APPENDIX V

TEXT OF PROPOSED CONTROL MEASURE

Adopt Section 93102, Subchapter 7.5, Chapter 1, Part III, Titles 17 and 26, California Administrative Code, to read as follows:

93102. Hexavalent Chromium Airborne Toxic Control Measure - Decorative and Hard Chrome Plating and Chromic Acid Anodizing Facilities.

(a) Definitions. For the purposes of this section, the following definitions shall apply:

(1) "Ampere-hours" means the integral of electrical current applied to a plating tank (amperes) over a period of time (hours).

(2) "Anti-mist additive" means a chemical which reduces the emission rate from the tank when added to and maintained in the plating tank.

(3) "Chrome" means metallic chrome.

(4) "Chrome plating" means either hard or decorative chrome plating.

(5) "Chromic acid" means an aqueous solution of chromium trioxide (CrO_3), or a commercial solution containing chromic acid, dichromic acid (H_2CrO_7), or trichromic acid ($H_2Cr_3O_{10}$).

(6) "Chromic acid anodizing" means the electrolytic process by which a metal surface is converted to an oxide surface coating in a solution containing chromic acid.

(7) "Chromium" means hexavalent chromium.

(8) "Control equipment" means any device which reduces emissions from the emissions collection system.

(9) "Decorative chrome plating" means the process by which chromium is electrodeposited from a solution containing compounds of chromium onto an object resulting in a chrome layer 1 micron (0.04 mil.) thick or less.

(10) "Emission factor" means the mass of chromium emitted during a test conducted in the emissions collection system in accordance with ARB Test Method 425, divided by the ampere-hours consumed by the tanks in the tested emissions collection system, expressed as the mass of chromium emitted per ampere-hour of electrical current consumed.

(11) "Emissions collection system" means a device or apparatus used to gather chromium emissions from the surface of a chrome plating or chromic acid anodizing tank or tanks.

(12) "Facility" means a business or businesses engaged in chrome plating or chromic acid anodizing which are owned or operated by the same person or persons and are located on the same parcel or on contiguous parcels.

(13) "Facilitywide emissions from hard chrome plating or chromic acid anodizing" means the total emissions from all hard chrome plating or chromic acid anodizing at the facility over a calendar year. Emissions shall be calculated as the sum of emissions from the emissions collection system at the facility. The emissions from an emissions collection system shall be calculated by multiplying the emission factor for that emissions collection system by the sum of ampere-hours consumed during that year for all of the tanks served by the emissions collection system.

(14) "Hard chrome plating" means the process by which chromium is electrodeposited from a solution containing compounds of chromium onto an object resulting in a chrome layer thicker than 1 micron (0.04 mil).

(15) "Plating tank" means any container used to hold a chromium or chromic acid solution for the purposes of chrome plating or chromic acid anodizing.

(16) "Uncontrolled chromium emissions from the hard chrome plating or chromic acid anodizing facility" means the chromium emissions from the emissions collection systems at the facility calculated as if no control equipment is in use. For the purpose of determining compliance with this rule, the uncontrolled chromium emissions shall be calculated using an emission factor based on tests conducted in accordance with ARB Test Method 425 or 14 mg/ampere-hour, whichever is less.

(b) Requirements for Decorative Chrome Plating Facilities

(1) No person shall operate a decorative chrome plating tank unless an anti-mist additive is continuously maintained in the plating tank, or control equipment is installed and used, in a manner which has been demonstrated to and approved by the district air pollution control officer as reducing chromium emissions by 95 percent or more relative to chromium emissions when an anti-mist additive is not maintained, or control equipment is not installed and used.

(c) Requirements for Hard Chrome Plating and Chromic Acid Anodizing Facilities

(1) The owners or operators of all hard chrome plating and chromic acid anodizing facilities shall maintain a continuous record of current integrated over time (ampere-hours) for all plating tanks for each collection system used in the hard chrome plating or chromic acid anodizing operations and shall,

within six months after district adoption of regulations enactig this control measure, and upon request thereafter, submit the information to the district air pollution control officer.

(2) No person shall operate a plating tank for hard chrome plating or chromic acid anodizing unless the tank has an emissions collection system.

(3) No person shall operate a hard chrome plating or chromic acid anodizing tank unless:

(A) the chromium emissions from the emissions collection system serving the plating tank have been reduced by 95 percent or more of the uncontrolled chromium emissions or

(B) the chromium emissions from the emissions collection system serving the plating tank have been reduced to less than 0.15 milligrams (mg) of chromium per ampere-hour of electrical charge applied to the plating tank.

(4) No person shall operate a hard chrome plating tank or chromic acid anodizing tank at a facility if facilitywide chromium emissions from hard chrome plating or chromic acid anodizing are greater than 2 pounds per year, but less than 10 pounds per year, unless:

(A) the chromium emissions from the emissions collection systems serving the plating tanks have been reduced by at least 99 percent of the uncontrolled chromium emissions from the hard chrome plating or chromic acid anodizing facility or

(B) the chromium emissions from the emissions collection systems are reduced to less than 0.03 mg of chromium per ampere-hour of electrical charge applied to the tanks.

(5) No person shall operate a hard chrome plating or chromic acid anodizing tank at a facility if facilitywide chromium emissions from hard chrome plating or chromic acid anodizing are 10 pounds per year or greater, unless:

(A) the chromium emissions from the emissions collection systems serving the plating tanks have been reduced by at least 99.8 percent of the uncontrolled chromium emissions from the hard chrome plating or chromic acid anodizing facility or

(B) the chromium emissions from the emissions collection systems are reduced to less than 0.006 mg of chromium per ampere-hour electrical charge applied to the tanks.

(d) Compliance Schedule - Decorative Chrome Plating Facilities

(1) No later than six months after district adoption of regulations enacting this control measure, the owners or operators of decorative chrome plating tanks must comply with the provisions of (b)(1).

(e) Compliance Schedule - Hard Chrome Plating and Chromic Acid Anodizing Facilities

(1) No later than twelve months after district adoption of regulations enacting this control measure, the owner or operator of a hard chrome plating or chromic acid anodizing facility subject to sections (c)(3) or (c)(5) shall submit to the district air pollution control officer an application for an Authority to Construct the equipment necessary to meet the requirements of (c)(2) and (c)(3) and no later than eighteen months after district adoption of

regulations enacting this control measure, the facility shall be in compliance with the requirements of (c)(2) and (c)(3).

(2) No later than eighteen months after district adoption of regulations enacting this control measure, the owner or operator of a hard chrome plating or chromic acid anodizing facility subject to (c)(4) shall submit to the district air pollution control office an application for an Authority to Construct the equipment necessary to meet the requirements of (c)(2) and (c)(4) and no later than twenty four months after district adoption of regulations enacting this control measure the facility shall be in compliance with the requirements of (c)(2) and (c)(4).

(3) No later than thirty months after district adoption of regulations enacting this control measure, the owner or operator of a hard chrome plating or chromic acid anodizing facility subject to (c)(5) shall submit to the district air pollution control officer an application for an Authority to Construct the equipment necessary to meet the requirements of (c)(5) and no later than forty eight months after district adoption of regulations enacting this control measure the facility shall be in compliance with the requirements of (c)(5).

NOTE: Authority cited: Sections 39600, 39601, 39650 and 39666, Health and Safety Code. Reference: Sections 39650 and 39666, Health and Safety Code.

APPENDIX VI

IDENTIFIED SHOPS AND EMISSIONS

ALL COMPANIES ANSWERING
THE SURVEY OF CHROME PLATERS

HARD PLATING

COMPANY NAME	AIR BASIN	THOUSANDS AMP-HOURS/YR.
STANDARD NICKEL CHROMIUM PLAT.	SC	741954
UNITED AIRLINES MAINTENANCE	BA	226262
V&M PLATING	SC	210000
DIXON HARD CHROME, INC.	SC	135322
CHROMAL PLATING COMPANY	SC	176904
CHROME-CRAFT	SAC	134734
J & S CHROME PLATING CO., INC.	SC	131914
SERVICE PLATING CO., INC.	SC	83117
CALIFORNIA TECHNICAL PLATING	SC	66560
DOLSBY INC.	BA	60840
ELECTRONIC CHROME	SC	60800
USS-POSCO INDUSTRIES	BA	60000
VALLEY TODECO CO.	SC	48000
ARCATA GRAPHICS/SAN JOSE	BA	44928
DOMAR PRECISION, INC.	SC	44640
ROHR INDUSTRIES INC.	SD	44000
C&R RECONDITIONING CO., INC.	SC	31200
SUPERCHROME PLATING & ENGR. CO	SC	30738
MENASCO OVERHAUL DIVISION	SC	25600
U.S. CHROME CORP. OF CALIF.	SC	24960
MID-SPEC PLATING	SC	18000
EMBEE PLATING	SC	17500
MULTICHROME CO. INC.	SC	17493
RUTTER ARMEY	SJV	16848
CONTINENTAL AIRLINES	SC	14560
ELECTRO COATINGS	SAC	14508
MODERN PLATING CO.	SC	11952
EXCELLO PLATING CO., INC.	SC	11466
AVIALL, INC.	SC	11232
L.G. TURNER HARD CHROME PLAT.	SC	10920
A-H PLATING	SC	10800
BIGGERS INDUSTRIAL GERLINGER	SAC	10500
MARE ISLAND NAVAL SHIPYARD	BA	10200
PACIFIC PISTON RING CO. INC.	SC	9000
GARY'S GRINDING & HARD CHROME	SC	8840
MAGNA PLATING CO.,INC.	SC	8320
ELECTRO-COATINGS INC.	BA	8300
AC PLATING	SJV	7800
CHROMEX	BA	7687
KRYLER CORP.	SC	7680
LEAR SEIGLER,INC.	SC	7280
FLIGHT ACCESSORY SERVICES	SC	6864
SPECIALIZED HARD CHROME	SJV	6240
WESTERN INDUSTRIAL & MARINE	SD	6032
PAMPARCO PACIFIC INC.	SC	5000
MULITCHROME-OXNARD PLATING DIV	SCC	4875
CHROMPLATE CO.	SC	4700

ALL COMPANIES ANSWERING
THE SURVEY OF CHROME PLATERS

HARD PLATING

COMPANY NAME	AIR BASIN	THOUSANDS AMP-HOURS/YR
NOVA TECHNO CORP.	SC	4586
SCIENTIFIC HARD CHROME PLATING	SC	4576
FEDERAL-MOGUL CORPORATION	SC	4312
STANDAFER ENTERPRISES	SC	4050
PRINTRONIX	SC	4000
MICROPLATE COMPANY INC.	SC	3575
ALLIED/BENDIX ELECTRODYNAMICS	SC	3427
CANYON PRECISION PLATING	SC	3000
CHAS P. YOUNG, LOS ANGELES	SC	2912
DYNA-CHROME ENGINEERING	SC	2898
CACO PACIFIC CORPORATION	SC	2548
ANGELUS SANITARY CAN MACHINE	SC	2500
ALUMIN-ART PLATING CO.	SC	2304
FRANCIS PLATING	SC	1300
K L PLATING CO.	BA	1750
AUTOMOTIVE BATTERY PRODUCTS CO	SC	1566
KAHR BEARING	SC	1020
VEILING PLATING CO., INC.	SC	1000
BROWN INTERNATIONAL CORP.	SC	600
TECHPLATE ENGINEERING	SC	525
WEST COAST PLATING	SCC	468
J&K AEROCHROME	SC	450
PRECISION PLATING & GRINDING	SAC	440
NAVAL SHIPYARD/P.W./ENGR.	SC	412
WESTERN ROTO ENGRAVERS INC.	SC	362
GAR HONING SERVICE, INC.	SC	312
CRANE CO., HYDRO-AIRE DIVISION	SC	250
C & M PLATING WORKS	BA	250
ROCKWELL INTERNATIONAL	SC	240
LAWRENCE LIVERMORE NATL LAB	BA	208
BUCK'S OF UPLAND	SC	104
SPECIALIZED PROCESSING CO. INC	SD	75
THE MARQUARDT CO.	SC	72
STERLING ELECTRIC, INC.	SC	33
LAWRENCE BERKELEY LABORATORY	BA	23
SUPERIOR QUALITY PLATING INC.	SC	21
PENNOYER-DODGE CO	SC	16
BORG WARNER	SC	7
STANFORD LINEAR ACCELERATOR	BA	5
ITT GENERAL CONTROLS	SC	2
LIMON METAL FINISHING	SCC	0
*** Total ***		2763825

ALL COMPANIES ANSWERING
THE SURVEY OF CHROME PLATERS

ANODIZING

COMPANY NAME	AIR BASIN	THOUSANDS AMP-HOURS/YR.
ROHR INDUSTRIES INC.	SD	14800
GENERAL DYNAMICS, CONVAIR DIV.	SD	6600
BOWMAN PLATING COMPANY	SC	1716
CRANE CO., HYDRO-AIRE DIVISION	SC	1500
SPECIALIZED PROCESSING CO. INC	SD	1500
EXCELLO PLATING CO., INC.	SC	780
UNITED AIRLINES MAINTENANCE	BA	390
BARRY AVENUE PLATING CO., INC.	SC	312
ANODIZING SPECIALIST	SD	196
ALLIED/BENDIX ELECTRODYNAMICS	SC	153
CONTINENTAL AIRLINES	SC	117
MCDONNELL DOUGLAS HELICOPTERS	SC	50
MARE ISLAND NAVAL SHIPYARD	BA	25
PRECISION ANODIZING & PLATING	SC	9
LOCKHEED CALIFORNIA COMPANY	SC	0
ROCKWELL-ROCKETDYNE	SC	0
MULITCHROME-OXNARD PLATING DIV	SCC	0
AEROSPACE COATINGS & TECHNOLOG	SD	0
LIMON METAL FINISHING	SCC	0
ROCKWELL INTERNATIONAL	SC	0
MONITOR POLISHING AND PLATING	SC	0

ALL COMPANIES ANSWERING
THE SURVEY OF CHROME PLATERS

DECORATIVE PLATING

COMPANY NAME	AIR BASIN	THOUSANDS AMP-HOURS/YR
CROWN CITY PLATING CO.	SC	69370
DYNAMARK	SC	53760
LOS ANGELES PLATING	SC	45760
PRODUCTION PLATING	SC	45240
VIRCO MFG. CORPORATION	SC	43200
MODERN PLATING CO.	SC	36750
SIGMA PLATING CO.	SC	31554
FOSS PLATING CO., INC.	SC	28080
PRICE PFISTER, INC.	SC	22100
KEYSTONE PLATING	SC	18720
CAL-STYLE FURNITURE MFG. CO.	SC	16800
CUSTOM PLATING CORPORATION	SC	14950
CHEMPLATE CORPORATION	SC	12000
PCA METAL FINISHING INC.	SC	11200
DYNAMARK, LTD.	SC	10700
PORTER PLATING CO. INC.	SC	10400
VALLEY PLATING WORKS INC.	SC	8800
CAL BUMPER CO., INC.	SC	8320
GENE'S PLATING WORKS	SC	8268
ACE PLATING COMPANY INC.	SC	7344
ALLIED PLATING WORKS	SC	6750
CAL-TRON PLATING	SC	6240
ROYAL PLATING WORKS CO.	SC	4992
NU-WAY PLATING CO.	SC	4680
EMPIRE PLATING INC.	SC	4680
ALL AMERICAN MANUFACTURING	SC	4368
PACIFIC PLATING	SD	4160
ARTISTIC POLISHING & PLATING	SC	3744
MODEL PLATING CO., INC.	SC	3432
THE CHROME SHOP	BA	3360
CALIFORNIA ELECTRO PLATING	SC	3120
KEYSTONE AUTOMOTIVE IND. INC.	SD	3120
MESTAS PLATING	SC	3120
WASHINGTON PLATING	SC	3120
LONG BEACH PLATING	SC	3072
PACIFIC POLISHING AND PLATING	SC	3060
SANTA ANA PLATING	SC	3000
WEISER LOCK CO.	SC	2851
HOOKER INDUSTRIES	SC	2600
SANTEE IND	SC	2600
ACME METAL FINISHING	SC	2496
AMERICAN PRECISION METAL WORKS	SC	2496
CHROME MASTERS PLATING CO.	SC	2496
DORANGE COUNTY PLATING CO. INC	SC	2288
BROTHERS PLATING	SC	2116
FIELD MANUFACTURE CORP.	SC	2080
CALIFORNIA PLATING	SD	2002

ALL COMPANIES ANSWERING
THE SURVEY OF CHROME PLATERS

DECORATIVE PLATING

COMPANY NAME	AIR BASIN	THOUSANDS AMP-HOURS/YR
ANGELUS PLATING WORKS	SC	2000
BUMPERLINE INC.	SC	1950
PEMACO METAL PROCESSING	SC	1875
FAITH PLATING CO.	SC	1820
LE MANS PLATING INC.	SC	1760
UNITED PLATING INC.	BA	1680
CENTRAL PLATING SERVICE	SC	1664
S & K PLATING, INC.	SC	1560
ROBERT MFG. CO.	SC	1560
CARTER PLATING	SC	1536
JAYDIE	SC	1500
HOAK BROS. PLATING	SC	1456
SPENCE ELECTRO PLATING COMPANY	SC	1400
BRITE PLATING CO. INC.	SC	1312
BUMPER SHOP	SC	1260
DEL RAY CHROME	SC	1250
CALIFORNIA POLISHING & PLATING	SC	1248
ARROWHEAD BRASS PRODUCTS	SC	1200
BAKERSFIELD CHROME & BUMPER	SJV	1170
CONSOLIDATED DEVICES, INC.	SC	1144
ACCESSORY PLATING	SC	1050
ALAMEDA PLATING & POLISHING	SC	1040
J & J PLATING WORKS	BA	1040
QUALITY HARDWARE MFG. CO.	SC	1001
HARDEN INDUSTRIES	SC	1000
NEWPORT PLATING	SC	1000
VEILING PLATING CO., INC.	SC	1000
BARRETT METAL FINISHING INC.	BA	960
BARRY AVENUE PLATING CO., INC.	SC	936
SUN ART PLATING CO.	SC	910
JAMES G. LEE RECORD PROCESSING	SC	795
ESPOSITO PLATING CORP.	BA	780
IDEAL PLATING	SC	735
CAL TECH METAL FINISHERS	BA	715
LEAVITT'S METAL FINISHING	SC	624
HENRY SOSS & CO. INC.	SC	621
AMERICAN ELECTROPLATING	SC	546
WALLY'S METAL POLISH & PLATE	SC	500
C & M PLATING WORKS	BA	475
MARE ISLAND NAVAL SHIPYARD	BA	450
EXCELLO PLATING CO., INC.	SC	400
AC PLATING	SJV	390
CASA DE CHROME	SC	375
EL MONTE PLATING COMPANY	SC	374
TMC PLATING	SC	360
T & B AUTO BUMPER SERVICE	BA	325
A-1 CHEMNETICS	BA	300

ALL COMPANIES ANSWERING
THE SURVEY OF CHROME PLATERS

DECORATIVE PLATING

COMPANY NAME	AIR BASIN	THOUSANDS AMP-HOURS/YR
EQUALITY PLATING CO	SD	262
ELECTRO FORMING CO.	BA	250
METCOR MFG.	SC	234
BRONZE WAY PLATING CORP.	SC	231
S&G TUBE CO. INC.	SC	210
LAWRENCE LIVERMORE NATL LAB	BA	208
SANTA ROSA PLATING WORKS	BA	200
GELARDI'S PLATING INC.	BA	191
LOGO PARIS	BA	156
OPTICAL RADIATION CORPORATION	SC	153
MASTER PLATING	SD	150
CALIFORNIA PLATING	BA	144
LA HABRA PLATING CO.	SC	125
WYREFAB INC.	SC	120
JOHNSON PLATING WORKS INC.	BA	117
WESTERN PLATING	SC	90
PHYLRICH INTERNATIONAL	SC	62
CROPPER'S PLATING CO.	SC	52
INDUSTRIAL PLATING CO., INC.	BA	50
CHRISTENSEN PLATING INC.	SC	50
PICHEL INDUSTRIES INC.	SC	40
BRICO METAL FINISHING	SC	39
BUCK'S OF UPLAND	SC	31
A-1 METAL FINISHING, INC.	SC	26
NAVAL SHIPYARD/P.W./ENGR.	SC	22
BEVERLY HILLS PLATING WORKS	SC	10
BATHROOM JEWELERY INC.	SC	8
CERTIFIED CADMIUM PLATING WORK	SC	2
BROOKSHIRES PLATING	SJV	0
WEST COAST PLATING (S.D.)	SD	0
A & A PLATING	SJV	0
MONITOR POLISHING & PLATING	SC	0
STOCKTON PLATING INC.	SJV	0
CHROME NICKEL PLATING	SC	0
LEMON GROVE PLATING INC.	SD	0

APPENDIX VII

ACTUAL VS. AMBIENT EXPOSURE

There are few comparisons of simultaneous indoor and outdoor (ambient) concentrations of particulate species. Moschandreas[1] found cadmium in homes without smokers to average 1.2 times outoor concentrations. Spengler et al.[2] found indoor concentrations of respirable sulfates, which have no known indoor source, to range from 0.6 to .9 times outdoor concentrations. Kim et al.[3] found indoor concentrations of chromium to average 0.8 times outdoor concentratins.

From these data, we assume that indoor concentrations of chromium average 0.75 times outdoor concentrations. This value is low compared to most of the referenced data.

Moschandreas[3] estimated tha 90 percent of living time is spent indoors. Therefore, we estimate that the effective concentration corresponding to unit ambient concentration is

$$.90 \times .75 + .1 \times 1 = .78 \approx .8$$

Therefore, all modeling results have been adjusted by 0.8 to estimate actual exposures.

REFERENCES

(1) Moschandreas, D.J., J. Zabransky, and D.J. Pelton. Final Report, "Comparison of Indoor and Outdoor Air Quality," 1981. Report EA-1733 of the Electric Power Research Institute, Palo Alto, California.

(2) Spengler, J.D., D. W. Dockerey, W.A. Turner, J.M. Wolfson, B.G. ferris, Jr. "Long Term Measurements of Respirable Sulfates and Particles Inside and Outside Homes." Atmos. Environ. 1981, 15, 23-30.

(3) Moschandreas, D.J., J. Winchester, J.W. Nelson, R.M. Burton. "Fine Particle Residential Indoor Air Pollution." Atmos. Environ, 1979, 13, 1413-1418.

APPENDIX VIII

FINANCIAL ANALYSIS OF SMALL PLATING COMPANIES

I. INTRODUCTION

This appendix presents a financial analysis of the small businesses (less than 250 employees) that make up the California chrome plating industry. The analysis is intended to provide the Air Resources Board with an indication of the financial ability of these small businesses to pay for the proposed air pollution abatement measures.

Ability to pay for the proposed control measures was assessed on the basis of the profitability and borrowing potential of composite or "typical" firms in the chrome plating industry. These firms are classified as small, medium, and large firms according to their annual sales; however, they all qualify as small businesses. Essentially six typical firms were analyzed: one small, one medium, and one large, for each of the two data sets available to the staff.

The analysis emphasizes firms in the California hard chrome plating industry rather than the chrome plating industry as a whole because the proposed control measure emphasizes abatement from hard chrome platers.

At this time, staff can not be sure how closely the analysis represents the hard chrome industry in California. The two data sets on California platers were relatively small and incomplete. The use of a typical firm analysis based on the median or mean (average) of a small sample size means that the statistics presented here may not accurately represent the industry. However, in the staff's opinion, the financial data supports the general findings presented below.

II. FINDINGS

The findings below relate to the hard chrome plating industry's profitability and borrowing potential as indicators of its ability to pay for pollution abatement measures.

* The analyses of the overall industry indicates that the "typical hard chrome firm" could most likely generate enough profits to fund the suggested control measure.

* Analyses of the typical small and large size firms' ability to pay for emission controls out of retained earnings (undistributed profits) indicate that the fall in these firms' rates of return due to the costs of control is not enough to prevent them from complying with the proposed regulations. The low rate of return to net worth of the typical medium size firm indicates that this firm size may experience difficulty financing the control measures.

* A firm's borrowing potential as measured by its leverage, i.e., the relationship between its debt and the owners' equity, shows that small and medium size firms were not highly leveraged and therefore were in a

favorable position to acquire debt financing. The large size firms' debt-to-equity ratios were higher, indicating that these firms may have more difficulty securing bank financing.

III. DISCUSSION OF THE FINDINGS

The findings above are not conclusive. The ability to pay of any one single firm is not considered because of the proprietary nature of the profitability and debt data needed to make such an assessment. Further, extrapolating results from a small sample of firms to the entire industry provides only an indication of the ability to pay of the firms within that industry.

The firm has two sources of financing from which it derives its ability to pay for pollution control. The first is internally generated financing from profits; the second is debt financing from lending institutions. Therefore, the procedure to analyze a firm's ability to pay requires an analysis of profitability and debt financing. For example, the firm may have profits, but it may also have large amounts of existing debt on which the firm has to make interest and principal payments. In this case the firm may not qualify for additional financing as lenders become uneasy about the size of the owners' investment in the firm (net worth) in relation to the amount of outstanding debt incurred by the firm. The firm, while profitable, may not be able to secure the additional loans to pay for additional capital equipment.

A. Profitability Analysis

Table 1 presents profitability in terms of the average return on owners' investment (ROI) with and without the annual chrome abatement expense. Three firm sizes are presented along with the aggregated "all category" firm. The cost of control for each firm size is also included. The rates of return were calculated as an average value for each firm size from the "typical" financial accounts presented in Tables 3 - 6 for the years 1984, 1985, and 1986.

Table 1
Return on Owners' Investment (ROI)
With and Without Pollution Control
Small, Medium, and Large Firm Size
Average Value for 1986, 1985, & 1984

	Small	Medium	Large	All Firms
Annualized Cost of Control	$1,317	$4,384	$8,958	$4,886
Without Annual Chrome Abatement Cost	40.5%	5.2%	22.1%	16.8%
With Annual Chrome Abatement Cost	39.5%	4.3%	20.9%	15.2%
Difference	1.0%	0.9%	1.2%	1.6%
Percentage Change	-2.5%	-17.3%	-5.4%	-9.5%

These results are a worst case scenario. It is assumed here that the cost of pollution control is not passed on to the consumer but is financed out of annual earnings (profits).

Table 1 indicates that the three-year average rate of return of owners' invested capital, without the control cost, ranges between 40.5% for small size firms and 5.2% for medium size firms. The bottom-line effect of incurring the control cost is to decrease the average rate of return between 0.9% (medium firm) and 1.6% (small firm). Under this scenario, average ROI would fall to between 39.5% (small firm) and 4.3% (medium firm). This is a percentage decrease of between 17.3% (medium firm) and 2.5% (small firm) as the firms purchase, operate, and maintain their emission control systems. It is the staff's opinion that in all but the medium size firm category, the rates of return do not decline enough to prevent the firms from purchasing the necessary pollution control equipment.

It appears from the financial data (see Tables 3,4,5 & 6) for the 39 California hard chrome firms that the small and medium size firms showed

good rates of profitability in 1986 with the small firm size having an outstanding year in 1985. Large firms showed a moderately profitable year in 1986, and had good years in 1985 and 1984.

The data (see Tables 3 & 4) indicate that small and medium size firms probably generate sufficient profits to provide enough additional cash to internally finance the annualized cost of control. The large size firms (Table 5) appear to be consistently profitable enough to generate the required cash. The aggregate data set (Table 6) indicates that the "typical hard chrome firm" could most likely generate enough profit to fund the suggested control measure.

B. Debt Financing Analysis

The debt-to-equity ratio is used to assess how much debt financing the firm has incurred in relation to the owners' investment (net worth). This ratio gives some indication of the firm's ability to qualify and support additional loans to pay for pollution control. The ability of the firm to qualify for funding depends on other factors, among them, historical rates of profit and projected forecasts of profitability.

The main objective of the debt-to-equity ratio is to indicate a firm's ability to meet both the principal and interest payments on long-term debt. These measures stress the long-term financial and operating structure of the firm. The creditor prefers as large a net worth as possible as a cushion against losses from adverse business conditions.

$$\text{Total Debt-to-Equity Ratio} = \frac{\text{Total current liabilities + total long-term liabilities}}{\text{Net worth (shareholders' equity)}}$$

The total debt-to-equity ratio indicates the degree of a firm's financial leverage. A large ratio of debt-to-equity implies that a high proportion of long-term financing is from debt sources. Long-term creditors generally prefer a modest debt-to-equity ratio as they are afforded more protection from a larger equity base (retained earnings). If the debt load becomes too heavy, the company may be unable to meet its debt principal and interest obligations during sluggish business periods. This is of particular concern if the hard chrome plating industry fluctuates with the general business cycle. The up and down profit picture form our data indicate that this could be a problem for some of the firms in this industry.

Table 2
Debt to Equity Ratio
With and Without Pollution Control
Small, Medium, and Large Firm Size
Average Debt to Equity Ratio for 1986, 1985, & 1984

	Small	Medium	Large	All Firms
Total Cost of Control	$9,820	$25,000	$49,000	$27,940
Without Annual Chrome Abatement Cost	.46	.27	.62	.46
With Annual Chrome Abatement Cost	.54	.33	.69	.56
Difference	0.08	0.06	0.07	0.10
Percentage Change	17.4%	22.2%	11.3%	21.7%

The three-year average debt-to-equity ratios (Table 2) for the small and medium firm indicate that these firms are not highly leveraged. An increase in debt does not increase the debt-to-equity ratio a significant amount. These two firm sizes would most likely qualify for financing to purchase emission control other things being equal. The value of 0.62 for the large firm indicates that these firms are more leveraged than the small or medium size firms. The additional debt required by chrome abatement equipment increases these firms debt-to-equity ratio to .69, about 11%. This indicates that if these numbers represented a particular large firm, the average debt load increase could negatively affect the firm's ability to qualify for additional loans.

IV. DISCUSSION OF PROFITABILITY RATIOS

The financial strength of the industry's firms and their ability to pay for the suggested control measures is largely determined by their profitability. Profitability is an important indicator of a firm's ability to finance future expansion, including investments in air pollution control, and remain competitive in its industry. A firm with a low level of profits or a declining rate of profitability may be unable to finance investments internally (or secure additional outside capital) for new facilities or new technologies required to remain competitive.

Staff has assessed the adequacy of the firms' profitability with the use of profitability ratios derived from the financial accounts of the industry's firms.

Ratio analysis provides an indication of a firm's ability to withstand increases in its costs, to finance new investments, and to earn a reasonable

return on its investments. It is designed to evaluate a firm's operational performance by indicating how efficient the firm is in using the assets financed by stockholders and lenders.

These ratios provide insight into the financial condition of firms; but, they do not indicate a precise amount that firms can afford for air pollution abatement. Ratio analysis is viewed as only one input into the assessment of a firm's financial health.

Profitability ratios are computed from data in the firm's financial statements, that is, profits (net income) and sales from the income statement and total assets and net worth from the balance sheet.

1. Ratio of Sales Profitability

$$\text{Ratio of sales profitability} = \frac{\text{Net income}}{\text{Net sales}}$$

The ratio of sales profitability measures the amount of profit generated on a given sales volume. Net income, or profit, is the remainder from gross revenues (sales) for a given period after all operating expenses, including interest and taxes, have been subtracted. This ratio is useful in assessing the firm's efficiency in generating profits from overall operations.

2. Ratio of Overall Business Efficiency

$$\text{Ratio of business efficiency} = \frac{\text{Net income + interest expense}}{\text{Total assets}}$$

The ratio of business efficiency measures the average profitability of a firm's assets. It concentrates on overall business efficiency, as distinct from financial efficiency (see following ratio), by eliminating differences due to the degree of financial leverage.

Differences in financial leverage occur as firms vary the amount of bonds (debt) or shares of stock (equity capital) they offer. The interest expense on the amount of debt and equity financing will therefore also vary between firms. To minimize the influence of the manner in which capital is financed, the interest expense is added to net income in the numerator.

Business efficiency can be defined as the rate of profit derived from the total assets employed by the firm regardless of whether they are financed by debt or shareholders' equity. Measuring the rate of profit on the total assets of the firm, whether they are financed by debt or owners' equity, facilitates comparisons between firms with different financial structures. The difficulty with constructing this ratio is the unavailability of data. Sometimes interest expense is not broken out separately on the financial

data statement available to the ARB. Because interest expense was not available for all groupings it is not included in the analyses.

3. Ratio of Financial Efficiency

$$\text{Ratio of financial eff.} = \frac{\text{Net income}}{\text{Net worth (shareholders' equity)}}$$

The financial efficiency ratio measures a firm's profitability relative to the capital supplied by the shareholders (owners). This ratio is often considered the final criterion of profitability because it focuses on the rate of return (ROI, rate of return on investment) to those supplying the risk capital of a business. It is the single most important ratio to evaluate a firm's long-term financial success. This ratio measures what some analysts refer to as the "financial efficiency" of the business, i.e., its ability to generate a profit on the amount of money invested by its owners.

V. FINANCIAL DATA

Staff obtained financial data from an independent credit information agency to perform an ability to pay analysis on the chrome platers in California. The Metal Finishers Association of Southern California also provided data. These two data sets are discussed next.

1. California Hard Chrome Platers Data (HCD)

Staff obtained profitability data for 39 California hard chrome plating firms for the years 1984 through 1986 from an independent credit information firm. Staff was able to obtain 1984 financial data for 17 firms, 1985 financial data for 19 firms, and 1986 financial data for 22 firms. As some firms supplied financial data for more than one year, the aggregate number of financial statements over the three years exceeds 39.

These firms were disaggregated into small, medium, and large size categories based on their sales volume. Small firms are defined as those with sales less than $500,000 per year, medium size firms with sales between $500,000 and $1 million, and large firms as those with sales more than $1 million per year. While we have categorized these firms into small, medium, and large size firms, they are all small businesses as defined by California law. In California, a small manufacturing business is one that has less than 250 employees.

The firms were, first, disaggregated by sales size. Second, the data was processed by year to yield median values for each financial account. This second step provided the financial data for the composite, typical firm. Third, profitability ratios were calculated for each small, medium, and large size firm. The results are presented in Tables 3 through 6.

Two caveats are in order here. First, because the financial data were not taken from a statistically drawn sample, we do not consider the results of the analyses using these data statistically significant. Rather, they provide an indication of the financial strength of a sample of the firms in the hard chrome industry. Second, because of the aggregated nature of the data, we do not say anything concerning the financial situation of any single firm.

2. California Chrome Platers Data (MFASC)

Financial data for the chrome plating industry in Southern California was provided by the Metal Finishing Association of Southern California Inc. (MFASC) to the ARB late in 1986. This data is based on a survey conducted by Smith, Bucklin & Associates of Chicago, Illinois for the MFASC and is based on responses from both hard and decorative chrome platers in Southern California. There were 23 responses from companies that provided 1985 data and 21 responses that provided data for both 1983 and 1984.

The data was disaggregated by firm size into small, medium and large size categories based on the firms' sales volume. A small firm is defined as a firm with sales of under $500,000 a year, medium firms with sales between $500,000 and $1 million, and large firms with sales over $1 million a year.

There are five basic problems with this data set. First, it combines data from both hard and decorative chrome platers. Second, it is disaggregated into the mean values for the industry when the median values would be more representative of the industry's typical firm. Staff believes that for this analysis the median, representing the middle firm, is a more appropriate and meaningful indicator of central tendency, or the typical firm in the industry, than the mean. In general, the median is more representative of a typical firm in the industry because untypical firms making either large profits or losses have less influence on the median than on the mean.

Third, because the data are aggregated, nothing definitive can be said about the financial viability of any specific firm. Fourth, how the survey data were obtained or the exact nature of the firms that supplied the data is not known. For example, it is not known how many hard chrome firms were included in the sample. Finally, because of the small sample size, the numbers cannot be considered to be statistically significant, i.e., they are only indicative of the financial strength of the firms for which information is available.

In order to analyze the industry's financial strength, profitability ratios were constructed from the MFASC data base and are provided below (Tables 3A, 4A, 5A, and 6A) for the years 1983-1985. These ratios represent the average (mean) value for each firm size.

VI. FINANCIAL ANALYSIS

The financial analysis is based on the two data sets reviewed immediately above, but centers on the profitability of the hard chrome companies. Three profitability ratios are used in the analysis: (1) return on sales, (2) return on assets, and (3) return to owners' equity. Because of the limited number of firms in the sample size, the results should only be extrapolated to the rest of the industry with great care.

Two separate analyses were undertaken, one for each set of data. Staff considers the hard chrome analysis (HCD) the most relevant because it includes only the hard chrome firms, the firms that face the bulk of the regulation, and it represents the median, or middle firm, rather than the mean, or average, firm. For comparative purposes profitability ratios calculated from an industry survey of the chrome plating firms in Southern California (MFASC data base) are also presented.

A. Profitability Analyses

The results of the analysis of three years of HCD profitability data are mixed. They indicate that the 39 hard chrome platers, stratified into small, medium, and large size categories, generally showed poor to good performance levels over the years 1984-1986.

The information is presented by firm size by year. Tables 3, 4, and 5 present three years of financial and profitability information of the small, medium, and large size firm, respectively. Table 6 presents the financial information of the aggregate 39 firms over the three years of data.

B. Small firms

Table 3 indicates that for 1986, the latest year for which data is available, total assets, net worth, sales, and net profits for the typical small size firm declined substantially over 1985 levels. The typical small firm, however, still earned an impressive 35.2% rate of return on its investment in 1986. In 1985, assets, net worth, sales, and net profits were much improved over 1984. In contrast, the data indicate that 1984 was a dismal year. The median profits for the 5 firms show a net loss of $18,600 in 1984.

Table 3

Financial and Profitability Data
Hard Chrome Plating Industry
Typical Small Size Firm
(Sales ≤ $500,000)
1986 - 1984

	1986 (6 firms)	1985 (4 firms)	1984 (5 firms)
Total Assets	$147,163	$248,000	$149,812
Net Worth	$97,863	$173,848	$101,123
Net Sales	$400,000	$673,000	$300,000
Net Profit	$34,400	$135,273	($18,600)
1) Return on Sales %	8.6%	20.1%	(6.2%)
2) Return on Assets %	23.4%	54.5%	(12.4%)
3) Return on Net Worth %	35.2%	77.8%	(18.4%)

The profitability analysis indicates that the small firm rate of return on net worth in 1986 was 35.2% down from a high of 77.8% of 1985. In 1984 the rate of return was negative (loss of 18.4%). These results, based on the limited sample size, indicate that these small hard chrome platers were experienced financial success over the previous two years.

The MFASC average profitability ratios indicate that the small size firm category (Table 3A) had a very high return on net worth in 1985 (29.1%) and losses in 1983 and 1984. The losses in 1983 and 1984 appear puzzling when compared to the impressive rate of return in 1985. The loss in 1984, however, coincides with the loss reported in the HCD data (Table 3) for the same year. HCD return on owners' investment in 1985 was 77.8% this is substantially above MFASC's 29.1% rate of return.

Table 3A

MFASC
Small Size Firm
(Sales < $500,000)
Average
1985 - 1983

	1985 (7 Firms)	1984 (6 Firms)	1983 (6 Firms)
1) Return on Sales (%)	3.8%	(loss)	(loss)
2) Return on Assets (%)	9.2%	(loss)	(loss)
3) Return on Net Worth (%)	29.1%	(loss)	(loss)

C. Medium Firms

The results of our analyses for HCD medium size hard chromers (Table 4) indicate that this firm size performed slightly below their small firm counterparts. Return on net worth increased each year from a negative 0.7% in 1984 to a positive 20.4% in 1986.

Net profits more than doubled in 1986 ($52,000) over 1985 levels ($25,454).

Table 4

Financial and Profitability Data
Hard Chrome Plating Industry
Typical Medium Size Firm
(Sales > $500,000 ≤ $1,000,000)
1986 - 1984

	1986 (4 firms)	1985 (5 firms)	1984 (4 firms)
Total Assets	$315,043	$492,757	$964,361
Net Worth	$255,185	$375,974	$761,845
Net Sales	$1,000,000	$727,244	$835,306
Net Profit	$52,000	$25,454	($5,012)
1) Return on Sales %	5.2%	3.5%	(0.6%)
2) Return on Assets %	16.5%	5.2%	(0.5%)
3) Return on Net Worth %	20.4%	6.8%	(0.7%)

The MFASC results for medium size chromers (Table 4A) indicate that Southern California chromers had a marginal year in 1984 and suffered losses in 1983 and 1985. These results are inconsistent with the HCD analyses (Table 4) which shows that Medium size hard chromers suffered a loss in 1984 and had a marginal year in 1985.

Table 4A

MFASC
Medium Size Firm
(Sales > $500,000 < $1,000,000)
Average
1985 - 1983

	1985 (7 Firms)	1984 (7 Firms)	1983 (7 Firms)
1) Return on Sales (%)	(loss)	2.4%	(loss)
2) Return on Assets (%)	(loss)	5.0%	(loss)
3) Return on Net Worth (%)	(loss)	6.8%	(loss)

D. Large Firms

The results of the "typical" large size firm (Table 5) analysis show a positive, but declining rate of return on net worth for 1986 over 1985 levels. The return on net worth was 9.7% in 1986, 32.5% in 1985, and 21.0% in 1984. Median profits decreased substantially in 1986, which coincided with a large decrease in net worth over 1985. Net worth fell to less than $500,000 from over $1 million in only two years. The large reduction in both net profit and net worth caused the return on net worth to decline substantially to 9.7% in 1986. This ratio, at 9.7%, represents a large decrease from 1985's 32.5% rate of return.

Table 5

Financial and Profitability Data
Hard Chrome Plating Industry
Typical Large Size Firm
(Sales > $1,000,000)
1986 - 1984

	1986 (11 firms)	1985 (8 firms)	1984 (4 firms)
Total Assets	$869,364	$1,085,306	$1,786,902
Net Worth	$483,366	$680,487	$1,125,748
Net Sales	$2,470,982	$3,627,583	$2,300,000
Net Profit	$46,949	$221,283	$236,900
1) Return on Sales %	1.9%	6.1%	10.3%
2) Return on Assets%	5.4%	20.4%	13.3%
3) Return on Net Worth %	9.7%	32.5%	21.0%

The MFASC results for large size firms (Table 5A) indicate that this size category performed better over the three years than the MFASC's small and medium size firms. Table 5A indicates that the large size segment of the industry suffered a loss in 1984, realized a marginal 5.4% return on owners' invested capital in 1985, and a 10.2% return in 1983. The return on net worth presented in Table 5A is in direct contrast with the more rosy results of the HCD return on net worth presented in Table 5.

Table 5A

MFASC
Large Size Firm
(Sales > $1,000,000)
Average
1985 - 1983

	1985 (8 Firms)	1984 (8 Firms)	1983 (8 Firms)
1) Return on Sales (%)	1.1%	(loss)	3.0%
2) Return on Assets (%)	2.6%	(loss)	6.1%
3) Return on Net Worth (%)	5.4%	(loss)	10.2%

E Overall results

An overall view of the HCD is presented in Table 6 which shows the results of aggregating the data in Tables 3, 4, and 5. The combined results show profits and positive profitability ratios in all three years. In 1986, sales increased to exceed one million dollars, but net profits declined 47% from 1985. The reason "typical" net worth and net profit declined as sales increases in 1986 is not clear.

Table 6

Financial and Profitability Data
Hard Chrome Plating Industry
Typical Firm
All Size Firms
1986 - 1984

	1986 (22 Firms)	1985 (19 firms)	1984 (17 Firms)
Total Assets	$398,560	$582,143	$317,006
Net Worth	$258,665	$411,575	$216,515
Net Sales	$1,009,899	$928,531	$650,000
Net Profit	$45,445	$85,425	$18,200
1) Return on Sales %	4.5%	9.2%	2.8%
2) Return on Assets %	11.4%	14.7%	5.7%
3) Return on Net Worth %	17.6%	20.8%	8.4%

The overall MFASC results are presented in Table 6A which shows the results of aggregating the data in Tables 3A, 4A, and 5A. The combined results show profitability ratios that are much lower than corresponding profitability ratios presented in Table 6.

Table 6A
MFASC
ALL Size Firms
Average
1985 - 1983

	1985 (22 Firms)	1984 (21 Firms)	1983 (21 Firms)
1) Return on Sales (%)	0.8%	0.2%	0.8%
2) Return on Assets (%)	1.9%	0.5%	2.0%
3) Return on Net Worth (%)	3.6%	0.9%	3.2%

A strict interpretation of the financial ratios constructed from the MFASC data (Tables 3A, 4A, & 5A) indicate that South Coast chrome platers are teetering on the brink of bankruptcy; their data show more losses than profits, and the profits are at a low to moderate level, except for the one year, 1985, when small firms returned 29.1% on owners' equity.

The MFASC results for small, medium, and large size firms for 1983, 1984, and 1985 have not shown any consistent trend to identify why different firm size categories suffer losses in one year and then are profitable the following year. It is difficult to explain precisely why for each year of data, at least one size of firm category suffered a loss. The most likely explanation is that the use of the mean will produce these wide swings in profitability values, especially, as in this case, when the sample size is small.

To put the results of Table 6 into perspective, 1986 rates of return on owners' investment for some industries are provided directly below.

	1986
Petroleum Refining	10.3%
Motor Vehicle Car Bodies	14.6%
Semi-conductors	9.8%
Phonograph Records	10.6%
Tires & Inner-tubes	7.9%
Crude Oil & Natural Gas	6.8%
Paints & Allied Products	10.4%
Book Publishing	13.2%

When compared to the industries in the above table, the rates of return on net worth in Table 6 indicate that the chrome industry overall performed very well in 1986. The average rate of return on net worth for 1986 was higher, 17.6%, than the average rate of return on owners' investment, 10.5%, of the eight manufacturing firms listed above.