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Met. Techs.

Subject Condition by Size Testwork

Conclusions:

1) Conditioning by size shows promise with respect to improved metallurgy, particularly in the zinc circuit. The "best test" results for each ore type are shown below:

ORE TYPE	TEST NUMBER		TYPE OF	CUMULATIVE METALLURGY			
	Pb cct	Zn cct	Conditioning	% Grade	% Recovery	% Grade	% Recovery
2BCD	3	22	cond by size	30.9	87.9	18.6	82.2
2EF	2	10	cond by size	40.0	87.2	20.2	84.5
2H	4	--	cond by size	28.8	89.4	----	----

2) For 2BCD and 2EF ores, the "best test" conditions were a 5 minute conditioning by size in the Pb circuit at normal Z-11 consumption levels with an 8 minute condition by size in the Zn circuit at a +50% Z-11 consumption level (over normal).

3) For 2H ore, the "best test" conditions were a 2.5 minute conditioning by size in the Pb circuit at normal Z-11 consumption levels.

Recommendations:

1) Further reagent optimization should be done on each ore type prior to further conditioning by size tests.

2) Further conditioning by size testing should be performed including evaluation of the relationship between conditioning by size and reagent consumption.

3) In the future, reagent/grind optimization should be done on each new sample.

Analysis and Discussion:

A. General

In this conditioning by size test program, little was done to optimize procedures before the testwork was initiated. Therefore, the tests should only be compared to each other, with little comparison drawn to previous testwork.

Three types of conditioning prior to flotation were utilized: the standard method; the condition by size method and the parallel method. It must be noted that the "standard" method is actually a modified standard as no Z-11 was added during primary grinding. Procedures are outlined following analysis and discussion. Reagent/time schemes for each test are detailed in Appendix C.

One point worth considering regarding procedure is that the rougher/scavenger flotation time for a rougher test is a total of 10 minutes whereas only 8 minutes is usually employed for rougher/scavenger in a cleaner test. The 10 minute rougher test time was established for convenience. The 8 minute cleaner test time was established through optimization. That an 8 minute rougher/scavenger flotation time is optimum is confirmed on examination of the zinc condition by size testwork in this program. Several of the "best tests" showed loss of grade (with improved recovery) over the parallel method test, but it is felt that the shorter (8 minute) flotation time would avoid the decreased grade while still obtaining the benefits of improved recoveries.

High recoveries (at reasonable grades) has been the major thrust of ore type testwork. Lead and zinc recoveries throughout this test program have been considerably lower than expected. These differences can be explained in part by no use of Z-11 in the primary grind and losses of reagents on washing the sample through a 325 mesh screen. Also, the new technicians are not as yet as proficient at flotation testwork as the previous crew of technicians.

Regardless of these reasons, it is felt that a major factor contributing to the poor results is the difference in ore samples. The ore samples presently used in the metallurgy lab are samples collected in June, 1983. The body of previous reagent/grind optimization tests and locked cycle tests were performed on another sample, collected in December, 1982. A comparison of head grades of these samples can be seen in Table 1 below.

Analysis and Discussion - (Cont'd)

A. General - (Cont'd)

TABLE 1: ORE SAMPLE HEAD GRADES

ORE TYPE	SAMPLE	ASSAYS (%)				
		Pb	Zn	Fe	Cu	Ag
2BCD	December/82, normal grade	2.2	4.0	10.3	No Assay	1.9
2BCD	December/82, high grade	3.1	6.0	13.6	0.15	1.4
2BCD	June/83	3.1	5.9	12.7	0.12	2.3
2EF	December/82	3.2	4.6	39.5	0.10	1.3
2EF	June/83	3.5	5.1	29.7	0.18	1.2
2H	December/82	4.8	7.0	38.4	0.34	2.2
2H	June/83	4.0	7.2	34.0	0.37	2.5

As a result of the poor metallurgy obtained throughout these preliminary condition by size tests, some further testwork on reagent/grind/conditioning/flotation time schemes were performed on the June, 1983 ore samples (see E. Morris' Conditioning Times report of January, 1984, and Y. Boudreau's Repeat Cleaner Testing report of February, 1984). These further tests were done with the hope of achieving the metallurgical perfomance of the December, 1982 ore samples. A summary of the "best test" results from these tests follows here in Table 11.

TABLE 11: OPTIMIZATION OF NEW ORE TYPE SAMPLES

ORE TYPE	SAMPLE TYPE	TEST # IN SERIES	TEST TYPE	AIM OF TESTWORK	COMMENTS ON TEST CONDITIONS	LEAD		ZINC	
						%GR.	%REC	%GR.	%REC
2BCD	Dec./82	11	cleaner	reagent optimization of May/83	BEST TEST	61.8	88.9	53.0	93.2
2BCD	June/83	5*	cleaner	repeat cleaners of Jan./84	10/10 Pb/Zn regrind at "Best Test" reagent levels using new frother	54.4	83.1	51.6*	87.2*
2EF	Dec./82	10	cleaner	reagent optimization of May/83	BEST TEST	72.0	83.8	53.7	87.5
2EF	June/83	7**	cleaner	repeat cleaner of Jan./84	5/10 Pb/Zn regrind at "best test" reagent levels for Pb and at high reagent levels for Zn using new frother	66.9	76.1	49.4**	87.6**

Analysis and Discussion (Cont'd)

A. General (Cont'd)

Table 11: Optimization of New Ore Type Samples (Cont'd)

ORE TYPE	SAMPLE TYPE	TEST # IN SERIES	TEST TYPE	AIM OF TESTWORK	COMMENTS ON TEST CONDITIONS	LEAD		ZINC	
						%GR.	%REC	%GR.	%REC
2EF	June/83	1	rougher	cond. vs flot. time of Jan/84	condition time ↑ flotation time ↓	27.8	92.5		
2EF	June/83	6	rougher	cond. vs flot. time of Jan/84	condition time ↑ flotation time ↓			10.5	87.1
2EF	June/83	11	rougher	cond. vs flot. time of Jan/84	condition time ↑ at constant flotation time	33.0	91.2		
2EF	June/83	14	rougher	cond. vs flot. time of Jan/84	condition time ↑ at constant flotation time			13.0	86.4

*Actual Zn results are from test 2 as test 5 results are unreliable
**Acutal Zn results are from test 6 as test 7 results are unreliable

Examination of these results indicates that further work is required in order to optimize the base metallurgical performance of these ore types. It also must be recognized that, in the future, new ore type sample will require initial testwork to determine the optimum reagent/time scheme in order to compensate for differences in sample quality .

B. 2BCD Ore

This ore type was the first tested for conditioning by size. Several tests (1, 2, 11, and 12) were performed in order to establish technique and procedures. These tests have little importance to the series of condition by size tests as extraneous variables were introduced to determine the method for subsequent testing. It is interesting to note that in test 11, Na_2SO_3 was used in addition to the (modified) standard reagent scheme. This test showed similar metallurgical performance to the standard in the Pb circuit but, showed somewhat improved grades and recoveries over the standard in the Zn circuit.

Analysis and Discussion - (Cont'd)

B. 2BCD Ore - (Cont'd)

Throughout the rest of the 2BCD ore portion of these tests; conditioning times, primary grind times and amounts of Z-11 additions were varied, making comparisons between tests difficult. A comparison of the test parameters and results obtained in the 2BCD ore testing are contained in the following tables (Table III & Table IV). Detailed explanation of reagent/time schemes employed can be found in Appendix C. The final results and graphs for these tests are in Appendix A and B.

TABLE III: LEAD TESTS ON 2BCD ORE

TEST NUMBER	TEST TYPE	TYPE OF CONDITIONING	CONDITIONING TIME (MIN)	ADDITIONAL PARAMETERS	CUM. LEAD METALLURGY	
					% GRADE	% RECOVERY
3	rougher	Cond. by size	5.0	15 min. grind normal reagents	30.87	87.92
4	"	Parallel	5.0	" "	26.32	86.23
5	"	Cond. by size	2.5	" "	33.41	87.20
6	"	Parallel	2.5	" "	32.84	86.27
7	"	Cond. by size	4.0	16½ min grind normal reagents	27.91	86.21
8	"	Parallel	4.0	" "	23.88	87.35
9	"	Cond. by size	4.0	15 min. grind +50% Z-11	20.34	88.75
10	"	Parallel	4.0	" "	19.19	87.42
13	"	Standard	None	15 min. grind Normal reagents	24.76	91.89
20	cleaner	Standard	None	" "	77.90	56.55
21	"	Cond. by size	5.0	" "	71.10	74.83

TABLE IV: ZINC TESTS ON 2BCD ORE

TEST NUMBER	TEST TYPE	TYPE OF CONDITIONING	CONDITIONING TIME (MIN)	ADDITIONAL PARAMETERS	CUM. ZINC METALLURGY	
					% GRADE	% RECOVERY
13	rougher	Standard	None	Normal reagents	13.94	78.05
14	"	Cond. by size	8.0	" "	18.19	80.19
15	"	Parallel	8.0	" "	32.62	75.05
16	"	Cond. by size	6.0	" "	20.26	76.71
17	"	Parallel	6.0	" "	15.89	80.75
18	"	Cond. by size	4.0	" "	13.92	74.83
19	"	Parallel	4.0	" "	17.44	79.68
22	"	Cond. by size	8.0	+50% Z-11	18.63	82.24
23	"	Parallel	8.0	" "	26.20	77.26
24	"	Cond. by size	8.0	Repeat of test 14	17.56	77.90
25	"	Parallel	8.0	Repeat of test 15	14.92	75.09

Analysis and Discussion - (Cont'd)

B. 2BCD Ore - (Cont'd)

Of the condition by size method and parallel method rougher tests performed on the Pb circuit of 2BCD ore, test 3 (5 minute condition by size) showed the best metallurgy with a 30.9% grade at a 87.9% recovery. In all but one of the Pb condition by size tests on this ore type, conditioning by size provided superior metallurgy over the parallel tests.

Two lead cleaner tests were also performed as a part of this series; one implementing the modified standard method and the other using the 5 minute condition by size method (test 20 and 21 respectively). The condition by size test showed improved overall recovery at 74.8% (although the rougher/scavenger recovery was still somewhat lower than the standard test) with a 7% loss in grade. These tests confirm that conditioning by size has benefit to the Pb circuit. Further work is still required to accurately determine the optimum conditions required for 2BCD Pb conditioning by size.

All testwork performed on the 2BCD ore Zn circuit for conditioning by size was in the form of rougher tests. The best Zn test in this series was test 22 which had a 5% improvement in recovery over the parallel test (with an 8% loss in grade which could be decreased by shortening the length of rougher flotation). Test 22 also showed a 4% improvement in grade and recovery over the standard (test 13). Test 22 utilized an 8 minute period of conditioning by size as well as a 50% increase in Z-11 consumption. The two other good tests in this series were tests 14 and 24, duplicate tests employing 8 minutes of conditioning by size at normal Z-11 consumption levels.

Some interesting trends can be observed by comparing tests 14 through 19 with the standard (test 13). In the condition by size method tests (14, 16 & 18), as conditioning time for Zn decreased, the metallurgical performance dropped. However, the parallel tests (15, 17 & 19) showed very little difference between conditioning times, but with generally improved performance compared to the standard.

These trends and the "best test" results indicate that conditioning by size is beneficial to the Zn circuit for 2BCD ore. More work should be done on conditioning by size, particularly examining longer conditioning times and the relationship between conditioning by size and reagent consumption.

A locked cycle test was performed on this ore type employing the most promising condition by size times, as determined in the rougher and cleaner series of tests. The test used a 5 minute condition by size time in the Pb circuit at normal Z-11 consumption levels and an 8 minute condition by size time in the Zn circuit, also at normal Z-11 consumption levels.

Reasonable stability was achieved in the locked cycle test but grades and particularly recoveries were disappointing. The P80's achieved were acceptable with 18.1μm size in the Pb concentrate and 22.9μm in the Zn concentrate and somewhat low in the final tails with P80 = 37.7μm. Pb recoveries were 10% lower than expected and in the Zn circuit, recoveries were 15% lower than expected. These results can be explained in part by reagent losses on washing, no Z-11 in the primary grind and activation of pyrite with increased conditioning time. Further investigation into the differences between this sample of 2BCD ore and the previous sample must be done, followed by further investigation into conditioning by size.

Analysis and Discussion - (Cont'd)

C. 2EF Ore

In the 2EF ore condition by size tests, conditioning time and amounts of Z-11 addition were the only parameters varied. All tests performed were rougher tests. Table V and VI summarize the test parameters and results for 2EF ore tests in this program. The complete results and graphs for thesetests can be found in Appendices A and B. A detailed explanation of reagent/time schemes can be found in Appendix C.

TABLE V: LEAD TESTS ON 2EF ORE

TEST NUMBER	TEST TYPE	TYPE OF CONDITIONING	CONDITIONING TIME (MIN)	ADDITIONAL PARAMETERS	CUM. LEAD METALLURGY	
					% GRADE	% RECOVERY
1	rougher	Standard	None	Normal reagents	29.84	91.47
2	"	Cond. by size	5.0	" "	40.02	87.21
3	"	Parallel	5.0	" "	38.23	84.26
4	"	Cond. by size	2.5	" "	39.00	86.52
5	"	Parallel	2.5	" "	39.21	83.92

TABLE VI: ZINC TESTS ON 2EF ORE

TEST NUMBER	TEST TYPE	TYPE OF CONDITIONING	CONDITIONING TIME (MIN)	ADDITIONAL PARAMETERS	CUM. ZINC METALLURGY	
					% GRADE	% RECOVERY
1	rougher	Standard	8.0	Normal reagents	17.69	85.16
6	"	Cond. by size	8.0	" "	28.78	81.71
7	"	Parallel	8.0	" "	29.94	78.80
8	"	Cond. by size	6.0	" "	36.75	35.20
9	"	Parallel	6.0	" "	47.62	70.90
10	"	Cond. by size	8.0	+50% Z-11	20.19	84.45
11	"	Parallel	8.0	" "	29.31	73.66

The best Pb conditioning by size test for 2EF ore was test 2, with 5 minutes of conditioning by size. A final grade of 40.0% Pb at an 87.2% recovery was a 2% improvement in grade and a 3% improvement in recovery over the parallel test (test 3). Test 2 grade was also better than the standard (test 1) by 10% but the standard recovery was 4% greater than in the best test. A longer Pb rougher/scavenger flotation time for the 5 minute condition by size test could improve recovery to that of the standard, but at some loss of grade. The 2.5 minute condition by size method test (test 4) also showed improved recovery (+3%) over its parallel (test 5) at similar final grades. Conditioning by size does appear to improve the metallurgical performance in the Pb circuit of 2EF ore.

The best

Analysis and Discussion - (Cont'd)

C. 2EF Ore - (Cont'd)

The best Zn test in the 2EF series of conditioning by size tests was test 10, employing an 8 minute condition by size and a 50% increase in Z-11 consumption over the standard addition rate. Test 10 showed a 20.2% Zn grade at 84.5% recovery which was an 11% improvement in recovery over the parallel method test (test 11). The improved recovery was somewhat negated by a 9% loss in grade that would be reduced if the rougher/scavenger flotation time was decreased. Other tests in this series showed considerably improved grades but recovery never was as high as that of the standard method test (test 1). This test series indicates that conditioning by size will improve the Zn metallurgy, particularly at shortened flotation times.

An examination of the graphs (see Appendix B) shows that decreases in conditioning time for the condition by size method tests had significant negative effects on the recovery of Zn. This effect could be offset by increases in Z-11 addition (see test 10). These results suggest that conditioning by size is favourable in the Zn circuit of 2EF ore when longer conditioning times are utilized. As well, the relationship between conditioning by size and reagent consumption should be examined.

A locked cycle test was also performed using 2EF ore and employing the most promising condition by size times as determined in this series of tests. The test used a 5 minute condition by size time in the Pb circuit at normal Z-11 consumption levels and an 8 minute condition by size time in the Zn circuit with a 50% increase in the Z-11 consumption over the standard.

Reasonable stability was achieved in the locked cycle test despite overflow problems in cycles 4 and 5. The P80's were higher than expected for the Pb and Zn concentrates at 27.6 microns and 30.3 microns respectively, where as the final tails P80 was 43.9 microns, not a surprising size for this test. Grades and recoveries were lower than expected. These results can be explained in part due to the lack of Z-11 in the primary grind which caused poor activation of lead and zinc. The washing of mineralized surfaces during wet screening caused losses of reagents, negatively affecting metallurgical performance. Further investigation into the differences between this sample of 2EF ore and the previous sample must be done, followed by further investigation into conditioning by size.

D. 2H Ore

Only a small amount of work was done on conditioning by size for 2H ore. Only the Pb circuit was examined to the same degree as the other ore types. All tests performed were rougher tests. Table VII summarizes the test parameters and results for the 2H ore tests in this series. The complete results and graphs for these tests can be found in Appendix A and B. A detailed explanation of reagent/time schemes can be found in Appendix C.

Analysis and Discussion - (Cont'd)

D. 2H Ore - (Cont'd)

TABLE VII: LEAD TESTS ON 2H ORE

TEST NUMBER	TEST TYPE	TYPE OF CONDITIONING	CONDITIONING TIME(MIN)	ADDITIONAL PARAMETERS	CUM. LEAD METALLURGY	
					% GRADE	% RECOVERY
1	rougher	Standard	None	Normal Reagents	27.61	91.60
2	"	Cond. by size	5.0	" "	32.53	87.02
3	"	Parallel	5.0	" "	26.76	90.78
4	"	Cond. by size	2.5	" "	28.80	89.32
5	"	Parallel	2.5	" "	25.40	89.40

The best 2H conditioning by size test in the Pb circuit of this series was test 4, a 2.5 minute condition by size method test. The 28.8% Pb grade was a 3% improvement over the parallel test (test 5) at a similar recovery (89.3%). This indicates that conditioning by size may be advantageous to the Pb circuit of 2H ore. It should be noted that tests 1,2 and 3 are very similar in metallurgical performance, requiring further testwork to determine the optimum method.

Two tests were performed on the Zn circuit for 2H ore (test 6 and 7: see Appendices A, B and C). Major pH meter problems were encountered and therefore these tests were not evaluated for conditioning by size benefits.

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Procedure

Standard Pb Conditioning Prior to Flotation

- Wash contents of primary grind into a 2.5 litre flotation cell.
- Raise pH to 10.0 with Na_2CO_3.
- Add 50g/tonne Z-11 collector.
- Immediately collect Pb Ro/Sc concentrate samples.

Condition by Size Pb Conditioning Prior to Flotation

- Wash contents of primary grind through a 325 mesh screen.
- Filter -325 mesh fraction, collecting water for use as make-up water during the test.
- Condition each fraction separately in 1.5 litre cells by:
  - raising pH to 10.0 with Na_2CO_3.
  - adding 1.5 g/tonne Z-11 collector to +325 mesh fraction and 35 g/tonne Z-11 collector to -325 mesh fraction and condition for set lengths of time (the same time for each fraction)
- recombine fractions in a 2.5 litre cell and again raise pH to 10.0 with Na_2CO_3.
- immediately collect Pb Ro/Sc concentrate samples.

Parallel Pb Conditioning Prior to Flotation

- Wash contents of primary grind through a 325 mesh screen.
- Filter -325 mesh fraction, collecting water for use as make-up water during the test.
- Recombine fractions in a 2.5 litre cell and raise pH to 10.0 with Na_2CO_3.
- Add 50 g/tonne Z-11 collector and collect Pb Ro/Sc concentrate samples.

Procedure - (Cont'd)

Standard Zn Conditioning Prior to Flotation

- Conditioning is done to Pb Ro/Sc Tails in the 2.5 litre cell.
- Check pH, add 1000 g/tonne $CuSO_4$, check pH again and then raise pH to 11.0 with lime while conditioning for 8 minutes.
- Add 60 g/tonne Z-11 collector and condition for 2 more minutes.
- Collect Zn Ro/Sc concentrate samples.

Condition by Size Zn Conditioning Prior to Flotation

- Wash Pb Ro/Sc Tails through a 325 mesh screen.
- Filter -325 mesh fraction, collecting water for make-up water.
- Condition each fraction separately in 1.5 litre cells by:
  - checking pH of each fraction, adding 500 g/tonne $CuSO_4$ to each fraction, checking pH again and then raising pH to 11.0 with lime while conditioning each fraction for a set length of time (the same time for each fraction).
- Recombine each fraction in a 2.5 litre cell and again raise the pH to 11.0 with lime.
- Add 60 g/tonne Z-11 collector (or 90 g/tonne for locked cycle test) and condition for 2 more minutes.
- Collect Zn Ro/Sc concentrate samples.

Parallel Zn Conditioning Prior to Flotation

- Wash Pb Ro/Sc Tails through a 325 mesh screen.
- Filter -325 mesh fraction, collecting water for make-up water.
- Recombine fractions in a 2.5 litre cell, check pH, add 1000 g/tonne $CuSO_4$, check pH again and raise with lime for 8 minutes.
- Add 60 g/tonne Z-11 collector and condition 2 more minutes before flotation.

Procedure - (Cont'd)

Rougher Procedure for 2BCD, 2EF and 2H Ores

Grind: 1 kg of ore
3 kg/tonne Na_2CO_3
100 g/tonne NaCN
500 ml H_2O (66% solids)

Grind for: 15 min. for 2BCD, 14 min. for 2EF and 12 min. for 2H ores.

Condition prior to Pb flotation (standard, condition by size or parallel method)

Collect Pb rougher and scavenger concentrates using MiBC frother as necessary.

Sample	Flotation Time	Collector Addition
$PbRo_1$	1	
$PbRo_2$	2	
$PbSc_1$	2	15 g/tonne Z-11
$PbSc_2$	2	
$PbSc_3$	3	15 g/tonne Z-11

Condition prior to Zn flotation (standard, condition by size or parallel method).

Collect Zn rougher and scavenger concentrates using DOW 1012 frother as necessary.

Sample	Flotation Time	Collector Addition
$ZnRo_1$	1	
$ZnRo_2$	2	
$ZnSc_1$	2	20 g/tonne Z-11
$ZnSc_2$	2	
$ZnSc_3$	3	20 g/tonne Z-11

Procedure - (Cont'd)

Cleaner Test Procedure Used For 2BCD Ore Lead Circuits

Grind: 1 kg of 2BCD ore
3 kg/ tonne Na_2CO_3
100 g/tonne NaCN
500 ml H_2O (66% solids)

Grind for 15 minutes.

Condition prior to Pb flotation (standard, condition by size or parallel method)

Collect Pb rougher/scavenger concentrate as one sample using MiBC frother as necessary.

Sample	Flotation Time	Collector Addition
RbRo/Sc Conc.	3	
	2	15 g/tonne Z-11
	3	15 g/tonne Z-11

Regrind: Pb Ro/Sc concentrate
50 g/tonne NaCN
1 kg/tonne Na_2CO_3

Grind for 10 minutes.

Cleaner flotation of Pb (using MiBC frother as necessary)
- raise pH to between 10.0 and 10.2 with Na_2CO_3
- Add the correct amount of Z-11 collector before each cleaning stage and condition for 2 minutes prior to collection.

Sample	Condition Time	Collector Addition	Flotation time
$PbCC_1$	2	60 g/tonne Z-11	5
$PbCC_2$	2	20 g/tonne Z-11	4
$PbCC_3$	2	10 g/tonne Z-11	3

Procedure - (Cont'd)

Locked Cycle Condition by Size Procedure for 2BCD and 2EF Ores (KRAL)

See attached flowsheet for order and cycling arrangements for samples.

Grind: 1 kg of ore + PbSc concentrate of previous cycle + $PbCT_1$ of previous cycle.
3 kg/tonne Na_2CO_3
100 g/tonne NaCN
500 ml H_2O (66% solids)

Grind for: 15 min. for 2BCD, 14 min. for 2EF.

Condition by size method used prior to Pb flotation.

Collect Pb rougher and Pb scavenger concentrates (2 samples) using MiBC frother as necessary.

Sample	Flotation Time	Collector Addition
PbRo	4	
PbSc	2	15 g/tonne Z-11
	2	15 g/tonne Z-11

Regrind: Pb Ro concentrate + $PbCT_2$ of previous cycle
50 g/tonne NaCN
1 kg/tonne Na_2CO_3

Grind for 5 minutes.

Cleaner flotation of Pb (using MiBC frother as necessary)
- raise pH to between 10.0 and 10.2 with Na_2CO_3 while conditioning for 2 minutes.
- add decreasing amounts of Z-11 collector each minute to a total for each collection stage.

Sample	Flotation Time	Collector Addition (Tot)		Samples Added From Last Cycle
		2BCD	2EF	
$PbCC_1$	5	60 g/tonne	60 g/tonne	------
$PbCC_2$	4	20 g/tonne	20 g/tonne	$PbCT_3$
$PbCC_3$	3	20 g/tonne	10 g/tonne	------

Condition by size method used prior to Zn collection. Samples conditioned in preparation for Zn Ro/Sc stage are Pb Ro/Sc Tails from same cycle + Zn Sc concentrate from last cycle + $ZnCT_1$ from last cycle.

Collect Zn rougher and Zn scavenger concentrates (two samples) using Dow 1012 frother as necessary.

Sample	Flotation Time	Collector Addition
ZnRo	4	
ZnSc	2	30 g/tonne Z-11
	2	30 g/tonne Z-11

Procedure - (Cont'd)

Locked Cycle Condition by Size Procedure - (Cont'd)

Regrind: Zn Ro concentrate + $ZnCT_2$ from last cycle.
500 g/tonne lime
300 g/tonne $CuSo_4$

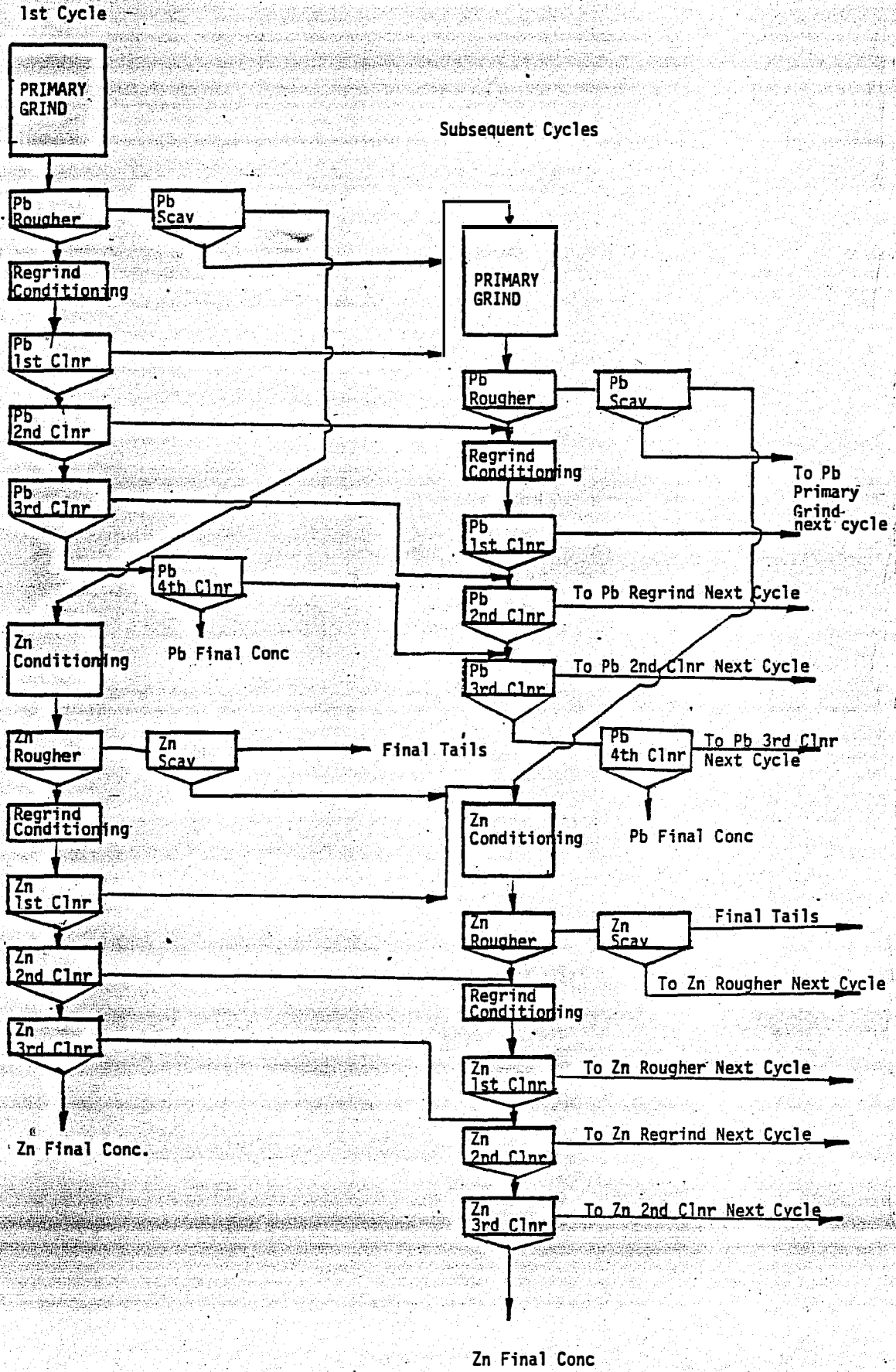
Grind for 5 minutes.

Cleaner Flotation of Zn (using DOW 1012 frother as necessary)
- raise pH with lime to: 11.5 for Zn 1st cleaner, 11.8 for Zn 2nd cleaner and 12.0 for Zn 3rd cleaner and condition for 2 minutes.
- add decreasing amounts of Z-11 collector each minute to a total for each collection stage.

Sample	Flotation Time	Collector Addition (Tot)		Samples Added From Last Cycle
		2BCD	2EF	
$ZnCC_1$	7	80 g/tonne	70 g/tonne	-------
$ZnCC_2$	4	40 g/tonne	30 g/tonne	$ZnCT_3$
$ZnCC_3$	3	20 g/tonne	20 g/tonne	-------

KARL Locked Cycle Cleaner Test Procedure

Pb CIRCUIT CLOSED - Zn CIRCUIT CLOSED



Appendix C

ROUGHER TEST

TEST NO.: 1

PURPOSE: Establishing Standard Roughen Procedure (Pb circuit only)

PROCEDURE: Modified Standard Roughen Test (no Z-11 in grind)

FEED: A B C D

GRIND: 26 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000	—	100	—		—			20					
$PbRo_1$	2120 (total)			50 (total)		—	1			5	1		7.7	10.1
$PbRo_2$				—			1				2			
$PbSc_1$				15			2				2			
$PbSc_2$				—			1				2			
$PbSc_3$				15			—				3			
Zn COND.	—			—	—	—	—			—	—			
	—			—		—	—			—	—			
	—			—		—	—			—	—			
$ZnRo_1$				—				—			—			
$ZnRo_2$				—				—			—			
$ZnSc_1$				—				—			—			
$ZnSc_2$				—				—			—			
$ZnSc_3$				—				—			—			
												—		

ROUGHER TEST

TEST NO.: 2

PURPOSE: Establishing Standard Rougher Procedure (Pb circuit only) (Duplicate of test #1)

PROCEDURE: Modified Standard Rougher Test (no Z-11 in grind)

FEED: 2 BC-D

GRIND: 20 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000		100						20					
$PbRo_1$	7410 (total)			50 (total)			1			5	1		7.2	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			1				2			
$PbSc_2$							1				2			
$PbSc_3$				15			1				3			
Zn COND.														
$ZnRo_1$														
$ZnRo_2$														
$ZnSc_1$														
$ZnSc_2$														
$ZnSc_3$														

ROUGHER TEST

TEST NO.: 3

PURPOSE: Condition By Size (Pb Circuit only)

PROCEDURE: Modified Standard Rougher Test

FEED: 2 BCD

GRIND: 15 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000		100						15					
$PbRo_1$	7320 (total)			50 (total)			1			5	1		7.8	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			1				2			
$PbSc_2$											2			
$PbSc_3$				15			1				3			
Zn COND.														
$ZnRo_1$														
$ZnRo_2$														
$ZnSc_1$														
$ZnSc_2$														
$ZnSc_3$														

ROUGHER TEST

TEST NO.: 4

PURPOSE: Condition By Size (Pb circuit only) (Parallel Test)

PROCEDURE: Modified Standard Rougher Test (no Z-11 in grind)

FEED: 2BCD

GRIND: 15 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000		100						15					
$PbRo_1$	7100 (total)			50 (total)			1			5	1		7.7	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			1				2			
$PbSc_2$							1				2			
$PbSc_3$				15			1				3			
Zn COND.														
$ZnRo_1$														
$ZnRo_2$														
$ZnSc_1$														
$ZnSc_2$														
$ZnSc_3$														

ROUGHER TEST

TEST NO.: 5

PURPOSE: Condition By Size (Pb circuit only)

PROCEDURE: Modified Standard Rougher Test (no Z-11 in grind)

FEED: 2 BCD

GRIND: 15 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAVTL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000	—	100	—		—			15					
$PbRo_1$	6600 (total)			50 (total)		—	1			2½	1		7.9	10.0
$PbRo_2$				—			1				2			
$PbSc_1$				15			1				2			
$PbSc_2$				—			1				2			
$PbSc_3$				15			1				3			
Zn COND.	—			—	—	—				—	—		—	—
	—					—				—	—		—	—
	—					—				—	—		—	—
$ZnRo_1$				—				—			—			
$ZnRo_2$				—				—			—			
$ZnSc_1$				—				—			—			
$ZnSc_2$				—				—			—			
$ZnSc_3$				—				—			—	—		

ROUGHER TEST

TEST NO.: 6

PURPOSE: Condition By Size (Pb circuit only) (Parallel Test)

PROCEDURE: Modified Standard Rougher Test (no Z-11 in grind)

FEED: 2 BCD

GRIND: 15 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000		100						15					
PbRo$_1$	600(6 total)			50(total)			1			2½	1		8.4	10.0
PbRo$_2$							1				2			
PbSc$_1$				15			1				2			
PbSc$_2$							1				2			
PbSc$_3$				15			1				3			
Zn COND.														
ZnRo$_1$														
ZnRo$_2$														
ZnSc$_1$														
ZnSc$_2$														
ZnSc$_3$														

ROUGHER TEST

TEST NO.: 7

PURPOSE: Condition By Size (Pb circuit only)

PROCEDURE: Modified Standard Rougher Test (no reagents in grind)

FEED: 2 BCD

GRIND: 16 ½ min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND									16½					
$PbRo_1$	66 (total)			50 (total)			1			4	1		6.9	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			1				2			
$PbSc_2$							1				2			
$PbSc_3$				15			2				3			
Zn COND.														
$ZnRo_1$														
$ZnRo_2$														
$ZnSc_1$														
$ZnSc_2$														
$ZnSc_3$														

ROUGHER TEST

TEST NO.: 8

PURPOSE: Condition By Size (Pb circuit only) (Parallel test)

PROCEDURE: Modified Standard Rougher Test (no reagents in grind)

FEED: 2 BCD

GRIND: 16½ min. primary

STAGE	REAGENTS ADDED (g/t)								TIME (MIN)			SCAV TL $P_{80}\mu$	PH	
	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH		START	FINISH
PRIMARY GRIND	—	—	—			—			16½					
$PbRo_1$	534o(total)			60(total)		—	1			4	1		6.7	10.0
$PbRo_2$				—			—				2			
$PbSc_1$				15			1				2			
$PbSc_2$				—			1				2			
$PbSc_3$				15			3				3			
Zn COND.	—				—	—				—			—	—
	—					—				—			—	—
	—			—		—				—			—	—
$ZnRo_1$				—				—			—			
$ZnRo_2$				—				—			—			
$ZnSc_1$				—				—			—			
$ZnSc_2$				—				—			—			
$ZnSc_3$				—				—			—			

ROUGHER TEST

TEST NO.: 9

PURPOSE: Condition By Size (Pb circuit only) (+50% 2-11)

PROCEDURE: Modified Standard Rougher Test (no reagents in grind)

FEED: 2 Bc.D

GRIND: 15 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	—	—	—	—		—			15					
$PbRo_1$	6.20 (total)			75 (total)		—	2			4	1		6.9	10.0
$PbRo_2$				—			1				2			
$PbSc_1$				35			—				2			
$PbSc_2$				—			1				2			
$PbSc_3$				25			1				3			
Zn COND.	—				—	—				—			—	—
	—					—				—			—	—
	—			—		—				—			—	—
$ZnRo_1$				—				—			—			
$ZnRo_2$				—				—			—			
$ZnSc_1$				—				—			—			
$ZnSc_2$				—				—			—			
$ZnSc_3$				—				—			—			
												—		

ROUGHER TEST

TEST NO.: 10

PURPOSE: Condition By Size (Pb circuit only) (+50% Z-11) (Parallel test)

PROCEDURE: Modified Standard Rougher Test (no reagents in grind)

FEED: 2 BC.D

GRIND: 15 min primary

	REAGENTS ADDED (g/t):								TIME (MIN)			SCAV TL	PH	
STAGE	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH	P_{80} μ	START	FINISH
PRIMARY GRIND									1.5					
$PbRo_1$	534 (total)			75 (total)			2			4	1		6.7	10.0
$PbRo_2$							1				2			
$PbSc_1$							1				2			
$PbSc_2$							1				2			
$PbSc_3$							2				3			
Zn COND.														
$ZnRo_1$														
$ZnRo_2$														
$ZnSc_1$														
$ZnSc_2$														
$ZnSc_3$														

ROUGHER TEST

TEST NO.: 11

PURPOSE: Establishing Standard Rougher Procedure

PROCEDURE: Modified Standard Rougher Test (No Z-11 conditioning in PbRo's)

FEED: 1 Bc D

GRIND: 15 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000	1000	100			—			15					
$PbRo_1$	6030 (total)			60 (total)		—	—			—	1		8.7	10.0
$PbRo_2$				—			1				2			
$PbSc_1$				15			1				2			
$PbSc_2$				—			1				2			
$PbSc_3$				15			1				3			
Zn COND.	—			—	(total) 1000	1360 (total)				2			at start 9.7	after CuSO4 11.3
	—			—		—				2				11.3 at end
	—			60 (total)										
$ZnRo_1$				—				—			1			
$ZnRo_2$				—				1			2			
$ZnSc_1$				20				1			2			
$ZnSc_2$				—				—			2			
$ZnSc_3$				20				—			3			
												—		

ROUGHER TEST

TEST NO.: 12

PURPOSE: Establishing Standard Roughor Procedure

PROCEDURE: Modified Standard Roughor Test (no reagents in grind) (no Z-11 conditioning in PbRo's)

FEED: 2BCD

GRIND: 15 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL P_{80} μ	PH: START	FINISH
PRIMARY GRIND									15					
$PbRo_1$	7450 (total)			50 (total)			1				1		5.5	10.0
$PbRo_2$							1				2			
$PbSc_1$							1				2			
$PbSc_2$							1				2			
$PbSc_3$							1				3			
Zn COND.				60 (total)	10 c/s total	1400 (total)				8 2			at start 9.65	11.14 at end
$ZnRo_1$											1			
$ZnRo_2$								2			2			
$ZnSc_1$				20				1			2			
$ZnSc_2$											2			
$ZnSc_3$				20				2			3			

ROUGHER TEST

TEST NO.: 13

PURPOSE: Doing standard Rougher test

PROCEDURE: Modified Standard Rougher test (no Na_2SO_3 in grind).

FEED: 2 BC D

GRIND: 15 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH START	PH FINISH
PRIMARY GRIND	300		100						15					
$PbRo_1$	6020 (total)			50 (total)			1				1		8.5	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			2				2			
$PbSc_2$							1				0			
$PbSc_3$				15			2				3			
Zn COND.				60 (total)	1000 (total)	1800 (total)				0 2			9.9	11.3
$ZnRo_1$											1			
$ZnRo_2$								2			2			
$ZnSc_1$				20							2			
$ZnSc_2$											2			
$ZnSc_3$				20							3			

ROUGHER TEST

TEST NO.: 14

PURPOSE: Condition By Size (50/50 split of $CuSO_4$ Addition)

PROCEDURE: Modified Standard Rougher Test (Zinc circuit)

FEED: 2BC.D

GRIND: 15min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000		100						15					
$PbRo_1$	6250 (total)			50 (total)							1		8.8	10.1
$PbRo_2$							1				2			
$PbSc_1$				15			1				2			
$PbSc_2$							1				2			
$PbSc_3$				15			1				3			
Zn COND.				60 (total)	1000 (total)	3000 (total)				8 2			8.9	11.31
$ZnRo_1$											1			
$ZnRo_2$								1			2			
$ZnSc_1$				20				1			2			
$ZnSc_2$								1			2			
$ZnSc_3$				20							3			

ROUGHER TEST

TEST NO.: 15

PURPOSE: Condition By Size (Parallel test)

PROCEDURE: Modified Standard Rougher Test (Zn circuit)

FEED: 2 Bc. 10

GRIND: 15 min in primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000		100						15					
$PbRo_1$	6420 (total)			50 (total)			1				1		8.6	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			2				2			
$PbSc_2$							1				2			
$PbSc_3$				15			2				3			
Zn COND.				60 (total)	1000 (total)	2100 (total)				0 2			8.1	11.03
$ZnRo_1$								1			1			
$ZnRo_2$											2			
$ZnSc_1$				20							1			
$ZnSc_2$								1			2			
$ZnSc_3$				20							3			

ROUGHER TEST

TEST NO.: 16

PURPOSE: Condition By Size (Zn circuit) (50/50 split of $CuSO_4$ Addition)

PROCEDURE: Modified Standard Rougher Test

FEED: 2 BCD

GRIND: 15 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000	—	100			—			15					
$PbRo_1$	467.5 (total)			50 (total)		—	—			—	1		8.4	10.0
$PbRo_2$				—			—				1			
$PbSc_1$				15			1				2			
$PbSc_2$				—			1				2			
$PbSc_3$				15			—				3			
Zn COND.	—			60 (total)	1000 (total)	1700 (total)				6 2			8.0	11.1
$ZnRo_1$				—				—			1			
$ZnRo_2$				—				1			2			
$ZnSc_1$				90				1			2			
$ZnSc_2$				—				1			2			
$ZnSc_3$				90				1			3	—		

ROUGHER TEST

TEST NO.: 17

PURPOSE: Condition By Size (Zn circuit) (Parallel Test)

PROCEDURE: Modified Standard Rougher Test

FEED: 2 Bcn

GRIND: 15 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000		100						15					
$PbRo_1$	390 (total)			50 (total)			1				1		8.6	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			1				2			
$PbSc_2$							1				2			
$PbSc_3$				15							3			
Zn COND.				60 (total)	1000 (total)	3400 (total)				6 2			8.5	11.1
$ZnRo_1$											1			
$ZnRo_2$								2			2			
$ZnSc_1$				20				2			2			
$ZnSc_2$											2			
$ZnSc_3$				20				1			3			

ROUGHER TEST

TEST NO.: 18

PURPOSE: Condition By Size (Zn circuit) (60/40 split of $CuSO_4$ Addition)

PROCEDURE: Modified Standard Roughar Test

FEED: 2 BCD

GRIND: 15 min primary

	REAGENTS ADDED (g/t):								TIME (MIN)			SCAV TL	PH	
STAGE	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH	$P_{80}\mu$	START	FINISH
PRIMARY GRIND	3000		100						15					
$PbRo_1$	6140 (total)			60 total							1		8.6	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			1				1			
$PbSc_2$							1				2			
$PbSc_3$				15			1				3			
Zn COND.				60 total	1000 total	1900 total				4 1			9.2	11.0
$ZnRo_1$											1			
$ZnRo_2$								3			2			
$ZnSc_1$				20				1			1			
$ZnSc_2$								1			1			
$ZnSc_3$				20				1			3			

ROUGHER TEST

TEST NO.: 19

PURPOSE: Condition By Size (Zn circuit) (Parallel test)

PROCEDURE: Modified Standard Rougher Test

FEED: 2BCD

GRIND: 15 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000	—	100	—		—			15					
$PbRo_1$	462c (total)			60 (total)		—	—			—	1		8.5	10.0
$PbRo_2$				—			—				2			
$PbSc_1$				15			1				1			
$PbSc_2$				—			1				2			
$PbSc_3$				15			—				3			
Zn COND.	—					3600 (total)				4			9.5	9.1
	—			60 (total)	1000 (total)					2				
	—													
$ZnRo_1$				—				1			1			
$ZnRo_2$				—				2			2			
$ZnSc_1$				90				1			2			
$ZnSc_2$				—				1			2			
$ZnSc_3$				90				1			3			
												—		

CLEANER TEST

TEST NO.: 20

PURPOSE: Comparison purposes (Pb circuit only)

PROCEDURE: Standard Cleaner Test (Repeat of test 3 reagents, etc.)

FEED: 2BCD

GRIND: 15 min. primary 10 minute regrind

	REAGENTS - added (g/t)						Time (minutes)			PH	
STAGE	Na_2SO_3	NaCN	Z-11	$CuSO_4$	Na_2CO_3	CaO	Grind	Cond	Froth	Start	Finis
PRIMARY GRIND		100			3000		15				
"											
LEAD Ro/SC			50 (total) 15 15		4780 (total)				3 1 3	8.6	10.0
LEAD REGRIND		50			1000		10				
LEAD 1st CL.			60		550			2	5	9.9	10.1
LEAD 2nd CL.			20		750			9	4	9.4	10.1
LEAD 3rd CL.			10		820			2	3	9.1	10.0
ZINC COND.											
ZINC Ro/Sc											
ZINC REGRIND											
ZN 1st CL.											
ZN 2nd CL.											
ZN 3rd CL.											

CLEANER TEST

TEST NO.: 21

PURPOSE: Condition By Size (Pb Circuit only)

PROCEDURE: Standard Cleaner Test

FEED: 2BCD

GRIND: 15 min primary ; 10 minute regrind

STAGE	REAGENTS - added (g/t)						Time (minutes)			PH	
	Na_2SO_3	NaCN	Z-11	$CuSO_4$	Na_2CO_3	CaO	Grind	Cond	Froth	Start	Finis
PRIMARY GRIND	—	100	—		3000	—	15				
"			—				—				
LEAD Ro/SC			50 (total)		2330 (total)	—		5	3	7.4	10.0
			15						2		
			15						3		
LEAD REGRIND	—	50	—	—	1000		10				
LEAD 1st CL.			60		280	—		9	5	9.8	10.1
LEAD 2nd CL.			20		660	—		3	4	9.2	10.0
LEAD 3rd CL.			10		880	—		2	3	9.1	10.0
ZINC COND.						—					
				—		—				—	—
			—			—				—	—
ZINC Ro/Sc											
			—						—		
			—						—		
ZINC REGRIND	—			—		—	—				
ZN 1st CL.			—			—			—	—	—
ZN 2nd CL.			—			—			—	—	—
ZN 3rd CL.			—			—			—	—	—

ROUGHER TEST

TEST NO.: 22

PURPOSE: Condition By Size (+50% Z-11 Addition) (50/50 Split on $CuSO_4$ Addition)

PROCEDURE: Modified Standard Rougher Test (Zn circuit)

FEED: 2BCD

GRIND: 16min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL P_{80} µ	PH: START	FINISH
PRIMARY GRIND	3000		100						15					
$PbRo_1$	533g (total)			60 total							1		8.2	10.0
$PbRo_2$							1				2			
$PbSc_1$				15							2			
$PbSc_2$							1				2			
$PbSc_3$				15			1				3			
Zn COND.				90 (total)	1000 (total)	2500 (total)				8 2			8.5	11.2
$ZnRo_1$											1			
$ZnRo_2$								2			2			
$ZnSc_1$				30				1			2			
$ZnSc_2$											2			
$ZnSc_3$				30				1			3			

ROUGHER TEST

TEST NO.: 23

PURPOSE: Condition By Size (50/50 split $CuSO_4$) (+50% increase 2-11)

PROCEDURE: Modified Standard Rougher Test (Zn circuit) (Parallel test)

FEED: 2BCN

GRIND: 15min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000		100						15					
$PbRo_1$	6.8% (total)			50 (total)							1		8.3	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			1				2			
$PbSc_2$							1				2			
$PbSc_3$				15							3			
Zn COND.				90 (total)	1000 (total)	1000 (total)				5.0 2.0			at Start 7.9	after case 6.5 11.2 at end
$ZnRo_1$								1			1			
$ZnRo_2$											2			
$ZnSc_1$				30				1			2			
$ZnSc_2$								1			2			
$ZnSc_3$				30							3			

ROUGHER TEST

TEST NO.: 24

PURPOSE: Condition By Size (Repeat of test 14) (Zn circuit)

PROCEDURE: Modified Standard Rougher Test

FEED: 2 lbs

GRIND: 15 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000		100						15					
$PbRo_1$	6260 (total)			5 (total)							1		8.5	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			1				2			
$PbSc_2$											2			
$PbSc_3$				15			1				3			
Zn COND.				60 (total)	1000 (total)	3740 (total)				8 2			9.0	11.1
$ZnRo_1$								1			1			
$ZnRo_2$								2			2			
$ZnSc_1$				20				2			2			
$ZnSc_2$								1			2			
$ZnSc_3$				20				1			3			

ROUGHER TEST

TEST NO.: 25

PURPOSE: Condition by Size (Repeat of test 15) (Parallel Test)

PROCEDURE: Modified Standard Roughter Test

FEED: 2 Bc YD

GRIND: 15 min primary

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL P_{80}	PH: START	FINISH
PRIMARY GRIND	300		100						15					
PbRo$_1$	5160 (total)			50 (total)			1				1		8.6	10.0
PbRo$_2$							1				2			
PbSc$_1$				15							2			
PbSc$_2$							1				2			
PbSc$_3$				15			1				3			
Zn COND.				60 (total)	1000 (total)	2200 (total)				8 2			at start 9.4	after cal 9.1 11.0 at end
ZnRo$_1$								1			1			
ZnRo$_2$								2			2			
ZnSc$_1$				20				1			2			
ZnSc$_2$								1			2			
ZnSc$_3$				20				1			3			

ROUGHER TEST

TEST NO.: #1

PURPOSE: CONDITION BY SIZE - STANDARD ROUGHER TEST (Pb & Zn)

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO Z-11 IN GRIND)

FEED: 2EF ORE

GRIND: 14 MIN. PRIMARY

	REAGENTS ADDED (g/t):								TIME (MIN)			SCAV TL $P_{80}\mu$	PH	
STAGE	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH		START	FINISH
PRIMARY GRIND	3000		100						14					
$PbRo_1$	4300			50							1		8.5	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			1				2			
$PbSc_2$							1				2			
$PbSc_3$				15			1				3			
Zn COND.				60	1000	2000				8 2			9.74	9.6 11.18
$ZnRo_1$											1			
$ZnRo_2$								3			2			
$ZnSc_1$				2							2			
$ZnSc_2$								1			2			
$ZnSc_3$				2							3			

ROUGHER TEST

TEST NO.: #2

PURPOSE: CONDITION BY SIZE - 5 MIN. CONDITIONING (Pb CIRCUIT ONLY)

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO Z-11 IN GRIND)

FEED: 2EF ORE

GRIND: 14 MIN PRIMARY

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000		100						14					
$PbRo_1$	3820 (TOTAL)			50 (TOTAL)			1			5	1		7.2	10.0
$PbRo_2$							2				2			
$PbSc_1$				15			2				2			
$PbSc_2$							1				2			
$PbSc_3$				15			1				3			
Zn COND.														
$ZnRo_1$														
$ZnRo_2$														
$ZnSc_1$														
$ZnSc_2$														
$ZnSc_3$														

ROUGHER TEST

TEST NO.: #3

PURPOSE: CONDITION BY SIZE - PARALLEL OF TEST #2

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO Z-11 IN GRIND)

FEED: 2EF ORE

GRIND: 14 MIN. PRIMARY

STAGE	REAGENTS ADDED (g/t)								TIME (MIN)			SCAV TL $P_{80}\mu$	PH	
	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH		START	FINISH
PRIMARY GRIND	3000	—	100	—		—			14					
$PbRo_1$	5550			50		—	2			5	1		7.2	10.0
$PbRo_2$				—			1				2			
$PbSc_1$				—			1				2			
$PbSc_2$				—			—				2			
$PbSc_3$				—			1				3			
Zn COND.	—			—	—	—				—			—	—
$ZnRo_1$				—				—			—			
$ZnRo_2$				—				—			—			
$ZnSc_1$				—				—			—			
$ZnSc_2$				—				—			—			
$ZnSc_3$				—				—			—	—		

ROUGHER TEST

TEST NO.: #4

PURPOSE: CONDITION BY SIZE - 2.5 MIN. CONDITIONING (PS CIRCUIT ONLY)

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO 241 IN GRIND)

FEED: 2EFORE

GRIND: 14 MIN. PRIMARY

	REAGENTS ADDED (g/t):								TIME (MIN)			SCAV TL	PH	
STAGE	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH	$P_{80}\mu$	START	FINISH
PRIMARY GRIND	3000	—	100	—	—	—	—	—	14	—	—	—	—	—
$PbRo_1$	7120 TOTAL			50 TOTAL		—	1	—	—	2.5	1	—	7.1	10.3
$PbRo_2$				—			1				2			
$PbSc_1$				—			2				2			
$PbSc_2$				—			1				2			
$PbSc_3$				—			—				3			
Zn COND.	—			—	—	—	—			—	—		—	—
	—					—	—			—	—		—	—
	—					—	—			—	—		—	—
$ZnRo_1$				—				—			—			
$ZnRo_2$				—				—			—			
$ZnSc_1$				—				—			—			
$ZnSc_2$				—				—			—			
$ZnSc_3$				—				—			—	—		

ROUGHER TEST

TEST NO.: #5

PURPOSE: CONDITION BY SIZE - PARALLEL OF TEST #4

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO Z-11 IN GRIND)

FEED: 2EF ORE

GRIND: 14 MIN. PRIMARY

	REAGENTS ADDED (g/t):								TIME (MIN)			SCAV TL	PH	
STAGE	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH	$P_{80}\mu$	START	FINISH
PRIMARY GRIND	3000		100						14					
$PbRo_1$	5230			50			4			2.5	1		7.3	10.0
$PbRo_2$											2			
$PbSc_1$							1				2			
$PbSc_2$				15							2			
$PbSc_3$				15			1				3			
Zn. COND.														
$ZnRo_1$														
$ZnRo_2$														
$ZnSc_1$														
$ZnSc_2$														
$ZnSc_3$														

ROUGHER TEST

TEST NO.: #6

PURPOSE: CONDITION BY SIZE - 8 MIN. CONDITIONING (ZN CIRCUIT ONLY)

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO Z-11 IN GRIND)

FEED: 2EF ORE

GRIND: 14 MIN. PRIMARY

	REAGENTS ADDED (g/t):								TIME (MIN)			SCAV TL	PH	
STAGE	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH	$P_{80}\mu$	START	FINISH
PRIMARY GRIND	3000		100						14					
$PbRo_1$	5030			50			1				1		8.8	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			2				2			
$PbSc_2$							1				2			
$PbSc_3$				15			1				3			
Zn COND.				60	1000	2100 TOTAL				8 2			8.8	9.5 11.0
$ZnRo_1$											1			
$ZnRo_2$								1			2			
$ZnSc_1$				20							2			
$ZnSc_2$								1			2			
$ZnSc_3$				20							3			

ROUGHER TEST

TEST NO.: #7

PURPOSE: CONDITION BY SIZE - PARALLEL OF TEST #6

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO 2-11 IN GRIND)

FEED: 2EF ORE

GRIND: 14 MIN. PRIMARY

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000		100						14					
$PbRo_1$	4970			50			1				1		8.6	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			1				2			
$PbSc_2$							1				2			
$PbSc_3$				15			1				3			
Zn COND.					1000	1800				8			9.4	9.0
				60						2				10.0
$ZnRo_1$											1			
$ZnRo_2$								1			2			
$ZnSc_1$				20							2			
$ZnSc_2$								1			2			
$ZnSc_3$				20							3			

ROUGHER TEST

TEST NO.: #8

PURPOSE: CONDITION BY SIZE - 6.0 MIN. CONDITIONING (ZN CIRCUIT ONLY)

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO Z-11 IN GRIND)

FEED: 2EF ORE

GRIND: 14 MM. PRIMARY

	REAGENTS ADDED (g/t):								TIME (MIN)			SCAV TL $P_{80}\mu$	PH	
STAGE	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH		START	FINISH
PRIMARY GRIND	3000		100						14					
$PbRo_1$	4840			50			1						8.5	10.0
$PbRo_2$							2							
$PbSc_1$				15			1							
$PbSc_2$														
$PbSc_3$				15			1							
Zn COND.				60	1000 TOTAL	1900 TOTAL				5 2			8.2	6.3 11.0
$ZnRo_1$											1			
$ZnRo_2$								1			2			
$ZnSc_1$				20							2			
$ZnSc_2$											2			
$ZnSc_3$				20							3			

ROUGHER TEST

TEST NO.: #9

PURPOSE: CONDITION BY SIZE - PARALLEL OF TEST #8

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO 2-11 IN GRIND)

FEED: 2EF ORE

GRIND: 14 min. PRIMARY

	REAGENTS ADDED (g/t)								TIME (MIN)			SCAV TL	PH	
STAGE	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH	$P_{80}\mu$	START	FINISH
PRIMARY GRIND	3000		100						14					
$PbRo_1$	13,630			50							1		9.2	10.0
$PbRo_2$											2			
$PbSc_1$				16			1				2			
$PbSc_2$							1				2			
$PbSc_3$				15			1				3			
Zn COND.				60	1000	3200				6 2			9.52	9.33 11.0
$ZnRo_1$								1			1			
$ZnRo_2$								1			2			
$ZnSc_1$				20				1			2			
$ZnSc_2$								1			2			
$ZnSc_3$				20				1			3			

ROUGHER TEST

TEST NO.: #10

PURPOSE: CONDITION BY SIZE - 8 MIN. CONDITIONING (ZN CIRCUIT)
- 50% MORE Z-11
- 50/50 $CuSO_4$ SPLIT

PROCEDURE: MODIFIED STD. ROUGHER TEST (NO Z-11 IN GRIND)

FEED: 2 EFORE

GRIND: 14 MIN. PRIMARY

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000		100						14					
$PbRo_1$				50							1		8.2	10.0
$PbRo_2$											2			
$PbSc_1$				15			1				2			
$PbSc_2$											2			
$PbSc_3$				15							3			
Zn COND.				90	1000 TOTAL	2100 TOTAL				8 2			9.5	9.1 11.0
$ZnRo_1$								1			1			
$ZnRo_2$								1			2			
$ZnSc_1$				30				1			2			
$ZnSc_2$								1			2			
$ZnSc_3$				30				1			3			

ROUGHER TEST

TEST NO.: #11

PURPOSE: CONDITION BY SIZE - PARALLEL OF TEST #10

PROCEDURE: MODIFIED STANDARD ROUGHER TEST

FEED: 2EFORE

GRIND: 14 MIN. PRIMARY

	REAGENTS ADDED (g/t):								TIME (MIN)			SCAV TL $P_{80}\mu$	PH	
STAGE	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH		START	FINISH
PRIMARY GRIND	3000		100						14					
$PbRo_1$	5810			50							1		8.5	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			1				2			
$PbSc_2$							1				2			
$PbSc_3$				15							3			
Zn COND.				90	1000	1700				8 2			8.5	6.6 11.1
$ZnRo_1$											1			
$ZnRo_2$											2			
$ZnSc_1$				30				1			2			
$ZnSc_2$											2			
$ZnSc_3$				30							3			

ROUGHER TEST

TEST NO.: #1

PURPOSE: CONDITION BY SIZE - ESTABLISHING STANDARD ROUGHER TEST (Pb & Zn)

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO 2-11 IN GRIND)

FEED: 2H ORE

GRIND: 12 MIN PRIMARY

STAGE	REAGENTS ADDED (g/t)								TIME (MIN)			SCAV TL	PH	
	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH	$P_{80}\mu$	START	FINISH
PRIMARY GRIND	3000		300						12					
PbRo$_1$	6700			50							1		8.0	10.0
PbRo$_2$							1				2			
PbSc$_1$				15			1				2			
PbSc$_2$							1				2			
PbSc$_3$				15			1				3			
Zn COND.				60	1000	2200				8 2			9.7	9.6 11.2
ZnRo$_1$											1			
ZnRo$_2$								2			2			
ZnSc$_1$				20				3			2			
ZnSc$_2$								2			2			
ZnSc$_3$				20							3			

ROUGHER TEST

TEST NO.: #2

PURPOSE: CONDITION BY SIZE - 5 MIN. CONDITIONING (Pb CIRCUIT ONLY)

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO 2-11 IN GRIND)

FEED: 2# ORE

GRIND: 12 MIN. PRIMARY

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000		300						12					
$PbRo_1$	3240 TOTAL			50 TOTAL			2				1		7.2	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			1				2			
$PbSc_2$							1				2			
$PbSc_3$				15			1				3			
Zn COND.														
$ZnRo_1$														
$ZnRo_2$														
$ZnSc_1$														
$ZnSc_2$														
$ZnSc_3$														

ROUGHER TEST

TEST NO.: #3

PURPOSE: CONDITION BY SIZE - PARALLEL TO TEST #2

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO Z-11 IN GRIND)

FEED: 2H ORE

GRIND: 12 min. PRIMARY

	REAGENTS ADDED (g/t)								TIME (MIN)			SCAV TL $P_{80}\mu$	PH	
STAGE	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH		START	FINISH
PRIMARY GRIND	3000		300						12					
PbRo$_1$	2570			50			2				1		7.1	10.0
PbRo$_2$							1				2			
PbSc$_1$				15			1				2			
PbSc$_2$											2			
PbSc$_3$				15							3			
Zn COND.														
ZnRo$_1$														
ZnRo$_2$														
ZnSc$_1$														
ZnSc$_2$														
ZnSc$_3$														

ROUGHER TEST

TEST NO.: #4

PURPOSE: CONDITION BY SIZE - 2.5 MIN. CONDITIONING (PB CIRCUIT ONLY)

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO Z-11 IN GRIND)

FEED: 2H ORE

GRIND: 12 MIN GRIND

	REAGENTS ADDED (g/t)								TIME (MIN)			SCAV TL $P_{80}\mu$	PH	
STAGE	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH		START	FINISH
PRIMARY GRIND	3000		300						12					
$PbRo_1$	3960 TOTAL			50 TOTAL			2				1		7.0	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			1				2			
$PbSc_2$							1				2			
$PbSc_3$				15			2				3			
Zn COND.														
$ZnRo_1$														
$ZnRo_2$														
$ZnSc_1$														
$ZnSc_2$														
$ZnSc_3$														

ROUGHER TEST

TEST NO.: #5

PURPOSE: CONDITION BY SIZE - PARALLEL OF TEST #4

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO Z-11 IN GRIND)

FEED: 2H ORE

GRIND: 12 min PRIMARY

	REAGENTS ADDED (g/t)								TIME (MIN)			SCAV TL $P_{80}\mu$	PH	
STAGE	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH		START	FINISH
PRIMARY GRIND	3000		300						12					
$PbRo_1$	3880			50			2				1		7.7	10.0
$PbRo_2$							1				2			
$PbSc_1$				15			1				2			
$PbSc_2$							1				2			
$PbSc_3$				15			1				3			
Zn COND.														
$ZnRo_1$														
$ZnRo_2$														
$ZnSc_1$														
$ZnSc_2$														
$ZnSc_3$														

ROUGHER TEST

TEST NO.: #6

PURPOSE: CONDITION BY SIZE - 8 MIN CONDITIONING (ZN CIRCUIT)

PROCEDURE: MODIFIED STANDARD ROUGHER TEST (NO Z-11 IN GRIND)

FEED: 2H ORE

GRIND: 12 MIN. PRIMARY

STAGE	REAGENTS ADDED (g/t)								TIME (MIN)			SCAV TL $P_{80}\mu$	PH	
	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	GRIND	COND	FROTH		START	FINISH
PRIMARY GRIND	3000	—	300			—			12					
$PbRo_1$	3460			50		—	2			—	1		8.1	10.0
$PbRo_2$				—			1				2			
$PbSc_1$				15			1				2			
$PbSc_2$				—			—				2			
$PbSc_3$				15			—				3			
Zn COND.	—				1000	1600 TOTAL				8			7.3	6.1
	—			60		—				2				11.2
	—													
$ZnRo_1$				—				1			1			
$ZnRo_2$				—				2			2			
$ZnSc_1$				20				1			2			
$ZnSc_2$				—				1			2			
$ZnSc_3$				20				—			3			
												—		

ROUGHER TEST

TEST NO.: #7

PURPOSE: CONDITION BY SIZE - PARALLEL OF TEST #6

PROCEDURE: MODIFIED STANDARD ROUGHER PROCEDURE (NO Z-11 IN GRIND)

FEED: 2H ORE

GRIND: 12 min. GRIND

STAGE	REAGENTS ADDED (g/t): Na_2CO_3	Na_2SO_3	NaCN	Z-11	$CuSO_4$	CaO	MIBC drops	DOW drops	TIME (MIN): GRIND	COND	FROTH	SCAV TL $P_{80}\mu$	PH: START	FINISH
PRIMARY GRIND	3000	—	300			—			12					
$PbRo_1$	3850			50		—	2			—	1		8.2	10.0
$PbRo_2$											2			
$PbSc_1$				15			1				2			
$PbSc_2$							1				2			
$PbSc_3$				15			1				3			
Zn COND.				60	1000	2700				8 2			10.8	6.2 11.3
$ZnRo_1$								2			1			
$ZnRo_2$								1			2			
$ZnSc_1$				20				1			2			
$ZnSc_2$								1			2			
$ZnSc_3$				20				1			3			

CLEANER TEST

TEST NO.: #12

PURPOSE: CONDITION BY SIZE - 5 MIN. Pb CONDITIONING (30/70 Z-11 SPLIT)
- 8 MIN. Zn CONDITIONING (50/50 $CuSO_4$ SPLIT, 50% MORE Z-11)

PROCEDURE: LOCKED CYCLE TEST (6 CYCLES)

FEED: 2 EFORE

GRIND: 14 MIN. PRIMARY, 5 MIN REGRIND

STAGE	REAGENTS - added (g/t)						Time (minutes)			PH	
	Na_2SO_3	NaCN	Z-11	$CuSO_4$	Na_2CO_3	CaO	Grind	Cond	Froth	Start	Fini
PRIMARY GRIND	—	100			3000	—	14				
"			—				—				
LEAD Ro/SC			50		8190 TOTAL	—		5	4	7.5	10.0
			15						2		
			15						2		
LEAD REGRIND	—	50			1000		5				
LEAD 1st CL.			6		760	—		2	5	9.9	10.1
LEAD 2nd CL.			2		2090	—		2	4	9.2	10.1
LEAD 3rd CL.			1		N/A	—		2	3	9.6	10.1
ZINC COND.				1000 TOTAL		1200 TOTAL		8		7.5	6.9
			90			—		2			11.1
ZINC Ro/Sc									4		
			30						2		
			30						2		
ZINC REGRIND	—			300		0.5	5				
ZN 1st CL.			70			0		2	7	11.8	11.8
ZN 2nd CL.			30			0		2	4	11.8	11.8
ZN 3rd CL.			20			1600		2	3	11.8	12.0

Appendix A

Appendix B

Cyprus Anvil Mining Corporation

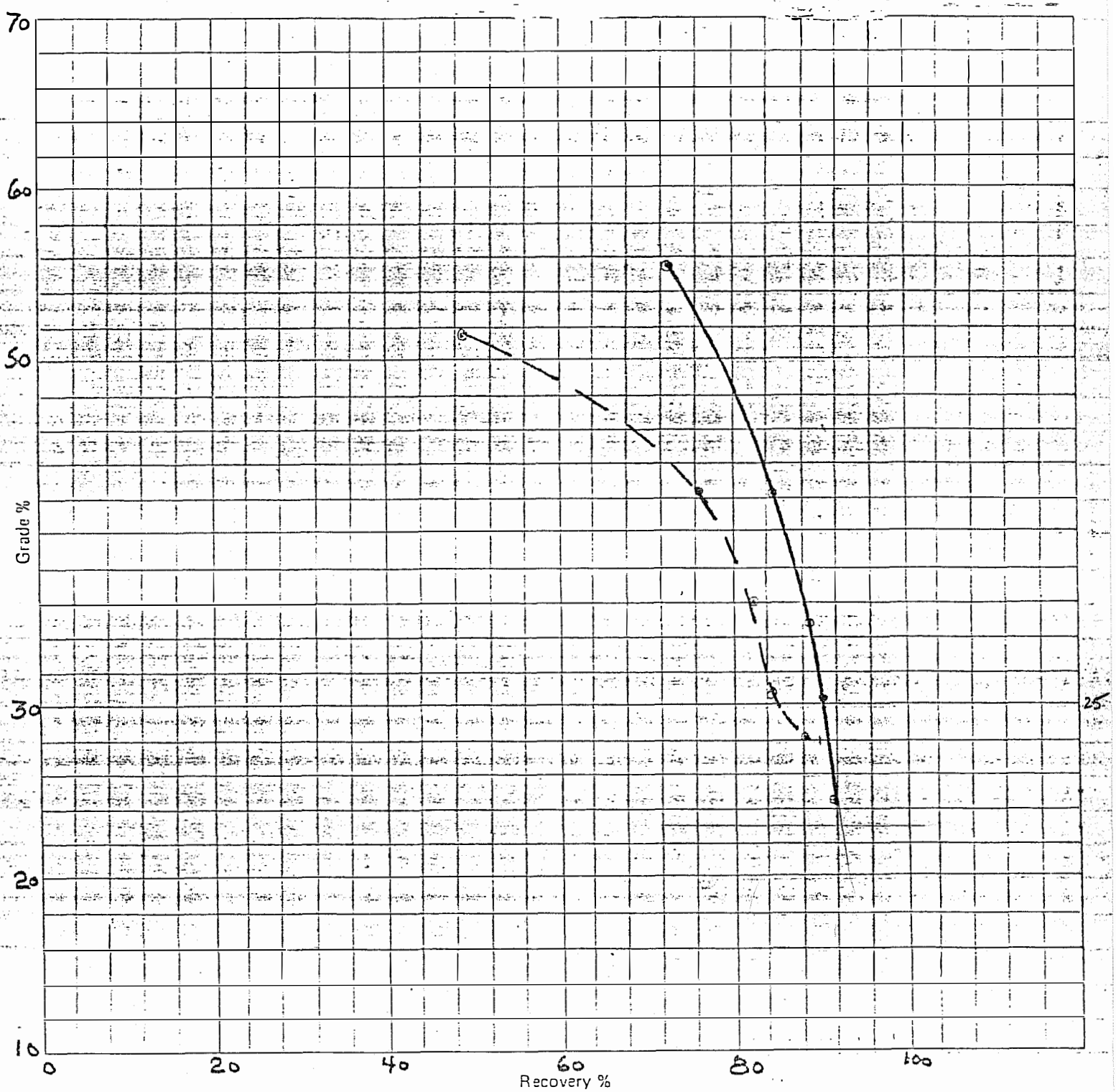
METALLURGICAL TEST REPORT

Grade-Recovery Curve

Test No.: #1 2BCD ORE Date: January 4th, 1984

Objective: Wet screen method development Key: Pb Std. ——— (13)

Reagents: Pb Cond. By Size — — — (1)



Cyprus Anvil Mining Corporation

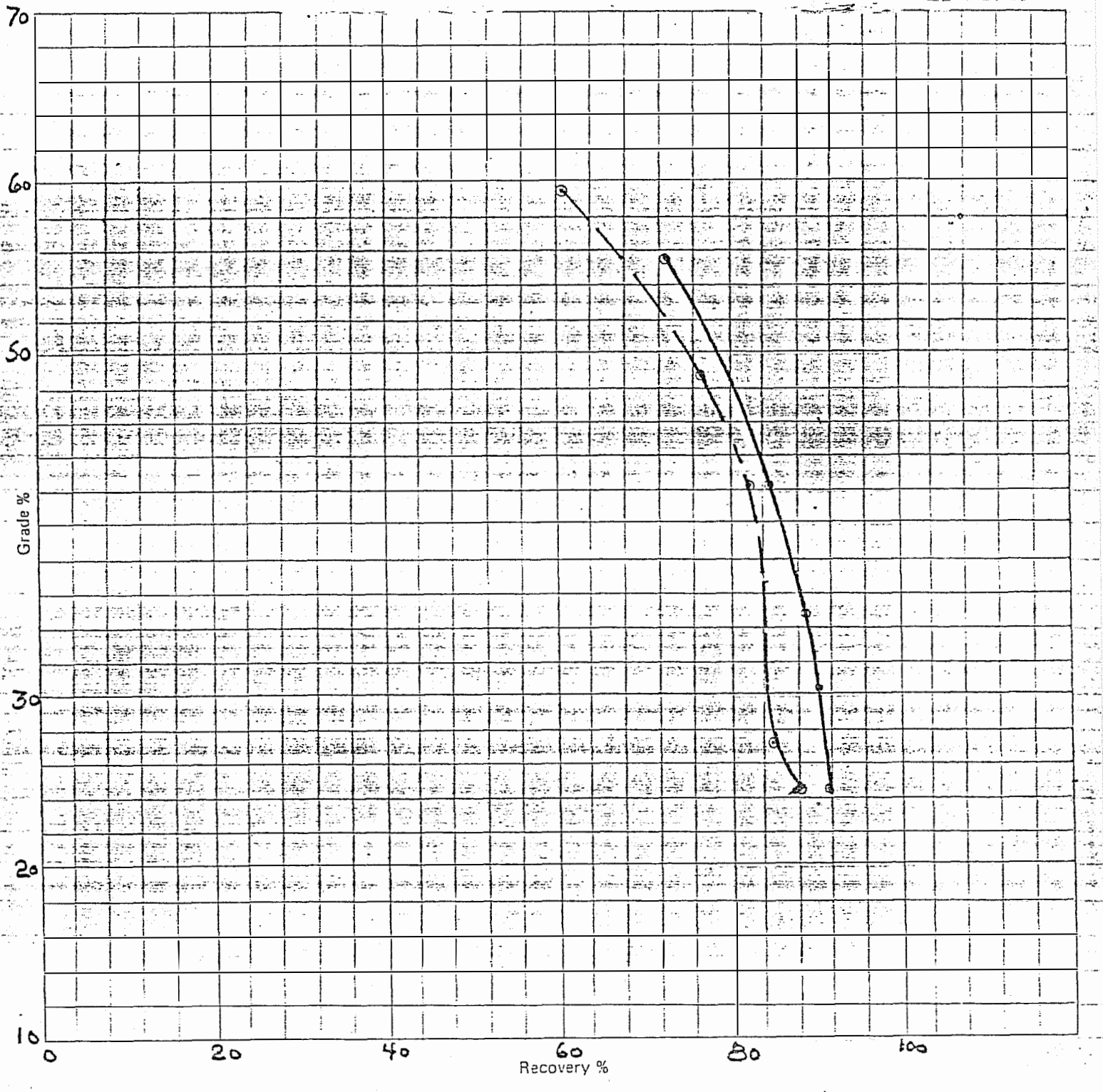
METALLURGICAL TEST REPORT

Grade-Recovery Curve

Test No.: #2 2BCD ORE Date: January 4th, 1984

Objective: wet screen method development Key: Pb Std. ———

Reagents: Pb Cond. By Size - - - -



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

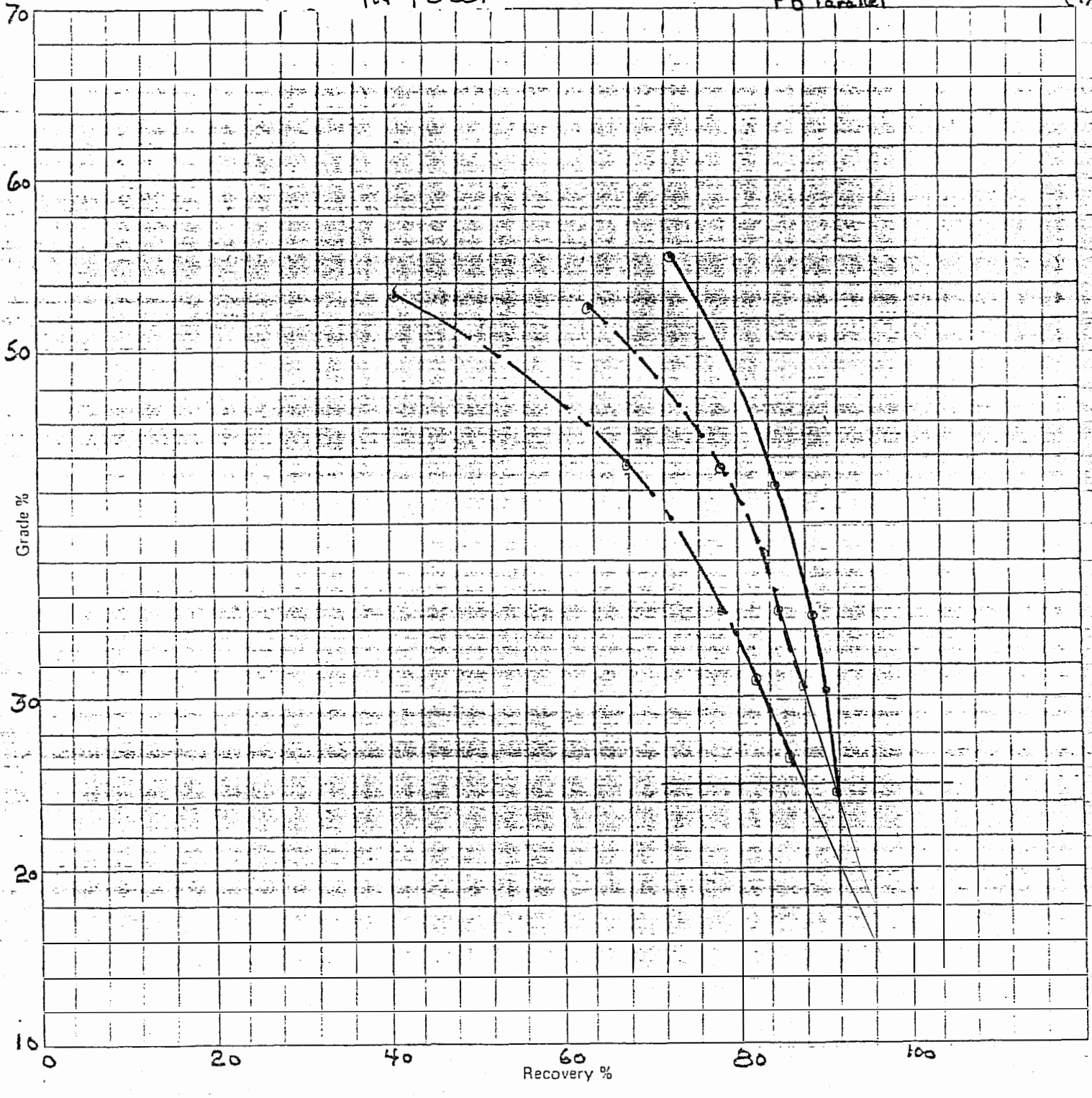
Grade-Recovery Curve

Test No.: #3 & 4 2BCD ORE Date: January 4th, 1984

Objective: 2 BCD COND. By Size Test Pb. Key: Pb Std. ——— (13)

Reagents: 5 minute conditioning tested for Pb cct Pb Cond. By Size — — — (3)

Pb Parallel —— - —— (4)



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

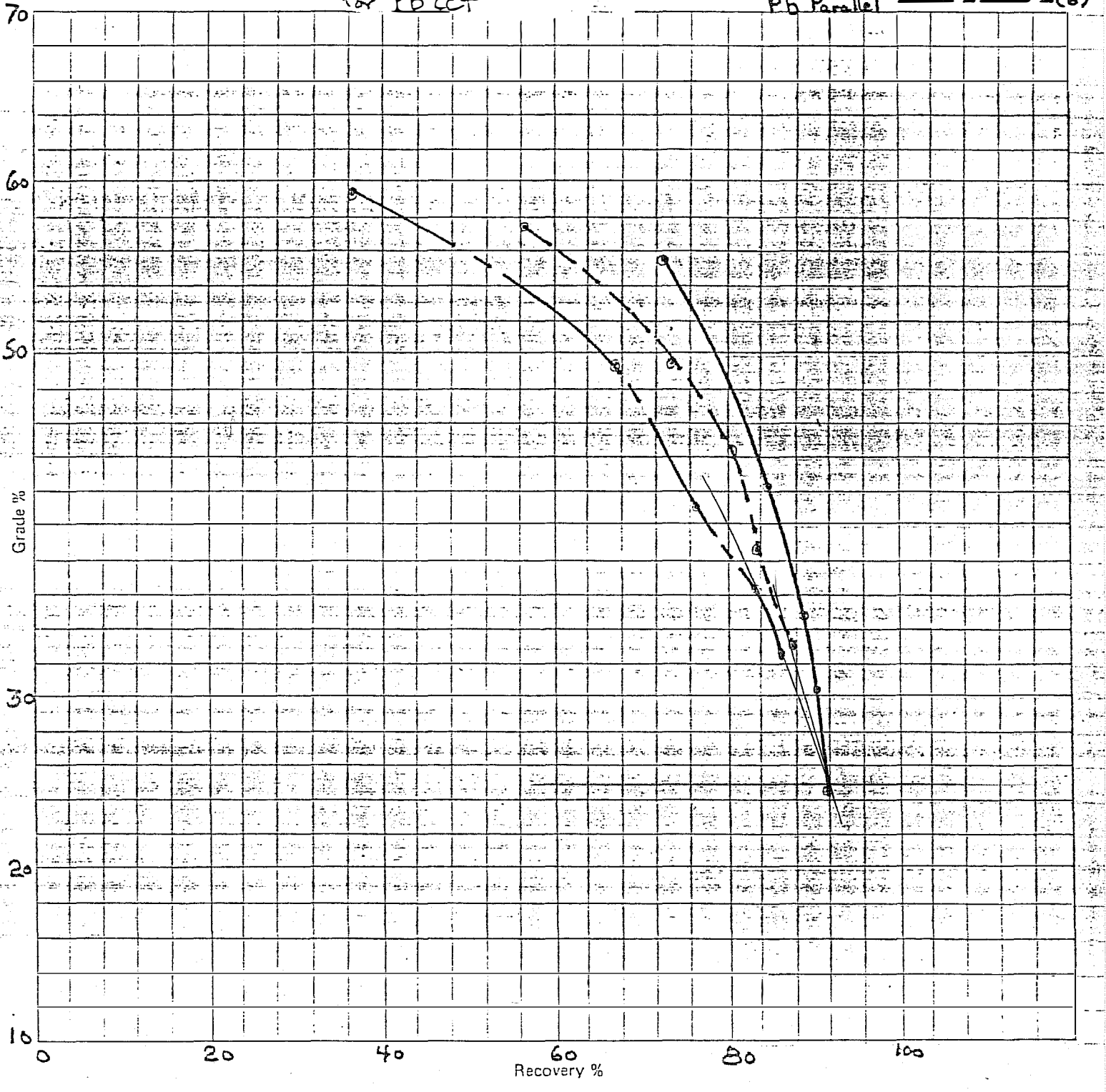
Grade-Recovery Curve

Test No.: #546 2BCD ORE Date: January 4th, 1984

Objective: 2 BCD COND. By Size Test Rn. Key: Pb Std. ——— (3)

Reagents: 2.5 min conditioning tested for Pb cct Pb Cond. By Size — — — (5)

Pb Parallel ——— (6)



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

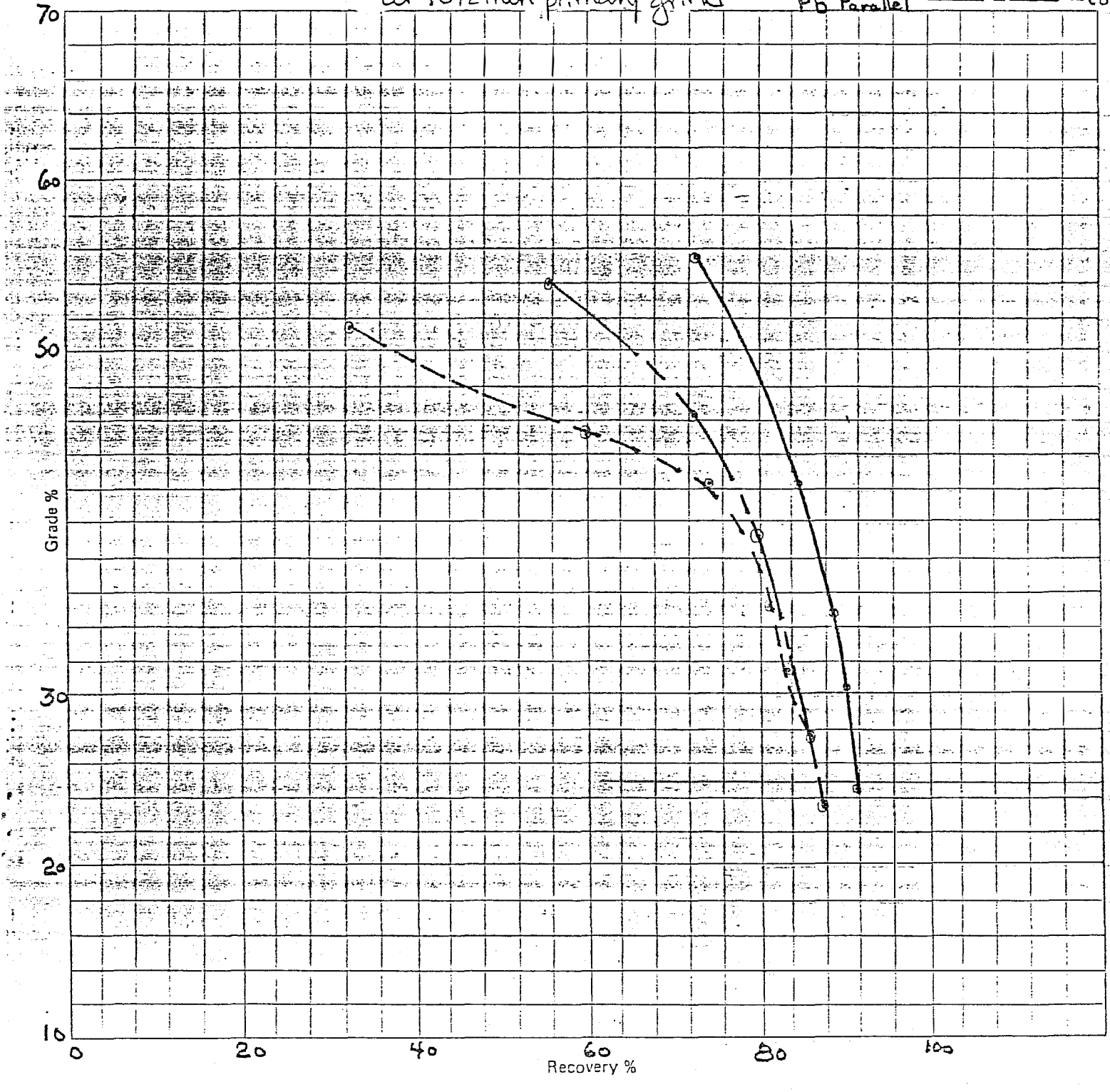
Grade-Recovery Curve

Test No.: #768 2BCD OAE Date: January 4th, 1984

Objective: 2BCD COND. By Size Test #0. Key: Pb Std. ——— (13)

Reagents: 4 min conditioning tested for Pb cct Pb Cond. By Size — — — (7)

at 16½ min primary grind Pb Parallel ——— — — (8)



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

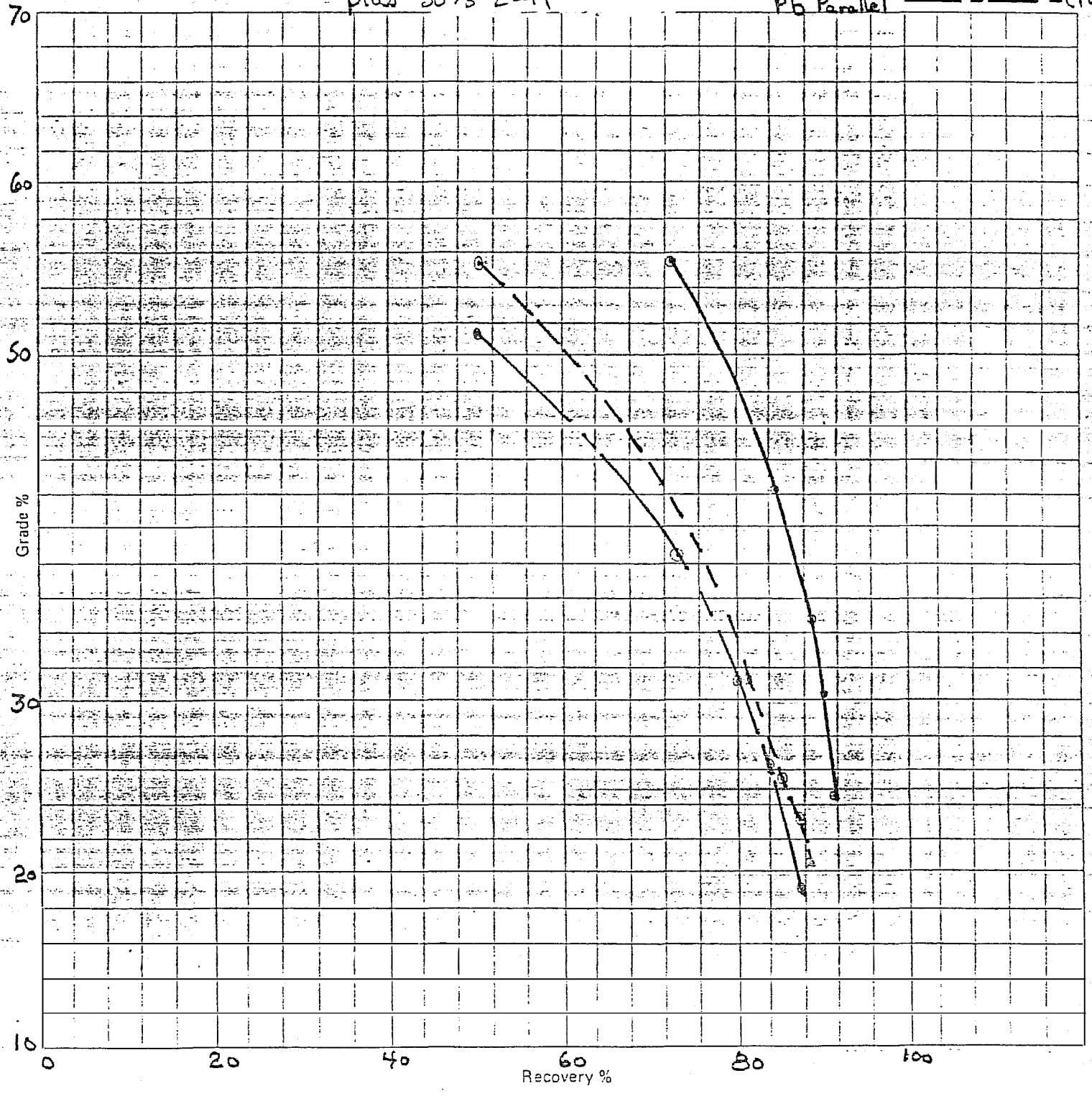
Grade-Recovery Curve

Test No.: #9610 2BCD DAF Date: January 4th, 1984

Objective: 2BCD Cond. By Size Test No. Key: Pb Std. ——— (13)

Reagents: 4 min conditioning tested for Pb ect plus 50% ZnI Pb Cond. By Size — — — (9)

Pb Parallel ——— — — (10)



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Grade-Recovery Curve

Test No.: #11 & 12 2BCD ORE (Rougher) Date: January 4th, 1984

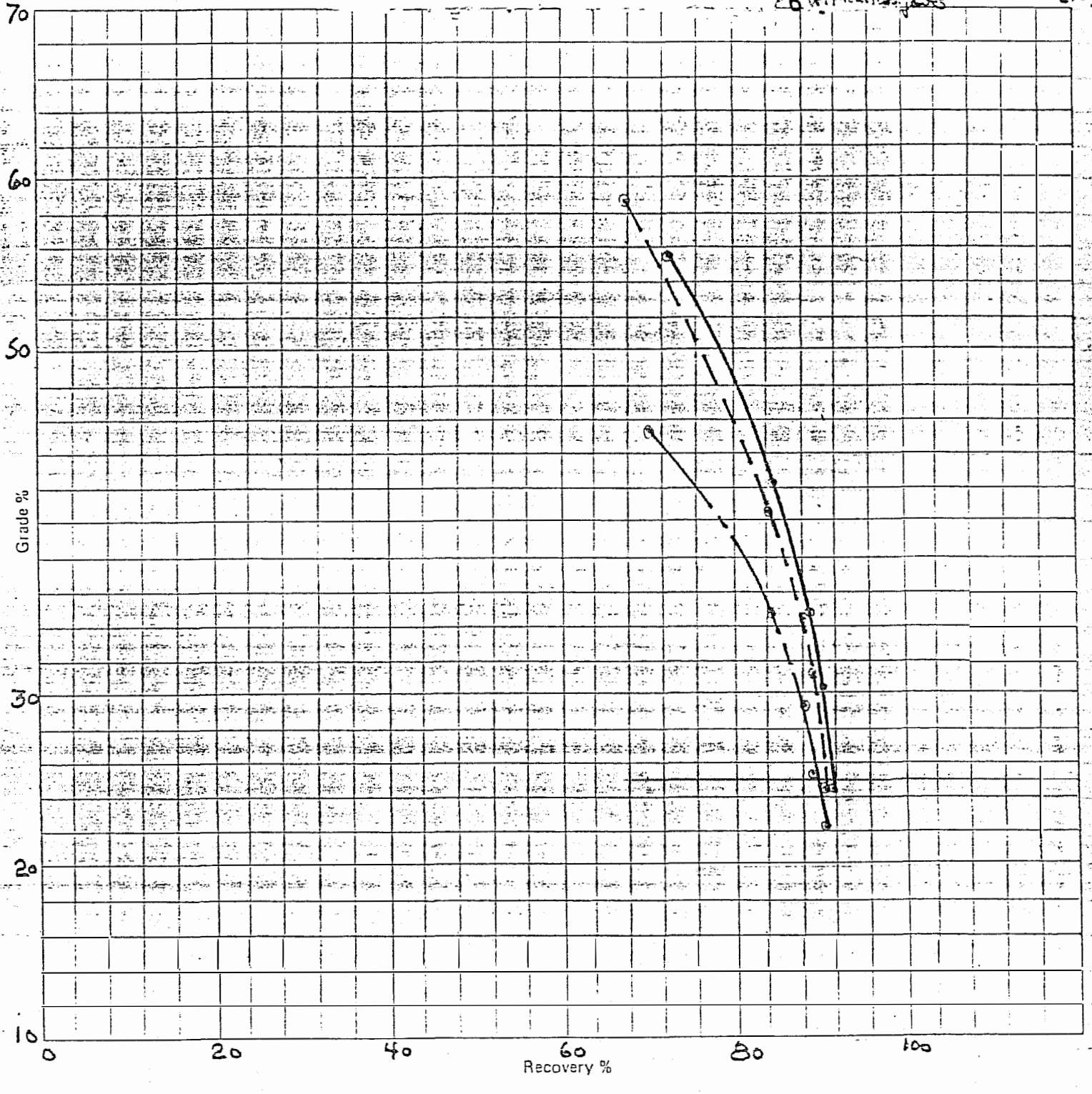
Objective: reagent optimization for Pb cct

Reagents:

Key: Pb Std. (13)

Pb Ro with Na_2S (11)

Pb without Reagents (12)



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

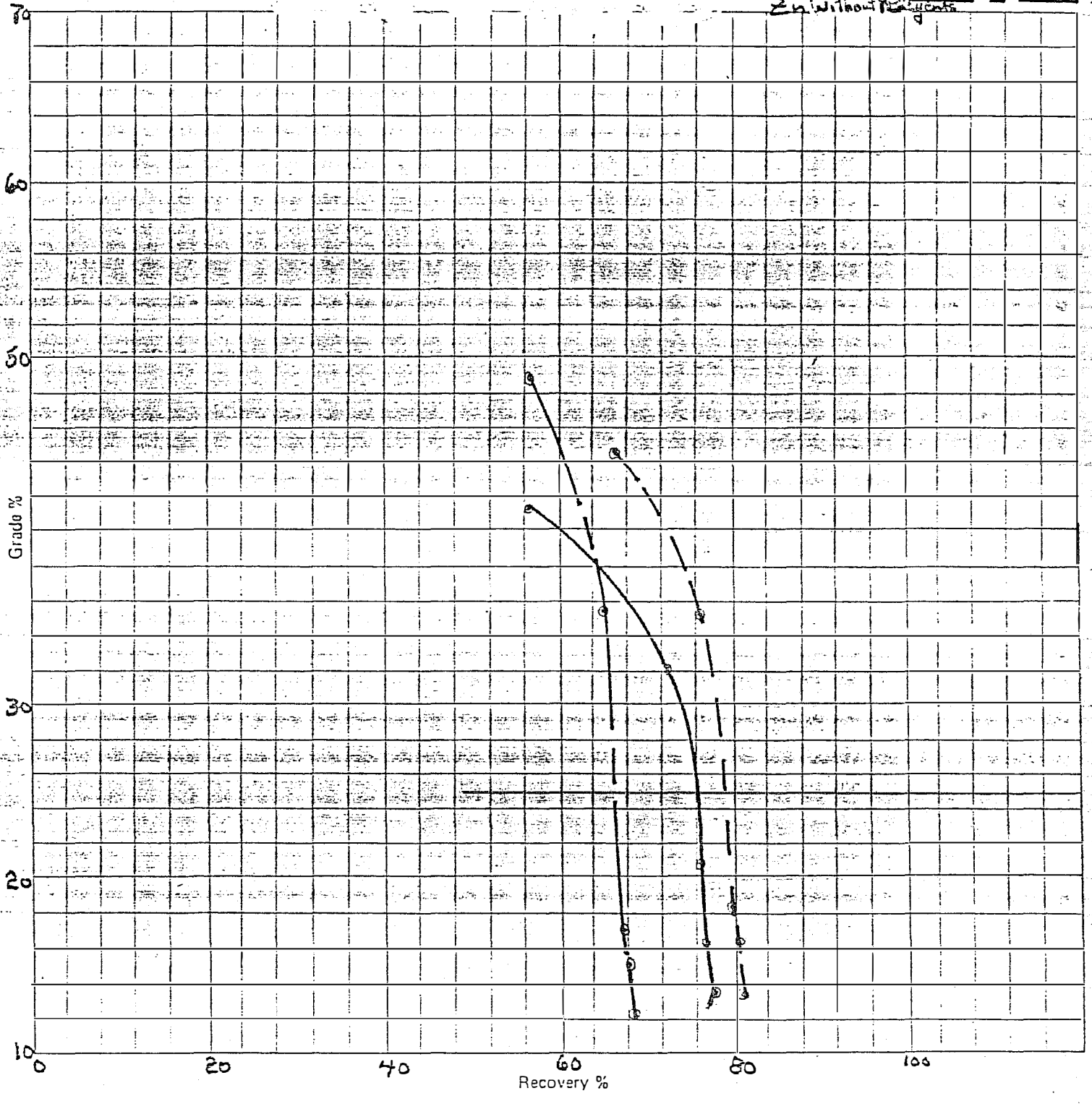
Grade-Recovery Curve

Test No.: #11 & 12 2BCD ORE (Rougher) Date: January 4th, 1984

Objective: reagent optimization Key: Zn Std. ——— (13)

Reagents: for Zn cct Zn Ro with Na_2SO_3 — — — (11)

Zn without Reagents — — — (



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

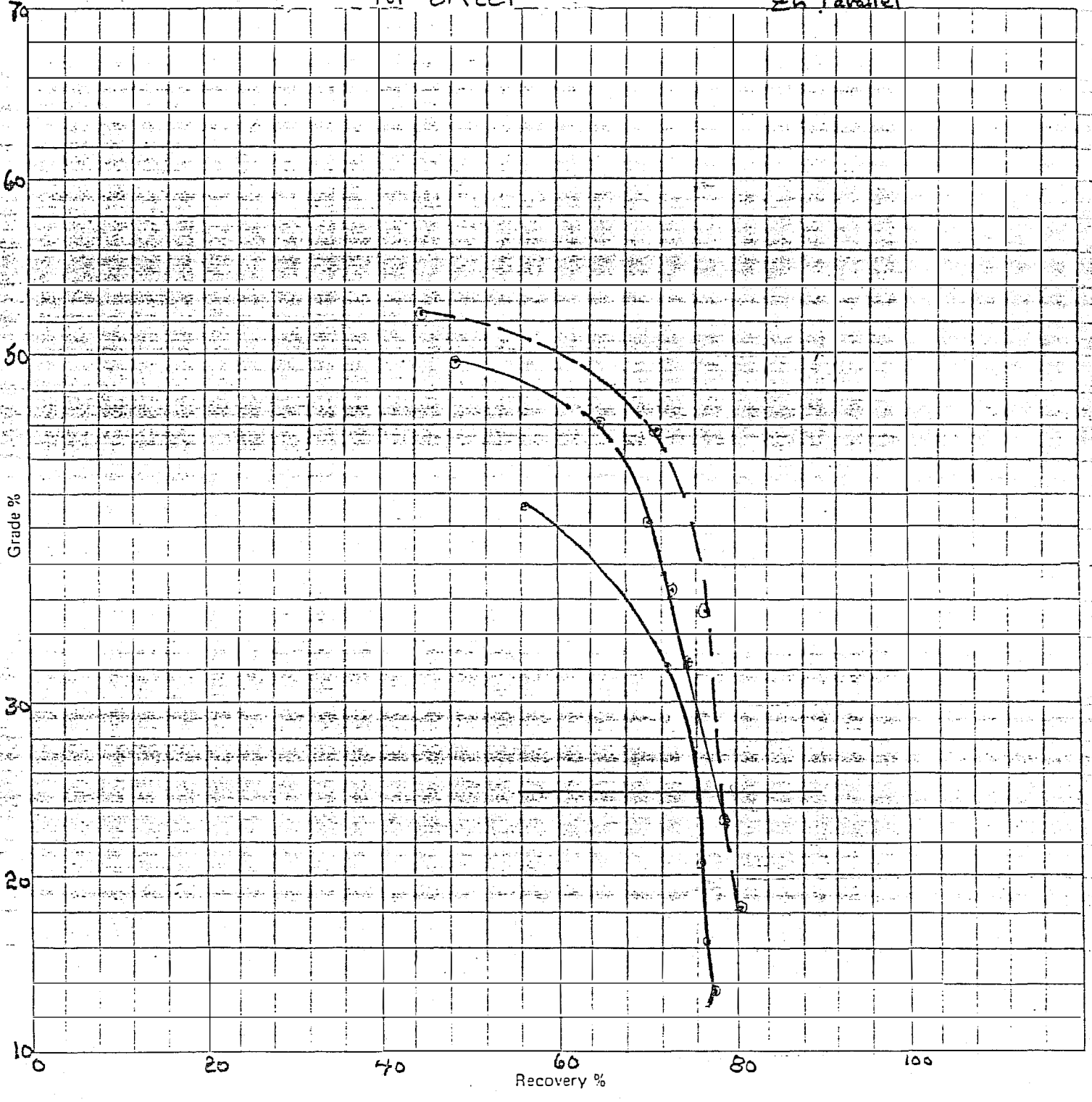
Grade-Recovery Curve

Test No.: #14 & 15 2BCD ORE Date: January 4th, 1984

Objective: 2BCD Conv. By Size Test Ro. Key: Zn Std. ——— (13)

Reagents: 8 min conditioning tested for Zn cct Zn Cond. By Size — — — (14)

Zn Parallel ——— - ——— -(



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

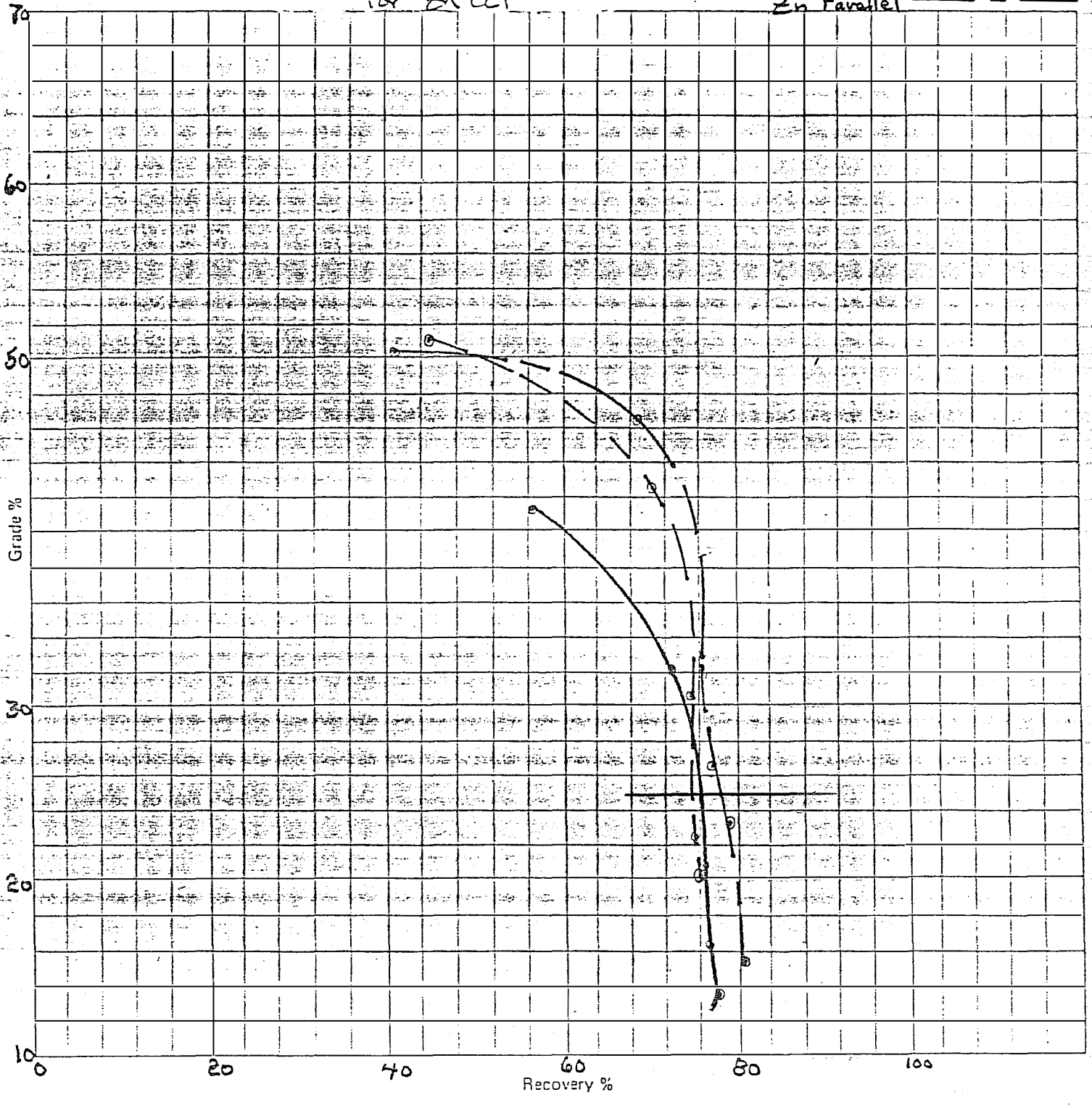
Grade-Recovery Curve

Test No.: #16&17 2BC ORE Date: January 4th, 1984

Objective: 2BCD Conv. By Size Test Ro. Key: Zn Std. ——— (13)

Reagents: 6 min conditioning tested for Zn cct Zn Cond. By Size — — — (16)

Zn Parallel —— - —— (1



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

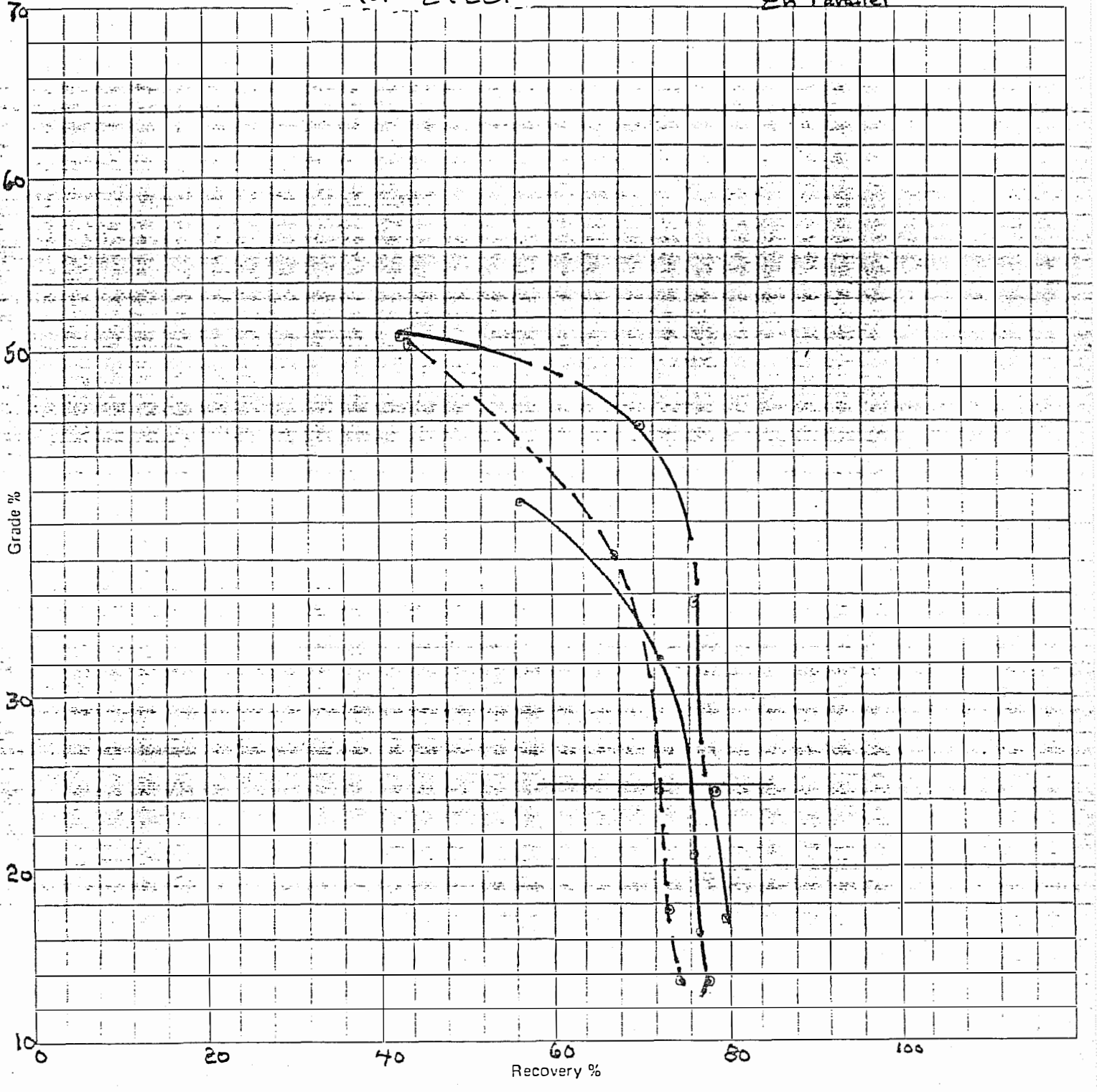
Grade-Recovery Curve

Test No.: #18 & 19 2DCD ORE Date: January 4th, 1984

Objective: 2DCD Cond. By Size Test Ro. Key: Zn Std. ——— (13)

Reagents: 4 min conditioning tested for Zn cct Zn Cond. By Size — — — (1

Zn Parallel — - — -



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Grade-Recovery Curve

Test No.: #20&21 BBCD ORE

Date: January 4th, 1988

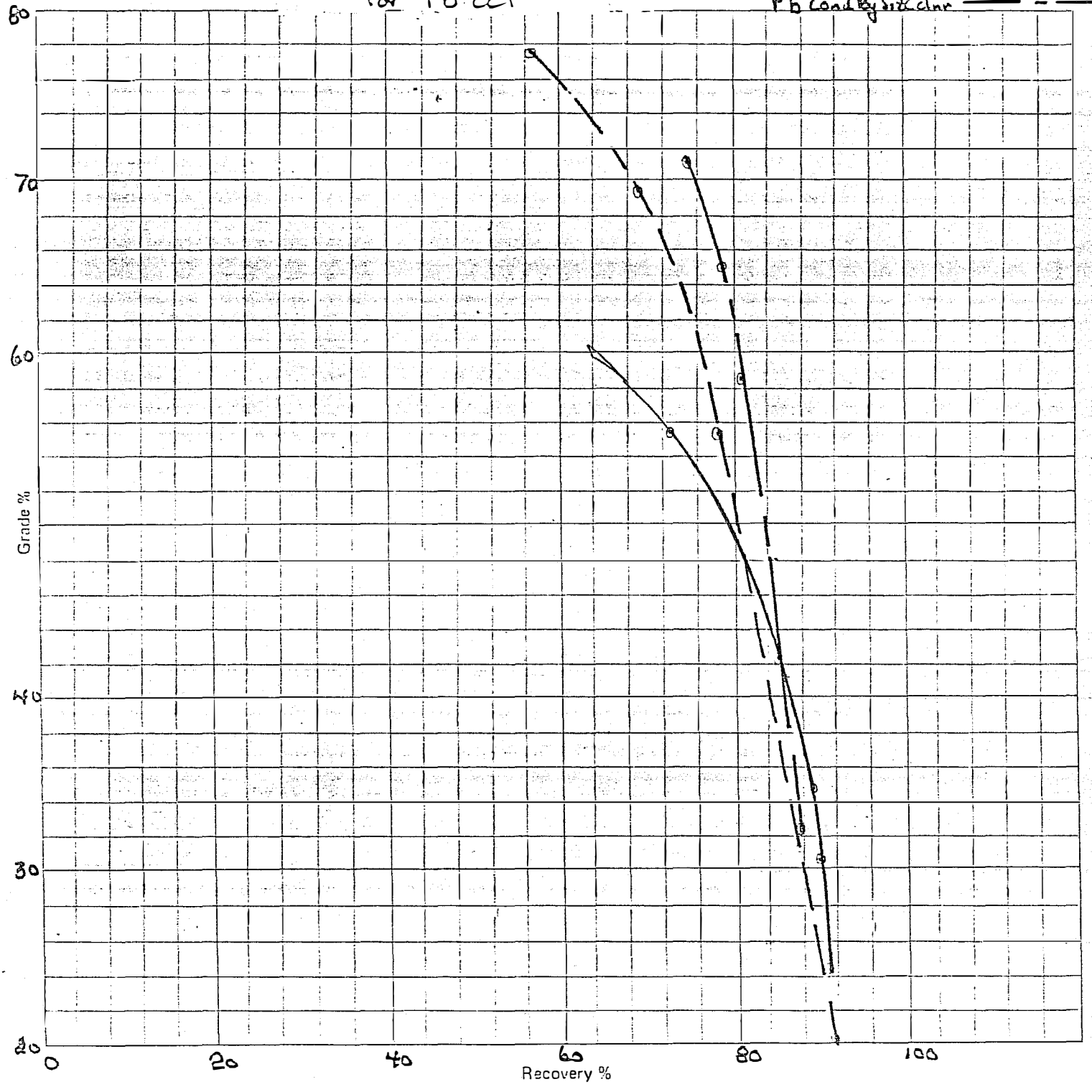
Objective: 2BCD conn By Size cleaner

Key: Pb Std. ——— (13)

Reagents: 5. min conditioning tested for Pb cct

Pb Std cleaner — — — (20)

Pb cond By Size clnr ——— (2



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Grade-Recovery Curve

Test No.: #22 & 23 2BCD ORE

Date: January 4th, 1984

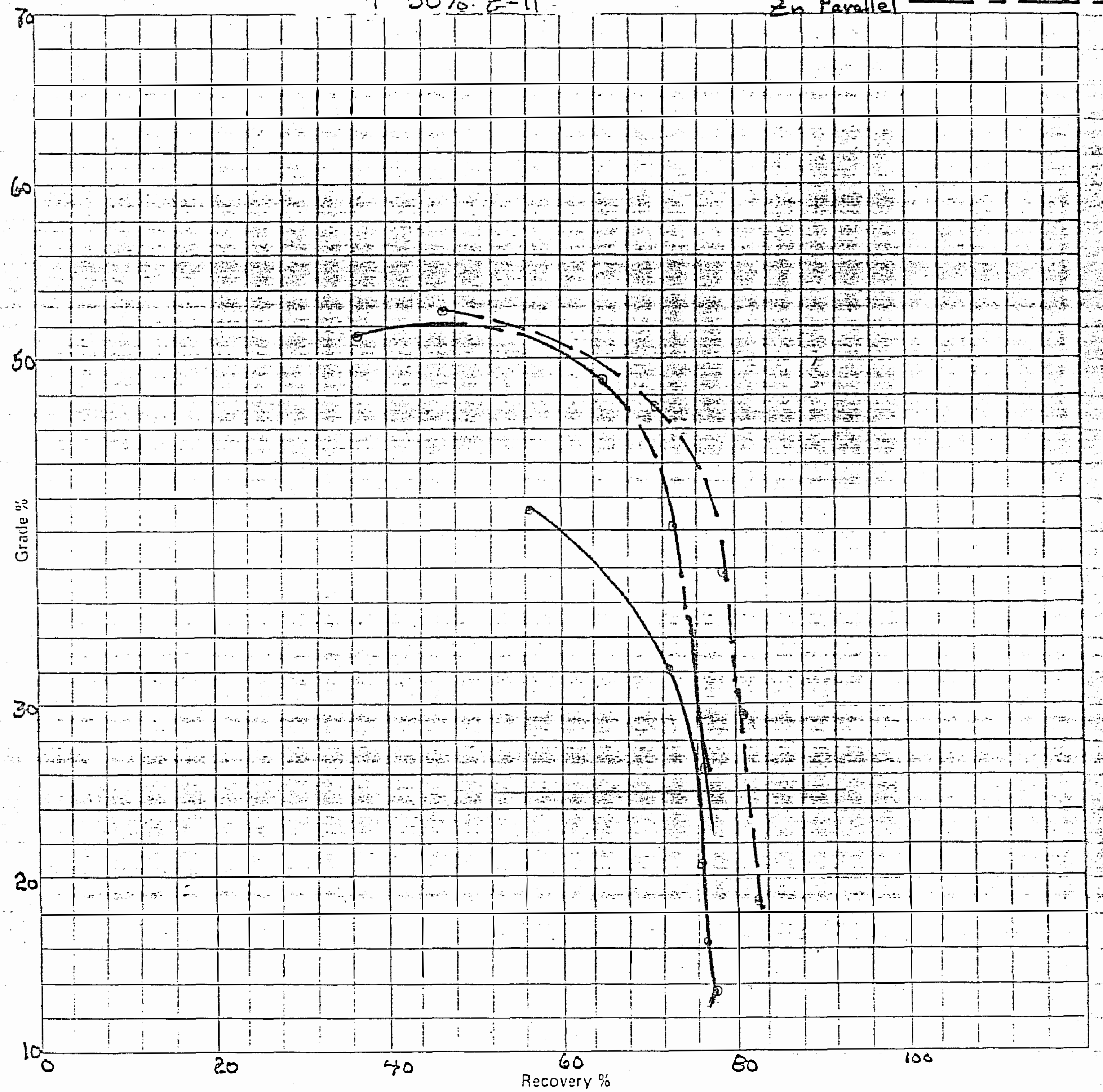
Objective: 2BCD Conc. By Size Test Ro.

Key: Zn Std. ——— (13)

Zn Cond. By Size — — — (2

Zn Parallel —— — ——

Reagents: 8 min conditioning tested for Zn cct + 50% Z-11



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

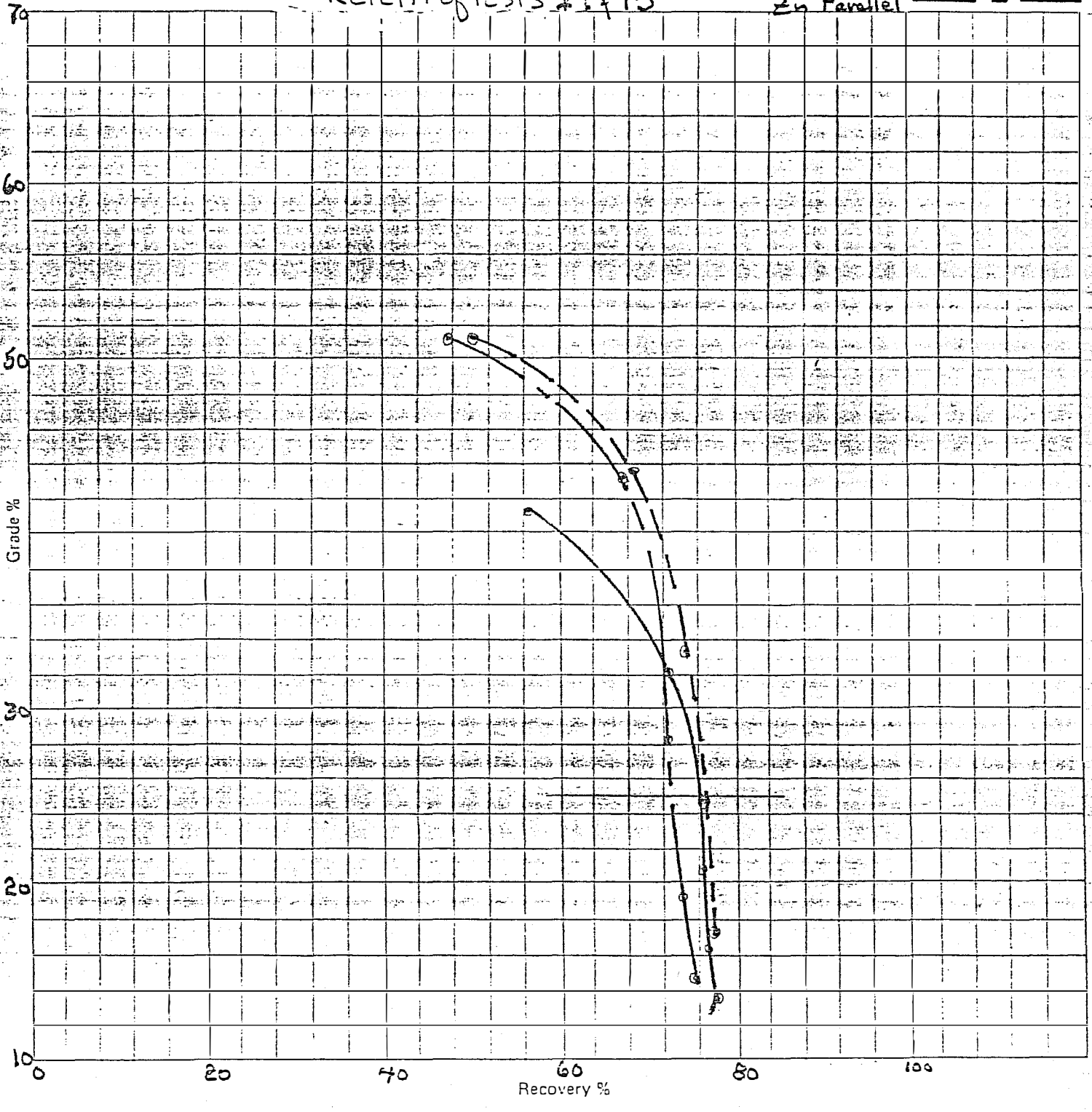
Grade-Recovery Curve

Test No.: #24 & 25 2BCD ORE (Repeat of #14 & 15) Date: January 4th, 1984

Objective: 2BCD Conn. By Size Test Key: Zn Std. ——— (13)

Reagents: 8 min conditioning, tested for Zn act. Zn Cond By Size — — — (24)

REPEAT of TESTS 24 & 25 Zn Parallel ——— - ——— (2



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

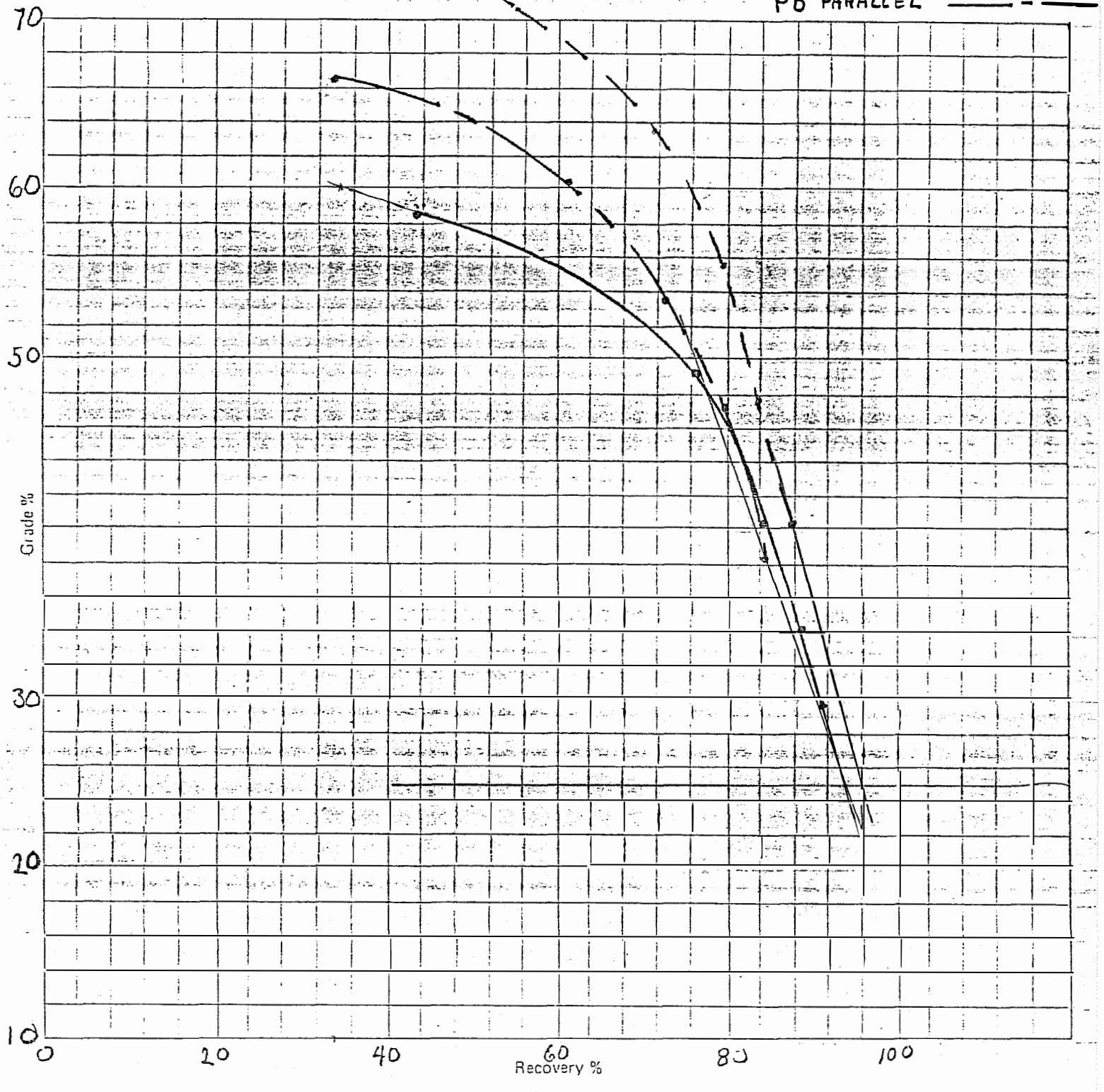
Grade-Recovery Curve

Test No.: TESTS #2,3 Date: 89-04-01

Objective: 2 EF ORE COND. BY SIZE TEST (Rg) Key: Pb STD. ——— (

Reagents: 5 MIN. CONDITIONING for Pb cct Pb COND. BY SIZE — — — —

Pb PARALLEL ——— - ———



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

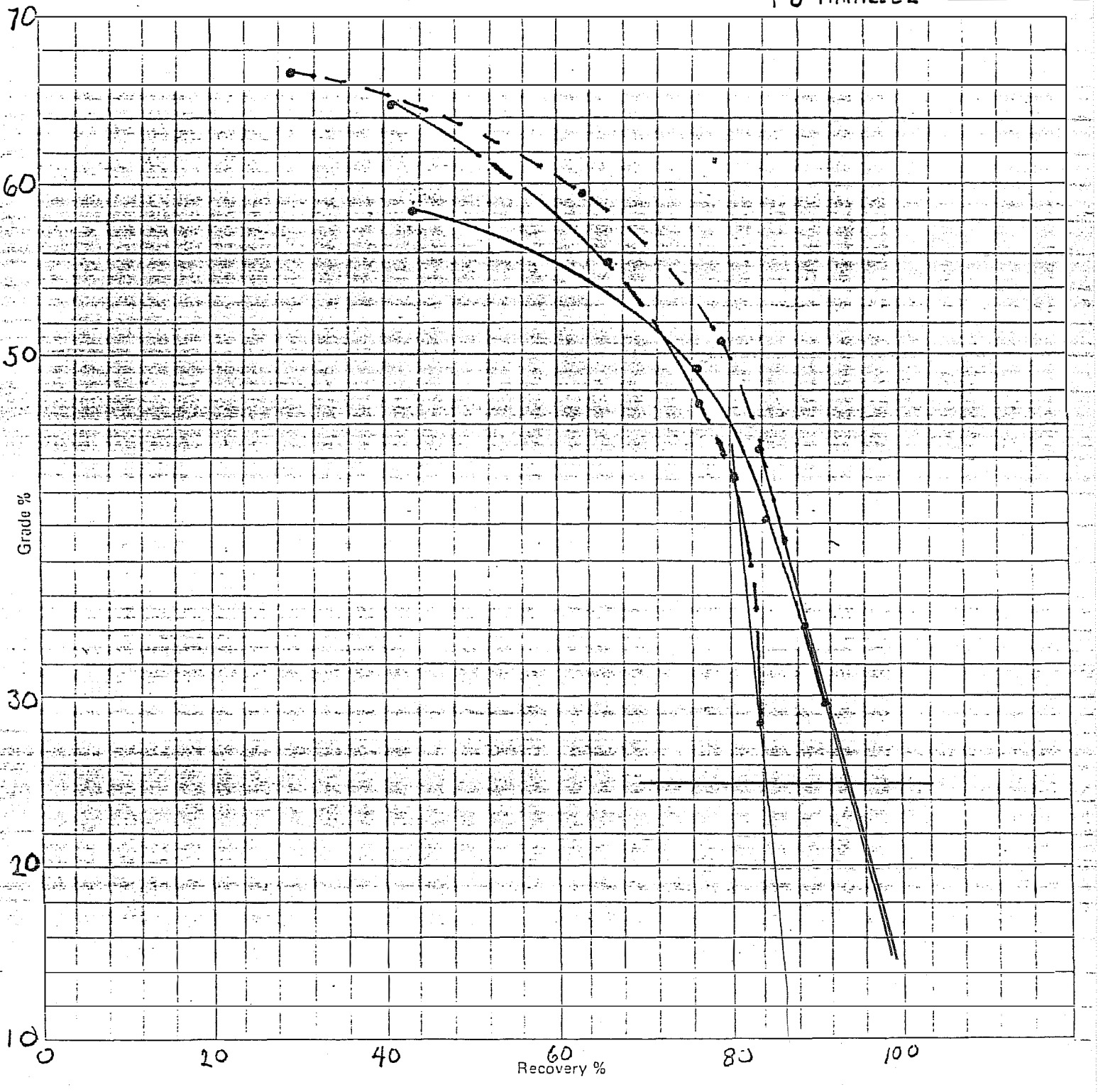
Grade-Recovery Curve

Test No.: TEST # 4.5 Date: 84-04-01

Objective: 2EF ORE COND. BY SIZE TEST (Ro) Key: Pb STD. ———

Reagents: 2.5 MIN. CONDITIONING FOR Pbcct Pb COND. BY SIZE — — — —

Pb PARALLEL ——— - ———



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

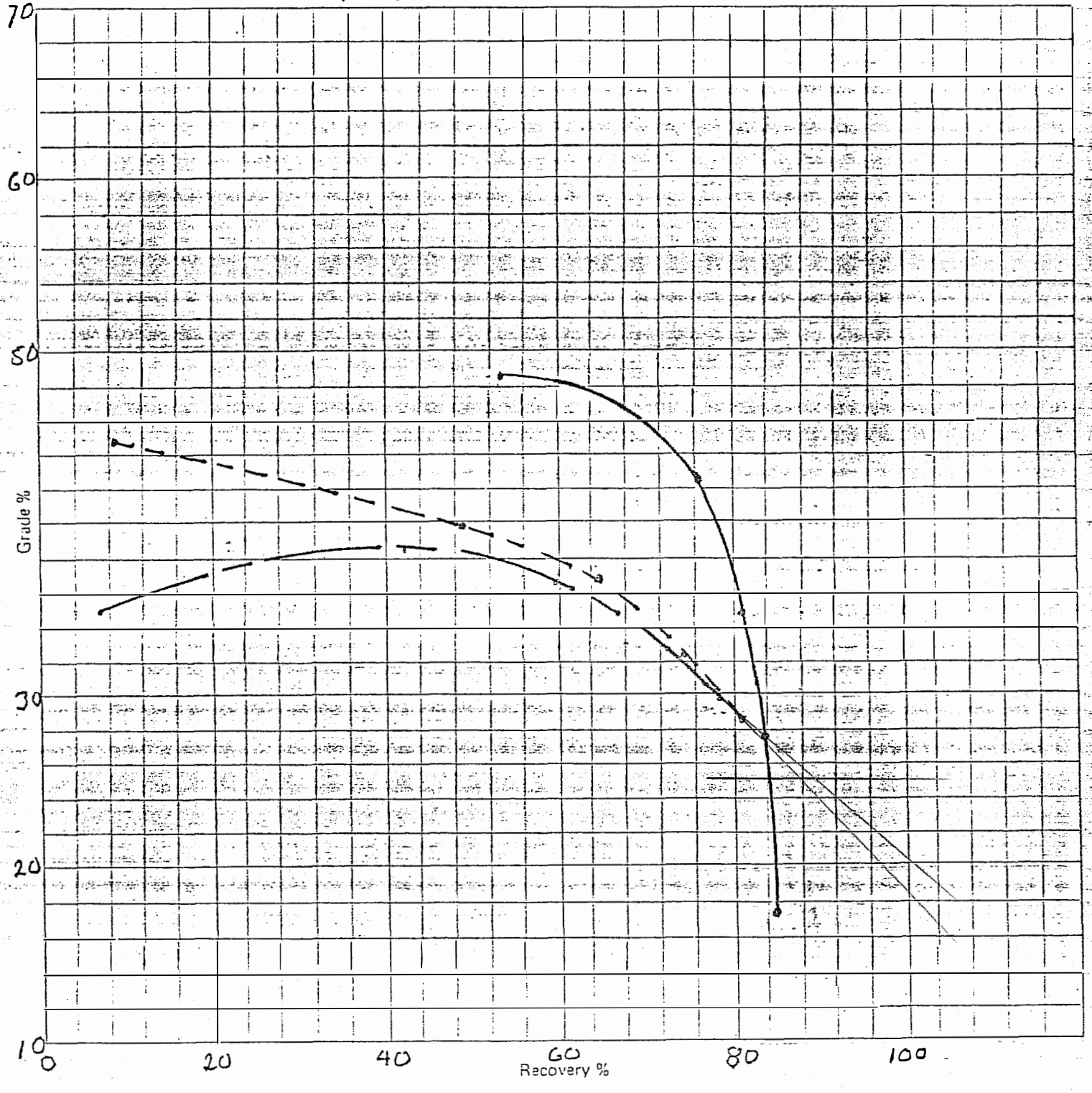
Grade-Recovery Curve

Test No.: TEST # 6,7 Date: 84-04-01

Objective: 2EF ORE COND. BY SIZE TEST (Rio) Key: ZN STD. ——— (1)

Reagents: 8 MIN. CONDITIONING for Zn cct ZN COND. BY SIZE - - - - (6

ZN PARALLEL ——— (7



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

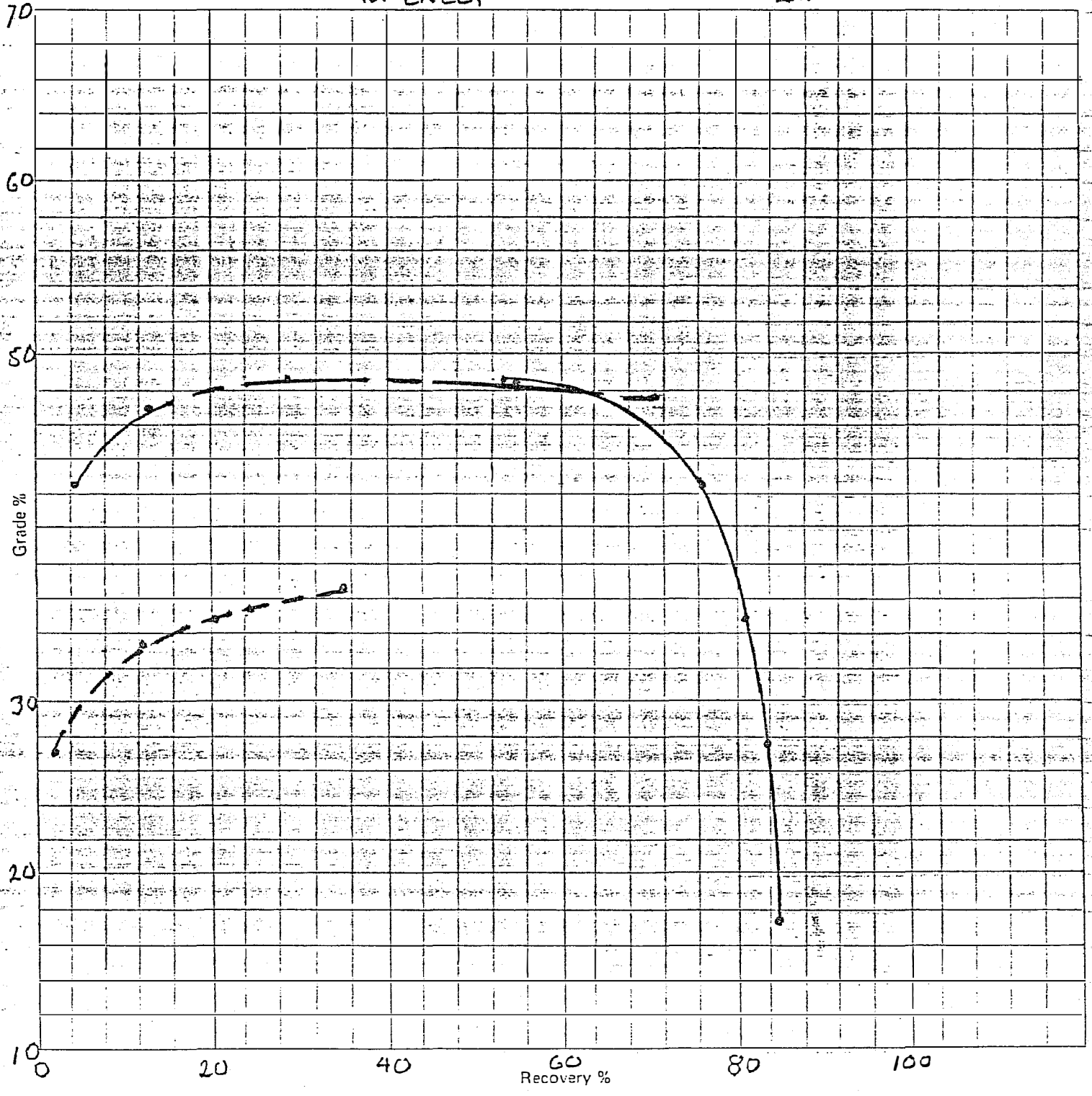
Grade-Recovery Curve

Test No.: TEST #8, 9 Date: 84-04-01

Objective: 2EF ORE COND. BY SIZE TEST (Ro) Key: ZN STD. ——— (1)

Reagents: 6 MIN. COND., 30/70 CuSO4 SPLIT for Zn cct ZN COND. BY SIZE - - - - (3)

ZN PARALLEL ——— (9)



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

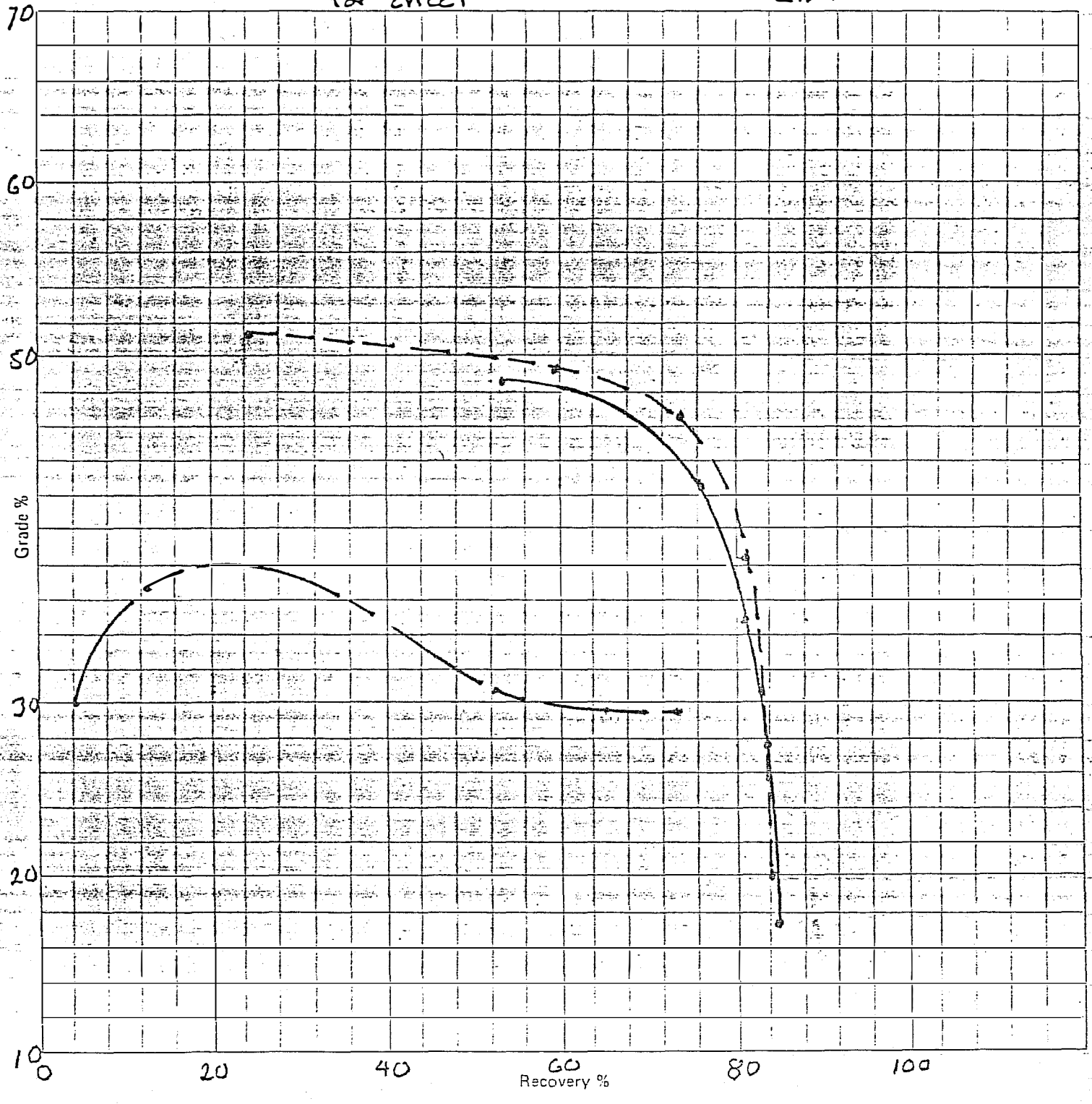
Grade-Recovery Curve

Test No.: TEST #10, 11 Date: 84-04-01

Objective: 2EF ORE COND. BY SIZE TEST (Ro) Key: ZN STD. ——— (1)

Reagents: 8MIN. COND, +50% 2-11 for Zn cct ZN COND. BY SIZE - - - - (1

ZN PARALLEL ——— (1



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Grade-Recovery Curve

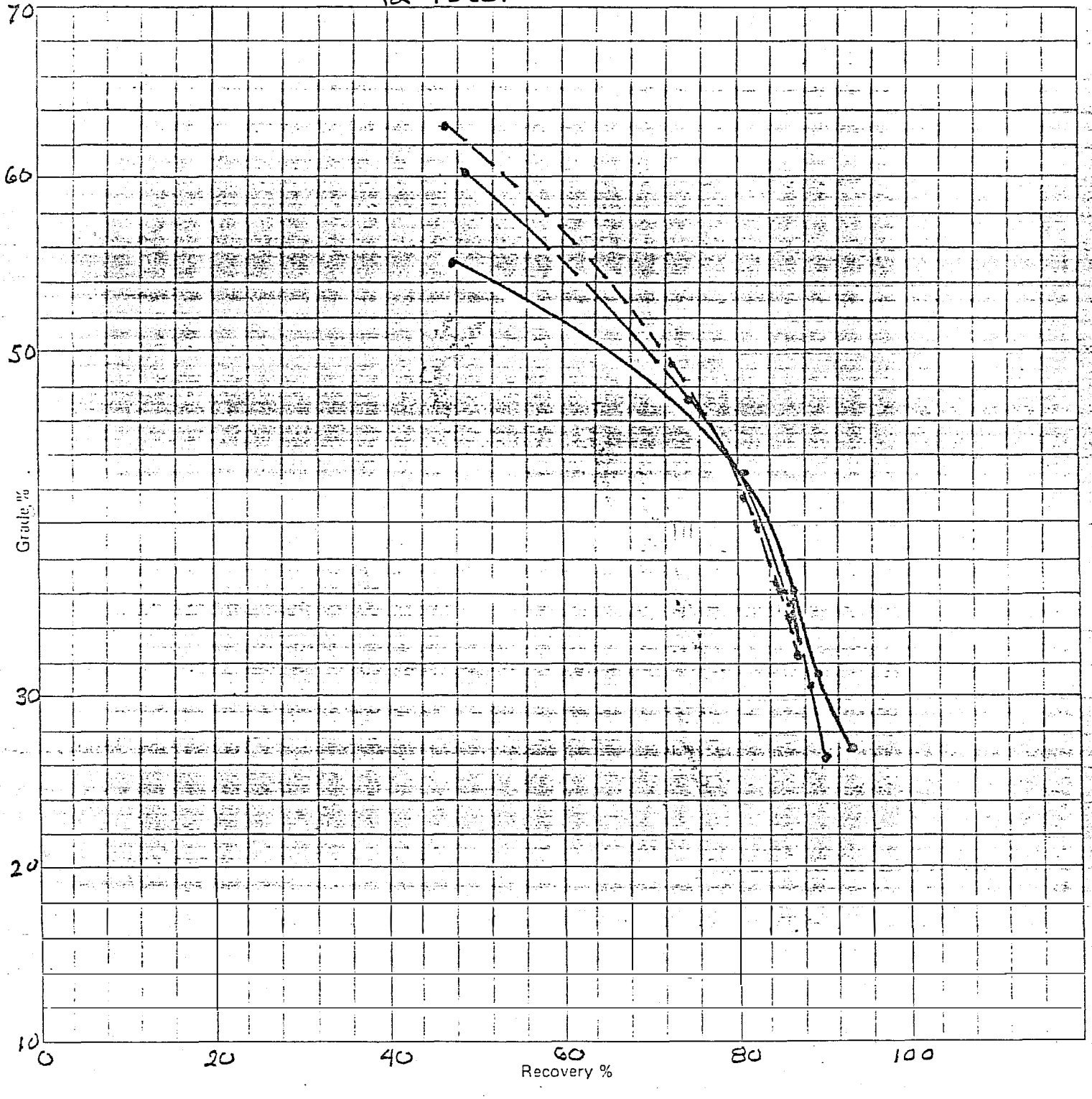
Test No.: TEST #2,3 Date: 89-04-01

Objective: 2H ORE COND. BY SIZE TEST (R&J) Key: Pb STD. ——————

Reagents: 5 MIN. CONDITIONING for Pb cct

Pb COND. BY SIZE - - - - - -

Pb PARALLEL ——— -



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

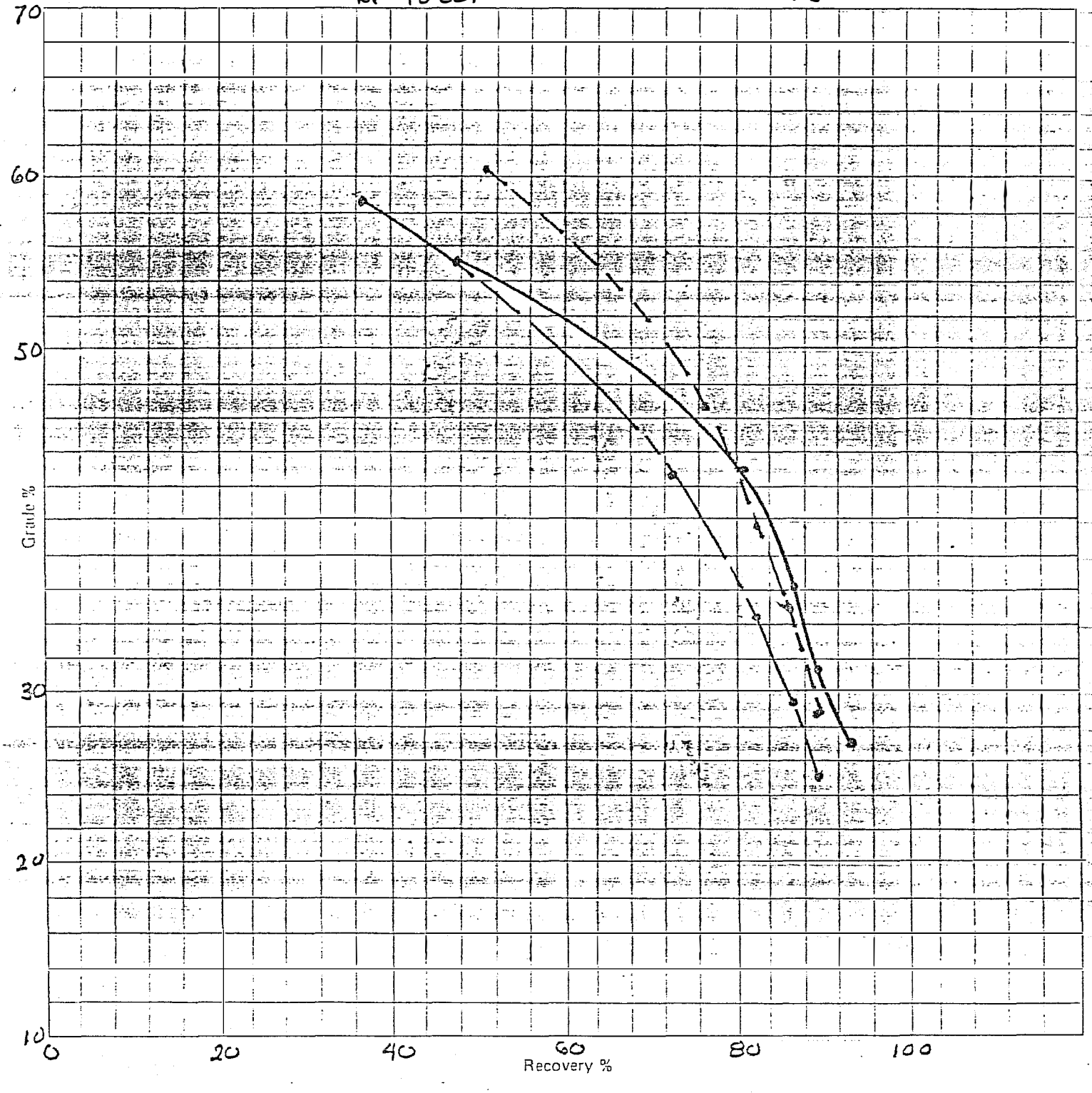
Grade-Recovery Curve

Test No.: TEST #4,5 Date: 84-04-01

Objective: 2H ORE COND. BY SIZE TEST (Ro) Key: Pb STD. ——————

Reagents: 2.5 MIN. CONDITIONING FOR Pb cct Pb COND. BY SIZE - - - - - -

Pb PARALLEL — — — —



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Grade-Recovery Curve

Test No.: TEST #67 Date: 84-04-01

Objective: 2H ORE COND. BY SIZE TEST (R6) Key: ZN STD. ——

Reagents: 8 MIN. CONDITIONING ZN COND. BY SIZE - - - -

for Zn cct ZN PARALLEL ——