst deactivation.

In order to achieve this understanding it is necessary to determine the elemental composition of the catalyst surface, the elemental distribution across the surface, and the oxidation state of these elements. The techniques to be used are ESCA (Electron Spectroscopy for Chemical Analysis) or XPS (X-ray Photoelectron Spectroscopy), AES (Auger Electron Spectroscopy), SAM (Scanning Auger Microscopy), AEM (Analytical Electron Microscopy), and EPMA (Electron Probe Microanalysis). A brief description of each of these techniques and its specific application in catalysis research follows. Other techniques which are deemed useful as the investigation proceeds will be used as required.

6.2 ESCA or XPS

XPS is the most widely used surface analytical technique in the study of catalyst surfaces(1). This is so because the technique is readily quantifiable, it provides elemental as well as chemical bond information and it is not destructive to the sample. Chemical shifts observed in the spectra (the difference between the observed binding energy and the binding energy of a given electron from an element in its zero valence state) allow for the determination of the oxidation state of the element.

A limitation of ESCA is that it provides information from a large area of the surface, about 1mm x 5mm. Thus it is difficult to obtain information regarding surface segregation. (The analytical volume of an ESCA measurement is ~1mm x 5mm x 5nm.)

6.3 AES/SAM

Auger electron spectroscopy and Scanning Auger have not been widely used in the study of supported catalysts because of the insulating nature of the supports commonly used (silicas, aluminas, zeolites). The electron beam excitation used in AES instruments results in substantial charging effects in these insulators. This problem may be overcome by carefully mounting the catalyst (2) in a conducting medium. While AES can provide similar elemental information as the XPS measurements, the major advantage of this technique in catalyst research is the ability to obtain elemental information from very small areas. This is achieved using the focusing properties of electron beams. In addition, by rastering the finely focused electron beam (50-200nm) over a given area (SAM) elemental mapping may be obtained providing a picture of the uniformity of composition in the X-Y direction. Since AES is very sensitive to the light elements, C, N, O, etc. may readily be monitored. In addition to element mapping, it is possible to monitor the distribution of elements across the catalyst pellet by measuring spectra in a point-by-point fashion or by doing a line scan. This will provide information similar to that obtained by EPMA, the difference being that AES is sampling $\sim 3\text{nm}$ into the catalyst.

6.4 AEM

The Analytical Electron Microscope is an instrument which is capable of obtaining morphological, crystallographic, and elemental analytical information on a cross-sectional sample area of $\sim 5\text{nm}$ diameter. It combines the techniques of TEM (Transmission Electron Microscopy), STEM (Scanning Transmission Electron Microscopy), SEM (Scanning Electron Microscopy), Electron Diffraction, and XRF (X-ray fluorescence or EPMA). Using AEM, it should be possible to identify the structure of the various catalyst supports, to monitor dispersion of active metals on the support, to monitor and identify the poisons picked up during the catalytic process, and to follow the distribution of these poisons.

6.5 EPMA

Electron microprobe analysis can be used to monitor the metals distribution across the catalyst surface. Currently, our JEOL 35U employs a program which measures the intensity of emitted X-rays as the catalyst sample is moved across the electron beam. A new program has been written which includes correction factors necessary to perform quantitative analysis for up to 10 elements. Thus, catalyst composition across the pellet may be obtained automatically, the number of points, time for data accumulation, and specific elements to be monitored are determined by the operator.

6.6 References

1. J. S. Brinen, "Electron Spectroscopy in Catalyst Research," ASTM Special Technical Publication 699, (1980) p.24 and references therein.
2. R. Bouwman and L. H. Toneman, "An Auger Spectroscopic Study of Radial Concentration Profiles in Spent Co,Mo/ γ -Al₂O₃ Hydrodesulfurization Catalysts," J. Cat. 61, 146 (1980).

APPENDIX I: Tabulation of Collected Data

INDEX TO DATA IN APPENDIX

ITEM NO.	CATALYST	SIZE	LIQUID	RUN NOS.
1	HDS-1442B	1/32 EXTR.	WATER	9-33
2	HDS-1442B	1/32 EXTR.	WATER	34-59
3	HDS-1442B	1/32 EXTR.	WATER	60-80
4	HDS-1442B	1/32 EXTR.	WATER	82-93
5	HDS-1442A	1/16 EXTR.	WATER	94-116
6	HDS-1442A	1/16 EXTR.	WATER	117-171
7	HDS-1442A	1/16 EXTR.	KEROSENE	172-212
8	HDS-1442B	1/32 EXTR.	KEROSENE	213-253
9	HDS-1442A	1/16 EXTR.	5 CP FL.	254-306
10	HDS-1442B	1/32 EXTR.	5 CP FL.	307-333
11	75A* BEADS	-20+60MESH	5 CP FL.	334-361
12	75A BEADS 2MM	-6+16MESH	5 CP FL.	362-406
13	75A BEADS 2MM	-7+14 MESH	5 CP FL.	407-436
14	75A BEADS 2MM	-7+14 MESH	KEROSENE	437-469
15	75A BEADS 0.5MM	-25+45 MESH	KEROSENE	470-505
16	75A BEADS 0.5MM	-20+50 MESH	KEROSENE	506-541
17	75A BEADS 0.5MM	-18+60 MESH	KEROSENE	542-574
18	75A BEADS 0.5MM	-25+45 MESH	KEROSENE	575-587
19	75A BEADS 2MM	-6+16 MESH	KEROSENE	588-622
20	75A BEADS 0.5MM	-20+50 MESH	KEROSENE	623-646
21	75A BEADS 2MM HD	-7+14 MESH	KEROSENE	647-677
22	75A BEADS 2MM	-8+12 MESH	KEROSENE	678-705
23	SAME AS ABOVE	-7+12 MESH	KEROSENE	706-725
24	SAME AS ABOVE	-6+12 MESH	KEROSENE	726-745
25	SAME AS ABOVE	-5+12 MESH	KEROSENE	746-765
26	SAME AS ABOVE	-5+14 MESH	KEROSENE	766-785
27	SAME AS ABOVE	-5+18 MESH	KEROSENE	786-805
28	75A BEADS 2MM HD	-5+18 MESH	KEROSENE	806-811

* 75A designates a rehydratable alumina.

ADDITIONAL INFORMATION RE APPENDIX

ITEM NO.	CATALYST	N/B NO.	WT. CHRGD., GM.	COMMENT
1	HDS-1442B	----	726	NEW CHARGE
2	HDS-1442B	-----	726	NEW CHARGE
3	HDS-1442B	-----	1113	387 GM ADDED TO PREVIOUS CHARGE
4	HDS-1442B	-----	1113	NEW CHARGE
5	HDS-1442A	-----	1175	NEW CHARGE
6	HDS-1442A	-----	1277	OLD CHARGE + 107 GMS.
7	HDS-1442A	-----	1213	NEW CHARGE
8	HDS-1442D	-----	1056	NEW CHARGE
9	HDS-1442A	-----	1163	NEW CHARGE
10	HDS-1442B	-----	1056	NEW CHARGE
11	75A BEADS		1062	UNIMPREG. BEADS. LOW DENSITY.
12	75A BEADS 2MM	S13501-31	1148	PAN GRANULTD. - 164 = 3%
13	75A BEADS 2MM	S13501-31	1111	NEW CHARGE
14	75A BEADS 2MM	S13501-31	1111	SAME CHARGE AS FOR NO 13.
15	75A BEADS 0.5MM	S14178-18	1086	NEW CHARGE, NORMAL DENSITY CATLST.
16	75A BEADS 0.5MM	S14178-17	1038	WIDER DISTRIBUTION
17	75A BEADS 0.5MM	S14178-16	1126	WIDER DISTRIBUTION
18	75A BEADS 0.5MM	S14178-10	1086	SAME CHARGE AS NO 15.
19	75A BEADS 2MM	S13501-35	1049	SIMILAR TO CHARGE OF NO 12.
20	75A BEADS 0.5MM	S14178-17	1038	SAME CHARGE AS NO 16.
21	75A BEADS 2MM HD	S13501-53	1498	HIGH DENSITY SIMULATES USED CATLST.
22	75A BEADS 2MM	S13501-35	522	NARROW FRACTION OF SERIES.
23	SAME AS ABOVE		860	338.2 GM OF -7+8 ADDED TO NO 22.
24	SAME AS ABOVE		1064	203.9 GM OF -6+7 ADDED TO NO 23.
25	SAME AS ABOVE		1158	93.8 GM OF -5+6 ADDED TO NO 24.
26	SAME AS ABOVE		1272	114.2 GM OF -12+14 ADDED TO NO 25.
27	SAME AS ABOVE		1308	36.3 GM OF -14+18 ADDED TO NO 26.
28	75A BEADS 2MM HD	S14178-23	1382	HIGH DENSITY, PAN GRANLTD. DISINTEGRATED.

Run No.	Liq. Vel (Sup.)	Gas Vel (Sup.)	Bed Height	
	Ft/Sec	Ft/Sec	Settld In.	Measurd In.

MANOMETRIC READINGS, C1. OF TRICHLOROETHANE

RN	UL	UG	HO	HM	10	H1	M2	M3	M4	M5	M6	M7	M8	M9
9	.110	.000	11.00	21.2	.0	.0	7.0	13.0	13.3	13.5	13.7	13.6	13.6	13.6
10	.110	.050	11.00	23.8	.0	.0	4.5	7.7	8.0	6.1	4.1	2.2	.0	-2.6
11	.120	.150	11.00	24.3	.0	2.7	3.3	2.0	-1.6	-5.3	-10.3	-14.5	-20.0	-24.5
12	.110	.050	11.00	23.8	.0	5.4	7.5	7.7	6.2	4.4	1.4	-1.0	-3.0	-5.3
13	.110	.150	11.00	.0	.0	3.1	3.9	1.5	-2.2	-5.6	-10.3	-14.7	-20.8	-25.0
14	.190	.000	11.00	36.3	.0	3.4	8.2	11.9	15.5	17.4	17.5	17.5	17.4	17.3
15	.110	.050	11.00	18.5	.0	4.0	7.5	6.2	5.0	2.9	1.0	-.8	-2.6	-5.2
16	.110	.150	11.00	32.0	.0	1.3	3.0	.6	-2.3	-6.3	-11.3	-16.0	-20.8	-26.0
17	.110	.000	11.00	18.5	.0	4.5	11.3	11.3	11.3	11.3	11.3	9.8	11.3	11.3
18	.040	.050	11.00	18.0	.0	1.1	1.1	-.8	-2.4	-4.0	-7.1	-9.1	-11.4	14.0
19	.040	.100	11.00	19.0	.0	.8	.2	-2.6	-5.6	-6.6	-12.1	-15.0	-19.3	-22.7
20	.040	.130	11.00	20.5	.0	.0	-1.5	-5.0	-9.6	-14.7	-19.6	-23.8	-29.3	-34.2
21	.040	.250	11.00	26.0	.0	-1.3	-4.5	-9.7	-15.6	-22.0	-28.0	-35.0	-42.2	-48.5
22	.077	.000	11.00	14.5	.0	5.2	8.5	8.6	8.6	8.5	8.6	.0	.0	.0
23	.077	.050	11.00	20.0	.0	2.8	4.7	3.3	1.4	-.7	-2.5	-4.3	-6.6	-6.8
24	.077	.100	11.00	22.0	.0	1.1	3.0	.0	-2.6	-6.1	-9.6	-12.8	-16.7	-20.3
25	.077	.150	11.00	27.0	.0	.5	1.0	-2.6	-6.2	-10.8	-15.8	-20.3	-25.7	-31.0
26	.077	.250	11.00	29.0	.0	-1.0	-2.5	-6.4	-11.9	-17.8	-24.5	-32.0	-38.9	-45.3
27	.150	.000	11.50	24.0	.0	4.0	10.5	13.7	13.7	13.4	13.5	13.4	.0	.0
28	.150	.050	11.50	31.0	.0	2.7	6.8	8.4	7.5	5.9	4.1	2.0	.4	-2.2
29	.150	.100	11.50	34.0	.0	1.2	4.3	4.0	2.3	-.2	-2.7	-5.7	-9.6	-13.0
30	.150	.150	11.50	35.0	.0	.7	2.7	1.0	-1.6	-4.8	-9.0	-14.0	-18.5	-23.7
31	.150	.250	11.50	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
32	.190	.000	11.00	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
33	.190	.050	11.00	40.0	.0	.4	2.8	3.0	2.4	.8	-1.3	-4.0	-7.8	-10.7

RN	UL	UG	HO	HM	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
34	.040	.000	12.00	12.8	.0	3.3	6.3	6.0	6.0	3.0	3.8	7.2	7.1	7.1
35	.040	.050	12.00	17.0	.0	2.6	2.0	.5	-1.5	-2.9	-5.0	-7.4	-10.0	-11.8
36	.040	.100	12.00	19.0	.0	1.8	.4	-2.0	-5.5	-8.8	-12.3	-16.3	-19.5	-24.0
37	.040	.150	12.00	20.0	.0	1.0	-.5	-4.0	-6.4	-13.6	-18.5	-23.7	-29.6	-34.0
38	.040	.200	12.00	22.0	.0	.3	-1.6	-6.7	-12.2	-18.1	-24.7	-30.0	-36.8	-43.3
39	.040	.250	12.00	21.0	.0	-.6	-3.5	-0.7	-14.7	-21.5	-28.3	-35.1	-42.6	-51.0
40	.077	.000	12.00	15.3	.0	8.6	9.6	7.6	7.3	7.7	9.7	9.0	7.7	9.9
41	.077	.050	12.00	19.0	.0	4.6	5.1	3.8	2.0	.7	-1.6	-3.3	-5.8	-7.8
42	.077	.100	12.00	21.0	.0	3.0	2.6	1.0	-1.8	-5.1	-6.6	-11.8	-16.0	-19.9
43	.077	.150	12.00	22.0	.0	1.1	.7	-1.7	-5.1	-10.1	-15.1	-20.2	-25.0	30.4
44	.077	.200	12.00	25.0	.0	.4	-.7	-4.0	-9.1	-14.6	20.6	-26.2	-33.6	-38.4
45	.077	.250	12.00	27.0	.0	.2	-1.7	-5.0	-12.1	-17.7	-24.8	-31.7	-38.8	-45.2
46	.120	.000	12.00	19.3	.0	6.7	12.2	12.4	12.4	12.4	12.4	12.4	12.4	12.4
47	.120	.050	12.00	23.0	.0	5.1	7.6	7.3	5.5	3.2	1.6	-.4	-2.7	-4.8
48	.120	.100	12.00	26.0	.0	3.2	4.6	3.4	.6	-1.3	-5.3	-8.7	-12.5	-15.8
49	.120	.150	12.00	29.0	.0	1.8	2.6	.6	-2.3	-6.3	-11.2	-15.4	-20.8	-26.3
50	.120	.200	12.00	30.0	.0	.7	.3	-2.3	-6.2	-11.3	-17.2	-23.4	-29.6	-36.6
51	.120	.250	12.00	33.0	.0	.7	.1	-3.5	-6.2	-13.6	-19.7	-26.5	-33.0	-40.2
52	.150	.000	12.00	24.0	.0	5.2	10.7	14.0	14.0	14.0	14.0	.0	.0	.0
53	.150	.050	12.00	30.0	.0	3.5	6.0	7.6	6.6	5.2	2.8	.9	-1.5	-4.0
54	.150	.100	12.00	32.0	.0	2.0	3.4	3.1	1.8	-.5	-3.5	-7.4	-10.5	-14.4
55	.150	.150	12.00	34.0	.0	1.0	1.8	.3	-2.4	-6.3	-10.0	-15.0	-20.3	-25.6
56	.150	.200	12.00	34.0	.0	.3	-.7	-2.3	-5.7	-10.2	-15.6	-21.3	-26.6	-34.0
57	.150	.250	12.00	34.0	.0	-.3	-1.8	-5.0	-6.0	-13.6	-19.7	-25.5	-33.0	-39.0
58	.190	.000	11.25	31.0	.0	3.8	8.0	12.5	15.8	15.6	15.5	15.6	15.6	.0
59	.190	.050	11.25	36.0	.0	2.0	3.7	5.0	6.0	5.4	4.3	2.3	.0	-3.0

RN	UL	UG	H0	HM	K0	M1	M2	M3	M4	M5	M6	M7	M8	M9
60	.040	.000	10.00	13.5	.0	11.7	18.2	10.2	10.2	18.2	18.2	10.2	.0	.0
61	.040	.050	18.00	22.0	.0	0.9	11.3	10.7	9.0	7.1	4.2	2.5	.8	-2.5
62	.040	.100	18.00	24.0	.0	7.0	0.0	7.2	3.5	1.0	-2.7	-6.6	-10.1	-14.7
63	.040	.150	18.00	26.0	.0	5.2	5.9	3.9	-1.6	-4.2	-7.7	-14.2	-19.7	-25.4
64	.040	.200	18.00	20.0	.0	4.2	4.4	.0	-3.5	-8.8	-13.0	-20.8	-27.6	-34.8
65	.040	.250	18.00	29.0	.0	3.6	3.1	-1.4	-6.0	-12.2	-18.4	-25.0	-34.0	-40.0
66	.077	.000	18.25	21.0	.0	9.8	20.0	20.7	20.7	20.7	.0	.0	.0	.0
67	.077	.050	18.25	23.0	.0	9.0	13.2	13.6	12.0	10.4	8.0	6.3	4.0	2.1
68	.077	.100	18.25	27.0	.0	6.8	10.1	9.8	7.8	4.4	1.2	-2.2	-5.9	-10.0
69	.077	.150	18.25	20.0	.0	5.2	7.0	6.4	2.7	-1.7	-4.8	-10.3	-16.0	-20.3
70	.077	.200	18.25	29.0	.0	3.2	4.0	2.6	-1.8	-5.7	-11.3	-18.1	-24.3	-30.8
71	.077	.250	18.25	31.0	.0	2.3	2.6	.7	-3.2	-9.3	-16.1	-22.6	-29.3	-36.2
72	.120	.000	18.25	20.0	.0	7.6	14.7	22.3	23.7	23.5	23.5	23.5	.0	.0
73	.120	.050	18.25	30.0	.0	6.7	11.6	15.3	16.1	14.6	12.6	11.2	8.5	6.3
74	.120	.100	18.25	33.0	.0	4.6	8.8	10.8	11.0	9.3	5.6	2.4	-1.2	-4.9
75	.120	.150	18.25	36.0	.0	3.0	6.3	7.1	6.0	4.0	-1.7	-4.3	-10.2	-15.1
76	.120	.200	18.25	36.0	.0	2.3	3.4	4.0	1.0	-1.7	-5.8	-11.5	-17.3	-23.3
77	.150	.000	17.00	37.0	.0	6.0	11.1	17.0	22.4	26.2	26.2	26.2	.0	.0
78	.150	.050	17.00	42.0	.0	4.0	7.4	11.3	13.9	15.7	14.8	13.1	11.2	9.0
79	.120	.100	17.00	44.0	.0	3.0	5.5	7.7	9.4	9.3	8.0	5.5	1.5	-1.6
80	.190	.000	10.00	50.0	.0	4.5	9.0	13.0	17.2	21.3	25.2	28.2	28.5	28.5

RN	UL	UG	H0	HH	HJ	H1	H2	H3	H4	H5	H6	H7	H8	H9
82	.040	.000	18.00	18.5	.0	12.3	17.2	18.5	19.4	19.8	18.6	.0	.0	.0
83	.077	.000	18.00	22.0	.0	9.0	19.1	21.4	21.7	21.7	21.1	21.5	21.5	21.5
84	.077	.050	18.00	25.0	.0	9.0	14.2	14.3	13.0	11.2	7.0	6.8	4.4	2.0
85	.077	.100	18.00	29.0	.0	7.0	11.0	10.3	9.1	8.0	2.0	-1.7	-5.2	-9.3
86	.077	.150	18.50	34.0	.0	4.1	7.2	6.3	4.7	1.2	-3.0	-7.8	-13.0	-18.3
87	.077	.200	18.50	35.0	.0	2.0	5.0	2.9	-1.2	-3.8	-9.2	-15.0	-20.7	-27.5
88	.077	.250	18.50	38.0	.0	.8	2.8	.2	-2.4	-7.5	-13.3	-19.7	-27.0	-34.3
89	.120	.000	18.50	30.0	.0	7.3	14.2	21.2	24.4	24.6	24.6	.0	.0	.0
90	.150	.000	18.50	30.0	.0	3.8	11.6	16.9	22.0	27.2	27.2	27.2	.0	.0
91	.150	.050	18.50	.0	.0	3.0	8.0	10.0	15.0	17.1	16.5	15.0	13.3	11.5
92	.150	.100	18.50	45.0	.0	2.8	6.0	7.4	9.5	10.4	9.1	6.8	3.5	.3
93	.190	.000	18.00	51.5	.0	4.2	9.7	12.5	16.7	21.1	24.8	28.4	29.2	29.5

RN	UL	UG	H0	HM	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
94	.040	.000	18.00	18.0	.0	13.5	10.1	17.0	17.8	17.8	17.8	.0	.0	.0
95	.077	.000	18.00	19.0	.0	12.0	20.2	20.1	20.0	20.2	20.0	.0	.0	.0
96	.240	.000	18.00	43.0	.0	6.0	11.3	16.1	21.7	26.8	30.7	31.7	31.1	31.1
97	.085	.000	18.00	20.0	.0	11.8	21.1	21.0	21.0	21.0	.0	.0	.0	.0
98	.035	.050	18.00	21.0	.0	7.5	16.0	14.5	12.7	11.1	8.7	6.5	4.5	2.4
99	.085	.100	18.00	22.0	.0	8.0	13.3	11.0	8.6	4.9	1.0	-2.1	-6.1	-10.3
100	.085	.130	18.00	25.0	.0	6.6	10.0	7.0	4.0	.0	-5.0	-9.7	-13.1	-19.7
101	.085	.200	18.00	25.0	.0	6.3	8.1	5.4	1.1	-3.0	-9.2	-15.8	-21.3	-20.8
102	.085	.250	18.00	25.0	.0	6.0	5.5	3.2	-.8	-6.5	-13.7	-20.0	-26.3	-36.0
103	.250	.000	18.00	42.5	.0	3.8	10.0	15.4	20.0	25.7	29.4	29.4	29.4	.0
104	.130	.000	18.00	23.0	.0	7.7	10.6	22.5	22.2	22.2	22.2	.0	.0	.0
105	.130	.050	18.00	25.0	.0	8.1	14.6	16.5	15.2	13.3	11.5	9.0	7.0	5.0
106	.130	.100	18.00	26.0	.0	6.8	12.3	13.1	11.2	8.0	4.7	1.4	-2.4	-5.8
107	.130	.150	18.00	28.0	.0	5.7	9.0	9.5	7.0	3.3	-2.2	-6.3	-11.3	-16.2
108	.130	.200	18.00	30.0	.0	3.7	5.0	6.5	2.7	-1.3	-7.5	-12.4	-18.2	-24.2
109	.130	.250	18.00	35.0	.0	2.7	4.1	2.7	.0	-4.5	-10.7	-17.3	-23.6	-30.7
110	.170	.000	18.00	27.0	.0	8.1	15.7	23.6	23.6	23.6	23.6	.0	.0	.0
111	.170	.050	18.00	28.0	.0	6.8	12.2	16.0	17.0	15.5	13.0	11.3	9.2	6.8
112	.210	.000	18.00	34.0	.0	6.6	12.7	10.0	25.3	26.2	26.1	26.2	26.2	.0
113	.210	.050	18.00	35.0	.0	4.8	9.8	14.0	17.8	10.1	16.1	14.3	12.2	10.4
114	.210	.100	18.00	37.0	.0	4.2	7.4	10.2	12.6	12.5	10.2	7.3	3.8	.0
115	.210	.150	18.00	36.0	.0	3.0	5.0	6.8	7.2	7.5	4.0	.0	-4.0	-8.6
116	.210	.200	18.00	40.0	.0	1.3	3.5	3.0	2.6	1.7	-2.2	-7.2	-12.0	-17.2

Run No.	Liq. Vel (Sup.) Ft/Sec	Gas Vel (Sup.) Ft/Sec	Bed Height		MANOMETRIC READINGS, CM. OF WATER									
			Settld In.	Measurd In.										
RN	UL	UG	H0	HM	M0	M1	M2	M3	M4	M5	M6	M7	M8	M9
117	.085	.000	18.00	21.0	.0	12.0	20.7	20.7	20.7	20.7	.0	.0	.0	.0
117	.085	.050	18.00	21.0	.0	7.5	16.0	15.2	13.0	11.3	7.0	6.9	4.8	2.4
117	.085	.100	18.00	22.0	.0	7.9	13.2	11.8	8.7	5.6	2.1	-1.7	-5.4	-9.4
117	.085	.150	18.00	24.0	.0	7.0	10.5	8.5	5.0	.0	-4.3	-9.0	-13.7	-18.7
118	.085	.200	18.00	25.0	.0	7.4	8.7	6.0	2.0	-2.8	-0.8	-15.2	-21.8	-28.0
119	.085	.250	18.00	27.0	.0	5.0	6.7	5.0	-1.4	-6.3	-13.1	-19.3	-26.0	-34.5
120	.130	.000	18.00	24.0	.0	9.3	10.2	23.4	23.3	23.3	23.3	.0	.0	.0
121	.130	.050	18.00	26.0	.0	8.1	13.2	10.0	16.7	15.1	13.1	10.8	9.0	7.4
122	.130	.100	18.00	27.0	.0	6.7	11.4	14.1	12.2	7.9	6.7	3.0	-1.5	-3.8
123	.130	.150	18.00	29.0	.0	5.3	10.1	9.0	8.5	5.0	.0	-4.6	-9.3	-13.7
124	.130	.200	18.00	31.0	.0	5.6	7.2	7.2	4.5	.6	-4.5	-10.3	-16.0	-22.0
125	.130	.250	18.00	32.0	.0	2.8	5.0	4.0	2.1	-2.8	-8.2	-16.2	21.7	-28.7
126	.170	.000	18.00	28.0	.0	7.9	15.2	23.4	25.2	25.3	25.0	25.3	25.3	.0
127	.170	.050	18.00	30.0	.0	6.5	12.2	17.6	18.7	17.5	15.2	13.3	11.6	9.3
128	.170	.100	18.00	33.0	.0	5.6	9.7	13.3	14.0	12.2	8.8	5.6	2.4	-1.7
129	.170	.150	18.00	34.0	.0	5.0	7.0	9.0	9.7	6.6	2.8	-1.6	-6.2	-10.1
130	.170	.200	18.00	36.0	.0	3.3	5.2	6.3	4.9	2.4	-2.6	-7.7	-13.7	-18.8
131	.170	.250	18.00	35.0	.0	2.6	4.2	3.9	3.0	.5	-6.1	-11.8	-18.0	-23.7
132	.210	.000	18.00	34.0	.0	6.3	12.1	10.3	24.7	26.3	26.0	26.0	26.0	.0
133	.210	.050	18.00	36.0	.0	5.2	8.8	13.0	17.2	18.0	16.3	14.4	12.8	10.8
134	.210	.100	18.00	36.0	.0	3.3	6.5	9.3	11.0	12.2	10.0	7.0	4.4	1.2
135	.210	.150	18.00	40.0	.0	2.6	4.0	5.0	7.0	6.4	4.0	.0	-4.0	-8.7
136	.210	.200	18.00	40.0	.0	2.3	2.6	3.0	3.5	2.2	-1.7	-6.8	-12.7	-17.0
137	.210	.250	18.00	42.0	.0	1.0	1.2	1.0	.8	-1.8	-5.7	-11.0	-15.8	-22.3
138	.235	.000	18.00	39.0	.0	5.6	10.6	16.1	21.0	26.5	26.5	26.5	.0	.0
139	.235	.050	18.00	40.0	.0	4.0	7.7	11.2	14.7	17.3	16.8	15.1	13.5	11.9
140	.235	.100	18.00	42.0	.0	2.0	5.1	7.1	9.5	11.2	10.2	8.3	5.7	2.3
141	.235	.150	18.00	45.0	.0	1.2	3.0	3.5	4.8	4.8	3.6	1.0	-2.8	-8.2

RN	UL	LG	H0	HM	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
142	.085	.000	16.50	10.0	-12.5	.0	11.0	16.1	17.7	17.5	17.5	17.5	.0	.0
143	.130	.000	16.50	22.0	-10.6	.0	8.7	10.4	20.9	20.8	20.8	20.8	.0	.0
144	.130	.050	16.50	24.0	-9.5	.0	7.3	14.6	15.7	13.0	11.7	9.9	7.7	6.0
145	.130	.100	16.50	25.0	-8.7	.0	5.8	11.2	11.5	8.7	5.9	2.4	-6.6	-4.7
146	.130	.150	16.50	26.0	-8.6	.0	3.6	0.3	7.6	5.0	1.0	-3.5	-8.5	-13.3
147	.130	.200	16.50	20.0	-7.9	.0	2.2	6.2	5.3	2.6	-3.4	-0.7	-15.2	-20.2
148	.130	.250	16.50	30.0	-7.3	.0	2.2	4.2	2.8	-1.2	-5.3	-12.3	-18.7	-25.7
149	.170	.000	16.50	26.5	-9.3	.0	7.0	15.1	22.5	22.4	22.4	22.4	.0	.0
150	.210	.000	16.50	32.5	-7.8	.0	5.8	12.7	19.0	24.7	24.0	24.7	24.7	.0
151	.210	.050	16.50	36.0	-5.5	.0	4.5	7.0	13.3	16.5	16.8	15.0	13.2	11.7
152	.210	.100	16.50	36.0	-4.6	.0	2.2	6.4	9.5	11.3	11.1	8.7	5.8	3.1
153	.130	.150	16.50	30.0	-3.7	.0	1.5	4.7	5.8	6.2	5.5	2.3	-1.4	-5.3
154	.210	.200	16.50	40.0	-2.7	.0	.5	2.0	2.0	2.1	.3	-3.5	-7.6	-13.6
155	.210	.250	16.50	40.0	-2.0	.0	.3	1.3	.6	.0	-2.6	-6.5	-11.7	-17.0
156	.235	.000	16.50	36.0	-7.0	.0	4.1	11.0	16.1	21.3	24.1	24.1	24.1	.0
157	.085	.000	16.00	10.0	-12.7	.0	7.7	17.0	17.0	16.7	16.7	16.7	.0	.0
158	.130	.000	16.00	21.8	-10.9	.0	9.6	10.8	20.0	19.4	19.6	19.7	19.8	19.8
159	.130	.050	16.00	23.0	-9.5	.0	8.1	13.9	14.7	13.1	11.3	9.4	7.3	5.5
160	.130	.100	16.00	25.0	-8.7	.0	7.1	11.3	11.0	8.5	5.7	2.3	-1.5	-5.0
161	.130	.150	16.00	27.0	-8.0	.0	5.5	8.5	7.7	5.3	1.7	-3.3	-8.0	-13.7
162	.130	.200	16.00	30.0	-7.4	.0	4.3	6.0	4.5	1.5	-3.0	-6.6	-14.9	-21.3
163	.130	.250	16.00	30.0	-7.1	.0	3.3	5.7	2.0	-2.1	-5.9	-12.8	-19.1	-26.2
164	.170	.000	16.00	26.0	-9.5	.0	7.8	14.7	21.8	21.5	21.5	21.5	21.5	.0
165	.210	.000	16.00	33.0	-8.1	.0	6.5	12.1	10.2	23.8	23.8	23.8	.0	.0
166	.210	.050	16.00	34.0	-5.6	.0	5.0	8.0	13.5	16.1	15.8	14.1	12.5	10.6
167	.210	.100	16.00	36.0	-3.9	.0	3.8	6.7	8.8	11.0	10.5	8.0	4.9	2.2
168	.210	.150	16.00	37.0	-3.2	.0	2.5	4.0	5.0	6.0	4.7	2.2	-2.0	-6.5
169	.210	.200	16.00	37.0	-2.1	.0	1.3	1.8	2.3	2.1	.7	-3.7	-8.9	-14.0
170	.210	.250	16.00	39.0	-1.5	.0	.7	.5	.0	-.9	-3.4	-8.3	-13.7	-19.7
171	.235	.000	16.00	36.0	-7.0	.0	4.0	11.0	16.3	21.5	24.5	24.5	24.5	.0

RN	UL	UG	HO	HM	H1	H0	H2	H3	H4	H5	H6	H7	H8	H9
172	.270	.000	18.00	40.0	-16.8	.0	13.8	26.7	40.0	52.5	65.0	76.5	82.2	83.0
173	.077	.050	18.00	22.0	-21.5	.0	21.7	30.0	37.5	27.0	21.0	12.7	3.8	-4.5
174	.077	.200	18.00	24.0	-12.4	.0	16.3	20.5	25.1	10.6	4.9	-22.2	-40.6	-59.0
175	.077	.100	18.00	22.0	-23.7	.0	17.1	35.2	32.2	21.2	10.7	.0	-12.5	-25.0
176	.077	.150	18.00	23.0	-18.0	.0	17.5	31.3	20.3	15.4	2.0	-12.5	-27.5	-44.0
177	.077	.250	18.00	24.0	-13.5	.0	13.7	25.5	21.4	5.1	-21.3	-31.0	-51.0	-72.2
178	.077	.000	18.00	20.0	-34.8	.0	20.7	55.0	55.4	55.4	55.7	55.7	56.7	56.3
179	.120	.000	18.00	24.5	-29.2	.0	23.7	47.3	63.0	62.7	63.2	63.3	63.3	.0
180	.120	.050	18.00	26.0	-10.4	.0	10.5	34.0	48.4	42.5	36.4	28.0	20.2	12.4
181	.120	.100	18.00	27.0	-17.3	.0	16.7	30.6	42.4	36.5	27.5	17.0	6.5	-3.5
182	.120	.150	18.00	27.0	-15.8	.0	14.2	26.6	36.2	29.2	17.5	4.9	-8.5	-22.5
183	.120	.150	18.00	20.0	-14.0	.0	13.3	24.4	30.2	23.3	10.2	-4.7	-21.2	-30.2
184	.120	.200	18.00	.0	-13.0	.0	11.4	21.1	25.6	10.4	4.0	-12.7	-31.0	-50.0
185	.170	.000	18.50	29.3	-19.8	.0	16.8	35.7	55.9	63.7	64.3	64.4	64.4	64.4
186	.170	.050	18.50	31.0	-16.4	.0	14.5	26.5	39.5	47.5	41.8	34.5	26.4	18.7
187	.170	.100	18.50	32.0	-15.3	.0	13.0	24.3	36.7	42.0	34.7	25.0	44.4	4.3
188	.170	.150	18.50	33.0	-13.0	.0	11.3	21.3	31.2	34.6	26.9	14.5	1.8	-11.4
189	.170	.200	18.50	33.0	-11.0	.0	9.5	18.2	25.3	27.7	19.7	5.2	-9.8	-26.2
190	.170	.250	18.50	33.0	-9.0	.0	9.0	15.4	21.0	22.4	13.8	-6	-19.0	-36.4
191	.220	.000	18.00	36.0	-20.5	.0	15.4	31.7	48.6	64.2	72.3	72.6	72.4	72.4
192	.220	.050	18.00	39.0	-11.8	.0	13.0	22.0	30.8	38.9	46.8	41.3	33.0	24.4
193	.220	.100	18.00	30.0	-10.5	.0	9.8	17.0	26.0	33.2	30.8	31.8	21.6	10.9
194	.220	.150	18.00	38.0	-7.5	.0	8.5	15.3	21.2	27.1	30.9	23.4	11.3	-1.3
195	.220	.200	18.00	40.0	-3.9	.0	7.4	12.1	16.8	19.2	22.0	14.9	1.8	-13.2
196	.270	.000	18.00	46.0	-18.0	.0	10.3	22.1	35.5	48.0	61.0	74.0	77.1	77.6
197	.270	.050	18.00	53.0	-1.9	.0	13.8	18.4	23.4	27.2	31.7	34.7	37.0	32.3
198	.120	.000	18.00	24.0	-26.5	.0	24.0	47.6	60.8	60.5	61.7	61.0	60.7	60.7
199	.120	.050	18.00	26.0	-16.4	.0	19.5	34.7	46.9	41.0	33.5	25.4	17.5	9.4
200	.120	.100	18.00	26.0	-16.7	.0	15.5	29.3	39.3	32.3	22.5	11.9	1.3	-9.3
201	.120	.150	18.00	27.0	-14.5	.0	14.1	26.3	34.1	25.3	12.8	.3	-13.8	-29.2
202	.120	.200	18.00	27.0	-12.3	.0	13.0	23.0	27.8	18.5	5.2	-11.3	-28.4	-47.0
203	.120	.250	18.00	27.0	-10.3	.0	11.4	21.0	24.8	15.1	.0	-17.3	-37.4	-57.8
204	.250	.000	18.00	39.5	-17.0	.0	12.5	25.6	40.5	55.3	71.0	72.2	72.0	72.0
205	.250	.050	18.00	43.5	-8.9	.0	9.3	16.2	22.3	27.7	34.7	39.0	31.0	22.8
206	.250	.100	18.00	43.0	-7.5	.0	7.0	11.5	16.2	21.6	26.5	27.3	19.4	8.0
207	.250	.150	18.00	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
208	.220	.000	18.00	34.0	-18.4	.0	16.2	32.3	49.3	65.8	69.5	69.5	69.5	.0
209	.220	.050	18.00	38.0	-10.6	.0	10.0	19.8	27.8	36.2	42.3	35.0	26.3	18.0
210	.220	.100	18.00	38.5	-8.2	.0	8.8	16.0	23.2	29.7	34.0	26.5	15.6	5.4
211	.220	.150	18.00	38.0	-6	.0	13.3	17.0	24.3	28.2	30.0	19.8	7.0	-5.3
212	.220	.200	18.00	38.0	-3	.0	10.5	15.0	19.0	26.5	20.4	9.8	-4.0	-20.3

RN	UL	UG	HO	HM	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
213	.215	.000	18.50	54.0	-11.7	.0	11.0	21.6	32.3	42.6	52.5	61.2	69.3	73.5
214	.180	.000	18.50	40.5	-15.7	.0	12.5	25.3	39.0	40.9	44.0	40.0	48.0	68.0
215	.135	.000	18.50	32.5	-10.0	.0	14.3	33.0	49.0	61.1	63.5	63.7	63.5	63.5
216	.095	.000	18.50	25.0	-22.8	.0	21.3	42.0	57.3	50.2	57.4	57.3	57.0	57.0
217	.050	.000	18.50	19.5	-28.0	.0	26.7	47.0	47.6	47.6	47.3	46.7	46.7	46.7
218	.050	.050	18.50	20.0	-19.3	.0	23.0	30.9	35.8	29.8	23.3	16.4	9.0	2.3
217	.050	.100	18.50	22.0	-17.9	.0	17.7	33.0	28.7	20.2	11.5	.3	-10.4	-22.3
220	.050	.150	18.50	23.0	-15.7	.0	14.1	27.8	23.4	17.6	.8	-13.2	-27.4	-44.0
221	.050	.200	18.50	23.0	-6.0	.0	24.4	30.5	25.2	11.1	-3.0	-21.3	-40.3	-59.5
222	.050	.250	18.50	24.0	-7.2	.0	20.5	26.2	20.0	5.0	-12.2	-33.0	-52.5	-74.0
223	.095	.050	18.50	26.0	-10.8	.0	16.0	32.4	42.0	38.7	33.3	27.0	20.0	13.0
224	.095	.100	18.50	26.0	-17.0	.0	14.4	27.4	35.2	30.0	21.2	11.7	1.4	-8.7
225	.095	.150	18.50	27.0	-10.6	.0	15.9	26.5	31.0	25.2	14.4	.0	-12.3	-27.0
226	.095	.200	18.50	27.0	-10.2	.0	17.6	21.3	24.0	17.0	6.0	-10.0	-27.4	-45.5
227	.095	.250	18.50	20.0	-7.7	.0	13.0	19.3	21.4	13.3	.0	-17.0	-36.5	-55.3
228	.135	.050	18.50	33.0	-12.8	.0	12.4	25.2	37.6	45.3	41.3	36.0	27.2	22.3
229	.135	.100	18.50	34.0	-11.2	.0	11.0	21.0	29.4	34.7	30.6	21.6	11.0	1.8
230	.135	.150	18.00	36.0	-6.6	.0	11.1	20.4	25.7	28.5	23.5	12.9	1.0	-12.1
231	.135	.200	18.00	36.0	-6.2	.0	9.4	15.8	19.5	20.3	14.6	1.8	-12.0	-29.0
232	.135	.250	18.00	36.0	-1.8	.0	11.2	16.2	17.5	16.0	9.0	-4.5	-22.2	-40.7
233	.180	.050	18.00	41.0	-9.5	.0	8.3	16.4	24.8	33.5	41.7	41.3	36.0	29.5
234	.180	.100	18.00	42.0	-6.0	.0	7.7	14.2	20.5	25.7	29.6	26.5	18.5	9.2
235	.180	.150	18.00	44.0	-1.5	.0	8.7	12.8	17.0	19.5	20.0	15.0	4.2	-6.2
236	.180	.200	18.00	45.0	-2.0	.0	5.7	7.4	11.5	10.9	10.7	3.6	-8.7	-22.4
237	.200	.000	18.00	42.0	-17.7	.0	8.2	21.5	34.0	45.6	59.0	64.0	64.0	.0
238	.200	.050	18.00	43.0	-7.0	.0	7.8	15.5	22.4	29.1	36.8	40.0	34.9	28.6
239	.200	.100	18.00	45.0	-4.5	.0	6.7	12.4	17.0	20.4	24.9	24.3	10.0	9.2
240	.200	.150	18.00	47.0	-3.0	.0	4.3	8.5	11.0	11.9	13.4	9.7	1.4	-9.7
241	.050	.000	17.50	19.5	-31.0	.0	25.6	45.4	45.3	45.2	45.2	.0	.0	.0
242	.095	.000	17.50	24.5	-23.6	.0	20.4	41.0	54.3	53.7	53.4	53.0	52.6	52.0
243	.095	.050	17.50	26.0	-17.8	.0	17.0	32.9	42.0	38.5	32.5	26.3	19.2	11.9
244	.095	.100	17.50	26.0	-16.5	.0	14.2	27.2	33.5	28.8	20.2	10.1	-2.2	-11.5
245	.095	.150	17.50	27.0	-14.7	.0	12.5	22.7	26.0	20.0	9.6	-3.8	-17.2	-33.0
246	.095	.200	17.50	27.0	-13.3	.0	10.3	17.1	19.2	12.0	-9	-16.5	-33.6	-52.7
247	.095	.250	17.50	20.0	-11.8	.0	9.0	15.7	15.5	4.9	-6.5	-24.4	-44.4	-63.6
248	.135	.000	17.50	30.5	-19.8	.0	16.2	33.0	49.6	59.0	58.0	50.0	57.8	56.6
249	.180	.000	17.50	40.0	-15.8	.0	13.5	26.4	39.6	52.0	63.0	64.0	63.4	62.8
250	.180	.050	17.50	42.0	-6.0	.0	10.7	10.5	26.7	34.5	41.0	30.7	32.6	25.6
251	.180	.100	17.50	42.0	-6.3	.0	8.2	14.3	20.2	25.4	27.0	23.9	15.2	5.2
252	.180	.150	17.50	43.0	-4.7	.0	6.5	12.0	15.8	17.5	17.9	11.6	1.5	-10.2
253	.180	.200	17.50	43.0	-3.0	.0	3.0	8.0	11.1	10.2	8.7	.0	-11.3	-27.0

RH	UL	UG	H0	HM	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
254	.180	.000	18.00	54.0	-33.0	.0	-6	13.6	26.1	39.0	52.3	64.0	74.5	80.0
255	.032	.000	10.00	20.0	-35.2	.0	26.1	55.5	55.5	55.5	55.5	.0	.0	.0
256	.072	.000	18.00	24.0	-41.2	.0	15.7	40.2	61.3	61.2	62.1	62.1	62.1	.0
256	.110	.000	10.00	32.0	-31.0	.0	22.0	39.4	57.7	75.0	75.0	75.0	.0	.0
257	.142	.000	18.00	39.5	-22.8	.0	10.8	34.8	52.0	66.7	80.7	81.2	81.2	81.2
258	.032	.050	18.00	20.0	-24.5	.0	32.0	52.3	40.3	42.0	32.4	28.0	20.5	13.0
259	.032	.100	18.00	20.0	-22.0	.0	20.4	45.5	39.6	29.5	16.3	5.0	-5.8	-18.8
260	.032	.150	18.00	20.5	-19.6	.0	24.7	38.8	31.7	17.5	1.3	-14.1	-31.0	-48.2
261	.032	.200	18.00	23.0	-17.2	.0	21.3	32.7	24.0	6.9	-10.2	-31.0	-51.6	-73.6
262	.032	.250	16.00	23.0	-12.6	.0	20.8	31.3	22.4	3.6	-16.6	-38.8	-61.6	-85.9
263	.072	.050	18.00	25.0	-29.7	.0	17.2	38.4	48.1	43.3	38.6	26.0	20.6	12.8
264	.072	.100	18.00	26.0	-20.2	.0	19.8	37.3	46.0	39.1	28.4	16.7	7.8	-8.6
265	.072	.150	18.00	27.0	-17.8	.0	17.3	32.3	30.4	29.4	14.0	-3	-17.2	-34.4
266	.072	.200	18.00	28.0	-10.5	.0	17.0	28.6	34.4	20.5	13.8	-2.2	-20.3	-40.0
267	.072	.250	18.00	30.0	-12.1	.0	13.5	22.7	25.3	18.4	2.5	-15.4	-36.6	-58.7
268	.110	.050	18.00	34.0	-25.5	.0	8.0	23.4	30.1	45.3	45.9	39.4	32.0	25.2
268	.110	.100	18.00	34.0	-18.8	.0	10.7	23.4	35.5	42.2	37.9	28.4	17.6	5.9
269	.110	.150	18.00	35.0	-11.6	.0	13.3	23.0	33.7	36.7	27.1	15.9	1.3	-14.1
270	.110	.200	10.00	35.0	-6.7	.0	13.0	21.0	27.7	28.3	18.5	3.7	-14.1	-33.5
280	.110	.250	19.00	35.0	-7.7	.0	11.7	19.2	22.8	21.0	9.7	-7.1	-26.8	-49.0
281	.142	.050	18.00	30.0	-12.5	.0	10.4	22.0	34.2	45.0	52.4	47.3	40.3	32.6
282	.142	.100	18.00	39.0	-9.3	.0	12.7	22.4	32.1	40.5	42.7	36.0	24.5	12.5
283	.142	.150	18.00	40.0	-9.3	.0	7.3	15.3	22.4	27.0	28.3	20.0	7.0	-7.9
284	.142	.200	18.00	40.0	-5.7	.0	10.0	16.0	20.0	23.3	20.7	10.6	-5.8	-23.7
285	.142	.250	18.00	41.0	-1.4	.0	9.1	13.4	16.4	17.0	12.4	.8	-16.7	-37.0
286	.180	.050	18.00	47.0	-15.0	.0	4.4	13.0	20.9	20.8	36.0	41.9	40.3	33.3
287	.150	.000	17.50	45.5	-31.3	.0	5.0	10.5	32.4	47.2	62.5	74.5	75.3	75.9
288	.160	.050	17.50	45.0	-9.8	.0	11.3	20.4	30.5	40.1	48.8	53.0	48.6	42.0
289	.160	.100	17.50	45.0	-7.0	.0	11.2	18.9	26.0	34.5	40.3	39.5	31.9	21.3
290	.160	.150	17.50	45.0	-4.1	.0	9.6	15.3	21.3	26.2	20.8	25.3	14.5	1.4
291	.032	.000	17.00	17.0	-32.2	.0	31.6	52.6	52.5	52.5	52.5	.0	.0	.0
292	.072	.000	17.00	24.0	-33.1	.0	25.2	49.6	63.4	63.3	63.3	63.3	.0	.0
293	.072	.050	17.00	25.0	-19.8	.0	26.0	45.0	54.7	49.4	42.7	35.0	27.3	18.8
294	.072	.100	17.00	27.0	20.5	.0	19.6	35.2	43.3	37.0	26.5	14.9	2.6	-10.2
295	.072	.150	17.00	26.0	-19.4	.0	16.7	29.4	34.3	26.0	12.6	-2.7	-18.2	-36.2
296	.072	.200	17.00	26.0	-17.3	.0	15.4	25.4	27.6	17.0	.9	-17.2	-36.2	-57.0
297	.072	.250	17.00	27.0	-17.5	.0	12.4	20.7	21.5	9.9	-8.0	-27.5	-50.0	-72.0
298	.110	.000	17.00	28.5	-28.5	.0	19.8	41.0	62.0	67.5	67.5	67.5	67.0	66.5
299	.142	.000	17.50	35.0	-24.3	.0	16.6	33.0	50.1	66.5	73.0	73.0	72.5	72.0
300	.142	.050	17.50	36.0	-12.8	.0	14.0	26.0	30.5	50.0	55.0	46.8	39.0	30.7
301	.142	.100	17.50	34.0	-10.0	.0	12.5	22.0	33.0	41.0	41.5	32.6	21.3	9.3
302	.142	.150	17.50	37.0	-5.8	.0	13.3	21.7	20.7	33.8	31.7	20.7	6.3	-9.3
303	.142	.200	17.50	39.0	-9.3	.0	5.6	10.9	15.0	17.5	.0	6.6	-8.0	-24.4
304	.142	.250	17.50	39.0	-4.2	.0	7.0	11.0	13.9	15.0	.0	-8	-17.3	-36.0
305	.180	.000	17.50	45.0	-25.2	.0	7.6	20.0	33.0	45.1	42.1	72.2	74.2	74.5
306	.180	.050	17.50	47.0	-8.8	.0	11.8	19.0	27.7	35.4	43.0	47.2	45.5	39.2

RN	UL	UG	HO	HH	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
307	.112	.000	18.00	54.0	-10.5	.0	10.5	21.0	35.2	46.4	57.0	69.4	77.0	78.0
308	.020	.000	18.00	20.0	-33.8	.0	29.6	55.0	53.2	56.2	56.2	56.2	56.2	.0
309	.045	.000	18.00	26.0	-14.5	.0	21.7	44.0	62.4	64.7	64.6	64.0	64.0	67.0
310	.068	.000	18.00	32.5	-24.5	.0	18.6	37.7	54.2	70.8	70.8	70.8	71.0	71.0
311	.090	.000	18.00	39.0	-21.4	.0	17.1	34.0	48.9	62.9	74.8	75.0	74.5	74.5
312	.020	.050	18.00	23.0	-30.0	.0	22.5	37.5	34.0	30.2	22.6	15.2	7.6	.0
313	.020	.100	18.00	24.0	-20.5	.0	22.2	36.4	31.0	23.0	11.8	.0	-12.5	-26.3
314	.020	.150	18.00	25.0	-16.5	.0	10.0	27.0	23.4	13.0	-1.7	-17.0	-35.0	-53.2
315	.020	.200	18.00	25.0	-11.8	.0	16.0	23.3	17.3	5.0	-12.4	-31.4	-52.5	-74.5
316	.020	.250	18.00	26.0	-10.2	.0	14.0	10.3	10.4	-2.3	-12.5	-43.4	-67.0	-91.2
317	.045	.050	18.00	20.0	-24.4	.0	10.3	33.6	45.4	43.5	37.0	29.6	22.7	14.0
318	.045	.100	18.00	29.0	-19.3	.0	16.3	30.0	35.0	33.0	23.4	12.3	.6	-12.9
319	.045	.150	18.00	31.0	-17.0	.0	13.8	23.9	26.0	21.2	9.4	-5.0	-22.2	-39.8
320	.045	.200	18.00	50.0	-19.7	.0	10.7	10.2	17.2	10.0	-4.0	-21.0	-41.0	-62.0
321	.045	.250	18.00	30.0	-14.7	.0	9.3	15.5	12.6	3.5	-12.0	-31.5	-53.6	-76.3
322	.068	.050	18.00	34.0	-31.5	.0	2.8	15.3	29.6	36.1	33.0	26.3	19.0	12.0
323	.068	.100	18.00	36.0	-15.3	.0	13.2	22.7	32.7	35.7	29.8	19.7	8.0	-4.3
324	.068	.150	18.00	36.0	-7.5	.0	14.3	23.3	27.3	26.7	18.7	6.0	-7.0	-25.0
325	.068	.200	18.00	30.0	.0	.0	17.4	21.5	24.9	24.0	16.0	4.7	-10.8	-20.7
326	.090	.050	18.00	40.0	-18.2	.0	7.5	16.0	20.0	38.4	42.0	39.5	34.0	27.8
327	.090	.100	18.00	40.0	-8.8	.0	12.5	21.0	20.3	33.5	33.0	27.0	16.7	5.7
328	.090	.150	18.00	42.0	-4.5	.0	11.7	19.7	21.7	22.5	17.0	8.6	-4.5	-19.4
329	.090	.200	18.00	42.0	-1.7	.0	11.3	17.0	16.0	12.6	5.4	-7.2	-24.2	-43.0
330	.090	.250	18.00	43.0	-2.7	.0	8.0	12.0	8.4	3.0	-8.4	-23.2	-43.5	-64.0
331	.112	.050	18.00	48.0	-12.5	.0	6.0	14.0	22.5	30.0	36.0	37.5	34.2	20.3
332	.112	.100	18.00	48.0	-6.3	.0	8.3	15.0	17.5	23.9	25.2	22.0	14.2	4.5
333	.112	.150	18.00	48.0	-2.7	.0	7.1	11.4	12.0	13.5	10.3	3.9	-7.5	-21.5

RN	UL	UG	H0	HM	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
334	.006	.000	20.50	30.7	-34.0	.0	14.8	35.2	51.0	58.4	57.0	57.0	58.9	59.0
335	.006	.050	20.50	40.5	-9.2	.0	17.5	27.5	34.7	33.4	39.7	30.3	32.2	26.5
336	.006	.100	20.50	40.0	-12.5	.0	9.1	15.2	19.3	12.6	16.9	10.0	1.2	-10.0
337	.006	.150	20.50	48.0	-11.7	.0	4.7	7.8	9.7	5.8	-1.4	-11.4	-25.0	-41.8
338	.006	.200	20.50	.0	-4.2	.0	7.3	8.2	7.3	1.6	-7.5	-20.4	-36.7	-35.9
339	.008	.000	20.50	39.0	-32.5	.0	10.1	26.8	42.5	53.0	57.5	59.0	59.3	59.0
340	.008	.050	20.50	60.0	-13.1	.0	11.5	20.7	27.6	31.0	31.4	28.7	24.4	10.0
341	.008	.100	20.50	63.0	-9.6	.0	10.3	16.2	19.3	19.7	16.3	10.0	1.5	-8.7
342	.008	.150	20.50	.0	-9.2	.0	6.3	.0	9.4	6.9	.0	-8.5	-21.0	-35.4
343	.008	.200	20.50	.0	-11.0	.0	2.2	2.7	1.3	-4.3	-11.4	-25.5	-40.6	-58.4
344	.006	.050	20.50	.0	.0	.0	6.0	16.1	23.5	28.7	29.6	27.4	23.8	17.3
345	.006	.100	20.50	.0	-11.4	.0	0.5	15.3	17.4	20.5	17.7	11.7	3.0	-6.9
346	.006	.150	20.50	.0	-9.5	.0	6.0	9.5	10.9	9.5	2.0	-6.5	-19.8	-34.3
347	.006	.200	20.50	.0	-8.5	.0	4.0	5.5	3.7	1.0	-11.3	-23.7	-39.6	-57.2
348	.006	.000	20.50	30.0	-38.8	.0	12.8	32.4	50.9	55.5	55.5	55.5	.0	.0
349	.008	.050	20.50	.0	-13.5	.0	12.0	22.0	29.3	33.5	34.0	32.0	27.2	20.7
350	.008	.100	20.50	.0	-10.0	.0	9.8	16.0	20.9	21.6	18.8	12.7	4.0	-5.7
351	.008	.000	20.50	39.0	-37.7	.0	4.9	23.6	39.5	51.0	56.5	56.5	56.5	.0
352	.008	.150	20.50	.0	-12.0	.0	4.3	8.5	10.6	9.1	3.0	-5.4	-17.2	-30.6
353	.008	.200	20.50	.0	-5.1	.0	4.8	8.0	6.2	.8	-6.0	-19.5	-34.8	-51.8
354	.011	.000	20.50	48.0	-21.8	.0	15.8	31.8	46.5	56.3	61.3	68.5	69.5	69.0
355	.011	.050	20.50	.0	-16.3	.0	6.7	16.0	22.5	27.0	27.5	25.5	24.3	19.6
356	.011	.100	20.50	.0	-11.4	.0	6.7	12.9	16.7	17.6	15.3	9.7	2.4	-5.4
357	.011	.150	20.50	.0	-11.4	.0	2.5	6.5	9.5	7.3	1.3	-6.0	-17.8	-29.7
358	.011	.200	20.50	.0	-10.5	.0	.8	.3	.6	-5.3	-13.0	-24.3	-30.3	-54.1
359	.013	.000	20.50	54.0	-25.4	.0	0.0	23.7	36.5	47.3	53.2	58.9	63.5	66.4
360	.013	.050	20.50	.0	-9.0	.0	11.8	20.4	26.6	30.8	32.5	31.0	20.0	23.1
361	.013	.100	20.50	.0	-8.3	.0	6.8	12.4	15.7	15.3	12.9	7.5	-.7	-10.3

RH	UL	UO	HO	HH	M1	HO	M2	M3	M4	M5	M6	M7	M8	M9
362	.017	.000	19.00	21.0	-42.5	.0	30.0	54.7	57.0	57.0	57.0	50.0	50.0	50.0
363	.136	.000	19.00	57.0	-18.8	.0	16.2	31.3	44.3	53.3	66.7	73.1	82.0	85.8
364	.047	.000	19.00	30.8	-33.6	.0	24.5	49.7	60.0	73.0	72.7	72.6	72.6	72.5
365	.077	.000	19.00	30.5	-28.0	.0	21.7	43.0	63.0	77.1	80.0	81.0	80.5	80.7
366	.106	.000	19.00	43.5	-22.5	.0	19.6	37.0	54.4	69.2	70.8	82.8	84.7	85.7
367	.017	.050	19.00	19.0	-20.5	.0	36.0	55.2	50.9	44.0	37.0	28.5	17.0	9.6
368	.017	.100	19.00	24.0	-23.6	.0	23.2	30.7	33.6	24.0	12.7	1.6	-12.8	-27.0
369	.017	.150	19.00	24.0	-17.4	.0	23.3	34.1	29.0	15.3	.0	-17.0	-36.3	-55.3
370	.017	.200	19.00	24.0	-13.3	.0	21.0	29.6	23.7	9.0	-10.5	-32.0	-54.0	-76.8
371	.017	.250	19.00	25.0	-15.3	.0	19.1	25.5	10.0	2.0	-19.7	-42.5	-67.5	-92.7
372	.047	.050	19.00	27.0	-35.5	.0	12.0	34.2	45.0	42.2	36.6	30.0	22.0	13.5
373	.047	.100	18.00	30.0	-32.0	.0	10.0	27.5	34.5	31.3	22.5	11.7	.0	-11.3
374	.047	.150	18.00	30.0	-19.3	.0	10.7	31.0	35.4	30.1	16.6	2.8	-13.5	-30.5
375	.047	.200	18.00	30.0	-17.4	.0	15.7	25.4	27.2	18.0	2.8	-13.1	-34.6	-55.2
376	.047	.250	18.00	32.0	-9.8	.0	19.3	26.8	26.1	15.3	-1.3	-21.3	-44.8	-68.7
377	.077	.050	18.00	33.0	-27.6	.0	11.5	30.8	45.3	49.4	46.0	39.9	33.5	24.5
378	.077	.100	18.00	33.0	.0	.0	19.5	35.6	46.3	40.0	40.6	29.8	17.8	5.7
379	.077	.150	18.00	33.0	-11.5	.0	18.3	30.9	37.0	35.5	25.2	10.8	-3.0	-19.2
380	.077	.200	18.00	33.0	-7.2	.0	19.3	9.5	32.8	20.5	15.0	.5	-19.4	-39.7
381	.077	.250	18.00	33.0	-7.4	.0	17.0	24.3	26.3	19.7	5.2	-10.5	-33.0	-55.5
382	.106	.050	18.00	38.0	-20.8	.0	11.1	27.3	39.8	50.1	51.0	46.8	40.2	33.8
383	.106	.100	18.00	38.0	-11.7	.0	13.3	28.3	38.4	46.0	42.4	32.8	23.1	11.8
384	.106	.150	18.00	38.0	-6.5	.0	15.6	26.3	30.3	37.1	30.9	19.3	6.0	-7.8
385	.106	.200	18.00	40.0	-11.5	.0	8.3	15.9	20.2	20.7	14.9	3.7	-12.0	-29.0
386	.106	.250	18.00	42.0	-6.3	.0	9.8	15.8	18.0	16.2	7.9	-4.4	-23.3	-43.0
387	.136	.050	18.00	42.0	-16.6	.0	10.3	23.6	34.0	44.4	51.7	50.4	45.8	40.2
388	.136	.100	18.00	42.0	-10.7	.0	13.3	24.4	33.7	41.5	42.8	36.0	26.7	16.1
389	.136	.150	18.00	42.0	-8.6	.0	11.1	20.5	26.7	31.0	29.3	20.0	8.2	-4.2
390	.136	.200	18.00	42.0	-6.3	.0	8.6	15.8	19.4	21.3	17.1	7.5	-6.3	-22.6
391	.136	.250	18.00	42.0	-2.4	.0	7.0	14.5	16.8	17.0	10.1	-1.0	-18.0	-37.1
392	.017	.050	16.25	18.0	-33.0	.0	28.3	40.0	35.5	29.4	21.7	15.0	6.3	-1.8
393	.017	.100	16.25	20.0	-26.2	.0	24.7	35.9	29.5	18.5	5.8	-4.4	-17.1	-33.0
394	.017	.150	16.25	21.0	-20.8	.0	22.7	31.5	24.0	9.2	-6.7	-24.3	-43.0	-61.8
395	.032	.050	16.25	22.0	-33.0	.0	22.6	43.1	42.6	37.8	30.8	23.0	14.2	5.6
396	.032	.100	16.25	22.0	-27.0	.0	21.0	38.5	37.0	28.1	16.5	4.8	-6.7	-20.3
397	.032	.150	16.25	24.0	-25.5	.0	10.4	30.6	27.1	14.8	-1.8	-16.3	-35.4	-54.0
398	.047	.050	16.25	26.0	-28.5	.0	21.0	42.3	48.7	44.1	37.5	30.0	21.3	13.3
399	.047	.100	16.25	26.0	-24.2	.0	20.0	37.2	40.1	33.1	20.7	9.3	-1.9	-15.3
400	.047	.150	16.25	26.0	-23.5	.0	16.2	29.6	30.0	19.5	5.2	-6.1	-25.3	-44.2
401	.062	.050	16.25	26.5	-26.9	.0	10.7	37.2	47.8	46.9	40.5	32.8	22.7	16.8
402	.062	.100	16.25	28.0	-22.5	.0	18.0	35.0	42.0	30.5	29.3	17.4	8.8	-4.2
403	.062	.150	16.25	20.0	-18.5	.0	16.5	30.7	33.7	27.0	13.2	1.8	-13.8	-32.5
404	.077	.050	16.25	29.0	-24.5	.0	17.4	36.0	49.8	47.8	44.8	35.6	27.5	21.0
405	.077	.100	16.25	29.0	-21.7	.0	16.7	37.4	40.9	30.3	29.2	17.3	7.6	-5.3
406	.077	.150	16.25	29.5	-17.3	.0	15.0	27.0	33.0	28.0	15.4	3.2	-12.4	-30.5

RN	UL	UG	HO	HH	M1	HO	M2	H3	M4	M5	M6	M7	M8	M9
407	.022	.000	18.00	20.0	-38.3	.0	34.4	56.4	56.3	56.4	55.7	55.3	54.4	54.5
408	.053	.000	18.00	26.0	-31.8	.0	28.0	54.5	51.0	69.7	60.5	60.7	67.6	66.5
409	.084	.000	18.00	31.0	-20.4	.0	24.2	47.5	59.3	76.3	75.3	74.6	73.7	73.2
410	.116	.000	18.00	40.0	-23.3	.0	20.3	40.2	50.6	73.7	82.7	82.5	81.0	81.0
411	.147	.000	18.00	54.0	-18.0	.0	10.0	35.0	49.2	63.7	74.4	83.4	86.0	87.0
412	.022	.050	18.00	19.0	-26.8	.0	32.0	40.5	42.0	35.0	26.3	16.6	0.0	-1.3
413	.022	.100	18.00	22.0	-24.3	.0	20.2	41.4	32.0	21.0	7.4	-4.8	-19.7	-34.1
414	.022	.150	18.00	23.0	-23.8	.0	22.9	32.0	22.5	6.4	-10.5	-29.0	-49.0	-68.9
415	.022	.200	17.50	24.0	-19.8	.0	20.8	26.1	14.5	-3.7	-25.3	-47.8	-71.8	-96.5
416	.022	.250	17.50	25.0	-25.3	.0	15.4	21.5	11.5	-6.7	-29.2	-53.7	.0	.0
417	.053	.050	17.50	27.0	-28.0	.0	21.5	43.5	50.8	46.0	41.0	32.7	24.8	16.9
418	.053	.100	17.50	27.0	-26.1	.0	20.6	30.5	41.4	33.6	22.3	10.6	-1.9	-15.0
419	.053	.150	17.50	27.0	-25.5	.0	16.1	30.8	31.0	20.4	5.2	-9.5	-27.8	-45.2
420	.053	.200	17.50	27.0	-25.0	.0	13.4	24.8	24.1	9.9	-6.5	-26.7	-47.3	-68.4
421	.053	.025	17.50	22.0	-31.5	.0	21.3	46.6	51.6	49.0	39.5	34.9	34.7	29.4
422	.084	.025	17.50	23.0	-25.3	.0	19.5	41.7	59.3	59.0	54.6	50.3	45.1	40.4
423	.084	.050	17.50	26.0	-21.8	.0	20.3	41.3	55.3	52.0	45.6	38.4	29.9	21.8
424	.084	.100	17.50	27.0	-20.0	.0	18.6	35.7	45.0	39.5	26.7	17.5	5.3	-6.0
425	.084	.150	17.00	28.0	-20.0	.0	14.3	27.8	33.0	27.7	14.3	1.4	-14.5	-30.8
426	.084	.200	17.00	28.0	-17.6	.0	12.5	22.4	25.7	18.7	2.9	-12.6	-33.0	-53.3
427	.116	.025	17.00	32.0	-20.7	.0	15.4	32.5	50.0	60.8	57.5	54.0	49.3	44.5
428	.116	.050	17.00	31.0	-16.7	.0	14.3	32.3	48.0	56.9	50.4	45.0	30.0	30.2
429	.116	.100	17.00	31.0	-15.7	.0	14.3	27.7	39.7	44.0	33.5	26.4	14.5	3.4
430	.116	.150	17.00	32.0	-14.8	.0	11.5	22.2	30.7	33.5	23.8	11.2	-2.2	-17.8
431	.116	.200	17.00	34.0	-12.0	.0	10.1	19.4	23.7	23.9	13.7	-1.2	-17.5	-36.7
432	.147	.025	17.00	30.0	-16.0	.0	11.8	25.3	30.6	53.8	63.3	61.0	56.6	51.0
433	.147	.050	17.00	30.0	-12.5	.0	12.3	24.0	36.8	49.0	56.5	51.7	46.5	37.5
434	.147	.100	17.00	30.0	-10.8	.0	11.1	21.0	30.8	39.8	42.5	34.7	27.5	10.2
435	.147	.150	17.00	39.0	-14.0	.0	5.3	13.6	24.0	30.9	33.0	20.7	20.5	10.0
436	.147	.200	17.00	42.0	.0	.0	6.1	11.7	16.3	17.8	18.1	10.0	-2.3	-17.4

RN	UL	UO	HO	HM	H1	H0	H2	H3	H4	H5	H6	H7	H8	H9
437	.064	.000	17.00	19.0	-33.4	.0	31.5	46.2	45.5	45.6	45.3	45.0	45.2	45.3
438	.113	.000	17.00	24.0	-27.7	.0	24.3	47.8	53.7	54.8	53.8	53.7	53.4	53.4
439	.161	.000	17.00	30.0	-23.0	.0	17.7	37.5	56.5	62.0	61.1	61.0	61.0	60.7
440	.210	.000	17.00	39.0	-18.7	.0	18.0	33.9	49.0	63.3	67.4	68.3	67.5	67.4
441	.259	.000	17.00	51.0	-14.5	.0	16.1	20.3	39.5	52.3	63.4	71.7	73.5	73.0
442	.064	.025	17.00	19.5	-26.8	.0	26.9	41.1	37.7	33.7	29.5	24.6	20.2	15.0
443	.064	.050	17.00	19.5	-25.7	.0	26.2	39.5	34.0	28.4	21.6	14.0	7.4	-3.3
444	.064	.100	17.00	20.0	-25.0	.0	23.7	35.0	27.9	19.0	8.4	-1.7	-13.7	-26.1
445	.064	.150	17.00	20.0	-24.2	.0	21.5	31.0	21.1	8.9	5.0	-20.0	-36.0	-52.0
446	.064	.200	17.00	20.0	-22.7	.0	19.8	26.3	15.7	.5	-16.9	-35.5	-54.2	-74.3
447	.113	.025	17.00	23.0	-23.0	.0	22.0	44.0	49.0	45.7	41.7	37.0	32.5	27.4
448	.113	.050	17.00	24.0	-22.4	.0	21.7	42.3	45.6	40.2	34.1	27.8	20.5	13.4
449	.113	.100	17.00	24.0	-21.5	.0	19.7	37.5	38.4	30.4	21.3	10.8	-.7	-11.4
450	.113	.150	17.00	25.0	-19.5	.0	17.8	33.1	32.4	22.2	9.4	-4.7	-19.3	-34.6
451	.113	.200	17.00	25.0	-18.2	.0	16.6	28.6	26.4	14.3	-1.4	-18.3	-35.5	-53.8
452	.161	.025	17.00	28.0	-18.8	.0	17.9	35.4	31.4	52.3	47.8	43.5	39.0	34.5
453	.161	.050	17.00	28.0	-17.8	.0	17.0	34.6	49.3	47.7	41.8	35.7	28.7	21.9
454	.161	.100	17.00	28.0	-16.2	.0	15.5	30.9	43.0	41.5	32.9	22.9	13.4	3.7
455	.161	.150	17.00	28.0	-14.1	.0	13.7	26.7	36.4	33.4	22.1	9.6	-3.7	-17.7
456	.161	.200	17.00	29.0	-12.5	.0	12.3	23.1	30.0	26.3	13.0	-2.7	-18.7	-36.2
457	.210	.025	17.00	35.0	-15.3	.0	14.3	20.1	40.4	52.5	353.0	48.7	45.5	41.0
458	.210	.050	17.00	35.0	-13.8	.0	13.7	26.3	38.0	48.8	47.3	40.5	34.4	27.9
459	.210	.100	17.00	35.0	-12.3	.0	12.3	23.0	33.4	41.7	37.7	27.7	18.3	8.5
460	.210	.150	17.00	35.0	-10.7	.0	1.0	19.0	27.5	33.1	28.1	16.3	3.9	-9.2
461	.210	.200	17.00	35.0	-8.0	.0	8.9	16.3	22.0	26.3	19.3	5.7	-9.1	-25.3
462	.259	.000	17.00	47.0	-14.4	.0	15.0	20.3	39.4	52.0	63.0	71.4	72.7	72.7
463	.259	.025	17.00	47.0	-11.4	.0	12.2	21.0	30.4	38.6	46.7	52.3	49.8	45.4
464	.259	.050	17.00	47.0	-10.2	.0	10.0	19.3	26.5	34.0	40.4	43.8	40.3	33.6
465	.259	.100	17.00	47.0	-8.4	.0	8.6	15.5	21.5	27.0	32.3	31.5	24.7	14.8
465	.259	.150	17.00	46.0	-6.8	.0	7.0	11.5	15.8	19.5	22.7	19.4	10.3	-1.3
466	.210	.000	17.00	39.0	-17.8	.0	18.4	34.9	49.7	63.0	70.0	71.5	71.0	71.0
467	.161	.000	17.00	29.0	-22.0	.0	22.0	42.3	59.4	64.0	63.7	63.6	63.2	63.3
468	.113	.000	17.00	23.5	-26.9	.0	26.7	50.5	56.6	56.6	56.5	56.4	55.7	55.5
469	.064	.000	17.00	18.5	-32.8	.0	33.1	47.3	47.2	47.6	46.9	46.5	46.3	46.0

RN	UL	UG	H0	HH	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
470	.039	.000	18.00	54.0	-17.8	.0	13.5	22.0	39.8	50.3	50.0	64.5	67.8	68.4
471	.005	.000	18.00	20.3	-28.8	.0	28.4	43.8	50.0	49.0	50.2	49.8	40.9	42.0
472	.005	.025	18.00	34.0	-24.8	.0	22.3	47.4	45.4	44.5	41.5	37.5	33.0	28.0
473	.005	.050	18.00	36.0	-21.6	.0	19.9	37.7	30.7	36.5	31.1	24.8	16.4	9.3
474	.005	.100	18.00	36.0	-17.8	.0	16.1	17.9	26.7	22.7	15.5	3.2	-7.1	-21.4
475	.005	.150	18.00	36.0	-11.3	.0	16.4	27.4	21.3	14.3	4.4	2.7	-25.8	-49.2
476	.005	.200	18.00	36.0	-10.9	.0	11.8	17.5	11.4	2.3	-10.2	-25.8	-40.3	-72.7
477	.014	.012	18.00	26.0	-23.4	.0	22.5	42.3	53.2	53.0	52.3	52.2	50.5	49.5
478	.014	.025	18.00	33.0	-22.7	.0	20.8	42.4	46.7	46.4	44.3	41.5	37.9	34.4
479	.014	.050	18.00	33.0	-26.5	.0	11.1	21.4	30.7	27.7	24.8	18.1	12.3	3.4
480	.014	.100	18.00	33.0	-11.4	.0	20.3	27.4	33.7	30.3	22.0	11.6	4.8	-12.3
481	.014	.150	17.50	34.0	-15.4	.0	11.9	15.8	16.6	11.0	2.7	-10.4	-15.3	-42.4
482	.014	.000	17.50	23.0	-33.8	.0	6.0	37.2	41.3	41.3	41.0	40.3	40.3	40.2
483	.022	.000	17.50	27.0	-22.5	.0	19.8	41.8	52.2	52.0	52.0	50.0	51.0	51.0
484	.022	.012	17.50	27.0	-20.4	.0	19.9	39.8	48.5	40.4	47.0	45.1	42.5	40.3
485	.022	.025	17.50	32.0	-19.5	.0	17.3	35.0	44.4	44.5	41.0	39.7	35.0	31.8
486	.022	.050	17.50	35.0	-18.7	.0	17.5	31.3	38.2	37.9	34.0	29.3	22.8	16.0
487	.022	.100	17.50	35.0	-15.5	.0	13.0	22.3	24.0	21.8	13.7	5.3	-6.4	-19.4
488	.022	.150	17.50	35.0	-12.7	.0	10.8	15.1	19.9	11.1	.8	-11.4	-12.8	-44.0
489	.031	.000	17.50	33.3	-20.0	.0	17.3	31.8	44.3	56.8	56.4	56.0	56.0	55.5
490	.031	.012	17.50	40.0	-17.7	.0	17.4	33.0	46.3	49.0	48.8	47.0	44.3	41.7
491	.031	.025	17.50	40.0	-17.4	.0	19.9	29.8	40.3	43.0	77.4	38.0	34.5	30.2
492	.031	.050	17.50	40.0	-16.0	.0	14.9	23.8	34.4	35.6	32.0	26.8	20.2	12.5
493	.031	.100	17.50	40.0	-13.7	.0	12.0	20.3	24.0	22.5	13.9	7.8	-3.7	-14.7
494	.031	.150	17.50	40.0	-11.0	.0	10.8	16.3	18.3	15.4	6.7	-4.4	-9.0	-31.5
495	.039	.000	17.50	40.0	-17.5	.0	15.6	20.7	30.0	40.5	59.0	60.0	60.0	60.0
496	.039	.012	17.50	42.0	-16.2	.0	15.3	22.1	41.9	48.6	48.7	47.3	45.1	42.8
497	.039	.025	17.50	42.0	-15.4	.0	14.8	27.3	37.8	42.2	41.5	39.6	35.7	31.4
498	.039	.050	17.50	42.0	-14.0	.0	13.3	22.8	31.5	34.3	31.3	26.9	20.0	12.8
499	.039	.100	17.50	.0	-11.7	.0	10.5	19.1	21.4	20.5	15.1	7.3	-3.4	-15.5
500	.039	.000	16.50	42.0	-18.2	.0	15.0	20.3	41.8	49.0	58.0	58.8	58.5	58.2
501	.031	.000	16.50	35.0	-20.0	.0	16.8	32.0	45.3	54.0	56.5	55.3	55.3	55.2
502	.022	.000	16.50	20.5	-22.8	.0	19.3	37.4	40.8	52.0	51.8	51.4	51.0	50.7
503	.014	.000	16.50	24.0	-25.3	.0	23.3	43.0	40.5	40.2	47.8	47.4	46.7	46.4
504	.000	.000	16.50	17.3	-30.4	.0	27.7	42.2	40.5	40.4	41.4	39.5	37.0	39.0
505	.045	.000	16.50	54.0	-15.2	.0	13.3	26.4	36.5	44.2	49.5	56.5	60.8	61.7

RN	UL	UG	HO	HM	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
506	.360	.300	18.00	34.0	-16.9	.0	14.4	20.5	38.0	47.0	52.0	55.0	57.4	60.4
507	.005	.300	18.00	21.0	-24.7	.0	25.5	44.0	42.5	44.3	44.0	44.7	44.0	43.7
508	.005	.012	18.00	20.0	-23.6	.0	21.0	30.0	41.3	40.0	39.5	37.5	35.6	33.3
509	.005	.025	18.00	32.0	-21.3	.0	19.7	34.4	30.7	37.2	34.4	31.1	27.6	23.0
510	.005	.050	18.00	32.0	-20.5	.0	16.7	28.8	32.9	30.4	25.0	20.3	13.0	7.0
511	.005	.100	18.00	34.0	-18.3	.0	13.5	21.4	22.8	18.5	10.9	3.3	-7.3	-18.8
512	.005	.150	18.00	34.0	-16.0	.0	9.7	15.5	14.0	8.0	-1.3	-1.3	-24.5	-41.9
513	.009	.000	18.00	22.0	-24.5	.0	24.0	43.1	43.3	43.0	42.8	42.7	42.8	42.2
514	.009	.012	18.00	30.0	-22.8	.0	19.0	36.7	39.8	30.7	37.5	34.8	32.7	31.0
515	.009	.025	18.00	30.0	-21.5	.0	10.5	32.2	35.0	33.4	31.1	29.7	25.2	20.1
516	.009	.050	18.00	32.0	-19.3	.0	15.8	26.5	29.3	26.4	21.7	19.7	11.4	3.4
517	.009	.100	18.00	33.0	-17.7	.0	12.0	17.8	19.8	14.8	7.6	2.3	-8.2	-22.2
518	.009	.150	18.00	33.0	-15.7	.0	9.3	14.0	12.1	5.4	-4.6	-12.8	-26.0	-44.0
519	.012	.000	18.00	21.0	-24.3	.0	23.4	30.5	39.0	38.6	38.6	39.5	38.6	37.8
520	.012	.012	18.00	29.0	-21.4	.0	20.3	36.8	39.1	30.2	37.0	36.3	33.0	31.0
521	.012	.025	18.00	30.0	-20.5	.0	10.8	33.5	37.6	36.0	33.6	31.7	26.0	23.8
522	.012	.050	18.00	32.0	-20.0	.0	16.4	20.5	32.0	30.8	26.8	22.4	15.6	10.5
523	.012	.100	18.00	53.0	-17.8	.0	11.7	10.2	10.5	13.8	5.3	2.4	13.4	23.8
524	.012	.150	18.00	33.0	-16.0	.0	8.4	13.2	11.3	4.2	-5.8	-16.6	-30.4	-44.6
525	.015	.000	17.00	22.0	-22.8	.0	21.5	30.1	30.4	38.0	38.1	37.4	37.6	37.6
526	.015	.012	17.00	28.0	-20.8	.0	19.0	34.4	37.5	36.7	35.5	34.0	31.9	29.8
527	.015	.025	17.00	30.0	-19.8	.0	17.2	30.0	33.2	32.1	29.4	26.8	22.5	19.0
528	.015	.050	17.00	30.0	-19.0	.0	14.5	24.3	27.0	24.4	19.5	14.3	7.3	.4
529	.015	.100	17.00	33.0	-17.8	.0	11.0	17.8	17.8	12.8	4.7	-2.6	-13.9	-24.4
530	.015	.150	17.00	33.0	-13.8	.0	7.5	14.2	13.2	7.0	-2.6	-13.0	-26.4	-40.5
531	.018	.000	17.00	24.8	-23.3	.0	21.1	36.1	41.5	41.1	41.1	41.0	40.5	40.5
532	.018	.012	17.00	30.0	-19.8	.0	19.1	34.8	39.8	39.1	30.0	36.4	34.2	32.2
533	.018	.025	17.00	33.0	-19.5	.0	16.6	30.3	35.3	34.2	32.3	29.1	25.7	22.3
534	.018	.050	17.00	33.0	-17.8	.0	14.8	25.4	29.5	27.8	23.7	10.5	12.1	6.0
535	.018	.100	17.00	34.0	-16.8	.0	11.7	10.5	19.4	15.0	7.9	.0	-9.8	-20.0
536	.018	.150	17.00	34.0	-15.2	.0	9.1	14.3	13.2	7.4	-1.4	-12.0	-23.8	-36.8
537	.018	.000	17.00	25.5	-22.3	.0	19.8	34.9	43.0	42.6	42.5	42.0	41.7	41.6
538	.015	.000	17.00	23.0	-24.6	.0	20.4	36.0	39.4	39.2	30.9	30.6	30.1	38.0
539	.012	.000	17.00	21.5	-25.4	.0	20.7	37.0	37.7	37.2	37.1	37.0	36.4	36.5
540	.009	.000	17.00	20.0	-25.8	.0	22.3	35.5	35.6	35.3	35.0	35.1	34.5	34.5
541	.005	.000	17.00	10.5	-26.2	.0	24.7	35.5	35.5	35.4	35.1	35.0	35.0	35.0

RN	UL	UG	H0	HM	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
542	.033	.000	19.00	40.0	-21.3	.0	19.7	36.3	50.3	57.4	60.3	60.0	60.1	60.1
543	.006	.000	19.00	21.0	-25.2	.0	28.2	40.0	40.3	40.0	48.0	48.7	47.6	40.0
544	.006	.012	17.00	23.0	-25.7	.0	25.0	30.0	39.0	37.7	36.1	34.3	31.5	29.5
545	.006	.025	19.00	24.0	-20.3	.0	23.3	30.4	39.6	37.6	35.1	32.0	27.5	23.5
546	.006	.050	19.00	20.0	-21.4	.0	20.0	34.0	36.6	33.8	29.2	23.7	16.8	7.7
547	.006	.100	19.00	31.0	-20.8	.0	14.8	24.9	25.9	21.6	14.8	5.7	-4.8	-17.3
548	.006	.150	19.00	33.0	-18.6	.0	12.0	19.5	10.5	12.5	3.9	-5.2	-12.4	24.5
549	.013	.000	17.00	22.0	-26.4	.0	25.0	45.4	47.3	46.9	46.8	46.4	46.0	46.4
550	.013	.012	19.00	26.0	-24.6	.0	22.3	42.2	45.8	44.5	44.0	41.7	39.5	30.3
551	.013	.025	19.00	30.0	-23.5	.0	21.3	30.8	42.8	41.5	39.4	36.4	33.0	29.5
552	.013	.050	19.00	30.0	-22.7	.0	19.5	35.5	39.0	37.0	33.3	29.0	23.5	18.3
553	.013	.100	19.00	30.0	-20.6	.0	15.8	27.4	30.0	26.1	19.5	12.8	2.9	-5.4
553	.013	.150	17.00	30.0	-15.1	.0	10.8	10.0	16.7	0.7	-3.0	-17.1	-32.6	-49.7
554	.020	.000	19.00	26.0	-25.7	.0	21.1	39.4	49.1	48.9	49.1	47.6	48.0	40.4
555	.020	.012	17.00	30.0	-22.3	.0	21.0	40.0	45.3	44.9	43.4	42.2	39.5	37.5
556	.020	.025	19.00	30.0	-21.5	.0	19.7	36.0	42.3	41.0	30.5	36.0	31.7	20.0
557	.020	.050	19.00	30.0	-20.2	.0	17.4	31.4	36.1	33.7	29.4	24.5	17.4	10.6
558	.020	.100	19.00	32.0	-17.8	.0	14.4	24.0	26.0	21.5	13.5	4.8	-6.4	-17.0
558	.020	.150	17.00	32.0	-13.8	.0	10.8	17.4	16.5	8.7	-2.8	-16.8	-32.2	-49.0
559	.026	.000	17.00	28.5	-22.8	.0	19.5	37.0	48.5	47.2	49.5	49.0	43.6	48.6
560	.026	.012	17.00	33.0	-19.9	.0	19.0	36.0	42.0	41.3	39.1	37.0	34.5	32.0
561	.026	.025	17.00	33.0	-17.3	.0	10.0	33.4	38.6	37.3	34.5	30.6	26.8	22.3
562	.026	.050	17.00	34.0	-17.7	.0	15.9	26.5	32.9	30.7	25.6	18.9	11.8	4.5
563	.026	.100	17.00	34.0	-15.4	.0	12.7	22.1	23.7	18.3	10.5	-5	-11.4	-23.3
563	.026	.150	17.00	34.0	-12.8	.0	10.5	16.8	16.0	8.7	-2.7	-16.5	-31.2	-48.0
564	.033	.000	17.00	32.0	-21.0	.0	17.4	33.0	45.4	49.5	49.5	49.0	48.5	48.3
565	.033	.012	17.00	34.0	-18.3	.0	17.8	33.8	41.0	40.5	30.4	36.0	33.1	30.0
566	.033	.025	17.00	34.0	-18.2	.0	17.1	32.0	37.5	36.8	34.0	30.2	26.2	21.5
567	.033	.050	17.00	34.0	-16.3	.0	15.4	20.0	32.5	30.7	26.4	20.5	13.0	6.0
568	.033	.100	17.00	34.0	-14.0	.0	12.0	21.9	23.5	19.4	11.0	1.4	-9.3	-21.5
569	.033	.150	17.00	34.0	-12.1	.0	10.8	16.8	17.1	10.5	.0	-12.7	-27.0	-41.7
570	.033	.000	17.00	31.5	-19.1	.0	10.0	37.5	45.5	53.5	53.8	53.0	53.6	53.5
571	.026	.000	17.00	27.3	-22.3	.0	10.8	36.3	47.5	47.7	47.6	47.8	47.8	47.0
572	.020	.000	17.00	24.5	-24.5	.0	20.8	30.0	44.1	44.1	44.0	44.0	43.8	43.4
573	.013	.000	17.00	20.5	-26.6	.0	23.8	40.3	40.6	40.7	40.3	40.2	40.0	39.7
574	.006	.000	17.00	17.8	-28.3	.0	27.1	35.8	35.8	35.8	35.5	35.3	35.0	34.7

RN	UL	UG	H0	HM	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
575	.005	.012	16.50	24.0	-22.8	.0	21.5	33.7	34.0	33.4	31.0	29.7	25.7	22.6
576	.005	.025	16.50	27.0	-22.5	.0	19.6	32.0	33.2	31.4	27.8	24.3	19.8	15.4
577	.005	.050	16.50	27.0	-20.8	.0	17.0	27.0	28.3	24.7	18.8	12.3	5.8	-1.8
578	.005	.100	16.50	28.0	-17.3	.0	13.2	19.0	19.4	13.0	4.0	-6.2	-17.5	-29.3
579	.005	.150	16.50	20.0	-15.0	.0	10.4	14.5	11.6	2.9	-9.3	-22.0	-36.5	-52.0
580	.014	.000	16.50	22.5	-23.6	.0	22.4	41.0	43.0	42.8	42.0	42.1	41.6	41.1
581	.014	.012	16.50	26.0	-21.4	.0	21.0	36.7	37.4	35.6	33.1	30.5	27.8	24.5
582	.014	.025	16.50	28.0	-20.2	.0	19.1	32.8	35.0	32.8	29.3	25.3	20.9	16.3
583	.014	.050	16.50	25.0	-18.0	.0	16.2	26.0	29.0	26.6	20.8	14.3	7.5	.0
584	.014	.100	16.00	30.0	-15.0	.0	12.0	20.4	20.5	15.1	6.5	-3.3	-14.0	-25.8
585	.014	.150	16.00	30.0	-12.4	.0	10.2	14.0	12.7	5.4	-6.2	-19.0	-33.7	-50.0
586	.022	.150	16.00	33.0	-11.2	.0	9.9	14.0	13.4	6.8	-4.0	-16.5	-31.0	-46.2
587	.039	.000	16.50	40.0	-17.8	.0	13.5	27.1	40.5	40.9	54.7	54.9	54.2	54.2

RN	UL	UG	HC	HM	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
588	.191	.000	18.00	40.0	-17.2	.0	16.1	32.0	42.0	56.0	62.3	63.7	63.4	63.4
589	.070	.000	18.00	22.0	-27.3	.0	26.1	46.0	47.3	47.1	47.0	46.7	46.2	46.2
590	.070	.012	18.00	21.5	-23.8	.0	22.1	43.4	42.7	40.3	37.4	34.0	31.8	28.9
591	.070	.025	18.00	22.0	-22.1	.0	21.0	41.0	39.6	36.2	32.1	27.7	23.0	18.4
592	.070	.050	18.00	22.0	-22.0	.0	19.0	37.4	33.0	30.0	23.8	17.0	10.0	2.8
593	.070	.100	18.00	22.0	-19.5	.0	19.0	32.8	31.0	22.5	11.0	.3	-10.0	-21.6
594	.070	.150	18.00	22.0	-18.9	.0	17.0	27.0	24.4	13.3	.6	-12.0	-27.4	-42.4
595	.010	.000	18.00	25.5	-24.6	.0	23.0	43.7	51.7	51.4	51.4	51.1	50.6	50.6
596	.010	.012	18.00	25.0	-20.8	.0	19.9	39.2	42.9	46.1	43.3	40.8	38.0	34.6
597	.010	.025	18.00	25.0	-19.9	.0	18.6	37.0	44.0	41.8	37.7	33.7	29.5	24.9
598	.010	.050	18.00	25.0	-18.5	.0	17.3	34.2	41.0	36.2	30.4	23.5	17.0	10.3
599	.010	.100	18.00	25.0	-17.8	.0	16.2	31.4	39.0	28.3	18.8	10.0	-.3	-10.2
600	.010	.150	18.00	25.0	-16.5	.0	14.9	26.2	27.0	18.6	6.8	-6.2	-19.3	-34.0
601	.132	.000	18.00	29.0	-22.7	.0	20.6	39.6	52.7	54.3	54.3	52.5	53.5	53.4
602	.132	.012	18.00	20.0	-18.3	.0	17.5	34.0	40.8	47.6	44.9	42.5	39.0	35.2
603	.132	.025	18.00	20.0	-17.4	.0	16.2	31.8	45.7	44.5	40.4	36.8	32.2	27.4
604	.132	.050	18.00	20.0	-16.1	.0	15.3	30.3	42.2	39.7	34.2	20.0	21.1	14.0
605	.132	.100	18.00	20.0	-15.2	.0	14.3	26.0	35.0	31.0	23.0	13.2	3.0	-7.5
606	.130	.150	18.00	29.0	-13.6	.0	12.5	23.7	29.9	24.3	12.9	.1	-12.4	-26.2
607	.159	.000	18.00	34.5	-19.7	.0	10.7	36.1	51.3	50.0	50.4	56.4	57.5	57.5
607	.160	.000	18.00	34.5	-19.7	.0	10.7	36.1	51.3	50.0	50.4	56.4	57.5	57.5
608	.160	.000	18.00	31.0	-16.4	.0	15.0	30.0	44.5	50.3	40.2	45.8	43.0	40.1
608	.159	.012	18.00	31.0	-16.4	.0	15.3	30.4	44.5	50.3	40.2	45.8	43.0	40.1
609	.159	.011	18.00	32.0	-15.4	.0	14.0	27.0	40.1	47.0	44.4	40.7	36.5	32.5
610	.159	.050	18.00	32.0	-13.8	.0	13.6	25.4	37.3	42.5	38.2	32.5	26.2	19.7
611	.159	.100	18.00	32.0	-12.5	.0	11.8	23.0	32.0	34.6	28.0	19.5	9.1	-.3
612	.159	.150	18.00	32.0	-11.1	.0	10.9	20.5	26.0	26.9	19.0	8.1	-4.8	-18.0
613	.191	.000	18.00	40.0	-17.8	.0	16.2	32.2	46.0	56.5	60.8	61.5	61.4	61.4
614	.191	.012	18.00	36.0	-14.4	.0	13.8	27.2	40.1	49.1	50.6	40.3	45.9	43.6
615	.191	.021	18.00	36.0	-13.3	.0	12.3	23.4	34.1	43.6	44.2	40.6	36.8	33.0
616	.191	.050	18.00	37.0	-11.8	.0	11.3	21.4	31.0	39.0	30.7	33.5	27.3	21.8
617	.191	.100	18.00	37.0	-10.6	.0	10.0	17.6	27.6	32.7	30.0	22.3	13.0	3.2
618	.191	.150	18.00	37.0	-9.3	.0	9.0	16.4	22.0	25.7	21.4	12.0	.0	-12.4
619	.159	.000	18.00	34.5	-20.3	.0	10.5	36.0	51.0	57.6	50.0	57.3	57.0	57.0
620	.132	.000	18.00	20.3	-22.5	.0	20.7	40.0	54.0	54.0	54.1	54.0	53.6	53.2
621	.010	.000	18.00	24.3	-25.0	.0	22.7	43.3	50.4	50.3	49.9	49.6	49.1	40.5
622	.070	.000	18.00	21.5	-28.2	.0	25.0	45.4	45.5	45.3	45.3	45.3	45.0	44.5

RN	UL	UG	H0	HH	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
623	.029	.000	17.00	40.0	-20.0	.0	15.0	28.1	39.0	46.0	51.7	52.0	51.7	51.5
624	.029	.012	17.00	42.0	-17.3	.0	13.8	30.0	40.0	43.0	42.8	41.5	39.1	36.7
625	.029	.025	17.00	42.0	-16.8	.0	15.1	27.6	35.5	37.5	36.1	33.0	29.5	25.4
626	.029	.050	17.00	42.0	-15.2	.0	13.3	23.7	29.0	27.2	25.4	19.7	13.2	6.0
627	.029	.100	17.00	42.0	-12.4	.0	10.4	18.0	20.2	17.3	9.9	.1	-9.8	-21.7
628	.029	.150	17.00	42.0	-10.2	.0	8.4	13.4	13.3	7.5	-2.4	-14.2	-28.8	-42.5
629	.018	.000	17.00	26.5	-22.7	.0	19.0	35.0	45.0	44.9	45.0	44.5	44.0	43.5
630	.018	.012	17.00	27.0	-20.3	.0	18.8	34.9	37.5	36.9	34.7	32.3	29.1	26.0
631	.018	.025	17.00	28.0	-19.8	.0	18.0	31.5	35.0	33.5	30.3	26.2	22.1	17.5
632	.018	.050	17.00	30.0	-17.5	.0	14.8	26.2	29.4	26.8	21.4	15.2	8.1	.7
633	.018	.100	17.00	31.0	-14.4	.0	11.9	17.3	20.2	14.8	6.2	-3.8	-13.8	-27.8
634	.018	.150	17.00	31.0	-12.2	.0	9.6	14.0	13.0	4.8	-5.7	-19.7	-34.5	-50.1
635	.022	.000	17.00	29.0	-21.7	.0	17.0	33.0	44.2	46.1	46.0	45.9	45.0	44.9
636	.022	.012	17.00	29.0	-19.0	.0	17.7	32.6	30.4	37.4	35.3	33.0	30.0	26.6
637	.022	.025	17.00	29.0	-18.3	.0	16.8	30.8	35.0	34.1	31.0	27.5	23.0	18.7
638	.022	.050	17.00	30.0	-16.8	.0	14.4	25.5	30.2	28.5	24.0	18.9	12.9	6.8
639	.022	.100	16.50	32.0	-13.4	.0	11.1	18.3	19.5	15.3	7.0	-2.4	-13.5	-26.0
640	.022	.150	16.50	32.0	-11.3	.0	8.7	12.4	11.0	5.0	-5.8	-18.8	-33.0	-50.5
641	.025	.000	16.50	32.0	-20.0	.0	16.1	31.2	42.2	47.7	47.9	46.8	47.5	47.2
642	.025	.012	16.50	33.0	-18.0	.0	16.3	31.6	38.9	38.3	36.7	34.3	31.7	29.0
643	.025	.025	16.50	33.0	-17.0	.0	15.4	27.7	34.0	33.5	30.6	26.1	22.0	17.3
644	.025	.050	16.50	34.0	-15.3	.0	13.3	23.3	27.8	26.0	21.0	14.8	7.6	.0
645	.025	.100	16.50	34.0	-12.5	.0	10.6	18.2	19.7	14.7	6.5	-3.8	-14.3	-26.5
646	.025	.150	16.50	35.0	-10.3	.0	8.0	13.3	12.0	5.3	-5.5	-19.2	-33.6	-50.0

RN	UL	UG	HO	HM	M1	HO	M2	M3	M4	M5	M6	M7	M8	M9
647	.230	.000	18.00	40.0	-23.3	.0	21.9	43.3	44.1	81.0	94.1	94.0	94.0	93.8
648	.091	.000	18.00	22.0	-38.4	.0	36.6	69.1	49.5	69.5	69.9	69.5	69.3	60.8
649	.091	.012	18.00	22.5	-32.9	.0	32.0	61.7	42.3	58.5	55.1	51.3	47.2	43.7
650	.091	.025	18.00	22.5	-31.8	.0	30.9	59.1	59.3	54.0	49.1	44.0	30.3	33.2
651	.091	.050	18.00	22.5	-30.5	.0	29.4	56.1	54.7	48.7	41.5	34.3	26.4	18.8
652	.091	.100	18.00	22.0	-29.3	.0	28.2	51.5	49.4	39.8	29.5	18.7	7.4	-4.5
653	.091	.150	18.00	22.0	-20.0	.0	26.2	47.1	43.2	31.5	17.3	3.6	-11.3	-26.3
654	.127	.000	18.00	24.5	-33.5	.0	32.7	61.5	73.0	72.5	72.4	71.5	71.1	71.0
655	.127	.012	18.00	25.0	-29.9	.0	28.0	55.2	46.8	63.1	60.0	56.6	52.8	49.3
656	.127	.025	18.00	25.0	-20.7	.0	24.0	51.8	45.1	60.0	56.4	51.9	46.8	42.0
657	.127	.050	18.00	25.0	-27.4	.0	26.2	51.0	42.3	56.6	50.7	44.0	37.2	29.9
658	.127	.100	18.00	25.0	-26.5	.0	25.0	48.0	56.4	42.1	37.4	29.7	18.8	8.0
659	.127	.150	18.00	25.0	-25.0	.0	22.9	44.5	50.4	40.6	27.7	14.4	.5	-13.5
660	.163	.000	18.00	28.0	-30.1	.0	27.0	53.1	70.6	76.6	76.5	76.0	76.0	76.0
661	.163	.012	18.00	28.0	-26.1	.0	24.1	47.2	40.6	67.6	64.0	61.0	57.8	54.4
662	.163	.025	18.00	28.0	-25.2	.0	23.4	44.9	45.7	63.3	50.4	53.7	48.5	43.7
663	.163	.050	18.00	28.0	-23.8	.0	22.5	45.0	42.8	59.7	53.4	46.8	39.5	32.5
664	.163	.100	18.00	27.0	-23.0	.0	22.4	43.2	57.8	51.7	42.3	33.0	21.8	11.0
665	.163	.150	18.00	27.0	-22.3	.0	21.0	40.8	52.0	45.0	32.5	19.7	6.3	-7.7
666	.195	.000	18.00	31.0	-27.7	.0	24.6	47.2	47.0	78.0	77.9	77.4	77.0	77.0
667	.195	.012	18.00	31.0	-23.6	.0	21.8	42.0	41.0	69.8	66.8	63.4	60.0	56.5
668	.195	.025	18.00	31.0	-22.6	.0	20.4	39.4	56.4	63.1	60.4	55.1	49.6	44.7
669	.195	.050	18.00	31.0	-21.4	.0	20.0	38.8	56.1	61.7	55.5	48.9	42.1	35.4
670	.195	.100	18.00	30.0	-19.8	.0	19.1	37.4	53.2	55.2	46.2	37.0	26.8	16.0
671	.195	.150	18.00	30.0	-18.6	.0	18.2	35.0	49.9	40.3	37.2	24.6	12.0	-1.5
672	.230	.000	18.00	37.0	-22.6	.0	21.6	42.2	52.0	79.0	84.4	84.3	84.2	84.0
673	.230	.012	18.00	36.0	-20.5	.0	18.7	36.7	52.3	66.7	70.0	67.0	63.8	61.0
674	.230	.025	18.00	36.5	-19.0	.0	17.9	34.0	48.5	61.5	64.8	60.2	54.8	49.8
675	.230	.050	18.00	36.0	-17.7	.0	17.3	32.0	47.7	60.7	59.5	52.2	45.0	38.1
676	.230	.100	18.00	34.0	-16.7	.0	16.7	32.1	45.8	56.7	50.9	42.0	32.2	22.0
677	.230	.150	18.00	35.0	-15.6	.0	15.8	29.0	42.4	49.0	42.0	31.2	17.8	4.5

RN	UL	U0	H0	HM	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
478	.064	.000	8.50	9.5	-27.3	.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
479	.064	.012	8.50	9.5	-22.9	.0	1.3	-.9	-3.2	-6.2	-8.7	-11.0	-14.6	-16.4
480	.064	.025	8.50	9.5	-22.3	.0	-.5	-3.9	-0.1	-12.7	-17.0	-22.2	-27.3	-31.2
481	.064	.050	8.50	9.0	-21.3	.0	-1.0	-6.7	-13.6	-20.7	-27.5	-35.5	-43.4	-50.6
482	.064	.100	8.50	8.5	-18.5	.0	-2.4	-10.5	-20.8	-32.0	-43.2	-54.7	-66.8	-79.7
483	.118	.000	8.50	12.5	-22.7	.0	0.7	0.9	8.0	8.0	8.0	7.5	7.4	7.1
484	.118	.012	8.50	12.0	-19.5	.0	0.2	6.3	3.5	.8	-1.9	-4.7	-7.2	-10.4
485	.118	.025	8.50	12.0	-18.3	.0	7.4	4.7	.3	-3.9	-8.6	-13.1	-13.0	-23.1
486	.118	.050	8.50	11.5	-17.4	.0	6.0	2.0	-4.3	-10.6	-17.3	-24.5	-32.0	-39.8
487	.118	.100	8.50	11.5	-15.3	.0	4.2	-2.3	-11.1	-21.4	-31.5	-42.5	-54.0	-65.8
488	.168	.000	8.50	15.5	-17.8	.0	15.2	15.9	15.0	15.0	15.0	14.8	14.5	14.0
489	.168	.012	8.50	15.0	-15.5	.0	13.5	12.7	10.3	7.3	4.5	2.0	-.7	-4.0
490	.168	.025	8.50	15.0	-14.7	.0	11.9	10.8	6.8	2.5	-1.9	-6.2	-10.8	-15.7
491	.168	.050	8.50	15.0	-13.5	.0	10.3	8.5	2.8	-3.8	-10.1	-17.0	-23.8	-31.4
492	.168	.100	8.50	15.0	-11.6	.0	7.8	5.2	-3.7	-13.2	-23.1	-33.2	-43.8	-55.2
493	.222	.000	8.50	17.5	-16.7	.0	13.8	17.7	17.7	17.0	16.9	16.3	16.0	15.9
494	.222	.012	8.50	17.0	-14.0	.0	12.7	14.8	12.3	9.5	6.8	4.3	1.5	-1.5
495	.222	.025	8.50	17.0	-13.0	.0	11.7	12.8	9.1	5.0	.7	-4.0	-8.5	-13.1
496	.222	.050	8.50	17.0	-12.2	.0	10.0	10.6	5.1	-1.3	-7.4	-14.2	-20.7	-28.0
497	.222	.100	8.50	18.0	-10.4	.0	7.7	6.6	-1.3	-10.9	-20.1	-30.5	-40.5	-52.0
498	.064	.150	8.50	10.0	-16.8	.0	-3.5	-13.7	-27.3	-41.5	-55.8	-70.8	-86.1	-103.0
499	.064	.200	8.50	10.0	-15.2	.0	-5.0	-17.5	-33.3	-49.8	-67.0	-85.2	-103.2	-121.2
700	.118	.150	8.50	12.0	-13.8	.0	1.7	-6.1	-18.2	-31.7	-45.4	-59.1	-73.8	-89.0
701	.118	.200	8.50	12.0	-12.4	.0	.5	-9.3	-23.3	-39.5	-55.6	-72.0	-.0	-.0
702	.168	.150	8.50	15.0	-11.3	.0	4.0	-.3	-11.4	-23.3	-36.7	-49.5	-63.3	-77.7
703	.168	.200	8.50	16.0	-8.7	.0	3.5	-2.3	-15.4	-30.0	-45.8	-62.0	-78.5	-.0
704	.222	.150	8.50	19.0	-9.5	.0	4.7	1.5	-8.3	-20.1	-33.0	-45.8	-59.5	-73.8
705	.222	.200	8.50	19.0	-7.4	.0	2.7	-1.0	-12.5	-26.6	-40.6	-57.6	-74.0	-.0

RN	UL	UG	HO	HM	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
706	.373	.004	14.50	16.0	-28.4	.0	24.5	28.3	25.7	28.0	27.0	27.8	27.8	27.8
707	.073	.058	14.50	16.0	-20.5	.0	19.3	20.5	17.6	7.8	.4	-6.6	-14.1	-22.7
708	.073	.100	14.50	16.0	-19.0	.0	15.0	16.7	0.5	-2.3	-13.0	-24.0	-36.0	-48.4
709	.073	.150	14.50	18.0	-18.5	.0	13.5	14.0	2.8	-10.6	-25.0	-39.5	-54.8	-71.0
710	.073	.200	14.50	19.0	-18.0	.0	12.2	10.2	-2.3	-17.8	-35.0	-52.5	-70.3	-90.3
711	.123	.000	14.50	21.0	-22.8	.0	21.0	38.1	38.1	37.7	38.0	37.5	37.5	37.5
712	.123	.050	14.50	21.0	-17.0	.0	15.0	20.1	21.3	10.0	12.1	5.8	-1.1	-8.5
713	.123	.100	14.50	21.0	-16.1	.0	14.0	24.2	19.3	10.6	.7	-9.1	-20.3	-31.5
714	.123	.150	14.50	22.0	-14.8	.0	11.5	19.2	13.1	1.8	-11.4	-24.6	-39.3	-53.5
715	.123	.200	14.50	22.0	-13.8	.0	10.2	15.9	7.0	-6.7	-22.4	-39.5	-56.5	-74.0
716	.172	.000	14.50	25.5	-19.0	.0	17.5	34.0	43.4	42.7	42.7	42.5	42.3	42.0
717	.172	.050	14.50	26.0	-13.8	.0	11.8	23.5	30.4	25.0	10.5	11.5	4.5	-3.0
718	.172	.100	14.50	26.0	-12.5	.0	10.6	20.9	23.7	16.2	6.8	-3.0	-14.0	-24.7
719	.172	.150	14.50	26.0	-11.0	.0	0.9	17.0	17.0	8.9	-3.2	-16.3	-29.4	-44.8
720	.172	.200	14.50	26.0	-9.4	.0	7.1	13.3	13.0	2.6	-11.0	-27.0	-43.4	-60.6
721	.222	.030	14.50	33.0	-15.2	.0	14.2	27.5	40.0	47.6	47.7	47.3	47.3	46.8
722	.222	.050	14.50	33.0	-10.5	.0	8.6	16.6	23.8	27.8	23.0	15.9	8.7	2.1
723	.222	.100	14.50	33.0	-8.6	.0	7.0	13.5	19.3	20.3	13.1	4.0	-5.7	-16.5
724	.222	.150	14.50	33.0	-7.5	.0	5.4	10.5	13.9	12.8	4.4	-7.3	-20.1	-33.7
725	.222	.200	14.50	33.0	-5.5	.0	3.7	8.3	0.5	6.1	-2.7	-16.4	-31.0	-47.4

RN	UL	U0	H0	HH	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
726	.057	.000	17.50	19.0	-29.8	.0	20.4	42.7	42.5	42.5	42.5	42.5	42.5	42.4
727	.057	.050	17.50	19.5	-22.0	.0	19.7	32.6	27.0	19.8	12.9	5.3	-2.1	-10.0
728	.057	.100	17.50	20.0	-19.5	.0	17.0	22.3	21.0	11.7	1.0	-8.7	-21.7	-34.5
729	.057	.150	17.50	20.0	-17.8	.0	16.4	25.3	17.3	14.4	-9.0	-22.7	-40.0	-56.0
730	.057	.200	17.50	21.0	-16.8	.0	15.2	21.7	12.3	-2.7	-19.6	-36.5	-55.5	-75.6
731	.111	.000	17.50	24.0	-24.8	.0	22.2	43.0	51.0	50.8	50.8	50.8	50.2	50.2
732	.111	.050	17.50	25.0	-19.2	.0	15.7	32.4	38.3	32.5	25.0	19.3	11.9	4.4
733	.111	.100	17.50	24.0	-18.1	.0	14.8	20.4	32.9	25.0	15.4	5.3	-5.3	-16.3
734	.111	.150	17.50	25.0	-14.3	.0	12.0	24.2	26.3	16.0	3.3	-10.2	-24.5	-40.0
735	.111	.200	17.50	25.0	-14.8	.0	10.8	20.3	21.5	9.4	-5.3	-21.8	-38.5	-56.7
736	.166	.000	17.50	30.0	-20.3	.0	17.7	35.0	51.7	57.7	58.0	58.0	57.9	57.7
737	.166	.050	17.50	30.0	-15.5	.0	12.7	25.3	37.3	39.6	34.0	27.4	21.0	13.9
738	.166	.100	17.50	30.0	-14.0	.0	10.8	21.4	32.0	32.1	24.3	14.7	4.9	-6.3
739	.166	.150	17.50	30.0	-12.0	.0	9.5	10.0	25.5	24.7	15.0	2.7	-10.5	-24.9
740	.166	.200	17.50	30.0	-10.4	.0	7.5	14.9	19.8	17.9	6.3	-8.2	-24.9	-42.0
741	.220	.000	17.50	40.0	-16.0	.0	13.0	20.5	42.5	53.8	64.1	64.5	64.5	64.3
742	.220	.050	17.50	40.0	-12.0	.0	8.8	17.0	25.8	32.4	37.6	32.7	26.0	18.9
743	.220	.100	17.50	40.0	-10.2	.0	7.3	14.8	21.4	26.8	29.0	22.1	12.8	3.0
744	.220	.150	17.50	40.0	-8.3	.0	5.0	10.5	15.0	18.8	18.3	10.8	-1.0	-14.2
745	.220	.200	17.50	40.0	-7.6	.0	4.5	9.4	12.0	15.8	14.3	5.8	-7.0	-22.0

RN	UL	UG	H0	HH	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
746	.070	.000	19.50	21.5	-29.0	.0	27.4	50.7	51.0	50.5	50.5	50.5	50.3	50.3
747	.070	.050	19.50	21.5	-21.5	.0	18.8	37.4	35.0	27.9	20.8	13.3	6.0	-2.3
748	.070	.100	19.50	21.5	-19.0	.0	17.0	32.4	29.0	19.0	9.8	-1.3	-12.7	-25.3
749	.070	.150	19.50	21.5	-18.4	.0	15.5	27.3	24.0	12.0	-1.5	-14.8	-29.5	-46.0
750	.070	.200	19.50	21.5	-17.0	.0	14.2	23.3	19.7	5.5	-10.7	-27.8	-46.5	-65.0
751	.120	.000	19.50	25.0	-25.4	.0	22.7	45.3	55.5	55.0	55.0	54.6	54.5	54.3
752	.120	.050	19.50	25.0	-19.8	.0	15.7	31.0	43.0	30.0	32.3	25.3	18.5	11.8
753	.120	.100	19.50	25.0	-18.5	.0	14.1	27.5	36.3	29.4	19.0	9.7	-1.6	-12.8
754	.120	.150	19.50	25.0	-16.7	.0	12.2	23.4	29.7	22.0	9.9	-3.4	-18.0	-33.0
755	.120	.200	19.50	25.0	-15.8	.0	10.0	19.3	24.0	15.0	.4	-15.6	-32.5	-50.2
756	.160	.000	19.50	32.0	-21.0	.0	10.3	36.9	54.1	63.6	63.7	63.0	63.7	63.5
757	.160	.050	19.50	32.0	-16.2	.0	12.5	25.4	30.0	45.3	40.0	33.8	26.7	19.5
758	.160	.100	19.50	32.0	-14.7	.0	11.3	22.4	33.0	36.8	29.2	19.6	9.4	-1.3
759	.160	.150	19.50	32.0	-13.0	.0	9.1	10.0	26.2	20.8	19.8	8.3	-4.8	-19.4
760	.160	.200	19.50	32.0	-11.6	.0	7.3	15.5	20.0	20.0	10.4	-3.4	-20.3	-38.3
761	.210	.000	19.50	39.0	-17.5	.0	15.2	30.7	45.4	57.0	67.0	65.6	66.6	66.5
762	.210	.050	19.50	39.0	-13.8	.0	10.1	20.3	29.7	37.5	42.0	36.4	29.5	22.3
763	.210	.100	19.50	30.0	-11.8	.0	8.4	17.5	24.7	31.0	32.7	25.2	15.3	4.9
764	.210	.150	19.50	30.0	-10.1	.0	6.4	12.7	18.4	22.2	22.3	13.0	1.4	-12.2
765	.210	.200	19.50	30.0	-7.8	.0	4.3	0.5	11.8	13.9	12.1	2.0	-11.5	-27.6

RN	UL	UB	HO	HH	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
766	.060	.000	21.00	23.0	-20.8	.0	27.1	53.0	57.3	57.0	57.0	57.0	57.0	56.8
767	.060	.050	21.00	23.0	-22.5	.0	19.0	39.0	41.0	35.5	29.0	21.7	14.4	6.6
768	.060	.100	21.00	23.0	-20.0	.0	17.0	34.7	35.3	26.3	16.0	5.3	-5.8	-18.0
769	.060	.150	21.00	22.0	-18.0	.0	16.2	30.5	31.0	19.7	6.4	-7.5	-22.2	-38.0
770	.060	.200	21.00	22.0	-15.8	.0	15.3	26.5	25.0	12.1	-4.4	-20.5	-40.0	-59.0
771	.118	.000	21.00	27.0	-24.2	.0	21.0	42.5	62.0	64.0	64.0	62.7	63.8	63.7
772	.115	.050	21.00	28.0	-19.8	.0	16.0	32.4	47.2	47.0	41.0	36.0	26.8	19.0
773	.118	.100	21.00	20.0	-18.3	.0	14.0	20.3	40.1	30.5	29.7	19.8	9.4	-2.0
774	.118	.150	21.00	20.0	-17.0	.0	12.0	23.0	32.7	29.6	18.3	5.5	-8.8	-22.8
775	.118	.200	21.00	20.0	-16.7	.0	8.6	19.0	24.2	18.5	4.7	-11.2	-29.0	-47.0
776	.170	.000	21.00	37.0	-20.2	.0	17.8	35.9	52.0	65.5	70.6	70.5	70.3	70.3
777	.170	.050	21.00	36.0	-16.6	.0	12.0	25.2	37.4	47.4	48.7	43.3	34.5	30.0
778	.170	.100	21.00	36.0	-14.9	.0	10.6	21.3	31.0	39.2	38.0	29.3	19.2	9.0
779	.170	.150	21.00	36.0	-13.5	.0	8.3	17.0	24.2	29.2	26.3	16.0	3.0	-10.5
780	.170	.200	21.00	36.0	-12.8	.0	5.0	12.3	17.8	19.8	15.8	3.0	-11.7	-28.0
781	.227	.000	21.00	49.0	-16.0	.0	13.7	27.6	41.0	52.3	63.5	72.3	75.0	75.3
782	.227	.050	21.00	48.0	-12.4	.0	10.0	19.0	27.0	33.7	40.4	44.3	41.0	35.0
783	.227	.100	21.00	40.0	-11.0	.0	6.8	14.2	20.0	25.4	29.5	31.5	26.0	16.8
784	.227	.150	21.00	40.0	-8.0	.0	5.8	10.5	14.5	17.6	20.0	19.0	12.0	.7
785	.227	.200	21.00	48.0	-7.6	.0	2.0	4.1	6.0	7.3	7.7	5.0	-4.4	-17.7

RN	UL	UD	H0	HM	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
786	.066	.000	21.50	23.5	-29.1	.0	27.3	57.4	58.2	50.2	50.2	50.0	57.9	57.5
787	.066	.025	21.50	23.0	-25.0	.0	21.8	43.0	47.0	42.8	39.1	33.8	29.4	24.3
788	.066	.050	21.50	23.0	-23.5	.0	19.0	40.0	43.3	37.3	31.6	24.3	16.8	9.8
789	.066	.100	21.50	23.0	-21.0	.0	17.9	34.1	35.4	28.0	17.8	7.8	-4.5	-16.0
790	.066	.150	21.50	23.0	-21.2	.0	15.0	20.7	29.9	19.0	6.0	-6.3	-20.5	-34.5
791	.116	.000	21.50	34.0	-24.3	.0	21.3	43.3	42.2	46.2	46.2	65.6	66.2	66.2
792	.116	.025	21.50	29.0	-20.5	.0	17.6	36.0	52.5	53.7	52.2	40.1	43.6	39.5
793	.116	.050	21.50	29.0	-20.4	.0	16.3	33.0	48.5	50.0	44.0	38.2	32.2	25.8
794	.116	.100	21.50	29.0	-19.8	.0	13.5	27.9	40.5	39.5	31.5	21.2	11.3	.5
795	.116	.150	21.50	29.0	-21.0	.0	11.5	24.0	34.0	32.0	22.3	10.5	-1.3	-15.1
796	.166	.000	21.50	30.0	-20.5	.0	17.3	33.3	31.1	65.0	71.3	70.5	71.0	71.0
797	.166	.025	21.50	36.0	-17.5	.0	14.2	20.4	42.0	53.3	56.0	51.9	47.0	43.5
798	.166	.050	21.50	36.0	-16.5	.0	13.5	26.5	39.4	50.0	50.4	44.4	30.6	32.7
799	.166	.100	21.50	36.0	-15.2	.0	10.0	22.2	33.3	40.0	39.3	30.7	21.3	11.4
800	.166	.150	21.50	36.0	-13.3	.0	5.7	13.2	17.7	20.3	15.6	2.8	-12.5	-20.8
801	.216	.000	21.50	49.0	-26.9	.0	14.7	29.3	43.2	54.8	65.8	73.8	76.3	76.3
802	.216	.025	21.50	47.0	-14.7	.0	11.0	22.9	33.4	41.8	49.4	54.5	51.8	47.8
803	.216	.050	21.50	47.0	-13.2	.0	10.0	20.5	30.0	37.5	44.0	46.3	42.0	36.0
804	.216	.100	21.50	47.0	-11.4	.0	8.0	15.7	23.4	28.8	33.2	33.7	26.8	17.9
805	.216	.150	21.50	47.0	-9.8	.0	6.2	12.0	16.0	19.0	22.3	20.4	12.9	1.4

RN	UL	UG	H0	HM	M1	M0	M2	M3	M4	M5	M6	M7	M8	M9
806	.093	.000	19.00	21.0	-32.5	.0	38.1	65.2	64.3	64.8	64.4	64.0	64.1	63.8
807	.093	.025	19.00	21.0	-31.0	.0	30.2	54.8	50.5	46.2	41.0	35.8	30.5	24.4
808	.093	.050	19.00	21.0	-31.5	.0	26.8	27.9	42.7	35.8	20.4	21.0	13.1	5.0
809	.093	.100	19.00	21.0	-29.4	.0	24.0	41.2	33.5	23.5	12.3	1.0	-10.7	-23.0
810	.093	.150	19.00	21.0	-27.4	.0	20.7	35.3	25.5	11.9	-2.2	-16.7	-33.0	-49.3
811	.093	.200	19.00	21.0	-25.5	.0	17.5	29.0	17.0	1.7	-15.7	-33.5	-53.0	-72.0

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