

LABORATORY TEST REPORT

CUSTOMER: [REDACTED]

SCOPE: To prove the feasibility of using Sutton-Steele Fluidized Bed Separators for separating Chromite from silica in a reclaimed and reconditioned resin-bonded, foundry sand.

Of special interest to the customer were these points:

1. Percent of recovery
2. Maximum capacity
3. Screen analysis of recovered product in comparison to purchased material.

EQUIPMENT USED: Sutton-Steele BX-255 Fluidized-Bed Separator, equipped with a linen deck with riffles, and an Overstrom Texas Shaker sizing screen.

BASIC PARAMETERS:

1. Two sample lots were received
 - a) Lot 1 was selected because of its low chromite content to determine whether or not a minimum recovery level exists
 - b) Lot 2 was "salted" to a chromite level in excess of 10 percent.
2. Each lot was split with a Jones-type splitter to a size convenient to analytical studies. A sieve analysis was run on each sample. Each size fraction was then subjected to a sink-float test, with Tetrabromethane as the medium, to determine the percentage of chromite present. These results are tabulated as follows:
 - a) Exhibit I. Distribution by size of Lot #1, as received, and Lot #1, chromite.
 - b) Exhibit II. Distribution by size of Lot #2, as received, and Lot #2, chromite.
3. Comparison of the purchased chromite specifications with the samples, as received, is:

| <u>U.S. Mesh sizes</u> | <u>Specs</u> | <u>Lot 1</u> | <u>Lot 2</u> |
|------------------------|--------------|--------------|--------------|
| 20 | 0-3% | 2% | 0 |
| 30 | 0-6% | 6% | 5% |
| 40 | 7-18% | 13% | 10% |
| 50 | 17-30% | 24% | 26% |
| 70 | 20-35% | 22% | 27% |
| 100 | 12-24% | 19% | 17% |
| 140 | 4-13% | 9% | 10% |
| 200 | 0-5% | 5% | 5% |
| 270 | 0-2% | 0 | 0 |
| Pan | 0-1% | 0 | 0 |

PROCEDURE:

1. Sizing.

- A. Initial examination of the sieve analysis showed that the fraction above 30 mesh contained very little chromite, with the balance being agglomerates of silica grains, still bonded to each other. Below 30 mesh, virtually all silica grains were free. The decision was to screen out the oversize, at 30 mesh. Projected losses to the separating system are: approximately 1% of the silica, and 1/2% of the chromite.
- B. As these fluidized-bed separators are also size-sensitive it was necessary to study the original specifications and make some decisions based upon experience with the equipment.
- 1) The ratio of the specific gravities of chromite (4.3) and silica (2.6) is 1.65:1.
 - 2) Chromite is cubical. Through repeated recycling and coating, the reconditioned silica will approach a smooth, rounded shape. This is good for separation.
 - 3) Typically, a 2:1 ratio in sizing works well on most separations, even with less variance in specific gravities.
 - 4) Some material will always be lost to the dust collection system. This usually is in the lower sizes of each fraction.

When these factors are compared with the sieve analyses, it becomes obvious that 60 mesh is an appropriate cutpoint. There are several reasons:

- 1) Assuming the 2:1 sizing ratio to be right, the 30 x 60 mesh fraction has a 2.39:1 ratio. This relates to a 60 x 140 mesh lower fraction.
- 2) Screening at 60 mesh will separate the flow into a 60/40 split. This is good for load balancing, in the system.
- 3) Should losses occur, they would show up in the 50 x 60 mesh fraction, and in the 120 mesh x down fraction.
 - a) The desired screen analysis, shows the greatest latitude in the 50 x 70 mesh fraction, so some losses can be tolerated.
 - b) The desired screen analysis shows that all losses below 140 mesh are acceptable, and, in fact, 75-80% of the minus 100 mesh could be lost, without harming the mix.

2. Separation. Each of the four sized fractions was run on the BX-255 Separator in the laboratory. Twelve timed samples

were taken, simultaneously, at even spacing across the discharge lip. This enabled us to determine:

- a) Process weight in tons per hour
- b) State of separation across the discharge lip
- c) Percentages of heavy and light discharges
- d) Amount to be recycled

Based upon these observations, the light and heavy portions were removed from the circuit, while new material was metered into the circuit, to observe changes, if any, in the discharge. Each of the twelve samples from each test was given a sieve analysis and sink float test. The results are shown in Exhibits III, IV, V and VII.

CONCLUSIONS:

It appears the separation is successful with efficiencies of recovery ranging from 52% to approximately 81%, depending upon the concentration of chromite in the silica. The most difficult separation was the smaller size fraction of the low chromite material which had a net chromite concentration of 1.35%. It was necessary to recycle that material for approximately 15 minutes before a concentration appeared, upon which time it maintained itself. Due to the necessity in getting the samples returned to General Electric as quickly as possible, we were unable to perform the final sieve analysis on the reclaimed chromite. We anticipate that it will fall within the required spectrum.


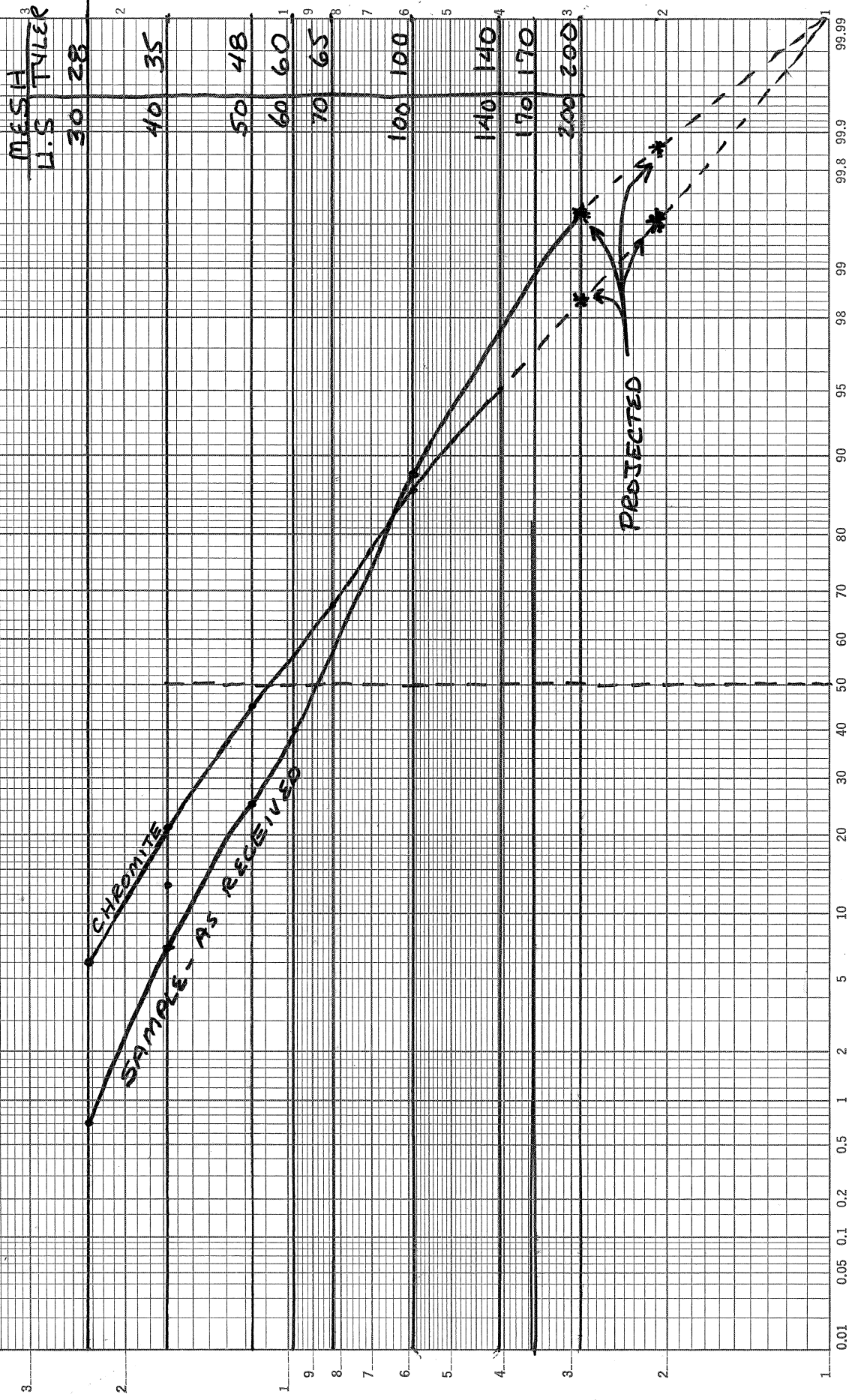


EXHIBIT I. SIZE DISTRIBUTION: LOT No. 1

PERCENT RETAINED



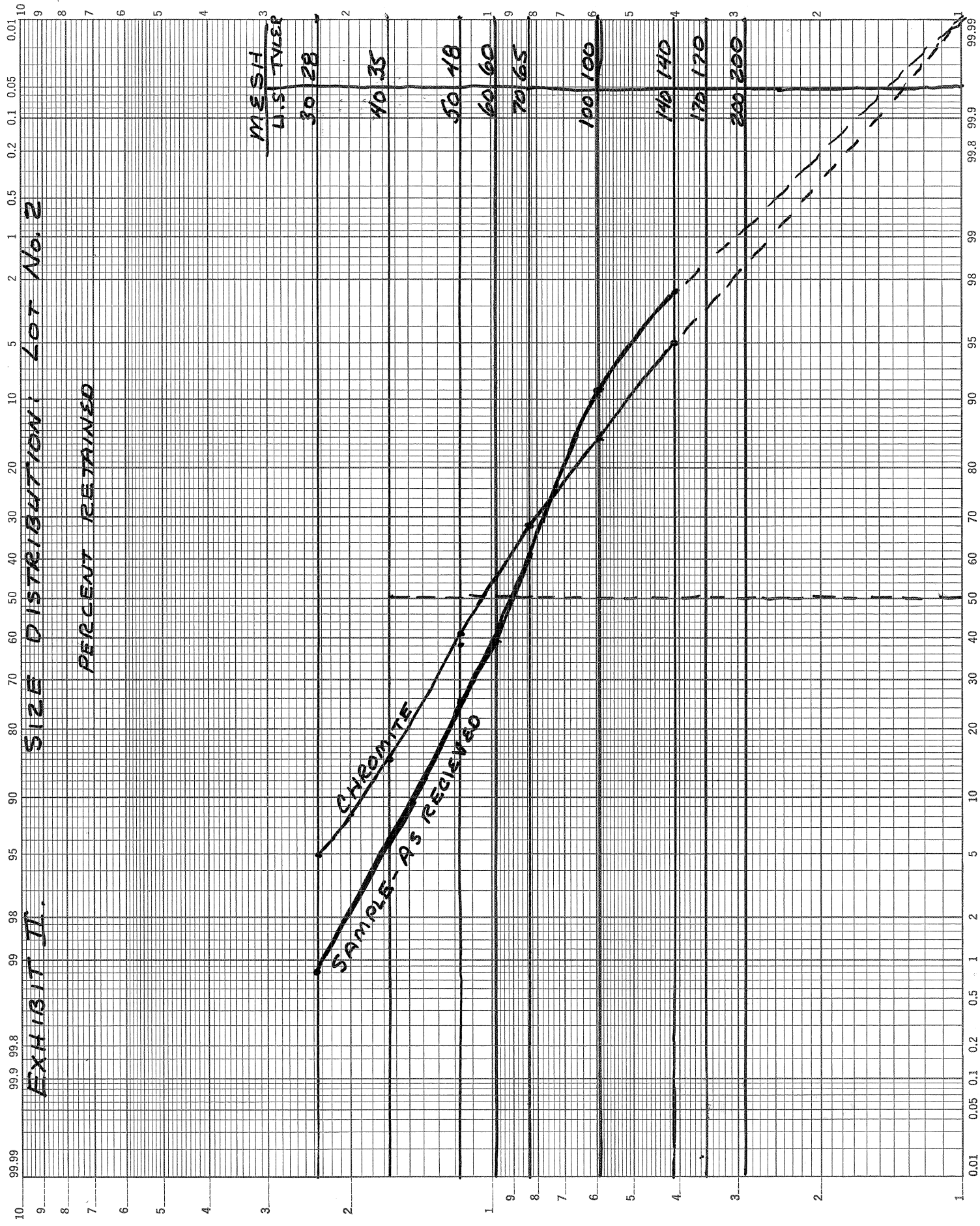


EXHIBIT III

30x60 MESH FRACTION OF 2.1% CHROMITE SAND

-- 40% OF SAND, 55% OF CHROMITE, ACTUAL TABLE FEED = 2.7%

-- MIDDINGS BAND WAS 18.7% OF FEED, SO GROSS INFEED EQUALS 12,225 LBS/HR, NET = 10,000 LBS/HR

-- NET CHROMITE FEED WAS 270 LBS/HR

| | TABLE POSITION | | | | | | | | | | | | LIGHT → HEAVY |
|--|----------------|------|------|---------|------|------|------|--|------|------|------|------|---------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| % FEED | 18.0 | 15.4 | 11.3 | 12.1 | 10.6 | 12.8 | 10.2 | 7.5 | 0.6 | 0.6 | 0.2 | 0.3 | |
| LBS/HOUR | 2862 | 1882 | 1381 | 1479 | 1296 | 1565 | 1247 | 916.9 | 61.1 | 73.3 | 24.5 | 36.7 | |
| % CHROMITE | 0.3 | 0.5 | 0.8 | 0.9 | 1.3 | 1.2 | 1.6 | 4.3 | 99.9 | 99.9 | 99.9 | 99.9 | |
| LBS/HOUR | 6.5 | 8.6 | 10.4 | 14.0 | 16.9 | 18.6 | 20.1 | 39.0 | 61.1 | 73.3 | 24.5 | 36.7 | |
| SILICA & CHROMITE 75 LBS/HR CHROMITE IN 9,805 LBS/HR OF A MIXTURE - 0.765% CHROMITE | | | | RECYCLE | | | | CHROMITE @ 195.6 LBS/HR, OR 72.4% OF INPUT | | | | | |

EXHIBIT IV.

- 60 MESH x DOWN FRACTION OF 2.1% CHROMITE SAND
- 60% OF SAND, 45% OF THE CHROMITE, 1.35% ACTUAL FEED
- MIDDINGS SAND WAS 22.3%, SO GROSS FEED TO ACHIEVE 10,000 LBS/HR, NET, IS 12,870 LBS/HR

| | TABLE POSITION | | | | | | | | | | | | LIGHT → HEAVY |
|---|----------------|------|------|------|------|------|------|-----|-----|-----|------|---|---------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| % FEED | 15.4 | 14.4 | 12.9 | 12.8 | 11.1 | 10.6 | 9.4 | 7.1 | 4.6 | 1.2 | 0.2 | 0.35 | |
| LBS/HOUR | 1902 | 1848 | 1660 | 1647 | 1427 | 1364 | 1210 | 914 | 592 | 155 | 25.7 | 45 | |
| % CHROMITE | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.3 | 0.4 | 0.6 | 1.1 | 5.7 | 99.9 | 99.9 | |
| LBS/HOUR | 2.0 | 1.8 | 3.3 | 3.3 | 4.3 | 4.1 | 4.8 | 5.5 | 6.5 | 8.8 | 25.7 | 45 | |
| SILICA & CHROMITE 18.8 LBS/HR CHROMITE IN 9980 LBS/HR OF A MIXTURE - 0.19% CHROMITE | | | | | | | | | | | | RECYCLE CHROMITE AT 70.7% OR 52% OF INPUT | |

EXHIBIT V.

- 30 x 60 MESH FRACTION OF 12% CHROMITE SAND
- 40% OF SAND, 55% CHROMITE, ACTUAL TABLE FEED = 16.5%
- MIDDINGS BAND WAS 22%, SO A GROSS FEED OF 12,820 LBS/HR RESULTS IN A NET OF 10,000 LBS/HR
- NET CHROMITE FEED WAS 1650 LBS/HR

| | | TABLE POSITION | | | | | | | | | | | |
|----------------------------------|------|-----------------------|------|------|------|-------|---------|-------|------|------|------|-------------------|------|
| | | LIGHT | | | | | | | | | | HEAVY | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| % FEED | | 16.5 | 12.7 | 12.2 | 13.1 | 13.1 | 10.8 | 8.4 | 2.8 | 2.6 | 2.9 | 3.1 | 1.8 |
| LBS/HR | | 2115 | 1629 | 1564 | 1679 | 1679 | 1385 | 1077 | 359 | 333 | 372 | 397 | 231 |
| % CHROMITE | 1.0 | 1.6 | 1.6 | 1.6 | 1.6 | 1.8 | 8.2 | 24.2 | 64.0 | 99.9 | 99.9 | 99.9 | 99.9 |
| LBS/HR | 21.1 | 26.1 | 25.0 | 26.9 | 30.2 | 113.6 | 260.6 | 229.8 | 333 | 372 | 397 | 231 | |
| SILICA & CHROMITE | | 129.3 LBS/HR CHROMITE | | | | | RECYCLE | | | | | CHROMITE AT | |
| IN 8667 LBS/HR OF MIXTURE - 1.5% | | | | | | | | | | | | 1333 LBS/HR. | |
| | | | | | | | | | | | | OR 80.8% OF INPUT | |

EXHIBIT VI.

- 60 MESH x DOWN FRACTION OF 12.0% CHROMITE SAND
- 60% OF SAND, 45% OF CHROMITE - ACTUAL TABLE FEED 8%
- MILLINGS SAND WAS 24.2% OF FEED, SO THE GROSS INFED WAS 13,193 LBS/HR, TO ACHIEVE A NET OF 10,000#/HR
- NET CHROMITE FEED WAS 800 LBS/HR

| | | TABLE POSITION | | | | | | | | | | | | | |
|------------|------|----------------|------|------|------|------|------|---------|------|------|------|------|----|--|--|
| | | LIGHT ← | | | | | | → HEAVY | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | |
| % FEED | 14.8 | 13.4 | 12.8 | 12.1 | 11.4 | 10.3 | 8.1 | 6.0 | 5.9 | 4.2 | 1.6 | 2.4 | | | |
| LBS/HOUR | 1952 | 1768 | 1688 | 1567 | 1455 | 1358 | 1068 | 792 | 778 | 554 | 182 | 291 | | | |
| % CHROMITE | 0.7 | 0.9 | 1.2 | 1.6 | 1.7 | 1.7 | 2.5 | 3.3 | 5.9 | 10.7 | 99.9 | 99.9 | | | |
| LBS/HOUR | 13.7 | 15.9 | 20.2 | 25.1 | 24.7 | 23.1 | 26.7 | 26.1 | 45.9 | 59.3 | 240 | 383 | | | |
| | | | | | | | | | | | | | | RECYCLE | |
| | | | | | | | | | | | | | | CHROMITE AT 623 LBS/HR OR 77.9% OF INPUT | |
| | | | | | | | | | | | | | | SILICA & CHROMITE 122.7 LBS/HR CHROMITE IN 9377 LBS/HR OF A MIXTURE - 1.3% CHROMITE | |

