

019794

METALLURGICAL TESTWORK ON GRUM DEPOSIT
ORE SAMPLES

Submitted by:

M. A. Holm
Senior Metallurgical Technician

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To

W. Muir

Date

January 25, 1977.

From

M. Holm

Subject The Metallurgical Testwork on the Five Ore Samples from the Grum Deposit.OBJECTIVES

To determine, by a series of flotation tests, the compatibility of Grum ores to:

1. The Anvil reagent scheme
2. The flotation scheme developed by Lakefield Research.

SUMMARY

All the Grum samples except the quartz sulphides responded favorably to the flotation scheme used in the Anvil concentrator. Slight adjustments were required in reagent additions due to the higher Grum metal contents (see Table I below).

TABLE I - GRUM HEAD ASSAYS

<u>Sample Number</u>	<u>Ore Type</u>	<u>Pb</u>	<u>Zn</u>	<u>Fe</u>	<u>Cu</u>
D-1	Massive banded sulphides	5.03	9.9	8.0	0.21
E-1	Massive flow sulphides	6.52	11.4	8.4	0.07
F-1	Massive porous sulphides	4.61	13.1	26.7	0.08
G-1	Quartz sulphides	1.73	3.3	6.2	0.09
H-1	Banded sulphides	5.46	9.4	15.5	0.11
	Anvil crusher stockpile	4.73	9.6	35.1	
	1976 Y.T.D. Anvil feed	2.66	5.48	30.7	

The good responses of these Grum samples were a marked contrast to those Grum samples previously tested at Cyprus Anvil¹. The previous testing showed the Grum ore to be highly oxidized and containing preactivated zinc which floated with the lead concentrate. The latest Grum samples were not as oxidized and did not contain as much preactivated zinc.

¹ M. Fernandes, July 1975.

The Grum quartz sulphide ore sample did not respond as well as the other Grum samples because it contained graphite, had lower heads, and was much more difficult to grind due to its hardness (see Table II).

The Cyprus Anvil flotation scheme proved superior to the Lakefield Research flotation scheme², which produced uncontrollable foaming when a duplication was attempted in the Anvil metallurgical laboratory. The Cyprus Anvil flotation scheme also proved itself equal to a modified Lakefield flotation scheme³ (see Table III). The considerably finer primary grinding used in the Lakefield flotation scheme did not appear to yield any benefits not obtained by regrinding the rougher concentrates⁴, as is the practice at Cyprus Anvil. The fine grind, however, did cause some sliming in the lead and zinc rougher flotation.

In general, the Grum ores responded very similarly to normal Anvil ore using Anvil practices in the lead flotation circuit. The zinc flotation of Grum ores with the Cyprus Anvil scheme was slightly superior to that of normal Anvil ore, this was due to the high zinc heads of the Grum ores, which made cleaning the rougher concentrates relatively simple.

² See Lakefield Test #139 in Appendix.

³ This had reduced reagent quantities to control foaming.

⁴ See regrind and cleaning test Appendix.

INTRODUCTION

This series of flotation tests was carried out on Grum ore samples which were frozen in water to prevent oxidation during storage. The purpose of the metallurgical testwork was to determine the response of the various types of Grum ores to the milling practices of the Anvil mill. The possibility of Cyprus Anvil custom milling Grum ore had also been expressed.

The testing also included a reagent and grinding scheme developed by Lakefield Research, specifically for Grum ores. The intention was to reproduce the Lakefield results at Cyprus Anvil.

John Carrington, of A. E. X., advised us that it would be possible to mine massive banded sulphides, massive flow sulphides and massive porous sulphides separately from the quartzitic and banded ores. He also advised us that massive sulphides constitute the major part of the orebody.

DISCUSSION

1. Grinding

There are considerable differences in the grindabilities of Grum ores and this was sometimes reflected in the flotation results. Screen analysis of flotation tailings from tests with the standard Anvil test grinding time⁵ yielded the results contained in Table II.

TABLE II - SCREEN ANALYSIS DATA (ANVIL GRIND)

Tyler Mesh	Cumulative Weight % Passing						Size Microns μ
	Anvil Crusher Stk. Pile	Grum Quartz Sulphides	Grum Massive Flow	Grum Massive Banded	Grum Massive Porous	Grum Banded (H-1)	
100	93.4	72.5	93.9	90.5	99.6	95.2	150
150	77.9	61.4	82.0	78.8	98.0	84.5	106
200	51.1	51.0	62.0	62.8	69.0	67.0	74
325	32.1	42.2	48.6	50.3	39.6	55.6	44
P ₈₀	120 μ	180 μ	110 μ	115 μ	90 μ	100 μ	

⁵ The Anvil test grind aims for @ 65% -200 mesh.

2. Oxidation

Although oxide assays were not performed on the Grum samples, it is evident that the degree of oxidation present in previous samples obtained from Grum was far greater. The ore samples used by Lakefield Research were also highly oxidized⁶. This point was underlined by the amounts of sodium carbonate required to achieve a pH of 9.8 during lead rougher flotation in the Lakefield Test #139* and during testing at Cyprus Anvil. The decrease of five pounds per ton consumption of soda ash, a fifty percent reduction from the Lakefield testing to the Cyprus Anvil testing, indicates significantly less oxidation. The fact that the latest samples from Grum had a great deal less preactivated zinc floating in the lead roughers, than during previous testing, is another sign of less oxidized ore.

3. The Grum milling scheme developed by Lakefield Research

Since a copy of a flotation test performed at Lakefield Research on Grum ore was available at Cyprus Anvil, an attempt was made to duplicate the results in an identical test in the Cyprus Anvil laboratory. This attempt produced a float which foamed excessively and floated all minerals available with no selectivity.

A modified Lakefield test, with reduced reagent amounts⁷, produced good results. This was adopted as the basic or modified Lakefield flotation test for the purpose of comparison. The results were comparable to those obtained with the standard Anvil tests⁸. The complete results of these tests are in Appendix III.

* See Appendix.

⁶ Lakefield Research Progress Report #3.

⁷ See Table III.

⁸ See Table IV.

TABLE III

MODIFICATIONS ON LAKEFIELD TEST #139

<u>Reagent</u>	<u>Lakefield #139 lbs./ton</u>	<u>Modified Lakefield lbs./ton</u>	<u>Change lbs./ton</u>
Na ₂ CO ₃	10	5.0	-5.0
ZnSO ₄	1.0	1.0	Nil
NaCN	0.30	0.30	Nil
R-242	0.12	0.07	-0.05
R-404	0.04	0.025	-0.015
M.I.B.C.	Nil	Nil	Nil
Ca(OH) ₂	2.0	2.0	Nil
CuSO ₄	1.5	1.0	-0.50
Z-200	0.14	@ 0.014	-0.126
M.I.B.C.	0.02	Nil	-0.02
Teefroth A*	0.01	N/A	-0.01
D.F. 1012	Nil	@ 0.02	+0.015
Z-11	0.04	@ 0.15	+0.11
Pb flot. time	12 min. (rgr.)	12 min. (rgr.)	Nil
Zn flot. time	7 min. (rgr.)	10 min.	+3 minutes
grind time	30 minutes	same	Nil
grind % pass	87.5% -325 mesh	same	Nil

* N/A (not available)

4. Testing with the Anvil standard flotation test

The flotation scheme used at Anvil, with the minor changes required by the higher mineral contents of the Grum ores, was tested on each individual Grum ore type. It was also used on a combination sample containing all Grum ore types, as well as a 1:1 blend of each Grum ore plus a sample of Anvil crusher stockpile ore. The following table contains some of the results.

TABLE IV FLOTATION RESULTS

<u>Ore Sample</u>	<u>Cumulative Grades</u>				<u>Cumulative Recoveries</u>			
	<u>Anvil</u>		<u>Mod. Lakefield</u>		<u>Anvil</u>		<u>Mod. Lakefield</u>	
	<u>Pb</u>	<u>Zn</u>	<u>Pb</u>	<u>Zn</u>	<u>Pb</u>	<u>Zn</u>	<u>Pb</u>	<u>Zn</u>
Grum H-1	35.5	33.9	32.3	25.4	82.7	70.1	82.9	74.6
Grum Banded	34.7	34.6	25.8	29.1	71.4	75.6	60.4	81.0
Grum Flow	35.1	34.1	34.9	35.4	74.9	72.1	78.9	74.9
Grum Porous	40.1	53.9	38.3	51.2	77.6	80.9	84.2	79.1
Grum Quartz	21.2	18.9	21.7	20.9	61.7	75.0	60.2	81.9
Grum Combined*	28.7	27.4	N/A	N/A	82.9	71.5	N/A	N/A
Grum Comb. + Anvil	36.7	40.6	N/A	N/A	84.0	78.7	N/A	N/A
Anvil Stk. Pile	55.6	38.1	48.3	50.5	90.4	70.6	92.0	80.5

* Composite of all Grum Samples

TABLE V - GRADE VS RECOVERY

<u>Sample Type</u>	<u>Pb Grade @ 70% Rec.</u>		<u>Zn Grade @ 70% Rec.</u>	
	<u>Anvil</u>	<u>Lakefield</u>	<u>Anvil</u>	<u>Lakefield</u>
Massive Banded (D-1)	36	graphite	42	46
Massive Flow (E-1)	43	40	37	47
Massive Porous (F-1)	46	51	58	51
Quartzitic (G-1)	24 *	22 *	37	39
Banded (H-1)	52	46	34	42
Anvil Stockpile +	67	67	46	50
Grum Combined	43	N/A	35	N/A

N/A not available

* at 60% recovery

+ exceptional Anvil ore sample

Notes: Lakefield grind 30 minutes or 87.5% -325 mesh.

Anvil test grind 11 minutes or 60% -200 mesh.

This is slightly coarser than normal in the Anvil mill.

TABLE VII

GRADE VS RECOVERY

Ore Type Plus 50% Anvil Ore	Anvil Ore & Grum Ore (1:1) Combinations		
	Cumulative %Pb Grade @ 75% Rec.	Cumulative Zn Grade @ 75% Rec.	Cumulative %Zn Grade @ 70% Rec.
Massive Banded (D-1)	52	46	51.5
Massive Flow (E-1)	48	46	52.0
Massive Porous (F-1)	49.5	56.5	57.5
Quartz Sulphide (G-1)	45	47	50.0
Banded (H-1)	48.5	40.5	50
Grum Combination	48.5	47.5	50.5

It was found, however, that careful control of collector to the lead roughers was essential in limiting the amount of zinc floating in the lead rougher concentrates. In attempting to improve lead recoveries by increasing the amount of collector used it was observed that the zinc sulphides in the lead concentrates increased dramatically after about 82 percent recovery, however this also occurs with Anvil ores. Zinc sulphate was tested as a zinc depressant as Lakefield Research had included it in their reagent scheme. The results of these tests showed that zinc sulphate had little or no affect on the amount of zinc floating with the lead. This is demonstrated in tests #2955 versus #2963 where in test #2963 with 1#/ton $ZnSO_4$ 21.0% of the total zinc floated in the lead roughers and scavengers, in test #2955 in which no zinc sulphate was used only 18.3% of the total zinc floated with the lead. This is further demonstrated by tests #9229 and #9233 (see Grade Recovery Curve #10).

The good results obtained with the relatively coarse Anvil grind (compared to the Lakefield) show that the extremely fine grind used by Lakefield research is probably unnecessary if regrinding of rougher concentrates is to be used, as in the Anvil mill. A standard Anvil regrind and cleaning test done on Grum banded (H-1) ores yielded final concentrates of 78.3% lead in the lead concentrate and 54.9% zinc in the zinc concentrate. This is at least as good as the best Anvil ores produce for concentrate grades. The complete cleaning tests are available as tests #2985 and #2986 in Appendix III.

The grum quartzitic, banded and flow samples do contain some graphite which may interfere with lead flotation as occurs in test #2946, and is usually not a serious problem.

CONCLUSIONS AND RECOMMENDATIONS

There should be no real problem milling the various Grum ores in the Anvil mill if they are not oxidized. The reagent consumption will be slightly higher than with normal Anvil ore, due primarily to the higher mineral contents of most of the Grum ores which would require slightly more copper sulphate and collector. ✓

The tonnage milled per hour may have to be reduced somewhat if Grum ore is milled without blending with Anvil ore. This would have to be done for two main reasons. The first reason would be to ensure a slightly finer primary grind than with Anvil ore if the Grum ore was quartzitic material. The other reason for slightly reducing the I. P. H. milled would be the very real possibility of overloading the zinc cleaning circuit due to extremely high zinc heads, especially with Grum porous ores. ✓

Recoveries and grades should approximate those obtained with Anvil ores. ✓

APPENDIX I

LAKEFIELD TEST #139

Test No: 139 Project No: 1868 Date: 13 July 16 Operator: CP-DJ

Purpose: To perform a six-stage locked cycle test on the
Mottosami ore sample. - GRUM SAMPLE

Procedure: As for test No. 126.

Feed: Six 1000 gram charges of minus 10 mesh re-sample
Grind: 30 minutes / kg at 60 percent solids with laboratory ball mill
Conditions:

	Reagents Added, pounds per ton						Time, minutes			
	N_2CO_3	$ZnSO_4$	$NaCN$	R-2 1/2	R-1/4	MIBC	Grind	Cond.	Froth	pH
Primary Grind	10.0	1.0	0.30	0.08			30			
1/2 Rougher				0.02	0.01			1	3	9.6
				0.01	0.01			1	3	
				0.01	0.01			1	3	
				0.01	0.01			1	3	
1/2 Re-grind	2.0	1.0	0.30	0.04			30			
1st Cleaner					0.01			1	4	9.7
				0.01	0.01			1	4	
2nd cleaner	0.4	0.2	0.10					2	5	9.9
1/2 3rd cleaner	0.4	0.1	0.10					2	4	9.8
1/2 4th cleaner	0.4		0.05					2	3	9.8

Stage	Rougher	P.G. Re-grind	1st 3rd Cleaner	4th Cleaner
Rotation Cell	500 g D-1	Lab Rod Mill	500 g D-1	250 g D-1
Speed: r. p. m.	1300		1300	1000
% Solids	33			
mesh				

LAKEFIELD RESEARCH OF CANADA LIMITED

Test No: 139 (cont'd) Project No: 1868 Date: _____ Operator: _____

Purpose: _____

Procedure: _____

Feed: _____

Grind: _____

Conditions: _____

	Reagents Added, pounds per ton						Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	Z-11	MIBC	Toutrol A	Grind	Cond.	Froth	
Zn Condition	2.0	1.5						3	-	10.0
Zn Rougher (1)			0.08	0.02				1	2	
(2)			0.04	0.02	0.02	0.01		1	3	
(3)			0.02	-	-	-		1	2	
Zn 1st Cleaner	.8							1	2	11.0
			0.01			0.01		1	3	
Zn 2nd Cleaner	.8							1	4	11.2
Zn 3rd Cleaner	.6							1	2 1/2	11.3
Zn 4th Cleaner	.4							1	2 1/2	11.3

Stage	Zn Rougher Cleaners			
Flotation Cell	50092-1			
Speed: r. p. m.	1100			
% Solids				

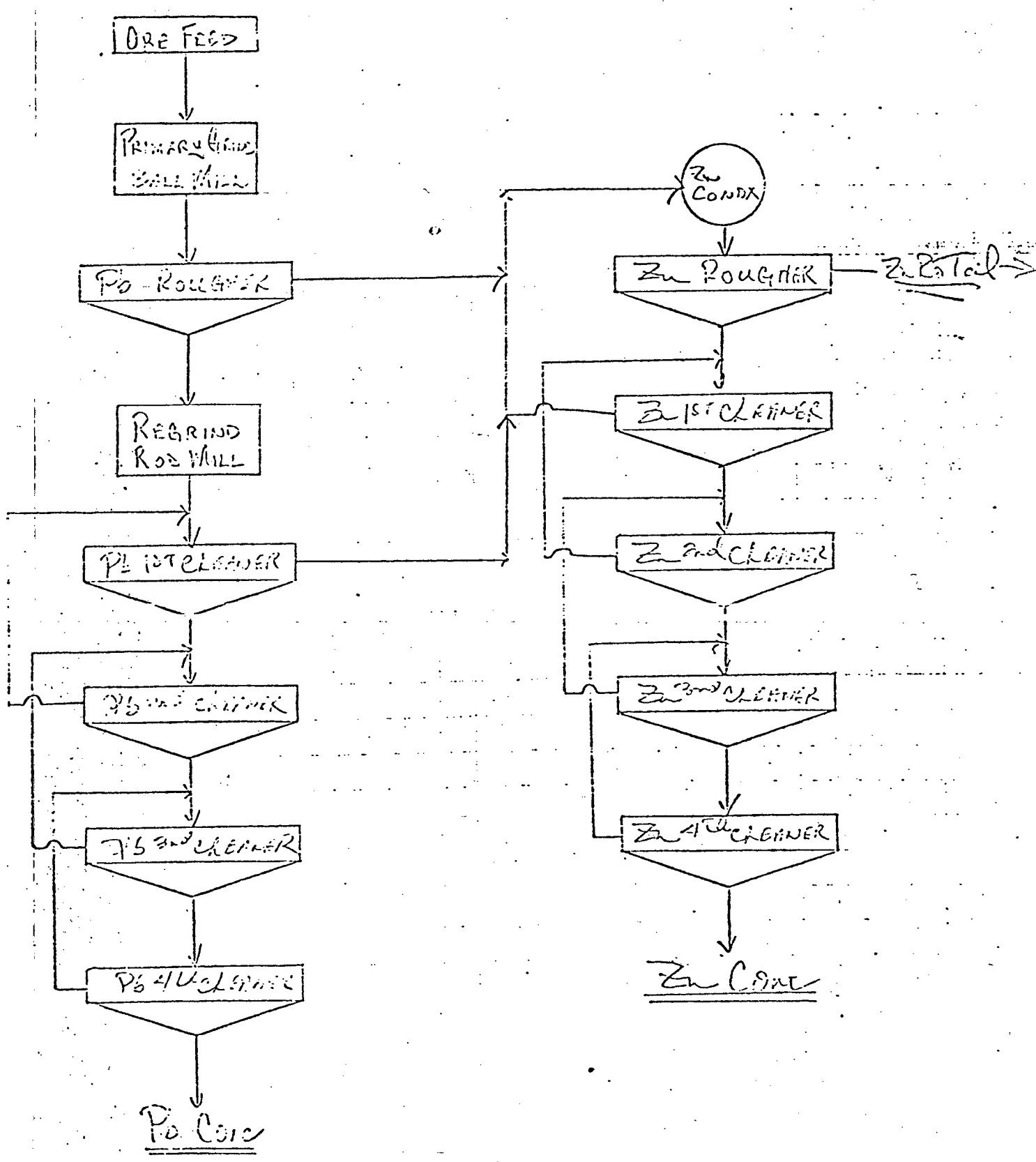
Product

PERCENTAGE DISTRIBUTION

	Product	g	%	Pb		Zn		PERCENTAGE DISTRIBUTION	
				Pb	Zn	Pb	Zn		
1	Pb Cleaner Conc A	63.0	1.05	4.0	67.2	10.7		8.1	0.7
	B	88.3	1.46		62.6	11.5		10.9	1.1
3	C	106.4	1.76		58.4	13.1		12.3	1.5
	D	110.5	1.83		59.0	13.2		12.9	1.5
2	E	102.7	1.71		56.0	12.4		11.5	1.3
	F	104.9	1.74		57.5	13.1		12.0	1.4
	Pb 4th Cleaner tail F	47.8	0.79		34.2	23.5		3.2	1.2
8	Pb 3rd Cleaner tail F	105.0	1.74		26.9	26.0		5.6	2.9
	Pb 2nd Cleaner tail F	201.3	3.34		15.9	27.0		6.4	5.7
10	Pb 1st Cleaner tail F	292.9	4.86		4.18	21.7		2.4	6.7
1	Zn Cleaner Conc A	111.5	1.85		7.16	53.8		0.3	6.3
12	B	152.1	2.62		2.25	54.2		0.7	9.0
	C	164.7	2.73		2.00	53.1		0.7	9.2
2	D	169.7	2.82		2.14	57.0		0.7	10.1
	E	150.2	2.49		2.42	55.2		0.7	8.7
4	F	159.5	2.65		2.71	57.0		0.8	9.5
	Zn 4th Cleaner tail F	66.0	1.09		5.00	48.9		0.7	3.1
6	Zn 3rd Cleaner tail F	134.3	2.23		4.77	41.2		1.3	5.7
	Zn 2nd Cleaner tail F	211.2	3.60		4.12	26.5		1.2	5.9
	Zn 1st Cleaner tail F	291.7	4.67		2.93	15.9		1.6	2.2
	Zn Rougher tail A	340.4	5.65		0.62	0.91		0.4	0.3
	B	483.8	8.03		0.83	1.69		0.8	0.9
	C	550.4	9.13		0.83	1.67		0.9	1.0
	D	592.6	9.83		0.87	1.85		1.0	1.1
	E	602.1	9.99		0.95	2.00		1.1	1.3
	F	623.6	10.34		0.98	2.08		1.2	1.4
	Head calc.)	6228.6	100.00		8.36	15.8		100.0	100.0

Calculated Grades and Recoveries

Combined Pb Cleaner Conc	9.55		59.2	12.5		67.7	7.5
Combined Pb Cleaner tail	10.73		13.7	21.2		17.6	16.5
Combined Zn Cleaner Conc	15.16		2.16	55.1		3.9	52.8
Combined Zn Cleaner tail	11.59		3.85	23.8		5.9	17.2
Combined Zn Cleaner tail	52.91		0.87	1.78		5.9	6.0



APPENDIX II

GRADE - RECOVERY CURVE GRAPHS

Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Grade-Recovery Curves ^{Pb}
ANVIL STD. TESTS COMBINED SAMPLES

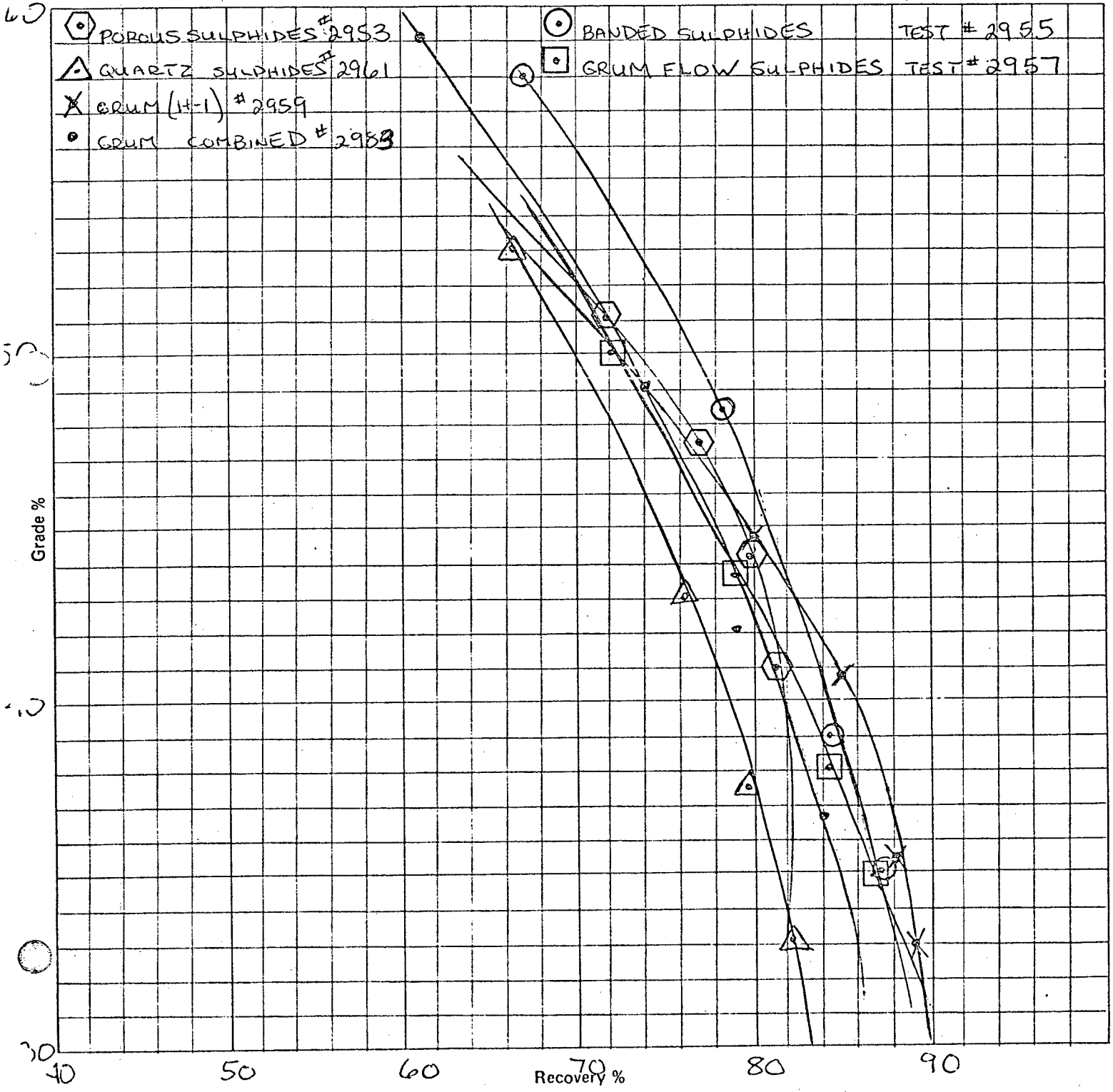
Test No.: _____

Date: _____

Objective: 50% ANVIL ORE + 50% GRUM

Key: _____

Reagents: _____

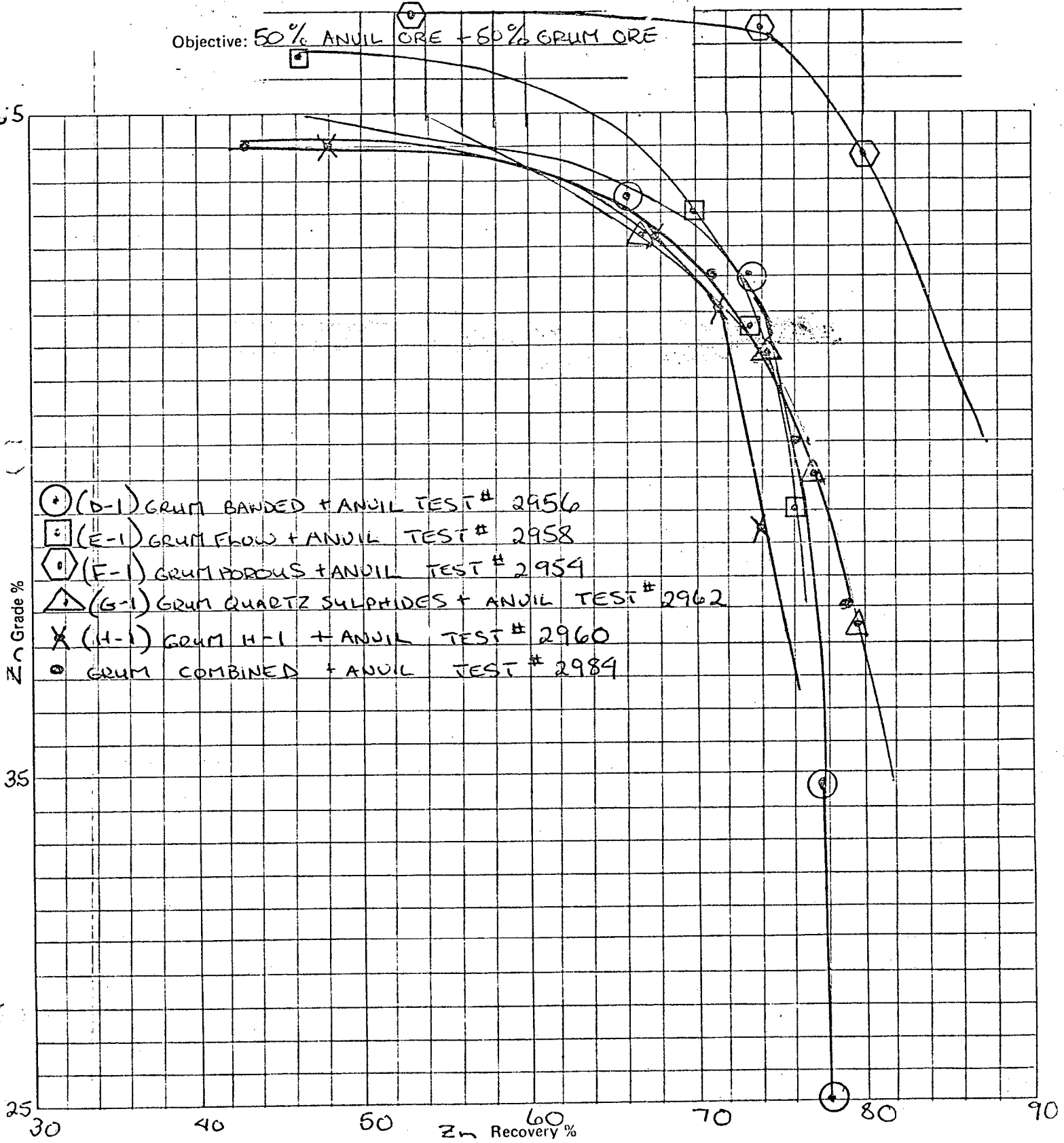


Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT
ANVIL STD. TESTS COMBINED SAMPLES

Zn Grade-Recovery Curves

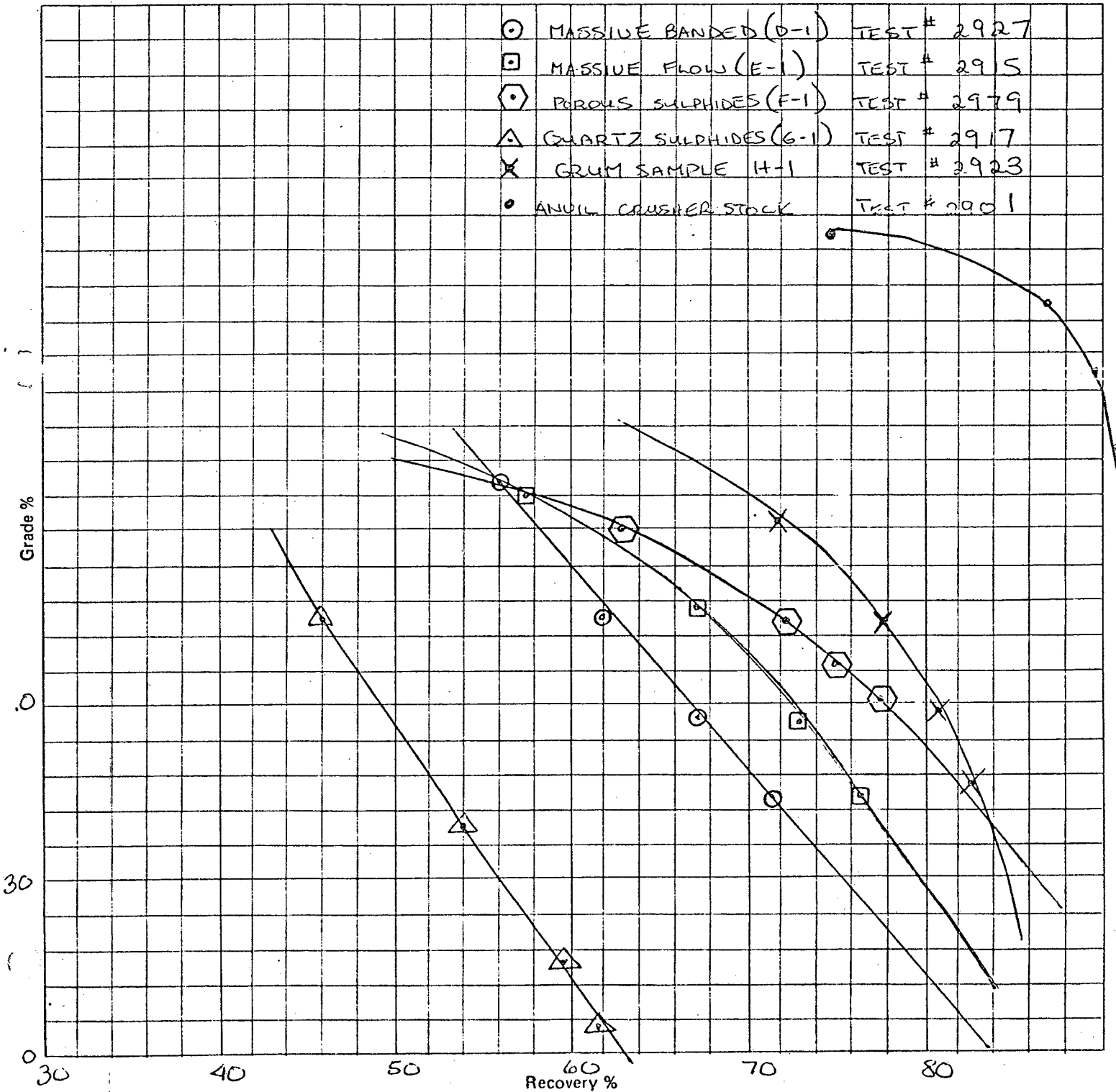
Objective: 50% ANVIL ORE + 50% GRUM ORE



Cyprus Anvil Mining Corporation
METALLURGICAL TEST REPORT

Grade-Recovery Curves Pb
ANVIL STANDARD TESTS

Test No.: _____ Date: _____
Objective: _____ Key: _____
Reagents: _____



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Grade-Recovery Curves ^{Zn}
ANVIL STANDARD TESTS

Test No.: _____

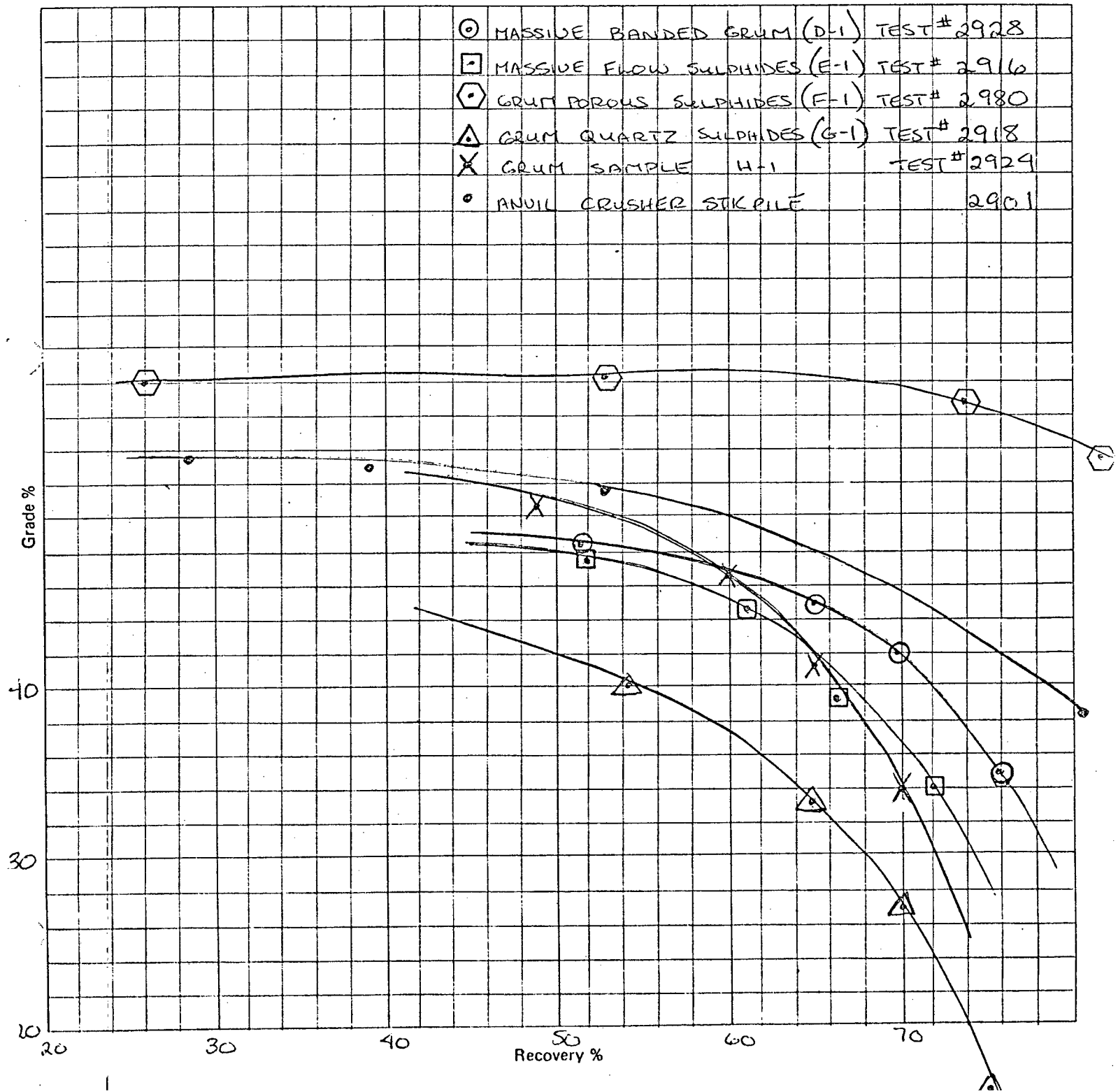
Date: _____

Objective: _____

Key: _____

Reagents: _____

- ⊙ MASSIVE BANDED GRUM (D-1) TEST# 2928
- MASSIVE FLOW SULPHIDES (E-1) TEST# 2916
- ⬡ GRUM POROUS SULPHIDES (F-1) TEST# 2980
- △ GRUM QUARTZ SULPHIDES (G-1) TEST# 2918
- X GRUM SAMPLE H-1 TEST# 2929
- ANVIL CRUSHER STK PILE 2901



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Grade-Recovery Curves
MODIFIED LAKE FIELD TESTS Pb

Test No.: _____

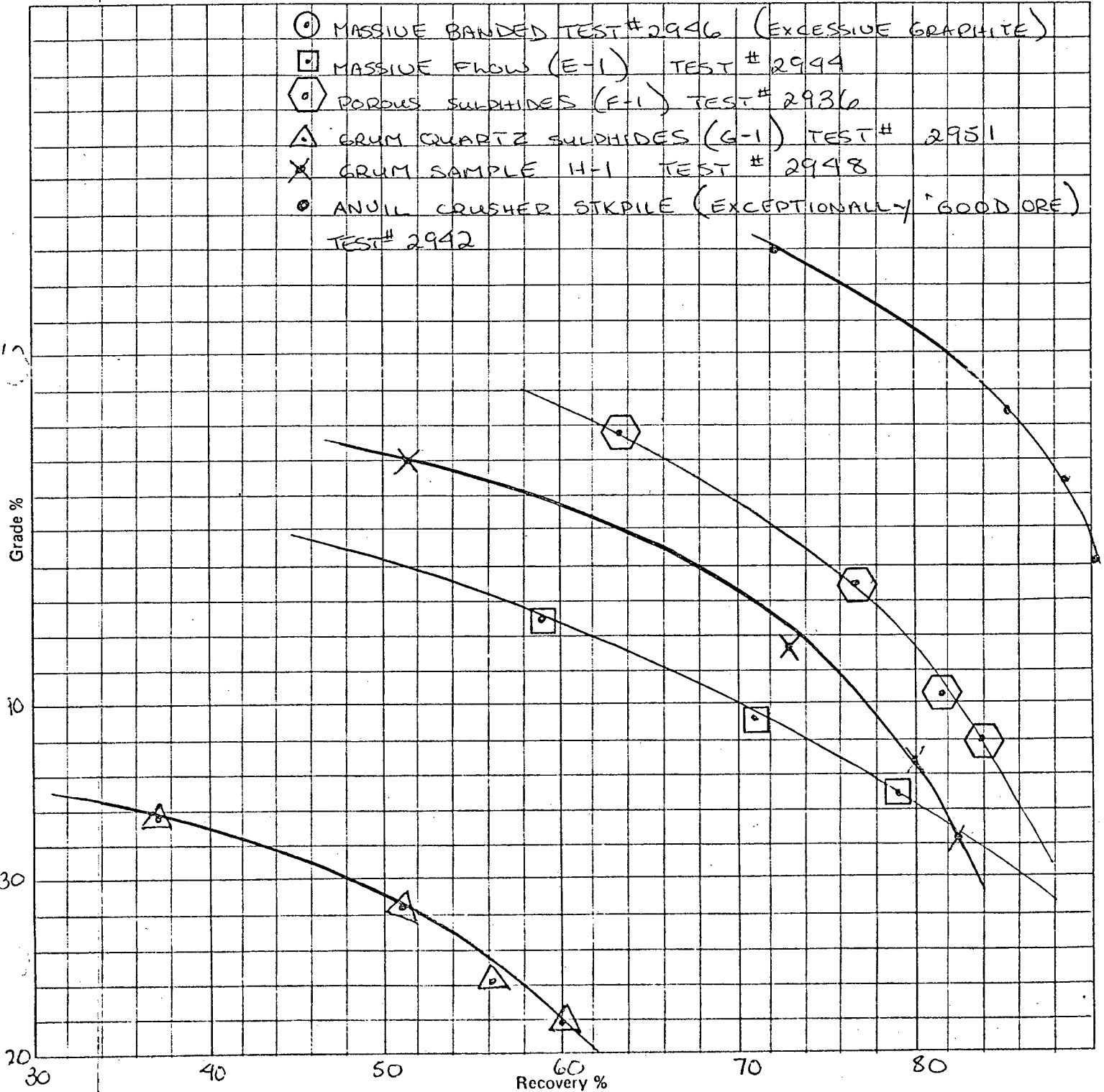
Date: _____

Objective: _____

Key: _____

Reagents: _____

- ⊙ MASSIVE BANDED TEST # 2946 (EXCESSIVE GRAPHITE)
- MASSIVE FLOW (E-1) TEST # 2944
- ⬡ POROUS SULPHIDES (E-1) TEST # 2936
- △ GRUM QUARTZ SULPHIDES (G-1) TEST # 2951
- × GRUM SAMPLE H-1 TEST # 2948
- ANVIL CRUSHER STKPILE (EXCEPTIONALLY GOOD ORE) TEST # 2942



METALLURGICAL TEST REPORT

Grade-Recovery Curve Zn
MODIFIED LAKEFIELD TESTS

Test No.: _____

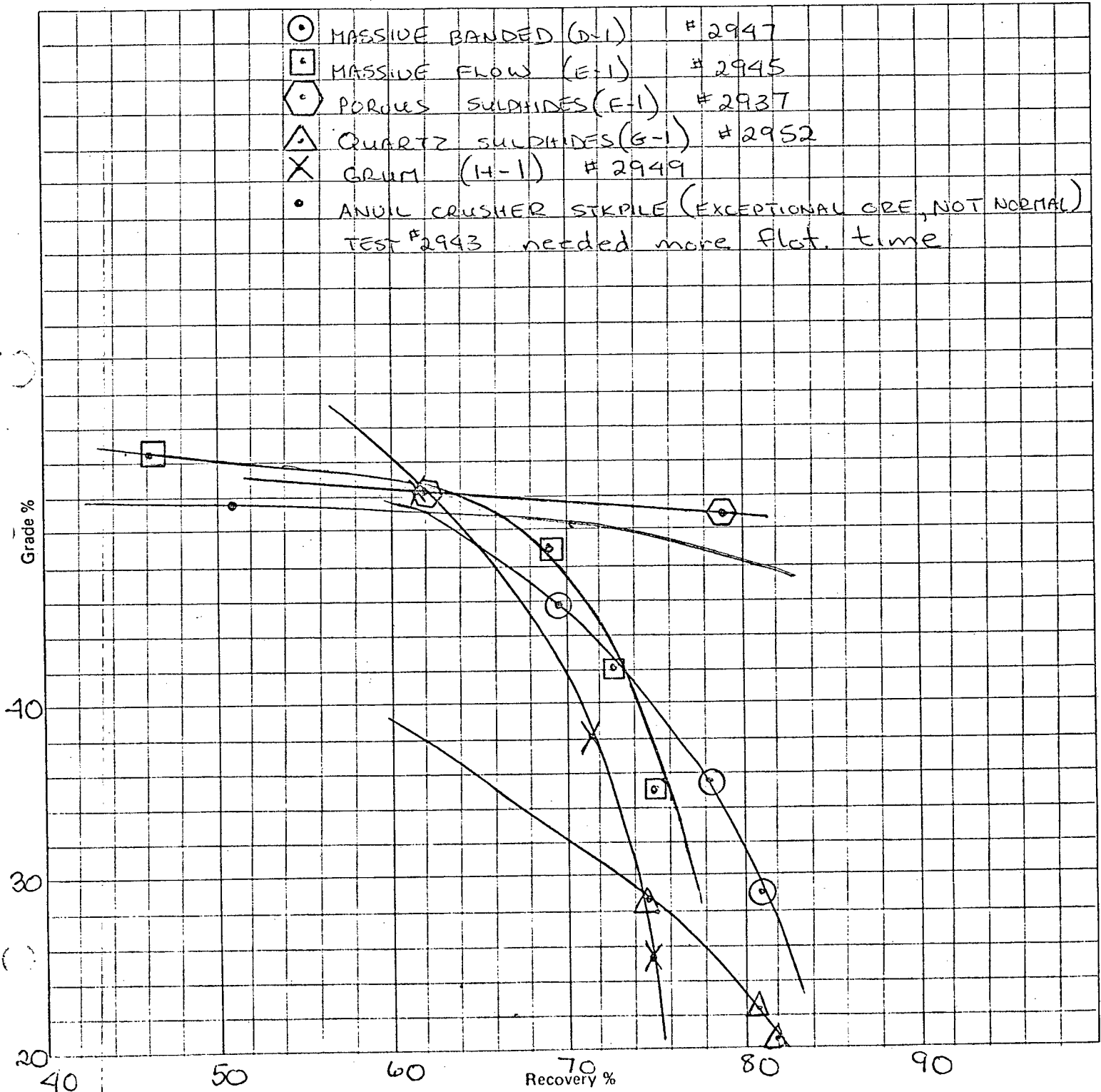
Date: _____

Objective: Zn Flotation

Key: _____

Reagents: LAKEFIELD SCHEME

- MASSIVE BANDED (D-1) #2947
- MASSIVE FLOW (E-1) #2945
- ◇ POROUS SULPHIDES (F-1) #2937
- △ QUARTZ SULPHIDES (G-1) #2952
- X GRUM (H-1) #2949
- ANVIL CRUSHER STKPILE (EXCEPTIONAL ORE, NOT NORMAL)
TEST #2943 needed more float. time



METALLURGICAL TEST REPORT

Pb Grade-Recovery Curves

Test No.: 2977, 2981, 2975 Date: _____

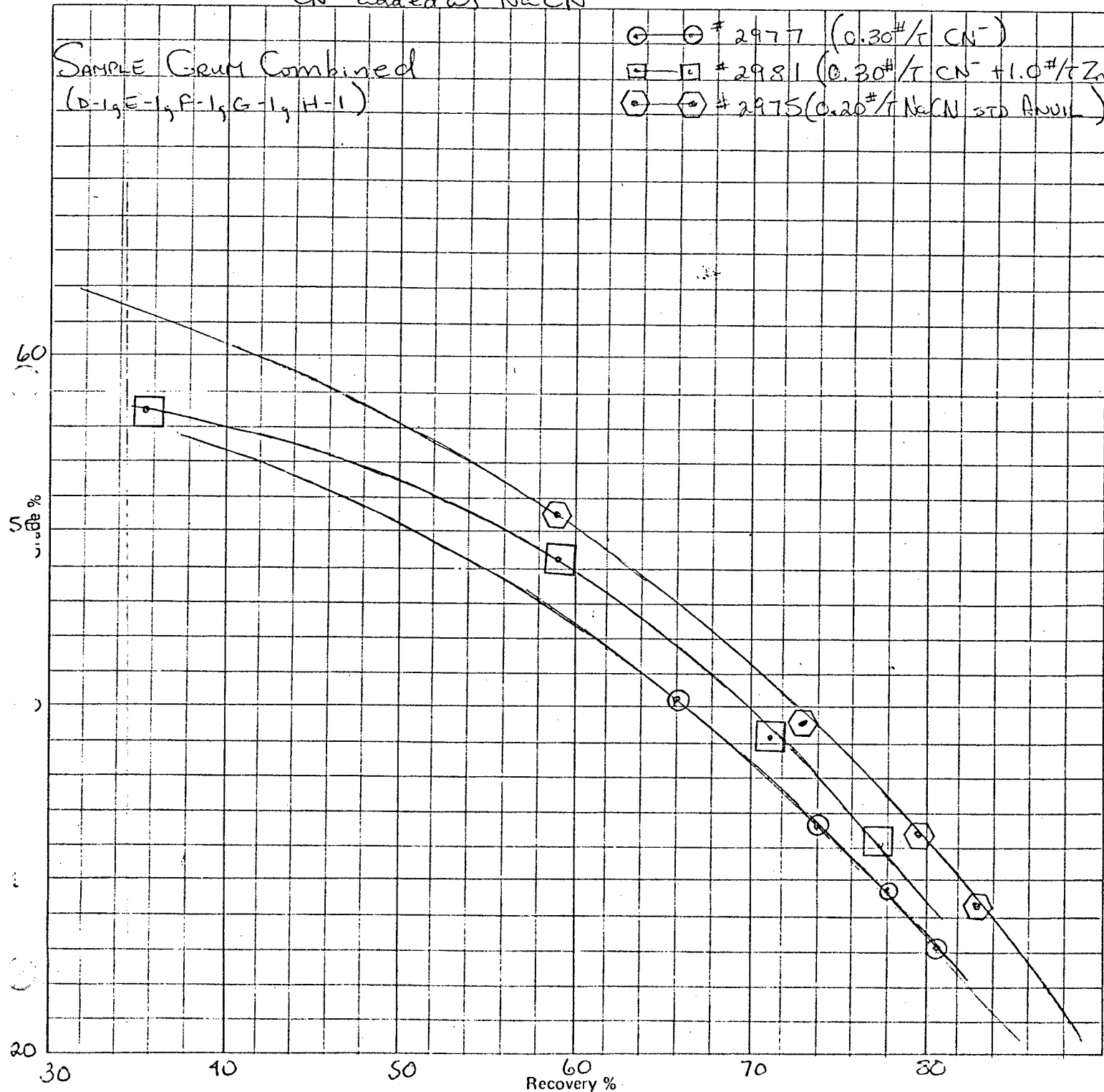
Objective: Pb GRADE (CN⁻ and ZnSO₄ affected) key: _____

Reagents: CN⁻, ZnSO₄ _____

CN⁻ added as NaCN

SAMPLE GRAM Combined
(D-1g, E-1g, F-1g, G-1g, H-1)

- ○ # 2977 (0.30#/T CN⁻)
- □ # 2981 (0.30#/T CN⁻ + 1.0#/T ZnSO₄)
- ⬡ ⬡ # 2975 (0.20#/T NaCN STD ANVIL)



Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Grade-Recovery Curve

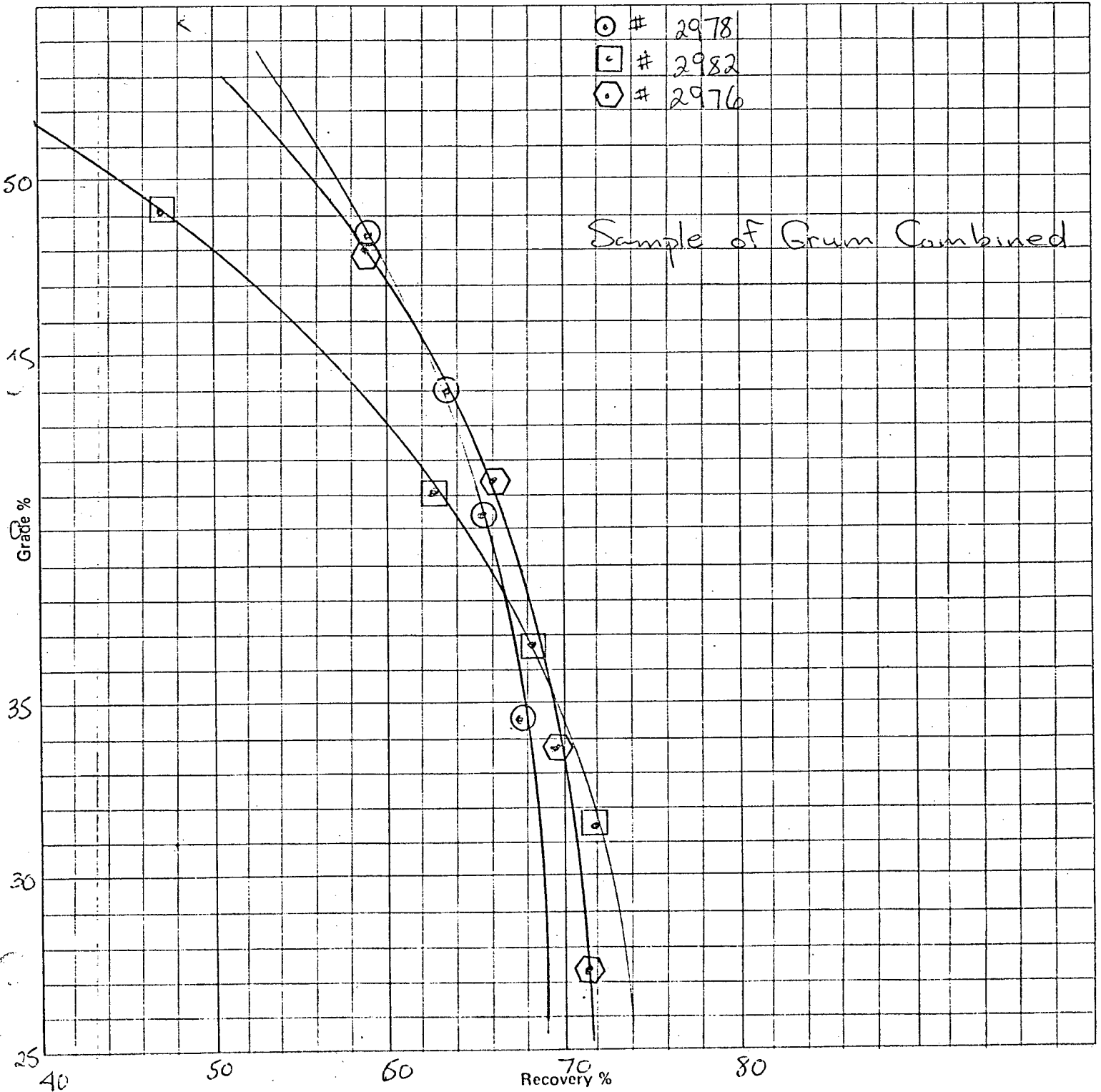
Test No.: 2978, 2982, 2976

Date: _____

Objective: Zn GRADE

Key: _____

Reagents: _____



METALLURGICAL TEST REPORT

Pb Grade-Recovery Curve

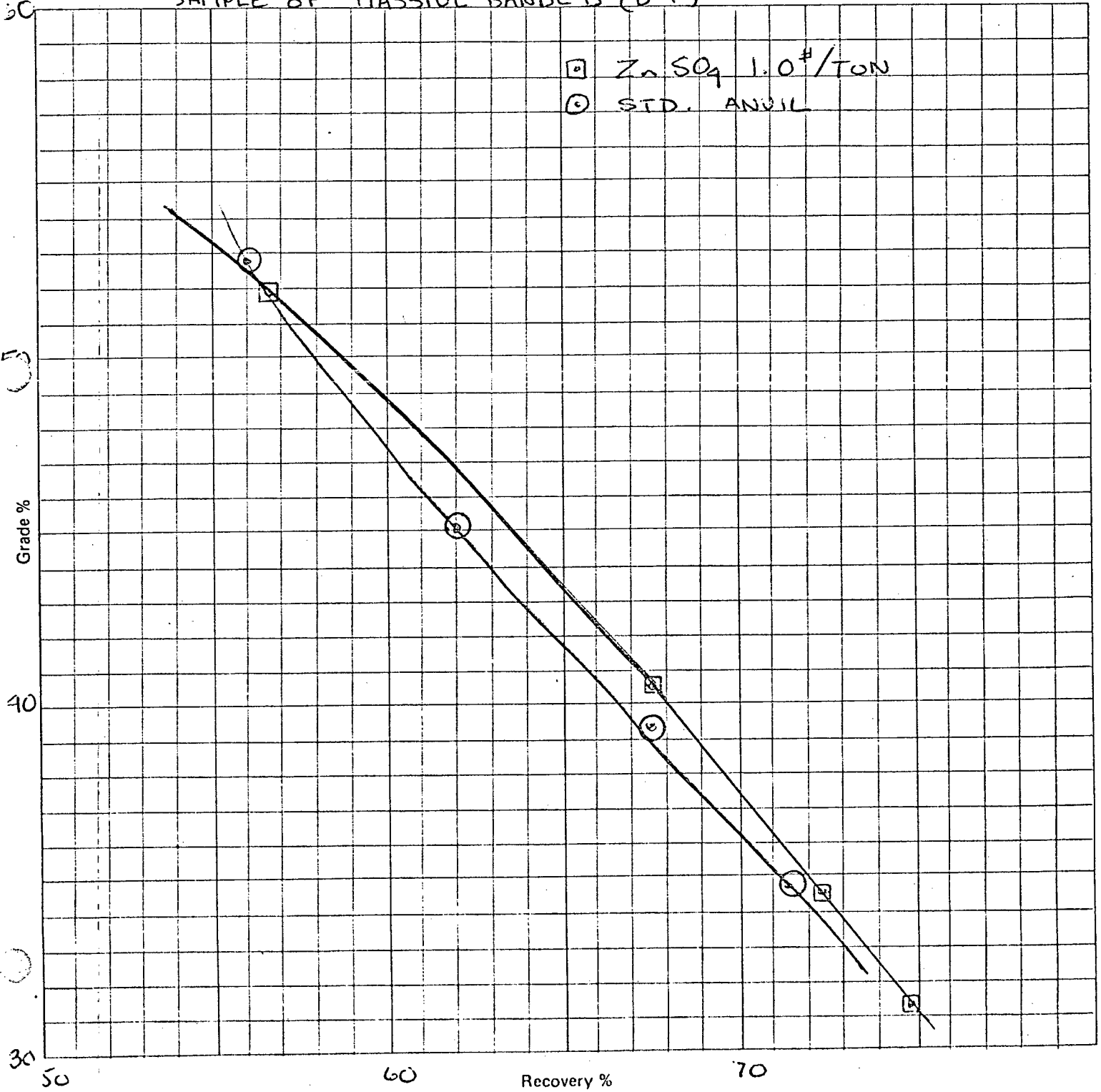
Test No.: 2469, 2427

Date: _____

Objective: EFFECT OF $ZnSO_4$ ON Zn
IN Pb CONC.

Key: _____

SAMPLE OF MASSIVE BANDED (D-1)



Cyprus Anvil Mining Corporation
METALLURGICAL TEST REPORT

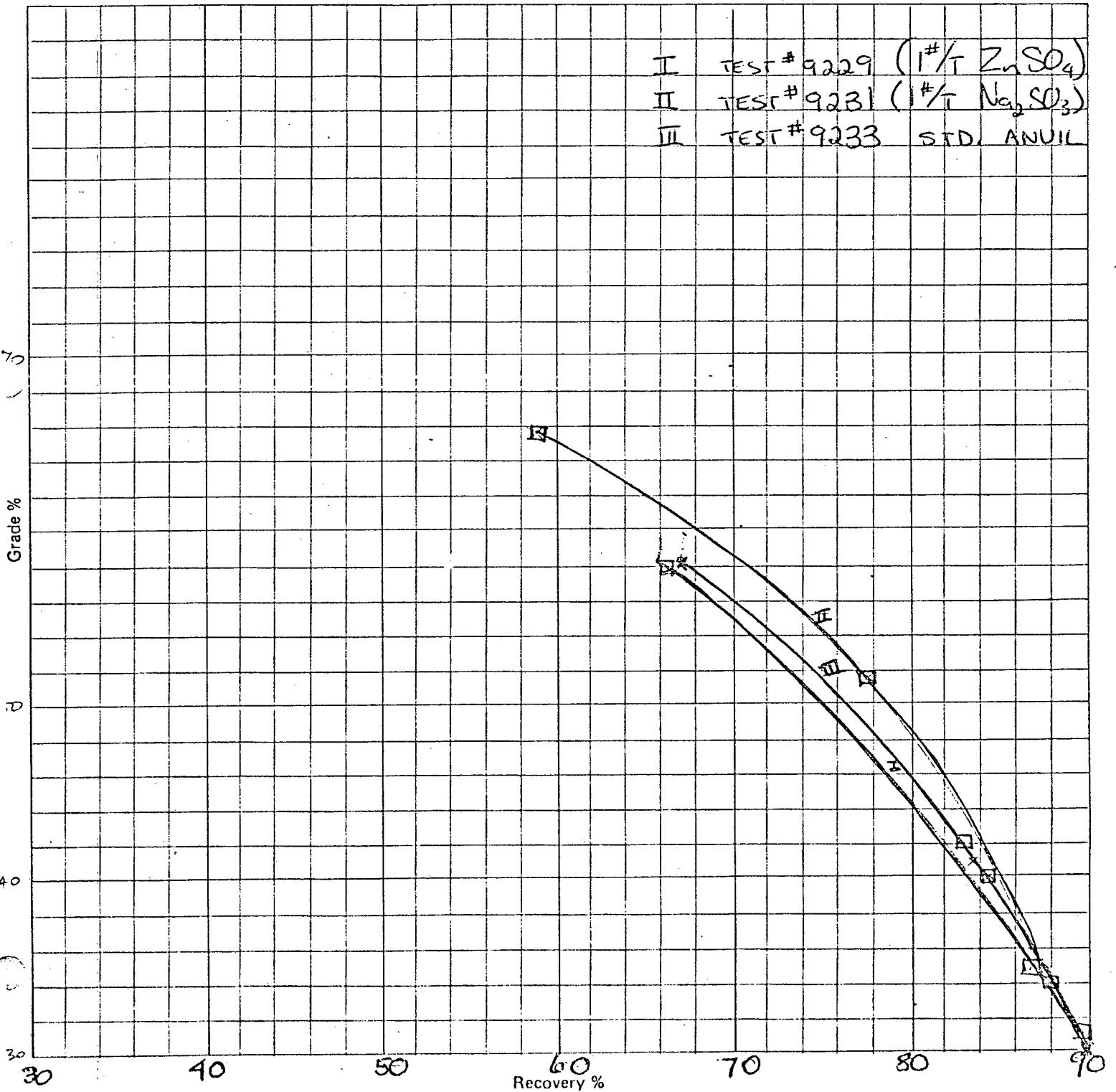
Pb Grade-Recovery Curve

SAMPLE OF: (H-1) and Cyprus Anvil 50/50 Date: _____

Objective: IMPROVED - Pb GRADE Key: _____

Reagents: $ZnSO_4$, Na_2SO_3 , STD. _____

- I TEST # 9229 (1#/T $ZnSO_4$)
- II TEST # 9231 (1#/T Na_2SO_3)
- III TEST # 9233 STD. ANVIL



APPENDIX III

THE MOST SIGNIFICANT FLOTATION TESTS

Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Test Format and Results

TEST No. 2985 | SAMPLE OF: Pb Rougher from 2 Test Flot. of Anvil Stk + Sur

OBJECTIVE: Lead Cleaning and Regrinding | DATE: Combined

REAGENTS: Jan 7/77

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS
	grms.	lbs./ton		Start	End	Cond.	Flot.	
NaCN		.03	Pb Regrd.			10		The rougher concentrates were obtained from tests done on Anvil flotation process.
2-11		.02	Pb 1st Clean.	10.5			5	
2-11		.05	Pb 2nd Clean.	10.5			4	
MIBC			Pb 3rd Clean	10.5			3	
2-11		.05						

RESULTS:

PRODUCT	WEIGHTS		ASSAYS %			UNITS			DISTRIBUTION %		
	gm.	%	Pb	Zn	Fe	Pb	Zn	Fe	Pb	Zn	Fe
Pb 1 ST Cl. Tail	111.3	41.45	12.40	22.2	17.20	5.14	9.20	7.13	11.48	11.37	78.78
Pb 2 Cl. Tail	47.1	17.54	47.7	13.8	7.60	8.37	2.42	1.33	18.69	18.77	14.70
Pb 3 Cl. Tail	17.6	6.55	65.6	6.7	3.80	4.30	.49	.25	9.60	3.41	2.76
Pb Final Conc.	92.5	34.45	78.3	2.4	1.00	26.98	.83	.31	60.24	6.49	3.76
Pb Rougher	268.5		44.79	12.89	9.05						

Tested by: Mallin

METALLURGICAL TEST REPORT

Test Format and Results

TEST No. 2486. SAMPLE OF: Zn Rgr. from 2 Flot. tests of ANVIL STACKPILE + GRUM COMBINE

OBJECTIVE: Zn Cleaning + Regrinding DATE: JAN 7/77

REAGENTS:

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS
	grms.	lbs./ton		Start	End	Cond.	Flot.	
			Zn Regrind			10		The rougher concentrate was obtained by doing 2 test flats on Anvil Flotation process.
CaO } Z-11	.03		Zn 1 Cleaner	11.0			3	
CaO } Z-11	.02		Zn 2 Cleaner	11.5			3	
CaO } Z-11	.02		Zn 3 Cleaner	11.8			3	
CaO } Z-11	.02		Zn 4 Cleaner	11.8			2	

RESULTS:

PRODUCT	WEIGHTS		ASSAYS %			UNITS			DISTRIBUTION %		
	gm.	%	Pb	Zn	Fe	Pb	Zn	Fe	Pb	Zn	Fe
Zn 1 Clean Tail	753.9	53.56	1.70	14.40	24.10	0.91	7.71	12.91	39.06	24.75	78.10
Zn 2 Clean Tail	88.3	10.42	5.00	45.10	9.50	0.52	4.70	0.59	22.32	15.09	5.89
Zn 3 Clean Tail	48.3	5.70	5.30	43.20	7.50	0.30	2.46	0.43	12.88	7.90	2.10
Zn 4 Clean Tail	30.9	3.65	4.70	44.80	6.80	0.17	1.63	0.25	7.30	5.23	1.51
Zn Final Conc.	226.1	26.68	1.60	54.90	7.30	0.43	14.65	1.95	18.44	47.03	11.80
Zn ROUGHER	847.5		2.33	31.15	16.53						

Tested by: Mallin

Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Test Format and Results

TEST No. 2955-56 | SAMPLE OF: ANVIL STOCKPILE + GRIND BLENDED SULPHIDES (50)

OBJECTIVE: ANVIL FLOT TEST + GRIND | DATE: DEC 14/76

REAGENTS: Na₂CO₃, NaCN, CuSO₄, Ca(OH)₂, Z-11, MIBC, DF 1012

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS
	grms.	lbs./ton		Start	End	Cond.	Flot.	
Na ₂ CO ₃		5.0	GRIND 9+2					
NaCN		0.20				2		
Z-11		0.05						
MIBC			Pb Ro 1	9.7			2	
Z-11		.01	Ro 2				2	
Z-11		.005	Sc 1				2	
Z-11		.005	Sc 2				3	
Ca(OH) ₂		2.0	Zn Cond	10.9		10		
CuSO ₄		1.0						
Z-11		.09						
DF 1012			Zn Res 1				2	
Z-11		.02	Zn Ro 2				2	
Z-11		.01	Zn Sc 1				2	lots of pyrite (need higher Zn pH)
Z-11		.01	Zn Sc 2				3	

RESULTS:

PRODUCT	WEIGHTS		ASSAYS %			UNITS			DISTRIBUTION %		
	GM.	%	PB	ZN	FE				PB	ZN	FE
PBRC1	111.80	.06	58.00	10.40	5.60	3.24	.58	.31	67.14	5.74	1.64
PBRC2	43.50	.02	24.70	18.90	13.60	.54	.41	.30	11.12	4.06	1.55
PBSC1	54.60	.03	11.30	20.90	17.40	.31	.57	.47	6.39	5.64	2.49
PBSC2	31.50	.02	7.10	18.60	16.60	.11	.29	.26	2.32	2.89	1.37
PBSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZNRC1	254.20	.13	1.00	52.50	9.50	.13	6.67	1.21	2.63	65.90	6.34
ZNRC2	73.20	.04	1.50	20.10	22.00	.05	.73	.80	1.14	7.27	4.23
ZNSC1	116.10	.06	.90	4.50	35.00	.05	.26	2.03	1.08	2.58	10.67
ZNSC2	213.20	.11	.60	2.00	39.00	.06	.21	4.15	1.32	2.11	21.83
ZNSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZN ST	1104.00	.55	.60	.70	17.20	.33	.39	9.48	6.86	3.82	49.86
HEADS	2002.10		34.79	24.01		4.82	10.11	19.02	86.97	77.85	
PB CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
	58.00		67.14								
	48.67		78.26								
	38.95		84.65								
	34.79		86.97								
	34.79		86.97								
ZN CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
	52.50		65.90								
	45.26		73.17								
	34.59		75.75								
	24.01		77.85								
	24.01		77.85								

Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Test Format and Results

TEST No. 2953-54 | SAMPLE OF: Anvil Crusher Stkpile + Pious Humm (50/50)

OBJECTIVE: Flotation with Anvil Scheme | DATE: Dec 13/76

REAGENTS:

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS
	grms.	lbs./ton		Start	End	Cond.	Flot.	
Na ₂ CO ₃		5.0	GRIND 9+2					
NaCN		0.20				2		
Z-11		0.05						
MIBC		0.029	Pb Ro 1	9.5			2	
			Ro 2				2	
Z-11		0.01	Sc 1				2	
Z-11		0.01	Sc 2				3	
CaO		2.5	Zn Cond					
CuSO ₄		1.0				10		
Z-11		.09						
DF1012		0.03	Zn Ro 1	10.8			2	
Z-11		0.03	Ro 2				2	
Z-11		0.02	Sc 1				2	
Z-11		0.01	Sc 2				3	

PROD.	WEIGHTS		ASSAYS			UNITS			DISTRIBUTION		
	GM.	%	PB	ZN	FE				PB	ZN	FE
PBRC1	151.60	.07	51.10	14.50	8.20	3.58	1.01	.57	71.79	8.03	1.95
PBRC2	23.90	.01	24.60	23.40	15.70	.27	.26	.17	5.45	2.04	.59
PBSC1	19.30	.01	13.40	25.70	20.10	.12	.23	.18	2.40	1.81	.61
PBSC2	18.70	.01	9.60	24.30	22.00	.08	.21	.19	1.66	1.66	.61
PBSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZNRC1	135.50	.06	1.50	57.20	8.40	.09	3.58	.53	1.88	28.33	1.79
ZNRC2	115.70	.05	1.50	68.00	7.00	.08	3.20	.37	1.61	25.37	1.27
ZNSC1	99.00	.05	2.40	55.90	9.30	.11	2.55	.42	2.20	20.23	1.45
ZNSC2	58.00	.03	2.90	30.30	21.30	.08	.81	.57	1.56	6.42	1.94
ZNSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZN ST	1545.00	.71	.80	1.08	37.00	.57	.77	26.38	11.45	6.10	89.76
HEADS	2166.70		41.09	53.86		4.98	12.63	29.39	81.29	80.35	
PB CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
	51.10								71.79		
	47.49								77.23		
	44.11								79.63		
	41.09								81.29		
	41.09								81.29		
ZN CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
	57.20								28.33		
	58.49								53.70		
	57.76								73.93		
	53.86								80.35		
	53.86								80.35		

Tested by: Ma Adams

Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Test Format and Results

(50/50)

TEST No. 2961-62 | SAMPLE OF: GRM QUARTZ SULPHIDES + ANVIL CRUSHER'S

OBJECTIVE: ANVIL STD FLOT TEST + GRIND. | DATE: DEC. 16

REAGENTS:

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS
	grms.	lbs./ton		Start	End	Cond.	Flot.	
Na ₂ CO ₃		5.5	GRIND 9+2					
Na ₂ CN		.20						
2-11		.04						
MIBC			Pb Res 1	9.8			2	Some graphite and tails
2-11		.005	Res 2				2	
		.005	Sc 1				2	
		.005	Sc 2				3	
Cu(OH) ₂		2.7	Cond					
CuSO ₄		.75				10		
2-11		.07						
DF 1012			Zn Res 1	11.1			2	
2-11		.01	Res 2				2	
2-11		.01	Sc 1				2	
2-11		.01	Sc 2				3	

RESULTS:

PROD.	WEIGHTS		ASSAYS %			UNITS			DISTRIBUTION %		
	GM.	%	PB	ZN	FE				PB	ZN	FE
PBRC1	88.60	.04	53.00	8.10	7.40	2.12	.32	.30	66.27	4.80	1.54
PBRC2	33.40	.02	19.00	14.90	17.70	.31	.25	.29	9.84	3.66	1.53
PBSC1	23.20	.01	10.20	15.20	21.00	.12	.17	.24	3.67	2.59	1.26
PBSC2	22.70	.01	7.10	13.90	20.50	.08	.16	.23	2.50	2.32	1.20
PBSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZNRC1	176.60	.99	1.00	51.30	9.30	.09	4.50	.81	2.74	66.55	4.25
ZNRC2	35.30	.02	1.70	30.50	14.90	.03	.53	.26	.93	7.91	1.36
ZNSC1	23.60	.01	1.90	16.40	19.60	.02	.19	.23	.70	2.04	1.20
ZNSC2	38.80	.02	1.80	8.30	22.30	.03	.16	.43	1.08	2.37	2.24
ZNSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZN ST	1581.00	.78	.50	.60	20.90	.39	.47	16.40	12.26	6.97	85.43
HEADS	2015.20		33.17	39.54		3.20	6.75	19.19	82.29	79.67	
PB CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
		53.00								66.27	
		43.04								76.12	
		37.49								79.79	
		33.17								82.29	
		33.17								82.29	
ZN CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
		51.30								66.55	
		47.83								74.46	
		44.68								77.31	
		39.54								79.67	
		39.54								79.67	

Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Test Format and Results

TEST No. 2983-84 | SAMPLE OF: *Dum Combined + Cy Anvil Stockpile*

OBJECTIVE: _____ DATE: _____

REAGENTS:

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS
	grms.	lbs./ton		Start	End	Cond.	Flot.	
Na_2CO_3		5.00	Gund 9+2					
Na_2SO_3		1.50						
Na_2CN		.30						
$ZnSO_4$		1.00						
Z-11		.035						
MIBC			Pb Ro 1	9.5			2	
			Po 2				2	
			Sc 1				2	
			Sc 2				3	
$Ca(OH)_2$	2.0		Zn Cond					
$CaSO_4$	0.90					10		
Z-11	.08							
DE 1012	0.02							
Z-200	.007		Zn Ro 1	10.9				
Z-11			Zn Ro 2					
Z-11			Sc 1					
Z-11			Sc 2					

RESULTS:

PROD.	WEIGHTS		ASSAYS			UNITS			DISTRIBUTION		
	GH.	%	PB	ZN	FE				PB	ZN	FE
PBRC1	89.60	.04	59.10	9.50	5.20	2.60	.42	.23	60.98	4.45	1.94
PBRC2	41.10	.02	27.30	19.10	14.90	.55	.39	.30	12.92	4.11	1.37
PBSC1	23.90	.01	17.80	20.00	17.00	.21	.23	.20	4.90	2.50	.91
PBSC2	44.20	.02	18.40	19.30	19.30	.23	.42	.42	5.29	4.46	1.91
PBSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZNRC1	152.90	.08	1.20	54.00	8.20	.89	4.05	.62	2.11	43.19	2.81
ZNRC2	116.00	.06	2.10	46.00	11.00	.12	2.62	.63	2.81	27.91	2.86
ZNSC1	56.30	.03	2.40	19.00	21.10	.87	.53	.58	1.56	5.60	2.66
ZNSC2	45.20	.02	1.90	8.60	25.00	.04	.19	.55	.99	2.03	2.53
ZNSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZN ST	1467.00	.72	.50	.75	25.50	.36	.54	18.37	8.45	5.75	83.89
HEADS	2036.20		36.73	40.63		4.26	9.39	21.90	84.09	78.72	
PB CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
	59.10		60.98								
	49.10		73.90								
	44.26		78.80								
	36.73		84.09								
	36.73		84.09								
ZN CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
	54.00		43.19								
	50.55		71.10								
	45.09		76.69								
	40.63		78.72								
	40.63		78.72								

Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Test Format and Results

TEST No. 2923-24 | SAMPLE OF: GRUM H-1

OBJECTIVE: Ann. STD

DATE: Nov 30/76

REAGENTS:

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS
	grms.	lbs./ton		Start	End	Cond.	Flot.	
Na ₂ CO ₃		1	GRIND 9+2					
NaCN		0.20					2	
Z-11		.05						
			Pb Ro 1	10.0			2	
			Ro 2				2	
Z-11		.015	Sc 1				2	
Z-11		.015	Sc 2				3	
CuO		2.0	Cond.					
CuSO ₄		0.75					10	
Z-11		.07						
			Zn Ro 1	11.05			2	
			Ro 2				2	
Z-11		.02	Sc 1				2	
Z-11		.02	Sc 2				3	

RESULTS:

PROD.	WEIGHTS		ASSAYS			UNITS			DISTRIBUTION		
	GM.	%	PB	ZN	FE				PB	ZN	FE
PBRC1	138.40	.07	51.40	9.80	8.70	3.73	.71	.63	70.91	7.59	4.09
PBRC2	35.80	.02	18.90	14.70	16.80	.35	.28	.32	6.74	2.94	2.04
PBSC1	29.30	.02	10.40	14.50	18.90	.16	.22	.29	3.04	2.38	1.88
PBSC2	30.00	.02	6.80	14.30	18.40	.11	.22	.29	2.03	2.40	1.88
PBSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PBSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.41	48.75	5.11
ZNRC1	172.90	.09	1.40	50.40	8.70	.13	4.57	.79	1.19	11.26	2.45
ZNRC2	56.70	.03	2.10	35.50	12.70	.06	1.05	.38	1.26	5.16	3.40
ZNRC2	56.70	.03	2.40	17.50	19.00	.07	.48	.52	2.01	4.91	7.25
ZNSC1	52.70	.03	2.40	17.50	19.00	.11	.46	1.12	0.00	0.00	0.00
ZNSC2	87.80	.05	2.30	18.00	24.30	0.00	0.00	0.00	0.00	0.00	0.00
ZNSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.41	14.60	71.68
ZN ST	1305.00	.68	.80	2.00	16.20	.55	1.37	11.08			
HEADS	1908.60		35.54	33.85		5.26	9.36	15.41	82.72	70.09	
PB CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
	51.40								70.91		
	44.72								77.65		
	39.78								80.69		
	35.54								82.72		
	35.54								82.72		
ZN CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
	50.40								48.75		
	46.72								60.00		
	41.27								65.18		
	33.85								70.09		
	33.85								70.09		

METALLURGICAL TEST REPORT

Test Format and Results

TEST No. 2917-18 | SAMPLE OF: GRUM QUARTZ SULPHIDES

OBJECTIVE: ANVIL STD. (ADJUSTED COLLECTOR COHEADS)

DATE: NOV 30/71

REAGENTS:

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS	
	grms.	lbs./ton		Start	End	Cond.	Flot.		
Na ₂ CO ₃		4	GRIND 9+2						
NaCN		0.20							
Z-11		0.04							
MIBC		300							
			Pb Ro 1	10.2			2	Tails since 4th fl.	
			Pb 2				2	T150 2.6	
Z-11		.015	Sc 1				2	T200 2.7	
Z-11		.015	Sc 2				3	T325 7.3	
								-325 12.5	
CuO		2.0	COND						
CuSO ₄		0.60					10		
Z-11		0.05							
			Zn Ro 1	11.2			2		
			Pb 2				2		
Z-11		.015	Sc 1				2	pyrite in Scans	
Z-11		.015	Sc 2				3		

RESULTS:

PROD.	WEIGHTS		ASSAYS			UNITS			DISTRIBUTION		
	GM.	%	PB	ZN	FE				PB	ZN	FE
PBRC1	34.70	.02	45.00	5.10	8.70	.79	.09	.15	45.98	2.63	2.15
PBRC2	20.70	.01	13.00	6.60	13.50	.14	.07	.14	7.92	2.03	1.99
PBSC1	23.10	.01	7.00	6.90	16.60	.09	.08	.19	5.31	2.37	2.73
PBSC2	20.20	.01	4.20	6.20	12.90	.04	.06	.13	2.50	1.86	1.86
PBSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZNRC1	91.10	.05	1.00	40.00	9.60	.05	1.84	.44	2.68	54.26	6.23
ZNRC2	39.70	.02	1.30	18.40	13.80	.03	.37	.28	1.52	18.88	3.90
ZNSC1	44.40	.02	1.40	7.30	21.80	.03	.16	.49	1.83	4.83	6.90
ZNSC2	91.70	.05	1.40	3.70	27.50	.06	.17	1.28	3.78	5.05	17.97
ZNSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZN ST	1612.00	.82	.60	.67	4.90	.49	.55	3.99	28.48	16.08	56.27
HEADS	1977.60		21.23	18.88		1.72	3.40	7.10	61.71	75.01	
PB CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
			45.00						45.98		
			33.04						53.90		
			25.62						59.21		
			21.23						61.71		
			21.23						61.71		
ZN CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
			40.00						54.26		
			33.44						65.13		
			26.82						69.96		
			18.88						75.01		
			18.88						75.01		

METALLURGICAL TEST REPORT

Test Format and Results

TEST No. 2927-28

SAMPLE OF: MASSIVE BANDED GRUM D-1

DATE: DEC 1/71

OBJECTIVE:

REAGENTS:

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS
	grms.	lbs./ton		Start	End	Cond.	Flot.	
Na_2CO_3		4.0	GRIND 9+2					
NaCN		0.20				2		
Z-11		0.05						
MIBC		3.00						
			Pb Re 1	10.0			2	
			Re 2				2	
Z-11		.015	Sc 1				2	Graphite?
Z-11		.015	Sc 2				3	
CaO		2.0						new line
CaSO_4		0.80						
Z-11		.07						
1012		6.00	Zn Re 1	10.9			2	very heavy Zn froth
			Re 2				2	
Z-11		.02	Sc 1				2	
Z-11		.02	Sc 2				3	

RESULTS:

PROD.	WEIGHTS		ASSAYS			UNITS			DISTRIBUTION		
	GM.	%	PB	ZN	FE				PB	ZN	FE
PBRC1	101.70	.05	52.70	9.60	4.30	2.67	.49	.22	56.00	5.19	3.09
PBRC2	30.20	.02	18.80	14.80	7.00	.20	.22	.11	5.93	2.37	1.49
PBSC1	32.80	.02	16.70	18.00	9.00	.27	.29	.15	5.72	3.14	2.09
PBSC2	32.80	.02	11.10	19.20	9.80	.18	.31	.16	3.71	3.26	2.22
PBSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZNRC1	199.60	.10	2.40	48.50	7.80	.24	4.81	.77	5.01	51.43	11.00
ZNRC2	72.70	.04	3.30	35.00	9.60	.12	1.27	.35	2.51	13.52	4.90
ZNSC1	40.30	.02	3.80	21.00	12.90	.08	.42	.26	1.60	4.50	3.65
ZNSC2	98.30	.05	3.30	11.80	15.90	.16	.58	.78	3.39	6.16	11.00
ZNSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZN ST	1403.00	.70	1.10	1.40	6.10	.77	.98	4.26	16.13	10.43	60.49
HEADS	2010.60		34.72	34.63		4.76	9.36	7.04	71.37	75.60	
PB CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
			52.70						56.00		
			44.94						61.94		
			39.31						67.66		
			34.72						71.37		
			34.72						71.37		
ZN CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
			48.50						51.43		
			44.90						64.95		
			41.82						69.44		
			34.63						75.60		
			34.63						75.60		

METALLURGICAL TEST REPORT

Test Format and Results

TEST No. 2948-9 | SAMPLE OF: GRUM H-1

OBJECTIVE: Maximize Rec. Using Lakefield Rpts

DATE: Dec 10/76

REAGENTS:

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS
	grms.	lbs./ton		Start	End	Cond.	Flot.	
Na ₂ CO ₃		5.0						
ZnSO ₄		1.0	GRIND 30					
NaCN		0.30						
R242		0.05						
R404		0.01	Pb Ro 1	9.6		1	3	100 MISC
R242		0.01	Pb Ro 2			1	3	
R404		.005						
R242		.005	Pb Ro 3			1	3	
R404		.005						
R242		.005	Pb Ro 4			1	3	
R404		.005						
Ca(OH) ₂		2.0	Zn Cond	10.7		6		
CuSO ₄		1.0						
Z-2000	300	.021	Zn Ro 1			1	3	Zn Cond + Flot time
Z-11		.07						increased from
Z200	200	0.014	Zn Ro 2			1	3	Lakefield tests
Z-11		.04						100% 1012
Z200	100	.007	Zn Ro 3	10.4				
Z-11		.03				1	4	

RESULTS:

PROD.	WEIGHTS		ASSAYS			UNITS			DISTRIBUTION		
	GM.	%	PB	ZN	FE				PB	ZN	FE
PBRC1	93.30	.05	54.00	6.30	7.10	2.51	.29	.33	51.40	3.13	2.14
PBRC2	71.10	.04	29.50	15.40	16.50	1.05	.55	.58	21.40	5.82	3.79
PBSC1	47.60	.02	13.50	15.00	21.50	.32	.36	.51	6.56	3.80	3.30
PBSC2	38.90	.02	8.90	14.80	23.90	.17	.29	.46	3.53	3.06	3.00
PBSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZHRC1	221.30	.11	1.50	52.40	8.70	.17	5.78	.96	3.39	61.68	6.22
ZHRC2	132.10	.07	2.00	14.00	23.60	.13	.92	1.55	2.70	9.84	10.07
ZHSC1	199.80	.10	1.20	2.90	34.40	.12	.29	3.43	2.45	3.08	22.19
ZHSC2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZHSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZN ST	1202.00	.60	.70	1.50	12.70	.42	.90	7.61	8.58	9.59	49.29
HEADS	2006.10		32.38	25.35		4.89	9.37	15.44	82.89	74.60	
PB CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
			54.00						51.40		
			43.40						72.80		
			36.69						79.36		
			32.38						82.89		
			32.38						82.89		
ZN CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
			52.40						61.68		
			38.05						71.52		
			25.35						74.60		
			25.35						74.60		
			25.35						74.60		

Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Test Format and Results

TEST No. 02944-45 | SAMPLE OF: GRUM MASSIVE FLOW E-1

OBJECTIVE: GRUM (LAKEFEILD TEST) WITH Extra COND FLOT. TIME DATE: DEC 8/76
and collector to maximize recovery

REAGENTS:

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS
	grms.	lbs./ton		Start	End	Cond.	Flot.	
Na ₂ CO ₃		5.0	GRIND 30					
ZnSO ₄		1.0						
NaCN		0.30						
R242		0.06						
R404		0.01	Pb Ro 1	9.8		1	3	
R242		0.01	Pb Ro 2					
R404		0.005				1	3	
R242		0.005	Pb Ro 3			1	3	
R404		0.005						
R242		0.005	Pb Ro 4			1	3	
R404		0.005						
Ca(OH) ₂		2.0	COND				3	
CuSO ₄		1.0						
Z-200	100	.014	Zn Ro 1	10.7		1	2	
Z-11		.07						
Z-11		.04	Zn Ro 2			1	3	
Z-11	100	.03	Zn Ro 3			1	2	
Z-11		.02	Zn Ro 4			1	3	
Z-200	100	.007						

RESULTS:

PRODUCT	WEIGHTS		ASSAYS %			UNITS			DISTRIBUTION %		
	gm	%	Pb	Zn	Fe	Pb	Zn	Fe	Pb	Zn	Fe
PBRC1	60.20	.03	49.70	8.60	4.60	1.49	.26	.14	24.22	2.12	1.5
PBRC2	101.90	.05	42.20	18.70	6.10	2.14	.95	.31	34.81	7.82	3.4
PBSC1	62.60	.03	24.30	24.60	10.20	.76	.77	.32	12.31	6.32	3.5
PBSC2	54.70	.03	17.00	25.10	12.30	.46	.60	.33	7.53	5.63	3.7
PBSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
ZNRC1	206.40	.10	3.20	54.60	7.20	.33	5.60	.74	5.35	46.23	8.2
ZNRC2	138.40	.07	4.30	40.00	10.00	.30	2.75	.69	4.82	22.71	7.6
ZNSC1	75.30	.04	4.10	12.30	15.50	.15	.46	.58	2.50	3.80	6.4
ZNSC2	96.50	.05	3.30	5.50	21.00	.16	.26	1.01	2.58	2.18	11.1
ZNSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
ZN ST	1215.00	.60	.60	.64	8.10	.36	.39	4.89	5.90	3.19	54.3
HEADS	2011.00		34.87	35.35		6.14	12.12	9.01	78.86	74.92	
PB CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
			49.70						24.22		
			44.99						59.02		
			39.22						71.33		
			34.87						78.86		
			34.87						78.86		
ZN CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
			54.60						46.23		
			48.74						68.94		
			42.21						72.74		
			35.35						74.92		
			35.35						74.92		

METALLURGICAL TEST REPORT

Test Format and Results

TEST No. 2901-2 | SAMPLE OF: Anvil Crusher Stockpile

OBJECTIVE: Anvil Grind vs. Drum Grind (Lakefield)

DATE: Nov 29/7

REAGENTS: 10 vs 30 minute grind

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS
	grms.	lbs./ton		Start	End	Cond.	Flot.	
Na ₂ CO ₃		2.50	GRIND 8+2					Screen Analysis Tail +100 6.7%
NaCN		0.20						
Z-11		.07						
MIBC		.014	Pb Ro 1	8.7				150 15.5
			Ro 2					200 26.8
Z-11		.015	Sc 1					325 19.0
Z-11		.015	Sc 2					-325 32.0
CaO		1.5	Zn Cond					51% - 200 mesh is coarser than normal Anvil grind (70% - 200 mesh)
CuSO ₄		0.75				10		
Z-11		.07						
DE 1012	200		Zn Ro 1					
			Ro 2					
Z-11		.02	Sc 1					
Z-11		.02	Sc 2					

PROD.	WEIGHTS		ASSAYS			UNITS			DISTRIBUTION		
	GM.	%	PB	ZN	FE				PB	ZN	FE
PBRC1	144.20	.07	67.10	7.00	5.30	4.81	.50	.38	75.05	6.59	1.22
PBRC2	32.70	.02	46.10	13.20	12.40	.75	.21	.20	11.69	2.82	.65
PBSC1	17.20	.01	23.00	18.00	21.00	.20	.15	.18	3.07	2.02	.57
PBSC2	19.20	.01	14.50	18.00	25.70	.14	.17	.25	2.16	2.26	.78
PBSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZNRC1	81.40	.04	1.00	53.50	10.00	.04	2.16	.40	.63	28.44	1.29
ZNRC2	33.10	.02	1.20	50.00	12.60	.02	.82	.21	.31	10.81	.66
ZNSC1	44.20	.02	.80	25.00	28.00	.02	1.09	.27	.34	14.29	.87
ZNSC2	165.30	.08	0.00	0.00	0.00	.07	2.05	2.30	1.03	26.99	7.36
ZNSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZN ST	1475.00	.73	.50	.60	36.90	.37	.44	27.05	5.72	5.78	86.59
HEADS	2012.30		55.59	38.06		6.41	7.61	31.24	91.97	80.53	
PB CUMULATIVE GRADES											
			67.10		75.05						
			63.22		86.74						
			59.65		89.81						
			55.59		91.97						
			55.59		91.97						
ZN CUMULATIVE GRADES											
			53.50		28.44						
			52.49		39.25						
			51.66		53.54						
			38.06		80.53						
			38.06		80.53						

Tested by: *IMQ/John*

Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Test Format and Results

TEST No. 2903-4 | SAMPLE OF: Anvil Crusher Stockpile

OBJECTIVE: Anvil grind vs. Drum Grind (cake field) DATE: Nov 24/76

REAGENTS:

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS	
	grms.	lbs./ton		Start	End	Cond.	Flot.		
Na ₂ CO ₃		2.5	GRIND 28+2	8.5		2		Screen Analysis Tail	
Na CN		0.20						+100	0.1%
Z-II		.07						150	TRACE
MIBC		.014						200	0.8%
								325	11.6%
			Ph Ro 1					-325	87.5%
			Ro 2						
Z-II		.015	Sc 1						
Z-II		.015	Sc 2						
CaO		1.5	Zn Cond	10.1					
CuSO ₄		0.75						10	
Z-II		.07							
DF1012	2 D20P								
			Zn Ro 1						
			Ro 2						
Z-II		.02	Sc 1						
Z-II		.02	Sc 2						

2903-04

PROD.	WEIGHTS		ASSAYS			UNITS			DISTRIBUTION		
	GM.	%	PB	ZN	FE				PB	ZN	FE
PBRC1	143.00	.07	70.37	4.10	4.90	4.95	.29	.34	82.13	2.51	1.10
PBRC2	30.20	.01	29.10	15.10	19.90	.43	.22	.30	7.17	1.95	.94
PBSC1	32.10	.02	13.00	17.00	26.40	.21	.27	.42	3.41	2.33	1.33
PBSC2	30.00	.01	6.00	16.50	29.80	.09	.24	.44	1.47	2.12	1.40
PBSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZNRC1	82.60	.04	1.20	45.00	15.10	.05	1.83	.61	.81	15.89	1.95
ZNRC2	42.00	.02	1.20	49.00	12.90	.02	1.01	.27	.41	8.80	.85
ZNSC1	117.80	.06	.50	54.50	9.80	.03	3.16	.57	.48	27.45	1.81
ZNSC2	128.10	.06	.60	50.00	13.00	.04	3.15	.82	.63	27.38	2.61
ZNSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZN ST.	1426.00	.70	.30	1.90	39.40	.21	1.33	27.65	3.49	11.58	98.01
HEADS	2031.80		49.04	50.20		6.03	11.51	31.42	94.18	79.51	
PB CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
			70.37						82.13		
			63.17						89.30		
			55.33						92.71		
			49.04						94.18		
			49.04						94.18		
ZN CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
			45.00						15.89		
			46.35						24.69		
			50.31						52.13		
			50.20						79.51		
			50.20						79.51		

Tested by: *MCCM*

METALLURGICAL TEST REPORT

Test Format and Results

TEST No. 2981-82 | SAMPLE OF: *Drum Combined*

OBJECTIVE: *Impurified Pb grade with increased NaCN and ZnSO₄*

DATE: *Dec 23/76*

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS
	grms.	lbs./ton		Start	End	Cond.	Flot.	
<i>Na₂CO₃</i>		<i>4.0</i>	<i>GRIND 9+2</i>					
<i>NaCN</i>		<i>0.30</i>				<i>2</i>		
<i>ZnSO₄</i>		<i>1.0</i>						
<i>Z-11</i>		<i>0.03</i>						
<i>MIBC</i>		<i>.012</i>	<i>Pb Ro 1</i>	<i>10.0</i>				
<i>Z-11</i>		<i>.01</i>	<i>Ro 2</i>					
<i>Z-11</i>		<i>.005</i>	<i>Sc 1</i>					
<i>Z-11</i>		<i>.005</i>	<i>Sc 2</i>					
<i>Ca(OH)₂</i>		<i>1.60</i>	<i>Zn Cond.</i>					
<i>CuSO₄</i>		<i>0.90</i>				<i>10</i>		
<i>Z-11</i>		<i>0.08</i>						
<i>D.F. 1012</i>		<i>.90</i>						
<i>Z-200</i>		<i>.007</i>	<i>Zn Ro 1</i>	<i>11.5</i>				
<i>Z-11</i>		<i>.02</i>	<i>Ro 2</i>					
<i>Z-11</i>		<i>.02</i>	<i>Sc 1</i>					
<i>Z-11</i>		<i>.005</i>	<i>Sc 2</i>					

PROD.	WEIGHTS		ASSAYS			UNITS			DISTRIBUTION		
	GM.	%	PB	ZN	FE				PB	ZN	FE
PBRC1	51.00	.03	57.00	8.50	4.60	1.71	.25	.14	35.57	2.39	.99
PBRC2	58.90	.03	39.40	16.70	9.30	1.13	.48	.27	23.51	4.48	1.92
PBSC1	63.00	.03	19.00	23.00	15.00	.58	.71	.46	12.13	6.61	3.31
PBSC2	55.10	.03	11.70	20.00	17.50	.31	.54	.47	6.53	5.02	3.38
PBSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZNRC1	209.40	.10	2.90	49.10	8.60	.30	5.00	.88	6.15	46.87	6.32
ZNRC2	115.70	.06	3.20	29.50	14.40	.18	1.66	.81	3.75	15.56	5.84
ZNSC1	99.30	.05	2.80	14.90	17.90	.14	.72	.86	2.82	6.75	6.23
ZNSC2	62.90	.03	2.30	9.80	17.90	.07	.30	.55	1.47	2.81	3.95
ZNSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZN ST	1329.00	.65	.60	1.57	14.60	.39	1.02	9.44	8.08	9.51	68.05
HEADS	2054.90		32.16	32.40		4.80	10.67	13.88	77.74	71.99	
PB CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
	57.00										
	48.40										
	38.30										
	32.16										
	32.16										
ZN CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
	49.10										
	42.12										
	35.75										
	32.40										
	32.40										

Tested by: *Malden*

Cyprus Anvil Mining Corporation

METALLURGICAL TEST REPORT

Test Format and Results

TEST No. 2977-78 | SAMPLE OF: Gum Combined

OBJECTIVE: Increased Na CN

DATE: Dec 22/70

REAGENTS:

NAME	AMOUNT		ADDITION POINT	pH		TIMES		REMARKS
	grms.	lbs./ton		Start	End	Cond.	Flot.	
Na ₂ CO ₃		4.5	GRIND 9+2					
Na CN		0.30				2		
Z-11		0.04						
MIBC	2.32015	0.012	Pb Ro 1	10.4			2	
Z-11		.01	Ro 2				2	
Z-11		.005	Sc 1				2	
Z-11		.005	Sc 2				3	
Ca(OH) ₂		2.0	Zn Cond					
CuSO ₄		0.90				10		
Z-11		0.055						
DF 1012			Zn Ro 1					
Z-11		2.02	Ro 2					
Z-11		0.015	Sc 1					
Z-11		0.01	Sc 2					

PROD.	WEIGHTS		ASSAYS			UNITS			DISTRIBUTION		
	GM.	%	PB	ZN	FE				PB	ZN	FE
PBRC1	155.50	.08	40.40	14.40	9.30	3.13	1.12	.72	65.83	10.64	5.41
PBRC2	56.70	.03	13.80	21.90	16.60	.39	.62	.47	8.19	5.90	3.52
PBSC1	41.10	.02	9.30	22.60	17.60	.19	.46	.36	4.00	4.41	2.70
PBSC2	41.00	.02	7.50	21.10	17.20	.15	.43	.35	3.22	4.11	2.64
PBSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZNRC1	254.70	.13	1.50	48.70	8.90	.19	6.19	1.13	4.00	58.93	8.47
ZNRC2	48.70	.02	2.50	19.00	16.40	.06	.46	.40	1.27	4.40	2.98
ZNSC1	34.80	.02	2.50	11.50	19.00	.04	.20	.33	.91	1.90	2.47
ZNSC2	72.70	.04	2.20	7.20	19.30	.08	.26	.70	1.67	2.49	5.24
ZNSC3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZN ST	1300.00	.65	.80	1.17	13.70	.52	.76	8.88	10.89	7.23	66.56
HEADS	2005.30		26.35	34.69		4.76	10.50	13.34	81.25	67.71	
PB CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
	40.40										
	33.30										
	29.40										
	26.35										
	26.35										
ZN CUMULATIVE GRADES			CUMULATIVE RECOVERIES								
	48.70										
	43.93										
	40.60										
	34.69										
	34.69										

Tested by: Malcolm

APPENDIX IV

SYMBOLS AND ABBREVIATIONS

<u>Symbol</u>	<u>Meaning</u>
D-1	Grum massive banded sulphides
E-1	Grum massive flow sulphides
F-1	Grum massive porous sulphides
G-1	Grum quartz sulphides
H-1	Grum banded sulphides
Y.T.D.	Year to date
P ₈₀	The 80% passing size
Rec.	Recovery
N/A	Not available
Na ₂ CO ₃	Sodium carbonate
NaCN	Sodium cyanide
ZnSO ₄	Zinc sulphate
R-242	Cyanamid Aero promotor
R-404	Cyanamid Aero promotor
M.I.B.C.	Methyl isobutyl carbinol
Ca(OH) ₂ or CaO	Lime
CuSO ₄	Copper Sulphate
Z-200	Dow Chemical promotor
D.F. 1012	Dow froth
Z-11	Sodium isopropyl xanthate
Pb	Lead
Zn	Zinc
Fe	Iron
Cu	Copper