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METALLURGY OF OWEN LAKE DEPOSIT

Prepared for:

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File Number: 6891
October 22, 1987

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TABLE OF CONTENTS

SECTION 1

SUMMARY

A flowsheet which produces copper, lead and zinc concentrates by differential flotation has been developed for the Owen Lake deposit of Houston Metals Corporation. The flowsheet development was performed with a composite ore sample using batch flotation tests. The viability of the flowsheet was confirmed by means of locked-cycle flotation testing. The results obtained with the composite sample are as follows:

Product	Cu %	Pb %	Zn %	Au oz/ton	Ag oz/ton
Copper conc	27.6	5.2	8.1	0.590	301.4
Lead conc	5.2	43.6	10.0	0.292	71.6
Zinc conc	1.1	0.7	51.1	0.071	12.7
Tailing	0.1	0.3	0.36	0.043	2.5
Feed	1.14	1.90	7.56	0.068	14.8

Product	Recovery, %				
	Cu	Pb	Zn	Au	Ag
Copper conc	66.5	8.3	3.5	23.1	59.5
Lead conc	13.7	76.1	4.9	12.5	15.5
Zinc conc	12.5	4.8	87.9	13.9	11.5
Tailing	7.3	10.8	3.7	50.4	13.5

While these results are acceptable, they are not the optimum results achieved in the testwork. During the batch testwork, selective concentrates were produced which are higher in content of the desired metal, and lower in impurities. With optimization of conditions during continuous operation, results which are even better than those presented above should be achievable.

Samples from individual veins show considerable variation in the results obtained, compared to the above results. The reason for this variation is that the composition of these veins varies widely, from almost copper free and high in lead to high in copper and almost lead free. Since the ore is prone to oxidation it cannot be stored after mining in order to carry out blending. The mill will have to accept feed from whatever area is being mined. The mill operators will have to learn to respond to changes in the feed composition as it affects the circuit performance. Although the intended plant is relatively small, the feasibility of installing some degree of on-line process control should be investigated.

The possibility exists to recover additional gold and silver from the flotation tails by cyanidation of a pyrite concentrate produced from these tails. In order to be economically viable, some form of cyanide regeneration would be mandatory. Economic comparisons of cyanide regeneration technologies are required to evaluate this option.

The concentrations of trace metals such as gallium and germanium are too low to result in payment for these metals. They are present in sufficient concentration however that they should contribute to the negotiation of favourable smelter terms.

The present circuit configuration does not provide for regrinding of rougher concentrates prior to cleaning as this did not appear to be required. Provision should be made in the plant layout for the installation of regrind circuits in the event that some areas of the mine require regrinding of the concentrates.

SECTION 2
INTRODUCTION

A metallurgical investigation of samples from the Owen Lake Mine was undertaken by Bacon, Donaldson & Assoc. Ltd. at the request of Mr. W. W. Cummings and Mr. A. A. Petancic of Houston Metals Corp. The scope of the test program initially was to carry out a preliminary metallurgical investigation of samples from several areas of the min. This scope was increased at a later date to include more detailed metallurgical work which would establish a flowsheet capable of producing marketable copper, lead and zinc concentrates.

While it is recognized that the different areas in the mine vary to a considerable degree with regard to Cu-Pb-Zn ratios, much of the detailed testwork was done on a composite sample intended to approximate the mill feed expected during the initial period of operation. Several other samples were tested subsequently to observe the effect of extremes in mineralogy on the results which could be achieved.

SECTION 3
PROCESS DESCRIPTION

The flowsheet proposed for treatment of the Owen Lake deposit is shown in Figure 1. This flowsheet is based on locked cycle testwork included in this report as Test 10F11.

The incoming ore is ground to 70% passing 200 mesh prior to copper-lead bulk flotation. The bulk copper-lead concentrate is cleaned twice with reagent additions to depress sphalerite and pyrite. The cleaned bulk Cu-Pb concentrate is conditioned in two stages to deactivate the lead. The copper is floated off to produce the final copper concentrate while the tails comprise the lead concentrate.

The copper-lead bulk flotation tailings, together with cleaner tailings from the Cu-Pb and Zn circuits are conditioned in two stages to activate the zinc prior to zinc rougher flotation. The zinc rougher concentrate is cleaned twice with depression of pyrite to produce the final zinc concentrate.

The zinc rougher tails form the final plant tails. The production of a pyrite concentrate for gold-silver recovery has not been included at this time. If such a concentrate was to be produced, a short conditioning stage followed by a flotation stage would be introduced prior to discharge of the tails.

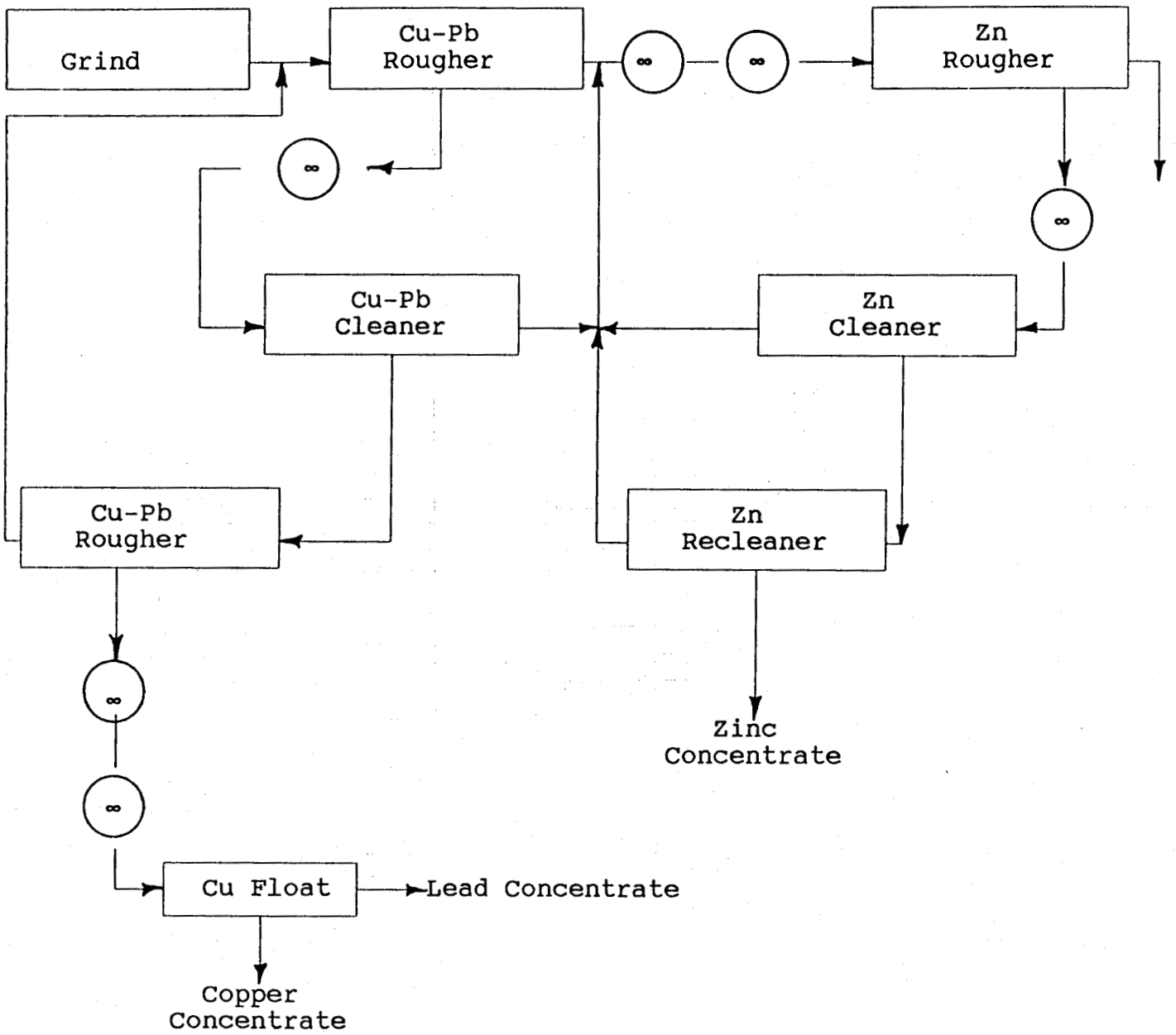

FIGURE 1

PROCESS FLOWSHEET

Residence Times (Batch)	
Cu-Pb rougher	10 minutes
Condition	5
Cu-Pb cleaner	10
Cu-Pb recleaner	7
Cu condition - stage 1	20
- stage 2	20
Cu float	5
Zn condition - stage 1	5
- stage 2	5
Zn rougher	8
Condition	5
Zn cleaner	6
Zn recleaner	5

The Cu-Pb rougher flotation time appears to be a critical parameter. While most of the batch tests were done on a 2 kilogram scale, several were done a on a 12 kilogram scale. For these larger tests the rougher flotation time had to be increased to 18 minutes while the other times were relatively unchanged.

The copper float time must not be made excessive. With increased flotation time at this stage excessive lead starts to float. It is possible that this problem could be controlled through continued sulphurous acid (SO_2) addition to the flotation cells.

Reagent Consumption

Reagent	lb/ton	kg/tonne
NaCn	0.65	0.33
Na_2SO_3	4.0	2.0
$ZnSO_4$	1.5	0.75
R-200	0.12	0.06
Aero 238	0.03	0.015
MIBC	0.05	0.025
Lime	7.4	2.7
$CuSO_4$	0.8	0.4
Aero 343	0.095	0.047
DF 1012	0.04	0.02
Dextrin	0.11	0.06
Sulphurous Acid	96	48

In full plant operation it will likely be preferable to replace the sulphurous acid addition with sulphur dioxide.

SECTION 4
SAMPLE DESCRIPTION

The preliminary metallurgical testwork described in the report dated March 12, 1987 by W. G. Bacon, P.Eng., was done on four samples. The descriptions and analyses of these samples are summarized in Table 4.1.

Table 4.1
Analyses of Samples Used for Preliminary Testwork

	Vein No.2	Vein No.5	High Zn High FeS_2	Ruby Vein
Cu, %	0.13	1.658	0.40	3.32
Pb, %	4.13	0.665	0.74	0.78
Zn, %	10.99	4.369	9.80	11.40
Fe, %	7.04	7.171	10.74	20.53
S, %	8.70	7.107	16.88	56.18
Au, oz/ton	0.068	0.088	0.090	0.073
Ag, oz/ton	2.208	16.338	5.738	39.445

Prior to the commencement of the detailed flowsheet development, three additional samples were received. The analysis of these samples are summarized in Table 4.2, together with the analysis of a composite sample (composite No. 2) having the following make-up:

Composite No. 2	Weight %
Vein No. 2	27.8
Vein No. 5	11.1
Footwall Vein	16.7
Ruby Vein	22.2
No. 3 Extension	22.2

Table 4.2

Analysis of Samples Used for Detailed Testwork

	No. 3 Extension	Switchback Vein	M3 Vein	Composite No. 2
Cu, %	0.86	0.10	0.61	1.20
Pb, %	0.96	4.24	0.94	2.10
Zn, %	1.68	12.40	30.4	8.48
Fe, %	16.30	10.92	12.95	13.13
S, %	19.59	17.00	26.74	16.75
Au, oz/ton	0.073	0.113	0.183	0.071
Ag, oz/ton	10.012	1.740	24.275	14.866

Each sample was prepared for testwork by stage crushing to minus 6 mesh prior to 2 kilogram test samples being riffled out.

SECTION 5
DISCUSSION

5.1 Cu-Pb ROUGHER FLOTATION

The conditions for Cu-Pb rougher flotation changed little throughout the test program. Pyrite and zinc depression was achieved through the use of NaCN, Na_2SO_3 and $ZnSO_4$. Copper and lead activation was achieved with Z-200 (available as reagent 200) and Aerofloat 238.

The pH in the Cu-Pb roughers was allowed to remain at the natural value for the ore. The natural pH varied from 5.1 for the Ruby Vein to 7.9 for the High Zn-High pyrite ore. There was no apparent correlation between the pH during Cu-Pb flotation and the recovery achieved for these metals.

There was some correlation between decreasing feed assay and decreasing recovery for both copper and lead in the rougher concentrate. The recoveries achieved with several samples are summarized in Table 5.1.

Table 5.1

Copper-Lead Rougher Recoveries

Sample	Head Assay		Rougher Recovery	
	% Cu	% Pb	Cu	Pb
Ruby Vein	3.32	0.78	91.8	70.1
No. 3 Ext.	0.86	0.96	80.6	86.2
Switchback	0.10	4.24	51.1	86.3
M3	0.61	0.94	82.0	83.5
Comp. 2	1.20	2.10	90.8	90.3

It was observed during the testwork that adequate rougher flotation time was important to maintaining high recoveries. For tests which were done on a 2 kilogram scale, a rougher flotation time of 10 minutes proved to be adequate. For tests done on a 12 kilogram scale, this time had to be increased to 18 minutes.

5.2 Cu-Pb CLEANER FLOTATION

The objective of the Cu-Pb cleaner flotation is to maintain the maximum recovery of these elements while at the same time rejecting pyrite and sphalerite.

The initial tests summarized in Table 5.2 used 1.5 lb/ton Na_2SO_3 and 1.0 lb/ton $ZnSO_4$ for pyrite and sphalerite depression. While these reagents appeared to give acceptable results for some feed materials (ie, No. 3 extension) for other samples, excessive pyrite continued to float.

Table 5.2

Cu-Pb Cleaner Results Without Cyanide Addition

Test No.	Sample	Cu-Pb Cleaner Concentrate % Cu	% Pb	% Zn	% Fe	% S
7F1	#3 Ext	14.0	18.0	7.4	15.7	31.1
8F1	Switchback	1.1	60.0	10.8	7.1	21.0
9F1	M3	8.6	13.2	10.4	24.4	38.2

An additional test (7F2) was done on the #3 Extension sample with increased sodium sulphite plus cyanide additions to the cleaners.

The concentrate produced in this test had the following composition:

20.0% Cu
30.8% Pb
5.0% Zn
6.9% Fe
24.3% S

The concentrate grade was improved over that produced in test 7F1 but both copper and lead recovery decreased by about 30%. A balance has to be achieved therefore between having sufficient cyanide present to depress the pyrite and not having so much that it depresses the copper and lead minerals. While the Cu and Pb concentration in the various test samples varies greatly, the pyrite concentration varies to a lesser degree. Once the appropriate cyanide level is established for a composite samples it should therefore also be suitable for material from the various individual veins.

Following Test 7F2, the remaining development work was done on the composite #2 sample. In Test 10F1, the cyanide addition to the first Cu-Pb cleaner was reduced from 0.2 to 0.1 lb/ton and to the second cleaner it was removed completely. Recoveries were maintained at high levels in this test while at the same time maintaining acceptable concentrate grades. No subsequent changes were made to the reagent additions to the Cu-Pb cleaners.

For most of the testwork the Cu-Pb rougher concentrate was reground prior to cleaning. It was observed that when a porcelain regrind mill was used for regrinding, the results appeared to be much better than when a steel mill was used. This was confirmed in Test 10F8. The rougher concentrate was split in

half and one half was reground with porcelain while the other half was reground with steel. The results summarized in Table 5.3 indicate much higher losses when steel was used for regrinding.

Table 5.3

Effect of Grinding Media on Losses to Cleaners

Media	Cleaner	% losses to tails	
		Cu	Pb
Steel	1st	6.4	1.5
	2nd	16.3	24.9
Porcelain	1st	5.0	1.6
	2nd	7.8	5.7

It is apparent that the use of steel results in increased losses to the cleaner tails, particularly in the 2nd cleaners. It would therefore be much preferable if the regrind could be eliminated since the need for pebble milling represents an undesirable complication. Test 10F10 was done without regrinding to establish whether it is in fact required. Table 5.4 compares the results of tests with and without regrinding prior to cleaning.

Table 5.4

Cu-Pb Cleaner Concentrate With and Without Regrinding

Test No.	Regrind	Assays, %				Recovery, %			
		Cu	Pb	Zn	Fe	Cu	Pb	Zn	Fe
10F9	Yes	14.3	26.0	6.3	8.8	69.8	83.3	4.4	4.1
10F10	No	15.9	26.2	10.0	9.6	78.3	84.9	7.6	4.6

Omitting the regrind does not have a detrimental effect on copper and lead recovery although it does increase the zinc and iron reporting to the bulk concentrate. It appears that for the composite sample, a regrind is not justified.

Tests 4F3 and 8F1 were done on the Ruby vein and Switchback vein respectively, without regrinding of the rougher concentrate. Both tests resulted in acceptable cleaning results, indicating that operation without a regrind will lead to satisfactory concentrate grades and recoveries.

5.3 Cu-Pb SEPARATION

Two copper-lead separation procedures were tested on the concentrate. Conditioning of the bulk concentrate at elevated temperature with starch and sodium bisulphite (Test 10F6) was found to be ineffective.

The separation procedure which has been determined to give good separation results on the composite feed consists of two stages of conditioning followed by flotation of the copper. In the first conditioning step, dextrin and active carbon are added. After a 20 minute conditioning period, sulphurous acid is added to maintain a pH of 4.8 for an additional 20 minutes. At the completion of conditioning, the copper is floated with an addition of Z-200. The separation results achieved in several tests are summarized in Table 5.5.

Table 5.5

Cu-Pb Separation Results for Composite Feed Sample

Test No.	Dextrin lb/ton	H_2SO_3* lb/ton	Cu Conc %Cu	Cu Conc %Pb	Cu Conc Cu Rec	Cu Conc Pb Rec	Pb Conc %Cu	Pb Conc %Pb	Pb Conc Cu Rec	Pb Conc Pb Rec
10F3	0.06	96	33.2	9.6	34.0	6.4	1.1	64.6	1.39	52.8
10F7	0.06	3	19.0	36.0	66.3	58.0	9.8	16.8	4.0	3.2
10F9	0.11	42	18.9	27.8	64.7	62.6	3.5	21.7	5.1	20.7
10F10	0.11	68	26.5	6.2	74.9	11.5	1.6	52.8	3.5	73.5

* H_2SO_3 addition represents lb/ton of 6% solution

The low recoveries shown for Test 10F3 resulted from losses during bulk concentrate cleaning. This test achieved high grade copper and lead concentrates and demonstrated that a separation could be made. In Tests 10F7, 10F9 and 10F10 the pH during conditioning was in each case maintained at 4.8. However, increasing additions of H_2SO_3 were made at the start of the conditioning period. The results are apparent in Table 5.5 with decreasing lead floating with the copper as the sulphurous acid addition is increased.

During the conditioning with H_2SO_3 the lead is depressed but this depression is not permanent. At the start of the copper flotation this froth is a dull gray as the tetrahedrite-tennantite floats. Once the flotation of the copper minerals is complete, additional flotation time results in lead flotation. This lead flotation is visually apparent as the froth becomes bluish-gray, characteristic of galena flotation. The operators in the plant will have to learn the color differences during flotation so that flotation of lead into the copper concentrate is avoided. Providing for additional SO_2 addition to the flotation cells should help to mitigate this problem.

The results indicate that for a composite sample having an "average" composition a satisfactory separation can be made. The composition of feed to the circuit can be expected to vary widely as feed is derived from predominantly one vein or another. Table 5.6 presents results for the composite sample as well as for samples which represent extremes in composition.

Table 5.6

Cu-Pb Separation Results for Samples Having Varying Cu-Pb Ratios

Test No.	H_2SO_3 lb/ton	Product	% Cu	% Pb	% Rec Cu	% Rec Pb
10F10	68	Feed	15.86	26.2	78.3	85.0
		Cu Conc	26.5	6.2	74.9	11.5
		Pb Conc	1.6	52.8	3.5	73.5
4F3	194	Feed	22.3	4.4	79.5	63.0
		Cu Conc	24.4	3.0	78.1	39.2
		Pb Conc	4.0	16.3	1.4	23.7
8F2	50	Feed	0.4	56.5	17.5	56.6
		Cu Conc	0.4	58.6	17.2	56.1
		Pb Conc	0.14	10.4	0.2	0.5

Test 4F3 was conducted on Ruby vein material which contains very little lead. The results indicate that copper flotation was satisfactory and that lead was depressed preferentially. Due to the low lead content of the feed, the lead concentrate has a very low lead content. This situation could not be avoided unless the separation was bypassed when only Ruby vein material was being processed.

Test 8F2 was conducted on Switchback vein material which has negligible copper but is high in lead. With this feed the lead was not adequately depressed and continued to float after conditioning. It was immediately apparent during flotation that

the concentrate consisted almost entirely of galena. With this type of feed the flotation operator would have to visually decide to bypass the separation to the lead concentrate thickener.

5.4 ZINC ROUGHER FLOTATION

The objectives during zinc rougher flotation are to maximize zinc recovery without excessive flotation of iron sulphides and to activate zinc to a sufficient extent that cleaning can be achieved with minimal additional reagent additions. The above objectives were achieved readily with few reagent variations. In Test 10F2 the reagent additions were increased to the following quantities and these were used for all subsequent testwork including the locked-cycle testing:

lime to pH = 10.5
0.6 lb/ton $CuSO_4$
0.1 lb/ton NaCN
0.03 lb/ton Z-200
0.075 lb/ton Aero 343
Dowfroth 1012

The success of zinc recovery was difficult to judge during batch testing due to flotation of zinc in copper-lead roughers. However, it is significant to note that generally less than 3% of the zinc reported to the final tails. During locked-cycle testing with recirculation of all streams this loss increased to only approximately 3.5%.

5.5 ZINC CLEANER FLOTATION

As for the zinc roughers, the zinc cleaners strive to maintain zinc recovery while achieving maximum rejection of iron sulphides. Sodium cyanide was used to depress the pyrite while Z-200, $CuSO_4$ and Aero 343 (isopropyl xanthate) were used to maintain zinc activation.

Throughout the test program the variations in reagent addition to the zinc cleaners were minor. The main variation was in the cyanide addition, varying from 0.175 to 0.2 lb/ton. The optimum level for the composite sample appears to be 0.2 lb/ton NaCN. It was found that a true indication for reagent additions to zinc cleaning was only obtained from locked cycle testing (Tests 10F4 and 10F11). During batch testing the effects of recirculating the zinc and pyrite present in the lead cleaner tails do not become apparent. The results of Test 10F4 indicated that a large proportion of the zinc would report to the zinc cleaner tails with the quantities of reagent used in that test (ie, 0.25 lb/ton NaCN, 0.02 lb/ton Z-200). In Test 10F11 it was determined that while an addition of 0.175 oz/ton NaCN resulted in excessive pyrite flotation, increasing the cyanide to 0.2 lb/ton gave zinc concentrates containing 53 to 56% zinc while maintaining recovery.

Tests on the composite sample prior to Test 10F10 involved regrinding of the zinc rougher concentrate prior to cleaning. This regrind was eliminated in Tests 10F10 and 10F11. While it is difficult to compare the effects of eliminating the regrind because reagent changes were made at the same time, the results of Test 10F11 (51% Zn at 81.5% recovery) are acceptable indicating that a regrind is not mandatory for this feed material.

Table 5.7 summarizes the results of Ruby vein and Switchback vein material for zinc cleaning without regrinding and with reagent additions at levels developed for the composite sample.

Table 5.7

Zinc Cleaning of Ruby Vein and Switchback Vein Rougher Concentrates

Test No.	Sample	Assay Zn,%	Assay Fe,%	% Distribution Zn	% Distribution Fe
4F3	Ruby - Rougher	24.9	23.1	77.5	38.8
	- Cleaner	33.6	17.7	26.9	7.7
8F2	Switchback - Rougher	33.3	11.4	79.4	30.5
	- Cleaner	48.7	5.3	73.5	8.9

While the results for the switchback vein material are acceptable, the results for the Ruby vein ore are very poor. It is not immediately apparent whether the poor results are due to a lack of regrinding prior to cleaning because the zinc rougher results in Test 4F3 were also poor. The composite #2 sample contains 22.2 weight % Ruby Vein material so regrinding of this material is not a controlling factor when it is being treated together with other materials.

5.6 LOCKED CYCLE TESTING

Test 10F4 was performed as a locked-cycle test. While the Cu-Pb flotation conditions appeared to be adequate, zinc recovery was very poor due to a high circulating load through the zinc cleaner tails. After additional batch testwork, a second locked-cycle test, 10F11, was carried out. A block flowsheet for this test is included as Figure 2. The details of reagent additions and residence times are included in Appendix I.

The average results over the six cycles are presented in Table 5.8.

Table 5.8
Averaged Locked Cycle Results

Product	Wt%	Assay, %			% Distribution		
		Cu	Pb	Zn	Cu	Pb	Zn
Cu-Pb conc	6.5	14.1	24.7	10.0	80.2	84.4	8.4
Zn conc	13.3	1.1	0.7	51.1	12.5	4.8	87.9
Tail	80.2	0.1	0.3	0.36	7.3	10.8	3.7
Feed (calc)		1.14	1.90	7.56			

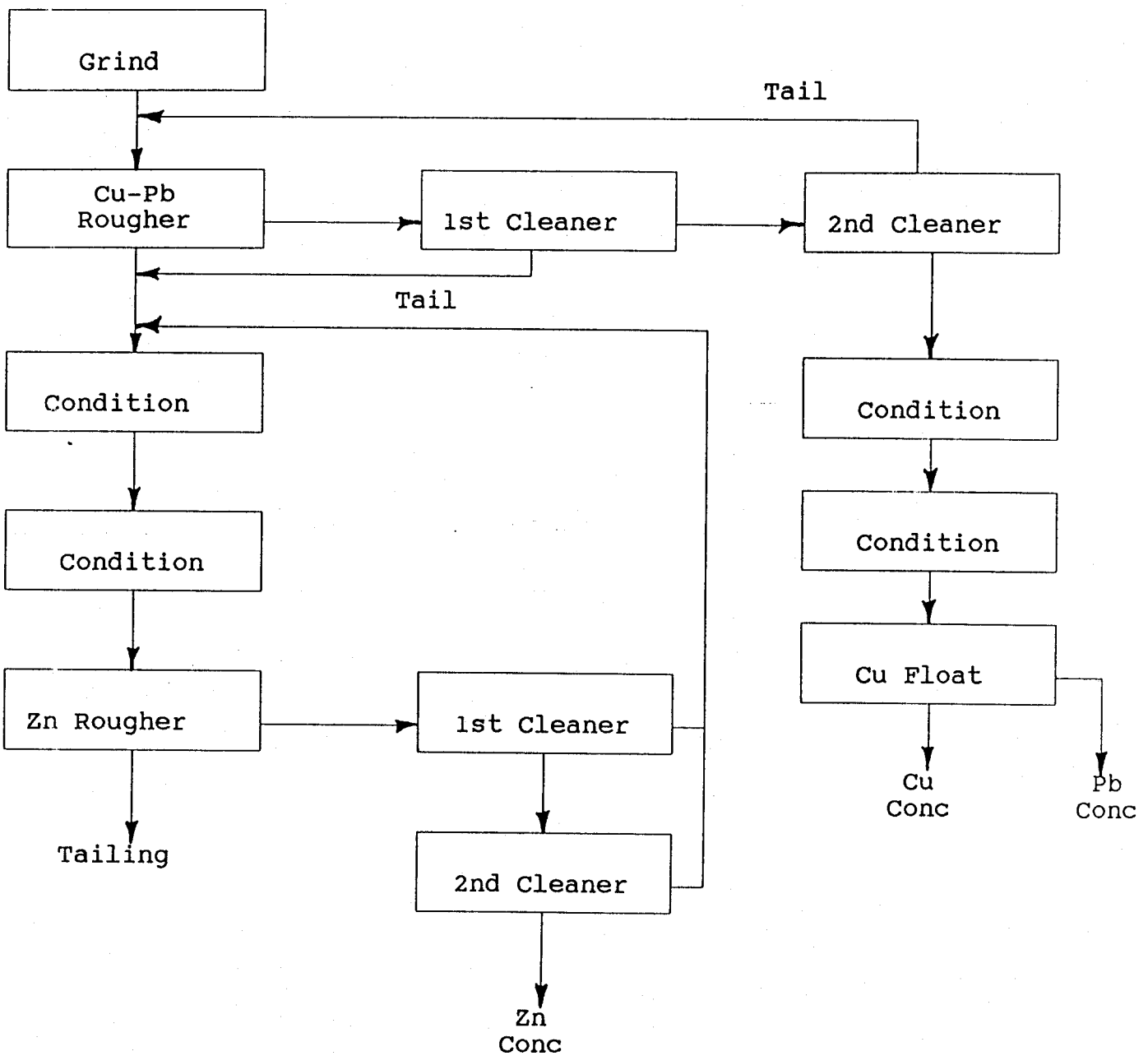

FIGURE 2.

LOCKED-CYCLE TEST BLOCK FLOWSHEET

The Cu-Pb concentrates are reasonably consistent over the six cycles indicating a good reagent balance. The zinc concentrate grade in the first two cycles was judged to be too low because excessive pyrite was visible in the froth. The cyanide addition to the third and subsequent cycle cleaners was increased from 0.175 to 0.2 lb/ton. The improvement in concentrate grade was visually apparent and was confirmed by the assays as the zinc grade went from 46.1% in the second cycle to 53.6% in the third cycle. It is estimated that in continuous operation a zinc grade of 53% Zn could be achieved.

Differential flotation of the bulk Cu-Pb concentrate was performed in the last cycle of the test producing the concentrates summarized in Table 5.9.

Table 5.9
Differential Copper and Lead Concentrates

Product	Cu %	Pb %	Zn %	Fe %	Au oz/ton	Ag oz/ton
Cu Conc	27.6	5.2	8.1	12.7	0.590	301.4
Pb Conc	5.2	43.6	10.0	8.7	0.292	71.6

The overall locked cycle results compare favorably with those of the batch tests (ie, Test 10F10). This consistency in results indicates that for this composite sample, the reagent additions and residence times are appropriate for continuous operation with recycling of cleaner tails.

5.7 GOLD-SILVER RECOVERY

Batch testing of the composite sample demonstrated that the silver in the feed reports predominantly to the Cu-Pb concentrate. Differential flotation of this product results in a copper concentrate containing most of this silver. Copper concentrates containing in excess of 250 oz/ton Ag were produced.

Approximately 33 to 34% of the gold in the feed reported to the Cu-Pb concentrate. Of this gold, 25% or more follows the copper mineralization resulting in a copper concentrate which contains 0.5 oz/ton Au or more.

The zinc concentrate produced in batch testing (10F10) contained approximately 8% of the silver and 12% of the gold.

The locked-cycle test confirmed the precious metal deportment for the composite sample as summarized in Table 5.10.

Table 5.10
Gold-Silver Distribution in Composite Sample Locked-Cycle Test

Product	Assays, oz/ton		% Distribution	
	Au	Ag	Au	Ag
Cu-Pb Conc	0.372	170.6	35.7	75.0
Zn conc	0.071	12.7	13.9	11.5
Tail	0.043	2.5	50.4	13.5
Feed (calc)	0.068	14.8		

The Cu-Pb concentrate produced in the last cycle of the test was floated differentially to produce copper and lead concentrates. The concentrate grades and calculated recoveries to these products are summarized in Table 5.11.

Table 5.11

Gold-Silver Distribution in Copper and Lead Concentrates

Product	Assay, oz/ton		% Distribution	
	Au	Ag	Au	Ag
Copper Conc	0.590	301.4	23.1	59.5
Lead Conc	0.292	71.6	12.5	15.5

Batch testing of samples from the individual veins gave somewhat different results due to the varying mineralogy. These results are summarized in Table 5.12.

Table 5.12

Gold-Silver Distribution for Individual Vein Samples

Test No.	Vein	Product	Assay, oz/ton		% Distribution	
			Au	Ag	Au	Ag
4F3	Ruby	Cu-Pb con	0.125	253.9	23.8	77.8
		Zn con	0.060	19.2	8.1	4.2
7F1	#3 Ext	Cu-Pb con	0.228	151.1	14.4	62.8
		Zn con	0.286	41.5	14.9	14.2
8F2	Switchback	Cu-Pb con	0.436	56.5	17.5	56.6
		Zn con	0.090	2.9	14.1	25.3
9F1	M3	Cu-Pb con	0.205	87.5	7.7	20.4
		Zn con	0.188	45.0	38.9	57.8

While it should be noted that several of the tests included in Table 5.12 were done before the reagent additions were finalized and represent products which may be off grade or have low recovery, there are some general trends which are significant. The gold recovery to the combined concentrates is less than 50% in every case and is in most cases near 30%. The total silver recovery is near 80%. The distribution of gold and silver between the two products is not consistent although the Cu-Pb concentrate tends to have a much greater silver content than the Zn concentrate.

Pyrite concentrates were produced in several of the batch tests. The gold and silver content of the pyrite concentrates is misleading in these batch tests because much of the pyrite is contained in the lead and zinc cleaner tails. Table 5.13 summarizes the gold and silver assays of pyrite concentrates produced from several samples.

Table 5.13
Composition of Pyrite Concentrates

Test No.	Feed	Pyrite Concentrate Au, oz/ton	Ag, oz/ton
4F3	Ruby	0.090	8.54
7F2	#3 Ext	0.071	4.88
8F2	Switchback	0.180	1.96
10F4	Composite	0.110	7.20

Following the removal of the pyrite concentrates, from 5.58% to 17.12% of the gold in the feed remained in the final tailing.

Table 5.14

Copper Concentrates Trace Element Analyses

Feed	Cu %	Pb %	Zn %	Hg ppb	As %	Cd ppm	Ga ppm	Ge ppm	In ppm
Ruby Vein	24.4	3.0	10.8	5125	11.72	870	11	233	42
Composite 2	26.5	6.2	9.9	10875	9.66	680	12	192	50

Table 5.15

Lead Concentrates Trace Element Analyses

Feed	Cu %	Pb %	Zn %	Hg ppb	As %	Cd ppm	Ga ppm	Ge ppm	In ppm
Ruby Vein	4.0	16.3	11.8	3125	2.09	950	20	157	38
Switchback	0.45	58.6	4.7	1050	0.58	265	1	24	1
Composite 2	0.71	56.9	8.3	4000	0.90	475	11	21	1

Table 5.16

Zinc Concentrates Trace Element Analyses

Feed	Cu %	Pb %	Zn %	Hg ppb	As %	Cd ppm	Ga ppm	Ge ppm	In
Ruby Vein	1.48	0.38	33.6	6875	0.24	5400	98	215	132
Switchback	0.14	4.0	48.7	8000	0.15	3000	34	367	12
Composite 2	0.52	0.47	48.4	9875	0.39	3375	54	179	108

Test 10F4 was a locked-cycle test and it is significant to note that the composition of the pyrite concentrate from this test is in the same range as that of the others. The 10F4 pyrite concentrate was reground to minus 400 mesh and was then cyanided for 48 hours. The test details are included as Appendix II. A gold extraction of 32.8% and a silver extraction of 69.9% was achieved in this test.

Using a gold extraction of 33% and a silver extraction of 70% together with a gold price of $450 per oz and a silver price of $7.50 per oz gives recoverable values for the concentrates shown in Table of $36.14 U.S. to $58.20 U.S. per ton pyrite. The cyanide consumption in the test was 23.13 kg/tonne (approx. 70 lb/ton) which has a value of approximately $35. This consumption of cyanide is sufficiently high that some method of cyanide regeneration could be considered. Cyanide regeneration could make the processing of the pyrite concentrate profitable.

5.8 TRACE ELEMENT CONCENTRATION

The Owen Lake deposit is known to contain various impurity elements which may result in penalties or bonus payments at the smelter. The concentration of various elements in copper, lead and zinc concentrates from several feed materials are summarized in Tables 5.14, 5.15 and 5.16. The concentrations of these impurities vary considerably depending on the feed material.

The potential for germanium to generate smelter credits was raised as a consideration early in the test program. Discussions with smelters and concentrate buyers revealed that payment for germanium was unlikely at concentrations less than 1000 ppm. Since the Ge appeared to occur most abundantly in the zinc concentrate, several samples of this product from the composite material were analyzed. Concentrations of Ge of 416 ppm and 506 ppm were determined in zinc concentrate containing 59.2% and

60.0% Zn. Although these concentrations of Ge are lower than those required to obtain payment directly, they could be used as a negotiating point to offset some of the undesirable trace constituents.

APPENDIX I

Flotation Test Details

Summary of Grinds	
Test No.	Cum. % -200 Mesh
4F3	75.5
7F1	70.0
7F2	69.4
8F1	72.6
8F2	66.2
9F1	91.4
10F1	76.9
10F2	79.5
10F3	76.5
10F4	74.6
10F5	71.7
10F6	74.0/69.9
10F7	73.4/77.9
10F8	73.3
10F9	76.4
10F10	75.1
10F11	70.1

TESTWORK PROCEDURE

Test No. 6891-4F3

Ruby Vein

STAGE	TIME (min)	ADDITIONS	
		lb/ton	REAGENT
GRIND	11	0.25	NaCN
		1.0	Na_2SO_3 pH = 5.7
		0.5	$ZnSO_4$
		0.02	Z-200
CU/PB ROUGHER	10	0.03	Aero 238
		0.05	MIBC
ZN CONDITION	5	2.712	Lime to pH = 10.5
	5	0.6	$CuSO_4$
		0.1	NaCN
		0.03	Z-200
		0.075	Aero 343
ZN ROUGHER	8	0.040	DF1012
PYRITE FLOAT	9	33.0	H_2SO_4 to pH = 6
		0.2	Aero 350
		0.06	DF1012
CU/PB CLEANING CONDITION	5	2.0	Na_2SO_3
		1.0	$ZnSO_4$
		0.1	NaCN
		0.02	Z-200
CU/PB CLEANER	10		
CU/PB RECLEANER	7	1.0	Na_2SO_3
ZN CLEANING CONDITION	5	0.40	Litre to pH = 10.8
ZN CLEANER	8	0.2	NaCN
		0.03	Z-200
		0.30	$CuSO_4$
		0.03	Aero 343

TESTWORK PROCEDURE

Test No. 6891-4F3

Ruby Vein

STAGE	TIME (min)	ADDITIONS	
		lb/ton	REAGENT
ZN RECLEANER	5	0.35	Lime to pH = 11.5
CU/PB SEPN CONDITION	20	0.22 0.22	Dextrin Carbon
CONDITION	20	194 ml	6% sulphurous acid to pH = 4.8
SCREEN OUT CARBON			
COPPER FLOAT	10	0.02	Z-200

TEST NUMBER: 6891-4F3 FLOTATION OF RUBY VEIN- Cu/Pb SEPARATION PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	UNITS Cu	Pb	Zn	Fe	% DIST Cu	Pb	Zn	Fe
Cu CONC	398.8	10.20	24.400	3.040	10.840	11.980	248.810	30.999	110.537	122.162	78.08	39.25	10.96	6.54
Pb CONC	44.8	1.15	4.000	16.350	11.840	18.380	4.582	18.729	13.563	21.055	1.44	23.71	1.35	1.13
Cu/Pb CONC	443.6	11.34	22.340	4.384	10.941	12.626	253.392	49.729	124.100	143.216	79.52	62.96	12.31	7.67
Cu/Pb 2nd CL TAIL	46.3	1.18	18.800	1.280	16.480	9.120	22.257	1.515	19.510	10.797	6.98	1.92	1.94	0.58
Cu/Pb 1st CL CONC	489.9	12.53	22.005	4.091	11.484	12.295	275.849	51.244	143.610	154.013	86.50	64.88	14.24	8.25
Cu/Pb 1st CL TAIL	204.9	5.24	3.200	0.790	7.980	26.000	16.765	4.139	41.704	136.219	5.26	5.24	4.14	7.29
Cu/Pb RO CONC	694.8	17.77	16.459	3.117	10.431	16.337	292.415	55.383	185.314	290.233	91.76	70.12	18.38	15.54
Zn CONC	316.1	8.08	1.480	0.380	33.600	17.700	11.962	3.071	271.573	143.061	3.75	3.89	26.93	7.66
Zn 2nd CL TAIL	282.0	7.21	0.310	0.124	47.820	7.890	2.235	0.894	344.812	56.892	0.70	1.13	34.20	3.05
Zn 1st CL CONC	598.1	15.29	0.928	0.259	40.305	13.075	14.197	3.965	616.385	199.953	4.46	5.02	61.13	10.71
Zn 1st CL TAIL	628.0	16.06	0.280	0.232	10.260	32.720	4.496	3.725	164.752	525.407	1.41	4.72	16.34	28.13
Zn RO CONC	1226.1	31.35	0.596	0.245	24.916	23.137	18.694	7.691	781.137	725.360	5.87	9.74	77.47	38.84
PYRITE CONC	403.1	10.31	0.260	0.284	2.010	38.880	2.680	2.927	20.717	400.740	0.84	3.71	2.05	21.46
TAIL	1586.9	40.58	0.120	0.320	0.520	11.120	4.869	12.984	21.100	451.209	1.53	16.44	2.09	24.16
CALC HEAD	3910.9	100.0	3.187	0.790	10.083	16.875	318.657	78.965	1008.268	1867.541	100.00	100.00	100.00	100.00

TEST NUMBER: 6891-4F3 FLOTATION OF RUBY VEIN- Cu/Pb SEPARATION PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au oz/ton	ASSAYS Ag oz/ton	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag
Cu CONC	398.8	10.20	0.126	272.840	1.285	2782.188	21.57	75.15
Pb CONC	44.8	1.15	0.116	85.360	0.133	97.781	2.23	2.64
Cu/Pb CONC	443.6	11.34	0.125	253.906	1.418	2879.969	23.80	77.79
Cu/Pb 2nd CL TAIL	46.3	1.18	0.090	152.764	0.107	180.853	1.79	4.88
Cu/Pb 1st CL CONC	489.9	12.53	0.122	244.347	1.524	3060.822	25.59	82.67
Cu/Pb 1st CL TAIL	204.9	5.24	0.080	26.232	0.419	137.435	7.04	3.71
Cu/Pb RO CONC	694.8	17.77	0.109	180.024	1.943	3198.257	32.63	86.39
Zn CONC	318.1	8.08	0.060	19.248	0.485	155.573	8.14	4.20
Zn 2nd CL TAIL	282.0	7.21	0.034	5.138	0.245	37.048	4.12	1.00
Zn 1st CL CONC	598.1	15.29	0.048	12.595	0.730	192.621	12.26	5.20
Zn 1st CL TAIL	628.0	16.06	0.088	7.970	1.381	127.980	23.19	3.46
Zn RO CONC	1226.1	31.35	0.067	10.226	2.111	320.601	35.44	8.66
PYRITE CONC	403.1	10.31	0.090	8.540	0.928	88.023	15.57	2.38
TAIL	1586.9	40.58	0.024	2.350	0.974	95.354	16.35	2.58
CALC HEAD	3910.9	100.0	0.060	37.022	5.956	3702.234	100.00	100.00

TESTWORK PROCEDURE

TEST NO. 6891 - 7F1 DATE _____

No. 3 Ext.

STAGE	TIME (min.)	ADDITIONS	
		Lb./Ton	REAGENT
Grind 55% solids	11	0.25 1.0 0.5 0.02	NaCN Na_2SO_3 $ZnSO_4$ pH=6.4 Z-200
Cu/Pb Rougher	6	0.03 0.050	AERO 238 pH=6.6 MIBC
Zn Condition	5 5	11.89 0.45 0.10 0.02 0.05	$Ca(OH)_2$ to pH-10.5 $CuSO_4$ NaCN Z-200 AERO 343
Zn Rougher	8	0.04	DF 1012
Cu/Pb Cleaning/Regrind	15	1.5 1.0	Na_2SO_3 $ZnSO_4$
Cu/Pb 1st Cleaner	7	0.02	Z-200
Cu/Pb 2nd Cleaner	6	---	---
Zn Cleaning/Regrind	15	0.10	$CuSO_4$
Condition	5	1.83	$Ca(OH)_2$ to pH=10.8
Zn 1st Cleaner	6	0.25 0.20 0.02 0.05 0.10	NaCN $CuSO_4$ Z-200 AERO 343 $CuSO_4$
Zn 2nd Cleaner	4	---	---

TEST NUMBER: 6891-7F1 FLOTATION OF #3 EXT. PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	S%	UNITS Cu	Pb	Zn	Fe	S	% DIST Cu	Pb	Zn	Fe	S
Cu/Pb CONC	88.1	4.59	14.000	18.000	7.360	15.670	31.110	64.290	82.658	33.798	71.959	142.861	79.10	83.33	21.67	4.20	7.42
Cu/Pb 2nd CL TAIL	27.8	1.45	0.470	1.320	9.600	19.800	25.810	0.681	1.913	13.911	28.691	37.400	0.84	1.93	8.92	1.68	1.94
Cu/Pb 1st CL CONC	115.9	6.04	10.755	13.999	7.697	18.661	29.839	64.971	84.571	47.709	100.650	180.261	79.94	85.26	30.58	5.88	9.36
Cu/Pb 1st CL TAIL	101.8	5.31	0.100	0.180	9.200	7.360	10.710	0.531	0.955	48.817	39.054	56.830	0.65	0.96	31.29	2.28	2.95
Cu/Pb RO CONC	217.7	11.35	5.772	7.537	8.506	12.312	20.894	65.501	85.526	96.526	139.704	237.091	80.59	86.23	61.87	8.16	12.31
Zn CONC	72.4	3.77	2.320	2.080	15.200	28.620	38.690	8.755	7.849	57.361	111.779	146.008	10.77	7.91	36.77	6.53	7.58
Zn 2nd CL TAIL	40.8	2.13	0.360	0.200	0.150	31.630	34.220	0.766	0.425	0.319	67.266	72.774	0.94	0.43	0.20	3.93	3.78
Zn 1st CL CONC	113.2	5.90	1.614	1.402	9.776	30.344	37.079	9.521	8.275	57.680	179.046	218.782	11.71	8.34	36.97	10.46	11.36
Zn 1st CL TAIL	270.3	14.09	0.200	0.090	0.030	32.460	35.720	2.818	1.268	0.423	457.333	503.264	3.47	1.28	0.27	26.71	26.13
Zn RO CONC	383.5	19.99	0.617	0.477	2.907	31.836	36.121	12.339	9.543	58.103	636.379	722.046	15.18	9.62	37.24	37.17	37.49
TAIL	1317.3	68.66	0.050	0.060	0.020	13.630	14.080	3.433	4.120	1.373	935.877	966.775	4.22	4.15	0.88	54.67	50.20
CALC HEAD	1918.5	100.0	0.813	0.992	1.560	17.120	19.259	81.273	99.189	156.003	1711.960	1925.912	100.00	100.00	100.00	100.00	100.00

TEST NUMBER: 6891-7F1 FLOTATION OF #3 EXT.

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au	ASSAYS Ag	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag
Cu/Pb CONC	88.1	4.59	0.228	151.077	1.047	693.765	14.42	62.78
Cu/Pb 2nd CL TAIL	27.8	1.45	0.112	12.824	0.162	18.583	2.24	1.68
Cu/Pb 1st CL CONC	115.9	6.04	0.200	117.915	1.209	712.348	16.66	64.46
Cu/Pb 1st CL TAIL	101.8	5.31	0.029	2.541	0.154	13.483	2.12	1.22
Cu/Pb RO CONC	217.7	11.35	0.120	63.964	1.363	725.831	18.78	65.68
Zn CONC	72.4	3.77	0.266	41.484	1.079	156.552	14.87	14.17
Zn 2nd CL TAIL	40.8	2.13	0.135	9.363	0.287	19.912	3.96	1.80
Zn 1st CL CONC	113.2	5.90	0.232	29.907	1.366	176.463	18.82	15.97
Zn 1st CL TAIL	270.3	14.09	0.148	5.410	2.057	76.222	28.34	6.90
Zn RO CONC	383.5	19.99	0.171	12.841	3.423	252.686	47.16	22.86
TAIL	1317.3	68.66	0.038	1.844	2.472	126.615	34.05	11.46
CALC HEAD	1918.5	100.0	0.073	11.051	7.258	1105.131	100.00	100.00

TESTWORK PROCEDURE

TEST NO. 6891 - 7F2 DATE _____

No. 3 Ext.

STAGE	TIME (min.)	ADDITIONS	
		Lb./Ton	REAGENT
Grind 55% solids	11	0.25 1.0 0.5 0.02	NaCN Na_2SO_3 pH=6.3 $ZnSO_4$ Z-200
Cu/Pb Rougher	8	0.03 0.05	AERO 238 pH=6.2 MIBC
Zn Condition	5 5	3.75 0.45 0.10 0.02 0.05	$Ca(OH)_2$ to pH=10.5 $CuSO_4$ NaCN Z-200 AERO 343
Zn Rougher	8	0.04	DF 1012
Cu/Pb Cleaning/Regrind	15	2.0 1.0 0.2	Na_2SO_3 $ZnSO_4$ NaCN
Cu/Pb 1st Cleaner	6	0.02	Z-200
Condition	2	1.0 0.1	Na_2SO_3 NaCN
Cu/Pb 2nd Cleaner	5	---	---
Zn Cleaning/regrind	15	0.10	$CuSO_4$
Condition	5	1.08	$Ca(OH)_2$ to pH=10.8
Zn 1st Cleaner	6	0.25 0.20 0.02 0.10	NaCN $CuSO_4$ Z-200 $CuSO_4$
Zn 2nd Cleaner	4	1.03	$Ca(OH)_2$ to pH=11.5
Pyrite Float	9	6.5 0.2	H_2SO_4 to pH=6 AERO 350

TEST NUMBER: 6891-7F2 FLOTATION OF #3 EXT. PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	S%	UNITS Cu	Pb	Zn	Fe	S	% DIST Cu	Pb	Zn	Fe	S
Cu/Pb CONC	38.3	1.94	20.000	30.800	4.960	6.860	24.310	38.824	59.789	9.628	13.317	47.191	45.34	58.03	5.87	0.82	2.47
Cu/Pb 2nd CL TAIL	42.1	2.13	10.240	12.880	7.440	14.460	26.810	21.850	27.483	15.876	30.855	57.207	25.52	26.68	9.67	1.90	2.99
Cu/Pb 1st CL CONC	80.4	4.08	14.889	21.417	8.259	10.840	25.619	60.674	87.273	25.504	44.172	104.398	70.86	84.71	15.54	2.72	5.46
Cu/Pb 1st CL TAIL	187.7	9.51	1.100	0.320	8.640	19.880	26.190	10.465	3.044	82.196	189.127	249.157	12.22	2.95	50.08	11.67	13.04
Cu/Pb RO CONC	268.1	13.59	5.235	6.647	7.926	17.169	26.019	71.139	90.317	107.700	233.299	353.555	83.08	87.66	65.61	14.39	18.50
Zn CONC	40.6	2.06	2.500	1.380	25.600	21.770	36.820	5.144	2.840	52.679	44.798	75.767	8.01	2.76	32.09	2.76	3.97
Zn 2nd CL TAIL	25.5	1.29	0.460	0.320	0.250	30.580	34.020	0.595	0.414	0.323	39.523	43.969	0.89	0.40	0.20	2.44	2.30
Zn 1st CL CONC	66.1	3.35	1.713	0.971	15.820	25.169	35.740	5.739	3.253	53.002	84.321	119.737	6.70	3.16	32.29	5.20	6.27
Zn 1st CL TAIL	540.3	27.38	0.220	0.130	0.050	38.950	43.790	6.025	3.560	1.369	1066.634	1199.176	7.04	3.46	0.83	65.80	62.76
Zn RO CONC	606.4	30.73	0.383	0.222	1.769	37.448	42.912	11.764	6.813	54.372	1150.955	1318.912	13.74	6.61	33.12	71.00	69.02
PYRITE CONC	158.9	8.05	0.220	0.200	0.080	21.710	23.560	1.772	1.611	0.644	174.846	189.746	2.07	1.56	0.39	10.79	9.93
TAIL	939.6	47.62	0.020	0.090	0.030	1.300	1.020	0.952	4.286	1.429	61.910	48.575	1.11	4.16	0.87	3.82	2.54
CALC HEAD	1973.0	100.0	0.856	1.030	1.641	16.210	19.108	85.6	103.0	164.1	1621.0	1910.8	100.0	100.0	100.0	100.0	100.0

TEST NUMBER: 6891-7F2 FLOTATION OF #3 EXT. PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au oz/ton	ASSAYS Ag oz/ton	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag
Cu/Pb CONC	38.3	1.94	0.289	256.935	0.561	498.764	9.39	45.65
Cu/Pb 2nd CL TAIL	42.1	2.13	0.119	102.096	0.254	217.853	4.25	19.94
Cu/Pb 1st CL CONC	80.4	4.08	0.200	175.856	0.815	716.617	13.64	65.59
Cu/Pb 1st CL TAIL	187.7	9.51	0.072	10.817	0.685	102.907	11.47	9.42
Cu/Pb RO CONC	268.1	13.59	0.110	60.310	1.500	819.524	25.11	75.01
Zn CONC	40.6	2.06	0.191	38.533	0.393	79.292	6.58	7.26
Zn 2nd CL TAIL	25.5	1.29	0.148	10.034	0.191	12.968	3.20	1.19
Zn 1st CL CONC	66.1	3.35	0.174	27.539	0.584	92.261	9.78	8.44
Zn 1st CL TAIL	540.3	27.38	0.109	4.407	2.985	120.684	49.96	11.05
Zn RO CONC	606.4	30.73	0.116	6.928	3.569	212.945	59.74	19.49
PYRITE CONC	158.9	8.05	0.071	4.878	0.572	39.270	9.57	3.59
TAIL	939.6	47.62	0.007	0.436	0.333	20.764	5.58	1.90
CALC HEAD	1973.0	100.0	0.060	10.925	6.0	1092.5	100.0	100.0

TESTWORK PROCEDURE

Test No. 6891-8F1
Switchback Vein

STAGE	TIME (min)	ADDITIONS	
		lb/ton	REAGENT
GRIND	11.5	0.25	NaCn
		1.0	Na_2SO_3 pH = 6.6
		0.5	$ZnSO_4$
		0.02	Z-200
CU/PB ROUGHER	7	0.03	Aero 238 pH = 6.8
		0.050	MIBC
ZN CONDITION	5	7.88	$Ca(OH)_2$ to pH = 10.5
	5	0.45	$CuSO_4$
		0.10	NaCN
		0.02	Z-200
		0.05	Aero 343
ZN ROUGHER	8	0.04	DF1012
CU/PB CLEANING/ REGRIND	15	1.5	Na_2SO_3
		1.0	$ZNSO_4$
CU/PB 1ST CLEANER	9	0.02	Z-200
CU/PB 2ND CLEANER	5		
ZN CLEANING/ REGRIND	15	0.10	$CUSO_4$
CONDITION	5	2.51	$Ca(OH)_2$ to pH = 10.8
ZN 1ST CLEANER	6	0.25	NaCN
		0.20	$CuSO_4$
		0.02	Z-200
		0.05	Aero 343
		0.10	$CuSO_4$
Zn 2ND CLEANER	5		

TEST NUMBER: 6891-8F1 FLOTATION OF SWITCHBACK VEIN PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	S%	UNITS Cu	Pb	Zn	Fe	S	% DIST Cu	Pb	Zn	Fe	S
Cu/Pb CONC	59.9	3.15	1.100	60.000	10.600	7.070	21.010	3.464	188.959	34.013	22.266	66.167	32.66	46.22	3.06	2.02	4.03
Cu/Pb 2nd CL TAIL	34.6	1.82	0.270	35.600	24.400	7.870	24.410	0.491	64.761	44.387	14.317	44.405	4.63	15.84	3.99	1.30	2.70
Cu/Pb 1st CL CONC	94.5	4.97	0.796	51.066	15.779	7.363	22.255	3.955	253.720	78.400	36.582	110.572	37.29	62.06	7.04	3.31	6.74
Cu/Pb 1st CL TAIL	174.3	9.16	0.160	10.800	38.800	7.890	28.650	1.466	98.972	355.565	72.304	262.550	13.82	24.21	31.95	6.55	15.98
Cu/Pb RO CONC	268.8	14.13	0.384	24.956	30.707	7.705	26.402	5.422	352.692	433.964	108.887	373.122	51.11	86.27	38.99	9.86	22.73
Zn CONC	229.1	12.05	0.180	1.960	52.000	6.470	31.660	2.168	23.609	626.351	77.933	381.592	20.44	5.77	56.27	7.06	23.24
Zn 2nd CL TAIL	21.0	1.10	0.230	1.280	14.800	16.010	21.920	0.254	1.413	16.341	17.677	24.202	2.39	0.35	1.47	1.60	1.47
Zn 1st CL CONC	250.1	13.15	0.184	1.903	48.878	7.271	30.860	2.422	25.022	642.692	95.609	405.794	22.83	6.12	57.74	8.66	24.72
Zn 1st CL TAIL	100.6	5.29	0.140	0.530	2.160	17.360	18.180	0.740	2.803	11.425	91.820	96.157	6.96	0.69	1.03	8.32	5.86
Zn RO CONC	350.7	18.44	0.172	1.508	35.478	10.165	27.223	3.163	27.825	654.117	187.429	501.951	29.82	6.81	58.77	16.98	30.57
TAIL	1282.5	67.43	0.030	0.420	0.370	11.980	11.370	2.023	28.320	24.948	807.800	766.668	19.07	6.93	2.24	73.16	46.70
CALC HEAD	1902.0	100.0	0.106	4.088	11.130	11.041	16.417	10.607	408.837	1113.029	1104.115	1641.741	100.00	100.00	100.00	100.00	100.00

TEST NUMBER: 6891-8F1 FLOTATION OF SWITCHBACK VEIN

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au	ASSAYS Ag	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag
Cu/Pb CONC	59.9	3.15	0.468	14.141	1.474	44.534	13.94	23.71
Cu/Pb 2nd CL TAIL	34.6	1.82	0.106	6.452	0.193	11.737	1.82	6.25
Cu/Pb 1st CL CONC	94.5	4.97	0.335	11.326	1.667	56.272	15.77	29.96
Cu/Pb 1st CL TAIL	174.3	9.16	0.093	3.364	0.852	30.828	8.06	16.41
Cu/Pb RO CONC	268.8	14.13	0.178	6.163	2.519	87.099	23.83	46.37
Zn CONC	229.1	12.05	0.068	2.908	1.072	35.040	10.14	18.65
Zn 2nd CL TAIL	21.0	1.10	0.162	2.628	0.179	2.902	1.69	1.54
Zn 1st CL CONC	250.1	13.15	0.095	2.885	1.251	37.941	11.83	20.20
Zn 1st CL TAIL	100.6	5.29	0.151	1.342	0.799	7.098	7.56	3.78
Zn RO CONC	350.7	18.44	0.111	2.443	2.050	45.039	19.39	23.98
TAIL	1282.5	67.43	0.089	0.826	6.001	55.696	56.78	29.65
CALC HEAD	1902.0	100.0	0.106	1.878	10.570	187.835	100.00	100.00

TESTWORK PROCEDURE

Test No. 6891-8F2

Switchback Vein

STAGE	TIME (min)	ADDITIONS	
		lb/ton	REAGENT
ZN RECLEANER	5	0.45	Lime to pH = 11.5
CU/PB SEPN CONDITION	20	0.11 0.11	Dextrin Carbon
CONDITION	20	50 ml	6% sulphurous acid to pH = 4.8 (pH = 1.2)
SCREEN OUT CARBON			
COPPER FLOAT	5	0.02	Z-200
CONDITION	15	0.55 0.11	Dextrin Carbon
CONDITION	5	50 ml	6% sulphurous acid
SCREEN OUT CARBON			
Pb	floated so didn't float		

TESTWORK PROCEDURE

Test No. 6891-8F2

Switchback Vein

STAGE	TIME (min)	ADDITIONS	
		lb/ton	REAGENT
GRIND	11	0.25	NaCN
		1.0	Na_2SO_3 pH = 6.9
		0.5	$ZnSO_4$
		0.02	Z-200
CU/PB ROUGHER	10	0.03	Aero 238 pH = 6.4
		0.05	MIBC
ZN CONDITION	5	5.46	Lime to pH = 10.5
	5	0.6	$CuSO_4$
		0.1	NaCN
		0.03	Z-200
		0.075	Aero 343
ZN ROUGHER	8	0.040	DF1012
PYRITE FLOAT	9	2 ml	H_2SO_4 to pH = 6
		0.2	Aero 350
		0.06	DF1012
CU/PB CLEANING CONDITION	5	2.0	Na_2SO_3
		1.0	$ZnSO_4$
		0.1	NaCN
		0.02	Z-200
CU/PB CLEANER	10		
CU/PB RECLEANER	7	1.0	Na_2SO_3
ZN CLEANING CONDITION	5	0.51	Lime to pH = 10.8
ZN CLEANER	8	0.2	NaCN
		0.03	Z-200
		0.20	$CuSO_4$
		0.02	Aero 343

TEST NUMBER: 8891-8F2 FLOTATION OF SWITCHBACK VEIN- Cu/Pb SEPARATION PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	UNITS Cu	Pb	Zn	Fe	% DIST Cu	Pb	Zn	Fe
SEP. CONC	139.3	3.56	0.450	58.620	4.730	8.290	1.603	208.845	16.852	29.535	17.22	56.14	1.52	3.00
SEP. TAIL	6.5	0.17	0.140	10.360	14.340	7.180	0.023	1.722	2.384	1.194	0.25	0.46	0.22	0.12
Cu/Pb CONC	145.8	3.73	0.436	56.468	5.158	8.241	1.626	210.568	19.235	30.728	17.47	56.61	1.74	3.12
Cu/Pb 2nd CL TAIL	90.6	2.32	0.490	9.380	14.780	16.580	1.135	21.735	34.248	38.419	12.20	5.84	3.10	3.90
Cu/Pb 1st CL CONC	236.4	6.05	0.457	38.422	8.846	11.437	2.762	232.302	53.483	69.147	29.67	62.45	4.84	7.02
Cu/Pb 1st CL TAIL	380.7	9.74	0.150	2.140	14.510	23.920	1.461	20.836	141.279	232.901	15.69	5.60	12.78	23.63
Cu/Pb RO CONC	617.1	15.78	0.268	16.039	12.340	19.138	4.222	253.139	194.762	302.048	45.37	68.05	17.62	30.65
Zn CONC	852.0	16.68	0.140	4.000	48.750	5.260	2.335	66.701	812.924	88.046	25.08	17.93	73.55	8.93
Zn 2nd CL TAIL	46.9	1.20	0.160	1.680	15.130	13.460	0.192	2.015	18.148	16.145	2.06	0.54	1.64	1.64
Zn 1st CL CONC	698.9	17.87	0.141	3.844	46.494	5.829	2.526	68.717	831.072	104.191	27.14	18.47	75.19	10.57
Zn 1st CL TAIL	332.9	8.51	0.080	1.050	5.480	23.120	0.681	8.940	46.658	196.847	7.32	2.40	4.22	19.98
Zn RO CONC	1031.8	26.39	0.122	2.943	33.261	11.408	3.208	77.656	877.730	301.038	34.46	20.88	79.41	30.55
PYRITE CONC	563.8	14.42	0.070	1.140	1.310	18.540	1.009	16.436	18.890	267.339	10.84	4.42	1.71	27.13
TAIL	1697.26	43.41	0.020	0.570	0.320	2.650	0.868	24.743	13.891	115.033	9.33	6.65	1.26	11.67
CALC HEAD	3910.0	100.0	0.093	3.720	11.053	9.855	9.308	371.977	1105.273	985.458	100.00	100.00	100.00	100.00

TEST NUMBER: 8891-8F2 FLOTATION OF SWITCHBACK VEIN- Cu/Pb SEPARATION PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au oz/ton	ASSAYS Ag oz/ton	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag
SEP. CONC	139.3	3.56	0.386	11.860	1.375	41.541	12.97	21.80
SEP. TAIL	6.5	0.17	0.245	5.314	0.041	0.883	0.38	0.46
Cu/Pb CONC	145.8	3.73	0.380	11.377	1.416	42.424	13.35	22.27
Cu/Pb 2nd CL TAIL	90.6	2.32	0.162	5.044	0.375	11.688	3.54	6.13
Cu/Pb 1st CL CONC	236.4	6.05	0.296	8.950	1.791	54.112	16.89	28.40
Cu/Pb 1st CL TAIL	380.7	9.74	0.206	2.620	2.006	25.510	18.91	13.39
Cu/Pb RO CONC	617.1	15.78	0.241	5.045	3.797	79.622	35.80	41.79
Zn CONC	652.0	16.68	0.090	2.888	1.501	48.125	14.15	25.26
Zn 2nd CL TAIL	46.9	1.20	0.146	3.156	0.175	3.786	1.65	1.99
Zn 1st CL CONC	698.9	17.87	0.094	2.904	1.676	51.911	15.80	27.24
Zn 1st CL TAIL	332.9	8.51	0.196	2.136	1.669	18.186	15.74	9.54
Zn RO CONC	1031.8	26.39	0.127	2.656	3.345	70.097	31.54	36.79
PYRITE CONC	563.8	14.42	0.180	1.958	2.596	28.234	24.47	14.82
TAIL	1697.26	43.41	0.020	0.290	0.868	12.589	8.18	6.61
CALC HEAD	3910.0	100.0	0.106	1.905	10.605	190.541	100.00	100.00

TESTWORK PROCEDURE

Test No. 6891-9F1
M-3 Vein

STAGE	TIME (min)	ADDITIONS	
		lb/ton	REAGENT
GRIND	10	0.25	NaCn
		1.0	Na_2SO_3 pH = 6.3
		0.5	$ZnSO_4$
		0.02	Z-200
CU/PB ROUGHER	7	0.03	Aero 238 pH = 6.4
		0.050	MIBC
ZN CONDITION	5	12.13	$Ca(OH)_2$ to pH = 10.5
	5	0.45	$CuSO_4$
		0.10	NaCN
		0.02	Z-200
		0.05	Aero 343
ZN ROUGHER	8	0.04	DF1012
CU/PB CLEANING/ REGRIND	15	1.5	Na_2SO_3
		1.0	$ZNSO_4$
CU/PB 1ST CLEANER	7	0.02	Z-200
CU/PB 2ND CLEANER	6		
ZN CLEANING/ REGRIND	15	0.10	$CUSO_4$
CONDITION	5	1.78	$Ca(OH)_2$ to pH = 10.8
ZN 1ST CLEANER	9	0.25	NaCN
		0.20	$CuSO_4$
		0.02	Z-200
		0.05	Aero 343
		0.10	$CuSO_4$
Zn 2ND CLEANER	7		

TEST NUMBER: 8891-9F1 FLOTATION OF M-3 VEIN PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	S%	UNITS Cu	Pb	Zn	Fe	S	% DIST Cu	Pb	Zn	Fe	S
Cu/Pb CONC	111.3	5.83	8.640	13.200	10.400	24.400	38.160	50.405	77.008	60.673	142.348	222.623	78.74	79.65	2.32	11.25	8.53
Cu/Pb 2nd CL TAIL	28.1	1.47	0.360	0.760	36.000	19.440	38.330	0.530	1.119	53.024	28.633	56.456	0.83	1.16	2.03	2.26	2.16
Cu/Pb 1st CL CONC	139.4	7.31	5.971	10.692	15.560	23.400	38.194	50.936	78.127	113.697	170.981	279.080	79.56	80.81	4.35	13.52	10.70
Cu/Pb 1st CL TAIL	168.6	8.84	0.180	0.300	50.000	8.100	31.820	1.591	2.651	441.870	71.583	281.206	2.48	2.74	16.92	5.66	10.78
Cu/Pb RO CONC	308.0	16.14	3.254	5.004	34.413	15.025	34.705	52.526	80.779	555.568	242.564	560.286	82.05	83.55	21.28	19.18	21.47
Zn CONC	613.5	32.16	0.180	0.230	62.000	2.240	32.020	5.788	7.396	1993.762	72.033	1029.682	9.04	7.65	76.36	5.69	39.47
Zn 2nd CL TAIL	23.8	1.25	0.260	0.240	12.400	17.060	23.310	0.324	0.299	15.469	21.283	29.079	0.51	0.31	0.59	1.68	1.11
Zn 1st CL CONC	637.3	33.40	0.183	0.230	60.148	2.793	31.695	6.113	7.696	2009.232	93.315	1058.761	9.55	7.96	76.95	7.38	40.58
Zn 1st CL TAIL	63.7	3.34	0.200	0.200	2.560	18.180	19.670	0.668	0.668	8.548	60.702	65.677	1.04	0.69	0.33	4.80	2.52
Zn RO CONC	701.0	36.74	0.185	0.228	54.915	4.192	30.802	6.780	8.363	2017.779	154.017	1124.438	10.59	8.65	77.28	12.18	43.10
TAIL	898.8	47.11	0.100	0.160	0.800	18.430	19.620	4.711	7.538	37.689	868.272	924.335	7.36	7.80	1.44	68.65	35.43
CALC HEAD	1907.8	100.0	0.640	0.967	26.110	12.649	26.091	64.018	96.880	2611.038	1264.853	2609.058	100.00	100.00	100.00	100.00	100.00

TEST NUMBER: 8891-9F1 FLOTATION OF M-3 VEIN

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au	ASSAYS Ag	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag
Cu/Pb CONC	111.3	5.83	0.205	87.515	1.196	510.558	7.70	20.37
Cu/Pb 2nd CL TAIL	28.1	1.47	0.234	37.352	0.345	55.016	2.22	2.20
Cu/Pb 1st CL CONC	139.4	7.31	0.211	77.403	1.541	565.573	9.91	22.57
Cu/Pb 1st CL TAIL	168.6	8.84	0.183	29.414	1.617	259.843	10.41	10.37
Cu/Pb RO CONC	308.0	16.14	0.196	51.134	3.158	825.517	20.32	32.94
Zn CONC	613.5	32.16	0.188	45.054	6.046	1448.822	38.91	57.82
Zn 2nd CL TAIL	23.8	1.25	0.172	10.170	0.215	12.687	1.38	0.51
Zn 1st CL CONC	637.3	33.40	0.187	43.751	6.260	1461.509	40.29	58.32
Zn 1st CL TAIL	63.7	3.34	0.154	5.318	0.514	17.756	3.31	0.71
Zn RO CONC	701.0	36.74	0.184	40.259	6.774	1479.266	43.60	59.03
TAIL	898.8	47.11	0.119	4.269	5.606	201.121	36.08	8.03
CALC HEAD	1907.8	100.0	0.155	25.059	15.539	2505.903	100.00	100.00

TESTWORK PROCEDURE

TEST NO. 6891 - 10F1 DATE _____

Composite #2

STAGE	TIME (min.)	ADDITIONS	
		Lb./Ton	REAGENT
Grind	11	0.25	NaCn
		1.0	Na_2SO_3
		0.5	$ZnSO_4$ pH=6.5
		0.02	Z-200
Cu/Pb Rougher	8	0.03	AERO 238 pH=6.7
		0.05	MIBC
Zn Condition	5	8.52	$Ca(OH)_2$ to pH=10.5
	5	0.45	$CuSO_4$
		0.10	NaCN
		0.02	Z-200
		0.05	AERO 343
Zn Rougher	8	0.04	DF 1012
Cu/Pb Cleaning/Regrind	15	2.0	Na_2SO_3
		1.0	$ZnSO_4$
		0.1	NaCN
		0.02	Z-200
Cu/Pb 1st Cleaner	7	---	---
Condition	2	1.0	Na_2SO_3
Cu/Pb 2nd Cleaner	6	---	---
Zn Regrind	15	0.1	$CuSO_4$
Condition	5	0.40	$Ca(OH)_2$ to pH=10.8
Zn 1st Cleaner	9	0.25	NaCN
		0.20	$CuSO_4$
		0.02	Z-200
		0.10	$CuSO_4$
Zn 2nd Cleaner	5	0.91	$Ca(OH)_2$ to pH=11.5

TEST NUMBER: 6891-10F1 FLOTATION OF COMPOSITE ORE #2 PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	S%	UNITS Cu	Pb	Zn	Fe	S	% DIST Cu	Pb	Zn	Fe	S
Cu/Pb CONC	102.7	5.36	17.600	32.800	8.160	8.300	31.110	94.328	175.794	43.734	44.484	166.736	78.58	89.07	5.13	3.32	9.11
Cu/Pb 2nd CL TAIL	25.3	1.32	6.720	3.600	19.200	13.080	25.810	8.873	4.753	25.350	17.270	34.077	7.39	2.41	2.97	1.29	1.86
Cu/Pb 1st CL CONC	128.0	6.68	15.450	27.028	10.342	9.245	30.062	103.201	180.547	69.084	61.754	200.814	85.97	91.48	8.10	4.61	10.98
Cu/Pb 1st CL TAIL	129.8	6.77	0.390	0.210	16.000	14.570	10.710	2.642	1.423	108.381	98.695	72.548	2.20	0.72	12.70	7.37	3.97
Cu/Pb RO CONC	257.8	13.45	7.867	13.526	13.191	11.926	20.319	105.843	181.969	177.465	160.449	273.361	88.17	92.20	20.80	11.98	14.94
Zn CONC	89.3	3.62	1.580	1.160	52.800	9.030	38.690	5.714	4.195	190.953	32.657	139.924	4.76	2.13	22.38	2.44	7.65
Zn 2nd CL TAIL	106.6	5.56	0.300	0.170	58.400	4.410	34.220	1.869	0.946	324.885	24.533	190.369	1.39	0.48	38.08	1.83	10.40
Zn 1st CL CONC	175.9	9.18	0.804	0.560	56.194	6.230	35.981	7.383	5.141	515.838	57.191	330.293	6.15	2.60	60.47	4.27	18.05
Zn 1st CL TAIL	121.0	6.31	0.180	0.160	22.600	14.320	35.720	1.137	1.010	142.710	90.425	225.557	0.95	0.51	16.73	6.75	12.33
Zn RO CONC	296.9	15.49	0.550	0.397	42.503	9.527	35.875	8.520	6.151	658.547	147.615	555.850	7.10	3.12	77.20	11.02	30.38
TAIL	1361.5	71.05	0.080	0.130	0.240	14.520	14.080	5.684	9.237	17.052	1031.676	1000.413	4.73	4.68	2.00	77.01	54.68
CALC HEAD	1918.2	100.0	1.200	1.974	8.531	13.397	18.296	120.047	197.357	853.065	1339.740	1829.624	100.00	100.00	100.00	100.00	100.00

TEST NUMBER: 8881-10F1 FLOTATION OF ORE COMPOSITE #2 PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au	ASSAYS Ag	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag
Cu/Pb CONC	102.7	5.36	0.412	202.778	2.208	1086.791	30.94	73.11
Cu/Pb 2nd CL TAIL	25.3	1.32	0.116	53.202	0.153	70.244	2.15	4.73
Cu/Pb 1st CL CONC	128.0	6.68	0.353	173.212	2.361	1157.035	33.09	77.83
Cu/Pb 1st CL TAIL	129.8	6.77	0.068	5.647	0.447	38.252	6.26	2.57
Cu/Pb RO CONC	257.8	13.45	0.209	88.844	2.808	1195.287	39.35	80.40
Zn CONC	69.3	3.62	0.119	22.762	0.430	82.320	6.03	5.54
Zn 2nd CL TAIL	106.6	5.56	0.039	4.832	0.217	25.768	3.04	1.73
Zn 1st CL CONC	175.9	9.18	0.071	11.775	0.647	108.088	9.07	7.27
Zn 1st CL TAIL	121.0	6.31	0.054	3.858	0.341	24.349	4.78	1.64
Zn RO CONC	296.9	15.49	0.064	8.548	0.988	132.437	13.85	8.91
TAIL	1361.5	71.05	0.047	2.236	3.339	158.872	46.80	10.69
CALC HEAD	1916.2	100.0	0.071	14.886	7.136	1486.596	100.00	100.00

TESTWORK PROCEDURE

TEST NO. 6891 - 10F2 DATE _____

Composite #2

STAGE	TIME (min.)	ADDITIONS	
		Lb./Ton	REAGENT
Grind	11	0.25	NaCN
		1.0	Na_2SO_3
		0.5	$ZnSO_4$ pH=6.4
		0.02	Z-200
Cu/Pb Rougher	10	0.03	AERO 238
		0.05	MIBC pH=6.2
Zn Condition	5	6.08	$Ca(OH)_2$ to pH=10.5
	5	0.60	$CuSO_4$
		0.10	NaCN
		0.03	Z-200
		0.075	AERO 343
Zn Rougher	8	0.04	DF 1012
Zn Cleaning/Regrind	15	0.10	$CuSO_4$
Condition	5	0.59	$Ca(OH)_2$ to pH=10.8
Zn 1st Cleaner	3	0.25	NaCN
		0.02	Z-200
		0.20	$CuSO_4$
		0.02	AERO 343
Zn 2nd Cleaner	4	0.59	$Ca(OH)_2$ to pH=11.5

TEST NUMBER: 6891-10F2 FLOTATION OF COMPOSITE ORE #2 PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	S%	UNITS Cu	Pb	Zn	Fe	S	% DIST Cu	Pb	Zn	Fe	S
Cu/Pb RO CONC	294.4	15.08	6.960	12.320	11.800	15.690	26.230	104.981	185.829	177.985	236.660	395.641	89.03	92.85	21.43	17.60	23.67
Zn CONC	202.4	10.37	0.620	0.390	59.200	4.850	31.910	6.429	4.044	613.899	50.294	330.904	5.45	2.02	73.93	3.74	19.80
Zn 2nd CL TAIL	30.2	1.55	0.340	0.380	13.600	21.480	28.340	0.526	0.588	21.043	33.236	43.850	0.45	0.29	2.53	2.47	2.62
Zn 1st CL CONC	232.6	11.92	0.584	0.389	53.279	7.009	31.446	6.955	4.632	634.942	83.530	374.754	5.90	2.31	76.46	6.21	22.42
Zn 1st CL TAIL	222.3	11.39	0.200	0.200	0.940	30.420	32.190	2.278	2.278	10.706	346.468	366.628	1.93	1.14	1.29	25.77	21.94
Zn RO CONC	454.9	23.31	0.396	0.296	27.702	18.450	31.810	9.233	6.910	645.648	429.998	741.382	7.83	3.45	77.75	31.99	44.36
TAIL	1202.5	61.61	0.060	0.120	0.110	11.000	8.670	3.697	7.393	6.777	677.708	534.157	3.14	3.69	0.82	50.41	31.96
CALC HEAD	1951.8	100.0	1.179	2.001	8.304	13.444	16.712	117.9	200.1	830.4	1344.4	1671.2	100.0	100.0	100.0	100.0	100.0

TEST NUMBER: 6891-10F2 FLOTATION OF COMPOSITE ORE #2 PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au oz/ton	ASSAYS Ag oz/ton	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag
Cu/Pb RO CONC	294.4	15.08	0.224	82.007	3.379	1236.954	48.60	82.97
Zn CONC	202.4	10.37	0.055	9.288	0.570	96.316	8.20	6.46
Zn 2nd CL TAIL	30.2	1.55	0.090	7.128	0.139	11.029	2.00	0.74
Zn 1st CL CONC	232.6	11.92	0.060	9.008	0.710	107.345	10.21	7.20
Zn 1st CL TAIL	222.3	11.39	0.100	5.325	1.139	60.649	16.38	4.07
Zn RO CONC	454.9	23.31	0.079	7.208	1.849	167.994	26.59	11.27
TAIL	1202.5	61.61	0.028	1.395	1.725	85.946	24.81	5.76
CALC HEAD	1951.8	100.0	0.070	14.909	7.0	1490.9	100.0	100.0

TESTWORK PROCEDURE

TEST NO. 6891 - 10F3 DATE _____

Composite #2 - 12 KG. Feed

STAGE	TIME (min.)	ADDITIONS	
		Lb./Ton	REAGENT
Grind	11	0.25	NaCN
		1.0	Na_2SO_3
		0.5	$ZnSO_4$
		0.02	Z-200
Cu/Pb Rougher	18	0.03	AERO 238
		0.05	MIBC
Zn Condition	5	27.87	Lime to ph=10.5
		0.45	$CuSO_4$
		0.10	NaCN
		0.02	Z-200
		0.05	AERO 343
Zn Rougher	8	0.04	DF 1012
Cu/Pb Regrind	30	2.0	Na_2SO_3
		1.0	$ZnSO_4$
		0.1	NaCN
		0.02	Z-200
Cu/Pb Cleaner	7		
Condition	2	1.0	Na_2SO_3
Cu/Pb recleaner	6		
Zinc Regrind	30	0.1	$CuSO_4$
Zn Cleaner	10	1.60	Lime to pH=11
		0.25	NaCN
		0.20	$CuSO_4$
		0.02	Z-200
		0.04	AERO 343
		0.10	$CuSO_4$
Zn Recleaner	5	1.20	Lime to pH=11.5

TESTWORK PROCEDURE

TEST NO. 6891 - 10F3 Cont'd DATE _____

Copper-Lead Separation

STAGE	TIME (min.)	ADDITIONS	
		Lb./Ton	REAGENT
Condition	20	0.06 0.06	Dextrin Carbon
Condition	20	96ml	Sulphuous Acid=6% to pH=4.8
Screen Out Carbon			
Copper Float	7	0.02	Z-200
Conc. #2	4	---	---

TEST NUMBER: 6891-10F3 FLOTATION OF COMPOSITE #2 BIG CELL TEST PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	S%	UNITS Cu	Pb	Zn	Fe	S	% DIST Cu	Pb	Zn	Fe	S
Cu CONC	148.8	1.25	33.200	9.600	6.800	7.320	27.410	41.849	12.043	8.531	9.183	34.386	33.96	6.43	1.34	0.74	2.32
Pb CONC	108.1	0.91	1.150	80.000	2.400	1.370	14.900	1.051	73.093	2.193	1.252	13.614	0.86	39.01	0.34	0.10	0.92
Cu/Pb SEP. TAIL	74.1	0.62	1.040	41.600	19.400	5.720	20.560	0.645	25.815	12.039	3.550	12.759	0.53	13.78	1.89	0.29	0.86
Cu/Pb CONC	333.0	2.79	15.543	39.786	8.162	5.015	21.787	43.346	110.951	22.762	13.984	60.758	35.34	59.21	3.58	1.13	4.10
Cu/Pb 2nd CL TAIL	230.9	1.93	7.400	24.600	15.600	10.410	23.740	14.309	47.568	30.165	20.130	45.905	11.67	25.39	4.74	1.63	3.10
Cu/Pb 1st CL CONC	563.9	4.72	12.209	33.568	11.208	7.224	22.587	57.655	158.519	52.927	34.114	106.663	47.01	84.60	8.32	2.77	7.19
Cu/Pb 1st CL TAIL	1565.0	13.11	4.400	1.440	26.800	12.810	25.590	57.667	18.873	351.244	167.889	335.385	47.02	10.07	55.21	13.62	22.61
Cu/Pb RO CONC	2128.9	17.83	6.468	9.950	22.670	11.330	24.795	115.322	177.392	404.171	202.003	442.049	94.03	94.67	83.52	16.38	29.81
Zn CONC	130.4	1.09	1.360	0.800	46.400	12.000	26.850	1.485	0.874	50.670	13.104	29.321	1.21	0.47	7.96	1.06	1.98
Zn 2nd CL TAIL	331.2	2.77	0.220	0.160	54.400	5.100	29.450	0.610	0.444	150.886	14.146	81.684	0.50	0.24	23.71	1.15	5.51
Zn 1st CL CONC	461.6	3.87	0.542	0.341	52.140	7.049	28.716	2.095	1.317	201.556	27.250	111.005	1.71	0.70	31.68	2.21	7.48
Zn 1st CL TAIL	363.5	3.04	0.160	0.180	5.800	18.300	19.650	0.487	0.548	17.656	55.708	59.817	0.40	0.29	2.78	4.52	4.03
Zn RO CONC	1725.1	14.45	0.179	0.129	15.174	5.742	11.824	2.582	1.865	219.212	82.958	170.822	2.11	1.00	34.45	6.73	11.52
TAIL	8087.0	67.72	0.070	0.120	0.190	14.000	12.850	4.741	8.127	12.868	948.145	870.262	3.87	4.34	2.02	76.89	58.68
CALC HEAD	11941.0	100.0	1.226	1.874	6.363	12.331	14.831	122.645	187.364	636.251	1233.106	1483.132	100.00	100.00	100.00	100.00	100.00

TEST NUMBER: 8891-10F3 FLOTATION OF COMPOSITE #2 BIG CELL TEST PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	Ag ASSAYS oz/ton	UNITS Ag	% DIST Ag
Cu CONC	149.8	1.25	458.206	574.820	41.78
Pb CONC	109.1	0.91	54.877	50.139	3.64
Cu/Pb SEP. TAIL	74.1	0.62	45.225	28.064	2.04
Cu/Pb CONC	333.0	2.79	234.167	653.023	47.46
Cu/Pb 2nd CL TAIL	230.9	1.93	91.580	177.086	12.87
Cu/Pb 1st CL CONC	563.9	4.72	175.782	830.109	60.33
Cu/Pb 1st CL TAIL	1565.0	13.11	27.907	365.751	26.58
Cu/Pb RO CONC	2128.9	17.83	87.076	1195.860	86.91
Zn CONC	130.4	1.09	16.547	18.070	1.31
Zn 2nd CL TAIL	331.2	2.77	4.094	11.355	0.83
Zn 1st CL CONC	461.6	3.87	7.612	29.425	2.14
Zn 1st CL TAIL	363.5	3.04	3.398	10.344	0.75
Zn RO CONC	1725.1	14.45	2.753	39.769	2.89
TAIL	8087.0	67.72	2.072	140.325	10.20
CALC HEAD	11941.0	100.0	13.760	1375.955	100.00

TESTWORK PROCEDURE

TEST NO. 6891 - 10F4 DATE _____

Locked Cycle - Composite #2

STAGE	TIME (min.)	ADDITIONS	
		Lb./Ton	REAGENT
Grind	11	0.25	NaCN
		1.0	Na_2SO_3
		0.5	$ZnSO_4$
		0.02	Z-200
Cu/Pb Rougher	10	0.03	AERO 238
		0.05	MIBC
Zn Condition	5		Lime to pH=10.5
	5	0.45	$CuSO_4$
		0.10	NaCN
		0.02	Z-200
		0.05	AERO 343
Zn Rougher	8	0.04	DF 1012
Cu/Pb Regrind	15	2.0	Na_2SO_3
		1.0	$ZnSO_4$
		0.1	$NaSO_4$
		0.02	Z-200
Cu/Pb 1st Cleaner	7		
Cu/Pb 2nd Cleaner	6	1.0	Na_2SO_3
Zn Regrind	15	0.10	$CuSO_4$
Condition	5		$Ca(OH)_2$ to pH = 10.8
Zn 1st Cleaner	3	0.25	NaCN
		0.02	Z-200
		0.20	$CuSO_4$
		0.02	Aero 343
Zn 2nd Cleaner	4		Lime to pH = 11.5

TEST NUMBER: 6891-10F4 LOCK CYCLE FLOTATION OF COMPOSITE #2 PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	UNITS Cu	Pb	Zn	Fe	% DIST Cu	Pb	Zn	Fe
Cu/Pb CONC #1	100.4	0.86	18.000	32.800	7.360	9.000	15.499	28.243	6.337	7.750	12.93	14.42	0.76	0.58
#2	125.8	1.08	16.000	24.800	8.960	11.110	17.262	26.757	9.667	11.987	14.41	13.66	1.16	0.90
#3	100.9	0.87	16.400	32.000	7.520	9.480	14.192	27.691	6.507	8.204	11.84	14.14	0.78	0.62
#4	118.1	1.01	17.600	28.400	8.000	10.320	17.826	28.765	8.103	10.453	14.88	14.69	0.97	0.79
#5	105.0	0.90	18.000	32.800	7.360	8.580	16.209	29.537	6.628	7.726	13.53	15.08	0.79	0.58
#6	107.3	0.92	17.600	32.400	7.520	8.630	16.196	29.816	6.920	7.942	13.52	15.22	0.83	0.60
TOTAL Cu/Pb CONCS	657.5	5.64	17.235	30.291	7.832	9.587	97.185	170.809	44.163	54.061	81.11	87.21	5.30	4.07
Cu/Pb 2nd CL TAIL	26.8	0.23	10.400	1.840	17.600	13.700	2.390	0.423	4.045	3.149	1.99	0.22	0.49	0.24
Cu/Pb 1st CL TAIL	146.7	1.26	0.920	0.880	15.200	17.180	1.157	0.856	19.124	21.615	0.97	0.44	2.29	1.63
Zn CONC #1	80.6	0.69	1.280	1.400	57.600	4.700	0.885	0.968	39.816	3.249	0.74	0.49	4.78	0.24
#2	84.1	0.72	1.560	1.240	52.800	4.980	1.125	0.894	38.083	3.592	0.94	0.46	4.57	0.27
#3	192.9	1.65	0.960	0.630	57.600	3.570	1.588	1.042	95.292	5.906	1.33	0.53	11.43	0.44
#4	148.8	1.28	1.320	0.720	57.600	3.380	1.685	0.919	73.507	4.313	1.41	0.47	8.82	0.32
#5	65.2	0.56	2.920	1.840	49.800	7.120	1.633	1.029	27.735	3.981	1.36	0.53	3.33	0.30
#6	110.5	0.95	1.520	1.040	55.200	7.140	1.440	0.986	52.312	6.766	1.20	0.50	6.27	0.51
TOTAL Zn CONCS	682.1	5.85	1.428	0.998	55.855	4.754	8.356	5.838	326.745	27.808	6.97	2.98	39.19	2.09
Zn 2nd CL TAIL	237.6	2.04	0.500	0.340	58.400	5.220	1.019	0.693	119.004	10.637	0.85	0.35	14.27	0.80
Zn 1st CL TAIL	637.2	5.46	0.290	0.240	42.800	6.490	1.585	1.312	233.895	35.467	1.32	0.67	28.05	2.67
PYRITE CONC #1	348.7	2.99	0.180	0.220	0.480	38.320	0.538	0.658	1.435	114.598	0.45	0.34	0.17	8.63
#2	343.8	2.95	0.220	0.260	0.940	36.700	0.649	0.767	2.772	108.211	0.54	0.39	0.33	8.15
#3	401.4	3.44	0.240	0.280	1.730	36.680	0.826	0.964	5.956	126.272	0.69	0.49	0.71	9.51
#4	346.7	2.97	0.340	0.350	1.940	30.820	1.011	1.041	5.768	91.641	0.84	0.53	0.69	6.90
#5	387.7	3.33	0.270	0.320	1.870	33.300	0.898	1.064	6.218	110.724	0.75	0.54	0.75	8.34
#6	494.2	4.24	0.260	0.340	11.400	28.200	1.102	1.441	48.318	119.523	0.92	0.74	5.80	9.00
TOTAL PYRITE CONCS	2322.5	19.92	0.252	0.298	3.538	33.686	5.024	5.934	70.467	670.970	4.19	3.03	8.45	50.53
TAIL #1	1060.4	9.09	0.040	0.120	0.320	4.980	0.364	1.091	2.910	45.290	0.30	0.56	0.35	3.41
#2	1219.0	10.45	0.050	0.120	0.270	7.940	0.523	1.255	2.823	83.009	0.44	0.64	0.34	6.25
#3	1214.4	10.42	0.050	0.180	0.250	8.320	0.521	1.666	2.604	86.654	0.43	0.85	0.31	6.53
#4	1325.1	11.36	0.060	0.160	0.260	10.110	0.682	1.818	2.955	114.895	0.57	0.93	0.35	8.65
#5	1214.9	10.42	0.060	0.280	0.240	9.830	0.625	2.917	2.501	102.423	0.52	1.49	0.30	7.71
#6	915.8	7.85	0.050	0.160	0.320	9.140	0.393	1.257	2.513	71.787	0.33	0.64	0.30	5.41
TOTAL TAILS	6949.6	59.60	0.052	0.168	0.274	8.457	3.107	10.005	16.305	504.057	2.59	5.11	1.96	37.96
CALC HEAD	11660.0	100.0	1.198	1.959	8.337	13.278	119.824	195.868	833.748	1327.764	100.00	100.00	100.00	100.00

TEST NUMBER: 6891-10F4 LOCK CYCLE FLOTATION OF COMPOSITE #2 PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au oz/ton	ASSAYS Ag oz/ton	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag
Cu/Pb CONC #1	100.4	0.86	0.779	200.540	0.671	172.678	9.17	11.61
#2	125.8	1.08	0.545	187.666	0.588	202.473	8.04	13.61
#3	100.9	0.87	0.498	198.359	0.431	171.650	5.89	11.54
#4	118.1	1.01	0.431	188.394	0.437	190.818	5.97	12.83
#5	105.0	0.90	0.476	202.576	0.429	182.423	5.86	12.26
#6	107.3	0.92	0.447	210.827	0.411	194.011	5.62	13.04
TOTAL Cu/Pb CONCS	657.5	5.64	0.526	197.564	2.966	1114.053	40.58	74.88
Cu/Pb 2nd CL TAIL	26.8	0.23	0.128	68.626	0.029	15.773	0.40	1.06
Cu/Pb 1st CL TAIL	146.7	1.26	0.068	9.594	0.086	12.071	1.17	0.81
Zn CONC #1	80.8	0.69	0.132	16.634	0.091	11.498	1.25	0.77
#2	84.1	0.72	0.144	19.538	0.104	14.092	1.42	0.95
#3	192.9	1.65	0.061	11.884	0.101	19.661	1.38	1.32
#4	148.8	1.28	0.055	14.518	0.070	18.527	0.96	1.25
#5	65.2	0.56	0.100	30.839	0.056	17.244	0.76	1.16
#6	110.5	0.95	0.070	17.433	0.066	16.521	0.91	1.11
TOTAL Zn CONCS	682.1	5.85	0.084	16.674	0.488	97.544	6.68	6.56
Zn 2nd CL TAIL	237.6	2.04	0.042	6.546	0.086	13.339	1.17	0.90
Zn 1st CL TAIL	637.2	5.46	0.040	4.752	0.219	25.969	2.99	1.75
PYRITE CONC #1	348.7	2.99	0.120	6.832	0.359	19.833	4.91	1.33
#2	343.8	2.95	0.118	7.200	0.342	21.230	4.68	1.43
#3	401.4	3.44	0.118	7.135	0.399	24.563	5.46	1.65
#4	346.7	2.97	0.108	7.681	0.321	22.839	4.39	1.54
#5	387.7	3.33	0.108	7.196	0.359	23.927	4.91	1.61
#6	494.2	4.24	0.098	7.307	0.407	30.970	5.56	2.08
TOTAL PYRITE CONCS	2322.5	19.92	0.110	7.197	2.187	143.361	29.91	9.64
TAIL #1	1060.4	9.09	0.011	0.555	0.100	5.047	1.37	0.34
#2	1219.0	10.45	0.021	1.150	0.220	12.023	3.00	0.81
#3	1214.4	10.42	0.021	1.116	0.219	11.623	2.99	0.78
#4	1325.1	11.36	0.027	1.287	0.307	14.626	4.20	0.98
#5	1214.9	10.42	0.021	1.171	0.219	12.201	2.99	0.82
#6	915.8	7.85	0.024	1.297	0.189	10.187	2.58	0.68
TOTAL TAILS	6949.6	59.60	0.021	1.102	1.252	65.707	17.12	4.42
CALC HEAD	11660.0	100.0	0.073	14.878	7.314	1487.817	100.00	100.00

TESTWORK PROCEDURE

TEST NO. 6891 - 10F5 DATE _____

Composite #2 - 12 KG. Test

STAGE	TIME (min.)	ADDITIONS	
		Lb./Ton	REAGENT
Grind	11	0.25	NaCN
		1.0	Na_2SO_3
		0.5	$ZnSO_4$ pH=6.4
		0.02	Z-200
Cu/Pb Rougher	15	0.03	AERO 238
		0.05	MIBC pH=6.2
Zn Condition	5	9.33	$Ca(OH)_2$ to pH=10.5
	5	0.60	$CuSO_4$
		0.10	NaCN
		0.03	Z-200
		0.075	AERO 343
Zn Rougher	8	0.04	DF 1012
Zn Cleaning/Regrind	30	0.10	$CuSO_4$
Condition	5	0.79	$Ca(OH)_2$ to pH=10.8
Zn 1st Cleaner	6	0.25	NaCN
		0.02	Z-200
		0.20	$CuSO_4$
		0.02	AERO 343
Zn 2nd Cleaner	5	0.79	$Ca(OH)_2$ pH=11.5
Cu/Pb Regrind	30	2.0	Na_2SO_3
		1.0	$ZnSO_4$
		0.1	NaCn
Cu/Pb 1st Cleaner	7	0.02	Z-200
Condition	2	1.0	Na_2SO_3
Cu/Pb 2nd Cleaner	---	---	NO FLOAT

TEST NUMBER: 6891-10F5 FLOTATION OF COMPOSITE #2 BIG CELL TEST #2 PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	UNITS Cu	Pb	Zn	Fe	% DIST Cu	Pb	Zn	Fe
Cu/Pb 1st CL CONC	513.0	4.29	10.000	32.000	7.800	10.890	42.870	137.183	33.438	46.685	39.17	78.34	4.16	3.54
Cu/Pb 1st CL TAIL	1245.2	10.41	5.300	2.200	19.400	16.320	55.150	22.893	201.871	169.821	50.39	13.07	25.10	12.86
Cu/Pb RO CONC	1758.2	14.69	6.671	10.895	16.015	14.736	98.020	160.076	235.309	216.506	89.57	91.42	29.25	16.40
Zn CONC	915.0	7.65	0.570	0.350	60.000	4.280	4.358	2.676	458.781	32.726	3.98	1.53	57.03	2.48
Zn 2nd CL TAIL	175.1	1.46	0.270	0.280	34.000	12.980	0.395	0.410	49.751	18.993	0.36	0.23	6.18	1.44
Zn 1st CL CONC	1090.1	9.11	0.522	0.339	55.824	5.677	4.753	3.086	508.531	51.719	4.34	1.76	63.22	3.92
Zn 1st CL TAIL	682.8	5.71	0.180	0.240	7.900	16.270	1.027	1.369	45.077	92.835	0.94	0.78	5.60	7.03
Zn RO CONC	1772.9	14.82	0.390	0.301	37.367	9.757	5.781	4.455	553.608	144.555	5.28	2.54	68.82	10.95
TAIL	8435.4	70.49	0.080	0.150	0.220	13.610	5.639	10.574	15.508	959.393	5.15	8.04	1.93	72.66
CALC HEAD	11966.5	100.0	1.094	1.751	8.044	13.205	109.440	175.105	804.426	1320.454	100.00	100.00	100.00	100.00

TEST NUMBER: 6891-10F5 FLOTATION OF COMPOSITE #2 BIG CELL TEST #2 PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au oz/ton	ASSAYS Ag oz/ton	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag
Cu/Pb 1st CL CONC	513.0	4.29	1.146	190.110	4.913	814.995	35.56	57.44
Cu/Pb 1st CL TAIL	1245.2	10.41	0.248	36.336	2.581	378.102	18.68	26.65
Cu/Pb RO CONC	1758.2	14.69	0.510	81.204	7.493	1193.098	54.24	84.09
Zn CONC	915.0	7.65	0.358	7.374	2.737	56.384	19.82	3.97
Zn 2nd CL TAIL	175.1	1.46	0.076	5.268	0.111	7.708	0.81	0.54
Zn 1st CL CONC	1090.1	9.11	0.313	7.036	2.849	64.093	20.62	4.52
Zn 1st CL TAIL	682.8	5.71	0.102	3.844	0.582	21.934	4.21	1.55
Zn RO CONC	1772.9	14.82	0.232	5.806	3.431	86.026	24.83	6.06
TAIL	8435.4	70.49	0.041	1.981	2.890	139.644	20.92	9.84
CALC HEAD	11966.5	100.0	0.138	14.188	13.814	1418.768	100.00	100.00

TESTWORK PROCEDURE

TEST NO. 6891 - 10F6 DATE _____

STAGE	TIME (min.)	ADDITIONS	
		Lb./Ton	REAGENT
Grind	11	0.25	NaCN
		1.0	Na_2SO_3
		0.5	$ZnSO_4$
		0.02	Z-200
Cu/Pb Rougher	10	0.03	AERO 238
		0.05	MIBC
Cu/Pb Cleaning/Regrind	15	2.0	Na_2SO_3
		1.0	$ZnSO_4$
		0.1	NaCN
		0.02	Z-200
Cu/Pb 1st Cleaner	7	---	---
Condition	2	1.0	Na_2SO_3
Cu/Pb 2nd Cleaner	6	---	---
Cu/Pb Separation			
Condition	20		60°C
		0.05	Staley Starch
		0.1	$NaHSO_3$
Cu Float	5	0.02	Z-200

TEST NUMBER: 6891-10F8 PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	UNITS Cu	Pb	Zn	Fe	% DIST Cu	Pb	Zn	Fe
Cu Conc	144.3	3.74	23.20	32.00	5.80	6.61	86.777	119.692	21.694	24.724	72.25	61.84	2.61	1.91
Pb Conc	43.0	1.11	4.00	42.40	12.00	11.94	4.458	47.259	13.375	13.308	3.71	24.42	1.61	1.03
Cu/Pb 2ND CL CONC	187.3	4.85	18.78	34.39	7.22	7.83	91.235	166.951	35.069	38.032	75.97	86.26	4.23	2.94
Cu/Pb 2nd CL Tail	42.4	1.10	10.40	4.80	18.00	14.49	11.430	5.275	19.783	15.925	9.52	2.73	2.38	1.23
Cu/Pb 1ST CL CONC	229.7	5.95	17.24	28.93	9.21	9.06	102.665	172.226	54.852	53.957	85.48	88.98	6.61	4.16
Cu/Pb 1st CL Tail	242.2	6.28	0.88	0.46	17.20	18.83	4.269	2.888	107.982	118.215	3.55	1.49	13.01	9.12
Cu/Pb RO CONC	471.9	12.23	8.74	14.32	13.31	14.08	106.934	175.114	162.834	172.173	89.04	90.48	19.62	13.29
Tail	3386.0	87.77	0.15	0.21	7.80	12.80	13.165	18.431	667.036	1123.430	10.96	9.52	80.38	86.71
CALC HEAD	3857.9	100.0	1.20	1.94	8.30	12.96	120.099	193.548	829.871	1295.602	100.00	100.00	100.00	100.00

TEST NUMBER: 6891-10F6 PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au oz/ton	ASSAYS Ag oz/ton	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag
Cu Conc	144.3	3.74	0.690	242.255	2.581	906.125	32.81	63.47
Pb Conc	43.0	1.11	0.212	93.916	0.236	104.678	3.00	7.33
Cu/Pb 2ND CL CONC	187.3	4.85	0.580	208.200	2.817	1010.803	35.82	70.81
Cu/Pb 2nd Cl Tail	42.4	1.10	0.200	77.893	0.220	85.608	2.79	6.00
Cu/Pb 1ST CL CONC	229.7	5.95	0.510	184.146	3.037	1096.411	38.61	76.80
Cu/Pb 1st Cl Tail	242.2	6.28	0.084	8.347	0.527	52.403	6.71	3.67
Cu/Pb RO CONC	471.9	12.23	0.291	93.918	3.564	1148.814	45.32	80.47
Tail	3386.0	87.77	0.049	3.176	4.301	278.751	54.68	19.53
CALC HEAD	3857.9	100.0	0.079	14.276	7.865	1427.565	100.00	100.00

TESTWORK PROCEDURE

TEST NO. 6891 - 10F7 DATE _____

STAGE	TIME (min.)	ADDITIONS	
		Lb./Ton	REAGENT
Grind	11	0.25	NaCN
		1.0	Na_2SO_3
		0.5	$ZnSO_4$
		0.02	Z-200
Cu/Pb Rougher	10	0.03	AERO 238
		0.05	MIBC
Cu/Pb Regrind	15	2.0	Na_2SO_3
		1.0	$ZnSO_4$
		0.1	NaCN
		0.02	Z-200
Cu/Pb 1st Cleaner	7	---	---
Condition	2	1.0	Na_2SO_3
Cu/Pb 2nd Cleaner	6	---	---
Cu/Pb Separation			
Condition	20	0.06	DEX-TRIN
		0.06	CARBON (-6#+16#)
Condition	20	3ml (6%)	Sulphurous Acid to Ph=4.8
Screen Out Carbon			
Cu Float	5	0.02	Z-200

TEST NUMBER: 6891-10F7 PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	UNITS Cu	Pb	Zn	Fe	% DIST Cu	Pb	Zn	Fe
Cu Conc	165.5	4.25	19.00	36.00	7.80	13.34	80.674	152.855	33.119	56.641	66.30	58.00	3.94	4.10
Pb Conc	19.4	0.50	9.80	16.80	9.60	19.01	4.878	8.362	4.778	9.462	4.01	3.17	0.57	0.69
Cu/Pb 2ND CL CONC	184.9	4.74	18.03	33.99	7.99	13.93	85.551	161.217	37.897	66.103	70.31	61.17	4.50	4.79
Cu/Pb 2nd CL Tail	46.9	1.20	12.70	16.20	13.90	18.21	15.281	19.493	16.725	21.911	12.56	7.40	1.99	1.59
Cu/Pb 1ST CL CONC	231.8	5.95	16.96	30.39	9.18	14.80	100.833	180.710	54.622	88.014	82.87	68.56	6.49	6.37
Cu/Pb 1st CL Tail	254.0	6.52	1.05	0.49	14.60	20.81	6.842	3.193	95.141	135.608	5.62	1.21	11.31	9.82
Cu/Pb RO CONC	485.8	12.46	8.64	14.76	12.02	17.94	107.675	183.903	149.763	223.622	88.49	69.78	17.80	16.19
Tail	3412.0	87.54	0.16	0.91	7.90	13.22	14.006	79.658	691.539	1157.233	11.51	30.22	82.20	83.81
CALC HEAD	3897.8	100.0	1.22	2.64	8.41	13.81	121.681	263.561	841.302	1380.856	100.00	100.00	100.00	100.00

TEST NUMBER: 6891-10F7 PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au oz/ton	ASSAYS Ag oz/ton	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag
Cu Conc	185.5	4.25	0.526	224.898	2.233	954.914	29.79	63.64
Pb Conc	19.4	0.50	0.437	118.151	0.218	58.806	2.90	3.92
Cu/Pb 2ND CL CONC	184.9	4.74	0.517	213.698	2.451	1013.719	32.69	67.56
Cu/Pb 2nd CL Tail	46.9	1.20	0.152	89.716	0.183	107.950	2.44	7.19
Cu/Pb 1ST CL CONC	231.8	5.95	0.443	188.613	2.634	1121.669	35.13	74.75
Cu/Pb 1st CL Tail	254.0	6.52	0.068	9.932	0.573	64.722	7.65	4.31
Cu/Pb RG CONC	485.6	12.46	0.257	95.190	3.207	1186.391	42.78	79.07
Tail	3412.0	87.54	0.049	3.588	4.289	314.081	57.22	20.93
CALC HEAD	3897.8	100.0	0.075	15.005	7.497	1500.472	100.00	100.00

TESTWORK PROCEDURE

Test No. 6891-10F8

Comp. #2

STAGE	TIME (min)	ADDITIONS	
		lb/ton	REAGENT
GRIND	11	0.25	NaCN
		1.0	Na_2SO_3 pH = 5.3
		0.5	$ZnSO_4$
		0.02	Z-200
CU/PB ROUGHER	18	1.63	Na_2CO_3 to pH = 6.5
		0.03	Aero 238
		0.05	MIBC pH = 6.5
ZN CONDITION	5	8.84	Lime to pH = 10.5
	5	0.6	$CuSO_4$
		0.1	NaCN
		0.03	Z-200
		0.075	Aero 343
ZN ROUGHER	8	0.04	DF1012
Note: Cu/Pb Rougher conc split and 1/2 reground with steel, 1/2 with porcelain			
CU/PB REGRIND	15	2.0	Na_2SO_3
		1.0	$ZnSO_4$
		0.1	NaCN
		0.02	Z-200
CU/PB 1ST CLEANER	9		
CU/PB 2ND CLEANER	8	1.0	Na_2SO_3
ZN REGRIND	30	0.1	$CuSO_4$
CONDITION	5	1.18	Lime to pH 10.8
ZN CLEANER	8	0.25	NaCN
		0.03	Z-200
		0.20	$CuSO_4$
		0.02	Aero 343
ZN 2ND CLEANER	6	0.94	Lime to pH 11.5

TEST NUMBER: 6891-10F8 FLOTATION OF COMPOSITE #2 BIG CELL FLOAT #3 PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	UNITS Cu	Pb	Zn	Fe	% DIST Cu	Pb	Zn	Fe
#1Cu/Pb CONC	136.4	1.15	22.640	27.360	5.870	8.830	25.932	31.338	6.494	10.114	21.24	17.68	0.80	0.75
#1 Cu/Pb 2nd CL TAIL	190.0	1.60	12.480	27.640	10.910	11.950	19.912	44.099	17.407	19.066	16.31	24.88	2.14	1.42
#1 Cu/Pb 1st CL CONC	326.4	2.74	16.726	27.523	8.720	10.646	45.843	75.437	23.901	29.180	37.55	42.57	2.94	2.17
#1 Cu/Pb 1st CL TAIL	257.5	2.16	3.640	1.220	13.560	22.280	7.871	2.638	29.321	48.176	6.45	1.49	3.60	3.58
#1 Cu/Pb RO CONC	583.9	4.90	10.955	15.923	10.855	15.777	53.714	78.075	53.222	77.356	43.99	44.06	6.54	5.74
#2 Cu/Pb CONC	247.3	2.08	16.680	32.960	6.860	8.060	38.792	68.446	14.246	16.738	31.77	38.62	1.75	1.24
#2 Cu/Pb 2nd CL TAIL	94.7	0.80	11.960	12.740	15.420	10.830	9.511	10.131	12.262	8.612	7.79	5.72	1.51	0.64
#2 Cu/Pb 1st CL CONC	342.0	2.87	16.819	27.361	9.230	8.827	48.303	78.578	26.508	25.350	39.56	44.34	3.26	1.88
#2 Cu/Pb 1st CL TAIL	223.5	1.88	3.230	1.510	14.260	17.100	6.062	2.834	26.763	32.093	4.97	1.60	3.29	2.38
#2 Cu/Pb RO CONC	565.5	4.75	11.448	17.144	11.218	12.097	54.365	81.412	53.271	57.443	44.53	45.94	6.54	4.27
COMB Cu/Pb RO CONC	1149.4	9.65	11.198	16.524	11.033	13.966	108.079	159.487	106.493	134.799	88.52	90.00	13.08	10.01
Zn CONC	149.8	1.26	3.710	1.600	42.520	10.010	4.667	2.013	53.487	12.592	3.82	1.14	6.57	0.93
Zn 2nd CL TAIL	637.0	5.35	0.340	0.200	54.240	5.550	1.819	1.070	290.134	29.687	1.49	0.60	35.64	2.20
Zn 1st CL CONC	786.8	6.61	0.982	0.467	52.009	6.399	6.486	3.082	343.620	42.279	5.31	1.74	42.21	3.14
Zn 1st CL TAIL	1215.5	10.21	0.190	0.210	34.080	13.310	1.939	2.143	347.851	135.854	1.59	1.21	42.73	10.09
Zn RO CONC	2002.3	16.81	0.501	0.311	41.125	10.594	8.425	5.226	691.472	178.133	6.90	2.95	84.93	13.23
TAIL	8756.9	73.53	0.076	0.170	0.220	14.060	5.589	12.501	16.178	1033.892	4.58	7.05	1.99	76.77
CALC HEAD	11908.6	100.0	1.221	1.772	8.141	13.466	122.092	177.213	814.143	1346.824	100.00	100.00	100.00	100.00

TEST NUMBER: 6891-10F8 FLOTATION OF COMPOSITE #2 BIG CELL FLOAT #3 PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au oz/ton	ASSAYS Ag oz/ton	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag	
#1Cu/Pb CONC	136.4	1.15	0.995	278.140	1.140	318.579	9.24	22.87	
#1 Cu/Pb 2nd CL TAIL	190.0	1.60	0.101	108.359	0.161	173.843	1.31	12.48	
#1 Cu/Pb 1st CL CONC	326.4	2.74	0.475	179.658	1.301	492.421	10.55	35.35	
#1 Cu/Pb 1st CL TAIL	257.5	2.16	0.097	27.857	0.210	60.235	1.70	4.32	
#1 Cu/Pb RO CONC	583.9	4.90	0.308	112.714	1.511	552.657	12.25	39.67	
#2 Cu/Pb CONC	247.3	2.08	1.579	212.762	3.279	441.832	26.58	31.72	
#2 Cu/Pb 2nd CL TAIL	94.7	0.80	0.160	101.291	0.127	80.549	1.03	5.78	
#2 Cu/Pb 1st CL CONC	342.0	2.87	1.186	161.896	3.406	522.381	27.62	37.50	
#2 Cu/Pb 1st CL TAIL	223.5	1.88	0.536	24.918	1.006	46.766	8.16	3.36	
#2 Cu/Pb RO CONC	565.5	4.75	0.929	119.854	4.412	569.147	35.77	40.86	0.00
COMB Cu/Pb RO CONC	1149.4	9.65	0.614	116.227	5.923	1121.804	48.02	80.53	0.00
Zn CONC	149.8	1.26	0.589	38.886	0.741	48.915	6.01	3.51	
Zn 2nd CL TAIL	637.0	5.35	0.079	8.643	0.423	35.534	3.43	2.55	
Zn 1st CL CONC	786.8	6.61	0.091	4.476	1.163	84.449	9.43	6.06	
Zn 1st CL TAIL	1215.5	10.21	0.190	0.210	1.939	2.143	15.72	0.15	
Zn RO CONC	2002.3	16.81	0.185	5.150	3.103	86.593	25.16	6.22	
TAIL	8756.9	73.53	0.045	2.511	3.309	184.645	26.83	13.25	
CALC HEAD	11908.6	100.0	0.123	13.930	12.335	1393.041	100.00	100.00	

TESTWORK PROCEDURE

Test No. 6891-10F9

Comp. #2

STAGE	TIME (min)	ADDITIONS	
		lb/ton	REAGENT
GRIND	11	0.25	NaCN
		1.0	Na_2SO_3 pH = 6.3
		0.5	$ZnSO_4$
		0.02	Z-200
CU/PB ROUGHER	10	0.03	Aero 238
		0.05	MIBC pH = 6.0
ZN CONDITION	5	10.95	Lime to pH = 10.5
	5	0.6	$CuSO_4$
		0.1	NaCN
		0.03	Z-200
		0.075	Aero 343
ZN ROUGHER	8	0.04	DF1012
CU/PB REGRIND	15	2.0	Na_2SO_3
		1.0	$ZnSO_4$
		0.1	NaCN
		0.02	Z-200
CU/PB 1ST CLEANER	9		
CU/PB 2ND CLEANER	8	1.0	Na_2SO_3
ZN REGRIND	15	0.010	$CuSO_4$
CONDITION	5	0.42	Lime to pH 10.8
ZN 1ST CLEANER	6	0.25	NaCN
		0.03	Z-200
		0.20	$CuSO_4$
		0.02	Aero 343
ZN 2ND CLEANER	5	0.78	Lime to pH 11.5

TESTWORK PROCEDURE

Test No. 6891-10F9

STAGE	TIME (min)	ADDITIONS	
		lb/ton	REAGENT
CONDITION	20	0.11 0.11	Dextrin Carbon
CONDITION	20	42 ml (6%)	Sulphurous to pH = 4.8
SCREEN OUT CARBON			6.0-4.8
COPPER FLOAT	1.5	0.02	Z-200
#2 CU FLOAT	5.5		

TEST NUMBER: 6891-10F9 FLOTATION OF COMPOSITE ORE - Cu/Pb SEPARATION PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	UNITS Cu	Pb	Zn	Fe	% DIST Cu	Pb	Zn	Fe
Cu CONC	144.8	3.69	18.920	27.800	5.280	6.490	69.896	102.701	19.506	23.976	64.68	62.61	2.59	2.14
Pb CONC	39.5	1.01	2.730	14.310	7.800	16.330	2.749	14.411	7.855	16.445	2.54	8.79	1.04	1.47
Pb TAIL	21.8	0.56	5.030	35.200	10.290	10.250	2.796	19.564	5.719	5.697	2.59	11.93	0.76	0.51
COMP Pb CONC & TAIL	61.3	1.56	3.548	21.738	8.686	14.168	5.545	33.975	13.574	22.142	5.13	20.71	1.80	1.97
Cu/Pb CONC	208.2	5.26	14.350	25.998	6.292	8.772	75.441	136.677	33.080	46.118	69.81	83.32	4.40	4.11
Cu/Pb 2nd CL TAIL	48.4	1.23	10.630	4.500	13.340	13.170	13.117	5.553	16.461	16.252	12.14	3.39	2.19	1.45
Cu/Pb 1st CL CONC	256.6	6.49	13.643	21.911	7.632	9.608	88.558	142.229	49.541	62.370	81.95	86.71	6.58	5.56
Cu/Pb 1st CL TAIL	241.8	6.16	1.180	0.410	13.050	18.190	7.274	2.528	80.451	112.138	6.73	1.54	10.69	9.99
Cu/Pb RO CONC	496.4	12.66	7.572	11.438	10.271	13.789	95.833	144.757	129.992	174.508	88.68	88.25	17.28	15.55
Zn CONC	371.1	9.46	0.580	0.540	52.360	5.430	5.488	5.109	495.397	51.375	5.08	3.11	65.84	4.58
Zn 2nd CL TAIL	48.8	1.19	0.350	0.500	16.630	12.970	0.416	0.594	19.758	15.409	0.38	0.36	2.63	1.37
Zn 1st CL CONC	417.7	10.65	0.554	0.536	48.374	6.271	5.903	5.703	515.155	66.785	5.46	3.48	68.47	5.95
Zn 1st CL TAIL	210.4	5.36	0.170	0.270	16.410	13.400	0.912	1.448	88.027	71.881	0.84	0.88	11.70	6.41
Zn RO CONC	628.1	16.01	0.426	0.447	37.667	8.659	6.815	7.152	603.182	138.665	6.31	4.36	80.16	12.36
TAIL	2797.8	71.33	0.078	0.170	0.270	11.340	5.421	12.126	19.259	808.886	5.02	7.39	2.56	72.09
CALC HEAD	3922.3	100.0	1.081	1.640	7.524	11.221	108.089	164.035	752.433	1122.059	100.00	100.00	100.00	100.00

TEST NUMBER: 6891-10F9 FLOTATION OF COMPOSITE ORE -Cu/Pb SEPARATION PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au oz/ton	ASSAYS Ag oz/ton	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag
Cu CONC	144.9	3.69	0.495	227.052	1.829	838.796	23.45	58.80
Pb CONC	21.8	0.56	0.392	86.142	0.218	47.878	2.79	3.36
Pb TAIL	39.5	1.01	0.390	113.189	0.393	113.989	5.04	7.99
COMP Pb CONC & TAIL	61.3	1.56	0.391	103.570	0.611	161.867	7.83	11.35
Cu/Pb CONC	206.2	5.26	0.464	190.343	2.439	1000.663	31.28	70.15
Cu/Pb 2nd CL TAIL	48.4	1.23	0.124	88.509	0.153	109.218	1.96	7.66
Cu/Pb 1st CL CONC	254.6	6.49	0.399	170.984	2.592	1109.881	33.24	77.80
Cu/Pb 1st CL TAIL	241.8	6.16	0.076	10.834	0.469	86.789	6.01	4.68
Cu/Pb RO CONC	496.4	12.66	0.242	92.974	3.061	1178.670	39.25	82.48
Zn CONC	371.1	9.46	0.070	8.252	0.662	78.075	8.49	5.47
Zn 2nd CL TAIL	46.8	1.19	0.070	7.730	0.083	9.184	1.07	0.64
Zn 1st CL CONC	417.7	10.65	0.070	8.194	0.745	87.259	9.56	6.12
Zn 1st CL TAIL	210.4	5.36	0.066	4.050	0.354	21.725	4.54	1.52
Zn RO CONC	628.1	16.01	0.069	6.806	1.100	108.984	14.10	7.64
TAIL	2797.8	71.33	0.051	1.975	3.638	140.877	46.65	9.88
CALC HEAD	3922.3	100.0	0.078	14.285	7.798	1426.532	100.00	100.00

TESTWORK PROCEDURE

Test No. 6891-10F10

Comp. #2

STAGE	TIME (min)	ADDITIONS	
		lb/ton	REAGENT
GRIND	11	0.25	NaCN
		1.0	Na_2SO_3 pH = 6.2
		0.5	$ZnSO_4$
		0.02	Z-200
CU/PB ROUGHER	10	0.03	Aero 238
		0.05	MIBC pH = 5.7
ZN CONDITION	5	14.05	Lime to pH = 10.5
	5	0.6	$CuSO_4$
		0.1	NaCN
		0.03	Z-200
		0.075	Aero 343
ZN ROUGHER	8	0.04	DF1012
CONDITION	5	2.0	Na_2SO_3
		1.0	$ZnSO_4$
		0.1	NaCN
		0.02	Z-200
CU/PB 1ST CLEANER	10		
CU/PB 2ND CLEANER	7	1.0	Na_2SO_3
CONDTION	5	0.66	Lime to pH 10.8
ZN 1ST CLEANER	6	0.175	NaCN
		0.03	Z-200
		0.20	$CuSO_4$
		0.02	Aero 343
ZN 2ND CLEANER	5	0.69	Lime to pH 11.5

TESTWORK PROCEDURE

Test No. 6891-10F10

Cu/Pb Separation

STAGE	TIME (min)	ADDITIONS	
		lb/ton	REAGENT
CONDITION	20	0.11 0.11	Dextrin Carbon
CONDITION	20	68 ml (6%)	Sulphurous to pH = 4.8
SCREEN OUT CARBON			6.1-4.8
COPPER FLOAT	3.5	0.02	Z-200
#2 CU FLOAT	4.5		

TEST NUMBER: 6891-10F10 FLOTATION OF COMPOSITE ORE WITHOUT REGRIND - Cu/Pb SEPARATION PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	UNITS Cu	Pb	Zn	Fe	% DIST Cu	Pb	Zn	Fe
Cu CONC	134.9	3.44	26.520	6.180	9.930	11.540	91.330	21.283	34.197	39.741	74.87	11.48	4.35	3.13
Pb CONC	30.1	0.77	3.820	43.080	13.970	7.900	2.935	33.103	10.735	6.070	2.41	17.85	1.37	0.48
Pb TAIL	71.0	1.81	0.710	56.920	8.330	6.790	1.287	103.169	15.098	12.307	1.05	55.63	1.92	0.97
COMP Pb CONC & TAIL	101.1	2.58	1.636	52.798	10.009	7.120	4.222	136.272	25.833	18.378	3.46	73.48	3.29	1.45
Cu/Pb CONC	236.0	6.02	15.860	26.151	9.964	9.647	95.552	157.555	60.030	58.119	78.33	84.95	7.64	4.57
Cu/Pb 2nd CL TAIL	28.3	0.72	7.650	7.650	13.940	11.090	5.871	5.527	10.071	8.012	4.65	2.98	1.28	0.63
Cu/Pb 1st CL CONC	264.3	6.75	15.002	24.170	10.390	9.801	101.223	163.082	70.101	66.131	82.98	87.93	8.93	5.20
Cu/Pb 1st CL TAIL	213.5	5.45	1.760	0.800	14.440	18.280	9.593	4.360	78.703	99.632	7.86	2.35	10.02	7.84
Cu/Pb RO CONC	477.8	12.20	9.085	13.728	12.200	13.590	110.816	167.442	148.804	165.763	90.85	90.28	18.95	13.04
Zn CONC	497.4	12.70	0.520	0.470	48.480	8.360	6.603	5.968	615.595	106.155	5.41	3.22	78.40	8.35
Zn 2nd CL TAIL	68.7	1.70	0.260	0.350	0.860	34.320	0.443	0.596	1.464	58.439	0.36	0.32	0.19	4.60
Zn 1st CL CONC	564.1	14.40	0.489	0.456	42.849	11.430	7.046	6.564	617.059	164.593	5.78	3.54	78.58	12.94
Zn 1st CL TAIL	160.4	4.09	0.160	0.260	0.500	23.520	0.655	1.065	2.047	96.309	0.54	0.57	0.26	7.57
Zn RO CONC	724.5	18.50	0.416	0.412	33.473	14.106	7.701	7.629	619.106	260.902	6.31	4.11	78.84	20.52
TAIL	2714.9	69.31	0.050	0.150	0.250	12.190	3.465	10.396	17.327	844.852	2.84	5.61	2.21	66.44
CALC HEAD	3917.2	100.0	1.220	1.855	7.852	12.715	121.982	185.467	785.237	1271.518	100.00	100.00	100.00	100.00

TEST NUMBER: 6891-10F10 FLOTATION OF COMPOSITE ORE WITHOUT REGRIND - Cu/Pb SEPARATION PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton	Ag oz/ton	ASSAYS	UNITS Au	UNITS Ag	% DIST Au	% DIST Ag
Cu CONC	134.9	3.44	0.572	269.642		1.970	928.594	27.15	62.20
Pb CONC	30.1	0.77	0.246	85.804		0.189	65.779	2.61	4.41
Pb TAIL	71.0	1.81	0.150	29.200		0.272	52.926	3.75	3.55
COMP Pb CONC & TAIL	101.1	2.58	0.179	45.993		0.461	118.705	6.35	7.95
Cu/Pb CONC	236.0	6.02	0.403	173.833		2.431	1047.299	33.51	70.15
Cu/Pb 2nd CL TAIL	28.3	0.72	0.134	81.474		0.097	58.862	1.33	3.94
Cu/Pb 1st CL CONC	264.3	6.75	0.375	163.944		2.528	1106.161	34.84	74.10
Cu/Pb 1st CL TAIL	213.5	5.45	0.092	19.622		0.501	106.947	6.91	7.16
Cu/Pb RO CONC	477.8	12.20	0.248	99.455		3.029	1213.107	41.75	81.26
Zn CONC	497.4	12.70	0.070	9.278		0.889	117.811	12.25	7.89
Zn 2nd CL TAIL	66.7	1.70	0.144	8.790		0.245	14.967	3.38	1.00
Zn 1st CL CONC	564.1	14.40	0.079	9.220		1.134	132.778	15.63	8.89
Zn 1st CL TAIL	160.4	4.09	0.078	4.274		0.319	17.501	4.40	1.17
Zn RO CONC	724.5	18.50	0.079	8.125		1.453	150.280	20.03	10.07
TAIL	2714.9	69.31	0.040	1.868		2.772	129.465	38.21	8.67
CALC HEAD	3917.2	100.0	0.073	14.928		7.255	1492.852	100.00	100.00

TESTWORK PROCEDURE

Test No. 6891-10F11

Locked Cycle

STAGE	TIME (min)	ADDITIONS	
		lb/ton	REAGENT
GRIND	11	0.25	NaCN
		1.0	Na_2SO_3 pH = 6.2
		0.5	$ZnSO_4$
RECYCLE CU/PB 2ND CLEANER TAIL		0.02	Z-200
CU/PB ROUGHER	10	0.03	Aero 238
		0.05	MIBC pH = 5.7
RECYCLE CU/PB 1ST & 2ND CLEANER TAIL			
ZN CONDITION	5	6.67	Lime to pH = 10.5
	5	0.6	$CuSO_4$
		0.1	NaCN
		0.03	Z-200
		0.075	Aero 343
ZN ROUGHER	8	0.04	DF1012
CU/PB CONDITION	5	2.0	Na_2SO_3
		1.0	$ZnSO_4$
		0.1	NaCN
		0.02	Z-200
CU/PB 1ST CLEANER	10		
CU/PB 2ND CLEANER	7	1.0	Na_2SO_3
ZN CONDITIONS	5	0.36	Lime to pH 10.8
ZN 1ST CLEANER	6	0.175	NaCN
		0.03	Z-200
		0.20	$CuSO_4$
		0.02	Aero 343
ZN 2ND CLEANER	5	0.38	Lime to pH 11.5

TESTWORK PROCEDURE

Test No. 6891-10F11

Cu/Pb Separation

STAGE	TIME (min)	ADDITIONS	
		lb/ton	REAGENT
CONDITION	20	0.11 0.11	Dextrin Carbon
CONDITION	20	60 ml (6%)	Sulphurous to pH = 4.8
SCREEN OUT CARBON			
COPPER FLOAT	5	0.02	Z-200

TEST NUMBER: 6891-10F11 FLOTATION OF COMPOSITE #2 - LOCKED CYCLE PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	Insol%	% DIST Cu	Pb	Zn	Fe	Insol
Cu/Pb CONC #1	115.1	0.96	13.450	22.740	10.360	10.380		11.01	11.63	1.23	0.78	
Cu/Pb CONC #2	92.1	0.77	13.760	22.960	8.110	11.490		9.01	9.39	0.77	0.69	
Cu/Pb CONC #3	163.1	1.36	13.600	26.400	8.800	10.100		15.78	19.13	1.48	1.08	
Cu/Pb CONC #4	122.0	1.02	14.560	26.240	13.440	12.900		12.64	14.22	1.70	1.03	
Cu/Pb CONC #5	147.0	1.22	13.440	23.520	10.240	13.000		14.05	15.36	1.56	1.25	
Cu CONC #6	53.7	0.45	27.600	5.200	8.080	12.700		10.54	1.24	0.45	0.45	
Pb CONC #6	53.9	0.49	5.200	43.600	10.000	8.700		2.18	11.41	0.61	0.34	
Cu/Pb CONC #6	112.6	0.94	15.883	25.287	9.084	10.608		12.72	12.65	1.06	0.78	
TOTAL Cu/Pb CONCS	751.9	6.26	14.063	24.663	10.031	11.410		75.21	82.38	7.80	5.63	
Cu/Pb 2nd CL TAIL	39.0	0.32	9.200	8.600	13.200	12.100		2.55	1.49	0.53	0.31	
Cu/Pb 1st CL TAIL	90.4	0.75	4.640	0.800	17.120	10.700		2.98	0.32	1.60	0.63	
Zn CONC #1	229.9	1.92	0.700	0.630	47.220	7.830	3.480	1.14	0.64	11.23	1.18	11.26
Zn CONC #2	279.6	2.33	0.830	0.730	46.130	7.600	3.920	1.65	0.91	13.34	1.39	15.43
Zn CONC #3	267.8	2.23	1.120	0.760	53.600	6.400	3.660	2.13	0.90	14.85	1.12	13.80
Zn CONC #4	228.6	1.90	1.240	0.680	48.800	6.000	8.840	2.02	0.69	11.54	0.90	28.44
Zn CONC #5	310.6	2.59	1.120	0.520	56.000	5.200	3.900	2.47	0.72	17.99	1.06	17.05
Zn CONC #6	226.5	1.89	1.440	0.800	53.600	6.700	4.400	2.32	0.81	12.56	1.00	14.03
TOTAL Zn CONCS	1543.0	12.86	1.070	0.681	51.068	6.574	4.605	11.74	4.67	81.52	6.66	100.00
Zn 2nd CL TAIL	63.5	0.53	0.560	0.600	27.200	9.400		0.25	0.17	1.79	0.39	
Zn 1st CL TAIL	245.6	2.05	0.220	0.370	12.960	11.200		0.38	0.40	3.29	1.80	
TAIL #1	1441.3	12.01	0.100	0.270	0.220	14.470		1.03	1.73	0.33	13.69	
TAIL #2	1528.9	12.74	0.096	0.280	0.310	13.320		1.04	1.90	0.49	13.36	
TAIL #3	1608.6	13.40	0.100	0.270	0.500	13.200		1.14	1.93	0.83	13.93	
TAIL #4	1459.6	12.16	0.120	0.240	0.450	14.400		1.25	1.56	0.68	13.79	
TAIL #5	1644.5	13.70	0.110	0.250	0.340	14.900		1.29	1.83	0.58	16.08	
TAIL #6	1585.5	13.21	0.100	0.230	0.340	13.200		1.13	1.62	0.56	13.73	
TOTAL TAILS	9268.4	77.22	0.104	0.257	0.361	13.908		6.87	10.56	3.47	84.58	
CALC HEAD	12001.8	100.0	1.171	1.875	8.054	12.699	0.592	100.00	100.00	100.00	100.00	100.00

TEST NUMBER: 6891-10F11 FLOTATION OF COMPOSITE #2 - LOCKED CYCLE PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton	Ag oz/ton	% DIST Au	% DIST Ag
u/Pb CONC #1	115.1	0.96	0.476	173.384	6.72	11.21
u/Pb CONC #2	92.1	0.77	0.478	195.250	5.40	10.11
Cu/Pb CONC #3	163.1	1.36	0.262	160.944	5.24	14.75
Cu/Pb CONC #4	122.0	1.02	0.282	171.164	4.22	11.78
u/Pb CONC #5	147.0	1.22	0.374	155.350	6.75	12.83
u CONC #6	53.7	0.45	0.590	301.446	3.89	9.10
Pb CONC #6	58.9	0.49	0.292	71.568	2.11	2.37
u/Pb CONC #6	112.6	0.94	0.434	181.199	6.00	11.47
OTAL Cu/Pb CONCS	751.9	6.26	0.372	170.648	34.34	72.10
Cu/Pb 2nd CL TAIL	39.0	0.32	0.184	84.860	0.88	1.86
u/Pb 1st CL TAIL	90.4	0.75	0.058	20.910	0.64	1.06
n CONC #1	229.9	1.92	0.098	9.910	2.77	1.28
Zn CONC #2	279.6	2.33	0.084	11.454	2.88	1.80
n CONC #3	267.8	2.23	0.074	13.624	2.43	2.05
n CONC #4	228.6	1.90	0.052	13.366	1.46	1.72
Zn CONC #5	310.6	2.59	0.052	12.216	1.98	2.13
Zn CONC #6	226.5	1.89	0.068	16.138	1.89	2.05
OTAL Zn CONCS	1543.0	12.86	0.071	12.725	13.41	11.03
2nd CL TAIL	63.5	0.53	0.060	8.708	0.47	0.21
Zn 1st CL TAIL	245.6	2.05	0.056	4.236	1.69	0.58
AIL #1	1441.3	12.01	0.041	2.224	7.25	1.80
AIL #2	1528.9	12.74	0.040	2.208	7.51	1.90
TAIL #3	1608.6	13.40	0.044	2.671	8.69	2.41
TAIL #4	1459.6	12.16	0.044	2.738	7.88	2.25
AIL #5	1644.5	13.70	0.042	2.562	8.48	2.37
AIL #6	1585.5	13.21	0.045	2.605	8.76	2.32
TOTAL TAILS	9268.4	77.22	0.043	2.505	48.56	13.05
LC HEAD	12001.8	100.0	0.068	14.827	100.00	100.00

TEST NUMBER: 6891-10F11 FLOTATION OF COMPOSITE #2 - LOCKED CYCLE PAGE 2

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Cu%	Pb%	Zn%	Fe%	Insol%	% DIST Cu	Pb	Zn	Fe	Insol
Cu/Pb CONC #1	115.1	1.00	13.450	22.740	10.360	10.380		11.74	11.91	1.33	0.81	0.00
Cu/Pb CONC #2	92.1	0.80	13.760	22.960	8.110	11.490		9.61	9.62	0.83	0.72	0.00
u/Pb CONC #3	163.1	1.41	13.600	26.400	8.800	10.100		16.82	19.60	1.60	1.12	0.00
u/Pb CONC #4	122.0	1.06	14.560	26.240	13.440	12.900		13.47	14.57	1.83	1.07	0.00
Cu/Pb CONC #5	147.0	1.27	13.440	23.520	10.240	13.000		14.98	15.74	1.68	1.29	0.00
u CONC #6	53.7	0.46	27.600	5.200	8.080	12.700		11.24	1.27	0.48	0.46	0.00
b CONC #6	58.9	0.51	5.200	43.600	10.000	8.700		2.32	11.69	0.66	0.35	0.00
Cu/Pb CONC #6	112.6	0.97	15.883	25.287	9.084	10.608		13.56	12.96	1.14	0.81	0.00
TOTAL Cu/Pb CONCS	751.9	6.50	14.063	24.663	10.031	11.410		80.16	84.40	8.41	5.81	0.00
n CONC #1	229.9	1.99	0.700	0.630	47.220	7.830	3.480	1.22	0.66	12.10	1.22	11.26
Zn CONC #2	279.6	2.42	0.830	0.730	46.130	7.600	3.920	1.76	0.93	14.38	1.44	15.43
Zn CONC #3	267.8	2.32	1.120	0.760	53.600	6.400	3.660	2.27	0.93	16.00	1.16	13.80
n CONC #4	228.6	1.98	1.240	0.680	48.800	6.000	8.840	2.15	0.71	12.44	0.93	28.44
n CONC #5	310.6	2.69	1.120	0.520	56.000	5.200	3.900	2.64	0.74	19.39	1.09	17.05
Zn CONC #6	226.5	1.96	1.440	0.800	53.600	6.700	4.400	2.47	0.82	13.54	1.03	14.03
AL Zn CONCS	1543.0	13.34	1.070	0.681	51.068	6.574	4.605	12.51	4.78	87.86	6.87	100.00
#1	1441.3	12.46	0.100	0.270	0.220	14.470		1.09	1.77	0.35	14.13	
TAIL #2	1528.9	13.22	0.096	0.280	0.310	13.320		1.11	1.95	0.53	13.79	
TAIL #3	1608.6	13.91	0.100	0.270	0.500	13.200		1.22	1.98	0.90	14.38	
IL #4	1459.6	12.62	0.120	0.240	0.450	14.400		1.33	1.59	0.73	14.24	
TAIL #5	1644.5	14.22	0.110	0.250	0.340	14.900		1.37	1.87	0.62	16.60	
TAIL #6	1585.5	13.71	0.100	0.230	0.340	13.200		1.20	1.66	0.60	14.18	
TAL TAILS	9268.4	80.15	0.104	0.257	0.361	13.908		7.33	10.82	3.74	87.32	
CALC HEAD	11563.3	100.0	1.141	1.900	7.757	12.767	0.614	100.00	100.00	100.00	100.00	100.00

TEST NUMBER: 6891-10F11 FLOTATION OF COMPOSITE #2 - LOCKED CYCLE PAGE 1

PRODUCT	WEIGHT GMS	WEIGHT %	ASSAYS Au oz/ton	ASSAYS Ag oz/ton	% DIST Au	% DIST Ag
Cu/Pb CONC #1	115.1	1.00	0.476	173.384	6.98	11.66
Cu/Pb CONC #2	92.1	0.80	0.478	195.250	5.61	10.51
Cu/Pb CONC #3	163.1	1.41	0.262	160.944	5.45	15.34
Cu/Pb CONC #4	122.0	1.06	0.282	171.164	4.38	12.20
Cu/Pb CONC #5	147.0	1.27	0.374	155.350	7.01	13.34
Cu CONC #6	53.7	0.46	0.590	301.446	4.04	9.46
Pb CONC #6	58.9	0.51	0.292	71.568	2.19	2.46
Cu/Pb CONC #6	112.6	0.97	0.434	181.199	6.23	11.92
TOTAL Cu/Pb CONCS	751.9	6.50	0.372	170.648	35.66	74.96
Zn CONC #1	229.9	1.99	0.098	9.910	2.87	1.33
Zn CONC #2	279.6	2.42	0.084	11.454	2.99	1.87
Zn CONC #3	267.8	2.32	0.074	13.624	2.53	2.13
Zn CONC #4	228.6	1.98	0.052	13.366	1.51	1.79
Zn CONC #5	310.6	2.69	0.052	12.216	2.06	2.22
Zn CONC #6	226.5	1.96	0.068	16.138	1.96	2.14
TOTAL Zn CONCS	1543.0	13.34	0.071	12.725	13.92	11.47
TAIL #1	1441.3	12.46	0.041	2.224	7.53	1.87
TAIL #2	1528.9	13.22	0.040	2.208	7.79	1.97
TAIL #3	1608.6	13.91	0.044	2.671	9.02	2.51
TAIL #4	1459.6	12.62	0.044	2.738	8.18	2.33
TAIL #5	1644.5	14.22	0.042	2.562	8.80	2.46
TAIL #6	1585.5	13.71	0.045	2.605	9.09	2.41
TOTAL TAILS	9268.4	80.15	0.043	2.505	50.42	13.56
CALC HEAD	11563.3	100.0	0.068	14.802	100.00	100.00

APPENDIX II

Cyanidation Test of Pyrite Concentrate

CYANIDATION REPORT

Feed Description:
6891-10F4 Cycles 1-5
Pyrite Conc Composite after
regrinding to -400 mesh

File No.: 6891
Test No.: 6891-C1

Starting Conditions:

912	dry g. of feed
1.368	ml. of water
40	% solids
2	gpl NaCN
10.5	pH target

Test Progress:

Time hr	NaCN Conc g/l	NaCN Addition g	$Ca(OH)_2$ Conc g/l	$Ca(OH)_2$ Addition ml 10%	pH	O_2 ppm
0	2.00	2.74		10	9.5-10.6	
0.5	0.00	2.74			10.6	
1	0.28	2.74			11.6	
2.5	0.10	6.84				
4	0.45	6.22				
5	3.38	2.22				
6	4.20	1.09				
20	2.88					
24	3.16					
48	2.56		0.30	41	11.2	

Reagent Consumption: NaCN = 23.13 kg/t
Lime = 0.65 kg/t

Reducing Power: RP = 2880 ml of N/10 $KMnO_4$ per 1000 ml solution

Assay Results:

Sample Time hr	Solids Assay Gold g/t	Solids Assay Silver g/t	Liquid Assay Gold mg/l	Liquid Assay Silver mg/l	Extraction Gold %	Extraction Silver %
6			0.76	56.2	26.2	33.8
24			0.84	104.2	28.9	62.1
48			0.96	117.72	32.8	69.9
Tail	2.43	62.61			67.2	30.1
Head	3.65 (.106 oz/ton)	207.74 (6.059 oz/ton)				

LAKEFIELD RESEARCH
A DIVISION OF FALCONBRIDGE LIMITED

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October 30, 1987

Houston Metals Corporation
Suite 910-800 West Pender Street
Vancouver, B.C.
V6C 2X6

Attn: Mr. Adolf A. Petancic:

Enclosed please find the minutes of the meeting held at Lakefield with Mr. E.W.S. Ward and Mr. N.C. Croome. During the meeting the metallurgical results were revieved and the final phase of the testwork proposed. So far we have defined a process by which separate copper, lead and zinc concentrates can be produced. Further work would be concentrated to optimize the results and to perform continuous locked cycle tests in order to generate data for a feasibility study, and to determine the effect of intermediate product recirculation on concentrates, grades and recoveries.

Mr. Croome pointed out that this testwork is not being performed on a representative sample (i.e. does not include vein No. 3 ore) and therefore standard tests should be carried out to define metallurgy on individual samples.

To date we have conducted 27 batch flotation tests at the total cost of $22,000. In order to complete all metallurgical testing we would need an additional $30,000. Please let me know if the budget for this testwork represents any problems.

Regards

LAKEFIELD RESEARCH

S. Bulatovic, P. Eng.
Chief Development Engineer

SB:jm

Encl.

c.c. Norman C. Croome
E.W.S. Ward

MINUTES OF MEETING

Purpose: Silver Queen Metallurgy Review

Present:

1. N.C. Croome, P. Eng., President
   N.C.. Croome and Associates Ltd.
   on behalf of James Wade Engineering
2. E.W.S. Ward, Metallurgical Consultant
   on behalf of James Wade Engineering
3. S.M. Bulatovic, P. Eng.
   Lakefield Research

1. Testwork Review

1.1 Ore Samples

All laboratory testwork was carried out on the composite sample consisting of the following individual samples:

a) No. 2 Vein = 3 parts
b) F.W. Vein - 2750 Level = 2 parts
c) F.W. Vein - 2600 Level = 1 part
d) No. 3 extension = 2 parts
e) No. 5 Vein = 1 part
f) S.B. Vein = 1 part

The head assays of the composite sample were as follows:

Copper (Cu)	1.60%
Lead (Pb)	0.96%
Zinc (Zn)	7.75%
Iron (Fe)	16.20%
Sulphur (S)	21.90%
Gallium (Ga)	0.0018%
Germanium (Ge)	0.0115%
Arsenic (As)	0.66%
Gold (Au)	2.16 g/t
Silver (Ag)	546.00 g/t

Mr. N.C. Croome and Mr. E. Ward pointed out that the composite sample on which laboratory testwork is being done is not representative because it does not include vein No. 3 ore which represents about 80% of the ore body. It was suggested that additional tests should be performed on individual samples. The individual samples from which the composite is prepared are still available. The weights of the individual samples remaining are as follows:

No. 2 Vein	96 kg
F.W. Vein 2750 Level	52 kg
F.W. Vein 2600 Level	21 kg
No. 3 Extension	3 kg
No. 5 Vein	20 kg
SB Vein	49 kg

1.2 Laboratory Testwork

A total of 27 laboratory tests were performed in which different treatment processes applicable to Silver Queen ore were examined.

This includes:

a) Cu-Pb bulk flotation followed by Cu-Pb separation
b) Cu-Pb-Zn bulk flotation and separation
c) Sequential Cu-Pb-Zn flotation

Cu-Pb Bulk Flotation. Although good metallurgical bulk flotation results were obtained using this method the Cu-Pb separation represents a problem because of the presence of secondary copper minerals. Separation may only be possible with the use of extremely high dosages of lead depressant. Even under these conditions sharpness of separation is poor.

Sequential Cu-Pb-Zn Flotation. This method is more suitable for treatment of the Silver Queen ore and would provide a more stable circuit for the future plant. Using this method the following metallurgical results were obtained.

Metallurgical Results

Product	Assays %					% Distribution		
	Cu	Pb	Zn	Au	Ag	Cu	Pb	Zn
Cu Concentrate	26.4	2.1	7.1	12.0	5617	76.0	10.0	4.0
Pb Concentrate	1.2	5.5	6.0	115.0	5400	3.0	54.0	1.0
Zn Concentrate	0.3	0.2	60.0	1.5	500	0.5	0.5	85

The gold recovery in the copper plus lead concentrates was about 50%. Extra gold, about 15% was recovered in a germanium concentrate after zinc flotation. The remaining gold, about 35% is enclosed within pyrite. The silver recovery in the combined copper and lead concentrate was over 85%. 10% of the Ag reports to the zinc concentrate.

2. Gallium and Germanium Distribution

Most of the recoverable gallium reported to the copper lead and zinc concentrates (about 50%) the remaining 50% of the gallium reports to the zinc tailing. Germanium, however, is not associated with either copper or zinc minerals and 85% of the germanium reports to the zinc tailing. We have conducted germanium occurrence tests to determine if germanium is associated with pyrite or is a separate mineral. This data is not available yet. However, the germanium concentrate assayed 10.0 g/t gold and 2000 g/t silver. If germanium is not associated with pyrite it may be possible to recover germanium in a separate concentrate with extra gold and silver recovery.

3. Further Testwork

In order to optimize the treatment method and further improve metallurgical results the following work would be required.

1. Conduct 5 batch tests on the composite to optimize the reagent scheme and flowsheet.
2. Conduct 15 tests on individual samples using the developed procedure to determine the metallurgical responses of the individual samples to the standard procedure developed.
3. Conduct two locked cycle tests to determine the effect of intermediate product re-circulation and to generate data for feasibility.
4. Conduct preliminary roasting tests on copper concentrate to determine if the arsenic can be removed from the concentrate along with mercury.

Minutes of Meeting Lakefield Research, October 25, 1987

Those present:	S. Bulatovic, P.Eng.	Chief Development Engineer Lakefield Research
	R. S. (Bob) Salter, PhD.	General Manager, Lakefield Research
	E. W. S. Ward	Metallurgist, James Wade Engineering
	N. C. Croome	Project Manager, James Wade Engineering

The testwork to be conducted by Lakefield Research:

(1) to develop a process by which separate Copper, Lead and Zinc concentrates can be produced

(2) maximize Germanium and Gallium recoveries in either the copper concentrate or zinc concentrate.

A series of tests have been conducted to optimize:

(1) Different treatment processes, ie. bulk float, sequential flotating minerals

(2) reagent consumption and material balances

(3) grinding characteristics.

A total of 27 tests have been completed to date and it was determined that sequential flotation was possible, as a separation of copper lead float was not recommended, a copper concentrate, lead concentrate and a zinc concentrate was possible.

Approximate results were:

Copper Concentrate containing:
26 percent copper
2.2 percent lead
with a 75 percent recovery.

Lead Concentrate containing:

45-65 percent lead, expected to average 55% with a 50 percent recovery

Zinc Concentrate containing:

62-63 percent zine with a plus 80% recovery.

Approximately 70 percent the precious metals Gold and Silver report to the Copper and Lead concentrates.

S. Bulatovic, of Lakefield Research, is of the opinion that a germanium concentrate, which contains a large percentage of the remaining precious metals, can be produced from the remaining pyrite tails. Very preliminary testing indicates that the germanium can be floated and a separate germanium concentrate can be prepared. While the quantity of concentrate is relatively small, preliminary testing shows it to contain up to 5 Troy ounces per ton Gold and 10 Troy ounces per ton Silver. The present price of germanium is approximately $140 U.S. per pound. World scarcity and demand indicates an increase in its value which would add materially to the overall value of the Silver Queen ore.

The arsenic reports to the copper concentrate giving up to 8 percent. There are several methods for roasting the copper concentrates to rid them of the arsenic. The economics of inclusion of a small roasting circuit is doubtful when consideration of the tonnages and capital costs involved.

Lakefield suggests additional flotation tests to optimize the results of the flotation tests to date, which would include an additional 15 tests and 2 locked-cycle tests. The preliminary testing program will be completed by mid December. However, the sample being used by Lakefield does not contain any ore from the No. 3 Vein and hence cannot be considered as truly representative of the average grade of ore in the mine as a large percentage of the proven and probable ore is in

the No. 3 Vein. In order to get a more representative sample for testing, it will be necessary to ship from the mine 20 kilos of average ore from No. 3 Vein and 20 kilos of ore which will have an average grade similar to that of the ore reserves. If these samples can be shipped by air freight to Lakefield in the near future, the information obtained from this testing can be included in the overall results for the mid December report. The data obtained will approximate that which can be anticipated for the treatment of ores from the mine.

For the purposes of a pre-feasibility study, these results can be averaged and projected to give a reasonable degree of confidence for the ultimate results.

For the Phase II Detailed Feasibility Study, it is recommended that Lakefield Research conduct a pilot plant study, treating 200 tons of ore from the Silver Queen property. The estimated cost of the program is estimated at $340,000 plus cost of mining and rail freight.

N. C. Croome, P.Eng.