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#### DEPARTMENT OF ENERGY, MINES AND RESOURCES

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MINES BRANCH INVESTIGATION REPORT IR 73-52

# A STUDY OF CONCENTRATING TECHNIQUES ON A COMPLEX, FINE-GRAINED Cu-Pb-Zn-Ag ORE FROM NADINA EXPLORATIONS LIMITED, OWEN LAKE AREA, BRITISH COLUMBIA.

A. STEMEROWICZ AND R.W. BRUCE MINERAL PROCESSING DIVISION

by

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Mines Branch Investigation Report IR 73-52

A STUDY OF CONCENTRATING TECHNIQUES ON A COMPLEX, FINE-GRAINED Cu-Pb-Zn-Ag ORE FROM NADINA EXPLORATIONS LIMITED, OWEN LAKE AREA, BRITISH COLUMBIA.

Ъy

A. Stemerowicz\* and R. W. Bruce\*\*

#### SUMMARY OF RESULTS

The two samples investigated assayed as follows:

| Sample No. | <u>% Cu</u> | <u>% Pb</u> | <u>% Zn</u> | oz/ton Ag | oz/ton Au |
|------------|-------------|-------------|-------------|-----------|-----------|
| No. 1      | 1.17        | 2.18        | 8.74        | 13.98     | 0.17      |
| No. 2      | 0.72        | 1.90        | 9.75        | 8.37      | 0.10      |

Mineralization consisted mainly of pyrite and sphalerite with lesser amounts of galena, chalcopyrite, and silver-bearing tennantite. Other important economic minerals identified in the ore were argentiferous tetrahedrite and native gold. Most of the tennanite was intimately associated with pyrite and chalcopyrite. Other significant associations were silverbearing minerals with galena and galena with pyrite.

The best results obtained for copper and lead concentration were as follows:

#### Analyses

|   | <u>No. 1 Sa</u>       | mple                    |                       | <u>No. 2.</u>         | Sample_                 |
|---|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| <u>Cu %</u>                                   | <u>Pb %</u>           | Ag oz/ton               | <u>Cu %</u>           | РЪ %                  | Ag oz/ton               |
| Cu conc 23.25<br>Pb conc 1.05<br>Tailing 0.36 | 4.20<br>59.00<br>0.41 | 99.13<br>122.14<br>7.10 | 27.08<br>0.69<br>0.21 | 4.45<br>70.45<br>0.39 | 163.36<br>43.71<br>3.98 |

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#### Distribution %

| :  | 1                           | No. 1 Sa                    | ample                        |                             | No. 2 Sau                   | mple                        |
|--|-----------------------------|-----------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|
|  | <u>Cu</u>                   | <u>Pb</u>                   | Ag                           | Cu                          | Pb                          | Ag                          |
| Cu conc<br>Pb conc<br>Middlings<br>Tailing | 53.2<br>1.8<br>16.2<br>28.8 | 5.6<br>58.4<br>19.1<br>16.9 | 18.4<br>16.9<br>18.2<br>46.5 | 44.7<br>1.0<br>26.1<br>28.2 | 3.0<br>42.6<br>32.6<br>21.8 | 21.4<br>5.1<br>30.0<br>43.5 |

These results were achieved on the No. 1 Sample by selectively floating copper and lead concentrates directly from the ore and on the No. 2 Sample by separating the copper from a bulk copper-lead concentrate by means of the sulphur dioxide-starch method and floating the lead from the reground separation tailing.

The recovery of silver from the ore could be increased by as much as 14% by floating a pyrite concentrate, followed by roasting it and then cyaniding the calcines to recover the associated silver.

The flotation of zinc from the copper-lead rougher tailings gave a cleaner concentrate assaying 64 to 65% zinc with rougher recoveries of 82 to 87%.

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|------|---|---|----------|------|--------|---------|-----|-----|--------|--------|----|----|-----------|----|----|
|      |   |   | but with | iout | 1ime   | added   | to  | roa | sting  | charge | 2  |    | • • • • • |    | 66 |

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#### INTRODUCTION

#### Location of Property

The property is located at Owen Lake, 27 miles south of Houston, B. C. Shipment:

Two ore Samples were received as follows:

| Sample No. | Date received     | Weight, 1b. |
|------------|-------------------|-------------|
| 1          | December 29, 1969 | 140         |
| 2          | December 16, 1970 | 200         |

#### Nature of Investigation Requested

In a letter dated December 16, 1969, Mr. H. B. Johnston, Manager of Nadina Explorations Limited (N.P.L.) P.O. Box 489, Houston, B.C. requested a metallurgical investigation of the ore. In answer to a request for further information, it was stated that the potential of the orebody was greater than a million tons and that production at 500 tpd was being contemplated.

#### Sampling and Analysis

The ore samples were stage-crushed to minus 10 mesh and riffled into portions. One of these portions was chosen as the head sample, the remaining portions, after adjustment to 2000 grams, made up the charges to individual tests. In order to minimize oxidation of sulphide minerals, the crushed material was stored in a freezer.

| TABLE 1 |
|---------|
|---------|

| Constituent    | Sample No. 1 | Sample No. 2 |
|----------------|--------------|--------------|
| Copper 🧳       | 1.17         | 0.72         |
| Lead "         | 2.18         | 1.90         |
| Zinc "         | 8.74         | 9.75         |
| Gold oz/ton    | 0.17         | 0.103        |
| Silver " "     | 13.98        | 8.37         |
| Cadmium %      | 0.07         |              |
| Soluble iron " | 12.83        | 12.51        |
| Sulphur "      | 16.41        | 16.04        |
| Insolubles "   | 40.18        | 41.00        |
| Arsenic "      | 0.36         |              |
| Antimony "     | 0.17         |              |

Head Sample Analyses\*

\*From Internal Reports 70-139, 147, 745 and 71-79, 86.

#### TABLE 2

Semi-Quantitative Spectrochemical Analysis of Head Sample No. 1\*

| Elements  |   |
|---|---|
| Si, Fe, Zn<br>Pb, Ba<br>Mn, Al, Cu, Ni, Ca<br>Mg, Sr, Cr, In<br>Ti, Bi, Ag, Mo, Zr<br>V | Principal constituents<br>0.5 to 0.7<br>0.1 to 0.3<br>0.04 to 0.09<br>0.01 to 0.03<br><0.01 |
| Be, Sb, As, W, Sn, Nb<br>Ta, Ga, Ge, Na, Co, Cd   | Not detectable  |

\*From Internal Report SL 70-12

#### Mineralogical Examination

A comprehensive mineralogical examination\* was carried out on No. 1 Sample by the Mineral Sciences Division. This showed that the ore was composed essentially of small masses and disseminations of various sulphide minerals in a siliceous and carbonaceous matrix. The zinc content of the ore was largely accounted for by sphalerite, the lead by galena, and the copper by chalcopyrite, tennantite, and tetrahedrite. Most of the silver in the ore was present as a constituent of tennantite and tetrahedrite. Electron microprobe analyses gave a silver content of 1.5 to 4.0% in the tennantite and 8.0 to 17% in the tetrahedrite. Other silver minerals present in the sample were stephanite(?), pyrargyrite(?), matildite (AgBiS<sub>2</sub>) and berryite  $6(Pb_2(Cu, Ag)_3 Bi_5S_{11})$ . Gold occurred in trace amounts as the native metal. Other minerals identified in the ore were pyrite, marcasite, alkinite (Pb Bi Cu S<sub>3</sub>), hematite, magnetite, ilmenite, goethite, rutile, anatase, quartz, manganiferous siderite, dolomite, apatite, mica, and barite.

The sphalerite, which contains an average of 0.3% cadmium and less than 1% iron, is essentially coarse-grained and should largely be liberated by normal grinding methods. It is expected that traces of silver (as tennantite) and lead as galena will be retained by the sphalerite as very small inclusions.

Most of the galena is quite coarse-grained. However, difficulty can be expected in liberating the very small grains of galena that occur in the pyrite, and to a lesser extent, in the sphalerite and tennantite.

\*Mines Branch Investigation Report IR 70-47 by D. Owens

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The silver in the ore will be distributed chiefly between the lead and copper concentrates, in the former as inclusions of pyrargyrite, stephanite, and tetrahedrite in the galena and in the latter as a constituent of the tennantite and tetrahedrite.

Liberation of the copper minerals from other minerals in the ore should generally be effective. However, some copper will occur in the lead concentrate as inclusions of tetrahedrite in galena. Most of these are very small and will be difficult to free. In addition, it is expected that some of the tennantite in association with pyrite and, to a lesser degree with sphalerite will be difficult to liberate because many of these inclusions are very small.

#### OUTLINE OF INVESTIGATION

The aim of the investigation was to produce copper, lead, and zinc concentrates from the ore by flotation, with the optimum amount of gold and silver to be recovered in the copper and lead concentrates. Two techniques were developed for producing copper and lead concentrates, viz; flotation of a bulk copper-lead concentrate followed by copper-lead separation of the bulk concentrate and selective flotation of copper and lead concentrates directly from the ore. After flotation of the copper and lead minerals, a zinc concentrate was floated from the tailing using standard procedure. Copper-Lead Separation of Bulk Concentrate

The copper, lead, and silver minerals were floated together into a bulk concentrate. The bulk rougher concentrate was upgraded by cleaning and then subjected to copper-lead separation either by (1) depressing the copper minerals with cyanide and floating off the galena or (2) depressing the galena with either dichromate or sulphur dioxide and starch and floating off the copper minerals.

Before attempting copper-lead separation of the bulk concentrate, reagents and conditions for bulk flotation were investigated as follows:

- (1) Alkalinity regulator and depressants:
  - (a) Soda ash + sodium sulphite + cyanide, pH 7.6 to 8.4
  - (b) Lime + zinc sulphate + cyanide, pH 10.5 to 10.9
  - (c) Lime + sodium sulphite + cyanide, pH 10.0 to 10.2
- (2) Grind:
  - (a) 80.6% minus 200 mesh (b) 92.3% " " "
- (3) <u>Collectors</u>:
  - (a) amyl xanthate
  - (b) Aerofloat 208 + Z-200
  - (c) Aerofloat 208 + Aerofloat 242
- (4) Conditioning:
  - (a) with aeration in an aerator
  - (b) without aeration in a laboratory flotation cell.

After determining which set of reagents and conditions gave optimum results for bulk flotation, 8 copper-lead separation tests were carried out; 3 on bulk concentrate produced from No. 1 Sample and 5 on bulk concentrate produced from No. 2 Sample.

In addition to the standard separation methods, other schemes were developed in which selective flotation techniques were employed in conjunction with regrinding. The purpose of regrinding was to improve separation efficiency by liberating the copper, lead, and silver minerals that were intimately associated with pyrite.

In the initial test (20), the bulk rougher concentrate was reground before cleaning. Soda ash, sodium sulphite, and cyanide were added to the regrind mill; the former for alkalinity control and the latter two reagents to depress sphalerite and pyrite. The depressants added to the regrind mill had such a severe depressing action on the copper minerals that most of the copper-lead separation occurred during cleaning instead of in the subsequent separation step as was intended. The enhanced effect of the depressants in regrinding was used to advantage in Test 21 in which a lead concentrate was floated from the reground bulk rougher concentrate followed by the addition of copper sulphate and copper flotation. This scheme had the disadvantage that the sphalerite was reactivated with copper sulphate along with the copper Then a new approach was adopted. It consisted of regrinding the minerals. bulk rougher concentrate with sulphur dioxide and starch followed by the selective flotation of copper, lead, and zinc concentrates from the reground material (Test 24). It was hoped that the zinc concentrate produced would be high enough in grade to be included with the primary zinc concentrate floated from the ore and that the tailing would be low enough in metal values so that it could be rejected to waste. When this method gave disappointing results further modifications were made. These were to subject the bulk rougher concentrate to copper-lead separation using the sulphur dioxide-starch method followed by lead flotation from the regound separation tailing. Soda ash, sodium sulphite and cyanide were added to the regrinding step.

A flowsheet for bulk flotation with copper-lead separation of the bulk concentrate is given in Figure 1, while Figures 2 to 5 give flowsheets and other pertinent data for the more complex separation techniques described above.

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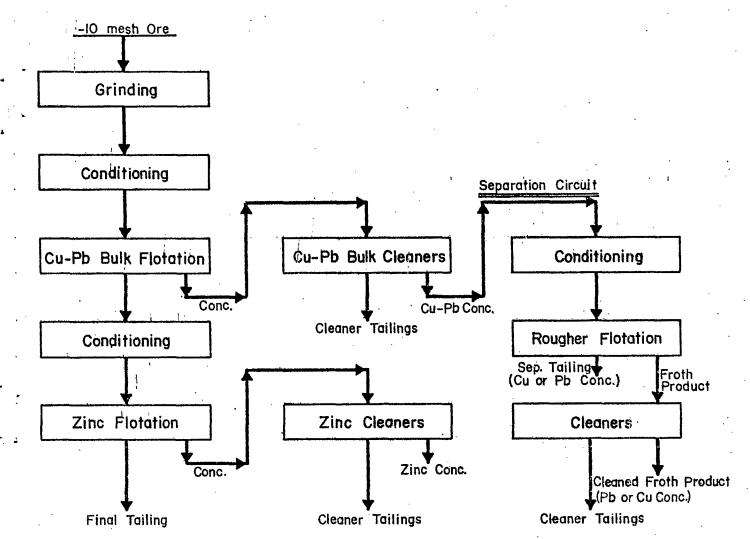
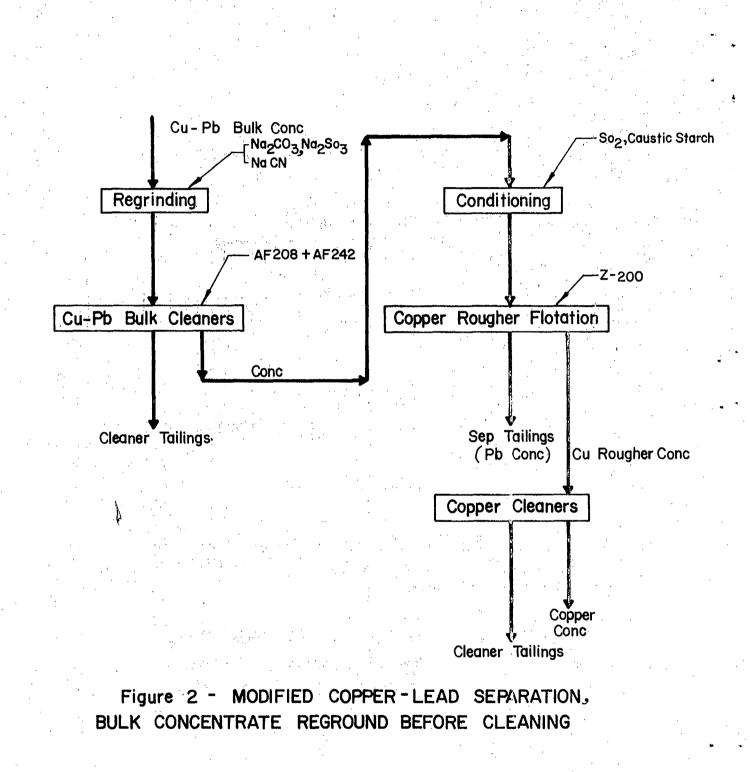
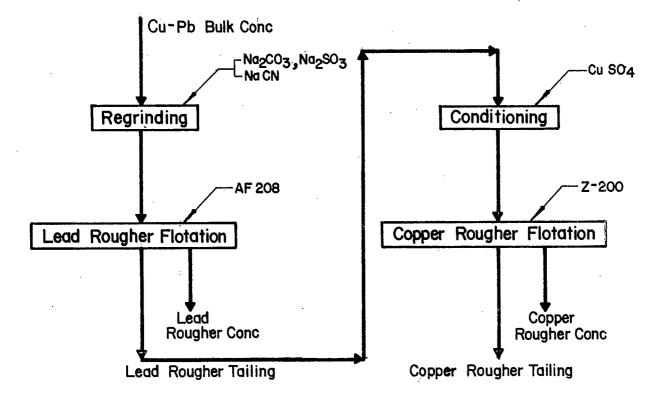


FIGURE I FLOWSHEET No.I - BULK FLOTATION FOLLOWED BY COPPER LEAD SEPARATION OF BULK CONCENTRATE



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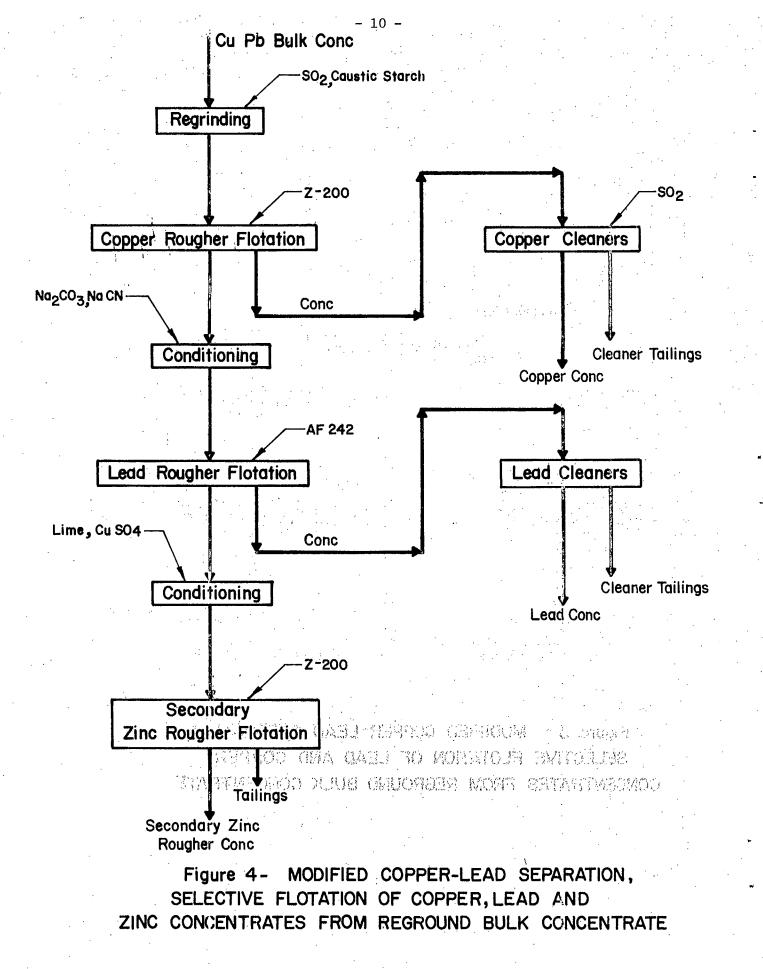


## Figure 3 - MODIFIED COPPER-LEAD SEPARATION, SELECTIVE FLOTATION OF LEAD AND COPPER CONCENTRATES FROM REGROUND BULK CONCENTRATE

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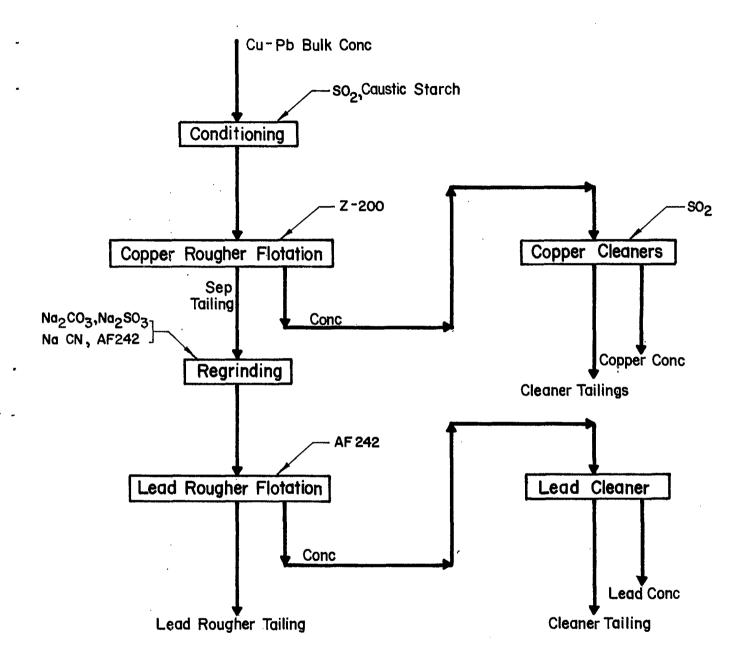


Figure 5- MODIFIED COPPER-LEAD SEPARATION, SO<sub>2</sub>-STARCH SEPARATION ON Cu-Pb BULK ROUGHER CONC FOLLOWED BY LEAD FLOTATION FROM REGROUND SEPARATION TAILING

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#### Selective Flotation Directly from the Ore

A copper concentrate was selectively floated from the ore by employing sulphur dioxide as a galena depressant. The galena was then reactivated by adding lime and cyanide, and a lead concentrate was floated off. It was anticipated that the liberated, argentiferous tetrahedrite and tennantite would be unaffected by sulphur dioxide and would therefore float with chalcopyrite while the balance of the silver minerals intimately associated with galena would be recovered in the lead concentrate.

Five selective flotation tests were done, all on the No. 1 Sample. In the first two tests potassium amyl tanthate was employed as collector for both lead and copper. In the remaining tests it was replaced by the more selective copper and lead collectors, Z-200 and Aerofloat 242. Other variables investigated were aeration of the pulp before copper flotation and very fine grinding (Test 16). Figure 6 gives the flowsheet for selective flotation. Dolmage Campbell Flowsheet

In addition to the schemes described above, a third flowsheet was tried on No. 2 Sample at the request of Mr. J. D. Gunn of Dolmage Campbell and Associates Ltd., who had been retained as consulting engineers by Nadina Explorations and were carrying out a concurrent metallurgical investigation. This flowsheet, which was developed by Mr. Gunn, employed a combination of selective flotation and copper-lead separation techniques as follows:

- (1) The ore was ground with sodium sulphite and zinc sulphate added as sphalerite and pyrite depressants.
- (2) A low-lead bulk concentrate was floated off (pH < 7) with Aerofloat 208 as collector.
- (3) The pulp was conditioned with lime and cyanide (pH c.8) and a scavenger concentrate was floated off using ethyl xanthate as collector.

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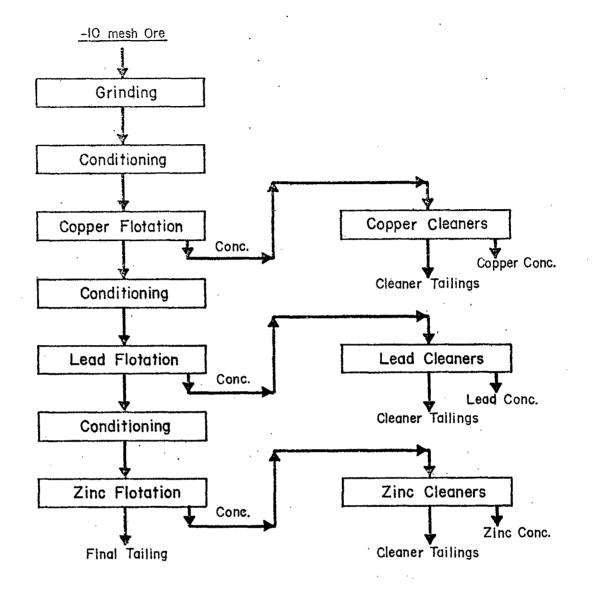


Figure 6 FLOWSHEET No. 2 - SELECTIVE FLOTATION OF COPPER AND LEAD CONCENTRATES DIRECTLY FROM THE ORE

- (4) The scavenger concentrate was reground and subjected to a series of selective flotation techniques to produce a secondary copper-lead concentrate and a secondary lead concentrate.
- (5) The secondary copper-lead concentrate was combined with the cleaned bulk concentrate from (1) and the resultant product was subjected to copper-lead separation using the sulphur dioxide-starch method.

The flowsheet was designated by Mr. Gunn, as the "Nadina Flowsheet, October 1970" but will be referred to in this report as the Dolmage Campbell flowsheet. The flowsheet, which is shown in Figure 7, without zinc flotation which was omitted, was tried in two tests on the No. 2 Sample (22 and 23). In Test 22, the object was to ascertain the make-up of the intermediate products, therefore copper-lead separation and lead flotation from the secondary copper-lead rougher and cleaner tailings was not done. In Test 23, the flowsheet was tried in its entirety.

#### Modified Dolmage Campbell Flowsheet

A study of the reagent scheme employed in the Dolmage Campbell flowsheet along with the results obtained indicated that it could be modified to serve as a method for selectively floating copper and lead concentrates directly from the ore. What was designated as the copper-lead rougher concentrate and the copper-lead scavenger concentrate would then become the copper and lead rougher concentrates respectively. A modified version, as shown in Figure 8 was tried on No. 2 Sample in Test 25. Modifications were as follows:

- Z-200, a more selective copper promoter, was substituted for Aerofloat 208 in the copper rougher float.
- (2) Sulphur dioxide was added to the copper cleaners for lead depression.
- (3) After regrinding the lead rougher concentrate was upgraded by simple cleaning.

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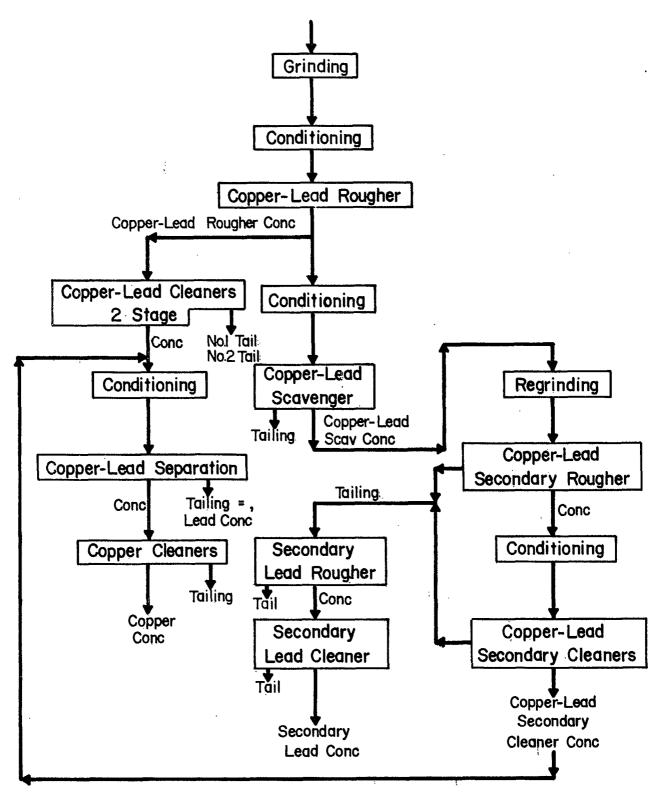


Figure 7- DOLMAGE CAMPBELL FLOWSHEET

#### Zinc Flotation

In most tests (16 out of 26), a zinc concentrate was floated from either the copper-lead rougher tailing or, in the case of selective flotation, from the lead rougher tailing. The sphalerite floated readily to give excellent concentrate grades accompanied by high recoveries. Sodium aerofloat was employed as the main zinc collector augmented by smaller additions of either amyl xanthate or Z-200. A high pH (11-12) was maintained in the roughers and cleaners to ensure maximum selectivity between sphalerite and pyrite.

#### Silver Recovery from Pyrite Concentrate

The main problem encountered in concentrating the ore was the high loss of silver in the tailing. Mineralogical examination showed that this was due mainly to the interlocking of silver minerals with pyrite. As a first step in recovering this silver, a pyrite concentrate was floated from the zinc rougher tailing.

Two silver recovery methods were tried on the pyrite concentrate as follows:

#### (1) <u>Flotation of Silver from the Pyrite Concentrate</u>

The pyrite concentrate was reground to liberate the interlocked silver minerals and a silver concentrate was selectively floated away from the pyrite. This was accomplished by employing lime and cyanide as pyrite depressants and Aerofloat 208 and 242 as collectors for the silver minerals.

#### (2) Cyanidation

Silver recovery by cyanidation was tried in nine tests on pyrite concentrate floated from both the No. 1 and No. 2 Samples. In most tests, the pyrite concentrate was roasted prior to cyanidation but cyanidation of the finely reground, raw concentrate was also tried. Roasting temperature and length of roast were varied; also the effect of adding lime to the charge was investigated.

#### Test Data

Screen analyses of grinds employed, detailed test procedure, and metallurgical balances for all flotation and cyanide tests are given in Appendix A.

#### EVALUATION AND DISCUSSION OF RESULTS

#### Best Copper and Lead Results

Tables 3 and 4 compare the best results obtained for copper and lead concentration by various flotation techniques.

TABLE 3

#### Best Copper and Lead Flotation Results Obtained on No. 1 Sample

| <b>_</b>                 |                             |              |       |       | •     |                 |             |         |         | · ·            |
|--------------------------|-----------------------------|--------------|-------|-------|-------|-----------------|-------------|---------|---------|----------------|
| Test No.                 | Product                     | Wt           |       | Anal  | ysis* |                 | D:          | istribu | ition 2 | 7.             |
| and Method               |                             | % -          | Cu    | РЪ    | Zn    | Ag              | Cu          | . РЪ    | Zn      | Ag             |
| 16                       | Copper conc                 | 2.45         |       |       |       |                 |             |         | 1       | 18.4           |
| Selective<br>flotation   | Copper cl tail<br>Lead conc | 2.54<br>1.82 | \$    |       |       | 51.72<br>122.14 | 11.7<br>1.8 |         |         | $10.0 \\ 16.9$ |
| 140 000000               | Lead cl tail                | 7.29         | 0.66  |       | 8.68  | 14,76           |             | 9.5     | 6.6     | 8.2            |
|                          | Lead ro tail                | 85.90        | 0.36  | 0.41  | 9.90  | 7,10            | 28.8        | 19.1    | . 89.0  | .46.5          |
|                          | Feed (calcd)                | 100.00       | 1.Q6  | 1.84  | 9.56  | 13.14           | 100.0       | 100.0   | 100.0   | 100.0          |
| 18                       | Copper conc                 | 2.67         | 23.68 | 12.98 | 3.43  | 130.70          | 56.5        | 17.8    | 1.0     | 26.5           |
| Copper-lead              | Copper cl tail**            | 1.08         | 7.12  | 19.31 | 3.98  | 108.15          | 6.9         | 10.8    | 0.5     | 8.9            |
| Separation               | Lead conc                   | 2.45         | 2.66  | 34.08 | 5.49  | 87.88           | 5.8         | 43.0    | 1.5     | 16.3           |
| (SO <sub>2</sub> -starch | Cu-Pb cl tail**             | 5.43         | 2.13  | 6.21  | 11.50 | 33.67           | 10.4        | 17.4    | 7.0     | 13.9           |
| method)                  | Cu-Pb ro tail               | 88.37        | 0.26  | 0.24  | 9.07  | 5.14            | 20.4        | 11.0    | 90.0    | 34.4           |
|                          | Feed (calcd)                | 100.00       | 1.12  | 1.94  | 8.90  | 13.18           | 100.0       | 100.0   | 100.0   | 100.0          |

\* Analysis in this and all subsequent tables is given in per cent except silver which is in oz per ton.

\*\* Combined

As can be seen from Table 3 the best copper and lead concentrate grades obtained on No. 1 Sample were produced by selective flotation directly from the ore. However, copper, lead, and silver losses in the rougher tailing were higher than the losses in the tailing from bulk flotation. None of the copper-lead separation methods tried on the bulk concentrate were effective in producing a copper concentrate low enough in lead to be acceptable to a copper smelter.

#### TABLE 4

#### Best Copper and Lead Flotation Results Obtained on No. 2 Sample

|   |   | <u>.</u>  |   | • •   |  | •                       |   |                             |  | · · · · · · · · · · · · · · · · · · ·               |
|---|---|---|---|---|--|-------------------------|---|-----------------------------|--|---|
| Test No.  | Product   | Wt<br>% +   |   | Anal  | lysis                                  |                         | Ĩ   | )istrib                     | ution  | %   |
| and Method  |   | 6 7   | Cu  | РЪ  | Z'n                                    | Ag .                    | Cu  | Pb                          | Zn   | Ag  |
| 0.  | Copper conc<br>Copper cl tail<br>Lead conc<br>Sec lead tail<br>Cu-Pb cl tail<br>Cu-Pb ro tail<br>Feed (calcd) | 2.45<br>0.52<br>2.74<br>2.44<br>3.57<br>88.28<br>100.00 | 12.50<br>4.84<br>2.85<br>0.68<br>2.13<br>0.14 | 1 1   | 4.17<br>4.68<br>12.24<br>10.09<br>9.20 | 32.37<br>3.86           | 48.9<br>4.0<br>12.4<br>2.7<br>12.2<br>19.8<br>100.0 |                             | 0.8<br>0.2<br>1.4<br>3.4<br>4.0<br>90.2<br>100.0 | 21.1<br>4.2<br>18.5<br>4.2<br>13.2<br>38.8<br>100.0 |
| 25<br>Modified<br>Dolmage-<br>Campbell<br>Flowsheet<br>(Figure 8) | Copper conc<br>Copper cl tail<br>Lead conc<br>Lead cl tail<br>Lead ro tail<br>Feed (calcd)                    | 1.02<br>4.85<br>0.70<br>2.58<br>90.85<br>100.00         | 1.25<br>1.90<br>0.23                          | 2.74<br>3.68<br>67.70<br>24.79<br>0.43<br>1.71  | 5.70<br>2.50<br>9.10                   | 40.74<br>94.92<br>48.28 | 1.3<br>7.2<br>31.0                                  | 27.7<br>37.4                | 3.2<br>0.2<br>2.7<br>93.5                        | 7.5<br>14.0<br>48.1                                 |
| Copper-lead<br>Separation   | Copper conc<br>Copper cl tail<br>Lead<br>Lead cl tail<br>Sec lead ro tail<br>Cu-Pb ro tail                    | 1.11<br>1.42<br>0.99<br>0.48<br>3.23<br>92.77           | 7.51<br>0.69<br>2.21                          | 4.45<br>14.85<br>70.45<br>25.43<br>6.22<br>0.39 | 5.14<br>3.00<br>10.00<br>10.41         | 43.33<br>24.33          | 15.9<br>1.0<br>1.6<br>8.6                           | 12.8<br>42.6<br>7.5<br>12.3 | 0.7<br>0.3<br>0.5<br>3.6                         | 18.3<br>5.1<br>2.5<br>9.2                           |
|   | Feed (calcd)  | 100.00  | 0.67  | 1.64  | 9.30                                   | 8.47                    | 100.0   | 100.0                       | 100.0  | 100.0   |

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Of the schemes tried on No. 2 Sample the modified copper-lead separation method employed in Test 26 gave the best set of copper and lead results. This method which is outlined in Figure 5 consisted of using the  $SO_2$  - starch separation method on the copper-lead rougher concentrate to produce a copper concentrate followed by the flotation of a lead concentrate from the reground separation tailing. The Dolmage-Campbell flowsheet (Test 23) gave low-grade concentrates attributable to a high pyrite content, whereas the modified form of this flowsheet (Test 25) gave improved cleaner concentrate grades but with excessive amounts of copper and lead rejected to the cleaner tailings.

#### Best Zinc Results

Table 5 gives a summary of the best zinc results obtained on the two ore samples. The feed given in this table is the feed to zinc flotation, i.e., either the copper-lead rougher tailing or the lead rougher tailing.

#### TABLE 5

| 1Comple       | Thest | Declarat     | Wt     | Andlin | 10 7     | Diata 9 | l Orrora 11   | Flotation Method                      |
|---------------|-------|--------------|--------|--------|----------|---------|---------------|---------------------------------------|
| Sample<br>No. | No.   | Product      | WL     | Analys | 318 %    |         | Overall<br>7n |                                       |
| NO.           | NO.   |              | %      | Zn     | Fe       | Zn      | Zn<br>Distn % | for Copper and<br>Lead                |
|               |       |              | /0     |        | <u> </u> |         | DISCII %      | Leau                                  |
|               |       | Zinc ro conc | 13.50  | 57.63  | 2.82     | 94.4    | 81.9          |                                       |
| 1             | 6     | Zinc ro tail | 86,50  | 0.54   |          | 5.6     | 4,9           | Bulk Flotation                        |
|               |       | Feed (calcd) | 100.00 | 8.74   |          | 100.0   | 86.8          | · ·                                   |
|               |       | Zinc cl conc | 9.43   | 64.24  | 1.22     | 73.5    | 63.8          |                                       |
|               |       | Zinc ro conc | 15.23  | 49.19  | 4.64     | 94.9    | 79.6          | · · · · · · · · · · · · · · · · · · · |
| 1             | 12    | Zinc ro tail | 84.77  | 0.48   |          | 5.1     | 4.3           | Selective Flotation                   |
|               |       | Feed (calcd) | 100.00 | 7.90   |          | 100.0   | 83.9          |                                       |
|               |       | Zinc ro conc | 16.83  | 52.76  | 3.83     | 96.1    | 87.4          |                                       |
| 2             | 21    | Zinc ro tail | 83.17  | 0.43   |          | .3.9    | 3.5           | Bulk Flotation                        |
|               |       | Feed (calcd) | 100.00 | 9.23   |          | 100.0   | 90.9          |                                       |
|               |       | Zinc cl.conc | 12.92  | 65.44  | 1.39     | 91.5    | 83.2          |                                       |
|               |       | Zinc ro conc | 14.69  | 50.00  | 4.19     | 81.3    | 76.0          | Modified                              |
| 2             | 25    | Zinc ro tail | 85.31  | 1.99   |          | 18.7    | 17.5          | Dolmage-Campbell                      |
|               |       | Feed (calcd) | 100.00 | 9.04   |          | 100.0   | 93.5          | Flowsheet                             |

#### Summary of Best Zinc Results Obtained on No. 1 and No. 2 Samples

Excellent zinc concentrate grades and recoveries were obtained for both samples when copper-lead bulk flotation was employed in the preceding step (Tests 6 and 21). When copper-lead selective flotation was employed (Tests 12 and 25), subsequent zinc flotation resulted in a significantly lower, but still satisfactory grade of rougher concentrate. Also, in Test 25 the zinc loss in the tailing was inexplicably higher.

#### Nature of Metal Losses in Zinc Rougher Tailing

In order to determine the nature of the metal losses in the zinc rougher tailing a sample from Test 12 was separated into sized fractions by screening through 200 and 270 mesh screens and then running the minus 270 mesh material through a Warman Cyclosizer. Each size fraction was assayed and submitted for mineralogical examination to determine the mode of occurrence of the metallic minerals and their textural relationships. Assays and metal distribution in the various size fractions of the tailing are given in Table 6.

#### TABLE 6

#### Assays and Metal Distribution in Various Size Fractions of Zinc Rougher Tailing from Test 12

| Size Fr            | action                             | Wt                                  |                                      | As                                   | ssays                                | · .  |                                      | · .               | . Die                     | tribut   | ution %                             |                             |  |  |
|--------------------|------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--|--------------------------------------|-------------------|---------------------------|--|-------------------------------------|-----------------------------|--|--|
|                    |                                    | % -                                 | Cu .                                 | Pb                                   | Zn                                   | Au   | Ag                                   | Cu .              | РЪ                        | Zn   | Au                                  | Ag .                        |  |  |
| + 270              | nesh<br>"<br>"<br>"<br>"<br>"<br>" | 8.7<br>14.3<br>13.3<br>11.4<br>16.0 | 0.11<br>0.15<br>0.08<br>0.06<br>0.05 | 0.16<br>0.17<br>0.09<br>0.08<br>0.10 | 0.21<br>0.20<br>0.13<br>0.10<br>0.09 | 0.13<br>0.113<br>0.156<br>0.096<br>0.072<br>0.062<br>0.074 | 4.96<br>6.72<br>3.74<br>3.00<br>2.40 | 9.4<br>6.0<br>7.1 | 8.4<br>14.7<br>7.3<br>5.5 | 15.5<br>9,5<br>14.8<br>9.0<br>5.9<br>7.5<br>37.8 | 10.3<br>23.3<br>13.3<br>8.6<br>10.4 | 10.4<br>23.2<br>12.0<br>8.3 |  |  |
| Total (<br>Total ( | (calcd)<br>(assay)                 | 100.0                               |                                      |                                      | 0.19                                 |  | 4.14                                 | 100.0             | 100.0                     | 100.0  | 100.0                               | 100.0                       |  |  |

\*Quartz particle size in cyclosizer fractions

As can be seen, the coarse fractions generally had a higher metal content than did the finer fractions. This was especially true for gold and silver. Mineralogical examination (see report in Appendix A) showed that in every case the metal losses were due mainly to interlocking of the various minerals with pyrite. Silver was present entirely as a constituent of tetrahedrite and tennantite. These two minerals also accounted for most of the copper loss.

#### Results of Silver Flotation from Pyrite Concentrate

Results of pyrite flotation from the zinc rougher tailing are given in Table 7 followed by Table 8 which gives the results of silver flotation from the reground pyrite concentrate.

#### TABLE 7

|                                      | Wt             | An   | alysis % |               | Distribution % |       |               |  |
|--------------------------------------|----------------|------|----------|---------------|----------------|-------|---------------|--|
| Product                              | 7              | Ag   | Au       | <b>S</b> .    | Ag             | Au .  | S             |  |
| Pyrite rougher conc<br>Final tailing | 25.15<br>74.85 | 9.96 | 0.28     | 39.10<br>1.82 |                |       | 87.8<br>.12.2 |  |
| Feed (calcd)                         | 100.00         | 3.28 | 0.085    | 11.20         | 100.0          | 100.0 | 100.0         |  |

#### Results of Pyrite Flotation from Zinc Rougher Tailing (Test 13)

#### TABLE 8

| Results of Silver | Flotation | from H | Pyrite | Rougher | Concentrate | (Test 13) |  |
|-------------------|-----------|--------|--------|---------|-------------|-----------|--|
|                   |           |        |        |         |             |           |  |

| Product             | Wt<br>% | Analys | is % | Distribution % |       |  |
|---------------------|---------|--------|------|----------------|-------|--|
|                     | 70      | Ag     | Au   | Ag             | Au    |  |
| Silver cleaner conc | 3.71    | 29.01  | 0.80 | 10.8           | 10.7  |  |
| Silver cleaner tail | 8.98    | 13.44  | 0.32 | 12.1           | 10.4  |  |
| Silver rougher tail | . 87.31 | 8.79   | 0.25 | 77.1           |       |  |
| Feed (calcd)        | 100.00  | 9.96   | 0.28 | 100.0          | 100.0 |  |

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Most of the precious metals present in the zinc rougher tailing were recovered in the pyrite concentrate. However, only about 23% of the contained silver and 21% of the gold were subsequently recovered in the silver concentrate floated from the reground pyrite concentrate. During cleaning, about half of the recovered precious metals were rejected to the cleaner tailing.

#### Results of Cyanidation of Pyrite Concentrate

Table 9 compares the results of cyaniding a sample of pyrite concentrate in the raw state and after roasting.

#### TABLE 9

#### Results of Cyanidation of Pyrite Concentrate

| Test<br>No. | Cyanidation<br>Feed                                    | Product   | Wt                  | As <b>s</b> ay | s,oz/ton             | Distribution %  |                    |  |
|-------------|--|---|---------------------|----------------|----------------------|-----------------|--------------------|--|
| NO.         | reed   | · · · · · · · · · · · · · · · · · · ·                     |                     | Au             | Ag                   | Au              | Ag                 |  |
| 'n          | Raw pyrite conc<br>reground to                         | Pregnant soln<br>Residue                                  | _<br>100.0          | 0.07           | 4.06<br>6.84         | 25.0<br>75.0    | 37.3<br>62.7       |  |
|             | 91% -500 mesh  | Feed (assay)  | 100.0               | 0.28           | 10.90                | 100.0           | 100.0              |  |
| 4           | Calcines from<br>3-hour low-temp<br>(475°C) roast with | Loss in roasting<br>Loss in calcine wash<br>Pregnant soln | 14.36<br>18.81<br>- |                | 0.80<br>0.04<br>7.45 | 3.5<br><br>71.1 | 7.4<br>0.4<br>68.6 |  |
| -           | lime   | Resideu   | 66.83               | 0.11           | 3.83                 | 25.4            | 23.6               |  |
|             |  | Feed (assay)  | 100.00              | 0.28           | 10.86                | 100.0           | 100.0              |  |

#### Notes:

- (1) Assays for pregnant solution and roasting loss expressed as oz/ton feed and obtained by difference.
- (2) Loss in calcine wash determined as mg/liter and converted to oz/ton feed.

As can be seen from the comparison of results in Table 9, there was a very sharp increase in precious metal extraction by cyanidation when the pyrite concentrate was subjected to a low-temperature roast with lime added to the charge. Cyanidation of the raw pyrite concentrate was not too

effective even though the concentrate was very finely reground.

#### Bulk Flotation

A comparison of results for bulk rougher flotation obtained by employing various reagent combinations is given in Table 10, whereas Table 11 gives reagents and conditions for these tests.

#### Effect of Aeration

The employment of a soda ash - aeration scheme along with xanthate as collector (Test 2) resulted in the flotation of excessive amounts of pyrite. Zinc depression using this scheme, however, was very good. In a comparison test without aeration (Test 9), a similar concentrate grade was obtained and was accompanied by similar copper and silver recoveries but lead recovery was significantly lower. The essential difference between the two tests was the high flotation rate of the copper, lead, and silver minerals obtained when aeration was employed. Note that it required a skimming time of 6 minutes in Test 9 to achieve the same level of copper and silver recoveries obtained after only  $1\frac{1}{2}$  minutes of skimming in Test 2.

#### Lime vs Soda Ash

The use of lime as an alkalinity regulator (pH 10 +) in place of soda ash (Tests 4, 5, 6, and 8) resulted in much improved pyrite depression but zinc depression was much poorer - the amount reporting in the bulk rougher concentrate increased by about 3 times. In Test 8, about half of the zinc was recovered in the bulk rougher concentrate despite the increase in cyanide addition to 0.15 lb/ton. In this test, the original intent was to use Aerofloat 242 and Z-200 as collectors. When these appeared to be ineffective, some amyl xanthate was added. A light, foamy froth was obtained which carried excessive amounts of fine sphalerite.

Unexpected were the high lead recoveries obtained in Tests 5, 6, and 8. Generally, lime has a detrimental effect on the flotation of galena.

| FABLE 1 | 0 |  |
|---------|---|--|
|---------|---|--|

#### Comparison of Results for Bulk Rougher Flotation

| Test | Product             | Wt             |               | · · · · ·     | Assays       | 3     | · · ·          | D:           | istrib       | ution        | %.           |
|------|---------------------|----------------|---------------|---------------|--------------|-------|----------------|--------------|--------------|--------------|--------------|
| No.  | :                   | %              | Cu            | РЬ            | Zn           | Fe    | Ag             | , Cu         | РЪ           | Zn           | Ag           |
| 2    | Ro conc<br>Ro tail  | 9.89<br>90.11  | 8.74<br>0.26  | 12.08<br>0.86 |              | 29.25 | 64.74<br>7.25  | 78.7<br>21.3 | 60.6<br>39.4 | 3.9<br>96.1  | 49.5<br>50.5 |
| 4    | Ro conc<br>Ro tail  | 8.16<br>91.84  | 4.76<br>0.83  |               |              | 12.39 | 69.28<br>8.25  |              | 72.8<br>27.2 | 12.1<br>87.9 | 42.7<br>57.3 |
| 5    | Ro conc<br>Ro tail  | 7.17<br>92.83  | 10.49<br>0.39 | 23.94<br>0.31 |              |       | 104.22<br>5.57 | 67.5<br>32.5 | 85.7<br>14.3 | 12.8<br>87.2 | 59.1<br>40.9 |
| 6    | Ro conc<br>Ro tail  | 7.98<br>92.02  | 9.90<br>0.36  |               |              | 13.41 | 97.84<br>5.50  |              | 89.6<br>10.4 | 13.2<br>86.8 | 60.7<br>39.3 |
| 8    | Ro conc<br>Ro tail  | 15.75<br>84.25 | 5.32<br>0.31  | 10.08<br>0.33 |              |       | 54.51<br>5.23  |              | 85.0<br>15.0 | 49.4<br>50.6 | 66.1<br>33.9 |
| 9    | Ro conc*<br>Ro tail | 9.64<br>90.36  | 8.87<br>0.21  | 10.77<br>1.07 |              | 26.93 | 71.75<br>6.67  | 82.1<br>17.9 | 51.7<br>48.3 | 5.3<br>94.7  | 53.5<br>46.5 |
| 13   | Ro conc<br>Ro tail  | 13.92<br>86.08 |               | 13.08<br>0.26 |              | 24.76 | 64.60<br>4.50  |              | 89.0<br>11.0 | 10.7<br>89.3 | 69.9<br>30.1 |
| 19   | Ro conc<br>Ro tail  | 11.52<br>88.48 | 7.58<br>0.26  | 14.29<br>0.30 |              | 18.15 | 74.27<br>5.10  |              | 86.1<br>13.9 | 11.2<br>88.8 | 65.5<br>34.5 |
| 20   | Ro conc<br>Ro tail  | 8.04<br>91.96  | 6.55<br>0.14  | 18.24<br>0.31 | 9.18<br>9.18 | 14.19 | 65.25<br>3.98  |              | 83.7<br>16.3 | 8.2<br>91.8  | 59.0<br>41.0 |

\*Rougher conc after 6 minutes skimming (see Appendix A page16)

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| Reagents | and | Conditions | tor | Butk | Rougher | Flotation |  |
|----------|-----|------------|-----|------|---------|-----------|--|
|          |     |            |     |      |         |           |  |

| Test<br>No. |      | Reagents to grind<br>1b/ton |                                 |      |                    |      |      | Conditioning<br>Aeration pH |      | Collectors               | Skimming<br>time min. |
|-------------|------|-----------------------------|---------------------------------|------|--------------------|------|------|-----------------------------|------|--------------------------|-----------------------|
| 2           | 80.6 | 3.0                         | $Na_2CO_3$                      | 1.0  | $Na_2SO_3$         | 0.10 | NaCN |                             | 8.1  | CX51                     | 112                   |
| 4           | 11   | 3.5                         | lime                            | 0.5  | Zn SO <sub>4</sub> | 11   | • 11 | No                          | 10.9 | AF 242+Z-200             | 3                     |
| 5           | 11   | 11                          | 11                              | 11   | tī                 | Ŧt   | Tt   | No                          | 10.5 | CX51                     | 4                     |
| 6           | TT   | 3.0                         | lime                            | 1.0  | Na2SO3             | 11   | 11   | No                          | 10.2 | tt TT                    | 4                     |
| 8           | 92.3 | 77                          | 11                              | 11   | 11                 | 0.15 | NaCN | No                          | 10.0 | CX51+AF 242<br>+ Z-200   | 2 <u>1</u> 2          |
| 9           | 11   | 3.0                         | Na <sub>2</sub> CO <sub>3</sub> | 1.0  | $Na_2SO_3$         | 0.10 | NaCN | No                          | 8.2  | CX51                     | 10*                   |
| 13          | 11   | 11                          | tt -                            | 11   | 11                 | TT   | ŦŦ   | No                          | 7.8  | AF242 <del>+</del> AF208 | 4                     |
| 19          | TŤ   | 3.5                         | Na <sub>2</sub> CO <sub>3</sub> | tT . | 11                 | 11   | 11   | No                          | 8.3  | 11 11                    | 4                     |
| 20          | 87.6 | 3.0                         | Na <sub>2</sub> CO <sub>3</sub> | 11   | 11                 | 11   | 11   | No                          | 7.6  | 11 If                    | 3                     |

\*Floated in 5 increments.

#### Most Effective Reagent Combination

The combination of soda ash, sodium sulphite and cyanide with nonaerative conditioning and Aerofloat 242 and 208 as collectors proved to be effective and was adopted as the standard method for bulk flotation. Generally, it gave good copper, lead, and silver recoveries accompanied by reasonably good pyrite and zinc depression.

#### Effect of Grind

Generally, higher copper and silver recoveries were obtained at the finer grind (92.3% minus 200 mesh) but there was no appreciable change in lead recovery. However the higher recoveries obtained may have been caused by other changes in reagents and conditions. None of the tests were specifically designed to test the effect of varying the fineness of grind. Copper-Lead Separation

#### Standard Methods

Table 12 gives a comparison of the results obtained for copper-lead separation using the three standard methods on cleaned bulk concentrate produced from No. 1 Sample. Included in the comparison are the results of a sulphur dioxide-starch separation test on bulk rougher concentrate from No. 2 Sample (Test 26). The criterion used in evaluating these tests is the separation efficiency\* which is a quantitative measure of the extent of separation between the copper and lead minerals. It is calculated by subtracting the per cent distribution of the unwanted metal in the concentrate from the per cent distribution of the metal concentrated.

\* "Separation Efficiency" by N.F. Schultz, SME Transactions, Vol. 247, March 1970.

#### TABLE 12

#### Comparison of Results for Copper-Lead Separation Using Standard Methods

| Test<br>No | Separation<br>Method    | Product                                      | Wt<br>% -               | Analysis |       |                            | Distribution         |       |       | Sepn* |
|------------|-------------------------|--|-------------------------|----------|-------|----------------------------|----------------------|-------|-------|-------|
|            |                         |  | /6                      | Cu       | Pb    | Ag                         | Cu                   | РЪ    | Ag    | Eff % |
| 17         | Dichromate              | Copper conc<br>Copper cl tail<br>Lead conc   |                         | 10.53    |       | 175.36<br>158.21<br>61.89  | 19.9                 | 32.7  | 29.6  | 30.1  |
|            |                         | Feed (calcd)                                 |                         | 1        |       | 135.58                     | 1                    | 1     | L     |       |
|            | ·····                   | Copper ro conc                               | 68.78                   | 18.54    | 21.99 | 169.03                     | 95.3                 | 65.2  | 85.7  |       |
| 18         | SO <sub>2</sub> -Starch | Copper conc<br>Copper cl tail<br>Lead conc   |                         | 7.12     |       | 130.70<br>108.15<br>87.88  | 81.6<br>9.9<br>8.5   | 15.0  | 17.2  | 51.6  |
|            |                         | Feed (calcd)                                 | 100.00                  | 12.49    | 22.42 | 109.85                     | 100.0                | 100.0 | 100.0 |       |
|            |                         | Copper ro conc                               | 60.48                   | 18.91    | 14.80 | 124.21                     | 91.5                 | 39.9  | 68.4  |       |
| 19         | Cyanide                 | Lead conc<br>Lead c1 tail<br>Copper conc     |                         | 17.38    | 20.45 | 140.40<br>133.27<br>126.70 | 9.6<br>21.5<br>68.9  | 16.4  | 19.2  | 15.7  |
|            |                         | Feed (calcd)                                 | 100.00                  | 15.10    | 23.45 | 130.05                     | 100.0                | 100.0 | 100.0 |       |
|            |                         | Lead ro conc                                 | 34.20                   | 13.75    | 32.08 | 136.49                     | 31.1                 | 46.8  | 35.9  |       |
| 26         | SO <sub>2</sub> -Starch | Copper conc<br>Copper cl tail<br>Sep tailing | 15.38<br>19.57<br>65.05 | 7.51     |       | 163.36<br>108.72<br>30.28  | 62.3<br>22.0<br>15.7 | 16.4  | 32.2  | 64.0  |
|            |                         | Feed (calcd)                                 | 100.00                  | 6.68     | 17.71 | 66.10                      | 100.0                | 100.0 | 100.0 |       |
|            |                         | Copper ro conc                               | 34.95                   | 16.12    | 10.28 | 132.76                     | 84.3                 | 20.3  | 70.2  |       |

\* For initial rougher flotation.

bulk concentrate (Tests 17, 18 and 19) gave satisfactory results. In each case the copper content in the lead concentrate was excessively high. comparison of the separation efficiencies indicates that the sulphur dioxide-Comparison of Results for Copusiv Load Severation Using Standard Bollody starch method was the most effective. When tried on the No. 2 Sample bulk concentrate (Test 26), it gave much more acceptable results probably because Inclusteres 10mbox§ of the more favourable ratio of copper to lead in the separation feed. 49 SŻ. Modified Methods Table 13 gives a comparison of the results obtained for copper-lead separation using the modified methods as outlined on pages 5 and 6. All of these tests were done on bulk concentrate produced from No. 2 Sample. 95.13 (Copper 20 coin) 68.78118.54(21.09)(169.03) ----From a comparison of separation efficiencies it can be seen that the [Copper conc. - 1 43.06;23.68/12.98/730.70 - 81.6] 24.9 - 91.2 method, employed in Test 269 was much superior, to all the other methods 6-16Dead code 39,521 2,66 24,08 87,88 819 30,1 21,6 1 31 this test, the bulk rougher concentrate was subjected to sulphur dioxide-starch Weed (caled) 100.00 1A.49 22.42109.85 100.0 100.0 100.0 separation followed by lead flotation from the reground separation tailing. However, when tried in conjunction with regrinding of the bulk rougher concentrate in Test 24, sulphur dioxide starch did not effectively depress sbhanvA galena 6.002 [0.001/0:001/20.001/20.001/20.01/01.21/00.001] (hotas) boot In Test 20 the cyanide added to the regrinding step had a severe depressing effect on the copper minerals (presumably chalcopyrite was affected to the greatest degree) such that about 53% of the copper present dottas 2~ . O in the reground rougher concentrate was rejected to the cleaner tailings. Because of this, a greater degree of separation between the lead and copper minerals took place during cleaning (separation efficiency, 38,2%) than in A For thirthe rougher through the the subsequent sulphur dioxide-starch separation of the copper-lead cleaner concentrate (separation efficiency 20.3%). However, when the enhanced depressing effect of cyanide in the regrind was taken advantage of in Test 21, it depressed

None of the three separation methods employed on the No. 1 Sample

only about 2/3 of the copper. This could have been due to the ineffectiveness of cyanide as a depressant for the copper-bearing minerals, tennantite, and tetrahedrite.

### TABLE 13

Comparison of Results for Copper-Lead Separation Using Modified Methods

| Test | Separation              | Product         | Wt     | 1     | Analys | is     | Dis      | stribut  | ion   | Sep   |
|------|-------------------------|-----------------|--------|-------|--------|--------|----------|----------|-------|-------|
| No.  | Method                  |                 | × -    | Cu    | РЬ     | Ag     | Cu       | РЪ       | Ag    | Eff % |
|      | Flowsheet 2             | Copper conc     |        |       |        | 142.26 |          | 7.1      | 12.3  |       |
| 20   | Modified                | Copper cl tail  | 22.75  | 12.09 | 47.30  | 134.46 | 29.0     | 22.6     | 25.9  |       |
|      | S02-Starch              | Lead conc       | 67.01  | 7.06  | 50.00  | 109.19 | 50.0     |          |       |       |
|      |                         | Feed (calcd)    | 100.00 |       |        | 118.33 |          |          |       |       |
|      |                         | Copper ro conc  |        |       |        | 136.88 |          |          | 38.2  | 20.3  |
|      | Flowsheet 3             | Lead conc       | 26.42  | 7.02  | 46.60  | 112.65 | 33.1     | 77.5     | 50.3  | 44.4  |
| 21   | Selective               |                 |        |       |        |        |          |          |       | . 1   |
|      | flotation               | Copper conc     |        | 10.00 |        |        |          |          | 22.4  |       |
|      |                         | Copper ro tail  |        |       | 2.11   |        |          |          |       |       |
|      |                         | Feed (calcd)    | 100.00 | 5.61  | 15.90  | 59.13  | 100.0    | 100.0    | 100.0 |       |
|      | reground                |                 |        |       |        |        |          |          |       |       |
|      | bulk conc               | Lead ro tail    |        | 5.10  |        |        |          |          |       |       |
|      |                         | Copper conc     | 11.01  | 21.94 | 21.18  | 178,90 | 52.1     | 16.9     | 39.4  |       |
|      | Selective               |                 |        |       |        | •      |          | •        |       |       |
|      | flotation               | Copper cl tail  | 9,48   | 7.33  | 28.30  | 89.06  | 15.0     | 19.4     | 16.9  |       |
| 24   | of copper               |                 |        |       |        |        |          |          |       |       |
|      | lead                    | Lead conc       |        | 3.79  |        |        |          |          |       |       |
|      | and zinc                | Lead cl tail    | 17.60  | 2.99  | 8.86   | 37.78  | 11.3     | 11.3     | 13.2  |       |
|      | from                    |                 |        |       | _      |        |          |          |       |       |
|      | reground                | Sec Zn ro conc* | 5.29   | 2.21  | 5.63   | 26,56  | 2.5      | 2.2      | 2.8   |       |
|      | bulk conc               | Sec Cu-Pb ro    |        |       |        |        |          |          |       |       |
|      |                         | <u>tail</u>     |        |       |        | 13.60  |          |          |       | 4     |
|      |                         |                 |        |       |        | 50.05  |          |          |       |       |
|      |                         | Copper ro conc  |        |       |        | 137.33 |          |          |       | 30.8  |
|      |                         | Copper conc     |        |       |        | 163.36 |          |          |       |       |
| 26   | SO <sub>2</sub> -starch | Copper cl tail  | 19.57  |       |        | 108.79 |          |          |       |       |
|      | with lead               | Lead conc       | 13.68  | 0.69  | 70.45  | 43.71  | 1.4      | 54.4     | 9.0   |       |
|      | Flotation               |                 |        |       |        |        |          |          |       |       |
|      | from                    | Lead cl tail    | 6.69   | 2.21  | 25,43  | 43.33  | 2.2      | 9.6      | 4.4   |       |
|      | reground                | Sec Cu-Pb ro    |        |       |        |        |          |          |       |       |
|      |                         | tail            |        |       |        | 24.23  | 12.1     |          | 16.4  | -     |
|      | Sep tailing             |                 | 100.00 |       |        |        |          |          |       |       |
|      |                         | Copper ro conc  |        |       |        | 132.76 | 1        |          |       | 64.0  |
|      |                         | Lead ro conc    | 20.37  | 1.19  | 55.68  | 43.59  | 3.6      | 64.0     | 13.4  |       |
| 1    |                         |                 |        |       |        | L      | <u> </u> | <u> </u> | l     |       |

\*11.29% zinc with recovery of 22.9%

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### Selective Flotation Directly from the Ore

The results for selective flotation directly from the ore are compared in Table 15, while reagents and conditions for these tests are given in Table 14.

### TABLE 14

| •   | ·        |                   | •         | •   | · · ·       |              |
|-----|----------|-------------------|-----------|-----|-------------|--------------|
| : [ | Test No. | Grind<br>%-325m - | Condition | ing | Collectors, | 1b/ton       |
|     |          | ~-323m -          | Aeration  | pH  | Copper      | Lead         |
|     | 11       | 85.0              | No        | 6.6 | CX51, 0.03  | CX51, 0.005  |
|     | Ĩ12      | tT                | Yes       | 5.7 | CX51, 0.04  | CX51, 0.02   |
|     | 15       | 11                | Yes       | 5.7 | Z-200, 0.03 | AF 242, 0.06 |
| · . | 16       | 97.3              | Yes       | 5.8 | Z-200, 0.06 | AF 242, 0.05 |
|     |          |                   |           |     |             |              |

### Reagents and Conditions for Selective Flotation Directly from the Ore

From Table 15, it can be seen that the best results were achieved by aerating the pulp prior to copper flotation and by employing Z-200 and Aerofloat 242 as copper and lead promoters respectively. The very fine grind employed in Test 16 did not bring about any significant changes in results.

|            |   | · · · · · · · · · · · · · · · · · · · | 1             |               |       |                |                         |                     |        |        |              | 1                                       |
|------------|---|---------------------------------------|---------------|---------------|-------|----------------|-------------------------|---------------------|--------|--------|--------------|---|
| Test<br>No |   | Wt<br>% -                             |               | As            | says  |                |                         |                     | Distri | bution | %            | Sep<br>Eff                              |
|            |   | ,,, .                                 | Cu            | РЪ            | Zn    | Fe             | Ag                      | Cu                  | РЪ     | Zn     | Ag           | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ |
| 11         | Copper ro conc<br>Lead ro conc<br>Lead ro tail  | 3.03<br>3.77<br>93.20                 |               | 25.53         | 5.93  | 6.11           | 105.39<br>85.33<br>7.46 | 21.0                | 50.5   | 2.6    | 23.8         | 48.8                                    |
|            | Feed (calcd)                                    | 100.00                                | .1.07         | 1.91          | 8.39  |                | 13.31                   | 100.0               | 100.0  | 100.0  | 100.0        |   |
| 12         | Copper ro conc<br>Lead ro conc<br>Lead ro tail  | 6.18<br>5.25<br>88.57                 | _             | 21.66         | 17.59 | 24.03<br>11.16 |                         | 13.5                | 58.5   | 11.1   | 30.0         | 38.8                                    |
| Ī          | Feed (calcd)                                    | 100.00                                | 1.10          | 1.94          | 8.33  |                | 12.81                   | 100.0               | 100.0  | 100.0  | 100.0        |   |
| 15         | Copper ro conc<br>Lead ro conc<br>Lead ro tail  | 4.23<br>5,96<br>89.81                 |               | 23.11         | 9.45  |                | 1                       |                     | 70.8   | 6.5    | 30.7         | 55.0                                    |
| ſ          | Feed (calcd)                                    | 100.00                                | 1.21          | 1.95          | 8.65  |                | 13.95                   | 100.0               | 100.0  | 100.0  | 100.0        |   |
|            | Copper cl conc<br>Lead cl conc                  | 2.94<br>2.24                          | 25.00<br>2.26 | 5.52<br>55.13 |       |                | 101.17<br>149.45        |                     |        |        |              |   |
| 16         | Copper ro conc.<br>Lead ro conc<br>Lead ro tail | 4.99<br>9.11<br>85.90                 |               | 13.70         | 788   | 19.41<br>10.56 | 75.00<br>36.21<br>7.10  | 64.9<br>6.3<br>28.8 | 67.9   | 7.5    |              | 51.9                                    |
| -          | Feed (calcd)                                    | 100.00                                | 1.07          | 1.84          | 9.56  |                | 13.14                   | 100.0               | 100.0  | 100.0  | 100.0        | -                                       |
| -          | Copper cl conc<br>Lead cl conc                  | 2.45<br>1.82                          | 23.25<br>1.05 | 4.20<br>59.00 |       | 22.73<br>5.90  | 99.13<br>122.14         | 53.2<br>1.8         |        |        | 18.4<br>16.9 | -                                       |

. .

### TABLE 15

Comparison of Results for Selective Flotation Directly from the Ore

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### Dolmage Campbell Flowsheet

Table 16 gives a metallurgical balance for Test 2 which, as was mentioned previously, was done to ascertain the make-up of the intermediate products initially produced using the Dolmage Campbell flowsheet.

### TABLE 16

#### Product Wt Assays Distribution % 7 Cu ΡЪ Zn Ag Cu Pb. Zn Ag Copper-lead cleaner conc 2.79 12.85 5.39 7.63 102.28 58.6 9.7 2.1 33.0 Copper-lead cleaner tail 1.50 2.32 11.57 9.08 22.64 5.7 11.2 3.9 1.4 Sec Cu-Pb cleaner conc 1.37 3.06 59.81 64.44 4.41 6.9 52.8 0.6 10.2 Sec Cu-Pb cleaner tail 0.74 18.30 12.03 1.13 43.28 1.4 13.3 1.4 5.7 Sec Cu-Pb rougher tail 3.64 0.43 2.55 11.27 8.95 2.6 4.1 3.8 6.0 Copper-lead rougher tail 89.57 0.17 0.12 10.00 4.20 24.8 90.4 7.0 43.4 Feed (calcd) 100.00 0.61 1.55 9,91 8.65 100.0 100.0 100.0 100.0 Copper-lead rougher conc 4.29 9.17 7.55 8.14 74.43 64.3 20.9 3.5 36.9 Copper-lead scav conc 6.14 1.07 18.22 9.88 27.65 10.9 72.1 6.1 19.7

### Metallurgical Balance for Test 22

The results in Table 16 indicate that the greatest proportion of the copper floats in the copper-lead rougher, whereas most of the lead is recovered in the subsequent copper-lead scavenger float. Also, the galena that floats in the copper-lead rougher tends to be depressed during the cleaning operation. The so-called secondary copper-lead cleaner concentrate which is floated from the scavenger concentrate (see Figure 7) is actually a finished lead concentrate. From this test, therefore, it can be concluded that, other than additional cleaning of the copper-lead concentrate, further treatment as outlined in Figure 7 is unnecessary and that, in effect the initial portion of the flowsheet is equivalent to selective flotation directly from the ore.

### Roasting and Cyanidation of Pyrite Concentrate

Table 17 compares results obtained for cyanidation of raw and

roasted pyrite concentrates.

### TABLE 17

Comparison of results for Cyanidation of Raw and Roasted Pyrite Concentrates

| Test | Cyanidation        | Roastir       | ıg con     | ditions       | S con        | tent in       |         | -       | Reagen |              |      |
|------|--------------------|---------------|------------|---------------|--------------|---------------|---------|---------|--------|--------------|------|
| No.  | feed               | 1             |            |               | <u>calci</u> | nes, %        | Cyanida | ation,% | 1b/ton | pyrite       | conc |
|      |                    | Temp<br>°C    | Time<br>hr | Lime<br>added | Total        | Sul-<br>phide | Au      | Ag      | Lime-1 | **<br>Lime-2 | NaCN |
| 1    | Raw pyrite<br>conc |               |            |               |              |               | 25.0    | 37.2    |        | 8.5          | 15.4 |
| 2    | Calcines           | 450<br>to 700 | 5          | No            | 1.13         | 0.09          | 58.4    | 28.5    |        | 1.0          | 4.8  |
| 3    | Calcines           | 475           | 0.8        | Yes           | 12.71        | 2.04          | 64.5    | 55.9    | 102    | 9.7          | 14.0 |
| 4    | Calcines           | 475           | 3          | Yes           | 1.31         | 0.67          | 71.1    | 68.6    | 104    | 10.6         | 3.8  |
| 5    | Raw pyrite<br>conc |               |            |               |              |               | 28.1    | 40.8    |        | 10.2         | 16.4 |
| 6    | Calcines           | 475           | 3 .        | Yes           | 16.71        | 1.54          | 66.2    | 57.1    | 80     | 6.9          | 14.7 |
| 7    | Calcines           | 475           | 3          | No            | 13.48        | 1.52          | 60.4    | 58.7    |        | 7.1          | 13.4 |
| 8    | Calcines           | 475           | 4          | Yes           | 5.05         | 0.86          | 72.1    | 55.7    | 71     | 3.9          | 11.1 |
| 9    | Calcines           | 475           | 4          | No            | 4.30         | 0.78          | 70.8    | 61.0    |        | 3.9          | 11.1 |

\* Consumed in roast

\*\* Consumed in cyanidation.

Cyanidation of the raw pyrite concentrate (Tests 1 and 5) was not effective in extracting the precious metals. When the pyrite concentrate was subjected to a complete roast at a high temperature prior to cyanidation (Test 2), gold recovery more than doubled but there was a decrease in silver recovery.

In an investigation on gold and silver ores carried out by the U.S. Bureau of Mines (Technical Paper 423, 1928), it was found that, when sulphosalts such as tennantite or tetrahedrite were roasted at a high temperature, they were converted to base metal arsenates and antimonates. These compounds contained the silver originally present in the sulphosalts and were insoluble in cyanide solution. It was found that by subjecting these minerals to a low-temperature roast (450°C) in the presence of lime, calcium arsenate and antimonate were formed in preference to the corresponding base metal compounds. These calcium conpounds gave up their silver more readily to dissolution by cyanide.

A number of tests were tried in which the pyrite concentrate was roasted at a low-temperature for varying periods. In some of these tests, 20 grams of lime were mixed with the roasting charge. In every test, there was at least a doubling of silver extraction by cyanidation over that obtained on calcines from the high-temperature roast thus confirming the findings of the U.S. Bureau of Mines investigation. However, it was found that the addition of lime to the roasting charge was not essential (compare results of Tests 6 and 7 and 8 and 9). The best results (Test 4) could be related to the lowest sulphur content in the calcines of any of the low-temperature roasts. Cyanide consumption in this test was also very much lower.

#### CONCLUS IONS

Marketable grades of copper, lead, and zinc concentrates can be produced from this ore by differential flotation techniques. On No. 1 Sample, the only successful technique for copper and lead concentration was selective flotation directly from the ore (Test 16), whereas on the lower-grade No. 2 Sample the best results were achieved by floating a copper-lead bulk concentrate, subjecting it to the sulphur dioxide-starch separation method to produce a copper concentrate followed by reactivation and flotation of a lead concentrate from the reground separation tailing (Test 26).

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In order to maintain satisfactory copper and lead concentrate grades, recoveries would have to be compromised. This is because of the intimate association of some of the lead and copper minerals with pyrite.

An appreciable portion of the silver is also intimately associated with the pyrite in the form of tiny inclusions of silver-bearing tennantitetetrahedrite. In order to recover this silver, it is necessary to float a pyrite concentrate from the zinc tailing, roast the concentrate and cyanide the calcines. A significant amount of gold is also recovered by this scheme. Precious metal extraction by cyanidation in the best test (4) expressed as oz/ton flotation feed was 1.82 oz/ton for silver and 0.05 oz/ton for gold which represent additional recoveries of 14% and 30% respectively.

In contrast to the difficulty experienced in concentrating the copper, lead and silver minerals the sphalerite in the ore floated readily to give an exceptionally high grade zinc concentrate accompanied by good zinc recovery.

### ACKNOWLEDGEMENTS

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### APPENDIX A

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| 45-Mi         | nute Rod Mil | 1 Grind            |
|---------------|--------------|--------------------|
| Tyler<br>Mesh | Wt<br>%      | Cumulative<br>Wt % |
| +100          | 0.3          | 0.3                |
| +150          | 2.5          | 2.8                |
| +200          | 16.6         | 19.4               |
| +270          | 14.3         | 33.7               |
| +325          | 11.7         | 45.4               |
| +400          | 3.5          | 48.9               |
| -400          | 51.1         | 100.0              |
| Total         | 100.0        |                    |
| 30-Mi         | nute Ball Mi | 11 Grind           |
| +100          | 0.2          | 0.2                |
| +150          | 1.7          | 1.9                |
| +200          | 5.8          | 7.7                |
| +270          | 7.2          | 14.9               |
| +325          | 8.7          | 23.6               |
| +400          | 3.9          | 27.5               |
| -400          | 72.5         | 100.0              |
| Total         | 100.0        |                    |
| 60-Mi         | nute Ball Mi | 11 Grind*          |
| +150          | 0.2          | 0.2                |
| +200          | 0.7          | 0.9                |
| +270          | 1.8          | 2.7                |
| +325          | 4.5          | 7.2                |
| +400          | 1.1          | 8.3                |
| +500          | 14.2         | 22.5               |
| -500          | 77.5         | 100.0              |
| Total         | 100.0        |                    |

### Screen Analyses of Primary Grinds

\*Screen analysis of lead rougher tailing.

## Classification of Tests

## According to Flowsheet Employed

| Flowsheet<br>No. | Description  | Test No                      |
|------------------|--|------------------------------|
| 1                | Bulk flotation only.   | 1,2,3,4,5,6,7,<br>8,9,13,14. |
| 1                | Bulk flotation followed by copper-lead separation.   | 17,18,19.                    |
| 2                | Modified copper-lead sepn, bulk conc reground before cleaning.   | 20                           |
| 3                | Modified copper-lead sepn, selective<br>flotation of lead and copper conc<br>from reground bulk conc.  | 21                           |
| 4                | Modified copper-lead sepn, selective<br>flotation of copper, lead and<br>zinc conc from reground bulk conc.  | 24                           |
| 5                | Modified copper-lead sepn, SO <sub>2</sub> -starch<br>sepn on Cu-Pb bulk rougher conc<br>followed by Pb flotn from reground<br>separation tailing. | 26                           |
| 6                | Selective flotation of copper<br>and lead conc directly from<br>the ore.   | 10,11,12,15,16               |
| 7                | Dolmage Campbell flowsheet   | 22,23                        |

### Abbreviations Used in Flotation Test Reports

| RM     | Rod mill                                  |
|--------|---|
| BM     | Ball mill                                 |
| CX51   | Potassium amyl xanthate                   |
| DF 250 | Dowfroth 250                              |
| NaAF   | Sodium aerofloat                          |
| PO     | Pine oil                                  |
| Fe/FeS | Iron present as iron sulphides            |
| Z-200  | Trade name for selective copper collector |
| AF 242 | Aerofloat 242                             |
| AF 238 | Aerofloat 238                             |
| AF 208 | Aerofloat 208                             |
| Dich   | Sodium dichromate                         |
| CS     | Caustic starch                            |
| MIBC   | Methyl isobutyl carbinol                  |
|        |   |

ZnCN Na<sub>2</sub>Zn (CN)<sub>4</sub>

Z-3 Potassium ethyl xanthate

| TEST NO. 1 SAMP                        | PLE: ]  | Nadina  | Explo  | rations Limit | ed      |          |        |          |          |          | DATE  | Feb.   | 9,19    | 70  |
|--|---------|---------|--------|---------------|---------|----------|--------|----------|----------|----------|-------|--------|---------|-----|
| OBJECT OF TEST: Cop                    | per-lea | ad bull | k flot | ation using 1 | ime +   | ZnS0,    | + NaCN | [        |          |          |       | RGE: 2 |         |     |
| fol                                    | Lowed 1 | by zin  | c flot | ation.        |         |          |        |          |          |          |       | ED BY  | · A.S   | 3.  |
| OPERATION                              | Time    | %       | рΉ     | Unit          |         |          | •      | Rea      | agents,  | lb per   | ton   |        |         |     |
| OPERATION                              | min     | Solids  | рп     | used          | Lime    | ZnSO4    | NaCN   | CX51     | DF250    | CuS04    | NaAF  |        |         |     |
| Grinding                               | 45      | 65      | 6.8*   | 7 x 14 RM     | 1.0     | 0.5      | 0.05   | <u> </u> |          |          |       | 1      |         |     |
| Conditioning                           | 10      |         | 8.1    | 1000-g cell   | 0.5     |          |        | 0.02     | · ·      |          |       | 1      |         | 1   |
| Copper-lead rougher                    |         |         |        |               |         |          |        |          |          |          | Ì     |        |         |     |
| Stage 1                                | 1/2     | 1       |        |               |         |          |        |          | 0.02     |          |       |        |         |     |
| <u>й 2</u>                             | 1       |         |        | · · ·         |         |          |        | 0.01     |          |          |       | 1      | ·       | 1   |
| Copper scavenger                       | 1       |         |        |               |         |          |        |          | 1        |          |       | 1      |         | 1.  |
| Conditioning                           | 10      | 1       | 11.1   |               | 3.0     |          |        | 0.01     | 0.01     | 1.0      | •     |        |         |     |
| Zinc rougher                           |         |         | ·      |               |         |          |        |          | · - ·    |          |       |        |         | 1   |
| Stage 1                                | 1       |         |        |               |         |          |        | 0.02     |          |          | 0.10  |        |         |     |
| " 2                                    | 1       |         |        |               |         |          |        |          | 0.02     |          | 0.05  |        |         |     |
| " 3                                    | 2       |         |        |               | · · · · |          |        |          |          |          | 0.05  |        | · · · · |     |
| ·                                      |         |         |        |               |         |          |        |          |          |          |       |        |         |     |
|  | W       | т       |        | ANAL          | YSIS    | %        |        |          |          | DI       | STRIB | UTION  | 1 %     |     |
| PRODUCT                                | 9       | 6       |        |               |         |          |        |          |          | <u> </u> |       | ·      |         |     |
|  |         |         |        |               |         |          |        |          |          |          |       |        |         |     |
| TEST PRODUCTS                          | 11      |         |        |               |         |          |        |          |          |          |       |        |         |     |
| ······································ |         |         | -      |               |         |          |        |          |          |          |       |        |         | •   |
| DISCARDED                              |         |         |        |               |         |          |        | ļ        |          |          |       | 2      |         |     |
|  |         |         |        |               |         |          |        |          |          |          |       | •      |         |     |
|  |         |         |        |               |         |          |        |          |          |          |       |        |         |     |
|  | 1       |         |        | 5 A.          |         |          |        |          |          |          |       |        |         |     |
|  |         |         |        |               |         |          |        |          |          |          |       |        |         |     |
|  |         |         |        |               |         | •        |        |          |          | ľ        | •     |        | .       |     |
|  |         |         | · .    |               | ÷ .     | •        |        |          |          | · · · ·  |       |        | * . • [ | ٠,  |
| •                                      |         | ·.      |        |               |         |          |        |          |          |          | ľ     |        |         | • • |
|  | ļ       |         |        |               |         |          |        |          |          | }        |       |        | -       |     |
|  |         |         |        |               |         |          |        |          |          |          |       | ·      |         |     |
|  |         |         |        |               |         |          |        |          |          |          |       |        |         |     |
|  |         |         |        |               |         |          | · ·    | <u> </u> | <u>.</u> |          |       |        |         |     |
| REMARKS: Excessive a                   | nounts  | of pv   | rite a | opeared to fl | oat es  | special  | ly in  | copper   | scave    | nger.    |       |        |         |     |
| pH too low?                            |         |         |        |               |         | <b>_</b> | ,      | -11      | • .      | ,<br>,   | . · · |        |         |     |
| * after dilu                           |         |         |        |               |         |          |        |          |          |          |       |        | •••     |     |

Sheet 1 of 2

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| TEST NO. 2 SAME         | PLE:   | Na   | dina   | Explo | ratio              | ns Limit                     | ed:                |                    | <u></u> |        |              |        |        |        | . 9, 1     | 970      |
|-------------------------|--|------|--------|-------|--------------------|------------------------------|--------------------|--------------------|---------|--------|--------------|--------|--------|--------|------------|----------|
| OBJECT OF TEST: As in   | ı Tes  | st 1 | but    | used  | Na <sub>2</sub> CO | $_3 + Na_2S$                 | $50_3 + N_1$       | aCN alc            | ng wit  | h      |              |        | CHAF   | RGE: 2 | 000 g      |          |
|                         |  |      |        |       |                    |                              |                    |                    |         |        |              |        |        |        | : A.S      | •        |
|                         | Tin  | ne   | %      |       | 1                  | Jnit                         |                    |                    |         | Rea    | gents,       | lb per | ton    |        |            |          |
| OPERATION               | mi   | n S  | Solids | рп    | u                  | ised                         | Na <sub>2</sub> CO | Na <sub>2</sub> SO | NaCN    | CX51   | PO           | CuS04  | Lime   | NaAF   | DF250      |          |
| Grinding                | 45   |      | 65     | 7.2*  |                    | 14 RM                        | 2.0                | 1.0                | 0.10    |        |              |        |        |        |            |          |
| Conditioning            | 20   |      |        | 8.1*  | * Aera             |                              | 1.0                |                    |         | 0.02   |              |        |        | _      |            |          |
| Copper-lead rougher     | L  |      |        |       | 1000               | )-g ce11                     | -                  |                    |         |        |              |        | ļ      |        |            |          |
| Stage 1                 | 1  |      |        |       |                    |                              | 1                  |                    |         |        | 0.02         |        |        |        |            |          |
|                         | •  | _    |        |       |                    |                              |                    |                    |         | 0.01   |              |        |        | -      |            |          |
| Conditioning            | 10   |      |        | 11.4  |                    |                              |                    |                    |         |        |              | 1.0    | 4.0    |        |            | <u> </u> |
| Zinc rougher            | T OF TEST: As in Test 1 but used aerative conditioning         OPERATION       Time %       ph         ng       45       65       7.2         ioning       20       8.3         -lead rougher       1       1         ge 1       1       1         2       1/2       1         ioning       10       11.4         ge 1       1       1         2       1       1         2       1       1         3       2       1         3       2       1         3       2       1         -lead conc       7.78       10.55         -lead c1 tail No.1       0.92       2.86         1.19       1.42       0.87         onc       6.81       0.87         1 tail No.2       2.72       1.11         " Nó.1       5.48       1.11         ougher tail       75.10       0.11 |      |        |       |                    |                              |                    |                    |         |        |              |        |        |        |            | ļ        |
| Stage 1                 | 1  |      |        |       |                    |                              |                    |                    |         | 0.02   |              |        |        | 0.10   |            |          |
| 2                       |  |      |        |       |                    |                              |                    |                    |         |        |              | 1      | 0.05   | 0.02   |            |          |
| " 3                     | 2  |      |        |       |                    |                              |                    |                    |         |        |              |        | 0.05   |        |            |          |
|                         |  |      |        |       |                    |                              |                    |                    |         |        |              |        |        |        |            |          |
|                         |  |      |        |       |                    |                              |                    |                    |         |        |              |        |        |        |            |          |
| PRODUCT                 |  | wт   |        |       |                    | ANAL                         | _YSIS              | %                  |         |        |              | DI     | STRIE  | BUTION | <b>v</b> % |          |
|                         | PRODUCT II I   |      |        |       |                    |                              | Fe                 | Insol              | Au      | Ag     | Cı           | 1 ]    | РЪ     | Zn     | Au         | Ag       |
|                         |  |      | 0 10   | 55    | 13.09              | 2.96                         | 29.31              | 2.60               | 0.57    | 73.33  | 74.          | 0 5    | i.6    | 2.7    | 28.1       | 44.1     |
|                         | 1  |      |        |       | 9.60               |                              | 31.48              | 7.52               | 0.53    | 43.26  |              |        | 4.5    | 0.4    | 3.1        | 3.1      |
|                         | 2  |      |        |       | 7.43               |                              | 27.14              | 16.58              | 0.34    | 25.17  |              |        | 4.5    | 0.8    | 2.5        | 2.3      |
| Zinc conc               |  |      |        |       |                    | 63.40                        | 1.44               | 0.76               | 0.12    | 16.64  | - 11         |        |        | 50.2   | 5.2        | 8.8      |
| Zinc cl tall No.2       |  |      |        |       |                    | 56.00                        | 2.68               | 3.36               | 0.17    | 17.98  |              | 1      |        | 17.7   | 2.9        | 3.8      |
|                         |  |      |        |       |                    | 32.00                        | 9.08               | 1.22               | 0.23    | 22.40  | 5.           | .5   8 | 8.7    | 20.4   | 8.0        | 9.5      |
| Zinc rougher tail       |  |      |        |       |                    | 0.90~                        |                    |                    | 0.11    | 4.90   |              |        | 3.9    | 7.8    | 50.2       | 28.4     |
| Feed (Calcd)            | 1(   | 0.00 | 0    1 | .10   | 1.97               | 8.61                         |                    |                    | 0.16    | 12.93  | 100          | .0 100 | 0.0 1  | 00.0   | 100.0      | 100.0    |
|                         |  |      |        |       |                    |                              |                    |                    |         |        |              |        |        |        |            |          |
|                         |  |      |        |       |                    |                              |                    |                    |         |        |              |        |        |        |            |          |
|                         |  |      |        |       |                    |                              |                    |                    |         |        |              |        |        |        |            |          |
|                         |  |      | l      |       |                    |                              |                    |                    |         |        |              |        |        |        |            |          |
|                         |  |      |        |       |                    |                              |                    |                    |         |        |              |        |        |        |            |          |
|                         |  |      |        |       |                    |                              |                    |                    |         |        | .            |        |        |        |            |          |
|                         |  |      |        |       |                    |                              |                    |                    |         |        |              |        |        |        |            |          |
| REMARKS: Fe/FeS in (    |  | 1    | ead o  |       | 0.0%               |                              | er-lea             | d rough            |         | c 21.6 | <del>.</del> |        |        |        | <u> </u>   |          |
| 20,200 111              |  |      |        |       | -                  |                              |                    | -                  |         |        |              | F1     | a      |        |            |          |
| Copper-lead float - cop |  |      |        |       |                    | igner bu<br>at <u>15 m</u> i |                    | ssive a            | mounts  | or py  | rite i       | Loare  | a in s | econd  | rougne     | r;       |
| * after dilution with r |  |      |        |       |                    | <u>11 13 11</u>              |                    |                    |         |        |              |        |        |        |            |          |

\* after dilution with water \*\* at end and after dilution in cell.

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| TEST NO. 2 SAMP                       | LE:      | Nadina   | a Expl   | oratio       | ons Limi  | Lted        |           |                                       |             | •         |          | 1     |            | b. 9, 1 | 970       |
|---------------------------------------|----------|----------|----------|--------------|-----------|-------------|-----------|---------------------------------------|-------------|-----------|----------|-------|------------|---------|-----------|
| OBJECT OF TEST:                       |          |          |          |              | · ·       |             |           |                                       |             |           |          | CHA   | RGE:       |         |           |
| L                                     |          |          |          |              |           | · · · · · · |           |                                       |             |           |          | J     | TED B      | Y: _    |           |
| OPERATION                             | Time     | %        | рН       | ι            | Jnit      |             |           |                                       | Rea         | gents,    | lb per   | ton   |            |         |           |
| UPERATION                             | min      | Solids   | hu.      |              | ised      |             |           |                                       |             |           |          | Lime  | 3.         | DF250   |           |
| Copper-lead cleaners                  |          |          |          |              |           | 1           |           |                                       |             |           |          |       |            |         |           |
| No. 1                                 | 11/2     |          |          |              | g cell    |             |           |                                       | ·           |           |          |       |            | 0.005   |           |
| No. 2                                 | 1        |          |          | . 11         | 11        |             |           |                                       |             |           |          |       |            |         |           |
| Zinc cleaners                         |          |          |          |              | •         |             |           |                                       |             | ·         |          |       |            |         |           |
| No. 1                                 | 2        |          | 11.7     | 500-         | g cell    |             | ·         |                                       |             |           | ·        | 1.0   | •          |         | · · · · · |
| No. 2                                 | 11/2     |          | 11.7     | 11           | · 11      |             | · ·       |                                       |             |           |          | 0.2   | <u>;</u>   |         |           |
|                                       |          | ļ        | <br>     |              |           |             |           |                                       |             |           | ļ        |       |            |         | ļ         |
|                                       |          | ļ        |          |              | ····      | _           | <b>_</b>  |                                       |             | ·         |          |       |            |         | <u> </u>  |
| ·                                     |          |          |          | <u> </u>     | · · · · · | · · ·       |           | `                                     |             |           |          |       |            |         |           |
|                                       |          | ·        |          | <u>  · ·</u> |           |             |           | · · · · · · · · · · · · · · · · · · · |             |           |          |       |            |         |           |
| ```                                   |          |          | <u> </u> | <u> </u>     | <u></u>   |             | <u>  </u> |                                       | · ·         |           | ·        |       | _ <u>_</u> |         |           |
|                                       |          | <u> </u> |          | <u> </u>     |           |             |           |                                       |             |           | <u> </u> |       | _ <u>_</u> |         | <u></u>   |
| PRODUCT                               | W        | 1        | ······   |              |           | LYSIS       |           |                                       |             |           |          |       | BUTIO      |         |           |
|                                       |          | 6 (      | Cu       | РЪ           | Zn        | Fe          | Insol     | Au                                    | Ag          |           | 1 P      | Ь     | Zn         | Au      | Ag        |
| Calculated assays                     | <b>.</b> |          | 1        |              |           |             |           |                                       |             |           |          |       |            |         |           |
|                                       |          |          |          |              | . [       |             |           |                                       |             |           |          |       |            | • •     |           |
| lst Stage copper-lead<br>Cleaner conc | Q        | .70 9.   | 7/       | 10 70        | 3.08      | 20 54       | 5.65      | 0 56                                  | 70:15       | 77.       | 2 5      | 6.1   | 3.1        | 31.2    | 47.2      |
| Copper-lead rougher con               |          | .89 .8   |          | 12.08        |           | 29.04       |           | 0.54                                  | 64.74       |           | 1        | 0.6   | 3.9        | 33.7    | 49.5      |
| Copper-lead rougher tai               |          | .11 0.   |          | 0.86         |           |             |           | 0.12                                  | 7.25        |           |          | 9.4   | 96.1       | 66.3    | 50.5      |
| lst stage zinc cl conc                |          | .53 0.   | .94      | 1.40         | 61.29     | 1.79        | 1.50      | 0.13                                  | 17.02       |           | .2       | 6.8   | 67.9       | 8.1     | 12.6      |
| Zinc rougher conc                     | 15.      | .01   1. | .00      | 2.04         | 50.59     | 4.45        | 1.40      | 0.17                                  | 18.99       | 13.       | .7   1   | 5.5   | 88.3       | 16.1    | 22.1      |
|                                       | .        |          |          |              |           |             |           |                                       |             |           |          |       |            |         |           |
|                                       |          |          |          |              |           |             |           |                                       |             | e 🛛 🖓 🖓 🖓 |          |       |            |         |           |
|                                       |          |          |          |              |           | . •         |           |                                       |             |           |          |       |            |         |           |
| <b>-</b> . '                          |          |          | ÷ [ ·    |              |           |             |           |                                       |             |           |          |       |            |         |           |
|                                       |          |          |          |              |           |             |           | •                                     |             |           |          |       |            |         |           |
|                                       |          |          |          |              |           |             |           |                                       |             | 1         |          |       |            |         | •         |
|                                       |          |          |          |              |           |             |           |                                       |             |           |          |       |            |         |           |
| REMARKS:                              |          |          |          | `            |           |             |           |                                       |             |           | · ·      |       |            |         |           |
|                                       |          |          |          |              |           |             |           |                                       |             |           |          |       |            |         |           |
|                                       |          |          |          |              |           |             |           |                                       |             |           |          |       |            |         |           |
|                                       |          |          |          |              | <u> </u>  |             |           |                                       | · · · · · · |           |          | ····· | <u></u>    |         |           |
|                                       |          |          |          |              |           |             |           |                                       |             |           |          |       |            |         |           |
| 4 <sup>1</sup> 4                      |          |          |          |              |           |             |           |                                       |             |           |          |       |            | *       |           |

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| TEST NO. 3 SAME        | LE:     |                             |         |            |      |        |         |        |       |         |        |       |       |          |   |
|------------------------|---------|-----------------------------|---------|------------|------|--------|---------|--------|-------|---------|--------|-------|-------|----------|---|
| OBJECT OF TEST: Repe   | eat of  | Test                        | 1 but t | with incre | ase  | in li  | me and  | cvani  | .de   |         |        | CHAR  | GE:   | 2000 g   | 5 |
| f                      |         |                             |         |            |      |        |         |        |       |         |        | TEST  | ED BY | A.S.     |   |
| ODERATION              | Time    | %                           |         | Unit       |      | [      |         |        |       | agents, |        |       |       |          |   |
| OPERATION              | min     | Solids                      | рН      | used       |      | Lime   | ZnS04   | NaCN   | CX51  | DF250   | CuS04  | NaAF  |       | .        |   |
| Grinding               | 45      | 65                          | 9.8*    | 7 x 14 R   | 1    | 3.0    | 0.5     | 0.10   |       |         |        |       |       |          | 1 |
| Conditioning           | 10      |                             | ca 10*: | 1000-g     | cell | 0.5    |         |        | 0.02  |         |        |       |       |          |   |
| Copper-lead rougher    | 1       |                             | 10.6    |            |      | .0,5   |         |        | 0.01  | 0.02    |        |       |       |          |   |
| " " scavenger          | 1       |                             | 10.7    |            |      |        |         |        | 0.02  |         |        |       |       |          |   |
| Conditioning           | 10      |                             | 11.3    | ·····      |      | 1.0    |         |        |       |         | 1.0    |       |       |          |   |
| Zinc rougher           |         |                             |         |            |      |        |         |        |       |         |        | · · · |       |          |   |
| Stage 1                | 1       |                             |         |            |      |        |         |        | 0.02  |         |        | 0,10  |       |          |   |
| " 2                    | 1       |                             |         |            |      |        |         |        |       | 0.02    |        | 0.05  |       |          |   |
| " 3                    | 2       |                             |         |            |      |        |         |        |       |         |        | 0,05  |       |          |   |
|                        |         |                             |         |            |      |        |         |        |       |         |        |       |       | L        |   |
|                        |         |                             |         |            |      |        |         |        |       |         |        |       |       | <u> </u> |   |
|                        |         |                             |         |            |      |        |         |        |       |         |        |       |       |          |   |
| PRODUCT                | W       | т                           |         | AI         | VAL  | YSIS   | %       |        |       |         | DI     | STRIB | JTION | %        |   |
| FRODUCT                | 9       | 6                           |         |            |      |        |         |        |       |         |        |       |       |          |   |
| Copper-lead ro conc    | 4       | 4                           |         |            |      |        |         |        |       |         |        |       |       |          |   |
| " " scav conc          |         | 0                           |         |            |      |        |         |        |       |         |        |       |       |          |   |
| Zinc rougher conc      | 14      |                             |         |            |      |        |         |        |       |         |        |       |       |          | 1 |
| Zinc rougher tail      | 76      |                             |         |            | -    |        |         |        |       |         |        |       |       |          |   |
| Feed                   | 100     | .0                          |         | ľ          |      | ~      |         |        |       |         |        |       |       |          | 1 |
| _                      | 1       |                             |         |            |      |        |         |        |       |         |        |       |       |          |   |
| TEST PRODUCTS          |         |                             |         |            |      |        |         |        |       |         |        |       |       |          |   |
| NOT ASSAYED            | 1       |                             |         |            |      |        |         |        |       |         |        |       |       |          |   |
| BECAUSE OF UNSTABLE PH |         |                             |         |            |      |        |         | -      |       |         |        |       |       |          |   |
|                        |         |                             |         |            |      |        |         |        |       |         |        |       |       |          |   |
|                        |         |                             |         |            |      |        |         |        |       |         |        |       |       |          |   |
|                        |         |                             |         |            |      |        |         |        |       |         |        |       |       |          |   |
|                        |         |                             |         |            |      |        |         |        |       | 1       |        |       |       |          |   |
|                        |         |                             |         |            |      |        |         |        |       |         |        |       | •     |          |   |
| REMARKS: Light, leady  | 7 frotl | $\frac{1}{1 \text{ in } c}$ | opper-  | lead roug  | ier. | pyrit  | e came  | up qu  | ickly | in sca  | venger | •     |       |          |   |
| *after dilu            | ition : | in cel.                     | L.      |            |      |        |         |        |       |         | 0      |       |       |          |   |
| **unstable p           | H, st   | tarted                      | at abo  | out 10.5 a | and  | then b | egan to | o drop | •     |         |        |       |       |          |   |

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|  |         |              |  |           | ns Limi |         |                    |          |          |                  |         |            |         | . 17,                                 |          |
|--|---------|--------------|--|-----------|---------|---------|--------------------|----------|----------|------------------|---------|------------|---------|---------------------------------------|----------|
| OBJECT OF TEST: Copp                                   | er-lead | d bulk       | flot   | ation     | using 1 | ime + Z | ns0 <sub>4</sub> + | NaCN     | but wi   | th Z-2           | 00      |            |         |                                       |          |
| and AF 242 as  | coppe   | r and        | lead   | promot    | ers in  | place c | of CX 5            | 1.       |          |                  |         | TES        | TED B   | Y: A.S                                | •        |
|  | Time    | %            | 1  | 1. 1      | Jnit    |         |                    |          | Rea      | igents,          | lb p.e. | r.ton      |         | · · · · · · · · · · · · · · · · · · · |          |
| OPERATION  | 1       |              | pH   |           |         | Lime    | ZnS0/              | NaCN     | AF242    | Z-200            | CuSO    | DF2        | 50 NaAl | <u>r</u>                              |          |
| Grinding   | 45      | 65           | 10.0   | * 7 x     | 14 RM   | 3.0     | 0.5                | 0.10     |          |                  |         |            |         |                                       |          |
|  | 10      |              | 10.9   | 1000      | -g cell | 0.5     |                    |          | 0.02     | 0.02             |         | 1          |         | -                                     |          |
|  |         |              |  |           |         |         |                    |          |          |                  |         |            |         |                                       |          |
|  | 1       | · .          | 10.7   |           |         |         | 1                  |          | 0.02     |                  |         | 1          |         |                                       |          |
|  | 1       |              | <u> </u>   |           | • .     |         |                    |          | 0 02     |                  |         |            |         |                                       |          |
| " 3  | 1       | <del> </del> |  | <u></u>   |         | -       |                    |          |          |                  |         | +          |         |                                       |          |
| Conditioning   |         |              | 111.6  |           | ·····   | 1.5     | 1                  |          |          |                  | 1.0     |            |         |                                       |          |
|  | 1.      |              | +  |           |         |         |                    |          |          |                  |         |            |         | •                                     |          |
|  | 1       |              |  |           | ·····   |         |                    |          |          | ••               |         | 0.0        | 2       |                                       |          |
|  |         |              | 1  |           |         |         |                    |          |          |                  |         | 10.0       |         | 5                                     |          |
|  |         |              | +  |           |         |         |                    |          |          |                  |         |            |         |                                       |          |
|  |         |              |  |           |         |         |                    |          |          |                  |         | - <u> </u> |         |                                       |          |
|  |         |              | <u></u>  |           |         |         | 0/                 | L        | <u>.</u> | <u>li.</u><br>]j |         | ISTR       |         | N %                                   | <u> </u> |
| PRODUCT  | 11      | · ⊪—         |  |           | ····    |         |                    | <u> </u> |          |                  |         |            |         |                                       | 1        |
| ·  |         |              | Cu   | <u>РЬ</u> | Zn      | Ľе      | Au                 | Ag       |          |                  |         | <u>Pb</u>  | Zn      | Au                                    | Ag       |
| Conner-lead ro conc                                    | l g     | 16 4         | .76  | 16 20     | 12 26   | 12 30   | 0 65               | 69.28    | 1        | 33               | 7 -     | 2.8        | 12 1    | 30 6                                  | 42 7     |
|  | 14      |              |  |           |         |         |                    | •        |          | 11               |         |            |         |                                       |          |
|  |         |              |  |           |         |         |                    |          |          |                  |         |            |         |                                       |          |
| Feed (calcd)   |         |              |  |           |         | , i     |                    |          |          | 11               |         |            |         |                                       | 1 .      |
| Copper-lead ro tail                                    |         |              | TESTED BY: A.         Reagents. lb per.ton         Munit         Reagents. lb per.ton         65       10.0*       7 x 14 RM       3.0       0.5       0.10       Image: state of the s |           |         |         | 1                  |          |          |                  |         |            |         |                                       |          |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ |         |              |  |           |         |         |                    |          |          |                  |         |            |         |                                       |          |
|  |         |              |  |           |         |         |                    |          |          |                  | ·       |            |         |                                       |          |
|  |         |              |  |           |         |         |                    |          |          |                  |         |            |         |                                       |          |
|  |         | .            |  | · . ·     |         |         |                    |          |          |                  |         |            |         |                                       |          |
|  |         |              |  |           |         |         |                    |          |          |                  |         |            |         |                                       |          |
|  |         |              |  |           | 1       | •       |                    |          |          |                  |         |            |         |                                       | [        |
|  |         |              |  |           |         |         |                    |          |          |                  |         |            | ·       |                                       |          |
|  | 11      |              |  |           |         | ×       |                    |          | ) ·      |                  | `·      | •          | · · ·   |                                       |          |
|  |         |              |  |           |         |         |                    |          |          |                  |         |            |         |                                       |          |
|  |         |              |  |           |         |         |                    |          | <u> </u> |                  |         |            |         |                                       |          |
|  |         |              |  |           |         |         |                    |          |          |                  |         |            |         |                                       |          |

after dilution in cell.

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## MINES BRANCH FLOTATION TEST REPORT

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| TEST NO. 5 SAMPL                     | E: Na   | dina     | Exp   | lorati   | ons Li  | nîted             |       |         | · · · · · · · · · · · · · · · · · · · |        |       |             |       | ь. 18,   | 1970      |
|--------------------------------------|---------|----------|-------|----------|---------|-------------------|-------|---------|---------------------------------------|--------|-------|-------------|-------|----------|-----------|
| OBJECT OF TEST: Repe                 | at of   | Test     | 3     |          |         | • • • • • • • • • |       |         |                                       |        |       | СНА         | RGE:  | 2000 g   |           |
|                                      |         |          |       |          |         |                   |       |         |                                       |        |       | TES         | TED B | Y: A.S.  |           |
|                                      | ime     | %        | pН    | ι        | Init    |                   |       |         |                                       | gents, |       |             |       |          |           |
| OPERATION                            | min So  | olids    | рп    | Ú U      | sed     | Lime              | ZnS04 | NaCN    | CX51                                  | DF250  | CuSO4 | NaA         | F     |          |           |
| Grinding                             | 45      | 65       |       | 7 x      | 14 RM   | 3.5               | 0.5   | 0.10    |                                       |        |       |             |       |          | · · ·     |
| Conditioning                         | 10 -    | 1        | .0.5* |          | ·       |                   |       |         | 0.02                                  |        |       |             |       |          | ·         |
| Copper-lead rougher                  |         |          |       |          |         |                   |       |         |                                       |        |       |             |       |          |           |
| Stage 1                              | 1       |          |       |          |         |                   |       |         | 0,01                                  | 0.02   |       |             |       |          |           |
| <u>.</u> 2                           | 1/2     |          |       |          |         |                   |       |         |                                       | 0.01   |       |             |       |          | <u> </u>  |
| A CAR STORE STORE                    | 1/2     |          |       | <u> </u> |         |                   | -     |         | 0.004                                 |        |       |             |       |          | ·         |
| Copper-lead scavenger                | 2       | 1        | .0.0* | *        |         |                   |       |         | 0.004                                 |        |       |             |       |          |           |
| Conditioning                         | 10      | 1        | 1.6   |          |         | 1.5               |       |         |                                       |        | 1.0   |             |       |          | <u> </u>  |
| Zinc rougher                         | ·       |          |       |          |         |                   | ļ     |         |                                       |        | ••••  | 0.10        |       |          |           |
|                                      | 1       |          |       |          |         |                   |       |         | 0.02                                  | · .    |       | 0.10        | ·     |          | .         |
|                                      | 1       |          |       |          |         |                   |       |         |                                       |        |       | 0.05        |       |          |           |
|                                      | 2       |          |       | <u> </u> |         |                   |       |         |                                       |        |       | 0,05        |       | <u> </u> |           |
| PRODUCT                              | WT      |          |       |          | ANA     | LYSIS             | %     | ,       |                                       |        |       | , -         | BUTIO | N %      |           |
|                                      | %       | Cu       | L     | РЪ       | Zn      | Fe                | Insol | Au      | Ag                                    | Cu     | P     | Ъ           | Zn    | Au       | <u>Ag</u> |
|                                      |         | 10       | (0)   | 0.00     | 1.20    | 10.00             | 1 76  | 1,18    | 127 0                                 | 5 24   | 0 5   | 2,7         | 1.3   | 19.4     | 28.2      |
| Copper-lead conc                     |         | 10.      | 68 4  | 0.00     | 4.36    | 12,90             | 1,70  | 1,10    | 1.57,0                                | 24     | .9 ]  | 2.7         | 1.7   | 17.4     | 20.2      |
| Copper-lead cl tail No.2             | 2.76    | 9        | 63 2  | 2.42     | 22,63   | 14.55             | 12.72 | 0,38    | 96.6                                  | 7 23   | .9 3  | 0.9         | 7.1   | 6.6      | 21.1      |
| Copper-lead scav conc                | 1.81    | 11       |       | 2.33     | 21,43   | 18.68             |       |         | 68.5                                  |        |       | 2.1         | 4.4   | 4.1      | 9.8.      |
| Zinc conc                            | 7.50    | - 11     |       | 0.33     | 64.15   | 1.24              | 1.02  |         | 9.6                                   |        | · ·   | 1.2         | 54.4  | 4.7      | 5.7       |
| Zinc cleaner tail No. 2              | 2.73    | 3   1.   |       | 0.64     | 55.65   | 3.40              | 5.46  |         | 15.6                                  |        |       | 0.8         | 17.2  | 2.6      | 3.4       |
| H " No. 1                            | 2.60    | . 11     |       | 1.15     | 36,88   | 8,05              | 19.38 |         | 21.3                                  | 11     | · •   | 1.5         | 10.8  | 2,8      | 4.4       |
| Zinc rougher tail                    | 80.00   |          |       | 0.27     | 0,54    |                   |       | 0.12    | 4.3                                   |        | 1     | .0.8<br>0.0 | 4,8   | 59.8     | 27.4      |
| Feed (calcd)                         | 100.00  | )        | .11   | 2.00     | 8.85    |                   |       | 0.10    | 12.0                                  | 4 100  |       |             |       | 100.0    |           |
|                                      |         |          |       |          |         |                   |       |         |                                       |        |       |             |       |          |           |
| the state of the second state of the |         |          |       |          |         |                   |       |         |                                       |        |       |             |       |          |           |
|                                      |         |          |       |          |         |                   |       |         |                                       |        | Ì     |             |       |          |           |
|                                      |         |          |       |          |         |                   |       |         |                                       |        |       |             |       |          |           |
| -                                    |         |          |       |          |         |                   |       |         |                                       |        |       |             |       |          |           |
| REMARKS Clean, leady                 | ll frot | <u> </u> |       | r-102    | d rough | or                |       | <u></u> | <u> </u>                              |        |       |             |       |          |           |
| REMARKS: Clean, leady<br>* at start  | y LEOEI | 1 111 C  | oppe  | r-rea    | a rough | C                 |       |         |                                       |        |       |             |       |          |           |
| ** at end                            |         |          |       |          |         |                   |       |         |                                       |        |       |             |       |          |           |

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| TEST NO. 5 SAMP   | LE:            | Nadin    | a Exp    | lorati       | lons Lin                              | nited |                |       |                                       | · · · · · · · · · · · · · · · · · · · |  | ATE: Feb                              | ). 18, <sup>-</sup> | 1970      |
|---|----------------|----------|----------|--------------|---------------------------------------|-------|----------------|-------|---------------------------------------|---------------------------------------|--|---------------------------------------|---------------------|-----------|
| OBJECT OF TEST:   |                |          | · · ,    |              |                                       | · .   |                |       |                                       |                                       | <b>.</b>                                     | HARGE:                                |                     |           |
|   |                |          |          |              |                                       |       |                |       |                                       |                                       |  | ESTED E                               | 3Y:                 |           |
| OPERATION   | Time           | %        | pН       | L            | Jnit .                                |       |                |       | Rea                                   | gents, It                             | per to                                       | n .                                   |                     |           |
|   | min            | Solids   |          | <u>  .</u> ι | used                                  | Lime  |                |       | •                                     | <u>DF 250</u>                         |  |                                       |                     |           |
| Copper-lead cleaners  |                |          |          |              |                                       |       |                |       |                                       |                                       |  |                                       |                     | 1         |
| No. 1   | 11/2           |          | · .      | 500-8        | g cell                                |       |                |       |                                       | 0.02                                  |  |                                       |                     |           |
| No. 2   |                |          |          | 250-8        | g_cell                                |       |                |       |                                       |                                       | <u>.                                    </u> |                                       | · / · ·             |           |
| Zinc cleaners   |                |          |          |              |                                       | · ·   |                |       | ••• • • •                             | -                                     |  |                                       |                     |           |
| No.sclin  | 11/2           |          | 12.1     | 500-5        | g cell                                | 1.0   | <u> </u>       |       |                                       | 0.02                                  |  |                                       |                     |           |
| ColNo.2-2009 9082 Cold  | $1\frac{1}{2}$ |          | 12.1     | 11 1         | 1                                     | 0.5   | letter and the |       | . ·                                   |                                       |  |                                       |                     |           |
| <u> </u>  |                | ļ.       | · ·      | <u> </u>     |                                       | ·     | ļ              |       | ·                                     |                                       |  |                                       |                     |           |
| Geeper-Jand 21 sail ha  | <u> S</u> .    |          | ļ        |              | · · · · · · · · · · · · · · · · · · · |       | ļ              |       |                                       |                                       |  | · · · · · · · · · · · · · · · · · · · |                     |           |
| Conner-Lesd conc  |                |          | · · · ·  |              |                                       |       |                |       |                                       | ·                                     | · · · ·                                      | · · · · · · · · · · · · · · · · · · · |                     |           |
| romantan ing binang si s  |                |          |          |              |                                       |       | ļ. <u></u>     | ļ     |                                       |                                       | ·  |                                       |                     |           |
| 5 157.67.022  |                | · .      |          |              |                                       |       |                |       |                                       | ·                                     |  |                                       |                     |           |
|   |                | <u> </u> | <u> </u> |              | •                                     |       | <u>.</u>       |       | . ·                                   |                                       | L  |                                       |                     |           |
| PRODUCT   | W              |          |          |              | ANA                                   | LYSIS | %              |       | · · · · · · · · · · · · · · · · · · · |                                       | DIST   | RIBÚTIC                               | N %                 |           |
|   | 9              | 6 C      | u        | РЬ           | Zn                                    | Έe    | Insol          | Au    | Ag                                    | Cu                                    | ₽Ъ   | Zn                                    | Au                  | Ag        |
| Calculated assays   |                |          |          |              |                                       |       |                |       |                                       |                                       |  |                                       |                     | 1         |
| And the second product in the second s |                |          |          | · .          |                                       |       |                |       | · ·                                   |                                       | · · ·  |                                       | · · · · · ,         | 1         |
| Cu-Pb rougher conc  |                |          |          | 31.24        |                                       | 13,75 | 7.40           |       |                                       | 48.8                                  |  |                                       | . 26.6              | 49.3      |
| " " rougher tail  |                | 11       |          | 23.94        | 15.70                                 |       | 8.71           | 0.67  |                                       |                                       |  | 1                                     | A 1 .               | 59.1      |
| 1st stage Zn cleaner con  | 92.            | 11       | .39      | 0.31<br>0.41 | 8,32                                  | 1,82  | 2.21           | 0.12  | 5.5                                   |                                       | 14.3   | (. ·                                  | 1 1 10              | 40.9      |
| Zn rougher conc   |                |          | .08      | 0.56         | 56.82                                 |       | 5.69           |       |                                       | 12.4                                  |  |                                       | 10.1                | 3.5       |
| Zerszerel szál rotziket – – j   | 1              |          |          | 0.50         |                                       | 5100  | 3.05           | 0.113 |                                       |                                       |  | 0211                                  |                     |           |
| Condistanda<br>Condistanda  |                |          |          |              |                                       | -     |                | · -   | -                                     |                                       |  |                                       |                     |           |
| son an  |                |          |          |              |                                       |       |                |       |                                       |                                       |  |                                       |                     | · · · · · |
|   |                |          | ·. ·     |              |                                       |       |                |       |                                       |                                       |  |                                       |                     | ***       |
|   |                |          |          |              |                                       |       | • •            |       |                                       |                                       | ·  |                                       |                     |           |
|   |                |          |          |              | ·<br>·                                |       |                |       |                                       |                                       |  |                                       |                     |           |
| Servol de level dé  |                |          |          |              |                                       |       |                |       |                                       |                                       |  | .  · · · .                            |                     |           |
|   | at liter to    | 11       |          |              |                                       |       |                |       | 1                                     |                                       | · · .  | 1                                     | N. 201              |           |
| CERCOLOLIER 🦓   | 11.            |          |          |              |                                       |       | ••             |       |                                       | 11                                    | 1  | 1                                     |                     | 1         |

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## MINES BRANCH FLOTATION TEST REPORT

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| TEST NO. 6  | SAMPI                        | E: Na          | ndina   | Expl     | oratio   | ons Lim:            | ited                                  |          |        |         |          |               |          |            | uary 18     | , 1970          |
|---|------------------------------|----------------|---------|----------|----------|---------------------|---------------------------------------|----------|--------|---------|----------|---------------|----------|------------|-------------|-----------------|
| OBJECT OF TEST  | : To tr                      | v the          | e combi | inatio   | n lime   | $e + Na_2$          | $50_3 + N$                            | aCN in   | n bulk | copper  | -lead    |               |          |            | 2000 g      |                 |
|   |                              | ition          |         | <u>.</u> |          | 2                   |                                       |          |        |         |          |               | \$       | ED B       | Y: A.S.     |                 |
| OPERATION   |                              | Ťime           | %       | рН       | U        | nit                 |                                       |          |        | Reag    | gents,   | lb per        | ton      |            |             |                 |
| OPERATION   |                              | min            | Solids  | · pm     | u        | sed                 | Lime                                  | Na2S03   | NaCN   | CX51    | DF250    | CuSO2         | NaAF     |            |             |                 |
| Grinding  |                              | 45             |         |          | 7 x      | 14 RM               | 3.0                                   | 1.0      | 0.10   |         |          |               |          |            |             |                 |
| Conditioning  |                              | 10             |         | 10.23    | * 1000   | -g cell             |                                       |          |        | 0.02    |          |               |          |            |             |                 |
| Copper-lead roug  | her                          | 11             |         |          |          |                     |                                       |          |        |         |          |               | <u> </u> |            |             | ļ               |
| Stage 1   |                              | 1              |         |          |          |                     |                                       |          |        |         | 0.02     |               | ļ        |            |             |                 |
| 11 2  |                              | 12             |         |          |          |                     |                                       |          |        | 0.01    | 0.01     |               | <u> </u> |            |             |                 |
| Copper-lead scav  | enger                        | 1 <sup>1</sup> |         |          |          |                     |                                       | <u> </u> |        |         |          |               | ļ        |            |             | .l              |
| Stage 1   |                              | 1              |         | L        |          |                     |                                       | ļ        |        | 0.002   |          |               |          |            |             | <b>.</b>        |
| Same March 2011 St.   |                              | 1              |         |          | <u> </u> |                     | · · · · · · · · · · · · · · · · · · · |          |        | 0.002   | <u>,</u> |               |          |            |             |                 |
| <u>ichteleinen en e</u><br>Ny tonisten szerie   | i.V.                         | 1)             |         |          |          |                     | <u>.</u>                              |          |        |         |          |               |          |            |             | ļ.              |
| TOTCHTHERE FOR SPECT  |                              | <u> </u>       |         |          |          |                     |                                       |          |        |         |          |               |          |            |             |                 |
|   |                              | ţ,             |         |          | · · ·    |                     |                                       |          |        |         |          |               |          |            | ·           |                 |
|   |                              | ····<br>··     |         |          |          |                     |                                       | -        |        |         | •        |               |          | <u> </u>   |             | <u>l'</u>       |
| PRODUCT   |                              | W.             |         |          |          | ANA                 | LYSIS                                 | %        |        |         |          | D             | STRIE    | BUTIO      | N %         |                 |
|   | د رابد الدر الاسار را<br>رام | %              | ő C     | u        | Pb       | Zn                  | Fe                                    | Insol    | Au     | Ag      | Cu       | E             | 2Ъ       | Zn         | Au          | Ag              |
|   | ;                            |                |         |          |          |                     |                                       |          |        |         |          |               |          |            |             |                 |
| Copper-lead cond  |                              |                |         | 5.08     |          | 6.85                |                                       | 3.74     | 1.02   |         | - 11     |               | +.2      | 2.7        | 22.6        |                 |
| Copper-lead cl t  |                              | 11 1           |         | 4.92     |          | 20.53               | 11.91                                 | 4        | 0.34   | 1       | 51       | ć             | 0.0      | 6.4        | 5.9         | 14.9            |
| Copper-lead scav  |                              | 13             |         | 7.54     |          | 19.63               |                                       | 15.34    | 0.34   |         |          |               | 5.4      | 4.1        | .4.0        | 7.4<br>7.4      |
| Zinc conc   |                              |                |         | 0.33     |          | 64.24               |                                       | 1.42     | 0.08   | 1       | 11       |               | 5        | 63.8       | 4.8         |                 |
| Zinc el-tail No.  | 2                            |                |         | 0.87     |          | 52.60               |                                       | 8.24     | 0.15   |         |          |               | .8       | 11.5       | 1.9         | 2.4             |
| 11 11 11 No.  |                              |                |         | 1.89     |          | 31.50               | 9.27                                  | 27.18    | 0.18   |         |          |               | 8.6      | 6.6<br>4.9 | 2.1<br>58.7 |                 |
| Zinc rougher tai  | .1                           |                |         | 0.32     |          | 0.54                |                                       |          | 0.12   |         | 7 22     | .0 100        | 7.3      | 100.0      | 100.0       |                 |
| Feed (calcd)  | <u></u>                      | 100            | .00     | 1.12     | 1.9/     | 8.74                |                                       |          | 0.10   | 12.0    |          | <u>.0 μ00</u> |          | 100.0      | 100.0       | 100.0           |
|   | *.                           |                |         |          |          |                     |                                       |          |        |         | i i      |               |          | ·          |             |                 |
| ನ ಜನ್ಮದ. ಆಗಡ್ ೧೯  |                              |                |         |          |          |                     |                                       |          | 1      |         |          |               |          |            |             |                 |
|   |                              |                |         |          |          |                     |                                       |          |        |         |          |               |          |            |             |                 |
| الطورية التي المحافظ ويروعون  |                              |                |         |          |          |                     |                                       |          |        |         |          |               |          |            |             |                 |
| in the second |                              |                |         |          |          |                     |                                       |          |        |         |          |               |          |            |             |                 |
|   |                              |                |         |          |          |                     |                                       |          |        |         |          | ·             |          |            |             | l               |
| REMARKS:  | · · · · ·                    |                |         | <u></u>  |          | d 0                 | 0 1 W                                 |          |        |         | -hor -   |               | 2 1.91   |            |             |                 |
| · - · · · · · · · · · · · · · · · · · ·   | it start                     |                |         |          |          | d conc,<br>4.7%.    | ر %0.1                                | in cop   | per-le | ao roug | gner C   | onc, s        | •4%,     | ru cot     | oper-iea    | an <sup>'</sup> |
|   |                              | rou            | Buer -  | scav     | conc,    | - <b>t</b> • / /o • |                                       |          |        |         |          |               |          |            |             |                 |

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## MINES BRANCH FLOTATION TEST REPORT

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| Zn rougher       Image: Stage 1       Image: St  |   | :                                     |           |           |           |          |           |             |                                       |              |               |                  |  |                 |          |            |
|---|---|---------------------------------------|-----------|-----------|-----------|----------|-----------|-------------|---------------------------------------|--------------|---------------|------------------|--|-----------------|----------|------------|
| OPERATION         Time<br>min<br>Solids         %<br>pH         Unit<br>used         Term<br>Line         Reagents:<br>(x 5 tbp: 250 (cs50, NaAT)         Term<br>NaAT         Term<br>Stage 1         NaAT         NaAT         Term<br>Stage 1         NaAT         Term<br>Stage 1         NaAT   | OPERATION   | 11                                    |           |           |           |          | • •       |             |                                       |              |               |                  |  |                 |          |            |
| OPERATION         min         Solids         PH         used         Lime         GX 5hpr 22d GuS04 NaAF         AAF           Conditioning         10         11.8         1000-g cell         2.0         1.0         1.0         1.0           An rougher         1         1         0.002         0.10         1.0         1.0         1.0         1.0           Stage 1         1         0.002         0.10         0.05         1.0         <   | OPERATION   |                                       | 1         | <u></u>   |           | · · ·    | ·····     | · · · · · · | · · · · · · · · · · · · · · · · · · · |              | <u> </u>      |                  |  | ED B            | Y:       | - <u></u>  |
| Conditioning       10       11.8       1000-g cell       2.0       0.0 July 200 0000 Hate       1.0       1.0         Stage 1       1       1       1       1       1.0       0.005       1.0       1.0       0.005       1.0       1.0       0.005       1.0       1.0       0.005       1.0       1.0       0.005       1.0       1.0       0.005       1.0       1.0       0.005       1.0       1.0       1.0       0.005       1.0   |   | ,' • •                                | · · ·     | PH.       |           | • •      | <u> </u>  | 1           | <b></b>                               | ·····        | <u> </u>      |                  | r                                      | - <u></u>       |          |            |
| Zn rougher       Image: Stage 1       Image: St  |   | min                                   | Solid     | 5         | _         | <u> </u> | Lime      | ļ           |                                       | <u>CX 51</u> | <u>DF 250</u> | CuS04            | NaAF                                   |                 |          |            |
| Stage 1       1       0.02       0.10       0.02         1       0.001       0.05       0.05         Copper-lead cleaner       1 ½       250-g cell       0.01       0.05       0.01         X0.1       1 ½       250-g cell       0.01       0.02       0.01       0.05         X0.1       1 ½       ~12       00-5       0.01       0.02       0.01       0.05         X0.1       1 ½       ~12       00-5       0.01       0.02       0.01       0.05         N0.1       1 ½       ~12       0       0.5       0.02       0.01       0.02         N0.2       1 ½       ~12       "       0.5       0.5       0.01       0.02       0.01         PRODUCT       %T       ~12       "       0.5       0.5       0.5       0.5       0.5         Calculated assays       6.15       10.60       26.62       12.87       12.71       6.46       0.72       111.52       58.0       83.2       9.1       28.5       53.         Copper-lead-rotsation       92.02       0.36       0.22       8.24       0.11       5.50       29.7       10.4       86.8       67.5       39.9  |   |                                       | · · · ·   | 11.8      | 100       | 0-g cell | 2.0       |             |                                       |              | · .           | 1.0              |  |                 |          | ·          |
| 1       1       0.01       0.05       0.05         Copper-lead cleaner       1 ½       250-g cel1       0.006       1       1         No.1       1 ½       250-g cel1       0.006       1       1       1         No.1       1 ½       250-g cel1       0.00       0.02       1       1         No.2       1 ½       ~12       500-g cel1       1.0       0.02       1       1         No.2       1 ½       ~12       70       10.5       1   |   | · · · · · · · · · · · · · · · · · · · | · · ·     | · · · ·   |           |          | ·.        |             |                                       |              |               |                  |  |                 |          |            |
| 1       2   |   |                                       |           |           |           | <u> </u> | <u> </u>  | <u> </u>    |                                       | 0.02         |               |                  | 0.10                                   |                 |          |            |
| Copper-lead cleaner         1 *         250-rg cell         0.01         0.02         1           No.1         1 *         ~12         500-g cell         0.02         1  |   |                                       |           |           |           | `        |           |             |                                       |              |               |                  | 0.05                                   | 1 1 1           | • .      |            |
| Copper-lead cleaner         1 ½         250-ag celT         0.006         1         1         1           N0c.1         1 ½         ~12         500-g cel1         1.0         0.02         1   | 21.n row31 er taff  | 2                                     |           |           |           | ·        |           |             |                                       |              | 0.01          |                  | 0.05                                   | •               |          |            |
| Zinc cleamers       ~12       ~12       ~12       ~12       ~12       ~12       0.02            No. 1       12       ~12       ~12        0.5   |   | 1 1                                   | . ·       |           | 250       | -e cell  |           |             |                                       |              |               |                  |  | 1               |          | 1          |
| No.1       1 ½       ~12       500-g cell       1.0       0.02       0.02       0.02         No.2       1 ½       ~12       " " 0.5       0.5       0.02       0.02       0.02       0.02         No.2       1 ½       ~12       " " 0.5       0.5       0.02       0.02       0.02       0.02         Properties       0.00       0.02       0.00       0.02       0.00       0.02       0.00         Properties       0.00       0.00       0.00       0.00       0.00       0.00       0.00         Properties       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00         Properties       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00         Calculated assays       0.11       0.60       26.62       12.87       12.71       6.46       0.72       111.52       58.0       83.2       9.1       28.5       53.         Copperties       0.00       20.036       0.22       8.24       0.11       5.50       29.7       10.4       86.8       67.5       39.9         Ist stage zinc conc       12.42       <   | Zinc cleaners   |                                       |           |           |           | · · ·    |           |             |                                       | · ·          |               |                  |  |                 | · .      | 1          |
| No. 2         1.1/2         ~12         1         1         0.5         1         <   | No. 1   | 1 1/2                                 |           | ~12       | 500       | -g cell  | 1.0       | 1           |                                       | :            | 0.02          |                  |  | 1               | 1        | 1 .        |
| PRODUCT         WT         ANALYSIS %         DISTRIBUTION %           Calculated assays         6.15         10.60         26.62         12.87         12.71         6.46         0.72         111.52         58.0         83.2         9.1         28.5         53.           Copper-lead ro conc         6.15         10.60         26.62         12.87         12.71         6.46         0.72         111.52         58.0         83.2         9.1         28.5         53.           Copper-lead ro scav conc         7.86         9.90         22.10         14.43         13.41         8.49         0.63         97.84         70.3         89.6         13.2         32.5         60.           Copper-lead ro tail         92.02         0.36         0.22         8.24         0.11         5.50         29.7         10.4         86.8         67.5         39.           Ist stage zinc cl conc         12.42         0.64         0.48         57.63         2.82         6.26         0.11         12.76         7.1         3.1         81.9         8.8         12.           Zinc rougher conc         12.42         0.64         0.48         57.63         2.82         6.26         0.11         12.76         7.1  |   |                                       |           |           |           |          | 0.5       | 1           |                                       |              |               | · · · · ·        | · · · · · · · · · · · · · · · · · · ·  | 1.              | 1        | 1:         |
| PRODUCT         WT         ANALYSIS %         DISTRIBUTION %           Calculated assays<br>Copper-lead ro conc<br>Copper-lead ro conc<br>Copper-lead ro rotscav conc<br>Copper-lead rotscav conc<br>Conc<br>Copper-lead rotscav conc<br>Copper-lead rotscav conc<br>Coper-lead rotscav conc<br>Coper-lea   | مراجع المراجع المراجع المراجع مي من المراجع المراجع من من المراجع من          |                                       |           |           | 1.        | ·        |           | <br> .      |                                       |              |               |                  | · · · ·                                | 1               |          |            |
| PRODUCT         WT         ANALYSIS %         DISTRIBUTION %           Calculated assays<br>Copper-lead ro conc         6.15         10.60         26.62         12.87         12.71         6.46         0.72         111.52         58.0         83.2         9.1         28.5         53.           Copper-lead ro conc         6.15         10.60         26.62         8.24         0.11         5.50         29.7         10.4         86.8         67.5         39.           Ist stage rinc cl conc         10.55         0.43         0.42         62.14         1.71         2.65         0.10         11.93         4.0         2.3         75.3         6.7         9.           Zinc rougher conc         12.42         0.64         0.48         57.63         2.82         6.26         0.11         12.76         7.1         3.1         81.9         8.8         12.  | · · · · · · · · · · · · · · · · · · ·   |                                       | B         | 1         |           | · .      |           |             |                                       | · · · · ·    |               |                  |  |                 |          | +          |
| PRODUCT         9%         Cu         Pb         Zn         Fe         Insol         Au         Ag         Cu         Pb         Zn         Au         Ag           Calculated assays         Copper-lead ro conc         6.15         10.60         26.62         12.87         12.71         6.46         0.72         111.52         58.0         83.2         9.1         28.5         53.           Copper-lead rot-scav conc         7.98         9.90         22.10         14.43         13.41         8.49         0.63         97.84         70.3         89.6         13.2         32.5         60.           List stage zinc. cl conc         10.55         0.43         0.42         62.14         1.71         2.65         0.10         11.93         4.0         2.3         75.3         6.7         9.           Zinc rougher cone         12.42         0.64   |   |                                       |           |           | ,         |          | 1         |             |                                       | · · · ·      |               | · · ·            | ······································ |                 |          | +          |
| Cu         Pb         Zn         Fe         Insol         Au         Ag         Cu         Pb         Zn         Au         Ag           Calculated assays         Copper-lead ro conc         6.15         10.60         26.62         12.87         12.71         6.46         0.72         111.52         58.0         83.2         9.1         28.5         53.           Copper-lead ro conc         7.98         9.90         22.10         14.43         13.41         8.49         0.63         97.84         70.3         89.6         13.2         32.5         60.           Copper-lead ro tail         92.02         0.36         0.22         8.24         0.11         5.50         29.7         10.4         86.8         67.5         39.           Ist stage zinc cl conc         10.59         0.43         0.42         62.14         1.71         2.65         0.10         11.93         4.0         2.3         75.3         6.7         9.           Zinc rougher conc         12.42         0.64         0.48         57.63         2.82         6.26         0.11         12.76         7.1         3.1         81.9         8.8         12.4   |   | II: W                                 | T         |           |           | ΔΝΔΙ     | VSIS      | <u> </u>    |                                       |              |               |                  |  |                 |          | <u> </u>   |
| Calculated assays         Cold         FD         Zn         Fe         Insol         Ad         Fe         Cold         FD         Zn         Ad         A   | PRODUCT   | 10                                    | . Ih      |           | D1        | ·        |           |             | · · · ·                               | 1 10         | _             |                  |  | - ومحدث المحافظ | <u>,</u> |            |
| Copper-lead ro conc       6.15       10.60       26.62       12.87       12.71       6.46       0.72       111.52       58.0       83.2       9.1       28.5       53.         Copper-lead ro+scav conc       7.98       9.90       22.10       14.43       13.41       8.49       0.63       97.84       70.3       89.6       13.2       32.5       60.         Copper-lead ro tail       92.02       0.36       0.22       8.24       0.11       5.50       29.7       10.4       86.8       67.5       39.         Ist stage zinc cl conc       10.59       0.43       0.42       62.14       1.71       2.65       0.10       11.93       4.0       2.3       75.3       6.7       9.         Zinc rougher conc       12.42       0.64       0.48       57.63       2.82       6.26       0.11       12.76       7.1       3.1       81.9       8.8       12.         Zinc rougher conc       12.42       0.64       0.48       57.63       2.82       6.26       0.11       12.76       7.1       3.1       81.9       8.8       12.         Zinc rougher conc       12.42       0.64       14.43       14.44       14.44       14.44       14.44<  |   |                                       |           | <u>u</u>  | PD        | 2n       | <u>re</u> | Insol       | Au                                    | - Ag         |               | P                | D                                      | Zn              | Au       | Ag         |
| Copper-lead ro conc       6.15       10.60       26.62       12.87       12.71       6.46       0.72       111.52       58.0       83.2       9.1       28.5       53.         Copper-lead ro+scav conc       7.98       9.90       22.10       14.43       13.41       8.49       0.63       97.84       70.3       89.6       13.2       32.5       60.         Copper-lead ro tail       92.02       0.36       0.22       8.24       0.11       5.50       29.7       10.4       86.8       67.5       39.         Ist stage zinc cl conc       10.59       0.43       0.42       62.14       1.71       2.65       0.10       11.93       4.0       2.3       75.3       6.7       9.         Zinc rougher conc       12.42       0.64       0.48       57.63       2.82       6.26       0.11       12.76       7.1       3.1       81.9       8.8       12.         Zetae       0.64       0.48       57.63       2.82       6.26       0.11       12.76       7.1       3.1       81.9       8.8       12.         Zetae       0.64       0.48       57.63       2.82       6.26       0.11       12.4       13.4       14.4  |   |                                       |           |           |           |          | •         |             |                                       | - A.         | -             |                  |  |                 | . • .    | i di se se |
| Copper-lead-rot-scav conc       7.98       9.90       22.10       14.43       13.41       8.49       0.63       97.84       70.3       89.6       13.2       32.5       60.         Copper-lead ro tail       92.02       0.36       0.22       8.24       0.11       5.50       29.7       10.4       86.8       67.5       39.         1st stage zinc cl conc       10.59       0.43       0.42       62.14       1.71       2.65       0.10       11.93       4.0       2.3       75.3       6.7       9.         Zinc rougher conc       12.42       0.64       0.48       57.63       2.82       6.26       0.11       12.76       7.1       3.1       81.9       8.8       12.         2000       0.64       0.48       57.63       2.82       6.26       0.11       12.76       7.1       3.1       81.9       8.8       12.         2000       0.64       0.48       57.63       2.82       6.26       0.11       12.76       7.1       3.1       81.9       8.8       12.         2000       2000       2000       2000       2000       2000       2000       2000       2000       2000       2000       2000 <t< td=""><td></td><td>6</td><td></td><td>in an</td><td>26.62</td><td>12.87</td><td>12 71</td><td>6 16</td><td>0 72</td><td>111 5</td><td>2 58</td><td>0 83</td><td>2.</td><td>0 1</td><td>-28 5</td><td>53 3</td></t<>  |   | 6                                     |           | in an     | 26.62     | 12.87    | 12 71     | 6 16        | 0 72                                  | 111 5        | 2 58          | 0 83             | 2.                                     | 0 1             | -28 5    | 53 3       |
| Copper-lead ro tail       92.02       0.36       0.22       8.24       0.11       5.50       29.7       10.4       86.8       67.5       39.         1st stage zinc cl conc       10.55       0.43       0.42       62.14       1.71       2.65       0.10       11.93       4.0       2.3       75.3       6.7       9.         Zinc rougher conc       12.42       0.64       0.48       57.63       2.82       6.26       0.11       12.76       7.1       3.1       81.9       8.8       12.  |   |                                       |           |           |           | 1 1      |           |             |                                       |              |               | · •              |  | ,               |          |            |
| Ist stage zinc_cl conc       10.55       0.43       0.42       62.14       1.71       2.65       0.10       11.93       4.0       2.3       75.3       6.7       9.         Zinc rougher conc       12.42       0.64       0.48       57.63       2.82       6.26       0.11       12.76       7.1       3.1       81.9       8.8       12.         View       0.64       0.48       57.63       2.82       6.26       0.11       12.76       7.1       3.1       81.9       8.8       12.  |   |                                       |           |           |           |          | 10.41     |             |                                       | 4            | · II          |                  | 4                                      | 1.              | . 1      | 39.3       |
| Zinc rougher conc<br>12.42 0.64 0.48 57.63 2.82 6.26 0.11 12.76 7.1 3.1 81.9 8.8 12.  |   | 14                                    | . 0 .     |           |           |          | 1.71      | 2.65        |                                       |              | · ++-         | 1                |  |                 | •        | 9.8        |
| CUEDEAL SAFT LOUISING<br>CUEDEAL SAFT LOUISING |   |                                       |           |           |           |          |           |             | 4 .                                   |              |               |                  |  | 1               |          | 12.3       |
| REMARKS   |   | -                                     |           |           |           |          |           | ·           |                                       |              |               |                  |  |                 |          | · ·        |
| REMARKS   |   |                                       |           |           |           |          |           |             |                                       | 1            |               |                  |  |                 |          |            |
| REMARKS   | Cooper-lead coesies (   |                                       | _ ` {{ `` | • • • •   | • • •     |          |           |             |                                       |              |               |                  |  |                 |          | l          |
| REMARKS   | n far se  | ·                                     | 2.<br>1   |           |           |          |           |             | · .                                   |              |               |                  |  |                 |          |            |
| REMARKS   |   |                                       |           |           |           |          |           |             |                                       |              |               |                  |  |                 |          |            |
| REMARKS   | ענים שריבשרי עוביסה שלא שלאלי לעורדי בר ופריסריקרי.<br>קר   |                                       |           |           |           |          | · .       | • .         |                                       |              |               |                  |  |                 | ····     | 1 7        |
| REMARKS   |   |                                       |           |           |           |          |           |             |                                       | · .          |               |                  |  |                 | · · ·    | ·<br> .    |
| REMARKS   | د .<br>الحمار الإجراد بين المالية المالية المراجع المراجع المراجع المراجع المراجع المراجع المراجع المراجع المراجع |                                       |           |           | • • • • • |          |           | 1. E        |                                       |              |               | - <sup>1</sup> • |  | ·               |          |            |
|   |   |                                       | <b>.</b>  | 1         |           |          |           | •           | 1                                     |              |               |                  |  |                 |          |            |
|   | EMARKS  |                                       | <u> </u>  |           | -         | <u></u>  |           |             |                                       |              | <u></u>       | <u>_</u>         |  |                 |          |            |
|   |   |                                       | •         |           |           | · .      |           |             |                                       | •            |               |                  | :                                      |                 |          |            |
|   |   |                                       |           |           | , :       | •        | • • •     |             |                                       | ·            | · .           |                  |  |                 |          |            |
|   |   | ·                                     |           | · · · · · | <u> </u>  | <u></u>  | <u>`</u>  | · .         |                                       |              |               |                  |  |                 |          |            |

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| TEST NO. 7 SAMP                                 | LE: 1  | Vadina  | Explo | rations  | Limit                        | ed                              |          |          |        |        |        | DATE  |            | ril 7,   |          |
|---|--------|---------|-------|----------|------------------------------|---------------------------------|----------|----------|--------|--------|--------|-------|------------|----------|----------|
| OBJECT OF TEST: To t                            | ry the | e combi | natio | n Na_CO, | , + Na                       |                                 | - NaCN   | in bul   | k copp | er-lea | đ      | CHAF  | GE:        | 2000 g   |          |
| OBJECT OF TEST: To t<br>flotation with AF242 an | d AF 2 | 238 as  | colle | ctors.   | 5                            | 2 3                             |          |          |        |        |        | TEST  | ED B       | <u> </u> |          |
|   | Time   | %       | pН    | Uni      |                              | 1                               |          |          | Rea    | gents. | lb per | ton   |            |          | ]        |
| OPERATION                                       | min    | Solids  | рп    | use      | d                            | Na <sub>2</sub> CO <sub>3</sub> | Na2SO3   | NaCN     | AF242  | AF238  | DF250  |       |            |          |          |
| Grinding  | 30     | 65      | 8,2   | 12 in,   | BM                           | 3.0                             | 1,0      | 0.10     | 0,04   |        |        |       |            |          | 1        |
| Conditioning                                    | 20     |         |       | Aerator  |                              | 1.0                             |          |          |        | 0.02   |        |       |            |          |          |
| Copper-lead rougher                             |        |         |       | 1000-g   |                              |                                 |          | <u> </u> |        |        |        |       |            |          |          |
| Stage 1   | 1      |         | 8.0   |          |                              |                                 |          |          | 0.02   | 0.02   |        |       |            |          |          |
| " 2   | 1/2    |         |       |          |                              |                                 | <u> </u> |          |        |        | 0.02   |       |            |          | _        |
| " 3   | 1      |         |       |          |                              |                                 |          |          | 0.02   |        |        |       |            |          |          |
|   |        |         |       | Į        | ·····                        | ļ                               | ļ        | L        | Į      |        |        |       | . <u> </u> |          |          |
|   |        |         |       |          |                              |                                 | <u></u>  |          |        |        | -      |       | <u> </u>   |          |          |
|   |        |         |       |          | محمد الروم ومورد ريوها المار |                                 | ļ        | <u> </u> | ļ      |        |        |       | <u> </u>   |          |          |
|   |        |         |       |          |                              |                                 | <u> </u> |          |        |        |        |       |            | }        |          |
|   |        |         |       |          |                              |                                 | ļ        |          |        |        |        |       |            |          | -+       |
|   |        |         |       | [        |                              |                                 | <u> </u> | [        |        | L      |        | L     | <u> </u>   |          | <u> </u> |
| PRODUCT   | W      |         |       |          | ANAL                         | YSIS                            | %        | <b></b>  |        |        | DI     | STRIB |            | N %      |          |
|   | 9      | 6       |       |          |                              |                                 |          |          |        |        |        |       |            |          |          |
| Copper-lead ro conc                             | 15     | .18     |       |          |                              |                                 |          |          |        |        |        |       |            |          |          |
| " " ro tail                                     |        | .82     |       |          |                              |                                 |          |          |        |        |        |       |            |          |          |
| Feed  |        | .00     | · [   |          |                              |                                 |          |          |        |        |        |       |            |          |          |
|   |        |         |       |          |                              |                                 |          |          |        |        |        |       |            |          |          |
|   |        |         |       |          |                              |                                 |          |          |        |        |        |       |            |          |          |
| TEST PRODUCTS<br>NOT ASSAYED                    | li -   | Ì       |       |          |                              |                                 |          |          |        |        |        |       |            |          |          |
| NOI ASSAILD                                     |        |         |       |          |                              |                                 |          |          |        |        |        |       |            |          |          |
|   |        |         |       |          |                              |                                 |          |          |        |        |        |       |            |          |          |
|   |        |         |       |          |                              |                                 |          |          |        |        |        |       |            |          |          |
|   |        |         |       |          |                              |                                 |          |          |        |        |        |       |            |          |          |
|   |        |         |       |          |                              |                                 |          |          |        |        |        |       |            |          |          |
|   |        |         |       |          |                              |                                 |          |          |        |        |        |       |            |          |          |
|   |        |         |       |          |                              |                                 |          |          |        |        |        |       |            |          |          |
|   |        |         |       |          |                              |                                 |          |          |        |        |        |       |            |          |          |
| REMARKS: Dirty, no:                             |        | et ive  | flost |          | ive a                        | mounta                          | of pr    | rito f   | loatod |        |        |       |            |          |          |
| Dirty, no.                                      | n-sere | CLIVE   | LUAL  | ercess   | TAG G                        | mounes                          | от ЪМ    | LILE I.  | ruated | •      |        |       |            |          |          |
|   |        |         |       |          |                              |                                 |          |          |        |        |        |       |            |          | ł        |

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MINES BRANCH FLOTATION TEST REPORT Sheet 1 of 2

|                      |        |                |      |            | ns Limit |            |         |         | ··· <u>·</u> ····                     |                                   |         |       |            | ril 7,  | 1970  |
|----------------------|--------|----------------|------|------------|----------|------------|---------|---------|---------------------------------------|-----------------------------------|---------|-------|------------|---------|-------|
| OBJECT OF TEST: Repe | eat of | Test           | 6,Ъı | it empl    | oyed AF: | 242 and    | 1 Z-200 | as co   | llecto                                | rs                                |         |       |            | 2000 g  |       |
| <u>în c</u>          | onjunc | tion           | with | CX51*.     |          |            |         |         |                                       |                                   |         |       | TED B      | Y: A.S. |       |
| OPERATION            | Time   | %              | - pH |            | Unit     |            |         |         |                                       | igents,                           |         |       |            |         |       |
| OFERATION            | min    | Solid          | s    | <u>.</u>   | used     | Lime       | Na2S03  | NaCN    | AF242                                 | Z-200                             | CX51    | DF25( | ) $CuSO_4$ | NaAF    |       |
| Grinding             | _30    | 65             |      | 12 1       | n. B.M.  | 3.0        | 1.0     | 0.15    | 0.04                                  |                                   | Ĺ       |       |            |         |       |
| Conditioning         | 10     |                | 10.  | 0 1000     | -g cell  | · ·        |         |         |                                       | 0.02                              | 0.01    |       |            |         |       |
| Copper-lead rougher  | i ·    |                | 1    |            | •        |            |         |         |                                       |                                   | :       |       |            |         |       |
| Stage 1              | 1/2    |                | 1    | <u> </u>   |          |            |         | · ·     |                                       |                                   |         | 0.02  | 2          |         |       |
| " 2                  | 1      |                |      | 1          |          | 1.         |         |         |                                       |                                   | 0,01    |       |            |         |       |
| " 3                  | 1      | ·              |      |            |          |            |         |         |                                       |                                   | 0,01    |       |            |         |       |
| Conditioning         | 10     |                | 11,  | 6          |          | 2.0        |         |         |                                       |                                   | ······  |       | 1.0        | : ]     |       |
| Zinc rougher         | [      |                | -    |            |          | -          |         |         | 1                                     |                                   | • • •   |       |            |         |       |
| Stage 1              | 1/2    | · · · ·        |      |            |          |            |         |         |                                       |                                   | 0.02    |       |            |         |       |
| <u> </u>             | 1      | <u> </u> -     |      |            |          |            |         |         | · · ·                                 |                                   |         | 0.02  | 2          | 0.10    |       |
| " 3                  | 1      |                |      |            |          |            |         |         | <u> </u>                              | · · · · · · · · · · · · · · · · · |         |       |            | 0.05    |       |
| <sup>11</sup> 4      | 1/2    |                | -    |            |          |            | ·       |         | · · · · · · · · · · · · · · · · · · · |                                   |         |       |            | 0.05    |       |
|                      | l w    | <del>,</del> 1 |      |            | ΔΝΔ      | LYSIS      | %       |         | · · · · · · · · · · · · · · · · · · · | 1.                                | D       | STRI  | BUTIO      | N %     |       |
| PRODUCT              | %      |                | Cu   | РЪ         | Zn       | Fe         | S       | Au      | Ag                                    | C                                 |         | Pb    | Zn         | Au      | Ag    |
|                      |        |                |      |            |          |            |         | <u></u> |                                       |                                   |         |       |            |         |       |
| Copper-lead ro conc  | 11     |                | .32  | 10.08      | 26.40    | 9.77       | 1       | 0.40    | 54.5                                  | 0                                 |         | 35.0  | 49.4       | 38.9    | 66.1  |
| Zinc ro conc         |        |                | .,47 | 1.00       | 40.40    | 7.42       |         | 0.15    | 14.9                                  |                                   |         | 5.4   | 48.3       | 9.3     | 11.6  |
| Pyrite ro conc       |        |                | .36  | 0.42       | 0.54     |            | 39.58   | 0.29    | 10.4                                  |                                   | .1      |       | 1.6        | 42.4    | 19.0  |
| Final tailing        |        |                | .04  | 0.16       | 0.13     |            | 1.83    | 0.30    | 0.8                                   | · H                               | .9      | 4.3   | 0.7        | 9.4     | 3.3   |
| Feed (calcd)         | 11     |                | .10  | 1.87       | 8.43     | 14.50      |         | 0.16    | 12.9                                  | - II ·                            | .0   10 | 0.0   | 100.0      | 100.0   | 100.0 |
| Copper-lead ro tail  |        |                | .31  | 0.33       | 5.07     |            |         | 0.12    | 5.2                                   | 11                                |         | • •   |            |         |       |
| Linc ro tail         | ∦ 74.  | .18 C          | .15  | 0.24       | 0.27     |            |         | 0.11    | 3.9                                   | 1.                                |         | [     |            |         |       |
|                      | //     |                | ·    |            | · .      |            |         |         |                                       |                                   |         |       |            |         |       |
|                      |        |                |      |            |          |            |         |         |                                       |                                   |         |       | (          |         |       |
|                      |        |                |      |            |          |            |         |         |                                       |                                   |         |       |            |         |       |
|                      |        |                | •    | <b>.</b> . |          |            |         | •       |                                       |                                   |         |       |            |         | •     |
| · · · · ·            |        |                |      |            |          |            |         |         |                                       |                                   |         |       |            | ·. ·    |       |
| · ·                  |        |                |      |            |          |            |         |         | 1.1                                   |                                   |         |       |            |         | · .   |
|                      | ll.    |                |      |            |          | <i>.</i> . |         |         |                                       |                                   |         |       |            |         |       |
|                      |        |                |      |            |          |            |         |         |                                       |                                   |         | •     |            |         |       |
|                      | 11     | 11             |      | 1          | I 'l     |            | 1       |         | 1                                     | · II · ·                          |         |       | 1          | 1       |       |

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|  |        |          |          |            |        | 2017   |            |            |      |        |          |          | Sheet  |              |          |
|--|--------|----------|----------|------------|--------|--------|------------|------------|------|--------|----------|----------|--------|--------------|----------|
| TEST NO 8 SAM  | PLE: N | Jadina   | a Exp    | lorat      | ions ] | Limite | d          |            |      |        |          | DAT      | E: Apr | <u>il 7,</u> | 1970     |
| OBJECT OF TEST:  | 3.     |          |          |            |        |        |            |            |      |        |          | CHA      | RGE:   |              |          |
|  |        |          |          |            |        |        |            |            |      |        |          |          | TED BY | :            |          |
| OPERATION  | Time   | %        | pН       | l          | Jnit_  |        |            |            | Reag | gents, | lb per   | ton      |        | <del></del>  | 7-00     |
| OFERATION  | min    | Solids   |          | - ī        | ised   |        |            |            |      |        | CX51     |          |        |              | H2SO4    |
| Conditioning   | 10     | 1        | 8.7      | - 1        |        | 1.     |            |            |      |        | 0.10     |          |        |              | 2.9      |
| Pyrite rougher   | ÷;     |          |          |            |        |        |            |            |      |        |          |          |        | <u> </u>     |          |
| Stage 1  | 1/2    |          |          |            |        |        |            |            |      |        |          |          | _      | ļ            |          |
| " 2  | 1      |          |          | ł.         |        |        |            |            |      |        | 0.05     |          |        | <b>_</b>     |          |
| <u> </u>   | 1      |          |          |            |        |        |            |            |      | · .    | 0.05     |          |        | ļ            |          |
| and the start of the start of the  | 1 1/2  | 4        |          |            |        |        |            |            |      |        | 0.05     |          |        | <b>_</b>     |          |
| ۵  | -      | ·        | ļ        | _ <u>_</u> |        |        | <u></u>    | <b>├</b> ; |      |        |          |          |        | <b></b>      | +        |
| 54 · · · · · · · · · · · · · · · · · · ·   | ļ      | ļ        | · ·      |            |        |        |            | ļ          |      |        |          | ·        |        | <b></b>      | ╂┩       |
| E is a   |        |          |          |            |        | 1      | . <u> </u> | <b> </b>   |      |        | ·····    | <b> </b> |        | <u> </u>     |          |
|  |        | <b>_</b> |          |            |        |        |            |            |      |        |          |          |        | ╂            | 4        |
|  |        | L        |          |            |        |        |            |            |      |        |          |          |        | ÷            | ╉┿┯╼╼┿┙┥ |
|  |        | <u> </u> | <u> </u> |            |        |        | <u> </u>   |            |      | 11     |          |          |        |              | <u> </u> |
| PRODUCT  | . W    | 11       |          |            | ANA    | LYSIS  | %          |            |      |        |          | SIRI     | BUTION |              |          |
|  | 9      | 6        |          |            |        |        |            |            |      |        | <u> </u> |          |        |              |          |
| ~ · ·  |        |          |          |            |        |        |            | 1          |      | 1      |          | ŀ        |        |              | l I      |
|  |        | ×        | 1        |            |        |        |            |            |      |        |          |          |        |              |          |
| · · · · · · · · · · · · · · · · · · ·  |        |          |          |            |        |        |            |            | · ·  |        |          |          |        |              | 1        |
|  |        |          | ļ        |            |        |        |            |            |      |        |          |          |        |              | 1        |
|  | •      |          |          |            |        |        | 1          |            |      |        |          |          | •      |              | í I      |
|  |        |          |          |            |        |        |            |            |      |        |          |          |        |              | F        |
| n an the state of the second sec   |        |          | - e      |            |        |        |            |            |      |        |          |          |        |              |          |
| traffe ?   |        |          |          |            |        |        |            |            |      | ┡      |          |          | ļ      |              |          |
| the second s<br>The second se<br>The second s<br>The second seco |        |          |          |            |        |        |            |            |      |        |          |          |        |              |          |
|  |        |          |          |            |        |        |            |            |      |        |          |          |        |              |          |
|  |        |          |          |            |        |        |            |            | 1    |        |          |          |        |              |          |
|  | ľ      |          |          |            |        |        |            |            |      |        |          | .<br> -  |        |              |          |
| n<br>Shara an  |        |          |          |            |        |        |            |            | 1    |        |          |          |        |              |          |
|  |        |          |          |            |        |        | <u> </u>   | <u> </u>   |      |        |          | <u> </u> |        |              | l        |
| REMARKS:   |        |          |          |            |        |        |            |            |      |        |          |          |        |              |          |
| •,   |        |          |          |            |        |        |            |            |      |        |          |          |        |              |          |

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Sheet 1 to 2

| TEST NO 9 SAMP  |                    |        |                                       |       | ons Limi  |          |             |       |        |         | •    |       |         | pril 8,    | 1973         |
|---|--------------------|--------|---------------------------------------|-------|-----------|----------|-------------|-------|--------|---------|------|-------|---------|------------|--------------|
| OBJECT OF TEST: Repe  | at of              | Test 2 | but w                                 | vitho | ut aerat: | Lon      | •           |       |        |         |      |       | ARGE:   |            |              |
|   |                    |        |                                       | . : . |           | <u> </u> |             |       |        |         |      |       | STED E  | <u>BY:</u> | ·            |
| OPERATION   | Time               | %      | - pH                                  |       | Unit      |          |             |       |        | igents, |      | r ton |         | *          |              |
| OFERATION   | min                | Solids | - pri                                 |       | used      | Na2CO    | Na2S03      | NaCN  | CX 51  | DF 250  |      |       | •       |            |              |
| Grinding  | :30                | 65     |                                       | 12    | in. BM    | 3.0      | 1.0         | 0.10  | 0.01   |         |      |       |         |            |              |
| Conditioning  | 10                 | · · ·  | 8.2                                   | 100   | 0-g_cel1  | 1        |             |       | 0.01   | 0.02    |      | T     | *       |            | <u></u>      |
| Copper-lead rougher   |                    |        |                                       |       |           | <u> </u> |             |       |        |         |      |       |         |            | $\mathbf{F}$ |
| Stage 1   | с.<br>7.           |        |                                       | 1     |           | · .      |             |       | 0.005  |         |      | 1     |         | •          |              |
| " 2   | . ij               |        |                                       | Ì     | · ·       |          |             |       | 0.005  | 0.008   |      |       |         | ŀ          |              |
| " 3   | ł.                 |        |                                       |       | · · · ·   | ĺ        |             |       | 0.0025 | 0.004   |      | ·     | ;       |            |              |
| <del></del>   | 5                  | ·      |                                       | İ     |           | 1        |             |       | 0.0025 |         |      |       |         |            |              |
| " 5   | 3                  | 3.4    |                                       | 1     |           | 1        |             |       | 0.0025 | 0.004   |      | 1     |         |            |              |
|   | <u> </u>           |        |                                       | 1     |           | 1        |             |       |        | İ       |      |       | -       |            | 1            |
|   |                    |        |                                       | Τ     | · .       | · ·      |             |       |        |         | `    |       | : .     | 1          |              |
|   |                    | -      |                                       |       |           | 1        |             |       | ·      |         |      |       |         |            | :            |
|   |                    | 1<br>  |                                       |       | • .       |          |             |       |        | ·       |      |       |         |            |              |
|   | W.                 | Т      |                                       |       | ANAL      | YSIS     | %           |       |        |         | D    | ISTR  | IBUTIO  | N %        | :            |
| PRODUCT   | %                  |        | u                                     | Pb    | Zn        |          | Fe/FeS      | Au    | Ag     | Cu      |      | РЪ    | Zn      | Au         | Ag           |
| Copper-lead ro conc-No.   | 1 1.               | 68 14  | .51 1                                 | 1.94  | 6.32      | 16.72    | 3.97        | 1.20  | 128.4  | 0.23.4  | 4 1  | 0.0   | 1.3     | 12.0       | 16.7         |
| <u>11 11 11</u> No.   | 2 3                | 65 11  |                                       | 0.73  | 1 1       | 27.24    | 17.43       | 0.65  | 81.7   | . 11    |      | 9.5   | 2.0     | 14.1       | 23.1         |
| 11 11 11 11 NO.   | 3 4.               | 31 4   |                                       | .0.35 |           |          | 26.49       | 0.40  | 41.1   | 11      |      | 2.2   | 2.0     | 10.2       | 13.7         |
| 11 11 11 11 No.   | 4 2.               | 71 2   |                                       | 8.00  |           | 33.85    | 31.89       | 0.35  | 28.3   | 61      |      | 0.8   | 1.4     | 5.6        | 5.9          |
| 11 11 11 17 No.   | 5 2.               | 50 0   | .96                                   | 6.24  |           |          | 28.57       | 0.34  | 27.0   |         |      | 7.8   | 1.9     | 5.0        | 5.2          |
|   | 85.                |        | · · · · · · · · · · · · · · · · · · · | 0.70  |           | L0.08    |             | 0.11  | 5.3    |         |      | 9.7   | 91.4    | 53.1       | 35.4         |
| Feed (calcd)  | 100.               | 00 1   | .04                                   | 2.01  | 8.24      | 12.83    |             | 0.17  | 12.9   | 4 100.0 | ) 10 | 0.0   | 100.0   | 100.0      | 100.0        |
|   |                    |        |                                       |       |           |          | · · · · · · |       |        |         |      |       |         | ·          |              |
|   | 119_ ;             |        |                                       |       |           | - , A    | 2           |       |        |         |      |       |         |            |              |
|   |                    |        |                                       |       |           |          |             |       |        |         |      |       |         |            |              |
|   |                    |        | · ·                                   | ·     |           |          |             |       |        |         |      |       |         | · .        |              |
|   |                    |        |                                       |       |           | · · · .  |             | · · · |        |         |      |       |         |            |              |
|   |                    |        |                                       |       |           |          | · ·         |       | · · .  |         |      | • •   | · · · · | · · ·      | • •          |
|   |                    |        |                                       |       |           | · · · ·  | · · · ·     |       |        |         |      | : ·   |         |            | · ·          |
| <u> 18730 log lagu (                                   </u>   |                    |        | ·                                     | •     |           |          |             |       |        |         |      | · .   |         | <u>.</u>   | <u> </u>     |
| REMARKS:  |                    |        |                                       |       |           |          |             |       |        |         |      |       |         | <u></u>    |              |
| a contra de la contra de contra de la contra contra la contra de la contra de la contra de la contra de la cont | يري يا ميدي الله ا |        | • •                                   |       |           |          |             |       |        | ۰.      |      | ۰.    |         |            |              |
|   |                    |        |                                       |       |           |          |             |       |        |         |      |       |         |            |              |

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| TEST NO.   | 9                           | SAM | PLE:                     | Nadin  | a Exp                        | loratio                         | ons Lim                      | ited                             |        |              |                                  |                          |            | DA                       | TE: A                    | pril 8,                      | 1970 |
|--|-----------------------------|-----|--------------------------|--------|------------------------------|---------------------------------|------------------------------|----------------------------------|--------|--------------|----------------------------------|--------------------------|------------|--------------------------|--------------------------|------------------------------|------|
| OBJECT OF  | TEST                        | :   |                          |        |                              |                                 |                              |                                  |        |              |                                  |                          |            | CH.                      | ARGE:                    |                              |      |
|  |                             |     |                          |        |                              |                                 |                              |                                  |        |              |                                  |                          |            | TE                       | STED E                   | ۶Y:                          |      |
|  |                             |     | Time                     | %      |                              |                                 | Unit                         |                                  |        |              | Rea                              | gents,                   | lb pe      | r ton                    |                          |                              |      |
| OPERA  | ATION                       |     |                          | Solid  | s p⊦                         |                                 | used                         |                                  | ·      |              |                                  |                          |            |                          |                          |                              |      |
|  |                             |     |                          |        |                              |                                 |                              |                                  |        |              |                                  |                          |            |                          |                          |                              |      |
|  |                             |     |                          |        | +                            |                                 |                              |                                  |        |              |                                  |                          |            | +                        |                          |                              |      |
|  |                             |     |                          |        | 1                            |                                 |                              |                                  |        |              |                                  |                          |            |                          |                          |                              |      |
|  |                             | ·   |                          |        |                              |                                 |                              |                                  |        |              |                                  |                          |            | 1                        |                          |                              |      |
|  |                             |     |                          |        |                              |                                 |                              |                                  |        |              |                                  |                          |            |                          |                          |                              |      |
|  |                             |     |                          |        |                              |                                 |                              |                                  |        |              |                                  |                          |            |                          |                          |                              |      |
|  |                             |     |                          |        |                              |                                 |                              |                                  |        |              |                                  |                          |            |                          |                          |                              |      |
|  |                             |     |                          |        |                              |                                 |                              |                                  |        |              |                                  | ·                        |            |                          |                          |                              |      |
|  |                             |     |                          |        | <u> </u>                     |                                 |                              |                                  |        |              |                                  |                          |            |                          |                          |                              |      |
|  |                             |     |                          |        |                              |                                 |                              |                                  |        |              |                                  |                          |            |                          |                          |                              |      |
|  |                             |     |                          |        |                              |                                 |                              |                                  |        |              |                                  |                          |            |                          |                          |                              |      |
|  |                             |     |                          |        |                              | <u> </u>                        |                              | <u> </u>                         |        |              |                                  |                          |            |                          |                          |                              |      |
| PRO  | толст                       |     | W                        |        | _                            |                                 |                              | LYSIS                            |        |              |                                  |                          |            |                          | ΙΒυτιο                   |                              |      |
|  |                             |     | %                        |        | Cu                           | РЪ                              | Zn                           | Fe                               | Fe/FeS | Au           | Ag                               | C                        | u          | РЪ                       | Zn                       | Au                           | Ag   |
| Calculated a<br>of combined<br>copper-lead<br>No. 1 + 2<br>No. 1 + 2 +<br>No. 1 + 2 +<br>No. 1 + 2 + | <u>ro con</u><br>3<br>3 + 4 | nc  | 5.<br>9.0<br>12.<br>14.3 | 35 🛛 🖯 | 2.22<br>3.87<br>7.42<br>5.33 | 11.10<br>10.77<br>10.16<br>9.50 | 5.05<br>4.51<br>4.43<br>4.77 | 23.92<br>26.93<br>28.45<br>28.61 |        | 0.63<br>0.57 | 96.48<br>71.75<br>62.23<br>56.31 | 62.<br>82.<br>87.<br>90. | 1 5<br>9 6 | 9.5<br>1.7<br>2.5<br>0.3 | 3.3<br>5.3<br>6.7<br>8.6 | 26.1<br>36.3<br>41.9<br>46.9 | 53.5 |
| REMARKS:   |                             | ,   |                          |        |                              |                                 |                              |                                  |        |              |                                  |                          |            |                          |                          |                              |      |

| TEST NO. 10                           | SAMP    | LE:      | Nadina  | Exp1o                                 | rations I | imit          | ed       | ¢      |         |         | <u></u>  |       |  |          | ri1 8, 1 |              |
|---------------------------------------|---------|----------|---------|---------------------------------------|-----------|---------------|----------|--------|---------|---------|----------|-------|--|----------|----------|--------------|
| OBJECT OF TEST                        |         |          |         |                                       |           |               |          | irect1 | v from  | the or  | e.       |       | СНА  | ARGE:    | 2000 g   |              |
| , · · ·                               | usin    | g sul    | phur di | ioxide                                | for gale  | en <u>a</u> d | lepress  | ion.   | ,       |         |          |       | TES  | STED B   | Y: A.S   |              |
|                                       |         | Time     | %       | · · · · · · · · · · · · · · · · · · · | Unit      |               | 1        |        |         | Reag    | ients, I | b per | torr   |          |          |              |
| OPERATION                             |         | min      | Solids  | рН                                    | used      |               | SO2      | Z-200  |         | . •     |          |       |  |          |          |              |
| Grinding                              |         | 30       | 65      |                                       | 12 in. ]  | 3M            |          |        |         |         |          |       |  | •        |          |              |
| Conditioning                          |         | 5        |         | 6.7                                   |           |               | .3.0     |        |         |         | · · .    | · · · | ļ  |          |          | ┦───┥        |
| 11                                    |         | <u> </u> |         |                                       |           |               |          | 0.04   |         |         |          |       |  | <u> </u> |          | - <u> </u>   |
|                                       |         |          |         |                                       | <u>.</u>  |               | ·        |        |         |         |          |       | <b> </b>   |          |          |              |
|                                       |         |          |         |                                       | ļ         |               |          | ·      | _ · _   |         |          |       |  |          |          |              |
|                                       |         | ·        |         |                                       |           |               | ·        | · · ·  |         |         |          |       |  |          |          | <del> </del> |
|                                       |         |          |         |                                       |           |               | <u> </u> |        |         |         |          |       | ┼──  |          |          | ╂╂           |
| <u></u>                               |         |          |         |                                       | <u>}</u>  | ·             |          |        |         |         |          | ·     | 1  |          |          | +            |
| · · · · · · · · · · · · · · · · · · · |         |          |         |                                       | <u></u>   |               |          |        |         |         |          |       | 1  |          |          |              |
| · · ·                                 |         | <u></u>  |         |                                       |           |               |          |        |         |         |          |       |  |          |          |              |
| · · · · · · · · · · · · · · · · · · · |         | · · ·    |         |                                       |           |               | ·        |        |         |         |          |       | 1994 - 19 |          | • •      | · ·          |
| PRODUCT                               |         | W        |         |                                       | A         | NAL           | YSIS     | %      |         |         |          | D     | ISTR   | BUTIO    | N %      |              |
|                                       |         | %        |         |                                       |           |               |          |        |         |         |          |       |  |          |          |              |
| <u> </u>                              | · · ·   |          |         |                                       |           |               |          |        |         |         |          |       |  |          |          |              |
| •                                     |         |          |         |                                       | ł         |               |          |        |         |         |          |       |  |          |          |              |
| •                                     |         |          |         |                                       | 1         |               |          |        |         |         |          | •     | -  |          |          |              |
|                                       |         |          |         |                                       | ŀ         |               |          |        |         |         |          |       |  | •        |          |              |
| TEST PRODUCTS                         |         |          |         |                                       |           |               |          |        | •       |         |          |       | [  |          |          |              |
| DISCARDED                             |         |          |         |                                       |           |               |          |        | . •     |         |          |       |  | •        |          |              |
| -                                     |         |          |         |                                       |           |               |          |        |         | 1       |          |       | ł  | • •      |          | · ·          |
|                                       |         |          |         |                                       |           |               |          |        |         |         |          |       |  |          | · .      | 1            |
|                                       | · .     |          |         |                                       | · · ·     |               |          |        |         |         |          |       | •  | •        | х.       | ·            |
|                                       |         |          |         |                                       |           |               |          |        |         |         |          |       |  |          |          |              |
|                                       |         |          | ·       |                                       |           |               |          | · · ·  | · · .   |         |          |       |  |          |          | ·            |
| ·                                     |         |          |         |                                       |           |               |          |        |         |         |          |       |  |          |          |              |
|                                       |         |          | i i     |                                       |           |               | ł        |        | ,       |         |          |       |  |          |          |              |
|                                       |         | <u></u>  |         |                                       |           |               |          |        |         |         |          |       |  |          | <u> </u> |              |
|                                       |         |          | •       | o prom                                | ote chalo | copyr         | ite ef   | fectiv | ely, ob | otained | a dep    | resse | ed, s  | Limy, a  | and      |              |
| tine-                                 | -graine | d fro    | tn.     |                                       | •         |               |          |        |         |         |          |       |  |          |          |              |
| · · · · · · · · · · · · · · · · · · · |         |          |         |                                       |           |               | ·        |        |         |         |          |       |  |          |          | i            |

Sheet 1 of 2

| TEST NO. 11 SAM           | PLE: 1   | Nadina | Expl  | oratio  | ns Limi | ted             |          |         |       |          | D        | ATE: Ap | ril 11, | 1970  |
|---------------------------|----------|--------|-------|---------|---------|-----------------|----------|---------|-------|----------|----------|---------|---------|-------|
|                           |          |        |       |         | flotati |                 |          |         |       |          | Ċ        | HARGE:  | 2000 g  |       |
| but                       | used X   | Kantha | te as | coppe   | r promo | ter in          | place    | of Z-20 | 0     |          | T        | ESTED E | 8Y: A.S | •     |
| OPERATION                 | Time     | %      |       | 1       | Jnit -  |                 |          |         | Rea   | gents, I | b per to | n       |         |       |
| UPERATION                 | min      | Solid  | pH    |         | used    | 50 <sub>2</sub> | CX51     | DF250   | Lime  | NaCN     |          |         |         |       |
| Grinding                  | 30       | 65     | 7.2   | 12-i    | n. B.M. | -               | 1        |         |       |          |          |         |         |       |
| Conditioning No. 1        | 5        |        | 6.6   |         | -g cell |                 |          |         |       |          |          |         |         |       |
| " No. 2                   | 5        |        |       |         |         |                 | 0.02     | 0.02    |       |          |          |         |         |       |
| Copper rougher            |          |        |       |         |         | -               |          |         |       |          |          |         |         |       |
| Stage 1                   | 1        |        |       |         |         |                 | 0.005    |         |       |          |          | -       |         |       |
| " 2                       | 1        |        |       |         |         |                 | 0.005    |         |       |          |          |         |         |       |
| " 3                       | 2        |        |       |         |         |                 |          | 0.01    |       |          |          |         |         |       |
| Conditioning              | 5        |        | 9.2   |         |         |                 |          |         | 4.0   | 0.10     |          |         |         |       |
| Lead roughers             |          |        |       |         |         |                 |          |         |       |          |          |         |         |       |
| No. 1                     | 1        |        |       |         |         |                 | 0.005    |         |       |          |          |         |         |       |
| No. 2                     | 4        |        |       |         |         |                 |          | 0.02    |       |          |          |         |         |       |
|                           |          |        |       |         |         |                 |          |         |       |          |          |         |         |       |
| PRODUCT                   | W        | т      |       |         | ANA     | LYSIS           | %        |         |       |          | DIST     | RIBUTIC | N %     |       |
| PRODUCT                   | 9        | 6      | Cu    | РЪ      | Zn      | Fe              | Fe/FeS   | Au      | Ag    | Cu       | РЪ       | Zn      | Au      | Ag    |
| Copper rougher conc       | 3        | .03 1  | 9.00  | 3.00    | 6.60    | 16.30           | -        | 0.67    | 105.3 | 9 53.6   | 5 4.8    | 2.4     | 12.1    | 24.0  |
| Lead rougher conc No. 1   |          |        |       | 52.50   | 4.25    | 6.11            | 1        | 1.19    |       | 1        |          | 1       | 11.5    | 10.4  |
| " " No. 2                 | 11       |        | 9.56  | 5.20    | 7.20    | 14.68           |          | 0.44    | 1     | 7 19.1   |          | 1       | 5.6     | 13.4  |
| Zinc rougher conc         | 11       |        | 1.08  | 2.30    | 47.60   | 4.76            | 3.81     | 0.14    | 1     | 9 16.0   |          | 1       | 13.2    | 21.8  |
| Zinc rougher tail         | 77.      | .35    | 0.13  | 0.63    | 0.55    |                 |          | 0.13    | 5.2   | 4 9.4    | 25.6     |         | 57.6    | 30.4  |
| Feed (calcd)              | 100.     | .00    | 1.07  | 1.91    | 8.39    |                 |          | 0.17    | 13.3  | 1 100.0  | ) 100.0  | 100.0   | 100.0   | 100.0 |
| Calculated assays         |          |        |       |         |         |                 |          |         |       |          |          |         |         |       |
| Lead rougher conc $1 + 2$ | 3.       | . 77   | 6.00  | 25.53   | 5.93    | 11.00           | 5.73     | 0.76    | 83.9  | 8 21.0   | 50.5     | 2.6     | 17.1    | 23.8  |
| Lead ro tail              |          |        | 0.29  | 0.91    |         |                 |          | 0.13    | 1     | 6 25.4   | 1        |         | 70.8    | 52.2  |
|                           |          |        |       |         |         |                 |          |         |       |          |          |         |         |       |
|                           |          |        |       |         |         |                 |          |         |       |          |          |         |         |       |
|                           |          | li     |       |         |         |                 |          |         |       |          |          |         |         |       |
|                           |          |        |       |         |         |                 |          |         |       |          |          |         |         |       |
|                           |          | l.     |       |         |         |                 |          |         |       |          |          |         |         |       |
|                           |          | 1      |       |         |         | }               |          |         |       |          |          |         |         | · ·   |
| REMARKS: Copper rough     | 1er - 1  | light  | froth | , mixe  | d leadv | + CODE          | ery co   | lour    | ÷     |          |          |         |         |       |
| Lead rougher              |          |        |       |         |         |                 | <i>.</i> |         |       |          |          |         |         |       |
|                           | ľ        | io. 2, | brig  | ht copy | pery co |                 |          |         |       |          |          |         |         |       |
| Zinc rougher              | <u> </u> | ght vo | lumin | ous fr  | oth, sh | ort of          | CuSO4?   |         |       |          |          |         |         |       |

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# MINES BRANCH FLOTATION TEST REPORT Sheet 2 of 2

| TEST NO. 11 SAMP                             | PLE: N | ladina   | Explor   | ation   | ıs Limi | ted   |      |     |  |                                       |       |          |       | :il 11, | 1970     |
|--|--------|----------|----------|---------|---------|-------|------|-----|--|---------------------------------------|-------|----------|-------|---------|----------|
| OBJECT OF TEST:                              |        |          |          |         |         |       | •    |     |  |                                       |       | CHAR     |       |         |          |
|  |        |          |          |         |         |       |      |     |  |                                       |       | TEST     | ED B  | Y:      |          |
|  | Time   | %        |          | U       | Init    | 1 .   |      |     | Rea  | gents, l                              |       |          |       | · · ·   |          |
| OPERATION                                    |        | Solids   | рН       | u       | sed     |       | CX51 | ·   | Lime   | 0                                     | CuSO4 | NaAF     |       |         |          |
| Conditioning                                 | 10     |          | 11.3     |         |         |       |      |     | 3.0  |                                       | 1.0   |          |       |         |          |
| Zinc rougher                                 |        |          |          |         |         | 1     |      |     |  |                                       |       |          |       |         |          |
| Stage 1                                      | 1/2    |          |          |         |         |       | 0.02 |     |  |                                       |       | 0.10     | · ,   | •       |          |
| " 2  | 1      | · · · ·  |          |         |         |       | 0.01 | ÷   |  |                                       |       |          |       |         |          |
| " 3  | 2      |          | . *      | •       |         |       | 0.01 |     | ·  |                                       |       | 0.05     |       |         |          |
| ·  |        |          |          |         |         |       |      |     |  |                                       |       |          |       |         | ·        |
|  |        |          |          |         |         |       |      |     |  |                                       |       |          |       |         |          |
|  |        |          |          |         |         |       |      |     | · · · ·                                      | ·                                     |       |          |       |         |          |
|  |        |          |          |         |         |       |      |     | · · ·  | · · · · · · · · · · · · · · · · · · · |       |          | •     |         |          |
| <u>`````````````````````````````````````</u> | -      |          |          |         |         |       |      |     |  |                                       |       |          |       |         |          |
|  |        |          |          |         |         |       |      |     |  |                                       |       |          |       |         |          |
|  |        |          |          | ·       |         |       |      |     |  |                                       |       |          |       |         | <u> </u> |
| PRODUCT                                      | W      | r        |          |         | ANA     | LYSIS | %    |     | •  |                                       | DI    | STRIB    | UTIOI | N %     |          |
| FRODUCT                                      | %      | 5        |          |         | ·       |       |      |     |  |                                       | }     |          |       |         |          |
|  |        |          |          |         |         |       |      |     |  |                                       |       |          |       |         |          |
|  |        |          |          | · · · ] |         | •     |      |     | 1  | 1                                     |       | ŀ        |       |         |          |
|  |        |          | ·        |         |         | • • • |      |     |  |                                       |       | ·        |       |         | -        |
|  |        |          |          |         |         |       |      |     | · .  |                                       |       |          |       | }       | •        |
| · · · · ·                                    |        | <b> </b> |          | •       |         |       |      |     |  | * <b>[</b> ]                          |       |          |       |         |          |
| · · · · · · · · · · · · · · · · · · ·        |        |          |          |         |         |       |      |     |  |                                       |       |          | ·     |         | •        |
|  |        |          |          |         |         |       |      |     |  |                                       |       |          |       |         |          |
| · · · ·                                      |        |          | • ] •    |         |         |       |      |     | · ·  |                                       | ·     |          | · ·   |         | • •      |
|  |        |          |          |         | ĺ       |       |      |     |  |                                       |       |          |       |         | •        |
|  |        | ll l     | 1        | •       |         |       | . N  |     |  |                                       | •     | · · ·    | · · · |         | •        |
|  |        |          |          |         |         |       |      |     |  |                                       |       | ·   ·    |       |         |          |
|  |        | 1 ·      |          |         |         |       |      |     |  |                                       |       |          |       | • •     | •        |
|  |        |          |          |         |         |       |      |     |  |                                       |       |          | :     |         |          |
|  |        |          |          |         |         |       |      | • . |  | • •                                   |       |          |       |         |          |
|  |        |          |          |         |         |       | L    |     | <u> </u>                                     |                                       |       | <u> </u> |       |         |          |
| REMARKS:                                     |        |          | <u> </u> |         |         |       |      |     |  | •                                     |       |          |       |         |          |
|  | •      |          |          |         |         |       |      |     |  |                                       |       |          |       |         |          |
|  |        |          |          |         |         |       |      |     | <u>.                                    </u> |                                       |       |          |       |         |          |
|  |        |          |          |         |         |       |      |     |  |                                       |       |          |       |         |          |

### MINES BRANCH FLOTATION TEST REPORT Sheet 1 of 2

TEST NO. 12 SAMPLE: Nadina Explorations Limited DATE: April 10, 1970 CHARGE: 2000 g OBJECT OF TEST: Copper-lead selective flotation as in Test 11 but employed aerative conditioning prior to copper float, TESTED BY: A.S. Reagents, lb per ton Time % Unit OPERATION pН CX51 DF250 Lime NaCN AF242 used min Solids SOn Grinding 30 65 12 in. BM Conditioning 30 5.7 4.0 0.02 Aerator Copper rougher No. 1 1/2 0.005 0.02 Stage 1 11 2 1 0.005 Copper rougher No. 2 Stage 1 1 0.005 11 2 1 0.005 5 Conditioning 5.0 0.10 11.0 Lead rougher No. 1 Stage 1 1 0.01 " 2 1 0.005 0.01 ŴТ ANALYSIS % DISTRIBUTION % PRODUCT % Fe/FeS Cu РЪ Fe Zn Au Ag Cu FЪ Zn Ag Au Copper ro conc No. 1 7,74 6,59 16.57 23.43 8.87 0.51 78.99 43.7 11.5 2.3 9.0 17.9 10.51 6.79 24.56 17.39 8.16 0.45 59.49 24.3 17.7 2.7 9.0 15.2 Lead ro conc No. 1 9.50 1.02 98.46 1.29 38,71 7.01 10.63 3.21 54.6 2.3 17.0 21.1 " " No. 2 3.04 29.13 11.74 4.51 0.26 7.78 45.23 10.3 3.9 8.8 4.0 8.9 Zinc rougher conc 0.54 49.19 0.78 4.64 3.96 0.13 13.99 9.6 3.7 79.6 10.7 14.7 Zinć rougher tail 0.13 0.22 0.49 14.04 0.11 3.80 8.9 8.6 4.3 50.3 22.2 Feed (calcd) 1.94 8.33 13.24 1.10 100.0 100.0 100.0 100.0 0.16 12.81 100.0 REMARKS:

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| TEST NO. 12 SAMI                | LE:      | Madin        | а БХ        | hroi          | acı        | ons Lim        | 100 |                                       |                                       | ·      |                   | ;  |                          |                 |             | DATE: April 10, 1970 |          |              |                         |                 |                   |
|---------------------------------|----------|--------------|-------------|---------------|------------|----------------|-----|---------------------------------------|---------------------------------------|--------|-------------------|--|--------------------------|-----------------|-------------|----------------------|----------|--------------|-------------------------|-----------------|-------------------|
| BJECIKOF TEST:                  |          |              |             |               |            |                |     | · · · · · · · · · · · · · · · · · · · |                                       |        |                   |  |                          |                 |             | CHA                  |          |              |                         |                 |                   |
|                                 |          |              |             |               |            |                |     |                                       | Ţ,                                    | 1      | 1                 |  | 1                        |                 |             | TES                  | TED      | BY           |                         | 1               |                   |
| OPERATION                       | Time     | %            |             | н             |            | Unit           | ŀ   |                                       | l                                     | 1      | F                 | Reag   | jents,                   | lb p            | er t        | on                   |          |              |                         |                 |                   |
|                                 | min      | Solid        | s           |               |            | used           | -   | · · ·                                 | CX41                                  | DF250  | LİM               | e  |                          | AF2             | 42 C        | uS02                 | Na       | 1F           |                         |                 |                   |
| Lead rougher No. 2              |          |              |             |               |            |                |     |                                       |                                       |        |                   |  |                          | 1               |             |                      |          |              |                         | 1               |                   |
| Stage 1<br>" 2                  | 11       |              |             |               |            |                | 1   |                                       | 0.01                                  | 1      |                   |  |                          | 1               |             | 1                    | 1.       |              |                         |                 |                   |
| " 2                             | 1        |              |             |               |            |                | Y.  |                                       | 0.005                                 |        |                   |  |                          | 0.              | 01          |                      |          |              |                         | 1               |                   |
| Conditioning                    | 10       |              | 11          | .5            |            |                | 1   |                                       |                                       | 1.     | 2.0               | 0  |                          |                 |             | 2.0                  |          |              | • •                     |                 | ~                 |
| Zinc rougher                    |          |              |             |               |            |                |     |                                       |                                       |        |                   |  |                          |                 |             | į                    |          |              |                         |                 |                   |
| Fe <b>Stage</b> alcd)           | 1        |              | 1.1         | 0             | 1.92       | 1 8.33         | 11  | 3.24                                  | 0.02                                  | 0.1    | IT:               | 5° 81  | .    T(                  | 0.0             | irdo        | 0                    | 100:     | 10           | 190°0                   | ĴŨ              | 00                |
| Zinc rougher tail               | 1        |              | p.1         |               | 0.23       |                |     |                                       | 0.01                                  | 00.02  | The Local and and | 3,80   | Lord and a second second | 8.9             |             | .6                   | Ū.       | .05          | 56.3                    | 3               | 33                |
| Sinc mougher conc               | 3        | ŀ            | b.7         | 8             | 0.54       | 49.19          |     | 4.64                                  | 3.96                                  | 0.1    | 113               | 6516   |                          | 9.6             | 3           | .7                   | 20       | .05          | 10.7                    |                 | 17                |
| " " " No. 2                     | 1        |              | 4.5         | 1             | 3.04       | 1 29-13        | 1   | 1.74                                  | 7.78                                  |        | 1 1               | 2 33   |                          | 03              | Э           | 6                    | 8        | 8            | <del>, 0</del>          |                 | \$                |
| Lead to conc No. 1              |          | l li         | 1 .2        |               | 8.7.       |                |     | 0.63                                  | 9.50                                  | 10     |                   | 3 45   |                          | 3 5             |             | 1 2                  | 3        | 3            | <u>-12.0</u>            |                 | 53                |
| 14 11 11 MO. 2                  |          |              | 83          | 215           | 0.5        | 6.79           |     |                                       | 17.35                                 | 0.4    |                   | <u>)                                    </u> |                          | 7-3             |             |                      | 1 .      | - 1          | 0 <del>-5-</del><br>∩`£ | 1 7             | <u>3 −</u><br>7 \ |
| Copper to cone No. 1            |          | 1            | 202         | <u> -    </u> | <u></u>    | 1 6-79         | Ľ   | 3.43                                  | <u>j 8 82</u>                         |        |                   | <u> - 6</u> 5                                |                          | <del>12 à</del> |             | <u> </u>             |          | -i           |                         |                 | <u>, , ,</u>      |
|                                 | W        |              |             |               | Śr         |                |     | cić                                   | % \1-0                                |        |                   | <u>-98</u> -                                 |                          | <u></u>         | hie         | TRIE                 |          |              | - 0/                    | - <u></u>       |                   |
| Product                         | 11 11    |              | Cu          |               | <u>и</u> р |                |     |                                       | re/FeS-                               |        | 1.                |  | Ci                       |                 |             | 816                  |          |              |                         |                 | A                 |
| ~                               |          |              | <u>u</u>    |               | <u></u>    | 2n             |     | <u>e</u>                              | 0.005<br>0.005                        |        |                   | Ag   |                          |                 |             |                      | <u></u>  |              | AU                      |                 | Ag                |
| Calculated, assays              |          |              |             |               | <u> </u>   |                |     |                                       |                                       |        | -                 |  | ╢                        | ╶┼┨             | · • • •     |                      |          |              |                         |                 |                   |
|                                 | <u> </u> |              |             |               | ļ          |                |     |                                       |                                       |        | -                 |  |                          |                 | <u>,01</u>  |                      |          |              |                         |                 |                   |
| Conbined Custon Cont            |          |              | <u>2.11</u> |               |            | 6.70           |     | a marchan barren pa                   | 13.39                                 |        |                   |  | 68                       |                 | _29,        | 7                    | -5-(     | -            | 8.0                     | 3.              |                   |
| Conditio Bango couc             |          |              |             | 129.          |            | 17.59          |     | .16                                   | 8.67<br>0.003                         | 0.66   |                   |  | 0 <u>13</u>              |                 | <u>58</u> , |                      | 11.      |              | 1.0                     | _30.            |                   |
| Lead rougher tail               | 88.      | <u> -   </u> | 0.23        | 0.            | <u> </u>   |                |     |                                       | 0.005                                 | 0.11   |                   | .35  | 18                       | -7              | 12.         | <u>-</u>             |          | 0            | 1.0                     | <u>    36  </u> | . 9               |
| Copper rougher No. 2<br>Stage 1 |          |              |             | ·             | <b>_</b>   |                | ÷   |                                       | 0 002                                 |        | -                 |  | <u>   ·</u>              |                 |             | <u>├</u>             | -        | ╤┼╤╤         | +                       | _               |                   |
|                                 |          |              |             |               |            | ·              |     |                                       | 0.003                                 |        |                   |  | ╢                        |                 |             | ┟┈╍                  |          |              |                         |                 |                   |
| <u>11 2</u>                     |          |              |             |               |            |                |     |                                       |                                       |        |                   |  | <b></b>                  |                 |             | $\left  - \right  -$ |          |              |                         |                 |                   |
| Stage 1                         |          |              |             |               |            |                |     |                                       | 0.001                                 | 0.0    | 511               |  | <u>  </u>                |                 | <u> </u>    |                      |          |              |                         |                 | <del>.</del>      |
| Copper rougher No. 1            |          |              |             |               |            |                |     |                                       |                                       |        |                   | ·  | ¥                        |                 | ·.          | <u></u> }            | <u> </u> |              |                         |                 |                   |
| Conditioning                    | 30       | ┉┼╢──        |             | <u>3.7</u>    | 40.        | cator          |     | 4.0                                   | 0,02                                  |        | -[-               |  |                          |                 | <u>```</u>  | <b>├</b> ─-├         |          |              |                         |                 |                   |
| Grinding                        | 30       | 65           |             |               | 12         | in. BM         |     | <u> </u>                              | _                                     | _      | _                 |  | 1                        |                 |             |                      |          |              |                         |                 |                   |
|                                 | mir      | 3 11         | ds          | 5.1           |            | pesu           |     | 502                                   | CX51                                  | . DF25 | )  r:             |  | NaCi                     |                 |             |                      |          |              |                         |                 |                   |
| OPERATION                       | Lim      | s   %        |             | 러             | · ·        | Unit .         |     | ·                                     |                                       |        | ·                 | 300  | gant                     | <u>s, iþ</u>    | ber         | ion                  |          |              |                         |                 |                   |
| SSI SSI                         | SITAS    | coldi        | CTOÙ        | 118           | brī        | <u>5 07 70</u> | obb | 6 <u>1</u> 1                          | .080.                                 |        |                   | ······································       |                          |                 |             | LES                  | 21EL     | C 8.         | <b>∀:</b> ∀.            | 5.              |                   |
|                                 |          |              |             |               |            |                |     |                                       |                                       | ouc s  | ubrol             | yea  | ······                   | ·               |             |                      |          |              | 000 g                   |                 |                   |
| EWARKS: OF TEST: Cop            | ner-le   | 29 00        | 100*        | 1 770         | £10.       | tons Iti       |     |                                       | · · · · · · · · · · · · · · · · · · · | T      |                   |  |                          |                 | •           |                      | v 00     | <u>e</u> . v | 11 10                   |                 |                   |

WINES BRANCH FLOTATION

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| TEST NO. 13 SAMP   | LE:         | Nadi  | na Ex    | plorati       | ons Lir                               | nited    |               |           |          |         |       | DAT      | E: Ju  | ne 15, | 1970  |
|--|-------------|-------|----------|---------------|---------------------------------------|----------|---------------|-----------|----------|---------|-------|----------|--------|--------|-------|
| OBJECT OF TEST: To se  | electi      | velv  | float    | a silv        | ver con                               | c away   | from tl       | <u>ле</u> |          | · · · · |       | СНА      | RGE:   | 2000   | g     |
|  |             |       |          | grindin       |                                       |          |               |           |          |         |       | TES      | TED E  | Υ: A.  | S     |
| OPERATION  | Time        | %     | 1        |               | Jnit                                  | 1        |               |           | lb per   | r ton   |       |          |        |        |       |
| OFERATION  | min         | Solic | ls p⊢    |               | used 1                                |          | 3 NaCN Na2SO3 |           | AF208    | AF242   | DF250 | Lime     | e CuSO | 4 CX51 | NaAF  |
| Grinding   | 30          | 65    |          | 12 <b>-</b> i | in. B.M.                              | . 3.0    | 0.1           | 1.0       | 0.02     | 0.035   |       |          |        |        |       |
| Conditioning   | 5           | 7.    | 8        |               |                                       |          |               |           | 0.02     | 0.02    | 0.02  |          |        |        |       |
| Copper-lead rougher  | .:          |       |          | 1000          | )-g ce1                               | 1        |               |           |          |         |       |          |        |        |       |
| Stage 1  | : 1         |       |          |               |                                       |          |               | -         |          |         |       |          |        |        |       |
| And the set of the set | 1           |       |          |               |                                       | <u> </u> |               |           | 0.02     | 0.02    |       |          |        |        |       |
|  | 2           |       | ·        |               | · · · · · · · · · · · · · · · · · · · |          |               |           | 0.02     | 0.02    |       |          |        |        | · ·   |
| Conditioning   | 10          | 10.   | .8       |               |                                       |          |               |           |          |         |       | 4.0      | 1.0    |        |       |
| Zinc rougher   | · · ·       |       |          |               |                                       |          |               |           |          |         |       | · .      |        |        |       |
| Stage 1  | 1/2         |       |          |               |                                       |          | ļ             |           |          |         |       |          |        | 0.02   |       |
| <u>nerriets 2087 45 18403</u>  | 1           |       |          |               |                                       |          |               |           |          |         | 0.02  | <u> </u> |        | -      | 0.05  |
|  | 1           |       |          |               | •                                     |          |               |           |          |         | 0.02  |          |        |        | 0.05  |
| <u>" 5:45000.</u>  | $1^{1}_{2}$ |       |          |               |                                       |          |               |           |          |         |       |          |        |        |       |
| PRODUCT  | -   W       | τΪ    | <i>.</i> |               | ANA                                   | LYSIS    | %             |           |          |         |       |          | BUTIO  | N %    |       |
| T KODOCT   | 9/          | 6     | Cu       | РЪ            | Zn                                    | Fe       | S             | Au        | Ag       | Cu      |       | РЪ       | Zn     | Au     | Ag    |
| Copper-lead ro conc  | 1.10        | . 92  | 6.98     | 13.08         | 6.59                                  | 24.76    |               | 0.53      | 64.60    | 0       | .5 8  | 9.0      | 10.7   | 50.8   | 69.9  |
| Zinc rougher conc  |             |       | 0.35     |               | 55.45                                 | 3.30     | *             | 0.075     | 11.34    | . 11    |       | 2.6      | 84.6   | 6.7    | 11.4  |
| Silver cleaner conc  |             | .68   | 1.15     |               | 18.54                                 | 22.91    |               | 0.80      | 29.01    |         |       | 1.0      | 1.5    | 3.7    | 1.5   |
| collect of tail  |             | .65   | 0.42     | 0.84          | 1                                     | 32.30    |               | 0.32      | 13.44    | 11      |       | 0.7      | 0.5    | 3.6    | 1.7   |
| Silver rougher tail  |             | .03   | 0.20     | 0.32          |                                       | 35.60    | 39.10         | 1         | 8.79     | 11      | ,     | 2.5      | 1.8    | 27.6   | 11.0  |
| Final tailing  |             | .65   | 0.04     | 0.16          |                                       | 5.37     | 1.82          |           | 1.03     | 2       | .0    | 4.2      | 0.9    | 7.6    | 4.5   |
| -Feed (calcd)  | 100         | .00   | 1.09     | 2.05          | 8.56                                  | 13.21    |               | 0.15      | 12.87    | 100     | .0 10 | 0.0      | 100.0  | 100.0  | 100.0 |
| Calculated Assays  |             |       |          |               |                                       |          |               |           |          | 1       |       |          |        |        |       |
| Copper-lead ro tail  | 86          | .08   | 0.13     | 0.26          |                                       |          |               | 0.083     | 4.50     | 10      | .5 1  | 1.0      |        | 49.2   | 30.1  |
| Zinc rougher tail  | 73          | .01   | 0.10     | .0.24         | 0.55                                  |          |               | 0.085     | 3.28     | 6       | .3    | 8.4      | 4.7    | 42.5   | 18.7  |
|  |             |       |          |               |                                       |          |               |           |          |         |       |          |        |        |       |
| OLEBATUR -   | -   .       |       |          |               |                                       |          |               | 1.        | 1        | 1       |       |          |        |        |       |
|  |             |       |          |               |                                       |          |               |           |          |         |       |          |        |        |       |
| Denso: Quitter.  |             | ļ     |          |               |                                       |          |               |           |          |         |       |          |        |        |       |
| REMARKS: Copper-lead   | rough       | er -  | - lig    | ht, lea       | dy fro                                | th       |               | <u></u>   | <u> </u> |         |       | ·        |        |        |       |
| Zinc rougher   |             |       |          |               | h, "weep                              |          | t end o       | of floa   | t        |         |       |          |        |        |       |
| Pyrite rough   |             |       |          |               | tive py:                              |          |               |           | -        |         |       |          |        |        |       |
| 272200 20461   |             |       | 0        |               |                                       |          |               |           |          |         |       |          |        |        |       |

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| FEST NO 13 CODING SAMP    | ۲ĽÊ: ۲           | Nadina      | Exp] | oratio         | ons Limi     | Lted           |             | · · · · · · · · · · · · · · · · · · · | •            |  |            |                   |                  | ne 15, i                              | 1970         |
|---------------------------|------------------|-------------|------|----------------|--------------|----------------|-------------|---------------------------------------|--------------|--|------------|-------------------|------------------|---------------------------------------|--------------|
| DBJECT OF TEST:           |                  |             |      | · :.           |              |                | ж.<br>ж. ст | • •                                   |              |  | . –        | CHAF              |                  | · · · · · · · · · · · · · · · · · · · |              |
|                           |                  | `           | ,    |                |              |                | ·           |                                       |              |  |            |                   | EDB              | Y:                                    |              |
| OPERATION                 | Time             | %<br>Solids | . pH | 1              | Jnit<br>used |                | NaCN        |                                       | Rea<br>AF208 | gents, lb<br>AF 242  |            |                   | H2 SU            | +   CX51                              | 1            |
| Conditioning care         | 5                |             | 7.8  | <u></u> -      |              |                | 1           |                                       |              |  |            |                   | 1.5              | 5                                     |              |
| vrite-rougher             |                  |             |      |                |              |                |             | 1 - N.                                |              | · · ·  |            | ; ·               |                  |                                       |              |
| STStage of Veesla         | 1.1              |             |      |                | •            |                |             |                                       |              |  |            | · · ·             | 1 .              | 0.05                                  | 1.           |
| <u>2</u>                  | 1                |             |      |                | 2            |                | · .         |                                       |              |  |            |                   | 2                | 0.05                                  |              |
| Trear cyr3958             | 1                |             | .:   |                |              |                |             | -                                     | · · · · ·    |  |            | · · · · · · · · · | 1 .              | 0.05                                  |              |
| yrite conceregrinding     | 15               |             |      | 8-ir           | . B.M.       | ×              | 0.1         |                                       |              |  |            | 1.0               |                  |                                       |              |
| Conditioning a structure  | 5                |             | 11.2 | 2 500-         | g cell       |                |             |                                       | 0.02         | 0.02   |            | · · ·             |                  |                                       |              |
| tlver rougher conc        |                  |             |      |                | · · ·        |                |             | · · · ·                               |              |  |            |                   |                  |                                       |              |
| STEST age There contained | 1                |             |      |                |              | 2              |             | ľ                                     |              |  |            |                   |                  |                                       |              |
| Jobomini est an norm      | 11 <sup>11</sup> |             |      |                |              |                |             |                                       | 0.02         | 0.02   |            | · .               |                  |                                       |              |
| ilver cleaner             | 1                |             |      | 250-           | g cell       |                |             |                                       |              | 11 H A   | : :        |                   | 1 - 1 - 1<br>N   |                                       |              |
| , SECONCL                 |                  |             |      |                | · · · .      |                | · · ·       |                                       |              |  |            | - <u>-</u>        |                  | · · · · · ·                           |              |
| PRODUCT                   | W                | т           | •    |                | ANA          | LYSIS          | %           |                                       |              |  | DIS        | TRIB              | UTIO             | N %                                   | • • •        |
| FRODUCT                   | 9                | 6 C         | u    | Pb             | Zn           | Fe             | Au          | Ag                                    |              | Cu   | Pl         | <b>)</b>          | Zn               | Au                                    | Ag           |
| letallurgical Balance     |                  |             |      |                |              |                |             |                                       |              |  |            |                   |                  |                                       | 3            |
| or Pyrite Rougher         |                  | 1           |      |                |              |                |             |                                       |              |  |            | · · ·             | · .              | ••••                                  | · .          |
| Pyrite rougher conc*      |                  | 11          | .26  | 0.46           | 1.76         |                | 0.28        | 9.96                                  | 1            | 68.6   | 49         |                   | 30.9             | 82.4                                  | 76.          |
| inal tailing              |                  |             | .04  | 0.16           | 0.14         |                | 0.02        | 1.03                                  |              | 31.4   | 50         |                   | L9.1             | 17.6                                  | 23.          |
| eed (zinc-rougher tail    | )* 100           | .00 0       | .10  | 0.24           | 0.55         | · · ·          | 0.085       | 3.28                                  |              | 100.0  | 100        | .0 10             | 0.00             | 100.0                                 | T00.(        |
| Metallurgical Balance     |                  | · ·    -    |      | <del>.</del> . |              |                |             |                                       | 1.4.1        |  |            |                   |                  |                                       |              |
| or Silver Flotation       |                  |             |      |                |              |                |             |                                       |              |  |            |                   |                  |                                       |              |
| Silver cleaner conc       | - 13             |             | .15  | 2.95           |              | 22.91          | 0.80        | 29.07                                 | 1            | 16.7   | 23         |                   | 39.0             | 10.7                                  | 10.8         |
| Silver rougher tail       |                  | 11 .        | .42  | 0.84           |              | 32.30          | 0.32        | 13.44                                 |              | 14.8   | 16.<br>60. |                   | L3.4             | 10.4<br>78.9                          | 12.]<br>77.] |
| Reed (pyrite ro conc)     |                  |             | .20  | 0.32           |              | 35.60<br>34.83 | 0.25        | 8.79                                  |              | 100.0  | 100        |                   | $\frac{1}{20.0}$ | 100.0                                 |              |
| een (pyrre to cond)       | · [[.±00         |             | • 20 | 0.40           | 1.10         | J              | 0.20        |                                       | -            |  | 1.00       |                   |                  | 200.0                                 |              |
| COBERATION .              |                  |             | · ·  |                |              |                |             | ÷ .                                   |              |  |            |                   |                  |                                       |              |
|                           |                  |             |      | • •            |              | 3 A            |             |                                       |              |  |            |                   |                  |                                       | · ·          |
| OBVECT OF TRAT. The s     |                  |             |      |                |              | · ·            |             |                                       | 1 · · ·      |  |            | • :               |                  |                                       | ÷            |
| 아내라도한 비 양성 소통성 소문 영향 것    | 11 1             | 11          | ·    |                | 1 1 1        |                | l           | 1                                     | 1            | a a la construction de la construction de la construcción de la constr | 1          | 5 Y Y             | 1. T. T. T.      | er e mara y                           | • • • • •    |

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| TEST NO. 14 SAMP   | · · · ·      |              |                |                  | ns Limi |          | <u></u>  |                                       | ×     |           |       | TE: Ju:<br>ARGE: |          | 1970       |
|--|--------------|--------------|----------------|------------------|---------|----------|----------|---------------------------------------|-------|-----------|-------|------------------|----------|------------|
| OBJECT OF TEST: Repea  | t of<br>ased | Test<br>from | 13 bu<br>15 to | t with<br>30 min | regrind | ling tin | ne for   | pyrite                                | conc  |           |       | STED B           |          | •          |
|  | Time         | 1            |                |                  | Jnit    | 1        |          | · · · · · · · · · · · · · · · · · · · | Reag  | jents, Ib |       |                  |          |            |
| OPERATION  | min          | Soli         | ds             |                  | used    | ·        |          |                                       |       |           |       |                  |          |            |
| Procedure identical  |              |              |                |                  |         |          |          | ·                                     |       |           |       |                  |          |            |
| to Test 13 except  | ,            |              |                | ·                |         |          |          |                                       |       |           |       |                  |          |            |
| as noted above   |              | <u> </u>     |                |                  |         |          | ļ        |                                       |       |           |       |                  | _        | ───        |
| RUL PARA LOSS FOR  |              | <u> </u>     |                |                  |         |          | <u> </u> |                                       |       |           |       |                  |          |            |
| provide and the second of  |              |              |                |                  |         |          |          |                                       |       |           |       |                  |          |            |
| A CARLES AND A CAR |              | ļ            |                |                  |         |          | ļ        | -                                     |       |           |       |                  |          |            |
| Construction of the second sec | · · ·        | ļ            |                |                  |         |          |          |                                       |       |           |       |                  |          | - <u> </u> |
| sance sonthing of th   |              | <u> </u>     |                |                  |         |          | <u> </u> |                                       |       | <u> </u>  |       |                  |          |            |
| and the second  |              |              |                |                  | •       |          | ļ        |                                       |       |           |       |                  |          | <u>.</u>   |
|  |              | ļ            |                |                  |         |          |          |                                       |       |           |       |                  |          |            |
|  | <u></u>      | · · ·        |                |                  |         |          | <b>_</b> |                                       |       |           |       | · · · ·          |          |            |
| <u> </u>   | ;:<br>       | 34           | <u>l</u>       | <u> </u>         |         | <u> </u> | 1        |                                       |       |           |       |                  |          |            |
| PRODUCT  | W            |              |                | •                |         | LYSIS    |          | -                                     |       |           |       |                  |          |            |
|  | 9            | 6            | Cu             | Pb               | Zn      | Fe       | S        | Au                                    | Ag    | Cu        | Pb    | Zn               | Au       | Ag         |
| Copper-lead ro conc  | 12           | 76           | 7.20           | 12.54            | 6 23    | 22,88    |          | 0,53                                  | 64.59 | 87.3      | 89.5  | 10.5             | 47.6     | 69.5       |
| Zinc rougher conc  | · H          | . 66         | 0.61           |                  | 50.64   | 4.36     |          | 0.11                                  | 12.16 | 11 .      |       | 84.3             | 9.8      | 13.0       |
| Silver cleaner conc  |              | .63          | 1.18           |                  | 16.46   | 23.46    |          | 0.96                                  | 32,93 |           | 4     | 1.3              | 3.9      | 1.6        |
| <u>"</u> tail  | 1            | .72          | 0.36           |                  | 3.20    | 33.52    | 36.55    | 0.34                                  | 12.54 | 0.5       |       | 0.7              | 3.8      | 1.7        |
| Silver rougher tail  | · •          | .05          | 0.19           |                  | 1.13    |          | 1.64     | 0.25                                  | 8.50  | 41        |       | 2.2              | 26.2     | 10.7       |
| Final_tailing  |              |              | 0.03           | 0.14             |         | 5,24     |          | 0.03                                  | 0.85  | 11        | 3.9   | 1.0              | 8.7      | 3.         |
| Feed (calcd)   | 100          | 00.00        | 1.13           | 1.93             | 8.20    | 13.10    |          | 0.15                                  | 12.80 | 100.0     | 100.0 | 100.0            | 100.0    | 100.0      |
| Calculated assays  |              |              |                |                  |         |          |          |                                       |       |           |       |                  |          |            |
| Copper-lead ro tail  | 11           |              | 0.17           | -                | 8,52    |          |          | 0.093                                 |       |           |       | 89.5             | 52.4     | 30.5       |
| Zinc_rougher_tail  | . 72         | .58          | 0.08           | 0.20             | 0.59    |          |          | 0.09                                  | 3.10  | 5.4       | 7.5   | 5.2              | 42.6     | 17.        |
|  |              | .            |                |                  |         |          |          |                                       |       |           |       |                  |          |            |
| CLERNE CLA   |              | .            |                |                  |         |          |          |                                       | l     |           |       |                  |          | 1          |
|  |              |              |                |                  |         |          |          |                                       | 1     |           | ł .   | · ·              |          |            |
| 1000001 01 1121  |              |              |                |                  |         |          |          |                                       |       |           |       |                  | <u> </u> |            |
| REMARKS:   |              |              |                |                  |         |          |          |                                       |       |           |       |                  |          |            |

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| TEST NO. 14   | SAMPL   | . <b>E:</b> ] | Nadina         | Exp.     | loratio      | ons Lim  | ited     |   |          |              |             | DA   | TE: Ju      | ne 15,       | 1970    |
|---|---|---------------|----------------|----------|--------------|----------|----------|---|----------|--------------|-------------|--|-------------|--------------|---------|
| OBJECT OF TEST  |   |               |                |          |              | ···.     |          |   |          | <del>`</del> |             | СН   | ARGE:       |              |         |
| ÷   |   |               |                |          |              |          | · .      |   |          |              |             | TE   | STED B      | IY:          |         |
| OPERATION   |   | Fime          | %              |          |              | Unit     | T        |   |          | Reag         | gents, Il   | per ton  |             |              |         |
| UPERATION   |   | min           | Solids         | рН       |              | used     |          |   |          |              |             | × .  |             |              |         |
|   |   | · ·           | · · ·          |          |              |          | ·        |   |          |              |             |  |             |              |         |
| Zist trugher isil   | · · · ·   | 25            |                |          |              |          |          |   |          |              |             |  |             |              |         |
| COPREY-LORD TO THE  | 1   |               | e N            |          | . •          |          | ·        |   |          |              |             |  |             |              |         |
| Calculated as-and   |   |               |                | · ·      |              |          | ·        |   |          |              |             |  |             |              |         |
| જુલ્લ્ય (cc) કર્યું) 👘 🖓  |   |               | : <sup>1</sup> | ;        |              |          |          |   |          |              |             |  | *           |              |         |
| Final ceiling   | ,   |               | •              | 1        |              | · · · ·  |          |   |          |              | • • •       |  |             |              |         |
| 「「「「「「「」」」、「「」」、「」」、「」」、「」」、「」」、「」」、「」」   |   |               |                |          | ·            |          |          |   |          |              |             |  |             |              |         |
| 44  | 1:  |               | ·              |          |              | · · · ·  |          |   | <u> </u> |              |             |  |             |              |         |
|   |   |               |                |          |              |          |          |   |          |              |             |  |             |              |         |
| ATTE REALTA CON   |   |               | · · ·          | 3        |              | ·        |          | ļ |          |              |             |  |             |              | •       |
|   |   |               |                |          |              |          | · ·      |   |          | ···· · ·     | · · · · / · |  |             |              |         |
|   |   | <u> </u>      |                | :        | <u>.t.</u>   |          |          |   |          |              |             | · .  |             |              |         |
| PRODUCT   | · · · · · · · · · · · · · · · · · · ·   | W1            |                |          |              | ANA      | LYSIS    | % | _`       | · ·          | 12.0        | DISTR  | RIBUTIO     | N %          | i stati |
| FRODUCE   |   | %             | C              | u        | РЬ           | Zn       | Fe       | ; | Au       | Ag           | Cu          | Pb.  | Zn          | Au.          | Ag      |
| Metallurgical Bala  | ance "  |               |                |          | · · ·        |          |          |   |          |              |             |  |             | 1.5          |         |
| for Pyrite Rougher  |   |               |                | .        |              |          |          |   |          |              |             |  |             |              |         |
|   |   | -25.          |                | .24      | 0.37         | 1.85     | 35.43    |   | 0.28     | 9.72         | 73.1        | 47.3   | 79.7        | 79.2         | 79.5    |
| -Final-tailing  |   | 74.           |                |          | 0.14         | 0.16     | 5.24     |   | 0.025    | 0.85         | 26.9        |  | 20.3        | 20.8         |         |
| Feed (zinc rougher  |   | 100.          |                | .08      | 0.20         | 0.59     | 12.90    |   | 0.09     | 3.10         | 100.0       |  | 100.0       | 100.0        |         |
| Metallurgical Bala  |   | · · · ·       |                |          | ·            |          | <u> </u> |   |          | +            | ╺╢╼╼╌──     |  |             |              |         |
| -for Silver Flotati   |   |               | . In the       |          |              | · .      |          |   |          |              |             |  | · · · · · · | ·            |         |
|   |   |               |                |          | ~            |          |          | - | 0.00     |              |             | 00.0   |             | 11.7         | 11.7    |
| Silver cleaner cor  | nC  | 3.            |                | .18      | 2.44<br>0.65 | 16.46    | 23.46    |   | 0.96     | 32.93        | 16.9        |  | 30.6        | 11.3         |         |
| co "eac to" sootai<br>"rougher tai  | LL<br>11  | 9.<br>87.     |                | .19      | 0.05         | 1.13     | 36.11    |   | 0.25     | 8.50         | 69.1        |  | 53.2        | 77.0         | 1 . 1   |
| Feed (pyrite ro co  | onc)  | 100.          |                | .24      | 0.37         | 1.85     | 35.43    |   | 0.28     | 9.73         | 100.0       | and the second sec | 100.0       | 100.0        |         |
|   |   |               |                |          |              |          |          |   |          | <u></u>      |             |  |             | <sup>-</sup> |         |
| ا منه من مراجع بها مین<br>استان از ایند میر میروند.<br>۳. میروا استان میرود میرواند این میرواند این میرواند.  |   |               |                |          |              |          |          |   |          |              |             |  | 1           |              |         |
| namen kan pengan pengan pengan kan pengan r>Pengan pengan | and a second second second second second second second second second second second second second second second<br>Second second |               |                |          | •            |          |          |   |          |              |             |  | · ·         |              |         |
|   |   | <u>µ</u>      | <u> </u>       | <u> </u> |              | <u> </u> |          |   | 1        | <u> </u>     | <u>łl</u>   |  | 1           | <u> </u>     |         |
| REMARKS:  | <br>  |               | ·              |          |              | 12<br>   | . ·      |   |          |              |             |  | •           | •            |         |
|   |   |               |                |          |              |          |          |   |          |              |             |  |             |              |         |

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| TEST NO. 15 SAMP        | LE: Na  | dina Exp | loratic  | ons Limi     | .ted    |        |  |          |        |         | DA  | TE:      | June 17 | , 1970   |
|-------------------------|---------|----------|----------|--------------|---------|--------|--|----------|--------|---------|-----|----------|---------|----------|
| OBJECT OF TEST: Copp    |         |          |          |              |         | ctly c | on the                                 | ore usi  | ing Z- | 200     | СН  | ARGE:    |         |          |
| as copper promoter a    |         |          |          |              |         |        |  |          | -      |         | TE  | STED E   | BY: A.S | •        |
|                         | Time    | %        |          | Unit         |         |        | ······································ | Rea      | gents, | lb per  | ton | ·····    |         |          |
| OPERATION               | min S   | olids pł |          | used         | Z-200   | S02    | <b>D</b> F 250                         | Lime     | NaCN   | AF242   | 2   |          |         |          |
| Grinding                |         | 65       | 12-i     | n. B.M.      |         |        |  |          |        |         |     |          |         |          |
| Conditioning            | 20      | 5.       | · •      |              | 0.01    | 4.0    |  |          |        |         |     |          |         |          |
| Copper rougher, stage 1 | 1       |          | 1000     | )-g cell     | -       |        | 0.02                                   |          |        |         | 1   |          |         |          |
| 11 11 11 2              | 1       |          |          |              | 0.01    |        |  |          |        |         |     |          |         |          |
| Conditioning            | 10      | 9.       | 7        |              |         |        |  | 4.5      | 0.1    |         | +   |          |         |          |
| 11                      |         |          |          |              |         |        |  |          |        | 0.02    | 1   |          |         |          |
| Lead rougher, stage 1   | 1       |          |          |              |         |        |  |          |        |         | 1   |          |         |          |
| " " 2                   | 1       |          |          |              |         |        |  |          |        | 0.02    | 1   |          |         |          |
| <u>" " 3</u>            | 1       |          |          |              |         |        |  |          |        | 0.02    |     |          |         |          |
| Copper cleaner          | 1       |          |          | g cell       |         |        |  |          |        |         | T   |          |         |          |
| Lead cleaner No. 1      | 1       |          |          | 11 <u>11</u> |         |        |  |          |        |         |     |          |         |          |
| " " 2                   | 1       |          | 11       | H 11         |         |        |  |          |        | <u></u> | 1   |          |         |          |
|                         | WT      |          |          | ANA          | LYSIS   | <br>%  |  |          | 1      | DI      | STR | BUTIO    | N %     |          |
| PRODUCT                 | %       | Cu       | Pb       | Zn           | Fe      |        | Au                                     | Ag       | Cu     | I       | ?Ъ  | Zn       | Au      | Ag       |
| Copper conc             | 2.9     | 4 25.00  | 5.52     | 4.82         | 21.75   |        | 0.64                                   | 101.17   | 7 61   | .0 8    | 3.3 | 1.6      | 12.3    | 21.3     |
| Copper cleaner tail     | 1.2     |          | 7.11     | 10.00        | 1 1     |        | 0.40                                   | 60.56    |        |         | 4.7 | 1.5      | 3.4     | 5.6      |
| Lead conc               | 2.2     |          | 55.13    |              | 6.57    |        | 1.18                                   | 149.45   |        |         | 3.5 | 1.7      | 17.3    | 24.0     |
| Lead cleaner tail No. 2 | 0.7     | 7 2.04   | 7.90     | 13.58        | 11.53   |        | 0.28                                   | 43.74    | 4 1    | .3 3    | 3.1 | 1.2      | 1.4     | 2.4      |
| " '' No. 1              | 2.9     |          | 2.76     | 10.53        | 11.20   |        | 0.185                                  | 20.16    |        |         | 4.2 | 3.6      | _ 3.6   | 4.3      |
| Lead rougher tail       |         | 1 0.32   | 0.35     | 8.70         |         |        | 0.105                                  |          |        |         | 5.2 | 90.4     | 62.0    | 42.4     |
| Feed (calcd)            | 100.0   | 0 1.21   | 1.95     | 8.65         |         |        | 0.15                                   | 13.59    | 100    | .0 100  | ).0 | 100.0    | 100.0   | 100.0    |
| Calculated Assays       |         |          |          |              |         |        |  |          |        |         |     |          |         |          |
| Copper rougher conc     |         | 3 19.37  | 6.00     |              | 20,22   |        | 0.57                                   | 88.78    |        | .0 13   |     | 3.1      | 15.7    | 26.0     |
| Lead rougher conc       | 5.9     | 6 1.65   | 23.11    | 9.45         | 9.50    |        | 0.57                                   | 71.80    | 8    0 | .2 70   | ).8 | 6.5      | 22.3    | 30.7     |
|                         |         |          |          |              |         |        |  | 1        |        |         |     |          |         |          |
|                         |         |          |          |              |         |        |  |          |        |         |     |          |         |          |
|                         |         |          |          |              |         |        |  |          |        |         |     |          |         |          |
|                         |         |          |          |              |         |        |  |          |        |         |     |          |         |          |
|                         |         |          | <u> </u> | l            |         |        | L                                      | <u> </u> |        |         |     | <u> </u> |         | <u> </u> |
| REMARKS:                |         |          |          |              |         |        |  |          |        |         |     |          |         |          |
| Clean and b             | right f | roth in  | both co  | opper ar     | nd Lead | roughe | ers.                                   |          |        |         |     |          |         |          |

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|                                    |         |                 |          |                | ons Lim                               |                |                   |          |          |        |         | _        |        | ne 17,      |          |
|------------------------------------|---------|-----------------|----------|----------------|---------------------------------------|----------------|-------------------|----------|----------|--------|---------|----------|--------|-------------|----------|
| OBJECT OF TEST: Si                 | milar t | o Test          | t 15 t   | out gri        | inding '                              | time inc       | reased            | l from 3 | 30 to    | 60 min | •       | · [      | ARGE:  | 2000        |          |
|                                    | ·       |                 | •• ••••• |                |                                       | ·              | · ·               | · ·      | <u> </u> | •      |         | - ·      | STED E | 3Y: A.S     | •        |
| OPERATION                          | Time    | %               | рH       |                | Unit                                  |                | • • • • •         | ·        | r ton    | ton    |         |          |        |             |          |
|                                    | min     | Solid           | s        |                | used                                  | Z-200          | ) SO <sub>2</sub> | DF250    | Lime     | NaCN   | AF242   | _        |        |             |          |
| Grinding                           | 60      | 65              |          | 12 3           | n. BM                                 | 0.02           |                   |          |          |        |         | 1        |        |             |          |
| Conditioning                       | 20      |                 | 5.8      | Aera           | ator                                  | 0.02           | 4.0               |          |          |        |         |          |        |             |          |
| Copper rougher                     | 2       |                 |          | 1000           | )-g cel:                              | 1 0.02         |                   | 0.02     |          |        |         |          |        |             |          |
| Conditioning 1                     | 5       |                 | 9.6      | 5              |                                       |                |                   |          | 4.5      | 0.1    |         |          |        |             |          |
| " 2                                | 5       |                 |          |                |                                       |                |                   |          |          | 0.1*   | 0.05    |          |        |             |          |
| Lead rougher                       | 2       |                 | -        |                | •                                     |                |                   | ·        |          |        |         |          | · ·    |             |          |
| Copper cleaner                     | 1_      |                 |          |                | <u>g cell</u>                         |                | ļ                 |          |          |        |         |          |        | •           |          |
| Lead cleaner                       | 1       |                 |          | 500-           | g cell                                |                |                   |          |          |        |         |          |        |             | <u>}</u> |
|                                    |         |                 |          |                |                                       | ·              | <u> </u>          | ļ        |          |        |         | ļ        | ·      |             |          |
|                                    | •       |                 | <u> </u> | ·              |                                       |                |                   |          | ·        |        |         | <u> </u> |        |             |          |
| ······                             |         |                 |          | · <del>-</del> | · · · · · · · · · · · · · · · · · · · |                | ļ                 | ļ        |          |        |         | ·        |        |             |          |
| ·                                  |         |                 |          | <u> </u>       |                                       |                |                   | <u> </u> |          |        |         | <u> </u> |        | <u> </u>    |          |
| PRODUCT                            | 11      |                 |          |                |                                       |                |                   |          | ISTR     | IBUTIO | N %     |          |        |             |          |
|                                    | %       | 5               | Cu       | РЪ             | Zn                                    | Fe             |                   | Au       | Ag       | Cu     | . ]     | РЪ       | Zn     | Au          | Ag       |
|                                    |         | 1 - 0 - 0       |          |                | 1 00                                  | 0.0 70         |                   | 0 77     | 00.1     |        |         |          |        | 11.0        | .18.4    |
| Copper conc<br>Copper cleaner tail | r I     | .45 23<br>.54 2 | 4.94     | 4.20<br>5.39   | 4.29 9.12                             | 22.73<br>16.21 |                   | 0.77     | 99.1     |        |         | 5.6      | 1.1    | 11.8<br>6.3 | 10.0     |
| Lead conc                          | 11      |                 | 1:05     | 59.00          | 4.67                                  | 5.90           |                   | 1,04     | 122.1    |        |         | 58.4     | 0.9    | 11.9        | 16.      |
| Lead cleaner tail                  |         |                 | .66      | 2.39           | 8.68                                  | 11.72          |                   | 0.13     | 14.7     |        | .5      | 9.5      |        | 5.9         | 8.       |
| Lead rougher tail                  |         |                 | ).36     | 0.41           |                                       |                | -                 | 0.12     | 7.1      |        |         | 19.1     | 89.0   | 64.1        | 46.      |
| Feed (calcd)                       | 100     | .00 1           | L.07     | 1.84           | 9.56                                  |                |                   | 0.16     | 13.1     | 4 100  | .0 10   | 00:00    | 100.0  | 100.0       | 100.     |
| Calculated assays                  |         |                 | · · ·    | <u> </u>       |                                       |                |                   |          | 1        |        |         |          |        |             |          |
| Copper rougher conc                | 4       | .99 13          | 3.93     | 4,81           | 6.75                                  | 19.41          |                   | 0.58     | 75.0     | 0 64   | .9      | 13.0     | 3.5    | 18.1        | 28.      |
| Lead rougher conc                  | 9       | .11 0           | ).74     | 13.70          | 7.88                                  | 10.56          |                   | 0.31     | 36.2     | 1 6    | ,3 6    | 67.9     | 7.5    | 17.8        | 25.      |
|                                    |         |                 |          | ·              |                                       |                |                   |          |          |        | ·       | · .      |        |             |          |
|                                    |         |                 |          | · . · ·        |                                       |                |                   |          |          |        |         |          |        | •           |          |
|                                    |         |                 |          |                |                                       |                | •                 |          |          |        |         |          | · ·    |             |          |
|                                    |         |                 |          | •              |                                       |                |                   | · .      | ·        |        |         |          |        |             |          |
|                                    |         |                 |          |                |                                       | · · ·          |                   | N        |          |        |         |          |        |             |          |
|                                    |         |                 | <u> </u> | · · · ·        | l                                     |                |                   | <u></u>  | 1        |        | <u></u> |          | 1      | l           | l        |
| REMARKS: Copper fl                 |         |                 |          |                |                                       |                |                   |          |          |        |         | -        |        |             |          |
| Lead floa                          | t – 1i  | ight,           | foamy    | froth          | Ļ                                     |                |                   |          |          |        |         | • •      |        |             |          |

\*Additional NaCN added to depress pyrite which appeared in froth.

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### MINES BRANCH FLOTATION TEST REPORT Sheet 1 of 2

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|                                     |                  |          |              |         | s Limi         |                    |              |                                 |        |       |              | DA       | TE: A                | ug. 25,     | , 1970     |
|-------------------------------------|------------------|----------|--------------|---------|----------------|--------------------|--------------|---------------------------------|--------|-------|--------------|----------|----------------------|-------------|------------|
|                                     |                  |          |              |         |                | ing the            |              |                                 | ethod  |       |              | CH       | ARGE:                | 2 x 200     |            |
| (coī                                | pper-1           | ead ro   | oughe:       | r flota | ation s        | imilar t           | to Test      | : 13).                          |        |       |              |          |                      | Y: A.S.     |            |
| OPERATION                           | Time             | %        |              | 1       | Jnit           |                    |              |                                 |        |       | , lb per     |          |                      |             |            |
| OPERATION                           | min              | Solid    | s pH         |         | used           | Na <sub>2</sub> CO | NaCN         | Na <sub>2</sub> SO <sub>3</sub> | AF208  | AF242 | DF250        | Lin      | ne CuS               | 04 CX51     | NaAF       |
| Grinding                            | 30               | 65       |              |         | BM             | 3.5                | 0.1          | 1.0                             | 0.02   | 0.02  | 5            | <u> </u> |                      |             |            |
| Conditioning                        | 5                |          | 8.4          | 4 1000- | g cell         |                    | 1            |                                 | 0.02   | 0.02  | 0.02         | 1        |                      |             |            |
| Copper-lead rougher                 |                  |          |              |         |                |                    |              |                                 |        |       |              |          |                      |             |            |
| Stage 1                             | 1                | 1        |              |         |                |                    |              |                                 |        |       |              |          |                      |             |            |
| 2                                   | 1                |          |              |         |                |                    | [            |                                 | 0.02   | 0.02  |              |          |                      |             |            |
| " 3                                 | 2                |          |              |         | ,,             |                    |              |                                 | 0.02   | 0.02  | 1            | 1        |                      |             | -          |
| Conditioning                        | 10               | T        | 11.4         | 4       |                |                    |              |                                 |        |       |              | 4.5      | 5 1.0                |             |            |
| Zinc roughers                       |                  | <u> </u> |              | -       | ,              |                    |              |                                 |        |       |              |          |                      |             |            |
| Stage 1                             | 1/2              |          | 11.4         | 4       |                |                    |              |                                 |        |       | 0.02         | 1.0      | )                    | 0.02        | 2          |
| " 2                                 | 1                | <b>_</b> |              |         |                |                    |              |                                 |        |       |              |          |                      |             | 0.05       |
| " 3                                 | 2 <sup>1</sup> 2 | 1        |              |         |                |                    |              |                                 |        |       |              |          |                      |             | 0.05       |
|                                     |                  |          |              |         |                |                    |              |                                 |        |       | 1            |          |                      |             |            |
| PRODUCT                             | W W              | т        |              |         | ANA            | LYSIS              | %            | · · · ·                         |        | 1     | DI           | STR      | IBUTIO               | N %         |            |
| PRODUCT                             | %                | 6 (      | Cu           | Pb      | Zn             | Fe                 | Au           | Ag                              |        | C     | 1 1          | ?Ъ       | Zn                   | Au          | Ag         |
| Copper conc                         | 2                | .22 2    | 3.22         | 17.36   | 4.49           | 16.50              | 1.28         | 175.36                          |        | 5     | 0.8          | 19.1     | 1.1                  | 16.8        | 28.0       |
| Lead conc                           | 1                | .60 2    | 2.00         | 25.84   | 3.00           | 26.64              | 0.54         | 61.89                           |        |       | 3.1 2        | 20.5     | 0.5                  | 5.1         | 7.1        |
| Copper cleaner tail No.2            | 2    0           | .60 1    | 2.94         | 29.16   | 4.49           | 15.90              |              | 231.46                          |        |       | 7.6          | 8.7      | 0.3                  | 4.3         | 10.0       |
| " " " No.]                          | L    O           |          | 8.50         | 30.55   | 4.26           | 19.08              | 0.54         | 95.42                           | 1      |       | 1            | 10.6     | 0.3                  | 2.2         | 4.8        |
| Copper-lead cl tail No.3            | · II             |          | 3.27         | 19.40   |                | 20.87              | 0.50         | 59.51                           | 1      |       |              | 10.8     | 1.3                  | 3.3         | 4.8        |
| " " " No.2                          |                  |          | 2.86         |         | 12.59          | 19.48              | 0.44         | 48.25                           |        |       | 3.0          | 5.1      | 1.5                  | 2.7         | 3.6        |
| NO.J                                | 51               | 11       | 1.22         |         | 10.00          | 17.89              | 0.29         | 25.40                           | 1      | 11    | 5.8 :<br>5.7 | 12.0     | 5.4                  | 8.2         | 8.8        |
| Zinc rougher conc No. 1<br>"""No. 2 |                  | 11       | 0.70<br>0.70 |         | 41.53<br>33.88 | 7.16               | 0.14<br>0.20 | 11.72                           |        |       | 6.3          | 2.6      | 38.8<br>34.8         | 6.8<br>10.5 | 7.0<br>6.8 |
| Pyrite rougher conc.No.J            | - <del></del>    |          | 0.30         | 0.55    | 2.90           | 36.58              | 0.20         | 11.50                           | 1      |       | 2.9          | 2.7      | 3.2                  | 17.7        | 8.0        |
| " " No.2                            |                  | 11       | 0.37         |         | 11.52          | 27.43              | 0.28         | 11.44                           | 4      | 11    | 3.3          | 2.7      | 11.9                 | 15.2        | 7.6        |
| Final tailing No.1                  |                  | £1       | 0.04         | 0.12    | 0.16           | 27113              | 0.027        | 1                               | 1      | 11    | 1.0          | 1.6      | 0.5                  | 4.2         | 1.8        |
| " No.2                              |                  |          | 0.04         | 0.12    | 0.15           |                    | 0.02         | 0.92                            |        |       | 1.0          | 1.5      | 0.4                  | 3.0         | 1.7        |
| Feed (calcd)                        | 100              | .00      | 1.01         | 2.01    | 8.87           |                    | 0.17         | 13.90                           |        | 100   | 0.0 10       | 0.00     | 100.0                | 100.0       | 100.0      |
|                                     |                  |          |              |         |                |                    |              |                                 |        |       |              |          |                      |             |            |
| REMARKS: Two 2000-gra               | II bat           | ches d   | round        | 1 and f | loated         | separat            | elv -        | CODDer                          | -lead  | rough | er cond      | centr    | ates c               | ombined     | tor        |
| cleaning and copper-lead            |                  |          | -            |         |                |                    |              |                                 |        |       |              |          |                      |             |            |
| Pyrite appeared in zinc             |                  |          |              | tion of | CX 51          | . theref           | ore ad       | lded ex                         | tra li | me -e | ffect d      | of ox    | xidatio <sup>.</sup> | n?          |            |
| Tyrree appeared in 21nc             |                  | <u></u>  |              |         |                | ,                  |              |                                 |        |       |              | •••      |                      |             |            |

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| TEST NO. 17 SAMP                      | LE: N          | Vadina | Exp   | loratio | ons Limi      | ted   |      |        |             |          |           | · · · · · · · · · · · · · · · · · · · | ug. 25, | 1970  |
|---------------------------------------|----------------|--------|-------|---------|---------------|-------|------|--------|-------------|----------|-----------|---------------------------------------|---------|-------|
| OBJECT OF TEST:                       |                |        |       |         |               | · -   |      |        |             |          | CH        | HARGE:                                |         |       |
| · · · · · · · · · · · · · · · · · · · |                |        |       |         | • •           |       |      |        |             |          |           | STED E                                | 3Y:     |       |
|                                       | Time           | %      | T     |         | Jnit          | 1     |      |        | Reag        | ents, It | per to    | <u>ר</u>                              |         |       |
| OPERATION                             |                | Solid  | .  pH | 1 1     | used          | Dich* | ł    |        |             | D        | F250      | •                                     | CX51    | H2S04 |
| Conditioning                          | 5              |        | 8.    | 7       | •             | · ·   |      |        |             |          |           |                                       |         | 1.5   |
| Pyrite ro, Stage 1                    | 1              |        |       |         |               |       |      |        |             |          |           |                                       | 0.0     |       |
| " " 2                                 | 1              |        | 1     |         |               |       |      |        |             |          |           |                                       | 0.0     | 5     |
| <u>"" " 3 .</u>                       | i              |        |       |         |               |       |      |        |             |          |           |                                       | 0.0     | 5     |
| n n n 4                               | 1              | ······ | 1     |         |               |       |      |        |             |          |           |                                       | 0.0     | 5     |
| Copper-lead c1 No. 1                  | 3              |        |       | 1000    | -g cell       |       |      |        |             | 0        | .02       |                                       |         |       |
| No. 2                                 | 11/2           |        |       | 1       | <u>e cell</u> |       |      |        |             |          |           |                                       |         |       |
| " " No. 3                             | 11/2           |        |       | 11      | й п           |       |      |        | ·           |          |           |                                       |         |       |
| Copper-lead separation                | · .            |        |       |         |               |       |      | ·      |             |          |           | ·                                     |         |       |
| Conditioning                          | _5             | -      | L     | 250-    | <u>g cell</u> | 4.0   |      |        |             |          |           |                                       |         | · .   |
| Copper rougher                        | $1\frac{1}{2}$ |        |       |         |               |       |      |        |             | •        |           |                                       |         |       |
| Copper cleaner #1 &2                  | 1              |        |       | 250-    | g cell        |       |      |        |             |          | <u>  </u> |                                       |         |       |
| PRODUCT                               | W              |        |       |         | ANA           | LYSIS | %    |        |             | 1        | DIST      | RIBUTIC                               | N %     |       |
|                                       | %              |        | Cu    | РЪ      | Zn            | Fe    | Au   | Ag     |             | Cu       | РЪ        | Zn                                    | Au      | Ag    |
| Metallurgical Balance fo              | r              |        |       |         |               |       |      |        |             |          |           |                                       | . *     |       |
| Copper-Lead Separation                |                |        |       |         |               |       |      |        |             |          |           |                                       |         |       |
| Copper conc                           | 11             | 11     |       | 17.36   | 4.49          | 16.50 |      | 175.36 |             | 75.4     | 32.5      | 48.8                                  | 59.2    | 56.1  |
| Copper cleaner tail No.2              | 11             |        |       | 29.16   | 4.49          | 15.90 |      | 231.46 |             | 11.3     | 1         | <u>د</u>                              | 15.0    | 20.0  |
| " " " No.1                            | 11             |        |       | 30.55   | 1 1           | 19.08 |      |        |             | 8.6      |           | *                                     | 7.8     | 9.6   |
| ead conc                              | <u> </u>       |        |       | 25.84   | 3.00          | 28.64 |      |        |             | 4.7      |           |                                       | 18.0    | 14.3  |
| Feed (calcd)**                        | 100.           | 00 1   | 3.38  | 23.19   | 3.99          | 19.95 | 0.94 | 135.58 |             | 100.0    | _         |                                       | 100.0   | 100.0 |
| Calculated Assays                     |                |        |       |         |               |       |      |        |             |          | •••       |                                       |         |       |
| lst Stage copper cl conc              |                |        |       | 19.87   | 4.49          | 16.37 |      | · · ·  |             | 86.7     | 1         |                                       | 74.2    | 76.1  |
| Copper rougher conc                   | 68.            | 78 1   | 8.54  | 21.99   | 4.44          | 16.91 | 1.12 | 169.03 |             | 95.3     | 65.2      | 76.5                                  | 82.0    | 85.7  |
|                                       |                |        |       |         |               |       | • •  | · ·    |             |          | · ·       |                                       | · ·     | • •   |
| • •                                   | <b>  </b> .    |        |       |         |               | 1     |      |        |             |          |           |                                       |         |       |
|                                       |                |        |       |         |               |       |      |        | •           |          | ·         |                                       |         |       |
|                                       | <u>  </u> · ·  |        |       |         | .             |       |      |        |             | ]]       | -         |                                       |         | · .   |
|                                       |                |        |       |         |               |       | 1    |        |             |          |           |                                       |         |       |
| REMARKS:                              |                |        |       |         |               |       |      |        | · · · · · · |          |           |                                       |         |       |
| KEMARKS: * Sodium die                 | chroma         | te     |       |         |               |       |      |        |             |          |           |                                       |         |       |

\*\* Copper-lead cleaner concentreate

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| TEST NO. 18 SAMPI                           | E: Nad            | ina Expl | oration | s Limit | .ed     |          |        |          |          |         |          | ug. 26, |         |
|---|-------------------|----------|---------|---------|---------|----------|--------|----------|----------|---------|----------|---------|---------|
| OBJECT OF TEST: To tr                       | y coppe           | r-lead s | eparati | on usin | g the s | ulphur   | dioxid | le-starc | h metho  | d CH    | ARGE:    | 2 x 20  | 00 g    |
| (copper-lead rough                          | er flot           | ation as | in Tes  | t 17)   |         |          |        |          |          | TE      | STED E   | Y: A.S  | •       |
|   | Time              | %        | ι ι     | Jnit    |         |          |        | Reage    | ents, Ib | per ton |          |         |         |
| OPERATION                                   | min S             | olids pH | ι ι     | ised    |         |          |        |          |          |         |          |         |         |
|   |                   |          |         |         |         |          |        |          |          |         |          |         |         |
| <u>Grinding</u> ) as<br>Copper lead ro > in |                   |          |         |         |         |          |        |          |          |         |          |         |         |
| Zinc rougher Test                           |                   |          |         |         |         |          |        |          |          |         |          |         |         |
| Pyrite rougher ) 17*                        |                   |          |         |         |         |          |        |          |          |         |          |         |         |
| - iyiile iougnei j i/                       |                   |          |         |         |         |          |        | ···      |          |         |          |         |         |
|   |                   |          |         |         |         | <b> </b> |        |          |          |         |          |         |         |
|   |                   |          |         |         |         |          |        |          |          |         |          |         |         |
|   | ·                 |          |         |         |         | ļ        |        |          |          |         |          |         |         |
|   |                   |          |         |         | _       | ļ        | ·      |          |          |         |          |         |         |
| · · · · · · · · · · · · · · · · · · ·       |                   |          |         |         |         |          | ļļ-    |          |          |         |          |         |         |
|   |                   |          |         |         | · ·     |          |        |          |          |         |          |         |         |
|   |                   |          |         |         |         |          |        |          |          |         |          |         |         |
|   |                   |          |         |         |         |          |        |          |          |         |          |         |         |
|   | WT                |          |         | ANA     | LYSIS   | %        |        | ·        |          | DISTR   | BUTIO    | N %     |         |
| PRODUCT                                     | %                 | Cu       | РЪ      | Zn      | Fe      | Au       | Ag     | S        | Cu       | РЪ      | Zn       | Au      | Ag      |
|   |                   |          |         |         |         |          |        |          |          |         |          |         |         |
| Copper conc                                 | 2.6               | 11       | 12.98   |         | 19.58   |          | 130.70 |          | 56.5     | 17.8    | 1.0      | 15.6    | 26.5    |
| Copper cleaner tail No.2                    | 0.3               |          | 21.58   |         | 24.05   |          | 130.67 |          | 2.7      | 3.8     | 0.2      | 1.9     | 3.4     |
| " " " No.1                                  | 0.7               |          | 18.26   |         | 27.83   | 0.74     | 97.80  |          | 4.2      | 7.0     | 0.3      | 3.3     | 5.5     |
| Lead conc                                   | 2.4               |          | 34.08   |         | 20.48   | 0.56     | 87.88  |          | 5.8      | 43.0    | 1.5      | 8.2     | 16.3    |
| Copper-lead cl tail No.3                    | 1.0               |          |         | 12.79   | 24.05   | 0.57     | 50.08  |          | 3.6      | 6.2     | 1.5      | 3.6     | 4.0     |
| NO.Z  | 1.1               |          |         | 13.90   | 21.47   | 0.53     | 45.02  |          | 2.3      | 4.5     | 1.7      | 3.5     | 3.8     |
| NO.1  | 3.2               |          |         | 10.26   | 17.20   | 0.28     | 24.49  |          | 4.5      | 6.7     | 3.8      | 5.4     | 6.1     |
| Zinc rougher conc No. 1                     | 9.4               |          |         | 46.18   | 15.75   | 0.15     | 12.16  |          | 7.7      | 2.6     | 49.0     | 8.5     | 8.7     |
| NO• Z                                       | 9.7               |          |         | 33.89   | 11.88   | 0.15     | 11.56  | 20.00    | 6.4      | 2.7     | 37.0     | 8.7     | 8.5     |
| Pyrite rougher conc No.1                    | 8.3               | 11       | 0.58    |         | 34.89   | 0.34     | 11.10  | 38.02    | 2.2      | 2.5     | - 1.3    | 16.9    | 7.0     |
| NO.2  | 9.0               |          | 0.48    |         | 33.80   | 0.31     | 10.14  | 36.52    | 1.9      | 2.2     | 2.0      | 16.7    | 6.9     |
| Final tailing No. 1                         | 26.6              |          | 0.05    |         |         | 0.02     | 0.90   |          | 1.2      | 0.7     | 0.4      | 3.2     | 1.8     |
| <u>INO • Z</u>                              | 25.2              |          | 0.02    |         |         | 0.03     | 0.75   | <u> </u> | 1.0      | 0.3     | 0.3      | 4.5     | 1.5     |
| Feed (calcd)                                | 100.0             | 0 1.12   | 1.94    | 8.90    |         | 0.1/     | 13.18  |          | 100.0    | 100.0   | 1100.0   | 100.0   | 100.0   |
|   |                   |          |         |         |         |          |        | <u> </u> |          |         | <u> </u> | L       |         |
| REMARKS: *Except that<br>added in Tes       | Z-200 v<br>st 17. | was adde | to th   | e first | stage   | of the   | zinc r | ougher   | in plac  | e of th | ne CX51  |         | <u></u> |

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| TEST NO. 18 SAME<br>OBJECT OF TEST:                 | PLE:              | Nadin  | a Exp      | loratio | ons Lim | ited  |       |                 | <u> </u> | <u></u>   |         | ATE: <u>Au</u><br>IARGE:              | g. 26, | <u>1970</u> |
|---|-------------------|--------|------------|---------|---------|-------|-------|-----------------|----------|-----------|---------|---------------------------------------|--------|-------------|
|   |                   |        |            |         |         | -     |       |                 | · · •    |           | TE      | STED E                                | 3¥:    |             |
|   | Time              | %      | T.         |         | Unit    |       |       |                 | Reag     | gents, Ib | per ton | · · · · · · · · · · · · · · · · · · · | · ·    |             |
| OPERATION   | min               | Solid  | s pŀ-      | 1 1     | used    | AF242 | DF250 | S0 <sub>2</sub> | CS*      |           |         |                                       |        |             |
| Copper-lead cleaners                                |                   |        |            |         |         | ·     |       |                 |          |           |         |                                       |        |             |
| No. 1   | 3                 | 1      | 1.         | 1000-   | -g cell | 0.01  | 0.02  |                 |          |           |         |                                       |        | j.          |
| No. 2   | 11/2              |        |            | 500-8   | g cell  |       |       |                 |          |           |         |                                       |        |             |
| No. 3   | $1^{\frac{1}{2}}$ |        |            | 11 1    | 1 11    |       | 0.004 |                 |          | ,         |         |                                       |        |             |
| Copper-lead separation                              |                   |        |            |         |         |       |       | 0.25            | 0.05     |           |         |                                       |        | -           |
| Conditioning  | _5                |        | 5.         | 3 250-  | g cell  |       |       |                 |          |           | `       |                                       | 1      |             |
| Copper rougher                                      | 2                 | 1      |            |         |         | •     | 0.004 |                 |          |           |         |                                       |        |             |
| Copper cleaner No. 1                                | $1^{\frac{1}{2}}$ |        | 1          | 250-8   | g cell  |       | 0.004 |                 |          |           |         |                                       |        |             |
| No. 2   | 1 .               | · ·    | 1          | 111     | 1 11    |       | 0.004 |                 |          |           |         |                                       |        |             |
| · · · · · · · · · · · · · · · · · · ·               |                   | 1      |            |         |         |       |       |                 |          | -         |         |                                       |        |             |
| · · · · · · · · · · · · · · · · · · ·               |                   | 1      | 1          |         | •       |       | 1     |                 |          |           |         |                                       |        |             |
|   |                   |        | 1          |         |         |       |       |                 |          |           |         |                                       |        |             |
|   | l w               | TI     | <u>.</u>   |         | ANA     | LYSIS | %     | ·               | ł.       | 1         | DISTE   | RIBUTIO                               | N %    |             |
| PRODUCT   | 11                | . !!   | Cu .       | РЬ      | Zn      | Fe    | Au    | Ag              | ·····    | Cu        | РЪ      | Zn                                    | Au     | Ag          |
| ·····   |                   |        |            |         |         |       |       |                 |          |           |         |                                       |        |             |
| Metallurgical Balance                               | .                 |        | •          | • ·     |         |       | •     |                 | 1        |           |         |                                       |        |             |
| for Copper-Lead Separat                             | ion               |        |            |         |         |       |       | · ·             |          |           |         |                                       |        |             |
| Copper conc   | 43                | 06 2   | 3 68       | 12 08   | 3 /3    | 19.58 | 0.08  | 130.70          |          | 81.6      | 24.9    | 34.0                                  | 53.9   | 51.2        |
| Copper cleaner tail No.                             |                   | .50    |            | 21.58   |         | 24.05 |       | 130.67          |          | 3.9       | 5.3     | 5.3                                   | 6.6    | 6.5         |
| - " " No.   | 1 1 11            | . 90   |            |         |         | 27.83 |       | 97.80           |          | 6.0       | 9.7     | 10.7                                  | 11.3   | 10.6        |
| Lead conc   |                   | .52    |            | 34.08   |         | 20.48 | 0.56  | 87.88           |          | 8.5       | 60.1    | 50.0                                  | 28.2   | 31.6        |
| Feed (calcd)  |                   | .00 1  |            | 22.42   | 4.34    | 21.16 | 0.78  | 109.85          |          | 100.0     | 100.0   | 100.0                                 | 100.0  |             |
|   |                   |        |            |         |         |       |       |                 |          |           | ·       |                                       |        | · · .       |
| <u>Calculated Assays</u><br>1st stage Copper cl con |                   | 56 2   | ,          | 13 0 =  | 2 57    | 10 00 | 0.97  | 130.70          | 1        | 85.5      | 30.2    | 39.3                                  | 60.5   | 57.7        |
|   |                   |        |            | -14.80  |         | 21.61 |       | 124.21          |          | 91.5      | 39.9    | 50.0                                  | 71.8   |             |
|   | P 60              |        | )• 7 L ' I | ~14.0V  | 5.55    | 21.01 | 0.95  | 124.21          |          | 91.5      | 59.9    | 30.0                                  | /1.0   | 00          |
| Copper rougher conc                                 | 60                | • - 11 | _          |         | 2       |       |       | 1               |          | IC ·      | 1       | 1 .                                   | , .    |             |
|   | 60                |        |            | ÷       |         |       | •     |                 |          | 1 · .     | •       |                                       |        |             |
|   | 60                |        |            | ÷       |         |       | •     |                 |          |           | · · ·   |                                       |        |             |
|   | 60                |        |            | -       |         |       | •     |                 |          |           |         |                                       |        |             |

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| TEST NO. 19 SAMP                      | LE:                | Nadi  | na Ex      | plorat  | ions Lim         | ited     |                   |         |      |         |        | DA  | TE: No              | v, 10, | 1970          |
|---------------------------------------|--------------------|---|------------|---------|------------------|----------|-------------------|---------|------|---------|--------|---|---------------------|--------|---------------|
| OBJECT OF TEST: To t                  | ry cop             | per-1   | ead s      | separat | ion usin         | g the    | cyanid            | e metho | bd   |         |        | СНА                                       | ARGE:               | 2 x 20 | 00 g          |
| (cop                                  | per-le             | ad ro   | ughei      | flota   | tion as          | in Tes   | t 17).            |         |      | <u></u> |        |   | TED B               | Y: A.  | 5.            |
| OPERATION                             | Time               | ~~%   | рH         |         | Unit             |          |                   |         | Rea  | igents, | lb per | ton                                       |                     |        |               |
| OFERATION                             | min                | Solid   | s          |         | used             | Lime     | CuSO <sub>4</sub> | DF250   | MIBC | Z-200   | NaAF   | CX  | 51                  |        |               |
| Grinding ) as                         |                    |   |            |         |                  | 1        |                   |         |      |         | ,      |   |                     |        |               |
| Conditioning in                       |                    |   |            |         |                  | 1        |                   |         |      |         |        |   |                     |        |               |
| Copper-lead ro ) Test 17              |                    |   |            |         |                  |          |                   |         |      |         |        |   |                     |        |               |
| Conditioning                          | 10                 | <i></i>                                       | 11.        | 2 100   | 0- <u>g_cell</u> | 6,0      | 2.0               |         |      |         |        |   |                     |        |               |
| Zinc rougher                          |                    |   |            |         |                  |          |                   |         |      |         |        |   |                     |        |               |
| Stage 1                               | 1                  |   |            |         |                  |          |                   | 0.02    |      | 0.02    |        | <u> </u>                                  |                     |        |               |
| . "2                                  | 1                  |   |            |         |                  | ļ        | ļ                 |         |      |         | 0,05   | <b> </b>                                  | <u>.</u>            |        |               |
| <u> </u>                              | · 2 <sup>· ·</sup> |   | ļ          |         |                  |          | ļ                 |         | 0.02 |         |        | <u> </u>                                  |                     |        |               |
| <u> </u>                              | 3                  |   | <u> </u>   |         |                  |          |                   |         |      |         | 0.05   | <b> </b>                                  |                     |        |               |
|                                       |                    |   |            |         |                  | ļ        |                   |         |      |         |        | <b> </b>                                  | <u> </u>            |        |               |
| · · · · · · · · · · · · · · · · · · · |                    |   | . <u> </u> |         |                  |          |                   |         |      |         |        | ──  |                     | _      |               |
|                                       | -                  | l   |            |         |                  | <u> </u> |                   |         |      |         |        |   |                     |        |               |
| PRODUCT                               | W-<br>%            | . 11  |            |         | 1                | YSIS     | %                 | r       |      |         | `      |   | BUTIO               | N %    | ·             |
|                                       | ×                  | <u>,                                     </u> | Cu         | РЪ      | Zn               | Au       | Ag                |         |      | Cı      | 1      | РЪ  | Zn .                | Au     | Ag            |
| Metallurgical Balance                 |                    |   |            |         |                  |          | -                 |         |      |         |        |   |                     |        |               |
| for Copper-Lead Sepn                  |                    |   |            |         |                  |          |                   |         |      |         |        |   |                     |        |               |
|                                       |                    |   |            |         |                  |          |                   |         |      |         |        |   |                     |        |               |
| Copper conc                           |                    |   |            | 18.96   | 4.78             |          | 126.70            | ł       | · ·  | 68.     | 9 5    | 3.2                                       | 62.3                | 69.6   | 64.1          |
| Lead conc                             |                    |   |            | 46.20   | 6.70             |          | 140.40            |         |      |         |        | 0.4                                       | 20.5                | 15.0   | 16.7          |
| Lead cleaner tail No. 2               |                    |   |            | 19.92   | 5.37             |          | 131.56            |         |      |         |        | 6.3                                       | 7.8                 | 6.3    | 7.4           |
| "" No. 1<br>Feed (calcd)              |                    |   |            | 20.80   | 4.15             |          | 134.38<br>130.05  | ·····   |      | 13.     |        | $\begin{array}{c} 0.1 \\ 0.0 \end{array}$ | <u>9.4</u><br>100.0 | 9.1    | 11.8<br>100.0 |
| Lead ro conc (calcd)                  |                    |   |            | 32.08   | 5.56             |          | 136.49            |         |      | 31.     |        | 6.8                                       | 37.7                | 30.4   | 35.9          |
|                                       |                    |   |            | -2.00   |                  |          |                   |         |      |         | -   .7 |   |                     |        |               |
|                                       |                    |   |            |         |                  |          |                   |         | 1    |         |        |   |                     |        |               |
|                                       |                    |   |            |         |                  |          |                   |         |      |         |        |   |                     |        |               |
|                                       |                    |   |            |         |                  |          |                   |         | ļ    |         |        |   |                     |        |               |
|                                       |                    |   |            |         |                  |          |                   |         |      |         |        |   |                     |        |               |
|                                       |                    |   |            |         |                  |          |                   |         | -    |         |        |   |                     |        |               |
| REMARKS:                              |                    |   |            |         |                  |          |                   |         |      |         |        |   |                     |        |               |

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| TEST NO. 19 SAMPI                     | LE:            | Nadir            | ia Ex | plorati        | ons Li       | mited          |         |              |        |        |              |            |       | . 10,      | 1970       |
|---------------------------------------|----------------|------------------|-------|----------------|--------------|----------------|---------|--------------|--------|--------|--------------|------------|-------|------------|------------|
| OBJECT OF TEST:                       |                |                  |       | ·              |              |                | ````    |              |        |        |              | CHA        | RGE:  |            |            |
| · · · · · · · · · · · · · · · · · · · |                | •                |       |                |              |                | ·       | · · ·        |        |        |              | TES        | ED B  | <b>/</b> : |            |
|                                       | Time           | · %              | 1.    |                | Jnit         | 1.             |         |              | Rea    | gents, | lb per       | ton        |       |            |            |
| OPERATION                             |                | Solids           | рH    |                | used         |                |         |              |        | )F250  |              | H2SO4      | ZnCl  | AF242      | NaCN       |
| Conditioning                          | 5              |                  | 8.    | 7              |              |                |         |              |        |        |              | 3.0        |       |            |            |
| Pyrite rougher, Stage 1               | 1              |                  |       |                |              | 1              |         |              |        | 0.02   | 0.05         |            |       |            |            |
| <u>11 11 11 2</u>                     | 1              |                  |       |                |              |                |         |              |        |        | 0.05         | · .        |       |            | ·          |
| " " 3                                 | 1              |                  |       |                |              |                |         |              |        |        | 0.05         |            |       |            |            |
| 11 11 11 4                            | 1              | •                |       |                |              |                |         |              |        |        | 0.05         |            |       |            |            |
| Cu-Pb cleaners (as in Te              | st 17          | <u>) '</u> .     |       |                |              |                | · ·     |              |        |        |              |            | ·     |            |            |
| Copper-lead separation                |                |                  |       |                |              |                | L       |              |        | ·      |              |            |       |            |            |
| Conditioning                          | 5              |                  | 11.   | 6 250-         | g cell       |                |         |              |        | ·      |              |            | 0.87  | , }        | · ·        |
| Lead rougher                          | 11/2           |                  |       |                |              |                |         | •            |        |        |              |            |       | 0.01       |            |
| Lead cleaner                          |                | . <u>.</u> .     |       |                |              |                |         |              |        |        |              | · .        | · · · |            |            |
| No. 1                                 | $1\frac{1}{2}$ |                  |       | 250-           | g cell       |                |         |              |        |        |              | :          |       | 0.005      | 0.10       |
| No. 2                                 | 1              |                  |       | 11             | 11 11        |                |         | ·            |        |        |              | <u> </u>   | 1     | 0.01       | · · ·      |
| PRODUCT                               | W              |                  |       |                | ANA          | LYSIS          | %       |              |        |        | - <u>D</u> I | STRIE      | UTIO  | N %        |            |
| I KODOCI                              | %              |                  | Cu    | Pb             | Zn           | Fe             | S       | Au           | Ag     | Cu     | L 9          | ?Ъ         | Zn    | Au         | Ag         |
|                                       |                |                  |       |                |              |                |         |              |        |        | -            |            |       |            |            |
| Copper conc                           |                | .18 15           |       | 18.96          | 4.78         | 19.57          |         | 0.86         | 126.70 |        |              | L.5        | 1.8   | 17.0       | 30.8       |
| Lead conc                             |                |                  | .34   | 46.20          | 6.70         | 7.35           |         | 0.79         | 140.40 |        |              | 3.1        | 0.6   | 3.7        | 8.1        |
| Lead cleaner tail No. 2<br>""" No. 1  |                | .36 17<br>.55 17 |       | 19.92<br>20.80 | 5.37<br>4.15 | 17.43<br>18.82 |         | 0,69<br>0,65 | 131.56 |        | 1            | 8.8<br>5.0 | 0.2   | 1.6        | 3.6<br>5.7 |
| Copper-lead cl tail No.3              | 14             |                  | .88   | 17.44          |              | 19.49          |         | 0.49         | 56.19  |        |              | 9.6        | 1.6   | 3.2        | 4.5        |
| " " " No.2                            |                |                  | .31   |                | 12.37        | 18.69          |         | 0.42         | 48.45  |        | 1            | 5.4        | 1.5   | 2.7        | 3.9        |
| " " " No.1                            |                |                  | .46   | 4.88           | 9.44         | 18.48          |         | 0.31         | 25.43  |        |              | Ĺ.7        | 5.2   | 8.8        | 8.9        |
| Zinc rougher conc                     |                |                  | .44   |                | 50.35        | 5.04           | • .     | 0.11         | 10.42  |        | 1            |            | 80.9  | 9.1        | 10.6       |
| Pyrite rougher conc                   |                |                  | .60   | 0.59           | 2,46         | 33.71          | 38.47   | 0.29         | 11.41  |        |              | 7.2        | 6.9   | 41.9       | 20.3       |
| Final tailing                         |                |                  | .06   | 0.16           | 0.16         | 4.94           |         | 0.03         | 0.91   |        | 8 4          | 4.4        | 1.0   | 9.8        | 3.6        |
| Feed (calcd)                          | 100            | .00 1            | .10   | 1,91           | 8.30         | 13.16          |         | 0.16         | 13.07  | 100.   | 0. 100       | 0.0 1      | 00.0  | 100.0      | 100.0      |
|                                       | 1              |                  |       |                | · · · ·      |                |         |              | 1.5    | 1      |              |            |       | · ·        |            |
| · •                                   |                |                  |       |                |              | •              |         | •            |        |        | ŀ            | _          | • • • |            |            |
|                                       |                |                  | •     |                |              |                |         | • •          | 1 × 1  |        |              |            |       | . ]        |            |
|                                       |                |                  |       |                |              |                |         |              |        |        | ·            |            |       |            |            |
| REMARKS: Zinc roughe                  | r hici         |                  | 0 h   |                |              |                | - offer | t of L       | ich C. |        |              | •          |       |            |            |
| Zine roughe                           | r urgi         | r grad           | ebu   | L GYLTG        | шету 8       | 5 cumiy        | errec   |              |        | 4      |              |            |       |            |            |
|                                       |                |                  |       |                |              |                |         |              |        |        |              |            |       |            |            |
|                                       |                |                  |       |                |              |                |         |              | ······ |        |              |            |       |            |            |

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| TEST NO. 20 SAMP                   |        |               |       |        | ons Lim         |                |                      |              |         |                    |       | -      |            | b. 4, 1     | 971        |
|------------------------------------|--------|---------------|-------|--------|-----------------|----------------|----------------------|--------------|---------|--------------------|-------|--------|------------|-------------|------------|
| OBJECT OF TEST: Coppe              | r-lea  | d sepa        | ratio | n on 1 | new sam         | ple usi        | ng S0 <sub>2</sub> - | starch       | n metho | d in               |       |        | RGE:       | 2 x 20      | 00 g       |
|                                    | nctio  | <u>n with</u> | regr  | inding | <u>g prior</u>  | to cle         | aning <sup>~</sup>   |              |         |                    |       |        | TED E      | Y: A.S      | 5.         |
| OPERATION                          | Time   | %             | рН    | -      | Unit            | 17 00          | hz                   | 17 017       |         | igents,            | -     |        | -1         |             |            |
|                                    |        | Solids        | ×     | _      | used            |                | $3^{Na}2^{SO}3$      | NaCN         | AF208   | AF242              | DF250 |        | e CuSO     | 4 Z-20      | O NaA      |
| Grinding                           | 45     | 65            |       | 7 x    | 14 RM           | 3.0            | 1.0                  | 0.1          | 0.015   | 0.015              |       |        |            |             |            |
| Conditioning                       | 5      |               | 7.6   | 1000   | )- <u>g cel</u> | 1              | · ·                  |              | 0.01    | 0.01               | 0.02  |        |            |             |            |
| Copper-lead rougher                |        |               | · ·   | _      |                 |                |                      |              |         |                    |       |        |            |             |            |
| Stage 1                            | 1/2    |               | ļ     |        |                 |                |                      |              |         |                    |       |        |            |             |            |
| " 2                                | 1/2    |               |       |        |                 |                |                      |              | 0.01    | 0.01               |       |        |            |             |            |
| " 3                                | 1      |               |       |        |                 |                |                      |              | 0.01    | 0.01               |       |        |            |             |            |
| " 4                                | 1      | - •           |       |        |                 |                |                      |              |         | 0.02               |       |        |            |             |            |
| Conditioning 1                     | 10     |               | 9.1   |        |                 |                |                      |              |         |                    |       | 3.0    | 0.5        | 0.02        | 2          |
| " 2                                | 5      |               | 10.2  |        |                 |                |                      |              |         |                    |       | 1.0    |            |             |            |
| Zinc rougher - Stage 1             | 1      |               |       |        |                 |                |                      |              |         |                    |       |        |            |             |            |
| " " 2                              | 1      |               | 1     |        |                 |                | · +                  |              |         |                    |       |        |            |             | 0.0        |
| 11 11 11 3                         | 2      |               |       |        |                 |                |                      |              |         |                    |       | 1      |            |             | 0.1        |
|                                    | W      | r II          |       |        | ANA             | LYSIS          | %                    |              |         |                    | DI    | STRI   | BUTIO      | N %         |            |
| PRODUCT                            | %      |               | Cu    | РЪ     | Zn              | Fe             | Insol                | Au           | Ag      | Cu                 |       | РЪ     | Zn         | Au          | Ag         |
| Copper conc                        | 0.     | 7 19          | .48 - | 33.03  | 2.70            | 13.17          |                      | 3.02         | 142.2   | 6 8.               | 0     | 5.1    | 0.1        | 7.6         | 4.3        |
| Copper cleaner tail                | 0.0    | 14            |       | 47.30  | 3.86            | 8.93           |                      | 0.99         | 134.4   |                    |       | 5.2    | 0.3        | 5.6         | 9.1        |
| Lead conc                          | 1.     | 76    7       |       | 50.00  | 5.00            | 8,63           |                      | 0.47         | 109.1   |                    |       | 0.2    | 1.0        | 7.7         | 21.6       |
| Copper-lead cl tail No.2           |        |               | .69   |        | 12.70           | 13.02          |                      | 0.30         | 80.4    | 7 14.              | 5 5   | 5.5    | 1.4        | 2.7         | 8.9        |
| · · · · · · No.1                   |        |               | .12   |        | 11.19           | 17.44          |                      | 0.16         | 30.3    | 11                 |       | 5.7    | 5.4        | 6.6         | 15.1       |
| Zinc conc                          | 10.1   | 11            | .56   |        | 40.92           | 15.54          | 2.44                 | 0.13         | 10.0    | 11                 | 1     | 3.5    | 45.4       | 12.5        | 11.5       |
| Zinc cleaner tail                  | 4.4    | 31            | .35   |        | 18.58           | 20.41          |                      | -0.17        | 9.2     |                    |       | 2.4    | 9.1        | 7.2         | 4.6        |
| Pyrite conc<br>Pyrite cleaner tail | 17.    |               | .19   |        | 18.64           | 28.94<br>15.02 | 7.78<br>48.14        | 0.22<br>0.15 | 9.4     |                    | 1     | 4.6    | 35.2       | 35.2        | 18.4       |
| Final tailing                      | 56.    | 11            | .03   | 0.15   | 1.35<br>0.30    | 6.14           | 40.14                | 0.15         | 5.7     |                    |       | 1.0    | 0.4<br>1.7 | 4.2<br>10.7 | 2.0<br>4.5 |
| Feed (calcd)                       | 100.0  |               | .65   | 1.75   | 9.18            | 12.61          |                      | 0.11         |         | $\frac{5}{1100}$ . |       |        | L00.0      | 100.0       |            |
|                                    |        |               |       | 2.15   | <b>J</b> . ±0   | 12:01          |                      | 0.11         |         |                    |       |        |            | 100.0       | 100.0      |
|                                    |        |               |       |        |                 |                |                      |              |         |                    |       |        |            |             |            |
|                                    | 1      |               |       |        |                 |                |                      |              |         |                    |       | 1      |            |             |            |
|                                    |        |               |       |        |                 |                |                      |              |         |                    |       |        |            |             |            |
|                                    |        |               |       |        |                 |                |                      |              |         |                    |       |        |            |             |            |
| REMARKS: Two 2000-g                | batche | es gro        | und a | nd flo | bated se        | eparate        | ly - ro              | ugher        | concen  | "<br>trates        | comb: | ined 1 | or cl      | eaning      |            |
| %S, pyrite                         | conc:  | 41.58         | . fin | al tai | ling:           | 1.38           | •                    | -            |         |                    |       |        |            | 5           |            |

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| TEST NO. 20 SAMP                              | LE: N       | adina    | Explo                                 | ration  | s Limit          | ed No.             | 2       | · · · · · · · · |          |          |          |          |       | o. 4, 19                       | 971       |
|---|-------------|----------|---------------------------------------|---------|------------------|--------------------|---------|-----------------|----------|----------|----------|----------|-------|--------------------------------|-----------|
| OBJECT OF TEST:                               |             |          |                                       |         |                  |                    |         |                 |          |          |          | СНА      | RGE:  |                                |           |
|   |             | . •      |                                       |         |                  |                    |         |                 |          |          |          | TES      | TEDB  | Y:                             |           |
|   | Time        | %        | <u> </u>                              | 1       | Jnit             | 1.                 |         |                 | Reag     | jents,   | lb per   | ton      |       |                                |           |
| OPERATION                                     |             | Solids   | ∮рН                                   |         | ised             | Na <sub>2</sub> CO | Na2SO3  | NaCN            | <u> </u> |          | DF250    | Lim      | e     | H <sub>2</sub> SO <sub>4</sub> | CX51      |
| Conditioning - 1                              | 5           |          | 8.6                                   | -       |                  |                    |         |                 |          |          |          |          |       | 0.35                           |           |
| " - 2   | 2           |          |                                       | 1       |                  |                    |         |                 |          |          |          |          |       |                                | 0.05      |
| Pyrite rougher                                |             |          |                                       |         |                  |                    |         |                 |          |          |          | •        |       |                                |           |
| Stage 1                                       | 1           |          |                                       |         |                  |                    |         |                 | <u> </u> |          |          | ·        |       |                                | · ·       |
| " 2   | _1          |          |                                       |         |                  |                    |         |                 |          |          |          |          |       |                                | 0.05      |
| " 3.  | 1           |          |                                       |         |                  |                    |         |                 |          |          |          | · .      |       | · · ·                          | 0.05      |
| Zinc cleaner                                  | 2           |          | 10.6                                  |         | )- <u>g_cell</u> |                    |         |                 |          |          | 0.01     | 0.5      |       |                                | <b>  </b> |
| Pyrite cleaner                                | 2           |          |                                       | - 1     | 1 11 11          | <u> </u>           |         |                 |          |          | 0.01     | ļ        |       |                                | ļļ        |
|   | <del></del> |          |                                       |         |                  |                    | 0.5     |                 |          |          | <u> </u> | <u> </u> |       |                                | <u> </u>  |
| Cu-Pb conc regrinding                         |             | *        |                                       |         | **               | 1.0                | 0.5     | 0.05            |          |          |          |          | _     |                                |           |
|   | · · ·       |          | ·                                     |         |                  |                    |         |                 |          |          |          |          |       |                                |           |
|   | `````       |          | <u> </u>                              | <u></u> |                  | <u> </u>           |         |                 | <u> </u> |          |          | <u> </u> |       |                                | <u></u>   |
| PRODUCT                                       | ŵ           |          | · · · · · · · · · · · · · · · · · · · |         | ANAL             | _YSIŞ              | %       |                 |          | <u> </u> |          |          | BUTIO | r                              |           |
|   | %           |          | Cu                                    | РЪ      | Zn               | Fe                 | Au      | Ag              |          | Cu       | 1        | РЪ       | Zn    | Au                             | Ag        |
| Metallurgical Balance<br>for Copper-Lead Sepn |             |          |                                       |         |                  | •                  |         |                 |          |          |          |          |       |                                |           |
| Copper conc                                   | 10.         | 2/ 10    | .48                                   | 33.03   | 2.70             | 13.17              | 3.02    | 142.26          |          | 21.      | 0 `      | 7.1      | 6.1   | 36.4                           | 12.3      |
| Copper cleaner tail                           | 22.         |          |                                       | 47.30   |                  | 8.93               |         | 134.46          |          | 29.      |          | 2.6      | 19.5  | 26.5                           | 25.9      |
| Lead conc                                     | 67.         |          |                                       | 50.00   |                  | 8.63               | 0.47    | 109.19          |          | 50.      |          | 0.3      | 74.4  | 37.1                           | 61.8      |
| Feed (calcd)                                  | 100.        |          |                                       | 47.65   | 4.51             | 9.16               |         | 118.33          |          | 100.     |          |          | 100.0 | 100.0                          | 100.0     |
| Copper ro conc (calcd)                        | 32.         | 99 14    | .38                                   | 42.87   | 3.50             | 10.25              | 1.62    | 136.88          |          | 50.      | 0 2      | 9.7      | 25.6  | 62.9                           | 38.2      |
|   |             |          |                                       |         |                  |                    |         |                 |          |          |          | × .      |       |                                |           |
|   |             |          |                                       |         |                  |                    |         |                 |          |          |          | · [      |       |                                |           |
| · .   |             |          |                                       |         | · .              |                    |         | • . •           |          |          |          | [        | 1     |                                |           |
|   |             |          |                                       |         |                  |                    |         |                 |          |          | •        |          |       | ,                              |           |
|   |             |          |                                       |         |                  |                    |         |                 |          |          |          |          |       |                                |           |
|   |             |          |                                       |         |                  |                    |         |                 |          |          |          | 1        |       |                                |           |
|   |             | <u> </u> | <u> </u>                              |         |                  | <u> </u>           |         |                 | ·        |          |          |          |       | L                              |           |
| REMARKS: * Wet filte                          | er cak      | e + 35   | 0 cc                                  | water   |                  |                    | •       |                 |          |          | • •.     |          |       |                                |           |
| ** In Abbé j                                  | porcel      | ain mi   | .11 wi                                | th ful  | ll charg         | e of s             | teel ba | ills.           |          | ·        |          |          |       |                                |           |
|   |             |          |                                       |         |                  |                    |         |                 | <u>.</u> |          |          |          |       |                                |           |

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| TEST NO. 20 SAM          | PLE: N   | adina  | Explor | ations Limi  | ted No.  | 2        |                                       |       |        |        | DATE   |        | . 4, 1 | 1971     |
|--------------------------|----------|--------|--------|--------------|----------|----------|---------------------------------------|-------|--------|--------|--------|--------|--------|----------|
| OBJECT OF TEST:          |          |        |        |              |          |          |                                       |       |        |        | CHAF   |        |        |          |
|                          |          |        |        |              |          |          |                                       |       |        |        |        | ED BY  | :      | <u> </u> |
|                          | Time     | %      | ·      | Unit         | 1        |          |                                       | Rea   | gents, | lb per | ton    |        |        |          |
| OPERATION                |          | Solids | рН     | used         |          |          | AF                                    | 208   | AF242  | DF250  |        | Z-200  | CS     | S02      |
| Copper-lead cleaner No.1 | <u> </u> |        |        | 500-g cel1   |          |          |                                       |       |        |        |        |        |        |          |
| Stage 1                  | 1        |        |        |              |          |          |                                       |       | .0025  |        |        |        |        |          |
| " 2                      | 1        |        |        |              |          |          |                                       |       | .0025  |        |        |        | l      |          |
| " 3                      | 1        |        |        |              |          |          | .0                                    | 025   | .0025  |        |        |        |        |          |
| <u> </u>                 | 2        |        |        |              |          |          | · · · · · · · · · · · · · · · · · · · |       | 0.005  |        |        |        |        |          |
| Copper-lead cleaner No.2 | 2        |        |        |              |          | -        |                                       | ·     |        | 0.002  |        |        |        |          |
| Copper-lead separation   |          |        |        |              |          |          |                                       |       |        |        |        |        |        |          |
| Conditioning*            | 5        |        | 5.5    |              |          |          |                                       |       |        |        |        |        | 0.05   | 0.75     |
| Copper rougher           |          |        |        | 250-g cell   | L        |          |                                       |       |        |        |        |        |        |          |
| Stage 1                  | 1        |        |        |              |          | T I      |                                       |       |        |        |        | 0.008  |        |          |
|                          | 1        |        |        |              |          |          |                                       |       |        |        |        | 0.005  |        |          |
| Copper cleaner           | 1        |        |        | 250-g cel1   |          |          |                                       |       |        |        |        |        |        |          |
|                          | W        | т      |        | ANA          | ALYSIS   | %        |                                       | ,     |        | DI     | STRIB  | UTION  | %      |          |
| PRODUCT                  | %        | 6      |        |              |          |          |                                       |       |        |        | · .    |        |        |          |
|                          |          |        |        |              |          |          |                                       |       |        |        |        |        |        |          |
|                          |          |        |        |              |          |          |                                       |       |        |        |        |        |        |          |
|                          | 11       |        | [      |              |          |          |                                       |       | 1      |        | 1      | 1      | [      |          |
|                          | 1        | l      |        |              |          |          |                                       |       |        |        |        |        |        |          |
|                          |          |        |        |              |          |          |                                       |       |        |        |        |        |        |          |
|                          | l.       |        |        |              |          |          |                                       |       |        |        |        |        |        |          |
|                          |          |        |        | 1            |          |          |                                       |       |        |        |        |        |        |          |
|                          |          |        |        |              |          |          |                                       |       |        |        |        |        | 1      |          |
|                          |          |        |        |              |          |          |                                       |       |        |        |        |        |        |          |
| · ·                      |          |        |        |              |          |          |                                       |       |        |        |        |        |        |          |
|                          |          |        |        |              |          |          |                                       |       |        |        |        |        | [      |          |
|                          |          |        |        |              |          |          |                                       |       |        |        |        |        |        |          |
|                          |          |        |        |              |          |          |                                       |       | ļ      |        |        |        |        |          |
|                          |          |        |        |              |          |          |                                       |       |        |        |        |        | l l    |          |
|                          |          |        |        |              |          |          | · .                                   |       |        |        |        |        |        |          |
| REMARKS: * All sul       | ohides   | depres | sed un | oon addition | n of cau | stic st  | arch - o                              | could | 1 not  | get co | pper t | o floa | t      |          |
| •                        |          |        |        |              |          |          |                                       |       |        |        |        |        |        |          |
|                          | VCLY EV  |        | ugn er | cess amoun   | ts of Z- | ·200 wer | e added.                              | •     |        |        | -      |        |        |          |

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| TEST NO. 21SAMPLE: Nadina Explorations Limited No. 2DATE: Feb. 5, 1971OBJECT OF TEST:To try selective flotation of lead and copper concentratesCHARGE: 2 x 2000 g |        |        |         |         |                                       |           |                   |              |          |                     |           |       |          |            |             |
|---|--------|--------|---------|---------|---------------------------------------|-----------|-------------------|--------------|----------|---------------------|-----------|-------|----------|------------|-------------|
|   | rv sel | lectiv | é flo   | tation  | of lea                                | d and o   | copper            | concen       | trates   |                     |           | J     |          |            |             |
| from  | regro  | ound c | opper   | -lead   | rougher                               | concer    | <u>ntrate</u>     |              |          |                     |           |       | TED B    | Y: A.S.    |             |
|   | Time   | %      | 1       | t       | Jnit                                  |           | -                 |              |          |                     | lb per    |       |          |            |             |
| OPERATION   |        | Solids | pH      |         | used                                  | $Na_2CO.$ | Na2SO3            | NaCN         | AF208    | F242                | DF250     | Lim   | e CuSO4  | Z-200      | ) NaAF      |
| Grinding  | 45     | 65     |         | 7 x     | 14 RM                                 | 4.0       | 1.0               | 0.10         | 0.015    |                     |           |       |          |            |             |
| Conditioning  | . 5    |        | 8.0     |         | ,                                     |           |                   |              | 0.01     | 0.02                | 0.02      |       |          |            | ļ           |
| Copper-lead rougher   |        |        |         | 1000    | -g cell                               |           |                   |              |          |                     | · · · ·   |       |          |            |             |
| Stage 1   | 1/2    |        |         |         |                                       |           |                   |              |          |                     |           |       |          |            | · ·         |
| " 2   | 1/3    |        |         | •       |                                       |           |                   | İ            |          | ).01                |           |       |          |            | <u> </u>    |
| " 3   | 1      |        | · · · · |         | · · ·                                 |           |                   |              |          | 0.01                |           |       |          |            | . <u> </u>  |
| 11 4  | 1      |        |         |         |                                       |           |                   |              |          | 0.02                |           |       |          |            | ļ           |
| Conditioning 1  | 10     |        | 10.8    | 3 .     |                                       |           | -                 |              |          |                     |           | 7.0   | 1.0      |            |             |
| " 2   | 2      |        | 1       |         |                                       |           |                   |              |          |                     | 0.02      |       |          | 0.01       | 0.10        |
| Zinc rougher  | ·····  |        |         |         |                                       |           |                   |              |          |                     | ·         |       |          |            |             |
| Stage 1   | 3      |        |         |         |                                       |           |                   | <u>.</u>     |          |                     |           |       |          |            |             |
| 2   | - 3    |        |         |         | · · · · · · · · · · · · · · · · · · · |           |                   |              |          |                     | · · ·     |       | <u> </u> |            |             |
|   | Ŵ      | т      | ·       |         | ANA                                   | LYSIS     | %                 |              | <u></u>  |                     | D         | ISTRI | Βυτιο    | N %        |             |
| PRODUCT   | %      |        | Cu      | Pb      | Zn                                    | Fe        | Inso              | Au           | Ag       | C                   | 1         | РБ    | Zn       | Au         | Ag          |
| Lead rougher conc   | 2.     | 44 7   | 7.02    | 46.60   | 4.50                                  | 9.69      |                   | 0.95         |          | 5 2                 |           | 5.4   | 1.2      | 22.0       | 30.9        |
| Copper rougher conc   | 1.     |        | 0.00    | 13.72   |                                       | 8.81      |                   | 0.29         | 75.6     | 5 24                |           | 2.8   | 4.3      | 4.5        | 13.8        |
| Copper rougher tail   |        |        | 3.57    | 2.11    |                                       | 20.72     | 1                 | 0.18         |          |                     | ·         | 6.3   | 3.6      | 8.8        | 16.7        |
| Zinc conc   | 11.    | 73 0   | .36     |         | 65.44                                 | 1.39      | 1.64              | 0.06         | 7.6      | 11                  | 1         | 1.6   | 83.2     | 6.6        | 10.1        |
| Zinc cleaner tail   | 41     |        | ).64    |         |                                       | 11.89     |                   | 0.11         |          | 11                  | · .       | 2.0   | 4.2      | 3.7        | 3.0         |
| Pyrite conc   | 18.    |        | ).26    | 0.56    |                                       | 38.18     |                   | 0.25         |          |                     | · 1       | 6.0   | 2.1      | 44.2       | 20.9<br>1.4 |
| Pyrite cleaner tail   |        |        | .20     | 0.59    |                                       | 10.73     | 57.70             |              |          |                     |           | 1.2   | 0.2      | 2.7<br>7.5 | 1.4<br>3.2  |
| Final tailing   | 53.    |        | 0.04    | 0.15    |                                       | 5.68      | <u> </u>          | 0.15<br>0.11 |          | 3 <u>3</u><br>9 100 |           | 4.7   | 100.0    | 100.0      | 100.0       |
| Feed (calcd)  | 100.   | 00   L | ).66    | 1.74    | 9.23                                  | 12.57     |                   | U.I.I        | 0.0      | 9 100               |           | .0.0. | 100.0    | 100.0      | 100.0       |
|   |        |        |         |         |                                       |           |                   |              | · · ·    | · ·                 | * • • • • |       |          |            |             |
|   |        |        |         |         | · .                                   |           |                   |              |          |                     |           |       |          |            |             |
|   |        |        |         | •       |                                       |           |                   |              |          |                     |           |       |          |            | ·           |
|   |        |        | 1       |         |                                       | •         |                   |              |          |                     |           |       |          |            |             |
|   |        |        |         |         |                                       |           |                   |              |          |                     |           |       |          |            |             |
|   |        |        |         |         |                                       |           |                   |              |          |                     |           |       |          |            |             |
| REMARKS: Two 2000-g   | hotch  |        | Jund .  | and fl  | ated se                               | marate    | $\frac{1}{v} - r$ | nicher       | concen   | trate               | s comb    | ined  | for cl   | eaning.    |             |
|   |        | -      |         |         |                                       |           | y I               | - agrici     | 00110011 |                     |           |       |          | 8-         |             |
| %S, pyrite  | conc:  | 43.42  | 2, IlI  | nai ta: | Ling: (                               | 1.90      |                   |              |          | •                   | •         |       |          |            |             |

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### MINES BRANCH FLOTATION TEST REPORT Sheet 2 of 3

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| TEST NO. 21                            | SAMPL | E: N | adina   | Exp1 | oratio | ons Limit                             | ed No. | 2        |                                       |      |         |          | DA   | TE: Fe | ėb.5,2                         | L971  |
|--|-------|------|---------|------|--------|---------------------------------------|--------|----------|---------------------------------------|------|---------|----------|------|--------|--------------------------------|-------|
| OBJECT OF TEST:                        |       |      |         |      |        |                                       |        |          |                                       |      |         |          | СНА  | ARGE:  |                                |       |
|  |       |      |         |      |        |                                       |        |          |                                       |      |         |          | TES  | STED B | Y:                             |       |
|  | -     | Time | %       | TT.  |        | Unit                                  | T      |          |                                       | Reag | jents,  | lb per   | ton  |        |                                | ]     |
| OPERATION                              |       |      | Solids  | pH   |        | used                                  |        | 1        |                                       | •    |         | DF250    | Lin  | ie     | H <sub>2</sub> SO <sub>4</sub> | CX51  |
| Conditioning                           |       | 5    |         | 8.   | 6      |                                       |        |          |                                       |      |         |          | 1    |        | 1.2                            |       |
| Pyrite rougher                         |       |      |         |      |        | · · · · · · · · · · · · · · · · · · · |        |          |                                       |      |         |          |      |        |                                |       |
| Stage 1                                |       | 1    |         |      |        |                                       |        |          |                                       |      |         |          |      |        |                                | 0.10  |
|  |       | 1    |         |      |        |                                       |        |          |                                       |      |         |          |      |        |                                | 0.05  |
| " 3                                    |       | 1    |         |      |        |                                       |        |          | · · · · · · · · · · · · · · · · · · · |      |         |          |      |        |                                | 0.05  |
| 11 4                                   |       | 1    |         |      |        |                                       |        |          |                                       |      |         |          |      |        |                                | 0.05  |
| Zinc cleaner                           |       | 3    |         | 10.  |        | 00-g cell                             |        |          |                                       |      |         | 0.02     | 0.5  | 5      |                                |       |
| Pyrite cleaner                         |       | 3    |         |      |        | u <u>1</u> 11                         |        |          |                                       |      |         | 0.01     |      |        |                                |       |
|  |       |      |         |      |        |                                       |        |          |                                       |      |         |          |      |        |                                |       |
|  |       |      |         |      |        | •                                     |        |          |                                       |      |         |          |      |        |                                |       |
|  |       |      |         |      |        |                                       |        |          |                                       |      |         |          |      | ·      |                                |       |
|  |       |      |         |      |        |                                       |        |          |                                       |      |         |          |      |        |                                |       |
| PRODUCT                                |       | W    | т       |      |        | ANA                                   | LYSIS  | %        |                                       |      |         | D        | ISTR | IBUTIO | N %                            |       |
| FRODUCT                                | -     | %    | 5 .     | Cu   | РЪ     | Zn                                    | Fe     | Au       | Ag                                    |      | Cı      | 1        | РЪ   | Zn     | Au                             | Ag    |
| Metallurgical Balan                    |       |      |         |      |        |                                       |        |          |                                       |      |         |          |      |        |                                |       |
| for Selective Flota<br>from Cu-Pb Conc | tion  |      |         |      |        |                                       |        |          |                                       |      |         |          |      |        |                                |       |
| Lead rougher conc                      |       | 26.  | 42 7    | 7.02 | 46.60  | 4.50                                  | 9.69   | 0.95     | 112.65                                |      | 33,     | .1 7     | 7.5  | 13.0   | 62.3                           | 50.3  |
| Copper rougher conc                    |       | 17.  |         |      | 13.72  |                                       |        |          | 75.65                                 |      | 31      |          | 5.1  | 47.3   | 12.6                           | 22.4  |
| Copper rougher tail                    |       | 56.  |         |      | 2.11   |                                       | 20.72  | 0.18     |                                       |      | 35.     |          | 7.4  | 39.7   | 25.1                           | 27.3  |
| Feed (calcd)                           |       | 100. | 00    5 | 5.61 | 15.90  | 9.17                                  | 15.72  | 0.40     | 59.13                                 |      | 100     | .0 10    | 0.0  | 100.0  | 100.0                          | 100.0 |
| · · · · · · · · · · · · · · · · · · ·  |       |      |         |      |        |                                       |        |          | ·                                     |      |         |          |      |        |                                |       |
|  |       |      |         |      |        |                                       |        |          |                                       |      |         |          |      |        |                                |       |
|  |       |      |         |      |        |                                       |        |          | ļ                                     |      |         |          |      |        |                                | 1     |
|  |       |      |         |      |        |                                       |        |          |                                       |      |         |          |      |        |                                |       |
|  |       |      |         |      |        |                                       |        |          |                                       |      |         |          |      |        |                                | 1     |
|  |       |      | 1       |      |        |                                       |        |          |                                       |      |         | . [      |      |        |                                |       |
| REMARKS:                               |       | -11  |         |      |        | l                                     |        | <u>1</u> | <u></u>                               |      | <u></u> | <u>_</u> |      |        | <u></u> 1                      |       |
| NEWARRO:                               |       |      |         |      |        |                                       |        |          |                                       |      |         |          |      |        |                                |       |
|  |       |      |         |      |        |                                       |        |          |                                       |      |         |          |      |        |                                |       |

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| TEST NO. 21 SAMP   | LE:             | Nadina   | Exp1c    | rations Limi                             | ted No              | . 2      |          | · · · · · |            |        | DATE     |           | b. 5, 3  | 1971           |
|--|-----------------|----------|----------|--|---------------------|----------|----------|-----------|------------|--------|----------|-----------|----------|----------------|
| OBJECT OF TEST:  |                 |          | ÷        |  |                     |          |          | • .•      |            |        | CHAF     |           |          |                |
|  |                 |          | ·        | ·  |                     | <u> </u> |          | •         |            |        | TEST     | ED BY     | <u> </u> |                |
| OPERATION  | Time            | .%       | рH       | Unit                                     | [                   | · .      |          | Reag      | gents,     | lb per |          |           |          |                |
| OFERATION  | min             | Solids   | рп       | used                                     | Na <sub>2</sub> CO, | Na,SO    | NaCN     | AF208     |            | DF250  | }        | CuS04     | Z-200    |                |
| Cu-Pb conc regrinding  | 30              | *        |          | **                                       | 1.0                 | 0.5      | 0.05     |           |            |        |          |           |          |                |
| Lead rougher   |                 |          |          |  |                     |          |          |           |            |        |          |           |          |                |
| Stage 1  | 1               |          | 9.9      | 500-g cell                               |                     |          |          | 0.005     |            |        |          | -         | · •      |                |
| <sup>11</sup> 2  | 2               |          |          |  |                     |          | •        | 0.005     |            |        |          |           |          |                |
| Conditioning   | 5               |          | 9.6      |  |                     |          |          | al a      |            |        |          | 0.1       | · .      |                |
| Copper rougher   | 2               |          |          | ·  |                     |          |          |           |            | 0.01   |          |           | 0.003    |                |
|  |                 |          |          |  |                     |          |          |           |            |        |          | L         | -        |                |
|  |                 |          |          |  | <u> </u>            |          |          |           |            |        |          | L         | ļ        |                |
| · · · · · · · · · · · · · · · · · · ·  |                 |          |          |  | ļ                   |          |          |           | <u> </u>   |        |          | ļ         |          | · · ·          |
|  |                 |          |          | · · ·                                    | <u> </u>            | ļ        |          |           |            |        |          | <b> </b>  | <u> </u> |                |
|  | <u>.</u>        | <u> </u> |          |  | <u> </u>            |          |          |           |            | ·      |          |           | <u> </u> | · · ·          |
|  |                 |          |          |  | <u> </u>            |          | <u> </u> | LL        |            |        | <u> </u> | <u> </u>  | <u> </u> |                |
| PRODUCT  | W               |          |          | ANAL                                     | YSIS                | %        | ··· ·    | ·         | -∥         |        | STRIB    | UTION     |          |                |
|  | %               | <u> </u> | ·        |  |                     | •        |          |           |            |        |          |           |          | ·              |
|  |                 |          |          |  |                     | •••      |          |           |            |        |          |           | •        |                |
| · · · · · ·  |                 |          |          |  |                     | . ·      |          | · · ·.    |            | 1 ×    |          | . 7       |          |                |
|  | <b>  </b>       |          |          |  |                     |          |          |           |            |        | . · · ·  | · .]      |          | ļ              |
|  |                 |          |          |  |                     |          |          |           |            |        |          |           |          |                |
|  |                 |          |          |  |                     |          |          |           |            |        |          |           | ••••     | . ·            |
| the second second second second second second second second second second second second second second second s | []              |          | ·        |  | 3                   | ; • •    |          |           | 1 ·        |        |          | i.        |          | 5 - 5 - 5<br>5 |
|  |                 |          |          |  |                     |          |          | · · ·     |            |        |          |           |          | . ·            |
|  |                 | -        |          |  |                     |          |          | · .       | <u>∦</u> . |        |          |           |          |                |
| •  | ll <sup>n</sup> |          |          | a an an an an an an an an an an an an an |                     |          |          | · · .     |            |        |          |           |          |                |
|  | <u>  .</u> .    | ∦        |          |  |                     |          |          | · · ·     |            |        |          |           |          |                |
| · · · · · · · · · · · · · · · · · · ·  |                 |          |          |  |                     |          |          |           |            |        |          | 4 ·       |          |                |
|  |                 |          |          |  |                     | •        |          |           |            |        | ·        |           |          |                |
|  | 1               |          |          |  |                     |          |          |           |            |        |          |           |          |                |
|  |                 |          | <u> </u> | <u> </u>                                 |                     | <u> </u> |          | 1         |            |        |          | · · · · · |          |                |
| REMARKS: * Wet filt  | er cak          | e + 40   | 0 cc w   | vater                                    |                     |          |          | ······    |            |        |          |           |          |                |
|  |                 |          |          | h full charg                             | e of s              | teel ba  | 11s      |           |            |        | •        | • .       |          |                |
|  |                 |          |          |  |                     | <u></u>  |          | <u></u>   |            |        |          |           |          | · ·            |

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| TEST NO. 22 SAM                       | PLE:     | Nadi     | na Expl | Loratic  | ons Ltd.     | No. 2    |         |          | <u></u>  |         |       | DAT           | E: F                                  | eb. 11/ | 71       |
|---------------------------------------|----------|----------|---------|----------|--------------|----------|---------|----------|----------|---------|-------|---------------|---------------------------------------|---------|----------|
| OBJECT OF TEST: To t                  | rv pro   | nnse     | d Octol | per 197  | 'O Nadir     | na flows | sheet*  | - prel   | iminar   | v test  | with- | CHA           | RGE:                                  | 2000 g  |          |
| out Cu-Pb separation or               | lead     | flot     | ation : | from se  | condary      | v tailir | ngs (se | e atta   | ched f   | lowshe  | et).  | TES           | TED B                                 | Y: A.S  |          |
|                                       | Time     | %        |         | ·····    | Jnit         | 1        |         |          |          | gents,  |       | ton           |                                       |         |          |
| OPERATION                             | min      | Soli     | I PH    | 1        | used         | Na SO    | ZnSO.   | AF208    | DF250    | Lime    | NaCN  | Z-3           |                                       |         | 1        |
|                                       |          | 1        |         |          |              |          | 1       |          |          | DTINE   | Naon  |               |                                       |         |          |
| Grinding                              | 45       | 65       |         |          | <u>14 RM</u> | 0.5      | 0.1     | 0.015    | 1        |         |       | ·             |                                       |         |          |
| Conditioning                          | 5        |          | 6.      | 8   1000 | -g cell      | L        |         | 0.015    | 0.02     |         |       |               |                                       |         |          |
| Copper-lead rougher                   | 3        |          | 8.      |          |              |          |         |          | <u> </u> | 2.0     | 0.15  |               | <u>••</u>                             |         |          |
| Conditioning<br>Copper-lead scavenger | 5        |          |         | <u></u>  |              |          |         |          |          | 2.0     | 0.15  |               |                                       |         |          |
| · · · · · · · · · · · · · · · · · · · | <u> </u> |          |         |          |              |          |         | 1        |          |         |       | 0.03          |                                       |         |          |
| Stage 1                               | 1/2      | []       |         |          |              |          |         |          |          | <u></u> |       | 1 · · · · · · |                                       |         |          |
| <u> </u>                              | 1        |          |         |          |              |          |         | <u> </u> | 1        |         |       | 0.02          |                                       |         | <u> </u> |
|                                       |          |          |         |          |              |          | 1       |          |          |         |       | 0.02          | · · · · · · · · · · · · · · · · · · · |         |          |
| " 4                                   | 11       | í        |         |          |              |          |         |          |          |         |       | 0.02          | ·   · · ·                             |         |          |
| Copper-lead cleaner                   | 1        | ļ        |         | 250-     | g cell       |          |         | <u> </u> |          |         |       | <u> </u>      | <u> </u>                              |         |          |
|                                       |          | <u> </u> |         |          |              |          | ļ       | ļ        |          |         |       |               |                                       |         |          |
|                                       |          | <u> </u> |         |          |              |          |         |          |          |         | •     |               |                                       |         |          |
| PRODUCT                               | W        | Т        |         |          | ANA          | LYSIS    | %       |          |          |         | DI    | STRIE         | <b>3UTIO</b>                          | N %     |          |
| FRODUCT                               | 9        | 6        | Cu      | РЪ       | Zn           | Fe       |         | Au       | Ag       | Cu      | 1     | РЪ            | Zn                                    | Au      | Ag       |
| Copper-lead conc                      | 2        | 79       | 12.85   | 5.39     | 7.63         | 28.27    |         | 0.75     | 102.2    | 8 58.   | 6 9   | 9.7           | 2.1                                   | 19.1    | 33.0     |
| " " cleaner ta                        |          |          | 2.32    | 11.57    |              | 20.63    |         | 0.20     | 22.6     |         |       | 1.2           | 1.4                                   | 2.7     | 3.9      |
| Secondary Cu-Pb conc                  |          | .37      | 3.06    | 59.81    |              | 5.56     |         | 0.41     | 64.4     | 4 6.    | 9 5   | 2.8           | 0.6                                   | 5.3     | 10.2     |
| " " cl tai                            |          | .13      | 0.74    | 18.30    | 12.03        | 11.61    |         | 0.32     | 43.2     |         |       | 3.3           | 1.4                                   | 3.3     | 5.7      |
| " " " ro tai                          | L    3   | .64      | 0.43    | 2.55     | 11.27        | 13.19    |         | 0.12     | 8.9      |         |       | 6.0           | 4.1                                   | 4.0     | 3.8      |
| Copper-lead scav tail                 |          | .57      | 0.17    | 0.12     |              |          |         | 0.08     |          | 0 24.   |       | 7.0           | 90.4                                  | 65.6    | 43.4     |
| Feed (calcd)                          |          | .00      |         | 1.55     |              |          |         | 0.11     |          | 5 100.  |       |               | 00.0                                  | 100.0   | 100.0    |
| Cu-Pb ro conc (calcd)                 | 11       | .29      | 9.17    | 7.55     |              | 25.60    |         | .0.56    | 74.4     | 11      |       | 0.9           | 3.5                                   | 21.8    | 36.9     |
| Cu-Pb scav conc (calcd)               | )    6   | 5.14     | 1.07    | 18.22    | 9.88         | 11.20    |         | 0.22     | 27.6     | 5 10.   | 9 7   | 2.1           | 6.1                                   | 12.6    | 19.7     |
|                                       |          |          |         |          |              |          |         |          |          |         |       |               |                                       |         |          |
|                                       |          |          |         |          |              |          |         | -        |          |         |       |               |                                       |         |          |
|                                       |          |          |         |          |              |          |         |          |          |         |       |               |                                       |         |          |
|                                       |          |          |         | -        | ł            |          |         |          |          |         |       |               |                                       |         |          |
|                                       |          |          |         |          |              |          |         |          |          |         |       |               |                                       |         |          |
|                                       |          |          |         |          |              |          |         |          |          |         |       |               |                                       |         | :        |
| REMARKS: *Developed                   | by Mr.   | J.       | D. Gun  | n of Do  | olmage       | Campbel  | 1 & As  | sociate  | es Ltd.  | . Vano  | ouver | . B.C         |                                       |         |          |
|                                       |          |          |         |          |              |          |         |          |          | ,       |       | , 2.0         | -                                     |         |          |
|                                       |          |          |         |          |              |          |         |          |          |         |       |               |                                       |         |          |
|                                       |          |          |         |          |              |          |         |          |          |         |       |               |                                       |         |          |

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| TEST NO. 22                          | SAMP    | LE:        | Nadin      | a Expl  | orations Ltd                          | No.                | 2         | · · ·    | · · · · · · · · · · · · · · · · · · · |        |       |          |                 | 11., 1      | .971                                  |
|--------------------------------------|---------|------------|------------|---------|---------------------------------------|--------------------|-----------|----------|---------------------------------------|--------|-------|----------|-----------------|-------------|---------------------------------------|
| OBJECT OF TEST                       |         |            |            |         |                                       |                    |           | _        |                                       |        |       | CHAF     | GE:             |             |                                       |
| •                                    |         |            | • •        |         | • •                                   |                    | . • •     |          |                                       |        |       | TEST     | ED B            | <i>(</i> :  |                                       |
|                                      |         | Time       | %          |         | Unit                                  | <u> </u>           |           |          | Rea                                   | gents, | lb pe | r ton    |                 |             |                                       |
| OPERATION                            |         |            | Solids     | pН      | used                                  | Na <sub>2</sub> SO | ZnSO,     | AF208    | DF250                                 | Lime   |       | Z-3      | SO <sub>2</sub> | 1           |                                       |
|                                      |         |            |            |         |                                       |                    |           |          |                                       |        |       |          |                 |             |                                       |
| Flotation from                       |         |            |            |         |                                       |                    |           |          |                                       |        |       |          |                 |             |                                       |
| <u>Cu-Pb scav conc</u><br>Regrinding | · · · · | 20         | 50 **      |         | *                                     | 0.15               | 0 10      | 0.01     |                                       | 0.5    |       |          | +               | ·           |                                       |
| Secondary Cu-F                       | b ro    | 20         | - 00       |         | 500-g cell                            | 0.13               | 0.10      | 0.01     |                                       | 0.5    |       |          | · · · · ·       |             |                                       |
|                                      | 0 10    | 1          |            | ,       | JOU g CEII                            |                    |           | 0.005    |                                       |        |       | 0.005    |                 |             |                                       |
| Stage 1<br>" 2                       |         |            |            |         | · · · · ·                             | <u> </u>           |           | 0.005    | · · · · · · · · · · · · · · · · · · · |        |       | 0.005    | 1               | - <u> </u>  |                                       |
| <u>L</u>                             |         | 1/2<br>.^2 |            |         | · · · · · · · · · · · · · · · · · · · | ļ                  |           |          |                                       |        | ····· | 0.005    |                 |             |                                       |
| <u>"3</u>                            |         |            |            |         | ·                                     |                    | · · ·     |          | 0.004                                 |        |       | 0.005    |                 |             |                                       |
| 4                                    |         | 1/2        |            |         |                                       | <u> </u>           |           |          |                                       |        |       | 0.005    |                 | ·   · · · · |                                       |
| Secondary Cu-F<br>Condition          | D CT    | 5          |            | 6.6     | 250 0 0011                            | · · · · ·          | · · · · · |          |                                       |        |       |          | 0.7             |             | · · · · · · · · · · · · · · · · · · · |
|                                      |         |            |            | 0.0     | 250-g cell                            |                    | · · ·     | 0.005    | 0.002                                 |        |       |          | 0.7             |             |                                       |
| Float                                |         | 1/2        |            |         |                                       |                    |           | 0.005    | 0.002                                 |        |       |          |                 | · · · · ·   |                                       |
| •                                    |         |            | <u>   </u> |         | I                                     |                    | <u> </u>  | <u> </u> |                                       |        |       | <u> </u> | <u>.</u>        | <u> </u>    |                                       |
| PRODUCT                              |         | W          |            |         | ANAL                                  | YSIS               | %         |          |                                       |        | D     | ISTRIB   | UTION           | <b>J</b> %. |                                       |
|                                      |         | . 9        | ó .        |         |                                       |                    |           |          |                                       |        | .     | · .      | ·               |             |                                       |
| · ·                                  |         |            |            |         |                                       |                    |           |          |                                       |        |       |          |                 |             |                                       |
|                                      |         |            |            |         |                                       |                    |           |          |                                       |        | l     |          |                 |             |                                       |
|                                      |         | <b>.</b>   |            |         |                                       |                    |           |          |                                       |        |       |          | •               |             |                                       |
|                                      |         |            |            |         |                                       | .                  |           |          |                                       |        |       | ľ        |                 |             |                                       |
|                                      |         |            |            |         |                                       |                    | ×         |          | ·                                     |        |       |          |                 |             |                                       |
|                                      |         |            |            |         |                                       |                    |           |          | · ·                                   |        |       |          |                 |             |                                       |
|                                      |         |            | . []       |         |                                       |                    | • •       |          |                                       |        |       |          |                 |             |                                       |
|                                      |         | 1 .        |            |         |                                       |                    |           |          |                                       |        |       |          |                 |             | ·                                     |
|                                      |         |            |            |         |                                       | ·                  |           | ·        |                                       |        |       |          |                 |             |                                       |
|                                      |         |            |            |         |                                       |                    |           |          |                                       |        |       |          | [               |             | •                                     |
| •<br>• •                             |         |            |            | ŀ       |                                       |                    |           | 1 · · ·  | 1. N. 14                              |        |       |          |                 |             | •                                     |
|                                      |         |            |            |         |                                       | ļ                  |           |          |                                       | ľ      |       |          |                 |             |                                       |
|                                      |         |            |            |         |                                       |                    | •         |          |                                       |        |       |          |                 |             |                                       |
|                                      |         |            |            |         |                                       |                    | -         | . •      |                                       |        |       |          |                 |             |                                       |
|                                      |         |            |            |         |                                       | ľ                  |           | ţ        |                                       |        |       |          | ·               |             |                                       |
| REMARKS: * 8-;                       |         |            | <u></u>    | <u></u> |                                       | •                  | ~         | <u> </u> |                                       |        |       |          |                 |             |                                       |
| × 8-i                                | ndia    | Abbe       | porcela    | ain mi  | ll with half                          | charge             | e of st   | teel ba  | alis.                                 |        |       |          |                 |             |                                       |
|                                      |         |            |            |         |                                       |                    |           |          |                                       |        |       |          |                 |             |                                       |
|                                      |         |            |            |         |                                       |                    |           |          |                                       |        |       |          |                 |             |                                       |

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|                         |             |        | a Explo |        |         |                    |         |         |         |        |          | 1      |        | b. 12,   |       |
|-------------------------|-------------|--------|---------|--------|---------|--------------------|---------|---------|---------|--------|----------|--------|--------|----------|-------|
| OBJECT OF TEST: As in   | n Test      | 22 b   | ut with | ı copp | er-lead | l separ            | ation   | and le  | ad flot | ation  | from     |        |        | 2 x 200  |       |
| secondary rougher and c | leaner      | tail   | ings (s | see at | tached  | flowsh             | eet)    |         |         |        | <u> </u> |        | TED B  | Y: A.S   | 5.    |
|                         | Time        | %      |         | L      | Jnit    |                    |         |         |         | -      | , lb pe  |        |        |          |       |
| OPERATION               |             | Solid  | s pH    | u      | ised    | Na <sub>2</sub> SO | ZnSO4   | AF208   | DF250   | Lime   | NaCN     | I Z-3  |        |          |       |
| Grinding                | 45.         | 65     |         | 7 x 1  | 4 RM    | 0.5                | 0.1     | 0.03    |         |        |          |        |        |          |       |
| Conditioning            | 5           |        |         | 1000-  | g cell  |                    |         | 0.01    | 0.02    |        |          |        |        |          |       |
| Copper-lead rougher     | 3           | ļ      | .6.3    |        |         | _                  |         |         |         |        |          |        |        |          |       |
| Conditioning            | 5 .         |        | 7.9     |        |         |                    |         |         |         | 1.5    | 0.15     |        |        |          | _     |
| Copper-lead scavenger   |             |        |         |        |         |                    |         |         |         |        |          |        |        |          |       |
| Stage 1                 | 1/2         |        |         |        |         |                    |         |         |         |        |          | 0.0    |        |          |       |
| 2                       | 1           |        |         |        |         |                    |         |         |         |        |          | 0.0    | 2      |          |       |
| " 3                     | 1           |        |         |        |         |                    |         |         | 0.004   |        |          | 0.0    |        |          |       |
| " 4                     | 1           |        |         |        |         |                    |         |         | 0.004   |        |          | 0.0    |        | <u> </u> |       |
| " 5                     | 11/2        |        |         |        |         |                    |         |         |         |        |          | 0.0    | 2      |          |       |
| Copper-lead cleaner #1  | $1^{1}_{2}$ |        |         |        | g cell  |                    |         |         |         |        |          |        |        |          |       |
| #2                      | 1           |        |         | 250-g  | g cell  |                    |         |         |         |        |          |        |        |          |       |
| PRODUCT                 | W           | τ      |         |        | ANA     | LYSIS              | %       |         | ··· ·   |        | D        | ISTRI  | BUTIO  | N %      |       |
|                         | . 9         | 6      | Cu      | РЪ     | Zn      | Fe                 | Au      | Ag      |         | (      | u 1      | ?Ъ     | Zn     | Au       | Ag    |
| Copper conc             | 2           | . 45 1 | 2.50    | 2.12   | 3.10    | 31.65              | 0.74    | 75.5    | 7       | 48     | 3.9      | 3.0    | 0.8    | 16.5     | 21.1  |
| Copper cleaner tail     | 13          | ).52   |         | 17.90  | 4.17    | 26.32              |         | 70.6    |         | 11     | .0       | 5.4    | 0.2    | 2.6      | 4.2   |
| Lead conc               | 11          | .04    |         | 25.50  |         | 23.33              |         | 67.2    | 9       | 10     | .9       | 30.1   | 1.0    | 7.4      | 15.6  |
| No. 2 copper-lead cl ta | 11          | ).74   | 2.36    | 7.70   |         | 22.63              | 0.35    | 42.6    | 2       | 2      | .8       | 3.3    | 0.8    | 2.4      | 3.6   |
| No. 1 " " "             |             | 2.83   | 2.07    | 7.01   | 10.19   | 18.08              |         | 29.6    | 1       | 11     | 1        | 11.5   | 3.2    | 5.9      | 9.6   |
| Secondary lead conc     | C           | ).7d   | 1.37    | 51.60  | 5.10    | 5.57               | 0.20    | 36.6    | 1       | 1      | .5       | 20.9   | 0.4    | 1.3      | 2.9   |
| " " cl tail             | C           | ).29   | 1       |        | 14.00   | 10.55              |         | 25.6    |         | - 11   | 0.6      | 3.8    | 0.5    | 0.5      | 0.8   |
| " " ro tail             | 11          | 2.15   | 0.60    |        | 12.00   | 13.38              | 1       | 13.9    | 1       |        | 2.1      | 9.2    | 2.9    | 3.1      | 3.4   |
| Copper-lead scav tail   |             | 3.28   | 0.14    | 0.25   |         |                    | 0.075   | 3.8     |         |        |          | 12.8   | 90.2   |          | 38.8  |
| Feed (calcd)            |             | 0.00   | 0.63    | 1.73   | 9.01    |                    | 0.11    | 8.7     |         |        |          |        |        | 100.0    | 100.0 |
| Combined lead conc      | 2           | 2.74   | 2.85    | 32.17  | 4.68    | 18.79              | 0.35    | 59.4    | ./      | 1 12   | 2.4      | 51.0   | 1.4    | 0.7      | 10.5  |
|                         |             |        |         |        |         |                    |         |         |         |        |          |        |        |          |       |
| · ·                     |             |        |         |        |         |                    |         |         |         |        |          |        |        |          |       |
|                         |             |        |         |        |         |                    |         |         |         |        |          | ŀ      |        |          |       |
|                         |             |        |         |        |         |                    |         |         |         |        |          |        |        |          |       |
| REMARKS: Two 2000-g     | lots g      | ground | d and f | loated | l separ | ately -            | - coppe | er-lead | rough   | er and | l scav   | enger  | concer | ntrates  | com-  |
| bined for further treat | ment.       | Арре   | eared t | o floa | at more | weight             | : in Cu | -Pb ro  | ugher   | than ' | Cest 2   | 2 - is | this   | due to   | extra |
| 0.01 1b/ton AF208?      |             | * *    |         |        |         | -                  |         |         |         |        |          |        |        |          |       |
|                         |             |        |         |        |         |                    |         |         |         |        |          |        |        |          |       |

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| TEST NO. 23 SAMP  | LE:          | Nadina                                | Explo  | ratio  | ns Limi   | ited No.                                | 2                                     |                     | antina da.                            | -                 | · · · · · ·                           | DATE           | <b>.</b>                                      |  |               |
|---|--------------|---------------------------------------|--|--|---|---|---------------------------------------|---------------------|---------------------------------------|-------------------|---------------------------------------|----------------|---|--|---------------|
| OBJECT OF TEST:   |              |                                       |  |  |   | :                                       | :                                     |                     |                                       |                   |                                       | CHAR           | GE:   |  | :             |
|   |              | · · ·                                 |  |  | · · · .   |   | · ·                                   | · · · ·             | :                                     | - ·               | · 1                                   | TEST           | ED BY   | <i>/</i> :   |               |
|   | Time         | %                                     | <u> </u>   | Ι ι  | Jnit  | 5                                       |                                       |                     | Rea                                   | gents,            | lb per                                | ton            |   |  |               |
| OPERATION   | min          | Solids                                | pH   |  | ised  | Na <sub>2</sub> SO                      | ZnS04                                 | AF208               | DF250                                 | Lime              | NaCh                                  | Z-3            | S02   | 1 .  |               |
| Flotation from  | a di seri y  |                                       |  | 12. J. m.  |   |   | · · · · · ·                           | 1 20 1              |                                       |                   |                                       |                |   |  |               |
| Cu-Pb scav conc   |              |                                       | •  |  | <u> </u>  |   |                                       |                     | 2<br>1 :                              |                   |                                       |                |   |  |               |
| Regrinding  | 20           | 50                                    |  | · · · · ·  | *   | 0.15                                    | 0.1                                   | 0.01                |                                       | 0.5               | · · · · · · · · · · · · · · · · · · · | · ·            |   |  | 300           |
| Secondary Cu-Pb ro  |              |                                       |  | 500-   | g cell  | 1 5.70 7.7                              | a sa ang                              |                     |                                       |                   |                                       | 2 4 4 5        |   |  |               |
| Stage 1   | 1            | 1.3.5                                 | 9.9  | 12 1.0   | 3 3 70  | 1 2.2                                   |                                       | 0.005               | . · ·                                 |                   |                                       | 0.005          |   |  |               |
| "2 · · · · · ·  | 1            | - 851 - 1                             | 1000   | 1.501  |   |   | 7. 7. 1.                              | 1 7 1 v             | 0.004                                 |                   | tig a tit                             | 0.005          | · · · · · ;                                   | 0.2  |               |
| <b>II</b> -33   | 12           |                                       |  | 12 .2  |   | 115163                                  | na na                                 | 1. 2019             |                                       |                   | 2                                     | 0.005          | ang i   | 514  |               |
| Secondary Cu-Pb cl  |              |                                       | 38° .  | 12.00  | 1143  | 1 62132                                 | 1110                                  | 1 C. 1 C            |                                       |                   | ê : 3                                 |                | 100   |  |               |
| Condition   | 5            | 3                                     | 6.4  | 250-   | g cell  | 1 17 A.X                                |                                       |                     | . · (                                 |                   | 4 L .                                 |                | 0.35  | 1  | 115           |
| Float   | 11/2         | NA                                    |  |  |   | - 14 - C.C.                             | - 2N                                  | 0.005               |                                       | с III<br>С        | 14 H                                  | 0.002          |   | 11 H   | 1947 A.       |
|   |              |                                       | 11   | <u> </u>   |   |   |                                       |                     |                                       | ·····             |                                       |                | 11. J. D. D. D. D. D. D. D. D. D. D. D. D. D. | a da na sera ana ana ana ana ana ana ana ana ana a |               |
|   |              |                                       |  | 1  | بسید ، بیمیر محمد<br>در زور افته                              | 1, 1, 1, 2                              | 3,7                                   |                     |                                       |                   |                                       |                | ·····   | · · · · · · · ·                                    |               |
| PRODUCT   | W            | . 11                                  |  |  | ANA   | LYSIS                                   | %                                     |                     |                                       | · · · ·           | DI                                    | STRIB          | UTION   | 1 %  |               |
|   | %            | Č                                     | u  | Pb.  | Zn  | Fe                                      | Au                                    | Ag                  | -                                     | Cu                |                                       | ?Ъ 2           | Zn -  | Au ····  | Ag            |
| Metallurgical Balance   |              |                                       |  | 1  |   | - 347                                   |                                       |                     |                                       | 1                 |                                       |                |   |  |               |
| for Copper-Lead Separati  | .on          |                                       |  | in normalised and the second sec   |   | · • · · · • · · · · · · · · · · · · · · | · · ···· · ····                       |                     | · · · · · · · · · · · · · · · · · · · | · · · · · · · · · |                                       |                | · · · · · · · · · · · · · · · · · · ·         | :  |               |
| Copper conc   | 48.          | 81 12                                 | .50  | 2.12   | 3.10  | 31.65                                   | 0.74                                  | 75.57               | 7 7505                                | 76.               | 5                                     | .8             | 39.9  | 62.2   | 51.5          |
| Copper cleaner tail   | 10.          |                                       | · ·  | 7.90   | 4.17  | 26.32                                   | 0.56                                  | 70.60               |                                       | 6.                |                                       |                |   | 10.0   | 10.2          |
| Lead conc   | 40.          |                                       |  | 5.50   |   | 23.33                                   | 0.40                                  | 67.29               |                                       | 17.               |                                       |                |   | 27.8   | 38.3          |
| Feed (calcd)**  | 100.         |                                       |  | 3.30   |   | 27.70                                   | 0.58                                  | 71.67               |                                       | 100.              |                                       |                | 0.01  | 00.0<br>72.2                                       | 100.0         |
| Copper rougher conc(calc  | a) 59.       | 18    11                              | .16  | 4.89   | 3:29  | 30.72                                   | 0.71                                  | 74.70               | J. <br>                               | - 82.             | 8 2.                                  | L•8            | DT-2  | 12.2   | 61.7          |
| r Colo se pásy so dápra i li  |              | 1                                     |  |  | <ul> <li>measure the pay by</li> </ul>                        |   | · · · · · · · · · · · · · · · · · · · |                     |                                       | ·                 | an a ann an                           |                | · · · · · · · · · · · · · · · · · · ·         |  |               |
| 가 있었는 말한 말한 것이다. 이번 가지 않는 것이다.<br>같은 것이 같은 것이 같은 것이 같은 것이 같은 것이다. 것이 같은 것이 같은 것이다.                                    | . <u>1</u> 2 | 1                                     |  |  |   | ,                                       |                                       |                     |                                       |                   |                                       | 1              | · · · · · · · · · · · · · · · · · · ·         |  |               |
| · 상황가 위험생활  | 122 .        |                                       |  |  | N. 84   | 0.5                                     | 277                                   | Q1 03               |                                       |                   |                                       |                |   | 1  |               |
|   | - The second | 생활자                                   |  |  |   |   |                                       |                     |                                       |                   |                                       |                |   |  | a an dan 🖓    |
| , se a la marte en la traverse en la seconda de la seconda de la seconda de la seconda de la seconda de la seco<br>No | 1.1          |                                       |  |  | 44 E  |   |                                       |                     |                                       |                   | ు సినిగ<br>సినికర                     | n di Ang<br>Ng | ····  |  | -             |
| in the second second second second second second second second second second second second second second second       | -            | · · · · · · · · · · · · · · · · · · · | n da Polisia.<br>National de la composición de la composición de la composición de la composición de la composición de la compos | nan s  | اس بر مراجع معنده<br>این ایر مراجع می<br>این ایر ایر ایر برای | المنت المنتقد .<br>الرقي الارج ال       |                                       | · · · · · · · · · · |                                       | · · ·             | ·                                     |                |   |  | · · · · · · · |
|   | 1. P. 1      |                                       | * * 1 i i  |  |   |   |                                       |                     |                                       |                   |                                       |                |   |  |               |
|   |              | <u></u>                               |  | and the second s | ······  | · · · · · · · · · · · · · · · · · · ·   | <u> </u>                              | <u> </u>            |                                       | <u> II</u>        |                                       |                | <u></u>                                       |  |               |
| REMARKS: * 8-india A  |              |                                       |  |  |   |   |                                       |                     |                                       |                   |                                       |                |   |  | ppeared       |
| to be high grade lead co<br>** Copper-lead  | nc - c       | some o                                | r the  | galen  | a was c<br>_load c  | iepresse                                | ed in s                               | subsequ             | HENT CL                               | eaning            | WITH                                  | 2°at           | -∵hu ∘o                                       | ±.0.4.   |               |
| copper-read   | . Lea        | uer co:                               | $\mathbf{u} \subset \mathbf{T} \subset \mathbf{C}$   | -opper   | L'au s  |   |                                       |                     |                                       |                   |                                       |                |   |  |               |

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| TEST NO. 23 SAMP       | PLE:   | Nadina  | Explo    | rations Ltd  | . No. 2    |            |           |         |        |        | DATE     |             | . 12,   |   |  |  |  |
|------------------------|--------|---------|----------|--------------|------------|------------|-----------|---------|--------|--------|----------|-------------|---------|---|--|--|--|
| BJECT OF TEST:         |        |         |          |              |            |            |           |         |        |        | CHAR     |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        |        |          | ED BY       |         |   |  |  |  |
| OPERATION              | Time   | %       | pН       | Unit         |            | . <b>.</b> | _ <u></u> |         | gents, | lb per |          |             |         |   |  |  |  |
|                        | min    | Solids  | P1 (     | used         |            |            | AF208     | DF250   |        | NaCN   | Z-3      | S02         | CS      |   |  |  |  |
| Flotation from         |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
| Secondary tailings     |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
| Secondary lead ro      |        | <u></u> |          | 500-g cell   |            | <u> </u>   |           |         |        |        |          |             |         |   |  |  |  |
| Stage 1                | 1/2    |         | 8.5      |              |            |            |           | 0.01    |        | 0.10   | 0.01     |             |         |   |  |  |  |
| " 2                    | 1      |         |          |              |            |            |           | 0.01    |        |        | 0.01     |             |         |   |  |  |  |
| " 3                    | 1      |         |          |              |            |            |           |         |        |        | 0.01     |             |         |   |  |  |  |
| Secondary lead cl      |        |         |          | 250-g cell   |            |            |           |         |        | 0.05   |          |             |         |   |  |  |  |
| Copper-lead separation |        |         |          | 11 11 11     |            |            |           |         |        |        |          |             |         |   |  |  |  |
| Conditioning           | 5      | 1       | 3.3      |              |            |            |           |         |        |        |          | 0.75        |         |   |  |  |  |
| 11                     | 5      |         | 5.4      |              |            |            |           |         |        |        |          |             | 0.05    |   |  |  |  |
| Copper rougher         | 14     |         |          |              |            |            | 0.01      |         |        |        | <u> </u> |             |         |   |  |  |  |
| Copper cleaner         | 3/4    |         | 3.1      | 250-g cell   |            |            |           |         |        |        |          | 0.50        |         |   |  |  |  |
|                        | W      | т       |          | ANA          | LYSIS      | %          |           |         |        | DI     | STRIB    | TRIBUTION % |         |   |  |  |  |
| PRODUCT                | 9      | 6       |          |              | 1          |            | 1         |         |        |        |          |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
| · · · ·                |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        |        |          |             |         |   |  |  |  |
|                        |        |         |          |              |            |            |           |         |        | 1      |          |             |         |   |  |  |  |
|                        |        |         |          |              | <u> </u>   | L          |           | 1       |        |        |          | l           |         |   |  |  |  |
| REMARKS: Copper-lead   | senar  | ration  | Brid     | t, conner    | / froth    | after      | additi    | on of   | SO h   | ut sub | sequen   | t addi:     | tion o: | f |  |  |  |
| Oopper read            |        |         |          | a came up ag |            |            |           |         |        |        | - 1      |             |         |   |  |  |  |
| staren depi            | .essed | copper  | . willCl | i came up as | jaring IIC | WEVEL      | , apon    | auaitiu |        |        |          |             |         |   |  |  |  |

|  | ĪVi     | INES     | BRA    | NCH     | FLOT    | ΔΤΙΟ               | N TE         | ST R     | EPO                | RT    | She   | et l c     | f 3    |        |
|--|---------|----------|--------|---------|---------|--------------------|--------------|----------|--------------------|-------|-------|------------|--------|--------|
| TEST NO. 24 SAMPL  | E: Nad  | ina Expl | oratio | ns Ltd. | No. 2   |                    |              | <u> </u> | ·····              |       | DA    | TE: Fe     | ь. 25, | 1971   |
| OBJECT OF TEST: To try   | y selec | tive flo | tation | of cop  | per, le | ad and             | zinc d       | concent  | rates              |       | CHA   | ARGE:      | 2 x 20 | )0 g   |
| from reground copper-lead  | l rough | er conce | ntrate | •       |         |                    |              |          |                    |       | TES   | STED E     | Y: A.  | 5.     |
|  | lime    | %        |        | Unit    |         |                    |              |          | igents,            |       |       | ·          | · · ·  |        |
| OPERATION  |         | olids pH |        | used    | Na CO   | Na <sub>2</sub> SO | NaCN         | AF208    | AF242              | DF250 | Lin   | ne CuSC    | 4 Z-20 | ) NaAF |
| Grinding   | 45      | 65       | 7 x    | 14 RM   | 4.0     | 1.0                | 0.1          |          |                    |       |       |            |        |        |
| Conditioning   | 10      | 7.       | 9 2000 | -g cell |         |                    |              | 0.02     | 0.02               | 0.02  |       |            |        |        |
| Copper-lead rougher  |         |          | 11     | 11 11   |         |                    |              |          |                    |       |       |            |        |        |
| Stage 1  | 1       |          |        |         |         |                    |              | 0.01     | 0.01               |       |       |            |        |        |
| " 2  | 1       |          |        |         |         |                    |              | 0.01     | 0.01               |       |       |            |        |        |
| " 3  | 1       |          |        |         |         |                    |              |          | 0.02               |       | 1     | ·          |        |        |
| " 4  | 1       |          |        | · ,     |         |                    | •            |          | 0.02               |       |       |            |        |        |
| Conditioning   | 10      | 10.      | 9      |         |         |                    |              | •        |                    |       | 7.0   | 0.7        | 5      | •      |
| Zinc rougher, Stage 1  | 1       |          |        |         |         |                    |              |          |                    | 0.02  |       |            | 0.0    | -      |
| " " Stage 2  | 1       |          | •      |         |         |                    |              |          |                    | 0.02  |       |            |        |        |
| " " Stage 3  | 2       |          |        |         |         |                    | •            |          |                    |       |       |            |        | 0.05   |
| " " Stage 4  | 1       |          | -      |         |         |                    | •            |          | •                  |       |       |            |        | 0.05   |
| PRODUCT  | WT      | · ·      |        | ANA     | LYSIS   | %                  | . `          |          |                    | D     | ISTRI | BUTIO      | N %    |        |
|  | %       | Cu       | РЪ     | Zn      | Fe      | S                  | Au           | Ag       | Cu                 | 1     | РЪ    | Zn         | Au     | Ag     |
| Copper conc  | 1.20    | 21.94    | 21.18  | 3.82    | 14.00   |                    | 1.25         | 178.9    | 0 41.              | 3 1   | 4.3   | 0.5        | 14.6   | 24.5   |
| No. 2 Copper cleaner tail  | 0.3     |          | 32.11  |         | 14.96   |                    | 0.76         | 120.8    |                    | 1     | 6.3   | 0.2        | 2.6    | 4.8    |
| No. 1 " "  | 0.69    |          | 26.37  |         | 18.41   |                    | 0.46         | 72.9     |                    |       | 0.2   | 0.4        | 3.1    | 5.7    |
| Lead conc  | 1.1     | 3.79     | 51.82  | 6.74    | 7.45    |                    | 0.40         | 72.0     | 0 6.               | 8 3   | 3.4   | 0.9        | 4.5    | 9.5    |
| No. 2 Lead cleaner tail  | 0.29    |          |        | 10.50   |         |                    | 0.33         | 54.6     | 7 2.               | 0     | 2.3   | 0.3        | 1.0    | 1.8    |
| No.1 " " "   | 1.6     |          |        | 4       | 29.46   | -                  | 0.25         | 34.7     | 11                 |       | 7.2   | 1.8        | 4.0    | 6.4    |
| Secondary zinc ro conc   | 0.58    |          |        | 11.29   |         |                    | 0.21         | 26.5     |                    | •     | 1.8   | 0.7        | 9.0    | 7.8    |
| " Cu-Pb ro tail  | 5.02    |          | 3.15   |         | 29.46   |                    | 0.19         | 13.6     | 11                 |       | 8.9   | 3.0        | 1.2    | 1.8    |
| Zinc rougher conc  | 15.90   | 11 1     |        | 47.02   | 5.60    | ,                  | 0.075        | 8.0      | 11                 | 1     | 4.4   | 82.3       | 11.6   | 14.5   |
| Pyrite conc<br>Pyrite cleaner tail   | 14.56   |          |        |         | 37.47   | 44.58              |              | 10.0     |                    | ÷     | 4.7   | 8.5        | 35.4   | 16.7   |
| Final tailing  | 56.95   | 11 · I   |        |         | 1.      | 1.29               | 0.12         | 5.5      | 14                 |       | 0.7   | 0.2<br>1.2 | 1.9    | 1.1    |
| Feed (calcd)   | 100.00  |          | 1.78   |         |         |                    | 0.02<br>0.10 |          | $\frac{2}{0}$ 100. |       |       | 100.0      | 11.1   | 100.0  |
| Cu-Pb ro tail (calcd)  | 89.10   |          |        |         |         |                    | 0.07         |          | 0 20.              |       | 5.6   | 100.0      | 60.0   | 37.7   |
|  |         |          |        |         |         |                    |              |          |                    |       |       |            |        | 5      |
| REMARKS: Two 2000 gram<br>further treatment.<br>Coarse pyrite floated at e |         |          |        |         | separa  | tely -             | roughe       | r conc   | <br>entrat         | es co | mbine | d for      |        |        |

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| TEST NO. 24 SAM         | PLE:             | Nadir | a Exp | loratio | ons Ltd.      | No. 2                           |      |        |         |       |            |          |                | ь. 25, | 19/1        |
|-------------------------|------------------|-------|-------|---------|---------------|---------------------------------|------|--------|---------|-------|------------|----------|----------------|--------|-------------|
| OBJECT OF TEST:         |                  | -     |       |         |               |                                 |      |        |         |       |            |          | RGE:           |        |             |
|                         |                  |       |       |         |               |                                 |      |        | ·····   |       |            | <u> </u> | TED B          | Y:     |             |
|                         | Time             | %     | На    | ι       | Jnit          |                                 |      |        | Reag    | ents, | lb per     | ton      |                |        | . <u></u> . |
| OPERATION               |                  | Solid | spri  | ι       | ised          | Na <sub>2</sub> CO <sub>3</sub> | NaCN | AF242D | F 250 H | 2 SO4 | <u>Z-6</u> | Z-20     | 00 <u>50</u> 2 | CS     |             |
| Conditioning            | 5                |       | 8.5   | 1000    | -g cell       |                                 |      |        |         | 1.4   |            |          |                |        | _           |
| Pyrite ro, Stage 1      | 1                |       |       | · ·     |               |                                 |      |        |         | ·     | 0.10       | ļ        |                |        |             |
| " " 2                   | 1                |       |       |         |               |                                 |      |        |         |       | 0.05       |          |                |        |             |
| " " 3                   | 1                |       |       |         |               |                                 |      |        |         |       | 0.05       |          |                |        |             |
|                         | 1                |       | _     |         |               |                                 |      |        |         |       | 0.05       |          |                |        |             |
| Pyrite cleaner          | 2 <sup>1</sup> 2 |       |       | 1000    | -g cell       |                                 |      | 1      | 0.02    |       |            |          |                |        |             |
| Selective flotation     |                  |       |       |         |               |                                 |      |        |         |       |            |          | -              |        |             |
| from Cu-Pb rougher conc |                  |       |       |         |               |                                 |      |        |         |       |            |          |                |        |             |
| Regrinding              | 30               | 50    |       |         | *             |                                 | L    |        |         |       |            |          | 0.75           | 5 0.03 |             |
| Conditioning            | 2                |       | 5.7   | 500-    | <u>g_cell</u> |                                 |      |        |         |       |            |          | 0.5            |        |             |
| Copper ro, Stage 1      | 1                |       |       |         |               |                                 |      |        | 0.003   |       |            | 10.0     | 03             |        |             |
| " " Stage 2             | 1                |       |       |         |               |                                 |      |        | 0.003   |       |            | 0.00     | 03             |        |             |
|                         | W                | ·Τ    |       |         | ANA           | LYSIS                           | %    |        |         | 1     | D          | ISTRI    | BUTIO          | N %    |             |
| PRODUCT                 | 9                | 6     | Cu    | РЪ      | Zn            | Fe                              |      | Au     | Ag      | Cu    | I          | ?Ъ       | Zn             | Au     | Ag          |
| Metallurgical Balance f | or               |       |       |         |               |                                 |      |        |         |       |            |          |                |        |             |
| Selective Flotation fro |                  | -     |       |         |               |                                 |      |        |         |       |            |          |                |        |             |
| Copper-Lead Rougher Con | 11               |       |       |         |               |                                 |      |        |         |       |            |          |                |        |             |
| Copper conc             | 11               | .01   | 21.94 | 21.18   | 3.82          | 14.00                           |      |        | 178.90  | 52    |            | 16.9     | 6.5            | 36.7   | 39.         |
| No. 2 Copper cleaner ta | il   3           | .19   | 9.48  | 32.11   | 4.41          | 14.96                           | •    |        | 120.84  | 11    | .5         | 7.4      | 2.2            | 6.4    | 7.          |
|                         |                  | .29   | 6.24  | 26.37   | 5.30          | 18.41                           |      | 0.46   | 72.94   |       | 1          | 12.0     | 5.2            | 7.7    | 9.          |
| Lead conc               |                  | . 54  |       | 51.82   | 6.74          | 7.45                            |      | 0.40   | 72.00   |       |            | 39.6     | 11.0           | 11.2   | 15.         |
| No. 2 Lead cleaner tail | 2                | .69   | 4.36  | 14.36   | 10.50         |                                 |      | 0.33   | 54.67   | 11    | .5         | 2.8      | 4.4            | 2.4    | 2.          |
| No. 1 " " "             | 14               | .91   | 2.74  | 7.87    | 9.87          | 21.10                           |      | 0.25   | 34.73   | 11    | .8         | 8.5      | 22.9           | 9.9    | 10.         |
| Secondary Zn ro conc    | 5                | .29   | 2.21  | 5.63    | 11.29         | 21.31                           |      | 0.21   | 26.56   | 11    | .5         | 2.2      | 9.3            | 3.0    | 2.          |
| " Cu-Pb ro tail         | 46               | .08   |       | 3.15    | 5.37          | 29.46                           |      | 0.19   | 13.60   | 10    |            | 10.6     | 38.5           | 22.7   | 12.         |
| Feed (calcd)            |                  | .00   |       | 13.79   | 6.43          | 22.27                           |      | 0.38   | 50.05   | 100   |            |          | 100.0          | 100.0  | 100.        |
| Copper ro conc (calcd)  | 20               | .49   |       | 24.47   | 4.37          | 15.50                           |      |        | 137.33  | 67    |            | 36.3     | 13.9           | 50.8   | 56.         |
| Lead ro conc (calcd)    | 28               | 3.14  | 3.29  | 24.95   | 8.76          | 15.62                           |      | 0.31   | 50.60   | 19    | .9         | 50.9     | 38.3           | 23.5   | 28.         |
|                         |                  |       |       |         |               |                                 |      | 1      |         | 1     |            |          |                |        |             |
|                         |                  | 1     |       |         |               |                                 |      |        |         |       |            |          |                |        | 1           |

REMARKS: \* 8-in.-dia Abbé ceramic ball mill with full charge of ceramic balls.

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| TEST NO. 24 SAMP  | PLE:              | Nadina | Explo | ratio           | ns Ltd. | No. 2              |                                       |       |     |         |        | DATE   | •     |          |     |
|-------------------|-------------------|--------|-------|-----------------|---------|--------------------|---------------------------------------|-------|-----|---------|--------|--------|-------|----------|-----|
| OBJECT OF TEST:   |                   | · · .  |       |                 |         |                    |                                       | •     |     |         |        | CHAR   | GE:   | . ·      |     |
|                   | · .               |        |       |                 |         | ÷                  |                                       |       |     |         |        | TEST   | ED BY | <b>.</b> | _   |
| OPERATION         | Time              | %      |       | υ               | nit     | [ · · · · ·        | · · · · · · · · · · · · · · · · · · · |       | Rea | igents, | lb per | ton    |       |          |     |
| OPERATION         | min               | Solids | рН    | u               | sed     | Na <sub>2</sub> CO |                                       | NaCN  |     | AF242   | DF250  | Lime   | CuS04 | Z-200    | S02 |
| Conditioning      | 5                 |        | 8.7   | 500-9           | g cell  | 0.5                |                                       | 0.05  |     |         |        | :      |       | -        |     |
| Lead rougher      |                   |        |       | -               |         |                    |                                       |       |     |         |        |        | ·     | 1        |     |
| Stage 1<br>       | 1                 |        |       |                 | •       |                    |                                       | •     |     | 0.005   |        |        |       | 1        |     |
| ." 2              | 2                 |        |       |                 |         |                    |                                       |       |     | 0.005   |        |        |       | · .      |     |
| Conditioning      | 10                |        | 11.5  |                 |         | · .                |                                       |       |     |         |        | 0.75   | 0.2   |          |     |
| Secondary zinc ro | $1^{\frac{1}{2}}$ |        |       |                 |         |                    |                                       |       |     |         |        |        |       | 0.005    |     |
| Copper cleaners   |                   |        |       |                 |         |                    |                                       |       |     |         |        |        |       |          |     |
| No. 1             | $1\frac{1}{2}$    |        | 35    | 250-8           | g_cell  |                    |                                       |       |     |         | 0.004  |        | •     |          | 0.5 |
| No. 2             | 14                |        | 3.2   | <u>, 11 - 1</u> | 1 11    |                    |                                       |       |     |         | 0.002  |        |       | · .      | 0.5 |
| Lead cleaners     |                   |        |       |                 |         |                    |                                       |       |     |         |        |        |       |          |     |
| No. 1             | 11/2              |        |       |                 | g cell  |                    |                                       |       |     |         | 0.004  |        |       | •        | •   |
| No. 2             | 1½                |        | -     | 250-8           | g cell  |                    |                                       |       | · · | 0.003   |        |        | L     |          |     |
| PRODUCT           | W                 |        | •     |                 | ANAL    | YSIS               | %                                     |       |     | 1       | DI     | STRIBU | JTION | %        |     |
|                   | %                 |        |       |                 |         |                    |                                       |       |     |         |        |        |       |          |     |
|                   |                   |        |       | •               |         |                    |                                       |       |     |         |        | •      |       |          |     |
| •                 |                   |        |       |                 |         |                    |                                       | ·     |     |         |        |        |       |          |     |
|                   | <b>[</b> ].       |        |       |                 |         |                    |                                       |       |     |         |        |        |       |          |     |
|                   |                   |        |       |                 |         |                    |                                       |       |     |         |        |        |       |          |     |
|                   |                   |        |       | 1               |         |                    |                                       |       |     |         |        |        |       |          |     |
|                   |                   |        | •     |                 |         |                    |                                       |       |     |         |        |        |       |          |     |
|                   |                   |        |       | 1               |         |                    |                                       | · · · | · . | li i    |        |        | •     |          |     |
|                   |                   |        |       |                 |         |                    |                                       |       |     |         |        | •      |       |          |     |
|                   |                   |        |       |                 |         |                    |                                       |       |     |         |        | •      |       |          |     |
|                   |                   |        |       |                 |         |                    |                                       |       |     |         |        |        | •     |          | · · |
|                   |                   |        |       |                 |         |                    |                                       |       | ,   |         |        |        |       |          |     |
|                   |                   |        |       |                 |         |                    |                                       |       |     |         |        |        |       |          |     |
|                   |                   |        |       |                 |         |                    |                                       |       |     |         |        |        |       |          |     |
|                   |                   |        | į.    |                 |         |                    |                                       |       |     |         |        |        |       |          | l   |
|                   |                   | Ц      | 1     |                 |         | <u>· .  </u>       |                                       |       |     |         | 1      | I      | l     |          |     |
| REMARKS:          |                   |        |       |                 |         |                    |                                       |       |     |         |        |        |       |          |     |
|                   |                   |        |       |                 |         |                    |                                       |       |     |         |        |        |       |          |     |
|                   |                   |        |       |                 | ·_····  |                    |                                       |       |     |         |        |        |       |          |     |

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| OBJECT OF TEST: To tr<br>for selectively floatin |        |          |          | oratio  |          |          |          | . 25, 1  |        |         |       |        |          |         |                |
|--|--------|----------|----------|---------|----------|----------|----------|----------|--------|---------|-------|--------|----------|---------|----------------|
| C 1. (* .1. £1. +                                | y mod: | ified    | versi    | on of   | October  | 1970 N   | ladina : | flowshe  | et as  | a met   | hod   | CH.    | ARGE: 2  | 2 x 200 | ) g            |
| for selectively floating                         | ig cop | per an   | d lea    | d conc  | entrate  | s direc  | tly fr   | om the   | ore    |         |       |        |          | Y: A.S  |                |
|  | T:     | 1 %      | 1        |         | Jnit     | 1        |          |          | Rea    | gents,  | lb pe | r ton  |          |         |                |
| OPERATION  | Time   | Solid    | Hq       |         | used     | No CO    | ZnS04    | 7 200    | Lime   |         | Z-3   |        | 50       |         | 1              |
|  | min    |          | 5        |         |          |          |          |          | L TITE | INA OIN |       |        |          |         | <del>.  </del> |
| Grinding   | 45     | 65       |          |         | 14 RM    | 0.5      | 0.1      | 0.02     |        |         |       |        |          |         |                |
| Conditioning                                     | 10     |          | 6.6      | 1000    | -g cell  |          |          |          |        |         |       | _      |          |         |                |
| Copper rougher                                   | 3      |          |          |         |          |          |          | 0.01     |        |         |       | 0.0    | 02       |         |                |
| Conditioning                                     | 5      |          | 9.5      | 5       |          |          |          |          | 2.0    | 0.15    |       |        |          |         |                |
| Lead rougher                                     |        |          |          |         |          |          |          |          |        |         |       |        |          |         |                |
| Stage 1  | 1      |          |          |         |          |          | 1        |          |        |         | 0.03  |        |          |         |                |
| 11 2   | 1      |          |          |         | <u>.</u> |          |          |          |        |         | 0.02  | 2      |          |         |                |
| ······································           | 1      |          |          |         |          |          |          |          |        |         | 0.02  | 2      |          |         |                |
| 11 4   | 11/2   |          |          |         |          |          |          |          | -      |         | 0.02  |        |          |         |                |
|  | - 2    |          |          |         |          |          |          |          |        |         |       |        |          |         |                |
| ·····  |        |          |          |         |          |          |          |          |        |         |       |        |          |         |                |
|  |        |          |          |         |          |          |          |          |        |         |       |        |          |         |                |
|  |        |          | <u> </u> |         |          |          | <u> </u> | ·        |        |         | L     |        | <u> </u> |         |                |
|  | W      | 'T       |          |         | ANA      | LYSIS    | %        |          |        |         | C     | ISTR   | IBUTIO   | N %     |                |
| PRODUCT  | 9      | %        | Cu       | РЪ      | Zn       | Fe       | S        | Au       | Ag     | 0       | Cu    | РЪ     | Zn       | Au      | Ag             |
| Copper conc                                      | 1.     | 06 17    | .86      | 2.74    | 3.06     | 28.94    | •        | 0.28     | 70.9   |         | .8    | 1.6    | 0.4      | 2.8     | 8.1            |
| No. 2 copper cleaner ta:                         |        |          | .49      | 2.62    | 4.03     | 33.93    |          | 0.41     | 51.3   |         | +.2   | 2.0    | 0.6      | 5.2     | 7.5            |
| No. 1 " " "                                      | 3.     | 56 3     | .74      | 4.21    | 6.30     | 27.34    |          | 0.43     | 36.9   | 1    19 | .5    | 8.8    | 2.6      | 14.9    | 14.8           |
| Lead conc  | 0.     | 70    1  | .25      | 67.70   | 2.50     | 2.59     |          | 0.50     | 94.9   | 2    1  | 3     | 27.7   | 0.2      | 3.4     | 7.5            |
| No. 2 lead cleaner tail                          | 0.     | 63    1  | .90      | 48.88   | 6.30     | 6.09     |          | 0.31     | 69.4   | 9    1  | 8     | 18.0   | 0.5      | 1.9     | 4.9            |
| No. 1 " " "                                      | 1.     | 95    1  | .90      | 17.01   | 10.00    | 11.48    |          | 0.26     | 41.4   | 2 5     | 5.4   | 19.4   | 2.2      | 5.0     | 9.1            |
| Zinc rougher conc                                | 13.    | 3.5 0    | .63      | 0.47    | 50.00    | 4.19     |          | 0.09     | 11.5   | 2    12 | .3    | 3.7    | 76.0     | 11.7    | 17.3           |
| Pyrite conc                                      | 16.    | 42    (  | .63      | 0.53    | 8.00     | 36.49    | 44.68    | 0.23     | 12.6   | 6    15 | 5.2   | 5.1    | 14.9     | 36.8    | 23.4           |
| Pyrite cleaner tail                              | 2.     | 60 0     | .24      | 0.59    | 4.42     | 19.77    | 17.04    | 0.16     | 6.8    | 7    C  | .9    | 0.9    | 1.3      | 4.1     | 2.0            |
| Final tailing                                    | 58.    | 48 0     | .03      | 0.38    | 0.19     |          | 2.23     | 0.025    | 0.8    | 2 2     | 1,6   | 128    | 1.3      | 14.2    | 5.4            |
| Feed (calcd)                                     | 100.   |          | .68      | 1.71    | 8.77     |          |          | 1        |        | - 100   | 0.0 1 | .00.0  | 100.0    | 100.0   | 100.0          |
| Copper rougher conc (cal                         |        |          | .02      | 3.60    | 5.24     | 29.07    |          | 0.40     | 45.9   | 9 60    | ).5   | 12.4   | 3.6      | 32.9    | 30.4           |
| Lead rougher conc (calco                         | 1) 3.  | 28    1  | .77      | 33.95   | 7.69     | 8.55     |          | 0.32     | 58.2   | 3    8  | 3.5   | 65.1   | 2.9      | 10.3    | 21.5           |
| Lead rougher tail(calcd)                         | ) 90.  | 85 0     | .23      | 0.43    |          |          |          | 0.075    | 4.7    | 0    31 | .0    | 22.5   |          | 66.8    | 48.1           |
| <b>C</b>   |        |          |          | :       |          |          |          |          |        |         |       |        |          |         |                |
| -  |        |          | -        |         |          |          |          |          |        |         |       |        |          | 1       |                |
|  |        | <u> </u> |          |         | <u> </u> | <u> </u> | J        | <u> </u> | 1      | 11      |       |        | 1        | 1       | i              |
| REMARKS: Two 2000-gr                             | am bat | ches g   | ground   | d and f | loated   | separat  | :ely -   | roughe   | r conc | entrat  | es co | ombine | ed for   | cleanin | g.             |

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# MINES BRANCH FLOTATION TEST REPORT Sheet 2 of 3

|                 | PLE: N   | adina I              | Explora  | ations Ltd. | No. 2 | <u>.</u> |       |            |        | ········  | DAT     | E:Marc       | n 25, 1            | .971                                   |
|-----------------|----------|----------------------|----------|-------------|-------|----------|-------|------------|--------|-----------|---------|--------------|--------------------|--|
| OBJECT OF TEST: |          |                      |          |             |       | ,        |       |            |        |           |         | RGE:         |                    |  |
|                 |          | • <u>-</u> - · · · · | <u> </u> |             |       | • •      |       |            |        |           |         | TED BY       | <u>/:</u>          |  |
| OPERATION       | Time     | %                    | рН       | Unit        |       |          |       | Rea        | gents, | lb pe     | r ton   |              | •                  |  |
|                 | min      | Solids               |          | used        |       |          | Z-200 | Lime       |        |           | CuS04   | NaAF         | H <sub>2</sub> SO4 | Z-6                                    |
| Conditioning    | 10       |                      | 11.2     |             |       |          | · · · | 3.0        |        |           | 1.0     | )            | 1                  |  |
| Zinc rougher    |          |                      |          |             |       |          |       |            |        |           |         |              |                    |  |
| Stage 1         | 1        |                      |          | . <u>.</u>  |       |          | 0.01  |            |        |           |         |              |                    |  |
| " 2             | 1        |                      |          |             | · ·   |          | 0.01  |            |        |           |         |              |                    | -                                      |
| 11 3<br>11 4    | 1        |                      |          | ······      |       |          | · .   |            |        |           | .  <br> | 0.05         | ł                  |  |
|                 | 2        |                      |          |             |       |          |       |            |        |           |         | 0.05         |                    |  |
| Conditioning    | 5        |                      | 8.2      |             |       |          |       |            | ·      |           | ·   ·   | · .          | 1.5                |  |
| Pyrite rougher  |          |                      |          |             |       | ļ        |       |            |        |           |         | <u>.   .</u> |                    |  |
| Stage 1<br>11 2 | <u> </u> |                      |          | <del></del> |       |          |       |            |        |           |         |              |                    | 0.01                                   |
| 11 3            |          |                      |          |             | · · · | <u> </u> | · · · |            |        | · · · · · |         | <u> </u>     | <u> </u>           | 0.05                                   |
| 11 4            |          |                      |          | •••         |       |          |       |            |        |           |         |              |                    | ···· · · · · · · · · · · · · · · · · · |
|                 |          |                      |          |             |       | L        | L     |            | 11     |           |         |              |                    | 0.05                                   |
| PRODUCT         | W<br>9   | 12                   | i        |             | LYSIS | %        | 1     | - <u>T</u> |        | D         |         | BUTION       | 1 %                |  |
|                 |          |                      |          |             |       |          |       |            |        |           |         |              |                    |  |
| · · ·           |          |                      |          |             |       |          |       |            |        |           |         |              |                    |  |
|                 |          |                      |          |             |       |          |       |            |        |           | · .     |              |                    | . *•                                   |
|                 |          |                      |          |             |       |          |       |            |        |           |         |              |                    |  |
|                 |          |                      |          |             |       |          |       |            |        | · ·       |         |              |                    |  |
|                 |          |                      |          |             | 1     | ÷        | 2.3   |            |        |           | •       |              |                    |  |
|                 |          |                      |          |             |       | · .      |       |            |        | · ·       |         |              |                    |  |
|                 |          |                      |          |             |       |          |       |            |        |           |         |              |                    |  |
|                 |          |                      |          |             |       |          |       |            |        |           |         |              |                    |  |
|                 |          |                      |          |             |       |          |       |            | · ··   |           |         |              |                    |  |
| ·               | 1        |                      |          |             |       | •        |       |            |        | ••        |         | •            |                    |  |
|                 |          |                      |          | · ·         |       |          |       |            |        |           |         |              |                    |  |
|                 |          |                      |          |             |       |          |       |            |        |           |         |              |                    |  |
| · · ·           |          |                      |          |             |       |          |       | · ·        |        | ł         |         |              |                    |  |
|                 |          | I                    |          |             |       |          | L     | <u> </u>   |        |           |         |              |                    |  |
| REMARKS:        |          |                      |          |             |       |          |       |            |        |           |         |              |                    |  |
|                 |          |                      |          |             |       |          |       |            |        |           |         |              |                    |  |
| ·····           | <b></b>  |                      |          |             |       |          |       |            |        |           |         |              |                    |  |
|                 |          |                      |          |             |       |          |       |            |        |           |         |              |                    |  |

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| TEST NO. 25 SA    | MPLE: Na  | dina Ex | xplora | ations         | Ltd.,             | No. 2   |              |       |  |            |          |          | E:March |        |              |
|-------------------|-----------|---------|--------|----------------|-------------------|---------|--------------|-------|--|------------|----------|----------|---------|--------|--------------|
| OBJECT OF TEST:   |           |         |        |                |                   |         |              |       |  |            |          |          | RGE: 2  |        |              |
| •                 |           |         |        |                |                   |         |              |       | ······                                 |            |          | J        | TED BY  | : A.S. |              |
|                   | Time      | %       |        | U              | nit               | T       |              |       | Rea                                    | gents,     | lb pei   | ton      |         |        | <del> </del> |
| OPERATION         | 1         | Solids  | pН     | us             | sed               | Na 2SO3 | ZnSO4        |       | Lime                                   | <b>Z-3</b> |          |          | DF250   | S02    |              |
| Copper cleaners   |           |         |        |                |                   |         |              |       |  |            |          |          |         |        |              |
| No. 1             | 2         |         | 5.1    | 500 <b>-</b> g |                   |         |              |       |  |            | <u></u>  |          |         | 0.5    |              |
| No. 2             | 1         |         | 4.0    | 250 <b>-</b> g |                   |         |              |       |  |            |          |          |         | 0.15   |              |
| No. 3             | 1         |         | 4.7    | 11             | 11                |         |              | ·     |  |            |          |          |         | 0.1    |              |
| Lead rougher conc |           |         |        |                |                   |         |              |       |  |            |          |          |         |        | ļ            |
| regrinding        | 20        |         |        | *              |                   | 0.15    | 0.1          |       | 0.5                                    | 0.005      |          |          |         |        | ļ            |
| Lead cleaners     |           |         | **     |                |                   |         |              |       |  |            |          |          |         | ļ      |              |
| No. 1             | 2         |         |        | 500 <b>-</b> g | cell              |         | 0.1*         | k     |  | 0.04       |          |          |         | 0.25*  | *            |
| No. 2             | 11/2      |         |        | 250 <b>-</b> g | cell              |         |              |       |  |            | •        |          | 0.002   | ·      | ļ            |
| Pyrite cleaner    | 3         |         |        | 1000-          | g cell            |         |              |       |  |            |          | <u> </u> | 0.03    | L      | ļ            |
|                   |           |         |        |                |                   | 1       |              |       |  |            |          |          |         |        | 1            |
|                   |           |         |        | 1              |                   |         |              |       |  |            |          |          |         |        |              |
|                   |           | τ       |        |                | ANA               | YSIS    | <u></u><br>% |       | •••••••••••••••••••••••••••••••••••••• | <u> </u>   | D        | ISTRI    | BUTION  | %      |              |
| PRODUCT           | 9         | 11.     |        |                |                   |         |              |       |  |            | <u> </u> |          |         |        |              |
|                   |           |         |        |                |                   | · · · · |              |       |  |            |          |          |         |        |              |
|                   |           |         |        |                |                   |         |              |       |  |            |          |          |         |        |              |
|                   |           |         |        |                |                   |         |              |       |  |            |          |          |         |        |              |
|                   |           |         |        |                |                   |         |              |       |  |            |          | }        |         |        |              |
|                   |           |         |        |                | 1                 |         |              |       |  |            |          |          |         |        |              |
|                   |           |         |        |                |                   |         |              |       |  |            |          |          |         |        |              |
|                   |           |         |        |                |                   |         |              |       |  |            |          |          |         |        |              |
|                   |           |         |        |                |                   |         |              |       |  |            |          |          |         |        |              |
|                   |           |         |        |                |                   |         |              |       |  |            |          |          |         |        |              |
| - ·               |           |         | 1      |                |                   |         |              |       |  |            |          |          |         | ł      |              |
|                   |           |         |        |                |                   |         |              |       |  |            |          |          |         |        |              |
|                   | -         |         |        |                |                   |         |              |       |  |            |          |          |         | 1      |              |
|                   |           |         |        |                |                   |         |              |       |  |            |          |          |         |        |              |
|                   |           |         |        |                |                   |         |              |       |  |            |          |          |         |        |              |
|                   |           |         |        |                |                   |         |              |       |  |            |          |          |         | 1      |              |
|                   |           |         |        |                |                   |         |              |       |  |            |          | <u> </u> |         | · .    |              |
| REMARKS: * 8 in   | dia Abl   | he porc | elain  | mi11 -         | with <sup>1</sup> | charoe  | of st        | eel h | a11e                                   |            |          |          |         |        |              |
|                   | d to lowe |         | ~14 II | *****          | WILL 2            |         |              |       |  |            |          |          |         |        |              |
|                   | before a  |         | n of   | ZnSO4          | and SO            | 2       |              |       |  |            |          |          |         |        |              |
|                   |           |         |        |                |                   |         |              |       |  |            |          |          |         |        |              |

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| oat w<br>lotat<br>Time<br>min \$<br>45<br>10 | ion fi<br>%   | rom ro  | egroun   | of coppe<br>nd separ<br>Jnit<br>used                   | er-lead  | roughe<br>tailing                                      | r conc   |  |  | <u> </u>   | TES   |   | 2 x 200<br>Y: A.S                                      |   |
|--|---|---|--|--|--|--|--|--|--|--|---|---|--|---|
| Time<br>min \$<br>45                         | %<br>Solids   | nH.   |  | Jnit -   | ation  |  | •  |  |  |  | L   | TED B   | Y: A.S   | •   |
| min S<br>45                                  | Solids  | рН  | I  |  |  |  |  |  |  | 14   |   |   |  | التقابين والتراجي والمتحد                               |
| 45   |   | рп.   |  | used   |  |  |  | Rea  | gents,   | ID per   | ton   |   |  |   |
|  | 65  |   |  |  | Na <sub>2</sub> CO                                     | 3Na 2SO3   | NaCN   | AF 208   | AF 242   | DF250  | SO 2  | CS  |  |   |
| 10   |   |   | 7 x  | 14 RM  | 4.0  | 1.0  | 0.1  | 0.01   | 0.02   |  |   |   |  | ·   |
|  |   | 7.9   |  |  |  |  |  | 0.01   | 0.01   | 0.02   |   |   |  |   |
|  |   |   |  | ,  |  |  |  |  |  |  |   |   |  |   |
|  |   |   | 1  |  |  |  |  |  |  |  |   |   |  |   |
| ·  |   |   |  | · · · · · · · · · · · ·                                | <u> </u>   |  |  | 0.01   | 0.02   |  |   |   |  |   |
|  | ····  |   |  |  |  |  |  | 0.01   | 0.02   |  |   |   |  |   |
|  |   |   | -  |  |  |  |  | · · · ·  |  |  | · · ·   |   |  | -   |
| 10   |   | 5.1   | 500-   | a cell   |  |  |  |  |  | ·  | 2.5   | 0.0   | 5  |   |
|  | ··· · ·   |   | 1000   | g corr   |  |  |  |  |  |  |   |   |  |   |
|  | <u>-</u>  | 2 7   | 250  | a aa11   |  |  |  | ·  |  |  | 0.25  |   |  |   |
|  |   |   |  | -g cerr  |  |  |  |  |  |  |   | · · · j · · · · · · · · · · · · · · · ·                 |  |   |
| ±  |   | 4.0   |  |  | · · · · · · · · · · · · · · · · · · ·                  | · · ·  |  |  |  |  | 0.1   |   |  |   |
| 1  |   | [   | .  |  |  |  |  |  |  |  | L   | <u> </u>  |  |   |
| 11.  | ·   | ·····   | ···  | ANA  | LYSIS  | %  |  |  |  |  |   | BUTIO   | N %  |   |
| %  |   | Cu  | Pb   | Zn   | Fe   | Au   | Ag.  |  | Cu   | . <u> </u>   | ?Ъ  | Zn  | Au   | Ag  |
|  | 1 27  | .08   | 4.45   | 5.15   | 17.47  | 0.94   | 163.36   |  | 44.  | 7 3  | 3.0   | 0.6   | 9.8  | 21.4  |
|  |   |   |  |  |  | 1.09   | 1  | 1  | 10.  | 0 5  | 5.6   | 0.3   | 6.9  | 11.2  |
| 11   | 11  |   |  |  |  | £  | 1  |  | 41   | -  | 1   | 0.4   | 3.2  | 7.1   |
|  | 81  | 1   |  | 1 1  |  | 1  | •  |  | 11   | 5  | 1   | -   |  | 5.1   |
|  | 11  |   |  |  |  |  |  |  |  |  | -   | 1   |  | 2.5   |
|  | - 11  |   |  |  | 17.56  | 1  | 1  |  |  |  |   |   | 6.7  | 9.2   |
|  |   |   |  |  |  |  |  |  |  |  |   |   |  | 43.5  |
|  |   |   |  |  |  |  | the barrow of the second                               | ŀ  |  |  |   |   |  | 100.0   |
| 4.70   | 0    1.   | •61   3   | 21.71  | 8.81   | 14.08  | 0.24   | 30.28  |  | 11.  | 2   62   | 2.4   | 4.4   | 10.5   | 16.8  |
|  |   |   |  |  |  |  |  |  |  |  |   |   |  | i   |
| 1  |   |   |  |  |  |  |  |  |  |  |   |   |  | ł   |
| 1  |   |   |  |  | • •  |  |  |  |  |  | •   |   |  |   |
|  |   |   |  |  |  |  |  |  |  |  |   |   |  | I   |
|  |   |   |  |  |  |  |  | · ·  |  |  |   |   |  | -   |
|  |   |   |  |  | 1  |  |  |  |  |  |   |   |  | í.  |
|  | 1   |   |  |  |  |  | 1  | · ·  |  |  |   |   |  | 1   |
| +  |   |   |  |  | · · · ·  | · · · · · · · · · · · · · · · · · · ·                  | :  |  |  |  |   |   |  |   |
| LCHES  | grour   | ia and  | i Iloa   | tea sep  | aratel   | y - ro   | ugher d  | concent  | trates   | combi  | ned f   | or fui  | ther   |   |
|  | %<br>1.1<br>0.6<br>0.7<br>0.9<br>0.4<br>3.2<br>92.7<br>100.0<br>4.7 | 1½         1         1         1         %         1.11         %         1.11         0.67         0.75         0.99         0.48         3.23         92.77         100.00         4.70 | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | $\begin{array}{ c c c c c c c c c c c c c c c c c c c$ | $\begin{array}{ c c c c c c c c c c c c c c c c c c c$ | $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$ | $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$ | $\begin{array}{ c c c c c c c c c c c c c c c c c c c$ | $ \begin{array}{c c c c c c c c c c c c c c c c c c c $ |

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|                           | LE: Na | ldina       | .Expl | oration                                   | s Ltd.   | No. 2   |                                       |         |          |        |       | -     |             | . 30, 1  | 971   |
|---------------------------|--------|-------------|-------|---|----------|---------|---------------------------------------|---------|----------|--------|-------|-------|-------------|----------|-------|
| OBJECT OF TEST:           |        |             |       |   |          |         |                                       | *       |          |        |       |       | ARGE:       |          |       |
|                           |        |             |       |   |          |         |                                       | <u></u> |          | ·····  |       | TES   | STED B      | Y:       |       |
| OPERATION                 | Time   | %           | p⊢    | , L                                       | Jnit     |         |                                       |         | Rea      | gents, | lb pe | r ton |             |          |       |
|                           | min    | Solid       | s     | ۱<br>ــــــــــــــــــــــــــــــــــــ | used     | Na 2CO3 | Na <sub>2</sub> SO <sub>3</sub>       | NaCN    | ¥        | F242   | DF250 |       |             |          |       |
| Lead flotation from       |        |             |       |   | iiiiiiii |         |                                       |         |          |        |       |       |             |          |       |
| separation tailing        |        |             | 1     |   |          |         | 1                                     |         |          |        |       |       |             |          |       |
| Regrinding                | 30     |             |       |   | *        | 0.4     | 0.1                                   | 0.025   |          | 0.005  |       | 1     |             |          | 1     |
| Lead rougher              |        |             |       | 500-                                      | g cell   | 1       |                                       |         |          |        |       |       |             |          |       |
| Stage 1                   | 12     |             |       |   | ×        | 1       |                                       |         |          |        | 0.003 | 1     |             |          | 1     |
| <u>n</u> 2                | 12     |             |       |   |          |         | · · · · · · · · · · · · · · · · · · · |         | 0        | .003   |       |       |             |          |       |
| " 3                       | 1      |             | -     |   |          |         |                                       |         | 0        | .003   | 0.003 |       |             |          |       |
|                           | 1      |             |       |   |          |         |                                       |         |          |        | 0.003 |       |             |          |       |
| Lead cleaner              | 12     |             | +     | 250-                                      | g cell   |         |                                       |         |          |        |       | +     |             |          |       |
|                           |        |             |       |   |          |         |                                       |         |          |        |       | +     |             |          |       |
|                           |        |             |       |   |          |         |                                       |         |          |        |       |       |             |          |       |
|                           |        |             |       |   |          |         |                                       |         |          |        |       | +     |             | <u> </u> |       |
|                           | l w    | г.<br>г. (( | 1     |   |          | LYSIS   | 04                                    |         | l        |        |       |       | I<br>IBUTIO | N 94     |       |
| PRODUCT                   |        | ;           | Cu    | РЪ  | Zn       | Fe      | <br>Au                                | 1       | <u> </u> | Cu     |       | Pb    | Zn          | Au       | 1.0   |
|                           |        |             |       | PD  |          | re      | Au                                    | Ag      |          |        |       |       |             | Au       | Ag    |
| Metallurgical Balance for | r      |             |       |   |          |         |                                       |         |          |        |       |       |             |          |       |
| Copper-Lead Separation    |        | 11          |       |   |          |         |                                       |         |          |        |       |       |             |          |       |
| Copper conc               | 15     | 38 27       | .08   | 4.45                                      | 5.15     | 17.47   |                                       | 163.36  |          | 62     | .3    | 3.9   | 16.3        | -32.3    | 38.0  |
| No. 2 copper cleaner tai  |        |             |       | 13.79                                     | 4.79     |         |                                       | 141.34  |          |        | .8    | 7.2   | 13.3        |          | 19.   |
| No. 1 " " "               |        | .36   5     |       | 15.80                                     | 5.45     |         |                                       | 79.22   |          |        | .2    | 9.2   | 15.0        |          | 12.5  |
| Lead rougher conc         |        | 05 1        |       | 21.71                                     | 8.81     |         |                                       | 30.28   |          |        |       | 79.7  | 55.4        |          | 29.8  |
| Feed (calcd)**            | 100    | .00 6       | 5.68  | 17.71                                     | 7.53     | 16.53   | 0.45                                  | 66.10   | <u> </u> | 100    | .0 1  | 0.00  | 100.0       | 100.0    | 100.0 |
|                           |        |             |       |   |          |         |                                       |         |          |        |       |       |             |          |       |
|                           |        |             |       |   |          |         |                                       |         |          |        | ļ     |       |             |          |       |
|                           |        |             |       |   |          |         |                                       |         | ļ        |        |       |       |             |          |       |
|                           |        |             |       |   |          |         |                                       |         |          |        |       |       |             |          |       |
|                           |        |             |       |   |          |         |                                       |         |          |        |       |       |             |          |       |
|                           | ·      |             |       |   |          |         |                                       |         |          |        |       |       |             |          |       |
|                           |        |             |       |   |          |         |                                       |         |          |        |       |       |             |          |       |
| ······                    |        |             |       |   |          |         |                                       |         |          |        |       |       |             |          |       |
| REMARKS: * 8 india        | . Abb  | e por       | celai | n mill                                    | with 1/2 | charge  | of ste                                | el ball | s.       |        |       |       |             |          |       |
| ** Copper-le              | ad ro  | ıgher       | conc  | entrate                                   | •        | -       |                                       |         |          |        |       |       |             |          |       |
|                           |        |             |       |   |          |         |                                       |         |          |        |       |       |             |          |       |

| <br>,     |                                      |                |  |  |       | 51              |                  |  |                                       |  |                                       |
|-----------|--------------------------------------|----------------|--|--|-------|-----------------|------------------|--|---------------------------------------|--|---------------------------------------|
|           |                                      |                |  |  | INES  |                 | AN               |  | — — — — — — — — — — — — — — — — — — — |  | <u>^</u>                              |
|           |                                      |                |  | and address of the local division of the loc |       |                 |                  | and the local division of the local division | RT She                                | et 1 of 1                              | 2                                     |
| est No:   | 1                                    | Sampl          |  |  |       |                 |                  | - <del>F</del> -   | ite conc                              |  |                                       |
| Test By:  |                                      | <u> </u>       |  |  |       |                 |                  |  | omposite ]                            |  |                                       |
| OBJECT    | OF TES                               | T: Ini         | tial tes   | st c   | on re | groun           | ıd,              | raw p  | yrite con                             | c*                                     | · · · · · · · · · · · · · · · · · · · |
|           | -                                    |                | <u></u>  |  |       |                 |                  |  |                                       | <u></u>                                |                                       |
|           |                                      |                |  |  |       |                 |                  |  |                                       |  |                                       |
|           | ;=}                                  |                |  |  |       | T DA            |                  |  |                                       |  |                                       |
|           | Time                                 | Na CN,<br>Solu | ition  |  |       | lb/to:<br>ution | n                | Charg  |                                       | · · · ·                                |                                       |
| Date      | hr                                   | Added          | Titen  |  | Idad  | T:4.            |                  |  | Solids, o                             |  | 581<br>1000                           |
| <u></u>   | Added Inin Added Inin Water, cc      |                |  |  |       |                 |                  |  |                                       |  |                                       |
| Sept.2/70 | 0                                    | 2.0            |  | <b> </b>   | 0.6   |                 | <u> </u>         | Dilu   | tion (Water                           | : Solids)                              | 1.7:1                                 |
| 11 11     | 1.25                                 | 1.7            | 0.3  | {  | 0.5   | tra             |                  | <u></u>  |                                       |  |                                       |
| 11 11     | 3.25                                 | 2.6            | 0.4  |  | 1.5   |                 | 1                |  | al Solution                           |  |                                       |
| Sept.3/7  |                                      | 2.0            | 0.3  |  | 1.5   | ''              |                  | <u> </u>   | b/ton_Solu                            | tion:                                  | 2.0                                   |
|           | 23.25                                | 1.4            | 1.4  | <u>}                                    </u>   | 0.7   | }               | , 3 <sup>.</sup> |  | NaCN                                  |  | 2.0                                   |
| 11 11     | 26.25                                | 0.5            | 2.0  | ╎  | 0.2   |                 |                  |  |                                       |  | 0.5                                   |
|           | 7044.25 0.5 1.5 0.2 0.3 Reagent Cons |                |  |  |       |                 |                  |  |                                       |  |                                       |
| 11 11     | 48.50                                |                | 1.76 0.24 <u>Ib/ton Solids Cyanided:</u>   |  |       |                 |                  |  | 15.4                                  |  |                                       |
| Total     |                                      | 10.7           | ·  |  | 5.2   | <u> </u>        |                  | <u>`</u>   | Na CN                                 | ······································ | 8.5                                   |
| •         | <u> </u>                             |                |  | ┨  |       | ļ               |                  | <u> </u>   | Lime                                  | ·                                      | 0.5                                   |
|           | <u> </u>                             |                | <u> </u>   | <u> </u>   |       | <u> </u>        |                  |  | cing power                            | **                                     | 1984                                  |
|           |                                      |                | M  | ET/  |       | GICAL           | - B              | ALAN   |                                       |  |                                       |
|           | Pro                                  | oduct          |  |  | W     | t               |                  | Assays   | , oz/ton                              | Distribu                               | ition, %                              |
|           |                                      |                |  |  | %     |                 |                  | Au   | Ag                                    | Au                                     | Ag                                    |
| Pregnant  | solut                                | ion***         | · · · ·  |  | +     | -               | 0                | .07  | 4.06                                  | 25.0                                   | 37.2                                  |
| Cyanidat  | ion rea                              | sidue          |  |  | 100   | .0              | .0               | .21  | 6.84                                  | 75.0                                   | 62,8                                  |
| Feed (as  | say)                                 | - <u></u> -    |  | •••  | 100   | .0              | 0                | .28  | 10.90                                 | 100.0                                  | 100.0                                 |
|           |                                      |                |  |  |       |                 |                  | · .  |                                       | . · · ·                                |                                       |
|           |                                      |                |  |  |       |                 |                  |  |                                       |  | <br>                                  |
|           |                                      |                |  |  |       |                 |                  |  | · · · · · ·                           |  |                                       |
|           |                                      |                |  |  |       | ·               | - <u>Lau</u>     |  | <u> </u>                              |  | <u> </u>                              |
|           |                                      |                |  |  |       | <u> </u>        |                  |  |                                       |  | <u> </u>                              |
| Remarks   |                                      |                | eed ana  | lys  |       |                 | _                |  |                                       |  |                                       |
| Cu        | Рb                                   | Zn             | Fe   |  | S     |                 | so1              |  | As Sb                                 |  |                                       |
| 0.32      | 0.48                                 | ·              | 32.00  |  | .68   |                 | .28              |  | .38 0.14                              |  |                                       |
|           |                                      |                |  |  |       |                 |                  |  | 11 with st                            | teel balls                             | 3                                     |
|           |                                      | ~~~~~~         | een ana  |  |       |                 |                  |  | · · ·                                 |  |                                       |
|           | ·                                    |                | and the second states and the second states are set of the second states a |  |       |                 |                  | oxid   | ize all re                            | educing ag                             | gents                                 |
| prese     | ent in                               | 1000 cc        | of preg  | man  | it so | lutio           | n.               |  |                                       |  |                                       |

\*\*\* Assays expressed as oz/ton feed and obtained by difference

v wirreitence.

#### Cyanidation Test Report

#### Test No. 1

#### Screen Analysis of Pyrite Concentrate

| Tyler Mesh Size | Before Regrinding<br>% Wt | After Regrinding<br>% Wt |
|-----------------|---------------------------|--------------------------|
| +200            | 14.0                      | -                        |
| +325            | 21.1                      | 1.2                      |
| +400            | 5.2                       | 0.7                      |
| +500            | 19.3                      | 6.8                      |
| -500            | 40.4                      | 91.3                     |
| Total           | 100.0                     | 100.0                    |
|                 |                           |                          |

|                             |         |          | CYANI                                   | MINES    |            | RAN      |                      | RT          | Sheet 1    | of 2                                  |  |  |
|-----------------------------|---------|----------|---|----------|------------|----------|----------------------|-------------|------------|---------------------------------------|--|--|
| Test No:                    | 2       | Samp     | le: Nadi                                | na Expl  | orati      | lons     | - ca                 | lcines fr   | om roasti  | ng .                                  |  |  |
| Test By:                    | M.R.    |          | of p                                    | yrite c  | onc o      | omp      | osite                | No. 1       |            |                                       |  |  |
| OBJECT                      | OF TES  | ST: To t | ry a co                                 | mplete,  | higi       | 1-te     | mpera                | ture roas   | t prior t  | 0                                     |  |  |
|                             |         | cyar     | nidation                                | •        |            |          |                      |             | · ·        |                                       |  |  |
|                             |         |          |   |          |            |          |                      |             |            |                                       |  |  |
|                             |         |          |   | TES      | T DA       | TA       |                      |             |            |                                       |  |  |
|                             | Time    | No CN,   | lb/ton                                  |          | Ib/to      | on       | Charg                | je:         |            |                                       |  |  |
| Date                        |         | 5010     | ition                                   | Sol      | ution<br>I |          |                      | Solids,     | g          | 386                                   |  |  |
|                             | hr      | Added    | Titrn                                   | Added    | Tit        | rn       |                      | Water, c    | c          | 1000                                  |  |  |
| Sept 2/70                   | 0       | 2.0      |   | 0.6      | <u> </u>   |          | Dilu                 | tion (Water | : Solids)  | 2.6:1                                 |  |  |
| 11 .11                      | 1.25    | 0.4      | 0.                                      | 1.       |            |          |                      |             |            |                                       |  |  |
| 11 11                       | 3.25    | 1.0      | 1.4                                     | 0.2      | ö.         | 5        | Nomir                | al Solution | Strength,  |                                       |  |  |
| Sept 3/70                   | 20.25   |          | 2.0                                     |          | 0.         | 7        |                      | b/ton Solu  | ition :    |                                       |  |  |
| " " 23.25 2.0 0.7 Na CN 2.0 |         |          |   |          |            |          |                      |             |            |                                       |  |  |
| " " 26.25 1.9 0.7 Lime (    |         |          |   |          |            |          |                      |             |            |                                       |  |  |
| Sept 4/70                   | 44.25   |          | 1.8                                     |          | 0.         | 7        | Reagent Consumption, |             |            |                                       |  |  |
| ft <b>11</b>                | 48.5    |          | 2.04 0.68 <u>b/ton Solids Cyanided:</u> |          |            |          |                      |             |            | <u> </u>                              |  |  |
| [otal                       |         | 4.5      | 4.5 1.2 Na CN                           |          |            |          |                      |             | 6.4        |                                       |  |  |
| · •                         |         |          |   |          |            |          |                      | Lime        | • ;<br>•   | 1.3                                   |  |  |
|                             |         | ÷        |   |          |            |          | Reduc                | ing power   |            | 44                                    |  |  |
| · ·                         |         | ;        | M                                       | ETALLUF  | RGICA      | LB       | ALAN                 | CE          |            | · · · · · · · · · · · · · · · · · · · |  |  |
|                             |         |          |   | <u> </u> |            | į        | Assays               | , oz/ton    | Distribu   | ition, %                              |  |  |
|                             | Pro     | oduct    |   | W %      |            |          | Au                   | Ag          | Au         | Ag                                    |  |  |
| Løss in 1                   | roastir | ng*      |   | 24.4     |            | ,<br>t   | -                    | 0.04        |            | 0.4                                   |  |  |
| Pregnant                    |         | <u> </u> | •.                                      |          |            | 0.       | ,16                  | 3.11        | 58.4       | 28.5                                  |  |  |
| Cyanidat:                   |         |          |   | 75.5     | 6          |          | 16                   | 10.64       | 41.6       | 71.1                                  |  |  |
| Feed (as                    |         |          |   | 100.0    | 00         | 0        | .28                  | 10.90       | 100.0      | 100.0                                 |  |  |
| Calcines                    |         |          |   |          |            | 0        | .39                  | 14.36       |            |                                       |  |  |
| ;                           |         |          | ······                                  |          |            |          |                      |             |            | · ·                                   |  |  |
|                             |         |          |   |          |            |          |                      |             | <u> </u>   | ·                                     |  |  |
|                             |         |          |   |          | · ·        |          |                      |             |            |                                       |  |  |
| Remarks                     | : Addit | cional a | nalyses                                 | %        |            | _        |                      |             |            |                                       |  |  |
|                             | ( Cu    | Pb       | Zn 1                                    | e Tot    | -91 0      | Ç.       | ilphic               | le S Insc   | ol As      | Sb                                    |  |  |
| Feed                        | 0.32    |          |   |          | 3.68       | <u> </u> | <u>,</u>             | 18.2        |            | 0.14                                  |  |  |
| Calcines                    | 0.33    | 0.65     | 5.77 42                                 | 2.41 1   | L.13       |          | 0.09                 | 22.5        | 55 0.36    | 0.08                                  |  |  |
| *Assays                     | for roa | asting 1 | oss and                                 | pregnar  | nt so      | lut:     | ion ez               | xpressed a  | as oz/ton  | feed                                  |  |  |
| and obt                     | ained 1 | oy diffe | rence.                                  | Losses   | in c       | alc      | ine g                | rinding ar  | nd wash so | lution                                |  |  |
| not det                     | ermined | l but as | sumed to                                | be neg   | gligi      | Ъle      | beca                 | use of the  | e complete | e nature                              |  |  |
| of the                      | roast.  |          |   |          | •          |          |                      |             |            |                                       |  |  |

#### Test No. 2

#### Roasting Procedure

|   | Elapsed     Temp       time     C       hr     min |     | Remarks                                    |
|---|--|-----|--|
| s | start room   |     | Charge in, controller set at 450°          |
| 1 | 5  | 410 | Charge ignited, fan on, door open 2 inches |
| 1 | 15   | 450 |  |
| 2 | 15   | 450 | Controller set at 600 <sup>0</sup>         |
| 2 | 30   | 600 | Door ½ open                                |
| 3 | 30   | 600 | Controller.set.at.700 <sup>0</sup>         |
| 4 | 5  | 700 |  |
| 5 | 5  | 700 | Shut power off, calcine cooled in furnace  |

#### Calcine Treatment Before Cyanidation

- After removing 50 grams for analysis, calcines ground with pebbles for 30 min in an 8-in. dia. porcelain mill with 500 cc water.
- (2) Ground calcines filtered, and the filter cake washed 3 times to remove last traces of soluble salts.
- (3) Washed cake repulped in agitation bottle to make up a volume of 1000 cc water.

| ÷.,   | :<br>1   |                   | CYAN                                  | MINES                   |       | RAN<br>ST       | CH<br>REP( | DRT          | She                     | et 1 of  |  |  |
|---|----------|-------------------|---------------------------------------|-------------------------|-------|-----------------|------------|--------------|-------------------------|----------|--|--|
| Test No:  | 3        | Samp              | le: Nad                               | ina Exp                 | lorat | :ions           | 3 – ć      | alciņes fi   | com roasti              | ng       |  |  |
| Test By:  | J.C.1    | в.                | of                                    | pyrite (                | conc  | from            | n Tes      | t 19;        |                         |          |  |  |
| OBJECT (  | OF TES   | ST: <sub>To</sub> | try a s                               | hort pa:                | rtial | L roa           | ast a      | t a low te   | emp (475 <sup>0</sup> ( | 3)       |  |  |
| prior to  | cyani    | lation w          | vith lim                              | e added                 | to 1  | coast           | ting_      | charge       |                         |          |  |  |
|   | <u></u>  |                   |                                       | TES                     | T DA  | ATA             |            |              | <del>.</del>            |          |  |  |
|   | <b>T</b> | Na CN,            | lb/ton                                | Lime                    |       | on              | Char       | ge :         |                         | 253      |  |  |
| Date  | Time     | Solu              | ution                                 | Sol                     | ution |                 |            | Solids,      | g                       | 1000     |  |  |
| :   | hr       | Added             | Titrn                                 | Added                   | Tit   | rn              |            | Water, co    | ;                       | 4.0:1    |  |  |
| Nov 24/70   | · 0      | 2.0               | · .                                   | 0.5                     |       |                 | Dilu       | ition (Water | : Solids)               |          |  |  |
| 11 11   | 1,       | 2.0               | 0.05                                  | 1.0                     | -     |                 |            |              |                         |          |  |  |
| "         2         1.2         0.8         1.0         0.05         Nominal Solution Strength,           "         "         4         0.6         1.5         0.4         0.3         white |          |                   |                                       |                         |       |                 |            |              |                         |          |  |  |
|   |          |                   |                                       |                         |       |                 |            |              |                         |          |  |  |
| ii ii   | 7        | 0.6               | 1.8                                   | 0.4                     | 0.4   | 4 ·             |            | NaCN         |                         | 2.0      |  |  |
| Nov 25/70 23.5 0.6 1.7 0.4 0.3 Lime 0.5   |          |                   |                                       |                         |       |                 |            |              |                         |          |  |  |
| " " 26.5 0.2 1.95 0.2 0.4 Reagent Consumption,  |          |                   |                                       |                         |       |                 |            |              |                         |          |  |  |
| " " 31.0 0.2 2.05 0.2 0.4 <u>lb/ton Solids Cyanided:</u>  |          |                   |                                       |                         |       |                 |            |              |                         |          |  |  |
| lov 26/70   | 48.0     | 1.88 0.28 Na CN   |                                       |                         |       |                 |            |              |                         |          |  |  |
| lotal   |          | 7.4               |                                       | 4.1                     |       |                 |            | Lime         |                         | 15.1     |  |  |
| · · ·   | · ·      |                   |                                       | ÷                       |       |                 | Redi       | icing powe   | r                       | 1000     |  |  |
|   |          |                   | M                                     | ETALLUR                 | GICA  | L B/            | ALAN       | CE           |                         |          |  |  |
| <u>.</u>  | Pro      | duct              |                                       | w                       | ,     | A               | ssays      | , oz/ton     | Distribu                | ition, % |  |  |
|   |          |                   | . <u> </u>                            | %                       |       | /               | 4u         | Ag           | Au                      | Ag       |  |  |
| Loss in 1   | oastin   | g*                | · · · · · · · · · · · · · · · · · · · | 10.                     | 41    | -               | ·          | 0.70         | <del>, ~</del>          | 6.4      |  |  |
| Loss in c   | alcine   | wash s            | oln                                   | 14.                     | 29    |                 |            | 0.092**      | -                       | 0.9      |  |  |
| Pregnant  | soluti   | on*               |                                       |                         |       | • 0.            | 18         | 6.07         | 64.5                    | 55.9     |  |  |
| Cyanidati   | on res   | idue              |                                       | 75.                     | 30    | 0.              | 13         | 5.31         | 35.5                    | 36.8     |  |  |
| Feed (ass   | ay)***   |                   |                                       | 100.                    | 00    | 0.              | 28         | 10.86        | 100.0                   | 100.0    |  |  |
| Calcines  | (after   | washin            | g                                     |                         |       | 0.              | 37         | 13.37        |                         |          |  |  |
|   |          |                   |                                       |                         |       |                 |            |              |                         |          |  |  |
|   |          |                   |                                       | ·                       |       |                 |            |              | <u> </u>                |          |  |  |
| Remarks:  | Addi     | tional            | analyses                              | s %                     | ,     | •               |            |              | -                       |          |  |  |
|   |          |                   | <u>Cu</u> J                           | <u>Pb Zn</u>            |       | Fe              | To         | tal S Sul    | phide S                 |          |  |  |
| Feed<br>Cyanidat  | ion re   |                   | 0.60 0.<br>0.26 0.                    | <u>59 2.4</u><br>71 1.7 |       | <u>3.71</u><br> |            | 8.47<br>2.71 | 2.04                    |          |  |  |
| * Assav   | ys for   | roastin           | g loss a                              | and preg                | nant  | so1             | utio       | n expresse   | d as oz/t               | on feed  |  |  |
|   |          |                   | fference                              |                         |       |                 |            |              |                         |          |  |  |
|   |          |                   |                                       |                         | valu  | .e: (           | ),15       | mg/litre i   | n first w               | rash     |  |  |
| A, \  |          |                   |                                       |                         |       |                 |            |              |                         |          |  |  |

\*\*\* Adjusted for dilution effect of the addition of 20 g lime to charge, actual values: Au 0.29 oz/ton, Ag 11.41 oz/ton. Cyanidation Test Report

Test No. 3

#### Preparation of Roasting Charge

- (1) Ground pyrite conc for 60 min in 8 in.-dia porcelain mill with full charge of steel balls.
- (2) Ground conc filtered and dried.
- (3) Dried cake bucked through 100 mesh screen to break up lumps.
- (4) Added 20 grams of lime and mixed thoroughly in tumbler mixer.

### Roasting Procedure

| ti     |         | Temp<br>°C   | Remarks   |  |  |  |  |  |  |  |  |
|--------|---------|--------------|---|--|--|--|--|--|--|--|--|
| hr     | min     |              |   |  |  |  |  |  |  |  |  |
|        |         |              | Furnace heated to 475°C                                   |  |  |  |  |  |  |  |  |
| st     | start 4 |              | Put charge in furnace                                     |  |  |  |  |  |  |  |  |
|        | 5       | 475          | Charge ignited, fan on, door open 2 inche                 |  |  |  |  |  |  |  |  |
| 50 475 |         | 4 <b>7</b> 5 | Hot calcines removed from furnace and cooled in fume hood |  |  |  |  |  |  |  |  |

#### Calcine Treatment Before Cyanidation

- (1) Repulped cooled calcines with cold water, conditioned in a 2000-g lab cell for 5 min and filtered.
- (2) Step (1) repeated on filter cake.
- (3) Both filterates from above saved and analysed for precious metals content.
- (4) Filter cake dried and 50 grams cut out for assay.
- (5) Balance of sample ground for 10 min in an 8 in.-dia ceramic mill with 1/2 charge of steel balls (this was done to break up hard lumps).
- (6) Wet cake transferred to agitation bottle and additional water added to bring volume to 1000 cc.

| MINES       | 00   | ICH    |
|-------------|------|--------|
| CYANIDATION | TEST | REPORT |

|   |                                       |                                       | CIAN             | Un       |                                       | 1        | 01              | NEFU             |             |           |          |  |
|---|---------------------------------------|---------------------------------------|------------------|----------|---------------------------------------|----------|-----------------|------------------|-------------|-----------|----------|--|
| Test No:  | 4                                     |                                       |                  |          |                                       |          |                 |                  | cines from  | n roastin | g of     |  |
| Test By:  | J.C.1                                 | 3.                                    | pyrit            | e c      | conc ;                                | from     | Tes             | t 19             |             |           |          |  |
| OBJECT (  | OF TES                                | ST: To t                              | t <b>ry a</b> pa | rti      | ial r                                 | oast     | at              | a low            | temp wit    | h lime as | in       |  |
| Test 3 b  | ut inc                                | reased a                              | roasting         | ; ti     | ime f                                 | rom      | 45 n            | nin to           | 3 hours*    | •         |          |  |
|   |                                       | ····                                  |                  |          |                                       |          |                 |                  | · ·         |           |          |  |
|   |                                       |                                       |                  |          | TES                                   | ΤĎΑ      | ATA             |                  |             |           |          |  |
|   | Time                                  | Na CN,                                | lb/ton           |          | Lime                                  |          | on              | Charg            | e :         |           |          |  |
| Date  | Time                                  | Solu                                  | ition            |          | Soli                                  | ution    |                 | ·                | Solids,     | 9         | 220      |  |
|   | hr                                    | Added                                 | Titrn            | A        | dded                                  | Tit      | rn              |                  | Water, co   | 3         | 1000     |  |
| Nov.24/70   | 0.                                    | 2.0                                   |                  |          | 0.5                                   |          |                 | Dilut            | tion (Water | : Solids) | 4.5;1    |  |
| 11 11   | 1.                                    | 0.2                                   | 0.85             |          | 1.0                                   | _        | ,               |                  |             |           |          |  |
| н. н. С   | 2                                     | 0.8                                   | 1.2              | i—       | 0.5                                   | 0.       | 1               | Nomin            | al Solution | Strength. |          |  |
| 11 11 1   | 4                                     | 0.2                                   | 1.9              | (        | 0.5                                   | 0,       | 15              | · [              | b/ton Solu  | tion:     |          |  |
| 11 11   | 7                                     | ·                                     | 1.9              | 1        | 0.4                                   | ·        | 25 <sup>.</sup> |                  | NaCN        |           | 2.0      |  |
| Nov 25/70   | 23.5                                  | 0.1                                   | 1.95             | <u> </u> | 0.5                                   | ·        | 15              | <u>.</u>         | Lime        | • •       | 0.5      |  |
| " " 26.5 - 2.0 0.4 0.25 Redgent Consumption,                                  |                                       |                                       |                  |          |                                       |          |                 |                  |             |           |          |  |
| 11 11   | 31.0                                  | 0.1                                   | 2.0              |          | 0.6                                   | Ó,       | 25              | lb/              |             |           |          |  |
| Nov.26/70   | 48.0                                  |                                       | 1.95             |          | 0.3                                   |          | 34              |                  | Na CN       |           | 6.6      |  |
| Total   |                                       | 3.4                                   |                  | 1        | 4.4                                   |          |                 | Lime             |             | 18.5      |          |  |
|   |                                       | · ·                                   |                  | 1.       |                                       | <u> </u> |                 | Reduc            | ing power   |           | 75       |  |
|   |                                       |                                       | M                | ET/      | ALLUF                                 | GICA     | L B             |                  | CE          |           | · · ·    |  |
|   |                                       |                                       |                  |          | · · · · · · · · · · · · · · · · · · · |          |                 | Assavs.          | oz/ton      | Distrib   | ution, % |  |
|   | Pro                                   | duct                                  |                  |          | ₩<br>`%                               |          | ———             | Au               | Ag          | Au        | Ag       |  |
| Loss in 1   | oastir                                | ייייייייייייייייייייייייייייייייייייי |                  |          | 14.                                   |          | 0.0             |                  | 0.80        | 3.5       | 7.4      |  |
| Loss in d   |                                       |                                       | oln              | -        | 18.                                   |          |                 | <u>.</u>         | 0.04**      |           | 0.4      |  |
| Pregnant  |                                       | · · · · · · · · · · · · · · · · · · · |                  |          |                                       |          | 0.              | 20               | 7.44        | 71.1      | 68.6     |  |
| Cyanidat  |                                       | ·····                                 |                  |          | 66.                                   | _        | ┟               | 105 <sub>2</sub> | 3.83        | 25.4      | 23.6     |  |
| Feed (as  | · · · · · · · · · · · · · · · · · · · |                                       | · .              |          | 100                                   |          | 0.              | ······           | 10.86       | 100,0     | 100.0    |  |
| Calcines  |                                       | washin                                | g)               |          |                                       |          | 0.              |                  | 14.97       |           |          |  |
|   | <u></u>                               |                                       |                  |          | -<br>-                                |          |                 |                  |             |           | <u> </u> |  |
|   |                                       |                                       |                  |          |                                       |          |                 |                  | i           | <u> </u>  |          |  |
| Remarks   | Add                                   | Itional                               | analvse          | s %      |                                       |          | I               | · · · ·          | L           | <b>.</b>  | <u></u>  |  |
| Remarks: Additional analyses %<br>Cu Pb Zn Total S Sulphide S                 |                                       |                                       |                  |          |                                       |          |                 |                  |             |           |          |  |
| Cyanidation residue 0.14 0.80 1.94 1.31 0.67                                  |                                       |                                       |                  |          |                                       |          |                 |                  |             |           |          |  |
| *Procedure identical to Test 3 except that pyrite conc was not reground prior |                                       |                                       |                  |          |                                       |          |                 |                  |             |           |          |  |
| to roasting.  |                                       |                                       |                  |          |                                       |          |                 |                  |             |           |          |  |
| **Expressed as oz/ton feed, actual value: none in first wash solution,        |                                       |                                       |                  |          |                                       |          |                 |                  |             |           |          |  |
| 0.066 mg/litre in second washsolution.  |                                       |                                       |                  |          |                                       |          |                 |                  |             |           |          |  |
|   |                                       |                                       |                  |          |                                       |          |                 | <u>,</u>         |             |           |          |  |

# MINES BRANCH CYANIDATION TEST REPORT

| Test No:  | 5        | Samp     |          | DATION     |         |                 | ite conc  | from       |          |  |  |  |
|---|----------|----------|----------|------------|---------|-----------------|-----------|------------|----------|--|--|--|
| Test By:  |          |          |          | <u>-</u> - | · · · · |                 | omposite  |            |          |  |  |  |
| OBJECT  |          | <u> </u> |          |            |         |                 | raw pyri  |            |          |  |  |  |
|   |          |          | duced f  |            |         |                 |           |            |          |  |  |  |
| <u>.                                    </u>  |          |          |          |            |         |                 |           |            |          |  |  |  |
|   |          |          |          | TES        | T DATA  |                 |           |            |          |  |  |  |
|   | 1        | Na CN,   | lb/ton   |            | lb/ton  | Charg           |           |            |          |  |  |  |
| Dula  | Time     |          | ition    |            | ution   |                 | Solids,   | 0          | 509      |  |  |  |
| Date  | hr       | Added    | Titrn    | Added      | Titrn   |                 | ···       |            | 1000     |  |  |  |
|   |          |          |          |            |         |                 | Water, c  |            | 2.0;1    |  |  |  |
|   |          |          |          |            |         |                 |           |            |          |  |  |  |
|   | 1        | 2.0      | 0.2      | 1.0        |         | <u> </u>        |           | <u></u>    |          |  |  |  |
| "     4 $2.0$ $0.2$ $1.0$ $-$ Nominal Solution Strength,       "     " $6.5$ $1.2$ $0.9$ $1.0$ $ 1b/ton$ Solution :   |          |          |          |            |         |                 |           |            |          |  |  |  |
|   |          |          |          |            |         |                 |           |            |          |  |  |  |
| Mar         9/71         23         1.4         0.6         0.6         trace         NoCN         2.0           ''         ''         26         0.8         1.3         0.6         0.1         1         1         0.5 |          |          |          |            |         |                 |           |            |          |  |  |  |
|   |          |          |          |            |         |                 |           |            |          |  |  |  |
| "         30.5         0.2         1.9         0.6         0.1         Reagent Consumption,   |          |          |          |            |         |                 |           |            |          |  |  |  |
| Mar 10/71 48 1.24 0.12 <u>lb/ton Solids Cyanided:</u>   |          |          |          |            |         |                 |           |            |          |  |  |  |
| Total   |          | 9.6      |          | 5.3        |         |                 | Na Cl     |            | 16.4     |  |  |  |
| •   |          |          | ·        | <b> </b>   |         |                 | Lime      |            | 10.2     |  |  |  |
|   | <u> </u> |          | <u> </u> | <u> </u>   |         |                 | ing power |            | 1276     |  |  |  |
|   |          |          | M        | ETALLUF    |         | BALAN           | CE        |            |          |  |  |  |
|   | Pr       | oduct    |          | w          | , L     | Assa <b>y</b> s | , oz/ton  | Distribu   | ition, % |  |  |  |
|   |          |          |          |            |         | Au Ag           |           | Au         | Ag       |  |  |  |
| Pregnant  | soluti   | lon      |          | 0,6        | 2** (   | 0.066           | 3.91      | 28,1       | 40.8     |  |  |  |
| Cyanidat  | ion res  | sidue    |          | 99.3       | 8       | 0.17            | 5.72      | 71.9       | 59,2     |  |  |  |
| Feed (as  | say)     |          |          | 100,0      | 0       | 0.24            | 9.60      | 100.0      | 100.0    |  |  |  |
|   |          |          |          |            |         |                 |           |            |          |  |  |  |
|   |          |          |          |            |         |                 |           |            |          |  |  |  |
|   |          |          |          |            |         |                 |           |            |          |  |  |  |
|   |          |          |          |            |         |                 |           |            |          |  |  |  |
|   |          |          |          |            |         |                 |           |            | L        |  |  |  |
| Remarks   | : Add:   | itional  | feed ana | lysis (    | %):     |                 |           | *          |          |  |  |  |
| ` Cu  | Pb       | Zn       | Fe       | Insc       | 1 To    | tal S           |           |            |          |  |  |  |
| 0.21  | 0.53     | L 8,50   | 35.13    | 3 10.1     | .0 4    | 3.35            |           |            | :        |  |  |  |
| * Same  | grindi   | ng proce | dure as  | in Test    | 1.      |                 |           |            | 1        |  |  |  |
|   |          |          |          |            |         | ely de          | termined  | in this an | đ        |  |  |  |
| 1   |          |          |          |            |         |                 |           | hat cyanid | 1        |  |  |  |
|   |          | vanidati |          |            |         |                 |           |            | •        |  |  |  |
|   |          |          |          |            |         |                 |           |            |          |  |  |  |

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|------|---|
|------|---|

MINES BRANCH

|  |        |          | CYANI    | MINES                |            | ₹AN<br>ST |                | RT                      | Sheet 1 of        | Ē 2      |  |  |
|--|--------|----------|----------|----------------------|------------|-----------|----------------|-------------------------|-------------------|----------|--|--|
| Test No:   | 6.     | Sampl    | e: Nadi  | na Expl              | orat       | ionș      | a, cal         | cines fro               | m low tem         | p roast  |  |  |
| Test By:   | M.R.   |          | of p     | yrite d              | onc        | com       | posite         | No. 2                   | · ·               |          |  |  |
| OBJECT (   | OF TES | T: Rej   | peat of  | Test 4               | on c       | ompo      | osite (        | No. 2, i.               | e., 3 hou         | r        |  |  |
|  |        | ro       | ast at 4 | 75 <sup>0</sup> C w: | th 1       | ime       | added          | to charg                | e                 |          |  |  |
|  |        |          |          |                      |            |           | ĺ              | 1                       |                   |          |  |  |
|  |        |          |          | TES                  | T DA       | ATA       |                | · · · ·                 |                   |          |  |  |
|  |        | Na CN,   |          |                      | lb/te      | on        | Charg          | e ;                     |                   |          |  |  |
| Date   | Time   | Solu     | ition    | Sol                  | ution<br>T |           |                | Solids,                 | a                 | 338      |  |  |
|  | hr     | Added    | Titrn    | Added                | Tit        | rn        |                | Water, co               | <b>;</b>          | 1000     |  |  |
| Mar. 8/71  | 0      | 2.0      |          | 0.5                  |            | ÷.        | Dilui          | ion (Water              | : Solids)         | 5.9:1    |  |  |
| 11 11  | 1 ·    | 2.0      | 0.3      | 1,0                  |            |           |                |                         |                   |          |  |  |
| TT 11  | 4      | .1.0     | 0.6      | 0.4                  | 0.         | 1         | Nomin          | al Solution             | Strength          |          |  |  |
| "         6.5         1.2         1.1         1.0         0.1         Ib/ton Solution: |        |          |          |                      |            |           |                |                         |                   |          |  |  |
| Mar 9/71   | . 23   | 1.2      | 0.8      | 0.4                  | 0.         | 2 ·       |                | Na CN                   |                   | 2.0      |  |  |
| " " 26 0.6 1.4 0.2 0.4 Lime 0.5  |        |          |          |                      |            |           |                |                         |                   |          |  |  |
| " " 30.5 0.4 1.6 0.2 0.4 Reagent Consumption,  |        |          |          |                      |            |           |                |                         |                   |          |  |  |
| Mar 10/71  | . 48   |          | 1.04     |                      | 0,24       |           | <u>16/</u>     | Ib/ton Solids Cyanided: |                   |          |  |  |
| Total  |        | 8.4      |          | 3.7                  |            |           |                | Na CN                   | ·                 | 21.8     |  |  |
| · · ·  | ,      |          |          |                      |            |           |                | Lime                    |                   | 10.2     |  |  |
|  |        | ×        |          |                      |            | •         | Reduc          | ing power               | r .               | 996      |  |  |
|  |        |          | M        | ETALLU               | RGICA      | LE        | BALANC         | E                       |                   | •        |  |  |
|  | Dr     | oduct    |          | W                    | +          | ·         | Assays,        | oz/ton                  | Distribu          | ition, % |  |  |
|  | FIL    |          |          | 9                    |            |           | Au             | Ag                      | Au                | Ag       |  |  |
| Loss in  | roasti | ng .     |          | 15.                  | 74         |           | ·              |                         | -                 |          |  |  |
| Loss in  | calcin | e wash s | soln     | 10.                  | 89         | ļ<br>     | <del>, -</del> |                         | _                 | <u> </u> |  |  |
| Pregnant   | solut  | îon*     |          | 0.                   | 51         |           | .15            | 5.27                    | 66.2              | 57.1     |  |  |
| Cyanidat   | ion re | sidue    |          | 72.                  | 86         | 0         | .105           | 5.43                    | 33.8              | 42.9     |  |  |
| Feed (as   | say)** |          |          | 100.                 | 00         | <u> </u>  | .23            | 9.23                    | 100.0             | 100.0    |  |  |
| Calcines   | (befo  | re washi | ing)     |                      |            | <u> </u>  | .29            | 12.11                   |                   |          |  |  |
|  |        |          |          |                      |            | <u> </u>  |                |                         |                   |          |  |  |
|  |        |          |          | ·                    |            |           | <u></u>        |                         | •                 |          |  |  |
| Remarks  | Addi   | tional a | analyses | , %:                 |            |           |                |                         |                   | · · · ·  |  |  |
|  |        |          | Cu       | РЪ                   | Zı         | n         | Fe             | Total S                 | Sulphide          | S        |  |  |
| Calcines   | (befo  | re washi | lng) 0.2 | 6 0.60               | 9.         | 90        | 41.85          | 16.71                   | 1.54              |          |  |  |
| Cyanidat   | ion re | sidue    | 0.1      | 0 0.65               | 8,         | 76        | 45.39          | 12.34                   | 1.59              |          |  |  |
| * Accer  | g pynr | essed or | a ozltón | feed                 | nd ci      | htai      | nod he         | y differe               |                   |          |  |  |
| 1  |        |          |          |                      |            |           |                |                         | nce<br>ne to cha: | rge,     |  |  |
|  |        |          | 1.oz/top |                      |            |           |                |                         |                   | ·        |  |  |

Cyanidation Test Report

Test No. 6

#### Preparation of Roasting Charge

(1) Added 20 grams of lime to charge.

(2) Mixed thoroughly in a tumbler mixer.

#### Roasting Procedure

Identical to that outlined for Test 3, Sheet 2.

#### Calcine Treatment Before Cyanidation

- (1) Cold calcines weighed and a 50 gram sample cut out for analysis.
- (2) Balance of sample ground for 20 min in an 8 in.-dia porcelain mill with a full charge of steel balls and 1000 cc water.
- (3) Reground calcines transferred to 2000-g lab cell, conditioned for 5 min and filtered.
- (4) Filter cake repulped with fresh water and again conditioned in a 2000-g cell for 5 min.
- (5) Both filterates from above saved and analyzed for precious metals content.
- (6) Filter cake dried and weighed before being transferred to agitation bottle.

| Test No:                             | 7            | Samp                      |         |         | TEST<br>loration |                            |                       | om low ter      | np ·                                  |
|--------------------------------------|--------------|---------------------------|---------|---------|------------------|----------------------------|-----------------------|-----------------|---------------------------------------|
| Test By:                             | M.R.         |                           | ·····   | st of p | yrite co         | nc coi                     | mposite N             | o, 2            | · · · · · · · · · · · · · · · · · · · |
| OBJECT (                             |              | ST: То                    | try 3 h | our roa | st at 47         | 5 <sup>0</sup> С р:        | rior to c             | yanidatio       | 1 :                                   |
|                                      |              | as                        | in Test | 6 but w | without          | the a                      | ddition o             | f lime to       | the                                   |
|                                      |              | cha                       | arge.   |         |                  |                            | ,                     |                 |                                       |
|                                      |              |                           |         | TES     | T DATA           |                            |                       |                 | ·                                     |
|                                      | Time         | Na CN, lb/ton<br>Solution |         |         | lb/ton           | Charge :                   |                       |                 | ,                                     |
| Date                                 | Time<br>hr   |                           |         | 501     | ution            |                            | Solids, g             |                 |                                       |
|                                      |              | Added                     | Titrn   | Added   | Titrn            |                            | Water, cc             |                 |                                       |
| 1ar. 8/71                            | 0            | 2.0                       |         | 0.5     |                  | Dilution (Water : Solids)  |                       |                 | 2.9:1                                 |
| n ù                                  | . <b>1</b> · | 2.0                       | 0.3     | 1.0     | -                |                            |                       |                 |                                       |
| <u>н (</u>                           | 4            | 1.0                       | 0.7     | 0.4     | 0.1              | Nominal Solution Strength. |                       |                 |                                       |
| f1 11                                | 6.5          | 1.2                       | 0.9     | 1.0     | 0.1              | <u>lb/ton Solution:</u>    |                       |                 |                                       |
| Mar. 9/71                            | 23           | 1.0                       | 0.9     | 0.4     | 0.2              | Na CN                      |                       |                 | 2.0                                   |
| 11 11                                | 26           | 0.4                       | 1.7     | 0.2     | 0.3              | Lime                       |                       |                 | 0.5                                   |
| 11 11                                | 30.5         | 0.2                       | 1.8     | 0.2     | 0.3              | Reagent Consumption,       |                       |                 |                                       |
| Mar 10/71                            | 48           | ·                         | 1.08    |         | 0.16             | Ib/ton Solids Cyanided:    |                       |                 |                                       |
| fotal                                |              | 7.8                       |         | 3.7     |                  |                            | Na CN                 |                 | 21.8                                  |
| •                                    |              |                           | ·<br>·  |         |                  | ļ                          | Lime                  | ) ~ · · ·       | 10.2                                  |
|                                      | l            |                           |         |         |                  | Reduc                      | ing power             | ci              | 1388                                  |
|                                      | · · · · · ·  |                           | M       | ETALLUF | GICAL B          | ALAN                       | CE                    |                 |                                       |
|                                      | Pro          | duct                      |         | w       | Wt               |                            | oz/ton                | Distribution, % |                                       |
|                                      |              |                           | ·····   | %       |                  | Au                         | Ag                    | Au              | <sup>;</sup> Ag                       |
| Loss in 1                            | roastir      | ıg                        |         | 17.1    | .0 .             | -                          | a - 1 <del>4</del> 22 |                 |                                       |
| Loss in (                            | calcine      | e wash s                  | oln     | 5.0     | 5.02             |                            |                       |                 |                                       |
| Pregnant                             | soluti       | on                        |         | 0.2     | 24 0             | .14                        | 5.63                  | 60.4            | 58.7                                  |
| Cyanidat:                            | ion res      | sidue                     |         | 77.6    | 64 0             | .12                        | 5.11                  | 39.6            | 41.4                                  |
| Feed <b>(as</b>                      | say)         |                           |         | 100.0   | 100.00 0         |                            | 9.60                  | 100.0           | 100.0                                 |
| Calcines                             | (þefor       | e washi                   | ng)     |         | 0                | .28                        | 11.44                 |                 |                                       |
|                                      |              |                           |         |         | ·                |                            |                       |                 |                                       |
|                                      |              |                           |         |         |                  |                            |                       |                 |                                       |
| Remarks                              | Addi         | ional a                   | malyses |         |                  |                            |                       | . 1 0 0         | 1                                     |
|                                      | /1 7         |                           | Cı      |         |                  |                            |                       | ******          | 1.52                                  |
| Calcines                             |              |                           |         |         | ······           |                            |                       | 3.48<br>6.56    | 2.43                                  |
| Cyanidát                             | 10n res      | sique                     | 0.1     | 11 0.0  | 53 9.3           | 4 4.                       | 3 <b>.9</b> 7 1       | 0.00            | . 2.43                                |
| •••••••••••••••••••••••••••••••••••• |              |                           |         |         |                  |                            |                       | · · · ·         |                                       |

#### - 65 -MINES BRANCH CYANIDATION TEST REPORT

İ

| Test No:                                   | 0      | Samp          |          | DATION     |               |                     |                            |                      | om low ten              | n roast      |
|--|--------|---------------|----------|------------|---------------|---------------------|----------------------------|----------------------|-------------------------|--------------|
| Test By:                                   |        |               |          |            |               |                     |                            |                      |                         |              |
| OBJECT (                                   |        |               |          |            |               |                     |                            |                      | Composite<br>nc prior f |              |
|  |        |               |          |            |               |                     |                            | roasting             |                         |              |
|  |        |               |          |            |               |                     |                            |                      |                         |              |
|  |        |               |          | TES        | T DA          | TA                  | <u></u>                    |                      |                         |              |
|  |        | Na CN, lb/ton |          |            | Lime lb/ton   |                     | Charge :                   |                      |                         |              |
| Date                                       | Time   | Solu          | Ition    | Sol        | Solution      |                     |                            | Solids,              | g                       | 348          |
|  | hr     | Added         | Titrn    | Added      | Tit           | rn                  | Water, cc                  |                      |                         | 1000         |
| Apr 13/71                                  | 0      | 6.0           |          | 2.0        |               | Dilt                |                            | tion (Water          | 2.9:1                   |              |
| 11 11                                      | 2      | 1.0           | 1.4      | 0.6        | 0.            | 7                   |                            |                      |                         |              |
| 11 11                                      | 7      | 0.4           | 1.9      | -          | 0.            | 8                   | Nominal Solution Strength, |                      |                         |              |
| Apr 14/71                                  | 24     |               | 1.8      | -          | 0.            | 5                   | <u> </u>                   | Ib/ton Solution:     |                         |              |
| 11 11                                      | 26     | 0.2           | 1.85     | . =        | 0.            | 5·                  |                            | Na CN                |                         | 2.0          |
| 11 11                                      | 31     | <u> </u>      | 1.8      | <u> </u>   |               |                     |                            | Lime                 |                         | 0.5          |
| Apr 15/71                                  | 48     |               | 1.36     |            | 0.            | 0.4 Reagent Consump |                            |                      |                         |              |
| Total                                      |        | 7.6           |          | 2.6        |               | ·_                  | <u>lb/</u>                 | ton Solids Cyanided: |                         |              |
|  |        |               |          |            |               |                     | <u> </u>                   | Na CN                |                         | 17,9         |
| ·  |        |               |          |            |               |                     |                            | Lime                 |                         | 6.3<br>400   |
|  |        |               |          |            |               |                     |                            | cing powe            | r                       | 400          |
|  |        |               |          | TALLUR     | GICAL         |                     |                            |                      |                         |              |
| Product                                    |        |               |          |            | VVT           |                     |                            | oz/toń               | Distribu                |              |
|  |        |               |          |            | 21.84         |                     | Au                         | Ag                   | Au                      | Ag           |
| Loss in roasting                           |        |               |          |            |               |                     | •<br>                      |                      | -                       |              |
| Loss in calcine wash soln                  |        |               |          |            | .0.27 -       |                     | -                          | -                    |                         |              |
| Pregnant solution                          |        |               |          |            | 0.46<br>67.43 |                     | 166                        | 6.07<br>7.16         | 72.1                    | 55.7<br>44.3 |
| Cyanidation residue                        |        |               |          |            |               | 0.095               |                            | 10.90                | 100.0                   | 100.0        |
| Feed (assay)*<br>Calcines (before washing) |        |               |          |            | 100.00        |                     | 30                         | 14.75                | 100.0                   |              |
| Garcifics                                  |        |               |          |            |               |                     |                            |                      |                         |              |
|  |        |               | <u></u>  | - <u>}</u> |               |                     | <u></u>                    |                      |                         |              |
| Remarks:                                   | Addit  | ional a       | nalyses: | <u>_</u>   |               | Tot                 | al S                       | ະ<br>%່ Su           | lphide S                | %            |
|  |        | ed            |          |            | <u></u>       |                     | 4.53                       | ······               | ~                       | ·····        |
|  |        | lcines        | (before  | washing    | ;)            |                     | 5,05                       |                      | 0.86                    |              |
| *Had inte                                  | nded a | 6-hour        | roast b  | ut beca    | use (         | of t                | he us                      | se of a la           | rger roas               | ting         |
| dish whi                                   | ch gav | ve an in      | crease i | n expos    | ed s          | urfe                | ice ai                     | ea of sul            | phides, r               | oasting      |
| rate was                                   | faste  | er than       | anticipa | ted. R     | oast          | ing                 | time                       | was there            | efore cut               | back to      |
| 4 hours.                                   | Othe   | er detai      | ls of te | est proc   | edur          | e id                | lentic                     | al to Tea            | st 6.                   |              |
| <u>* Adjuste</u>                           | d for  | dilutio       | n effect | of 20      | g li          | <u>ne t</u>         | to cha                     | rge.                 |                         |              |

| Test No:   | 9             | Samp     | CYANI                |          |          |        |       |                           |                       | om low ten      | p roast                                |
|--|---------------|----------|----------------------|----------|----------|--------|-------|---------------------------|-----------------------|-----------------|--|
| Test By:   |               | Sump     | ·····                |          |          |        |       |                           | te No. 3              |                 | , <del>i</del>                         |
| OBJECT (   |               | <u> </u> |                      |          |          |        |       |                           | yanidatic             | n as in         |  |
|  |               |          | our, 47.<br>out lime |          |          |        |       |                           |                       |                 | <del></del>                            |
| Tes  | <u>t 8, D</u> | ut with  |                      | aut      |          |        |       |                           |                       |                 | <u></u>                                |
|  |               |          |                      | <u>.</u> | TES      | T DA   |       |                           | - <u></u>             |                 | <u>.</u>                               |
|  |               | Nor CN   | Na CN, lb/ton        |          | *****    | lb/to  |       | Charge :                  |                       |                 | , , , , , , , , , , , , , , , , , , ,  |
| Data   | Time          |          | Solution             |          | Solution |        |       |                           | Solids, g             |                 | 344                                    |
| Date   | hr            | Added    | Titrn                | Add      | deá      | Tit    | rn    | Water, cc                 |                       | 1000            |  |
| pr 13/71   | 0             | 6.0      |                      | 2.       | 2.0      |        |       | Dilution (Water : Solids) |                       |                 | 2.9:1                                  |
| 11 11  | 2             | 1.4      | 1.1                  | ; 0,     | 0.6      |        | • 7   |                           |                       |                 | 2.7.1                                  |
| 11, 11   | 7             | 0.4      | 1.9                  | -        |          |        | .8    | Nomin                     | al Solution Strength. |                 | · · · · ·                              |
| 11 11  | 24            | 0.2      | 1.8                  |          |          | 0      | .5    |                           | b/ton Solution:       |                 | · ·                                    |
| 11 11  | 26            | -        | 1.9                  | -        |          | 0      | •5.   |                           | NaCN                  |                 | 2.0                                    |
| 11 11  | 31            |          | 1.9                  | -        |          | 0      | .5    |                           | Lime                  |                 | 0.5                                    |
| pr 15/71   | 48            |          | 1.72                 |          |          |        | •4 Re |                           | eagent Consumption,   |                 |  |
| otal   | •             | 8.0      |                      | 2.6      |          |        |       | Ib/ton Solids Cyanided:   |                       | · · · · · · ·   |  |
|  |               |          |                      |          |          |        |       |                           | Na Cl                 | N               | 18.2                                   |
| •  |               |          | ·                    |          |          | · .    | Lime  |                           |                       | 6.4             |  |
|  |               | •        | Reduci               |          | ing powe | r      | 408   |                           |                       |                 |  |
|  |               |          | M                    | ETAI     | LLUR     | GICA   | LB    | ALAN                      | CE                    |                 |  |
| and the second second second second second second second second second second second second second second second |               |          |                      |          |          | Wt     |       | Assays, oz/ton            |                       | Distribution, % |  |
| Product  |               |          |                      |          | %        |        |       | Au                        | Ag                    | Au -            | Ag                                     |
| Loss in roasting   |               |          |                      |          | 24.23    |        | 0.    | 005                       | · _                   | · -             |  |
| Loss in calcine wash soln  |               |          |                      |          | 7.09     |        | -     | -                         | -                     | -               | •••••••••••••••••••••••••••••••••••••• |
| Pregnant solution  |               |          |                      |          |          | 0.41   |       | .17                       | 6.89                  | 70.8            | 61.0                                   |
| Cyanidation residue  |               |          |                      |          |          | 68.27  |       | .095                      | 6.45                  | 27.1            | 39.0                                   |
| Feed (assay)   |               |          |                      |          |          | 100.00 |       | .24                       | 11.29                 | 100.0           | 100.0                                  |
| Calcines (before washing)  |               |          |                      |          |          |        |       | . 31                      | 1.5.45                |                 | · ;                                    |
|  |               |          |                      |          |          |        |       |                           |                       |                 |  |
|  | :             |          |                      |          |          |        |       |                           |                       |                 |  |
| Remarks  | Add           | itional  | analyses             | s :      |          |        | Tota  | al S,                     | % Su                  | lphide S,       | %.                                     |
| · · · · · · · · · · · · · · · · · · ·  | Cal           | cines (b | efore w              | ashi     | ng)      |        |       | 4.30                      |                       | 0.78            |  |
|  |               |          |                      |          |          |        |       |                           |                       |                 | ·.                                     |
|  |               |          |                      | •        |          |        |       |                           |                       |                 |  |
|  |               |          |                      |          |          |        |       |                           |                       |                 |  |

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